LABORATORY
pH / ION METER

CPI-505

USER'S MANUAL

ELMETRON

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pH/ION METER

CPI-505

Before use please read the instruction carefully!

CONTENTS

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.**
During ion selective measurements, the worsening of the results stability is a very frequent issue, connected strictly with the quality of the ion selective electrodes. The measuring diaphragm of the ion selective electrode is likely to be contaminated during measurements in solutions containing compounds influencing the electrode's membrane activity. It is very important to keep it clean. The methods of cleaning the electrodes are given by their manufacturer.
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. THE CHARACTERISTICS OF THE METER

The pH / Ion meter **CPI-505** belongs to the newest generation of measuring devices which offer wide range of additional functions. The meter ensures high accuracy and repeatability of the readings. The electronic elements of the newest generation used in the meter made its memory independent from power supply. The internal clock is powered from the battery which holds its charge for many years. The meter is equipped with a custom, backlit LCD display, which enables observing the measured function simultaneously with the temperature value. Additional graphic symbols make working easier.
Main features of **CPI-505** are:

- high accuracy and stability of readings;
- measurement of pH, ions, mV and temperature;
- automatic and manual temperature compensation;
- storing of calibration characteristics of three pH electrodes and ion selective electrodes independently;
- electrode calibration in 1 to 5 points;
- automatic recognition of pH buffers and standards;
- provided values of standard solutions with possibility of changing them;
- option of automatic introduction of temperature influence on the value of pH buffer solutions (NIST norm);
- information about the condition of the electrode;
- ion measurements in pX, g/l, M/l or ppm with automatic conversion between units;
- possibility of introducing a freely chosen values of the sample solutions in the ion measurement mode;
- storing the date and parameters of last calibration of three electrodes;
- storing the measurements results with time, date, individually or taken as series of measurements with set time interval;
- USB port;
- real clock with date.

3. WHAT IS THE METER DESIGNED FOR

The pH / ion meter **CPI-505** is a precise and easy-to-use meter designed for hydrogen ion concentration measurements in pH units, ion selective measurements in pX, g/l, M/l or ppm and redox potential (mV). There is a possibility of measurements of mono-valent and bivalent ions, positive and negative. Measurement of the chosen ion is connected with using of a combination ion selective electrode (ISE) or measuring and reference electrodes. It may be also used for accurate temperature measurement of solutions and air in ℃.

The meters are used in food, chemical, pharmaceutical, power industries, in water treatment stations, laboratories, agriculture, universities, scientific laboratories etc.

CPI-505 are prepared to work with all types of combination pH electrodes and ion selective electrodes equipped with BNC-50 connector. There is also a possibility of using a separate measuring and reference electrode. The meters co-operate with Pt-1000 temperature probe with a Chinch connector.

The meter may collect measurements taken as single or series of measurements with set time interval.

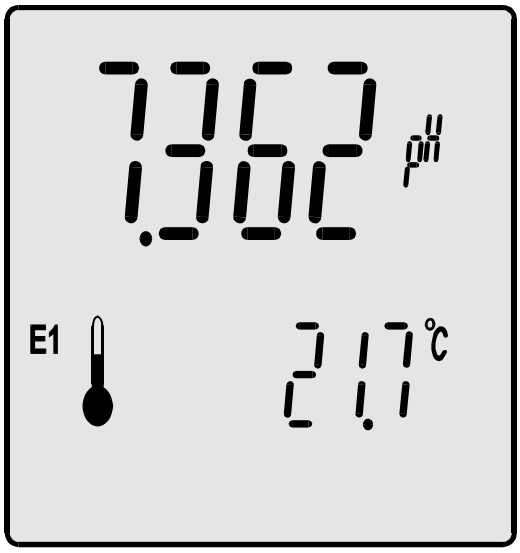
The built-in USB port enables sending the data to the PC. There is a possibility of sending current or collected measurement results together with date and time they have been collected.

In case of necessity to collect series exceeding the memory capacity it is possible to use a special PC software offered by our company.

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:
- result of the pH measurement in pH units;
- result of the ion measurements in pX, g/l, M/l or ppm;
- result of the mV measurement in mV;
- time and date.

A particular function is chosen with a specific button which is signalised by lighting the LED diode placed on this button.
The temperature value in ^{o}C is displayed simultaneously with the result. Symbols of units are displayed next to the results.



Pic. 1.

Beside the temperature value there is a symbol (automatic temperature compensation) or a symbol (manual temperature compensation) displayed. ***CAL*** symbol on the left side of the display informs that the meter is in the calibration mode. The number of the chosen electrode is displayed on the left side (E1, E2, E3). It informs which of the characteristics would be taken into consideration during all calculations. Flashing symbol of the electrode number informs that the characteristic has been deleted, the calibration validity has expired (point 6.5), or that the last calibration has shown that the electrode had lost its efficiency. The number of detected calibration point is displayed, during calibration, in the lower row of digits (P1, P2, P3, P4, P5).

When pressing the MODE button, all parameters introduced by the user are displayed.

The keyboard (Pic. 2) placed under the display is used for switching the meter on and off, choosing the measuring function, calibration, entering the parameters and memorising the results.

- switches the meter on and off;

- chooses the pH measuring function;

- chooses the mV measuring function;

- chooses the Ion measuring function;

- displays the time and date;

- holding of this button enters the calibration mode (*CAL* symbol displayed). Pressing shortly in this mode confirms the calibration result;

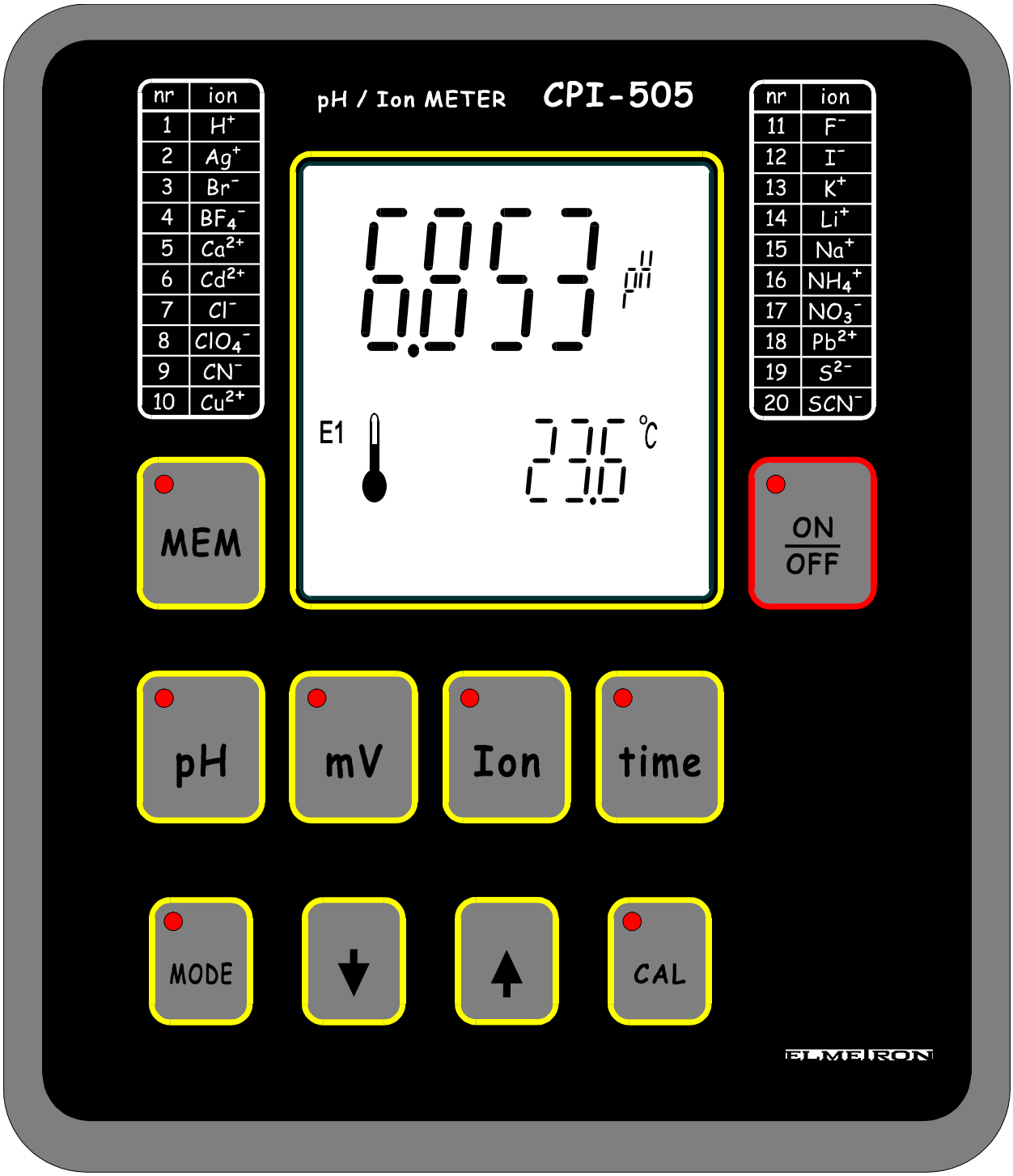
- pressing shortly causes memorising single results or measuring series, holding enters the stored results readout mode;

- chooses the entered parameter;


, - buttons for entering the parameters.

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

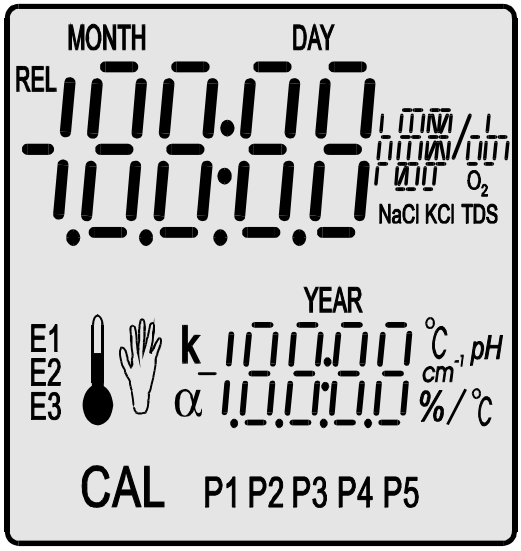
pH/mV - the **BNC-50** connector for combined or measuring pH electrode and redox or ion selective electrodes;
Gnd - connector for reference electrode;
temp - the **Chinch** connector for temperature probe;
USB - the **USB** port for connecting the meter with the PC;
POWER - connector for power adapter.


nr ion
1 H+
2 Ag+
3 Br-
4 BF4-
5 Ca2+
6 Cd2+
7 Cl-
8 ClO4-
9 CN-
10 Cu2+
pH / Ion METER
CPI-505
nr ion
11 F-
12 I-
13 K+
14 Li+
15 Na+
16 NH4+
17 NO3-
18 Pb2+
19 S2-
20 SCN-
E1
°C
MEM
ON
OFF
pH
mV
Ion
time
MODE
CAL
ELMETRON

Pic. 2.

