NPP «Automatica» JSC

SODIUM ANALYZER
SA-7101

INSTRUCTION MANUAL

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Introduction

Sodium Analyzer Industrial SA-7101 (hereinafter referred to as the analyzer) is designed for the continuous automatic measurement of (**pNa**) activity, ($\mathbf{C_{na}}$) mass concentration of sodium ions, (pH) activity of hydrogen ions and temperature in the chemically demineralized water and high-pressure boiler steam condensate and turbines, as well as for the monitoring the state of the H + - cation filters.

The measurement of the (pH) activity index of hydrogen ions of the analyzed liquid provides the effect determination of an alkalizing agent solution in the cell.

The manual contains the purpose, principle of operation, technical characteristics, presents data on the sequence of operation and monitoring of the technical condition.

Applications: nuclear power, thermal power as well as other branches of industry.

Depending on the sphere of application analyzers are subject to checking or calibration in accordance with the method described in *АВДП.414332.007.01МП*

Analyzers are manufactured in compliance with *ТУ 4215-096-10474265-2013*.

1 Purpose

1.1 The analyzer is designed for the continuous automatic transformation of the electromotive force (EMF) measured value, appearing at the terminals of the electrode system (hereinafter ES) placed into the test liquid, in pNa value characterizing the activity of sodium ions, followed by recalculation of the pNa value in mass concentration of sodium ions ($\mathbf{C_{na}}$).

1.2 The analyzers is composed of the electrode system (a set of sensors - primary transducers PP), temperature sensor, measuring transducer (MT), fixtures (tool kit for installation and mounting of the measuring transducer and electrode system in the measuring place).

1.3 Climatic execution as per GOST P 52931 B4.

1.4 The analyzer service conditions:

1. ambient air temperature: (5...50) °C;
2. ambient air relative humidity: up to 80 %;
3. atmospheric pressure: (84...106) kPa.

2 Technical data

2.1 **pNa** measuring range :

- with electrode NAB1502-004B (2,36… 8,36) pNa;
- with electrodes ЭС-10-07 и ЭЛИС-212Na/3 (2,36… 7,5) pNa.

2.2 $\mathbf{C_{Na}}$ measuring ranges:

- with electrode NAB1502-004B (0,1… 100 000) μg/dm^3;

- with electrodes ЭС-10-07 и ЭЛИС-212Na/3 (0,7… 100 000) μg/dm^3.

2.3 C_{Na} accuracy grade 0,01 μg/dm^3.

2.4 **pH** measuring range (0... 14) pH.

2.5 Temperature interval of test liquid (10... 50)ºC.

2.6 Nominal static characteristic (NSC) of resistance thermometers (RT) Pt (W_{100} = 1,3850).

Note - Type of NSC and RT resistance at 0 ° C (of R0), within the range of (50 ... 2000) Ohm, is set programmatically.

2.7 Liquid flow rate measuring range (with the sensor FCH-M) (0,9...48) л/ч.

2.8 The analyzer is designed for twenty-four-hour service. Available time after the power-up time is not more than 15 мин.

2.9 **Electrode system**:

- measuring ion-selective combined electrode NAB1502 (measuring ion-selective electrodes ЭЛИС-212Na, ЭС-10-07 can be used);
- combined pH electrode with built-in temperature sensor of ASP type.

2.10 **Analog output signal**

2.10.1 Quantity of analog outputs 2.

2.10.2 Output standardized direct-current signal (selected programmatically):

- (0… 5) mA on load resistance (0... 2) kOhm;
- (0... 20) mA on load resistance (0... 500) kOhm;
- (4... 20) mA on load resistance (0... 500) Ohm.

2.11 **Digital interface**

2.11.1 Fhysical layer RS-485.

2.11.2 Data link layer Modbus RTU Protocol.

2.11.3 Data rate from 1,2 to 115,2 kbaud.

Selecting the device address, date rate and other interface settings are set programmatically.

2.11.4 Frequency of updating registers "measurement result" (LAN) 5 Hz.

2.12 Indication

2.12.1 Indication of the measured parameters is accomplished of a graphical liquid-crystal display (display) in absolute terms.

2.12.2 LED single indicators:

- four red LEDs for light alarm display modes;
- one dual color LED for displaying interface communication.

2.12.3 Frequency of LED updating 2 Hz.

2.13 **Control**

2.13.1 Manual control is produced by four buttons and a liquid-crystal display with using menu.

2.13.2 Control from the upper level system is produced through the Modbus network.

2.14 **Current supply**

2.14.1 Supply voltage frequency of 50 Hz (187... 242) V.

2.14.2 Power consumption up to 10 VA.

2.15 **Structural specification**

2.15.1 Analyzer's version for dust and water protection according to GOST 14254 IP65.

2.15.2 Packed analyzers are resistant to vibration according to GOST P 52931 for group F3.

2.15.3 Dimensions (HxWxD) (190×192×104) mm.

2.16 **Reliability indicators**

2.16.1 Probability of no failure 0,9.

2.16.2 Average time between failures 20 000 h.

2.16.3 Average lifetime 10 years.

3 Specifications

3.1 The limit of the allowable value of the absolute error in **pNa** and **pH** measurement ± 0,05 pNa, ± 0,1 pH.

3.2 The limit of the allowable value of the absolute error in sodium ions concentration

$$\pm (0{,}1 + 0{,}1 \times A) \ \mu g/dm^3,$$

where A - analyzers reading.

3.3 The limit of the allowable value of the absolute error in temperature measurement of test liquid ± 0,3ºC.

3.4 The limit of the allowable value of the complementary error by the **pNa** measurement, caused by the variation in the temperature of the test liquid for every 25 ° C (ATK mode) regarding to 25 ° C in the temperature range (10 ... 50) ° C ± 0,05 pNa.

3.5 The limit of the allowable value of the complementary error by the **pNa** measurement, caused by the variation in the ambient temperature for every 10°C in the temperature range (5… 50)ºC, is max ± 0,05 pNa.

3.5.1 The transformation of the measured value of **pH**, **pNa**, $\mathbf{C_{Na}}$ or the temperature into the unified current output signal is performed by the formula:

$$I\,out = I_{min} + I_{range}\frac{pH_{meas} - pH_{min}}{pH_{max} - pH_{min}}$$

,

where pH_{meas} – **pH** measured value;

pH_{min}, pH_{max} – maximum and minimum pH value for recalculating the output current (set in the "Settings" menu, "Output signal");

I_{range} – output current range of 5 mA, 20 mA and 16 mA for ranges (0 ... 5) mA (0 ... 20) and mA (4 ... 20 mA), respectively;

I_{min} – minimum output current value of 0 mA, 4 mA and 0 mA for ranges (0 ... 5) mA (0 ... 20) and mA (4 ... 20 mA), respectively.

Note - For pNa, CNA and T [° C] values the formula is similar.

3.5.2 The limit of the allowable value of the basic error by the measured value transformation into an output current ± 0,3 %.

4 Completeness

4.1 The set of the analyzer delivery is illustrated in the table (Table 1).

Table 1 - Delivery set.

№	Specification	Qty.	Note
1	Sodium analyzer industrial SA-7101	1	
2	Manual instruction	1	
3	Communication interface. Application guide	1	
4	Product certificate	1	
5	Measuring ion-selective combined electrode pNa	1	optionally
6	Measuring ion-selective electrode pNa electrode combined with a temperature sensor	1	optionally
7	Combined pH electrode with a temperature sensor	1	
8	Hydraulic panels HP-7101	1	

4.2 Order code

SA-71 xx

01	- fixed analyzer
02	- portable analyzer

Example of the order processing

« SA-71**01** — fixed sodium analyzer».

5 Arrangement and principle of operation

5.1 **Arrangement of measuring transducer**

5.1.1 The measuring transducer is an electronic unit placed in the housing frame.

5.1.2 The electronic unit consists of two circuit boards: the board of display and the main board, connected to each other with a flat cable.

5.1.3 The main board contains: connectors for power supply and sensors, analog outputs and measuring part, galvanically isolated from the supply mains.

5.1.4 The board of display voltage power converter, elements of control indication and digital interface.

5.1.5 The front panel (Appendix B) has the following elements:

- graphic LCD display with LED backlight of the measurement value and the set parameters;
- power switch;
- two-color LED single indicator of the interface activity (RS);
- red LED single indicators for informing about the selected alarm settings (**1**, **2**, **3**, **4**);
- key **{** - left the menu, backout, cancel;
- key **я** - up the menu, right on the figures positions;
- key **ч** - down the menu, figures increase;
- key **}** - right the menu, selection and left the menu with the fixation.

5.1.6 The analyzer is a microcontroller device. One microcontroller processes the signal from the sensor, providing analog-to-digital conversion. The second microcontroller provides a keyboard and display control and data exchange over a local network.

5.1.7 In the case of the interface presence the reading the measurement results and device control through the Modbus network is possible. The instrument panel has a priority in the device control.

5.1.8 For prevention of unauthorized adjustment and interference, that may cause a distortion of the measurement results, the cover of body of the analyzer may be sealed. The user has two options for sealing (Appendix E).

5.2 **O**perating principle

The operating principle of the analyzer is based on the ion-selective potentiometric method of measuring the sodium ions activity.

When the pNa calculating the action of temperature on the pNa electrode sensitivity is considered.

Generally pNa of the analyzed environment is calculated by the formula:

$$E = E_o - R \cdot T/F \cdot \ln(a^{Na+}) = E_o + 2{,}3 \cdot R \cdot T/F \cdot pNa, \qquad (1)$$

where E – EMF of the electrodes system, mV;

E_o – the potential difference comprising the potential between a measuring and subsidiary electrodes, diffusion potential of a liquid junction, asymmetry and other potential under standard conditions;

$pNa = - \lg(a^{Na+})$ – index of sodium ion activity;

a^{Na+} – sodium ions activity;

R – universal gas constant;
T – temperature, °K;
F – Faraday constant.

When the measuring the index of sodium ions (pNa) activity an electrode system is used, which is composed of a measuring sodium-selective glass electrode and a reference electrode (subsidiary electrode). As a subsidiary electrode an auxiliary electrode of the combined pH electrode may be used.

According to the Nernst equation EMF of the electrodes system takes the form:

$$E = E_i + S_т (pNa – pNa_i), \quad (2)$$

where

E – EMF of the electrodes system, mV;
E_i – coordinate of the isopotential point, mV;
pNa_i – coordinate of the isopotential point of the measuring electrode;
pNa – index of sodium ions activity of the measured solution.
$S_т$ – theoretical value of the slope of the electrode characteristics calculated by the formula (3), mV/pNa.

$$S_т = - (54,196 + 0,1984 • t), \quad (3)$$

where

t – solution temperature of the analyzed environment, °C.

