Joint-Stock Company «NPP «AUTOMATICA»

CONDUCTIVITY ANALYZER

MODEL АЖК-3101М.х.АС

OPERATING INSTRUCTION MANUAL

АЖК3101.01.АС-15РЭ

Rev. 5.1

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Authorized signature

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Introduction

The present operation manual serves to introduce the structure and to ensure correct operation of the conductivity analyzer, АЖК-3101М.х.АС, (hereinafter referred to as the analyzer) offering improved reliability for NPP (nuclear power plant).

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 as well as other branches of industry requiring the reliable operation of the analyzer under severe service conditions, namely: in terms of seismic stability, climatic conditions, radiation stability, complex situation related to electromagnetic compatibility (EMC).

Depending on the sphere of application analyzers are subject to checking or calibration in accordance with the procedure set forth in the present operation manual (Annex A).

Analyzers are manufactured in compliance with spec ТУ 4215-046-10474265-2009.

1 Purpose

1.1 The analyzer is designed for the measurement and verification of electric conductivity (hereinafter referred to as EC) of solutions of acids, alkalies, salts and other solutions which do not form film on the sensor electrodes.

1.2 The analyzer is composed of the primary transducer (hereinafter referred to as PT) and the measuring device (hereinafter referred to as the MD). PT consists of the electronic block and a sensor.

The analyzer is produced in two variants:

- PT features a monoblock design with the electronic block and the sensor structurally integrated;
- PT with a spaced apart electronic block and a sensor. Such design is employed in the conditions of the radiation activity of test liquid.

1.3 Climatic execution as per GOST 15150*:

- the primary transducer, ТВ3;
- the measuring device, ТВ4.

1.4 The analyzer service conditions:

- ambient air temperature: (5...50) ˚С;
- ambient air relative humidity: up to 80 %;
- atmospheric pressure: (84...106,7) kPa.

1.5 In terms of the protection against penetration of dust and water the PT construction complies with IP65 as per GOST 14254.

MD is constructed as a general industrial version.

1.6 The design in terms of stability to mechanical effects complies with group V2 for PT and group N2 for MD under GOST 12997.

1.7 The seismic-stable version is in conformity with category II as per НП-031-01.

Note: GOST* - Russian state standard for NPP

1.8 Quality assurance category, QNC, agrees with ПОКАС(О).

1.9 Performance in terms of noise immunity, IV, is as per GOCT 50746*. Criterion of the functioning quality is A.

1.10 Stability to ionizing radiation effect:

- the absorbed dose rate of the sensor is up to 0,1 gray/h within one year;
- the integral absorbed dose of the PT electronic block does not exceed 150 grays.

2 Technical data

2.1 Measuring ranges

Measuring ranges as a function of the modification are illustrated in Table 1:

Table 1 Measuring ranges

Duty	Modification	Measuring range
EC analyzer	АЖК-3101М.1.АС	(0,000…1,000) µS/cm
		(0,00…10,00) µS/cm
		(0,0…100,0) µS/cm
		(0…1000) µS/cm
	АЖК -3101М.2.АС	(0,000…1,000) mS/cm
		(0,00…10,00) mS/cm
		(0,0…100,0) mS/cm
		(0…1000) mS/cm
Concentration analyzer for solutions of salts, acids, alkalies	АЖК -3101М.К.АС	0…20 %; 0…230 g/l (NaCl) 0…25 % , 95…99 % (H_2SO_4); 0…15 % (HCl); 0…20 % (HNO_3); 0…10 % , 20…40 % (NaOH); 0…20 % (KOH)

Notes:

1 On the customer request the specific measuring range can be set by the company- manufacturer. The customer can readjust the analyzer to a different range within the limits of the analyzer modification.

2 Upon the customer request a different range of measurement can be set in concentration analyzers.

3 On the customer request readings of the digital display in analyzers for concentration are set in percentage or grams per liter in compliance with the standardizable relation between EC and the concentration of the test component in the solution.

4 In case the linearization of the sensor performance is required EC analyzers can be produced in the АЖК-3101М.К modification.

5 On the customer request the concentration analyzer can be tailor-made for the determination of the concentration of solutions of other substances. In this case the concentration is calculated by the analyzer against the standardized dependence of the electric conductivity on the solution concentration at the preset operating temperature submitted by the customer in the inquiry schedule.

Note: GOST* - Russian state standard for NPP

2.2 The limit of the allowable value of the basic error, % of the range used:
- with EC analyzers max: ±2,0 %;
- with concentration analyzers it is specified with the order depending on the measuring range and the composition of test liquid, however, max: ±5,0 %.

2.3 The limit of the allowable value of the complementary error, % of the range, caused by the variation in the ambient air temperature as high as 10˚С within the limit of temperatures specified in item 1.4, is max. ±1,0 %.

2.4 Range of the temperature measurement: (0…150) ºС.

2.5 The limit of the allowable value of the absolute error in temperature measurement, not exceeding:
- within the range of (0…50)ºС ± 0,5ºС;
- within the range of (50…100)ºС ± 1,0ºС;
- within the range of (100…150)ºС: ± 2,0ºС.

2.6 The limit of the allowable value of the complementary error, % of the range, caused by the variation in the temperature of the test liquid as high as ±15˚С relatively the reduction temperature (with the temperature compensation activated) is max. ±2,0 %.

2.7 Temperature interval of test liquid (5…120) °С;

2.8 Pressure of test liquid, max. 0,6 MPa.

2.9 Viscosity of test liquid, max. 0,2 Pa·с.

2.10 Readings of EC (concentration) and temperature are taken against the four-digit seven-segment LED display of the measuring device. The display light is red or green.

2.11 Communication between PT and MD is effected via the four-wire cable. Conductor cross section is (0,35…1,0) mm^2 . The length of the communication line is up to 800 m.

2.12 The time of availability for service after connection, max. 15 minutes.

2.13 The analyzer is powered from the AC network having voltage of (100…240) V and frequency of (50 …60) Hz.

2.14 The direct current output analog signal (in compliance with the order):
- (4...20) mA, load resistance up to 0,5 kOhm;
- (0…5) mA, load resistance up to 2,0 kOhm.

2.15 Logic output signals that signal the output value of the test EC (concentration) value falling beyond the limits of settings, type switching "dry contact":
- switching voltage of 240 V;
- switching current up to 3 A.

The LED display activation signaling of the test EC (concentration) value falling beyond the limits of settings. Values of settings are programmable within the analyzer measuring range.

2.16 Wattage, max. 15 VA.

2.17 For the PT design exhibiting a spaced apart electronic block and a sensor communication between the sensor terminal box and the electronic block of the primary transducer is provided by a special cable with two screened twisted pairs. Conductor cross- section – (0,35…1,0) mm^2 . The length of the communication line is max. 5 m.

2.18 Weight of the primary transducer electronic block, max. 3,2 kg.

2.19 Weight of the sensor with the immersion depth of 400 mm, max 1,0 kg.

2.20 Weight of the measuring device, max. 0,7 kg.

2.21 Overall and fixing dimensions of primary transducers and measuring devices are specified in Annex B.

2.22 Mean time between failures, 20000 h.

2.23 Average service life is at least 8 years. Application of the analyzer on corrosive media results in the reduction of service life.

Example of the order interpretation:

«АЖК-3101М.1(2;К).АС» - liquid analyzer for conductivity, АЖК-3101М.1 featuring the measuring range from (0...1) µS/cm to (0...1000) µS/cm (2 – exhibiting the measuring range from (0...1) mS/cm to (0...1000) mS/cm; К – the concentration meter) with the stainless steel housing of the primary transducer electronic block. Besides, the specific measuring range, temperature of the temperature compensation reduction, length of the immersed part, output analog signal, display color are specified. With PT in the spaced apart design the length of cable between the terminal box and the electronic block is specified.

3 Completeness

The set of the analyzer delivery is illustrated in Table 2:

Table 2 – delivery set

Specification	Qty.	Note
Primary transducer including: - electronic block; - cable for communication _____ m - sensor	1 pc. 1 pc. 1 pc. 1 pc.	 with PT in spaced apart design
Measuring device	1 pc.	
Certificate	1 pc.	
Operation manual	1 copy	It is allowed to enclose 1 copy per the batch of 5 analyzers supplied to one address
Set of additional operational documentation	*	* Upon the agreement with manufacturer
Set of spare parts in accordance with the spare part list	*	* Upon the agreement with manufacturer

4 Arrangement and principle of operation

4.1 Principle of the analyzer operation

Principle of the analyzer operation is based on the determination of the liquid electric conductivity caused by the alternating electric field applied to electrodes of the electric conductivity contact sensor.

EC of liquid is calculated by the formula:

$$æ = \sigma C, \quad (1)$$

where, æ – EC, S/cm;

σ – test conductivity, S;

C – constant of the sensor defined by its geometric dimensions, cm^{-1}.

The ion mobility in liquids is highly temperature – dependent, therefore EC increases as the temperature rises.

Temperature dependence of EC of aqueous solutions in most cases can be determined by the formula:

$$æ_t = æ_{to}[1+(t - t_o)\ \alpha_t\ ], \quad (2)$$

where, $æ_t$ – EC at the operating temperature t, S/cm;

$æ_{to}$– EC at the temperature of the temperature compensation reduction t_o, S/cm;

t – temperature of test liquid, °C;

t_o – temperature of the temperature compensation reduction, °C;

α_t – EC temperature coefficient, $°C^{-1}$.

Rough values α_t equal to:

- 0,016 $°C^{-1}$ for acids (1,6 % / ºC),
- 0,019 $°C^{-1}$ for bases (1,9 % / ºC),
- 0,024 $°C^{-1}$ for salts (2,4 % / ºC).

4.2 The analyzer arrangement

The analyzer is composed of PT and MD linked by the four-wire communication line.

PT is a finished product functional and metrological characteristics of which define the technical specifications of the analyzer as a whole.

Depending on the modification primary transducers contain differences in sensor constants and settings of electronic blocks.

MD is designed to provide power supply to PT, galvanic isolation between the signal delivered from PT and output analog signal, filtration of electromagnetic interferences, display of measured EC and temperature values and signaling of the EC value falling beyond preset settings.

Measuring devices do not feature differences in the circuit diagram and the design as a function of modification. Depending on the modification measuring devices are provided with two types of different software.

4.3 Structure of the primary transducer

Structurally the primary transducer is composed of a frame housing the electronic block and the contact conductivity meter for the measurement of the test liquid EC.

In order to ensure the reliable operation of the primary transducer under the conditions of the ionizing radiation effect from test liquid use is made of PT in the spaced

apart design. In this case the PT electronic block can be removed from the sensor terminal box to the distance of up to 5 m.

Functionally PT is designed to generate the electric signal proportional to the EC value of test liquid. The circuit design of the PT electronic block is based on micro controller which provides for monitoring of all PT functions, namely:

- generation of supply voltage of the conductivity meter;
- measurement of EC and temperature;
- control of switching over of EC measuring ranges;
- correction of EC measured value with due regard for temperature;
- provision of communication with the measuring device.

The PT sensor is a cylinder construction made of steel 12Х18Н10Т (or other material as per the order). The sensor design ensures passage of the electric current through test liquid in a specific amount between the sensor electrodes. Specific geometric dimensions of the sensor electrode system enable to calculate EC of test liquid by the measured value of the flowing current.

The PT design, installation and maintenance are described in detail in the assembly, start-up and adjustment manual for АЖК3101.01.АС-15ИМ.

The electronic block consists of two circuit boards integrated into the frame. Circuit boards carry elements of the electronic circuit and terminal blocks for the connection of the communication line wires with the measuring device.

The frame is covered with a cover provided with a sealing braid. The communication line wires are connected to the analyzer via the air-tight cable entry.

The sensor and the electronic block frame are structurally integrated. In case of PT in the spaced apart design the sensor is structurally combined with the terminal box. The terminal box and the electronic block are joined by means of cable.

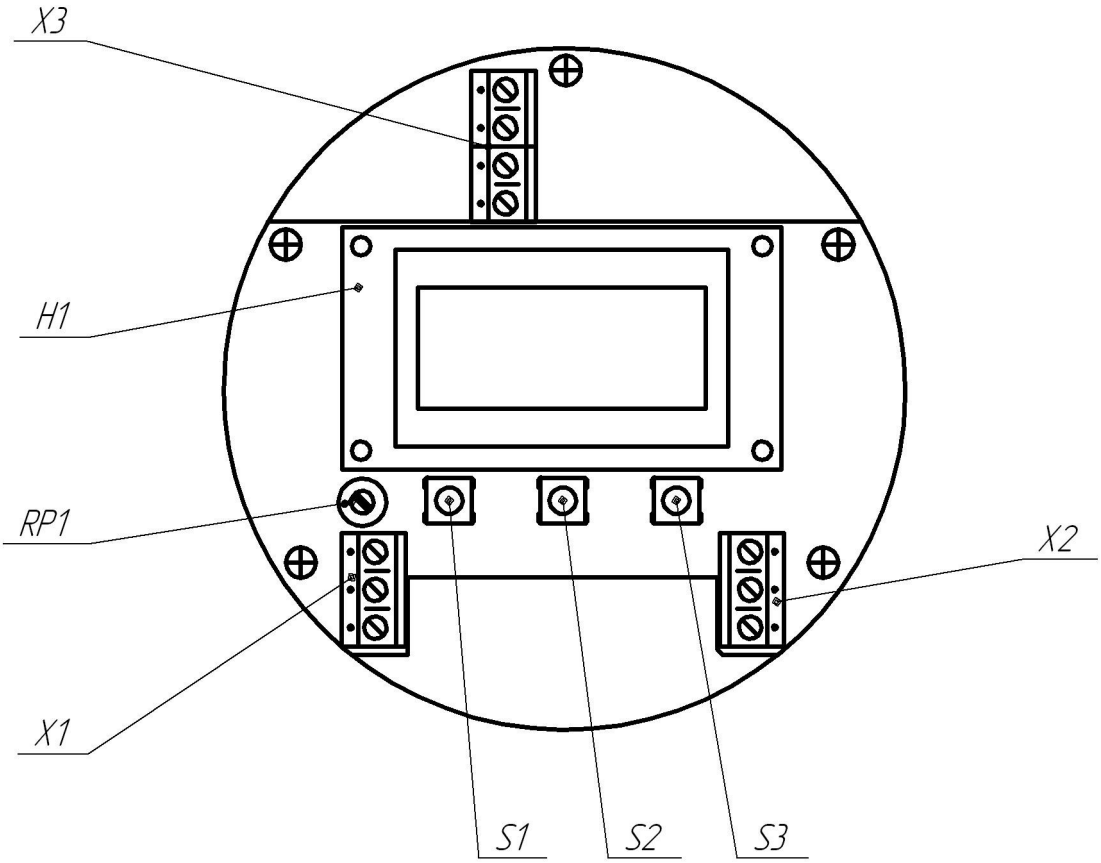
Fig 1 illustrates the relative position of plugs, controls and displays in the PT electronic block (with the front cover removed).

The top part of the electronic block contains a four-contact terminal block to which the connecting cable is connected for communication with the measuring device.

In the middle part of the electronic block there is a numeric – digital display designed for PT programming and the indication of EC and temperature values in the measuring mode. PT programming is performed using keys located under the display.

There are four wires coming from sensor to the electronic block which are connected by means of terminal strips positioned in the lower part of the electronic block.

