LABORATORY
pH / CONDUCTIVITY / SALINITY
METER

CPC-511

USER'S MANUAL

ELMETRON

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PH / CONDUCTIVITY / SALINITY METER

CPC-511

Before use please read the instruction carefully.

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I. INTRODUCTION

1. EXPLOITATION NOTICES

Dear User!

We present you a device distinguished by accuracy according to the technical data and by a high stability of the displayed results. We believe that the measurements would not cause you any trouble and that the meter would operate without any inconvenience. **Wide range of additional functions requires careful reading of the manual, in other case some of the features may stay unused or using the meter may be troublesome.**

Using electrodes of good quality and replacing them after a suitable time ensures obtaining high measuring accuracy. It is worth remembering that electrodes have much shorter lifespan than the meter. Deterioration of the result stability and increase of the measuring error are typical symptoms of an improper work of the electrode. **Some problems users have may arise from using pH electrodes not being conditioned before the measurement, making measurements not having removed the shielding ring from the liquid junction, with contaminated membrane or plugged junction.** To avoid such situations it is necessary to choose a proper kind of electrode for solutions which are going to be measured, e.g., sewage, liquids with deposits, meat, cheese etc. Therefore, if you observe improper operation of the device, please take control measurements with another electrode. **In most cases deterioration of the meter's work is caused by the electrode and not by the meter itself.**

In case of conductivity measurements it is important to choose the cell with the K constant value suitable for the measuring range. Improper selection may cause larger error occurrence, what may also happen during measurements with automatic temperature compensation with an inappropriate α coefficient introduced.

The essential feature of our products is their low failure frequency. However, in case of the meter's failure, our firm provides its immediate repair under the warranty conditions.

We wish you a pleasant and trouble-free work with our meter.

2. CHARACTERISTICS OF THE METER

The **CPC-511** pH / conductivity / salinity meter belongs to the newest generation of measuring devices which offer wide range of additional functions.
The electronic elements of the newest generation used in the meter made its memory independent from power supply. The meter is equipped with large custom LCD display, which displays the pH, conductivity, salinity or redox potential and temperature reading.

Main features of **CPC-511** are:
- high accuracy and stability of readings;
- automatic temperature compensation;
- pH electrode calibration in 1 to 3 points;
- storage of pH standard solutions values
- automatic recognition of pH buffers and standards;
- storage of the standard solutions values;
- the conductivity cell calibration by entering the K constant value given by the manufacturer or by deterining it with use if a standard;
- information about the pH electrode condition.

3. WHAT IS THE METER DESIGNED FOR

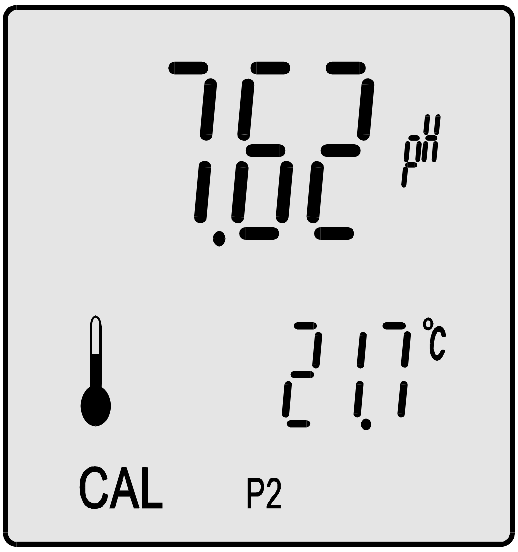
CPC-511 pH / conductivity / salinity meter is a precise and easy-to-use laboratory dewvice designed for measuring hydrogen ion concentration in pH units, redox potential (mV) and conductivity in µS/cm or mS/cm and accurate measurement of the solutions and air temperature in ℃.
The conductivity measurement result may be also displayed in concentration units (g/l or %) counted to NaCl, KCl or TDS. The meter is used in food, chemical, pharmaceutical and power industries, in water treatment stations, laboratories, agriculture, universities, scientific laboratories etc.
Depending on the type of applied pH electrode, the **CPC-511** meter is being used in food, chemical, pharmaceutical and power industries, in water treatment stations, laboratories, agriculture, universities, scientific laboratories etc.
The meter is prepared to work with all types of combination pH electrodes and redox electrodes equipped with BNC-50 connector. It is possible to connect the meter with two electrodes (measuring and reference) by special adapter offered as additional equipment. **CPC-511** cooperates with Pt-1000 temperature probe equipped with Chinch connector.

4. THE OUTSIDE VIEW

In the upper part of the meter there is an LCD display (Pic. 1), on which, depending on the chosen function, the following symbols are displayed:

- pH measurement reading in pH units;
- redox potential measurement in mV units;
- conductivity measurement readout with adjustment to 25 ^{0}C;
- salinity measurement readout in g/l with conversion to NaCl or KCl;
- salinity measurement readout in g/l with conversion to TDS.

The measurement function is chosen by pressing appropriately marked button and is signalised with lighting diode placed above the button.
Simultaneously with the readout the temperature value in ^{0}C is displayed. Symbols of units are displayed next to the readout.

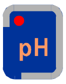


Pic. 1.

Next to the temperature reading the symbol is displayed:  - the symbol for automatic temperature compensation or  - the symbol for manual temperature compensation. The ***CAL*** symbol in the left on the display signalises that the meter is in the calibration mode. In the MODE mode it is possible to check the electrode parameters verified during the last calibration.

The meter's keyboard (Pic. 2) is equipped with the following buttons:.

- switches the meter on and off;

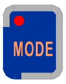


- chooses the pH measuring function;

- chooses the mV measuring function;

- chooses the conductivity and salinity measuring function;

- holding this button enters the calibration mode. Short press in this mode confirms the calibration result;



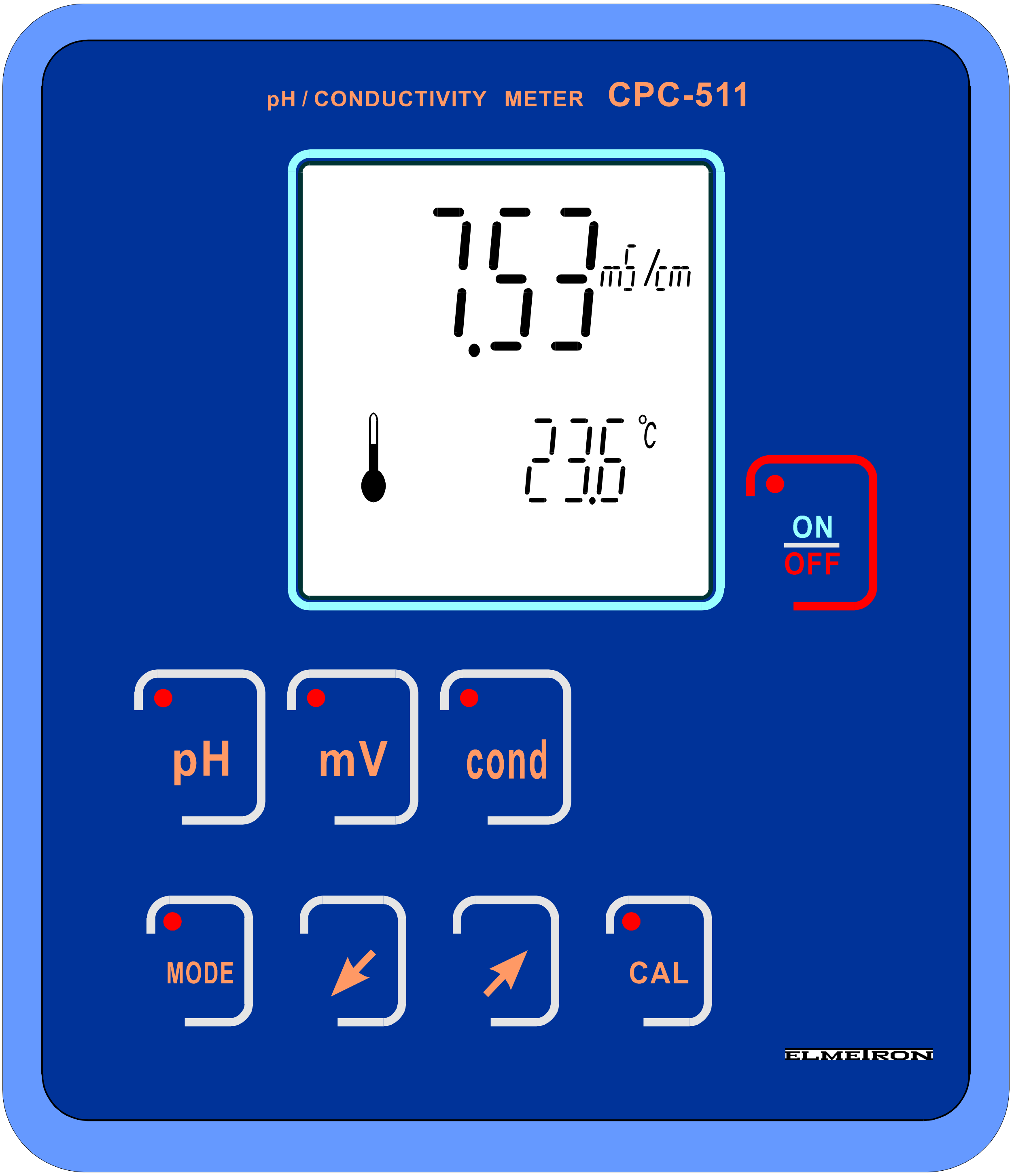
- chooses parameter for entering;

 , 

- buttons for entering parameters.