When analyzer operating the slope of the electrode feature gradually decreases by the expiration of service life of a measuring electrode. Therefore, the slope index is used in the analyzer (slope in%):

$$K_s = S_r / S_т, \quad (4)$$

where

$S_т$ – theoretical slope value of the electrode feature calculated by the formula (3) for the temperature of calibration solutions, mV/pX;
S_r – real slope value, calculated as a result of the calibration.

To eliminate the effects of hydrogen ions by the measuring of the sodium ions **pNa** ($\mathbf{C_{Na}}$) it is necessary to provide a **pH** value exceeding in comparison with **pNa**, not less than three units in the analyzed solution.

This condition provides the ammoniation of the analyzed solution with ammonical or diethylamine steam. Concentrated (not less than 25%) ammonia solution is used by the measurement of sodium concentration to 0.23 μg/dm3. If the sodium ion concentration is low, 50% diethylamine solution in water is used. The sample solution flows into the hydropanels, saturated with reagent steam and passed through the measuring cell of the hydropanels, where measuring glass electrode and a reference silver chloride electrode are placed.

The analyzer provides a conversion activity index in the units of the sodium ion mass concentration (μg/dm3).

The defendency between the index value of the sodium ions activity and their concentration is determined by the formula:

$$C_{Na} = 10^{(1,36-pNa)}, \quad (5)$$

where C_{Na} – sodium ion concentration, g / dm3;
pNa – index of sodium ion activity.

6 Directions related to safety measures

6.1 According to the method of protection against the electrical shock the analyzer belongs to the class OI according to GOST 12.2.007.0.

6.2 Only persons familiar with general safety regulations for operation of the electrical equipment having voltage of up to 1000 V are allowed to install and maintain the analyzer.

6.3 The analyzer frame must be grounded.

6.4 The installation and removal of the analyzer, connection and disconnection of the external circuits must be performed with a disconnected supply voltage. Connection must be made in accordance with the marking with supply voltage de-energized.

7 Preparation for operation and working sequence

7.1 Outer inspection

After unpacking it is necessary to check the following conformities:
- the analyzer must be completed in conformity with the certificate;
- serial number must correspond to that specified in the certificate;
- the analyzer must be free of mechanical damages.

7.2 Sequence of installation

7.2.1 Power connection of the electrodes system

Power connection of ES is accomplished according to external connection diagram (Annex C). Before starting the measurement it is necessary to open the hole of electrolyte filling of pNa electrode NAB1502, sliding a sealing gum up.

7.2.2 Installation of the measuring transducer (MT) of the analyzer

The MT is to install on the panel.

Ground the MT, connect the power and warm up the analyzer for 15 minutes.

7.3 Preparation of the measuring transducer

7.3.1 The analyzer is supplied set up according to the order. The factory settings are specified on the analyzer label and in the certificate.

7.3.2 Calibration of the standard solutions

Annex D contains a calibration procedure. Calibration of two buffer solutions (two-point) is required for initial and periodic (once a month during a continuous pNa (CNA) and pH measurement of the analyzed liquid) analyzer calibration during operation, and after replacing the used ES on a new one.

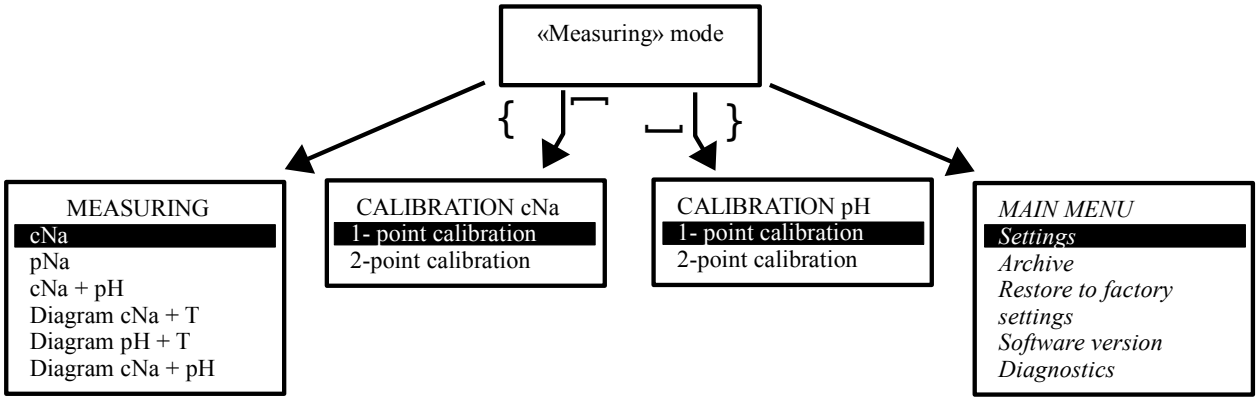
7.3.2.1 pNa ES calibration is performed by the control solutions of 100 mg / dm 3 to 1000 mg / dm3.

7.3.2.2 pH ES calibration is carried by the buffer solutions 6.86 pH and 9.18 pH by a temperature solution 25 ° C.

8 **Operating mode**

8.1 After energizing the analyzer starts functioning automatically in «**Measuring"** mode in accordance with pre-programmed parameter.

8.2 **«Measuring" mode**

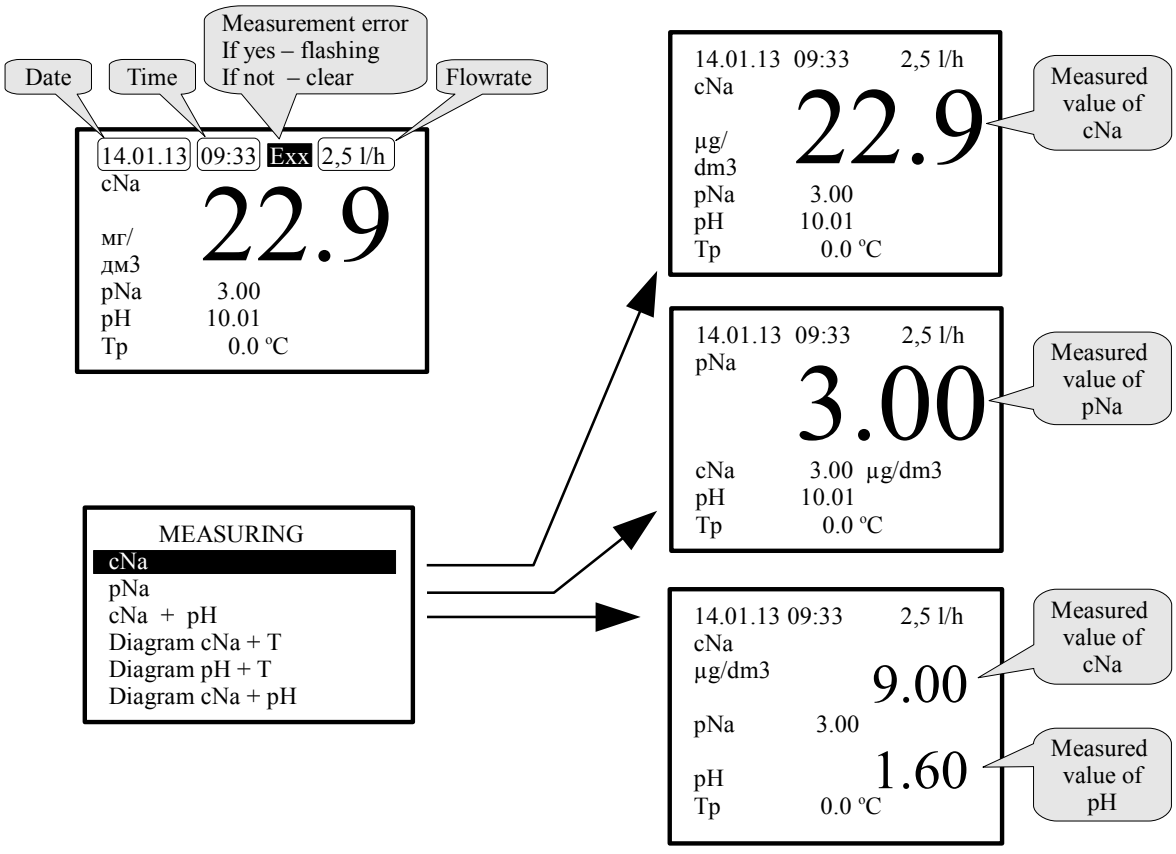


8.2.1 Assigning of the "Measuring" mode keys:

- **{** - enter key to the display type selection in the "Measuring" mode ;
- **я** - enter key to the calibration menu pH channel input №1;
- **ч** - enter key to the calibration menu pH channel input №2;
- **}** - enter key to the "MAIN MENU".

8.2.2 Selecting the data submission type in the "Measuring" mode

8.2.2.1 cNa , pNa и cNa + pH - digital display of the measured data (see figure):

