2023

GSV-1
Gas Analyzer
Operation Manual

PLA150.215.010.000RE

CONTENT

1. Description and work 3
2 Purpose Usage 12
3 Technical maintenance 16
4 Current repair 17
5 Storage 17
6 Transporting 17
7 Disposal 17

1. Description and work

1.1 Purpose

1.1.1. GSV-1 Gas analyzer (further GSV-1) is aimed at constant measuring of flammable and toxic gases air concentration in the working area of production facilities of oil industry, at open areas in the drilling zones, upstream, technological equipment of routine preprocessing, oil and gas transporting.

1.1.2. Gas analyzers GSV-1 are explosion-proof. Application area is hazardous areas of premises and outdoor installations in accordance with the explosion protection marking and regulatory documents governing the use of electrical equipment located in hazardous areas.

1.1.3. GSV-1 Gas Analyzers constructively consist of a main converter-transceiver (PP), and a universal digital replaceable gas converter (CCGT): with optical infrared (MIPEX-02-1-II-1.1.A, no. RUSSIAN RU.GB05.V03403 No. 0558624) - CCGT-IK and electrochemical (H2S / M-100 MembraporAG) - CCGT-E, sensors.

1.1.4. Indication of the status and operating modes of gas analyzers is provided by means of light-emitting diodes and a multifunctional graphic OLED display. The following information is displayed on the graphic OLED display:

Type of measuring gas (chemical formula:H2S, CH4, CO2,C3H8

a) the current gas concentration reading in the appropriate units of measurement (ppm,% LFL,% vol, etc.);

b) a graph of changes in gas concentration over time (trend) over a time interval;

c) specified alarm thresholds (Limit1, Limit2);

d) current state of the replaceable gas converter.

Two LEDs provide visual control of the excess of gas thresholds set.

The three-color LED indicator displays the device operation mode (normal, graduation, fault).

1.1.5 To build gas pollution control systems and integrate with actuators, gas analyzers have the following output signals and communication lines:

a) digital communication line RS-485, Modbus RTU / ASCII exchange protocol;

b) analogue unified current output of 4-20 mA proportional to the concentration of gas;

c) two relay outputs with contacts NC and NO for each threshold.

1.1.6. Gas analyzers comply with the requirements for explosion-proof equipment according to TP TS 012/2011 TP and belong to explosion-proof electrical equipment of group II.

1.1.7. Elements of gas analyzers are marked with explosion protection:

1Exdb[ib]IICT5GbX– PP transceiver with combined explosion protection type “flameproof enclosure” “d” according to GOST IEC 60079-1-2011 and “intrinsically safe electrical circuit” of level “ib” according to GOST R IEC 60079-11-2010. **ATEX certification is II2GExdbibIICT5Gb**

The transceiver is equipped with an interchangeable gas sensor. The transceiver is connected to a replaceable gas sensor via intrinsically safe circuits.

1.1.8. The sign "X" in the gas analyzers indicates special operating conditions associated with the fact that:

- connection of external electrical circuits to gas analyzers should be carried out through GOST IEC 60079-1-2011;
- unused when connecting gas analyzers cablegland should be closed by a plug supplied by the manufacturer, or another plug that meets the requirements of GOST IEC 60079-1-2011;
- the used cableglands and the elements of the gas analyzers must comply with the requirements for equipment with explosion protection “explosion-proof enclosure” of IIC subgroup, and have an operating temperature range corresponding to the conditions of application of gas analyzers.

- to prevent the formation of static electricity charges on the surface of the viewing window there is a warning sign: “Warning - Danger of potential electrostatic charge. Wipe with a damp cotton cloth (rags).

1.2 Technical and metrological characteristics

Main metrological gas analyzer characteristics are shown below in table **1**

Table 1

Таблица 2

Analyte/gas analyzer applied	Content of analyte %volume percent.	Measuring range % volume percent	Tolerance		The lowest indication rate	Allowed set time limit showing by level 0,9, $T_{0,9д}$, s
			Absolute	Relative, %		
Methane (CH_4) / GSV-1I	From 0 to 4,4 % (from0 to 100 % LFL)	From 0 to 2,2 % (from 0 to 50 % LFL)	±0,22 % (±5 % LFL)	-	0,01 % (0,1 % LFL)	45
Hydrogen Sulphide (H_2S) / GSV-1E[1)]	from 0 to 40 mg/m^3 (from 0 to 28,3 mln-[1])[2)]	From 0 to 10 mg/m^3 10 to 40 mg/m^3	±2 mg/m^3 -	- ±20	0,1 mg/m^3	30
Carbon dioxide / GSV-1I(CO2)	from 0 to 20 %	from 0 to 20 %	±1,0	-	0,1 %	45
Propane / GSV-1I(C3H8)	from 0 to 60 % LFL св. 60 to 100 % LFL	from 0 to 2,64 св. 2,64 to 4,40	± 3 % LFL 5 % rel.	-	0,01 % (0,1 % LFL)	45

Notes:

1) Provide measurement of the content of harmful substances in the air of the working facility with the ranges and accuracy specified in paragraph 43 of the Order of the Ministry of Health and Social Development No. 1034n dated from 09/09/2011 under normal operating conditions, as shown in Table 4.

2) recalculation of the values of the content of the component being determined, expressed in units of mass concentration, into a volume fraction, was carried out for normal conditions of 20 ° C, 760 mm Hg.

Gas analyzers metrological characteristics are shown in table 2

Table 2

Characteristics	Value
Limit of permissible variation of gas analyzer readings, in fractions of the limit of permissible basic error	0,5
The limits of the permissible additional error of the gas analyzer, caused by a change in the ambient temperature in the range of minus 40 to 60 ° C for every 10 ° C, are equal, in fractions of the limit of the permissible basic error:	±0,5
The limits of the permissible additional error of the gas analyzer caused by a change in	±0,5

the relative humidity of analyzed and environmental media in the range from 30 to 95% relative humidity at which the basic error was determined, in fractions of the limit of the permissible basic error	

Characteristics	Значение
Limit of permissible change of gas analyzer readings for 8 hours of continuous work, in fractions of the limit of permissible basic error	0,5
Warm-up time of gas analyzers, min, not more - GSV-1I / 1I (CO2) / 1I (C3H8) - GSV-1E	 5 2

The main Gas analyzers characteristics are shown in table3

Table 3

Characteristics	Value
Voltage range, V 9DC)	from 12 to 28
Electric power consumption at nominal value of supply voltage 15 V, W, not more	2
Relay-operated signaling communication	30
Max.Current commutation relay, A	2,0
Gas analyzer dimensions, mm no more: - height - width - depth	 190 206 90
Weight, kg, no more	2,6
ATBF, h	10 000
Average lifecycle, years Note - without taking into account the service life of the primary transducers.	10
The degree of gas enclosure according to GOST 14254-2015 - main transducer sygnal receiver - gas converter (CCGT)	 IP67 IP54
The gas analyzer is explosion-proof and meets the requirements of the technical regulations of TS TP 012/2011, GOST 31610 / 0-2012. Marking of explosion protection of gas analyzer elements: - main transducer sygnal receiver (EAC) - main transducer sygnal receiver (ATEX)	 1Exdb[ib]IICT5GbX II2GExdbibIICT5Gb
Operating temperature range ºC:	from +15 to +25
- relative humidity in temperature +35 ºC, %	from 30 to 80
- air pressure range, кPa	from 97,3 to 105,3
Operating conditions: - ambient temperature range, °C GSV-1I / 1I(CO2) / 1I(C3H8) GSV-1E	 from -40 to +60 from -40 to +50
- relative humidity in temperature 35°C, %	from 0 to 95
- air temperature range, кPa	from 91,1 to 111,4

Identified data of built-in Software are shown in table 4
Table 4

Identified data (features)	Value
Identified data Software	GSV1
Version number (identification number) Software	01.17
Digital identifier Software	B763C776
Note - software version number must be not lower than specified in the table. The value of the control sum indicated in the table refers only to the built-in file of the specified version.	