On the back wall of the meter there are inputs placed with the symbols given below:

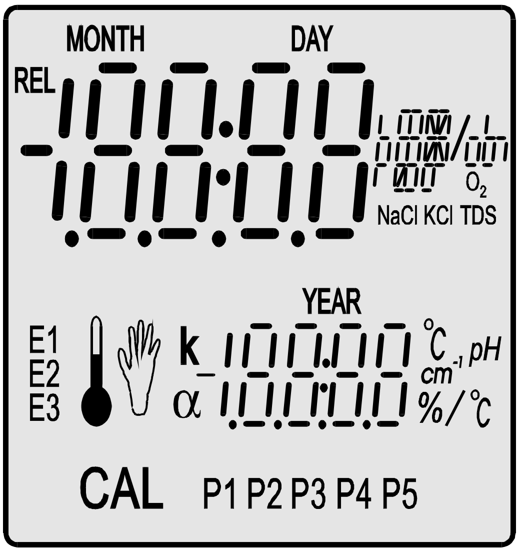
pH/mV - the **BNC-50** connector for combined or measuring pH electrode and redox electrodes;
Gnd - connector for the reference electrode;
cond - the **BNC-50** connector for conductivity cell;
temp - the **Chinch** connector for temperature probe;
POWER - connector for power adapter.


pH / CONDUCTIVITY METER CPC-511
7.53 mS/cm
23.6 °C
ON
OFF
pH
mV
cond
MODE
CAL
ELMETRON

Pic. 2.

5. SWITCHING THE METER ON AND OFF

After switching it on by pressing the  button the meter tests the memory and the display on which all symbols are being displayed (Pic. 3).



Pic. 3.

If the test ends successfully, after about 1.5 s the meter switches automatically to the measuring mode, in which it was switched off. Displaying of HELP sign informs that the meter has lost the factory settings and requires service repair. If after 1,5 s all symbols are continuously displayed, it informs that the calibration parameters of the electrode have been lost.

After pressing the  button the meter adopts standard characteristics:

- drift = 0 pH, slope = 100% for pH electrode;
- K constant = 1.000 cm^{-1} for conductivity cell;

and enters the measuring mode. It will be necessary to calibrate the conductivity cell and the pH electrode.

The meter is switched off by pressing the  button.

6. PREPARATION TO WORK

Before starting work:

- join the power adapter plug to the **Power** input;
- join the combination pH electrode or redox electrode to the **pH/mV** input (BNC-50);
- in case of using a measuring and reference electrode connect them with use of the adapter, available optionally;
- join the conductivity cell to the **cond** input (BNC-50);
- in case of using the temperature probe it should be connected with the chinch temperature input - **temp**;
- switch the meter on by pressing the ON/OFF button.

6.1. Choosing the kind of temperature compensation

The meter switches to the automatic temperature compensation mode after connecting the temperature probe. Next to the reading the symbol is displayed. The measurement will be compensated to the value of temperature measured by the probe.
Disconnecting the temperature probe switches the meter to the manual temperature compensation mode (the symbol disappears and the symbol appears). At the same time the , buttons will be unlocked, what enables the temperature value changing.

Note: pressing the , buttons simultaneously will set the compensation temperature to 20 ^{0}C.

II. pH MEASUREMENT

7. PREPARATION OF THE pH ELECTRODE

The electrode should be prepared to work according to the producer's instructions. If the instructions weren't given please act accordingly to the following steps:

- new electrode should be put into saturated KCl solution for about 5 hours;
- before starting measurements, the protecting rings (if used in this kind of electrode) should be removed. The ring placed on the junction - the lower part of the electrode - should be removed upward the electrode's body and the upper, which protects the KCl refilling hole, downward the body. **Removing the lower ring is essential, in other case the electrode would not measure.** Upper ring should be removed during measurements of high temperature solutions or to protect the junction during measurements in solutions with deposits or oils. Sometimes instead of a ring a cork is used;
- during measurements in laboratory it is advisable to use an electrode holder;
- after every measurement the electrode should be washed in distilled water;
- excess liquid on the electrode should be removed by gentle touching the glass with a tissue paper;
- after work the electrode should be stored in the saturated KCl solution. The protecting rings should be put on the junction and upper hole;
- in case of long breaks between measurements the electrode should be stored dry in the packaging;
- after taking the electrode out of the package the eventual deposit should be removed with use of water;
- before using it after a long break, the electrode should be placed in saturated KCl solution for about 1 hour;
- if construction of the electrode enables refilling the electrolyte, it should be controlled and refilled periodically by the upper hole in the electrode's body (usually as the electrolyte KCl solution is used).
- If the electrode is equipped with a small container (bottle) put on its end, the bottle should be taken off before measurements by unscrewing the nut gently and taking the bottle down the electrode's body. After the measurements the bottle should be put on again. Such electrodes are not equipped with the protective ring on the junction. It is necessary to control the level of the saturated KCl solution in the bottle and fill it up if necessary.

Note: storing the electrode in distilled water shortens its lifetime and may increase measurement error.

8. CALIBRATION

Before starting measurement with new electrode, after long-lasting use or before making measurements which require high accuracy the electrode connected with the meter should be calibrated. Results of measurements made without calibration will be burdened with a significant error. Calibration is made in buffer solutions. It consists in comparing pH value of buffer solutions with the value displayed by the meter and next in automatic introduction of correction which is taken into consideration during next measurements. Calibration should be periodically repeated because the parameters of the electrode are changing while working, what influences accuracy. The frequency of this procedure depends on the demanded accuracy, number of the measurements carried out, conditions in which the electrode was used, temperature and value of the measured solutions. When the highest accuracy is required, it is recommended to use fresh buffer solutions with certificates.

CPC-511 enables calibration in **buffer solutions with values determined by the manufacturer,** which are: 4.00; 7.00 and 10.00 pH, and are automatically detected.

There is a possibility of calibration minimum in 1 point and maximum in 3 points. The more calibration points are used, the higher accuracy in the whole range is ensured.

Calibration at 1 point does not ensure high accuracy. If the accuracy requirements are not very high and the measurement is made in the whole measuring range one-point calibration should be made with use of 7.00 pH buffer solution. Thanks to this the error connected with so called “zero offset” of the electrode will be eliminated.

At the rest of the points standard electrode’s slope parameters from the meter’s memory will be adopted. This slope corresponds to the theoretical efficiency of pH electrode. In case of accurate measurements in the whole range we recommend three-point calibration. In case of measurements in acids calibration in 2 buffer solutions: 4.00 and 7.00 pH is recommended, in case of alkali measurements calibration in 7.00 and 10.00 pH buffers is advisable.

In **CPC-511** the slope of the electrode is approximated in segments between the calibration points.

Starting the calibration process irreversibly erases the calibration data stored in the memory.

The buffer solutions may be used in a freely chosen order.

