



Russian Classification
of Production

421551

APPROVED BY
Director General
LLC NTF "BACS"

_____ R.K. Bibaev

«_____» _____

2017

Industrial gas analyzers "HygroScan" series

OPERATION MANUAL

KS 50.590-000 RE



Samara
2017

Contents

Contents	3
Introduction.....	4
1 Description and Operation.....	5
1.1 Functionality	5
1.2 Technical specifications	8
1.3 Completeness of the analyzer	11
1.4 Operating principle of the analyzer.....	11
1.5 The structure of analyzer of the “HygroScan-S” version	14
1.6 The structure of analyzers of the "HygroScan-T" version.....	17
1.7 The structure of the analyzer of “HygroScan-P” version	21
1.8 Provision of explosion protection requirements	24
1.9 Marking.....	27
1.10 Packaging.....	29
2 Intended use.....	30
2.1 General operation guidelines	30
2.2 Safety precautions	30
2.3 Placement and installation	30
2.4 Installation procedure, preparation for operation, start-up	31
2.5 Operation procedure of the analyzer	32
2.6 Software	33
2.7 Analyzer display	36
2.8 List of faults	38
3 Maintenance.....	39
3.1 Maintenance procedure	39
3.2 Maintenance contents.....	39
4 Transportation, storage and disposal.....	41
4.1 Transportation	41
4.2 Storage	41
4.3 Utilization.....	41
4.4 Warranty of service.....	42
APPENDIXES	43
Appendix A. Dimensional drawing	43
Appendix B. Electrical connection diagram.....	47
Appendix C. Schematic gas diagram.....	51

Introduction

This operation manual applies to Industrial Gas Analyzers series "HygroScan" KS 50.59X-000 (-01) (hereinafter referred to as analyzers) intended for determination of water vapor content with subsequent calculation of dew point water temperature (DPT) in gas media, including natural combustible gases.

The manual contains rules and guidelines for the operation of the analyzer, the rules of connection, configuration, maintenance, transportation and storage, as well as warranty repair conditions.

Read this manual carefully before operating the analyzer. Reliable operation and lifetime of the analyzer depend on the guidance given in the manual.

The manufacturer guarantees the correct operation of the analyzer only if the requirements and recommendations of this manual are strictly adhered to.

The device can be operated by an operator experienced in working with gas analyzers, who is familiar with the operating manual for the analyzer and is authorized to work with it.

The manufacturer has the right to introduce minor changes into the design of the analyzer, not degrading the technical, metrological and operational characteristics of the analyzer which may not be reflected in this manual.

1 Description and Operation

1.1 Functionality

1.1.1 The analyzer is designed to determine the content of water vapor with subsequent calculation of the dew point temperature of water (DPT) in gas media, including in combustible natural gases in accordance with GOST 20060-83 "Combustible natural gases. Methods for determination of water vapor content and humidity dew point", GOST R 53763-2009 "Combustible natural gases. Determination of the temperature of the dew point of water. "

1.1.2 Scope of applications: quality control of gases, including natural gas, pulsed, fuel, start-up gases, natural gas, prepared for liquefaction, natural gas fuel for internal combustion engines according to GOST 27577-2000, humidity content control in raw materials, technological flows and commodity products in petrochemical and gas processing industries.

1.1.3 Analyzer operation principle is sorption-capacitive based.

The measurement of the humidity of the air is made and calculations of DPT are carried out at the operating pressure of the analyzed medium. To calculate the humidity concentration and recalculate the dew point temperature with a set pressure value at a sample pressure other than atmospheric pressure, the analyzer can be equipped (depending on the version) with an integrated pressure sensor of the analyzed gas.

1.1.4 The measurement result can be represented in the following units (depending on the version):

- Concentration of water vapor (at normal conditions), mg/m^3 or ppm;
- Water dew point temperature (at operating pressure and in terms of preset pressure value, default is -3.92 MPa), ° C;
- Absolute pressure of the measured gas in the cell, MPa.

1.1.5 The analyzer is available in the following versions.

- "HygroScan-S" KS 50.591-000 (-01). Explosion-proof (stationary) industrial gas analyzer;
- "HygroScan-P" KS 50.592-000 (-01). Portable explosion-proof analyzer;
- Explosion-proof industrial gas analyzer in the "transmitter" version with the following modifications:
 - "HygroScan-T PRO" KS 50.593-000 (-01);
 - "HygroScan-T Light" KS 50.594-000 (-01);
 - "HygroScan-T Micro" KS 50.595-000 (-01).

1.1.5.1 "HygroScan-S" KS 50.591-000 (-01). Explosion-proof stationary industrial gas analyzer).

It is made in the form of a single unit in which all parts of the analyzer are enclosed in an explosion-proof enclosure of the "Ex d" type; the device is installed in an explosive zone near the sampling point.

The industrial analyzer is designed for continuous operation in an automatic mode, while humidity measurement, signal conversion, calculation of required parameters, storage and transmission of data, setting of the operating modes of the instrument are carried out under the control of the built-in microcontroller. Measurement results and analyzer parameters are displayed on the built-in display and can be transferred to external devices, including PCs, via various communication interfaces.

The industrial analyzer is equipped with a built-in flow selector with solenoid valves, which allows for an alternate analysis of up to 2 gas flows on a single instrument.

The analytical unit of the KS 50.596-000 (-01) of the "HygroScan-S" analyzer KS 50.591-000 (-01) is a complete metrologically significant part of the analyzer and can be used as part of other devices, for example, integrated into flow gas chromatographs to account the water vapor content in the analyzed gas.

1.1.5.2 "HygroScan-P" KS 50.592-000 (-01). Portable explosion-proof analyzer;

The portable explosion-proof analyzer (hereinafter the portable analyzer) is made in the form of a plastic case and has an explosion protection of the "Ex d mb" type.

The portable analyzer is designed for analyzing the gas humidity with the calculation of the water dew point temperature, while the connection of the analyzer to the sampling point, gas supply and shut off are carried out manually. Humidity measurement, signal conversion, calculation of required parameters, storage and transmission of data, setting of the operating modes of the instrument are carried out under the control of the built-in microcontroller, while the portable analyzer does not require its connection to an external PC.

The portable analyzer is equipped with an autonomous power source (accumulator).

1.1.5.3 "HygroScan-T". Explosion-proof industrial gas analyzer of the "transmitter" version is produced with the following modifications:

- "HygroScan-T PRO" KS 50.593-000 (-01) is a version of an industrial analyzer consisting of two enclosures of the "Ex d" type. In one enclosure there is an electronics unit that includes a display and an analyzer control button, in the other enclosure there is an analytical unit. The analyzer can be additionally equipped with an external solenoid valve to implement a periodic measurement mode to save the analyzed gas.
- "HygroScan-T Light" KS 50.594-000 (-01) is a version of an industrial analyzer consisting of two enclosures of the "Ex d" type. In one enclosure there is a simplified electronics unit without a display and controls, in the other enclosure there is an analytical unit.

- "HygroScan-T Micro" KS 50.595-000 (-01) is a version of an industrial analyzer consisting of one compact enclosure of the "Ex d" type, containing a simplified electronics unit without a display and controls, and an analytical unit without a pressure sensor.

The transmitter is permanently installed in an explosive zone near the sampling point with a discharge onto the spark plug, or mounted on a pipe in the "closed bypass" scheme with the return of the analyzed gas flowing through the analyzer back to the pipeline.

The transmitter is designed for continuous operation in an automatic mode, with the transmitter performing a primary humidity measurement of the analyzed gas, adjusting the measurement result to the required units and recalculation by the preset pressure (with a pressure sensor), and transmitting the data to external devices.

Transmitters can be used in conjunction with flow gas chromatographs to take into account the humidity content in determining the composition and calculating the physicochemical properties of natural combustible gas. The transmitter is designed for analysis of a single gas flow.

1.1.6 Analyzers are explosion-proof, comply with the requirements of technical regulation TR TS 012/2011 "On the safety of equipment for work in explosive environments", GOST 31610.0-2014 (IEC 60079-0: 2011), GOST IEC 60079-1-2011, GOST R IEC 60079 -18-2012 and can be installed in explosive zones (Electrical Installation Code (EIC), issue 6, Ch.7.3 2001) according to the explosion protection marking.

Explosion protection marking - 1Ex d IIC T6 Gb or 1Ex d mb IIC T6 Gb X

Accommodation zone –1.

Explosion protection types - explosion-proof enclosure (d) or compound sealing (m), depending on the version.

Electrical equipment sub-group – IIC.

Temperature class – T6.

Climatic version type – Moderately Cold Climate 3.1 according to GOST 15150.

1.2 Technical specifications

1.2.1 The main technical specifications of the analyzer are given in Table 1.

Table 1. Main technical specifications

Indicator name	Value and characteristics of the indicator				
Version	HygroScan-S	HygroScan-T			HygroScan-P
		PRO	Light	Micro	
Model	KS 50.591-000 (-01)	KS 50.593-000 (-01)	KS 50.594-000 (-01)	KS 50.595-000 (-01)	KS 50.592-000 (-01)
Analyzed mixture phase	Gaseous (natural gas, multicomponent gas mixtures)				
Concentration of mechanical impurities	Not more than 10 mg/m ³ with particle sizes of not more than 5 µm in the analyzed mixture The analyzed gas must not contain inclusions of the liquid phase in the form of fog or aerosol				
Sample pressure	Not more than 25 MPa				
Analyzed gas flow	0.5-5 nl/min				
Number of analyzed flows	up to 2, alternately	1	1	1	1
Operating mode	Automatic continuous/periodic	Automatic continuous/periodic	Automatic continuous	Automatic continuous	Manual
Solenoid valves on the sample line	Built-in (optional)	External (optional)	No	No	No
Pressure sensor	Yes	Optional	Optional	No	Optional
Explosion protection marking	1 Ex d IIC T6 Gb	1 Ex d IIC T6 Gb	1 Ex d IIC T6 Gb	1 Ex d IIC T6 Gb	1 Ex d mb IIC T6 Gb X
Enclosure protection degree	IP66	IP66	IP66	IP66	IP65
Power supply voltage	220 ⁺²² ₋₃₃ V	24 V DC			12 V from the accumulator battery

Indicator name	Value and characteristics of the indicator				
Version	HygroScan-S	HygroScan-T			HygroScan-P
		PRO	Light	Micro	
Model	KS 50.591-000 (-01)	KS 50.593-000 (-01)	KS 50.594-000 (-01)	KS 50.595-000 (-01)	KS 50.592-000 (-01)
Power consumption	Not more than 65 W	Not more than 45 W	Not more than 10 W	Not more than 5 W	Not more than 20 W
Communication interfaces	RS232/485, Ethernet, 4-20 mA, GSM/GPRS (optional)	2×RS485, 4-20 mA + HART	RS485 or 4-20 mA	RS485 or 4-20 mA (only for -01 model)	RS232
Storage of analysis archives and event logs	up to 35 days in the analyzer memory	No	No	No	up to 35 days in the analyzer memory
Operating temperature	-40...+50 °C	-40...+50 °C	-10...+50 °C	-10...+50 °C	-40...+50 °C
Dimensions, LxWxH, mm	200×370×355	210×180×240	210×160×90	Ø46×220	300×350×170
Weight, not more than, kg	25	3.5	2	0.6	9
Service life, years	at least 10				

1.2.2 The metrological characteristics of the analyzer are given in Table 2.

Table 2. Metrological characteristics

Indicator name	Indicator value	
	For models KS 50.59X-000	For models KS 50.59X-000-01
Measurement principle	Sorption-capacitive	
Analysis cycle time	from 30 seconds (without accounting for purge time)	
Humidity concentration measurement range *	2 ... 20 000 mg/m ³	0.01 ... 20 000 mg/m ³
Limits of the permissible relative error of measuring the humidity concentration	± 20% in the range of 2... 20 mg/m ³ ± 10% in the range of 20... 20 000 mg/m ³	± 20% in the range of 0.01 ... 20 mg/m ³ ± 10% in the range of 20 ... 20 000 mg/m ³
Range of dew point temperature	-70...+20 °C	-100 ... +20°C
Limits of the permissible absolute error of measuring the the dew point temperature	± 2 °C: in the range of DPT -70 ... -60 °C ±1 °C: in the range of DPT -60 ... +20 °C	±2 °C: in the range of DPT -100 ... -60 °C ±1 °C: in the range of DPT -60 ... +20 °C

* at an analyzed gas pressure of 0.1 MPa and a temperature of 20 ° C.

With increasing pressure of the analyzed gas, the humidity concentration range is proportionally shifted towards lower concentrations, as the partial pressure of water vapors and the number of molecules per volume unit of the gas increase.

1.2.3 The analyzer warm-up period is not more than 30 minutes.

1.2.4 The verification interval of the analyzer is 1 year.

During the verification interval, the analyzer does not require periodic calibration for gas mixtures. The analyzer implemented an algorithm for automatic sensitivity correction, which makes it possible to compensate for the possible drift of the readings of the measuring cell.

1.2.5 Reliability indicators:

- average time between failures is not less than 20,000 h;
- average life of the analyzer is 10 years.

1.3 Completeness of the analyzer

Table 3. Delivery package of the analyzer

Designation	Name	Quantity
KS 50.59X-000 (-01)	Humidity and dew point temperature analyzer	1
	Packaging	1
	Spare parts kit (completeness according to the service list)	1
KS 50.590-000 RE	Operation manual	1
KS 50.590-000 PS	Certificate	1
KS 50.590-000 34 01-1	Operator's manual for X-Meter software	*
	X-Meter software distribution on digital media	*
KS 50.438-200	Charging device with cable	**
KS 50.438-100	Interface cable	**
MP	Verification method	1
RU.C	Copy of the certificate of Approval for the type of measuring instrument	1
RU C-RU.GB	Copy of the Customs Union Certificate of Conformity	1

* - only for "HygroScan-S" 50.591-000 (-01) and "HygroScan-P" 50.592-000 (-01) models;

** - only for the "HygroScan-P" 50.592-000 (-01) model.

1.4 Operating principle of the analyzer

1.4.1 General information

The analyzer is based on the principle of sorption-capacitive measurement of water vapors content in gases. The essence of the method lies in the dependence of the dielectric permittivity of the polymer humidity-sensitive element (1), see Fig. 1, placed between two electrodes (2) and (3), one of which is humidity-permeable, on the humidity of the surrounding medium. The water molecules contained in the analyzed gas are sorbed on the surface of the sensitive element, changing the capacitance of the capacitor formed by the electrodes. This change is directly proportional to the content (partial pressure) of humidity, which makes it possible to quantify the content of water vapors in the gas.

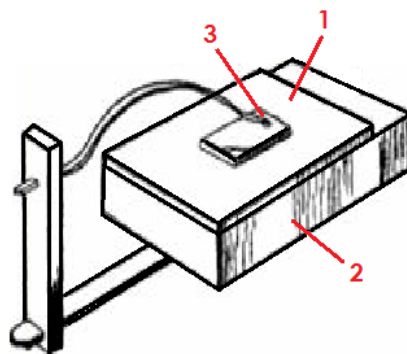


Fig. 1. The structure of the analyzer measuring cell

1.4.2 The composition of the analytical unit of the analyzer

Analytical unit of the analyzer includes (depending on the version):

- Measuring cell - humidity and temperature transducer (sensor);
- Pressure transducer (sensor);
- Peltier element with a temperature sensor for cooling the analytical unit;
- Heating element with temperature sensor.