A fine-tunable resistor designed for the regulation of the display contrast is installed on the top circuit board of the electronic block



X1 – plug for the connection of the temperature sensor
X2 – plug for the connection of the conductivity sensor
X3 – plug for the connection of the PT communication line cable with MD
RP1 – fine - adjustable resistor for the regulation of the display brightness
S1 – key to enter a parameter
S2 – key for the parameter decrease
S3 – key for the parameter increase

Fig. 1 – Exterior of the PT electronic block

4.4 Arrangement of the measuring device

Structurally MD is constructed in a frame provided with a detachable rear panel. Elements of the electronic circuit are located on three boards – the main board, the board of relay and the board of display. The main board is connected with the board of relay by wires and soldering, and with the board of display – by means of two plugs. The main board with the board of relay and the board of display is installed into the frame from the side of the rear panel across guiding grooves in the frame side walls and is fixed by the rear panel.

The main board houses the power supply elements, the microprocessor –based control unit, the digit-to-analog converter and the voltage – current converter, elements providing for the protection of the remaining MD assemblies against electromagnetic interferences effecting input, output and feed ports. The board of display contains single and seven-segment displays and push buttons.

The MD functions as described below.

The input current signal from PT causes variation in voltage drop which switches the photo coupler. The photo coupler ensures galvanic isolation between input and output circuits of the analyzer. From the photo coupler the output the signal is delivered to the input of the control unit which measures the length of this signal.

The microprocessor-based control unit ensures the operation of all analyzer assemblies: it computes and displays the information on the board of display and the digit – to analog converter.

The output current signal is generated by the galvanic isolated voltage-current converter to the input of which the signal is delivered from the output of the digit-to-analog converter.

Elements of control and display are located on the MD front panel (Fig. 2, а)

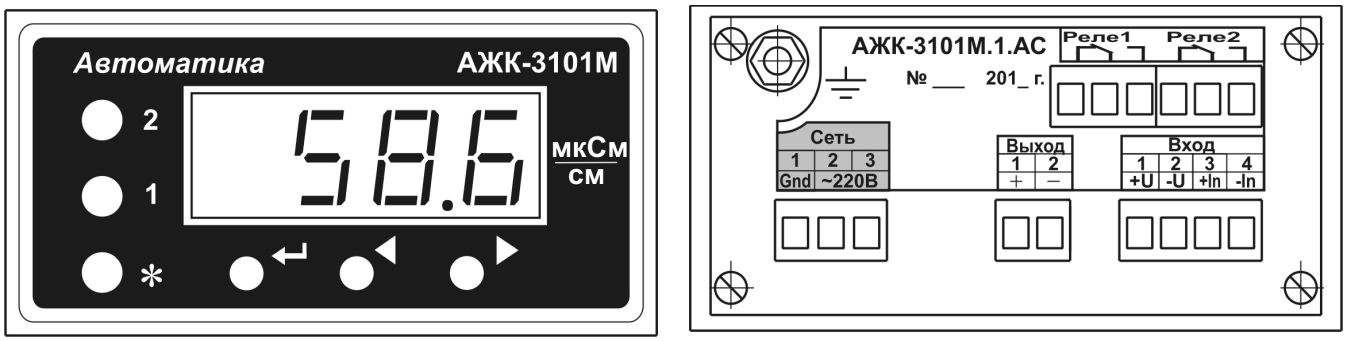
Single displays «**1**» and «**2**» signal about the test parameter falling beyond the limits of appropriate settings and the actuation of relevant relays.

A single display «*» in the «**Измерение**» (**Measuring**) mode signals about the absence of a signal from PT.

The operation of keys and single displays is described in item 7 in more details.

In the “Measuring” mode the digital display shows the value of the test parameter or settings.

The rear panel (see Fig. 2, b) contains plugs for the connection of input and output signals and supply voltage, a screw for grounding of the device frame.



a) front panel b) rear panel

Fig. 2 – exterior

5 Directions related to safety measures

5.1 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.

5.2 The analyzer frame must be grounded.

5.3 The analyzer connection must be made in accordance with the marking with supply voltage de-energized.

6 Preparation for operation

6.1 Outer inspection.

After unpacking it is necessary to check the following conformities:

- the analyzer must be complete in conformity with the certificate;
- serial number must correspond to that specified in the certificate;

- the analyzer must be free of mechanical damages.

6.2 Fixing of signaling settings.

6.2.1 Prior to the installation of the measuring device on a panel, if necessary, it is possible to perform re-programming of setting values and operating conditions of the signaling relay.

6.2.2 The description of programming of setting values and operating conditions of signaling relay for analyzers, АЖК-3101М.1.АС and АЖК-3101М.2.АС series, is presented in Annex F and for analyzers, АЖК-3101М.К.АС series, in Annex G.

6.3 Sequence of installation.

6.3.1 PT installation on the object.

The PT sensor is installed in the vertical or horizontal position by means of a boss welded to the tank or a pipe via a sealing gasket.

The PT design, installation and maintenance are described in detail in the installation, start-up and adjustment manual for АЖК3101.01.АС-15ИМ.

The PT frame must be grounded.

6.3.2 MD installation on a panel.

MD mounting dimensions and dimensions of the opening in the panel are specified in Annex B, (Fig.B.1). Connect cables in accordance with one of the diagrams (Annex C) depending on the design version of the primary transducer.

Cross section of cable conductors of the communication line must be (0,35… 1,0) $mm^{2.}$. When connecting the cable it is necessary to check the quality of sealing in the union.

Ground the MD frame.

7 Sequence of operation

7.1 Operational regulations.

7.1.1 The analyzer does not require tuning (with the exception of programming of signaling settings) and after energizing it starts functioning in accordance with pre-programmed parameters (in compliance with the inquiry specification).

7.1.2 After energizing the analyzer switches to the measuring mode.

The MD front panel houses single displays, «**1**» and «**2**» signaling of the test EC value falling beyond preset settings.

The single display, «✳», in the «**Измерение**» (**Measuring**) mode signals about the absence of a signal from PT. In case of the input signal absence at the MD input (e.g. in case of the break of the communication line with PT) this display flashes and the «**ОБР.**» (**Break)** indication appears on the digital display.

Under the normal operation in the measuring mode the test EC value (for АЖК-3101М.1.АС and АЖК-3101М.2.АС) or the concentration value (for АЖК-3101М.К.АС) is indicated on the digital display.

When pressing and holding ◁ or ▷ keys values of signaling settings "**1"** or "**2"**» resp. are displayed. In this case appropriate single displays are activated in the flashing mode confirming the control of settings.

When pressing and holding ↵ key the temperature value of test liquid is indicated on the digital display.

7.2 Description of the device operation

7.2.1 The analyzer set consists of the primary transducer and the measuring device. Power is supplied to PT from MD by two wires. The second pair of the communication line wires is used to transmit current pulses from PT to MD.

7.2.2 Analyzers, АЖК-3101М.1.АС and АЖК-3101М.2.АС series.

7.2.2.1 Analyzers, АЖК-3101М.1.АС and АЖК-3101М.2.АС series, are designed for the operation within four ranges, they differ from each other by the units of EC measurement: АЖК-3101М.1.АС analyzers operate within the ranges from (0…1) to (0…1000) µS/cm; АЖК-3101М.2.АС function within the ranges from (0…1) to (0…1000) mS/cm.

Measuring devices of the above modifications feature similar design and software.

7.2.2.2 The analyzer primary transducer can operate either in one of four basic measuring ranges (Table 1) or in their combinations. The measuring device automatically determines the range in which the primary transducer operates.

7.2.2.3 The generation of the analog output signal occurs in MD. The output signal proportional to EC is a bilinear function with two programmable parameters, H1 and H2.

In the area of EC variation from zero to **H1** value the output signal changes from the initial value to the average value of its variation range, e.g. from 4 to 12 mA (Fig. 3).

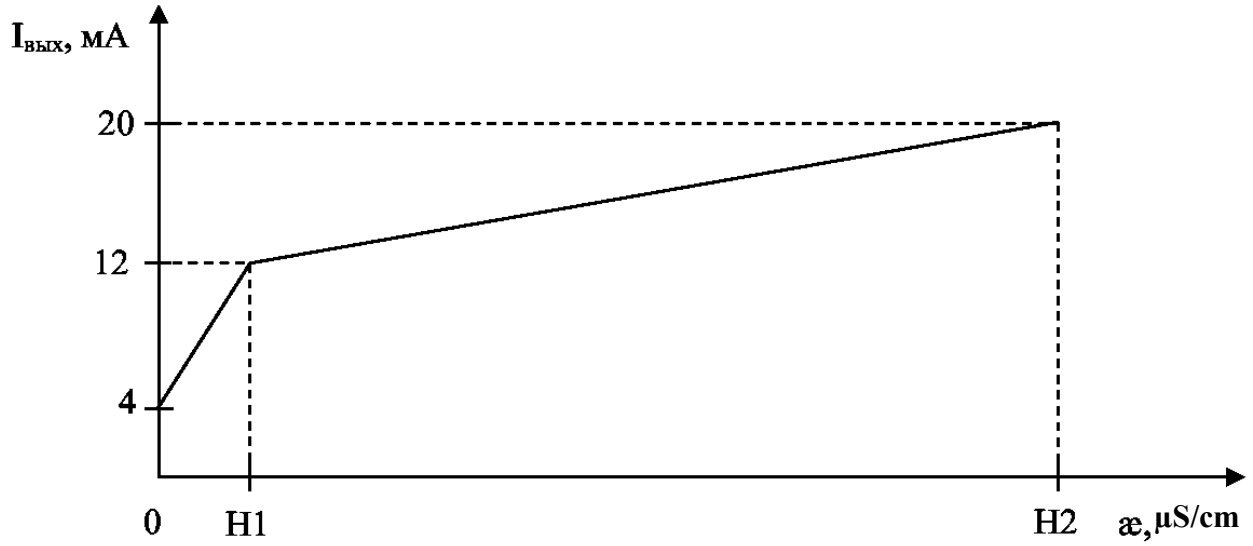


Fig. 3 – Output current as a function of EC

In the area of EC variation from **H1** value (inflection point) to **H2** value (the upper limit of the analyzer output characteristic) the output signal varies from the average value to the final value of its variation range, i.e. from 12 to 20 mA.

By varying the position of the inflection point, **H1**, it is possible to increase the output signal resolution for the initial or for the final part of the measuring range (from 0 to **H2**). The pattern of presetting of **H1** and **H2** parameters is presented in Annex F.

Note: the provision of the linear dependence of the output analog signal within the measuring range from 0 to H2 is possible by two variants:

- to set H1 > H2;

- to set H1 = H2/2.

7.2.2.4 The temperature compensation of the EC measured value is performed in the primary transducer.

Tree modes of operation are possible:

- temperature compensation is disengaged;
- temperature compensation is activated with due regard for the temperature dependence of theoretically pure water;
- simple temperature compensation is activated with the possibility of setting the temperature coefficient and the reduction temperature (see formula 2).

The activation of the required temperature compensation condition and setting of temperature compensation parameters is described in Annex E.

7.2.2.5 The measuring device offers the possibility to fix values of settings and the threshold (hysteresis) of the LED signaling system actuation as well as modes of operation (Annex F).

7.2.3 Analyzers, АЖК-3101М.К.АС series

7.2.3.1 Analyzers, АЖК-3101М.К.АС series, are designed for operation in one range. The required range is set at the company – manufacturer in compliance with the inquiry specification. The range is defined by the standardizable relation between EC and the concentration of the test component in the solution.

Measuring devices of АЖК-3101М.К analyzers feature software different from АЖК-3101М.1.АС and АЖК-3101М.2.АС analyzers enabling to perform the linearization of the input characteristic.

7.2.3.2 With the linearization activated MD readings in the units of concentration, including position of the comma, are defined in the course of programming by the assignment of known values of concentration (the output characteristic) of the test solution to the EC values (the input characteristic) (Annex G, item G 4).

Note: at the company-manufacturer one of the basic measuring ranges is set in the primary transducer, the required parameters of linearization are set in the measuring device.

7.2.3.3 The output current signal of the measuring device is proportional to the concentration of the test solution and is a function of the set lower and upper limits of the measuring range in terms of concentration (by the output characteristic).

Example: the measuring range of 0,0…100,0 mS/cm is set in PT. The variation range of the solution concentration of 0,00…5,70 % agrees with this range. If the lower limit of the measuring range is set to 2,00% and the upper to 5,00 % the output current signal will vary linearly from the initial (e.g., 4 mA) to the final value (e.g. 20 mA) with changing of MD digital display readings from 2,00 to 5,00 % (see Annex G).

7.2.3.4 The temperature compensation of the EC measured value is performed in the primary transducer.

Two modes of operation are possible:

- temperature compensation is activated;
- simple temperature compensation is activated with the possibility of setting the temperature coefficient and the reduction temperature (see formula 2).

It is not recommended to activate the temperature compensation mode with due regard for the temperature dependence of theoretically pure water, however, in case this mode of temperature compensation is activated the temperature coefficient will equal to 2 % per a degree and the reduction temperature will be 25ºС.

The order of the activation of the required mode of the temperature compensation is specified in Annex E.

7.2.3.5 The measuring device exhibits the possibility of fixing values of settings and threshold (hysteresis) of the signaling activation as well as operation modes (see Annex G).

8 Eventual failures and remedies

Failures	**Probable cause**	**Remedy**
Flashing indication «**ОБР.**»(**Break)** on the digital display of the measuring device, the single display "✳" is flashing	1. Break of the communication line between the primary transducer and the measuring device. 2. Wrong connection of the primary transducer	Check the communication line and correctness of the primary transducer connection

9 Maintenance

9.1 The analyzer maintenance includes the periodic test and, if required, cleaning of the sensor electrodes, inspection of its technical condition.

Inspection interval – 1 year.

9.2 Inspection and, if required, adjustment of the analyzer must be performed in the following cases:

- after routine repairs, cleaning of electrodes;
- after replacement of the sensor;
- in 1 year after the last test (in compliance with the inspection interval).

9.3 The analyzer test is conducted in accordance with the instruction for "Liquid analyzer for conductivity, АЖК-3101М. Inspection procedure" (see Annex A).

10 Marking, packaging, transportation and storage

10.1 The frame of the primary transducer bears the following information:

- type of the device;
- company – manufacturer;
- serial number and year of production;

10.2 The frame of the analyzer measuring device is provided with the following information:

- company - manufacturer;
- type of the device;
- serial number and year of production;
- measuring range;
- range of the output signal variation.

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

10.4 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.

10.5 Analyzers are transported in wooden cases or carton boxes bearing manipulation marks as per GOST 14192: “Handle with care, brittle,” “Top, do not turn over“. Transportation of analyzers in containers is allowed.

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

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

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

10.9 Analyzers must be stored in heated rooms having the temperature of (5...40) ºС 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.

11 Manufacturer warranties

11.1 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.

11.2 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.

11.3 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.

12 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
Check-up procedure

The present manual applies to liquid analyzers for conductivity, АЖК-3101М.х.АС series, (hereinafter referred to as analyzers), it introduces the method of primary and periodic checks. Calibration is performed using the same procedure.

Inspection interval is one year.

