NPP «Avtomatica» JSC

PH-METER INDUSTRIAL

pH-4122.P

INSTRUCTION MANUAL

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Introduction

The present operation manual serves for the studying and correct using the pH-meter Industrial 4122.P (hereinafter – pH-meter)

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

PH-meters are engineered for the sphere of state regulation ensuring the uniformity of measurements are subject to checking.

PH-meters which are not engineered for the sphere of state regulation ensuring the uniformity of measurements are subject to calibration.

Checking (calibration) is performed in accordance with the procedure set in the instruction «pH-meters industrial 41. Calibration procedure. АВДП.414332.001 МП»

pH-meters are manufactured in compliance with spec. ТУ 4215-085-10474265-2006.

1 Purpose

1.1 pH-meters industrial are designed for the index activity measurement of the hydrogen ion (pH) and temperature (T) of the analyzed liquid.

pH-4122.P can measure an oxidation-reduction potential (ORP), and a flow rate (F).

1.2 pH-4122.P has two galvanically isolated measurement channels. Each channel has two measuring inputs: pH (or ORP) and T. Additionally the pH-meter has an input for the fluid flow sensor connection (F). The pH-meter in the wall-mounted design has an outlet for the output digital signals external unit БВД-8.2 connecting for alarm system. If БВД-8.2 unit is not provided, the pH meter can have one discrete output. The pH-meter of a panel performance has built-in digital outputs (relay).

pH meter provides a digital display of the measured values (pH and temperature T), converting them to the proportional values of DC current analog outputs, data exchange via RS-485 digital interface, signaling the overranging of the measured parameters, as well as archiving and graphically display of the the measurement results.

pH meter pH-4122.P (transmitter) has a monoblock design.

1.3 Applications: thermal power, chemical, petrochemical and other industries.

1.4 Climatic execution as per GOST 15150-69*, kind of execution - УХЛ 4.2*, but at a temperature from 5 to 50 ° C.

Climatic modification group as per GOST R 52931-2008 В4.

pH meter service conditions:

- ambient air temperature: (5... 50) ºС;
- ambient air relative humidity: 80 %;
- atmospheric pressure (84... 106) кПа.

Note: GOST - Russian state standard for NPP*

2 Technical data

2.1 Input

2.1.1 Number of measurement channels: 2.

2.1.2 Measuring range pH: (0… 14,00) pH.

2.1.3 Measuring range ORP: ±2000 мВ.

2.1.4 Max temperature of the analyzed environment 95 ºС.

2.1.5 Nominal static characteristic (NSH) of the resistance temperature detectors (TD) Pt (W_{100} = 1,3850).

Notes
1 NSH type and a TR resistance at 0 ° C (R0) within the range of (2000 ... 50) ohms, is set programmatically.
2 Max temperature of the analyzed environment is determined by the parameters of pH electrodes.

2.1.6 The flow measuring range (with a sensor FCH-M) (0,9... 48) l/h.

2.2 The electrode system

The electrode system can be applied in one of the following variant:
- combined pH electrode, for example ASP type (measuring and auxiliary electrodes in the same case), with the built-in temperature sensor;

- combined pH electrode, for example ID type (measuring and auxiliary electrodes in the same case), with a single temperature sensor;

- individual measuring and auxiliary electrodes, for example ЭС-1 и ЭВЛ-1М3.1 type with a single temperature sensor;

- combined ORP electrode type SZ275 or ASR2811.

2.3 Analog output

2.2.1 Number of analog outputs 2.

2.2.2 Output unified DC signal (is set programmatically):
- (0… 5) mA at the load resistance (0... 2) kilohm;
- (0... 20) mA at the load resistance (0... 500) ohm;
- (4... 20) mA at the load resistance (0... 500) ohm.

2.4 Discrete outputs

2.4.1 Number of signals in the analyzer of a panel design 4.

Type - relay switching "dry contact", ~ 240 V, 3 A.

2.4.2 Number of signals in the wall-mounted analyzer with an unit БВД-8.2 8.

Type - relay switching "dry contact", ~ 240 V, 3 A.

2.4.3 Number of signals in the wall-mounted analyzer without an unit БВД-8.2 1.
Type - optorelay normally opened = 100 V, 150 mA (dial-signal parameters can be changed due customer's request).

2.5 Digital Interface

2.5.1 Physical layer RS-485.

2.5.2 Data link layer Modbus RTU Protocol.

2.5.3 Data rate from 1,2 up to 115,2 kbaud.

Selecting the device address, data rate and other interface parameters are set programmatically.

2.5.4 The frequency of the updating registers "measurement result" (LAN) 5 Hz.

2.6 Indication

2.6.1 Indication of the measured parameters is performed with a graphical LCD display (display) in absolute terms.

2.6.2 Single LED indicators:
- four red LEDs for display the light alarm modes;
- two-color display for the interface communication.

2.6.3 Display update rate 2 Hz.

2.7 Control

2.7.1 Manual control is carried out by means of four buttons and a LCD display using the menu.

2.7.2 Control of the upper level system is performed via the Modbus network

2.8 Power

2.8.1 Power supply voltage of 50 Hz (100... 244) V.

2.8.2 Power consumption 15 VA.

2.9 Structural specification

2.9.1 Dust and water protection of the wall-mounted pH meter is per GOST 14254-96 IP65.

2.9.2 The packed pH-meters are resistant to the vibration effects per GOST P 52931-2008 group F3.

2.9.3 Overall dimension (H×W×D) (96×96×124) мм.

2.10 Reliability index

2.10.1 The device is designed for twenty-four hour operation. Warm-up time after the switching on is more than 15 min

2.10.2 Probability of no-failure operation 0,9

2.10.3 Average time between failures 20 000 h

2.10.4 Average lifetime 10 years

3 Specifications

3.1 The limit of the allowable value of the absolute error in pH measurement:
- with the electrodes 102010, ASP, ID ± 0,05 pH;
- with the electrodes ЭСК-1, ЭС-71, SZ ± 0,1 pH.

3.2 The limit of the allowable value of the absolute error in the analyzed environment temperature measurement ± 0,5 ºC.

3.3 The limit of the allowable value of the complementary absolute error in **pH** measurement caused by the variation in the analyzed environment temperature for every 25 °C (in a ATK mode) relatively 0 ºC within the temperature range:

(0… 50) ºC ± 0,05 pH.

3.4 The limit of the allowable value of the complementary absolute error in **pH** measurement caused by the variation in the analyzed environment temperature for every 10 °C within the temperature range:

(5… 50) ºC, ± 0,05 pH.

3.5 The limit of the allowable value of the complementary absolute error in **pH** measurement caused by the variation in a measurement electrode resistance from 0 till 1000 Mom, not exceeding ± 0,05 pH.

3.6 The limit of the allowable value of the complementary absolute error in **pH** measurement caused by the variation in a subsidiary electrode resistance from 0 till 20 Kilohm, not exceeding ± 0,05 pH.

3.7 The limit of the allowable value of the basic absolute error in ORP measurement, not exceeding ±3 мВ.

3.8 Converting the measured pH (or ORP, temperature, T, flow rate V) to a standardized current output is calculated by the formula:

$$I_{output} = I_{min} + I_{range} \frac{pH_{measured} - pH_{min}}{pH_{max} - pH_{min}} \quad ,$$

where, $pH_{measured}$ – the measured **pH**;

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

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

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

Note - For the values of ORP [mV], T [° C] and V [l / h] this formula looks similar.

3.9 The limit of the allowable value of the basic reducial error in the converting the measured value into an output current ±0,25 %.

4 Completeness

The set of the pH meter delivery is illustrated in Table 1:

Table 1 - Delivery set

№	Specification	Qty.	Note
1	pH meter industrial pH-4122.I (transmitter)	1	
2	pH meter industrial pH-4122.I. Instruction manual	1	
3	pH meter industrial pH-4122.I. Communications interface. Application manual	1	
4	pH meter industrial pH-4122.I. Passport	1	
5	Combined pH electrode with the in-built temperature sensor		optionally
6	pH measuring electrode		optionally
7	pH subsidiary electrode		optionally

8	Combined ORP electrode		optionally
9	Temperature sensor		optionally
10	Hydropanel HP-4122		optionally
11	Hydropanel HP-4122. Instruction manual		
12	Discrete signal output unit БВД-8.2		optionally
13	Discrete signal output unit БВД-8.2. Instruction manual		optionally
14	Discrete signal output unit БВД-8.2. Passport		optionally
15	pH meters industrial pH-41. Test procedure	1	
16	pH meters industrial pH-41. Calibration procedure	1	optionally with ORP measuring

Example of the order:

« **pH-4122.I** — pH meter industrial dual channel». Additionally is indicated the number of the measurement channels (one or two), the specific measurements ranges, the output signals ranges, the types of pH electrodes.

5 Arrangement and principle of operation

5.1 Arrangement of transmitter

5.1.1 The pH meter transmitter is an electronic unit placed in the housing.

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

5.1.3 The main board has a power supply and sensors connectors, analog outputs and a measuring part galvanically isolated from the supply line on.

5.1.4 The display board has a power voltage converter, display and digital interface controls.

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

– graphic LCD display with LED-backlit display of the measured value and the set parameters;
– two-color LED single interface indicator (**RS**);
– LED single red indicator to inform about the selected alarm settings (**1**, **2**, **3**, **4**);
– ⮌ - left, return, cancel;
– ◀ - up, right to the figures positions;
– ▶ - down, and number increase;
– ↵ - right, selection and left with the fixation.

5.1.6 The meter is a microcontroller device. The first microcontroller processes a signal from the sensors providing analog-to-digital conversion. The second microcontroller provides a keyboard control, indicators and data exchange over a local network.

5.1.7 In the presence of the interface it is possible to read the measurement results and device control over the local Modbus network. The meter display has a priority in control device.

5.1.8 To prevent an unauthorized adjustment or tampering impairing the measurement results the analyzer body cover may be sealed.

5.2 Principle of operation

5.2.1 The oprinciple of the pH meter operating is based on the direct potentiometric method for the activity determination of hydrogen ions in the test liquid while the measuring the electromotive force (EMF) of the electrode system (ES), formed by the measuring electrode and reference electrode immersed in a tested liquid.

The pH meter provides the measurement of the analyzed liquid temperature (T) by applying the converting the thermometer resistance to a temperature resistance according to the nominal static characteristic (NSCH).

The pH meter allows to provide the measurement of the liquid flow rate (V) by applying the converting the frequency pulse signal of the flow sensor.

In the calculation of pH the influence of temperature on the pH-electrode sensitivity is considered.

In general, the pH of the tested environment is calculated by by the formula:

$$pH = -\frac{E - E_{И}}{0{,}1984 \times \frac{S}{100\,\%} \times (273{,}15 + t^{o})} + pH_{И} \text{ ,}$$

where pH – the measured pH value of the analyzed environment;

E – EMF value on the ES output, mV;

t^{o} – the measured temperature value (by the resistance thermometer automatically (ATC)) or specified manually (RTC)°C;

pH_{u} – the coordinate of the isopotential point of the pH electrode;

E_{u} – the coordinate of the isopotential point of the pH electrode, mV;

S – the slope of pH electrode, %

The compensation of pH temperature dependence of the ultrapure water (UPW) is carried out according to the procedure МУ 34-70-114-85.

5.2.2 EMF measuring between the ES electrodes is produced by the differential switching circuit. In this scheme, the analyzed liquid should be grounded (Appendix C).

5.2.3 ORP measuring, in millivolts, is made with a pH meter, as a high-resistance millivoltmeter, in a direct voltage mode measurement - "ORP mode."

In general, the ORP of the tested environment is calculated by by the formula:

$$ORP = (E + E_{CM}) * \frac{100\,\%}{S}$$

where ORP – ORP measured value of the analyzed environment, mV;

E – EMF value on the ES output, mV;

E_{CM} – the displacement of ES characteristics of the ORP electrode, mV;

S – the slope of ORP electrode, %

5.2.4 For the measuring the redox potential (ORP) the electrode system is used, consisting of a redoxometric (platinum or gold) measuring electrode and a silver chloride reference electrode.

5.2.5 The temperature by the measurement of ORP is not considered.

6 Directions related to the safety measures

6.1 The pH meter degree of protection against the electric shock is class I according to GOST 12.2.007.0-75.

6.2 Only persons specially trained for a manual operation, familiar with general safety regulations for operation of the electrical equipment having voltage of up to 1000 V, passed the examination for a group of electrical safety not less than III, and having a certificate of the established sample are allowed to install and maintain the pH meter.

6.3 The pH meter must be grounded.

6.4 The pH meter connection must be made in accordance with the marking with supply voltage de-energized..

6.5 When operation and maintenance of pH-meter it is necessary to follow the requirements of the following documents:

- "Rules of the technical operation of electrical consumers";

- "Safety regulations for the operation of electrical consumers."