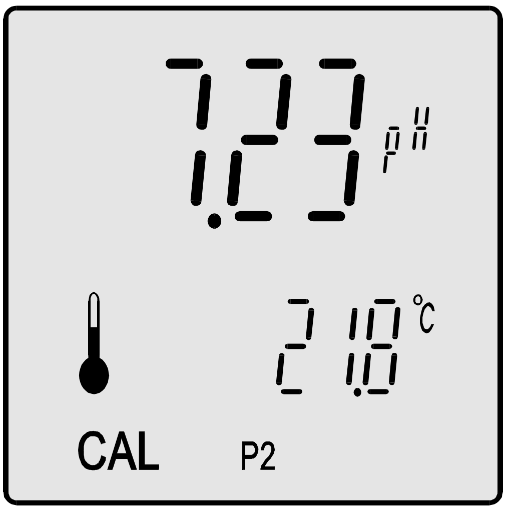
8.1. Calibration with automatic temperature compensation

After preparing the meter to calibration according to the chapter 6, in the pH measurement function:

a. press and hold the CAL button till the moment of appearance of the **CAL** symbol on the display (Pic. 4), **the previous parameters of calibration are now deleted;**

b. put the electrode and the temperature probe to the standard solution, the meter will recognise the pH value of the standard and the **P1** (calibration point) symbol will appear. The reading may be different than the actual pH value of the standard. After stabilisation of the reading press the CAL button. Blinking of the reading informs about recording the calibration value. At the same time the measured value will be adjusted to the value of the applied buffer solution.
If the value of the applied solution (buffer) is different then the recorded one and cannot be recognised by the meter or the electrode connected to the meter is broken, the Err symbol will appear.

c. the calibration may be finished at this moment by pressing the pH button or continued in next standard solutions accordingly to the point b. The electrode and the temperature probe should be washed before each immersion in the buffer.

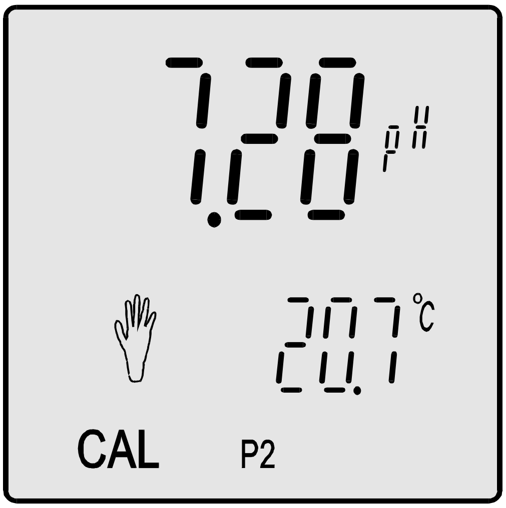


Pic. 4.

In case of entering the calibration mode and escaping it not having made calibration at least in one point, previously stored calibration data will be deleted and standard parameters will be adopted.

8.2. Calibration with manual temperature compensation

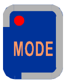
Disconnecting the temperature probe switches the meter to manual compensation (the 🌡 symbol next to the temperature reading disappears and the ✋ symbol appears – pic. 5). At the same time the ↙ , ↗ buttons will be unlocked, what enables the temperature value changing.
Next, connect the pH electrode to the meter and act accordingly to the points a ÷ c of the previous subchapter.

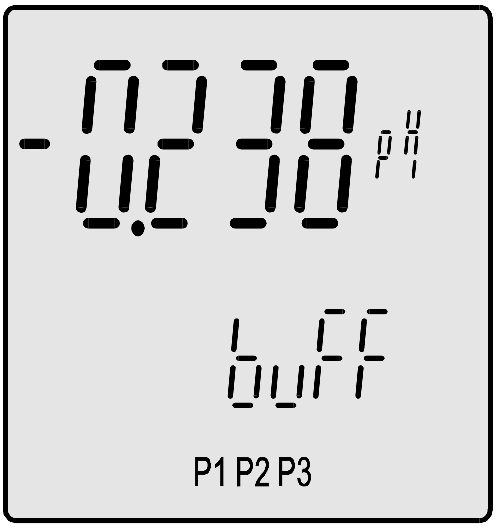


Pic. 5

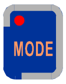
9. THE ELECTRODE PARAMETERS READOUT

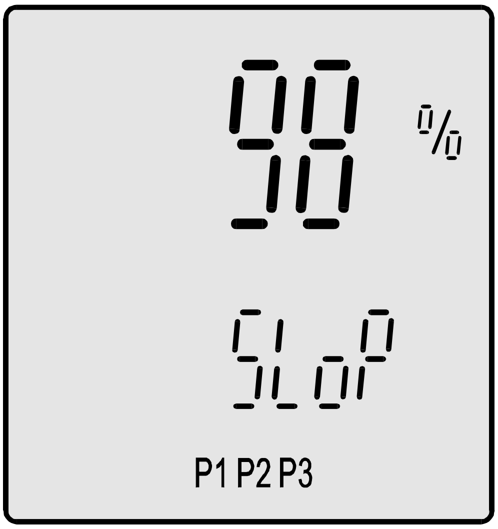
After the pH electrode has been calibrated, it is possible to check its condition: zero offset and slope.
To check, in the pH measurement mode:

- press the  button, in the lower display row the buFF symbol willl apear, the upper row will show the electrode's zero offset (Pic. 6);



Pic. 6

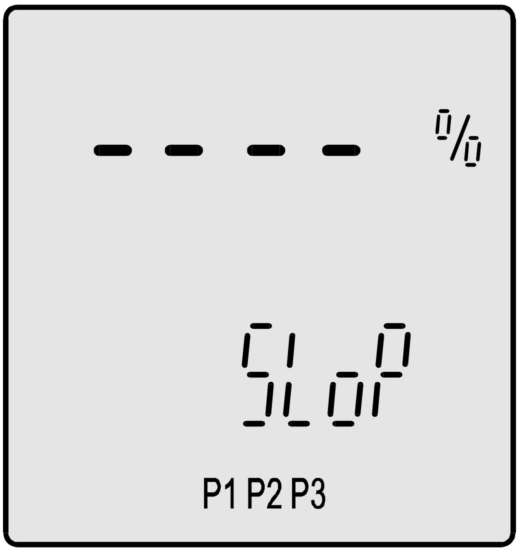
- press the  button once again, in the lower row the SLoP symbol will be displayed and the percentage value of the electrode condition - in the upper row. (Pic. 7);



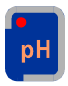
Pic. 7

In the lower row of the display the points of the electrode calibration are shown.

After deleting the electrode characteristics (entering the calibration mode and escaping it without calibrating at any point) the meter adopts the ideal electrode characteristics for its calculations and the actual electrode's parameters are unknown. In this case, after entering in the electrode parameters readout mode, in the place of the digital values, lines are displayed.
One-point calibration enables to indicate only the zero offset of the electrode. Instead of the slope value lines are displayed (Pic. 9).



Pic. 8

Return to the measurement mode by pressing the 

button.

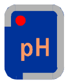
10. PH MEASUREMENT

Before starting measurement, prepare the meter (chapter 6) and the pH electrode (chapter 7) to work. Good condition of the electrode is the most important condition for accurate measurements.

10.1. Measurement with automatic temperature compensation

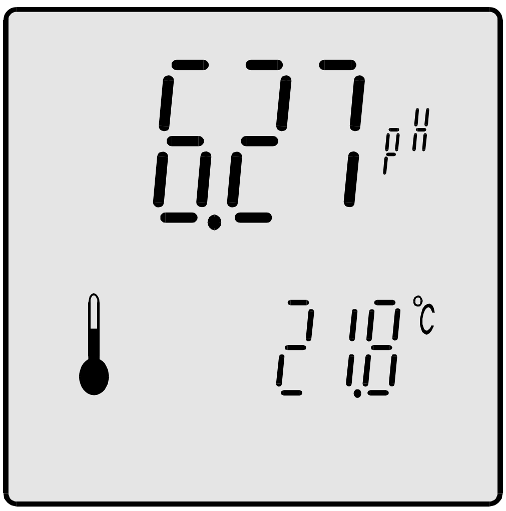
During measurements with automatic temperature compensation the meter cooperates with the temperature probe and measures the temperature of the solution simultaneously with pH. The measured temperature is taken into consideration during compensation.
In case of measurement with automatic temperature compensation:

- turn the meter on by pressing the  button;

- choose the pH measurement mode by pressing the  button;

- join the temperature probe and the combination pH electrode to the appropriate connectors on the meter;
- if the electrode is not calibrated or has been already used for some time it is advisable to calibrate it (chapter 8);
- insert the electrode and the temperature probe to the measured solution. During measurements in vessels do not touch the bottom and the walls with the electrode. It is to advisable to use an electrode stand;
- after stabilisation read the result (pic. 9).

Accurate laboratory measurements require using a stirrer.