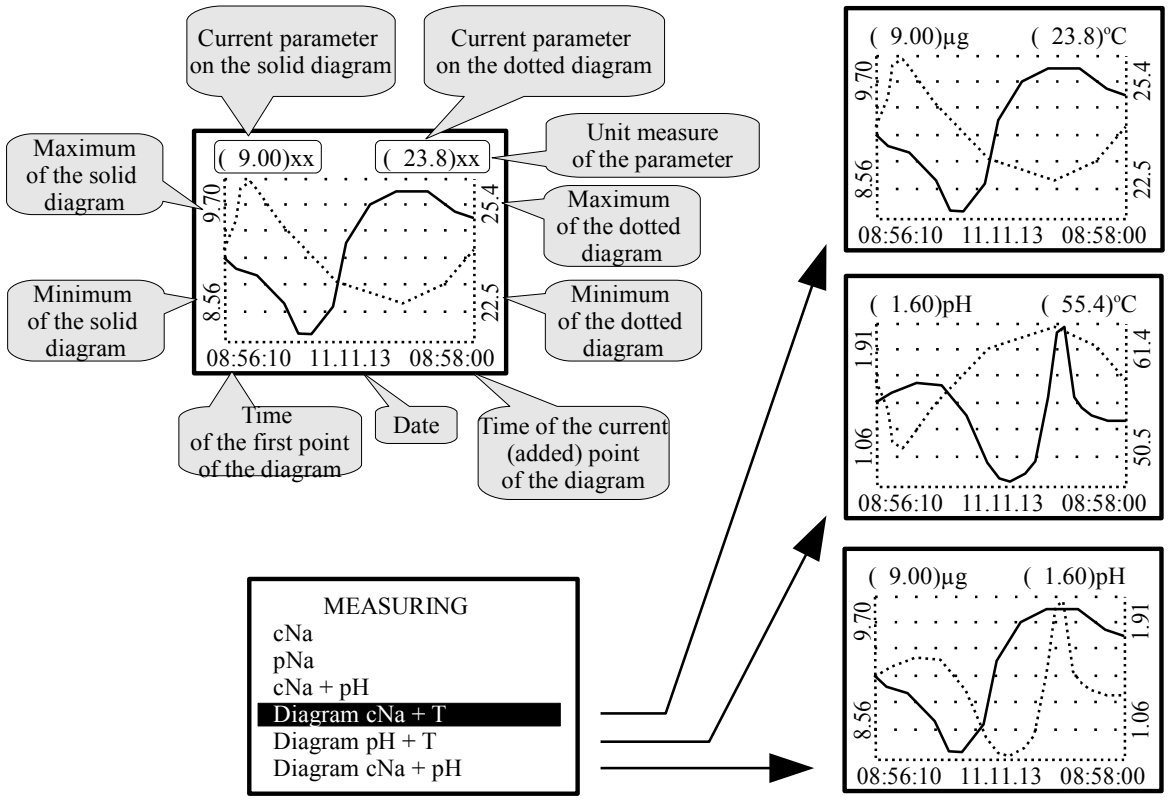


The measurement error in these modes is displayed as "Exx", where "xx" is the hexadecimal error code. This code includes bit-coded error codes, a list of which can be viewed in the "Diagnostics" menu (sec. 8.3.7).

Decoding XX (bits 0 1 2 3 4 5 6 7):

Bit number	The hexadecimal code	Error description
0	0x01	Select error with БВД-8
1	0x02	Internal error №1
2	0x04	Internal error №2
3	0x08	Temperature sensor failure

8.2.2.2 **Diagram cNa + T** , **Diagram pH + T** и **Diagram cNa + pH** - measured data display in the diagram form (see figure below):



8.3 MAIN MENU

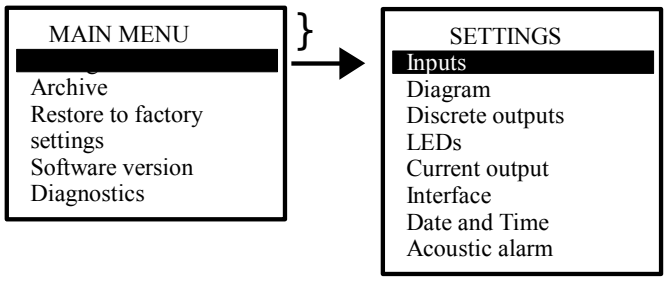
8.3.1 To access the main menu screen, press the } function key (see par.8.2).

8.3.2 Procedure of value input

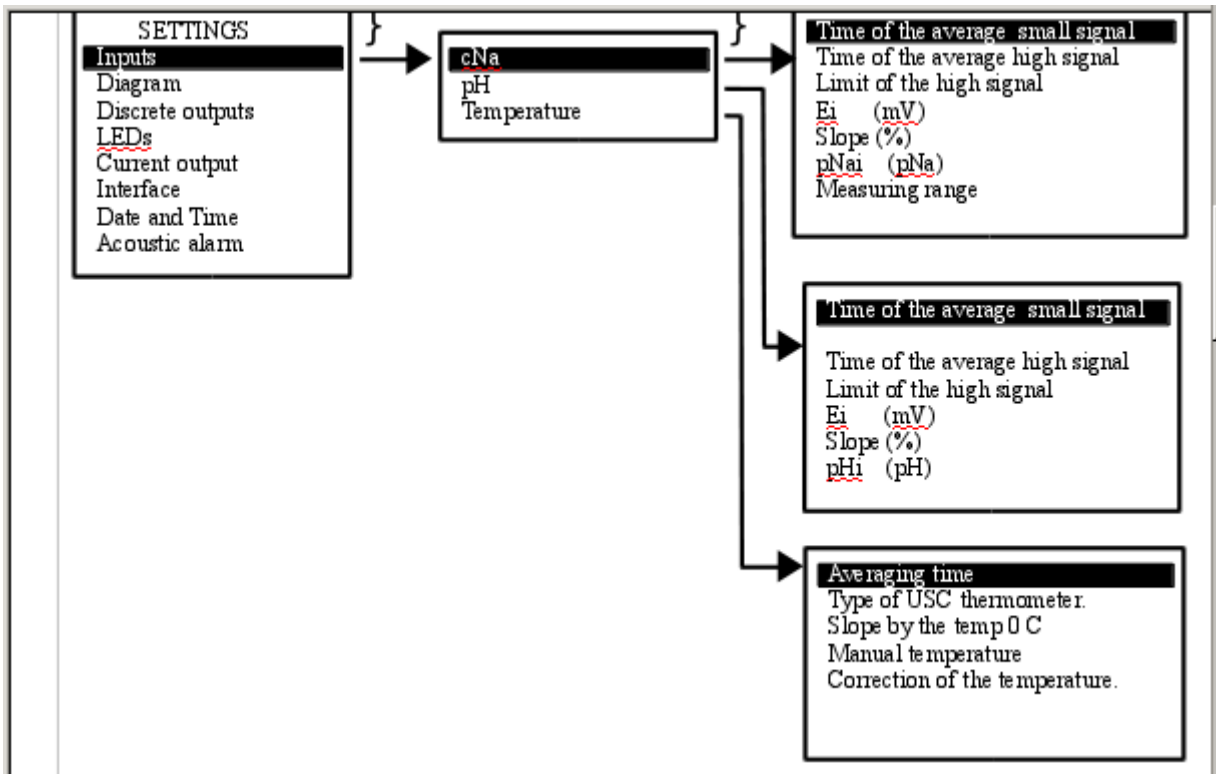
The analyzer data value input is performed bit to bit. Decimal digit selection, value of which should be changed, is performed by **я -** key. Correcting digit is displayed in the flashing mode.

To change the value of the selected digit, press the **ч** key, while the value of each digit (except the higher digit) will change cyclically in order of 0, 1, ..., 9, 0, and so on. When changing the most significant bit value changes cyclically in order 0, 1, ..., 9, -9, -8, ..., -1, 0, 1, and so on (if it is allowed for this parameter)

8.3.3 Submenu **SETTING**



8.3.3.1 **Inputs**



In this mode, the parameters of cNa, pH and temperature measurement are set.

Entry → cNa – cNa measurement parameters are reviewed and adjusted.

- Time of the average small signal and Time of the average high signal - reading and adjusting the average time for small and high signals, in seconds;
- Limit of the high signal – reading and adjusting of the threshold limit from a small signal filtering to a high, in mg;
- Ei (mV) — reading and adjusting of the pNa-electrode Ei parameter, in mV;
- Slope — reading and adjusting of the pNa-electrode S parameter, in %;
- pNai (pNa) — reading and adjusting of the pNa-electrode pNa_i parameter, in pNa terms.
- **Measuring range** — selection the indication measuring range.

Note - The measuring range determines the position of the decimal point and terms of measurement to be indicated on the display. Please note that by the configuring the current outputs, the same position of the value point and terms will be saved.

Inputs → pH –Entry → pH – pH measurement parameters are reviewed and adjusted.

- Time of the average small signal and Time of the average high signal - reading and adjusting the average time for small and high signals, in seconds;
- Limit of the high signal – reading and adjusting of the threshold limit from a small signal filtering to a high, in pNa;
- Ei (mV) — reading and adjusting of the pH-electrode Ei parameter, in mV;
- Slope — reading and adjusting of the pH-electrode S parameter, in %reading and adjusting of the pH-electrode S parameter, in %.
- pHi (pH) — reading and adjusting of the pH-electrode pH_i parameter, in pH terms.

Inputs → Temperature — temperature measurement parameters are reviewed and adjusted.

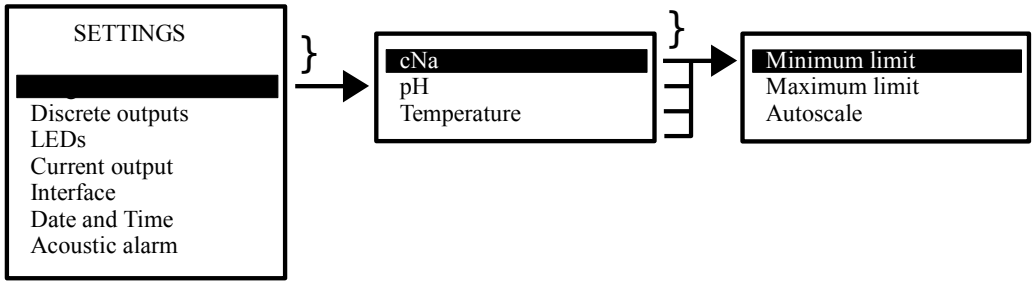
- Averaging time — reading and adjusting of the average time, in seconds.
- Type of USC thermometer — USC type selection of the used temperature sensor.
- Slope at 0°C — selection of the temperature sensor resistance at zero degrees Celsius.
- Manual temperature — temperature setting when there is no temperature sensor.
- Correction of temperature — temperature correction with two-wire connection of the temperature sensor, in degrees.

Note

1 manual setpoint temperature value is used automatically by a breakout or short circuit of a temperature sensor.

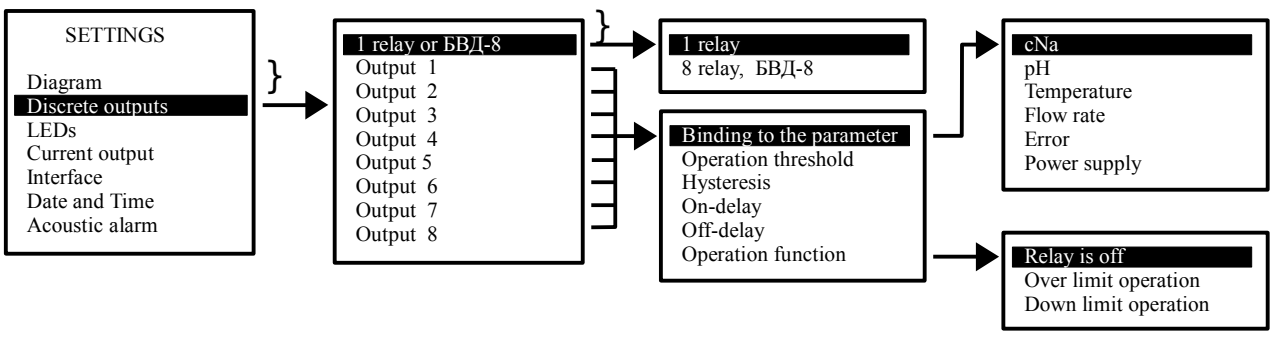
2 as a temperature sensor a built into the pH electrode temperature sensor is used, which is connected to the second input temperature Rt2.