5. SWITCHING THE METER ON AND OFF

After switching it on by pressing the ON/OFF 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 the 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 electrodes are lost.

After pressing the CAL button the meter adopts standard characteristics for the pH electrode:

- shift = 0 pH, characteristic slope = 100%

and enters the measuring mode. It will be necessary to calibrate the electrodes.

The meter is switched off by pressing and longer holding of the ON/OFF button.

6. PREPARATION TO WORK

Before starting work:
- join the power adapter plug to the **Power** input;
- join the combination pH electrode, ion selective electrode or redox electrode to the **pH/mV** input (BNC-50);
- in case of using a separate reference electrode, it should be connected to the **Gnd** input;
- in case of using the temperature probe it should be connected with the Chinch temperature input - **temp**;
- in case of working with a PC join the cable with the **USB** port;
- switch the meter on by pressing the 

button.

6.1. Choosing the kind of temperature compensation

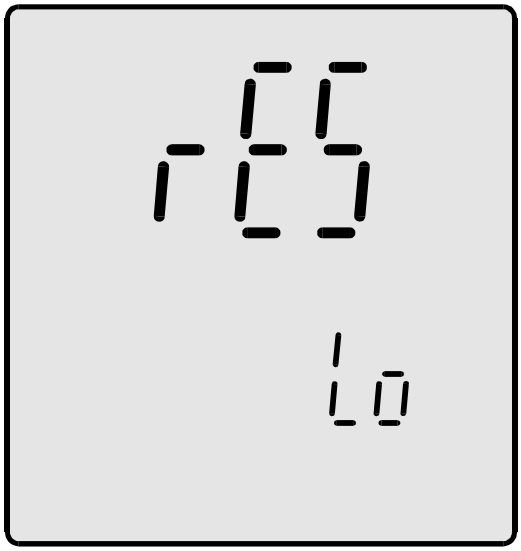
The meter switches to the automatic temperature compensation mode automatically after connecting the temperature probe, after disconnecting it the meter enters the manual temperature compensation mode. In the ATC mode, next to the displayed temperature  symbol appears. Manual temperature compensation is indicated by  symbol next to the value entered by the user, its value may be changed with use of the  keys.

6.2. Changing the resolution of the measurements

The measurement results may be displayed with a chosen resolution. In order to change it:

- in the measuring mode press the MODE button, a rES (resolution) sign will be displayed (Pic. 4);
- using the keys ▼ , ▲, choose:

  Lo - low resolution of the measurement;
  Hi - high resolution of the measurement.



Pic. 4.

For the pH measurement:

Lo - resolution of the measurement 0.01 pH;
Hi - resolution of the measurement 0.001 pH.

In the ion meter function:

for measurement in pX::

Lo - resolution of the measurement 0.01 pX;
Hi - resolution of the measurement 0.001 pX.

for measurement in M/l, g/l and ppm:

Lo - resolution of the measurement 0.1%;
Hi - resolution of the measurement 0.01 %.

There is no possibility of change the resolution in mV measuring mode.

Return to the measuring mode by pressing the chosen function button.

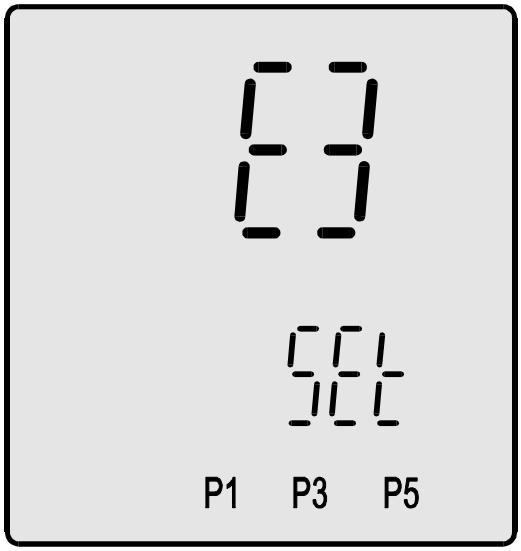
6.3. Changing the electrode number

If there is more than one electrode's characteristic stored in the meter's memory, it is possible to replace the electrode without the need of calibration. This option is quite useful in case of working with different kinds of electrodes, e.g. for sewage, clear water, etc. It is necessary to connect the electrode calibrated earlier, marked with the number which responds to the number stored in the memory and choose this number.
In order to do so, in the measuring mode:

- press the MODE button till the moment of displaying E1, E2 or E3 symbol in the upper row of the display, than using the ↓ , ↑ buttons choose the electrode number. The calibration results will be stored under this number (Pic. 5). Below the electrode number one of the following signs will be displayed:

  CLr - under this number there is no characteristic stored and the producer's values are provided. In the measuring mode the electrode number will be flashing.
  SEt - under this number there are values of the last calibration stored.
  bAd - the last calibration has shown that the electrode has been loosing it's efficiency and in a short time its calibration may not be possible. In the measuring mode the electrode number will be flashing.

Additionally, the points in which the electrode is calibrated are shown under the electrode number.



Pic. 5.

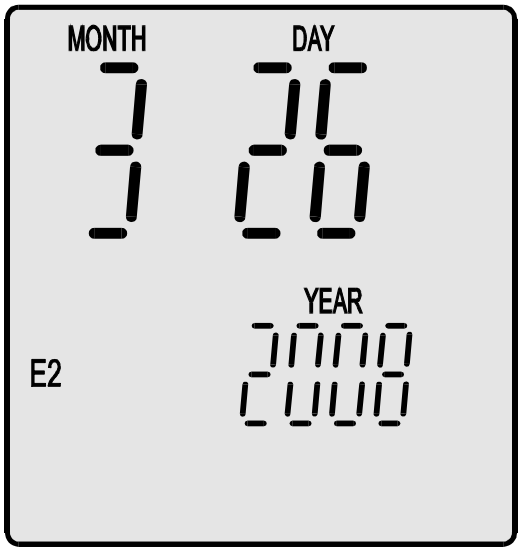
In the ion meter function it is possible to check the ion number for which the electrode was calibrated when changing the electrode number. It is done by pressing the CAL button shortly, in the lower row an ion symbol will be displayed and its number will be visible in the upper row. After pressing the MODE button the meter returns to the readout of the electrode number mode. Pressing of any function button returns the meter to the measuring mode.

6.4. Readout of the last calibration date

The meter remembers the dates of calibration of all electrodes in every measuring function. Before starting work it is possible to check the last calibration date.
In order to do so, in the measuring mode:

- press the MODE button till the moment of displaying the electrode number (E 1, E2 or E3 symbol) in the upper row of the display;
- using the ↓ , ↑ buttons choose the electrode number for which calibration date is to be checked and press the CAL button shortly. The last calibration date will be displayed in the following format: month - day - year (below), pic. 6. On the left the electrode number is displayed.

Flashing date informs about expiration of the electrode's calibration validity. Introducing the calibration time is described in the section 6.5.



Pic. 6.

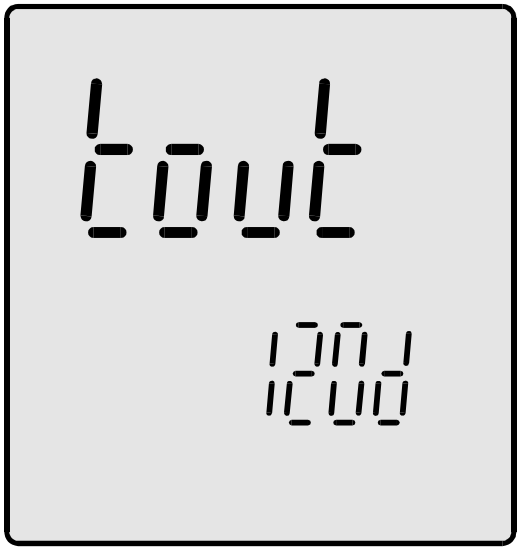
The meter memorises the date during calibration. If the date in the meter's clock is changed after calibration, the date of calibration validity expiration will be faulty signalised. It is important to set the current date before calibration.

Return to the readout of the electrode number by pressing the MODE button, or to the measuring mode by pressing any of the function buttons.

6.5. Entering the calibration validity date

The meter remembers the time of calibration validity separately for three electrodes. After this time has been exceeded, the meter signals with flashing number of the electrode (E1, E2 or E3 symbol) that it is necessary to calibrate this electrode.
In order to set the time validity of calibration, in the measuring mode of the chosen function:

- press the MODE button till the moment of displaying a tout (time out) symbol in the upper row. The number of days to the next calibration will be displayed below (Pic. 7);
- With ↓ , ↑ buttons enter the requested number of days till the next calibration. Choosing time of one day and pressing the ↓ button instead of digital values displays the --- symbol and the function of reminding about the next calibration is blocked.



Pic. 7.

Return to the measuring mode by pressing any of the function buttons.

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 follow the 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.

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

8. CALIBRATION

Before starting measurement with new electrode or before making measurements which require high accuracy, the electrode connected to the meter should be calibrated.
Calibration is performed in buffer or standard solutions with accurately determined value and consists in comparing pH value of the standard with the value displayed by the meter and automatic introduction of the correction into the meter's memory. The correction is calculated during next measurements. Calibration should be periodically repeated because the parameters of the electrode in use are changing what influences the accuracy. The frequency of this procedure depends on the required accuracy, number of the measurements carried out, conditions in which the electrode is used, temperature and pH value of the measured solutions.
CPI-505 enables storing characteristics of 3 calibrated pH electrodes marked by different symbols (E1, E2 or E3). This feature is especially useful when it is necessary to change the electrode quickly or replace a broken one.
The meter enables entering the calibration validity expiry date. In case of using this option, calibration should be performed when the symbol of the electrode in use (E1, E2 or E3) is blinking.
For accurate calibration, enter the pH values of the applied solutions to the meter's memory. During calibration, after immersing the pH electrode and the temperature probe, the meter will detect the value of the buffer automatically. When the highest accuracy is required, it is recommended to use certified standard solutions. The most frequently used are buffer solutions having total values i.e. 2.00 pH, 4.00 pH etc, with a composition specified by the manufacturer. Usually, they are also of high accuracy.
For accurate measurements it is necessary to use fresh solutions of good quality. The pH value of standard and buffer solutions is influenced by temperature changes.
The solutions contain the manufacturer's specifications of the pH values corresponding to the particular temperature.
In case of an accurate calibration the value of the solution recorded in the memory has to be the same as the value of this solution at the temperature in which the calibration is performed. Blinking of the electrode's symbol when the calibration process is finished
informs that the electrode is no longer efficient and should be replaced in a short time (description in the chapter 9).