If the pressure of the analyzed gas differs from the atmospheric pressure and the measurement result must be adjusted to a set pressure value, the analytical unit is equipped with a pressure sensor. For all analyzer models except "HygroScan-T Micro" 50.595-000 (-01).

The analytical unit is equipped with a Peltier element to maintain the optimum temperature of the sensing element of the humidity sensor (23 ± 2 ° C) in order to minimize the error when operating over a wide range of ambient temperatures. Only for the "HygroScan-S" 50.591-000 (-01) models.

The analytical unit is equipped with a heating element for the temperature of the sensing element of the humidity sensor at a level not lower than $+10$ ° C. For all analyzer models except "HygroScan-T Light" 50.595-000 (-01) and "HygroScan-T Micro" 50.595-000 (-01).

The models of the "HygroScan" analyzer, indicated by the "-01" index, are equipped with a humidity sensor with a sensitivity range of -100 ° C DPT (see Table 2).

1.4.3 Operation of the analytical unit of the analyzer

The analyzed gas, purified from drip liquid, aerosols and mechanical impurities by means of the appropriate sample preparation system (see point 1.4.4), is fed into the analytical unit of the analyzer under operating pressure.

The analyzed gas enters the humidity and temperature sensor, by means of which the concentration of humidity in the analyzed gas is determined in accordance with the principle described in the paragraph 1.4.1 and the subsequent calculation of the water dew point temperature .

Further, the analyzed gas passes through a pressure sensor, which, determining the gas pressure, allows the measured value of the humidity concentration to be normalized and the dew point temperature is recalculated to the required pressure value, for example, 40 kgf/cm^2 .

Then the analyzed gas is fed to the analyzer discharge and then to the spark plug through the adjustable pneumatic resistance, which serves to maintain the operating gas pressure in the analytical unit of the analyzer and to set the flow of the analyzed gas through it.

The humidity measurement period of a single gas flow is 30 seconds without accounting the purge time.

1.4.4 Requirements for the sample preparation system

The analyzer (except for the "HygroScan-P" 50.592-000 (-01) model) should be used in conjunction with the sample preparation system. Typical gas diagram of the sample preparation system for "HygroScan" analyzers is given on Fig. 2.

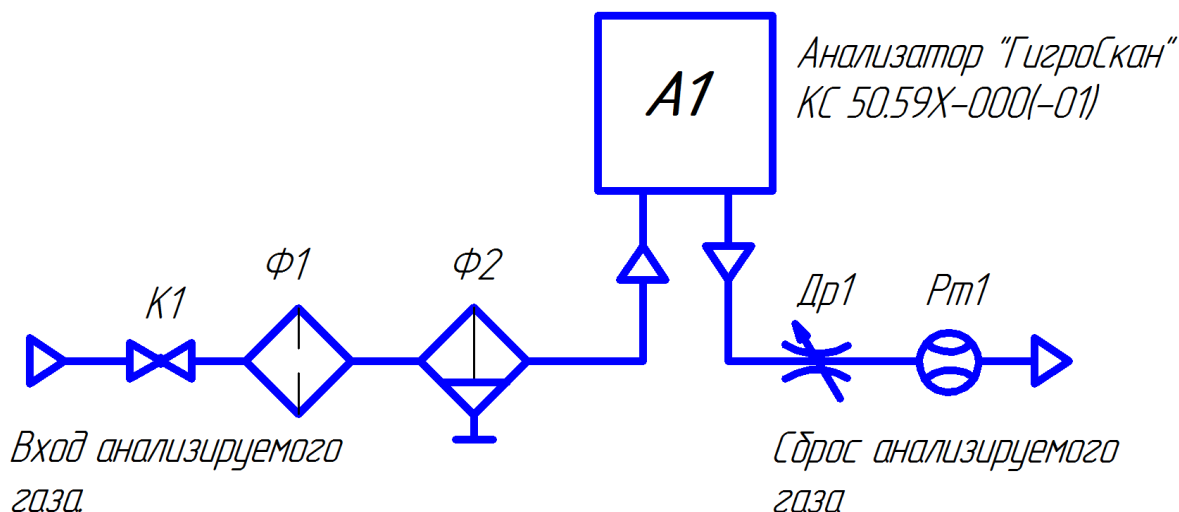


Fig. 2. Typical diagram of the sample preparation system for the analyzer

The sample preparation system should perform the following functions:

- Filtration from mechanical impurities larger than 5 μm (F1 filter, see Fig. 2);
- Removal of drip liquid, suspensions and aerosols from the analyzed gas (F2 coalescing filter);
- Sample heating (placing the sample preparation system in a heated cabinet);
- Maintaining the operating pressure of the sample in the analyzer measuring cell (Th1 throttle (needle valve) at the analyzer discharge);
- Indication of the volumetric flow rate of the sample passed through the analyzer (Rt1 rotameter).

The sample preparation systems of a specific analyzer may include all or some of the elements indicated on the diagram, and, if necessary, additional devices.

NOTE: *The configuration of the sample preparation system is selected depending on the composition and properties of the analyzed sample when ordering the analyzer.*

1.5 The structure of analyzer of the “HygroScan-S” version

1.5.1 Visual appearance of the “HygroScan-S” analyzer

The visual appearance of the “HygroScan-S” 50.591-000 (-01) industrial analyzer is shown on Fig. 3. All the units included in this version of the analyzer are enclosed in a compact explosion-proof housing.

On the front side of the analyzer housing, under the transparent front cover window, there is a display intended for displaying current measurement results, pressure in the measuring cell and other parameters.

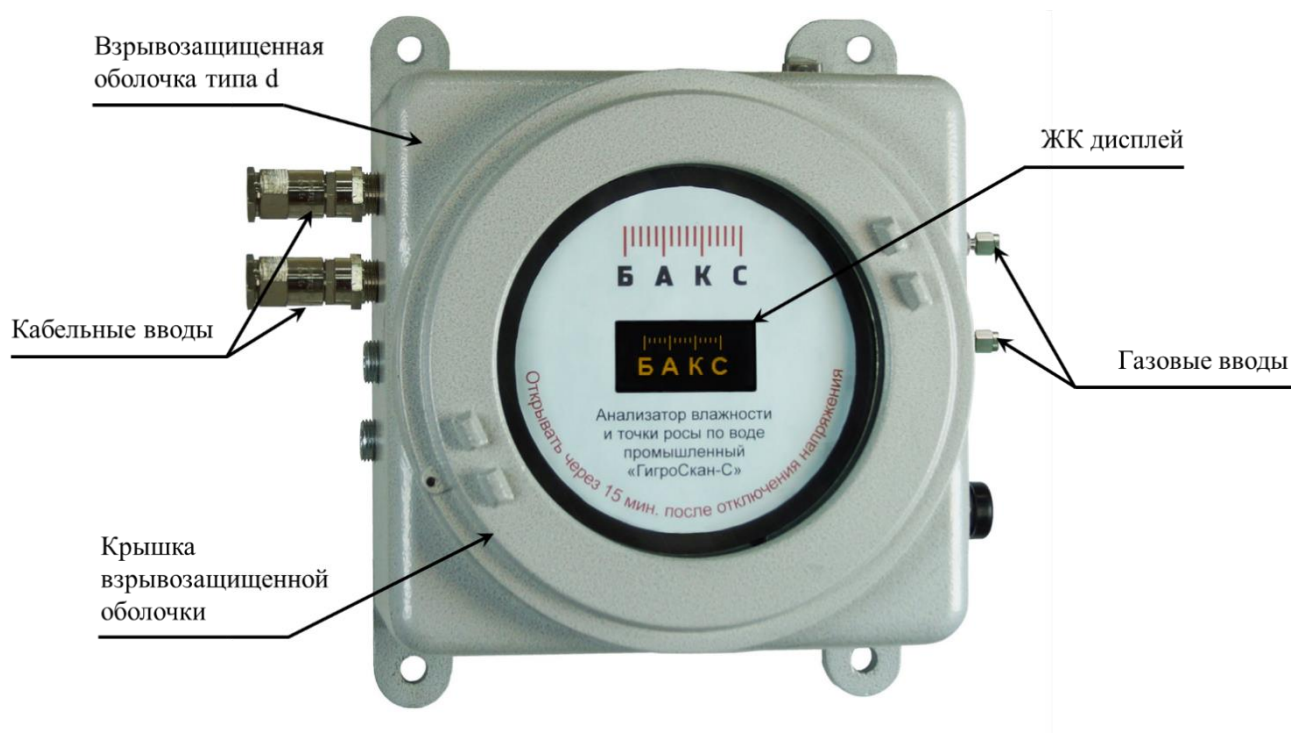


Fig. 3. Visual appearance of the “HygroScan-S” analyzer

The supply and discharge of the analyzed gas is carried out through certified gas inlets located on the side or bottom wall of the analyzer. The standard version uses a 1/8" tube for gas inlet and outlet.

1.5.2 The internal structure of the "HygroScan-S" analyzer

The analytical unit of the analyzer, as well as the electronics unit are inside the explosion-proof enclosure. Fig. 4

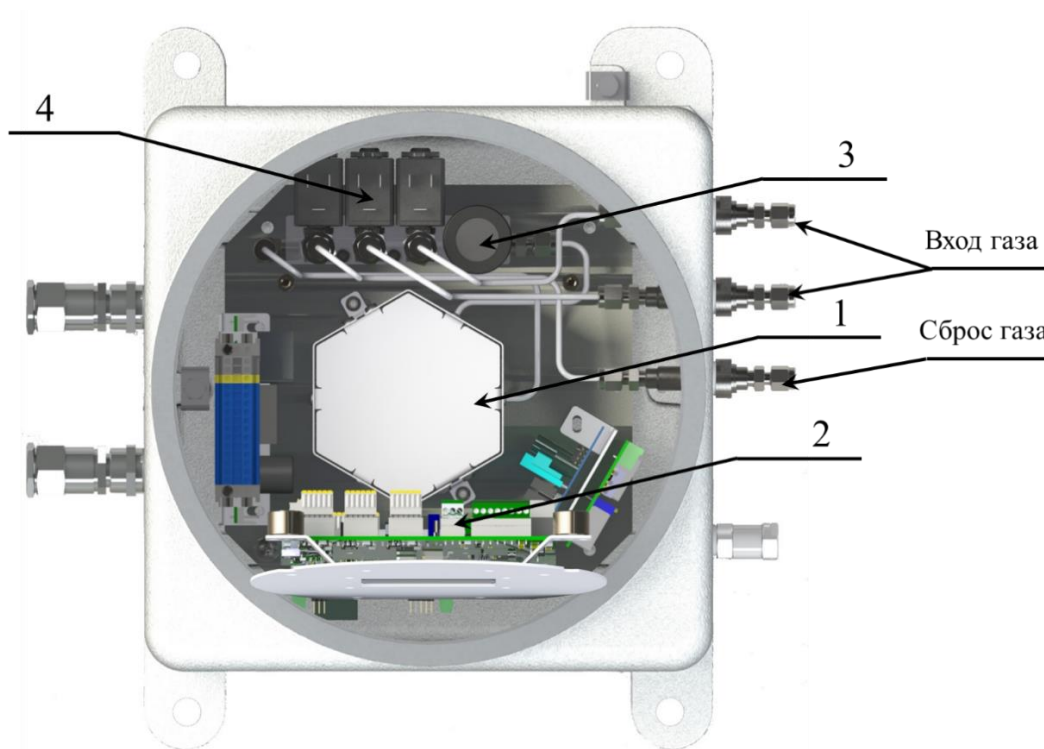


Fig. 4. The internal structure of the "HygroScan-S" analyzer

Analytical unit of the analyzer (1, see Fig. 4) consists of the following elements:

- Measuring cell - humidity and temperature transducer (sensor);
- Peltier element with a temperature sensor;
- Heating element with a temperature sensor.
- The pressure pressure transducer (sensor) (3, see Fig. 4) is located outside the measuring cell thermostat.

The housing of the analyzer measuring cell is placed in a thermostat. The temperature in the thermostat is maintained within $(23 \pm 2^\circ\text{C})$ using a Peltier element and a heater.

The analyzer can be additionally equipped with an analyzed flow switch unit (4), which includes up to 3 high-pressure solenoid valves, allowing the analyzed gas flow through the analyzer to be cut off and perform a sequential analysis of up to 2 gas flows on one instrument (one solenoid valve is installed on the analyzed gas discharge).

The schematic gas diagram of the analyzer is shown in Fig. 5. The diagram shows the version of the analyzer with an integrated analyzed gas flow switch unit with 2 solenoid valves (V1, V2) at the inlet and one valve (V3) at the outlet of the sample.

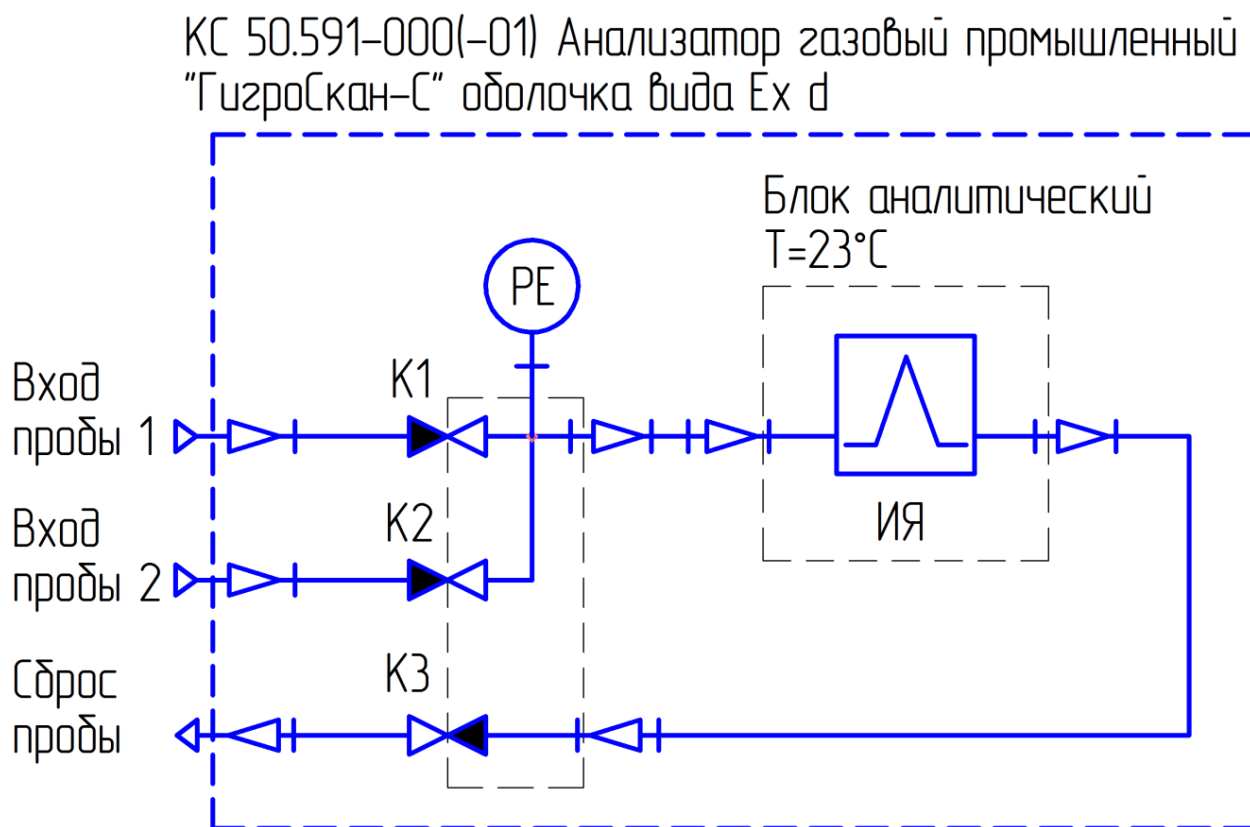


Fig. 5. The schematic gas diagram of the "HygroScan-S" analyzer

The diagram also identifies the gas pressure sensor (PS) and a measuring cell (MC), containing a humidity and temperature sensor.