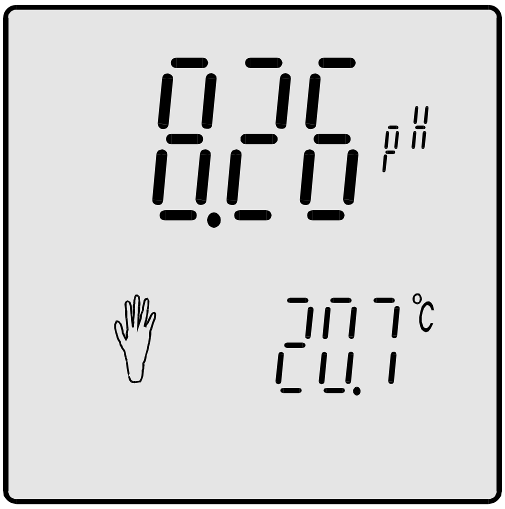
Pic. 9

Note: exceeding of the range of temperature compensation is indicated by blinking of the pH readout and the  symbol.

10.2. Measurements with manual temperature compensation

Disconnecting the temperature probe switches the meter to the manual temperature compensation mode (the symbol next to the temperature reading disappears).
Measurement with manual temperature compensation is similar to measurement with ATC, the difference is that for manual compensation the meter takes into consideration the value of the temperature introduced by the user instead of the temperature measured with the temperature probe.
Manual compensation may be applied during work in stable conditions e.g. during pH measurements in the laboratory, especially with use of a thermostat, or when the temperature probe is broken.
During measurement with manual temperature compensation:

- switch the meter on using the ON/OFF button;
- insert the pH electrode to the vessel with the measured solution, if the electrode is not calibrated or has been already used for some time it is advisable to calibrate it (chapter 8). During measurements in a vessel do not touch the bottom and the walls with the electrode. It is advisable to use an electrode stand;
- measure a temperature of measured solutions using laboratory thermometer;
- enter the temperature value of measured solution for manual compensation according with the , buttons;
- wait till the value stabilises and read the result (Pic. 10)



Pic. 10

Note: pressing the , buttons simultaneously will set the compensation temperature to 20 ^{0}C.

11. NOTICES ABOUT THE TEMPERATURE COMPENSATION AND INTERPRETATION OF THE pH MEASUREMENTS RESULTS

The **CP-511** pH meter has an automatic temperature compensation, which enables eliminating errors resulting from affecting the electrode characteristics by temperature changes. To explain the role of the temperature compensation it is important to remind that pH meter is an mV meter which displays redox counted to pH. In constant temperature one pH unit corresponds to constant mV value. In 20 ^{0}C it is 58.17 mV. The value of mV for one pH unit **is affected by the temperature,** what is taken into consideration in the formula for “k coefficient” of the pH electrode:

$$k=0.198423\ T$$

This coefficient is connected with the electrode’s slope and not with the measured solution. Temperature compensation doesn’t consider changes of the pH value of the solution caused by the temperature. Usually these are slight changes, however in e.g. pure water they tend to be significant. Values of solutions, which tend to be affected by the temperature changes, should be compared in the same temperature. Sometimes the results are unstable, which is connected with the quality of the electrode. **Unstable measurement results, slow drifting of the result or very long time of stabilisation are usually caused by clogged junction, contaminated or broken electrode.** It often happens in case of choosing inappropriate kind of electrode for the measured solution.
Putting the electrode into distilled water for a few hours or placing it in water with detergent may eliminate this symptoms, especially if measurements were made in solutions with deposits, fats or oils. The electrode which hasn’t been used for a long time, may have the junction clogged by KCl crystals, what may be removed by placing the electrode in distilled water. Heavily contaminated electrode may be cleaned in chloroform and deposits of iron in 2N HCl.

Depending on the kind of measured solution or substance, appropriate kind of electrode should be chosen. They differ one from another with shape, membrane's look, kind of junction and body. Electrode for heavily polluted sewage is different than this for clean water or for meat or soil. Using unsuitable electrode for measurements may cause its damage and make next measurements impossible.

Results of multiple pH measurements of the same solution with stabile temperature may differ one from another. When analysing this situation, the factors given below should be taken into consideration:

- the differences may occur because of using electrode of not very good quality;
- the result was treated as stabilised too soon (the time of stabilisation of an average-quality electrode is about 40 s.);
- the measured solution may not be homogeneous and without using the electromagnetic stirrer the results won't be equal;
- during measurements of sewage the result may be changed by chemical reactions.

Slight differences of the results are connected with the accuracy of the meter. The accuracy of **CPC-511** is ±0,01 pH, ±1 digit, what practically means that in extreme conditions results of two measurements of the same solution may differ in ±0,05 pH. This is an acceptable error, because one result has error equal – 0.02 and the second one + 0,02 pH. Expression ±1 digit in the technical data takes into consideration another possible difference which arises because of so called discretisation error – number of digits displayed on the LCD.

Sometimes the accuracy of calibration is checked in another buffer solution. In case of performing two-point calibration in 7,00 pH and 4,00 pH buffer solutions and the accuracy of such calibration is checked in 10,00 pH buffer in some cases the result may be 9,90 pH or 10,10 pH. Such difference is possible when the slope of the electrode isn't symmetrical to 7 pH.

Using three-point calibration in neutral, alkali and acidic buffer solutions may prevent such a situation.

III. CONDUCTIVITY AND SALINITY MEASUREMENT

12. BASIC INFORMATION ABOUT THE CONDUCTIVITY MEASUREMENT

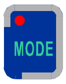
The conductivity measurement is based on applying electric current with a proper voltage and frequency to the measured solution. In **CPC-511** the voltage comes to several dozens of mV and the frequency depends on the measuring range and may vary from 100 Hz up to 10 kHz. The electric current value is dependent on the kind of the measured liquid, its concentration and temperature. The conductivity result indirectly informs about the salt concentration in the measured liquid – when it increases, the conductivity rises (KCl, NaCl). However, this dependence doesn't concern all of the solutions. In some of them, after overdrawing certain salinity value the conductivity starts decreasing. The value of a conductivity measurement also increases together with the temperature. Measured conductivity can be displayed as salinity in g/l of NaCl or KCl assuming that the measured liquid includes homogeneous salt. There is a possibility to define approximately the concentration of salt dissolved in water on the basis of the TDS coefficient. The electrodes' surface and the distance between them are decisive factors for the cell's K constant value. This value has a great influence on the accuracy of the measurement. Depending on the measured conductivity value, cells with K constant = 0,1 cm^{-1} up to 10 cm^{-1} are used. During measurement the meter multiplies the measured value by the K constant introduced to the meter's memory and displays the result in units of **conductivity** (µS/cm or mS/cm). The unit symbol in abbreviated form (µS or mS) is displayed next to the result. Conductivity changes along with temperature and salts concentration. In order to enable comparison of the results, the measured value is counted by the meter to the value which corresponds to measurement in reference temperature (it is usually the temperature 25°C). Measurement in reference tempera ture is the most accurate. In other temperatures the temperature compensation is used, which means that the meter calculates the influence of the temperature and α coefficient on the result. This coefficient describes how much (in %) the result changes with 1^0C of the temperature change. The α coefficient may be introduced into the meter's storage and is equal 2% / ^{0}C. For NaCl in temperatures close to 25 ^{0}C it amounts to 2%/ ^{0}C, e.g., in case of measurements in 30 ^{0}C the result change totals to 5x2%=10%. The conductivity measurement should always be treated as burdened with a certain error, which depends on the conductivity cell (its linearity) and temperature. When measurements are not made in the reference temperature, the error is dependent mainly on the α coefficient, which is affected by the temperature and concentration changes.

13. ENTERING THE CONDUCTIVITY MEASUREMENT PARAMETERS

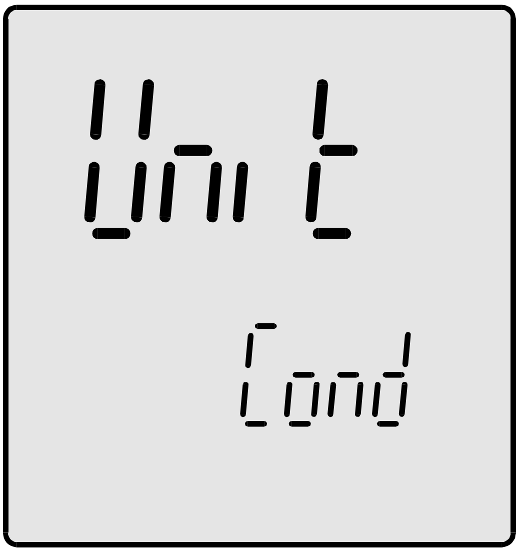
Before starting calibration and measurements it is necessary to perform all activities described in the chapter 6. Additionally, according to the chapter below, it is necessary to choose the unit in which the calibration and measurement are going to be made.