Calibration performed in one solution does not guarantee high accuracy. If only one solution is used, its value should be close to the anticipated value of the measured solution. If the required accuracy is not very high and the measurements will be made in the whole pH range, 1 point calibration should be performed with use of standard or buffer solution of value close to 7.00 pH. Thanks to this, the zero offset of the electrode will be eliminated and in other points a standard characteristic slope will be adopted.
If measurements are made both in acids and alkalis and not at the extremes of pH range, it is enough to calibrate the electrodes in 3 buffer solutions with values in range given in the table 2 – calibration points 2, 3 and 4. In case of performing accurate measurements in the whole measuring range it is recommended to calibrate the electrode in all 5 points, additionally taking into consideration the solutions' pH values given in points 1 and 5 in the table. In **CPI-505** the characteristics of the electrodes are approximated linearly between the calibration points. **Entering the calibration mode irreparably erases the electrode's characteristic stored under the chosen electrode number. There is no possibility to perform calibration only in one point without changing the rest of the data from the last calibration.**
Blinking of the electrode's number informs about its characteristic erase, its calibration validity expiry or that it is no longer efficient. In the calibration mode the number of the recognised calibration point is displayed between the upper and the lower row (P1, P2, P3, P4, P5).

8.1. Calibration in buffer or standard solutions

The user may choose between two independent ways of action:

1. **Enter the value of pH buffer solutions depending on the actually used buffers, in the range given for each point of calibration.**

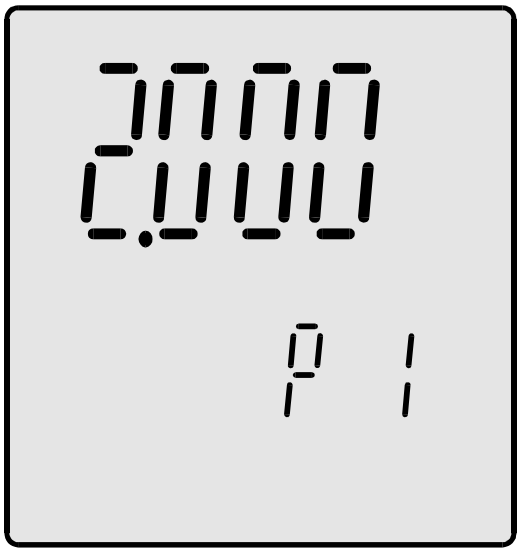
Use the values of pH standard solutions entered to the memory by the manufacturer. Those values are in conformity with the NIST norm. This type of calibration switches on the automatic correction introduction connected with the change of standard solution along with temperature changes. It eliminates the necessity of warming up or cooling down the standard solutions to the temperature given by the manufacturer or introducing the values of standard solutions responding to their real temperature.

8.2. Entering the buffers' values into the meter's memory

If the calibration in buffer solutions has been chosen and the pH values set by the producer are used, there is no necessity of changing them. However, it should be verified whether the values correspond to those of applied buffers. Different buffers' values should be introduced to the meter's memory before calibration.

In order to do so:

- in the pH measuring mode press the MODE button a few times until a PCAL symbol (points of calibration) displays in the upper row of the display. Using the ▼ , ▲ buttons choose buFF in the lower row (entering values of applied buffer solutions);
- press the CAL button a P1 symbol (point one of calibration) displays in the lower row and the value of the buffer displays in the upper row (Pic. 8) In case of using a buffer solution with a value different than this displayed one, bring the displayed value to the value of your buffer solution with use of the ▼ , ▲ buttons;



Pic. 8

- in order to pass to the second point of calibration again press CAL button, in the lower row a P2 symbol (point 2) will display. The upper row displays the value of the buffer solution stored for this point. For the next steps of checking or changing the values please follow the instructions given above.

Having the pH values of buffer solutions introduced, enter the pH measuring mode by pressing the pH button.

Each of the calibration points has a different range for entering the pH buffers' values. Such a limitation is essential for the meter's ability to detect the buffer solutions automatically.
Table 1 contains the producer's settings of the values of pH buffer solutions used for calibration. They can be changed according to the ranges given in this table. The range of introducing these changes is quite wide for each of the calibration points, what enables to use buffer solutions with values differing from those set by the producer even to a large extent.
The meter doesn't allow for introducing pH values in ranges other than those given in the table 1. In every case the introduced buffer solution will be automatically detected by the meter.

Calibration point	Factory value	Range of changes
1	2,000	0,800 ÷ 2,100
2	4,000	3,900 ÷ 4,100
3	7,000	6,800 ÷ 7,100
4	9,000	8,900 ÷ 10,200
5	12,000	11,800÷ 14,000

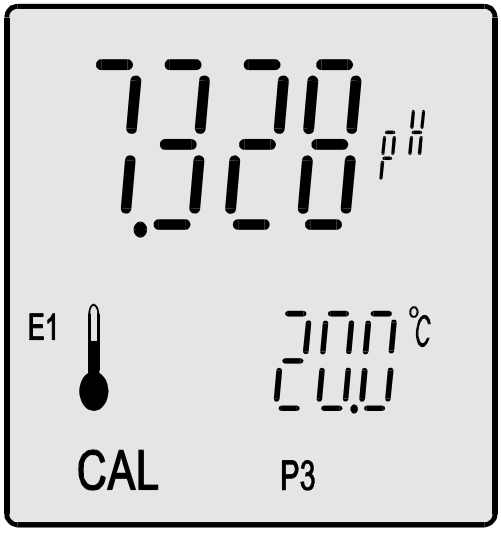
Table 1.

The meter takes into account only the values detected during calibration. The pH values stored in unused calibration points do not affect the calibration results.
During next calibrations there is no need to perform the actions described above provided that the buffer solutions applied for calibration are the same. The pH values introduced to the meter's memory by the user are stored until they would be changed to another buffers.
The manufacturer provides the values of the solutions in different temperatures. This data may be useful for calibrating the electrode in temperature other than 20 ^{o}C by introducing the value of the buffer corresponding to its value in this temperature to the meter's memory. In such a case there is no need to heat up or cool down the solutions.

8.3. Calibration in buffer solutions

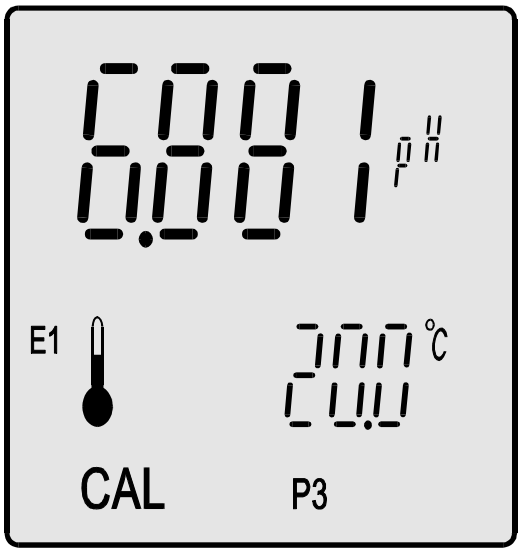
After preparing the pH electrode and after the pH buffers' values have been introduced or verified, calibration can be started. The buffers can be applied in any order.
It is necessary to:

a. choose the resolution with which the pH standard solution value will be introduced, section 6.2;
b. choose the electrode number (E1, E2, E3), under which the results of calibration will be stored, section 6.3 and mark the electrode with this number;
c. in the pH measuring mode press MODE button until PCAL symbol displays in the upper row of the display; using ▼ , ▲ in the lower row choose buFF (calibration in buffers);
d. connect the combination pH electrode and the temperature probe to the meter, use the **pH/mV** and **temp** connectors respectively;
e. put the electrode and the temperature probe into the buffer, do not touch the walls or bottom of the vessel – it is advisable to use an electrode holder;
f. bring the temperature of the buffers to the temperature corresponding to the buffers' values stored by the meter;
g. press and hold CAL until the **CAL** symbol appears on the display**.** The meter is now in the calibration mode. **Previously stored parameters of calibration are deleted,** the P symbol with a number of calibration point is displayed (Pic. 9);
h. wait till the result stabilises on the display (in most cases the result slightly differs from the standard's value)



Pic. 9

After the result stabilisation press the CAL button shortly. The result will blink and the value equal to the standard‘s value will be displayed. The correction is now stored in the meter‘s memory. If the result is still different than this of the standard, wait until it stabilises and shortly press the CAL button again.



Pic. 10

In case of using a buffer solution different than these given in the set and the meter is unable to detect this value, Err sign will be displayed. In this case it is necessary to check the value of the buffer solution or the electrode which may be broken.
The meter takes into account only the values detected during calibration. Values entered earlier do not affect the results.
After finishing calibration in the first buffer wash the electrode and the temperature probe with distilled water and start calibrating in the next buffers, acting according to the procedure given above (points e ÷h) after calibration in the last point exit the calibration mode pressing the pH button.
When one electrode has been calibrated, it is possible to calibrate two other electrodes, assigning remaining numbers to them in accordance with the section 6.3.

In case of choosing the electrode number, entering and escaping the calibration mode not having calibrated the meter, previously stored characteristics would be deleted and a standard characteristic will be adapted.