The electronics unit (2, see Fig. 4) includes the following elements:

- Measuring cell signal conversion board, intended for obtaining the result of humidity measurement of the gas from the measuring cell, performing calculations and adjusting the result to the required measurement units;
- Heating control board for the measuring cell;
- Peltier element control board for cooling the measuring cell;
- A universal analyzer processor board with a microprocessor module and a non-volatile memory module designed for collecting, processing, storing and transferring measurement results and instrument parameters to external devices, as well as controlling the analyzer operating modes automatically in accordance with the specified algorithm;
- A display designed for displaying the current measurement results and status information;
- Protection board intended for emergency power-off of the device when the maximum permissible temperature and pressure values are exceeded in the explosion-proof enclosure;
- Power unit for converting the mains voltage to 24 V.

The analyzer can be connected to a PC with the installed X-Meter software using RS 232/485 and Ethernet interfaces, as well as transmit measurement results and current parameters to external devices

using RS 232/485 and Ethernet via Modbus RTU and Modbus TCP/IP, 4-20 mA protocols. The analyzer can be additionally equipped with GSM or GPRS modem for wireless data transmission.

ATTENTION! When storing and transporting (in the absence of built-in solenoid valves in the analyzer), the inlet and discharge of the gas must be CLOSED by plugs. Otherwise, the penetration of moisture will require a lengthy purge of the measuring cell.

1.6 The structure of analyzers of the "HygroScan-T" version

Analyzers of the "HygroScan-T" version are compact explosion-proof transmitters located in an explosive zone near the sampling point.

The transmitters measure the analyzed gas humidity and dew point temperature and in the presence of a pressure sensor (except the "HygroScan-T Micro" 50.595-000 (-01) model), the gas pressure is measured with the dew point temperature adjusted to the required pressure value and the calculation of the humidity concentration under normal conditions.

Transmitters can be connected to the external controller unit or directly to the customer's telemetry system and transmit to them the current measurement results and analyzer parameters via RS485 and/or 4-20 mA. At the same time, there are no archives of measurement results, as well as events and interventions log.

Transmitters are installed stationary in an explosive zone near the sampling point after the sample preparation system with a discharge onto the spark plug (see Fig. 2) or mounted on a pipe in a "closed bypass" scheme with a return of the analyzed gas flowing through the analyzer back to the pipeline (see Fig. 6).

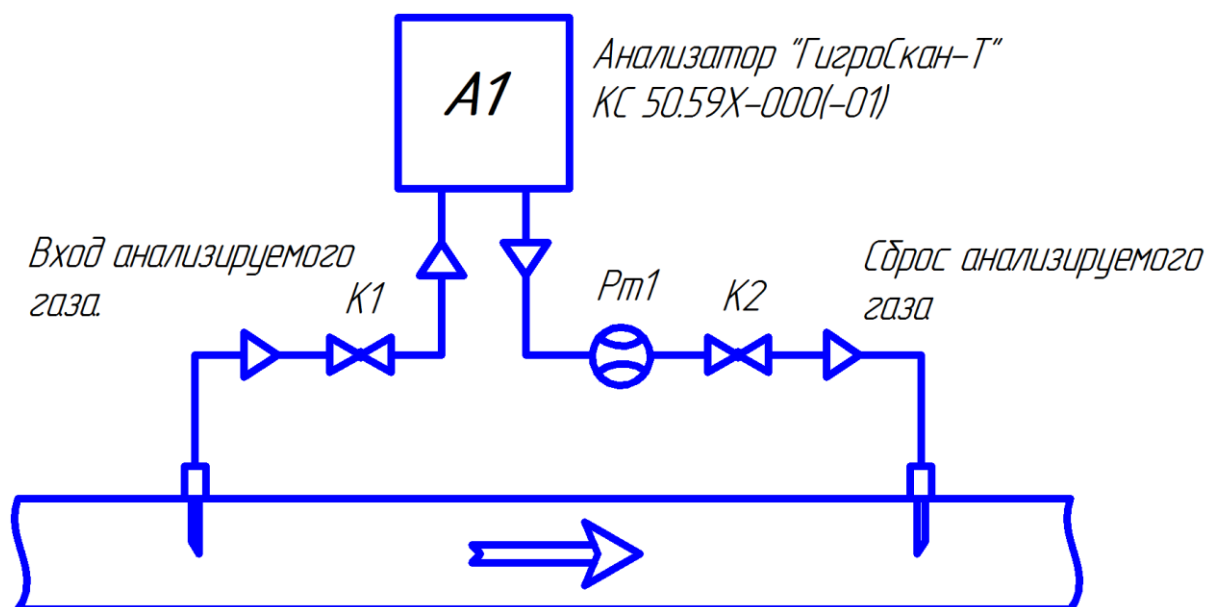


Fig. 6. Connection of "HygroScan-T" analyzers according to the "closed bypass" scheme

Such an arrangement of the analyzer makes it possible to carry out a continuous measurement of humidity and DPT without discharging the analyzed gas onto a spark plug. At the same time, the analyzer can be disconnected from the gas flow with the help of stop valves V1 and V2 for maintenance or replacement without overlapping the main gas flow in the pipeline.

Transmitters can be used in conjunction with flow gas chromatographs for accounting the humidity content in determining the composition and calculating the physicochemical properties of natural combustible gas.

The "HygroScan-T" analyzers are produced in the following versions:

- "HygroScan-T PRO" KS 50.593-000 (-01);
- "HygroScan-T Light" KS 50.594-000 (-01);
- "HygroScan-T Micro" KS 50.595-000 (-01).

ATTENTION! When storing and transporting, the gas inlet and discharge must be closed with plugs. Otherwise, the penetration of moisture will require a lengthy blowdown time of the measuring cell.

1.6.1 The structure of the "HygroScan-T PRO" analyzer

"HygroScan-T PRO" KS 50.593-000 (-01) is the version of an industrial analyzer consisting of two enclosures of the "Ex d" type, in which the electronics unit and the analytical unit are separately located. Visual appearance of the "HygroScan-T PRO" analyzer is shown on Fig. 7.



Fig. 7. The external structure of the "HygroScan-T PRO" analyzer

Analytical unit of the analyzer is located in the lower cylindrical Ex d housing and consists of the following elements:

-
- Measuring cell – humidity and temperature transducer (sensor);
 - Heating element with a temperature sensor.
 - Pressure transducer (sensor) (optional).

The housing of the analyzer analytical unit is thermally insulated. At ambient temperatures below 0°C, the measuring cell is heated, which allows the analyzer to be used in the ambient temperature range from -40 to +50 ° C.

The analyzer electronics unit, located in the upper explosion-proof enclosure, includes the following elements:

- Measuring cell signal conversion board, intended for obtaining the result of humidity measurement of the gas from the measuring cell, adjusting the result to the required measurement units and transmitting the received data;
- Control board, combined with the LCD display, is intended to monitor the analyzer operation, recalculate the measurement results, taking into account the pressure value of the analyzed gas and control the heating of the analytical unit and an external solenoid valve (if available);
- Interface board designed to provide communication with external devices;
- Power board and external connections for connecting power and communication cables to the analyzer.

The analyzer can be additionally equipped with an external high-pressure solenoid valve installed at the analyzer discharge and allowing to cut off the analyzed gas flow through the analyzer to save it and implement the periodic measurement mode.

The analyzer is equipped with a control button located on the left side of the explosion-proof housing of the instrument. Using the control button, you can switch the displayed parameters and measurement units on the screen, and after entering the password to access the settings, you can perform the following actions:

- identification of the analyzer software;
- choice of a method of concentration and dew point temperature recalculation (GOST 20060-83 or GOST R 53763-2009);
- setting the analysis period (in the presence of an external solenoid valve);
- setting the period for the automatic sensitivity correction of the humidity sensor and its forced start;
- configuration of RS485, 4-20 interfaces and discrete outputs;
- change password.

The analyzer can transmit measurement results and current parameters to external devices using RS 485 interfaces via the Modbus RTU (master and slave) and 4-20 mA + HART protocols.

1.6.2 The structure of the "HygroScan-T Light" analyzer

"HygroScan-T Light" KS 50.594-000 (-01) is the version of an industrial analyzer consisting of two enclosures of the "Ex d" type, where a simplified electronics unit without a display and controls and an analytical unit are located separately. Visual appearance of the "HygroScan-T Light" analyzer is shown on Fig. 8.

Analytical unit of the analyzer is located in the lower cylindrical Ex d housing and consists of the following elements:

- Measuring cell - humidity and temperature transducer (sensor);
- Pressure transducer (sensor) (optional).

The housing of the analytical unit is not heated, therefore the analyzer can be used in the range of ambient temperatures from -10 to +50 ° C.

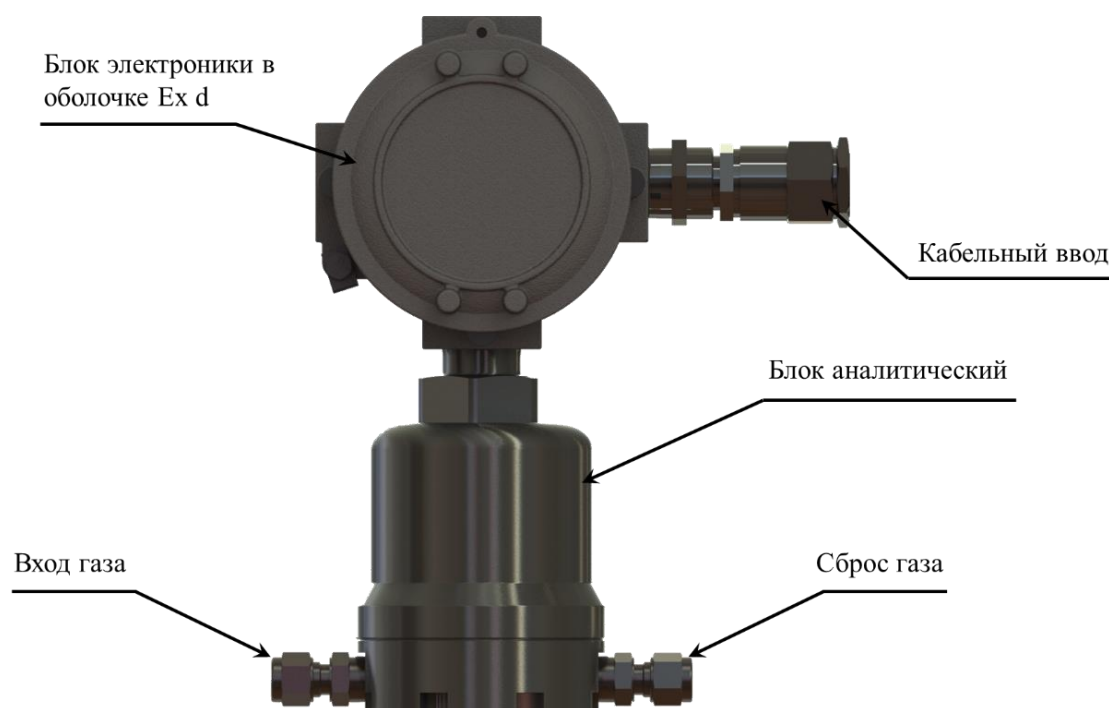


Fig. 8. The external structure of the "HygroScan-T Light" analyzer

The analyzer's electronics unit located in the upper explosion-proof enclosure is a measuring cell signal conversion board intended for obtaining the result of measuring the gas humidity from the measuring cell, calculations adjusting the result to the required measurement units, and transmitting the obtained data to external devices.

The analyzer can transmit measurement results and current parameters to external devices using the RS 485 interface via the Modbus RTU (master or slave, set by the jumper position on the conversion board) or 4-20 mA protocol.

1.6.3 The structure of the "HygroScan-T Micro" analyzer

"HygroScan-T Micro" KS 50.595-000 (-01) is a version of the industrial analyzer consisting of one compact enclosure of the "Ex d" type, containing a simplified electronics unit without a display and controls, and an analytical unit without a pressure sensor. External appearance of the analyzer "HygroScan-T Micro" is shown on Fig. 9.

The analytical unit of the analyzer includes only a measuring cell - a humidity and temperature transducer (sensor), the pressure sensor is not installed in this version of the analyzer.

The housing of the analytical unit is not heated, therefore the analyzer can be used in the range of ambient temperatures from -10 to +50 ° C.

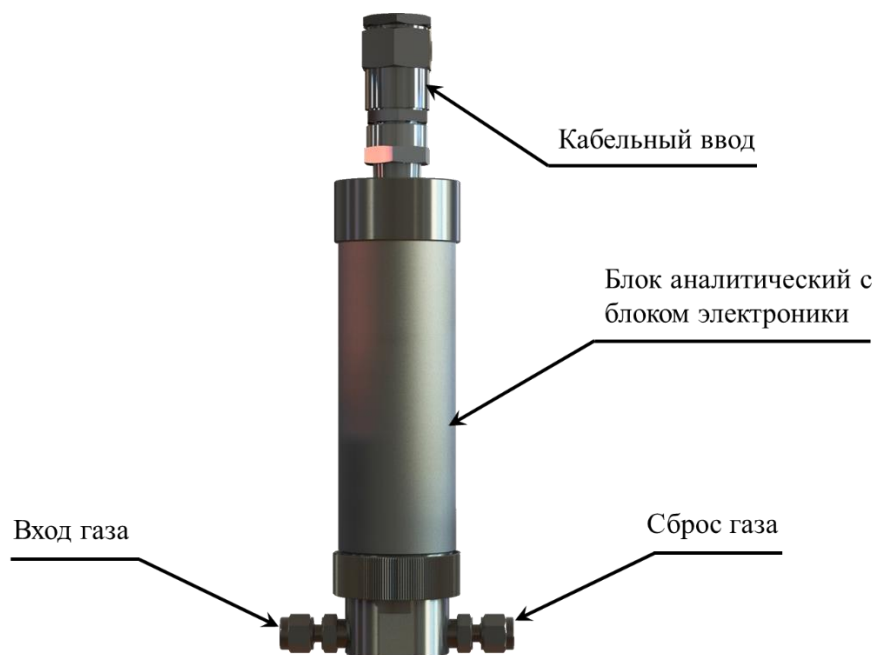


Fig. 9. The external structure of the "HygroScan-T Micro" analyzer

The analyzer electronics unit located in the same housing as the measuring cell, is a measurement cell signal conversion board for obtaining the result of measuring the gas humidity from the measuring cell and transferring the data to external devices.