8.3.3.2 Diagram



In this mode, scaling parameters for each of the measured parameters are selected: cNA, pH and temperature. For each parameter the minimum and maximum limits for the trend displaying can be selected. Either the auto scaling mode can be selected.

8.3.3.3 **Discrete outputs**



In this mode, eight relay outputs, which are located in the external output digital signals unit БВД -8 are programmable: operation threshold, hysteresis, delay on and off, operation function and binding to the parameter.

Note

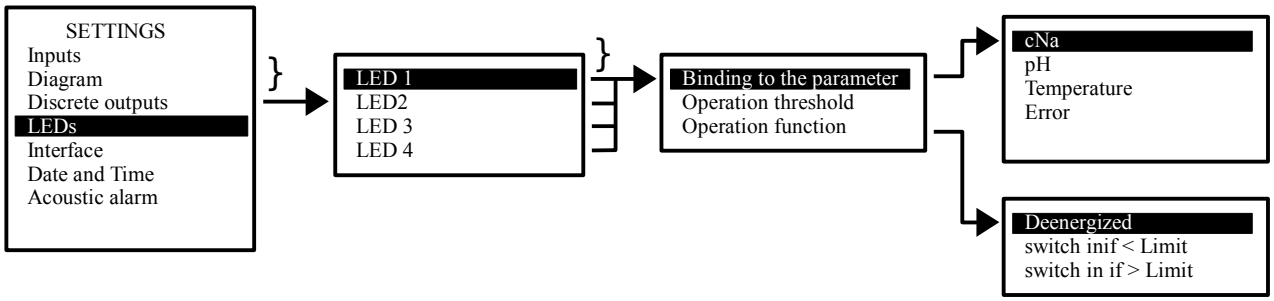
1 Each output can be configured for an error signaling (diagnostics). Select the mode: Binding to the parameter, Error (paragraph 8.3.7.).

2 Each output can be configured for a power supply absence signaling, supplied to the pH-meter. Select the mode: Binding to the parameter, power supply.

3 When de-energized, the output is operating in a single digital output mode, and for a changing only the settings of the first output are available.

To work with ***БВД-8*** unit entry the menu "Digital outputs" Relay 1 relay or БВД-8.

8.3.3.4 LEDs

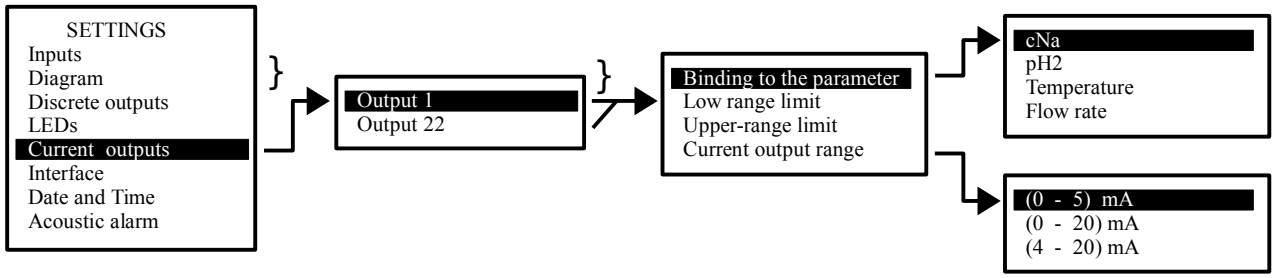


In this mode, for each of the four LEDs on the analyzer front panel, operation threshold, operation function and binding to the parameter are set.

Note

Each LED can be set on the alarm error (diagnostics). Select the mode: Binding to the parameter, Measuring error (paragraph 8.3.7.). In this case the LED is flashing .

8.3.3.5 Current outputs



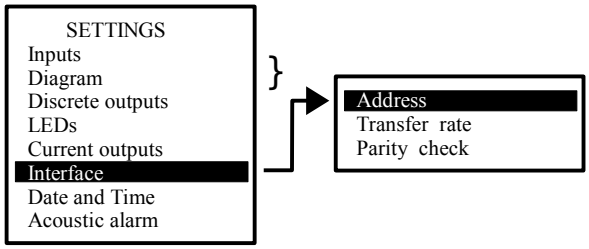
In this mode, the parameters of two current outputs are set.

Current outputs → Output 1 - configuration of the first current output parameters:

- Binding to the parameter - in this mode select one of the four measured parameters, translated by the output current signal (see figure);
- Low range limit - the lower limit value of the selected parameter is set.
- Upper-range limit - the upper limit value of the selected parameter is set.
- Current output range - one of the options of the current range is selected: (0 ... 5) mA (0 ... 20) mA or (4 ... 20 mA).

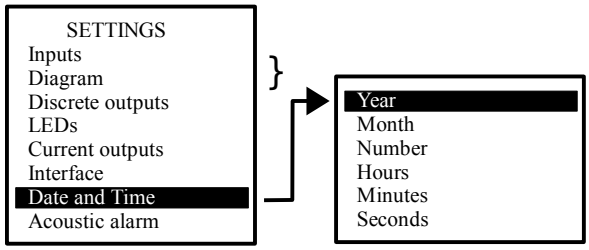
Current outputs → Output 2 - configuration of the second current output parameters. The parameters of the second current output are configured similarly to the setting the parameters of the first current output.

8.3.3.6 **Interface**



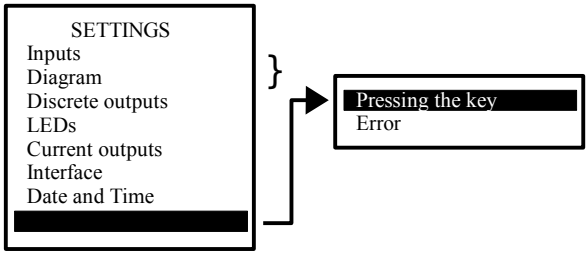
In this mode the interface parameters are set: the network address, transfer rate and parity check.

8.3.3.7 Date and Time



In this mode the current year, month, day, hour and minutes for the integrated real-time clock are set.

8.3.3.8 **Acoustic alarm**



In this mode the acoustic alarm is set.

- Pressing the key - when entering this mode by pressing the key on the front pH meter panel beeps are heard.
- Error - when entering this mode the acoustic alarm is activated if a diagnosed error takes place.

8.3.4 **Submenu ARCHIVE**

This mode is for viewing and configuring the archive view (see Figure 1).

- View archive - this mode is for reading the archive. } Right button is to switch the marker mode: keys **Я** and **Ч** change the discrete-time interval or transfers the marker indicating the reading time and the values of the measured parameters at this time (see Figure 2).
- Trend line N1 - in this mode the parameter displayed by the solid line is selected.
- Trend line N2 - in this mode the parameter displayed by the broken line is selected.
- Zooming - in this mode the minimum and maximum limits for the trend display for each measured parameter are set. When selecting the Auto zoom mode the minimum and maximum limits are determined automatically.

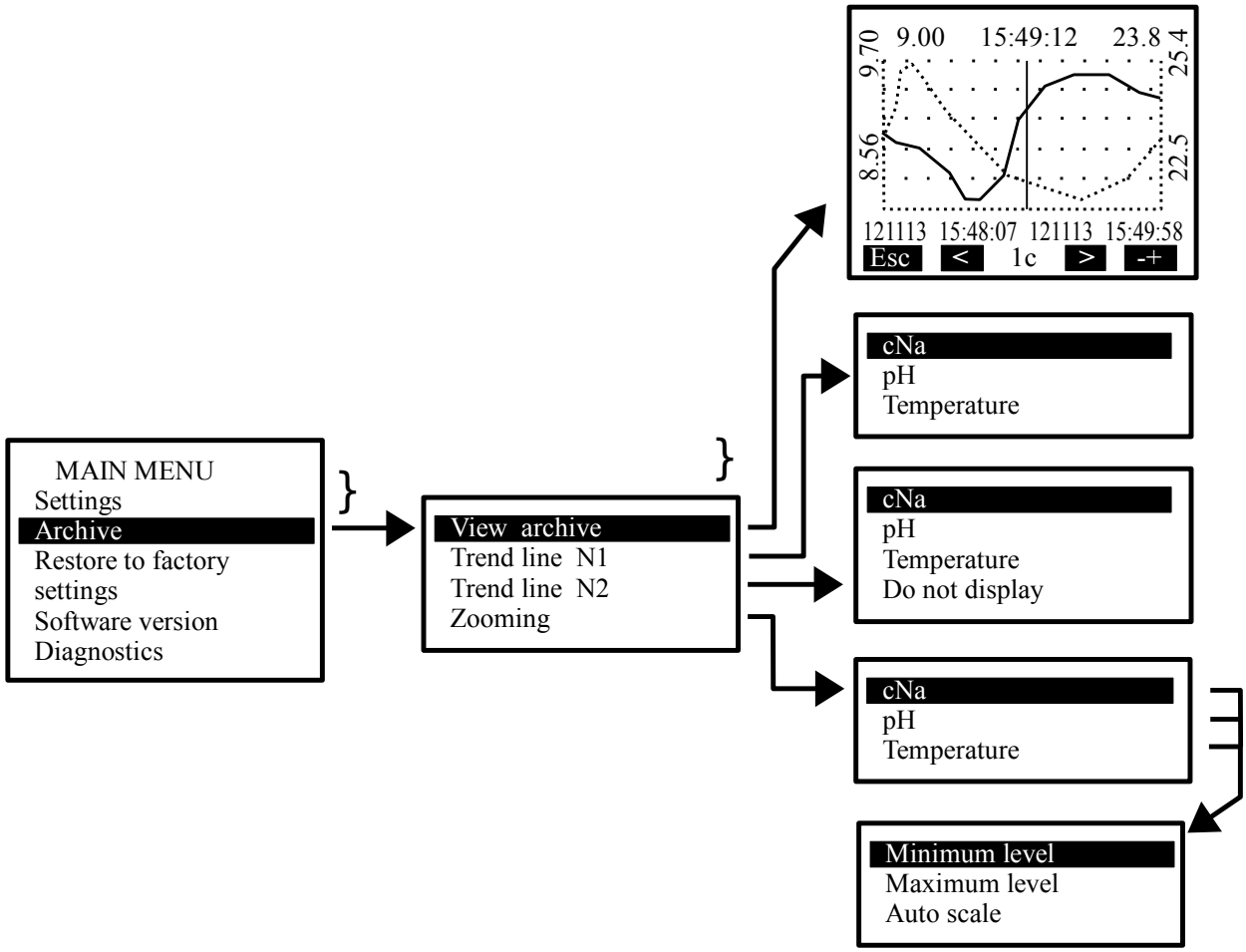
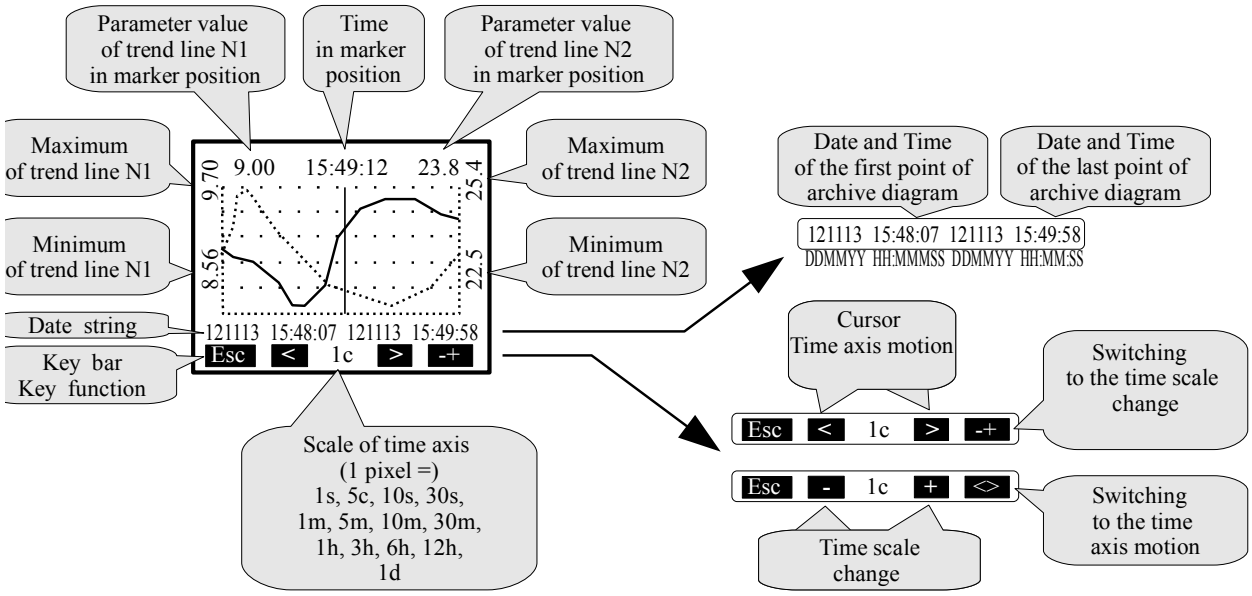


