NPP «Avtomatica» JSC

DISSOLVED OXYGEN ANALYZER
DO 5112

INSTRUCTION MANUAL

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Introduction

The present operation manual serves for the studying and correct using the dissolved oxygen analyzer DO 5112 (hereinafter – analyzer).
Analyzers are used in the automated control systems by monitoring the technological processes in communal and industrial water treatment systems, by the quality inspection of drinking water, in aquaculture plants and other industries.
The manual contains the purpose, principle of operation, design, technical characteristics, presents data on the sequence of operation and monitoring of the technical condition.
Depending on their application field the analyzers are subject to checking (when applying in the sphere of state metrological control and monitorung) or calibration (when applying out of the sphere of state metrological control and monitorung).
Analyzers are manufactured in compliance with spec. ТУ 4215-037-10474265-2009.

1 Purpose

1.1 Analyzers DO 5112 are designed for the oxygen concentration measurement of dissolved oxygen (C) and temperature (T) in **water and aqueous media along one or two channels.**

1.2 Analyzers consist of one or two optical sensors and a measuring transducer (MT). In accordance with the order, the analyzers are equipped with submersible fittings.

It is possible to connect a liquid flow sensor with an impulse-number output (option).

Analyzers provide a value digital indication of the measured parameters, their converting into proportional values of analog DC output signals, data exchange via RS-485 digital interface, signaling the overranging the measured parameters out of the setting values, as well as archiving and graphical display of the measurement results.
Immersion sensors for the measuring the dissolved oxygen in an open tank or a reservoir have a built-in device for compressed air lenses cleaning (clean compressed air with pressure up to 3 bar should be supplied externally).

1.3 Climatic execution as per GOST 15150, kind of execution - УХЛ 4.2*.

Operating conditions:

- Ambient temperature, °C	5…50;
- Ambient air relative humidity, %, not more than	95;
- Atmospheric pressure, kPa	84… 106,7.

2 Technical specifications

2.1 Electrode system:

- optical sensor — luminescent;

- cable length from the sensor to MT - 10м.

2.2 Analog output signal

2.2.1 Number of analog output signal 2.

2.2.2 Output unified DC signal (selected programmatically):
- (0… 5) mA at the load resistance (0... 2) kOhm;
- (0... 20) mA at the load resistance (0... 500) Ohm;
- (4... 20) mA at the load resistance (0... 500) Ohm.

2.3 Discrete outputs

2.3.1 Number of digital outputs 4.

2.3.2 Galvanic isolation of discrete outputs between themselves and other analyzer's circuits is not less than 500 V.

2.3.3 Digital outputs types and parameters of:

- electromagnetic relays (type P);
- solid state relays (type T);
- transistor optocouplers (type O);
- triac optocouplers (тип С).

ATTENTION! Outputs type is set on the customer's request. **All outputs are of the same type.**

2.3.4 The electromagnetic relay allows to switch the load with a maximum permissible current of 3 A at a voltage up to 240 V AC with a frequency of 50 Hz or 30 VDC. Voltage free output relay contacts are removed to units terminals. See the wiring diagram (a-fig.C2, Annex C).

2.3.5 The solid-state relay allows to connect the load with a maximum permissible current of 120 mA at a voltage up to 250 VAC with a frequency of 50 Hz, or 400 VDC (*b-Fig. C2*, Appendix C).

2.3.6 The transistor optocoupler is normally used to control a low-voltage relay (up to 50 V, 30 mA, see Fig. 2, Appendix C.). When connecting to the output with transistor optocoupler, it is neccessary to install a diode VD1 parallel to the relay P1 winding to avoid a failure of transistor due to the high self-inductance current. The diode VD1 should withstand reverse voltage of at least 50 V and a direct current of at least 30 mA.

2.3.7 The triac optocoupler is intended only for controlling the external power triacs, direct connection of the load is not allowed.

2.3.8 The triac optocoupler is connected to the powerful triac control circuit through the limiting resistor R1 (*g-Fig.* C2, Appendix C). Resistor resistance determines the value of the triac control current. To prevent a triac breakdown due to high-voltage power line surges, it is recommended to connect RC- chain filter (R3, C1) to its terminals.

2.3.9 The triac optocoupler can also control a pair of counter-parallel-connected thyristors VS1 and VS2 (*d-Fig. C2*, Appendix C).

2.3.10 The triac optocoupler has a built-in zero-crossing device, so it provides full opening of the connected thyristors without using additional devices.

2.4 Digital interface

2.4.1 Physical layer RS-485.

2.4.2 Data link layer Modbus RTU Protocol.

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

The interface option of device address, data rate and other parameters are selected programmatically.

2.4.4 Update rate of registers "measurement result" (for local network) 8 Hz.

2.5 Display

2.5.1 The measured parameters indication is carried out by a graphic liquid crystal display (display) in absolute units.

2.5.2 Single LED indicators:

- four red indicators for displaying the light-signaling modes;

- one two-color indicator for displaying communication via interface.

2.5.3 Display refreshing rate 2 Hz.

2.5.4 Measurement cycle (in sensors) 8 s

2.5.5 Flow range measurement

(When installing the sensor)**:** (0,9... 48) l/h.

2.6 Control

2.6.1 The manual control is performed by means of four buttons and LCD using the menu.

2.6.2 The control from the top-level system is performed through the local Modbus network.

2.6.3 The analyzers provide automatic and manual sensor cleaning (via the menu). The user sets the method (s) for enabling the automatic cleaning, cyclically on a periodic predetermined base:

- cleaning starting period (0... 24) h, step 1 h;
- cleaning durability (0,1... 59,9) s, step 0,1 s;
- measurement storage time (1... 20) min step 1 min;

Note - For a zero specified cleaning starting period, periodic cleaning is not enabled.

2.7 Current supply

2.7.1 Power supply frequency 50 Hz	(187... 242) V.
2.7.2 Power consumption, no more than	15 VA.

2.8 Structural specification

2.8.1 Ingress protection analyzer design is according to GOST 14254

- wall-mounted version	IP65;
- panel- mounted version	IP20.

2.8.2 Packaged analyzers are resistant to vibration in accordance with GOST R 52931 for Group F3.

2.8.3 Overall dimensions (H × W × D)	(190×192×104) mm; (96x96x120) mm.

2.8 Reliability number

2.8.1 Probability of failure-free operation	0,9.
2.8.2 Average time between failures	20 000 h.
2.8.3 Average life	10 years.

3 Features

3.1 Measuring range:
- dissolved oxygen concentration (0.00 ... 19.99) mg / dm3 with automatic switching;
- oxygen percent saturation of the liquid (0 ... 200)%.

3.2 Permissible value limits of the basic error when measuring the dissolved oxygen concentration

1 ± 0,5% from the scale.

4 Device components

4.1 The delivery completeness of analyzer is given in the table (Table 1).

Table 1- Delivery completeness

	Description	Quantity	Note
1	Dissolved oxygen analyzer DO 5112 (MD)	1	
2	Instruction Manual	1	
3	Communication interface. Application Guide	1	
4	Passport (certificate)	1	
5	Light detector	1-2	optionally
7	Fitting	1-2	optionally
8	Instruction Manual for fitting	1-2	optionally

4.2 Ordering code

DO 5112 xx **xx**

- P - panel mounting
- W - wall mounting
- 01 - single light detector
- 02 - two light detectors

Ordering example:
« **DO.01.P** — Dissolved oxygen analyzer with single light detector, panel mounting».

5 Design and device operation

5.1 Measuring procedure

The dissolved oxygen concentration measuring method in the analyzed liquid with light detector is based on the physical luminescence phenomenon. Transparent sensor covered with blue and red light emitting diodes is covered with phosphor that contacts with oxygen molecules of analyzed liquid.

During the measurement, the blue LED emits a light pulse that passes through the transparent sensor cover and excites the phosphor molecules. For some time, the molecules return to their original state, emitting red radiation. The oxygen molecules contacting with sensor phosphor affect the transition process**.**

To determine the oxygen concentration, the luminescence decay time is analyzed. Therefore, the oxygen concentration measuring is reduced to the time interval measuring.

