ELMEIRON

LABORATORY DISSOLVED OXYGEN METER

CO-501
CO-502

USER'S MANUAL

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LABORATORY
DISSOLVED OXYGEN METER
CO-501, CO-502

Before use please read the instruction carefully!

W A R R A N T Y

The "ELMETRON" company ensures a 24 months warranty for the dissolved oxygen meter CO-501, CO-502* number:

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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 users manual, using wrong power adapter, mechanical damages and damages caused by repairs made by unauthorised persons.

The oxygen sensor and temperature probe have one year warranty of the producer.

NOTICE: Before sending the meter to us please contact the firm by phone or email.
When sending the meter, the used oxygen sensor, temperature probe and power adapter and warranty with date of purchase should be also included.

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

* cross out the unnecessary

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 will not cause you any trouble and that the meter will 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 cause you a troubles.**

Accuracy of the dissolved oxygen measurements depends on the sensor calibration and regular maintenance which consist in replacing the membranes, electrolyte and cleaning the electrodes. **Lack of correct maintaining of the sensor after some time will make measurements impossible. Please turn your attention to the fact that stabile measurement is possible only with simulated or natural measured water flow.**

The essential feature of our products is their low failure frequency. However if your meter will fail, our firm immediately performs its warranty repair.

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

TABLE OF CONTENT

I. Introduction

The keyboard has the following keys:

ON/OFF - switches the meter on and off;

O_2 - chooses the dissolved oxygen measuring function;

time - displays the time and date;

CAL - longer pressing of this button enters the calibration mode (*CAL* symbol displayed). Short pressing in this mode confirms the calibration result;

MEM/PRINT - short pressing causes storing or printing of single result or measuring series, longer pressing enters the stored results readout mode.

MODE - chooses the entered parameter;

◄ , ► - buttons for entering the parameters.

LINE FEED - enables pulling out and slipping in of the paper by the printer (only in **CO-502**).

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

O_2 - connector for dissolved oxygen electrode;
temp - **Chinch** connector for temperature probe;
POWER - connector for power adapter.

On the right side of the meter there are RS-232 and Centronics outputs.

2. THE CHARACTERISTICS OF THE METER

The oxygen meters **CO-501** and **CO-502** belong to the newest generation of measuring devices which offer wide range of additional functions. Technical data, extra features and way of maintenance are identical in both models. The **CO-502** has additionally build in thermal printer which enables printing the actual and stored in the memory results.
The meters ensures high accuracy and repeatability of the readings. The newest generation electronic elements used in the meter made it's memory independent to power supply. The internal clock is powered from battery which is enough for many years. The meter is equipped with custom LCD display, which enables simultaneous observing of the measured function, temperature value and additional symbols which make working easier.
Main features of the **CO-501** and **CO-502** are:

- high accuracy and stability of the reading;
- automatic and manual temperature compensation;
- measurement and automatic compensation of the atmospheric pressure influence on the dissolved oxygen concentration;
- internal datalogger for 200 measurements with time date and temperature, optionally 450 or 950 measurements;
- taking series of measurements with set time interval;
- RS-232 and Centronics output
- possibility of printing the measurement results or values stored in the memory on standard printer ;
- real clock and date.

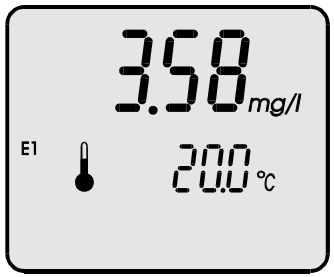
3. WHAT IS THE METER DESIGNED FOR

The **CO-501** and **CO-502** meters are precise and easy to use meters designed for dissolved oxygen measurement in % of saturation or mg/l and atmospheric pressure measurements in hPa. The meter may be also used for accurate temperature measurement of solutions and air in ℃.
The meters are being used in chemical, pharmaceutical, energetical industries, in water treatment stations, laboratories, agriculture, fish farming, universities, scientific laboratories etc.
The meters co-operate with Pt-1000 temperature probe with Chinch connector.
Thanks internal datalogger the meter may collect measurements taken as single or series with set time interval. Built in RS-232 interface enables connecting the meter wit a PC for sending the data. Centronics output enables connecting the meter with a standard printer. There is possibility of printing the data collected in the memory or current results of the measurement. **CO-502** enables printouts with use of the built in thermal printer (60 mm width).
In case of necessity to collect series longer than the memory capacity results it is possible to use special software offered by our company.

4. OUTSIDE VIEW

On the left side of the meter there is a LCD display (pic. 1) on which depending on the chosen function following symbols are displayed:
- result of the oxygen measurement in % or mg/l and temperature,
- time and date.

Choosing the function is done by specific buttons and is signalised by lighting LED diode placed on the button.
Simultaneously with the result a measured temperature value is displayed in ^{O}C. Symbols of the units are displayed by the results. In the oxygen measurement mode there is possibility of reading the atmospheric pressure value.



Pic. 1.