Fig.1 - The structure of the submenu "Archive"

Fig. 2 - Description of the control elements and data display in the submenu "View archive "

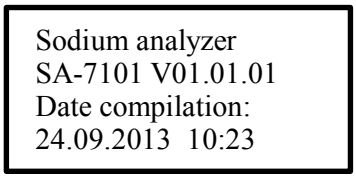


8.3.5 **RESTORE TO FACTORY SETTINGS**

This mode is for the recovering the analyzers settings, set up on the manufacturing factory.

8.3.6 **SOFTWARE VERSION**

This mode is for reading the «Na» software version, set up in the analyzer:



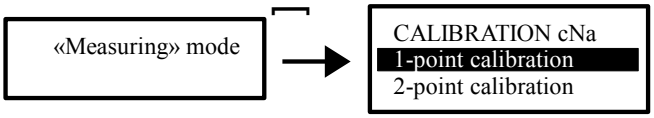
8.3.7 **DIAGNOSTICS**. This mode is for reading the errors diagnosed by the analyzer:

- no connection with БВД8;
- internal error 1;
- internal error 2;
- defective temperature sensor

If no error occurred, a message is displayed: No errors detected.

8.3.8 **C_{Na} calibration**

When pressing the **я**-key analyzer transfers from the mode "Measuring" into ES calibration mode, connected to the first channel of the analyzer. pNa-electrode will be connected to the first channel. Calibration is performed through the buffer solutions with known sodium ions C_{Na} mass concentration.



One-point (one buffer solution) or a two-point (two buffer solutions) calibration will be selected. By the one-point calibration a new Ei value is determined, the S parameter remains the same. By the two-point calibration new parameters of Ei and S values are determined.

After the selecting the type calibration and pressing **}** - key display highlights the parameters of the previous measurements of the first buffer (buffer): temperature, buffer concentration value, EDS.

At the bottom display appear four fields that specify the functionality of the corresponding (located below) buttons on the front panel of the analyzer.

When pressing the second button (Measuring) display highlights the temperature and EMF parameters, measuring at this time on the solution Buffer 1. By using a different buffer value, press the button Buffer and choose a buffer from the list, or take the buffer User, which allows to enter its value manually. Save the new buffer value pressing **}** - key.

After the setting the stable not changing values for saving the measurement results, press Safe. For the further calibration press >> key.

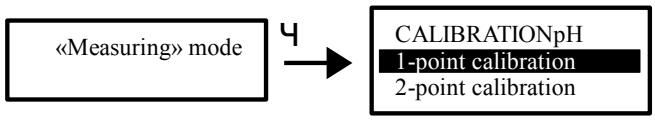
By the one-point calibration display highlights the Ei calibration result. If a value is beyond the defined limits, display highlights the warning: **The calibration result is incorrect!!!** You can save the result of the calibration by pressing Save? - key or to abandon the calibration results by pressing >> - key, and return to the calibration beginning.

By the two-point calibration after the saving the measurement results of the first buffer by pressing >> -key the analyzer operates with solution Buffer 2. Calibration of the second buffer solution is similar to the first buffer solution.

After calibration of the second buffer solution and pressing the button >> the display shows the Ei and S calibration results. If the value of these parameters go beyond the set limits, the display will hihglight a warning: **The calibration result is incorrect!!!** You can save the result of the calibration by pressing Save? or to abandon the calibration results by pressing the >> key, and return to the calibration beginning.

8.3.1 **PH calibration**

When pressing **ч** -key analyzer goes into ES calibration mode, connected to the second analyzer channel. pH electrode is connected to the second channel. Calibration is performed by pH buffer solutions.



Select one-point (one buffer solution) or a two-point (two buffer solutions) calibration. By the one-point calibration a new Ei value is determined, while the S parameter remains the same. In the two-point calibration new parameters of Ei and S values are determined.

After selecting the type of calibration and pressing **}**-key, parameters of the previous measurements of the first buffer solution (Buffer): temperature, pH buffer value and EMF appear on the display.

At the bottom display four fields are indicated, that specify the functionality of the corresponding (located below) buttons on the front panel of the analyzer.

When pressing the second button (**Measuring**) display highlights the temperature and EMF parameters, measured at this moment by solution **Buffer 1**.

At the top right display highlights the mode of buffer determination (or task mode): Automatic or Manual. In the first case the buffer value is determined by the analyzer automatically: from the run 1.65 pH 4.01 pH 6.86 pH 9.18 pH 12.43 pH, in the second case - is set manually. To select a task mode of the buffer press **Buffer** –key and choose accordingly **Auto** or **Manual task**.

After the setting the stable not changing values for saving the measurement results, press **Save**. For the further calibration press >> key.

By the one-point calibration display highlights the **Ei calibration result**. If a value is beyond the defined limits, display highlights the warning: **The calibration result is incorrect!!!** You can save the result of the calibration by pressing Save? -key or abandon the calibration results by pressing >> - key, and return to the calibration beginning.

By the two-point calibration after saving the first buffer measurement results by pressing >> - key analyzer operates with solution **Buffer 2**. Calibration of the second buffer solution is similar to the first buffer solution.

After the calibration of the second buffer solution and pressing the button >> display highlights the Ei and **S calibration results**. If the value of these parameters go beyond the set limits, display will highlight a warning: **The calibration result is**

incorrect!!! You can save the result of the calibration by pressing **Save.?** or abandon the calibration results by pressing >> - key, and return to the calibration beginning.

8.4 To entry the "Measuring" mode, press the **{** -key.

9 Eventual failures and remedies

When a failure diagnosis, display highlights a flashing failure code in the measuring mode at the top line on the screen analyzer, ex.gr. **E10**. To determine a kind of the failure, enter the MAIN MENU (**}** key) and select the mode DIAGNOSTICS.

Failures	Probable cause	Remedy
No connection with БВД8	No connection with БВД-8.2	Check the correctness of БВД-8.2 (if БВД-8.2 is not used, disconnect it in the Main Menu - Digital outputs - БВД8)
Internal error 1	Failure of the analog input 1	Send the analyzer to repairs
Internal error 2	Failure of the analog input 2	
Failure of the temperature sensor	Closing or breakout of the temperature sensor	Check the operability and correctness of the temperature sensors connection (second channel)

10 Maintenance operation

10.1 Maintenance operation includes the periodic cleaning the electrodes and the measuring cell from the analyzer contamination and calibration in the control solution. Purification of the cell is to provide with 1% HCl solution, previously removing the electrodes from the cell.

The Combined pNa-electrode must be regularly (at least once per a month) filled up with 0.1 M NH4Cl solution.

10.2 It is necessary to replace the reagent solution in a tank for alkalizing every two-four weeks or by the lower pH (below the acceptable level) in the cell.

10.3 To replace the filter element of the soiled filter of the Hydropanels with a new (synthetic wool ball).

10.4 Soaking, storage and cleaning of PX-electrode.

Handle the glass PX-sensitive membrane with care and protect it from a damage.

An essential prerequisite for the smooth functioning of the glass electrode PX is the presence of the soaked layer on the surface of the glass membrane. If the electrode is stored for a long time in a dry form, it must be properly prepared for the measurement. Immerse the sensitive part of the pH- electrode in a 3 mol / l KCl solution and the sensitive part of pNa electrode in 0.1 M NaCl solution and soak for one day. It is recommended by the storage of the electrode to put on a glass membrane a complete cap prefilled with 3 mol / l KCl solution for pH electrode and 0.1M NaCl solution for pNa-electrode.