The analyzer can transmit measurement results and/or current parameters to external devices using the RS 485 interface via the Modbus RTU (master or slave, set by jumper position on the conversion board), or 4-20 mA protocol (only for 50.595-000-01 model).

1.7 The structure of the analyzer of "HygroScan-P" version

1.7.1 Visual appearance of the "HygroScan-P" analyzer

Analyzer of the "HygroScan-P" KS 50.592-000 (-01) version is a portable explosion-proof instrument located in a plastic molded housing with a carrying handle (suitcase), see Fig. 10.

The following elements are located on the front panel of the instrument

- The control handle of the rotary gas valve, intended for supplying the sample of the analyzed gas to the analytical unit of the analyzer;
- Adjusting screw of variable pneumatic resistance (throttle) for regulating the gas flow through the analytical unit;
- LCD display for displaying measurement results and instrument parameters;
- Buttons for operation control and analyzer settings;
- Communication interface (RS-232) and charging device connectors;
- Fittings for connection and discharge of the analyzed gas.



Fig. 10. Visual appearance of the “HygroScan-P” analyzer

ATTENTION! When storing and transporting, the valve handle must be in the **CLOSED** position. Otherwise, the penetration of moisture will require a lengthy blowdown time of the measuring cell.

1.7.2 The internal structure of the "HygroScan-P" analyzer

The analytical unit and the electronics unit of the analyzer of the portable version are located behind the front panel.

The analytical unit of the portable analyzer includes the following elements:

- Measuring cell (MC) - humidity and temperature transducer (sensor);
- Heating element with a temperature sensor.
- Pressure transducer (sensor) (PS, optional).
- Rotary hand-operated dispenser (Ds, see Fig. 11);
- Filter of mechanical impurities (F);
- Adjustable pneumatic resistance (PR);

- Flow indicator (FI).

The housing of the measuring cell is thermally insulated. At ambient temperatures below 0°C, the measuring cell is heated, which allows the analyzer to be used in the ambient temperature range from -40 to +50 °C.

The schematic gas diagram of the portable analyzer version is shown in the figure below.

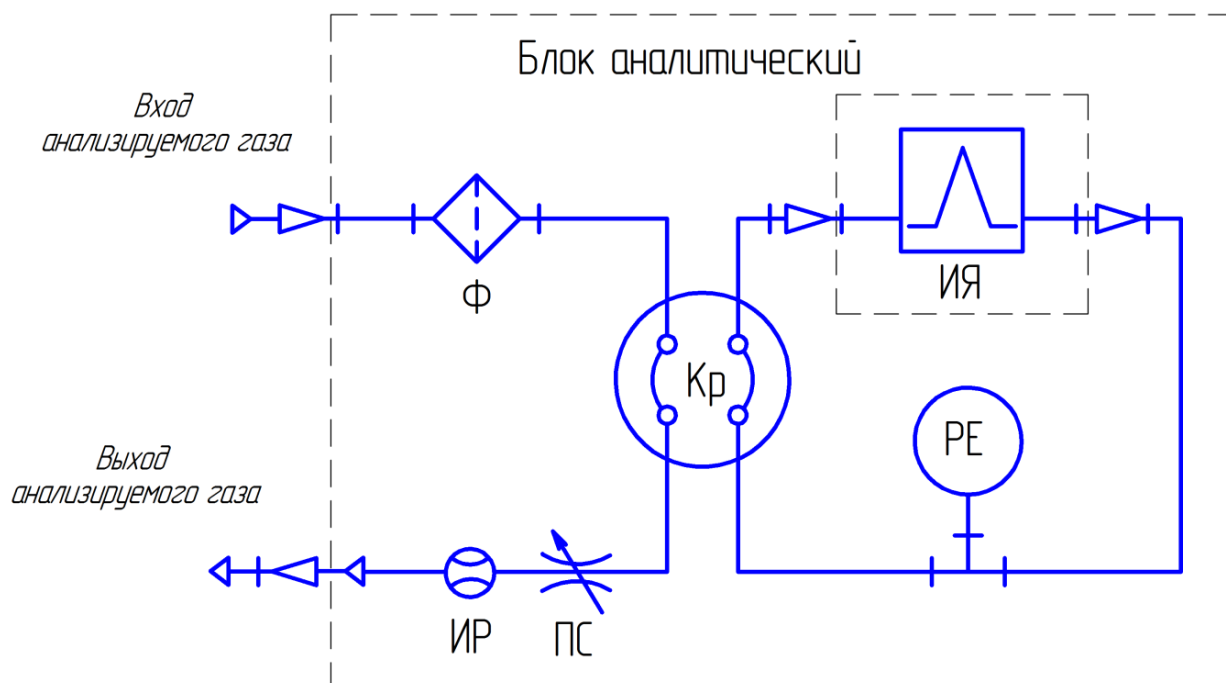


Fig. 11. The schematic gas diagram of the "HygroScan-P" analyzer

The dispenser (Ds) is designed to switch the analyzed gas flow between the bypass circuit and the full circuit, which includes a measuring cell and a pressure sensor. When connected to the analyzed gas line the valve must be installed in the "Closed" position, in which the analyzed gas purges the bypass circuit, displacing atmospheric air from the gas lines of the analyzer. After the purge, the dispenser is transferred to the "Analysis" position and the analyzed gas is supplied to the measuring cell and the pressure sensor.

With the help of adjustable pneumatic resistance (PR), the flow rate of the analyzed gas is set at the output within the limits specified in the analyzer's technical specifications. The flow rate is controlled by the built-in flow indicator (FI).

The electronics unit consists of the following elements:

- Measuring cell signal conversion board, intended for obtaining the result of humidity measurement of the gas from the measuring cell, performing calculations and adjusting the result to the required measurement units;
- The analyzer control board with a microprocessor module and a non-volatile memory module designed for collecting, processing, storing and transmitting to the external devices the measurement results and instrument parameters;

- OLED display;
- Accumulator battery.

The control board is a compound-sealed assembly of an OLED indicator and electronic board. The control board is attached inside the analyzer housing. The control board allows for receiving, storing, displaying and transmitting to external devices the measurement results and analyzer status parameters.

The analyzer can be connected to a PC with the "X-Meter" software installed via the RS 232 interfaces.

As the main power source, the analyzer uses an integrated sealed AGM rechargeable accumulator battery with an output voltage of 12 V.

The power supply to the analyzer's electronic boards is carried out by pressing the power button.

The accumulator is charged using external charging device provided with the analyzer and connected to the corresponding connector on the analyzer housing.

ATTENTION! Connection of the external charging device to the analyzer and charging procedure must be carried out solely OUTSIDE THE EXPLOSIVE ZONE!

ATTENTION! Connection of the communication cable and data reading must be carried out solely OUTSIDE THE EXPLOSIVE ZONE!

1.8 Provision of explosion protection requirements

1.8.1 Analyzers are explosion-proof, comply with the requirements of technical regulation TR TS 012/2011 "On the safety of equipment for work in explosive environments", GOST 31610.0-2014 (IEC 60079-0: 2011), GOST IEC 60079-1-2011, GOST R IEC 60079 -18-2012 and can be installed in explosive zones (Electrical Installation Code (EIC), issue 6, Ch.7.3 2001) according to the explosion-proof marking.

1.8.2 Analyzers can be installed in zone 1 (GOST R 31610.10-2012).

1.8.3 Sub-group of electrical equipment: IIC.

1.8.4 Temperature class: T6.

1.8.5 The following types of explosion protection types (depending on the version) are used:

- explosion-proof enclosure d (GOST IEC 60079-1-2011);
- compound sealing mb (GOST R IEC 60079-18-2012);

1.8.6 Explosion protection marking.

1 Ex d IIC T6 Gb for all models except "HygroScan-P" or 1Ex d mb IIC T6 Gb X for "HygroScan-P" 50.592-000 (-01).

1.8.7 To ensure the requirements of explosion protection, structural and organizational measures are used.

1.8.8 Constructive measures.

1.8.8.1 All units of the analyzer (for all models except "HygroScan-P") are placed in an enclosure of high mechanical strength degree capable of withstanding the pressure of the internal explosion without damage and transfer of ignition to the surrounding explosive gas atmosphere in accordance with GOST IEC 60079-1-2011. The enclosure volume depending on the used explosion-proof box is:

- For the "HygroScan-S" KS 50.591-000 (-01) model: 0.00864 m³ for Cortem SHCHORVA272721-O18 (former CCA-03V); 0.01095 m³ for F.E.A.M. MC UB014 and GUBW-03; 0.0062 m³ for Warom BXJ-IIC-III.
- For the "HygroScan-T PRO" KS 50.592-000 (-01) model: Limatherm XD-ID100 (510 cm³ + 300 cm³).
- For the "HygroScan-T Light" KS 50.593-000 (-01) model: Limatherm XD-JBA (240 cm³); Cortem CKB (170 cm³); FEAM-GUA (200 cm³).

1.8.8.2 The pressure inside the explosion-proof enclosure of the analyzer in the "HygroScan-S" KS 50.591-000 (-01) version should not exceed atmospheric pressure. To equalize the pressure, an SCU, VALVEEXD or DNV ventilation device is installed to release overpressure in the event of depressurization of the gas ducts. If the pressure inside the box exceeds 1.2 atmospheres, the analyzer's power supply is disconnected.

1.8.8.3 The cable inlet into the box (except for the portable version of the "HygroScan-P" 50.592-000 (-01) analyzer) is made out of certified explosion-proof cable inlets of the KOV or RAR and DQM type. The use of this type of cable inlets does not require a compound pouring operation due to the long elastomer sealing rings in them. Cable inlets, which are not used, are closed with VZN plugs.

1.8.8.4 An explosion-proof enclosure, cable inlets, a ventilation device are products of "GORELTEH Plant" (Russia), "ATEX-Electro"(Russia), "F.E.A.M Srl" (Italy), "Limatherm S.A." (Poland) or "Warom Technology Incorporated Company" (China), have valid certificates of conformity.

1.8.8.5 The gas inlets are made through a slot-type fire suppressors with the maximum possible clearance in accordance with GOST IEC 60079-1-2011, certified in the analyzer.

1.8.8.6 The analyzer of "HygroScan-P" 50.592-000 (-01) version has the type of explosion protection by means of compound sealing (mb) in accordance with GOST R IEC 60079-18-2012. The exposure of parts of the analyzer's electrical equipment to an explosive atmosphere which can cause an ignition due to sparking or heating is prevented by sealing the analyzer's electronic units.

The material of the "HygroScan-P" 50.592-000 (-01) analyzer housing meets the requirements of point 7.4 of GOST 31610.0-2014 (IEC 60079-0: 2011) "Explosive media. Part 0. Equipment. General requirements.

1.8.8.7 "HygroScan-T PRO" KS 50.593-000 (-01), "HygroScan-T Light" KS 50.594-000 (-01), "HygroScan-T Micro" KS 50.595-000 (-01) and "HygroScan-P" KS 50.592-000 (-01) models have a cap of sintered metal of 316L mark as one of the elements of explosion protection. The cap fulfills the function of filtering the gas from mechanical impurities and provides explosion protection of type d in accordance with point 10.5 and Annex C of point C.1 of GOST IEC 60079-1-2011.

1.8.8.8 A button is used to control the "HygroScan-T PRO" transmitter the explosion protection of which is provided for by threading and compound filling. . Explosion protection of the control buttons in the "HygroScan-P" model is provided by the compound filling.

1.8.9 Special conditions.

For the "HygroScan-P" 50.592-000 (-01) analyzer version, the connection of the interface connector and charging device connector must be carried out only outside the explosive zone.

In the explosive zone, connectors for communication and for the charging device must be enclosed with the KS 50.430-027, KS 50.430-027-01 covers.

1.8.10 Organizational measures

1.8.10.1 Tablets with information on the type and parameters of explosion protection and contact information of the manufacturer are fixed on the housing of the analyzer.

1.8.10.2 A tablet with a warning inscription is fixed on the analyzer bodies (except for "HygroScan-P") "Open in 15 minutes after switching off the voltage."

1.8.10.3 To protect the housing from unauthorized access, there is a protective locking screw on the analyzer housing (except for "HygroScan-P"), which is opened with a special key.

1.8.10.4 Analyzers (except for "HygroScan-P") are provided with an earthing clamp in accordance with GOST 21130-75.

1.8.10.5 A warning inscription tablet is fixed on the front and back of the "HygroScan-P" analyzer housing: "OPENING IN AN EXPLOSIVE ZONE IS FORBIDDEN".

1.8.10.6 On the housing of the "HygroScan-P" analyzer, a warning tablet is fixed at the back near the interface and the accumulator charging connector:

"CONNECTING IN AN EXPLOSIVE ZONE IS FORBIDDEN".

1.9 Marking

1.9.1 On the tablet installed on the analyzer (Fig. 12), it should be indicated:

- a manufacturer trademark;
- product name;
- serial number;
- year of manufacture;
- type approval mark of the measuring instrument according to PR 50.2.009;
- electrical parameters of the analyzer;
- maximum permissible gas pressure in gas lines;
- permissible ambient temperature range in the place of installation;
- equipment explosion protection sign (Ex);
- explosion protection marking and degree of protection against external influences IP;
- abbreviation CB and certificate number: TsS "STV" No. TS RU C-RU.GB04.V.00xxx;
- conformity mark in accordance with GOST R 50460-92;
- name and address of the manufacturer.



Fig. 12. The tablet on the analyzer housing

1.9.2 A tablet containing information on the metrological characteristics of the analyzer is also installed on the analyzer housing, see Fig. 13.


 Б А К С		Анализатор влажности и ТТРВ газовый промышленный “ГигроСкан-С”	
<input type="checkbox"/> Диапазон измерений ТТРВ: -70...+20 °C		<input type="checkbox"/> Диапазон измерений ТТРВ: -100...+20 °C	
Диапазон	Погрешность (абс.)	Диапазон	Погрешность (абс.)
-70... -60 °C	±2 °C	-100...-60 °C	±2 °C
-60...+20 °C	±1 °C	-60...+20 °C	±1 °C

Fig. 13. Tablet with the metrological characteristics of the analyzer

1.9.3 A warning inscription is placed on the cover of the industrial analyzer and the transmitter.

"Open in 15 minutes after switching off the voltage."

1.10 Packaging

Packaging of analyzers is performed in accordance with their operational documentation. The analyzer must be packed in a wooden or cardboard box. Before placing in the box, the analyzer must be placed in a plastic bag to prevent moisture ingress (or other material that does not allow moisture to penetrate).

The analyzer is placed in a transport packaging and fixed tightly on a position that prevents movement. To prevent damage, the walls of the box must be laid with packaging material.

The transport packaging also contains the operating manual, technical certificate, verification procedure, certificates, packed in a separate plastic bag.

