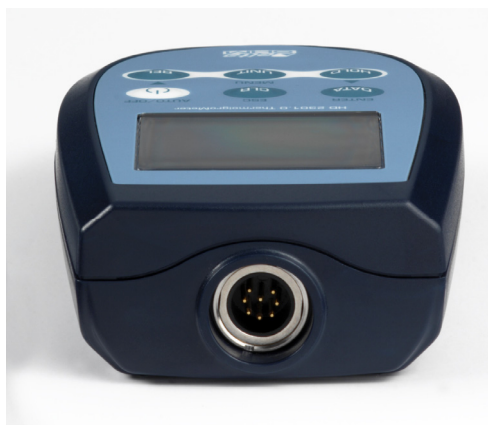
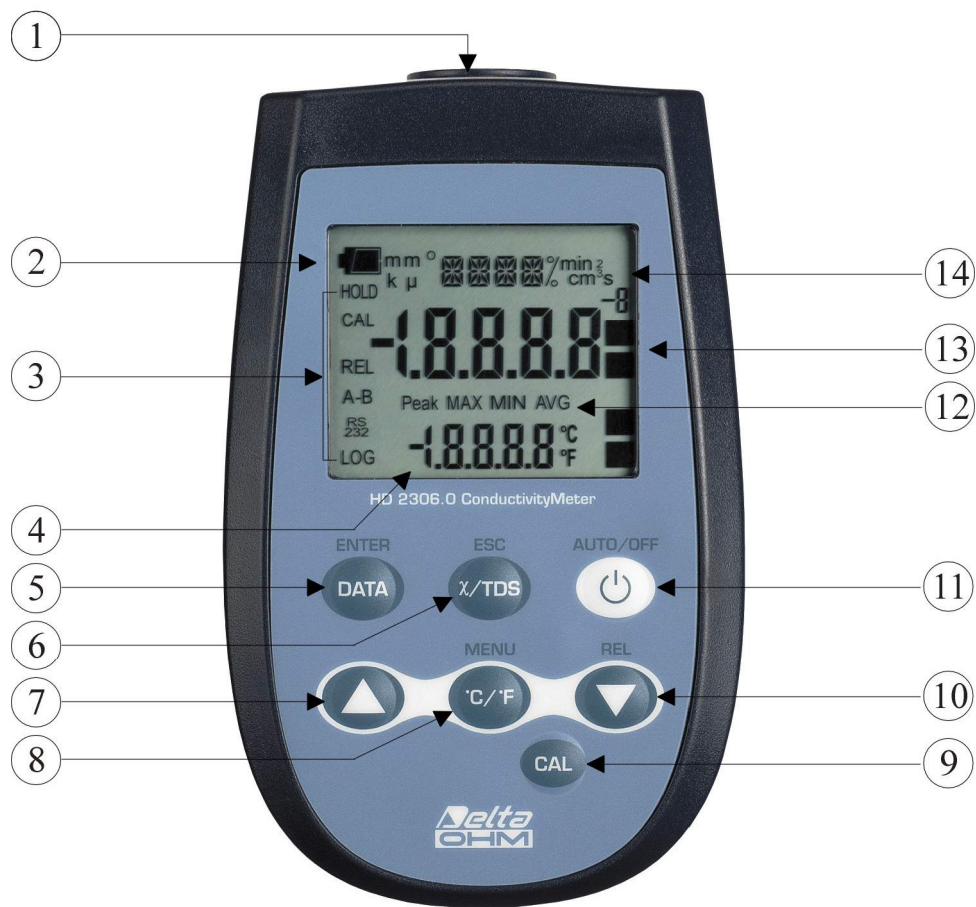


# **HD2306.0**

Our instruments' quality level is the results of the product continuous development. This can bring about differences between the information written in this manual and the instrument that you have purchased. We cannot entirely exclude errors in the manual, for which we apologize.

The data, figures and descriptions contained in this manual cannot be legally asserted. We reserve the right to make changes and corrections without prior notice.

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 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. To reset the previous values and restart with a new measurement session, press DATA until the message "FUNC CLR" appears, then use the arrows to select YES and confirm using ENTER. In the menu, confirms the current selection.
6. **κ/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 buffer 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 MENU key at any time.
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 nominal buffer 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.

