ANALYTICAL EQUIPMENT FOR

VZOR

ECOLOGY AND POWER INDUSTRY

MARK-603 CONDUCTIVITY METER

Operation Manual

АЯ 74

Nizhny Novgorod
2011

VZOR will appreciate any suggestions and comments aimed at product quality improvement.

If you have any trouble with the instrument performance, please contact us in writing or by phone.

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C O N T E N T S

1 DESCRIPTION AND OPERATION

1.1 Purpose

1.1.1 Name and identification of the product
MARK-603 Conductivity meter.
MARK-603/1 Conductivity meter.

1.1.2 The conductivity meter is used for measuring electric conductivity (SEC), salt content, and temperature of aquatic environment. The instrument measures both absolute SEC and SEC adjusted to 25 °C.

The MARK-603 conductivity meter finds its application at the facilities of heat and nuclear power industries for monitoring of water chemistry parameters.

The MARK-603/1 conductivity meter finds it application in ecology, boiler installations, production processes of various industries, training processes for monitoring water chemistry parameters.

1.1.3 The type of analyzer:

- contact;
- underfrequency;
- single-range;
- with flow-type/ dip sensor;
- with automatic temperature compensation;
- fast-response;
- portable;
- line and self-contained supply;
- with transfer of measuring results to PC via USB port.

1.2 Main parameters

1.2.1 By resistance to climatic effects, the analyzer version group is B4 in accordance with GOST R 52931-2008.

1.2.2 By resistance to mechanical effects, the analyzer version is L1 in accordance with GOST R 52931-2008.

1.2.3 The version of the conductivity meter according to its level of protection against environmental impacts is IP65.

1.2.4 By resistance to atmospheric pressure, the analyzer version group is P1 in accordance with GOST R 52931-2008 (atmospheric pressure between 84 and 106.7 kPa).

1.2.5 Parameters of the medium under investigation:

– temperature, °C ..... 0 to +75;

– operating temperature,°C ..... (25±0,2);

– pressure of the medium under investigation, MPa …….. 0.

1.2.6 Operating conditions:

– ambient air temperature, °C …….. +5 to +50;

– relative ambient air humidity at a temperature +35 °C and lower temperatures without condensation of moisture, %, max …….. 80;

– atmospheric pressure, kPa (mm of mercury) ……..... 84.0 to 106.7 (630 to 800).

1.2.7 Power supply of the conductivity meter – from a DC 2.2 to 3.4 V self-contained source.

1.2.8 Power consumption at a rated supply voltage 3.0 V, mV·A, max:

– without display lighting ……..... 20;

– with display lighting …… 300.

1.2.9 Table 1.1 contains overall dimensions and weight of the instrument components.

Table 1.1

Version of the conductivity meter	Name and identification of the components	Overall dimensions (without cable), mm, max	Weight, kg, max
MARK-603	Conversion unit	65×130×28	0,12
	CS-015 Conductivity sensor	Ø15×130	0,08
	CS-15 Conductivity sensor	Ø15×160	0,11
MARK-603/1	Conversion unit	65×130×28	0,12
	CS-3 Conductivity sensor	Ø15×130	0,08

1.2.10 Transportation conditions in a shipping container:

– temperature, °C ..... −20 to +50;

– relative air humidity at 35 °C, % …… 95;

– 5-35 Hz sinusoidal vibration with a 0.35 mm shift amplitude in the direction marked “Top. Do not turn over” on the package.

1.3 Technical characteristics

1.3.1 The ranges of SEC measuring and salinity in conversion to sodium chloride are in accordance with Table 1.2.

Table 1.2

Version of the conductivity meter	Conductivity sensor	Measuring range	
		SEC, µS/cm	Salinity in conversion to sodium chloride, ppm
MARK-603	CS-015	from 0 to 2000	from 0 to 1000
	CS-15	from 0 to 20000	from 0 to 10000
MARK-603/1	CS-3	from 0 to 20000	from 0 to 10000

1.3.2 Limits of the analyzer allowable basic absolute error in SEC and salinity at an analyte temperature of (25.0±0.2) °C and ambient temperature of (20±5) °C are in accordance with Table 1.3.

Table 1.3

Version of the conductivity meter	Conductivity sensor	Measuring range of the analyzer allowable basic absolute error	
		SEC, µS/cm	Salinity, ppm
MARK-603	CS-015	±(0,003+0,015χ)	±(0,004+0,02*C*)
	CS-15	±(0,05+0,015χ)	±(0,06+0,02*C*)
MARK-603/1	CS-3	±(0,05+0,025χ)	±(0,06+0,03*C*)
Note – χ – measured value of SEC, µS/cm; *C* – measured value of salt content, ppm.			

1.3.3 Limits of the analyzer allowable relative error in defining electric constant of sensor are according to the Table 1.4.

Table 1.4

Version of the conductivity meter	Conductivity sensor	Limits of the analyzer allowable relative error in defining electric constant of sensor, %
MARK-603	CS-015	±1
	CS-15	±1
MARK-603/1	CS-3	±2

1.3.4 Limits of the analyzer allowable additional absolute error in SEC measurement due to a change in the ambient temperature within the operating temperature range from 0 to +50 °C are according to the Table 1.5.

Table 1.5

Version of the conductivity meter	Conductivity sensor	Measuring range of the analyzer allowable additional absolute error due to a change in the ambient temperature	
		SEC, µS/cm	Salinity, ppm
MARK-603	CS-015	±(0,003+0,015χ)	±(0,004+0,02*C*)
	CS-15	±(0,05+0,015χ)	±(0,06+0,02*C*)
MARK-603/1	CS-3	±(0,05+0,025χ)	±(0,06+0,03*C*)

1.3.5 Analyte temperature measuring range, °C ……..from 0 to +75.

1.3.6 Limits of the analyzer allowable basic absolute error in analyte temperature measurement at an ambient temperature of (20±5) °C, °C …… ±0,3.

1.3.7 Limits of the analyzer allowable basic absolute error in SEC and salinity measurement due to a change in the ambient temperature by each ±10 °C from the normal temperature (20±5) °C, within the operating temperature range from +5 to +50 °C are according to the Table 1.6.

Table 1.6

Version of the conductivity meter	Conductivity sensor	Measuring range of the analyzer allowable basic absolute error due to a change in the ambient temperature	
		SEC, μS/cm	Salinity, ppm
MARK-603	CS-015	±(0,0015+0,0075χ)	±(0,002+0,01*C*)
	CS-15	±(0,025+0,0075χ)	±(0,03+0,01*C*)
MARK-603/1	CS-3	±(0,025+0,0125χ)	±(0,03+0,015*C*)

1.3.8 Limits of the analyzer allowable basic absolute error in analyte temperature measurement due to a change in the ambient temperature by each ±10 °C from the normal temperature (20±5) °C, within the operating temperature range from +1 to +50 °C, °C ……..……..……. ±0,1.

1.3.9 The time of unsteady process while steplike measurement of SEC, min, maximum ……..... 0,5.

1.3.10 Analyzer readout setting time while measuring SEC due to steplike measurement of analyte temperature within ±15 °C from the working temperature (25,0±0,2) °C, min, maximum ……. 3.

1.3.11 Analyzer readout setting time while measuring analyte temperature in steplike measurement of analyte temperature, min, maximum …… 2.

1.3.12 Full analyzer readout setting time while measuring analyte temperature in steplike measurement of analyte temperature t_y, min, maximum …… 3.

1.3.13 Stability of analyzer readings in SEC measurement for 8 h is according to the Table 1.7.

Table 1.7

Version of the conductivity meter	Conductivity sensor	Stability of analyzer readings in measurement	
		SEC, μS/cm	Salinity, ppm
MARK-603	CS-015	±(0,0015+0,0075χ)	±(0,002+0,01*C*)
	CS-15	±(0,025+0,0075χ)	±(0,03+0,01*C*)
MARK-603/1	CS-3	±(0,025+0,0125χ)	±(0,03+0,015*C*)

1.3.14 Time of setting measurement mode of analyzer, min, maximum ..... 5.

1.4 Product components

The analyzer comprises:

– converter unit;

– conductivity sensor CS-015, CS-15 for analyzer MARK-603 and CS-3 for analyzer MARK-603/1.

1.5 Description and operation

1.5.1 General analyzer data

The MARK-603 conductivity meter is a small-size microprocessor device designed to measure SEC, salinity and temperature of aquatic environment. It also allows to record the results in scratchpad.

For convenient measurement there is provided temperature compensation in the meter, i.e. reduction of absolute SEC value to SEC value at 25 °C. The algorithm of temperature compensation is double: one part is temperature compensation of pure water SEC, and the other part is temperature compensation of dissolved substance SEC (compensation of conductivity linear law). The list of used linear temperature compensation coefficients, due to dissolved in water solution substance, may be set by the user and saved in meter's memory.

There is a mode of measuring the absolute value of SEC (with temperature compensation turned off) in the analyzer.

Conductivity sensors CS-015 or CS-15 (for MARK-603) and CS-3 (for MARK-603/1) are equipped by electronic chip of volatile memory, where sensor parameters are stored. These parameters are based in memory of meter when connecting the sensor to convertor unit and include:

- type of sensor (CS-015, CS-15, CS-3);
- value of conductivity sensor electrical constant;
- resistance of temperature probe at temperature 0 °C;
- cable resistance;
- range of SEC measurement.