Remove the contamination settled on the surface of the glass membrane. If a gentle rubbing with a soft and moist filter paper or paper towel is unsuccessful, then use

depending on the type of the contaminants different chemical methods (mild detergent for cleaning glass, laboratory detergents, acetone, alcohol, not concentrated acid solutions, such as 10% hydrochloric acid). Do not use any abrasive cleaners when cleaning the membrane.

11 **Marking, packaging, transportation and storage**

11.1 On the front panel of the analyzer bears the following information:
- company – manufacturer (or a trade mark);
- identification mark;
- marking of the single indicators and control keys

11.2 The frame of the analyzer is provided with the following information:
- company - manufacturer;
- model of the analyzer;
- measuring range;
- range of the output signal variation (factory setting);
- serial number and year of production;

11.3 The analyzer frame cover can be sealed. The user is offered with two options for sealing (Appendix E) to prevent unauthorized adjustment or interference that may distort the measurement results.

11.4 The analyzer and documentation are enclosed into a package made of the polyethylene film and are placed into carton boxes.

11.5 Analyzers are transported by all types of closed transport including air transport, in heated air-tight cargo pits in compliance with rules for the freight carriage currently in force for this type of transport.

Analyzers are transported in wooden cases or carton boxes. Transportation of analyzers in containers is allowed.

The pattern of placement of analyzers into boxes must exclude their movement during transportation.

During handling operations and transportation boxes must not be subject to sharp impacts and effects of atmospheric precipitations.

Residence time for analyzers under appropriate conditions of transportation is max. 6 months.

11.6 Analyzers must be stored in heated rooms having the temperature of (5...40) ºC and relative humidity not exceeding 80 %.

Air of the store rooms must be free of dust and impurities of aggressive vapors and gases causing corrosion of the analyzer components.

Storage of analyzers in packages must meet terms 2 as per GOST 15150.

12 **Manufacturer warranties**

12.1 The manufacturer warrants the conformity of the analyzer to the requirements of specifications provided service, transportation and storage conditions set forth in the present operation manual are observed by the customer.

12.2 The guarantee service life is 18 months from the date of commissioning, however, not more than 24 months from the date of shipment to the consumer.

12.3 Should the customer detect defects, provided operating, storage and transportation regulations are observed by the consumer within the warranty period, the company – manufacturer shall repair or replace the analyzer free of charge.

13 **Information on claims**

При отказе в работе или неисправности анализатора по вине изготовителя неисправный анализатор с указанием признаков неисправностей и соответствующим актом направляется в адрес предприятия-изготовителя:

In case of failure or malfunction of the analyzer through the fault of the manufacturer a faulty analyzer accompanied by the specification of features of defects and the relevant certificate is sent to the company –manufacturer:

600016, Vladimir, B. Nizhegorodskaya str., 77,
“NPP “ Automatica” JSC,
tel.: +7(4922) 27-62-90, fax: +7(4922) 21-57-42.
e-mail: market@avtomatica.ru
http://www.avtomatica.ru

All claims submitted are registered

Annex 1
Overal and fixing dimensions

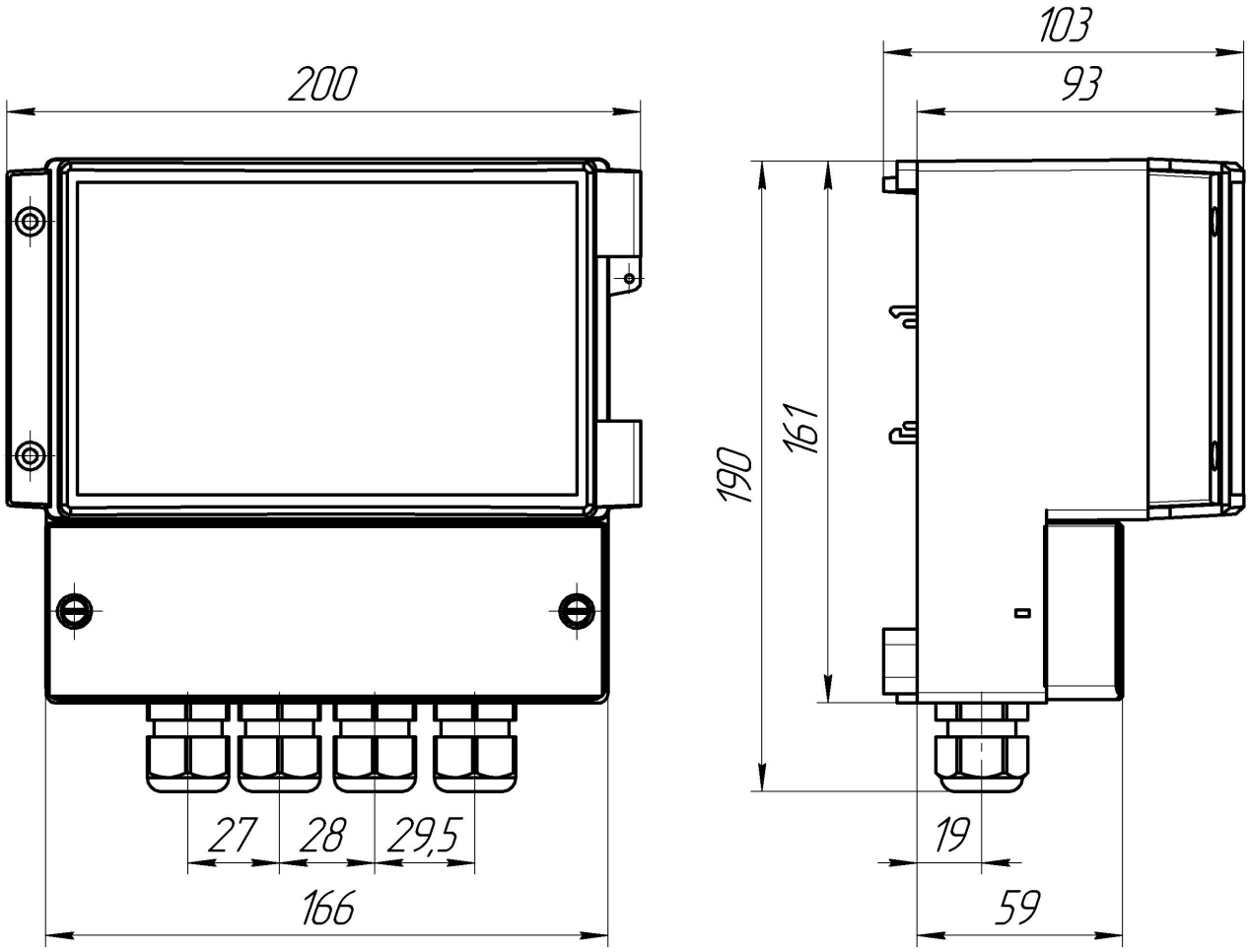
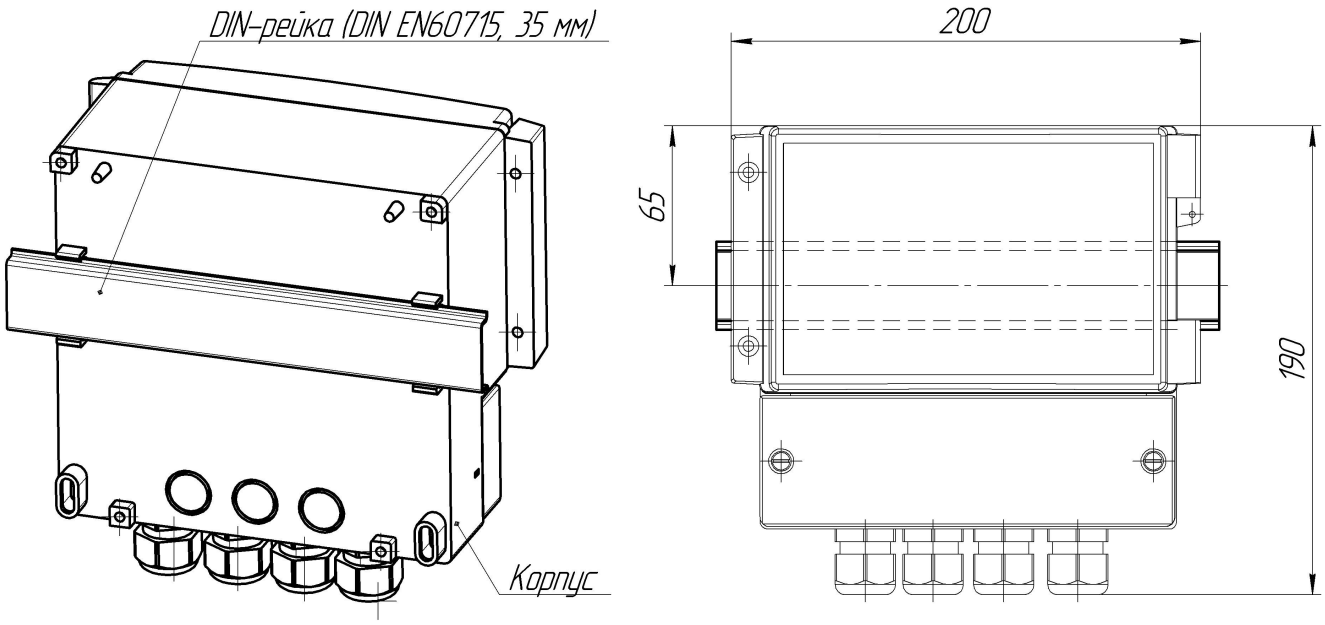