7 Preparation for operation and operation procedure

7.1 Outer inspection

After unpacking it is necessary to check the following conformities:

– the pH meter must be completed in conformity with the certificate;
– the serial number must correspond to that specified in the certificate;
– the analyzer must be free of mechanical damages.

7.2 Operation procedure

7.2.1 Connecting the electrode system

ES Connection is performed according with the external connections diagram (Appendix C).

7.2.2 Mounting of the pH meter transducer (MT)

When installing a pH meter it is necessary to provide the following conditions:

– The location should be easily accessible for the maintenance;
– over the place of installation should be no cranes, flanges and piping to avoid the dripping of aggressive solutions;
– combined electrode should be always immersed into the tested liquid, the electrode should be in a dry condition not more than 10 minutes.

Connect the ground wire to the corresponding terminal of the the analyzer. Connect the power supply and warm the analyzer for 15 minutes.

7.3 Transmitter preparation

7.3.1 The pH meter is supplied configured in accordance with the order. Factory settings are indicated in the passport.

7.3.2 Calibration on the standard solutions

Appendix D contains a calibration procedure of the pH meter. Calibration of two buffer solutions (two-point) is required for initial and periodic analyzer calibration during

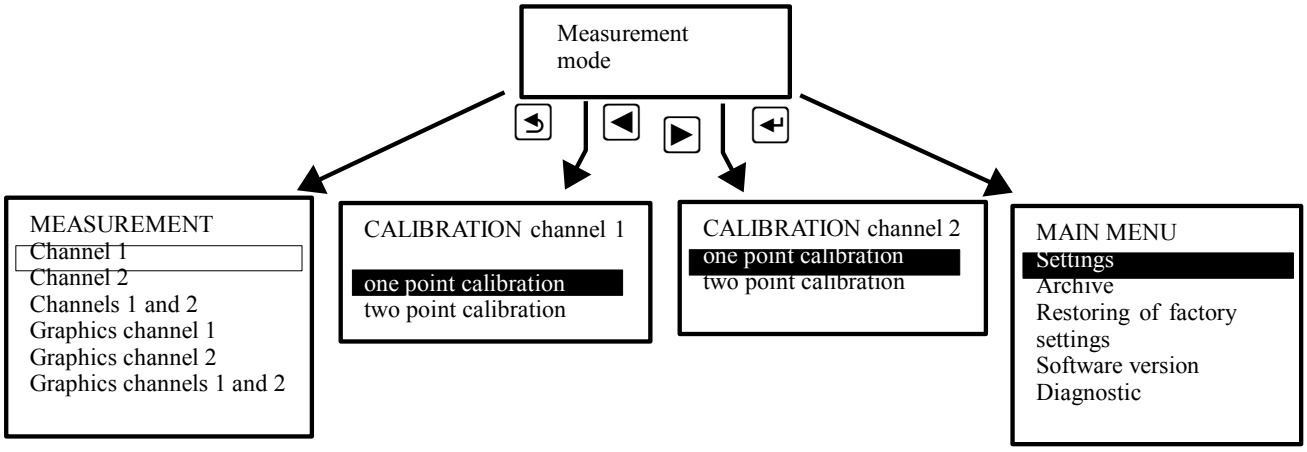
operation (once a month during a continuous measurement of pH (ORP) of the analyzed liquid), and after replacing the used ES on a new one.

7.3.2.1 ES calibration is performed by the pH buffers according to GOST 8.135-2004 or ORP solutions as per GOST R 8.702-2010.

8 Operating modes of pH meter

8.1 When power the pH meter switches to the mode "Measurement" automatically and operates on the previously set parameters.

8.2 "Measurement" mode

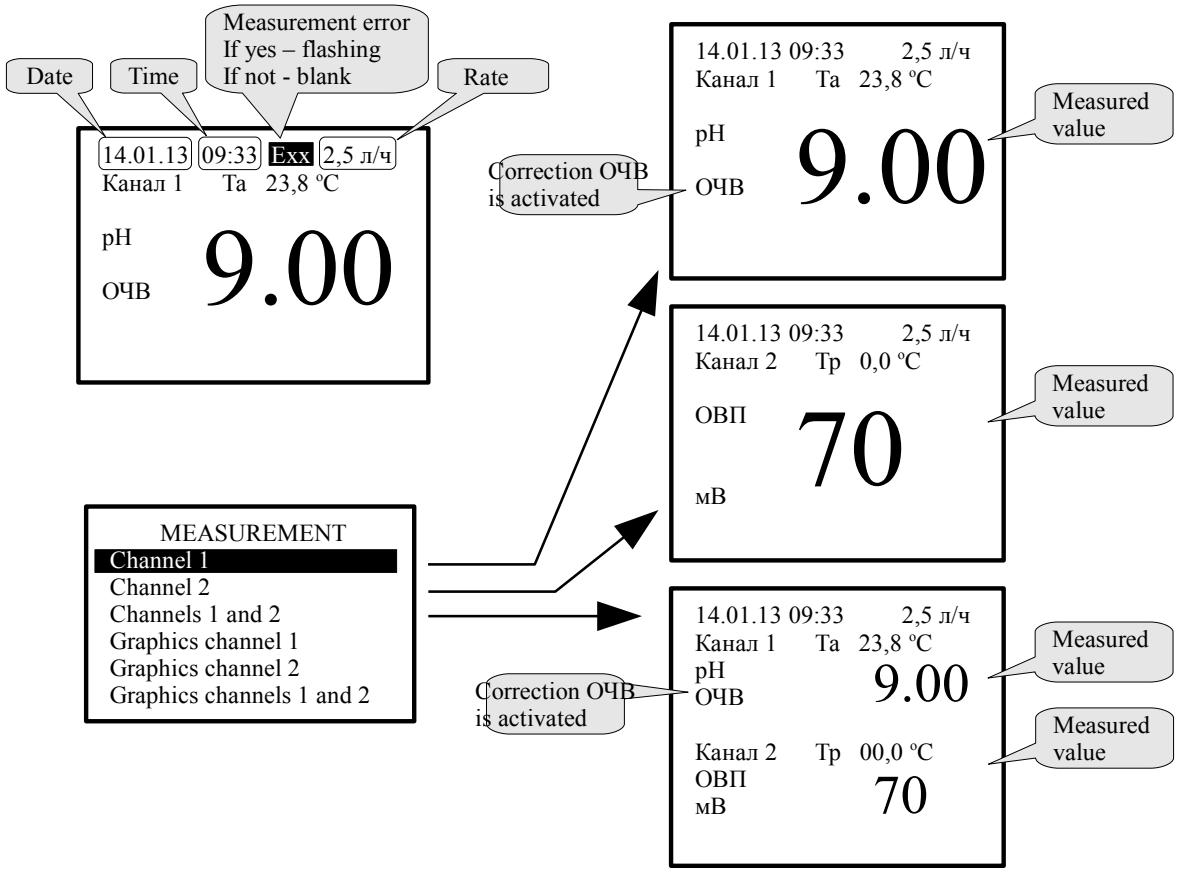


8.2.1 Buttons appointment in the " Measurement " mode:

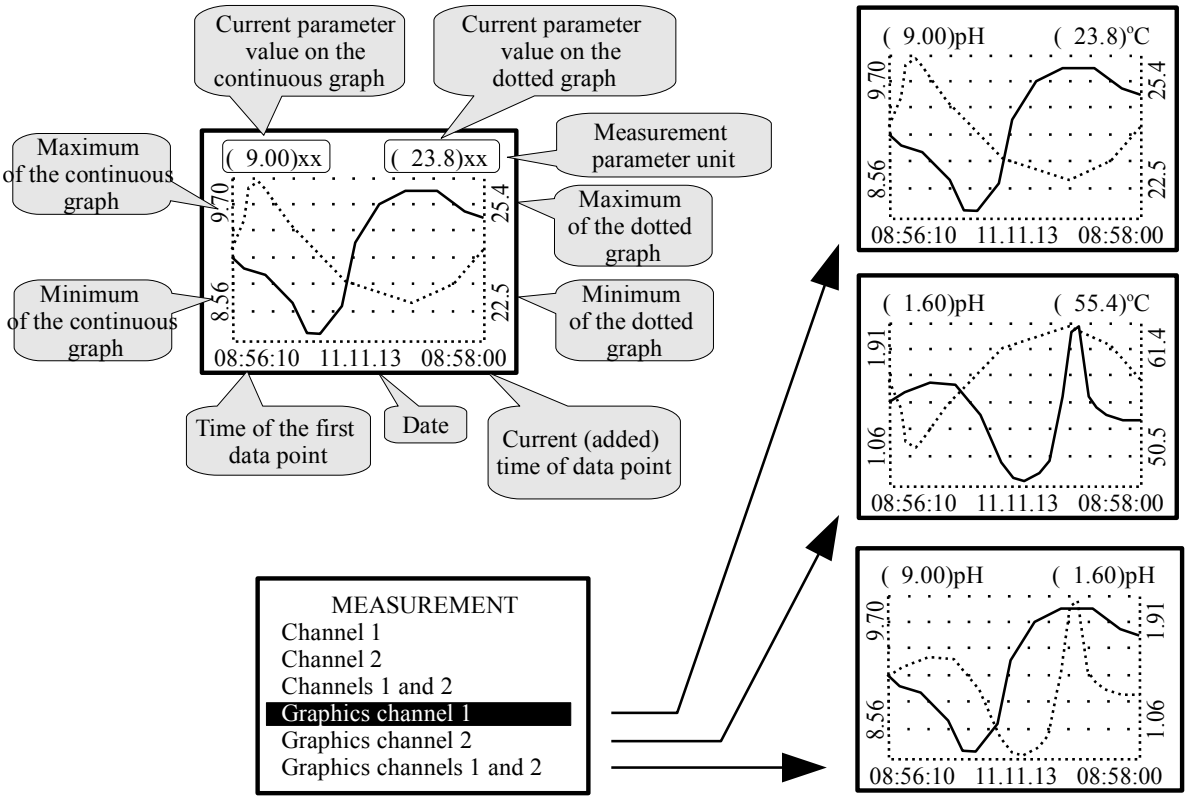
– ⮌ - entrance to the select menu of display type in the "Measurement" mode;
– ◀ - entrance to the calibration menu of pH (ORP) input channel 1;
– ▶ - entrance to the calibration menu of pH (ORP) input channel 2;
– ↵ - entrance to the "MAIN MENU".

8.2.2 Selecting the data type presentation in the measurement mode:

– Channel 1 , Channel 2 and Channels 1 и 2 - a digital displaying of the measured data (see figure):



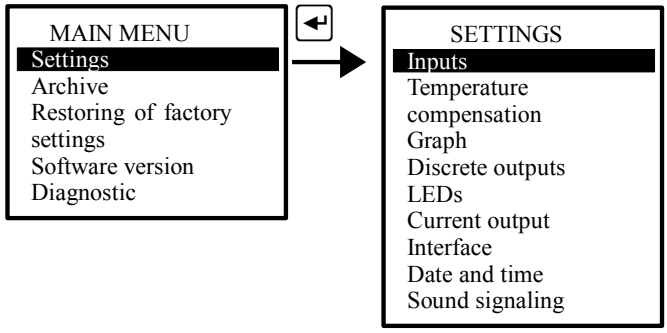
– Graphics channel 1 , Graphics channel 2 and Graphics channels 1 and 2 - displaying of the measured data in a graph (see figure):



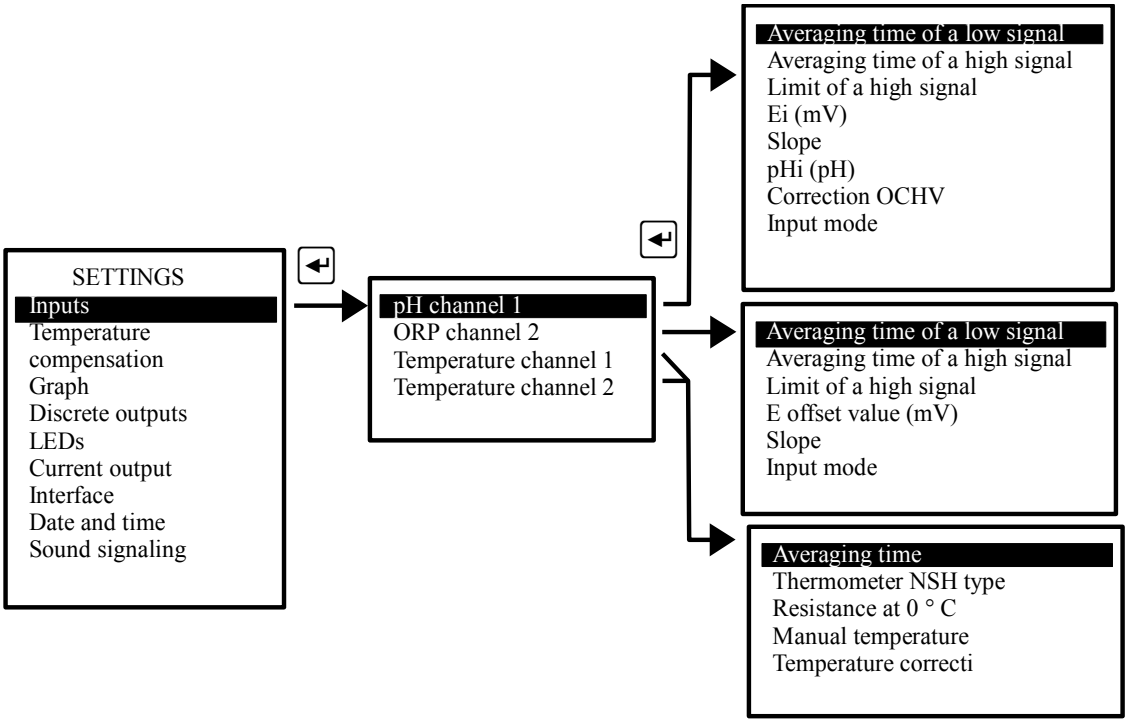
8.3 MAIN MENU

8.3.1 Entrance to the "MAIN MENU" is performed by pressing the button ↵ (See section 8.2).

8.3.2 **SETTINGS sub-menu**



8.3.2.1 Inputs



In this mode, the measuring input pH or ORP parameters (Channels 1 and 2) and the temperature (channels 1 and 2) are set.