1.3 Device content.

1.3.1 The main delivery set – Table 5

Nomenclature	Device	Units	Note
	GSV-1 Gas analyzer	1 piece.	Upon request
PLA150.215.010.000RE	Operation manual	1 piece	
PLA150.215.010.000PS	Passport		
MP-242-112-2017	Checking method		
	Packaging container	1 piece	
PLA150.215.010.030	Calibration camera	1 piece.	Upon request
PLA150.215.010.040	Wrench for replacing sensors	1 piece	Upon request

1.4 Device and work

1.4.1 GSV-1 Gas analyzers consist of a sygnal receiver and a universal digital replaceable gas converter (CCGT) with optical infrared (CCGT-IK) or electro-chemical (CCGT-E) sensors.

1.5 Sygnal receiver is structurally an explosion-proof enclosure – an enclosure with a transparent cover. On the enclosure there are hermetic cable glands, as well as the input for connecting interchangeable gas transducers. Inside the case is a set of electronic printed circuit boards with terminal clips, control buttons, information display elements.

Fig.1 GSV-1 general view

1.4.2 Replaceable gas transducers CCGT-IK or CCGT-E are connected to the signal receiver. Replaceable gas transducers consist of an enclosure, an electronic circuit board with intrinsically safe circuits, a replaceable analyte gas sensor (electrochemical / infrared), sealing elements, a protective filter, and a protective casing. When calibrating converters, a calibration chamber is installed instead of a protective casing.

1.4.3. In a replaceable gas sensor CCGT-IK, the explosive gas sensor MIPEX-02-1-II-1.1A (Optosensens LLC, certificate of conformity No ROSS RU.GB05. V03403 N0558624) is used as the primary gas sensor.

1.4.4. The replaceable gas sensor CCGT-E uses H2S / M-100 hydrogen sulfide hydrogen sensor (Membrapor AG) as the primary gas sensor.

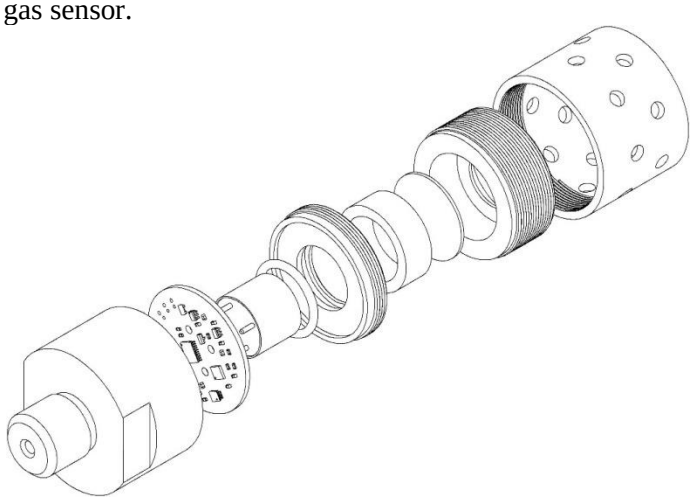


Fig.2 CCGT-E, CCGT-IK Replaceable Gas Transducer

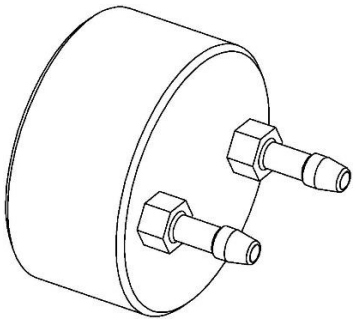


Fig.3 Calibration camera

1.5 Mode of operation.

1.5.1 When electric power is supplied to the gas analyzer, it is automatically switched on. Internal software in the microprocessor carries out an internal test and control the integrity of the metrological significant part of the program. Then the transceiver identifies the type of gas transducer connected.

The transceiver receives information about the current concentration of the analyte gas in digital form from interchangeable gas transducers CCGT-E or CCGT-IR. The process is controlled by the microprocessor device MP. The obtained gas concentration value is compared with the set threshold values and is displayed on the built-in display. If there is overlimit of the set values, the corresponding LED indication is triggered, as well as emergency relay alarm. The values of the current gas concentration are also used to display in a history of changes (trends) concentration.

The output analogue sygnal of the current loop 4-20 mA is formed in proportion to the current concentration of the analyte gas and has a linear relationship.

The values of the current concentration of the analyte gas are also available for reading through the serial RS-485 communication channel using the Modbus RTU / ASCII protocol.

In the course of operation, gas transducers continuously monitor the correctness of the sensitive elements of the sensors. And if deviations from normal operation occur, the transducers set the appropriate status to inform the signal receiver.

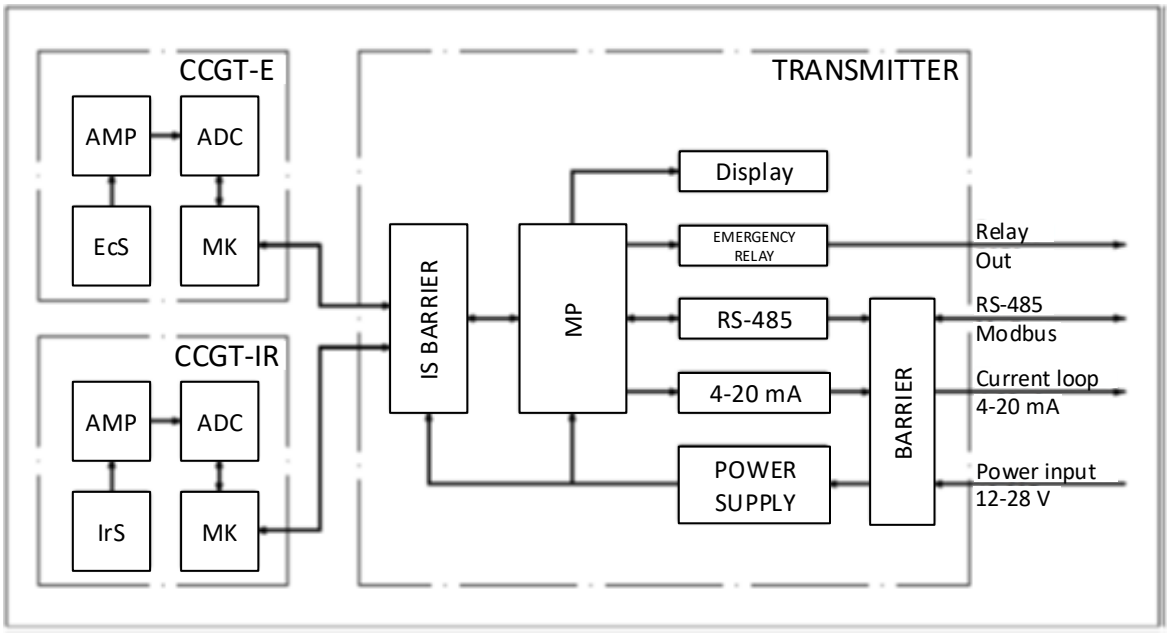


Fig.4 Gas analyser sensor structure

1.5.2 The principle of operation of the primary sensor of the CCGT-IK converter is based on specific absorption of IR radiation by gas molecules in the wavelength range of 3.2 ... 3.5 μm for hydrocarbons and 4.0 ... 4.25 μm for carbon dioxide. The infrared radiation of the LED passes through the measuring

target gas cell of diffusion type and falls on 2 photoreceivers, one of which registers radiation only in the range of absorption wavelengths of IR radiation by gases, and the other in the range of wavelengths 3.5 ... 3.7 μm. The test gas in the cell absorbs the radiation of the working wavelength (λs) and does not affect the emission of the reference wavelength (λref). The amplitude of the working and reference signals, Us and Uref, of the photoreceiver varies with concentration in accordance with the expression:

$$\frac{Us}{Uref} = \exp(-[K(\lambda_s) - K(\lambda_{ref})] \cdot C * L),$$

where:

K(λ) – coefficient of absorption in wavelength;

L – optical cell length;

C – measured gas concentration;

Us, Uref – sygnal amplitude on photoreceiver.