In accessory kit, supplied as agreed with customer, it is included:

- flowing vat to measure in channel;
- ion-exchange column for preparing the sample;
- bearing panel, that bears meter, vat with sensor, and ion-exchange column.

Design of ion-exchange column permits providing measurements without preliminary prepare of sample, or with preliminary sample preparation, when analyte water is provided from sampler to the flowing vat through ion-exchange column. To change direction of sample flow on should switch over flow relay; it is installed on the basis of the column.

The flow rate in channel – from 100 to 1000 cm^3/min.

1.5.2 Analyzer operating principle

1.5.2.1 SEC measuring principle

While measuring SEC, testing voltage is supplied to the sensor and current is measured. Measured value of current is scaled into SEC, taking into account electrolytic constant of conductivity sensor C_c.

1.5.2.2 Temperature measuring principle

The temperature values are defined as scaled value of resistant measured value of thermal resistor.

1.5.2.3 SEC temperature compensation principle (reduction of absolute SEC value to SEC value at 25 °C)

The algorithm of temperature compensation is double:
- temperature compensation of pure water SEC;
- temperature compensation of saline solution.

1.5.2.4 Salinity measurement principle

Salinity is defined as reduced, temperature compensated SEC of solution to concentration of salt NaCl by known characteristic curve.

1.5.3 Conductivity meter design

Figure 1.1 shows the conductivity meter.

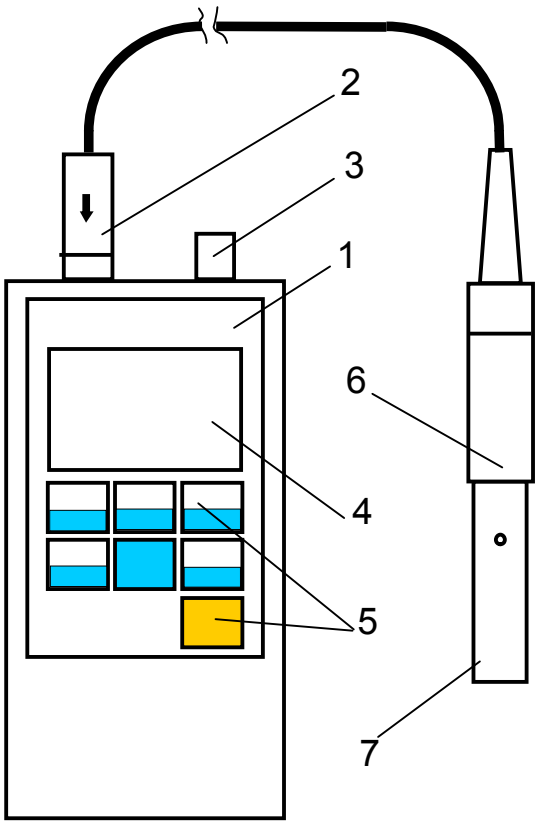


Figure 1.1 − General view of the conductivity meter

Converter unit (CU) 1 has a sealed plastic housing and is designed to convert signals from sensor, display measurement data, and transfer it to PC.

Located on top of the converter unit is sealed cable entry 2 for conductivity sensor, and connector 3 for external power supplier and PC connecting cable.

The front panel of the converter unit features:

– indicator screen 4 designed to display a measured SEC, salinity value or temperature (depending on the chosen measuring mode), linear temperature compensation coefficient, battery charge, date and current time, and to work with menu;

– buttons 5.

The back panel of the converter unit features a battery compartment cover.

Conductivity sensor 6, which housing is made of corrosion resistant alloy, is connected with CU with 1 meter cable through the connector. The sensor CS-3 (with MARK-603/1) has removable bushing for maintenance work.

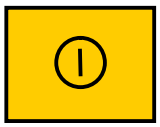
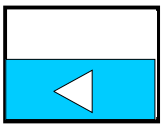
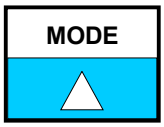
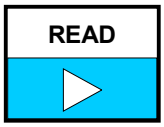
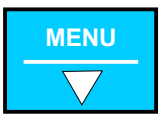
Temperature sensor is in one housing with conductivity sensor.

1.5.4 Functions of the buttons on the conversion unit front panel

The conductivity meter uses non-locking buttons.

The symbols located on the light background of the buttons correspond to their functions when working in the SEC or salt content measurements modes.

The symbols located on the dark background of the buttons correspond to their functions when working with a scratchpad and on-screen menus.

	This (yellow) button is used to switch on and off the conductivity meter. Holding down time for activation is 2 s.
	This button is used: – in measurement mode − to select the linear temperature compensation coefficient (ATC) and deactivating the temperature compensation. Holding down time for activation is 0.5 s; – when working with a scratchpad and on-screen menus – to move along the row to the left.
	This button is used: – in measurement mode − to select a measurement mode (conductivity or salinity measurement). Holding down time for activation is 0.5 s; – when working with a scratchpad and on-screen menus – to move rowwise upwards.
	This button is used: – in measurement mode − to jump from the measurement mode to the mode of scrolling the data recorded in the scratchpad. Holding down time for activation is 0.5 s; – when working with a scratchpad and on-screen menus – to move along the row to the right.
	The button is used: – in measurement mode − to switch on and off display lighting; – when working with a scratchpad and on-screen menus – to exit screens of the scratchpad and on-screen menus.
	The button is used: – in measurement mode − to enter an on-screen menu. Holding down time for activation is 0.5 s; – when working with a scratchpad and on-screen menus – to move rowwise downwards.
	The button is used: – in measurement mode − to enter data into the scratchpad. Holding down time for activation is 0.5 s; – when working with a scratchpad and on-screen menus – to confirm set parameters and modes of operation.

1.5.5 Measurement mode

Figure 1.2 shows the display screen while in the SEC measurement mode.

Figure 1.3 shows the display screen in the salinity measurement mode. The values may be different.

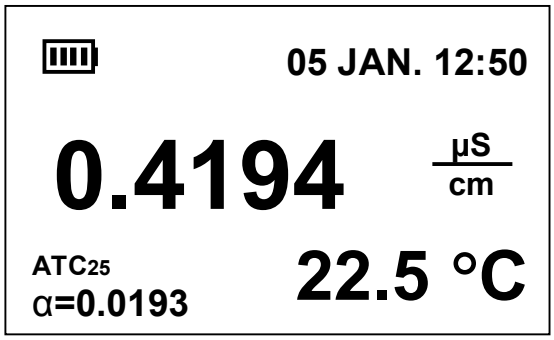


Figure 1.2

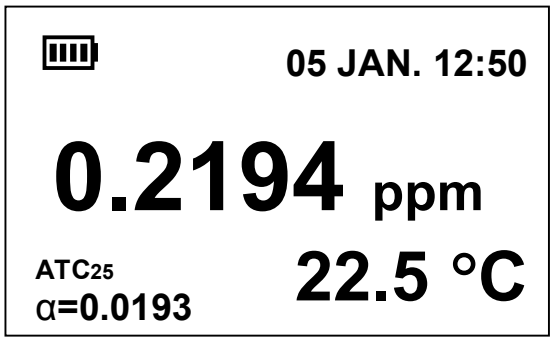


Figure 1.3

The display screen shows:

– battery charge. The number of sells is about battery charge: one cell – 25 %, two cells – 50 %, three cells – 75 %, four cells – 100 %;

– date, time. Date and time may be set in accordance with Para. 1.5.7.1 (menu point **DATE TIME**);

– SEC measured value, µSm/cm, or salinity, ppm. Change of measuring mode is made with button MODE ▲;

– coefficient of the linear temperature compensation of salt solution, $°C^{-1}$. Selection of the linear temperature compensation coefficient ATC_{25} and deactivating the temperature compensation is made with button ATC ◄. Measuring the SEC not adjusted to 25 °C is not accompanied by displaying ATC_{25}. Changing the list of ATC coefficients and saving new coefficients is made in accordance with Para. 1.5.7.4 (menu point **ATC COEFFICIENT**);

– temperature of analyte aquatic environment, C°.

To switch on and off display lighting use button ☼ EXIT. In accordance with Para. 1.5.7.3 (menu point **ADDITIONAL SETTINGS**) one can set a period of time, s, during which lighting switches on by pressing any button.

If there are blinking any blinking letterings or dashes instead of SEC, salinity or temperature values, accomplished by alarm signal, go to Para. 1.5.8.

1.5.6 Saving measurement data entered in the scratchpad

To record the measurement data in the scratchpad, press and hold down the RECORD/ENTER button for 0.5 s.

The screen will show a list of folders created by the user, including **«SHARED FOLDER»**. Using the MENU ▼ and MODE ▲ buttons set the cursor on the row with the name of the required folder, for example, **«SHARED FOLDER»** and then press the RECORD/ENTER button.

If the user has created no folder, the entry will automatically be done in **«SHARED FOLDER»**.

The screen shown in Figure 1.4 will appear during the next two seconds. The second upper row of the screen will identify the number of entered records and the maximum number of records designed for the scratchpad: «**3/100**». Then the conductivity meter jumps to the measurement mode.