This dependence is described by the Stern-Volmer equation. According to this equation, the analyzer calculates the concentration of dissolved oxygen.

The light detector consists of:

- the sensor cover with a phosphor layer, coated on a transparent substrate.
- the sensor housing with blue and red LEDs (light emitting diodes), receiving photodiode and an electronic signal converter.

In the working position, the cover is screwed onto the sensor and immersed into water. The oxygen molecules in the analyzed sample come into direct contact with phosphor.

During the measurement, the blue LED emits a light pulse that passes through the transparent substrate and is partially absorbed by phosphor layer. Electrons in phosphor molecules move to higher energy level (excited state). Within few microseconds, the electrons return to their initial state through the several intermediate energy levels, emitting energy difference in form of longer radiation wavelength (red).

If the oxygen molecules are in contact with phosphor at that moment, they can absorb the electrons energy in excited state and make it possible to return to their original state without emitting light quantum (nonradiative transition). With increasing the oxygen concentration, this process leads to reduction of intensity of emitted "red" radiation (luminescence).
If oxygen molecules cause vibration in phosphor, this leads to the electrons rapid transition from the excited state to the ground state.

Therefore the luminescence time goes down.
Both aspects of the oxygn effect can be attributed to the phenomenon denoted as "luminescence quenching". The maximum intensity (Imax) and decay time of red radiation depend on the surrounding oxygen concentration (decay time is defined as the time between the start of excitation and the drop in the red light level to 1 / e of maximum intensity). To determine the oxygen concentration, the decay time of the luminescence is analyzed.

5.2 Dissolved oxygen light detector :

- provides a continuous measurement with a short response time;
- does not require time to enter the measurement mode;
- does not absorb the oxygen during the analysis;
- is not poisoned by hydrogen sulfide and other sulfur-containing compounds;
- is not affected by interfering solutes.

5.3 Analyzer

5.3.1 The analyzer (measuring device) is an electronic unit housed in an aluminum alloy enclosure with a front panel of 96 × 96 mm for panel mounting or in a wall-mounting housing.

5.3.2 There are connectors for power supply and sensors, relays and current output signals on the back panel of the panel mounting design analyzer.

5.3.3 The following items are located on the front panel (see appendix B):
- graphic liquid crystal display with LED illumination of the measured value and set parameters;
- two-color LED single operation interface display (RS);
- red LED single displays for informing about the selected alarm settings (1, 2, 3, 4);
- key **{** - left to the menu, return, cancel;
- key **я** - up to the menu, right to the digit positions;
- key **ч** - down to the menu, increase the digit;
- key **}** - right to the menu, select and left the menu with commit.

5.3.4 The MD is a microcontroller device. One microcontroller processes the signal from the sensors, providing digital conversion. The second microcontroller provides the control of the keyboard, indicators and data exchange over the local network.

5.3.5 The analyzer interface provides reading of measurement results and MD over the local Modbus network. The dashboard takes precedence over the MD control.

5.3.6 In order to avoid the unauthorized configuration and interference, which may lead to distortion of measurement results, the analyzer case cover can be sealed. The user is offered two options for sealing (Appendix F).

5.4 Fittings

The analyzer can be equipped with submersible fittings AP-5101. For some applications, other types of fittings can be developed.

6 Safety precautions

6.1 According to the method of protection against electric shock the analyzer belongs to class 0I according to GOST.

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

6.3 Installation and removal of analyzer, connection and disconnection of external circuits should be performed with supply voltage de-energized. Connection of external circuits is according to the marking.

7 Setting up and operation procedure

7.1 External examination

After unpacking, identify the following matches:
- the analyzer should be completed in accordance with its certificate;
- the serial number should match the specified in the certificate;
- the analyzer should not have any mechanical damage.

7.2 Installation procedure

7.2.1 Connection

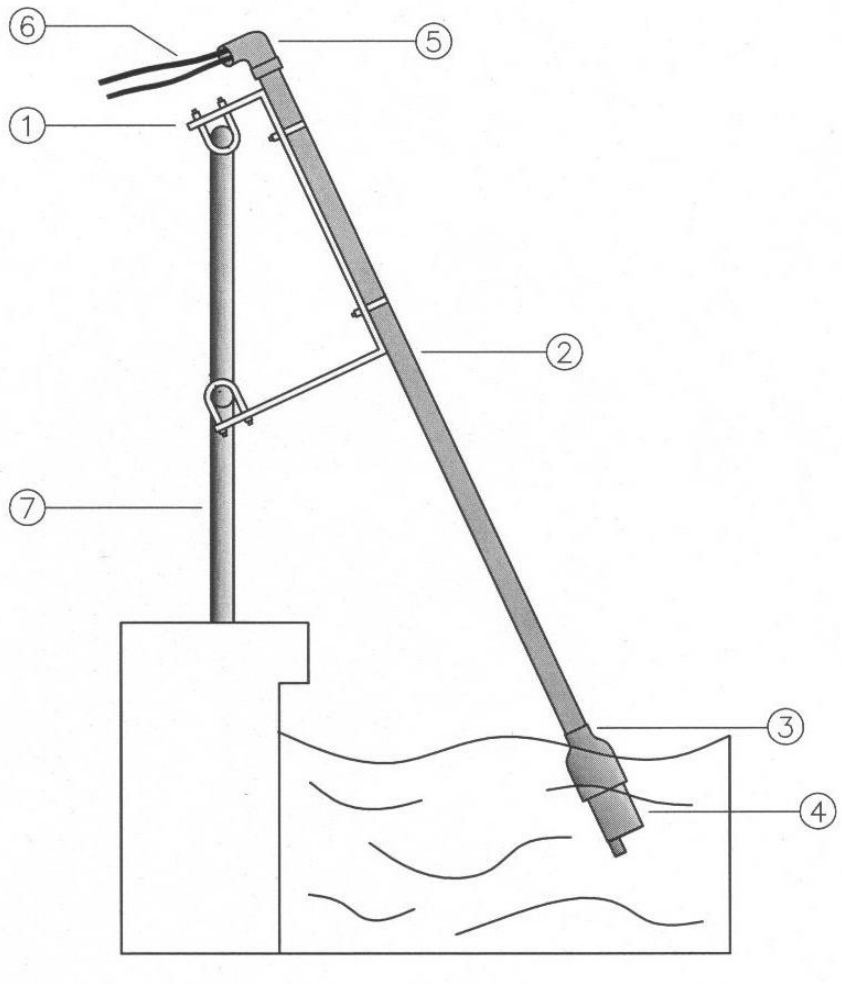
The analyzer is connected in accordance with external connection diagram (Appendix C).

7.2.2 Mounting

Mounting of the panel designed measuring device is performed from the panel board or box front side into a previously prepared cutout. Fixing brackets are installed on the side walls of enclosure. The screws in the fixing brackets are tightened using a screwdriver, and the body is fixed on the shield.

7.2.3 Installation of immersible dissolved oxygen sensor with auto-cleaning (DO8325).

Figure 1 shows a typical mounting of a submersible dissolved oxygen sensor with a mounting kit to the handrails at an open reservoir. The mounting kit (optional) includes an extension pipe, a sensor pipe adapter, and a hing mount for extension pipe.



1 - hing mount for extension pipe
2 - extension pipe
3 - adapter connector for extension pipe
4 - sensor with autocleaning atomizer
5 - rain protection
6 - cable and air tube
7 - handrail

Figure 1 Typical installation of a submersible sensor with a cleaning system

Before immersing the sensor, do the following:
- cut an extension pipe of suitable length,
- cut a PVC tube of suitable length,
- prepare the adapter for extension pipe,
- insert PVC tube into the sensor air connection,
- insert the cable and PVC tube into the adapter and fasten it to the sensor,
- insert the extension pipe into the adapter and secure it.

Compressed air provided by the user must be clean and with a pressure not more than 3 bar.
Typical cleaning time is 15 seconds, typical cleaning frequency is 2 times a day, but this depends on the medium measuring and the actual efficiency of the cleaning action.