13.1. Choosing the unit

The measurement result is displayed in units of conductivity or salinity. Salinity can be counted to NaCl, KCl or TDS content in **g/l**. To choose the unit:

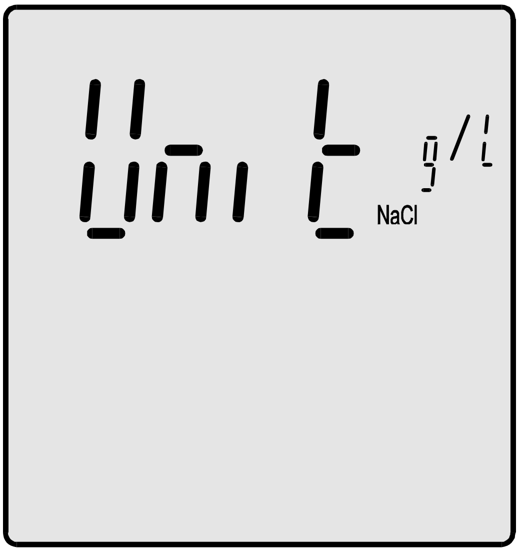
- in the conductivity measuring mode press the  button till the Unit (unit) symbol displays in the upper row on the LCD;
- with the  ,  buttons choose from the lower row on LCD:

Cond - measurement in units of conductivity (Pic.11);



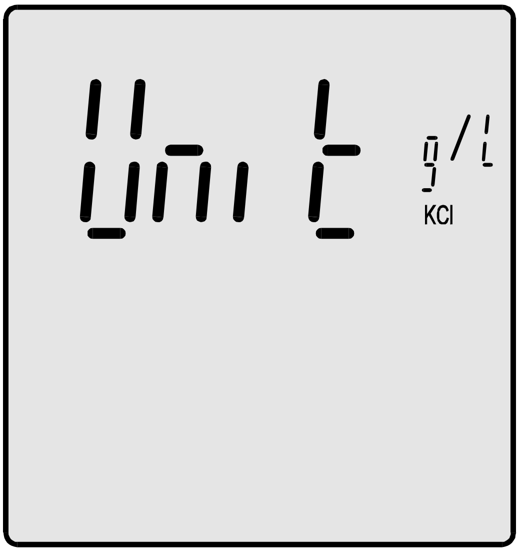
Pic. 11

NaCl - measurement result calculated to NaCl in **g/l** (Pic.12);



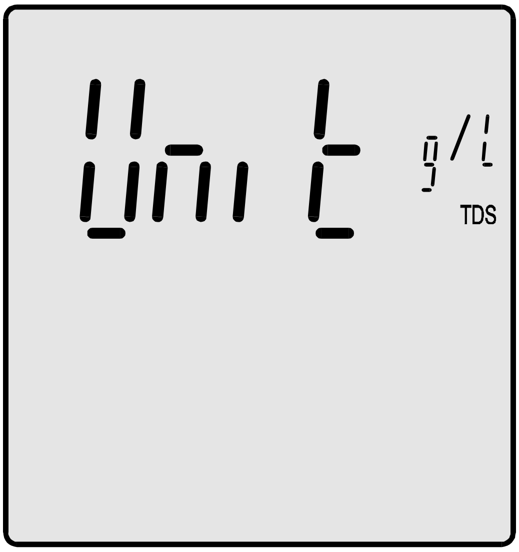
Pic. 12

KCl - measurement result calculated to KCl in **g/l** (Pic.13);

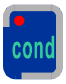


Pic. 13

tdS - measurement result calculated to TDS in **g/l** (Pic.14).



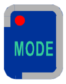
Pic. 14

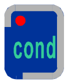
- enter the measurement mode by pressing the 

button

13.2. Entering the W_{TDS} coefficient

In case of measurement of salinity with conversion to TDS it is necessary to introduce the W_{TDS} coefficient:

- in the conductivity measuring mode press the 

button till the  symbol (TDS coefficient) displays in the upper row on the LCD (Pic. 15);
- with the ,  buttons enter the appropriate value of the TDS coefficient;
- enter the measuring mode by pressing the 

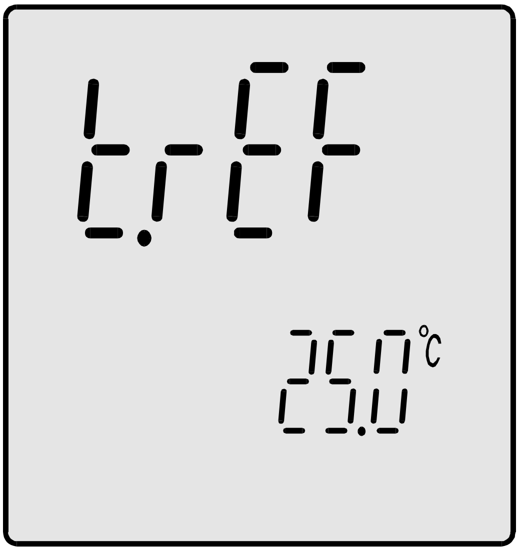
button.

Pic. 15.

13.3. Entering the reference temperature value

The range of introducing the reference temperature values is 10.0 ÷ 40.0 ^{0}C, every 0.1 ^{0}C. The most often used value is 25 ^{0}C.
In order to introduce the reference temperature:

- in the conductivity measuring mode press the MODE button till the screen with a value of the reference temperature and a t.rEF sign (temperature reference) displays (pic. 16);
- with the ↙ , ↗ buttons introduce the temperature value;
- return to the measuring mode by pressing the cond button.



Pic. 16.

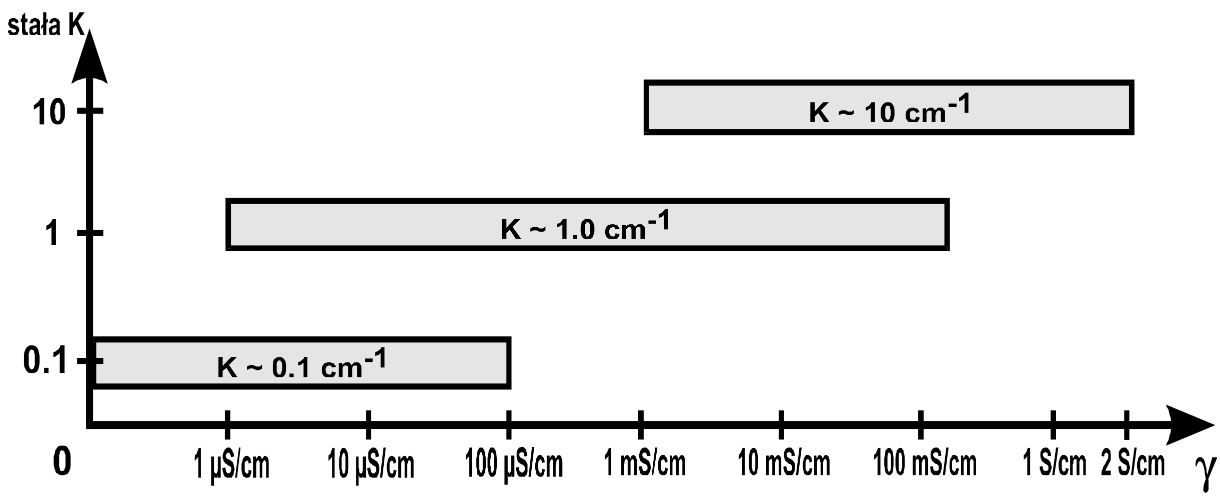
The measurement result will be calculated to the introduced reference temperature.

Note: pressing both ↙ , ↗ buttons simultaneously sets the temperature to 25 ^{0}C.

14. CHOOSING AND MAINTAINING THE CONDUCTIVITY CELL

14.1. Choosing the cell

The **CPC-511** meter measures conductivity in the range 0 – 1999.9 mS/cm. The meter cooperates with conductivity cells with K constant=0.010 ÷ 19.999 cm^{-1} and BNC-50 connector. Depending on the required measuring range it is necessary to choose the cell with a K constant which enables receiving valid results. **Beyond its range the cell looses its linearity and the results are burdened with an increasing error.** Accurate measurements in the whole range are possible when using 3 different conductivity cells.
Depending on the expected measuring range the appropriate cell may be chosen with use of the chart below.