A packaging list should be enclosed in each box of the shipping container containing the following information:

- name and designation of the analyzer, completeness;
- date of packaging;
- signature or stamp of the person responsible for the packaging and the stamp of the QC (Quality Control).

The packing list must be embedded in a polyethylene bag and placed under the lid of the box on the top layer of the packaging material so that its safety is guaranteed.

The transport packaging shall be sealed by the manufacturer's QC.

2 Intended use

2.1 General operation guidelines

2.1.1 The analyzer is a complex device that includes elements of electrical measuring equipment, gas flow control systems and pneumatic automatics.

2.1.2 During operation, it is necessary to monitor the operation of the analyzer. When any changes occur during operation there is need to check up on the pressure of the analyzed gas, tightness of gas lines and to look through the event log of the analyzer. It is necessary to ensure that the pressure of the analyzed gas in the analyzer's measuring cell is equal to the pressure in the pipeline. If necessary, the pressure of the analyzed gas in the measuring cell can be corrected by means of an adjustable pneumatic resistance (throttle) installed at the analyzing unit output or in the sample preparation system.

2.2 Safety precautions

2.2.1 The analyzer has pipelines operating under pressure of compressed gases (up to 25 MPa). Therefore, when operating the analyzer, it is necessary to observe the safety rules provided for working with devices under excessive pressure.

2.2.2 The analyzer of the "HygroScan-S" KS 50.591-000 (-01) model has electrical circuits with a voltage of 220 V. Therefore, when installing the analyzer in an explosive atmosphere, it is necessary to strictly follow the "Instructions for the installation of equipment for power and lighting networks of explosive zones VSN-332- 74 ", " Rules Electrical Installation Code" (EIC), " Operational Safety Regulations" (OSR) and "Rules for the technical operation of electrical installations (RTI) ", including Ch. EShch-13 of "Electrical equipment for explosive productions".

2.3 Placement and installation

2.3.1 Analyzers (except for "HygroScan-P") are placed on the technological object in accordance with the instructions of this operation manual.

2.3.2 When installing the device, connect:

- line for supplying the analyzed gas;
- line for discharge of the analyzed gas;
- electrical communications, connecting the device with external devices;
- 220 V or 24 V electrical supply .

2.3.3 The gas lines are connected by a 1/8" (or 3 mm) stainless steel tube with an internal diameter of 2 mm.

2.3.4 The gas lines of the analyzer are sealed at a pressure equal to 1.2 of the maximum operating value. The maximum allowable pressure drop for 30 minutes should not be more than 3% of the supplied pressure.

2.3.5 Mount the analyzer to a wall or frame on a technological facility using the guidelines shown in the dimensional drawing (Appendix A).

2.3.6 The analyzer is installed stationary on the site with observance of the permissible temperature range of operation specified in points 1.2 and 2.3.7.

2.3.7 The analyzer should be freely accessible from three sides.

2.3.8 The permissible temperature at the installation site is from -40 to +50 °C or from -10 to +50 °C, depending on the version (see Table 1), with a relative humidity of not more than 98%.

2.3.9 The instrument should be located remote from powerful heat sources. The minimum permissible distance between the device and the heat source is 1 m.

2.4 Installation procedure, preparation for operation, start-up

2.4.1 Installation of the analyzer on the technological facility (except for "HygroScan-P"). For operation at the technological facility, the installation must be carried out taking into account the instructions set out in point 2.3 of this operation manual.

2.4.2 The analyzer should be positioned as close as possible to the sampling point, as this reduces the transport lag time and facilitates required for transportation of the analyzed product.

2.4.3 Inspection of the protection means. The inspection is carried out by external examinations. On the surfaces of the parts that provide explosion protection, scratches, dents, damage to coatings and damage of threads are not allowed. Parts with defects must be rejected and replaced with new ones supplied by the manufacturer. Check the presence of tablets and the clarity of the inscriptions, the content and quality of the explosion protection marking and its compliance with the current certificate.

2.4.4 Preparing for operation and turning on the analyzer.

2.4.4.1 Connection to gas lines of the analyzed gas and discharge. The designations for gas inlets are given in Fig. 4, Fig. 7, Fig. 8, Fig. 9.

Auxiliary gases for the analyzer operation are not required.

The gas inputs not indicated in the drawings are muffled.

Connection of gas lines to the corresponding terminals of the analyzer is made by tubes of stainless steel (12Kh18N10T, AISI 304, AISI 316) 1/8" with an internal diameter of 2 mm using adapters with compression fitting included in the delivery.

The discharge line from the analyzer must be connected to the facility discharge lines, where there are no sudden changes in pressure.

Connection of the supply and discharge lines to the transmitter and the portable analyzer is carried out in the same way as indicated on the analyzer housing.

To connect the sample supply line to the portable version of the "HygroScan-P" analyzer, a quick-disconnect connection is used for the convenience of the operator.

2.4.4.2 Connecting electrical circuits to the analyzer. The electrical lines are connected in accordance with the electrical connection diagram (Appendix B).

Electric power supply (alternating current of 220 V) for the analyzer of the "HygroScan-S" model is supplied with an armored cable with copper conductors of at least 1,5 mm² cross section area. Number of cores in the cable is three.

To carry out data transfer to the analyzer, an armored twisted pair cable with a conductor cross-section of no more than 0.5 mm² is supplied. Number of twisted pairs in the cable depends on the number of interfaces used. The cable marks and the wiring and installation requirements in accordance with the EIC (issue 6).

Power supply connection (direct current with nominal voltage of 24 V) to the analyzers of "HygroScan-T" models is carried out with the same cable as that of the connection to communication lines, see above. The number of twisted pairs in the cable is two to four, depending on the number of interfaces used.

The cables are inserted into the explosion-proof enclosure through the cable glands located on the wall of the explosion-proof enclosure of the analyzer.

The "HygroScan-C" analyzer model must be grounded with the help of ground terminals connected to separate dedicated external bus for this purpose.

For stable and reliable operation of the analyzer of the "HygroScan-C" model it is recommended to use a uninterruptable power source (UPS), a residual current device (RCD) and a mains filter.

The portable analyzer of the "HygroScan-P" model does not require the connection of external electrical circuits during operation. The communication cable and the charging device cable are connected to the corresponding connectors of the analyzer strictly in the **explosion-proof zone**.

It is recommended to charge the portable battery of the analyzer's portable version with the supplied charging device in a room with an ambient temperature above 0 ° C.

2.5 Operation procedure of the analyzer

2.5.1 Switching on the analyzer.

For all version except for "HygroScan-P". After power is supplied, the system is ready for use. The system is fully automatic.

After the analyzer is started, the self-test system is activated, which checks the compliance of the analyzer parameters and the analyzed sample with the specified standard criteria. If the self-test is

successful, the analyzer automatically switches to the operating mode and the current measurement results and instrument parameters are displayed on the display (if present).

The analyzer output time on the operation mode is not more than 30 minutes.

2.5.2 Establishing a connection.

To display the current measurement results and information on the instrument status, load the archive, monitor the operation, and perform the settings of the stationary and portable versions of the analyzer, the X-Meter software is installed on an external computer (only for "HygroScan-C" and "HygroScan- P"). The communication with the network is established in accordance with the X-Meter software operator manual. This software is included in the package.

2.5.3 Performance of measurements.

The main purpose of the analyzer is to measure the humidity content and then calculate the dew point temperature of water in gas media in an automatic mode. When enabled, the analyzer defaults to the automatic mode of operation with the manufacturer's settings. In this case, the measurement of the humidity content and pressure of the analyzed gas is continuous (or periodic, in the presence of electromagnetic valves, for "HygroScan-C" and "HygroScan-T PRO" models).

Before performing the measurements, it is necessary to purge the gas lines of the analyzer. The flow of gas being analyzed through the analyzer should be from 0.5 to 5 nl/min.

If the analyzer is used periodically (if an external solenoid valve is used to shut off the flow of the analyzed gas for the HygroScan-C and HygroScan-T PRO models or for the portable version of the HygroScan-P analyzer), it may take some time to establish stable and reliable indication of the instrument - from 2 to 20 minutes, depending on the level of humidity and the pressure of the gas being analyzed.

2.5.4 Auto-correction of the sensitivity of the analyzer.

The analyzer does not require periodic calibration during the calibration interval. To compensate for a possible change in the sensitivity of the measuring cell of the instrument over time, the automatic sensitivity correction procedure of the analyzer is performed. This procedure is fully automated and does not require operator intervention.

2.6 Software

2.6.1 Description of the software analyzer of the "HygroScan-T" version.

"HygroScan-T" analyzers in conjunction with the "transmitter" version have built-in software that provides the following functions:

- processing of measurements information coming from the analytical analyzer unit;
- recalculation of dew point temperature on the stated value of pressure and concentration for standard conditions in accordance with GOST R 53763-2009 "Combustible natural gases".

Determination of the water dew point temperature or GOST 20060-83 "Combustible natural gases". Methods for determination of water vapor content and humidity dew point "(only for "HygroScan-T PRO" and "HygroScan-T Light" models);

- the formation of the accident flags in the event of sensor failure, or when the output values of the measurement parameters go beyond the required range of GOST R 53763-2009 "Combustible natural gases". Determination of the water dew point temperature or GOST 20060-83 "Combustible natural gases". Methods for determination of water vapor content and humidity dew point";
- ensuring the identification of the built-in software, which provides information on the software version and the checksum of the metrologically significant part of the software;
- providing communication via Modbus RTU protocol for providing information and adjustment of the transmitter parameters;
- ensuring the transmission of information on the current output 4-20 mA.

2.6.2 Description of the analyzers of the "HygroScan-C" and "HygroScan-P" version.

Analyzers of the "HygroScan-C" and "HygroScan-P" version have the following types of software:

- built-in;
- autonomous.

The built-in software of these versions, in addition to the functions performed by the built-in software of the "HygroScan-T" versions, performs the following:

- carrying out measurements in accordance with the specified algorithms (switching flows, analysis in manual and automatic mode),
- Formation analysis values archives (archive of current values, average hourly values, average daily values),
- display information on the analyzer screen,
- fixing of interruptions during the operation of the device (changing the operation mode, synchronizing time, setting new values of the standard criteria) in the event archive,
- interaction with the autonomous software,
- transmission of information through the available communication interfaces via Modbus RTU/TCP protocols.

In addition to the functions performed by the built-in software of the "HygroScan-T" versions, the software of the "HygroScan-P" analyzer performs:

- maintaining an archive of occasional tests conducted by the operator,
- display information on the analyzer screen,
- interaction with the autonomous software,

2.6.2.1 identification of the built-in software

identification of the built-in software is carried out by checking:

- built-in software versions;
- the correspondence of CRC codes for controlled programs to the values indicated in the certificate of the corresponding analyzer model.

2.6.2.2 Autonomous software for a PC running the Microsoft Windows XP/Vista/7/8/10 operating system, the X-Meter operator program is intended for setting up and monitoring the analyzers of the "HygroScan-C" and "HygroScan-P" versions.

The autonomous software performs the following functions:

1) At the user level:

- output of measurement results on the display of the personal computer;
- identification of the built-in software of the analyzer and its calculation module;
- reviewing the results of recent analysis;
- reviewing the results of archived analysis;
- reviewing events of the interruption log;
- reviewing the events of the alarm log.

2) At the administrator level:

- setting the modes of the analyzer;
- setting criteria for the norm of controlled parameters;
- setting the parameters of communication ports;
- user rights management;
- time synchronization as per computer time;
- updating the built-in software of the analyzer's microcontroller;
- setting of the output current parameters to 4-20 mA.

Identification of the software is carried out using the screen form "About the program.." for X-Meter software. Opening of this screen form is carried out from the main working window of the software by calling the menu item "Help\About the software" (Fig. 14). The top of the "About the software" dialog box displays the software version, as well as information about the manufacturer.

The lower table shows the description of the connected device: The model of the instrument, the serial number, the version of the built-in program, the list of CRC-codes of the monitored built-in software and the integral sum of the device.

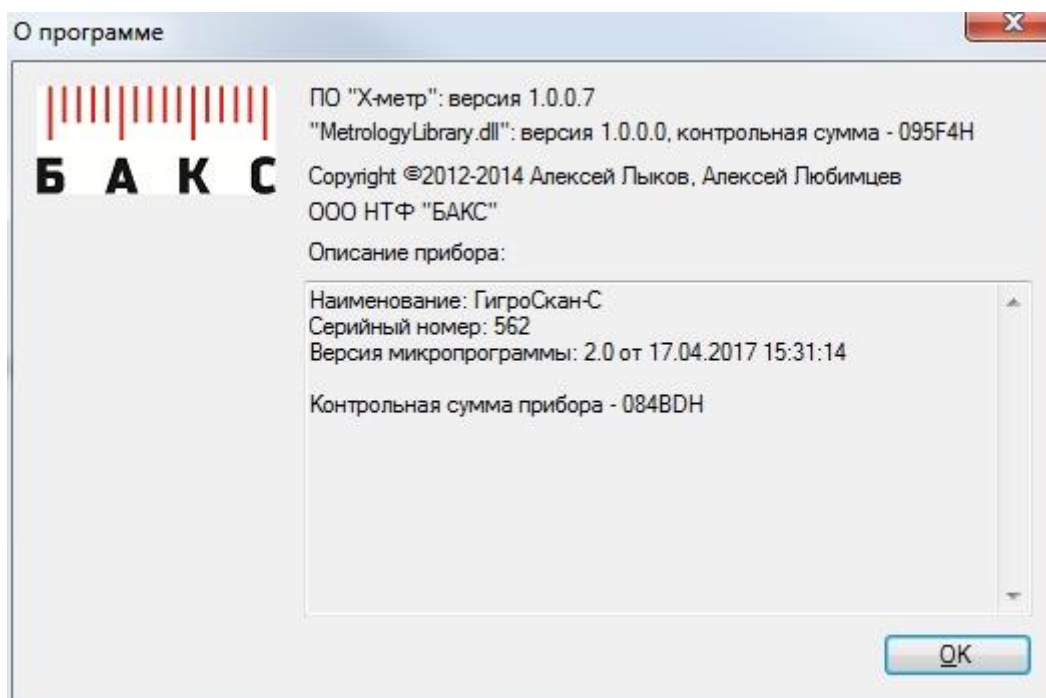


Fig. 14. X-Meter software.

A detailed description of the X-Meter software is given in the X-Meter operator manual

2.7 Analyzer display

The analyzer is equipped with a graphical display, which serves to display the results of the last analysis, as well as information about the current state of the device. The external appearance of the display is shown in Fig. 15.