Inputs → pH channel 1 - the pH measurement parameters channel №1 are reviewed and adjusted:

– Averaging time of a low signal and Averaging time of a high signal - review and adjusting of the averaging time of low and high signal, in seconds.
– Limit of a high signal - review and adjusting the changeover limit from the low signal filtering to a high, in pH.
– Ei (mV) - review and adjusting the pH electrode parameter Ei, in millivolts.
– Slope - review and adjusting the pH electrode parameter S, in percent.
– pHi (pH) - review and adjusting the pH electrode parameter pHi, in units pH.
– ОЧВ correction - turning on (On.) or off (Off) the temperature compensation for the ultrapure water for the first channel.
– Input mode — switching on the device to the pH or ORP measurement mode.

Inputs → ORP Channel 2 - ORP measurement parameters channel №2 are reviewed and adjusted:

– Averaging time of a low signal и Averaging time of a high signal - review and adjusting of the averaging time of low and high signal, in seconds.
– Limit of a high signal - review and adjusting the changeover limit from the low sig-

nal
– filtering to a high, in mV.
– E offset (mV) - review and adjusting the pH electrode parameters **E** offset, in millivolts.
– Slope - review and adjusting the pH electrode parameter **S,** in percent.
– Input mode — switching on the pH meter to the the pH or ORP measurement mode.

Inputs → **Temperature channel 1** - the temperature measurement parameters channel №1 are reviewed and corrected.
– Averaging time - viewing and adjusting the averaging time in seconds by the temperature measurement.
– HCX type thermometer - selecting the HCX type of the used temperature sensor.
– Resistance at 0 ° C - selecting the temperature sensor resistance at zero degrees Celsius.
– Manual temperature - setting the temperature values for a temperature compensation manual mode (or in the absence of the temperature sensor).
– Temperature correction - correction of the temperature when two-wire connection of the temperature sensor in degrees.

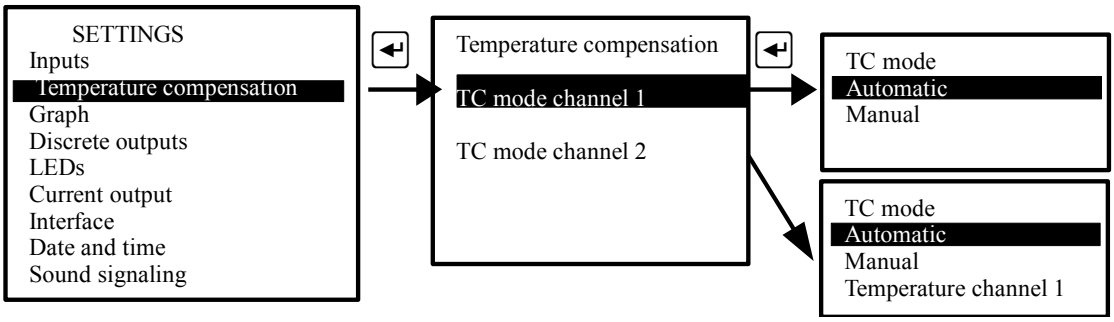
Inputs → **Temperature channel 2** - the temperature measurement parameters channel №2 are reviewed and corrected. The correction of the temperature measurement parameters channel 2 is performed similarly to the correction of the temperature measurement parameters channel 1.

When ORP measuring the temperature measurement is not considered.

8.3.2.2 Temperature compensation

The temperature compensation modes for each channel are set.

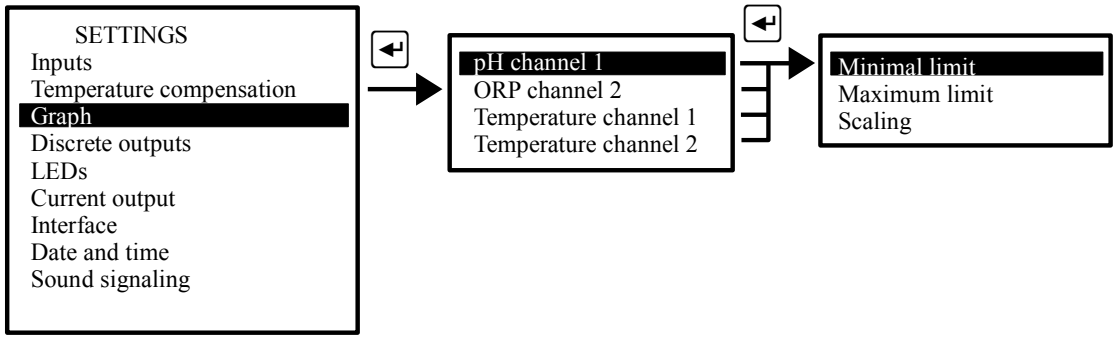
Temperature compensation
– TC mode channel 1 - the temperature compensation mode for the first channel is selecting:



– automatic or manual. If ***automatic*** temperature compensation while the pH calculating the temperature sensor of the first channel as a source of the temperature value will be taken. When ***manual*** temperature compensation while the pH calculating the collected temperature value for the first channel will be taken (see p. 8.3.2.1).
– TC mode Channel 2 - the temperature compensation mode for the second channel is selecting: automatic or manual. When ***automatic*** temperature compensation while the pH calculating temperature sensor of the second channel as a source of the temperature value will be taken. When ***manual*** temperature compensation while pH calculating the collected temperature value for the first channel will be taken (see p. 8.3.2.1).
– The second channel is additionally provided with an automatic temperature compen-

sation mode using the temperature sensor of the first channel as a source of a temperature value (Temperature channel 1).

– ***Notes***
– ***1 Set point value of a manual temperature is using with the pH meter automatically***
– ***when breaking or short-circuit of a temperature sensor.***
2 A built-in the pH electrode temperature sensor is used as a temperature sensor or another single sensor.



8.3.2.3 Graph

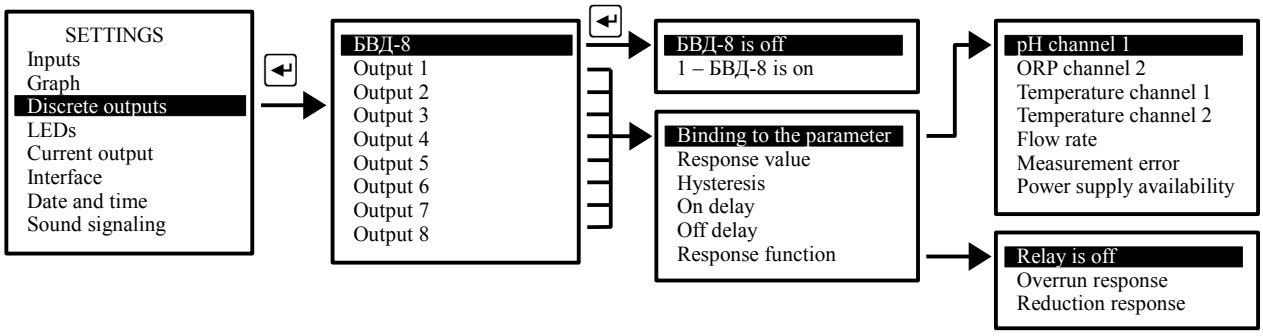
In this mode, the zoom parameters for each measurement parameter are selected: pH channel 1, OPR channel 2, temperature channel 1 and channel 2. For each parameter the minimum and maximum limits for displaying the trend are set. When selecting Auto zoom mode the minimum and maximum limits are determined automatically.

8.3.2.4 Discrete outputs

For each digital output such parameters as: binding to a parameter, response value, hysteresis, on and off delay and response function are set.

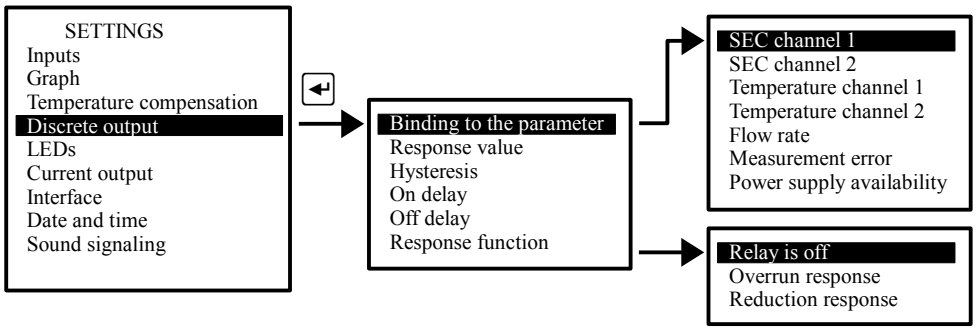
Notes
1 Each output can be set to the generalized measurement error alarm. To do this, select the mode: Binding to the parameter, measurement error (paragraph 8.3.6.).
2 Each output can be configured to the power supply absence signaling supplied to the analyzer. To do this, select the mode: Binding to a parameter, power supply availability.

8.3.2.4.1 Setting the digital outputs in the wall-mounted pH-meter with block БВД-8.2.



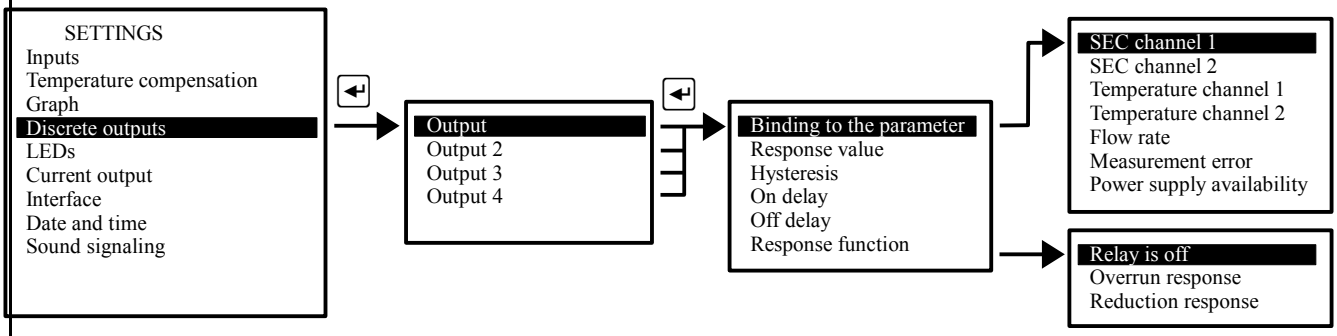
Here are eight digital outputs with switching options ~ 240 V, 3 A available (see Figure C.2).

8.3.2.4.2 Setting the digital outputs in the wall-mounted pH-meter with one digital output.



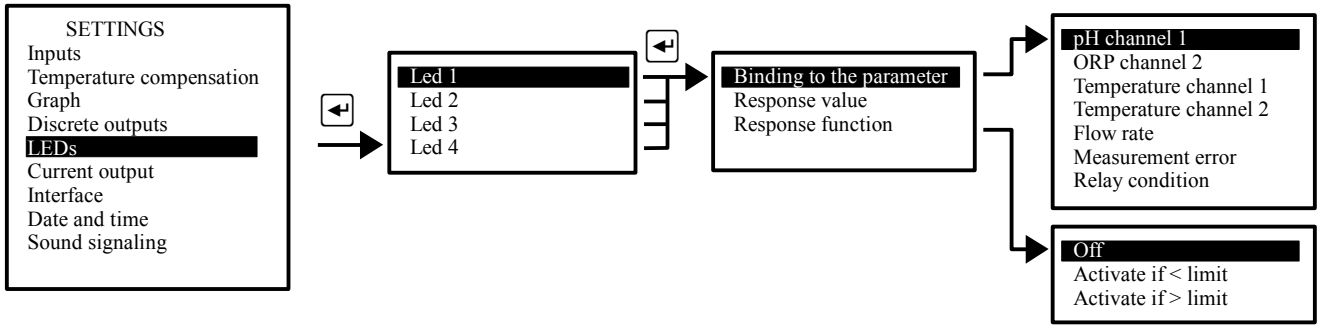
Herewith is only one digital output with switching settings = 100 V, 150 mA available (see Figure C.3).