A.1 Check procedure

The following operations must be carried out in the course of checking:

- outer examination (see item A.5.1);
- control of the MD insulation electric resistance (see item A.5.2);
- testing (see item A.5.3);
- determination of the basic error, % of the range, of EC measurement (item A.5.4);
- determination of the complementary error, % of the range, resulting from the variation of the test liquid temperature (with the temperature compensation activated) (see item A.5.5).

A.2 Check aids

When performing a check use must be made of the following measuring aids:

- EC reference solutions under GOST 8.457-2000 having values of (20±5), (50±5), (80±5) % of the measuring range and the relative error max. 0,5 %;
- test solutions prepared as per GOST 22171-90 (Annex D);
- a lab-scale conductivity apparatus, КЛС-1А type, accuracy rating of 0,25;
- lab-scale thermometers for the measurement of temperature from 5 to 95°С, scale factor of 0,1°С;
- water thermostat ensuring constancy of the temperature within the limits of ± 0,1°С within the range from 5 to 95°С;
- voltmeter (milliammeter), В7-38 type, the basic error is max. ±0,2%;
- resistance box, МСР-63 type, resistance up to 111111,1 Ohm, accuracy rating of 0,05;
- megohmmeter,М1101М type, 500 V, 500 Mohm;
- resistors, МЛТ-2 type: 0,25 кOhm and 1,0 кOhm.

Note: usage of different measuring aids offering metrological characteristics not inferior to those above mentioned is allowed.

A.3 Safety requirements

Safety measures required during the operation with analyzers are specified in item 5 of the present operation manual.

A.4 Conditions for the check performance

When performing a check it is necessary to observe the following conditions:

- ambient air temperature (20 ± 5°)C;
- air relative humidity (30…80) %;
- atmospheric pressure (84…106) kPa;
- supply voltage (220 ± 5) V;
- warming-up time, min. 30 minutes;
- lack of vibration, shaking, impacts and magnetic fields effecting the analyzer operation.

A.5 Performing a check

A.5.1 Outer inspection

In the course of the outer inspection mechanical damages and correctness of marking are determined. In case of defects it is necessary to evaluate whether further application of the analyzer is possible.

A.5.2 Checking electrical resistance of insulation

A.5.2.1 Checking of electrical resistance of insulation of the measuring device circuits is performed with the power supply de-energized by the megohmmeter between the MD frame (grounding terminal) and contacts of plugs «Реле 1» and «Реле 2».

A.5.2.2 The insulation resistance must be at least 20 MOhm.

A.5.3 Testing

Testing is conducted with respect to the analyzer functioning in the “Measuring” mode (see item 7.1.of the Operation manual for АЖК3101.01.АС.РЭ).

A.5.4 Determination of the basic error, % of the range

The basic error, % of the range, can be determined by the following methods:

- using reference solutions (see item A.5.4.1);
- using control solutions (see item A.5.4.2);
- using the element-by-element method (see item A.5.4.3).

During the check milliammeter is connected to the MD analog output (see Annex C) via the load resistance: 0,25 kOhm for the variation range of output current of (4…20) mA and 1,0 kOhm for the variation range of output current of (0…5) mA.

The basic error, % of the range, is determined with the temperature compensation **deactivated** (to deactivate the temperature compensation refer to Annex E). Measurements are made starting with the solution having the least EC value.

A.5.4.1 Determination of the basic error, % of the range, using reference solutions

A.5.4.1.1 Prepare reference solutions having EC values corresponding to (20±5), (50±5), (80±5) % of the measuring range.

A.5.4.1.2 Three times wash the PT sensor with the check solution.

A.5.4.1.3 Plug the bottom connection point of the PT sensor, fill the PT sensor with the reference solution and immerse the thermostat having the temperature

specified in the certificate for the reference solution. The temperature of water in the thermostat must be maintained accurate to ±0,1 ºС.

A.5.4.1.4 Wait for a period sufficient for the establishment of the solution thermal equilibrium.

A.5.4.1.5 Record values of the analyzer readings and values of output current.

A.5.4.1.6 Perform the above operations three times for each solution.

A.5.4.1.7 The basic error, and of the range, against the analyzer readings is calculated by the formula:

$$\gamma = ((æ_{meas} - æ_s) / æ_r) * 100\%, \quad (5)$$

where: $æ_{meas}$ – the EC value obtained against the analyzer readings, S/cm;

$æ_s$ – the EC value of the reference solution, S/cm;

$æ_r$ – the analyzer measuring range, S/cm.

The maximum value of the basic error, % of the range, must not exceed ±2,0 %.

A.5.4.1.8 A.5.4.1.8. The basic error, % of the range, in terms of the analyzer output current is calculated by the formula:

$$\gamma = ((I_{meas} - I_{est}) / I_r) \cdot 100\%, \quad (6)$$

where: I_{meas} – the value of the measured output current, mA; I_{est} – the estimated value of output current, mA;

I_r – the range (difference in maximum and minimum values) of the output current variation, mA.

The maximum value of the basic error, % of the range, must not exceed ± 2,0 %.

A.5.4.2 Determination of the basic error, % of the range, using control solutions.

A.5.4.2.1 The error is determined by the method of matching of EC values of reference solutions obtained against readings of the test analyzer with the readings of the lab conductivity apparatus.

When calibrating the analyzer graduated in the concentration units readings of the lab conductivity apparatus must be converted in the concentration units in conformity with the standardized dependence between EC and the test liquid composition.

A.5.4.2.2 Prepare solutions having values of EC (concentration) corresponding to approximately (20±5), (50±5), (80±5) % of the measuring range.

A.5.4.2.3 Three times wash the cell of the lab conductivity apparatus and the PT sensor with the control solution.

A.5.4.2.4 Plug the bottom connection point of the PT sensor, fill the PT sensor and the cell of the lab conductivity apparatus with the control solution and immerse them into the thermostat having the temperature equal to either the temperature of the temperature compensation reduction or to the working temperature of test liquid. The temperature of water in the thermostat must be maintained accurate to ±0,1 ºС.

A.5.4.2.5 Wait for a period sufficient for the establishment of the solution thermal equilibrium.

A.5.4.2.6 Record values of the analyzer and the lab conductivity apparatus readings and values of the analyzer output current.

A.5.4.2.7 Perform the above operations three times for each solution.

A.5.4.2.8 The basic error, and of the range, against the analyzer readings is calculated by the formula:

$$\gamma = ((æ_{meas} - æ_{lc}) / æ_{r)} * 100\%, \quad (7)$$

where: $æ_{meas}$ – the value of EC, S/cmсм, or concentration, g/l (%), of the control solution obtained against the analyzer readings;

$æ_{lc}$ – the value of EC, S/cm, or concentration, g/l (%), of the control solution measured using the lab conductivity apparatus;

$æ_{r}$ – the analyzer measuring range, S/cm or g/l (%).

The maximum value of the basic error, % of the range, must not exceed ±2,0 %.

A.5.4.2.9 The basic error, % of the range, in terms of the analyzer output current is determined by the formula 6.

The value of the basic error, % of the range, must not exceed ± 2,0 %.

In case the value is exceeded it is possible, if required, to perform the analyzer adjustment against the output current (see Annex F for EC analyzers and Annex G for concentration analyzers).

A.5.4.3 Determination of the basic error, % of the range, using the element-by-element method

A.5.4.3.1 Determination of the basic error, % of the range, of analyzers having the upper measuring limit of up to 10 μS/cm is performed using the element-by-element method: constant "C" of the PT sensor is determined, then in PT the sensor is replaced by the resistance box and the basic error is determined by the readings of the test analyzer and output current.

A.5.4.3.2 Values of constant "C" of the PT sensor is determined as follows:

- prepare the control solution having EC values equal to approximately 80 μS/cm;
- using the lab conductivity apparatus measure the solution EC at the temperature of (25±0.1)ºC;
- three times wash the PT sensor with the control solution;
- plug the bottom connection point of the PT sensor, fill the PT sensor with the control solution and immerse into the thermostat having the temperature of (25±0.1)ºC. The temperature of water in the thermostat must be maintained accurate to ±0,1 ºC;
- wait for the period sufficient for the establishment of the solution thermal equilibrium;
- enter the mode of the PT programming (see Annex E, items E.1.1-E.1.4), deactivate the temperature compensation (see Annex E, item E.4);
- adjust the EC value of the test solution, determine the value of C/C_{est} coefficient (see Annex E, item E.3).

The PT sensor constant is calculated by the formula:

$$C = C_{est.} (C/C_{est.}), \quad (8)$$

where $C_{est.}$ – the estimated structural value of the PT sensor constant (it is specified in the certificate for the device), cm^{-1};

$C/C_{est.}$ – the coefficient considering deviation of the real value of the PT sensor constant from its estimated value (the value of this coefficient is stored in the PT memory).

A.5.4.3.3 Connect the resistance box to the PT measuring circuit instead of the sensor (to contacts "E" and "⊥").

A.5.4.3.4 Calculate values of simulating resistances for EC values corresponding to 20, 50 и 80 % of the measuring range by the formula:

$$R_{sim} = C / æ_{est}, \text{ Ohm}, \quad (9)$$

where, $æ_{est}$ – EC value corresponding to each test point, S/cm;

C – constant of the PT sensor, cm^{-1}.

When setting estimated values of resistances by means of the resistance box for each of the test points take values of the analyzer and output current readings.

A.5.4.3.5 The basic error, % of the range, against the analyzer readings is calculated by the formula:

$$\gamma = ((æ_{meas} - æ_{est}) / æ_{max}) \cdot 100\ \%, \quad (10)$$

where, $æ_{meas}$ – the measured EC value at the appropriate simulating resistance, S/cm;

$æ_{est}$ – the estimated EC value corresponding to the test point, S/cm;

$æ_{max}$ – the upper limit of the EC measuring range, S/cm.

The value of the basic error, % of the range, must not exceed ±2,0 %.

A.5.4.3.6 The basic error, % of the range, by output current is determined by the formula (6).

The value of the basic error, % of the range, must not exceed ± 2,0 %.

A.5.5 Determination of the allowable complementary error, % of the range, from the variation of the test liquid temperature

The value of the allowable complementary basic error, % of the range, can be determined by the following methods:

- using reference solutions (see item A.5.5.1);
- using control solutions (see item A.5.5.2);
- using the element-by-element method (see item A.5.5.3).

Measurements are made with the temperature compensation **activated** using the solution having the EC value equal to (80±5) % of the analyzer measuring range.

A.5.5.1 Determination of the allowable complementary error, % of the range using the reference solution

A.5.5.1.1 Activate the mode of the simple temperature compensation (see Annex E, item E.4.2.3.). In this case it is necessary to set the reduction temperature and the temperature coefficient corresponding to the present reference solution.

A.5.5.1.2 Three times wash the PT sensor with the reference solution.

A.5.5.1.3 Plug the bottom connection point of the PT sensor, fill the PT sensor with the reference solution and immerse into the thermostat having the temperature which differs from the temperature specified in the certificate for the reference solution as much as +15°C or –15°C. The temperature of water in the thermostat must be maintained accurate to ±0,1 ºС.

A.5.5.1.4 Wait for enough time for the establishment of the solution thermal equilibrium.

A.5.5.1.5 Record values of the analyzer readings.

A.5.5.1.6 The analyzer complimentary error, % of the range, is determined by the formula:

$$\gamma = ((æ_t - æ_{to}) / æ_r) \cdot 100\%, \quad (11)$$

where, $æ_t$ – value of the reference solution EC obtained by the analyzer readings at the preset temperature, S/cm;

$æ_{to}$ – value of the reference solution EC at the temperature specified in the certificate for the reference solution, S/cm;

$æ_r$ – the analyzer measuring range, S/cm.

The analyzer complimentary error, % of the range, must not exceed ±2,0 %.

A.5.5.2 Determination of the allowable complementary error, % of the range using the control solution

A.5.5.2.1 Activate the mode of the simple temperature compensation (see Annex E, item E.4.2.3.). In this case it is necessary to set the reduction temperature and the temperature coefficient corresponding to this control solution.

A.5.5.2.2 Three times wash the cell of the lab conductivity apparatus and the PT sensor with the control solution.

A.5.5.2.3 Fill the cell of the lab conductivity apparatus with the control solution and immerse into the thermostat having the temperature equal to the temperature of the temperature compensation reduction. The temperature of water in the thermostat must be maintained accurate to ±0,1 ºC.

A.5.5.2.4 Record readings of the lab conductivity apparatus.

A.5.5.2.5 Plug the bottom connection point of the PT sensor, fill the PT sensor of the analyzer with the control solution and immerse into the thermostat having the temperature which differs from the temperature of the temperature compensation reduction as much as +15°C or –15°C. The temperature of water in the thermostat must be maintained accurate to ±0,1 ºC.

A.5.5.2.6 Wait for enough time for the establishment of the solution thermal equilibrium.

A.5.5.2.7 Record values of the analyzer readings.

A.5.5.2.8 Complementary error, % of the range, by the analyzer readings is determined by the formula:

$$\gamma = ((æ_t - æ^*_{to}) / æ_r \cdot 100\%, \quad (12)$$

where, $æ_t$ – value of the control solution EC obtained by the analyzer readings at the preset temperature, S/cm;

$æ^*_{to}$ – value of the control solution EC obtained be the readings of the lab conductivity apparatus at the temperature of the analyzer temperature compensation reduction, S/cm,;

$æ_r$ – the analyzer measuring range, S/cm.

The analyzer complementary error, % of the range, must not exceed ±2,0 %.

A.5.5.3 Determination of the allowable complementary error, % of the range using the element-by-element method

A.5.5.3.1 The element-to-element method allows to determine the permissible complementary error of analyzers having the upper limit of measurement of up to 10 μS/cm.

A.5.5.3.2 In PT disconnect from the terminal strip wires going to the EC sensor (contacts "E" and "⊥"). Instead of the sensor connect the resistance box to the PT measuring circuit. With the temperature compensation **deactivated** (to disconnect the temperature compensation see Annex E, item E.4.2.1.) by means of the resistance box set the analyzer readings equal to 50 % of the measuring range.

A.5.5.3.3 Calculate ultimate deviations of the analyzer readings with the solution temperature variation as much as ±15ºС relatively the temperature of the temperature compensation reduction using the formula:

$$æ_t = æ_o [1+ (t – t_o) \alpha_t], \quad (13)$$

where, $æ_t$ – the analyzer readings with the temperature variation as much as ±15ºС, S/m;

$æ_{to}$ – the analyzer readings with the temperature of the temperature compensation reduction equal to 50 % of the measuring range, S/m;

t_o – the temperature of the temperature compensation reduction, °С;

$(t – t_o) = ±15$ – maximum variation of the temperature, °С;

α_t – EC temperature coefficient, e.g., $\alpha_t = 0{,}024$ degr^{-1} (2,40 % per degree).

A.5.5.3.4 Using formula (9) calculate values of simulating resistances for $æ_t$ values corresponding to temperatures $(t_o – 15)$ºС and $(t_o + 15)$ºС.

A.5.5.3.5 Activate the mode of the simple temperature compensation (see Annex E, item E.4.2.3.). In this case it is necessary to set values of the reduction temperature and the temperature coefficient (in percentage per degree) which were accepted in the calculation of $æ_t$ values by the formula (13).

A.5.5.3.6 Load the PT sensor into the thermostat.

A.5.5.3.7 Set the thermostat temperature $(t_o – 15)$ºС.

A.5.5.3.8 On the resistance box set the value of the simulating resistance corresponding to the estimated $æ_t$ value at this temperature.