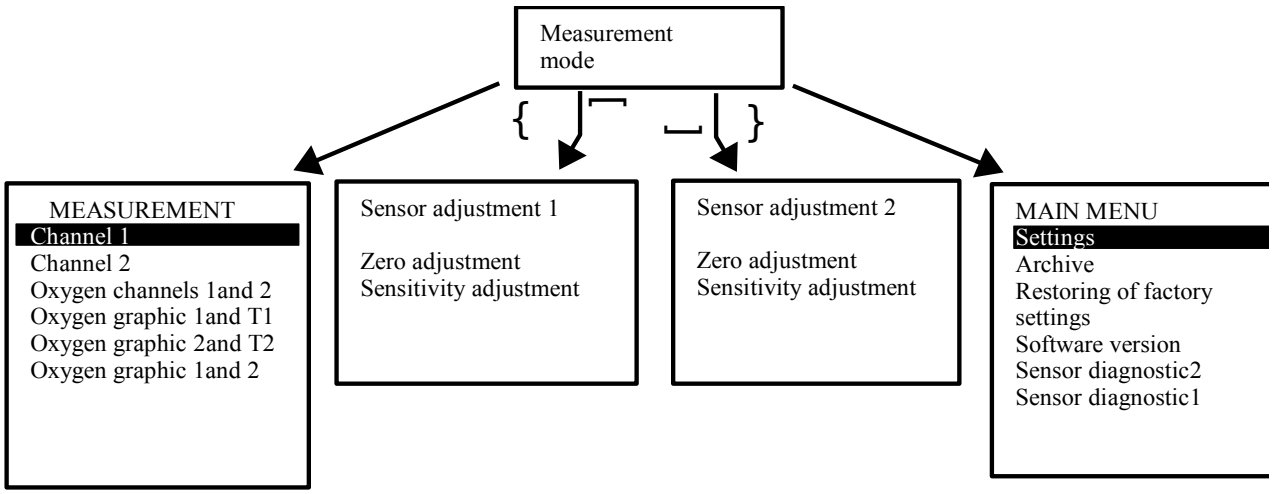
7.3 Analyzer preparation

7.3.1 The analyzer is delivered configured in accordance with the order. Factory settings are indicated in the certificate.
7.3.2 Energize and warm up the analyzer with the sensor connected.
7.3.3 Calibration
The calibration procedure contains Appendix D.

8 OP modes

8.1 When energized, the analyzer goes to the "Measurement" mode automatically and works according to the previously set parameters.

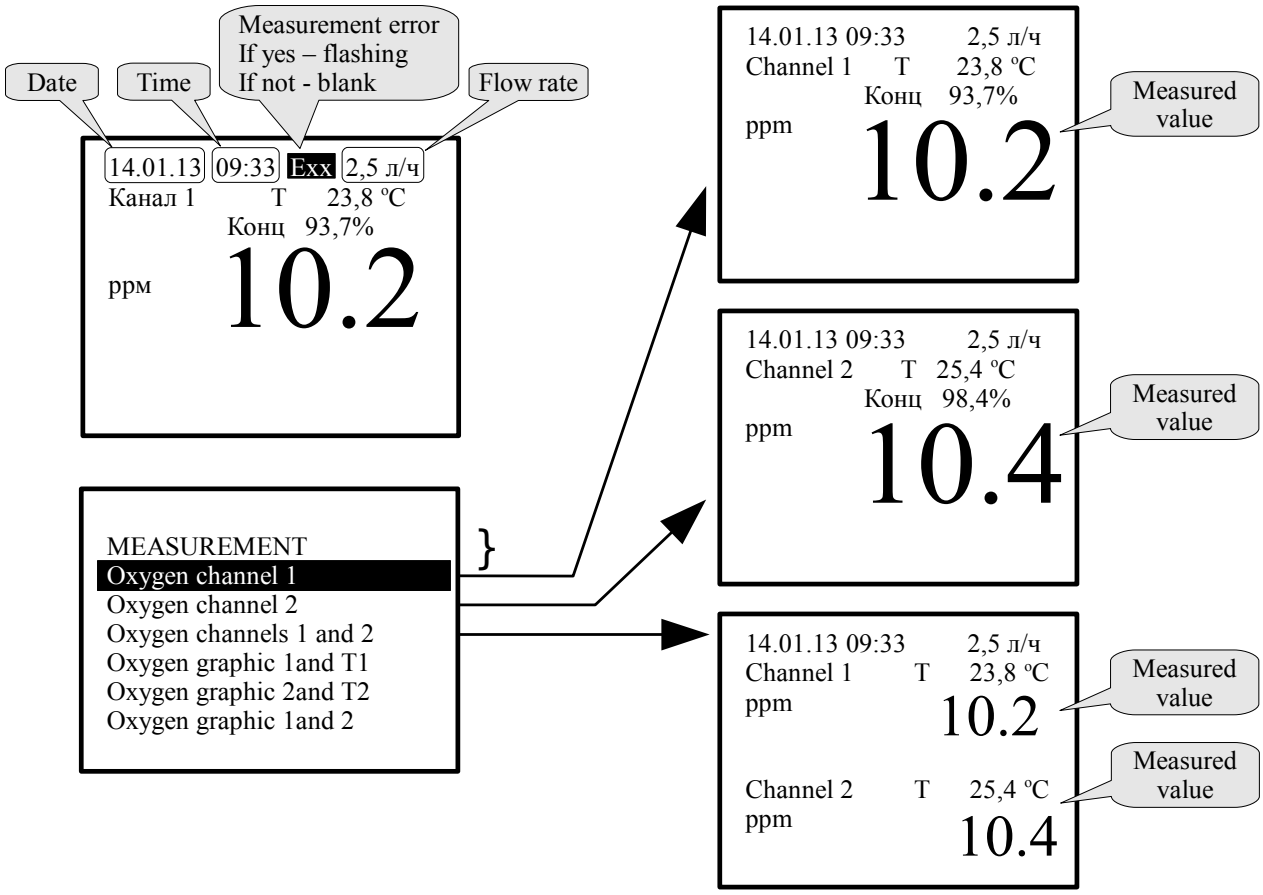
8.2 "Measurement" mode



8.3 Buttons appointment in the " Measurement " mode:
- **{** - entrance to the select menu of display type in the "Measurement" mode;
- **я** - entrance to the zero graduation menu of analyzer;
- **ч** - entrance to the slope graduation menu of analyzer;
- **}** - entrance to the "MAIN MENU".