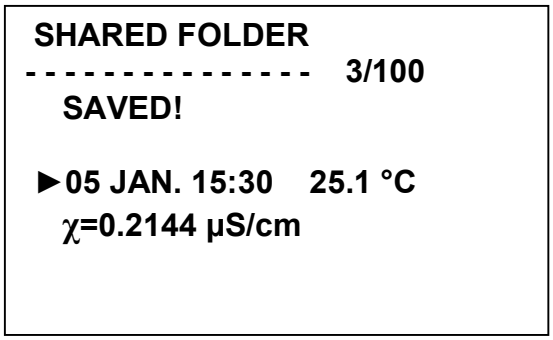


Figure 1.4

The following information will be entered into the selected folder:

- Date and time of measurement;
- Temperature of the medium under investigation;
- SEC measured value (adjusted to 25 °C χ_{25}, µS/cm, or not adjusted to 25 °C χ, µS/cm), or *C* salt content value, mg/L, depending on the selected switched on measurement mode.

If the scratchpad is overfilled when attempting to make the next entry, the following message appears on the screen: **«SAVING IS NOT POSSIBLE, SCRATCHPAD IS OVERFILLED»**.

To scroll the records, press and hold down the READ ▶ button for 0.5 s while the measurement screen is on the display.

The screen will show a list of folders created by the user, including the folder named **«SHARED FOLDER»**. Using the MENU ▼ and MODE ▲ buttons set the cursor on the row with the name of the required folder, for example, **«SHARED FOLDER»** and then press the RECORD/ENTER button.

If the user has created no folder, **«SHARED FOLDER»** automatically opens. The display screen will have the view shown in Figure 1.5.

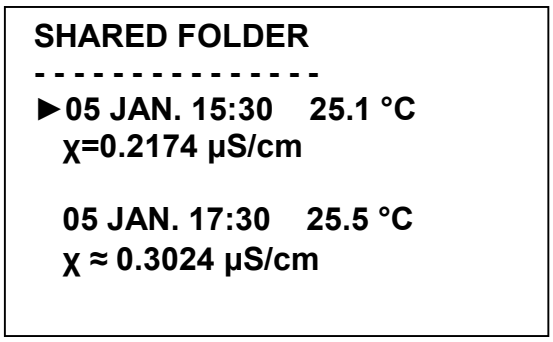


Figure 1.5

If while entering data the overload of any parameters takes place, these parameters will be displayed with the «≈» («approximately equal») sign.

A scroll bar will appear in the right-hand part of the screen. If all the measurements data cannot find room on the screen, the arrows above and under the scroll bar show where (whether in the lower or in the upper part of the list) the remaining measurement data is located.

For vertical scroll rowwise the data-list, use the MENU ▼ and MODE ▲ buttons. Holding these buttons down for more than 1 s activates the automatic move rowwise the data-list in a given direction.

As scrolling the data-list is accompanied by its moving up or down, the cursor is always located on the upper entry displayed on the screen.

Pressing the RECORD ENTER button displays the full data on the measurement marked by the cursor.

If the following value is written down in the scratchpad: χ_{25}, µS/cm, or *C*, ppm, the display screen will look like the one shown in Figure 1.6.

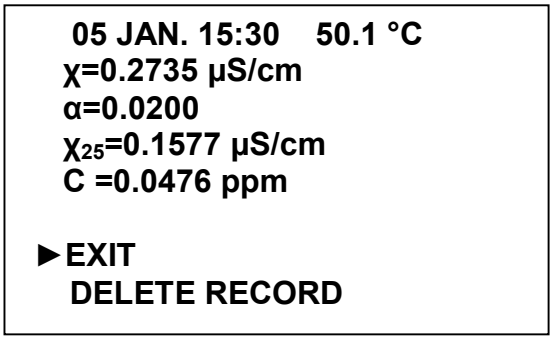


Figure 1.6

If χ, µS/cm, value is written down in the scratchpad, the display screen looks like the one shown in Figure 1.7.

To delete a record, it is necessary to display the full measurement data, place the cursor on the **«DELETE RECORD»** row and press the RECORD ENTER button. This will delete the data displayed on the screen. The message **«RECORD IS DELETED»** will appear on the screen.

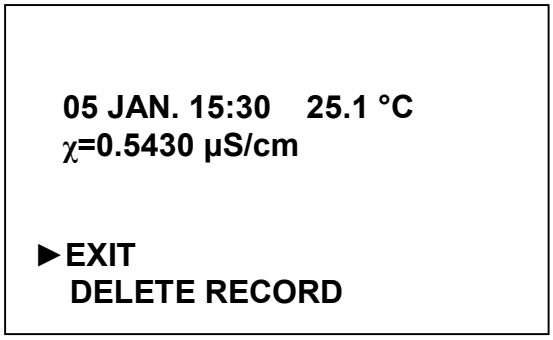


Figure 1.7

Scratchpad editing operations: clearing of folders, creation of a new folder, removing folders are executed according to item 1.5.7.5 (**«SCRATCHPAD EDITOR»** menu item).

To jump to the measurement mode or to return to the previous one, press the EXIT button.

1.5.7 The **MENU** mode

In the **MENU** mode you can view and change the analyzer parameters.

To move from the measurement mode to the **MENU** mode, press and hold down the MENU ▼ button for 0.5 s.

Figure 1.8 shows the **MENU** mode screen.

To exit any **MENU** mode screen, press the EXIT button.

To move the «►»marker on the menu items, use the MENU ▼ and MODE ▲. Holding the MENU ▼, MODE ▲ buttons down for more than 1 s switches on the automatic move of the cursor in the given direction.

To select the required menu item, place the marker on that item and press the RECORD ENTER button.

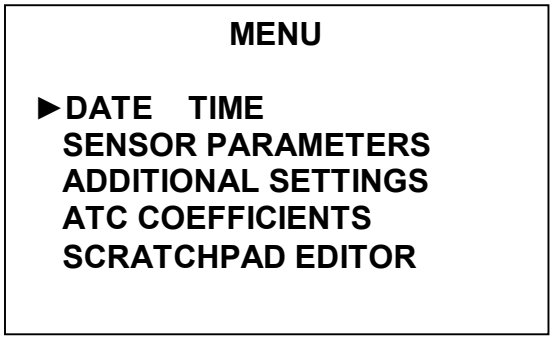


Figure 1.8

1.5.7.1 The **DATE TIME** menu item

Figure 1.9 shows the **DATE TIME**.

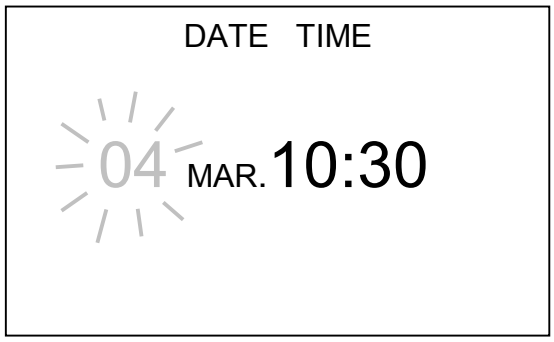


Figure 1.9

Date and time can be entered separately in any order: day, month, hours, minutes.

To move along the row to the left and to the right, use the ATC ◄, READ ► buttons.

In this case the figure of the parameter, which can be changed, will blink. To change the parameters, use the MENU ▼, MODE ▲ buttons.

When the **DATE TIME** screen is activated, the clock stop, after quitting this screen, the clock continue its work.

1.5.7.2 The **SENSOR PARAMETERS** menu item

Figure 1.10 shows the **SENSOR PARAMETERS** screen.

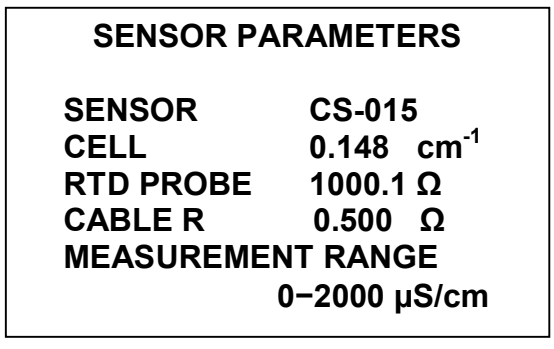


Figure 1.10

This screen displays the parameters of the connected conductivity sensor, which have been input in the conductivity meter memory from the sensor non-volatile memory chip.

The following conductivity sensor parameters are displayed on the screen:

- the type of conductivity sensor;
- conductivity sensor electrolytic coefficient;
- heat sensor resistance at 0 °C;
- cable resistance;
- measurement range.

These parameters are stored in the conductivity meter memory even after the conductivity sensor is switched off.

When connecting another conductivity sensor, the parameters of the new sensor will be entered into the conductivity meter memory.

WARNING: Switch off the conversion unit prior while making connection or disconnection of conductivity sensors!

1.5.7.3 The **ADDITIONAL SETTINGS** menu item

Figure 1.11 shows the **ADDITIONAL SETTINGS** screen.

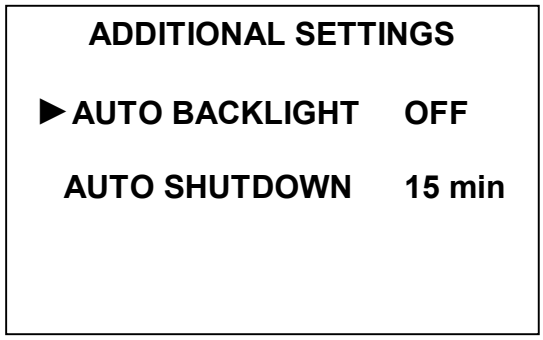


Figure 1.11

To change the parameters of the additional settings, place the cursor on the required row, for example, on **AUTO BACKLIGHT** row and press the RECORD ENTER button. In this case the screen looks like the one shown in Figure 1.12.