By the temperature value a symbol for automatic temperature compensation is displayed or for manual. ***CAL*** symbol on the left side of the display informs that the meter is in calibration mode. In this mode between the 2 main rows of digits a number of detected calibration point will be displayed (P1, P2).
On the left side of the LCD a number o the chosen oxygen sensor is displayed(E!, E2, E3) it informs which characteristic of the sensor will be taken for all calculations. In the MODE all parameters introduced by the user are displayed and also the value of atmospheric pressure measurement (in oxygen measurement function). 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, printing and storing the results in the memory.

6.2. Changing the resolution of the measurement

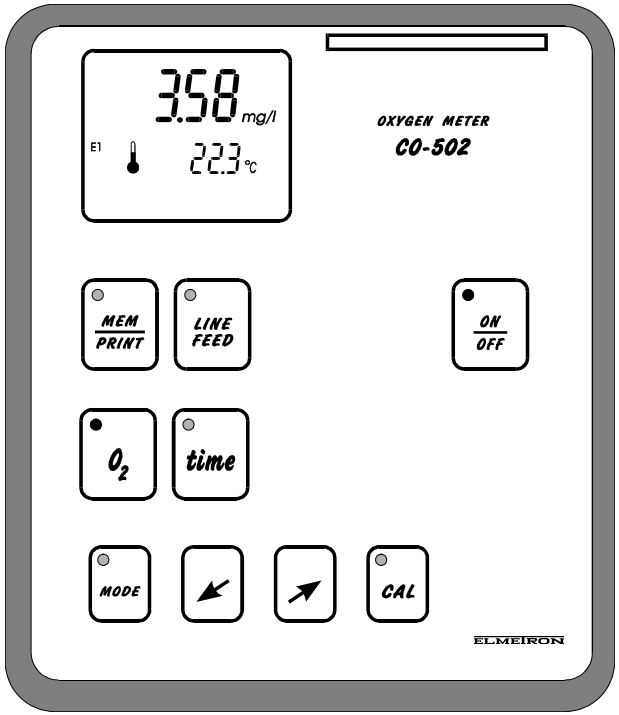
The measurement results may be displayed with chosen resolution. To change it one should:

- in the measuring mode press the MODE button, a rES (resolution) sign will be displayed. (Pic. 4)
- Using keys ◄ or ► one may choose:
  Lo - (low) resolution of the measurement;
  Hi - (high) resolution of the measurement.

Pic. 4

For the oxygen measurement:
Lo - resolution of the measurement 1% or 0,1mg/l;
Hi - resolution of the measurement 0.1% or 0.01 mg/l.

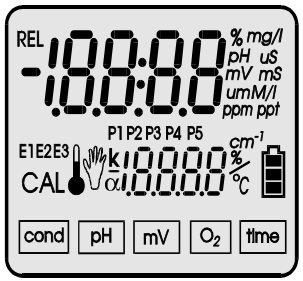
Return to the measuring mode by pressing the chosen function button.



Pic. 2.

5. SWITCHING THE METER ON AND OFF

The meter is switched on by pressing the ON/OFF button. The meter tests the memory and display on which all symbols are displayed (pic.3).



Pic. 3.

If the test was successful, after about 1.5 s the meter switches it self automatically to the measuring mode, in which it was switched off. If an HELP sign will be displayed it means that the meter has lost the factory settings and requires the service repair. If after the 1,5 s all symbols will be continuously displayed it informs that the calibration parameters of electrodes or cells were lost.

After pressing the CAL button the meter will take standard characteristics:
- shift = 0% O_2,
- characteristic slope = 100% O_2 for oxygen sensor.

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

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

6. PREPARATION TO WORK

Before starting the work one should:
- join the power adapter plug to the **Power** input;
- to **O_2** connector join the dissolved oxygen probe;
- in case of using the temperature probe it should be connected with the chinch temperature input - **temp**;
- In case of work with PC join the 5XX-PC cable with **RS-232** input
- In case of printing results on the printer connect the printer cable (5XX-PC) with **Centronics** output.
- switch the meter on by pressing the ON/OFF button.

6.1. Choosing the kind of temperature compensation

The meter switches it self to the automatic temperature compensation mode automatically after joining the temperature probe, after disconnecting it the meter enters the manual temperature compensation mode. In ATC mode near the displayed temperature a symbol appears. Manual temperature compensation is indicated by symbol near the value entered by the user, it's value may be changed using ◄ or ► keys.

8. THE OXYGEN SENSOR

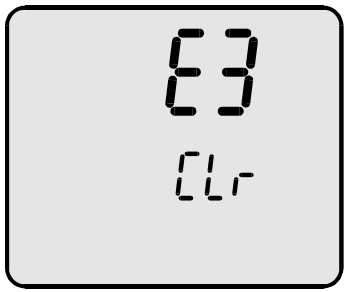
The meters may co-operate with galvanic oxygen sensors. Conventionally it co-operates with the sensor made by ELMETRON with accuracy of ±1%, if the measurement is done in this same temperature as the calibration. The accuracy of measurement decreases together with growing of the difference between the temperature of calibration and temperature of measurement. It is <3% when the difference is ±5℃ and 5% when the difference is ±1 0℃. **In case of using another sensor the device requires its adaptation by the manufacturer.**
It must be remembered that the membrane of the sensor should be replaced if it is mechanically damaged or if the device can't be calibrated. The necessary procedures are given in the instruction of the probe's manufacturer.
Before starting the work please read carefully the information given in chapter 7.