The differential two-wave registration method allows eliminating the influence of water vapor, the contamination of optical elements and other non-selective interference that equally affect both channels.

1.5.3 CCGT-E electrochemical sensor of the converter determines the concentration of toxic gas H2S by measuring the current according to the electrochemical principle, which uses the process of electrochemical oxidation of gas on the working electrode inside the electrolytic cell. The current generated by the electrochemical reaction of the detected gas is directly proportional to the concentration of the gas according Faraday's law, therefore the concentration of this gas can be determined by measuring the current value. The current value at the sensor output:

$$I_W = S \cdot C,$$

where:

Iw – current on working electrode (nA),

S – sensor sensitivity (nA/ppm),

C – measured gas concentration (ppm).

1.6 Measuring units and a tool.

For GSV-1 mounting and maintenance standard instrumentation of wireman is used.

1.7 Ex providing.

1.7.1 Gas analyzers are made in accordance with the requirements of the technical regulations of TR TS 012/2011 "On safety of equipment for work in explosive atmospheres", have a performance that ensures the level and type of explosion protection in accordance with regulatory documents:

GOST R IEC 60079-0-2011

GOST IEC 60079-1-2011

GOST R IEC 60079-11-2010

Gas analyzers GSV-1 has a combined type of explosion-proof “flameproof enclosure” according to GOST IEC 60079-1-2011, “intrinsically safe electrical circuit” of level “ib” according to GOST R IEC 60079-11-2010 and meet the requirements for electrical equipment of the IIC sub-group .

Sygnal receiver explosion-proof marking: 1Exd [ib] IICT5GbX.

Marking of the level of explosion protection of a replaceable gas converter CCGT: 1ExibIICT5Gb.

The flameproof enclosure of signal receiver is provided only as an assembly with an interchangeable gas sensor. The signal receiver is connected to a replaceable gas sensor via intrinsically safe circuits.

The marking of explosion protection is indicated on the nameplate in section 1.8.1.

Explosion protection of the “flameproof enclosure” type is achieved by placing the electrical parts of gas analyzer as an explosion proof enclosure according to GOST IEC 60079-1-2011,

which excludes the transfer of the explosion from the gas analyzer to the external explosive atmosphere. The explosion-tightness of the shell is provided by the following means:

–Shell is tested for explosion resistance by test pressure 0.6 MPa;

– the axial length of the thread and the number of complete turns in the engagement of the threaded flameproof joints of the shell comply with the requirements of GOST IEC 60079-1-2011;

–The magnitudes of gaps and lengths of cylindrical flame-proof joints meet the requirements of GOST IEC 60079-1-2011;

–The enclosure of protective shell corresponds to a high degree of mechanical strength according to GOST IEC 60079-1-2011;

-the maximum temperature of heating the surface of a gas analyzer under operating conditions does not exceed the value of 100 ° C set in GOST R IEC 60079-0-2011 for the temperature class T5;

– explosion-proof cablegland is used to input external circuits to the gas analyzer;

- an unused hole for cable entry is closed with a plug made in accordance with the requirements of GOST IEC 60079-1-2011;

- surfaces marked with the word “Explosion” are protected from corrosion by grease;

- friction intrinsic safety of the sheath of gas analyzers is ensured by the use of a material with a magnesium content of less than 7.5%.

The drawing of explosion-proof means of the “flameproof enclosure” is given in Appendix D.

Explosion protection of the input and output "intrinsically safe electrical circuit" level "ib" gas analyzer is provided by the following means:

–External electrical power supply and connection of external devices to digital and current-output gas analyzers should be carried out in accordance with the requirements of GOST R IEC 60079-11-2010;

—Electric load of intrinsic safety elements of gas analyzers does not exceed 2/3 of their passport values;

–The values of the circuit parameters do not exceed the permissible values according to GOST IEC 60079-1-2011;

–Intrinsic safety block is applied on zener diodes and shunt thyristors;

–Electric gaps and creepage distances comply with the requirements of GOST R IEC 60079-11-2010; the insulation strength between the containment case and electrical circuits holds the test voltage of 500 V;

–Internal capacity and inductance of the electric circuit do not accumulate energies that are dangerous due to spark ignition of gas mixtures of category IIC;

–Current-carrying connections and electronic components of a gas analyzer circuit are protected from environmental exposure by an enclosure that provides IP66 protection level for sygnal receiver and IP54 interchangeable gas sensor in accordance with GOST 14254-2015.

Table 6. CCGT-IK Input parameters of intrinsically safe circuits with a gas sensor MIPEX-02-1-II-1.1A

Parameter	Value
Max.input voltage Ui, V	5,4
Max.input current Ii, mA	232
Max.input capacity Ci, μF	39,74
Max.line inductance Li, mH	0
Max.power input, Pi, W	1,26

Table 7. CCGT-E Input parameters of intrinsically safe circuits with a gas sensor H2S/M-100

Наименование параметра	Value
Max.input voltage Ui, V	5,4
Max.input current Ii, mA	232
Max.input capacity Ci, μF	41
Max.line inductance Li, mH	0
Max.power input, Pi, W	1,26

Table 8. Output parameters of intrinsically safe circuits of sygnal receiver

Parameter	Value
Max.input voltage Um, V	28
Max.output voltage Uo, B	5,4
Max.input current Ii, mA	232
Max.input capacity Ci, μF	64,9
Max.line inductance Li, mH	3
Max.power input, Pi, W	1,26

1.7.2 Gas analyzers are used in hazardous areas of outdoor installations (Chapter 7.3 EIC) corresponds to zone 1, the group of explosion-proof electrical installations IIC, temperature class T5 according to the Safety Regulations in the oil and gas industry, approved by Rostechnadzor.

1.8 Marking and sealing

1.8.1 Marking printed on GSV-1 enclosure parts include the following data:

a) Logotype or manufacturer title.
b) Gas analyzer conventional name.
c) Factory serial number and year of manufacturing.
d) IP marking by GOST 14254-2015.
e) Ex marking.
f) Special sign for Ex.
g) Power voltage range.
h) Power consumption value.
j) Chemical formula of analyte.
k) Full scale value and physical unit.
l) Air temperature range in operating.
m) Intrinsically safe circuit parameter: U_0, I_0, P_0, C_0, L_0 and U_i, I_i, P_i, C_i, L_i.
n) Certification Body and number of certificate of compliance.
o) Earth ground sign.

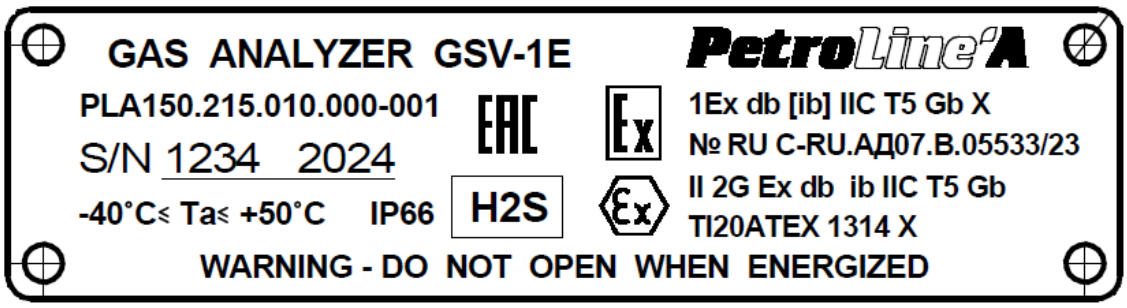


Fig 5. Tables for information

Also another data can be used required by normative-technical document which a manufacturer must reflect in a marking.