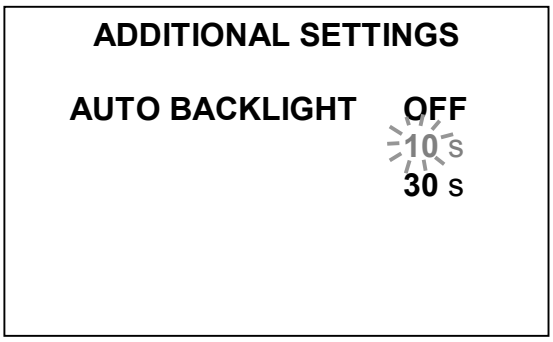


Figure 1.12

Use, the MENU ▼, MODE ▲ buttons to mark the desired row (**OFF**, **10 s**, **30 s**). The marked row will blink. Press the RECORD ENTER button, the display screen will look like the one shown in Figure 1.13.

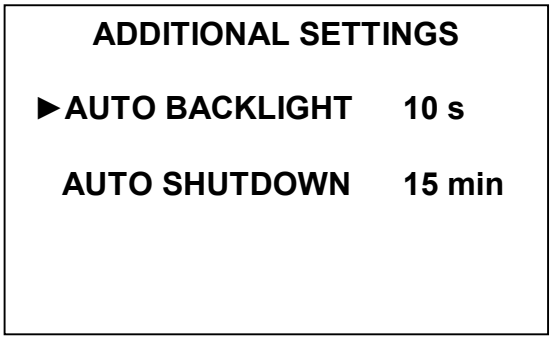


Figure 1.13

Then, depending on the selected parameter, the autolighting will either automatically be switched on during the selected time interval (10 or 30 s) counting from the last pressing of any button, or the autolighting function will be switched off.

Similarly, you can set up the second parameter of the additional setting, i.e. automatic switching off of the conductivity meter when reaching the selected time interval (15 or 30 min) after the last pressing of any button or deactivation of the automatic switch off function.

To enter **MENU,** press the ☼ EXIT button.

1.5.7.4 The **ATC COEFFICIENTS** menu item

The view of the **ATC COEFFICIENTS (α)** screen is shown in Figure 1.14.

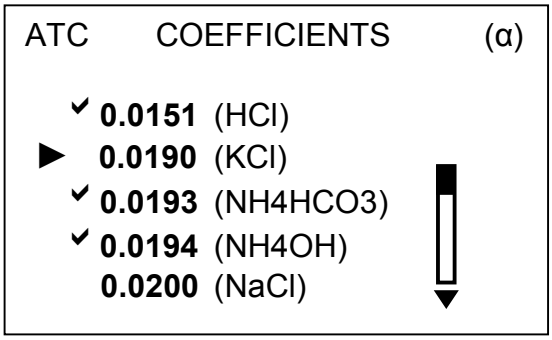


Figure 1.14

When the instrument is set to the measurement mode, you can select the desired ATC coefficient value from the work list of ATC coefficients (marked by the « ✔ » sign) by consequent pressing the ATC ◄ button.

To put ATC coefficient in the work list or to remove it from the work list, place the cursor on the row with this coefficient and then press the RECORD ENTER button to set or remove the « ✔ » sign.

If the coefficients, stored in the conductivity meter memory are not enough, one can set an additional «**USERS**» coefficient. The row with the «**USERS**» coefficient is located beyond the lower border-line of the screen.

To edit the «**USERS**» coefficient one should do the following.

Place the cursor on this row and press the RECORD ENTER button.

The screen will look like the one shown in Figure 1.15.

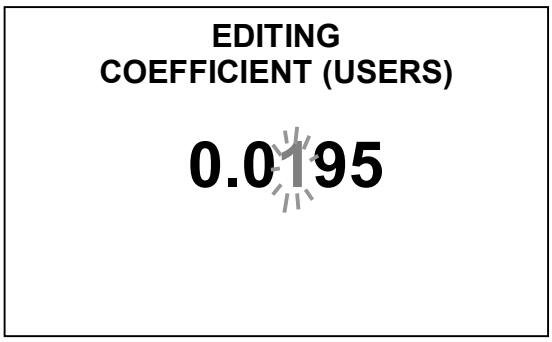


Figure 1.15

Define digit-by-digit the desired value of the ATC coefficient.

For this purpose, use the READ ► and ATC ◄ buttons to highlight one-by-one the digits of necessary position. As soon as a digit is highlighted, it starts to blink. Use the MENU ▼ and MODE ▲ buttons to set the desired value for each of the digit position.

One can edit only the second, third or forth digit after the comma (point).

If one presses the EXIT button, the conductivity meter will jump to the previous screen without retention of the changes in the «**USERS**» coefficient.

When pressing the RECORD ENTER button, the conductivity meter jumps to the previous screen with retention of the changes in the «**USERS**» coefficient. In this case the coefficient will be marked with the « ✔ » sign.

To cancel the « ✔ » sign, press the RECORD ENTER button once again.

Press the EXIT button. The conductivity meter will go over to the **MENU** mode, storing the new work list of ATC coefficients.

If none of the ATC coefficients has been marked with the « ✔ » sign, the **0,0200 (NaCl)** coefficient will automatically be entered in the work list and marked with the « ✔ » sign when the conductivity meter jumps to the **MENU** mode.

1.5.7.5 The **SCRATCHPAD EDITOR** menu item

Figure 1.16 shows the **SCRATCHPAD EDITOR** screen.

Figure 1.16

a) Figure 1.17 shows the **CLEAR A FOLDER** screen.
The folders can have different names.

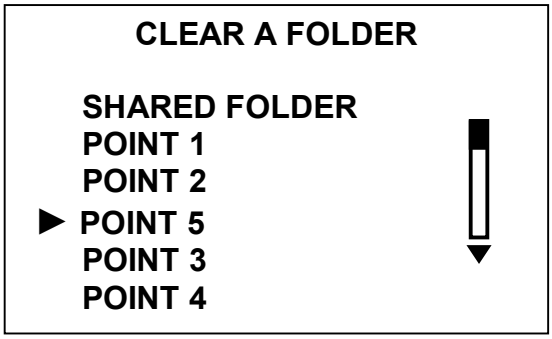


Figure 1.17

To clear a folder, use the cursor to highlight the folder, the records of which you are going to delete. Press the RECORD ENTER button. The system will display the name and the contents of the folder as shown in Figure 1.18.

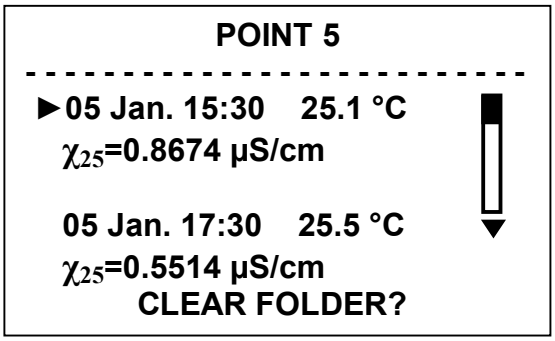


Figure 1.18

Press the RECORD ENTER button. This will clear the folder. The **NO RECORDS** mes-

sage appears on the screen. The conductivity meter goes over to the **CLEAR A FOLDER** screen.

Similarly, you can clear the remaining folders.

b) Figure 1.19 shows the **CLEAR ALL FOLDERS** screen.

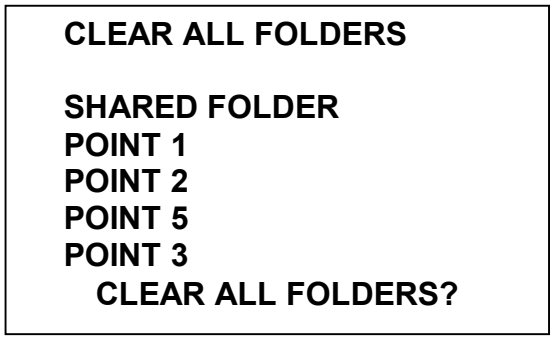


Figure 1.19

Press the RECORD ENTER button. This will clear all folders. The **NO RECORDS** message appears on the screen, the conductivity meter goes over to the **SCRATCH-PAD EDITOR** screen.

c) Figure 1.20 shows the **CREATE A FOLDER** screen.

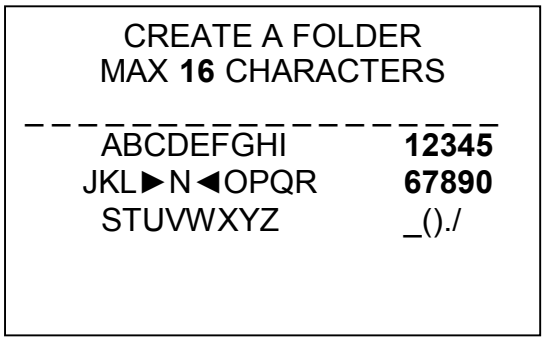


Figure 1.20

To enter a folder name, highlight the required character with the «► ◄» cursor. To move the «► ◄» cursor on the screen, use the ATC ◄, READ ►, MENU ▼ and MODE ▲ buttons.