Pic. 17 The dependence between the measuring range and K constant of applied conductivity cells.

The standard set includes the conductivity cell with a K constant = 1. Cells with the K constant =10 should be used for measurements in liquids with conductivity higher than 100 mS/cm.

14.2. Maintenance of the conductivity cell

In order to receive stable results it is advisable to soak the cell for a few hours before measurement, especially in case of measurements in distilled water.
Maintenance of the conductivity cell consists mainly in washing the inside of the measuring cell accurately with distilled water. The platinum electrodes **must not be cleaned mechanically**, because this results in rubbing off the platinum layer, what can cause decreasing of accuracy, lowering of stability and changing of the K constant.
Measurements of liquids with oils and heavy sediment content may cause platinum contamination, make the measurement impossible and irreparably damage the electrodes. In case of fat content in the measured liquids it is possible to clean the electrodes by immersing the cell in acetone, chloroform, 4-hydrofuran or detergent.
Certain norms propose universal liquid for cleaning the cells. This is a mixture of equal parts of isopropyl alcohol, ethyl ether and hydrochloric acid diluted with water in 1:1 ratio.
Broken measuring cell hinders any further measurements due to significant change of the K constant, unstable results and increase of the dependence of the result on the position of the cell in the measuring vessel.
The cell should be immersed in such a way for the solution to fill it up and not to include any air bubbles (single bubbles or silver coating). It is essential for obtaining accurate results of measurements. The best way is to immerse the cell, make a few vertical moves and thus to remove air bubbles through holes in the upper part of the cell. If the air bubbles appear each time after the cell has been immersed and they are difficult to remove, it is advisable to immerse the cell in a water – washing up liquid mixture, what will lower the surface tension and disable air bubbles to stick to the surface of the cell walls or electrodes. Next, wash the cell accurately with distilled water.

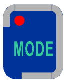
15. CALIBRATION

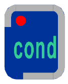
A characteristic feature of every conductivity cell is its K constant. Before the result is shown on the display, the value is multiplied by the K constant value. The value of the K constant depends on the size of the electrodes' surface and the distance between them. If the the cell is kept clean, the K constant is not changing. However, it is likely to change in case of contamination of the surface of the electrodes.
Calibration consists in introducing the K constant value into the meter's memory and is essential for obtaining accurate results. The meter may be calibrated without the standard solution, by entering the value of the K constant of the cell given by the manufacturer (recommended) or with use of standard solution with known conductivity – in order to determine the K constant.

The K constant is precisely determined by the cell manufacturer and using this value will be the most reliable.
In case of the user's calibration it is necessary to apply fresh, accurately prepared standard solution. Additionally it has to be accurately thermostatic to the temperature 25^{0}C. When these conditions are not kept, the calibration will be burdened with error.

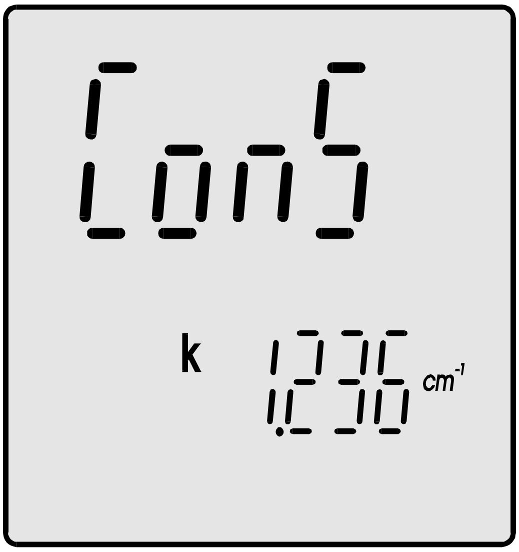
15.1. Calibration without standard solution

The meter has a possibility of calibration without the use of standard solution. In case of such calibration it is necessary to know the K constant of the conductivity cell. This value may be given by the cell manufacturer or may be determined using the **CPC-511** meter after having calibrated it in the standard solution.
In order to calibrate without the standard:

- in the measuring mode press the 

button till the screen with the value of the K constant displays (pic. 18);
- with the  ,  buttons enter the value of the K constant;
- enter the measuring mode by pressing the 

button.



Pic. 18

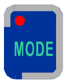
15.2. Calibration with use of standard solution

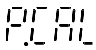
The purpose of such calibration is to determine the K constant. The meter enables one-point calibration in a freely chosen standard solution. To decrease the error it is recommended to use solutions with a value close to the estimated value of measurement. It is required to use standard solutions of high quality. Calibration is made in the chosen unit (section 13.1).
It is necessary to comply to the principles given below to obtain the exact results of calibration:

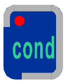
1. The temperature of the standard solution should be equal to the reference temperature (most often it is 25 ^{0}C).
2. New, unused standard solution should be applied.
3. The cell and its electrodes should be clean and devoid of air bubbles.
4. The electrode holder should be used.

15.2.1. Entering the standard solution value

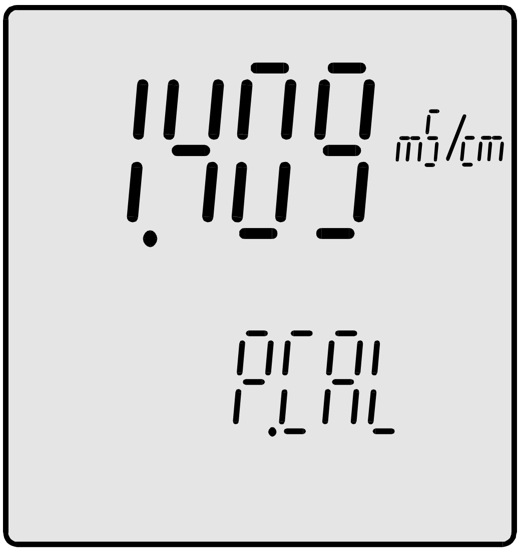
In order to enter the value of the standard solution:

- choose the unit according to the section 13.1;
- in the conductivity measuring mode press the 

button till the 

symbol appears in the lower row (pic. 19);
- with the  ,  buttons enter the value of the standard solution into the upper row;
- enter the measuring mode by pressing the 

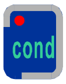
button.

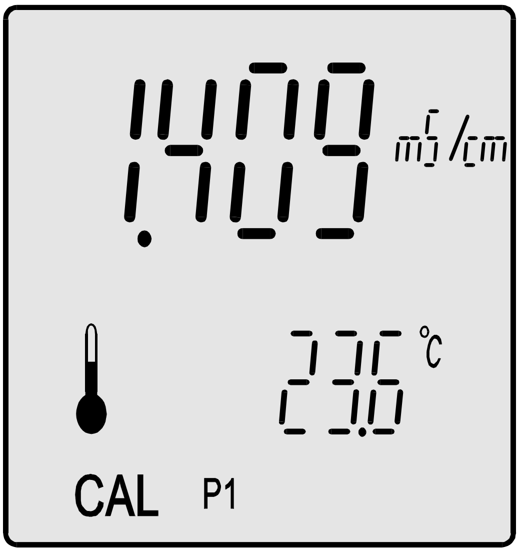


Pic. 19

15.2.2. Calibration with automatic temperature compensation

It is necessary to:

- enter the value of standard solution (point 15.2.1);
- connect the conductivity cell and the temperature probe;
- immerse both of them in the standard solution, hold the conductivity cell at least 1 cm away from the bottom and walls of the vessel. The measuring cell should be filled up with the measured solution, there shouldn't be any air bubbles and the electrodes should be evenly moistened*;
- measure the temperature of solution and bring it to the introduced value of reference temperature;
- press and hold the  button until the ***CAL*** symbol appears on the display (pic. 20).
- wait till the value stabilises and press . Flashing result informs about recording it in the memory. If the Err symbol displays, it is necessary to check the introduced value of the standard solution;
- exit the calibration mode by pressing .



Pic. 20

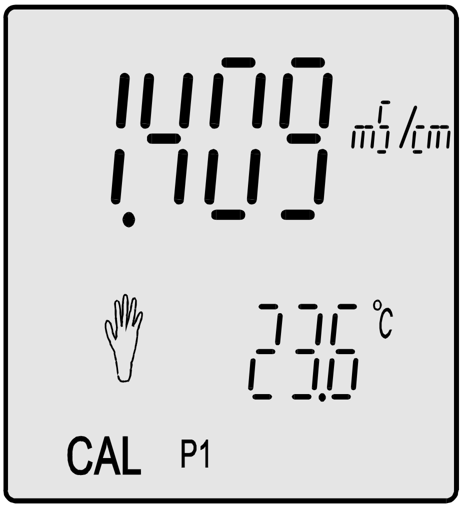
The meter is calibrated and ready to work.