9. ENTERING THE PARAMETERS

9.1. Changing the number of probe

The meter may store calibration characteristics of 3 DO probes. Before the calibration or measurement it is necessary to choose the required number of probe. It is done as follows:

- in the measuring mode press the MODE button till appearing in the lower row of LCD E1, E2 or E3 symbol (pic. 5).
- with ◄ , ► buttons choose the required number of probe
- enter the measuring mode by pressing the O_2 button



Pic. 5.

The symbol below the probe's number informs:

CLr - under this number there is no characteristic stored and manufacturers settings are applied.
SEt - under this number there are the calibration results stored.

II. Dissolved oxygen measurement

7. BASIC INFORMATION ABOUT DISSOLVED OXYGEN MEASUREMENT

The measurement of dissolved oxygen in water solutions is performed using an oxygen sensor. The basic element of the sensor is a Teflon semi-permeable membrane, which enables the penetration of oxygen contained in the measured solution, into the electrolyte – inside of the sensor. The sensor creates a cell, which voltage depends on the oxygen content in the electrolyte.

The meter enables measurement in % of oxygen saturation and **mg/l**. The calculation of the mg/l value is based on the saturation measurement in % and the temperature measurement. When requiring high accuracy during mg/l measurements, the values of salinity and atmospheric pressure must be additionally introduced. The saturation measurement in % does not depend on those factors.

The quality of the oxygen sensor has a decisive effect on the measurement accuracy. The troubles arising during the measurements are caused mainly (98%) by the sensor, yet not by the device. In many cases the troubles result from lack of basic maintenance of the sensor from the user's side. It must be remembered, that during the measurement the sensor takes oxygen from the environment of the membrane.

The sensor's manufacturers recommend in their instructions the minimal flow-rate of the tested water, assuring a stable result. If that requirement is not complied **the result will regularly decrease.** During measurements in stagnant solutions the flow can be partly simulated by keeping the sensor in motion with a suitable speed. In laboratory conditions, i.e. performing the measurements in a vessel, the flow can be forced with a magnetic stirrer. Although it must be kept in mind that when measuring low O_2 saturation intensive stirring can cause an increase of oxygen content in the tested solution. Taking water samples and transferring them to the laboratory can alter the O_2 concentration in the samples. The best results can be achieved **only in conditions, which are recommended by the manufacturer of the sensor in the operation manual.**

Long-lasting storing of the sensor without performing of measurements (above 1 month) requires removing of the electrolyte. After this period the container must be filled with a fresh electrolyte and the sensor stored in distilled water for about 24 hours. A correct measurement is determined by the good condition of the membrane. The membrane must be free of any cracks (appearing of electrolyte-drops or white spots when dry). Before the measurement the electrode should be activated by storing in distilled water for about 15 minutes.

Strongly polluted wastewater causes after some time clogging of the membrane. This is revealed by the impossibility of calibrating of the device at 100% oxygen content (the calibration range becomes too narrow). In both cases the membrane should be replaced according to the manufacturer's instructions. When replacing the membrane and replenishing the electrolyte it is important to pay attention weather there are no air bubbles in the container beneath of the membrane, because otherwise the measurements will be false. In that case the twisting of the sensor should be repeated after refilling the electrolyte. In order to obtain a stable result there must be some awaiting time before making the reading. According to the sensor's manufacturers that is about 1-1,5 min, depending on the thickness of the membrane. The accuracy of the measurement is connected with the temperatures of calibration and measurement. The greater the difference of these temperatures, the greater the measurement error. The used sensors require a two-point calibration in a zero O_2 saturated solution and an optional solution (most often a 100% - saturated one). Clean water contains about $60 \div 80\%$ oxygen. Waste water and chemical solutions are in general less saturated with oxygen but liquids with forced aeration are much more saturated. When performing accurate measurements the sensor's manufacturers recommend carrying out calibration just before the measurement since after some time the sensor's parameters are changing. Even the best oxygen sensors have so called drift about ±1%/24 h. Wide measuring range in multifunction meters **CO-501** and **CO-502** enable measurements of waters which are permeated with oxygen. This situation occurs when in the water plants are blooming and growing, in this moment during the photosynthesis process large quantities of oxygen are produced.

9.4. Automatic compensation of the atmospheric pressure influence

The value of oxygen saturated in water determined in mg/l depends directly on the atmospheric pressure value, this means that 10% pressure change causes oxygen saturation change for 10%. The meter ensures automatic compensation thanks build in atmospheric pressure sensor. This influence is automatically counted during measurements in **mg/l**.

There is possibility of reading the atmospheric pressure value:

- in the oxygen measuring mode press the MODE button till moment of appearing in the lower LCD row PrE (pressure) sign (pic. 7);
- in the upper row a value of atmospheric pressure will be displayed in hPa;

Pic. 7.