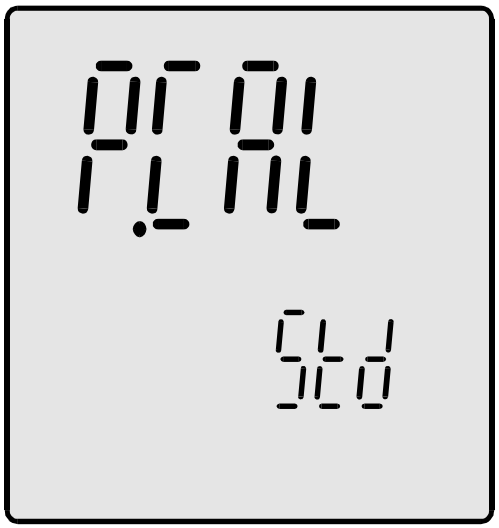
8.4. Calibration with use of NIST standard solutions

In this mode 5 constant standard solutions values, according to NIST, are used. **The meter's memory stores a table with a dependence between the temperature and pH values for these 5 standard solutions.** This dependence is shown in the table 2. Some standard solutions' values may differ from the values given in the table 2 in the third decimal place. In case of very accurate measurements it is possible to make a correction of the factory settings and introduce the value given by the standard's manufacturer.
After immersing the temperature sensor in the pH standard solution it's temperature is measured and the pH value responding to this temperature is given. The user doesn't have to warm up or cool down the standard solution.

To start the calibration in NIST standards it is necessary to:

a. according to the chapter 6.2 choose the resolution for the calibration process;
b. choose the electrode number (E 1, E2, E3), under which the calibration results will be stored (chapter 6.3) and mark the electrode with the number;
c. in the pH measuring mode press the MODE button a few times until the PCAL symbol (points of calibration) is displayed and using the ▼ , ▲ buttons choose Std (calibration in standard solution);
d. connect the combination pH electrode and the temperature probe to the meter, use the **pH/mV** and **temp** connectors respectively;
e. put the electrode and the temperature probe into the buffer, do not touch the walls or bottom of the vessel, it is advisable to use an electrode holder;
f. press and hold the CAL button until the **CAL** symbol appears on the display**.** The meter is now in the calibration mode. **The parameters of calibration stored previously are deleted;** a **P** symbol with a number of calibration point is displayed;
g. wait till the result stabilises on the display (in most cases the result slightly differs from the standard's value) and press the CAL button shortly. The result will flash and the value equal to the standard's value will be displayed. The correction is now stored in the meter's memory. If the result is still different than the standard value, wait until it stabilises and press the CAL button again.

At this point calibration may be finished by pressing the pH button or continued in other standard solutions. Wash the electrode and the temperature probe in distilled water after each immersing in the standard and dry them with a tissue paper. Act accordingly to the points e ÷ g.



Pic. 11

The meter takes into account only the values recognised during calibration. Another pH values stored in the memory do not influence the result of the calibration.
The range of the temperatures taken into consideration while introducing correction is 0 to 60 ^{o}C and can't be exceeded during calibration.

Table 2.

Temp. ^{0}C	Kind of buffer solution				
	1 oxalate	2 phthalate	3 phosphate	4 di-sodium tetraborate	5 calcium hydroxide
0	1.666	4.003	6.984	9.464	13.423
5	1.668	3.999	6.951	9.395	13.207
10	1.670	3.998	6.923	9.332	13.003
15	1.672	3.999	6.900	9.276	12.810
20	**1.675**	**4.002**	**6.881**	**9.225**	**12.627**
25	1.679	4.008	6.865	9.180	12.454
30	1.683	4.015	6.853	9.139	12.289
35	1.688	4.024	6.844	9.102	12.133
40	1.694	4.030	6.838	9.063	11.984
45	1.700	4.047	6.834	9.038	11.841
50	1.707	4.060	6.833	9.011	11.705
55	1.715	4.075	6.834	8.985	11.574
60	1.723	4.091	6.836	8.962	11.449

The values between the points given in the table are approximated linearly by the meter.
The values of standard solutions prepared according to the norm may differ from its values at the third decimal place. In case of very accurate measurements it is possible to make a correction of the factory settings and introduce the value given by the standard's producer. The meter enables changing the standard value differing in range of ±0.010 pH from the table values for 20 ^{0}C. The procedure of introducing changes in standard values is the same as for entering the buffers' values. In case of differences greater than ±0.010 pH it is recommended to perform calibration in buffers which enables entering a freely chosen solution value to the meter's memory.

When the electrode is calibrated, it is possible to calibrate two another electrodes, choosing the remaining electrode numbers.

After choosing the electrode number, entering the calibration mode and escaping it without performing calibration, the stored characteristic will be erased and the standard characteristic will be adopted.

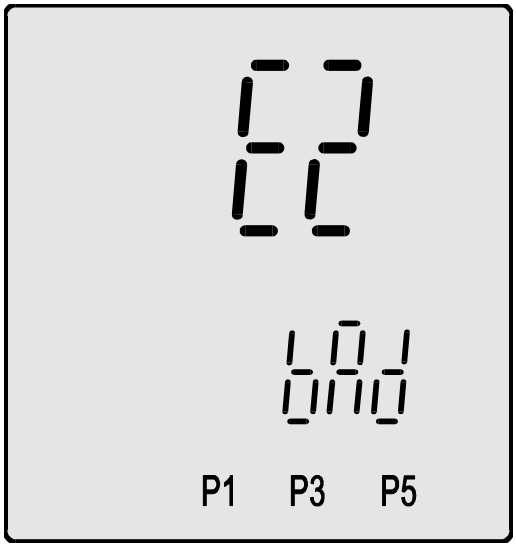
8.4.1. Calibration with manual temperature compensation

In order to start calibration with manual temperature compensation, disconnect the temperature probe. It switches the meter to manual temperature compensation. In this mode the display shows the temperature value introduced by the user, not the one measured with the probe. The  ,  buttons are being unlocked and entering the value of the solution temperature with their use is possible. This value is displayed in the lower row of numbers on the display. Next, connect the pH electrode to the meter and act accordingly to the previously given description of calibration.

Caution: pressing both  ,  buttons simultaneously sets the temperature to 20 ^{0}C.

9. CHECKING THE ELECTRODE CONDITION

Flashing of the electrode's symbol (E 1, E2, E3) after calibration informs that the electrode has lost its efficiency and that in a short time its calibration would not be possible. After entering the mode of the electrode's number changing, under the number of the electrode a bAd symbol is displayed (pic.12).
It is necessary to prepare a new electrode.

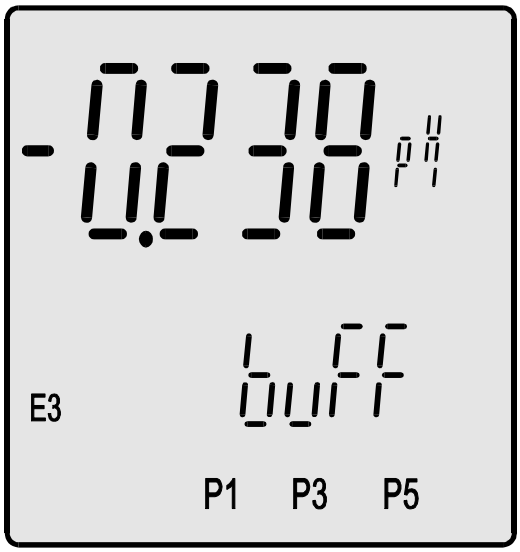


Pic. 12.

9.1. Readout of the electrode's parameters after calibration

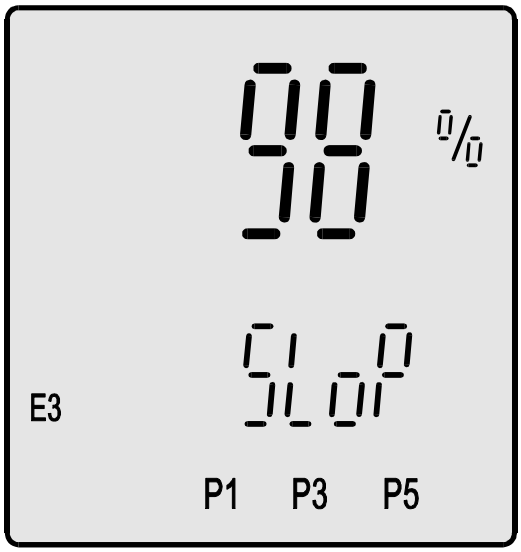
When the pH electrode has been calibrated, it is possible to check its parameters: zero offset and slope. In the pH measurement mode:

- press the MODE button until the electrode number shows at the upper part of the display (E 1, E2 or E3 symbol);
- with the ↓ , ↑ buttons choose the number of the electrode that is to be checked and press the CAL button shortly. The last calibration date will be displayed in the following format: month – day – year (below);
- press the CAL button again, a buFF symbol will be displayed in the lower row, the zero offset will be visible in the upper row of the display (Pic. 13);



Pic. 13

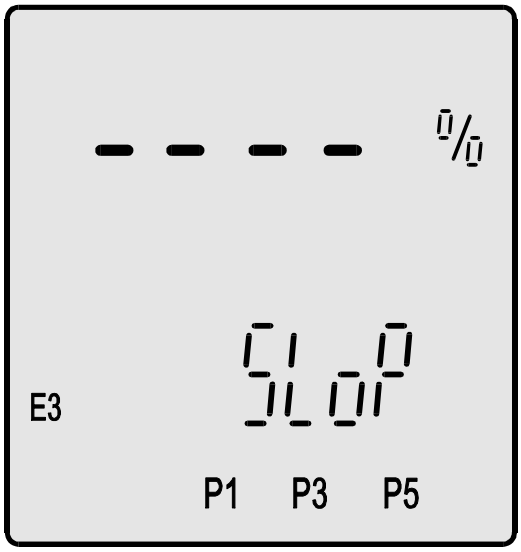
- press the CAL button once again, the lower row will display the SLoP aymbol, and the upper row – the percentage value of the electrode‘s condition (Pic. 14);



Pic. 14

The electrode‘s calibration points are displayed at the bottom.

After the electrode‘s characeristic has been deleted (entering the calibration mode and leaving it not calibrating in any point) the meter takes into consideration an ideal electrode‘s characteristics and its actual parameters are unknown. In such case, in the electrode parameters readout mode instead of numbers 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. 15).



Pic. 15

Back to the electrode number readout by pressing the MODE button, and to the measuring mode by pressing pH.

10. pH MEASUREMENT

Before starting measurement the meter and the pH electrode have to be prepared for work (chapters 6 and 7 respectively). Good condition of the electrode is essential for obtaining valid result. If the electrode is calibrated and connected to the meter, it is advisable to check whether the number of the electrode is the same as the number of the characteristic chosen from the memory. If not, the number should be changed according to the section 6.3 and the resolution of measurement should be chosen according to the section 6.2.