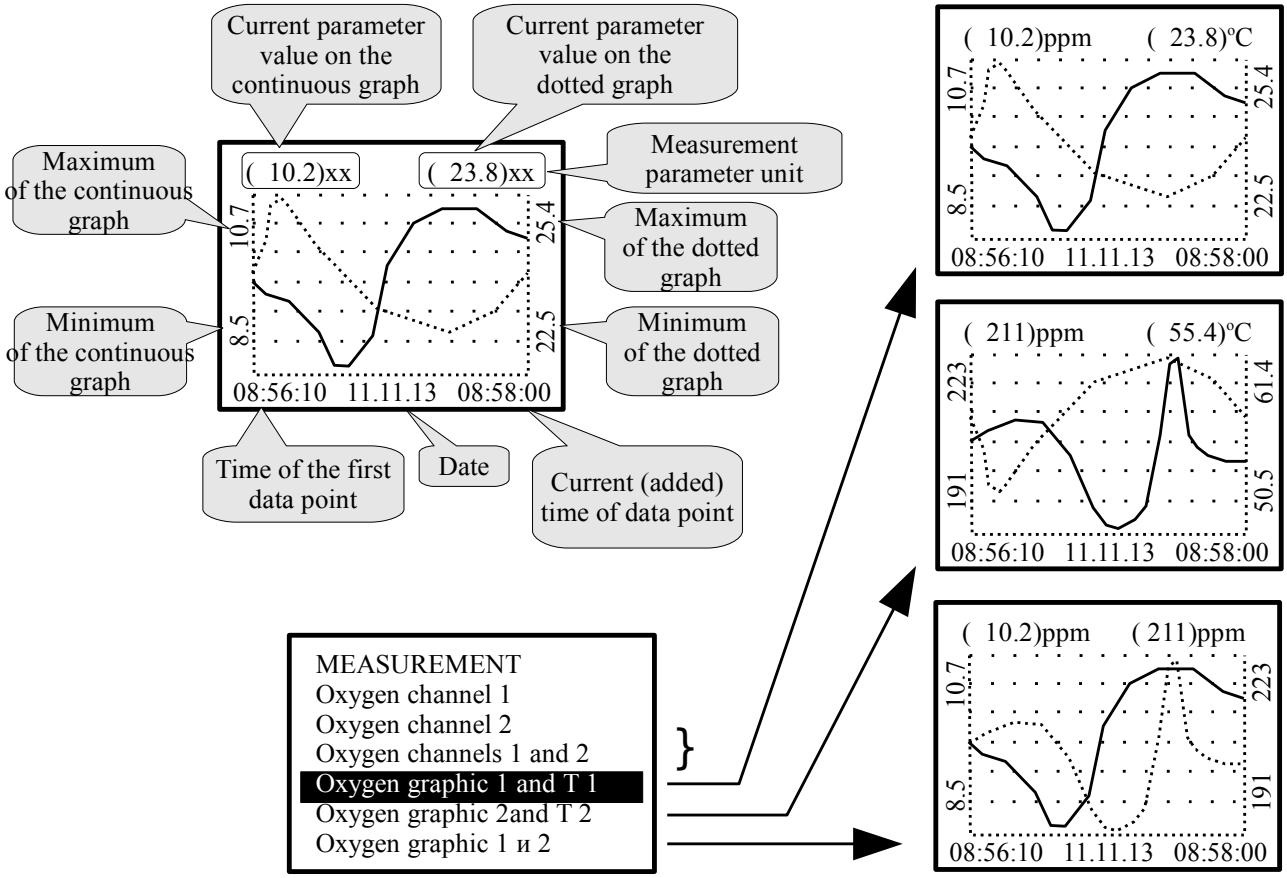
8.3.1 Selecting the data type presentation in the measurement mode:

8.3.1.1 Oxygen channel 1 , Oxygen channel 2 , Oxygen channels 1и2- a digital displaying of the measured data (see figure):



The measurement error in these modes is indicated in "Exx" form, where "xx" is the hexadecimal representation of the error code. In this digit, error codes are coded bit by bit, the list of which is viewed in sect. 9.

8.3.1.2 Oxygen graphic 1 and T1, **Oxygen graphic 2 and T2**, Oxygen graphic 1 and 2- measured data is displayed graphically (see the figure below):



8.4 MAIN MENU

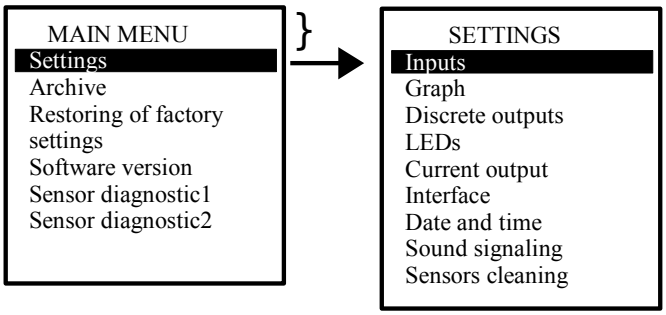
8.4.1 Entrance to the "MAIN MENU" is performed by pressing the button }

8.4.2 Algorithm for entering the numerical values

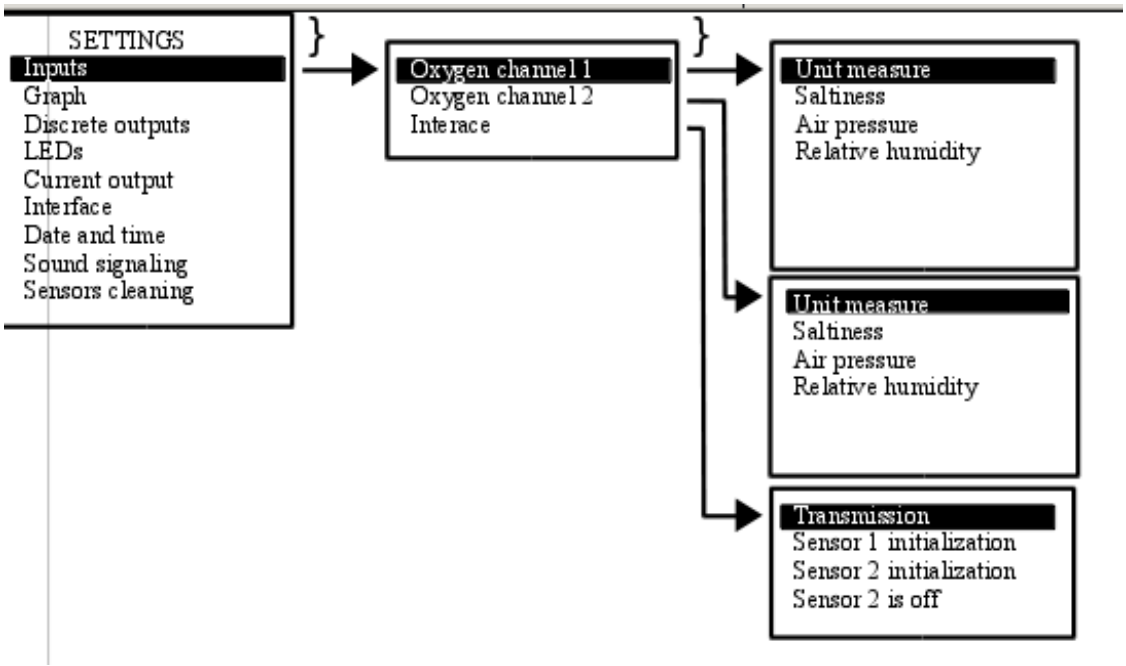
Input of numerical values of analyzer parameters is carried out bitwise. Selecting the the decimal digit value to change, is performed with the button **я**. The corrected bit is displayed in a flashing mode.

To change the selected digit value, press the button **ч**, the value of each bit (except the senior bit) will change cyclically in order 0, 1, … , 9, 0 and so on. When the senior digit is changed, the value changes cyclically in order 0, 1, … , 9, -9, -8, … , -1, 0, 1 and so on (if this is allowed for this parameter).

8.4.2 SETTINGS sub-menu



8.4.3 Inputs



In this mode **Inputs** the measuring parameters for oxugen sensors are set (channels 1 and 2).

Inputs → Oxygen channel 1 - the oxygen sensor parameters channel 1 are reviewed and adjusted.

Unit measure - the oxygen sensor measuring units channel 1 are reviewed and adjusted. (ppm, %);

Saltiness - the saltiness parameters are reviewed and adjusted, g/dm3;

Ait pressure - the air pressure parameters are reviewed and adjusted, mm of mercury;

Relative humidity - the relative humidity parameters are reviewd and set, %.

Inputs → Oxygen channel 2 - the oxygen sensor parameters channel 2 are reviewed and adjusted. The channel 2 parameters correction is performed similarly to the channel 2 parameters correction.

Inputs → **Interface** - sensors data rate, sensor 2 switch-off and sensors initialisation are set.

Data rate - **measuring device date rate review and selection with sensors: 2400, 4800, 9600, 19200 baud.** When removing the sensor more than 10 meters, the data rate should be reduced.

It is necessary to initialize the sensors after changing the data rate!