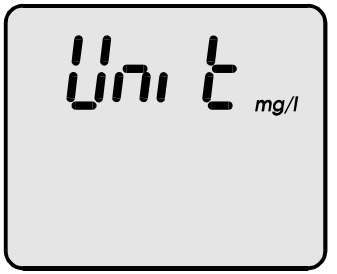
- enter the oxygen measuring mode by pressing the O_2 button.

During the oxygen measurement in % of saturation the atmospheric pressure has no influence on the result.

9.2. Changing the unit

The measurement result may be displayed in % of the oxygen saturation or in **mg/l**. To choose the unit one should:

- in the oxygen measuring mode press the MODE button till displaying in the lower row of LCD Unit (unit) sign;
- with ◄ , ► buttons choose the symbol:
  % - measurement in % of oxygen saturation
  mg/l – measurement in mg/l (pic. 6).



Pic. 6.

- return to the measuring mode by pressing the O_2 button.

9.3. Salinity influence compensation

Salinity of the solution decreases the oxygen solubility in water and requires taking into consideration during measurements in mg/l. **1 g/l change of salinity changes the oxygen saturation for about 5%.** The meter enables entering the salinity value in g/l and counts the change of oxygen saturation in mg/l.

9.3.1. Entering the salinity value

The salinity value may be determined on the basis of known conductivity of the measured solution. The table 1 gives the real dependence between the salinity and conductivity counted in NaCl. To enter the salinity value one should:

- with any conductivity meter measure the conductivity of the solution and from the table 1 read the salinity value;
- in the oxygen measuring mode press the MODE button till displaying in the lower LCD row SAL (salinity) sign;
- with ◄ , ► buttons enter in the upper LCD row the salinity value red from the table 1;
- enter the oxygen measuring mode by pressing the O_2 button.

Measurement in % of saturation doesn't require entering the salinity value

mS/cm	g/l	mS/cm	g/l	mS/cm	g/l
1	0.49	28	16.87	55	34.34
2	1.00	29	17.52	56	34.99
3	1.52	30	18.17	57	35.64
4	2.08	31	18.82	58	36.28
5	2.63	32	19.46	59	36.93
6	3.19	33	20.11	60	37.58
7	3.74	34	20.76	61	38.23
8	4.29	35	21.41	62	38.87
9	4.85	36	22.05	63	39.52
10	5.40	37	22.70	64	40.17
11	6.00	38	23.35	65	40.81
12	6.61	39	23.99	66	41.46
13	7.21	40	24.64	67	42.11
14	7.83	41	25.29	68	42.75
15	8.45	42	25.93	69	43.40
16	9.07	43	26.58	70	44.05
17	9.70	44	27.23	71	44.70
18	10.35	45	27.87	72	45.34
19	11.01	46	28.52	73	45.99
20	11.66	47	29.17	74	46.64
21	12.31	48	29.82	75	47.28
22	12.96	49	30.46	76	47.93
23	13.61	50	31.11	77	48.58
24	14.26	51	31.76	78	49.22
25	14.91	52	32.40	79	49.87
26	15.56	53	33.05	80	50.63
27	16.22	54	33.70		

Table 1. Determining the salinity in g/l NaCl on the basis of conductivity in mS/cm (in temperature 25^{o}C).

11.2. Measurement with manual temperature compensation

To make the measurement with manual temperature compensation one should:
- disconnect the temperature probe from the meter;
- turn the meter on by pressing the ON/OFF button;
- with O_2 button choose the oxygen measuring mode;
- choose the unit according to the chapter 9.2;
- by accurate measurements in **mg/l** enter the salinity value (chapter 9.3);
- insert the oxygen sensor to the measured solution;
- using thermometer measure the temperature of the solution;
- with ◄ , ► buttons enter in the lower row of LCD value of temperature of the measured solution;
- check or simulate the flow of the measured solution;
- after the stabilisation read the result.

During series of measurements it is recommended to check and correct the introduced value of solution temperature.

Caution: in case of measurements in solutions with low salinity check according to the chapter 9.3, weather the introduced salinity value is 0.00 g/l.