10.1. Measurement with automatic temperature compensation

During measurements with automatic temperature compensation, the meter co-operates with the temperature probe and measures the temperature of the solution simultaneously with the pH measurement and takes it into consideration during compensation.
In case of measurement with automatic temperature compensation:

- turn the meter on by pressing the 

button;
- using the 

button choose the pH measurement function;
- join the temperature probe and the combination pH electrode to the connectors **temp** and **pH/mV** respectively, the  symbol will be displayed;
- if the electrode wasn't calibrated or has already been in use for a quite long period of time, it is advisable to calibrate it (chapter 8);
- insert the electrode and the temperature probe to the measured solution. During measurements in vessels don't touch the bottom and the walls with the electrode. It is advisable to use an electrode stand;
- after stabilisation read the result.

Accurate laboratory measurements require using an electromagnetic stirrer.

NOTICE: exceeding of the measuring range is indicated by flashing digits on the display.
Exceeding the automatic temperature compensation range is signalised by flashing digits and the  symbol.

10.2. Measurement with manual temperature compensation

Disconnecting the temperature probe from the meter switches the meter to the manual temperature compensation mode (the  symbol is displayed). Measurement with manual temperature compensation proceeds similarly to the measurement with ATC, the difference is that the buffer's temperature is measured with a thermometer and entered by the  buttons. This value is displayed under the pH value and is taken into consideration during compensation.
Manual compensation may be used in stable conditions, e.g. during pH measurements in the laboratory, especially when a thermostat is used, or when the temperature probe has been damaged.
In case of measurement with manual temperature compensation:

- turn the meter on by pressing the  button;
- using the  button choose the pH measurement function;
- insert the pH electrode to the vessel with the measured solution; if the electrode wasn't calibrated or has already been in use for a quite long period of time, it is advisable to calibrate it (chapter 8). During measurements in a vessel don't touch the bottom and the walls with the electrode. It is advisable to use an electrode stand;
- using a laboratory thermometer, measure the temperature of the solution;
- with the  buttons enter the value of measured temperature;
- wait till the value stabilises and read the result.

Caution: pressing both  buttons simultaneously sets the temperature to 20 ^{0}C.

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

The **CPI-505** pH / ion meter has a possibility of manual and automatic temperature compensation, what enables eliminating errors which result from affecting the electrode characteristics by the temperature changes. The pH meter is a mV meter which displays voltage counted to pH units. In a constant temperature there is a constant mV value per one pH unit. In 20 ^{0}C it amounts to 58,168 mV. The value of mV per one pH unit **changes together with the temperature,** what is taken into consideration in the formula for the "k coefficient" of the pH electrode:

$$k = 0.198423\ T$$

Calculating this change into measurement result is called temperature compensation. It is connected with a change of the electrode efficiency and not with a change of the pH value of the measured solution caused by the temperature change.

Changes of the pH values with the temperature in the majority of solutions are rather slight, however in e.g. pure water they tend to be significant.

Values of solutions which tend to be affected by the temperature change should be compared in the same temperature. Sometimes the results of measurements in the same solution in stable temperature are different. These are possible reasons of such situations:

- differences occur because of poor quality of the electrode;
- the result is treated as stabilised too soon (medium class electrode needs about 40 seconds to full stabilisation);
- the measured solution is not homogeneous and lack of magnetic stirrer doesn't allow for obtaining similar results;
- during measurements in sewage some chemical reactions, which change the result, may occur.

The final measurement error is dependent mainly on the electrode's quality, the temperature measurement error, quality of the buffers applied for calibration and accuracy while performing procedures connected with a calibration as well as measurements. Minor differences may be caused by the meter. Accuracy of the meter totals to ±0.002 pH, ±1 digit, what practically means that in extreme situations the difference between results of measurements made by 2 meters in the same sample may come to 0.005 pH. Such error is acceptable because one measurement will be made with -0.002 pH error and the second with +0.002 pH error. ±1 digit information explains the difference caused by rounding up of the result on the last visible place on the LCD (discretisation error).

When the meter is calibrated in two points, in buffers 7.00 pH and 4.00 pH (acidic solutions), and the measurement accuracy is checked in 9.00 pH (alkali solution), in some cases the result may amount to 8.90 pH or 9.10 pH. This may occur when the electrode has unsymmetrical characteristic. Making a three-point calibration with alkaline, neutral and acidic buffers may prevent from such errors. Sometimes the measurement readings are unstable and in such cases the quality of the electrode has crucial meaning. **Slow drifting of the result, its unstability or prolonging time of stabilisation in most cases result from clogged junction, broken electrode or contaminated membrane.** It happens as a result of irrelevant kind of electrode chosen for the kind of measured solution.
Storing the electrode in distilled water for several hours or placing it in water with detergent may eliminate such problems, especially if the measurements were made in solutions with deposits, fats or oils. The electrode which hasn't been in use for a long time may have the junction clogged by KCl crystals, what can be removed by placing the electrode in distilled water. If it does not take effect, the thiourea solution in saline acid can be used. Heavily contaminated electrode should be cleaned in chloroform and deposits of iron in 2N HCl. The electrode life can be prolonged by storing it in KCl solution. Depending on the kind of measured solution or substance, proper kind of electrode should be chosen. They differ one from another in shape, membrane's look, kind of junction and body. Using unsuitable electrodes may cause their damage and make measurements impossible.

III. ION SELECTIVE MEASUREMENTS

12. NOTICES ABOUT ION SELECTIVE MEASUREMENTS

The ion selective electrode changes its potential depending on the concentration (activity) of the individual ions in the solution. The main rule of the measurement is based on the linear dependence of the electrode potential from the logarithm of ion activity in the solution and is expressed by the Nernst's equation:

$$E = E_O + 2.303\ RT/nF\ \log (a_j)$$

where:

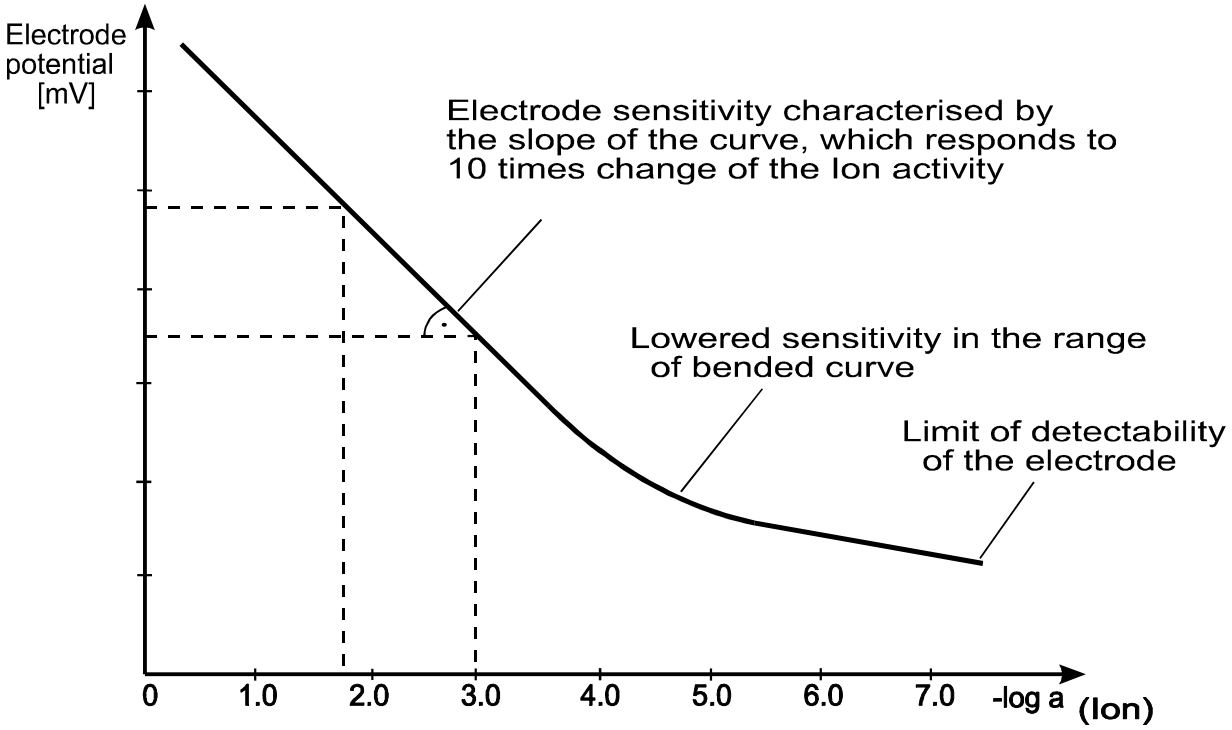
- E - Electro Motoric Force of the measuring cell which consists of the ion selective and reference electrode in the measured solution (V)
- Eo - normal ion selective electrode potential, depends mainly on the internal electrolyte activity of the ion selective electrode and the kind of reference electrode (V),
- ai - activity of the measured ion,
- n - valency of the measured ion,
- R - gas constant (8.31 J / K mol),
- T - temperature in K,
- F - Faraday's constant (96487 As/val)

The measurement of ion activity is based on measuring of the potential of ion selective electrode in relation with the reference electrode. In most cases these electrodes are in separate housings. The reference electrode should have an **appropriate external electrolyte**. Such electrodes have a construction which enables replacing the electrolyte to the one appropriate for the specific ion selective electrode. The electrode manufacturers give information what electrolyte should be used depending on the measured ions.

Measured ION	**External electrolyte**
F^-, Cl^-, Br^-, J^-, S^{2-}, CN^-, Ag^+, Cu^{2+}, Cd^{2+}	1,0 M KNO_3
Ca^{2+}	1,0 M KNO_3 or 0,1 M KCl
NH_3	1,0 M KNO_3 or 0,1 M CH_3COOLi
K^+, Li^+	0,1 M NH_4NO_3
Na^+	0,1 M NH_4NO_3 or 0,1 M CH_3COOLi
NO_3^-	saturated K_2SO_4

Table 3. The most often used electrolytes.

The ion selective electrodes differ one from another with their characteristics. The typical shape of the ion selective electrode characteristic is shown in the picture 16.



Pic. 16.