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## 1. GENERAL CHARACTERISTICS

The Conductivity meter – Thermometer Model **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-ring or 2-ring 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 $\mu$ S, 1413 $\mu$ S, 12880 $\mu$ S or 111,800 $\mu$ S/cm conductivity calibration solutions (see chapter 4).

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

Other available functions are:

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

See chapter 2 for further details.

## 2. DESCRIPTION OF THE FUNCTIONS

The keyboard of the Conductivity meter – Thermometer Model **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.

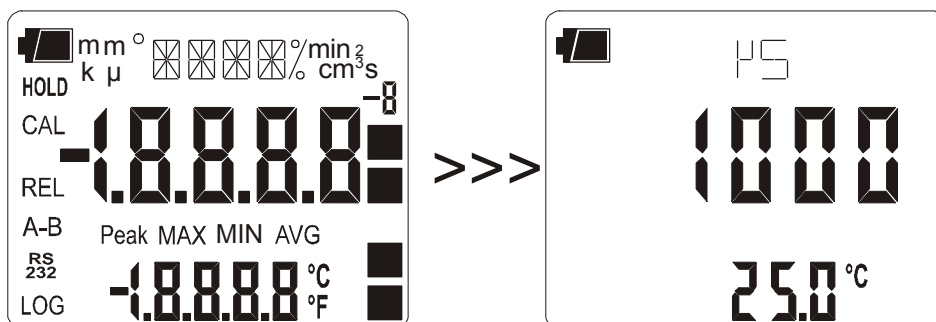


### ON-OFF and AUTO-OFF key

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/ESC** 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** keys, the **χ/TDS** key will allow to cancel the parameters set using the ▲ and ▼ arrows.
- In calibration mode, it allows to exit calibration.



### **DATA/ENTER key**

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;
  - by pressing this key 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 ▲ and ▼ arrows to select **YES**;
  - confirm by pressing **DATA/ENTER**.
- **ENTER:** once the MENU has been opened with the **DATA+°C/°F** keys, the **DATA** key will perform the ENTER function and the MENU can be browsed and the displayed parameter confirmed. In calibration mode, acquires the nominal buffer value.



### **▲ key**

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



### UNIT/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 (see chapter 3):
  - K CELL (Cell constant)
  - ALPH\_T (Temperature coefficient  $\alpha_T$ )
  - REF\_TEMP (Reference temperature)
  - TDS (Conversion factor  $\chi$ /TDS)
  - Probe type
- 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  **$\chi$ /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 4).



### ▼/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.



### 3. 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 (Cell constant)**: sets the conductivity probe's cell constant nominal value. The values 0.1, 0.7, 1.0 and 10 cm<sup>-1</sup> (**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 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.
2. **ALPH\_T (Temperature coefficient α<sub>T</sub>)**: the temperature coefficient α<sub>T</sub> 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 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.
  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 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.
  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 CaCO<sub>3</sub> (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 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.

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.
- 4 wire Pt100 using the TP47 module
  - 2 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 "- - -".

## 4. CONDUCTIVITY MEASUREMENT

The Conductivity meter – Thermometer Model **HD2306.0** works with:

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

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

The instrument obtains the following from the measurement of conductivity:

- the liquid resistivity measurement ( $\Omega$ ,  $k\Omega$ ,  $M\Omega$ );
- the total dissolved solids (TDS) concentration according to the  $\chi$ /TDS conversion factor which can be modified using the menu (see chapter 3).

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.**

### 4.1 STANDARD PROBE

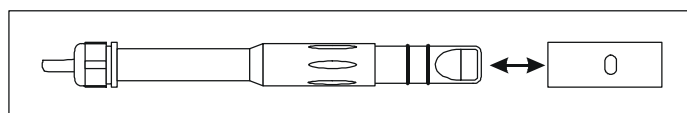
The standard 4-electrode combined conductivity/temperature probe code is **SP06T**.

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

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.**



This probe's temperature measuring range is -50...+90°C.

### 4.2 4-RING OR 2- RING PROBES

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

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

The **2-ring 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.

#### 4.3 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.

#### 4.4 CHOOSING THE CELL CONSTANT

The **cell constant K<sub>cell</sub>** is a piece of information which characterizes the cell and depends on its geometry: it is expressed in  $\text{cm}^{-1}$ .

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.