Figure A.1 Housing dimensions

End of the Annex 1



DIN-рейка — DIN-rail
корпус — frame housing

Figure A.2 Fixing of the wall-mounted measuring device using a DIN-rail

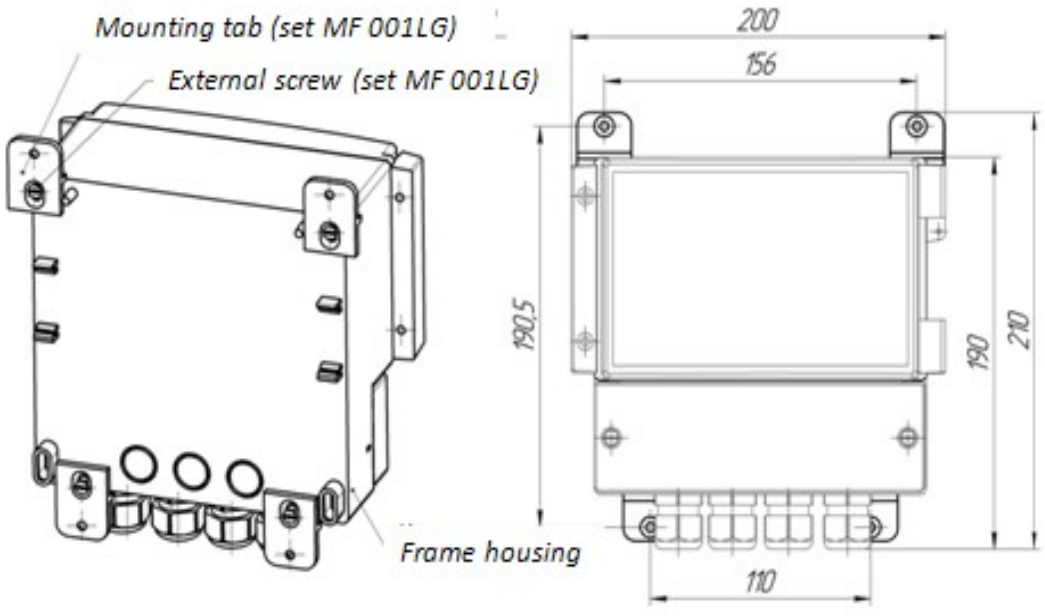
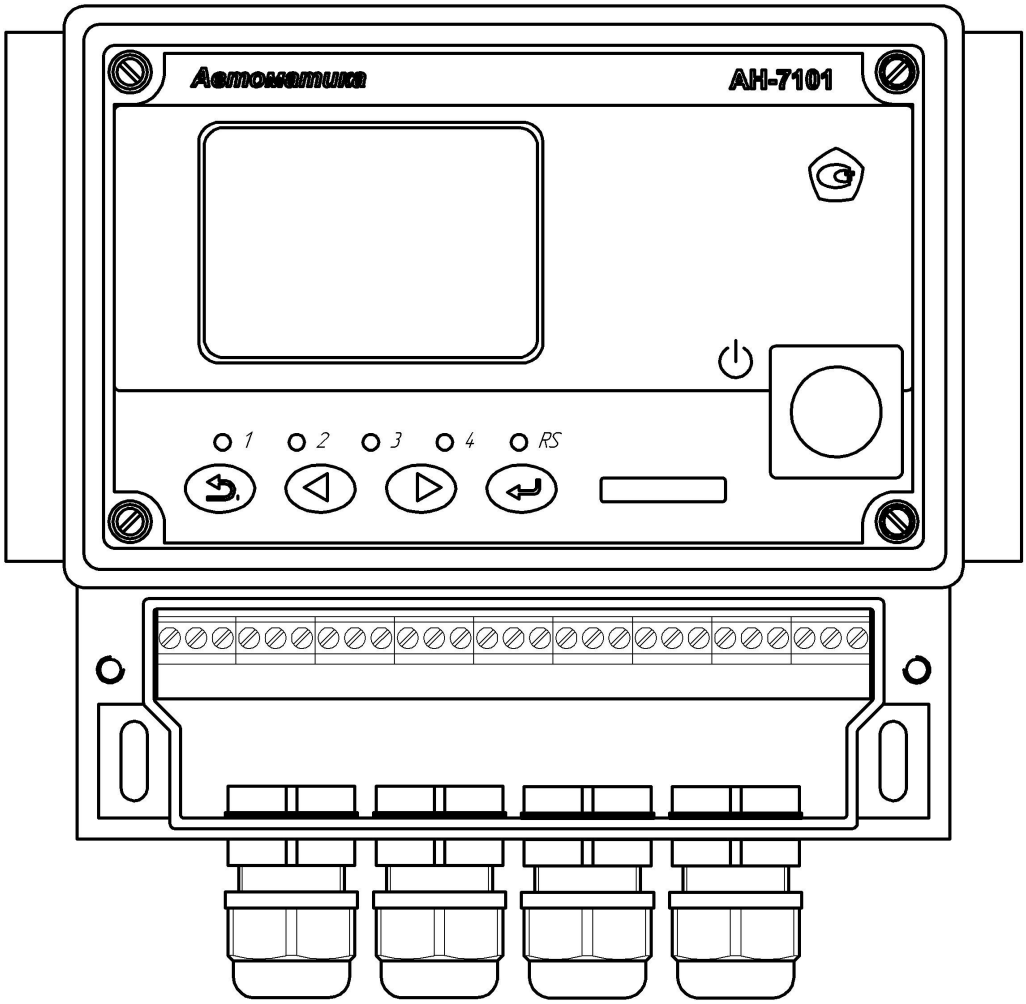


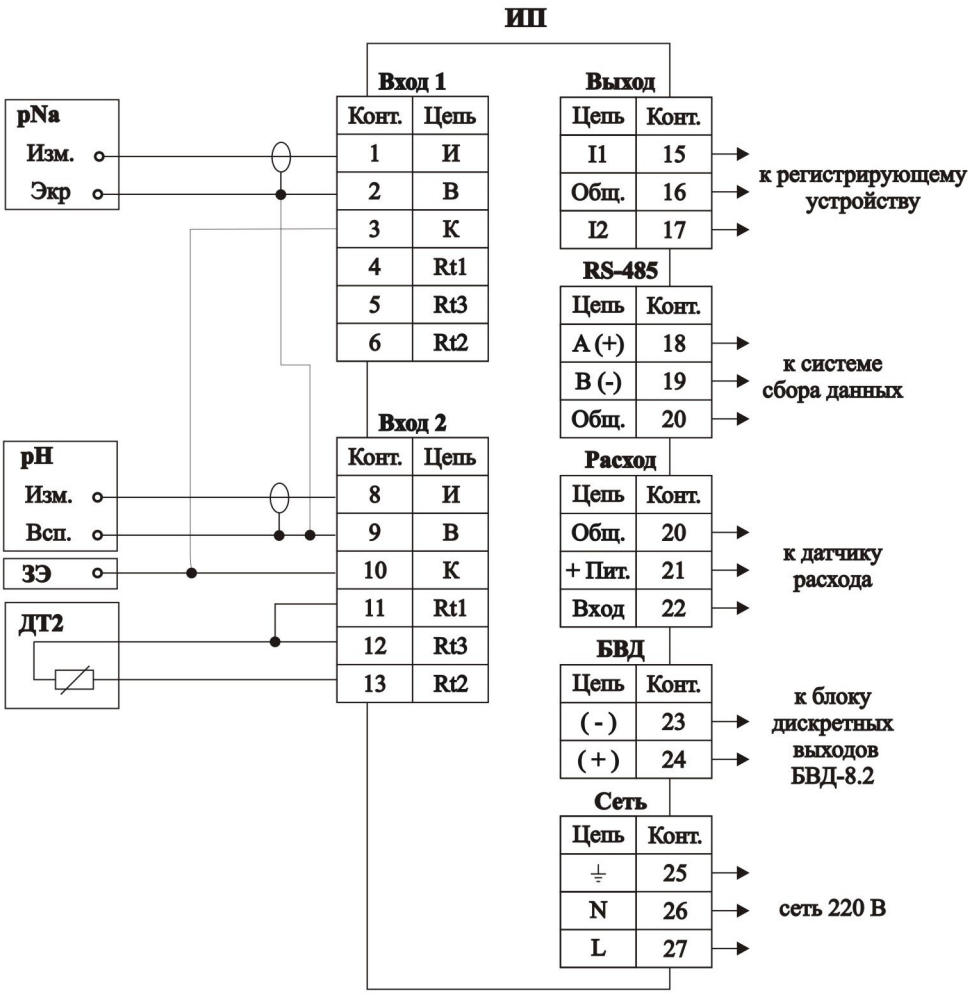
Figure A.3 Fixing of the wall-mounted measuring device using the mounting tabs

Annex B

Front panel view of the analyzer



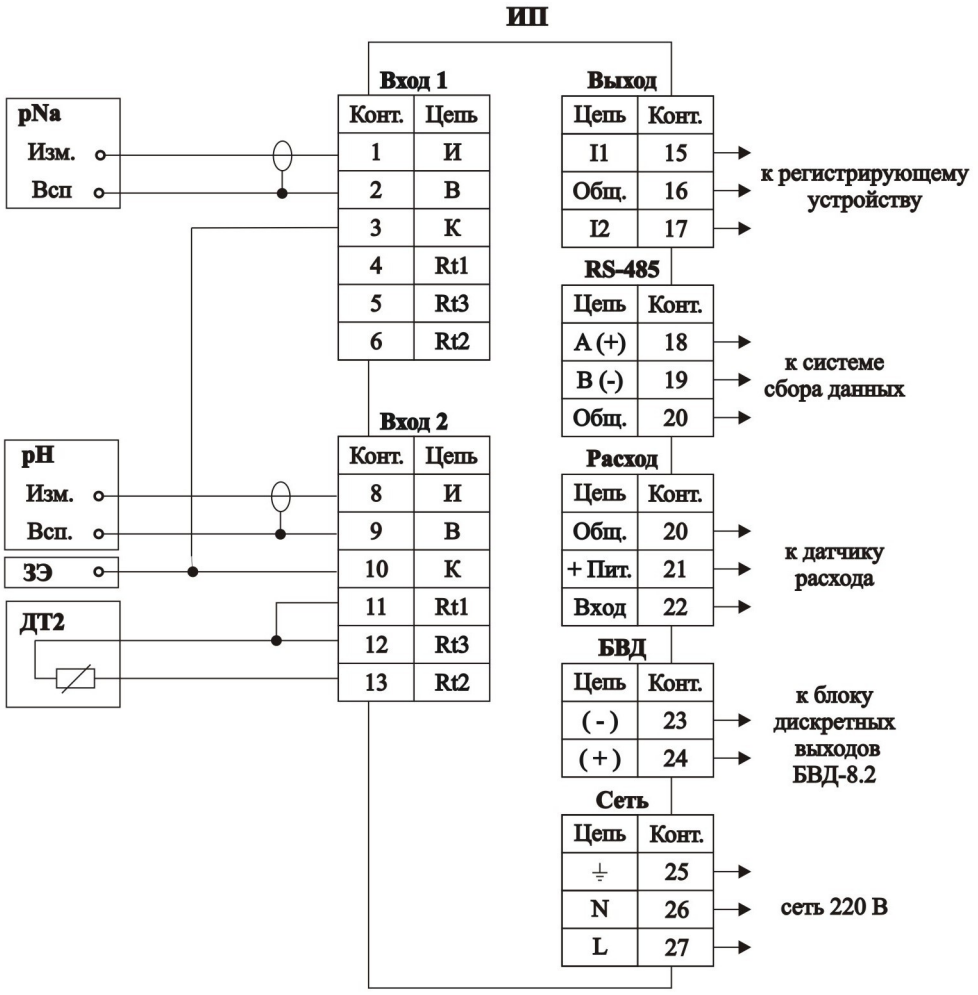
Annex C
External connection diagram



ИП - измерительный преобразователь
ДТ - датчик температуры
pH - комбинированный pH-электрод.
pNa - измерительный pNa - электрод
ЗЭ - заземляющий электрод