* - air bubbles may be removed by moving the immersed cell. In order to make moistening of the electrodes easier, it is recommended to immerse the cell in distilled water with washing-up liquid, and than wash it in distilled water.

15.2.3. *Calibration with manual temperature compensation*

In order to calibrate the meter it is necessary to:

- turn the meter on with ;
- choose the conductivity measuring modewith the button;
- disconnect the temperature probe and press the , . buttons simultaneously. Introduced reference temperature value will appear In the lower row;
- introduce the value of the standard solution (point 15.2.1);
- immerse the conductivity cell in the standard solution and hold it at least 1cm away from the bottom and walls of the vessel. The measuring cell should be filled up with the standard solution completely and shouldn’t include any air bubbles, the electrode’s surface should be evenly moistened*;
- measure the temperature of the standard solution with a lab thermometer and bring it to the introduced reference temperature;
- press and hold till the ***CAL*** symbol (pic. 21) appears on the display.
- wait till the result stabilises and press . Flashing result informs about recording it in the memory. If Err symbol displays it is necessary to check the introduced value of the standard solution.
- exit the calibration mode by pressing .



Pic. 21

The meter is calibrated and ready to work.

* - air bubbles may be removed by moving the immersed cell. In order to make moistening of the electrodes easier, it is recommended to immerse the cell in distilled water with washing-up liquid, and than wash it in distilled water.

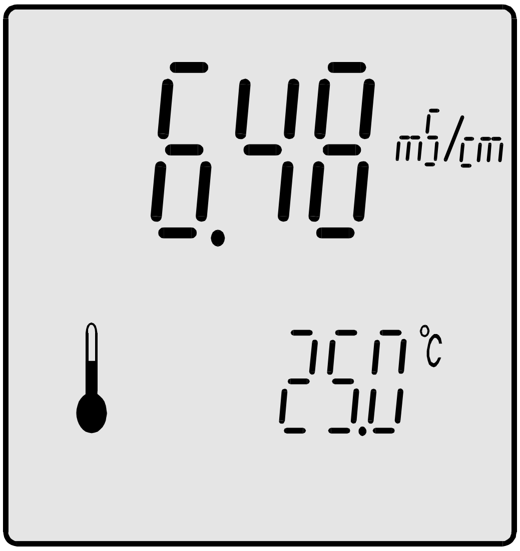
16. THE CONDUCTIVITY MEASUREMENT

16.1. Measurement without the temperature compensation

An accurate conductivity measurement should be made without the temperature compensation. The measured solution should be brought to the reference temperature value introduced earlier. When controlling, it is possible to use the temperature probe. In case of work without the temperature probe it is necessary to introduce the temperature value with the  , .buttons.

In order to make a measurement without the temperature compensation:
- connect the conductivity cell and the temperature probe to the **cond** and **temp** connectors respectively;
- turn the meter on with 

;
- choose the conductivity measuring mode and the unit (section 13.1);
- if the conductivity cell wasn't calibrated, calibrate it according to the chapter 15;
- place both probes in the measured solution, the conductivity cell can't touch the walls and the bottom. The measuring cell should be filled up with the standard solution and shouldn't include any air bubbles, the electrode's surface should be evenly moistened*;
- bring the temperature of the measured solution to the value of the reference temperature.
- read the result after it has stabilised (pic. 22).



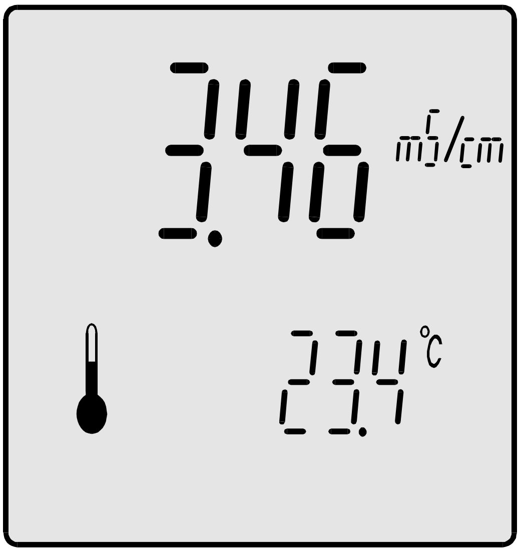
Pic. 22

* - air bubbles may be removed by moving the immersed cell. In order to make moistening of the electrodes easier, it is recommended to immerse the cell in distilled water with washing-up liquid, and than wash it in distilled water.

16.2. Measurement with automatic temperature compensation

In order to make measurement with automatic temperature compensation:

- connect the conductivity cell and the temperature probe to the **cond** and **temp** connectors respectively;
- turn the meter on with the button;
- choose the conductivity measuring mode with the button and the unit according to the section 13.1;
- if the conductivity cell is not calibrated, calibrate it according to the chapter 15;
- check or change the value of the reference temperature;
- place both probes in the measured solution, the conductivity cell can't touch the walls and the bottom. The measuring cell should be filled up with the standard solution and shouldn't include any air bubbles, the electrode's surface should be evenly moistened*;
- wait till the result stabilises and read it (pic. 23).



Pic. 23

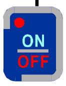
Note: in case of exceeding the range of temperature compensation the result a nd the symbol start flashing even though the conductivity measuring range has not been exceeded.

Displaying of the symbol instead of next to the value informs that the temperature probe is broken.

* - air bubbles may be removed by moving the immersed cell. In order to make moistening of the electrodes easier, it is recommended to immerse the cell in distilled water with washing-up liquid, and than wash it in distilled water.

16.3. Measurement with manual temperature compensation

Measurement with manual temperature compensation may be made in stable work conditions, e.g., during measurements in laboratory, especially with use of thermostat, or in case of the temperature probe damage. Disconnecting of the temperature probe switches the meter to manual temperature compensation.
In case of measurement with manual temperature compensation:

- connect the conductivity cell to the **cond** connector;
- disconnect the temperature probe;
- turn the meter on with the  button;
- choose the conductivity measurement unit (section 13.1);
- if the conductivity cell has not been calibrated earlier, calibrate it according to the chapter 15;
- check or change the value of the reference temperature;
- place the cell in the measured solution, the conductivity cell can't touch the walls and bottom. The measuring cell should be filled up with the standard solution and shouldn't include any air bubbles, the electrode's surface should be evenly moistened*;
- measure the temperature of the solution and introduce its value with the  ,  buttons.
- after stabilisation read the result (pic. 24).

Pic. 24

Notice: pressing of the  ,  buttons simultaneously sets the compensation temperature to the reference temperature value that has been entered earlier.

* - air bubbles may be removed by moving the immersed cell. In order to make moistening of the electrodes easier, it is recommended to immerse the cell in distilled water with washing-up liquid, and than wash it in distilled water.

17. SALINITY AND TOTAL DISSOLVED SOLIDS MEASUREMENT

Salts and minerals dissolved in natural water influence the conductivity, which in principle is proportional to the quantity of dissolved substances. This dependence enables to determine, after certain calculations, salinity of the measured solution in concentration units (g/l or %), or TDS (Total Dissolved Solids). Received values are always approximate and total accuracy depends on the way of making calculations, concentration of the measured solution and its temperature. In most salinity meters a simplification is used, that dependence between conductivity and salinity in the solution is linear in the whole measuring range. Usually a 0.5 coefficient is used, the conductivity result in mS/cm is multiplied by this coefficient and the result of salinity is received in g/l, e.g., if the conductivity value is 2 mS/cm, salinity amounts to 1g/l. In practice the dependence between conductivity and salinity isn't linear and the conversion coefficient is changing together with the concentration and temperature. Table 3 shows the dependence between conductivity and actual salinity of NaCl solution in temperature 25 ^{0}C and values of salinity counted for constant coefficient 0.5. This comparison shows that using a constant coefficient for greater concentrations introduces significant error.

Table 1.