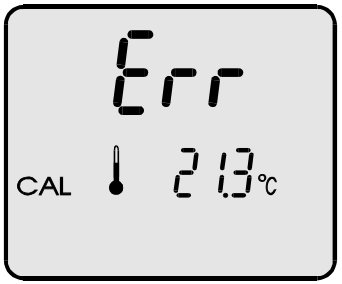
10. CALIBRATION OF THE OXYGEN PROBE

In order to eliminate the measurement error arising from the individual characteristic of the sensor a calibration of the device should be carried out. This procedure should be performed always before operation with a new sensor, after replacing the membrane or for special requirements concerning the measurement accuracy. The probes have a so-called "signal drift" associated with the interval between the calibration and measurement. A longer interval decreases the measurement accuracy. The calibration is also recommended if the temperature of the tested solution differs greatly from the temperature in which the probe was calibrated, because then an additional error arises. **In this case calibration solutions should be used, which temperature is almost the same as the predicted temperature of the tested solutions.**
If it is impossible to calibrate the device, the membrane of the sensor must be replaced according to the manufacturer's instruction. This situation usually takes place if the membrane is strongly polluted or ruptured (sometimes almost invisible). After replacing the membrane the sensor should be conditioned in distilled water for 24 hours.
The used oxygen sensors require one or two point calibration in standard solutions. During two point calibration a solution **with 0% oxygen saturation** is used (solution of Na_2SO_3) and second with **100% oxygen saturation**. It can be prepared by aeration of water for more than ten minutes. When using this solution it should flow or be stirred. The method of preparing both solutions is described in detail in the users manual for the oxygen sensor. A simplified calibration for 100% O_2 saturation can be carried out in the air, without immersing the sensor in water. **Before that the membrane must be wetted with water for several minutes.**
It is assumed that the O_2 content in the air correspondents to 100%- saturation, what enables a simplified calibration to be carried out.
The one point calibration is done only in the solution with 100% oxygen saturation.

Starting the calibration under the chosen sensor number deletes the characteristic stored in memory under this number.
If after choosing the sensors number and entering the calibration mode one will exit this mode the stored characteristic will be deleted and standard characteristic will be applied.

To calibrate the meter one should:
- place the sensor in the vessel with 0% saturation solution;
- choose the saturation in % measurement according to chapter 9.2;
- press and hold the CAL button till appearing in the left lower corner of display a ***CAL*** symbol;
- after the stabilisation of result press the CAL button.
  The result will pulsate what informs about storing the value of calibration at this same time in the upper row of LCD a corrected value of the measurement (0%) will be displayed.
  Take the sensor out, **wash it accurately in distilled water** and put it into 100% oxygen saturated solution ensuring the liquid flow or leave it on the air.
- after the stabilisation of the result press the CAL button.
  The result will pulsate, what informs about storing the calibration data at this same time in the upper LCD row corrected value of the measurement will be displayed (100%).
- enter the measuring mode by pressing the O_2 button.

If after pressing the CAL button the meter can't detect the value of the sample solution (0% or 100%), in the place of result for a moment an Err sign will be displayed (pic. 8). In this case it is necessary to check the condition of the membrane and the used solutions.



Pic. 8.

11. OXYGEN CONCENTRATION MEASUREMENT

Before starting the oxygen concentration measurement the meter should be prepared for work (chapter 6) and the oxygen sensor calibrated (chapter 10). As mentioned the measurement in % saturation does not require additional measurements associated with the temperature, salinity and atmospheric pressure. **Although the measurement in mg/l, used more frequently, depends on those factors.** This influence is corrected automatically by the device, taking into the consideration the temperature value measured by the sensor or in case of manual compensation value entered by the user. The oxygen sensor is equipped with an additional system compensating the temperature influence on the membrane. Because of the limited accuracy of this compensation the highest accuracy can be achieved by calibrating the sensor at the same temperature at which the measurement will be carried out. **The measurement error increases with the increase of the difference between the calibrating and measurement temperatures and results from characteristic features of the sensor but not from the device.** For the applied sensor ELMETRON this error is about < 3% at a $\pm 5^0$C temperature difference and increases to 5% at a $\pm 10^0$C temperature difference.
If a higher accuracy is required the interval from the last calibration must be additionally taken into consideration (signal drift). If the salinity of the tested solution is very small, the measurement can be started without entering it's value (value 0.00 g/l should be entered). **However accurate measurements should be preceded by the determination of the salt content in the tested solution.** The salinity of the solution can be determined simply by measuring the electric conductivity using the conductivity meter. The easiest way to determine the salinity is conductivity measurement with conversion to NaCl. The salinity value is introduced according to chapter 9.3.

11.1. Measurement with automatic temperature compensation

To make the measurement with automatic temperature compensation one should:
- connect the temperature probe with the meter;
- insert the oxygen and temperature probes to the measured solution;
- turn the meter on with ON/OFF button;
- with O_2 button choose the oxygen measuring function;
- choose the unit according to chapter 9.2;
- by accurate measurements in **mg/l** enter the salinity value (chapter 9.3);
- check or simulate the flow of the measured solution;
- wait till stabilisation of the result about 1 ÷ 1.5 min (depends on the probe) and read the result.

13. TEMPERATURE MEASUREMENT

The temperature measurement is done as follows:
- to the Chinch connector connect the temperature probe;
- by pressing the ON/OFF button switch the meter on;
- put the temperature probe to the measured solution;
- wait till the stabilisation of the value and read the lower row of numbers.

The meter co-operates with the PT-1000 probe. Depending on it's class the accuracy of the measurement changes.

NOTICE: break in the circuit of the temperature probe switches the meter to the manual temperature compensation mode. It is signalised by changing the symbol to  symbol. On the display the value of the temperature entered by the user is displayed.
Blinking -50℃ value during measurement in positive temperatures informs about short circuit in the temperature probe.