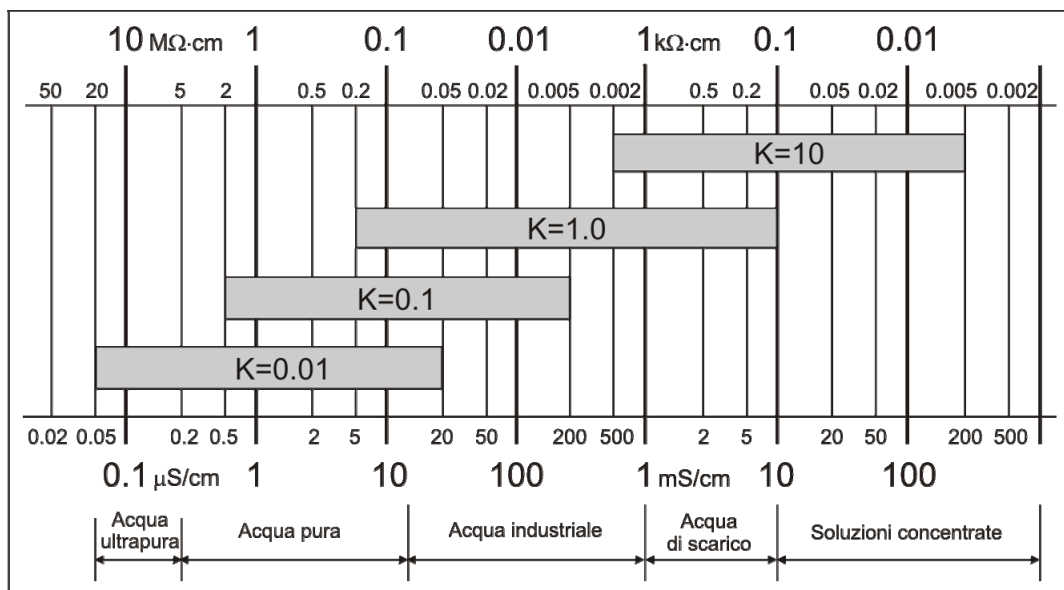
The cell with constant **K = 1 cm<sup>-1</sup>** allows measurements from low conductivity up to relatively high conductivity.

The **theoretical measurement cell** is made of two 1 cm<sup>2</sup> metallic plates separated one from the other by 1 cm. This type of cell has a cell constant K<sub>cell</sub> of 1 cm<sup>-1</sup>.

**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:



## 4.5 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 3).

The conductivity increase per each grade of temperature variation is a characteristic of the solution and is indicated by the term "temperature coefficient  $\alpha_T$ ": 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  $\alpha_T$  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 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.

## 4.6 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, chapter 3).

### 4.6.1 Automatic calibration of conductivity using memorized buffer solutions

The instrument can recognize four standard calibration solutions:

- 0.001 Molar KCl solution (147µS/cm @25°C),
- 0.01 Molar KCl solution (1413µS/cm @25°C),
- 0.1 Molar KCl solution (12880µS/cm @25°C),
- 1 Molar KCl solution (111800µS/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 (µS/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 buffer 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  $\alpha_T$  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 **⌫/TDS/ESC**. If on the other hand you wish to perform another calibration on a different buffer, 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.

#### 4.6.2 Manual calibration of conductivity using non memorized buffer 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  $\alpha_T$  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**. 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 **⌘/TDS/ESC**.
8. Press the **CAL** key. The CAL symbol is turned on. The unit of measurement ( $\mu\text{S}/\text{cm}$  or  $\text{mS}/\text{cm}$ ) 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 5 and confirm using **DATA/ENTER**. If the ERR indication appears, see the note below.
10. The cell constant nominal value ( $K_{\text{CELL}}$ ) and the temperature coefficient  $\alpha_T$  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 **⌘/TDS/ESC**.
12. Go back to the MENU and select ALPH: re-enter 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 ⌘/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.

#### 4.6.3 Table of buffer solution at 147μS/cm, 1413μS/cm, 12.88mS/cm and 111.8mS/cm

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

°C	μS/cm	μS/cm	mS/cm	mS/cm		°C	μS/cm	μS/cm	mS/cm	mS/cm
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						

#### 4.7 DIRECT INPUT INTO Pt100 AND Pt1000 TEMPERATURE PROBES

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

The Pt100 are connected to 4 wires, the Pt1000 to 2 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, chapter 3).

The °C or °F unit of measurement can be chosen for display using the °C/°F/MENU key.