Pressing the RECORD ENTER button enter the highlighted character in the name of the folder creating. The display screen will look like the one shown in Figure 1.21.

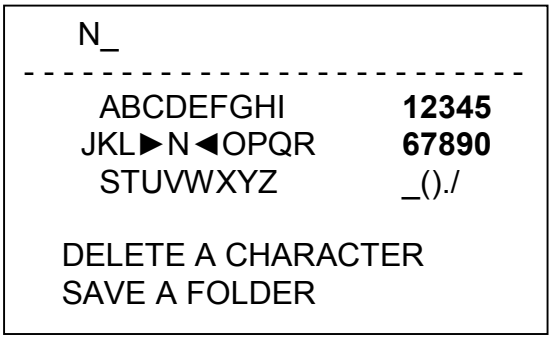


Figure 1.21

If you are holding the RECORD ENTER button for more than 1 s, the letter becomes a capital one.

To delete a character, place the cursor on the **DELETE A CHARACTER** row and press the RECORD ENTER button. The last entered character will be deleted.

Entering sixteen characters in the folder name will automatically place the cursor on the **DELETE A CHARACTER** row.

To store the created folder, place the cursor on the **SAVE A FOLDER** row and press the RECORD ENTER button. The conductivity meter jumps to the **SCRATCHPAD EDITOR** screen.

Pressing the EXIT button displays the **CREATED FOLDER IS NOT SAVED** message on the screen. The conductivity meter jumps to the **SCRATCHPAD EDITOR** screen.

d) Figure 1.22 shows the **DELETE A FOLDER** screen.

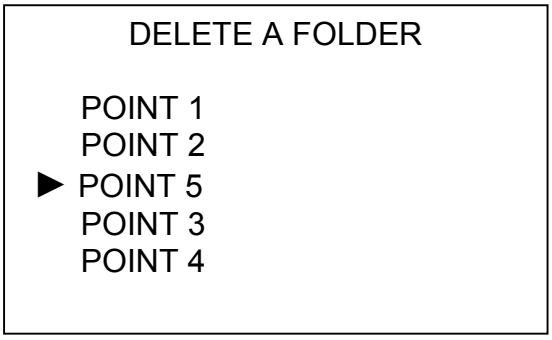


Figure 1.22

To delete a folder, highlight the folder to be removed by the cursor. Press the RECORD ENTER button. The name and contents of the folder will appear on the screen as shown in Figure 1.23.

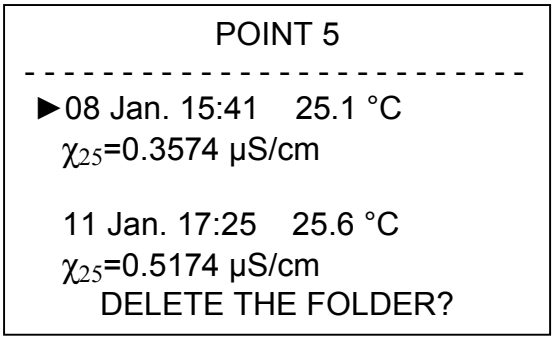


Figure 1.23

If the folder contains no records, the **NO RECORDS** message appears on the screen instead of measurement data. Press the RECORD ENTER button. The **FOLDER IS DELETED** message appears on the screen, the conductivity meter jumps to the **DELETE A FOLDER** screen.

Similarly, you can delete any the other folder, except the **SHARED FOLDER**.

1.5.8 Warning screens

If the warning screens are displayed (see Figures 1.24, 1.25, 1.27), refer to Section 2.5 of this Service Manual («Troubleshooting». Table 2.1).

The screen shown in Figure 1.24 appears if no sensor is connected to the conductivity meter. The appearance of this screen is accompanied with a sound signal.

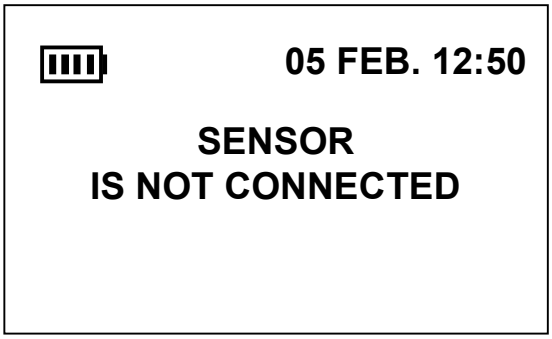


Figure 1.24

The screen shown in Figure 1.25 appears if the parameters of the sensor non-volatile memory can not be read or in the case of failure in reading these parameters.

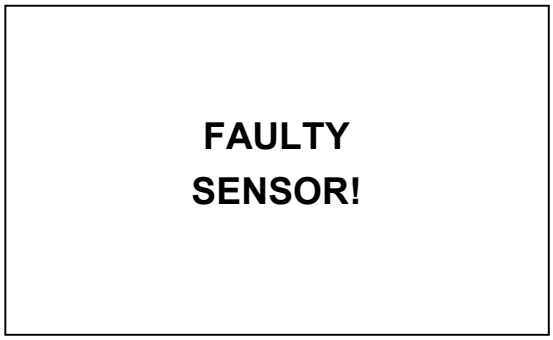


Figure 1.25

Pressing the RECORD ENTER button moves the conductivity meter from the screen as shown in Figure 1.25, to the measurement mode, and the screen shown in Figure 1.26 appears on the display.

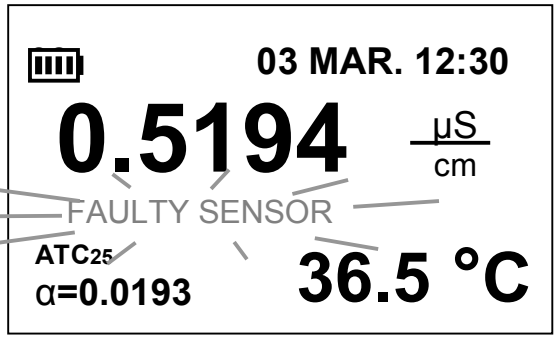


Figure 1.26

Measurements will be carried out based on the parameters that have been previously read from the sensor non-volatile memory.

In case of conductivity meter's programme malfunction the screen as shown in Figure 1.27 appears.

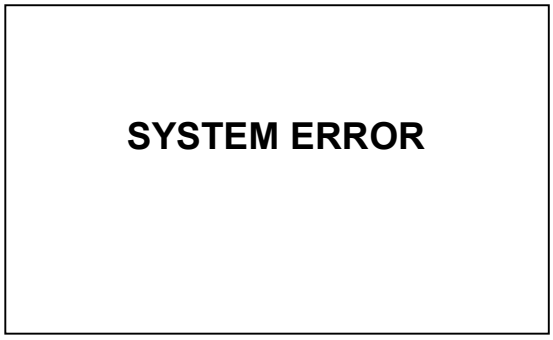


Figure 1.27

If, in case of minor problems connected with the execution of the conductivity meter programme, the screen shown in Figure 1.27 appears, press the RECORD ENTER button to jump to the measurement mode. The system will display the screen as shown in Figure 1.28 with the blinking message «**SYSTEM ERROR**».

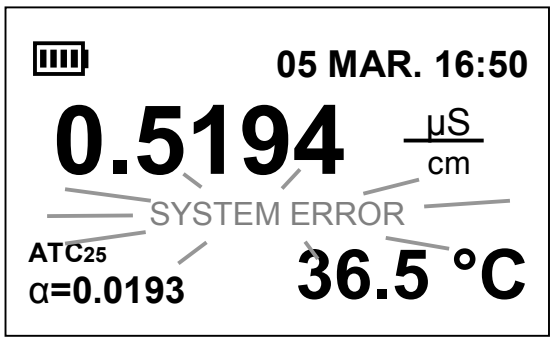


Figure 1.28

When the warning screens as shown in Figures 1.29-1.34 are displayed, the blinking messages will disappear after removing the overload of the displaying parameter, which may indicate: temperature, conductivity or salt content overload.

The screen shown in Figure 1.29 appears when the temperature of the medium under investigation is higher than 75 °C.

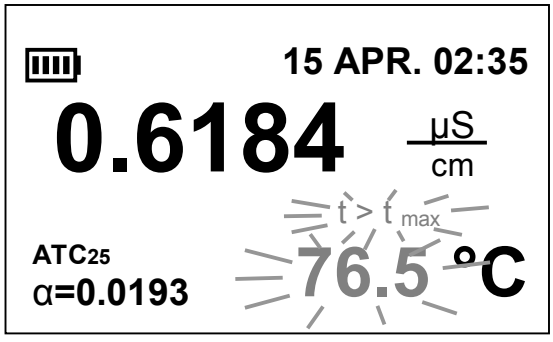


Figure 1.29

The appearance of this screen is accompanied with a sound signal.

The «**t > t $_{max}$**» caption blinks together with the measured temperature value.

The screen presented in Figure 1.30 appears when the temperature of the medium under investigation is higher than 99,9 °C.

The appearance of this screen is accompanied with a sound signal.

The «**t > t $_{max}$**» caption blinks together with the dash marks instead of the measured temperature value.