Sensor 1 initialization - Sensor 1 interface parameters initialization (when primary initialization and changing the data rate);

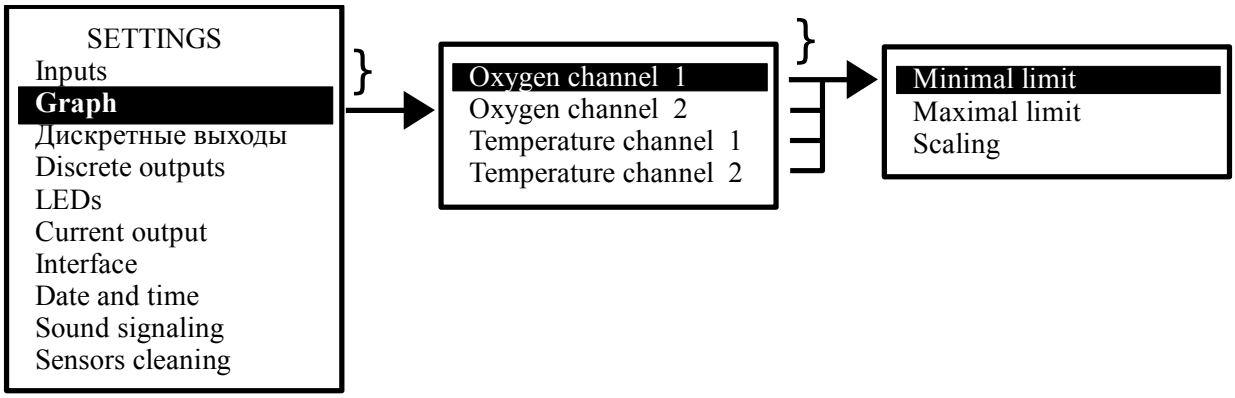
Sensor 2 initialization - Sensor 2 interface parameters initialization (when primary initialization and changing the data rate);

Sensor 2 is off / **Sensor 2 is on** - on / off connection with sensor 2 (if the unit is used in a single-channel mode).

Note - when initializing the sensors, only one of the sensors to be initialized should be connected to the device. The command "Sensor 1 initializing" assigns the address 01 to the sensor, "sensor 2 initializing the" - address 02.

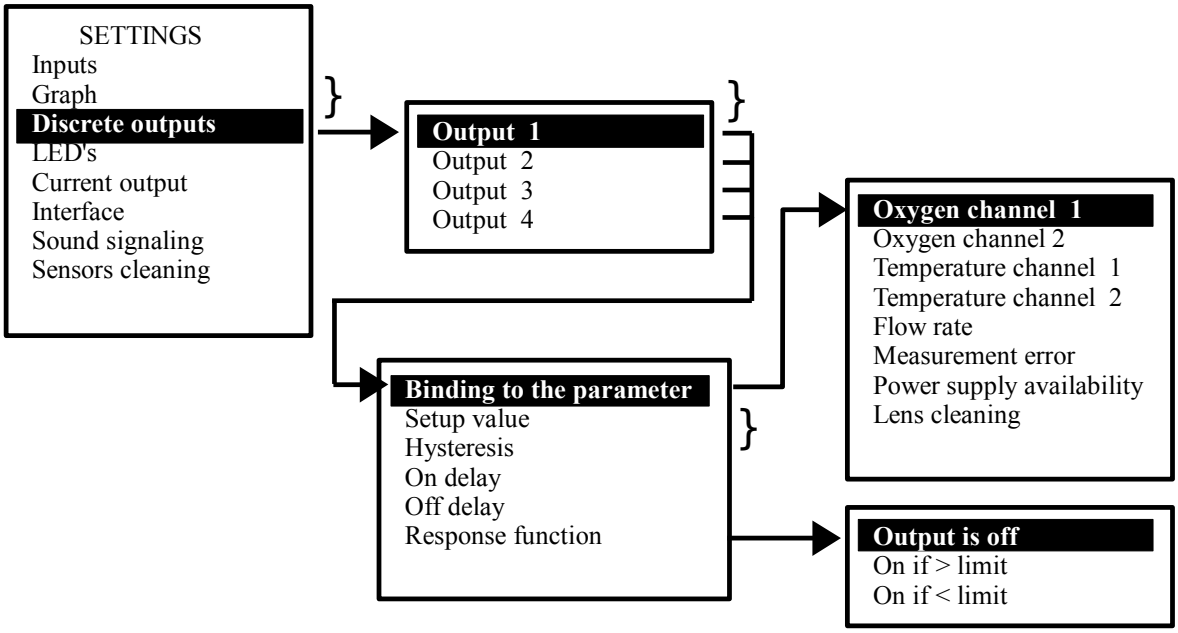
ATTENTION! The new sensor interface parameters, set at the initialization, take effect after the switching off and the next(not less than 5 seconds) switching on the analyzer.

8.4.3.1 Graph



In this mode the zoom parameters for each measurement parameter are selected:
Graph → **Oxygen channel 1** - turbidity graphical display parameters channel 1 are reviewd and adjusted:
Minimal limit - the minimal parameter value displayed is reviewd and adjusted;
Maximal limit -the maximal parameter value displayed is reviewd and adjusted;
Scaling - the minimum and maximum limits are determined automatically. (On / Off).
The scaling parameters for Oxygen channel 2, Temperature channel 1 and Temperature Channel graphical display are selected similarly.

8.4.3.2 Discrete outputs



In this mode the parameters of four discrete outputs **are set:**

Discrete outputs → **Output 1** **-** the parameters of discrete output 1 are reviwed and adjusted.

Binding to the parameter - Each digital output can be configured to the output signaling of the selected parameter (Oxygen channel 1, Oxygen channel 2, Temperature channel 1, Temperature channel 2, Flow rate) beyond the response value, as well as the signaling about the "Measurement error", "Power" , "Lens cleaning";

Setup value - discrete output setup value can be set in the whole measuring range of the bound parameter;

Hysteresis - hysteresis (deadzone) of the discrete output is used for the response value diversity when increasing and decreasing the bound parameter. The hysteresis value can be set in the whole measuring range of the bound parameter;

Discrete output response value when increasing the bound parameter:

$$Response\ value^{+} = Setup\ value + Hysteresis.$$

Discrete output response value when decreasing the bound parameter:

$$Response\ value^{-} = Setup\ value — Hysteresis.$$

On delay - discrete output on delay can be set between the limits 000 and 255 seconds;

Off delay - discrete output off delay can be set between the limits 000 and 255 seconds;

Response function - discrete output can be simply switched off (the output is off). And you can specify whether to switch on the discrete output when increasing the bound parameter above the limit (On if> limit) or when decreasing the bound parameter is below the limit (On if <limit).

Note - The reference to the "Power availability" parameter overturns the response logic: that is, the digital output is switched on in the normal state, and switches off when the response conditions are met.

The parameters of the digital outputs 2, 3 and 4 are adjusted in the same way as the setting the parameters of the first digital output.

8.4.3.3 LEDs
In this mode, the parameters for each of the four LEDs on the analyzer front panel are set.

LEDs → **LED 1** - the parameters of LED 1 are reviewed and adjusted:

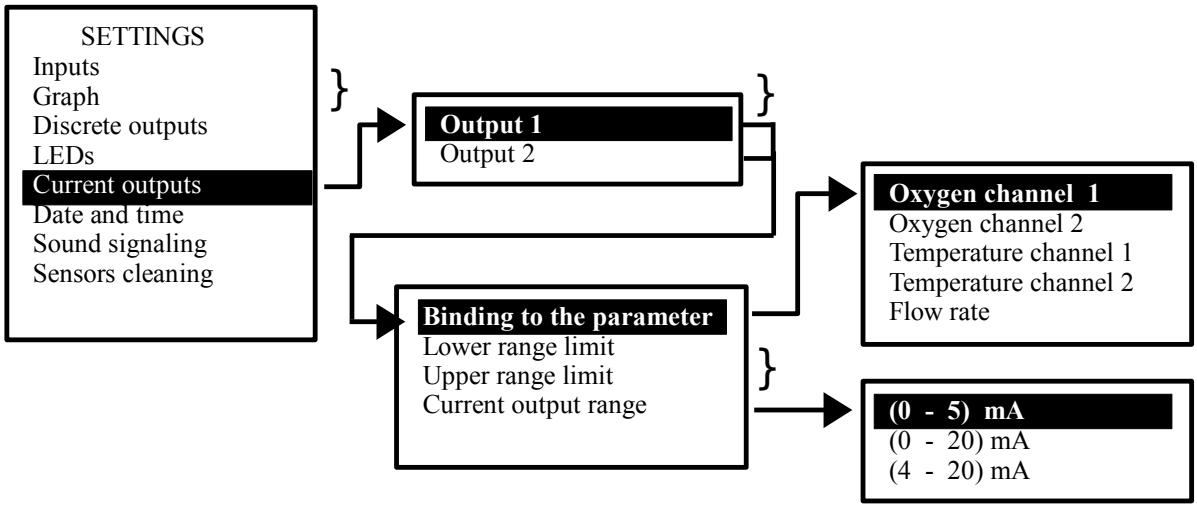
- **Binding to the parameter** - each LED can be set to the signal exceeding (or decreasing) of selected setpoint parameter (Oxygen channel 1, Oxygen channel 2, Temperature channel 1, Temperature channel 2, Flow rate), as well as to the "Measurement error" signaling or to the " Discrete output state" signaling with the same number;
- **Setup value** - LED setup value can be set in the whole measurement range of the binding parameter;
- **Response function** - the LED can be simply switched off (Off). And you can switch it on when increasing the bound parameter above the setup value (On if> setup value) or when decreasing the bound parameter below the setup value (On if <setup value).