III. Atmospheric pressure measurement

12. ATMOSPHERIC PRESSURE MEASUREMENT

The meter enables atmospheric pressure measurement. To read it's value one should:

- turn the meter on by pressing the ON/OFF button;
- with O_2 button choose the oxygen concentration mode (**O_2**);
- press the MODE button till moment of displaying in the lower row of LCD the PrES (pressure) sign;
- in the upper row the value of the pressure in hPa will be displayed (pic. 9);

Pic. 9.

- return to the measuring mode by pressing the O_2 button.

IV. Temperature measurement

14.4. Setting the time and date

The setting mode of the actually displayed parameter one enters by pressing and holding the CAL button. The position which we are going to change starts blinking, the value is changed with ↙ or ↗ buttons. The pulsating position is chosen by short pressing of the CAL button. After pressing the time button the setting mode is being left.
The clock is powered by lithium battery which life time is approximated to 10 years. Blinking time, after switching the meter, informs about loosing the time settings and requires introducing the correct time and date. If the situation is repeated after each turning the meter on it has to be sent to our service for replacing the battery.

V. Other

14. CLOCK WITH DATE

After choosing the **time** mode with time button the meter will display the actual time. By pressing the MODE button one may display the date, auto off time and battery condition.

14.1. Time display

The hour is displayed in two rows. In the upper one the hour and minutes are displayed and in the lower one seconds (pic. 10). The way of changing the hours is described below. There is no way to set the seconds, they are deleted after pressing any of the function buttons.

Pic. 10.

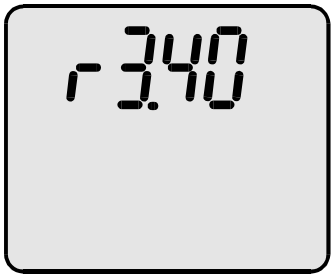
14.2. Date display

The date is displayed as follows: Month – Day – Year. (pic. 11) In the upper row the month and day are displayed and in the lower the year.

Pic. 11.

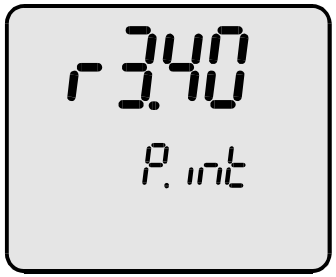
14.3. Readout of the meter's software version

In the **time** function press the MODE button till displaying a screen, as on the picture 12 for the **CO-501** or on the picture 13 for the **CO-502.** In the upper row the software version is displayed.:



Pic. 12.

In case of **CP-502** additionally in the lower row a **P.int** sign is displayed what informs thatthe internal printer is installed.



Pic. 13.

Return to the **time** mode is done by pressing the time button.

15.5. Reviewing of the results

Reviewing of the stored results is started from the measuring mode, by pressing and holding the MEM PRINT button until the number of last stored result on turns with it's value will be showed.

Every pressing of the ↙ or ↗ button shows the next or previous number and result with time and date if ALL **function was chosen** (p. 15.2.e).

In this mode the buttons ↙, ↗ work with repetition and after longer holding the numbers change very quickly till stopping on the highest or lowest number.
The reviewing mode may be left by pressing any of the function buttons.

15.6. Deleting the stored results

To delete the stored results one has to:

- press and hold the MEM PRINT button;
- with buttons ↙ or ↗ set the number of measurement from which we want do delete the memory;
- press the CAL button what will delete the stored results from the chosen one till the end of the memory. On the display in the place of results there will be a **– – –**, sign displayed what confirms the deleting.
- The reviewing mode may be left by pressing any of the function buttons.

In case of using all numbers of memory more results won't be stored. To store new results it is necessary to delete the old ones acting as it was described above.
If one wants to clear all the memory the deleting should be started from the first number.

15. STORAGE AND REDOUT OF THE RESULTS

15.1. Storing or printing

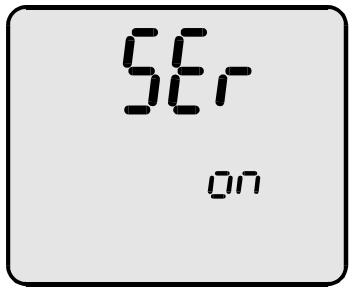
The meter enables storing, readout or printing of actually measured function results. The results are stored in EEPROM memory, which is non-volatile, so the data isn't lost even after complete lack of power. There is also possibility to printout on request the result of measurement which is being done at this moment or those stored in the memory. Before starting the work it is necessary to choose the storing or printing function and determine the way of displaying the result.

15.2. Parameters of storing and reading from the memory

The parameters are changed in the readout mode. It may be entered from every measuring function by pressing and holding the MEM PRINT button, until on the display the number of last stored result will be displayed. This number is displayed on turns with the stored result.
Before starting the storing one has to choose the kind of results collecting: on request or as series, and also the way of displaying the result.

Next pressing of the MODE button shows screens with following functions which may be changed:

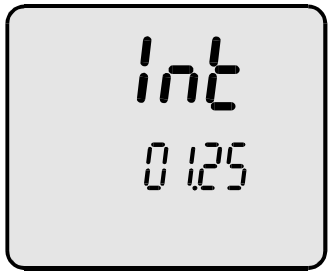
a. SEr - taking or printing series or single results (pic. 14).