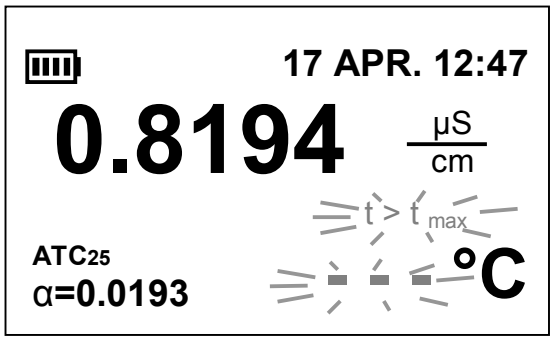


Figure 1.30

The screen shown in Figure 1.31 appears when the temperature of the medium under investigation is lower than 0,0 °C.

The appearance of this screen is accompanied with a sound signal.

The «**t < t $_{min}$**» caption blinks together with the measured temperature value.

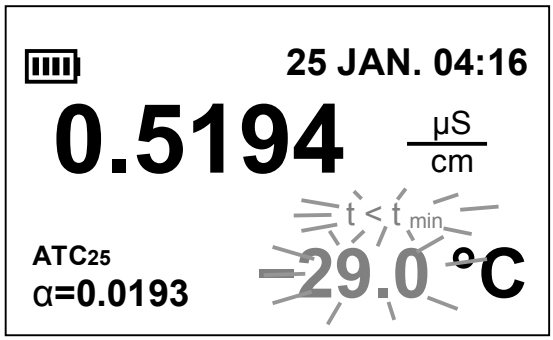


Figure 1.31

The screen shown in Figure 1.32 appears when the measured conductivity value exceeds the upper boundary of the range.

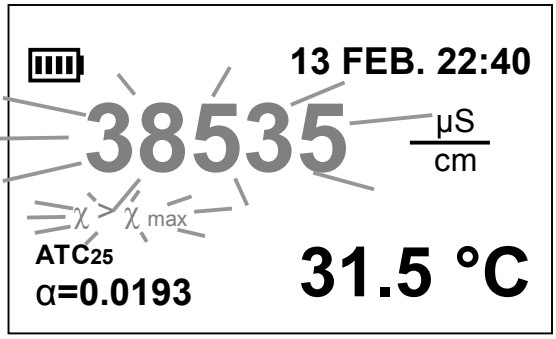


Figure 1.32

The appearance of this screen is accompanied with a sound signal.

The «**χ > χ max**» caption blinks together with the measured conductivity value. The measurement accuracy is not specified.

The screen shown in Figure 1.33 appears when the measured conductivity value exceeds the value that can be displayed on the screen (more than 99999 µS/cm).

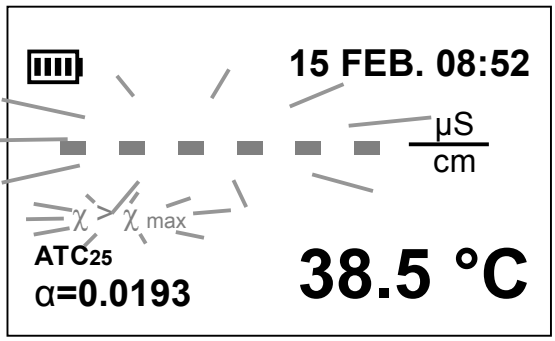


Figure 1.33

The appearance of this screen is accompanied with a sound signal.

The «**χ > χmax**» caption blinks together with the dash marks instead of the measured conductivity value.

The screen shown in figure 1.34 appears when the measured salt content value exceeds the value, which can be displayed on the screen.

The appearance of this screen is accompanied with a sound signal.

The «**C > Cmax**» caption blinks together with the dash marks instead of the measured conductivity value.

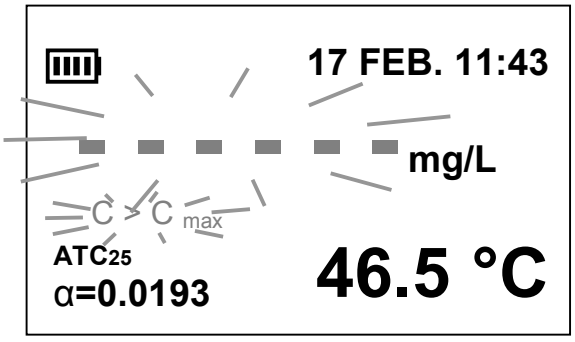


Figure 1.34

When the measurement screen as shown in Figure 1.35 is displayed you should jump to the mode of SEC absolute value measurement (with the temperature compensation disabled).

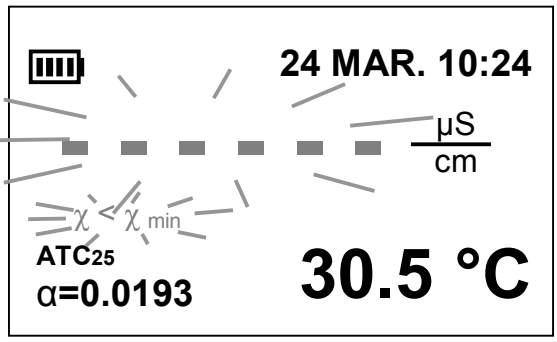


Figure 1.35

The SEC value adjusted to 25 °C should be calculated according to another formula of temperature compensation.

The screen which is similar to the one shown in Figure 1.35 appears, if the indicated value is either negative or exceeds the digit capacity of the indicator (65535).

The appearance of this screen is accompanied with a sound signal.

2 INTENDED USE

2.1 Operating limitations

2.1.1 For taking measurements locate the conductivity meter as required in Para. 1.2.6 of this Manual.

2.1.2 Never take measurements of the solutions containing chemical solvents, which can damage the electrodes and the body of the conductivity sensor.

2.1.3 When working with the conductivity meter, care should be taken to protect the conversion unit and the conductivity sensors against any mechanical shocks because some of their parts are made of fragile materials.

WARNING: NEVER disassemble conductivity sensors!

2.2 Safety

2.2.1 The work with this conductivity meter is allowed for people, who had familiarized themselves with the instructions of this Operating Manual and rules for handling chemical solvents.

2.2.2 Electrical safety of the attending person is guaranteed because the conductivity meter power supply source has the rated voltage within the range 2,2 V-3,4 V only.

2.3 Making the conductivity meter ready for operation

After receiving the product, open the package, make sure that you have a complete set and all the components are in good condition. If the conductivity meter was in a low-temperature environment for some time, hold it at a room temperature at least an hour.

2.3.1 Preparation of the conversion unit (CU) ready

To connect the power supply source, remove the battery compartment cover located on the CU back panel. Put two storage batteries or two galvanic cells of the AA type in the position according to the marking sign inside the battery compartment. Replace the battery compartment cover.

When switching on the conductivity meter, the battery charge level is displayed on the screen. The number of sections in the battery symbol approximately corresponds to the charge level: one section − 25 %, two sections − 50 %, three sections − 75 %, four sections − 100 %.

1 WARNING: STRICTLY FOLLOW THE POLARITY when connecting the power supply. Failure to meet this requirement can result in breakdown of the conductivity meter!

2 WARNING: Connect the power supply only when the conductivity meter is in the «off» position!

3 WARNING: **To avoid clearing the time and date entered in the scratchpad, replacement of the storage batteries or galvanic cells should take not more than 30 s!**

Charging is held at voltage 5V connecting the meter to PC via USB cable or to external power source.

2.3.2 Making conductivity sensors ready

Before making measurements, the conductivity sensors, which have been kept dry, should be held in distilled water for about 0,5-1 h.

2.4 Making measurements

2.4.1 Making measurements by dipping

2.4.1.1 Making ready for measurements

Pour the solution under investigation into a chemical vessel.

Wash the conductivity sensor with this solution by repeated submerging it in the vessel to achieve better penetration of the solution to the electrodes and then submerge the sensor into the solution under investigation so that the air escape hole will be bellow the solution level as shown in Figure 2.1.

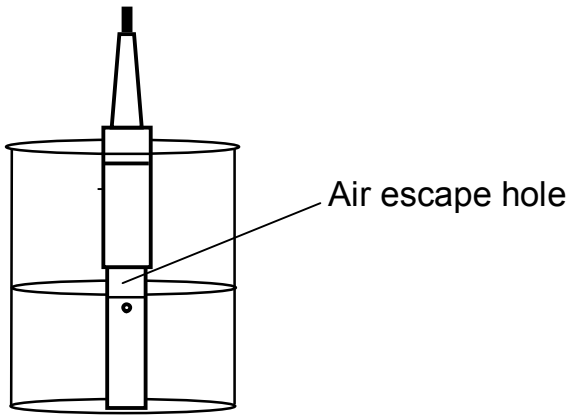


Figure 2.1 − Making measurements by submerging

2.4.1.2 Making measurements

Switch on the conductivity meter.

Use the **MODE** button to set the measurement mode (SEC or salinity measurement).

Use the **ATC** button to set the coefficient of linear temperature compensation (when measuring SEC adjusted to 25 °C and salinity), or deactivate the temperature compensation (when measuring an absolute value of SEC). In 30 s take the indicator reading.

Upon completion of the measurements, wash the conductivity sensor by repeated submerging it in distilled water.

2.4.2 Making measurements in a flow

2.4.2.1 Preparing for measurements

To make measurements in solutions with SEC less than 10 μS/cm, it is recommended to provide a continuous flow of the sample solution through a conductivity sensor using a flowing vat. To install a conductivity sensor, loosen the packing nut of the flowing vat, insert the sensor into the vat down to the end and then tighten the nut.