1.9 Packing

1.9.1. For transportation of GSV-1 gas analyzers, plywood boxes are used.

1.9.2 The gas analyzer is packed in paper and placed in a box together with the operating documentation.

1.9.3 Overall dimensions of the box, mm 300x100x100.

1.10 Security measures quideliness

1.10.1 To work with a gas analyzer it is allowed for personnel who have been instructed in the safety technique in the prescribed manner and have studied this operation manual.

1.10.2 The “Safety Rules for Gas Facilities” approved by Gosgortekhnadzor Supervision and the Order of the Ministry of Labor of Russia dated 07.24.2013 No. 328n should be observed.

1.10.3 When working with cylinders containing test gas mixtures under pressure, it is necessary to comply with safety requirements in accordance with PB 03-576-03 “Rules for the Construction and Safe Operation of Pressure Vessels” approved by Gosgorteckhnadzor Supervision of Russia.

1.10.4 Repair of a gas analyzer should be carried out only by personnel of the manufacturer or authorized personnel by the manufacturer to carry out repair work.

1.10.5 Before switching on the gas analyzer, check the absence of external damages of a gas analyzer, the integrity of the seals, and the presence of all fasteners.

1.10.6 It is forbidden to operate a gas analyzer that has mechanical damage of an enclosure or to a seal failure.

1.10.7 Gas analyzer enclosure must be grounded. A grounding bolt is provided for a gas analyzer grounding.

1.10.8 It is not allowed to dump the gas mixture into the atmosphere of the working premises when adjusting and calibrating the gas analyzer.

2 Purpose Usage

2.1 General guidelines in operating

2.1.1. For gas analyzer maintenance specialists who knows operating rules of electric installations in Ex, who has studied material part, gas analyzers operating documentation and who has a qualified group in electrical safety no less then III is permitted to work.

2.1.2. Installation and connection of gas analyzers, as well as repairs, maintenance should be carried out with the power off.

2.1.3. Conditions, urgency of work or other reasons are not grounds for safety violations.

2.1.4. Ground the gas analyzers using the protective element.

2.1.5. During operation, gas analyzers should be subjected to a systematic control inspection in accordance with Section 3 of this Operation Manual.

2.1.6. Gas analyzers should be used in accordance with the established marking of explosion protection, the requirements of GOST 30852.13-200, other regulatory documents governing the use of electrical equipment in hazardous areas, and the Operation Manual.

2.1.7. Repair of gas analyzers should be carried out only after disconnecting the gas main line and power supply network with mandatory posting in places where signs are turned off in accordance with GOST R 12.4.026-2001

2.1.8. Gas discharge during gas analyzers checking should be carried out outside the premises or into the gas duct according to the “Rules for the safety of gas distribution networks and gas consumption”, approved by order of Rostekhnadzor dated November 15, 2013 No. 542.

2.2 Gas analyzers preparation for use.

2.1.9. Preparation of gas analyzers for use includes the following main operations:

a) check completeness;

b) external examination;

c) placement and installation of gas analyzers;

d) electrical connection;

e) setting alarm thresholds;

f) setting the value of the a gas analyzer Modbus address in the information network for RS485 digital communication channel;

g) testing of gas analyzers.

2.1.0. Withstand gas analyzers in the package in normal conditions for at least 4 hours (after exposure to negative temperatures for 12 hours) and unpack.

2.1.11. Check completeness.

2.1.11.1. Checking the completeness of a gas analyzer is carried out by an external inspection and comparison of the completeness indicated in the statement.

2.1.11.2. The verification of the completeness of the operational documentation is carried out by comparing the completeness of the operational documents indicated in the statement.

2.1.12. Visual inspection.

2.1.12.1. Conduct an external inspection of gas analyzers in accordance with the requirements of section 3 of this Operation manual.

2.1.13. Placement and installation of gas analyzers.

2.1.13.1. Gas analyzers for toxic gases (hydrogen sulphide) should be installed in the working area at open sites of drilling, production, technological installations for field preparation and transport of oil and gas, gas processing and open MPUs, where there are sources of possible emissions of gases and vapors to the human body to 1 and 2 classes of danger according to GOST 12.1.005-76 and GOST 12.1.007-76, and hydrogen sulfide with a molar share in the technological environment of more than 5%.

2.1.13.2. MPC sensors should be installed at a height of 0.5 m from the ground (floor) level at the facilities for drilling, production, field transport of oil and gas:

a) at the main entrance to the industrial site;

b) in the facilities of the workplace staff.

Additionally, gas analyzers for toxic gases should be installed on the rig:

a) a shale shaker at a height of 0.5-0.7 m from its surface;
b) on the working site at a distance of 0.5 m from the rotor table (horizontally);
c) in the subsurface at the level of the universal preventer at a distance of 1 m from the axis of the well in the direction of the prevailing wind;
d) in pump facility between pumps
e) at production well
f) at well-head
g) at oil and gas field transport facilities:
h) in cameras for receiving and launching cleaning devices at a distance of 1 m from the main connector at the connector level;
j) at drainage tank and separator at a distance of 1 m from the approach of the servicing personnel;
k) on the input manifolds at a distance of 1 m from the reinforcement (one sensor for every 10 m of the service area);
e) at the above-ground valves for field pipelines at a distance of 1 m from the approach of the staff.

2.1.13.3. Gas analyzers for explosive gases should be installed in explosive zones of class B-1g (in accordance with EIC, Chapter 7) of the following installations:

a) technological installations for field processing of oil and gas, gas processing and gas chemical complexes containing combustible gases or flammable liquids;
b) storage tanks for liquefied hydrocarbon gases (LPG);
c) racks for loading of flammable liquids and LPG and discharge of LPG;
d) LPG filling stations;
e) pump-compressor installations of flammable liquids, LPG and combustible gases located on open sites.

2.1.13.4. Gas analyzers for explosive gases in open areas should be installed at height of 0.5-1.0 m from the ground (floor).
2.1.13.5. Gas analyzers should be located in such a way as to provide easy access for repair and operability testing.
2.1.13.6. Placement of gas analyzers should be carried out in accordance with Appendix A. Perform marking and installation of dowels or gas analyzer mounting bolts in accordance with Appendix B.
2.1.14. Controls and working procedures with the internal gas analyzer software. A general view of the display and control panel is shown in Fig.6.
2.1.14.1. Description of controls and display.
a) display, OLED graphic 128x128;
b) HL1 - LED indicating the achievement of the threshold level1;
c) HL2 - LED indicating the achievement of the threshold level 2;
d) HL3 - three-color multi-functional LED for indication of operating modes: REJECTION, COMMUNICATION.
e) SB1, SB2, SB3, SB4 - buttons for navigating through the built-in menu, editing and entering parameters.
2.1.14.2. To enter the menu mode, you must press and hold the "MENU" button for more than 3 seconds. The structure and menu navigation is presented in Appendix G.

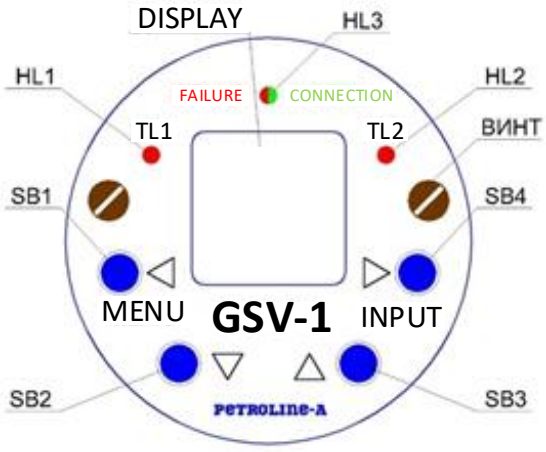


Fig.6 Display and control panel

2.1.5 Electric circuit connection

2.1.15.1. Connect to gas analyzers in accordance with the connection diagram. Appendix B.
2.1.15.2. Connect in the following order.

a) remove the gas analyzer cover by turning it counterclockwise;
b) unscrew the two captive screws;
c) holding the screws, pull the display unit out of the case;
d) stretch the cable with the stripped ends of the wires through the cableglands into the body of a gas analyzer. It is recommended to crimp the ends of the wires with cable lugs of the corresponding cross-section;
e) using a screwdriver, connect the conductors to the spring clip XT1 on the board with the distribution Fig. 7. in strict accordance with the wiring diagram;
e) assemble the gas analyzer in reverse order.