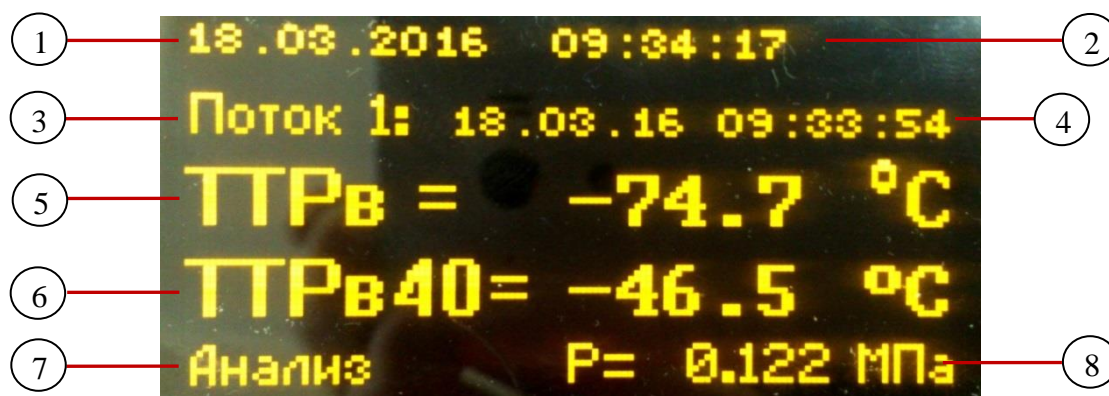


Fig. 15. Analyzer display

On Fig. 15, the digits indicate the following parameters of the analyzer:

1. Current date;
2. Current time;
3. Number of the analyzed flow (for version with the possibility of analyzing several flows);
4. Date and time of the last measurement;

5. Result of the last measurement in the selected units;
6. Result of the last measurement in the selected units (if necessary, display the measurement result in different units, for example, for DPT and humidity concentration);
7. Current state (operating mode) of the analyzer;
8. Current pressure of the analyzed gas.

2.8 List of faults

During operation, the analyzer's built-in software generates messages indicating the beginning or the end of an operation, as well as errors and malfunctions. All messages are automatically logged by the software into the electronic analysis protocol. Table 4 lists the error messages and the actions of the operator if they occur.

Table 4. List of malfunctions

Failure	Actions
Channel setting error	No communication with the channel management circuit. Disconnect the device. Contact the manufacturer
No connection to the measuring cell	No connection to the motherboard. Disconnect the device. Contact the manufacturer
The value of the parameter is below the set minimum or above the set maximum	Check the current instrument settings. If the parameters that have exceeded the tolerance limits are related to the operation of the equipment, provide the required mode, or turn off the device and contact the manufacturer. If the parameters are associated with the output of the calculated values, make a decision about the serviceability/malfunction of the equipment on the basis of the indications of these quantities

3 Maintenance

3.1 Maintenance procedure

Maintenance of the analyzer consists of periodic inspection of its technical condition and metrological verification. Maintenance of the analyzer should be carried out by specialists of the manufacturer's company or an authorized service center or by the engineering and technical personnel of the operating organization who has undergone specialized training in accordance with the current "Electrical Installation Code" (EIC), "Operational Safety Regulations" (OSR), "Rules for the technical operation of electrical installations" (RTI chapters 7.3, etc.) and the operation manuals for the analyzer and the X-Meter software. Maintenance requiring the opening of seals is carried out only by specialists of the manufacturer or authorized service center personnel.

3.2 Maintenance contents

The metrological characteristics of the analyzers during the verification interval should correspond to the established standards provided that the user observes the storage, transportation and operation rules specified in these operation manual. Types and periodicity of maintenance are shown in Table 5.

Table 5. Types of technical maintenance for the analyzer

Types of technical maintenance	Periodicity
Periodic monitoring of the technical conditions	At least once in a quarter
Preparation for metrological verification	At least once a year

3.2.1 Periodic monitoring of the technical state of the analyzer

The analyzer in service requires periodic monitoring of its technical condition, which consists of the following verifications:

- Verification of compliance with operating conditions;
- Verification of the firmness of labels and seals on the analyzer, warning labels and marking of explosion protection;
- Verification of the tightness of the analyzer connections to the pipeline;
- Verification of absence of external damage;
- Verification of the completeness of electrical connections;
- Verification of the contamination degree of the gas filters included in the sample preparation system and their replacement if necessary.

Inspection is carried out at intervals determined by the operating organization, together with the organization conducting technical maintenance of the facility on which the analyzer is installed, but at least quarterly.

3.2.2 Preparation for metrological verification of the analyzer

It is necessary to verify the analyzer once every year in accordance with the Test Method MP-242-xxxx-2016.

The preparation of the analyzer for the annual metrological verification process consists of the following activities:

- Verification of input devices, sealing, the grounding quality;
- Verification of warning labels, markings of explosion protection and their conformity to premise's classification as an explosive environment;
- Verification of the firmness of the threaded connections and the presence of all fasteners of explosion-proof enclosures;
- Verification of the absence of damage to the surfaces providing explosion protection (when detecting defects, holes, scratches as well as an increase in the gaps that are more than those permissible by GOST 22782.6, the analyzer will not be allowed any further operation. After inspection, the analyzer that does not have defects is sealed up);
- Verification of the tightness of the gas lines of the analyzer;
- Verification of the setting of the required flow rate of the gas to be analyzed;
- Verification of settings of the operating modes of the device;
- Verification of the correctness of the recounting of measurement results;
- check the degree of contamination of the gas filters included in the sample preparation system and replace them if necessary.

4 Transportation, storage and disposal

4.1 Transportation

4.1.1 Transportation of the analyzer in the packed condition can be carried out at any distance by any mode of transport, except unpressurized airplane compartments and open decks, subject to storage conditions 5 according to GOST 15150. During transportation, the transport packaging must be protected from atmospheric precipitation. Transport conditions:

- ambient temperature from -40 to + 50 ° C;
- relative air humidity of up to 98% at 25 ° C;
- The presence of dust and vapors of aggressive impurities in the air is unacceptable.

4.1.2 The method of packing the boxes in the transport vehicle should exclude the possibility of movement. During loading and unloading operations, the transport boxes must not be subjected to sharp impacts and atmospheric precipitation.

4.1.3 Unpack the analyzer in dry heated rooms and let to stay, if during transportation or storage the ambient temperature was below 5 ° C.

4.2 Storage

4.2.1 The analyzer in the packed state should be stored indoors under condition 2 in accordance with GOST 15150:

- air temperature from -40 to +50 ° C;
- relative humidity of air of not more than 98% at 25 ° C;
- the presence of acidic or alkaline vapors and other aggressive impurities in the air is unacceptable;
- Storage near heating appliances is not allowed.

ATTENTION! When storing and transporting (if there are no built-in solenoid valves in the analyzer, only for the "HygroScan-C" model), the gas inlet and discharge should be CLOSED by plugs and the handle of the tap for the "HygroScan-P" model should be in the CLOSED position.

Otherwise, the penetration of moisture will require a lengthy purge for the measuring cell.

4.3 Utilization

Analyzers do not contain harmful substances and components that pose a hazard to human health and the environment during and after the course of its working period and also during disposal. Disposal of the analyzer is carried out separately by groups of materials: plastic elements, metal housing elements and fasteners.

4.4 Warranty of service

The manufacturer guarantees the compliance of the analyzer with the requirements of TU 4215-028-21189467-2013 if the consumer observes and follows the conditions of installation, handling of transportation and storage.

The warranty period for the analyzers is 12 months from the date of commissioning, but not more than 18 months from the date of shipment to the consumer.

The consumer is deprived of warranty service in the following cases:

- Adjustment work during the servicing of the analyzer was not carried out by specialists of the manufacturer or authorized service center;
- operation and maintenance of the analyzer was carried out by inexperienced personnel who were not familiar with the operating manual for the instrument;
- the analyzer malfunction occurred as a result of the user violating the requirements of the operating manual;
- the analyzer is mechanically damaged;
- the analyzer was disassembled or any other interference with the product design without the manufacturer's agreement.

Guaranteed repair service of the analyzer is performed by the manufacturer, unless otherwise provided by an additional agreement between the operating organization and the manufacturer.

After expiration of the warranty period, the manufacturer makes post-warranty maintenance of analyzers under separate contracts with the consumer.