8.3.2.4.3 Setting the digital outputs to a panel pH meter.



Herewith are four digital outputs with switching parameters ~240 V, 3 A available (see Figure C.1).

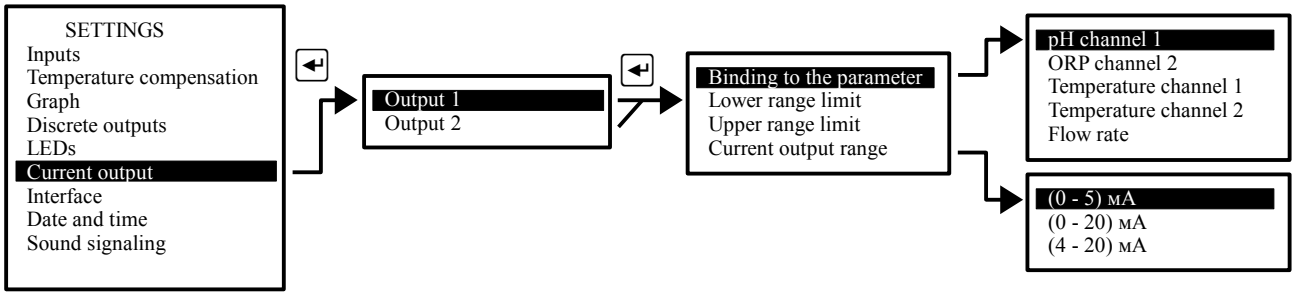
8.3.2.5 LEDs



In this mode, for each of the four LEDs on the front panel of the analyzer the following functions are set: response value, response function and binding to the parameter. For the mounted pH-meter the binding to the parameter "Relay condition" is off.

Note - Each LED can be set to the measurement error alarm. To do this, select the mode: Binding to the parameter, measurement error (paragraph 8.3.6.). In this case the LED is flashing.

8.3.2.6 Current outputs



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

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

– Binding to the parameter - in this mode one of the five measured parameters, which will be on the output current signal, is selected (See figure);

– Lower measurement limit - the lower limit value of the selected parameter is set.

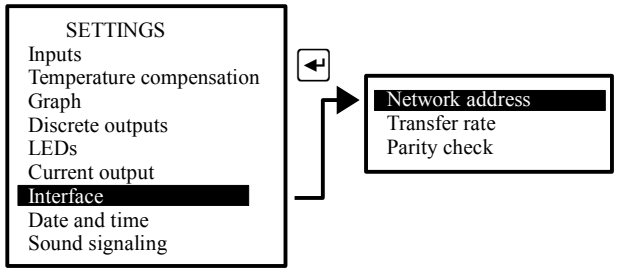
– Upper measurement limit - the upper limit value of the selected parameter is set.

– Current output range - one of the options of the current output range is selected: (0 ... 5) mA (0 ... 20 mA) or (4 ... 20 mA).

Current outputs → Exit 2 - setting the parameters of the second current output.

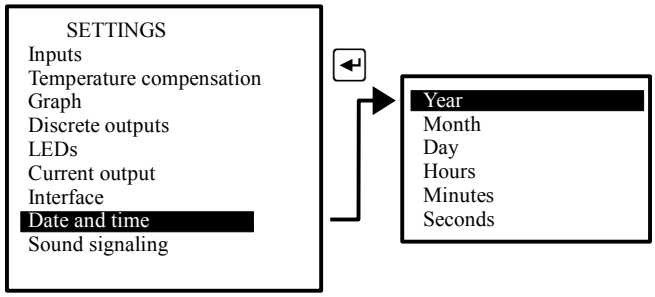
The parameters of the second current output are configured similarly to the setting the parameters of the first current output.

8.3.2.7 Interface



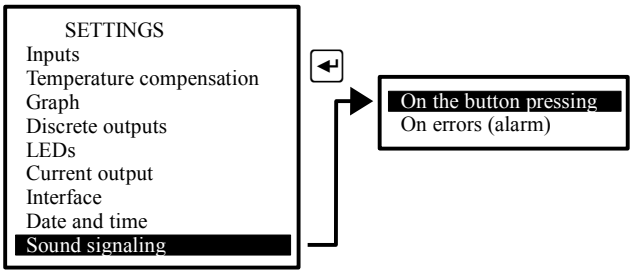
In this mode, the interface parameters are set: network address, transfer rate and a parity check.

8.3.2.8 Date and time



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

8.3.2.9 Sound signaling



In this mode, the sound alarm is set:

– On the button pressing - when this mode is on the beeps are audible by pressing the buttons on the front panel of the pH meter.

– On errors (alarm) - when this mode is on, the sound signal is activated (intermittent audible alarm), if a diagnosed pH meter error appears.

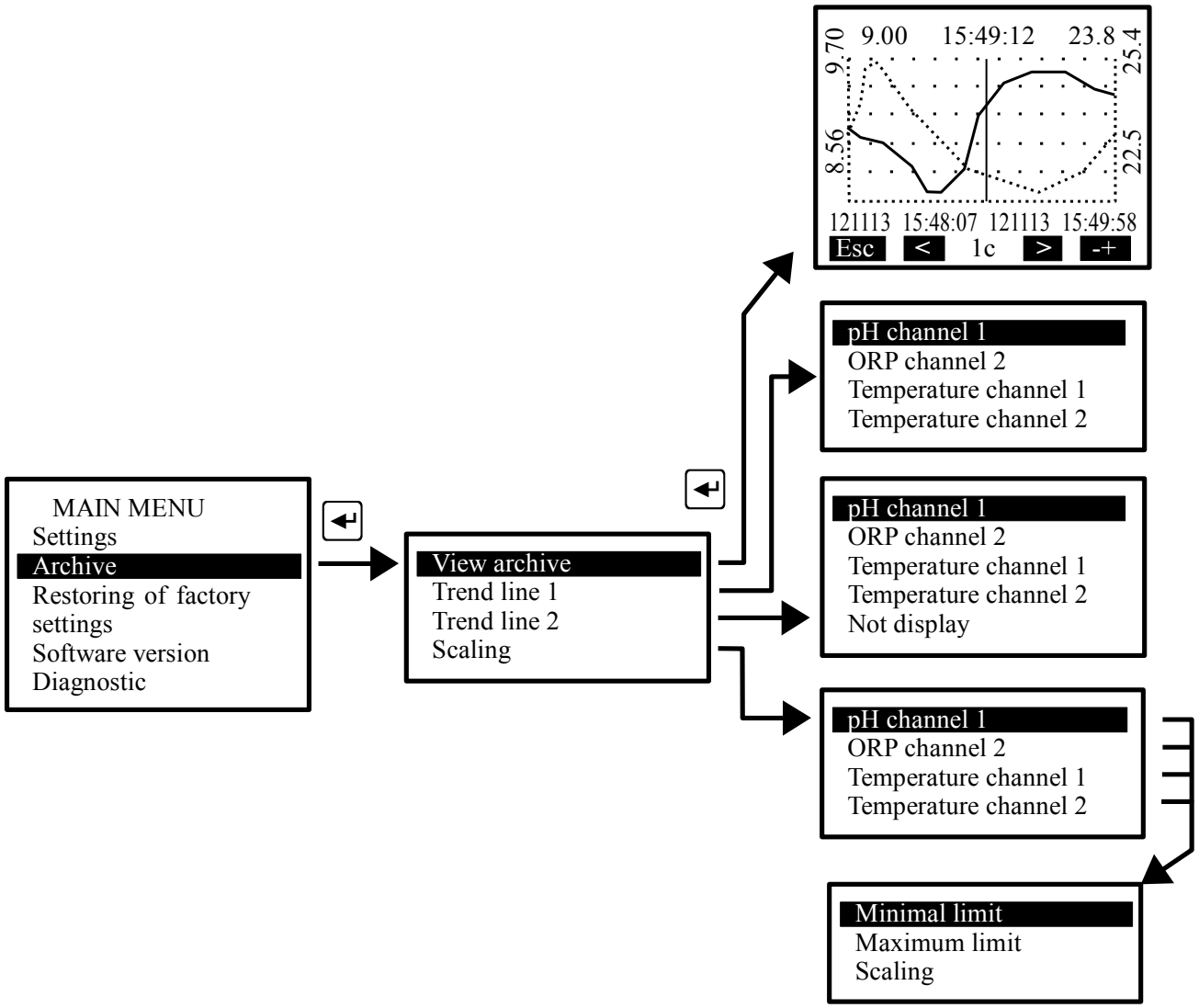
8.3.3 ARCHIVE sub-menu

In this mode the viewing and configuration of the archive display is made. (See section 8.2).

– View Archive - in this mode the archive is displayed. Right button ↵ allows to switch the control cursor mode: ◀ and ▶ or a time discrete interval will be changed or cursor indicating the time of viewing and the values of the measured parameters at this time moves (See Figure 1).

– Trend line N1 - in this mode a parameter with a ***continuous*** line will be displayed.

– Trend line N2 - in this mode a parameter with a ***broken*** line will be displayed.



– Scaling - in this mode, for each measured parameter the minimum and maximum limits for the trend displaying are set. When scaling mode selection, the minimum and maximum limits are determined automatically - sub-menu structure "Archive".

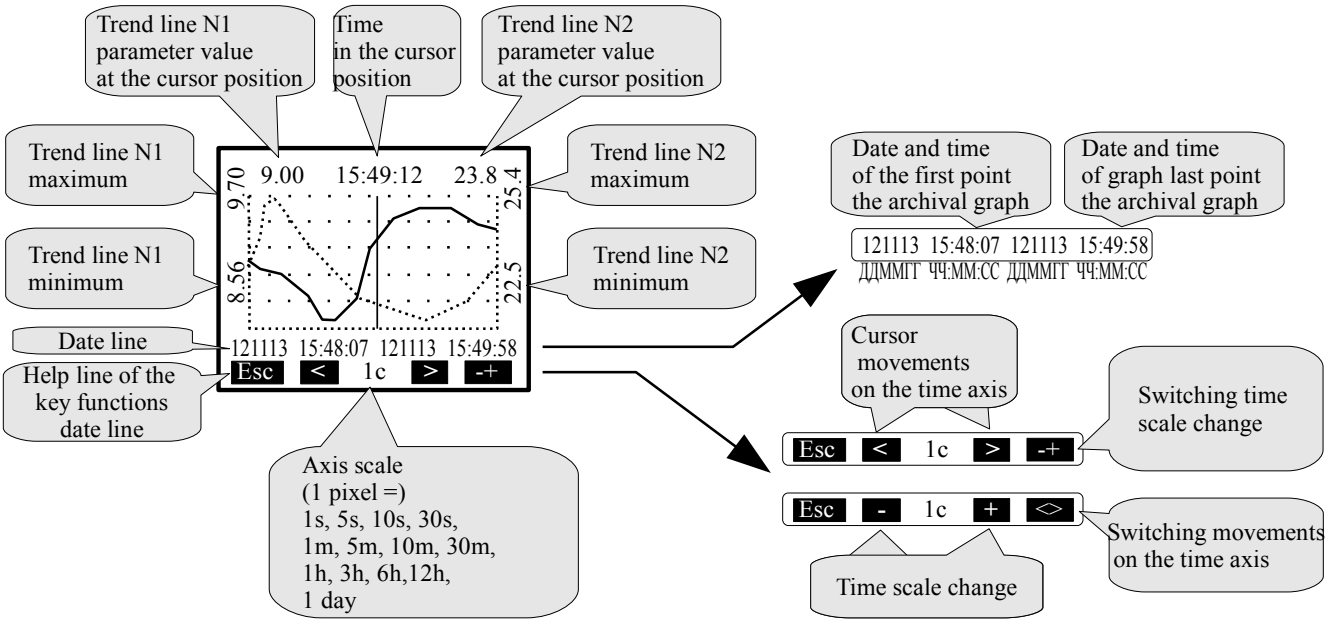


Figure 1 - Description of the control elements and data display in the "View Archive" sub-menu

8.3.4 Restoring the factory settings. In this mode, you can restore the pH meter settings installed at the manufacturing plant.

8.3.5 Software version

In this mode, you can view the software version of "PH" set in this pH meter:

pH-meter
pH-4122P V01.02.01
compilation date:
27.01.2015 15:36

8.3.6 DIAGNOSTICS. In this mode it is possible to read the errors diagnosed with a pH meter:

- Internal error 1;
- Internal error 2;
- No connection to БВД8 (for wall design only);
- defective temperature sensor. 1 (2).