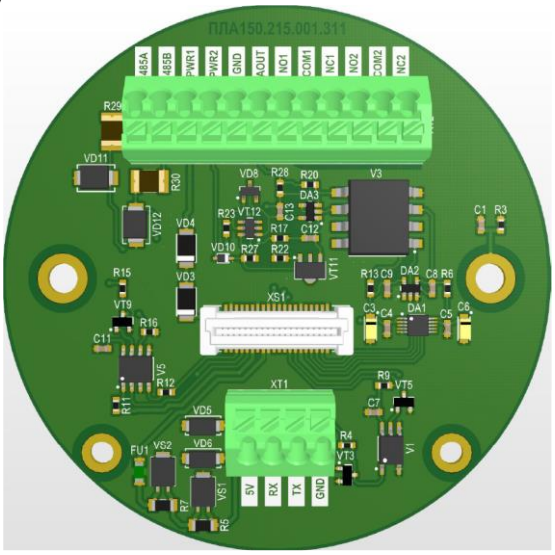


Fig.7 Distribution card

2.1.16. Switching on and checking of performability.
2.1.16.1 To switch on a gas analyzer it is necessary to provide power supply. Internal sygnal receiver software executes the necessary checking operations:

a) Checking of a sygnal receiver software control sum;
b) Identification of set replaceable CCGT gas sensor;
c) Checking of CCGT software control sum;

In case of there is a mismatch, then message about error will be in display status line. The full list of errors is shown in Appendix K.

2.1.16.2. In case of a successful initial testing, the following information will be on a display:

а) Alarm threshold;
б) Gas analyte;
в) Measuring units of gas analyte concentration;
г) Current concentration of analyte;
д) Scale of gas concentration changing with time;
е) Work running status.

2.1.16.3. The current concentration of analyte is not displayed immediately after switching on a gas analyzer, since interchangeable gas sensors require time to reach operating mode (see Table 1 and Table 2). At the same time, the message “SENSOR WARM” is displayed in the status line.
2.1.16.4. In the course of work, the replaceable gas sensors periodically automatically carry out control cycles for checking the operability of sensitive gas sensors. If there are faults in the work, then this is reported to the sygnal receiver. This ensures reliable and safe operation of gas analyzers.
2.1.16.5. If a device for receiving an analogue current sygnal of 4-20 mA is connected to the gas analyzer, the current value will change in proportion to the current concentration of analyte according to Appendix G.

2.3 Zero setting and sensor calibration.

2.3.1 Works are done by a qualified specialist out of Ex zone under normal conditions.

2.3.2 While gas analyzers operating in time of checking interval it can be required checking of gas analyzers performability, which consists of concentration readings control when there is no analyte gas in air gas environment and availability of analyte gas concentration GSO-CGM. The checking conditions are described in Checking Method.

2.3.3 Checking operation can be made locally with buttons on gas analyzer sygnal receiver or with set PC via interface equipment USB-RS485

2.3.4 Preparing for work.

a) unscrew the protective cover from the replaceable gas sensor of the CCGT;
b) screw calibration chamber and attach flexible gas supply and exhaust hoses to it;
c) turn on the gas analyzer, make sure that it is in normal operation and wait for at least 5 minutes.

2.3.5 Zero set readings.

2.3.5.1 This operation must be done in the following sequence:

a)Provide mixture to gas analyzer CGM №1 and withstand 2 min;
b)At gas analyzer menu setting choose option «ZERO SETTING»;
c)Set with button «ENTER» zero readings.
d)Go out from calibration mode and control concentration readings.
e)Shut off CGM №1 on a gas analyzer.

2.3.6 Sensitivity setting.

2.3.6.1 This operation must be done in the following sequence:

a) Provide mixture to gas analyzer CGM №2 and withstand 2 min;
b) At gas analyzer menu setting choose option «SENSITIVITY SETTING»;
c) Set with buttons ▲ and ▼ analyte gas concentration and press button «ENTER».
d) Go out from calibration mode and control concentration readings.
e) Shut off CGM №2 on a gas analyzer.
f) Supply mixture CGM №3 and check gas analyzer readings.
g)

2.3.6.2 After completion of zeroing and calibration procedure, if the error of CCGT gas sensor does not meet the requirements stated in Table 1 or Table 2, the procedure should be repeated. If the readings do not correspond again to the concentration value in CGM №3, the sensor must be replaced and sent to the manufacturer for repair.

2.3.7 Ensuring the explosion protection of gas analyzers during installation.

2.3.8 Installation of gas analyzers in explosive conditions must be carried out in accordance with the requirements of:

- The current Operation Manual;
- EIC Rules (гл.7.3);
- GOST 30852.0
- GOST 30852.1
- GOST 30852.10
- инструкции VCH332 74/MMCC («Instruction on electric equipment installation of power and lightning networks in explosive zones»);
- other regulative documents which act in a company.

2.3.8.1While mounting it is necessary to pay attention on special operating conditions

2.7 «Ex providing».

2.3.8.2 Before installation, the gas analyzer should be inspected. Special attention should be paid to the explosion protection marking, warning labels, the absence of damage to the enclosure of the flameproof shell of the sygnal receiver and interchangeable CCGT sensors, the presence of a grounding clamp, the availability of means of sealing for the cables and the cover, the condition of the connecting cable.

2.3.8.3Power cable wires must have section cut of 0,5 mm2 and length no more then 300 m.

2.3.8.4At the end of electrical installation, the electrical resistance of the ground line should be checked, which

should be no more than 1 Ohm. For grounding use copper wire with a cross section of at least 2.5 mm2.

3 Technical maintenance

3.1 General guidelines

3.1.1 Maintenance is divided into:

a) Daily mauntenance;

b) periodic maintenance performed after working off a certain time, and after moving (before installation).

3.1.2 Operational and routine maintenance of gas analyzers is performed by personnel, whose duties include ensuring the operability of gas analyzers. The list of these works includes:

a) checking the status and control of the instrument readings;

b) setting up gas analyzers;

c) operational actions for the replacement of damaged components with the registration of acts;

d) registration in the form according to the forms recommended by the manufacturer of all recorded deviations, failures, work performed and other information.

3.2 Security measures

3.2.1 When operating the complex, it is necessary to be guided by:

a) Chapter 3.4 "Electrical installations in hazardous areas" PEEP;

b) the current rules of electrical installations;

c) current operational documentation (OD) and other regulatory documents which act in the company.

3.2.2 Gas analyzers should be serviced outside the hazardous areas of the premises and outdoor installations.

3.2.3 Open the top cover of the gas analyzers in the hazardous area only after removing all voltages from the terminals of the gas analyzers.

3.3 Maintenance procedures.

3.3.1 Maintenance is carried out in the following order:

a) Cleaning from the enclosure of gas analyzers. It is necessary to ensure that moisture does not get inside the device.

b) Check the availability and durability of mounting fasteners.

c) Removing contaminated plug connectors.

d) Check for visible mechanical damage.

e) Replacement and / or repair of damaged cable products.

f) Replacement of damaged gas analyzers.

3.3.2 Wash the connector with an alcohol-gasoline mixture (need 0.5 ml) with a soft brush.

3.3.3 Wash the contact connectors with alcohol-gasoline mixture (need 3 ml) with a soft brush.

3.3.4 The absence of marks on the maintenance of the Form (section "Accounting for maintenance") ATTRACTS VIOLATION OF OPERATION RULES, and the manufacturer has the right to withdraw from the warranty.

4 Current repair

4.1 General guidelines

4.1.1 For gas analyzer maintenance specialists who knows operating rules of electric installations in Ex, who has studied material part, gas analyzers operating documentation and who has a qualified group in electrical safety no less then III is permitted to work.