Note
1. If the LED is bound to the "Measurement error" parameter, it flashes when an error occurs.

2. If the LED is bound to the "Discrete Output state" parameter, it lights when the digital output with the same number is on.

LEDs parameters 2, 3 and 4 are adjusted in the same way as the first LED parameters. Settings. In the factory setting, the LEDs are bound to the "Discrete Output State" parameter with the same number.

8.4.3.4. Current outputs



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

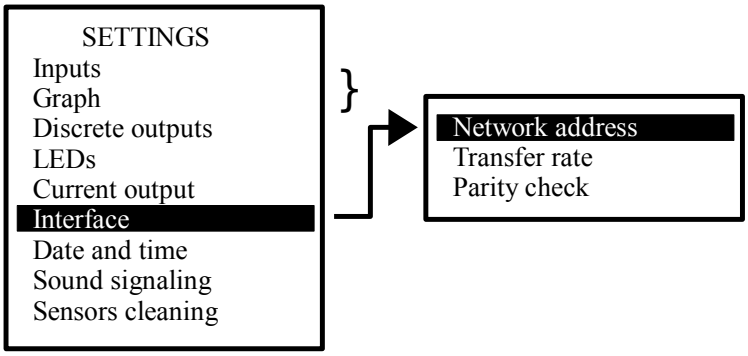
Current outputs → Output 1 - the first current output paremeters setting:

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

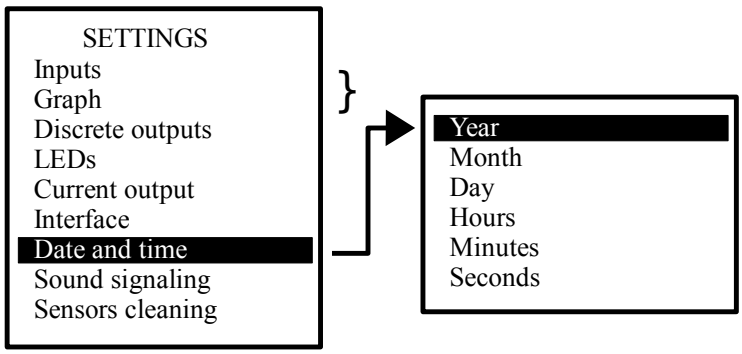
Current outputs → Output 2 - the second current output paremeters setting. The second current output parameters are set in the same way as the first current output parameters settings.

8.4.3.5 Interface

In this mode the interface parameters are set: Network address, Transfer rate and a Parity check.

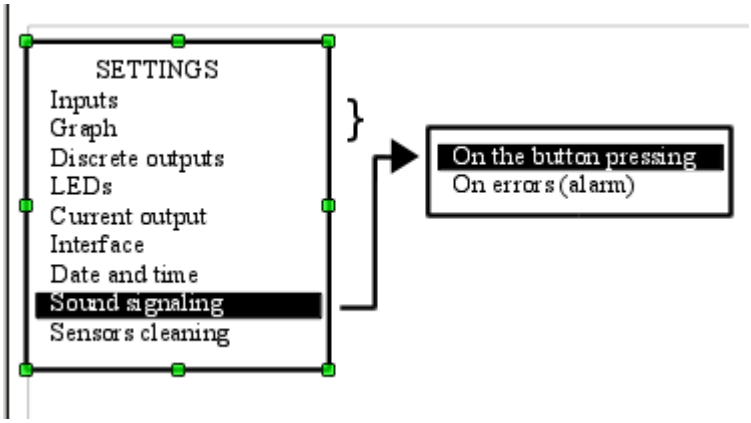


8.4.3.6 Date and time



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

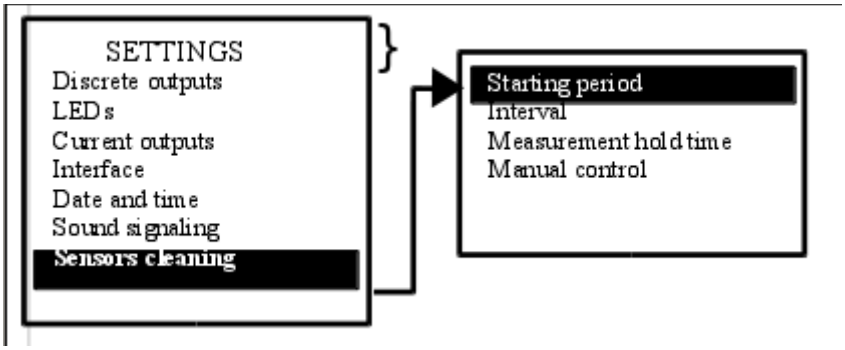
8.4.3.7 Sound signaling



In this mode the sound signaling is set:

- On the button pressing - when this mode is on, the beeps are audible by pressing the buttons on the front panel of the analyzer.
- On errors (alarm) - when this mode is on, the sound signal is activated, if a diagnosed error appears.

8.4.3.8 Sensors cleaning



In this mode the sensors cleaning is set:

- **Starting period** - the cleaning period (0 ... 24 hours) is set in a distance of 1 hour. If the value is set to "0", the self-timer cleaning will be disabled;

- **Interval** - the cleaning pulse interval (0,1... 59,9 s) with a distance 0,1 s is set;
- **Measurement hold time** - the measurement hold time of the measured values from the cleaning starting period and after the cleaning to the readings stabilization (0 ... 20 min) with a distance 1 min is set. The measurement-related discrete outputs and LEDs states are also hold;
-
- **Manual control** - forced (manual) on/off cleaning is performed with button — **Start**.

8.4.4 ARCHIVE sub-menu

In this mode the viewing and configuration of archive is performed. (See Figure 1).

- View Archive - in this mode the archive is viewed. Right button **}** allows to switch the control cursor mode: **я** and **ч**; or the time discrete interval changes, or cursor indicating the time of viewing and the values of the measured parameters at this time moves (See Figure 2).
- Trend line N1 - in this mode a parameter with a ***continuous*** line will be displayed.
- Trend line N2 - in this mode a parameter with a ***broken*** line will be displayed..
- Scaling - in this mode the minimum and maximum limits for every measured parameters for trend displaying are set.. In this mode the minimum and maximum limits for each measured parameters are displayed. When selecting the mode Auto scaling the minimum and maximum limits are determined automatically.