If no error the message will be displayed: No errors were detected

8.3.7 First channel calibration

Pressing **я-key** the pH meter switches to the electrode system calibration mode connected to the first channel of the pH meter. Calibration is performed on pH (ORP) buffer solutions.

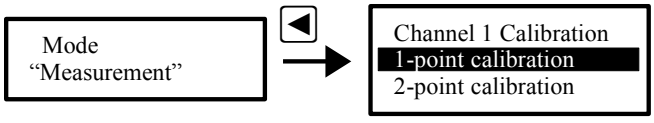


Figure 2 – pH channel 1 calibration

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

After selecting the type of calibration and pressing the button **},** display shows the parameters of the previous measurements of the first buffer (buffer): temperature, buffer value, EMF electrode system.

At the bottom side of the display there are four fields that specify the functionality of the corresponding buttons (below keys) on the front panel of the analyzer.

When you press the second button (**Measur.**) the parameters of the temperature and EMF appear on the display, which are measuring at this time by the solution. **Buffer 1** .

At the top right of the display the mode of the buffer determination (or buffer assignment): Automatic or Manual. In the first case the buffer value is determined automatically by the analyzer from the scale 1.65 pH 4.01 pH 6.86 pH 9.18 pH 12.43 pH (298 mV, 605 mV), in the second case – it is set manually. To select a specific mode (buffer assignment), its necessary to click the key **Buffer** and choose accordingly "**Auto"** or "**Manual assignment"**.

After the setting the stable and not changing values its necessary to click the key SAVE to save the measured results. Then click >> to continue the further calibration.

When one-point calibration Calibration Result Ei (Ecm) is displayed. If this parameter falls outside the set limits, the display will show a warning notes: Wrong calibration result!!!. You can save the result of the calibration pressing SAVE? key or to abandon this calibration result by pressing the >> button and returning to the start of calibration.

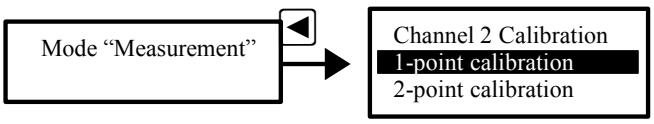
When two-point calibration by pressing the button >> after saving the first buffer measurement results analyzer goes to work with Buffer 2 solution. Calibration on the second buffer solution is similar to the first buffer solution.

After calibration with the second buffer solution and pressing the button >> display shows Calibration result Ei (Ecm) and S. If the value of these parameters fall outside the set limits, the display will show a warning: Wrong calibration result!!! . You can save the result of the calibration pressing SAVE? key or to abandon this calibration result by pressing the >> button and returning to the start of calibration.

8.3.8 Second channel calibration

While pressing the **Ч-key** pH meter enters the electrode system calibration mode, connected to the second channel of the pH-meter.

The second pH electrode with a temperature sensor or ORP electrode will be connected to the second channel. Calibration is performed with pH (ORP) buffer solutions.



Calibration of the second channel of the pH meter is performed similarly to the first channel.

8.3.9 Numeric value setting algorithm

Setting of the numerical values of pH meter parameters is carried out bit by bit.
Selection of decimal places, the value of which should be changed, is performed by pressing button **я**. Correcting position is displayed in the flashing mode.

To change the value of the selected position it is necessary to press the button **ч**, and the value of each bit (excluding the higher) will be changed cyclically in order of 0, 1, ..., 9, 0, and so on. If you change the higher order digit the value changes cyclically in order of 0, 1, ..., 9, -9, -8, ..., -1, 0, 1, and so on (if it is allowed for this option).

8.4 To entry the "Measurement" mode, press the button **{.**

9 Eventual failures and remedies

When error diagnosing, a flashing error code, such as E10 appears in the measurement mode in the analyzer screen top line.
To determine a kind of error enter the MAIN MENU (button }) and select the mode DIAGNOSTIC.

Failures	**Probable cause**	**Remedy**
No connection with БВД8 (For wall version only)	No connection with БВД8	Check the correctness of БВД-8.2 connection (if БВД-8.2 is not used, it must be disconnected from the MAIN MENU - Digital outputs - БВД -8)
Internal error 1	Analogue input 1 failure	Send analyzer for repair
Internal error 2	Analogue input 2 failure	
Temperature sensor 1 failure (2)	Temperature sensor channel 1 closing or breakout (2)	Check the operability and correctness of the temperature sensor channel 1(channel 2)
Incorrect "floating" pH measured value readings	No "grounding electrode" (see Appendix C)	"Ground" the solution by connecting the "Housing" terminal with the analyzed fluid by means of a wire, for example

10 Maintenance

10.1 Maintenance includes the periodic cleaning of the electrode from contamination, periodic inspection and calibration of the pH meter with the buffer solutions.
10.2 Inspection interval - one year.
10.3 Maintenance of electrodes.
10.3.1 pH electrode.
Its required to handle the glass pH-sensitive membrane with care and to protect it from damage.
An essential prerequisite for the correct functioning of the glass pH electrode is the presence of the water-containing, so-called soaked layer on the surface of the glass membrane. If the electrode for a long time was stored in a dry form, it is necessary

before the measuring to prepare it properly. For this purpose a sensitive part of it is immersed in the 3 mol / l KCl solution and soaked for one day. It is recommended for storage to put a prepacked cap on the electrode glass membrane, previous filled with 3 mol / l KCl solution.

It is necessary to remove the contamination on the surface of the glass membrane. If a gentle rubbing with a soft and moist filter paper or paper towel is unsuccessful, then depending on the type of contaminants the different chemical methods can be used (a mild glass clearers, laboratory detergents, acetone, alcohol, not concentrated acid solutions, such as 10% hydrochloric acid). Never use the abrasive cleaners to clean the membrane.

10.3.2 ORP electrode.

ORP electrode differs from the pH electrode, because it has no glass membrane, but contains platinum or gold pins. Soaking procedure of ORP electrode is similar to the soaking procedure of pH-electrode.

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

11.1 The front panel of the pH meter bears the following information:
- company – manufacturer (or a trade mark);
- identification code;
- approval mark of the types of measuring instruments;
- serial number and year of production;
- identification of units detectors and control buttons.

11.2 The frame bears the following information:
- company – manufacturer (or trade mark);
- identification code;
- approval mark of the types of measuring instruments;
- serial number and year of production.

11.3 The reverse side of the terminal compartment cover contains a diagram of external circuits.

11.4 Transparent housing cover and terminal compartment cover can be sealed to prevent unauthorized adjustment or interference that may distort the measurement results.

11.5 The pH-meter and documentation are enclosed into a package made of the polyethylene film and are placed into carton boxes.

11.6 The pH-meters 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.

Transportation of the pH meters is carried out in wooden boxes or cartons, transportation of the analyzers in containers is acceptable.

The boxing method of the pH meter boxes should exclude their movement during the transportation time.

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

Residence time for the pH meter under appropriate conditions of transportation is max. 6 months.

11.7 The pH meters should be stored in the heated rooms with a temperature (5 ... 40) ° C and a relative humidity of less than 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 3 as per GOST 15150-69.

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

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,
ZAO "NPP " Avtomatica"
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 A
Overal and fixing dimensions