5 Storage

Storage conditions

The entire range of gas analyzers requires careful handling, storage in dry, clean rooms with a constant temperature from -65 °C to +70 ° C and a relative humidity of not more than 80%.

The gas analyzers entering the warehouses in the factory packaging are not unpacked, packaged on flat pallets and stacked in storage blocks or in the cells of the racks.

Storage of gas analyzers should be only on the racks in warehouses.

6 Transporting

Transporting requirements and conditions

Sensors transporting must be done by any transport type: in a closed transport facility, also at pressurized plane container in accordance with cargo transporting rules, which are applicable at the very transport type.

7 Disposal

Gas analyzer disposal is made in accordance with requirements and demands applicable in oil and gas industry.

APPENDIX A Gas analyzer mounting

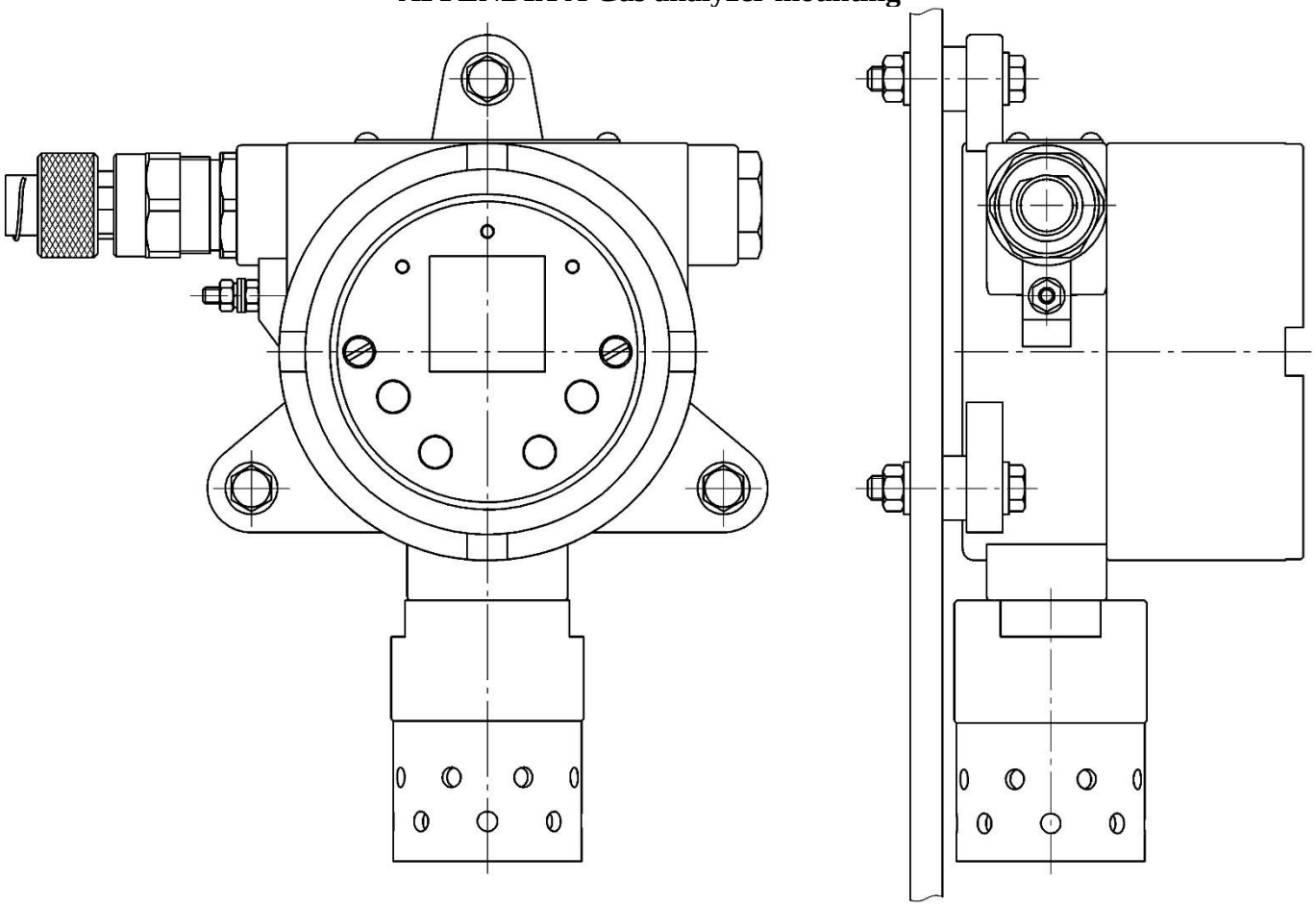


Fig.A1. Gas analyzer layout mounting

APPENDIX B

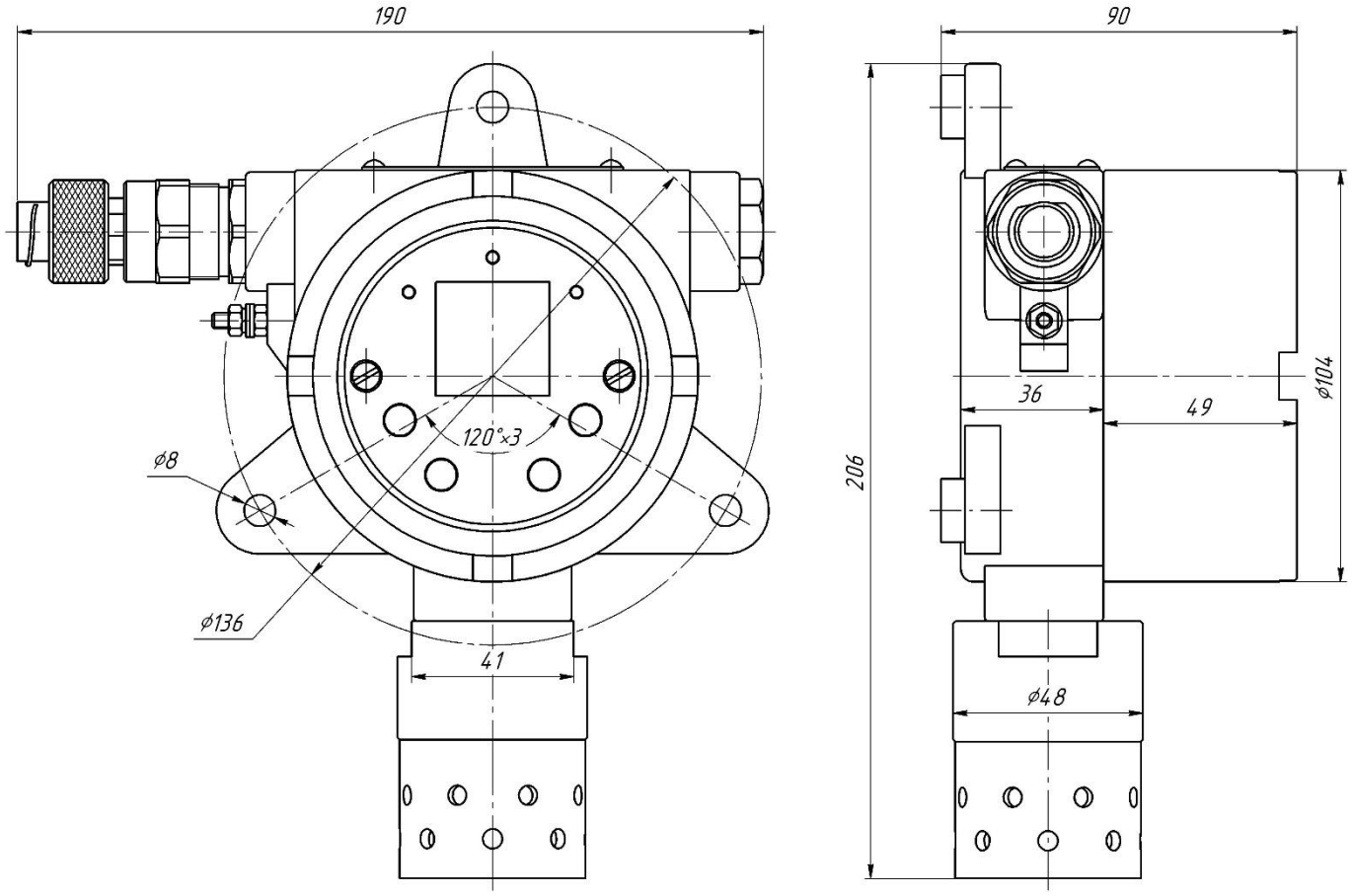


Fig.B.1. Adjusted and overall dimensions

APPENDIX C. (Compulsory)