The best results are achieved when the measurements are made in ranges that correspond with the linear parts of the characteristic. The electrode calibration on the sample solutions, which is essential, in such case may be performed with solutions differing more significantly in concentration. The measurements made in ranges where the characteristic bends require choosing the sample solution with only a slight concentration difference, because this lowers the electrode error. The measurements which are made in the ranges corresponding with the lower part of the characteristic will have an increasing error because of the lowering electrode sensitivity. For the bivalent ions the electrode sensitivity is twice lower than for mono-valent ions. Presence of other ions in the measured solutions may have influence on the measurement result. The ions which interfere the electrode are given by its producer, thus in case of accurate measurements it is important to know the ion composition of the measured solution and it is necessary to act according to the hints which enable reducing the measurement error.

Calibration and measurements should be performed in solutions with the same temperature – this is the condition of receiving accurate results. The best results are achieved in temperature close to 20 ^{o}C. High temperatures decrease the sensitivity and life time of the electrode. Large differences between the temperatures of calibration solutions and the measured samples, although using the temperature compensation, introduce error connected with lack of precisely determined isopotential point of the electrode.

The pH value has the essential influence on the ion measurements.

During accurate measurements the pH value of the measured sample should be identical with the pH value of the sample solutions. For each electrode a pH range is given in which it is working without interference.

Complying to the electrode producer's hints exactly is the basic condition of success during measurements.
Preparation of the measured solution has a great influence on the final result. The fundamental meaning for the measurements of high concentration solutions has the phenomenon of ion activity changes together with change of their concentration, what may be described with the formula:

$$a_i = f_i \cdot c_i$$

where:

- a_i - ion activity in the solution,
- f_i - ion activity coefficient,
- c_i - ion concentration in the solution in mol/l or g/l.

Stabilisation of the ion activity in the high concentration solutions is the condition of proper measurement. Adding the stabilising factor, recommended by the electrode producer, enables linearisation of the electrode characteristic for this concentrations, increases its sensitivity and enables stable measurements.
The electrode's ageing decreases its sensitivity, prolongs the reaction time, shrinks the measuring range and increases the membrane resistivity.

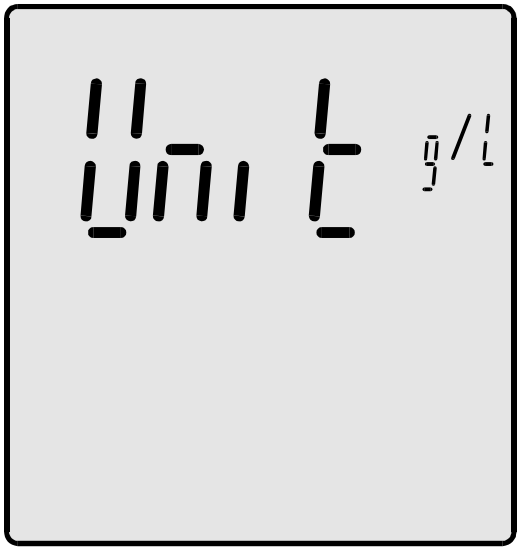
13. ENTERING THE PARAMETERS OF THE ION METER

Before calibration and measurements it is necessary to perform the activities described in the chapter 6. Additionally it is necessary to choose the unit in which we are going to calibrate and measure.

13.1. Choosing the unit

The result may be displayed in: **g/l**, **M/l, ppm or pX**. In order to choose the unit:

- in the ion meter mode press and hold the MODE button till a Unit (unit) sign displays in the upper row of the LCD;
- with ▼ , ▲ buttons choose the unit displayed on the right (Pic. 17).



Pic. 17.

- enter the measurement mode by pressing the Ion button.

14. CALIBRATION

Because of the non-linear characteristic of the ion selective electrodes, the values of the sample solutions should be close to the estimated value of the measured solution and the concentration ratio shouldn't be greater than 1:100. The most frequently used sample solutions have 1:10 ratio. It is advisable to prepare the sample solutions and measured solutions in the same volume, because differences in volume may have a certain influence on the result. The most accurate results are achieved in the same temperature in which the calibration has been performed. During calibration it is possible to choose the molar weight of one of twenty ions stored in the memory or to introduce the molar weight and valency of ion which is not stored in the memory. It enables changing the unit in which the measurement is made for the calibrated ion (e.g. from g/l to M/l) and reading the result in the chosen unit.

14.1. Entering the calibration parameters

The meter remembers the values of calibration points independently for each of 3 ion selective electrodes and after changing the electrode number restores the recent calibration values. Changing the ion also changes the values of the calibration points entered in **g/l** or **ppm**. **Therefore, it is very important to remember about the need of introducing the values of calibration points after changing the ion.**

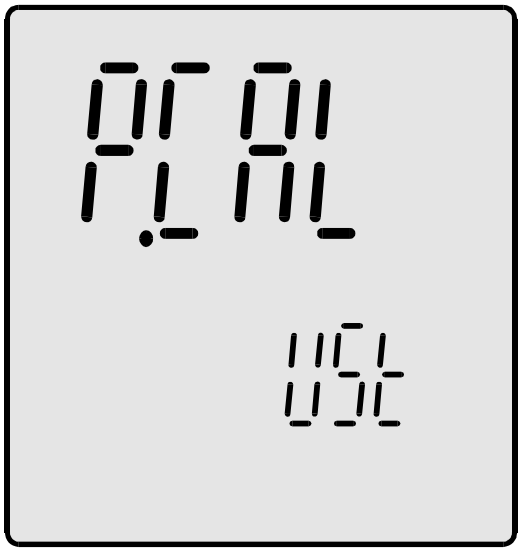
Caution: the changes would influence the counting not until the next calibration.

It is necessary to:

a. Enter the ion and the values of the sample solutions used for calibration.

   In order to do so, it is necessary to press the 

button; the upper row would display a PCAL symbol (points of calibration) and the lower row - an USE symbol (user settable value of the sample solution pic. 18);



Pic. 18.

b. Press the CAL button. The upper row displays the ion symbol and the lower one the ion number. According to the table placed on the meter (which is an abridged form of the table given below) with the buttons ↓ , ↑ choose the ion number according to applied electrode:

Table 4.

no	ion	weight		ion	weight
1	H^+	1.007	11	F^-	18.998
2	Ag^+	107.868	12	I^-	126.904
3	Br^-	79.904	13	K^+	39.098
4	BF^-_4	86.805	14	Li^+	6.941
5	Ca^{2+}	40.078	15	Na^+	22.990
6	Cd^{2+}	112.411	16	NH_4^+	18.038
7	Cl^-	35.453	17	NO_3^-	62.005
8	ClO_4^-	99.450	18	Pb^{2+}	207.200
9	CN^-	26.018	19	S^{2-}	32.066
10	Cu^{2+}	63.546	20	SCN^-	58.083

In case of measurement of an ion which is not listed in the table:

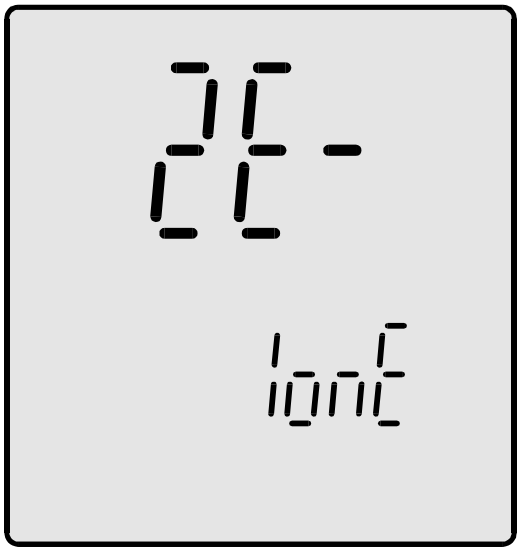
- press and hold the ↑ button till a USEr (user) symbol displays in place of the ion number;
- press the CAL button shortly, the lower row displays an ionG symbol and the upper row - the molar weight entered recently (Pic. 19);

- with the ↓ , ↑ buttons enter the **molar weight** of the measured ion;

Pic. 19.

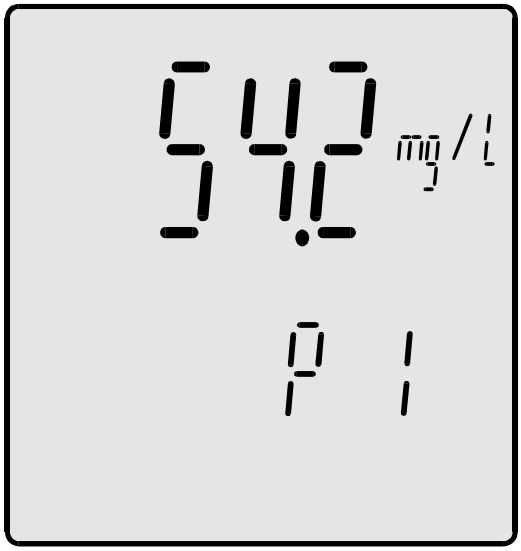
- press the CAL button shortly, the lower row displays an ionE symbol and in the upper row - the valency entered recently; (Pic. 20);
- with the ↓ , ↑ buttons choose the proper **valency** of the ion (2E-, E-, E, 2E);

By pressing the CAL button shortly return to the ion choosing screen, or enter the measuring mode by pressing the chosen function button.
The entered molar weight and valency would the counting not until the calibration has been performed.



Pic. 20.

c. Press the CAL button. In the lower row a P1 (the first sample solution) symbol would be displayed and the upper one displays the value of the sample solution in the recently chosen unit (pic. 21). With the ↓ , ↑ buttons enter the value of the sample solution used for this point.



Pic. 21.

To move to the second point of calibration introduction it is necessary to press the CAL button, in the lower row a P2 (point 2) symbol would be displayed and in the upper row - the value of the sample solution applied for this point. It is possible to control or change the values of sample solutions in the rest of the points as it has been described above. Entering the sample solution values may be finished any time by pressing the MODE button (returning to the PCAL mode) or Ion button (entering the measuring mode). **The values of sample solutions entered by the user are stored till they are changed.**

During next calibrations, if the values of previously used sample solutions would not be changed, it is not necessary to perform the actions described in this point.

Caution: the values of calibration points are stored in pX and than counted for displaying in the chosen unit. Therefore, when entering low values in units different than pX, the changes of values will be visible after pressing the ↓ , ↑ buttons a few times. Pressing and holding the ↓ or the ↑ button (repetition) eliminates this inconvenience.