Pic. 14.

With ◄ or ► button choose in lower row on or oFF symbols (pic. 14). Choosing on activates automatic storing of the results and oFF single, after every pressing of MEM PRINT. button

b. Int - time interval during series taking (pic.15).



Pic. 15.

Value of the time interval is displayed in the lower row of digits, and the informative symbol Int in the upper one.

Buttons ◄ and ► are used to set the chosen time in minutes and seconds. The shortest time is 1 seconds and the longest 60 minutes. Holding the buttons make changing quicker. (repetition).

In case of choosing the SEr parameter to oFF setting the interval isn't necessary.

c. Prt - printing - yes or no.

With ◄ ► buttons one has to choose on when the results should be printed, or oFF, when they should be stored in the memory.

d. Out - output – sending the result. With ◄, ► buttons choose in the lower row of LCD a symbol:

- PC - output to a PC by **RS-232**,
- CEn - output to outside printer by **Centronics**;
- Int - output to internal printer (only in **CO-502**).

e. ALL - Way of displaying the stored results.

on - successively number of sample, result, time and date of storing the result.

oFF - successively number of sample and result

Changing with ◄ ► buttons.

Return to the results readout display after pressing MEM PRINT button.
Exit from the readout mode after pressing any of the function buttons.

15.3. Storing the single measurements in the memory

If according to previous section storing of single results was chosen and that the results will be collected in the memory and not printed or sent to a PC every pressing of MEM PRINT button stores the measured result. The results are stored as the next ones after the last stored. If someone was checking the earlier stored results and didn't return to the last one the results won't be deleted and the value will be stored after the last measurement. If the user wants to store the result from the chosen number first he has to delete the results (as described in the point 15.6) and next start storing the results by pressing the MEM PRINT button.
During storing the results the number of result will be displayed for a moment.
If after pressing the MEM PRINT button instead of number an End sign will be displayed it informs that the maximal number of results was stored.

15.4. Storing the measuring series

There is possibility to store series of measurements. To do so one has to :
- choose the way of collecting the measurements (p. 15.2a);
- enter the time interval (p. 15.2b)
- delete the stored results starting from the chosen one (p. 15.6);
- with the proper button choose the function which results one wants to store
- with O_2 button return to the measuring mode;
- with MEM PRINT button start taking the series. The measurements will be stored starting from the first free number.

Taking the series is signalised by blinking LED diode in the MEM PRINT button. Before each storing of the result the number of measurement will be displayed for a moment. Taking of the series may be stopped by pressing MEM PRINT button, any of the function buttons or by filling the memory. If taking the series was stopped earlier than the memory was filled one may start to take the next series till the end of memory.

18. TECHNICAL DATA

OXYGEN METER:

range	Resolution	Accuracy
0 ÷ 600.0 %	0.1 %	Of probe* ±1 digit
0 ÷ 60.00 mg/l	0.01 mg/l	Of probe* ±1 digit

Temperature compensation range: 0.0 ÷ 40.0 ^{o}C
Salinity compensation range: 0.0 ÷ 50.0 g/l
Atmospheric pressure compensation range: 800 ÷ 1100 hPa
Probe calibration:
Two point 0% and 100% O_2
One point in 100%O_2
Oxygen probe: membrane, galvanic

* Accuracy given in the “oxygen Probe” section.

ATMOSPHERIC PRESSURE MEASUREMENT:

range	resolution	Accuracy* (±1 digit)
800 ÷ 1100 hPa	1 hPa	±2 hPa

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 Pt1000b resistor: ±0.8 ^{0}C
for Pt1000$^{1}/_{3}$b resistor: ±0.27 ^{0}C

16. PRINTOUTS ON THE PRINTERS

In the right wall of the meter there is a Centronics output which enables joining the meter with printer using standard cable. In the **CO-502** the results may be also printed on the internal printer.
There is possibility to print the measured value, or the results stored in the memory.

16.1. Choosing the direction of sending the data

Before sending the current results or those stored to the printer or PC it is necessary, in the readout mode (point 15.2) press the MODE button till appearing in the upper row of LCD an Out (output) symbol, and next with ◄, ► buttons choose in the lower row one of the symbols:
- PC - output for PC by **RS-232**,
- CEn - output for external printer by **Centronics**;
- Int - output for internal printer (only **CO-502**).

16.2. Printout of the result – single or serial

To print the result of the current measurement one should:
- connect the printer with the meter;
- switch the meter and the printer on;
- choose the direction of sending the data (chapter 16.1);
- set the printout parameter Prt to on (chapter 15.2.c);
- choose the printout form (chapter 15.2.e) and way of printing – single or serial printouts (chapter 15.2.a);
- if the single kind of taking measurements was chosen, every pressing of the MEM/PRINT button will cause printing the actually measured value temperature and number;
- if taking the series of measurements was chosen, after pressing the MEM/PRINT button printing of actually measured value, temperature and number of measurement with chosen time interval will be started.