Connect the hoses to the connecting branches of the flowing vat column as shown in Figure 2.2.

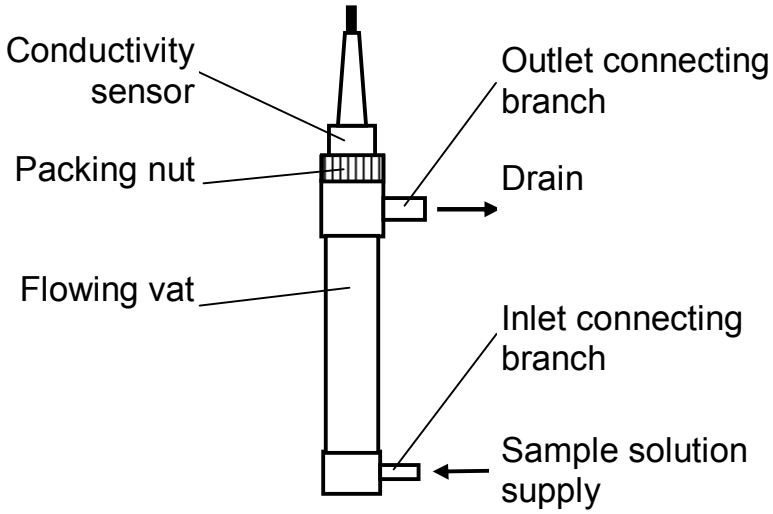


Figure 2.2 −Making measurements in a flow

Install vertically a flowing vat with a conductivity sensor. This will ensure free passing through the sensor the probable air bubbles in the water under investigation. Allowable vertical deviation is maximum 30°.

Deliver the investigated water from a sampler.

Check all the connections for tightness.

Set the water flow rate within the limits from 100 to 1000 cm^3/min.

The flowing vat should be fully filled with water. Insufficient concentration of air bubbles at the top part of the flowing vat is permissible.

In case of increased concentration of air bubbles, it is recommended to remove them from the vat by a momentary shutoff of the flow (for 3-5 s) and slight knocking at the flowing vat body.

2.4.2.2 Making measurements

Measurements shall be made in accordance with Para. 2.4.1.2.

When measurement completed, disconnect the flowing vat from the sample container and close the inlet and outlet connecting branches of the flowing vat with a hose.

2.4.3 Making measurements in a flow with preliminary preparation of a sample in an ion-exchange column

2.4.3.1 Making the ion-exchange column ready

The IEC603 (50/42/180) ion-exchange column is supplied to users without resin.

Wash the column with distilled water.

To charge the column with resin, screw out the top cover and put resin, prepared according to the standard procedure, into the ion-exchange column body as much as 3/4-4/5 of its volume.

Screw on the top cover back.

WARNING: When screwing on the cover, DO NOT APPLY EXTRA FORCE to avoid damaging the ion-exchange column body!

In the foundation of the ion-exchange column there is a sample flow distributor, which changes the feed direction of the sample water flow.

The scheme hydraulic fundamental of ion-exchange column with sample flow distributor with flowing vat is shown on Figure 2.3.

The **«SAMPLE FLOW DIRECTION»** flow distributor has three positions:

– **«DRAIN»** − in this position the sample water coming from the sample container is drained bypassing the ion-exchange column and the flowing vat;

– **«SENSOR»** − in this position the sample water is directed to the flowing vat bypassing the ion-exchange column;

– **«COLUMN+SENSOR»** − in this case the sample water is delivered to the flowing vat through the ion-exchange column.

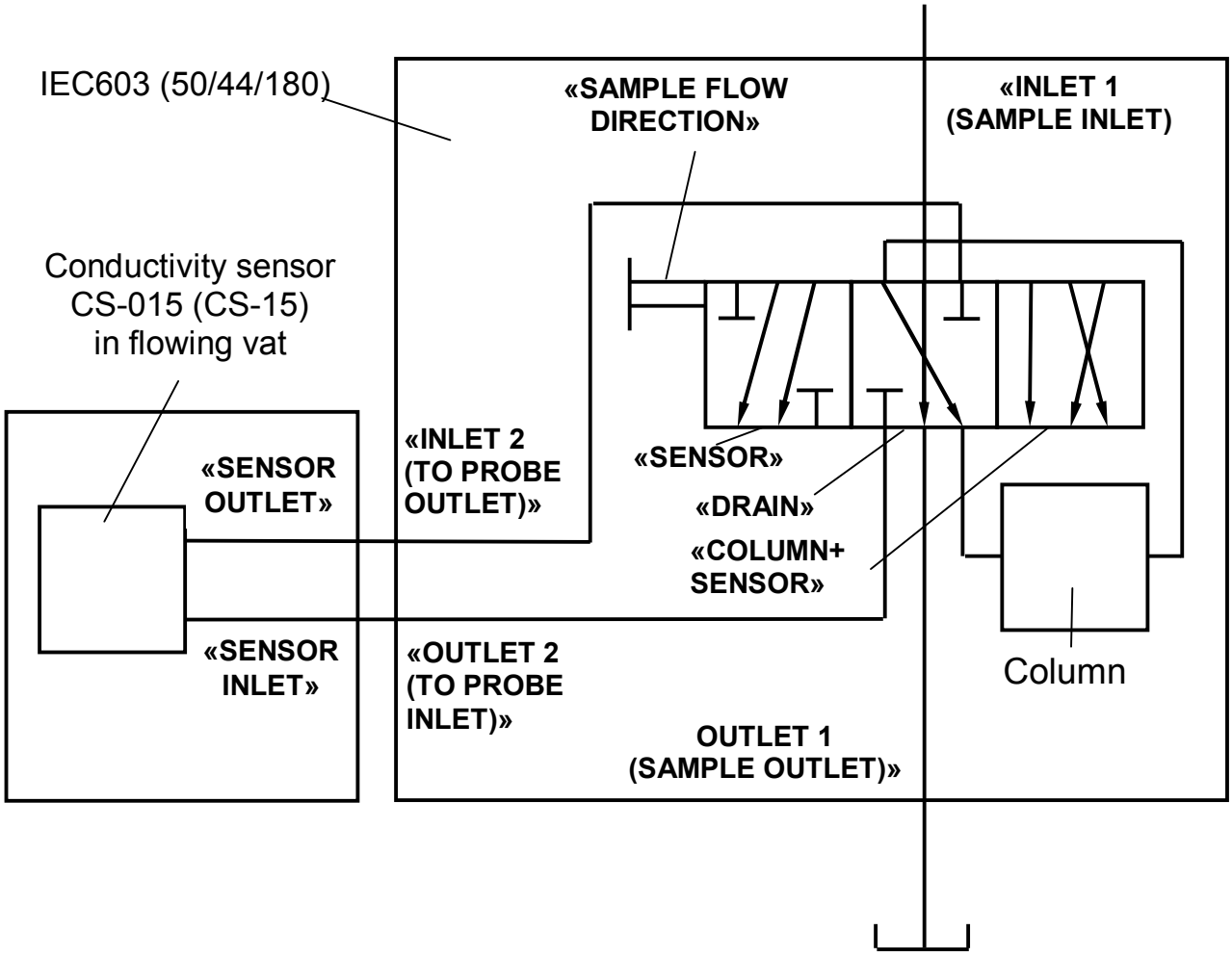


Figure 2.3

The ion-exchange column and the flowing vat are connected as shown in Figure 2.4.

2.4.3.2 Making ready for measurements

Before making measurements, the ion-exchange column, the flowing vat with the conductivity sensor and the conversion unit must be installed on a stand as shown in Figure 2.5.

Connect hoses to the connecting branches of the ion-exchange column and the flowing vat as in Figures 2.3 and 2.4.

Set the flow distributor to the **«DRAIN»** position.

Deliver the sample water from the sampler.

Set the flow distributor to the required position: **«SENSOR»** or **«COLUMN+SENSOR»**.

Check all the connections of the system for tightness.