Conductivity (mS/cm)	Real salinity (g/l)	Salinity (g/l) Counted for coefficient = 0.5	Error (%) by using the coefficient = 0.5
1.00	0.495	0.500	0.01
2.00	1.006	1.000	0.60
4.00	1.976	2.000	1.21
10.00	5.400	5.000	-7.40
30.00	18.174	15.000	-17.46

In CPC-511 microcontroller takes into consideration actual dependence between conductivity and salinity what greatly reduces the error. There is a possibility of counting the salinity in NaCl or KCl, because the dependence for these salts is slightly different.

17.1. Salinity measurement with conversion to NaCl or KCl content

The measurement of salinity with conversion to NaCl or KCl content is made in the following way:

- choose the salinity measurement with conversion to NaCl or KCl content according to the section 13.1;
- then act as during the conductivity measurement (chapter 16);
- after stabilisation read the result.

17.2. Salinity measurement with conversion to TDS content

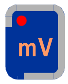
The measurement of salinity with conversion to TDS should be made in the following way:

- according to section 13.2 introduce the W_{TDS} coefficient;
- choose the measurement of salinity with conversion to TDS and the unit (g/l);
- then act as during conductivity measurement;
- after stabilisation read the result in g/l.

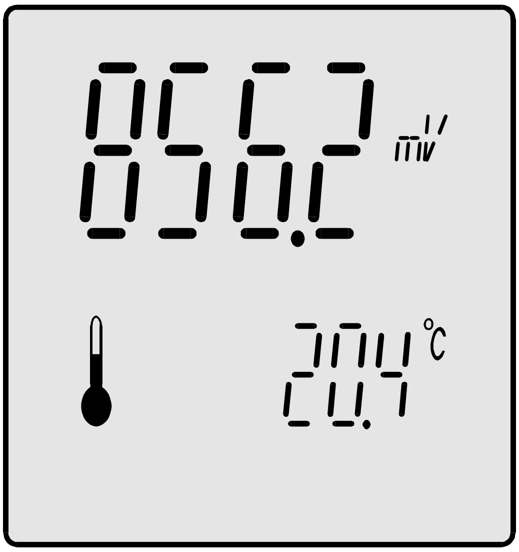
IV. REDOX POTENTIAL AND TEMPERATURE MEASUREMENT

18. REDOX POTENTIAL (mV) MEASUREMENT

CPC-511 pH / conductivity meter is an accurate redox potential meter. The measurement can be made with a special redox electrode or during titration.

The result is checked after choosing the mV mode with the 

button (pic. 25).



Pic. 25

19. TEMPERATURE MEASUREMENT

The temperature measurement is made as follows:
- connect the temperature probe to the Chinch connector;
- switch the meter on by pressing the 

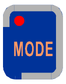
button;
- put the temperature probe to the measured solution;
- wait till the value stabilises and read the result from the lower row.

The meter cooperates with the Pt-1000 platinum resistor sensor and the final accuracy of the temperature measurement depends on its class.

NOTE: lack of the  symbol on the display signalises disconnecting the temperature probe or break in its circuit. In such case the meter shows the temperature value introduced by the user for manual temperature compensation. Blinking -50℃ value during measureme nt in positive temperatures informs about short-circuit in the temperature probe.

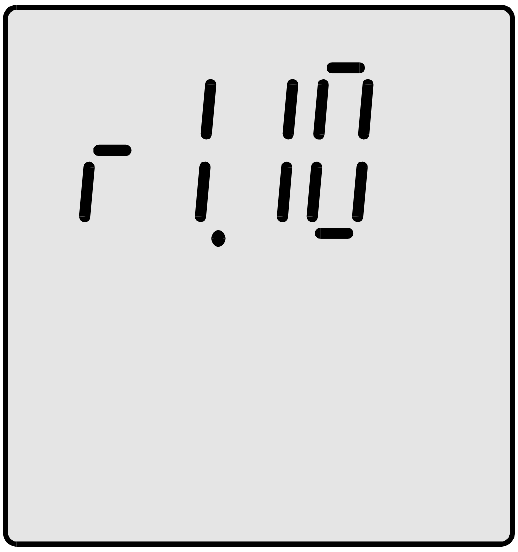
V. OTHER

20. READOUT OF THE SOFTWARE VERSION NUMBER

In order to check the software version number turn the meter off and next, holding the 

button, turn the meter on by pressing the 

button. Instead of the display test, the screen as in the picture below will appear (Pic. 26). In the upper row the software version will appear.



Pic. 26

After about 1.5 s. the meter enters the measurement mode.

21. TECHNICAL DATA

pH MEASUREMENT:

Range	Resolution	Accuracy (±1 digit)
-2.000 ÷ 16.000 pH	0.01 pH	±0.01 pH

INPUT IMPEDANCE: >10^{12} Ω
TEMPERATURE COMPENSATION: automatic
COMPENSATION RANGE: -5.0 ÷ 110.0 ^{0}C
pH ELECTRODE CALIBRATION: automatic, in 1 ÷ 3 points
THERMAL STABILITY OF ZERO : 0.001pH/^{0}C

REDOX POTENTIAL MEASUREMENT:

Ranges	Resolution	Accuracy (±1 digit)
-1999 ÷ 1999 mV	1 mV	±1 mV

INPUT IMPEDANCE: >10^{12} Ω

CONDUCTIVITY MEASUREMENT:

Ranges *	Resolution	Accuracy** (±1 digit)	Frequency
0.00 ÷ 199.9 µS/cm	0.1 µS/cm	±0.25 %	1 kHz
200 ÷ 1999 µS/cm	1 µS/cm	±0.25 %	1.6 kHz
2.00 ÷ 19.99 mS/cm	0.01 mS/cm	±0.25 %	4.6 kHz
20.0 ÷ 199.9 mS/cm	0.1 mS/cm	±0.25 %	12 kHz
200 ÷ 1000 mS/cm	1 mS/cm	±0.25 %	12 kHz

* Range for K=1 up to 100 mS/cm; above for K=10.
**Accuracy given for the end value of the range.

Ranges of frequency changes were given for constant K = 1. For other values of the K constant the values will be changing proportionally to changes of this constant.

TEMPERATURE COMPENSATION: manual/automatic
COMPENSATION RANGE: -5.0 ÷ 70.0 ^{0}C
K CONSTANT RANGE: 0.010 ÷ 19.999 cm^{-1}
α COEFFICIENT: 2.00 %/ ^{0}C

TDS COEFFICIENT RANGE: 0.20 ÷ 1.00
MEASURING RANGE KCl: 0 ÷ 200 g/l
MEASURING RANGE NaCl: 0 ÷ 250 g/l
PROBE CALIBRATION: one-point
1. by entering the K constant of the probe
2. using the calibration solution

TEMPERATURE MEASUREMENT:

Range	Resolution	Accuracy* (±1 digit)
- 50.0 ÷ 199.9 ^{o}C	0.1 ^{o}C	±0.1 ^{o}C

* accuracy of the meter. Final accuracy of the measurement depends on the accuracy of applied Pt-1000 probe

TEMPERATURE PROBE: Pt-1000 platinum resistor

ACCURACY OF THE PROBE IN RANGE 0 ÷ 100 ^{0}C:

for Pt-1000B resistor: ±0.8 ^{0}C
for Pt-1000$^{1}/_{3}$B resistor: ±0.3 ^{0}C

OTHER:

OPERATING TEMPERATURE:	0 ÷ 40 ^{o}C
POWER SUPPLY:	12V/100mA power adapter.
POWER CONSUMPTION:	120 mW
DISPLAY:	LCD 69 x 73 mm
DIMENSIONS:	200 x 180 x 50 mm
WEIGHT:	600g

22. EQUIPMENT

The standard set includes:

1. Combination glass pH electrode;
2. Conductivity cell (K constant=0.45);
3. Pt-1000B temperature probe (standard);
4. 12V/100mA power adapter;
5. User's manual with warranty.

Additional equipment:

1. Pt-1000 1/3B temperature probe with higher accuracy;

W A R R A N T Y

The “ELMETRON” company gives 24 months of warranty for the **CPC-511** pH / conductivity meter number

....

The electrode and the conductivity cell have a 12-month warranty.

In case of damage the manufacturer will repair the meter within 14 days of the day of delivery. The warranty doesn’t cover the damages caused by usage not in conformity with the users manual, using wrong power adapter, mechanical damages and damages caused by repairs made by unauthorised persons.

NOTICE: Before sending the meter to us please contact the firm by phone.

When sending the meter, please include the electrode, the cell, the temperature probe and the power adapter.
We also provide after-warranty repair service.

Date of production...........................
Date of sale.....................................
Date of expiry..................................

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