If the parameter ALL was set to on together with the value of actually measured result and temperature the date and hour will be printed.

Printing of the series may be stopped by pressing the MEM/PRINT button or any of the function buttons.

There are no limits in number of printed results.

16.3. Printout of the results stored in the memory

To print the results stored in the memory:
- join the printer with the meter using the cable (optionally);
- switch the meter and printer on;
- choose the direction of sending the data (chapter 16.1);
- choose the printout format (point 15.2.e) and way of printing – serial or single (point 15.2.a)
- enter the results viewing mode (point 15.5), with buttons ◄, ► set the number of measurement from which the printing should be started. Pressing the MEM PRINT .starts printing.

The results of measurements with numbers will be printed.
In case of setting the SEr parameter to on all results from the set one to the end of memory will be printed, in case of setting the SEr parameter to oFF only the result stored under the chosen number will be printed.
In case of setting the ALL parameter to on, together with the result of measured function and temperature the hour and date will be printed.

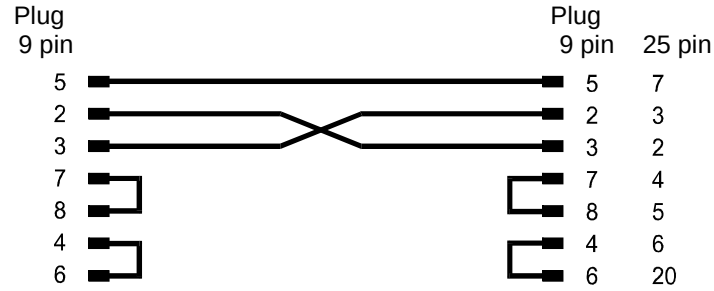
16.4. Internal printer maintenance in CO-502

The printer maintenance basically is based on installing the paper. To do this one should:
- change the direction of sending the data to Int (point 16.1);
- move up the lever on the right side of the meter;
- into the slot on the back of the meter insert an evenly cut paper simultaneously pressing the LINE FEED button, till the end of paper will appear in the upper slot of the meter;
- move down the lever, the LED diode on the LINE FEED button will light what confirms the readiness of printer to work;
- Through the roll of paper put the handle and the bended part place in the slot on the back of the meter and press it down.

The paper will move out, by one line, after each pressing of the LINE FEED button. Holding the LINE FEED button causes continuous moving out of the paper. The excess of the paper may by tear off on the notched edge of the slot.
In case of not using the printer for a longer time or using standard PC printer it is necessary to **move up the lever and leave it in this position**. The LED on the LINE FEED button will go out, what confirms switching the printer to stand by mode. End of the paper and improper lever position is signalised by blinking LED on the LINE FEED button.

17. CO-OPERATION WITH THE PC

Connecting the meter with a PC enables storing data directly on the computer, what eliminates the limitation of the memory capacity. The PC should be equipped with serial RS-232 connector (typically COM2) configured for 9600 b/s, 8 bit, 1 even bit, 1 stop bit, lack of steering the transmission.
On the picture 16 there is the way of joining the meter with the computer showed. On the right side of the picture there is the way of joining the cables with the 9 or 25 pin plug with relevant pin numbers.
For the transmission a special software prepared by our company may be ordered or residential Windows program - HyperTerminal (in menu Accessories / Communication). If it isn't there it should be installed from the Windows installation CD. The program should be configured with option „direct connection with port....COMx".
In the right wall of the meter there is a RS connector which enables joining the meter with a PC by a cable.



Pic. 16.

After connecting one should switch the meter and PC on and set in the meter the Prt parameter to on (chapter 15.2.c) and the direction of sending the data Out (output) to PC (output for PC by RS-232C) according to chapter 16.1.

After returning to the measuring mode and pressing the MEM PRINT button transmission of the current result and temperature will start. The mode and format of transmitted data depends on the set SEr, Int and ALL parameters.

There is a possibility of sending to the PC all data gathered in the meter's memory. To do so it is necessary to act according to point 16.1 and set the direction of sending the data Out (output) to PC (output for PC by RS-232C).

Caution: the meter and PC should be switched on after connecting the cable to both of them.

OTHER:

Memory:	950 results
Working temperature:	-5 - 45 ºC
Power:	stabilised power adapter **CO-501** - 12V/100mA, **CO-502** - 6V/2A.
Power consumption:	60 mW
Screen:	LCD 55 x 45 mm
Dimensions:	200 x 180 x 20 / 50 mm
Weight:	**CO-501** – 650g, **CO-502** - 720 g

19. EQUIPMENT

The standard equipment of the meter is:

1. Temperature probe Pt-1000B (standard);
2. Dissolved oxygen sensor.
3. Power adapter: **CO-501** 12V/100mA, **CO-502** 6V/2A;
4. Software for collecting large number of data on the PC
5. RS232 cable
6. User's manual with warranty.

The additional equipment available for this meter is:

1. Temperature probe Pt-1000 1/3B of higher accuracy;