14.2. Actions during calibration

a. choose the electrode number under which the calibration would be stored (section 6.3);
b. choose the unit in which the calibration would be performed (section 13.1); prepare the electrode to work according to the producer's instructions and mark it with the number corresponding to the number chosen in the meter (E1, E2, E3);
c. connect the electrodes: ion selective and reference and the temperature probe, use the valid connectors **pH/mV/Ion** and **temp;**
d. prepare the sample solutions according to the instructions of the ion selective electrode producer.

Under each number, it is possible to calibrate every next electrode in different sample solutions (after entering those values to the meter's memory).

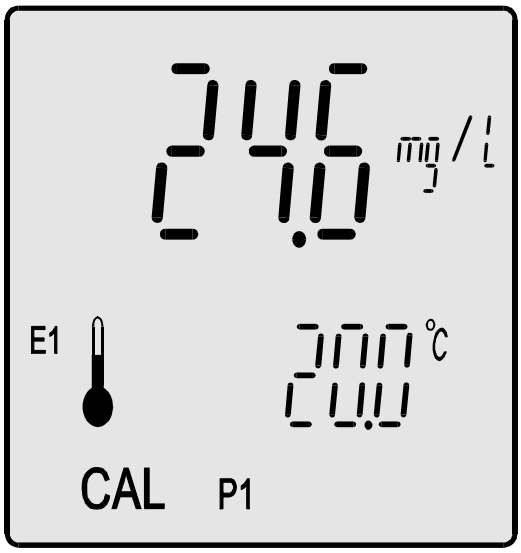
14.3. Calibration of the ion selective electrode

After preparing the meter to the calibration as it has been described above:

a. put the electrode and the temperature probee to the first standard solution and wait till the reading stabilises (if the g/l, ppm or M/l unit has been chosen, the meter may indicate 0.0);
b. press and hold the 

button till the *CAL* symbol (pic. 22) appears on the display; **the previous parameters of calibration are now deleted**. At the bottom of the display the P1 symbol (point 1 of calibration) will be displayed;
c. Press the 

button. The result will blink, what informs about recording of the calibration result, at the same time the corrected measurement value will be displayed in the upper row– it will be equal to the value of the applied standard solution. The P1 symbol will be changed to P2 (the second calibration point);



Pic. 22.

f. continue the calibration in another buffer solutions, washing the electrodes and temperature probe before every time they're being immersed in the sample solution and acting accordingly to the point e.

The attempt of calibration in the next point in the same solution causes appearance of the Err symbol and remaining at this point. The accidental exchange of the solutions in relation to points of calibration causes appearance of the Err symbol and exits the calibration mode with deleted electrode characteristic.

Calibration may be finished at every moment by pressing any function button.

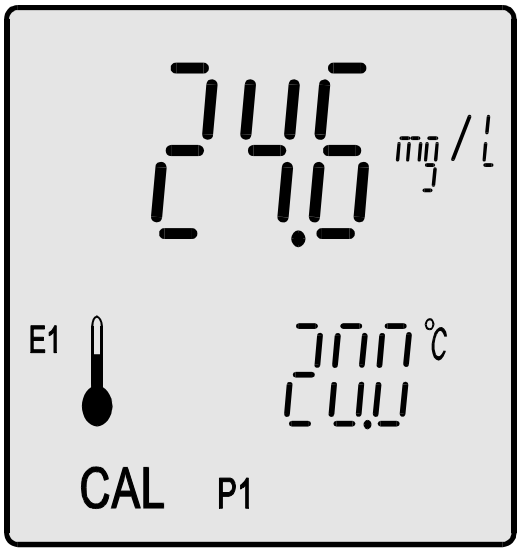
Having calibrated one electrode, it is possible to calibrate two another, choosing the remaining symbols according to the section 6.3.

Choosing the electrode number, entering the calibration mode and escaping it not having performed the calibration deletes the previously stored characteristics and adopts the standard characteristics for the chosen ion.

15. ION SELECTIVE MEASUREMENT

The ion selective measurement is made in mV (linear scale). After choosing the ***M/l*** or ***g/l*** unit the results in mV are converted and displayed in M/l or g/l (logarithmic scale).
In case of accurate measurements it is recommended to perform the calibration and measurements in the same temperature. The meter with the temperature probe connected may be used for the temperature measurements simultaneously with the ion selective measurements.
The best measurement accuracy may be achieved when the measurements are made just after calibration. The calibration is essential.
Slight changes of the result close to the measured value depend on the quality of applied electrode.

To make the measurement it is necessary to:
- the chosen ion electrodes (measuring and reference) connect to the respective connectors (**pH/mV/Ion and Gnd)**;
- connect the temperature probe **(temp)**;
- choose the number of the electrode under which it has been calibrated (section 6.3);
- choose the unit according to the section 13.1;
- set the required resolution according to the section 6.2;
- insert the electrodes and the temperature probe to the measured solution;
- bring the temperature of the measured solution to the sample solution temperature;
- make the measurement and after stabilisation read the result.

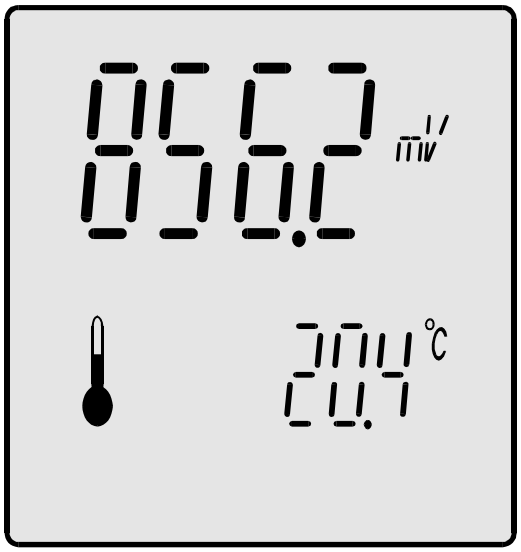


Pic. 23.

IV. REDOX POTENTIAL (mV) AND TEMPERATURE MEASUREMENT

16. REDOX POTENTIAL (mV) MEASUREMENT

The **CPI-505** pH / ion meter is an accurate mV meter (Oxidation Reduction Potential). The measurement may be made with a special redox electrode or during titration. The result may be checked after choosing the mV mode with the mV button (Pic. 24).



Pic. 24.

17. TEMPERATURE MEASUREMENT

The temperature measurement is made as follows:

- switch the meter on by pressing the ON OFF button;
- connect the temperature probe to the Chinch connector, the symbol will be displayed;
- 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 probe. Depending on its class the accuracy of the measurement changes.

CAUTION: break in the circuit of the temperature probe switches the meter to the manual temperature compensation mode. It is signalised by change of the symbol to the symbol. The display shows the value of the temperature entered by the user.
Flashing -50℃ value while making measurement in po sitive temperature informs about short circuit in the temperature probe.

V. OTHER

18. CLOCK WITH DATE

After choosing the **time** mode with the time button the meter displays current time. Pressing of MODE displays interchangeably: date, backlight mode and number of the software version.

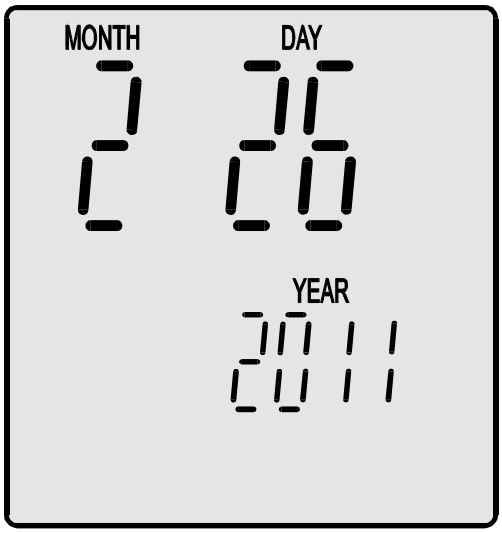
18.1. Clock

Current time is displayed in two rows (pic. 25). Hours and minutes are displayed in the upper one and the lower one displays seconds. The way of changing hours has been described in the section 18.3.

Pic. 25.

18.2. Date

The date is displayed as follows: Month – Day – Year. (pic. 26). In the upper row month and day are displayed and in the lower row - current year.



Pic. 26.

18.3. Setting time and date

The mode of setting currently displayed parameter (hour or date) is entered by pressing and holding CAL. The position which we are going to change starts flashing, the value can be changed with the ↓, ↑ buttons. Pulsating position is chosen by pressing the CAL button shortly. Seconds are not set, they reset after the mode has been left. Press the time button to leave the setting mode.

The clock is powered with a lithium battery which lasts for 10 years. Flashing of the clock readings after the meter has been connected to the power supply informs about loss of the clock settings. It is necessary to introduce new settings. If such situation occurs each time the meter is being switched on, it has to be sent to us in order to have the battery replaced.

18.4. The LCD backlight mode

In the **time** mode press MODE till a LCd sign displays in the upper row of the LCD (pic. 27). In the lower row the oFF, Auto or on parameter will be displayed.

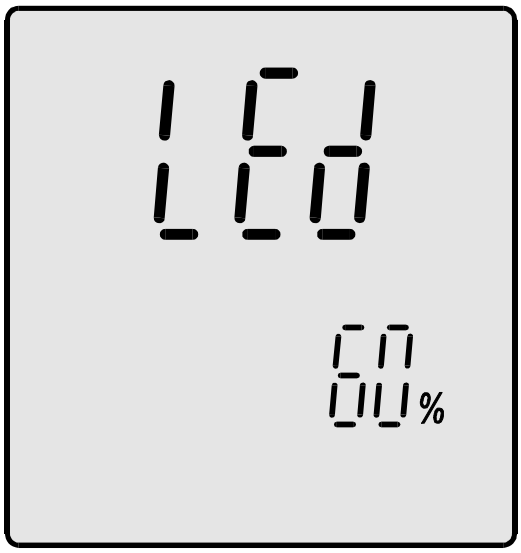
- oFF the backlight is switched off;
- Auto mode of automatic switch on of the backlight for 60 seconds after each press of any button;
- on the backlight is always on.

Pic. 27.

With the ↓, ↑ buttons choose the backlight mode. Return to the **time** mode after pressing the time button.

18.5. Brightness control

Controling brightness of the backlight is especially important in case of working in various lighting conditions. While choosing the backlight mode (section 18.4) it is possible to control brightness by pressing the CAL button shortly. Instead of oFF, Auto or on parameter the value of brightness in % displays. With the ▼, ▲ buttons it is possible to set the brightness value from 10 ÷ 100%, every 10%.



Pic. 28.