A.5.5.3.9 Record the analyzer readings after establishment of the thermal equilibrium.

A.5.5.3.10 Set the thermostat temperature $(t_o + 15)$ºС.

A.5.5.3.11 On the resistance box set the value of the simulating resistance corresponding to the estimated $æ_t$ value at this temperature.

A.5.5.3.12 Record the analyzer readings after establishment of the thermal equilibrium.

A.5.5.3.13 The analyzer complimentary error, % of the range, is determined by the formula:

$$\gamma = ((æ_t - æ_{to}) / æ_r) \cdot 100\%, \quad (14)$$

where, $æ_t$ – EC value obtained by the analyzer readings at the preset temperature, S/cm;

$æ_{to}$ – EC value obtained by the analyzer readings at the temperature of the temperature compensation reduction equal to 50 % of the measuring range, S/cm;

$æ_r$ – the analyzer measuring range, S/cm.

The analyzer complimentary error, % of the range, must not exceed ±2,0 %.

A.5.6 Execution of test (calibration) results

A.5.6.1 Positive test results are executed by issuance of the test certification in compliance with ПР 50.2.006 and the impress of the certification mark is stamped in the analyzer certificate in compliance with ПР 50.2.007.

A.5.6.2 Analyzers which do not meet the requirements of metrological characteristics are provided with the notification of unsuitability specifying the reasons.
The certification mark is canceled.

A.5.6.3 Positive calibration results are executed by issuance of the calibration certification in compliance with ПР 50.2.016 or by stamping a calibration mark in the analyzer certificate.

Annex B
Overall and fixing dimensions

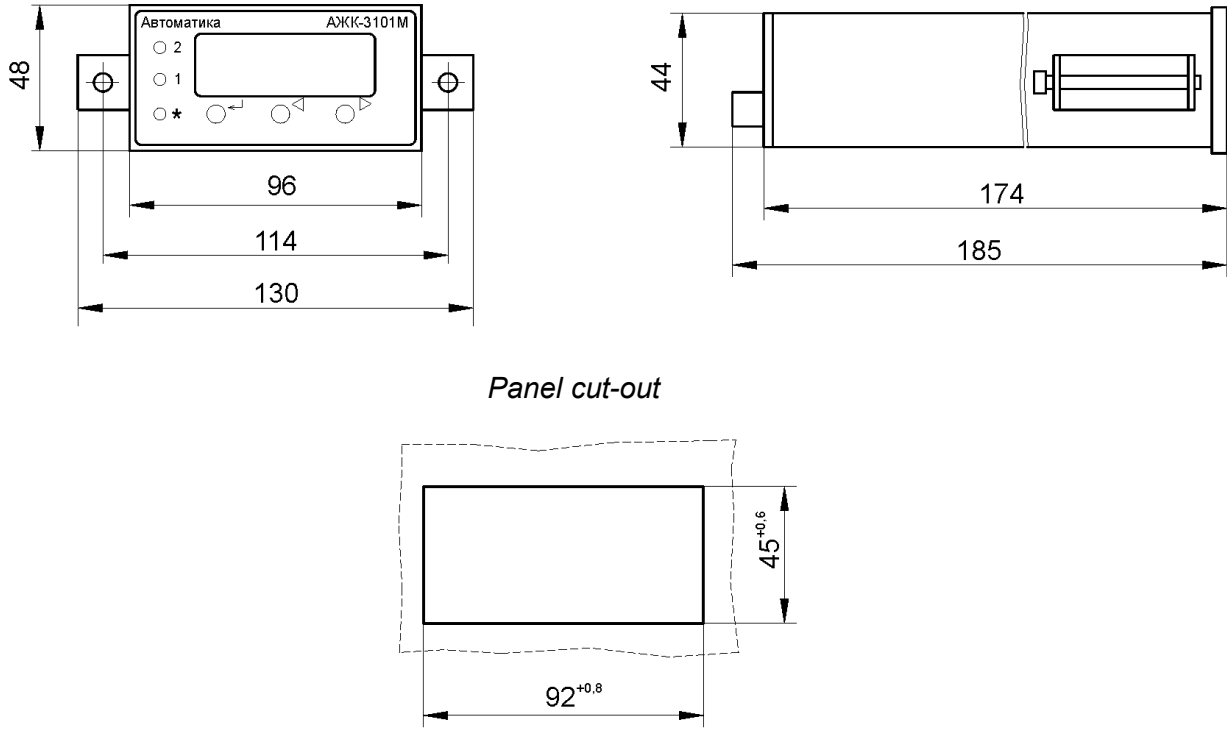


Fig. B.1 – The measuring device

Annex B, cont'd

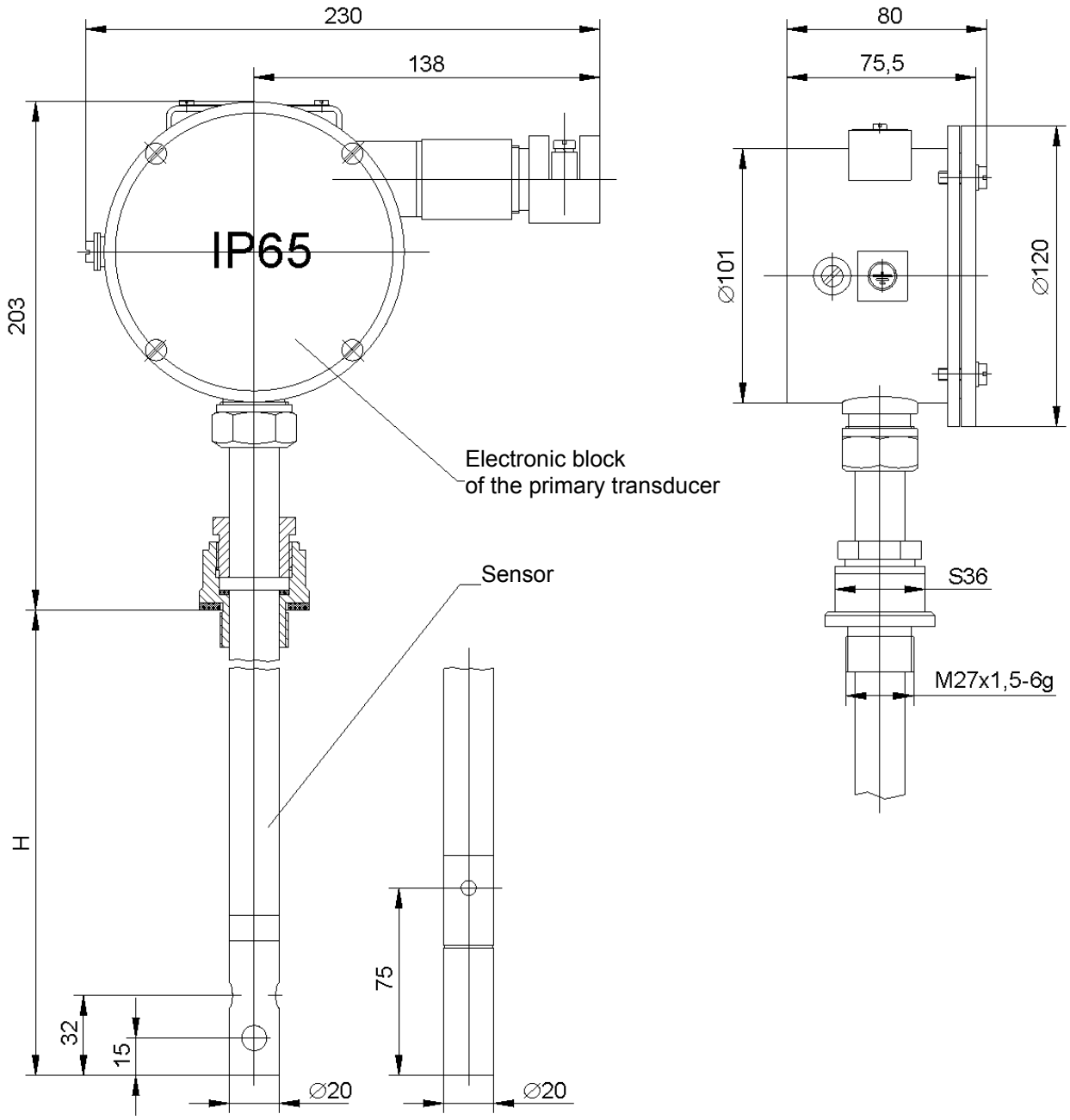


Fig. B.2 –The monoblock primary transducer of the analyzer,
АЖК-3101М.1(2;К).АС.100…2000 series

Annex B, cont'd

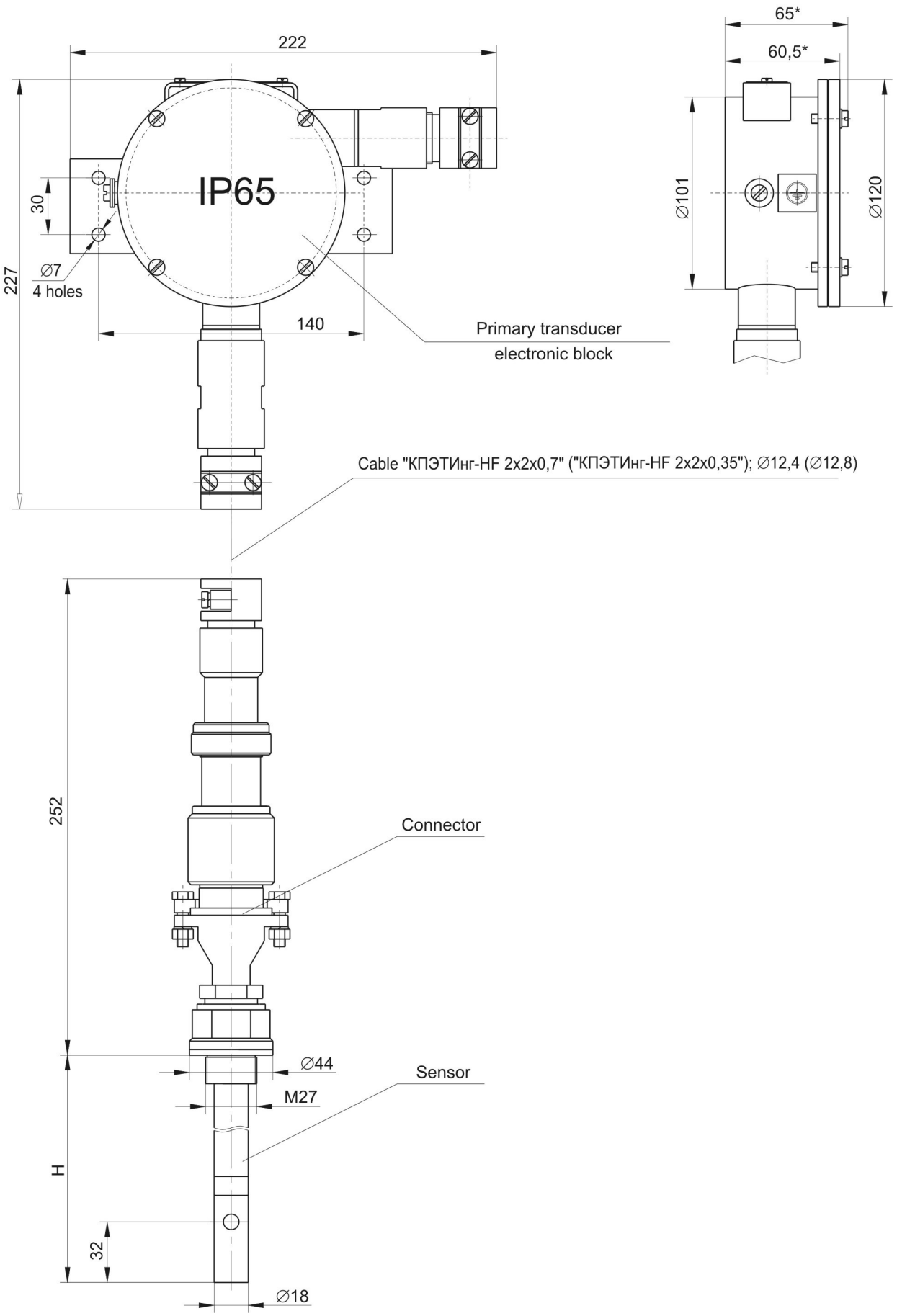


Fig. B.3 – Primary transducer of the analyzer, АЖК-3101М.1(2;К).АС.100…2000 series, with the spaced apart electronic block and sensor

Annex B, cont'd

Fig. B.4 – Primary transducer of the analyzer, АЖК-3101М.1(2;К).АС.
with the spaced apart electronic block and the flow-through sensor