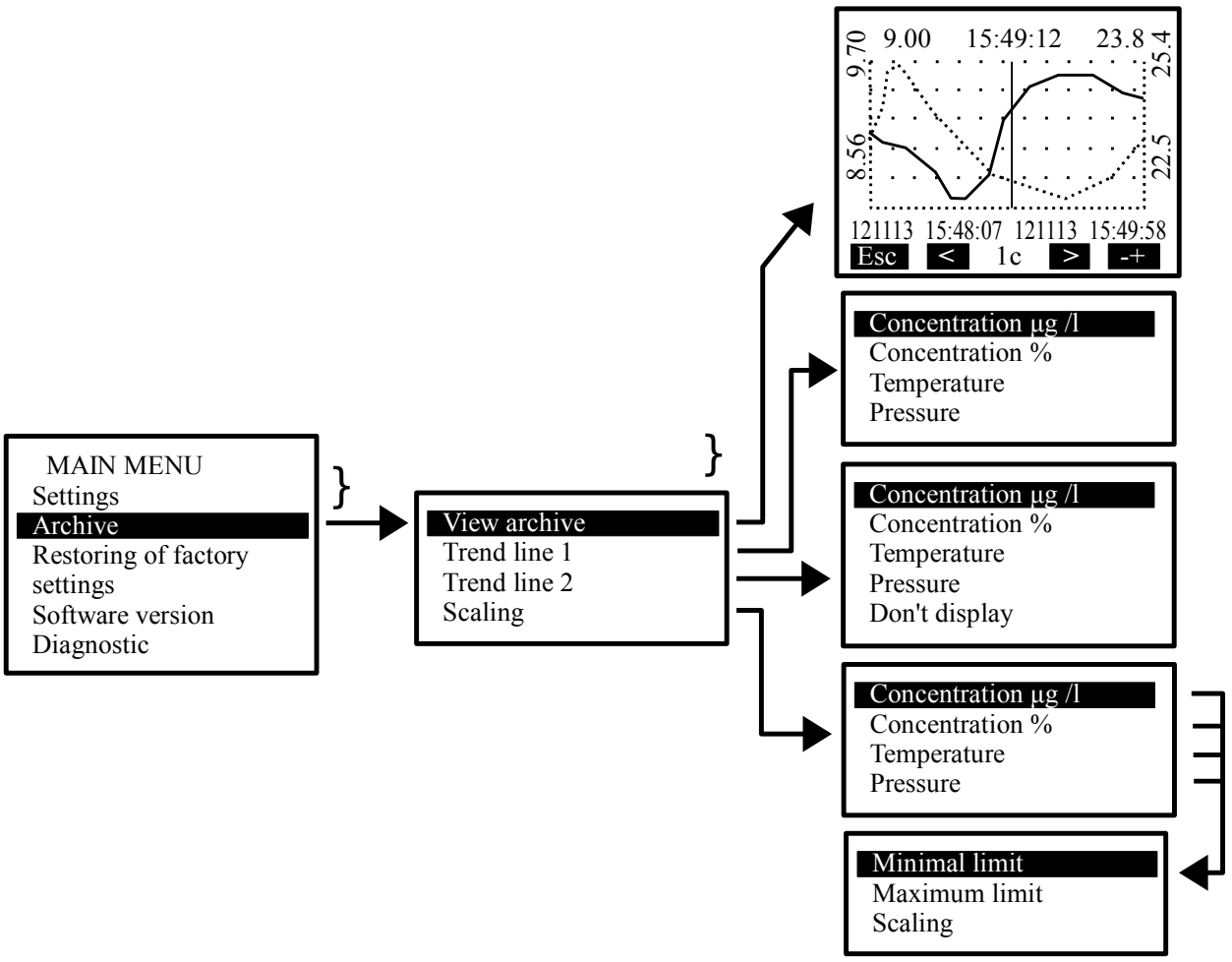


Figure 1- "View Archive" sub-menu structure

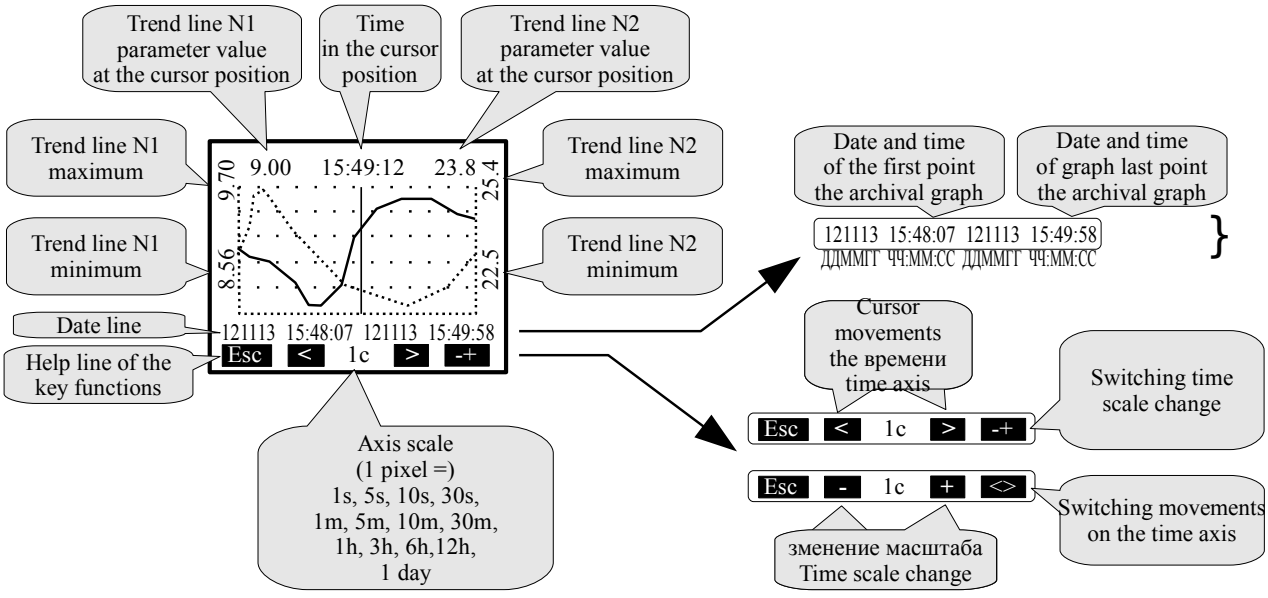
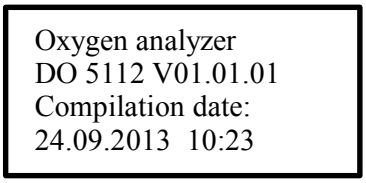


Figure 2 - Description of the control elements and data display in the "View Archive" sub-menu

8.4.5 Restoring the factory settings. In this mode you can restore the analyzer settings installed at the manufacturing plant.

8.4.6 Software version
In this mode you can view the software version of "DO" set in this analyzer:



8.4.7 DIAGNOSTICS. In this mode it is possible to read the errors diagnosed with the analyzer:
- Internal error 1;
- Internal error 2;
- Defective temperature sensor

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

8.5 To move to the «Measurement» mode press button **{**.

9 Eventual failures and remedies

When error diagnosing, a flashing error code, such as E02 appears in the measurement mode in the analyzer screen top line. To determine a kind of error see a Table 1.

Table 1 — Analyzer error code interpretation

Error code	Sexadecimal notation	Error description
E01	0x01	Sensor power fault
E02	0x02	No sensor 1 connection
E04	0x04	No sensor 2 connection

10 Maintenance

10.1 Maintenance includes the periodic sensor cleaning from contamination with soft damp filter paper or other similar materials and analyzer calibration.

10.2 Sensor verification (calibration)
It is required to make a calibration:
- after repair;
- in accordance with calibration interval.

Calibration interval - one year.

10.3 Analyzer verification (calibration) is performed on the instruction «Dissolved Oxygen Analyzer DO 5112. Calibration procedure».

11 Marking, packaging, transportation and storage

11.1 The analyzer front panel bears the following information:
- company – manufacturer (or a trade mark);
- identification code;
- identification of units detectors and control buttons.

11.2 The frame bears the following information:
- company – manufacturer;
- Analyzer title;
- Measuring range;
- Signal output variation range (factory setting);
- serial number and year of production.

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

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

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

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

The boxing method of analyzers should exclude their movement during the transportation time.

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

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

11.6 The analyzers should be stored in the heated rooms with a temperature (5 ... 40) ° C and a relative humidity of less than 80%. Air of the store rooms must be free of dust and impurities of aggressive vapors and gases causing corrosion of the analyzer components.
Storage of analyzers in packages must meet terms 1 as per GOST 15150.