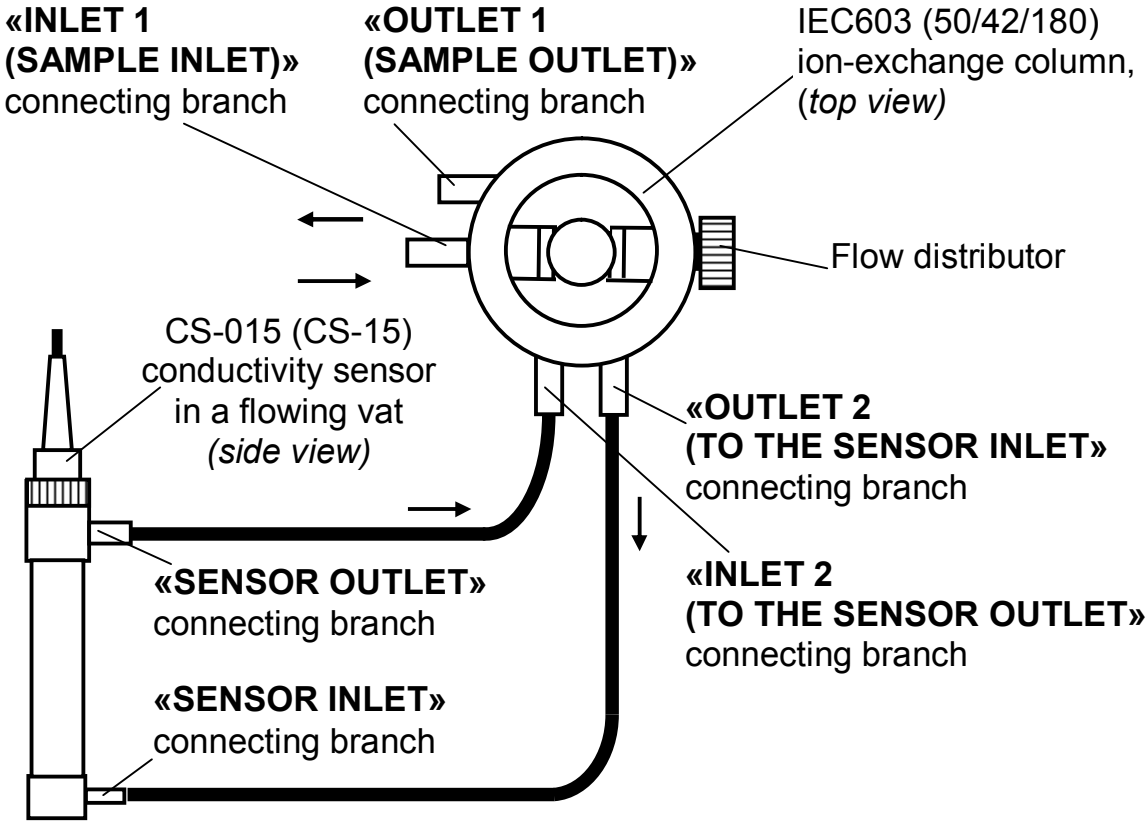
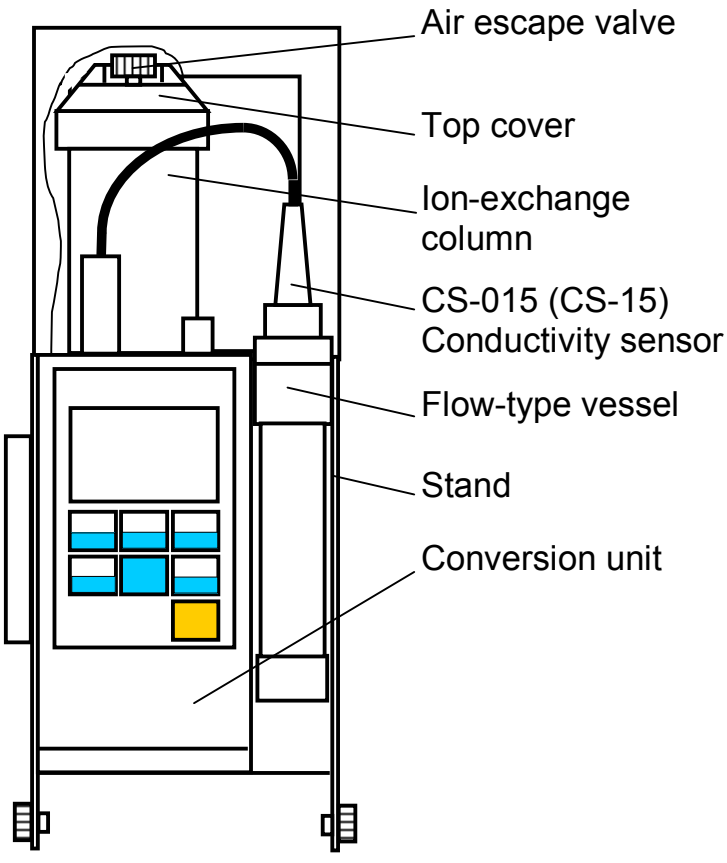


Figure 2.4



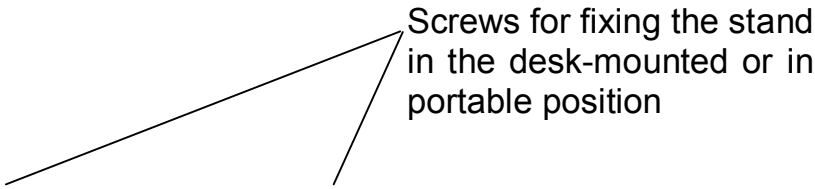


Figure 2.5

Set the water flow rate through the system within the limits from 100 to 1000 cm^3/min.

WARNING: When measuring solutions with SEC less than 5 µS/cm, the rate of analyte water should be more than 10 dm^3/h!

If the system is assembled properly, the ion-exchange column and the flowing vat must be fully filled with water. Insufficient concentration of air bubbles at the top part of the flowing vat is permissible.

In case of increased concentration of air bubbles, it is recommended to remove them from the vessel by a momentary shutoff of the flow (for 3-5 s) and slight knocking at the flowing vat body. When it is necessary to bleed the air from the ion-exchange column, use the air escape valve shown in Figure 2.5. Turn it off for a short time making 1-2 revolutions.

2.4.3.3 Making measurements

Measurements shall be made as written in Para. 2.4.1.2.

On completion of measurements proceed as follows:

- switch off the conductivity meter;
- put the flow distributor to the **«DRAIN»** position;
- disconnect the hose from the sample container and connect it with the draining hose by using a special adapting piece, included into the kit of tools and attachments. Availability of water in the column is necessary to keep the ion-exchange resin in water-wet condition.

2.5 Troubleshooting

Table 2.1 provides typical problems connected with the conductivity meter operation and their remedies.

In case of any problem mentioned in Table 2.1, proceed as recommended in the column «Remedy».

Table 2.1

Problem	Probable cause	Remedy
Conductivity meter fails to switch on or switches off at once.	Poor contact with the power supply source	Open the battery compartment and clean the contacts of the conversion unit and the galvanic cells or storage batteries
	Power supply voltage is lower than 2,2 V	Replace galvanic cells or charge the storage batteries
«SENSOR IS NOT CONNECTED» message appears on the screen	The conductivity sensor is not connected	Connect the conductivity sensor
	Poor contact in the connecting plug	Disconnect and connect again the conductivity sensor while the conductivity meter is switched off
	The sensor failed	Repair in the plant
«FAULTY SENSOR!» message appears on the screen	Failure in reading parameters from the sensor non-volatile memory	Switch off and then switch on again the conductivity meter
		Disconnect and connect again the conductivity sensor while the conductivity meter is switched off
	The sensor failed	Repair in the plant
«SYSTEM ERROR» message appears on the screen	Program malfunction	Switch off and then switch on again the conductivity meter
	The meter failed	Repair in the plant
The readings are unreal	The conductivity sensor was poorly washed.	Wash the conductivity sensor properly (see Para. 3.1 of this Service manual)
	The air escape hole of the sensor is located higher than the level of the sample solution.	Submerge the conductivity sensor into the sample solution down to the required depth

3 MAINTENANCE

3.1 Washing of conductivity sensors

3.1.1 When required, conductivity sensors should be washed with distilled water.

If the sensor electrodes are contaminated with oily deposits, it is advisable to use washing solutions that are harmless for the sensor body elements made of organic glass and also harmless for the metal electrodes.

It is recommended to use solution of ethyl alcohol with water in the proportion 1:2, or 4 % alkali liquor (NaOH).

3.1.2 Washing can be performed either by multiple submerging of the conductivity sensor into distilled water or washing solution, or by pumping distilled water or washing solution through the flowing vat with the conductivity sensor installed inside it. For better washing one can use a brush of a proper size.

3.1.3 If the CS-3 sensor is contaminated with mechanical impurities, in order to clean the sensor screw out the removable bushing (Figure 1.1), with the help of a brush clean and then wash with washing solution the internal surface of the removable bushing and the rack with electrodes. After the CS-3 sensor is cleaned, screw on the removable bushing home.

1 WARNING: NEVER use abrasive materials!

2 WARNING: NEVER use removal bushings taken from other CS-3 conductivity sensors!

3 WARNING: NEVER use, when serving the column, organic vehicles that may destroy PLEXIGLAS XT, the material of column!

3.2 Maintenance of the conversion unit

3.2.1 Clean the outside surface of the conversion unit using soft washing agents.

3.2.2 It is advisable not to disconnect the conductivity sensor from the conversion unit in the intervals between taking measurements.

3.2.3 The unused plug of external power supply must be covered with a protective cap.

3.2.4 In case of penetration of sample or washing solutions inside the connection plugs, wash these plugs with distilled water and dry them properly in the flow of warm air.

4 DELIVERY SET

4.1 The delivery set of the MARK-603 version conductivity meter consists of the components listed in Table 4.1.

Table 4.1

Description	Designation	Quantity
1. Conversion unit	BP41.01.000	1
2. CS-015 Conductivity sensor	BP41.02.000	1*
3. CS-15 Conductivity sensor	BP41.03.000	1*
4. Kit of tools and accessories	BP41.08.000	1**
5. Operation Manual	BP41.00.000OM	1

* To be supplied as per mutual agreement with the customer.

** The components of kit of tools and accessories – as per mutual agreement with the customer.

4.2 The delivery set of the MARK-603/1 version conductivity meter consists of the components listed in Table 4.2.

Table 4.2

Description	Designation	Quantity
1. Conversion unit	BP41.01.000	1
2. CS-3 Conductivity sensor	BP41.07.000	1
3. Kit of tools and attachments	BP41.09.000	1*
4. Operation manual	BP41.00.000OM	1

* The components of kit of tools and accessories – as per mutual agreement with the customer.