Annex C
Diagrams of cable connections

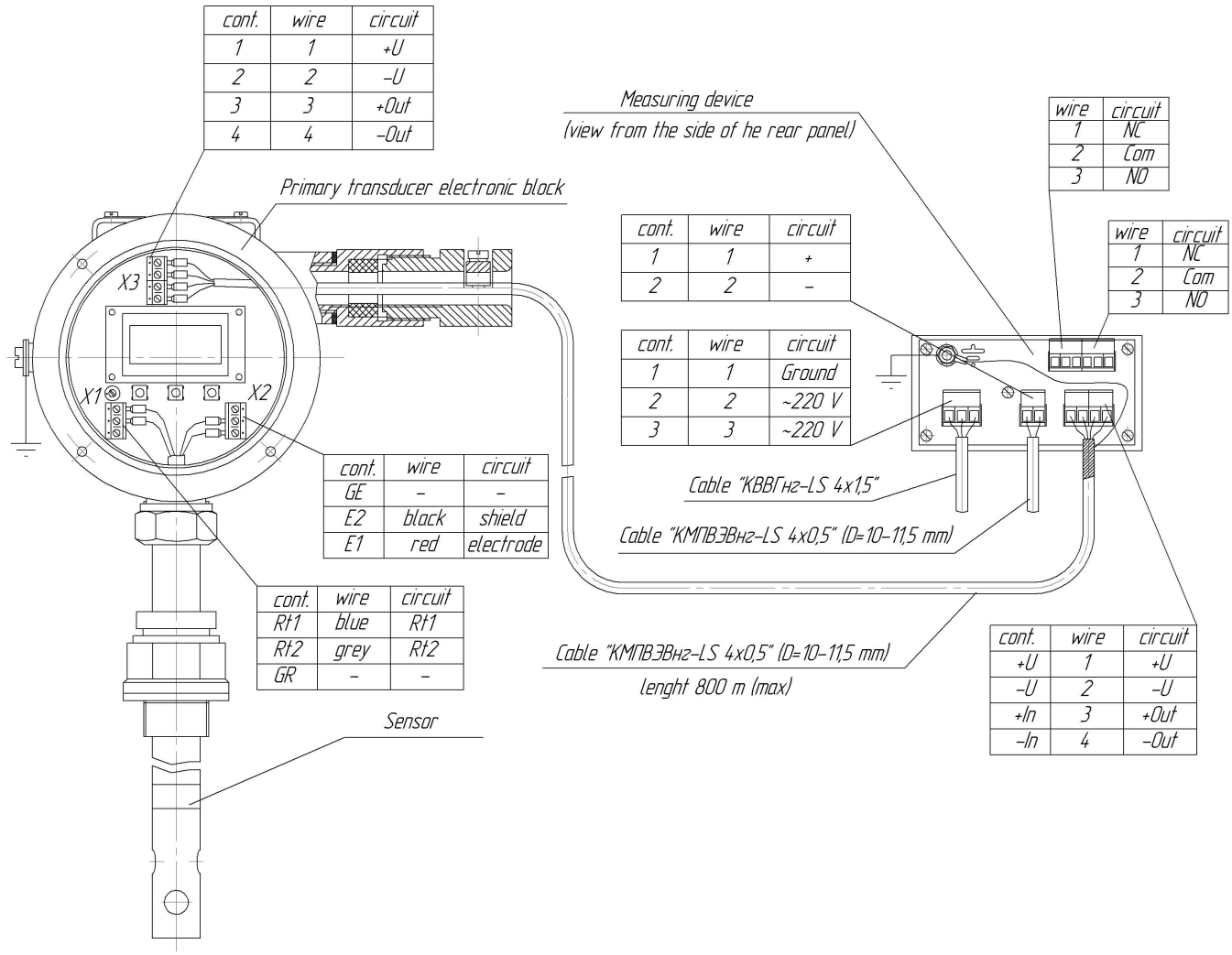
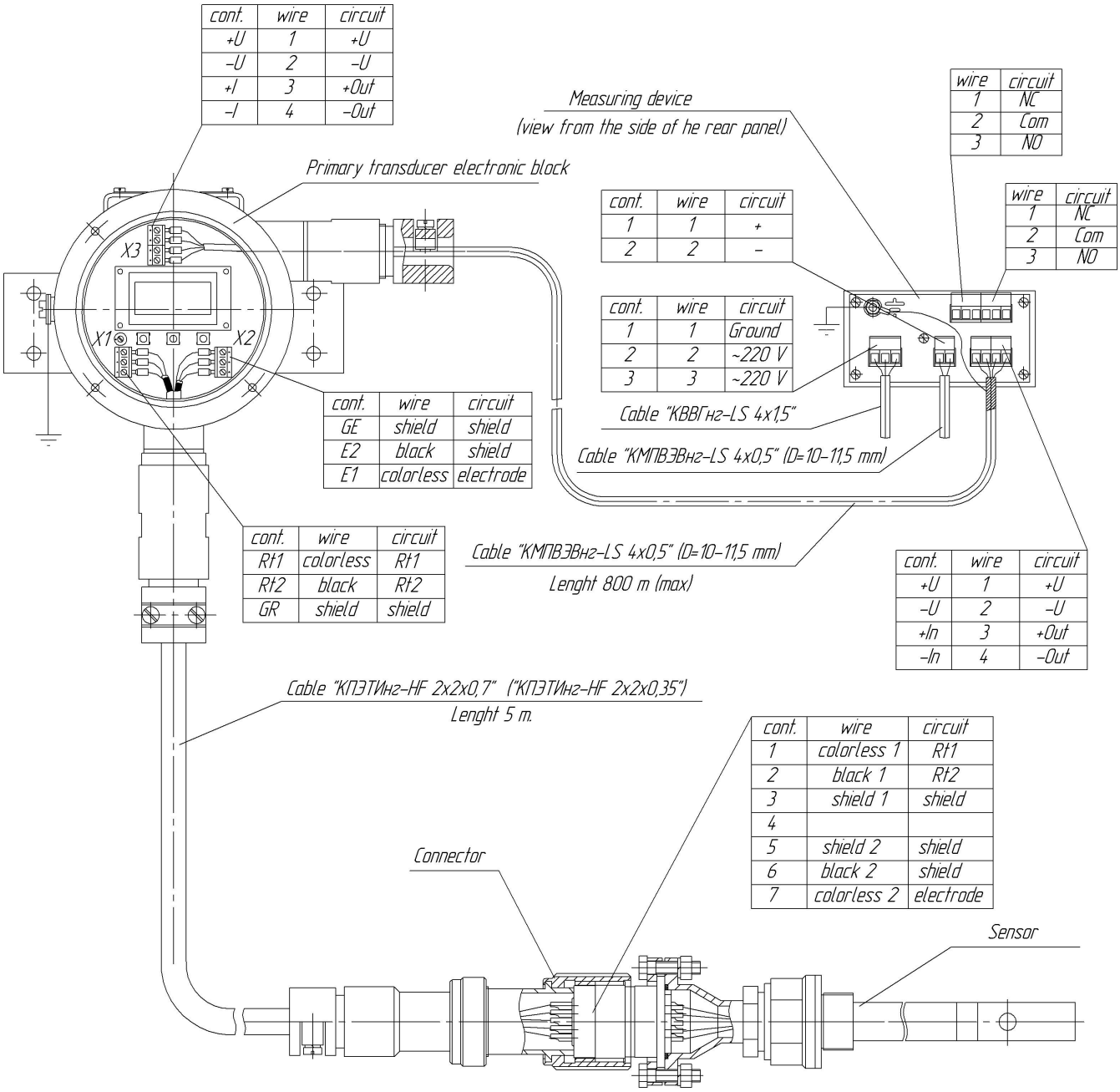


Fig. C.1 – Communication chart of the analyzer, АЖК-3101М.1(2;К).АС series, with the monoblock primary transducer

Annex C cont'd



* Other cable length when you order agreed

Fig. C.2 – Communication chart of the analyzer, АЖК-3101М.1(2; К).АС series, with the spaced apart electronic block and the primary transducer sensor

Annex D
Electric conductivity of sulfuric acid and potassium chloride solutions as a function of concentration at 25 °C

Measuring range	Solution	Concentration, g/l	Electric conductivity
0…1000 mS/cm	Aqueous solution of sulfuric acid	52,0 165,0 376,0	200 mS/cm 500 mS/cm 800 mS/cm
0…100 mS/cm	Aqueous solution of potassium chloride	11,98 31,51 52,08	20 mS/cm 50 mS/cm 80 mS/cm
0…10 mS/cm	Aqueous solution of potassium chloride	1,07 2,77 4,53	2 mS/cm 5 mS/cm 8 mS/cm
0…1000 µS/cm	Aqueous solution of potassium chloride	0,102 0,258 0,417	200 µS/cm 500 µS/cm 800 µS/cm
0…100 µS/cm	Aqueous solution of potassium chloride	0,0100 0,0252 0,0404	20 µS/cm 50 µS/cm 80 µS/cm
0…10 µS/cm	Potassium chloride solution in ethylene glycol	0,0015 0,0040 0,0064	2 µS/cm 5 µS/cm 8 µS/cm

Notes:

1 Thermostatting temperature (25±0,1)°C;

2 Control solutions must reproduce the EC value with the error not exceeding ±5% of the measuring range upper limit.

Annex E
Programming of the primary transducer

E.1 Entry and exit the mode of programming

E.1.1 With power energized press and hold simultaneously ◁ and ▷ keys until the indication «**Введите код**» (**Enter the code**) is displayed. Release the keys.

E.1.2 Using ◁ and ▷ keys set the first digit of the password (the password is shown in the device certificate). Enter the first digit by pressing ↵ key.

E.1.3 Similar to procedures described in item E.1.1 enter the second, third and fourth digits of the password. With the correct entry of the password the window indicating «**1-й уровень**» (**1st level**) is displayed.

Note: with incorrect entry of the password it is necessary to repeat procedures under items E.1.1 and E.1.2. In case the password is entered incorrectly 3 times the PT will switch over to the measuring mode.

E.1.4 Press ↵ key. The indication «**Диапазон измерения**» (**Measuring range**) is displayed. This is the first parameter from the menu of parameters which are programmed in the first level of programming. «**Диапазон измерения**» (**Measuring range**), «**Константа датчика**» (**The sensor constant**), «**Термокомпенсация**» (**Temperature compensation**) and «**Параметры ТК**» (**TK parameters**) are programmed in the parameter menu. The selection of the programmable parameter is effected by ◁ and ▷ keys.

E.1.5 To exit the menu of programmable parameters use ◁ and ▷ keys, select the window «**Выход**» (**Exit**) and press ↵ key. The indication «**1-й уровень**» (**1st level**) will appear on the display.

E.1.6 To exit the programming mode into the measuring mode select the «**1-й уровень**» (**1st level**) window. Using ◁ or ▷ key select the «**Выход**» (**Exit**) window and press ↵ key.

E.2 Measuring range

E.2.1 To enter the programming mode (see items E.1.1 – E.1.4). With ◁ and ▷ keys select «**Диапазон измерения**» (**Measuring range**). Still in the «**Диапазон измерения**» (**Measuring range**) window press ↵ key.

Selection (scrolling) of measuring ranges is performed with ◁ and ▷ keys. The primary transducer enables to operate in 4 basic, 3 expanded and survey ranges of the EC measurement. The basic ranges are understood as those presented in item 2.1.of the operation manual for EC analyzers.

Expanded ranges are two adjacent basic measuring ranges designed for the cases when EC falls beyond the upper limit of the junior basic range. E.g., 1st basic range (junior) – (0…1,000 μS/cm; 2nd basic range (senior) – (0…10,00) μS/cm. Switching over from the junior to the senior range and back is effected automatically.

With the activation of the survey range the primary transducer functions in all 4 basic measuring ranges with the automatic selection of the required range.

In order to set the required measuring range it is necessary to select the window with the relevant indication and press ⏎ key. The confirmation of the selection is the flashing indication of the selected range.

E.2.2 Using ◁ and ▷ keys select «**Выход**» (**Exi**t) window and press ⏎ key. The indication «**Диапазон измерения**» (**Measuring range**) will appear on the display.

E.2.3 With ◁ and ▷ keys select the next programmable parameter or exit the programming mode into the measuring mode (see items E.1.5, E.1.6).

E.3 The sensor constant

E.3.1 To enter the programming mode (see E.1.1 – E.1.4). With ◁ and ▷ keys select «**Константа датчика**» (**The sensor constant**). Still in the window «**Константа датчика**» (**The sensor constant**) press ⏎ key. The sensor constant describes the sensor sensitivity and is defined by its shape and geometric dimensions. The estimated value, C_{est}, of the constant is specified in the analyzer certificate. The actual value of the sensor constant, C, can be set by two methods.

E.3.2 The choice of the method for the sensor constant adjustment (direct or indirect) is made with ◁ and ▷ keys.

With the direct adjustment it is possible to enter the known value, C/C_{est}, equal to the ratio of the actual value of the sensor constant to its estimated value.

With the indirect adjustment of the sensor constant the C/C_{est} ratio is calculated automatically by entering the known EC value of the test solution.

E.3.3 For the direct adjustment it is necessary to select the window with the "**C/C_{est}**" indication in the top line of the display. The bottom line of the display shows the number equal to the ratio of the actual value of the sensor constant to its estimated value which was set previously.

To change this number press ⏎ key. The top line of the display starts flashing. With ◁ and ▷ keys it is possible to adjust the value of the number. To enter the new C/C_{est} value into the PT memory press ⏎ key. The «**C/C расч.**» (**C/C est)** indication will stop flashing.

E.3.4 For the indirect adjustment it is necessary to select the window with the «**Измерен.**» (**Measuring)** indication in the top line.

Note: prior to the constant adjustment the primary transducer must be filled with the test solution having the known EC value at the preset temperature. To ensure non- exceeding of the basic error, % of the range, in all basic ranges it is advisable to make use of the solution having the EC value of approximately (80…90) µS/cm for АЖК-3101М.1.АС and (80…90) mS/cm for АЖК-3101М.2.АС.

The bottom line of the display shows the EC value currently measured. To adjust the value in conformity with the known EC value of the test solution press ⏎ key. The «**Измерен.**» (**Measuring)** indication will change to «**Калибр.**» (**Calibration**) and starts flashing. Using ◁ and ▷ keys set the known EC value of the test solution.

After pressing ⏎ key the new data is entered into the device memory and the C/C_{est} ratio automatically changes. The top line of the display shows «**Измерен.**» (**Measuring)** again. The automatically set C/C_{est} value can be monitored in the «**C/C расч.**»(**C/C est)** window.

E.3.5 With ◁ and ▷ keys select «**Выход**» (**Exit**) window and press ↵ key. «**Константа датчика**» (**The sensor constant**) is displayed.

E.3.6 With ◁ and ▷ keys select the next programmable parameter or exit the programming mode into the measuring mode (see items E.1.5, E.1.6).

E.4 Temperature compensation

E.4.1 Enter the programming mode (see item E.1.1 – E.1.4). With ◁ and ▷ keys select «**Термокомпенсация**» (**Temperature compensation**). Still in the «**Термокомпенсация**» (**Temperature compensation**) window press ↵ key.

E.4.2 Selection (scrolling) of the temperature compensation modes is made with ◁ and ▷ keys. The mode set previously is defined by the window with the flashing indication.

To set the required mode of temperature compensation select the window with the relevant indication.

E.4.2.1 To deactivate the temperature compensation mode select the «**Выкл.**» (**OFF**) window and press ↵ key. The indication starts flashing.

E.4.2.2 To activate the temperature compensation mode considering temperature dependence of theoretically pure water select one of two windows indicating «**ТЧВ 1**» (**TPW 1)** or «**ТЧВ 2**» (**TPW 2)** and press ↵ key. The indication starts flashing. «**ТЧВ 1**» (**TPW 1)** and «**ТЧВ 2**» (**TPW 2)** modes differ in coefficients in the formulae of dependence of theoretically pure water EC on temperature.

E.4.2.3 To activate the mode of the simple temperature compensation select "**To, at"** window and press ↵ key. The indication starts flashing. The simple temperature compensation is effected in compliance with formula (2) (refer to item 4.1 of the operation manual).

Values of the temperature compensation parameters are set in «**Параметры ТК**» (**ТК parameters**) window (see item 4).

E.4.3 After the selection of the temperature compensation mode use ◁ and ▷ keys to select «**Выход**» (**Exit**) window and press ↵ key. The display will show the indication «**Термокомпенсация**» (**Temperature compensation**).

E.4.4 With ◁ and ▷ keys select the next programmable parameter or exit the programming mode into the measuring mode (see items E.1.5, E.1.6).

E.5 Temperature compensation parameters

E.5.1 To enter the programming mode (see items E.1.1 – E.1.4). With ◁ and ▷ keys select «**Параметры ТК**» (**ТК parameters**). Still in «**Параметры ТК**» (**ТК parameters**) window press ↵ key.

E.5.2 Selection of temperature compensation parameters is made with ◁ and ▷ keys.

E.5.2.1 To set the reduction temperature select «**To гр.С**» (**To , degr. C)** window. The bottom line of the display shows the reduction temperature value set previously.

To modify the reduction temperature value press ⏎ key. The display upper line will start flashing. After setting the required reduction temperature value with ◁ and ▷ keys press ⏎ key to enter this value into the device memory.

E.5.2.2 To set the temperature coefficient with ◁ and ▷ keys select "**at"** window**.** The bottom line of the display indicates the coefficient value set previously.

Note: the temperature coefficient value, α_m, is entered in % / ºC.

To change the temperature coefficient value press ⏎ key. The display upper line starts flashing. After setting the required $\alpha_т$ value with ◁ and ▷ keys press ⏎ key to enter this value into the device memory.

E.5.3 After setting the temperature compensation parameters with ◁ and ▷ keys select «**Выход**» (**Exi**t) window and press ⏎ key. «**Параметры ТК**» (**ТС parameters**) will be displayed.