Manufacturer

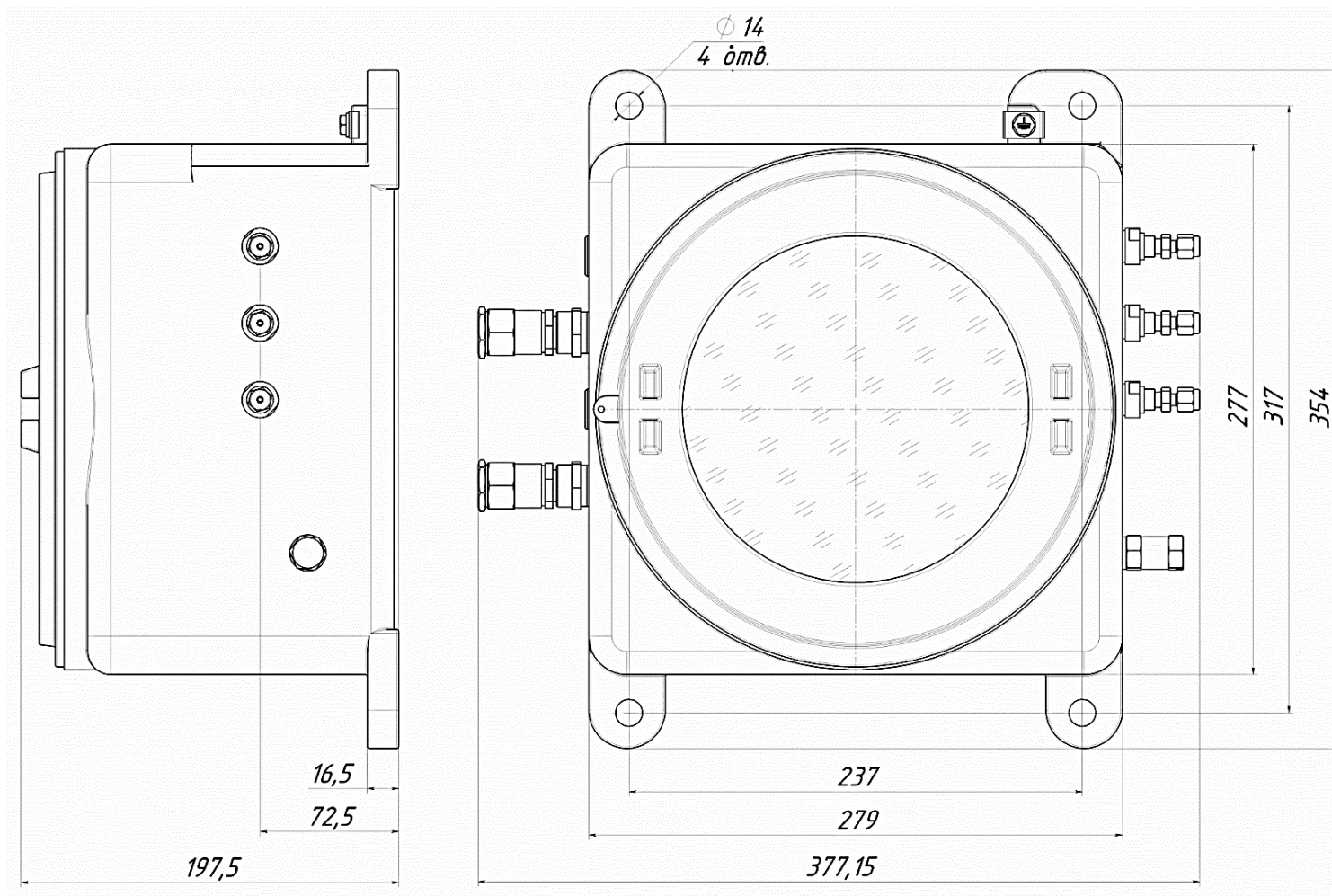
LLC NTF “BACS”, Samara

Address: 443022, Samara, Kirova ave., 10

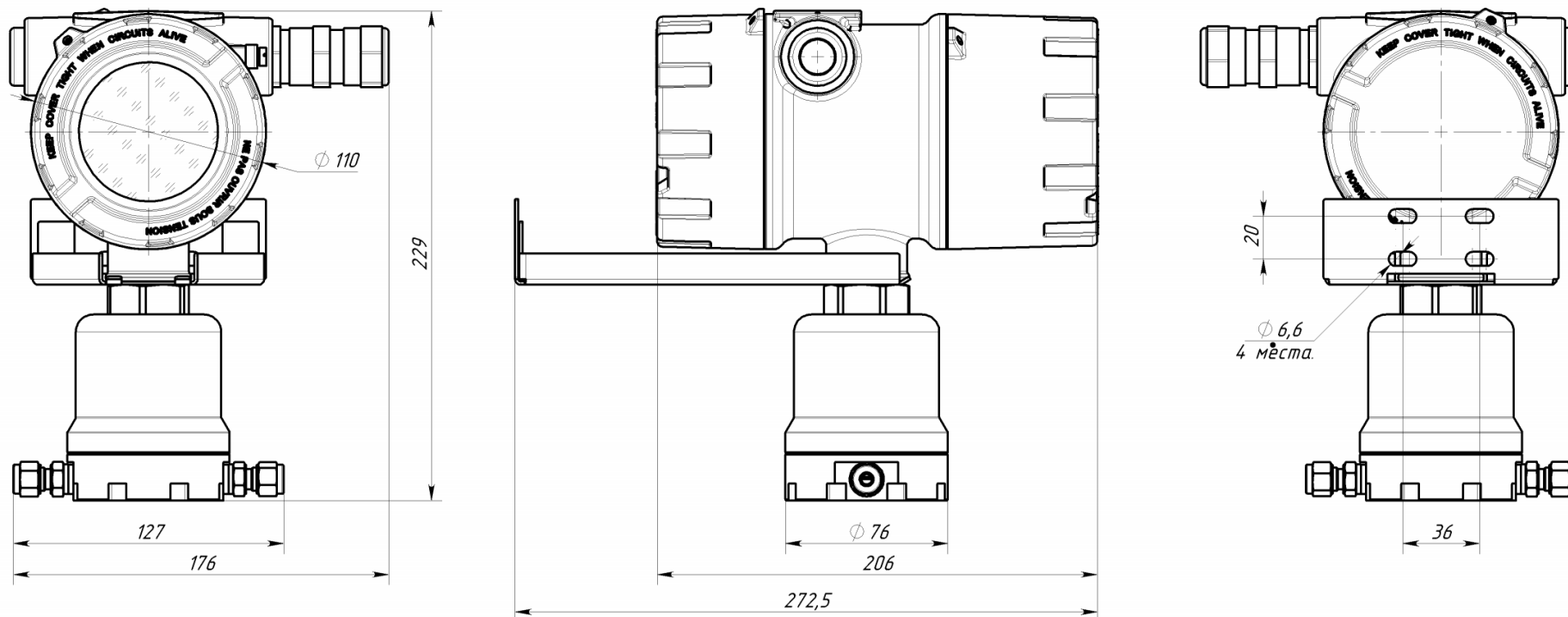
APPENDIXES

Appendix A. Dimensional drawing

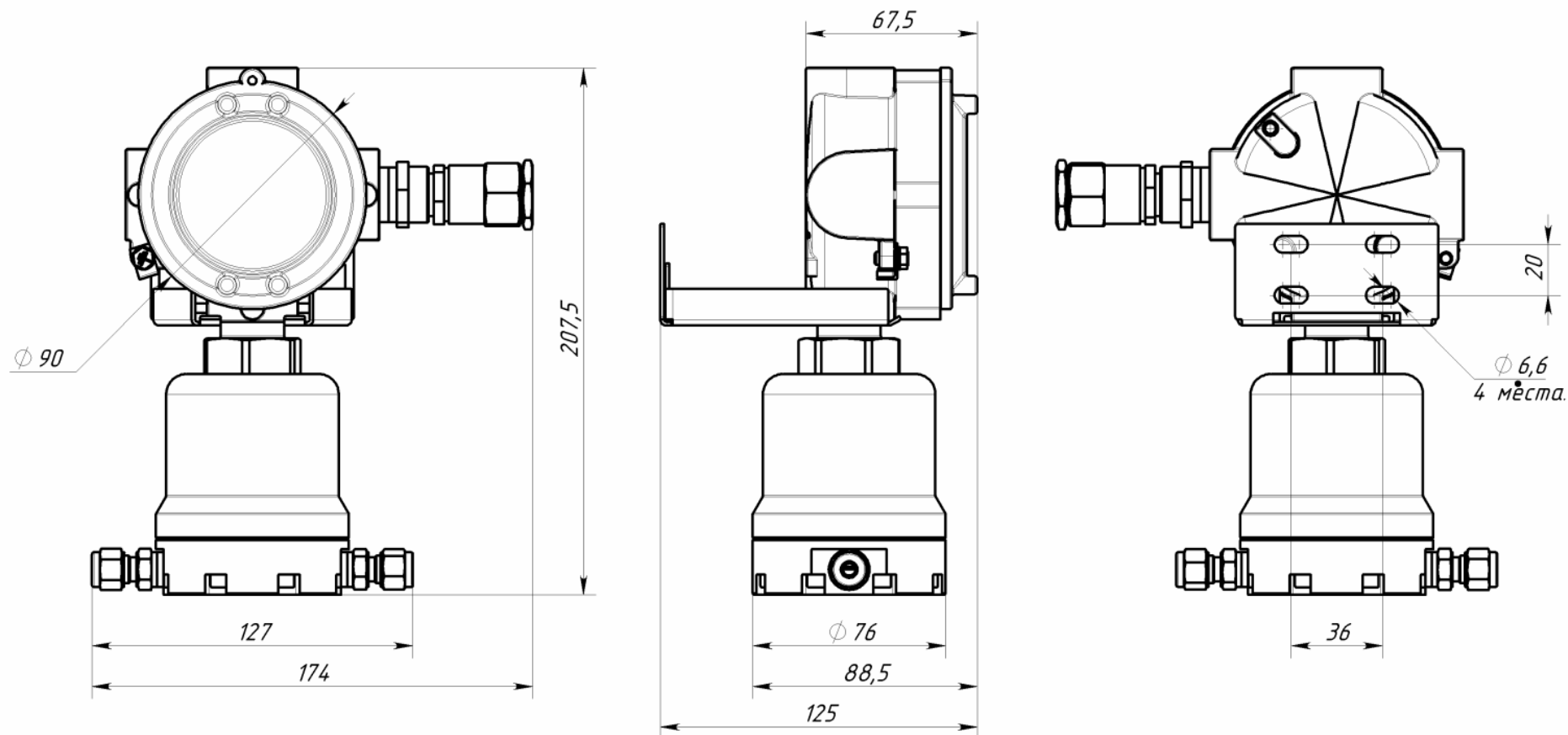
1. "HygroScan-S" KS 50.591-000 (-01) version



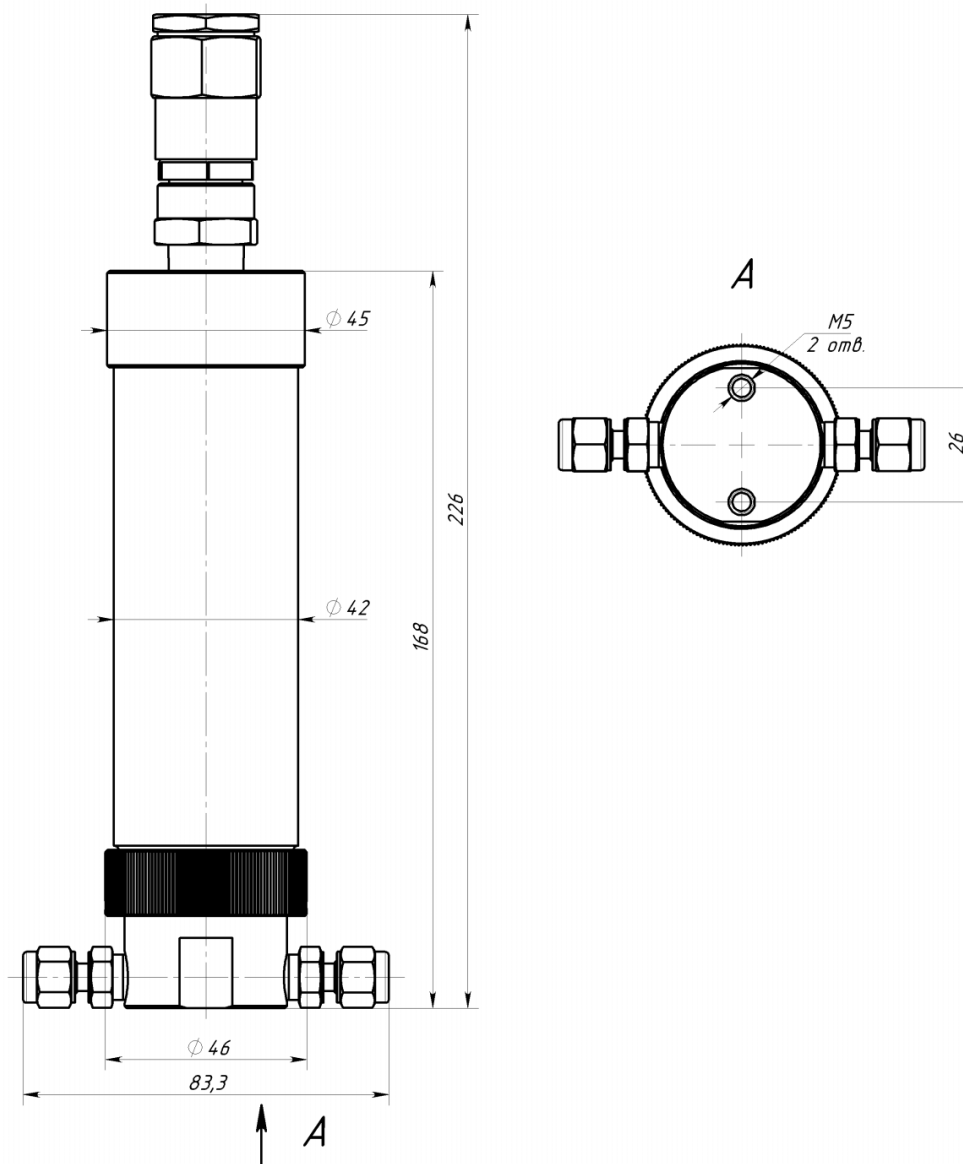
2. "HygroScan-T PRO" KS 50.593-000 (-01) version



3. "HygroScan-T Light" KS 50.594-000 (-01) version

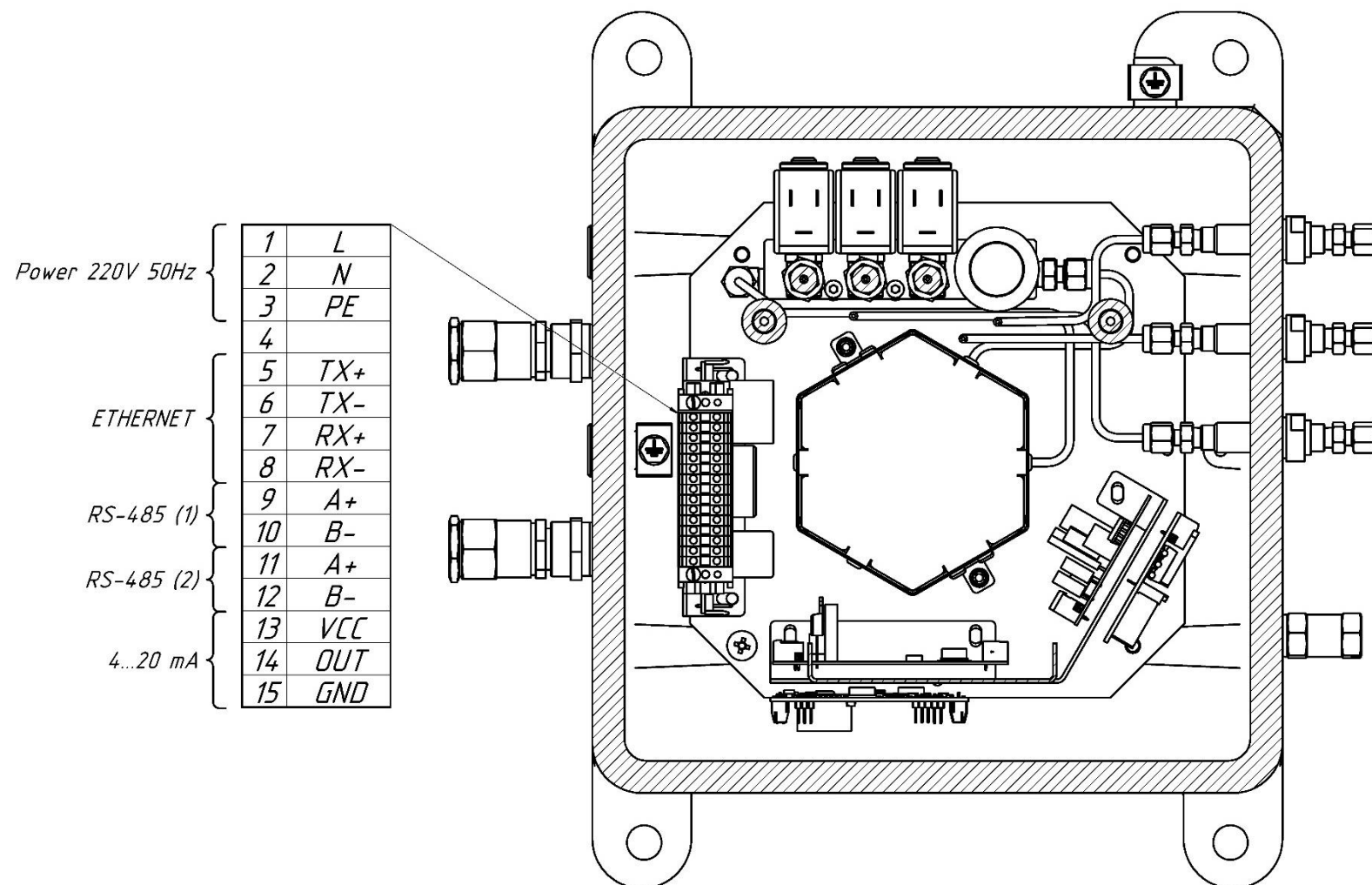


4. "HygroScan-T Micro" KS 50.595-000 (-01) version



Appendix B. Electrical connection diagram

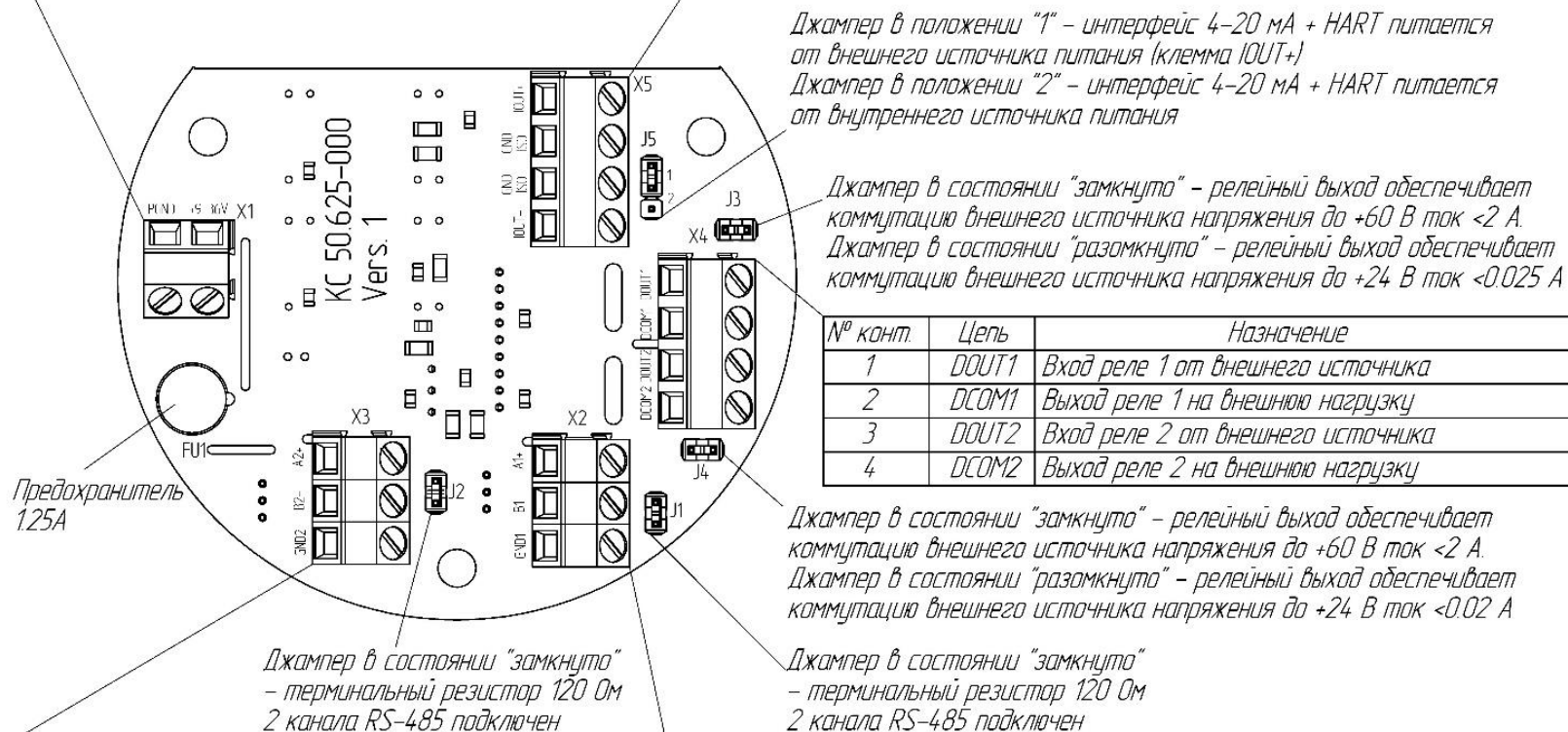
1. "HygroScan-S" KS 50.591-000 (-01) version



2. "HygroScan-T PRO" KS 50.593-000 (-01) version

№ конт.	Цепь	Назначение
1	+9...36V	Подключение линий внешнего питания
2	PGND	трансммиттера. +24 В постоянного тока