##### 4.7.1 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.

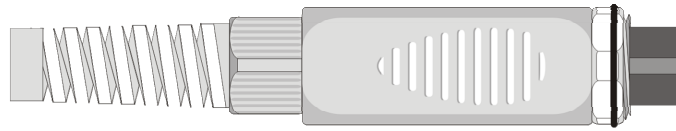
**So as to obtain the correct measurement, the insertion of a drop of oil or heat-conductive paste between the surface and the probe is useful (do not use water or solvents). This method also improves the response time.**



#### 4.7.2 Connecting the TP47 module

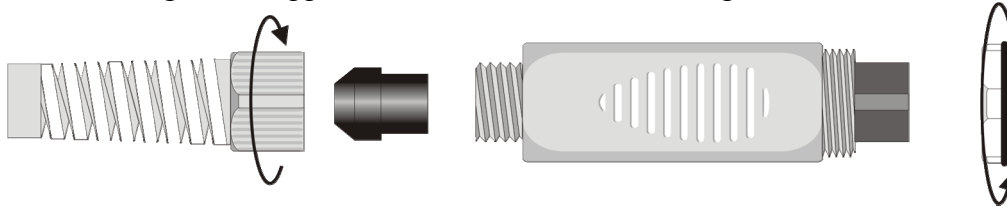
All probes produced by Delta Ohm are provided with a TP47 module.

The HD2306.0 instrument also work with direct 4 wire Pt100, and 2 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.

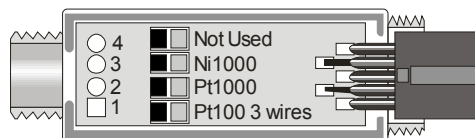


The instructions to connect the Platinum or Nickel probe to the TP47 module are provided below. The **TP47** module is supplied complete with fairlead and gasket for 5 mm maximum diameter cables. Do the following to open the module and connect a probe:

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:

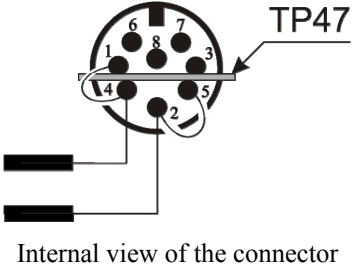
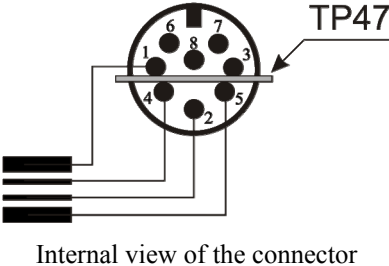


**Caution!** Before welding, pass the probe cable through the fairlead and gasket.

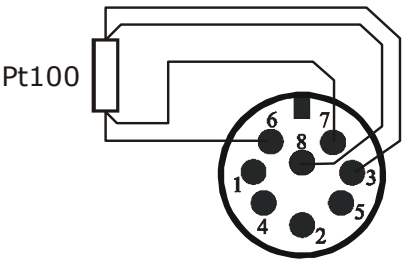
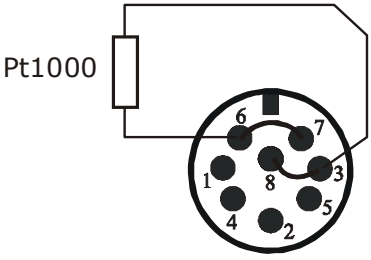
6. Weld the wires as shown in the table:

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

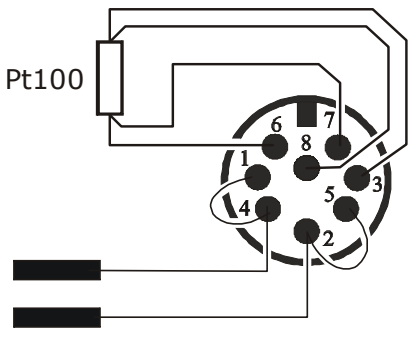
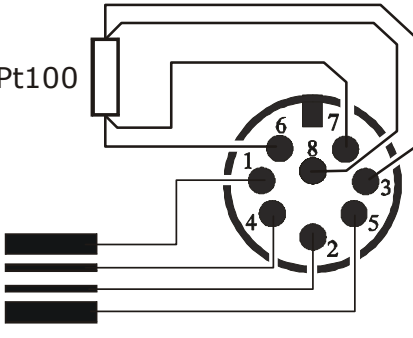
The wires coming from the **conductivity probe** are welded directly on the DIN45326 connector as reported in the following table:

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 DIN45326	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>

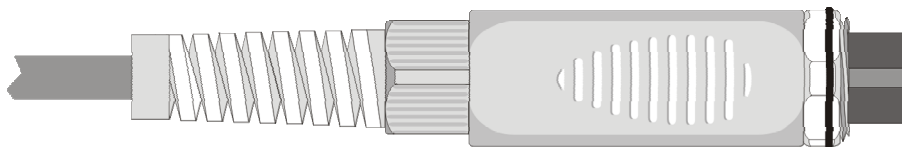
The wires coming from the conductivity/Pt100 temperature combined probe are welded directly on the connector as reported in the following table.

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

Ensure the welds are clean and perfect.

Once the welding operation is complete, close the two shells, insert the gasket in the module, screw the fairlead.


At the other end of the module, enter the ring with the O-Ring as indicated in the picture.



Make sure the cable is not twisted while you are screwing the fairlead.

Now the probe is ready.

## 5. 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.
3. Do not bend or force the contacts when inserting the probe connector into the instrument.
4. Do not bend, deform or drop the probes, as this could cause irreparable damage.
5. Always select the most suitable probe for your application.
6. 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.
7. Above 400°C and below -40°C, avoid violent blows or thermal shocks to Platinum temperature probes as this could cause irreparable damage.
8. To obtain reliable measurements, temperature variations that are too rapid must be avoided.
9. 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.
10. Temperature measurements on non-metal surfaces usually require a great deal of time due to the low heat conductivity of non-metal materials.
11. 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.
12. Avoid taking measurements in presence of high frequency sources, microwave ovens or large magnetic fields; results may not be very reliable.
13. Clean the probe carefully after use.
14. 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.

## 6. 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
<b>ALPH</b>	Temperature coefficient $\alpha_T$
<b>BATT TOO LOW CHNG NOW</b>	Indication of insufficient battery charge appearing on turning on. The instrument issues a long beep and turns off. Replace the batteries.
<b>CAL ERR</b>	This appears when, during calibration, the read value exceeds the limits of -30% or +50% of the buffer's value compensated for temperature or the solution temperature is lesser than 15°C or higher than 35°C.
<b>CAL blinking</b>	No calibration has yet been effected, or the cell constant value has been modified in the menu (please see the description of the K_CELL menu item on page 9).
<b>CAL LOST</b>	Program error: it appears after turning on for a few seconds. Contact the instrument's supplier.
<b>ERR</b>	This appears if the conductivity/temperature probe is measuring a value exceeding the set measuring range.
<b>FUNC CLR D</b>	Max, min and average values cleared.
<b>KCEL</b>	Cell constant K.
<b>m</b>	No probe with temperature sensor connected. The letter "m" indicates that the displayed temperature was entered manually.
<b>PLS_EXIT &gt;&gt;&gt; FUNC RES_FOR_FACT ONLY</b>	Please exit using ESC >>> function reserved to factory calibration.
<b>PRBE_SER</b>	Type of probe connected.
<b>REF TEMP</b>	Reference temperature.
<b>SYS ERR #</b>	Instrument management program error. Contact the instrument's supplier and communicate the numeric code # reported by the display.
<b>TDS</b>	Total dissolved solids.
<b>UNDR</b>	Minimum limit exceeded.

## 7. 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.

## 8. 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 POCAN, 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.**

### 8.1 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.

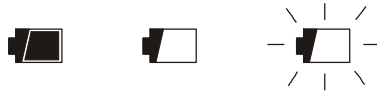
**Slow response or instability.** Check that the cell is not dirty, that there are no traces of oil or air bubbles inside it. If you work with a black Platinum cell, new platinum-coating of the electrode could be necessary.

**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.

## 9. 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.

### 9.1 WARNING ABOUT BATTERY USE

- Batteries should be removed when the instrument is not used for an extended time.
- Flat batteries must be replaced immediately.
- Avoid 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.