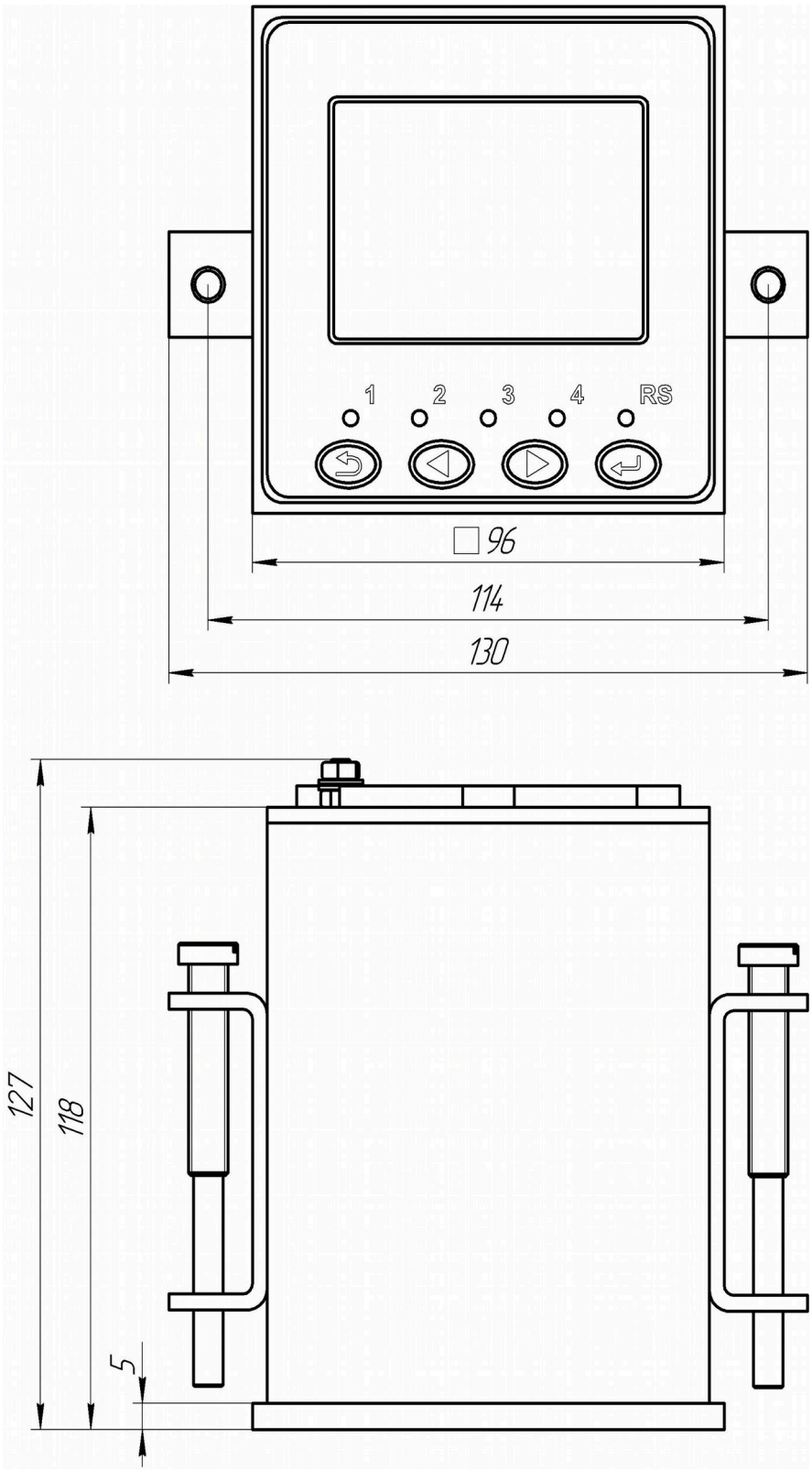


Figure A.1- Measuring device of a panel design

Continuation of Appendix A

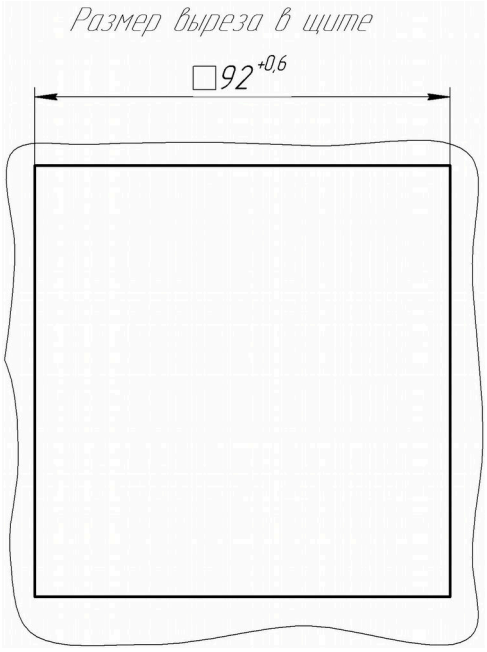


Figure A.2 - Panel cut size for the measuring device of a panel design

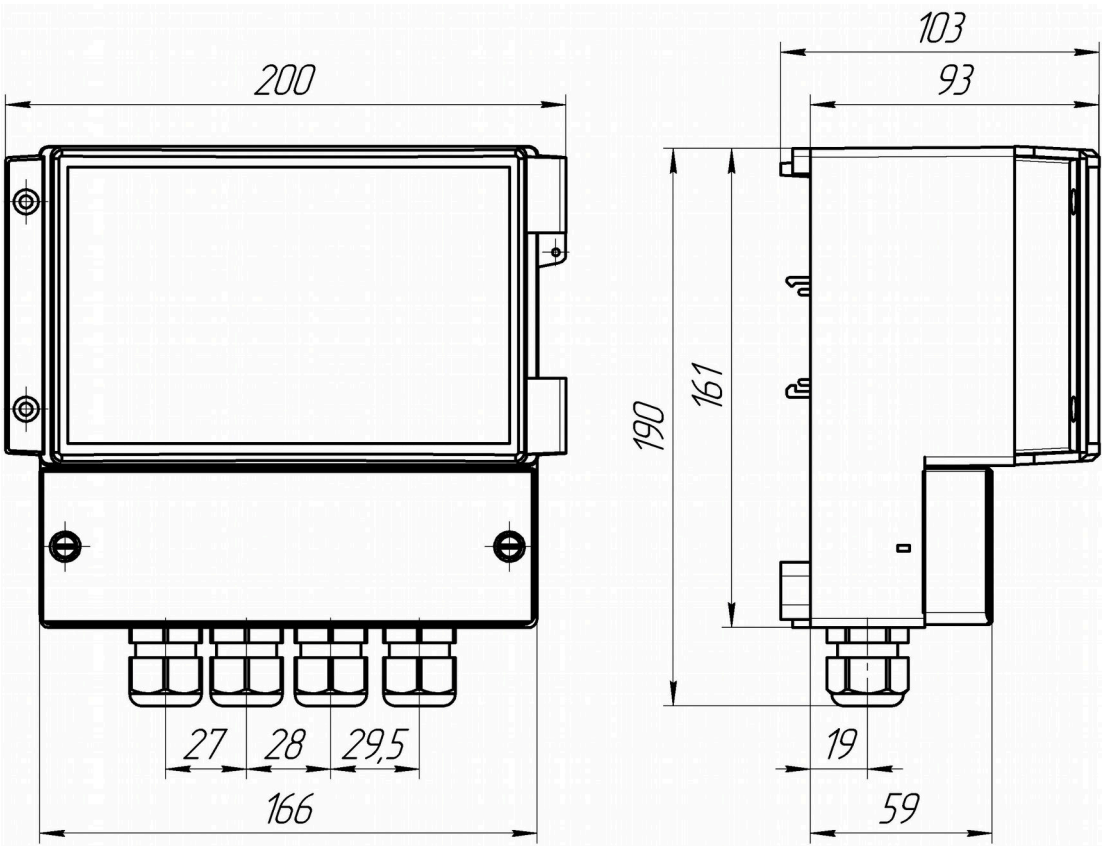


Figure A.3 Wall-mounted measuring device

Figure A.4 - Fixing the wall-mounted measuring device using a mounting panel

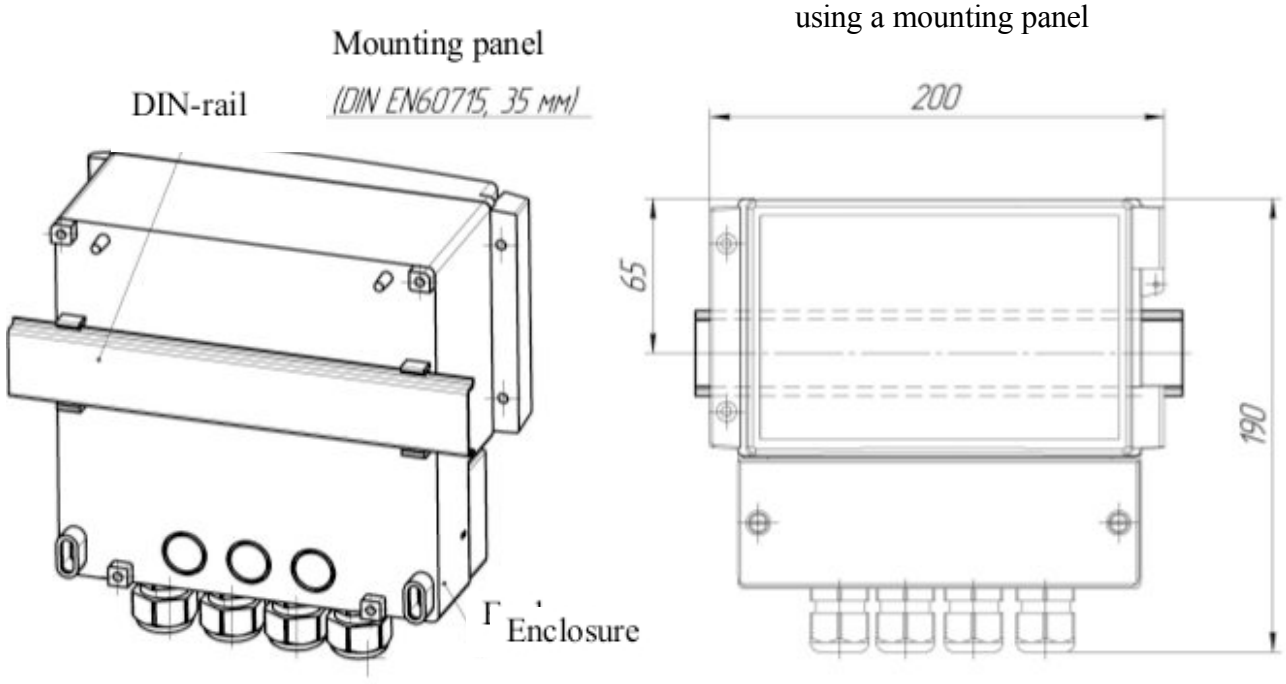


Figure A.5 - Fixing the wall-mounted measuring device on the DIN-rail

End of Annex A

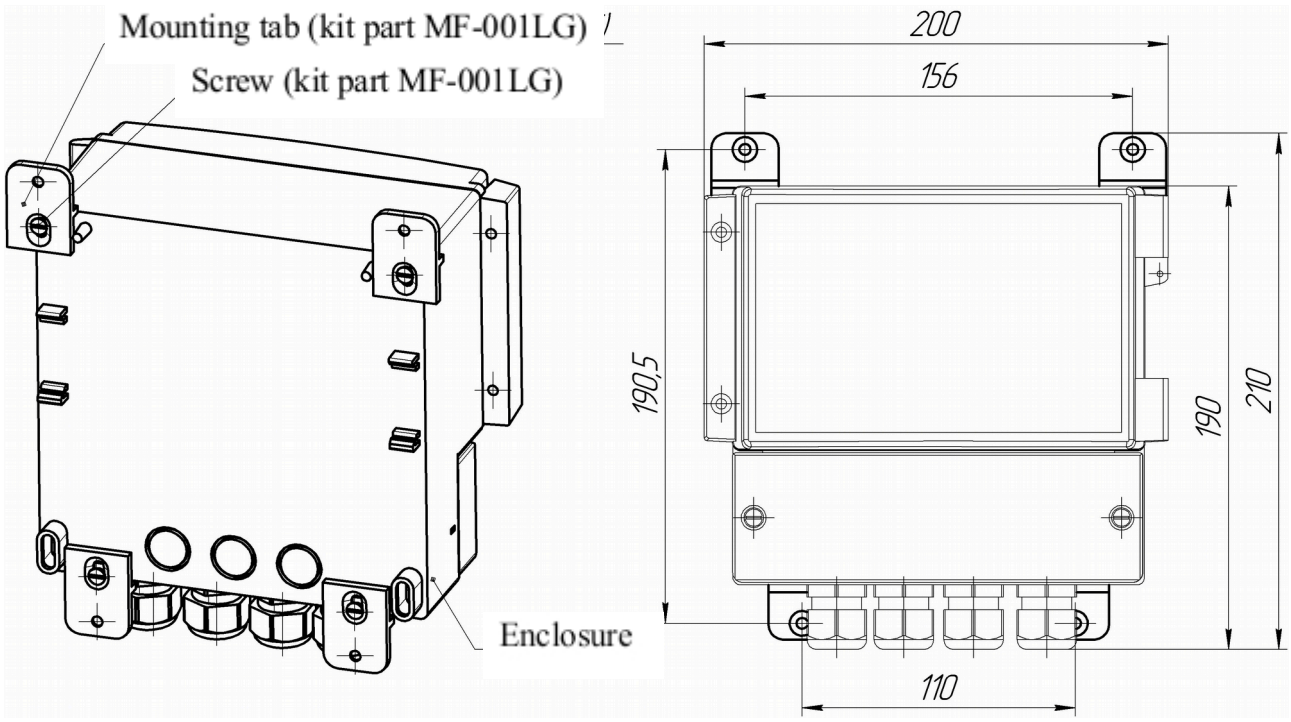


Figure A.6 - Fixing the wall-mounted measuring device using mounting loops

Annex B
External view of measuring devices

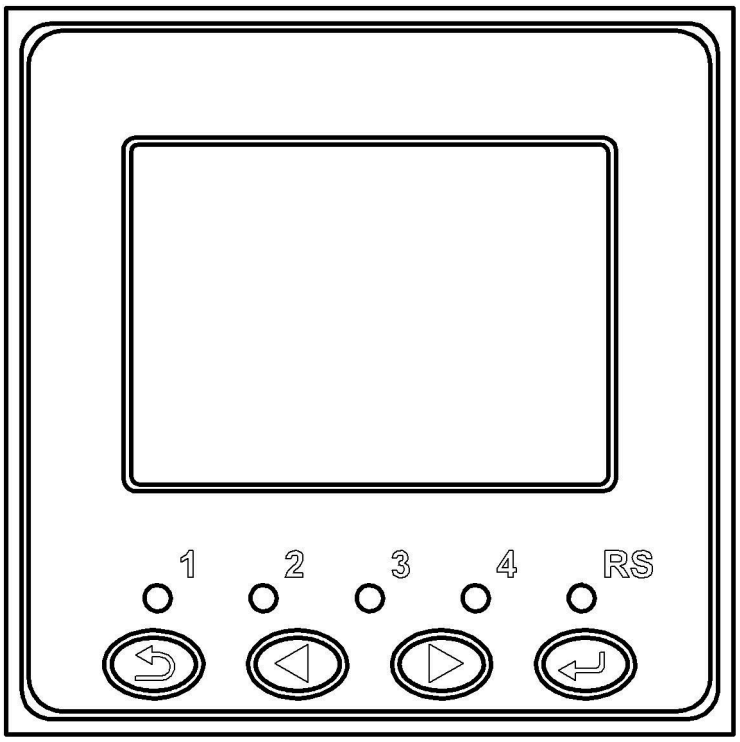


Figure B.1 The view from the front panel of the measuring device of a panel design