E.5.4 With ◁ and ▷ keys select the next programmable parameter or exit the programming mode into the measuring mode (see items E.1.5, E.1.6).

E.6 Resetting of the primary transducer factory settings

In some cases it is required to return to settings set at the company - manufacturer. Such a situation may occur in case of the improper programming of the primary transducer. In case of the primary transducer failure, for any reason, it is recommended to reset factory settings. To reset factory settings the following procedures are required:

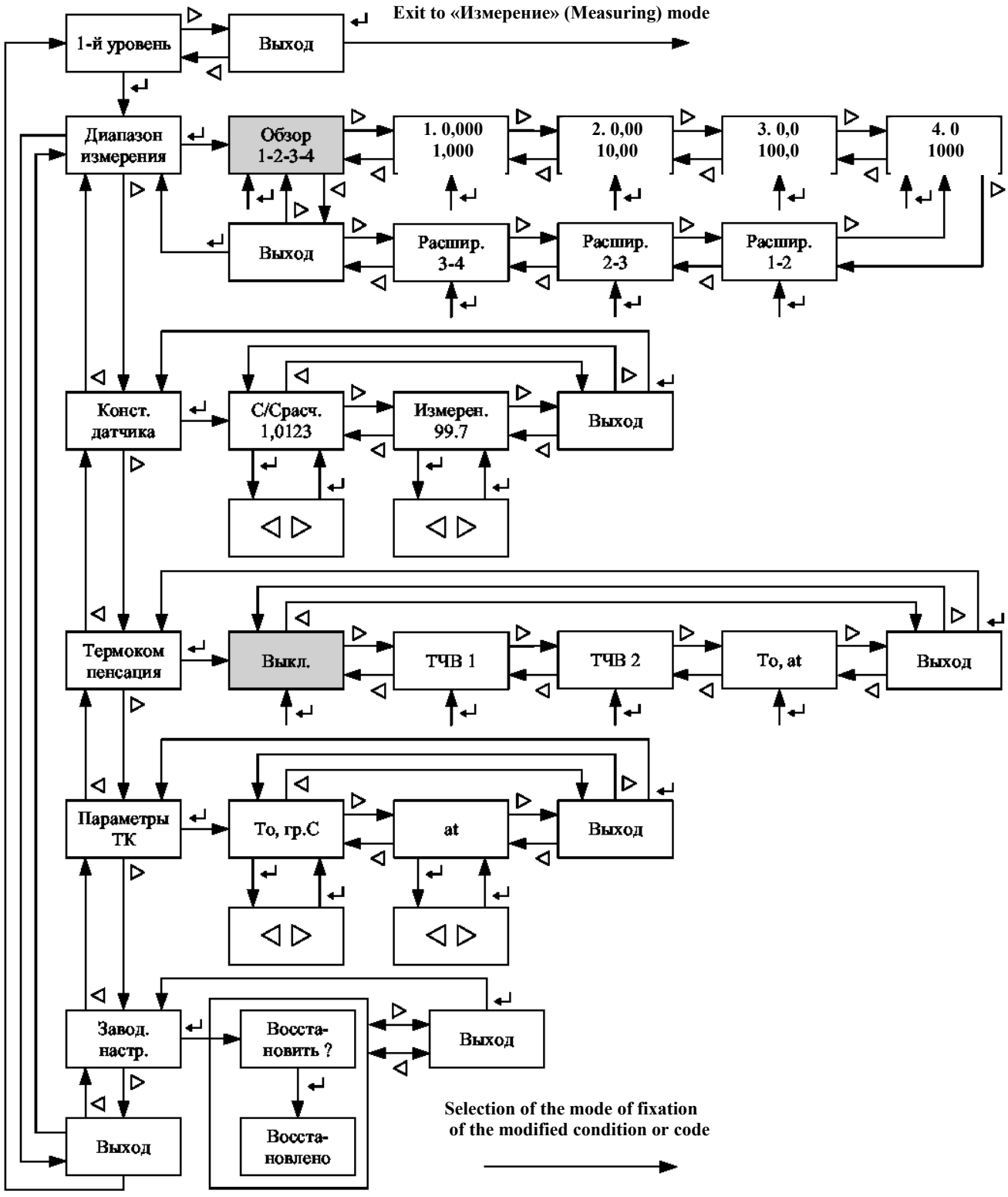
Enter the programming mode (see items E.1.1 – E.1.4). With ◁ and ▷ keys select «**Завод. настр.**» (**Factory settings**). Still in «**Завод. настр.**» (**Factory settings**) window press ⏎ key.

After the appearance of the «**Восстановить?**» (**Reset?)** indication pressing ⏎ key will lead to resetting of all factory settings which will be confirmed by the «**Восстановлено**» (**Reset**) indication. With ◁ and ▷ keys select «**Выход**» (**Exi**t) window and press ⏎ key. «**Завод. настр.**» (**Factory settings**) will be displayed.

Exit the programming mode into the measuring mode (refer to items E.1.5, E.1.6).

Turn on and off the device power supply. Factory settings are reset.

Block diagram of the operation algorithm in level No.1 of the “Programming” mode



Annex F
Programming of the measuring device (analyzer for conductivity)

F.1 General provisions

F.1.1 For the operational convenience the measuring device (MD) is provided with 3 levels of the "Programming" mode:

- **level No. 1** – fixing of settings for the activation of EC signaling relay, fixing of the threshold (hysteresis, insensitivity area) for the activation of the setting signaling relay (individual values for each setting);
- **level No. 2** – setting of the parameters of the MD measuring range by the output analog signal, setting of the signaling operation modes;
- **level No. 3** – it is used in setting of the initial and final values of the MD output current.

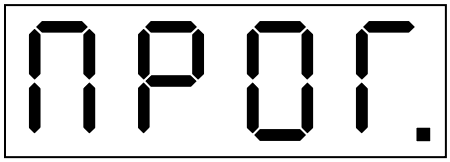
F.1.2 Single pressing the keys causes their single action, with the prolonged pressing the algorithm of the accelerated multiple action of the key starts functioning.

F.1.3 The single display "∗" signals entering in the programming levels No.2 and No.3.

F.1.4 In case the Programming" mode is exited improperly (e.g. the analyzer deenergizing) the last entered parameter is not stored.

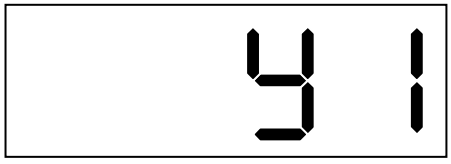
F.2 Level No.1 of the (Programming) mode

F.2.1 Entry in level No.1 of the "Programming" mode from the "Measuring" mode is effected with simultaneous pressing ◁ and ▷ keys (in this case the digital display goes out) and holding them pressed until the flashing indication "**ПРОГ.**" appears:



The single display "∗" is OFF.

F.2.2 Press ↵ key. The digital display highlights the indication designating the subsequent entry of the first EC setting:

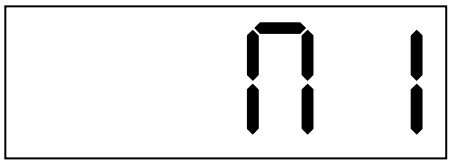


F.2.3 Press ↵ key. The digital display highlights the value of setting «**1**», e.g.:

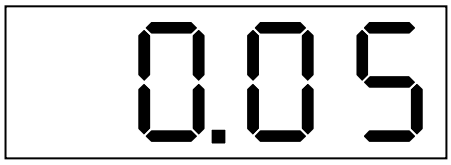
Flashing of the single display «**1**» confirms the setting number.

Changing of the setting «**1**» value is effected with ◁ and ▷ keys.

F.2.4 Press ↵ key. The digital display highlights the indication designating the subsequent entry of the value of relay «**P1**» threshold (hysteresis, insensitivity area):

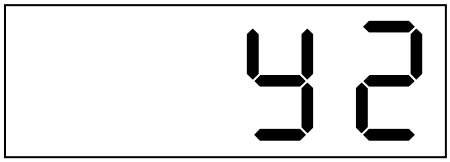


F.2.5 Press ↵ key. The digital display highlights the value of relay «**P1**» threshold (the position of comma with the entry of threshold corresponds to the position of comma in the entered value of setting «**1**»), e.g.:

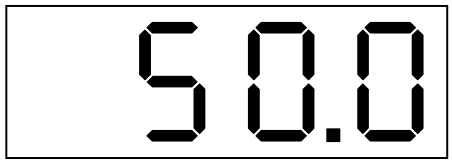


Changing of the operation threshold is effected with ◁ and ▷ keys.

F.2.6 Press ↵ key. The digital display highlights the indication designating the subsequent entry of the second EC setting:



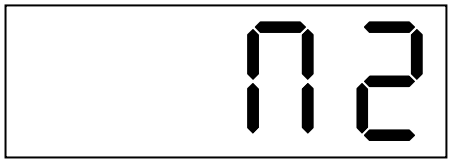
F.2.7 Press ↵ key. The digital display highlights the value of setting «**2**», e.g.:



Flashing of the single display «**2**» confirms the setting number.

Changing of the setting «**2**» value is effected with ◁ and ▷ keys.

F.2.8 Press ↵ key. The digital display highlights the indication designating the subsequent entry of the value of relay «**P2**» threshold (hysteresis, insensitivity area):



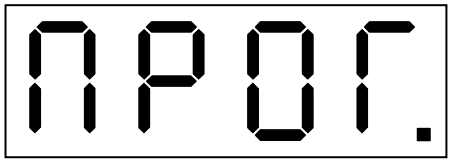
F.2.9 Press ↵ key. The digital display highlights the value of the value of relay «**1**» threshold (the position of comma with the entry of threshold corresponds to the position of comma in the entered value of setting «**P2**»), e.g.:

Changing of the operation threshold is effected with ◁ and ▷ keys .

Exit from level No.1 of the "Programming" mode to the "Measuring" mode is effected by pressing ↵ key.

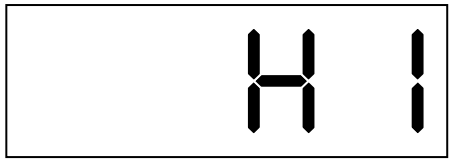
F.3 Level No.2 of the "Programming" mode

F.3.1 Entry to level No. 2 of the "Programming" mode is performed as follows: de-energize MD, press ◁ and ▷ keys and energize holding them in this position; hold ◁ and ▷ keys pressed until the flashing indication "**ПРОГ.**" is displayed:

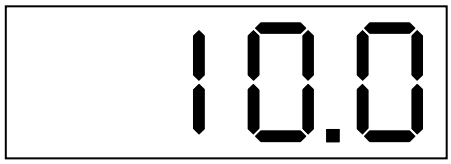


The single display "✳" is ON.

F.3.2 Press ↵ key. The digital display highlights the designation of the inflection point of the analyzer output characteristic, **H1,** which corresponds to the average value of the output analog signal, e.g.:

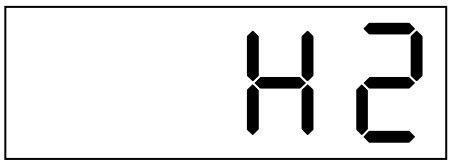


After pressing ↵ key the display shows the value of output characteristic inflection point which corresponds to the average value of the output analog signal, e.g.:

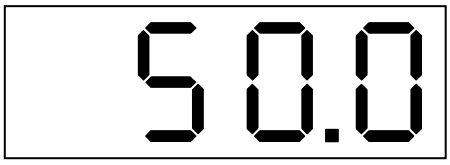


Setting of the value of the output characteristic inflection point is effected with ◁ and ▷ keys. With the specified value, for instance, H1=10,0 the average value of the output analog signal equal to 12 mA will correspond to the measured EC value equal to 10,0 µS/cm with the range of the output analog signal variation of (4…20) mA.

F.3.3 Press ↵ key. The digital display highlights the designation of the upper limit of the analyzer output characteristic, **Н2,** which corresponds to the final value of the output analog signal, e.g.:

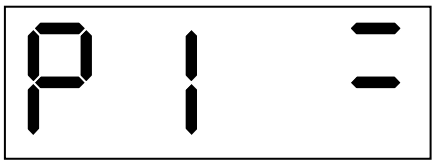


After pressing ↵ key the display shows the value of the output characteristic upper limit which corresponds to the final value of the output analog signal, e.g.:

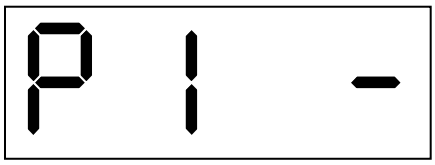


Setting of the value of the output characteristic upper limit is effected with ◁ and ▷ keys. With the specified value, for instance, Н2=50,0, the final value of the output analog signal equal to 20 mA will correspond to the measured EC value equal to 50,0 μS/cm with the range of the output analog signal variation of 4…20 mA.

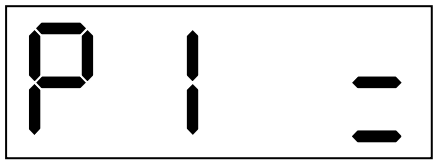
F.3.4 Press ↵ key. The digital display highlights the mode of operation of the relay «**Р1**», three variants are possible:



Variant 1



Variant 2



Variant 3

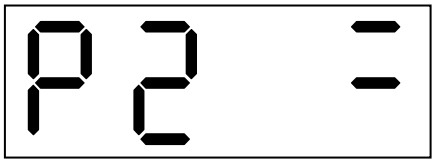
Variant 1: the relay «**Р1**» will be ON when the test parameter exceeds the **У1+П** value and OFF when the test parameter is below the **У1-П** value, where **У1** – setting '**1**', **П** – operation threshold (hysteresis, insensitivity area).

Variant 2: the relay «**Р1**» is OFF.

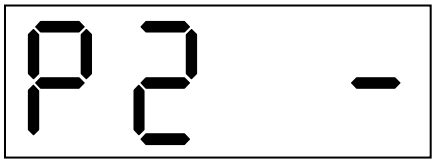
Variant 3: the relay «**Р1**» will be ON when the test parameter is below the **У1-П** value and OFF when the test parameter exceeds the **У1+П** value.

The mode of operation of the relay «**Р1**» is selected with ▷ key.

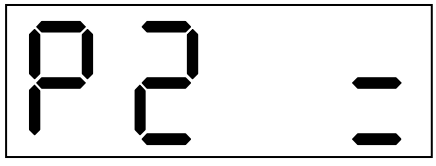
F.3.5 Press ↵ key. The digital display highlights the mode of operation of the relay «**Р2**», three variants are possible:



Variant 1



Variant 2



Variant 3

Variant 1: the relay «**Р2**» will be ON when the test parameter exceeds the **У2+П** value and OFF when the test parameter is below the **У2-П** value , where **У2** – setting '**2**', **П** – operation threshold (hysteresis, insensitivity area).

Variant 2: the relay «**Р2**» is OFF.

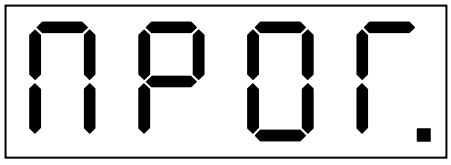
Variant 3: the relay «**Р2**» will be ON when the test parameter is below the (**У2-П**) value and OFF when the test parameter exceeds the (**У2+П**) value.

To exit level No.2 of the "**Programming**" mode to the "**Measuring**" mode press ↵ key.