## 10. 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



## 11. TECHNICAL CHARACTERISTICS

### 11.1 TECHNICAL INFORMATION ON THE CONDUCTIVITY METER – THERMOMETER

#### *Instrument*

Dimensions (Length x Width x Height)	140x88x38mm
Weight	160g (complete with batteries)
Material	ABS
Display	2x4½ digits plus symbols Visible area: 52x42mm

#### *Operating conditions*

Operating temperature	-5...50°C
Warehouse temperature	-25...65°C
Working relative humidity	0...90%RH without condensation
<b>Protection degree</b>	<b>IP67</b>

#### *Power*

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

#### *Connections*

Input for the conductivity/temperature probes	8-pole male DIN45326 connector
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#### *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...19.99µS/cm / 0.01µS/cm
Measurement range (Kcell=1) / Resolution	0.0...199.9µS/cm / 0.1µS/cm 200...1999µS/cm / 1µS/cm 2.00...19.99mS/cm / 0.01mS/cm 20.0...199.9mS/cm / 0.1mS/cm
Measurement range (Kcell=10) / Resolution	200...1999mS/cm / 1mS/cm
Accuracy (conductivity)	±0.5% ±1digit F.S.

### Measurement of resistivity by Instrument

Measurement range (Kcell=0.1) / Resolution	Up to 100MΩ·cm / (*)
Measurement range (Kcell=1) / Resolution	5.0...199.9Ω·cm / 0.1Ω·cm
	200...999Ω·cm / 1Ω·cm
	1.00k...19.99kΩ·cm / 0.01kΩ·cm
	20.0k...99.9kΩ·cm / 0.1kΩ·cm
	100k...999kΩ·cm / 1kΩ·cm
	1...10MΩ·cm / 1MΩ·cm
Measurement range (Kcell=10) / Resolution	0.5...5.0Ω·cm / 0.1Ω·cm
Accuracy (resistivity)	±0.5% ±1digit

### Measurement of total dissolved solids (with coefficient $\chi$ /TDS=0.5)

Measurement range (Kcell=0.1) / Resolution	0.00...19.99mg/l / 0.05mg/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)	±0.5% ±1digit

### Measurement of temperature by Instrument

Pt100 measurement range	-50...+200°C
Pt1000 measurement range	-50...+200°C
Resolution	0.1°C
Accuracy	±0.25°C F.S.
Drift after 1 year	0.1°C/year

Automatic/manual temperature compensation 0...100°C with  $\alpha_T=0.00...4.00\%/^{\circ}\text{C}$

Reference temperature 20°C or 25°C

$\chi$ /TDS conversion factor 0.4...0.8

Cell constant  $K$  (cm<sup>-1</sup>) 0.1, 0.7, 1.0 and 10.0

(\*) 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 <sup>-1</sup>		K cell = 0.1 cm <sup>-1</sup>	
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
...	...	...	...

*Standard solutions automatically detected (@25°C)*

147µS/cm

1413µS/cm

12880µS/cm

111800µS/cm

*EMC standard regulations*

Security

EN61000-4-2, EN61010-1 level 3

Electrostatic discharge

EN61000-4-2 level 3

Electric fast transients

EN61000-4-4 level 3,

EN61000-4-5 level 3

Voltage variations

EN61000-4-11

Electromagnetic interference susceptibility

IEC1000-4-3

Electromagnetic interference emission

EN55020 class B

## 11.2 ON LINE INSTRUMENT PROBES AND MODULES TECHNICAL DATA

### 11.2.1 2 and 4 electrode conductivity probes

ORDER CODE	MEASUREMENT RANGE	DIMENSIONS
<b>SP06T</b>	$K=0.7$ $5\mu\text{S/cm} \dots 200\text{mS/cm}$ $0 \dots 90^\circ\text{C}$ 4-electrode cell in Platinum Probe material Pocan General use Not heavy duty	
<b>SPT01G</b>	$K=0.1$ $0.1\mu\text{S/cm} \dots 500\mu\text{S/cm}$ $0 \dots 80^\circ\text{C}$ 2-electrode cell in Platinum-wire Probe material glass Pure water	
<b>SPT1G</b>	$K=10$ $500\mu\text{S/cm} \dots 200\text{mS/cm}$ $0 \dots 80^\circ\text{C}$ 2-electrode cell in Platinum wire Probe material glass General use heavy duty, high conductivity	
<b>SPT10G</b>	$K=0.1$ $0.1\mu\text{S/cm} \dots 500\mu\text{S/cm}$ $0 \dots 80^\circ\text{C}$ 2-electrode cell in Platinum-wire Probe material glass Pure water	