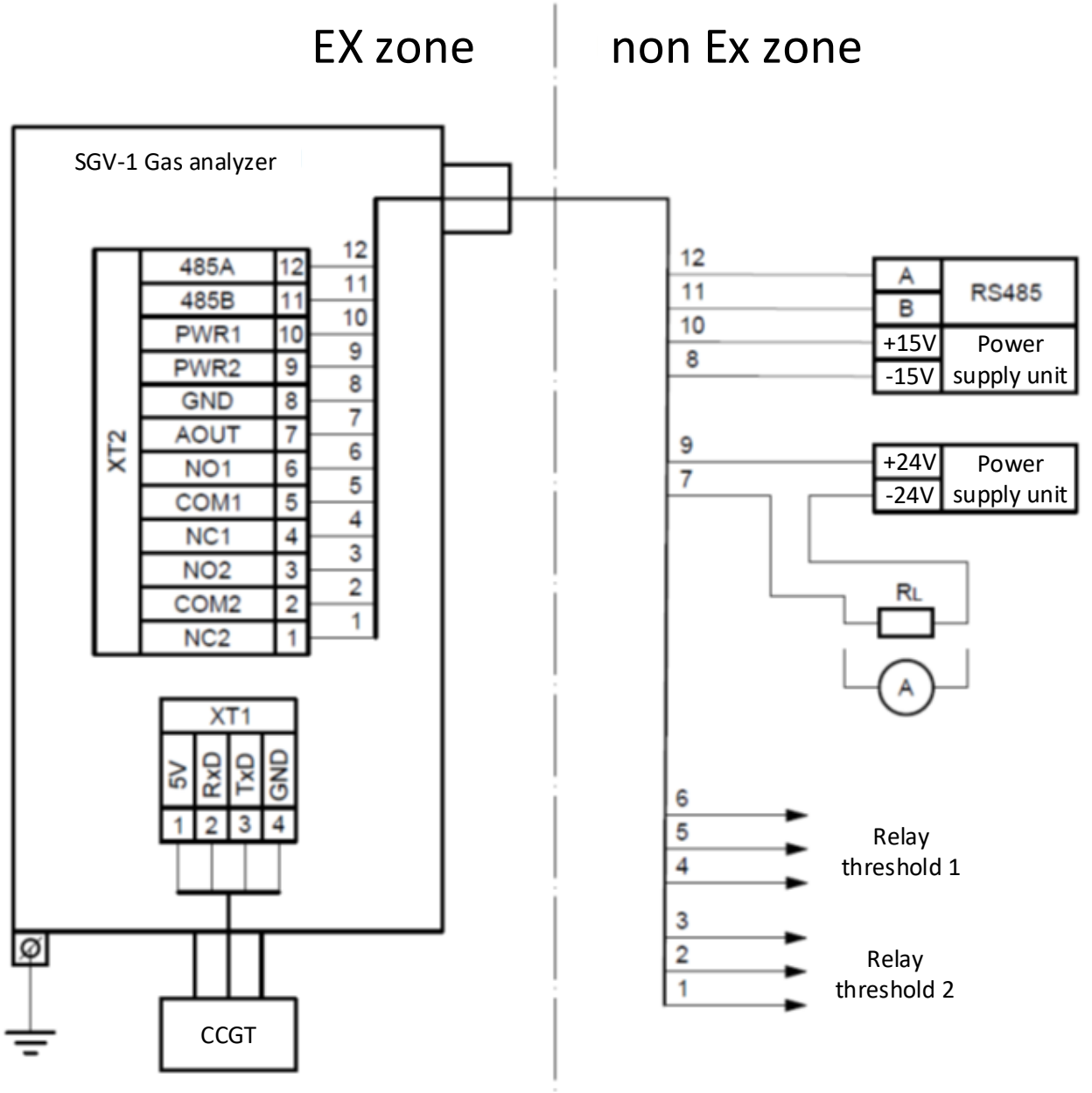


Fig.V1. Gas analyzer setting layout

APPENDIX D

Nominal static conversion function

The dependence of the current loop output is described as follows:

$$I_{LOOP} = 4 + (20 - 4) \cdot \frac{Ci}{C_{MAX}}, \qquad \text{(G.1)}$$

where:

I_{LOOP} – current output* (4÷20), mA;

C_i – current measures of target gas concentration;

C_{MAX} – max concentration of target gas.

Max concentration of target gas is fixed in gas analyzer settings and becomes scale range for current output

*3,6 mA in the next cases:

a) When the gas analyzer is turned on until stable concentrations are obtained, received from interchangeable gas sensors of the CCGT.

b) If the replaceable gas sensor CCGT is faulty.

The current concentration of analyte gas is calculated as follows.

$$Ci = C_{MAX} \cdot \left(\frac{I_{LOOP} - 4}{20 - 4} \right), \qquad \text{(G.2)}$$