F.4 Level No.3 of the "Programming" mode

F.4.1 Prior to programming of the minimum and maximum values of the MD output current it is necessary to connect the milliammeter to the measuring device. The milliammeter is connected via load resistors: 0,25 kOhm for the output current variation range of (4…20) mA and 1,0 kOhm for the output current variation range of (0…5) mA.

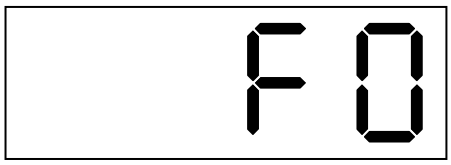
F.4.2 Entry to level No.3 of the "Programming" mode" is performed as follows: enter level No.2 of the "Programming" mode (see item F.3.1.) and, without pressing ↵ key, simultaneously press ◁ and ▷ keys again and hold them pressed within several seconds until the flashing indication "**PROG**" is displayed:



The single display, "∗' is ON in the flashing mode.

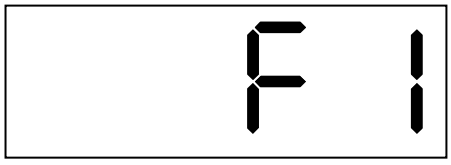
Let the analyzer warm up within 15 minutes.

F.4.3 Press ↵ key. The digital display highlights the designation of the setting mode for the initial value of the output analog signal (minimum value of the output current):



Setting of the required output current value which is monitored by the milliammeter is effected with ◁ and ▷ keys.

F.4.4 Press ↵ key. The digital display highlights the designation of the setting mode for the final value of the output analog signal (maximum value of the output current):

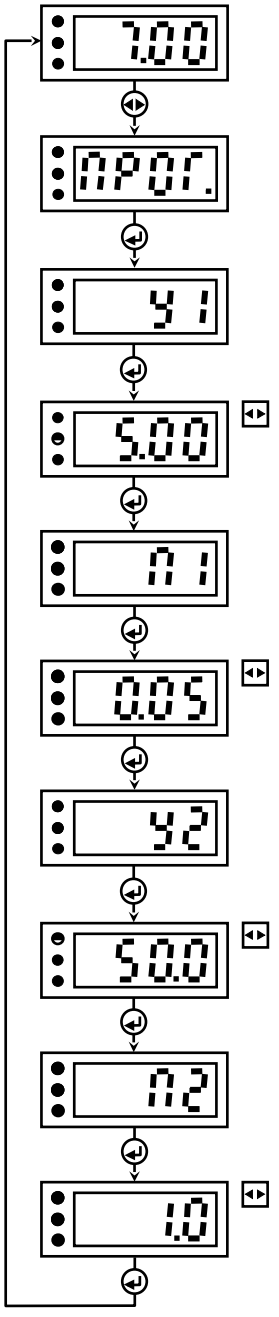


Setting of the required output current value which is monitored by the milliammeter is effected with ◁ and ▷ keys.

To exit level No.3 of the "Programming" mode to the "Measuring" mode press ↵ key.

Block diagrams of the operation algorithm in the "Programming" mode

LEVEL No. 1



"Measuring" mode (the parameter value is shown arbitrarily)

Entry to level No. 1 of the "Programming" mode

Designation of setting "**1"**

Value of setting "**1**" (shown arbitrarily)

Designation of the operation threshold (insensitivity area, hysteresis) of relay «**P1**» (shown arbitrarily)

Value of the operation threshold (insensitivity area, hysteresis) of relay «**P1**» (shown arbitrarily)

Designation of setting «**2**»

Value of setting "**2"** (shown arbitrarily)

Designation of the operation threshold (insensitivity area, hysteresis) of relay «**P2**»

Value of the operation threshold (insensitivity area, hysteresis) of relay «**P2**» (shown arbitrarily)

SYMBOLS

◐ - simultaneously press the parameter increase and decrease keys and hold them until the flashing indication "ПРОГ." appears

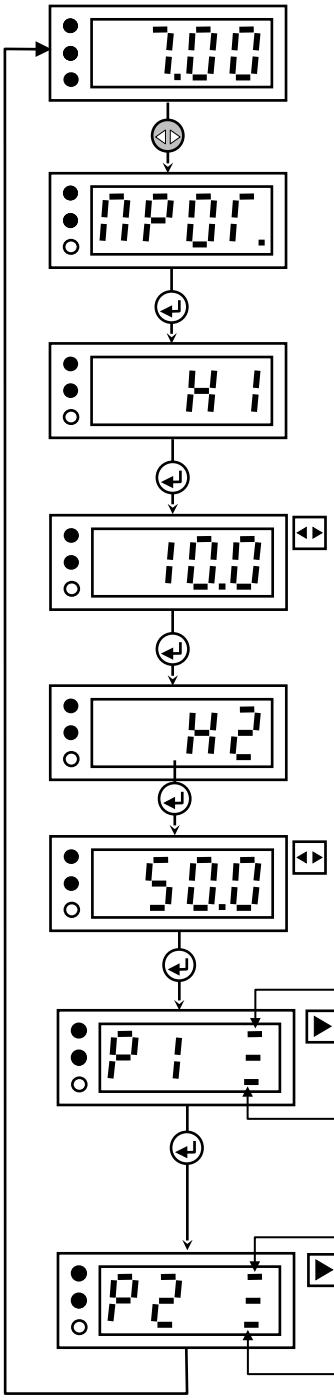
↵ - press the parameter entry key once

● - the dingle display is OFF

◓ - the single display is ON in the flashing mode

◐ - possibility of adjusting the parameter value with the parameter increase and decrease keys

LEVEL No. 2



"Measuring" mode (the parameter value is shown arbitrarily)

Entry to level No.2 of the "Programming" mode

Designation of the output characteristic inflection point corresponding to the average value of the output current

Value of the output characteristic inflection point in EC units

Designation of the output characteristic upper limit corresponding to the final value of the output current

Value of the output characteristic upper limit in EC units

Relay «**P1**» will be ON when the test parameter exceeds the **У1+П1** value and OFF when the test parameter is below the **У1-П1** value

Relay «**P1**» will be ON when the test parameter is below the **У1-П1** value and OFF when the test parameter exceeds the **У1+П1** value

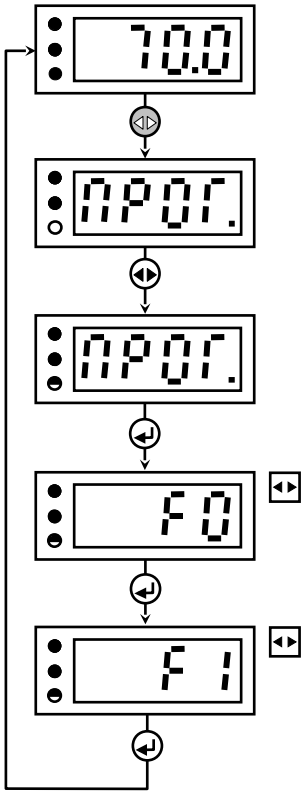
Relay «**P2**» will be ON when the test parameter exceeds the **У2+П2** value and OFF when the test parameter is below the **У2-П2** value

Relay «**P2**» will be ON when the test parameter is below the **У2-П2** and OFF when the test parameter exceeds the **У2+П2** value

SYMBOLS

- ◁▷ - after the measuring block is de-energized simultaneously press the parameter increase and decrease keys, energize the measuring block and hold the parameter increase and decrease keys until the flashing indication " ПРОГ.**"** appears
- ↵ - press the parameter entry key once
- ● - the single display is OFF
- ● - the single display is ON
- ◂▸ - possibility of adjusting the parameter value with the parameter increase and decrease keys
- ▶ - possibility of adjusting the parameter value with the parameter increase key

LEVEL No. 3



"Measuring" mode (the parameter value is shown arbitrarily)

Entry to level No.2 of the "Programming" mode

Entry to level No.3 of the "Programming" mode

Setting mode for the initial value of the output analog signal (minimum value of the output current)

Setting mode for the final value of the output analog signal (maximum value of the output current)

***Note: when adjusting the output current (in F0 and F1 modes connection of the input signal is not required*)**

SYMBOLS

- after the measuring device is de-energized simultaneously press the parameter increase and decrease keys, energize the measuring device and hold the parameter increase and decrease keys until the flashing indication " ПРОГ.**"** appears
- simultaneously press the parameter increase and decrease keys hold them until the flashing indication " ПРОГ.**"** appears
- press the parameter entry key once
- the single display is OFF
- the single display is ON
- the single display is ON in the flashing mode
- possibility of adjusting the parameter value with the parameter increase and decrease keys

Annex G
Programming of the measuring device (analyzer for concentration)

G.1 Description and rules of operation in the "Programming" mode

For the operational convenience the measuring device (MD) is provided with 3 levels of the "Programming" mode:

- **level No.1** – fixing of settings for the signaling relay operation; fixing of threshold (hysteresis, insensitivity area) for signaling relay operation (a single value for both settings);
- **level No. 2** – setting of the comma position on the MD digital display; setting of signaling relay operation modes; setting of the lower and upper limits of the measuring range (corresponding to the output current initial and final values);
- **level No.3** – activation/deactivation of linearization and setting of 10 points of correspondence against the input and output characteristics; setting of the output current signal initial and final values.

Single pressing the keys causes their single action, with the prolonged pressing the algorithm of the accelerated multiple action of the key starts functioning.

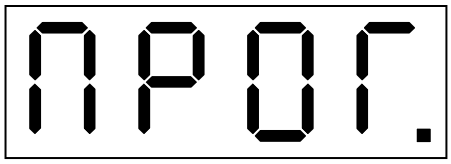
The single display "∗" signals entering in levels No.2 and No.3 of the "Programming" mode.

All set parameters are stored in nonvolatile memory.

In case the "Programming" mode is exited improperly (e.g. the analyzer de-energizing) the last entered parameter is not stored.

G.2 Level No.1 of the "Programming" mode

G.2.1 Entry in level No.1 of the "Programming" mode from the "Measuring" mode is effected with simultaneous pressing ◁ and ▷ keys (in this case the digital display goes out) and holding them pressed within a few seconds until the flashing indication "**ПРОГ.**" is displayed:



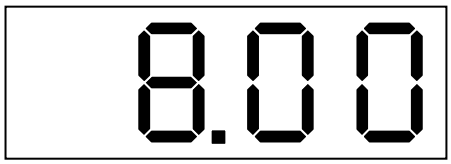
The single display "∗" is OFF.

G.2.2 Press ↵ key. The digital display highlights the value of setting "**1"** (for comma position refer to item G.3.2.), e.g.:

Flashing of the single display "**1"** confirms the setting number.

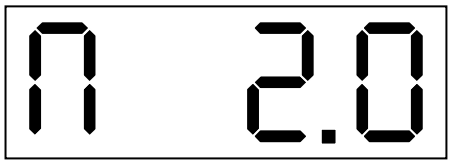
Changing of the setting "**1"** value is effected with ◁ and ▷ keys.G.2.3. Press ↵ key.

G.2.3 Press ↵ key. The digital display highlights the value of setting "**2"**, e.g.:



Flashing of the single display "**2"** confirms the setting number.
Changing of the setting "**2"** value is effected with ◁ and ▷ keys.

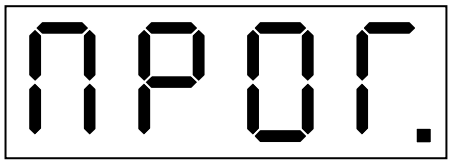
G.2.4 Press ↵ key. The digital display highlights the value of threshold (hysteresis, insensitivity area) of relay operation (a single value for both relays), e.g.:



This indication means that the threshold value equals 2.
Changing of the operation threshold is effected using ◁ and ▷ keys.

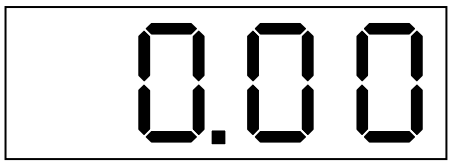
G.3 Level No. 2 of the "Programming" mode

G.3.1 Entry to level No. 2 of the "Programming" mode is performed as follows: de-energize MD, press ◁ and ▷ keys and energize holding them in this position; hold ◁ and ▷ keys pressed until the flashing indication "**ПРОГ.**" is displayed:



The single display "✳" is ON.

G.3.2 Press ↵ key. The digital display highlights the comma position with the indication of the concentration value in the measuring range, e.g.:



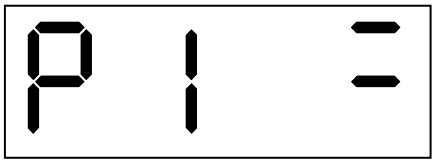
The number of characters after comma may range from zero to three.
Position of the comma is set with ▷ key.

Notes:

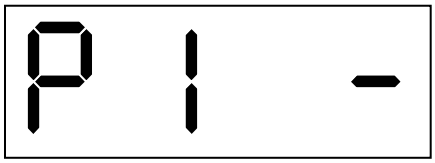
1. Setting of the comma position is used only with the activation of linearization (see item G.4.3) with the display of the concentration, settings and hysteresis values;

2. With linearization deactivated one character after comma is used in indication while EC in percentage of the range set in PT is displayed instead of the concentration.

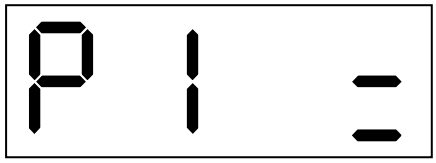
G.3.3 Press ↵ key. The digital display highlights the mode of operation of the relay «**Р1**», three variants are possible:



Variant 1



Variant 2



Variant 3

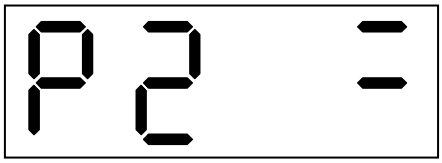
Variant 1: the relay «**Р1**» will be ON when the test parameter exceeds the (**У1+П)** value and OFF when the test parameter is below the (**У1-П)** value , where **У1** – setting '**1**', **П** – operation threshold (hysteresis, insensitivity area) of the relay.

Variant 2: the relay «**Р1**» is OFF.

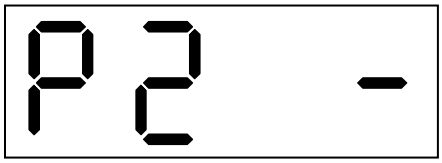
Variant 3: the relay «**Р1**» will be ON when the test parameter is below the (**У1-П)** value and will be OFF when the test parameter exceeds the (**У1+П)** value.

The mode of operation of the relay «**Р1**» is selected with ▷ key.

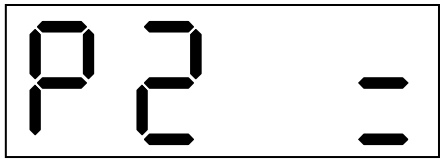
G.3.4 Press ↵ key. The digital display highlights the mode of operation of the relay «**Р2**», three variants are possible:



Variant 1



Variant 2



Variant 3

Вариант 1 Вариант 2

Вариант 2

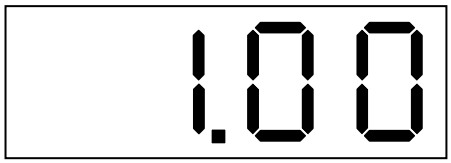
Variant 1: the relay «**Р2**» will be ON when the test parameter exceeds the (**У2+П)** value and OFF when the test parameter is below the (**У2-П)** value , where **У2** – setting '**2**', **П** – operation threshold (hysteresis, insensitivity area) of the relay.