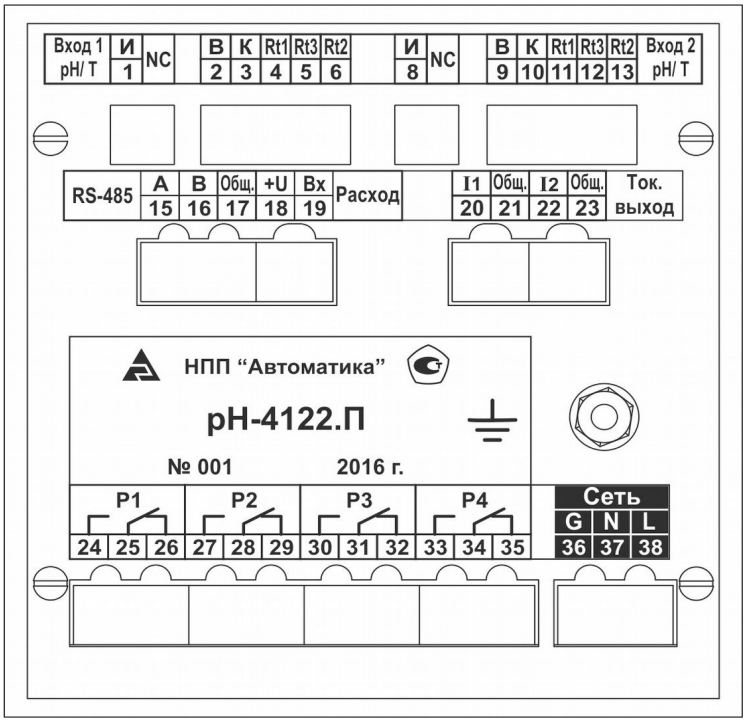


Figure B.2 - View from the back panel of the measuring device of a panel design

End of Annex B

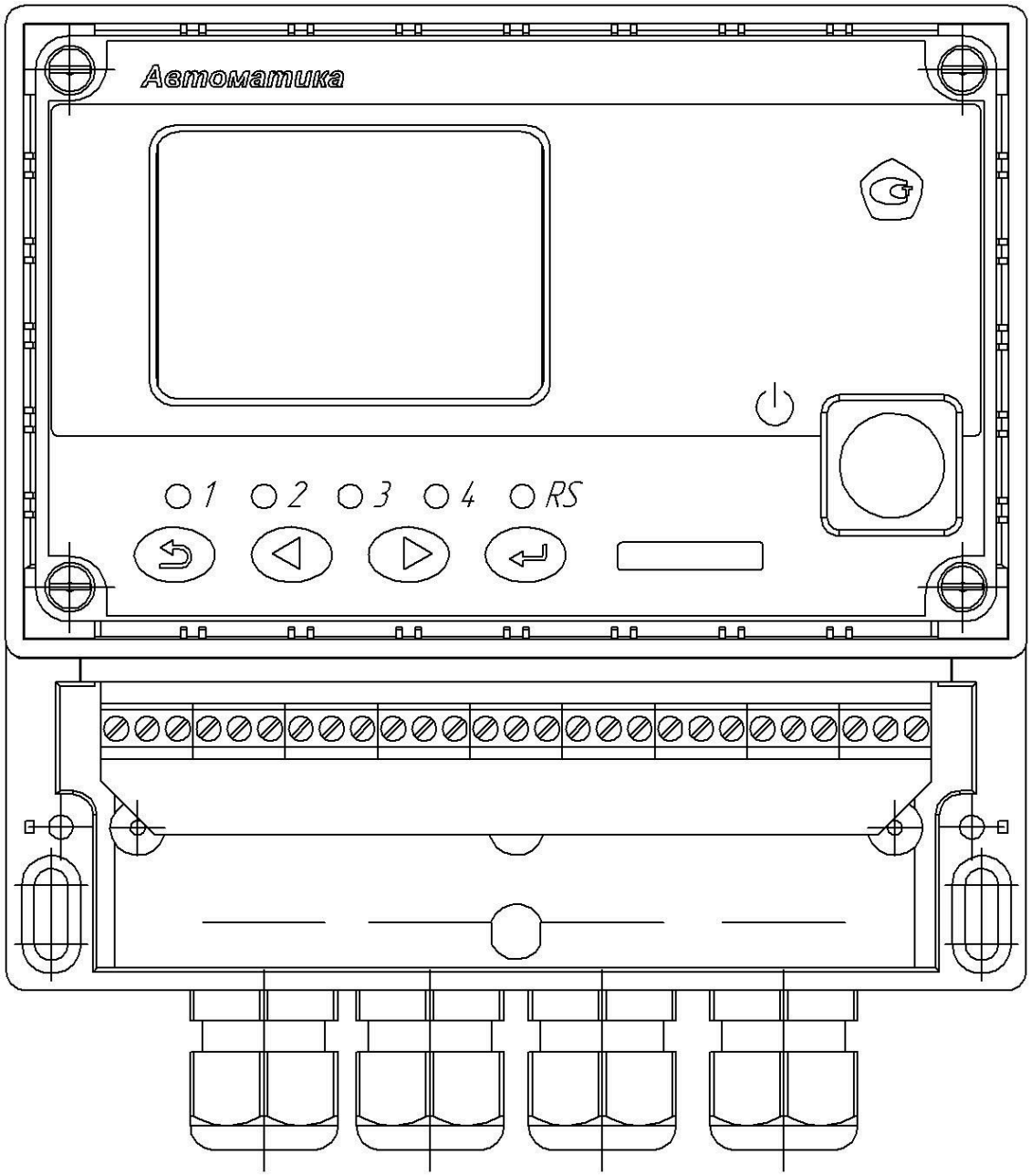
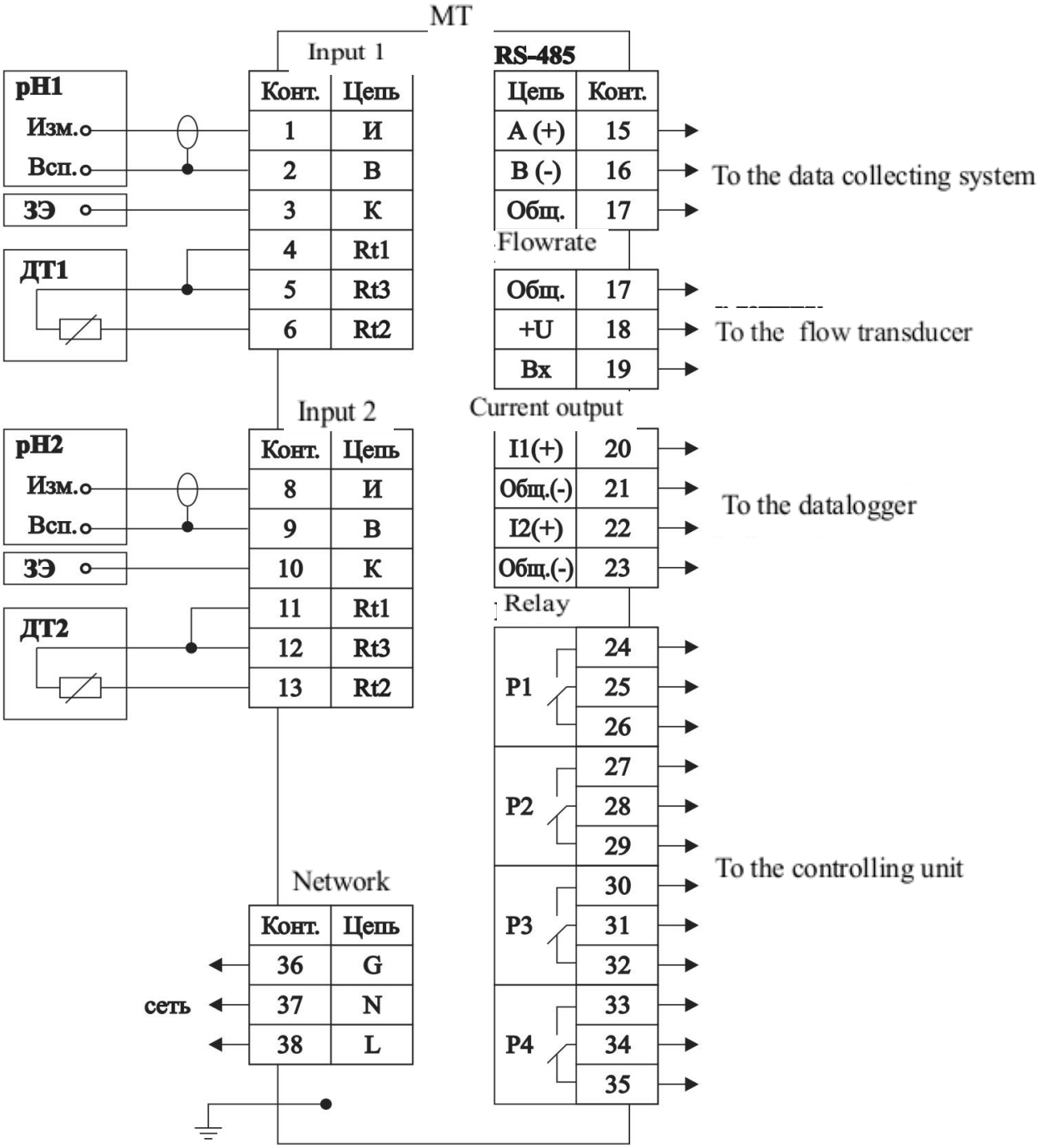


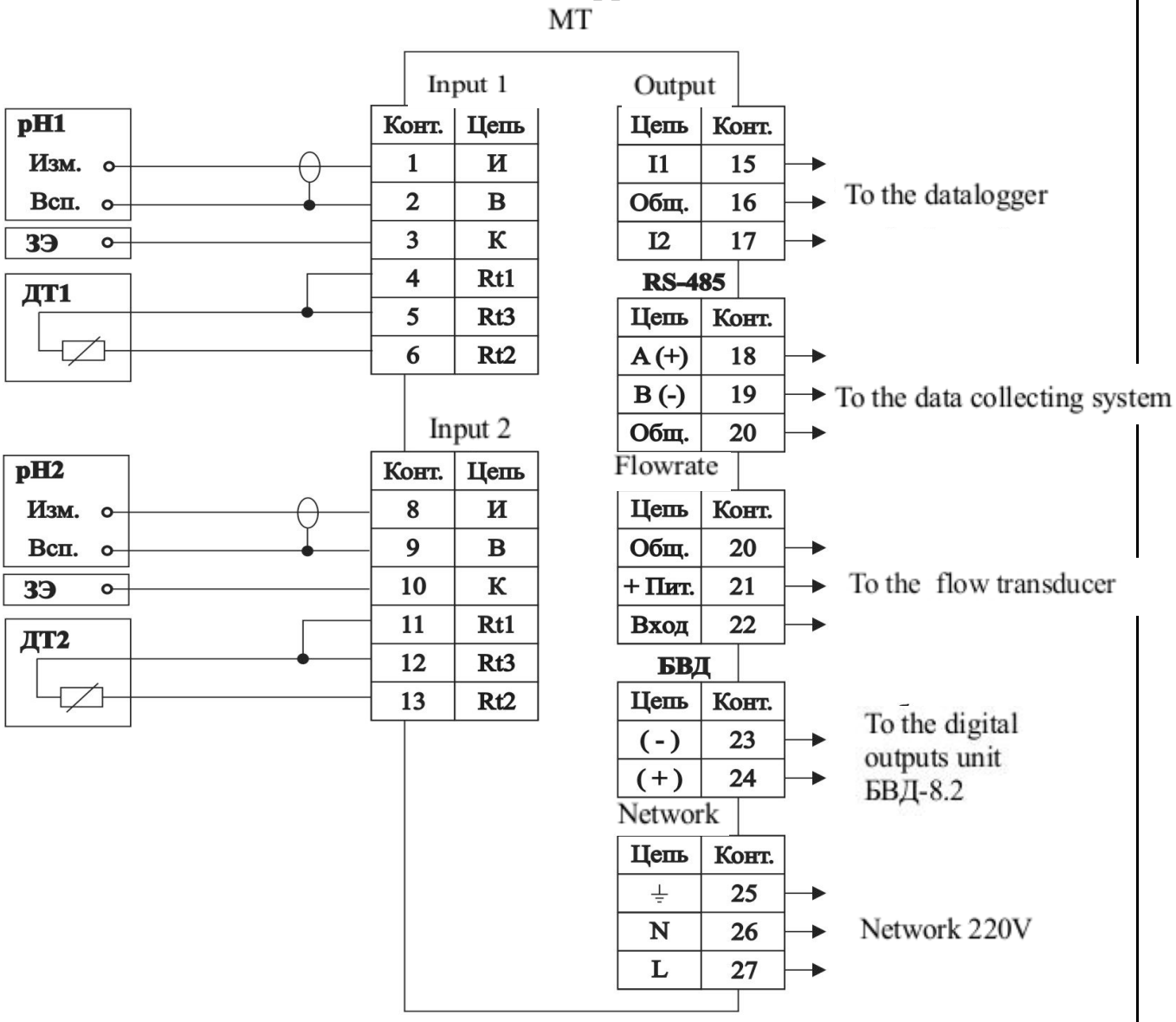
Figure B.3 - View from the front panel of the wall-mounted measuring device

Annex C
External connection diagram



MT - measuring transducer
TS — temperature sensor
pH — combined pH electrode. The similar connection have a space measuring electrode and a subsidiary electrode
GE - grounding electrode

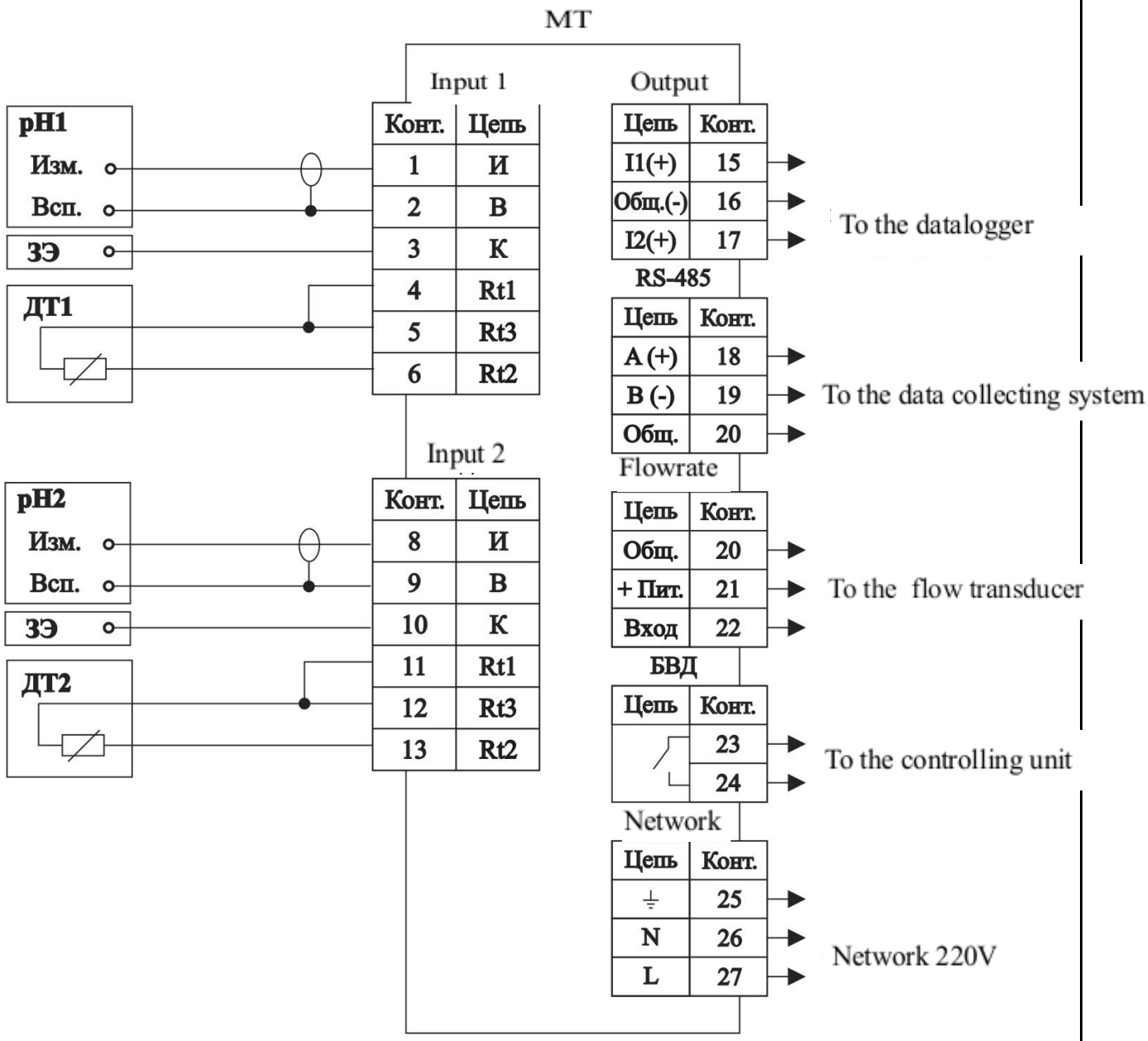
Figure C.1 - External connection diagram of the pH meter with MT of a panel design