Return to the backlight mode by pressing the MODE button, and to the measuring mode by pressing any function button.

18.6. Readout of the software version number

In the **time** function press the MODE button till the software version number displays (pic. 29).

Pic. 29.

Return to the **time** mode after pressing the time button.

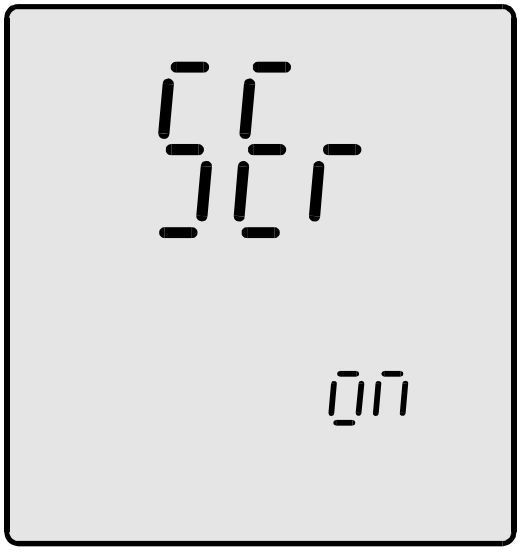
19. STORING AND READOUT OF THE RESULTS

The meter enables storing of 4000 results of the currently measured function. The results are stored in EEPROM memory, which is non-volatile, therefore the data isn't lost even after complete lack of power. Before starting work it is necessary to choose the parameters of storing or readout of the stored results.

19.1. Parameters of storage and readout from the memory

The parameters are changed in the readout mode, which is entered from every measuring function by pressing and holding the MEM button, until the number of last stored result shows. This number is displayed on turns with the stored result.
Before storing, choose the way of collecting results: on request or automatically in series, and also the way of displaying the result.

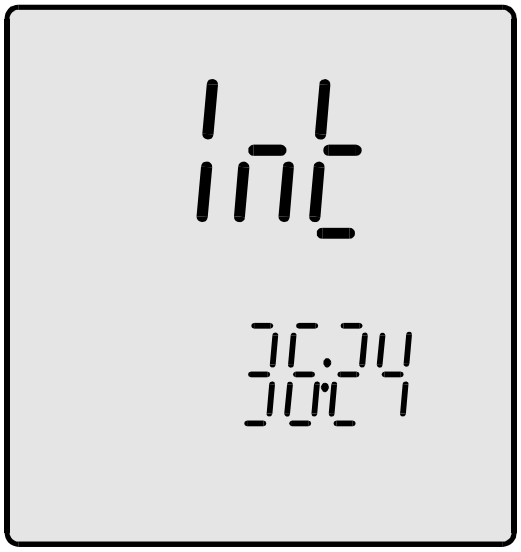
Next presses of the MODE button show screens with following parameters which may be changed:
a. SEr - taking or printing series or single results.



Pic. 30.

With the ↓ , ↑ buttons choose in the lower row the on or oFF symbol (pic.30). Choosing on activates automatic storage of the results and oFF - single storage, after every pressing of the MEM button.

b. int - time interval during series taking (Pic. 31).



Pic. 31.

The value of the time interval is displayed in the lower row of digits, and the informative symbol int in the upper row.

The ↓ , ↑ buttons are used for setting time in minutes and seconds. The shortest interval is 1 second and the longest - 60 minutes. Holding the button increases change rate (repetition).
In case of setting the SEr parameter to oFF, the position int is not displayed.

c. ALL - the way of displaying stored results;
on - successively: number of the sample, result, time and date of memorising the result.
oFF - successively: number of the sample and the result.

Changing with the ↓ , ↑ buttons.

Return to the results readout display after pressing the MEM button.
Exit from the readout mode after pressing the chosen function button.

19.2. Introducing single readouts into the memory

If storing of single results has been chosen according to previous section, every press of the MEM button memorises the result. The results are stored as the next ones after the latest stored. In case of checking the results stored earlier and not returning to the last one, the results won't be deleted and the value will be stored under the first empty position. In case of storing the result beginning with the chosen number, first delete the results starting from this particular number (as described in the section 19.5) and next start memorising the results by pressing the MEM button.
While memorising the result, its number is being displayed for a moment.

If after having pressed the MEM button instead of a number an End sign is displayed, it informs that the maximal number of results to store has been reached.

19.3. Storing the measuring series

There is a possibility to store series of measurements in the meter's memory. It is necessary to:

- choose the way of collecting the results serially (point 19.1 a);
- enter the time interval (point 19.1 b);
- delete the stored results starting from the chosen one (section 19.5);
- with the appropriate button choose the function of which results are going to be stored;
- with the MEM button start taking series. The measurement results will be collected starting from the first free number.

Collecting series is signalised by flashing diode in placed in the MEM button**.** Before each time the result is memorised, the number of the measurement is displayed for a moment. Collecting series may be stopped by pressing the MEM button, any function button or by filling up all the memory capacity. The next series can be started unless the memory capacity has been filled up.

19.4. Reviewing the results

Reviewing stored results is started in the measuring mode, by pressing and holding the 

button until the number of the last stored result displays on turns with its value.

Every press of the  or the  button shows the next or the previous number and the result with time and date **depending on which parameter of the ALL function has been chosen** (point 19.1 c).

In this mode the  ,  buttons function with repetition which means that after holding them the numbers are changing with increasing rate till they stop at the highest or the lowest number.
The reviewing mode is left by pressing any function button.

19.5. Deleting the stored results

In order to delete stored results:

- press and hold the 

button;
- with the  ,  buttons set the number of the measurement from which we want to start deleting results from the memory;
- press and hold the 

button until there is a --- sign displayed instead of the results; all the results from the chosen one up to the last one remembered are now deleted;
- press any function button to exit the reviewing mode.

Deleting all the results from the memory should be started beginning with the first number.

20. CO-OPERATION WITH A PC

Connecting the meter with a PC enables storing the data directly on the computer, what makes a possible number of results to store unlimited. The PC should be equipped with a USB connector. For transmission a special software prepared by our firm should be used. The software is delivered on a CD. After inserting the CD to a drive the installation program starts automatically. During installation it is necessary to follow the given instructions.

In the back wall of the meter there is a USB connector placed, which enables connecting with a PC using a cable. After connecting, turn on the meter and the PC and launch the transmission software. We have two options available:

- “Collect series” is used for collecting results of a current measurement. After choosing this option a window with the result of a current measurement displays. Only the elements which are marked in the field “Send” will be collected and stored. It is necessary to set the number of measurements which are to be stored and storage intervals. On the basis of this data the software will count the time of collecting the whole series. The series are stored in temporary file. In case of lack of power the collected data will be stored in a file “NoNamexx”. Collecting is started by pressing the “Collect” button.

- “Download data from memory” enables sending the chosen part or whole of the data stored in the meter’s memory to a file. In option “Collect” we mark the data we want to be sent. The transfer is started by pressing the button “Download”.

Caution: the meter and the PC should be switched on **after** connecting the cable.

21. TECHNICAL DATA

pH MEASUREMENT:

Range	Resolution	Accuracy (±1 digit)
-2.000 ÷ 16.000 pH	0.001 / 0.01 pH	±0.002 pH

INPUT IMPEDANCE: $>10^{12}\ \Omega$
TEMPERATURE COMPENSATION: manual/automatic
RANGE OF COMPENSATION: -5.0 ÷ 110.0 °C
pH ELECTRODE CALIBRATION: automatic, in 1 ÷ 5 points

RANGE OF RECOGNITION AND ENTERING OF THE pH BUFFER SOLUTIONS

Calibration point	Range
1	0,800 ÷ 2,100
2	3,900 ÷ 4,100
3	6,800 ÷ 7,100
4	8,900 ÷ 10,200
5	11,500÷ 14,000

AUTOMATIC CHANGE OF THE pH BUFFER VALUE TOGETHER WITH THE TEMPERATURE CHANGE, FOR SAMPLES CONSISTENT WITH NIST (table page 19) IN RANGE 0 ÷ 60 °C

THERMAL STABILITY OF ZERO: 0.0005 pH/ °C

ION SELECTIVE MEASUREMENT:

Range	Resolution	Accuracy (±1 digit)
-2.000 ÷ 16.000 pX	0.001 / 0.01 pX	±0.002 pX
0 ÷ 100 M/l	0.01 / 0.1 %	±0.25 %
0 ÷ 1 000 g/l	0.01 / 0.1 %	±0.25 %
0 ÷ 1 000 000 ppm	0.01 / 0.1 %	±0.25 %

INPUT IMPEDANCE: $>10^{12}\ \Omega$
TEMPERATURE COMPENSATION: none
CALIBRATION OF THE ELECTRODE: in 1 ÷ 5 points

mV MEASUREMENT:

Ranges	Resolution	Accuracy (±1 digit)
-1999.9 ÷ 1999.9 mV	0.1 mV	±0.1 mV

INPUT IMPEDANCE: $>10^{12}\ \Omega$

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 the used Pt-1000 probe

TEMPERATURE PROBE: platinum resistor Pt-1000

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: ±0.27 ^{0}C

OTHER:

MEMORY CAPACITY: 4000 results
OPERATING TEMPERATURE: 0 ÷ 40 ^{o}C
POWER: power adapter 12V/100mA.
POWER CONSUMPTION: 60 mW
DISPLAY: LCD 55 x 45 mm
DIMENSIONS: 200 x 180 x 50 mm
WEIGHT: 620g

22. EQUIPMENT

Standard set for the **CPI-505** meter is:

1. Combination glass electrode EPS-1
2. Temperature probe Pt-1000B (standard);
3. Power adapter 12V/100mA.
4. Software for collecting the data on the PC
5. USB cable
6. User's manual with warranty.

Additional equipment available for this meter is:

1. pH electrodes for special purposes (sewage, wastes, meet etc.);
2. Temperature probe Pt-1000 1/3B with higher accuracy;
3. Ion selective electrodes;
4. Redox measuring electrodes;
5. Reference electrodes.

W A R R A N T Y

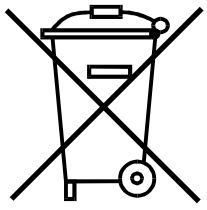
The ELMETRON company ensures a 24-month warranty for the **CPI-505** pH–meter number: .....

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

The pH electrode has a separate warranty of the producer.

NOTICE: Before sending the meter to us please contact the firm by phone or email.
When sending the meter, applied electrode, temperature probe and power adapter should be also included.

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



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