Variant 2: the relay «**Р2**» is OFF.

Variant 3: the relay «**Р2**» will be ON when the test parameter is below the (**S2-T)** value and OFF when the test parameter exceeds the (**У2+П)** value.

The mode of operation of the relay «**Р2**» is selected with ▷ key.

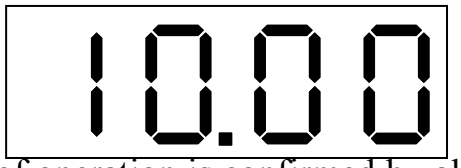
G.3.5 Press ↵ key. The digital display will highlight the value of measuring range lower limit which will correspond to the initial value of the output analog signal (for the position of the comma refer to item G.3.2.), e.g.:



Selection of the mode of operation is confirmed by simultaneous flashing of two single displays, "**1**" **and** "**2**".

Changing of this parameter is performed with ◁ and ▷ keys .

G.3.6 Press ↵ key. The digital display will highlight the value of measuring range upper limit which will correspond to the final value of the output analog signal, e.g.:



Selection of the mode of operation is confirmed by alternate flashing of two single displays, "**1**" **and** "**2**".

Changing of this parameter is effected with ◁ and ▷ keys.

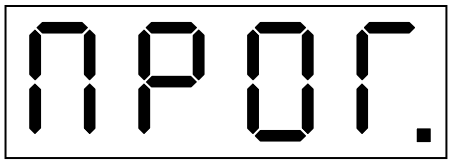
To exit level No.2 of the "Programming" mode to the "Measuring" mode press ↵ key.

G.4 Level No.3 of the "Programming" mode

ATTENTION! In level No.3 of the "Programming" mode the setting of the measuring device is performed which may result in the modification of the analyzer metrological characteristics. However, in case the parameter change keys, ◁ and ▷, in relevant modes are not pressed then when pressing ↵ key nonvolatile memory will not fix the variation in respective parameters of the input and output signal.

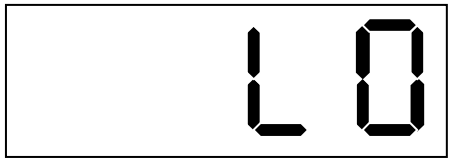
G.4.1 Prior to the MD programming in level No. 3 (in case setting of the output current initial and final values is required) it is necessary to connect the milliammeter to the measuring device. The milliammeter is connected via load resistors: 0,25 kOhm for the output current variation range of 4…20 mA and 1,0 kOhm for the output current variation range of (0…5) mA.

G.4.2 Entry to level No.3 of the "Programming" mode" is performed as follows: enter level No.2 of the "Programming" mode (see item G.3.1.) and, without pressing ↵ key, simultaneously press ◁ and ▷ keys again and hold them pressed within several seconds until the flashing indication "**ПРОГ.**" appears:

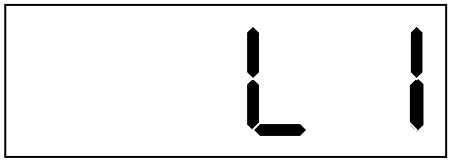


The single display "∗" is ON in the flashing mode.

G.4.3 Press ↵ key. The digital display highlights the condition of the linearization mode set previously:



Variant 1



Variant 2

Selection of the required variant is made using ▷ key.

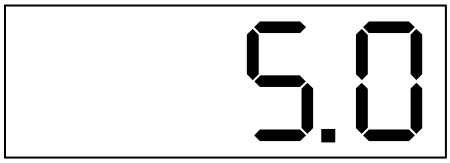
Variant 1: the linearization mode is OFF. If the linearization mode is deactivated then in the measuring mode EC values in percentage of the measuring range set in PT ("input characteristic") will be displayed.

ATTENTION! With the selection of the deactivated linearization mode programming will further switch over to the programming of the output current (see item G.4.8.).

Variant 2: the linearization mode is ON. If the linearization mode is activated then in the measuring mode the digital display will show numeric values in conformity with the output characteristic which results from the input characteristic by assigning ten values of the output characteristic to ten values of the input characteristic resp.

ATTENTION! With the selection of the activated linearization mode with the subsequent pressing ↵ key the digital display will consequently highlight 20 values, odd of which (oddness is confirmed by the activation of the single display "1") correspond to the points of the input characteristic and even (evenness is confirmed by the activation of the single "2") – to the points of the output characteristic.

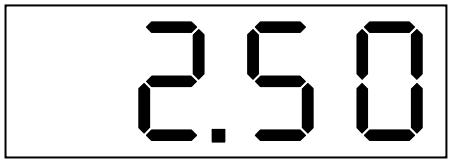
G.4.4 Press ↵ key. The digital display highlights the numeric value of the first point of the input characteristic (fixed position of comma – one character after comma), e.g.:



Activation of the single display "**1"** confirms that this is a point from the input characteristic (odd by count).

To change the point value it is necessary to unlock the operation of the parameter change keys. For unlocking press ▷ key and holding it in this position press and hold ↵ key until the single display "**1"** switches to the flashing mode. After these keys are released changing of the point value is effected with ◁ and ▷ keys.

G.4.5 Press ↵ key. The digital display highlights the numeric value of the first point of the output characteristic (comma position set in the programming level No. 2 – refer to item G.3.2), e.g.:



Activation of the single display "**2"** confirms that this is a point from the output characteristic (even by count).

To change the point value it is necessary to unlock the operation of the parameter change keys. For unlocking press ▷ key and holding it in this position press and hold ↵ key until the single display "**2"** switches to the flashing mode.

After these keys are released changing of the point value is effected with ◁ and ▷ keys.

G.4.6 Press ↵ key. The digital display highlights the numeric value of the second point of the input characteristic. Activation of the single display "1**"** confirms that this is a point from the input characteristic (odd by count).

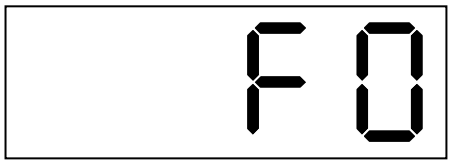
To change the value of the second point of the input characteristic follow the procedures described in item G.4.4.

Press ↵ key. The digital display highlights the numeric value of the second point of the output characteristic. Activation of the single display "**2"** confirms that this is a point from the input characteristic (even by count).

To change the value of the second point of the output characteristic follow the procedures described in item G.4.5.

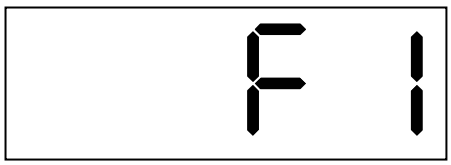
G.4.7 To change values of the rest points in the input and output characteristics repeat procedures described in items G.4.4. and G.4.5. for these points.

G.4.8 Press ↵ key. The digital display highlights the designation of the setting mode for the initial value of the output analog signal:



Setting of the required output current value which is monitored by the milliammeter is effected with ◁ and ▷ keys.

G.4.9 Press ↵ key. The digital display highlights the designation of the setting mode for the final value of the output analog signal:

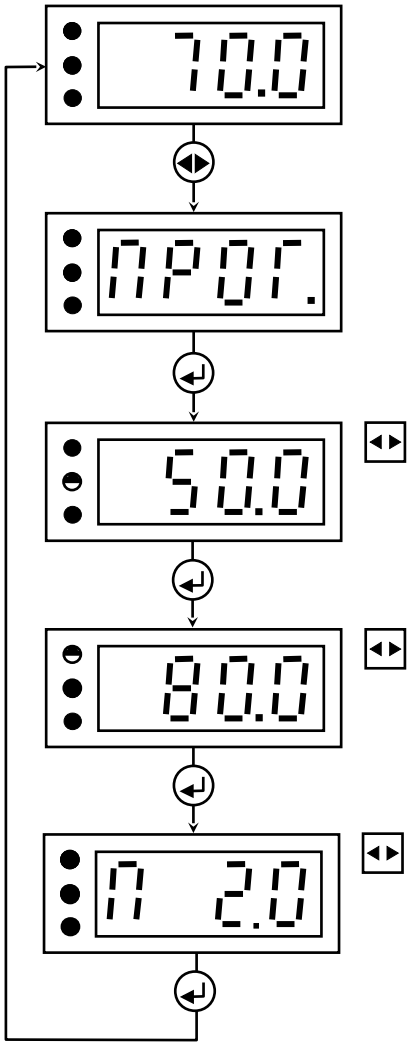


Setting of the required output current value which is monitored by the milliammeter is effected with ◁ and ▷ keys.

To exit level No.3 of the "Programming" mode into the "Measuring" mode press ↵ key.

Block diagrams of the operation algorithm in the “Programming” mode

LEVEL No. 1



Entry in level No.1 of the “Programming” mode

Value of setting “**1”** (shown arbitrarily)

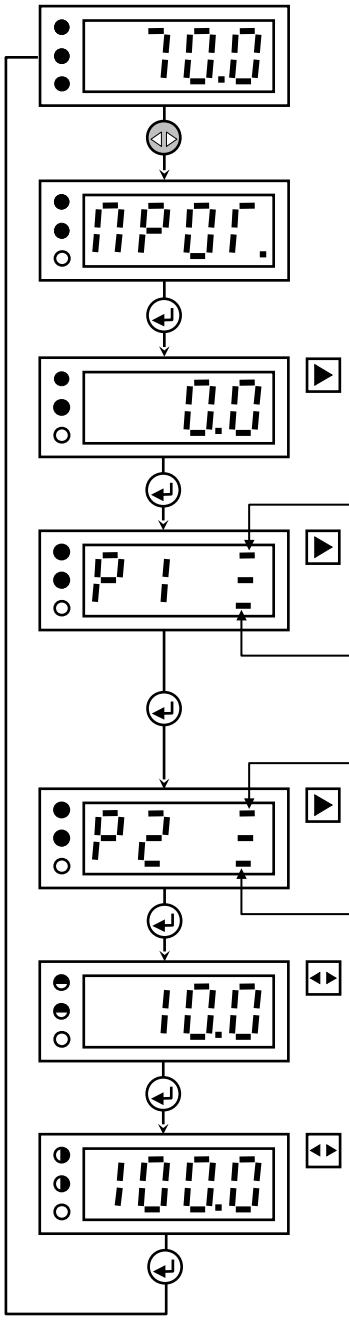
Value of setting “**2”** (shown arbitrarily)

Value of operation threshold (insensitivity area, hysteresis) for relays «**P1**» and «**P2**» (shown arbitrarily)

SYMBOLS

- simultaneously press the parameter increase and decrease keys and hold them until the flashing indication “ПРОГ.” appears
- press the parameter entry key once
- the single display is OFF
- the single display is ON in the flashing mode
- possibility of adjusting the parameter value with the parameter increase and decrease keys
- possibility of adjusting the parameter value with the parameter increase key

LEVEL No. 2



"Measuring" mode (the parameter value is shown arbitrarily)

Entry into level No.2 of the "Programming" mode

Position of comma with display of parameters (shown arbitrarily)

Relay «**Р1**» will be ON when the test parameter exceeds the **У1+П** value and OFF when the test parameter is below the **У1-П** value, where **У1** – setting "**1"**, **П** – operation threshold for relay

Relay «**Р1**» is OFF

Relay «**Р1**» will be ON when the test parameter is below the **У1-П** value and OFF when the test parameter exceeds the **У1+П** value, where **У1** – setting "**1"**, **П** – operation threshold for relay

Relay «**Р2**» will be ON when the test parameter exceeds the **У2+П** value and OFF when the test parameter is below the **У2-П** value, where **У2** – setting "**2"**, **П** – operation threshold for relay

Relay «**Р2**» is OFF

Relay «**Р2**» will be ON when the test parameter is below the **У2-П** value and OFF when the test parameter exceeds the **У2+П** value, where **У2** – setting "**2"**, **П** – operation threshold for relay

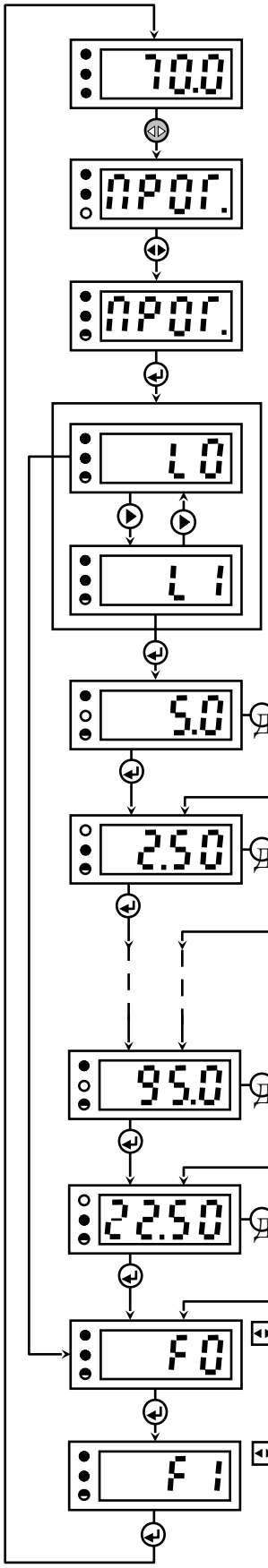
Value of the measuring range lower limit corresponding to the initial value of the output analog signal (shown arbitrarily)

Value of the measuring range upper limit corresponding to the final value of the output analog signal (shown arbitrarily)

SYMBOLS

- ◁▷ - after the measuring device is de-energized simultaneously press the parameter increase and decrease keys, energize the measuring device and hold the parameter increase and decrease keys until the flashing indication " ПРОГ.**"** appears
- ↵ - press the parameter entry key once
- ● - the single display is OFF
- ● - the single display is ON
- ● - the single display is ON in the flashing mode
- ◑ - the single display functions in the mode of the alternative connection with the other single display
- ◂▸ - possibility of adjusting the parameter value with the parameter increase and decrease keys
- ▶ - possibility of adjusting the parameter value with the parameter increase key

LEVEL No. 3



"Measuring" mode (the parameter value is shown arbitrarily

Entry into level No.2 of the "Programming" mode

Entry into level No.3 of the "Programming" mode

The linearization mode is OFF

The linearization mode is ON

Value of the first check point of the input characteristic (shown arbitrarily)

Value of the first check point of the output characteristic (shown arbitrarily)

Value of the tenth check point of the input characteristic (shown arbitrarily)

Value of the tenth check point of the output characteristic (shown arbitrarily)

Setting mode for the initial value of the output analog signal

Setting mode for the final value of the output analog signal

SYMBOLS

- after the measuring device is de-energized simultaneously press the parameter increase and decrease keys, energize the measuring device and hold the parameter increase and decrease keys until the flashing indication ” ПРОГ.” appears
- simultaneously press the parameter increase and decrease keys and hold them until the flashing indication “ПРОГ.” appears
- press the parameter entry key once
- make the parameter change accessible: press ▷ key and holding it in this position press and hold ↵ key until all single displays are activated in the flashing mode
- the single display is OFF
- the single display is ON
- the single display is ON in the flashing mode
- possibility of adjusting the parameter value with the parameter increase and decrease keys