### 11.2.3 4 wire Pt100 and 2 wire Pt1000 Temperature probes complete with TP47 module

Model	Type	Application range	Accuracy
<b>TP47.100</b>	4 wire Pt100	$-50 \dots +200^\circ\text{C}$	Class A
<b>TP47.1000</b>	2 wire Pt1000	$-50 \dots +200^\circ\text{C}$	Class A
<b>TP87.100</b>	4 wire Pt100	$-50 \dots +200^\circ\text{C}$	Class A
<b>TP87.1000</b>	2 wire Pt1000	$-50 \dots +200^\circ\text{C}$	Class A

Temperature drift @20°C

0.005%/°C

**TP47** Module for the connection of Pt100 4-wire and Pt1000 2-wire probes to instrument series HD23..., without amplifying electronics and linearization.

## 12. ORDER CODES

- HD2306.0** The kit is composed of: instrument HD2306.0, 3 1.5V alkaline batteries, operating manual, and case.  
**The conductivity probes, temperature probes, standard reference solutions have to be ordered separately.**
- HD22.2** Laboratory electrode holder composed of basis plate with incorporated magnetic stirrer, staff and replaceable electrode holder. Height max. 380mm. For Ø12mm electrodes.
- HD22.3** Laboratory electrode holder with metal basis plate. Flexible electrode holder for free positioning. For Ø 12mm probes.

### *CONDUCTIVITY PROBES AND COMBINED CONDUCTIVITY AND TEMPERATURE PROBES*

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- SP06T** Combined conductivity and temperature 4-electrode cell in Platinum, body in Pocan. Cell constant  $K = 0.7$ . Measurement range  $5\mu\text{S}/\text{cm} \dots 200\text{mS}/\text{cm}$ ,  $0 \dots 90^\circ\text{C}$ .
- SPT01G** Combined conductivity and temperature 2-electrode Platinum-wire cell, glass body. Cell constant  $K = 0.1$ . Measurement range  $0.1\mu\text{S}/\text{cm} \dots 500\mu\text{S}/\text{cm}$ ,  $0 \dots 80^\circ\text{C}$ .
- SPT1G** Combined conductivity and temperature 2-electrode Platinum-wire cell, glass body. Cell constant  $K = 1$ . Measurement range  $10\mu\text{S}/\text{cm} \dots 10\text{mS}/\text{cm}$ ,  $0 \dots 80^\circ\text{C}$ .
- SPT10G** Combined conductivity and temperature 2-electrode Platinum-wire cell, glass body. Cell constant  $K = 10$ . Measurement range  $500\mu\text{S}/\text{cm} \dots 200\text{mS}/\text{cm}$ ,  $0 \dots 80^\circ\text{C}$ .

### *STANDARD CONDUCTIVITY CALIBRATION SOLUTIONS*

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- HD8747** Standard calibration solution 0.001mol/l equal to  $147\mu\text{S}/\text{cm}$  @ $25^\circ\text{C}$  - 200cc.
- HD8714** Standard calibration solution 0.01mol/l equal to  $1413\mu\text{S}/\text{cm}$  @ $25^\circ\text{C}$  - 200cc.
- HD8712** Standard calibration solution 0.1mol/l equal to  $12880\mu\text{S}/\text{cm}$  @ $25^\circ\text{C}$  - 200cc.
- HD87111** Standard calibration solution 1mol/l equal to  $111800\mu\text{S}/\text{cm}$  @ $25^\circ\text{C}$  - 200cc.

### *TEMPERATURE PROBES COMPLETE WITH TP47*

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- TP47.100** Direct 4 wire Pt100 sensor immersion probe with connector. Probe's stem Ø 3mm, length 230mm. 4 wire connection cable with connector, length 2 metres.
- TP47.1000** Pt1000 sensor immersion probe. Probe's stem Ø 3mm, length 230mm. 2 wire connection cable with connector, length 2 metres.
- TP87.100** Pt100 sensor immersion probe. Probe's stem Ø 3mm, length 70mm. Connection cable 4 wires with connector, length 1 metre.
- TP87.1000** Pt1000 sensor immersion probe. Probe's stem Ø 3mm, length 70mm. Connection cable 2 wires with connector, length 1 metre.
- TP47** Module for the connection of Pt100 4-wire and Pt1000 2-wire probes to instrument series HD23..., without amplifying electronics and linearization.