ИП – Measuring transducer
ДТ – Temperature sensor
pH – pH electrode combined
pNa – measuring pNa electrode
ЗЭ - grounding electrode

Fig. C1 – Diagram of the electrodes connection to the device



ИП - измерительный преобразователь
ДТ - датчик температуры pH-электрода
pH - комбинированный pH-электрод.
pNa - измерительный pNa - электрод
ЗЭ - заземляющий электрод

ИП – Measuring transducer
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pH – pH electrode combined
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ЗЭ - grounding electrode

Fig. C1 – Diagram of the electrodes connection to the device

End of Annex C

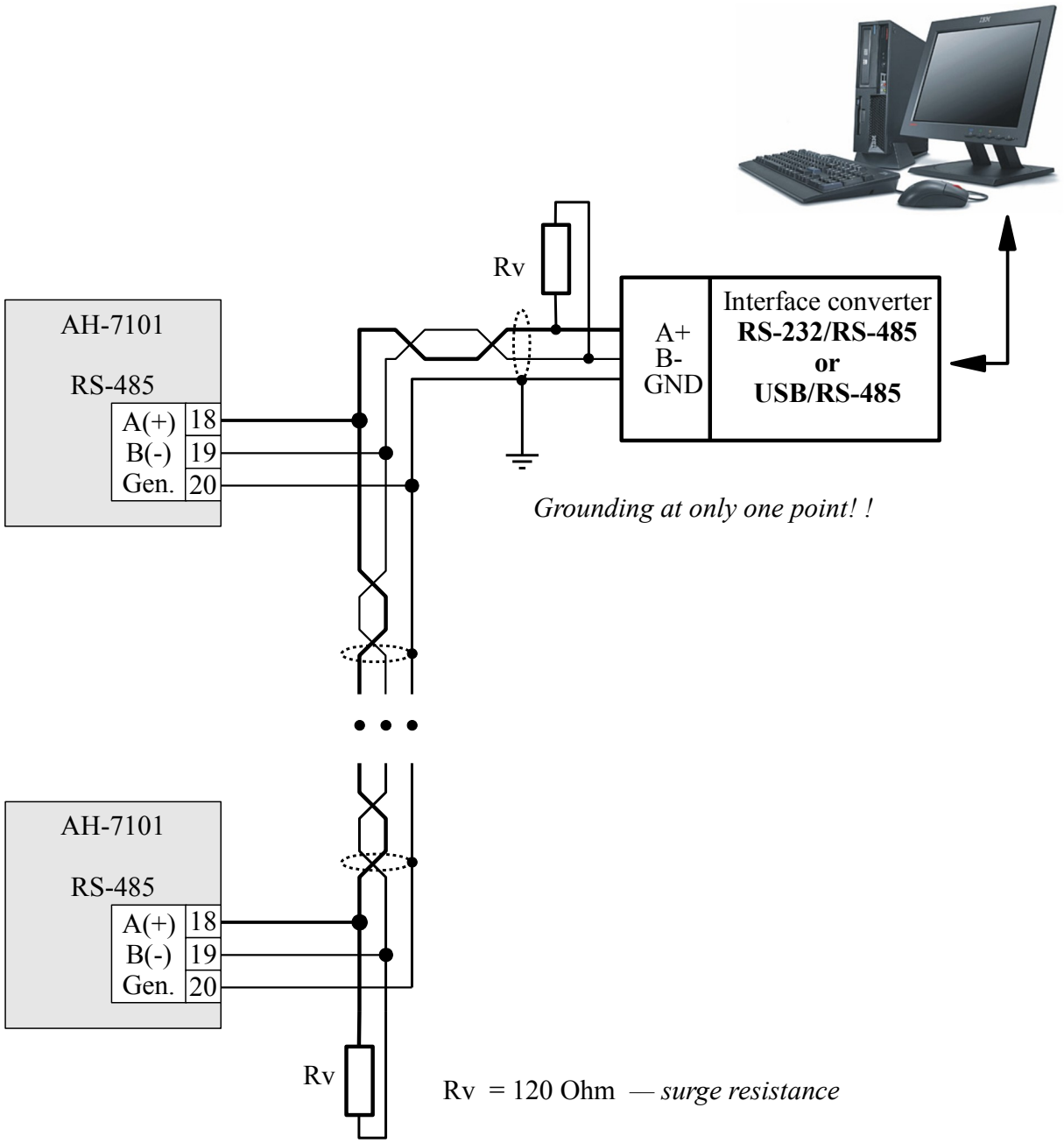


Fig.C3 – Powering on the devices with RS-485 interface to the local network

Annex D
ES calibration

D.1 Key assignment (the assignment is displayed in the calibration window) in the calibration mode:

<< - return to the previous window;
>> - moving to the next window;
Save? – permanent memory retention of the calibration results;

Measuring - switching over to the current measuring mode of the calibrate parameter;
Save - exit from the current measuring mode of the calibrate parameter with permanent memory retention of the measured values for the next calculations;

Buffer - buffer task menu access

D.2 Sequence for calibration:
- Set the temperature compensation mode;

- Calibrate the ES by one or two buffer solutions;

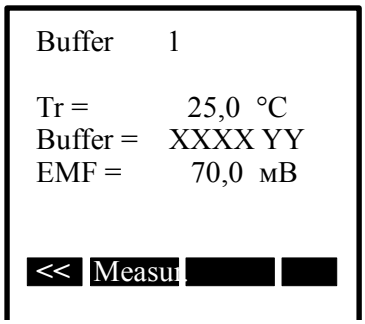
- Make sure that the calculated values of Ei and S are within the acceptable error threshold: ± 50 mV (80 ... 120)% respectively;

- If the errors do not satisfy the limit, check the correctness of ES connection of ES and re-calibrate;

- If the errors after the re-calibration do not satisfy the acceptable values, it is necessary to replace the electrode.

D.3 The analyzer for the temperature measurement contains a temperature sensor connected to the second input (pH measurement channel). If the sensor is not connected or is connected not correctly, by the calculation of pNa and pH values a temperature value is used, which is set manually.

D.4 Calibration
Press ***я*** **-** key to calibrate ES of the pNa electrode (channel 1);
Press ***ч*** **-** key to calibrate ES of the pH electrode (channel 2);
Choose a variant of the calibration: one-point or two-point;
Press **}** – key on the selected menu item, at this time a calibration window by the buffer solution appears on the display; see figure:



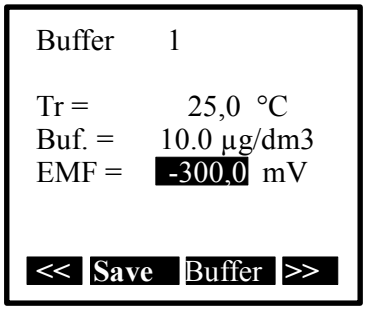
where T - saved temperature value;

Tr - indicates that the temperature sensor is disconnected, the set manually temperature value is switched on automatically;
Ta - indicates a measured temperature value;
XXXX - previously saved value of the calibrate parameter;
YY - parameter units measure (depending on the type of measurement channel);

If the change of the parameters of the buffer solution is not required, it is possible to move to the next calibration window. Press **>>** (**}**) key. For one-point calibration it is the calculation of ES parameters, for the two-point calibration it is a buffer 2 calibration window.

To exit the calibration lose changes press **<<** (**{**) key.

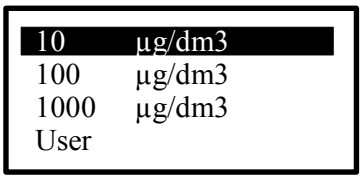
To move to the measuring mode of a set buffer, press **Measur** (**я**) key.



← **pNa** buffer calibration window

Flashing of EMF measured value (- 300.0 mV) means a change of the measured parameter. Wait the flashing stops (stabilization of the measured value) for at least 10 seconds.

D.5 For the buffer values change, press **Buffer** (**ч**). At the same time on the display appears the menu:

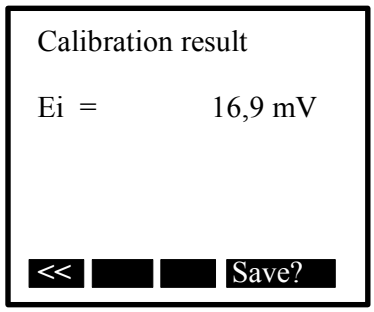


To select the required buffer value press **Save** (**я**) on the selected item. For data storage of the measured and / or set parameters press **Save** (**я**). To move to the next window without pressing **Save** (**я**) - key, all measured and / or set parameters for a given point calibration will be lost.

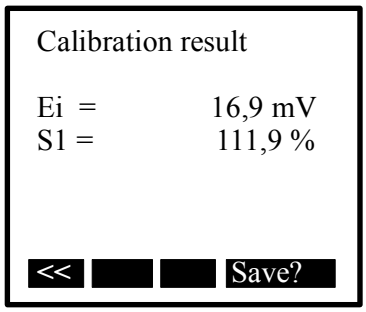
D.6 For the second buffer ES calibration it is necessary to make all the same steps as for the first buffer ES calibration.

D.7 To move to the window of ES parameters calculation of the stored data, press **>>** (**}**) - key, at the same time on the display appears the menu:

by the one-point calibration:



by the two-point calibration:



Appears the caption:
The calibration result is incorrect!!!

It means that the calculated Ei or S value falls outside the range (-150 ... 50) mV or (80 ... 120)% respectively, while the incorrect value is highlighted with a black background.

While the signal setting the EMF value (mV) flashing stops.

Appears the caption:
Select another buffer solution

It means that the buffer value is set not correct or the value for the second calibration point agrees with the value for the first calibration point. It is necessary to change the buffer solution.

Appears the caption:
The calibration result is incorrect!!!

It means that the calculated Ei or S value falls outside the range (-150 ... 50) mV or (80 ... 120)% respectively, while the incorrect value is highlighted with a black background.

Calculated and stored parameters are stored in the permanent memory and are applied immediately after the pressing Save? (**}**)- key.

Annex E
Options for sealing the analyzer body