MT - measuring transducer
TS — temperature sensor
pH — combined pH electrode. The similar connection have a space measuring electrode and a subsidiary electrode
GE - grounding electrode

Figure C.2 External connection diagram of pH meter with wall-mounted MT with БВД-8.2

Continuation of Appendix C



MT - measuring transducer
TS — temperature sensor
pH — combined pH electrode. The similar connection have a space measuring electrode and a subsidiary electrode
GE - grounding electrode

Figure C.3 External connection diagram of pH meter with a wall-mounted IP with one digital output

End of Annex C

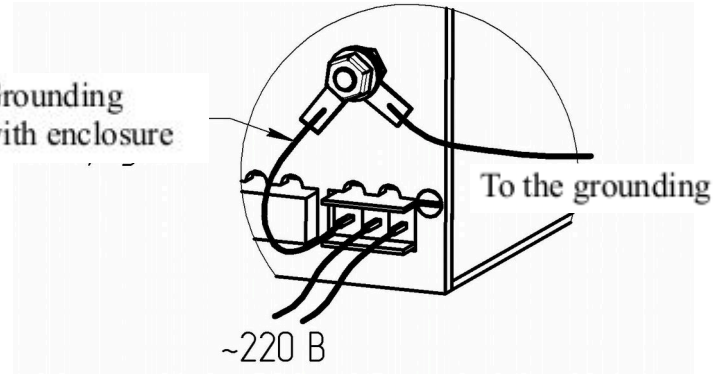


Figure C.4 - Grounding the measuring device of a panel design for EMC improving

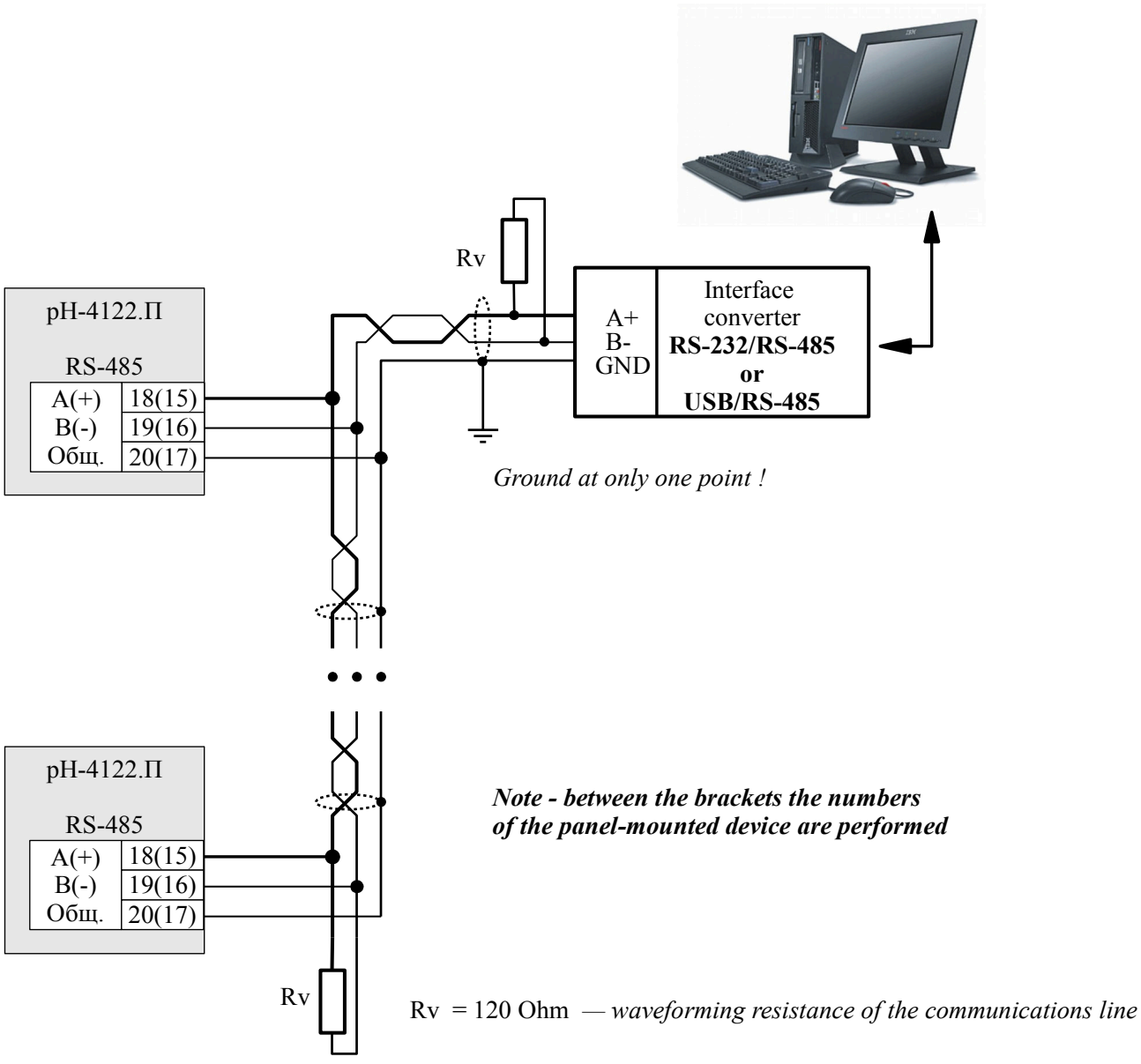


Figure C.5 Powering devices with RS-485 interface to the local network

Annex D
pH meter calibration

D.1 The button function (identification is displayed in the calibration window) in the calibration mode:

- **<<** - return to the previous window;
- **>>** - transfer to the next window;
- **Save?** - saving calibration results in the nonvolatile memory;
- **Measur** - moving to the current measurement mode of a calibrated parameter;
- **Save** - exit the current measurement mode of a calibrated parameter remembering the measured values for the further calculations and saving them in the nonvolatile memory;
- Buffer - enter the buffer task menu.

D.2 Procedure for calibration:

– set the temperature compensation mode;

– calibrate a pH meter 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)%, accordingly;

– If the error do not meet the limit, you need to check the the electrode connection correctness and do re-grading;

– If after the re-calibration the error does not satisfy the allowable values, it is necessary to replace the electrode.

D.3 The pH-meter temperature sensors connected to each measurement channel are used to measure the temperature. If the temperature sensor is not connected or misconnected, manually specified temperature values are used in the **pH** calculation.

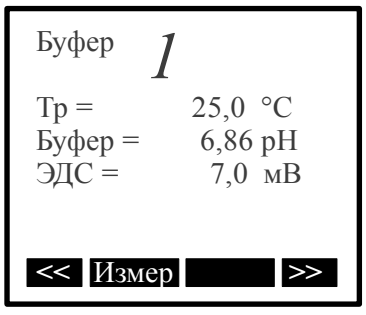
D.4 Calibration

Press the ◄-key for the pH/ORP-electrode calibration (channel № 1);

Press the ►- key for the pH/ORP-electrode calibration (channel № 2);

Select the calibration option: one-point or two-point calibration;

Press the button ↵ on the selected menu option, in this case the calibration window on the buffer solution appears on the display:



where T - saved temperature value;

Tp - indicates that the temperature sensor is disconnected and a manually setpoint temperature value is switched on automatically;

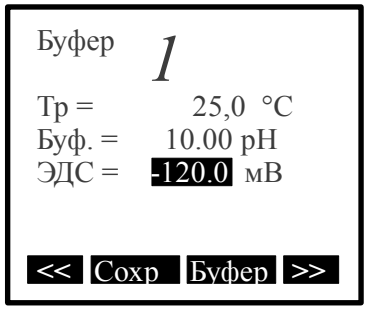
Ta - indicates the measured temptrature value;

6,86 pH - previously saved value of the calibrated parameter, for ORP - value is in millivolts (mV);

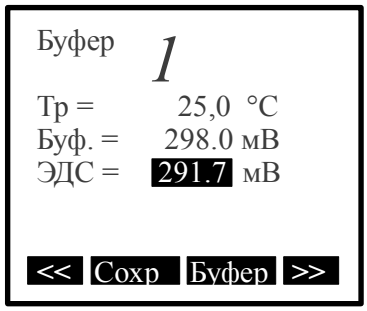
If the change of the buffer solution settings is not required, you can move to the next calibration window. Press **>>** (↵) button. For one-point calibration it is the calculation of ES parameters, for two-point calibration it is a window on the buffer №2;

To exit the calibtation without saving the changes press the button **<<** (↩);

To move to the measurement mode of a set buffer press the button **Measur** (◀).



← **pH** calibration window on the buffer solution.



← **ORP** calibration window on the buffer solution.

EMF measured value flashing means a change of a measured parameter. Wait until it stops flashing (measured value stabilization) for at least 10 seconds.

D.5 To change the buffer value press the button **Buffer** (▶). In this case appears the menu:

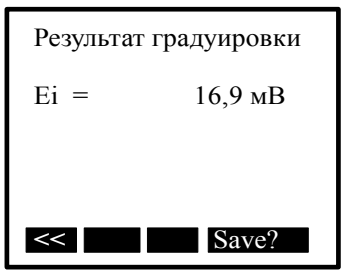
To select the required buffer value press ↵ on the selected item.

For storing the measured and / or set parameters press **Save** (◀). If to enter the next window without pressing **Save** (◀), all the measured and / or set parameters for this point of calibration will be lost.

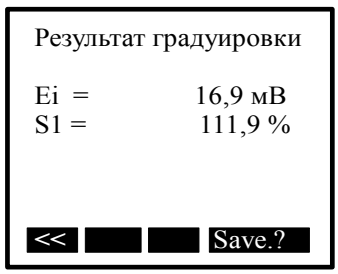
D.6 For ES calibration on the second buffer it is necessary to do all the same steps as for the ES calibration of the first buffer.

D.7 To move to the window of calculating ES parameters from the stored data, press the button **>>** (↵), the screen displays the following:

when one-point calibration:



when two-point calibration:



Warning notice appears:

Результат градуиров
ошибочный !!! - Wrong calibration result!!!

it means, that the calculated **Ei or S values** overruns (-50... 50) mV or (80... 120) % accordingly, a valid value is highlighted in a black background.

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

Notice appears:

Выберите другой
буферный раствор - select an other buffer solution

it means, that wrong buffer value is set, or the the value for the second calibration point is the same as the value for the first calibration point. It is necessary to change the buffer solution.

Notice appears:

Результат градуиров
ошибочный !!! - Wrong calibration result!!!

it means, that the calculated **Ei or S values** overruns (-50... 50) mV or (80... 120) % accordingly, a valid value is highlighted in a black background.

Calculated and saved parameters are registered in the nonvolatile memory and are used immediately after the pressing the key Save? (↵).

Sheets of registration changes

Rev.	Sheet number (page)				Total sheets quantity	Document No	Registration number and Date of the accompanying document	Signature	Date
	revised	replaced	new	cancelled					

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e-mail: **market@avtomatica.ru**
http://www.avtomatica.ru