№ конт.	Цепь	Назначение
1	IOU+	Плюсовая клемма внешнего источника питания токовой петли
2	GND ISO	Минусовая клемма внешнего источника питания токовой петли
3	GND ISO	Общий контакт токового выхода
4	IOU-	Токовый выход

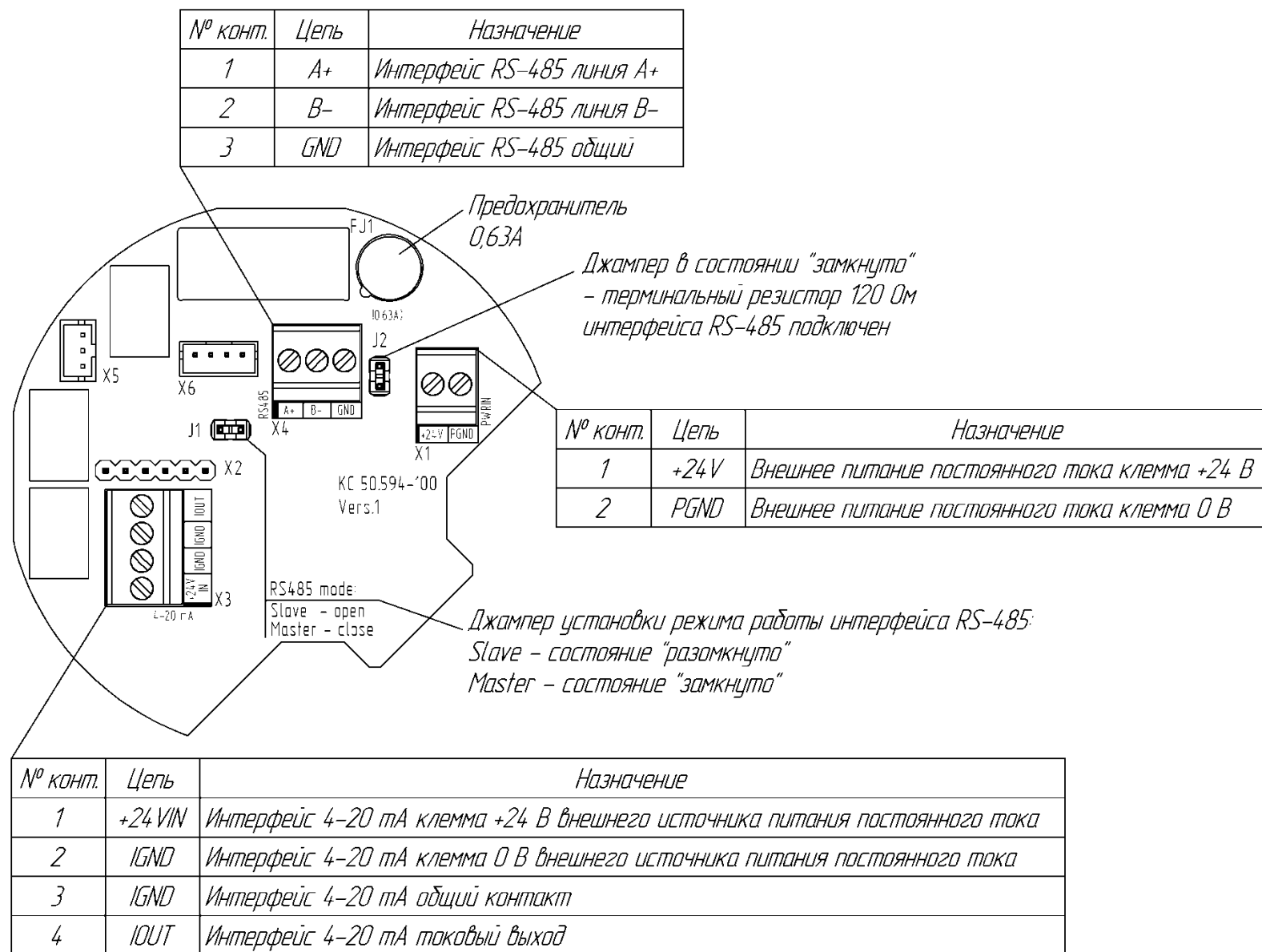


№ конт.	Цепь	Назначение
1	DOU1	Вход реле 1 от внешнего источника
2	DCOM1	Выход реле 1 на внешнюю нагрузку
3	DOU2	Вход реле 2 от внешнего источника
4	DCOM2	Выход реле 2 на внешнюю нагрузку

№ конт.	Цепь	Назначение
1	A2+	Интерфейс RS-485 канал 2 линия A+
2	B2-	Интерфейс RS-485 канал 2 линия B-
3	GND2	Интерфейс RS-485 канал 2 GND

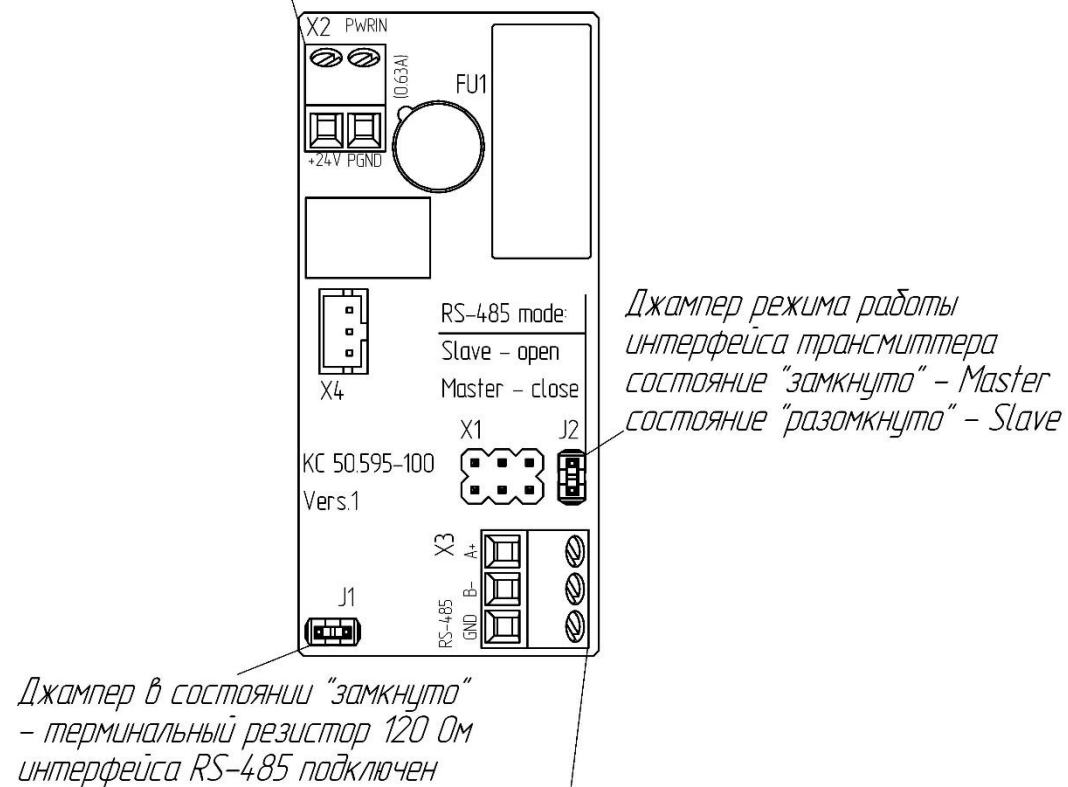
№ конт.	Цепь	Назначение
1	A1+	Интерфейс RS-485 канал 1 линия A+
2	B1-	Интерфейс RS-485 канал 1 линия B-
3	GND1	Интерфейс RS-485 канал 1 GND

3. "HygroScan-T Light" KS 50.594-000 (-01) version



4. version "HygroScan-T Micro" KS 50.595-000 (-01) version

№ конт.	Цепь	Назначение
1	+24V	Подключение линий внешнего питания трансммиттера +24 В постоянного тока
2	PGND	

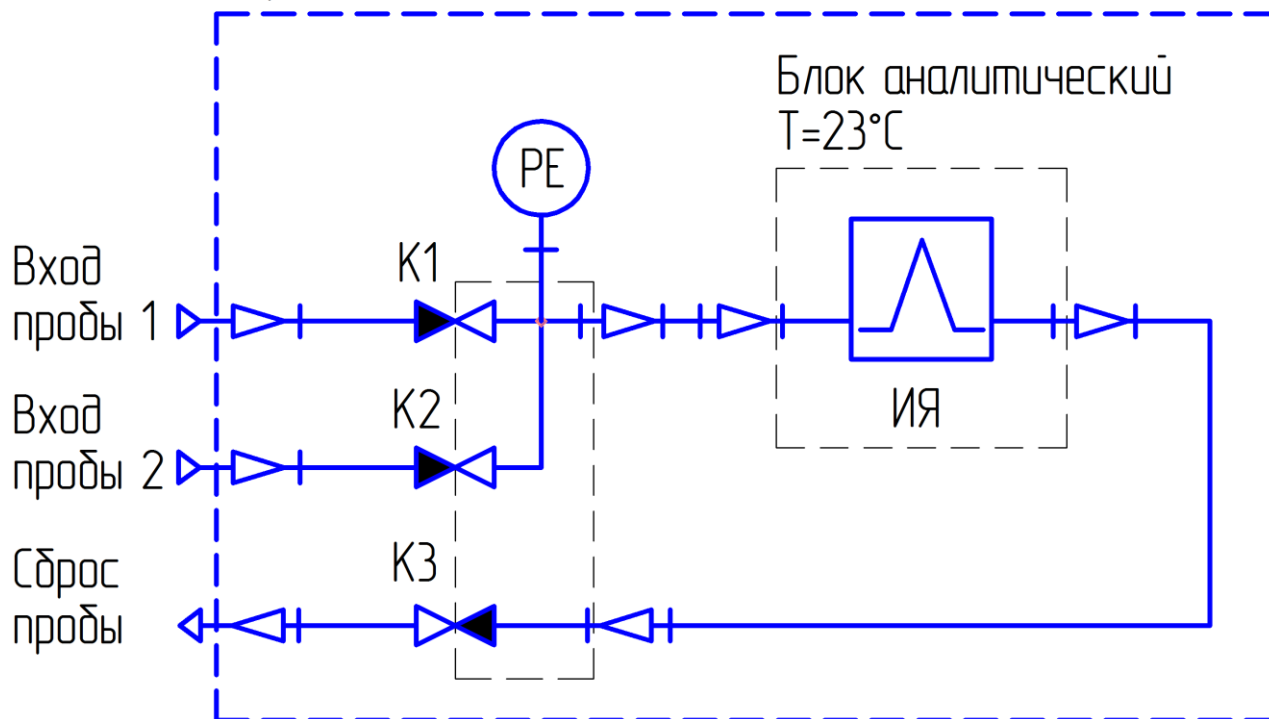


№ конт.	Цепь	Назначение
1	A+	Интерфейс RS-485 линия A+
2	B-	Интерфейс RS-485 линия B-
3	GND	Интерфейс RS-485 GND

Appendix C. Schematic gas diagram

1. "HygroScan-S" KS 50.591-000 (-01) version

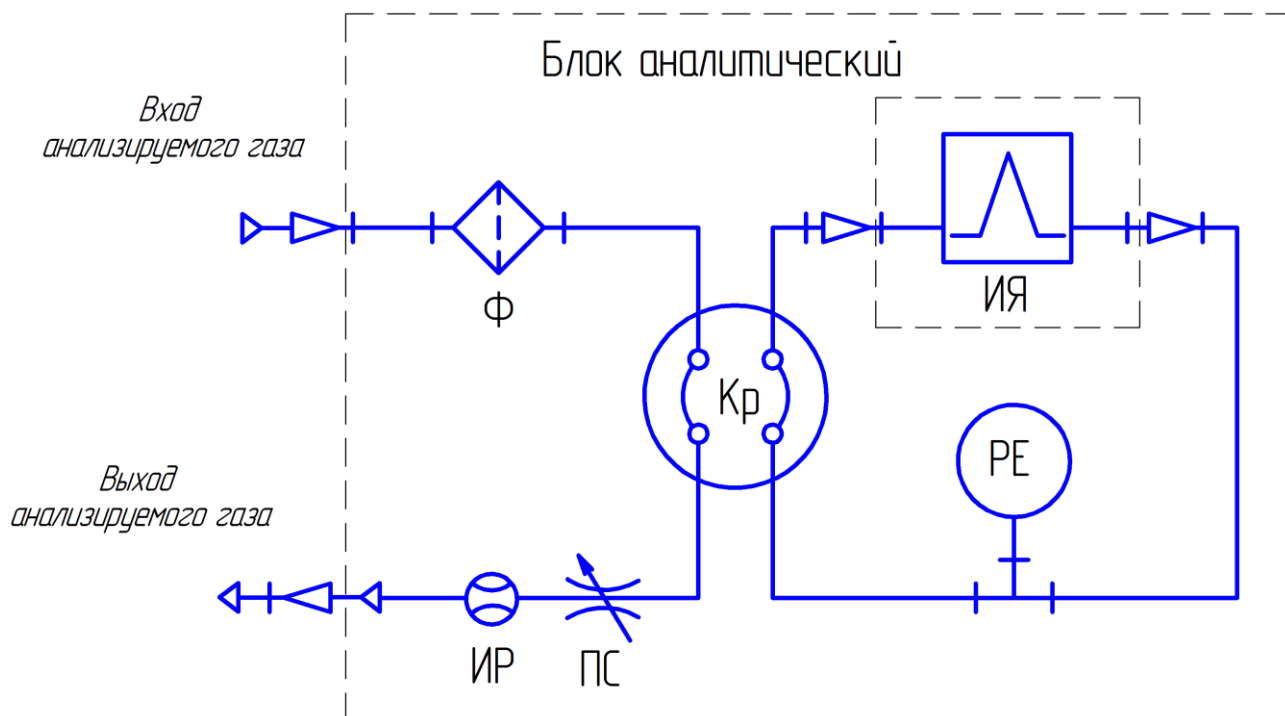
КС 50.591-000(-01) Анализатор газовый промышленный
"ГигроСкан-С" оболочка вида Ex d



The diagram shows:

- V1, V2 - solenoid valves at the inlet of the analyzed gas, intended for selection of the analyzed flow (optional);
- V3 - solenoid valve on the discharge of the analyzed gas, designed to shut off the flow of the analyzed gas in a periodic mode of operation (optional);
- PE - pressure sensor of the analyzed gas;
- MC - is a measuring cell containing a humidity and temperature transducer (sensor).

2. "HygroScan-P" KS 50.592-000 (-01) version



The diagram shows:

- F - filter to remove mechanical impurities from the analyzed gas;
- Ds - manual rotary tap-dispenser, designed to switch start the flow of the analyzed gas between the bypass circuit and the full circuit, which includes a measuring cell and a pressure sensor;
- MC - is a measuring cell containing a humidity and temperature transducer (sensor);
- PE - pressure sensor of the analyzed gas;
- PR - pneumatic resistance (throttle) for regulating the gas flow through the analytical unit of the analyzer;
- FI - flow indicator for visual monitoring of the flow of the analyzed gas flowing through the analyzer.