APPENDIX D

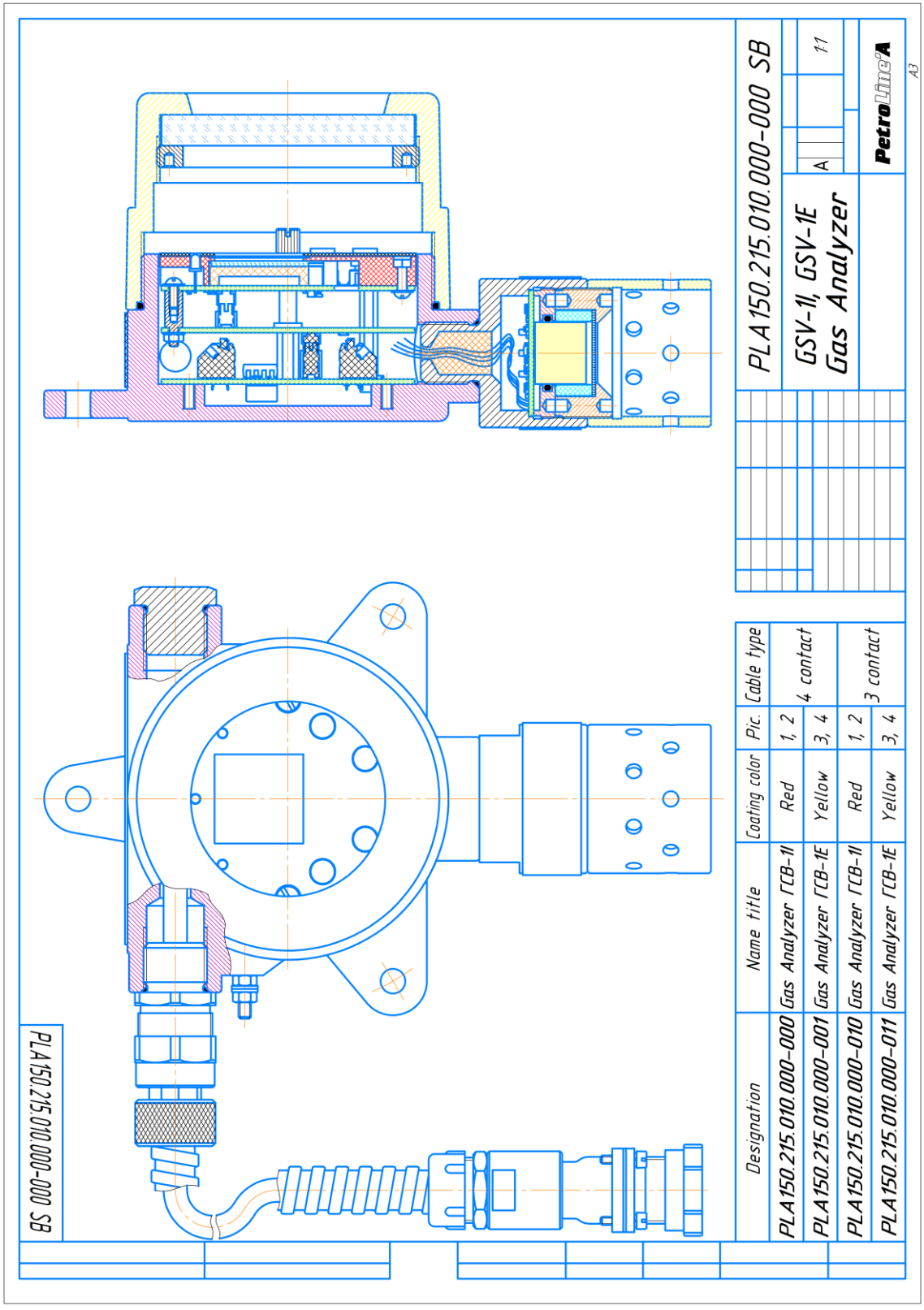


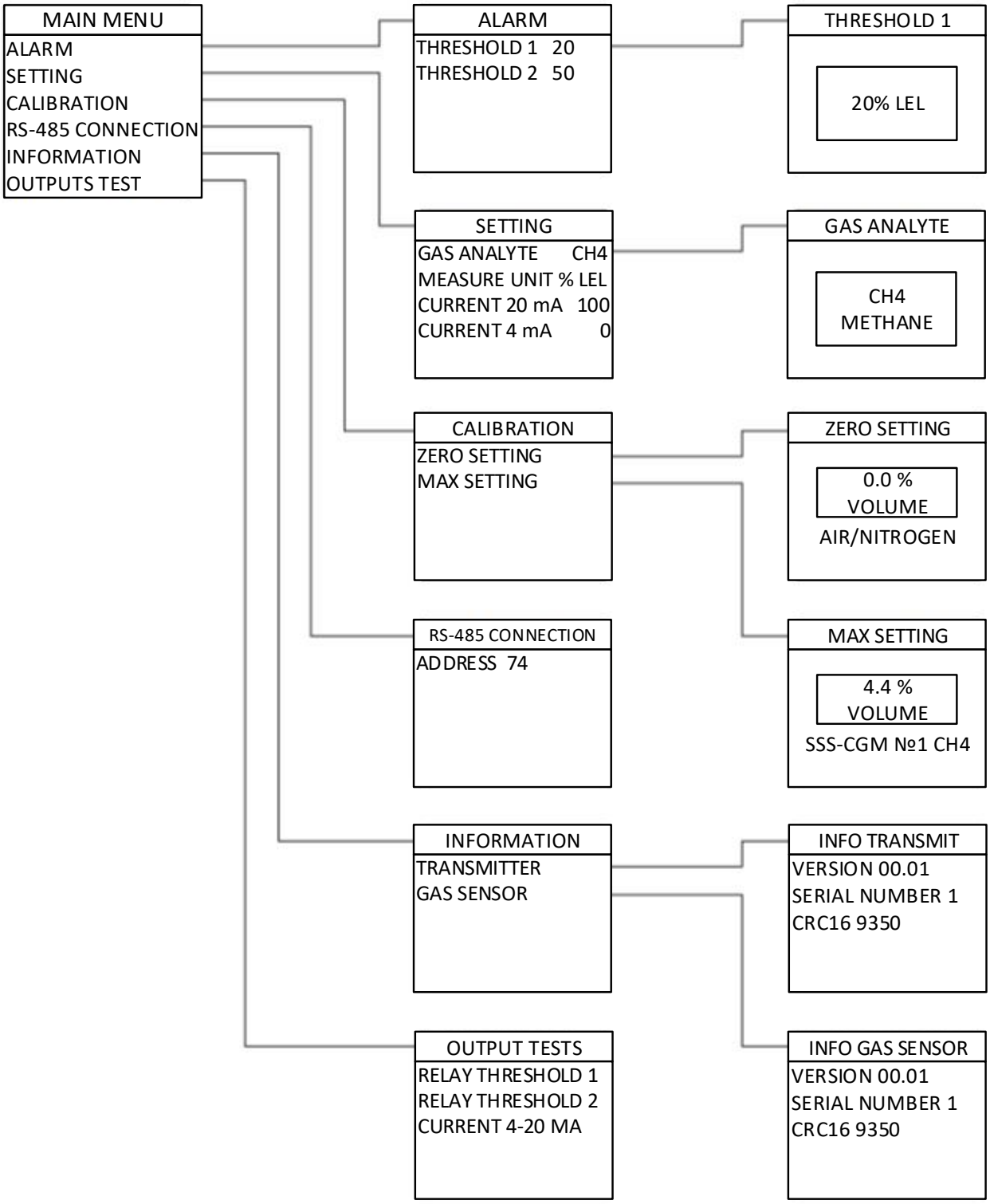
Fig.D.1. Layout of Ex gas analyzers

APPENDIX D(information)

Modbus Register distribution

№	Register address	Type	Access	Decription
Sygnal receiver				
1	0x100	int16	r	Gaz analyzer type
2	0x101	int16	r	Serial number
3	0x102	int16	r	Software version
4	0x103	int16	r	Software control sum
5	0x104	int16	r/w	Threshold1
6	0x105	int16	r/w	Threshold 2
7	0x106	int16	r/w	Modbus address
8	0x107	int16	r/w	Concentration for gas 20мА
Gas sensor CCGT				
1	0x200	int16	r	Type of changeable gas sensor
2	0x201	int16	r	Serial number
3	0x202	int32	r	Date of plant calibration
4	0x204	int16	r	Software version
5	0x205	int16	r	Software control sum
6	0x206	int16	r	Work status
7	0x207	int16	r	Current value of target gas concentration
8	0x208	int16	r	Current temperature of gas sensor

APPENDIX E Menu structure setting



APPENDIX F SGO-CGM list for gas analyzers checking

№ CGM	CGM components	Content of analyte gas %volume percent.	Approval tolerance, %, volume percent	CGM number by Gosregister
1	N2(air)	0	-	GSO-CGM 10463-2014
2	CH4+air	0,874	±0,009	GSO-CGM 10463-2014
3	CH4+air	2,16	±0,04	GSO-CGM 10095-2012

Table 3.2. CGM for calibration of H2S

№ CGM	CGM components	Content of analyte gas %volume percent (mg/m3)	Threshold %	Approval tolerance, %, volume percent	CGM number by Gosregister
1	N2(air)	0	-	-	GSO-CGM 10463-2014
2	H2S+air	0,0012 (17)	±20	±4	10697-2015
3	H2S +air	0,0024 (34)	±20	±4	10697-2015

APPENDIX G Structure of symbols

GSV-1x

GSV-1 – device

x – code of analyte gas

Table I.1. Analyte gas name

№	Code	Naming
1	I	Methane, CH4
2	E	Hydrogen sulphide, H2S

APPENDIX J

Table K.1. Gas analyzer messages

№	Message	Description
1	SENSOR IS FIXED	CCGT sensor is fixed and work without errors
2	SENSOR WARM UP	CCGT sensor is in the mode of sensitive element warming
3	SENSOR IS NOT FOUND	Sygnal reciver did not find CCGT sensor
4	SENSOR OSHB CRC16	CCGT sensor found non compliance of control sum CRC
5	SENSOR OSHB MEAS	CCGT sensor found malfunction of sensitive element