12 Manufacturer warranties

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

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

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

13 Information on claims

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

600016, Vladimir, B. Nizhegorodskaya str., 77,
ZAO “NPP “ Avtomatica”
tel.: +7(4922) 27-62-90, fax: +7(4922) 21-57-42.
e-mail: market@avtomatica.ru
http://www.avtomatica.ru
All claims submitted are registered.

Annex A
Overal and fixing dimensions

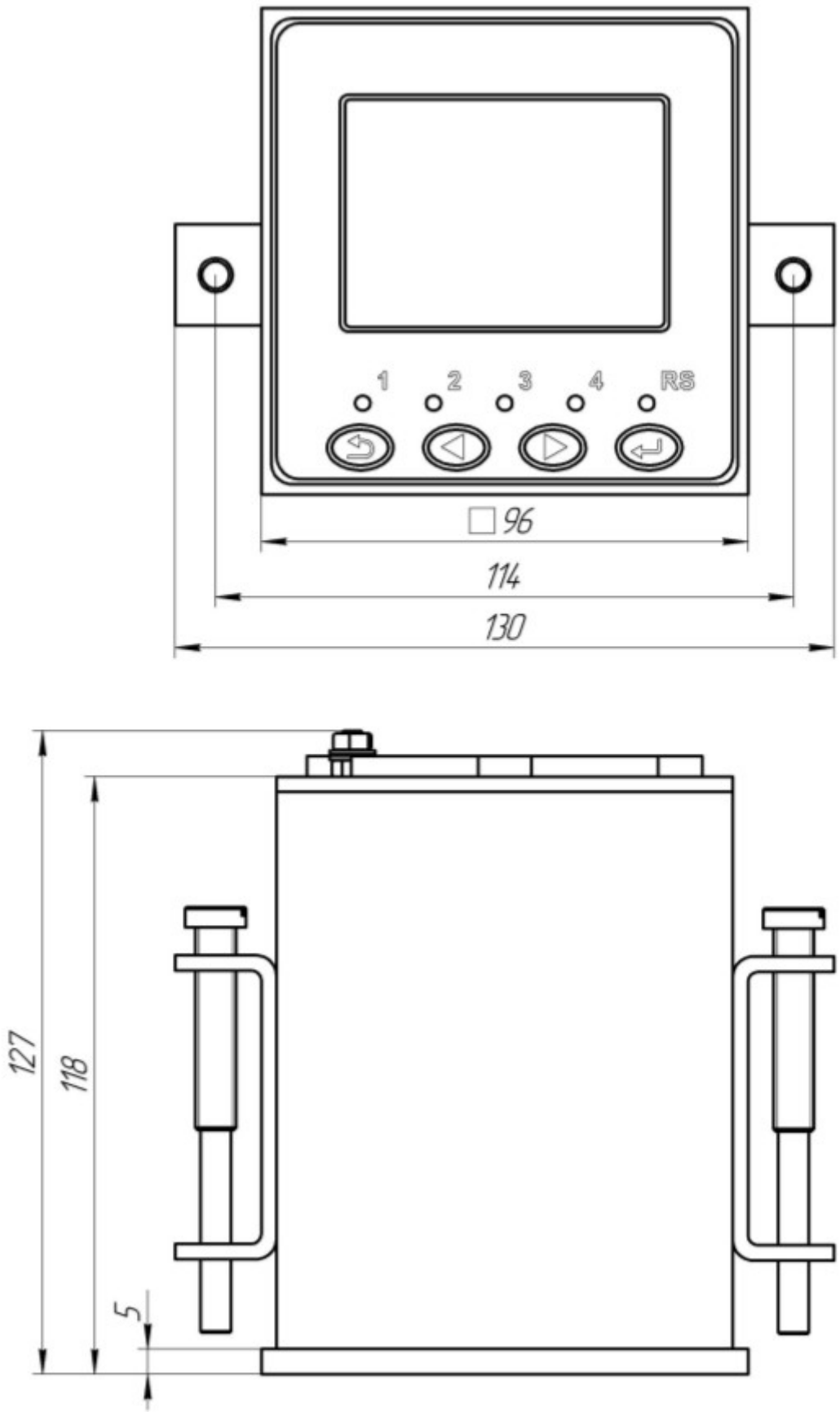


Figure A.1 - Analyzer of a panel design

Continuation of Appendix A

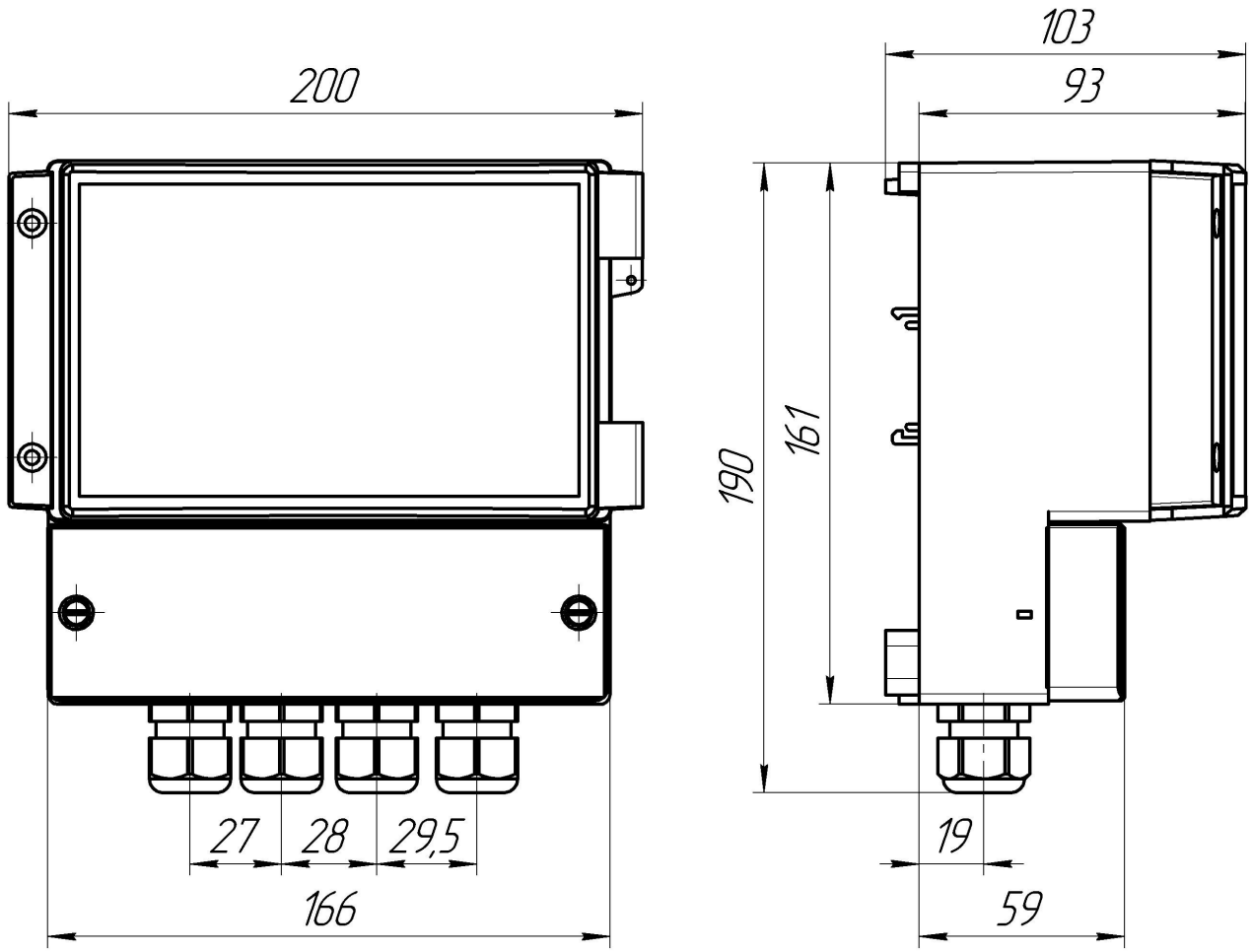


Figure A.2 — Wall mounting case overall dimensions

End of Annex A

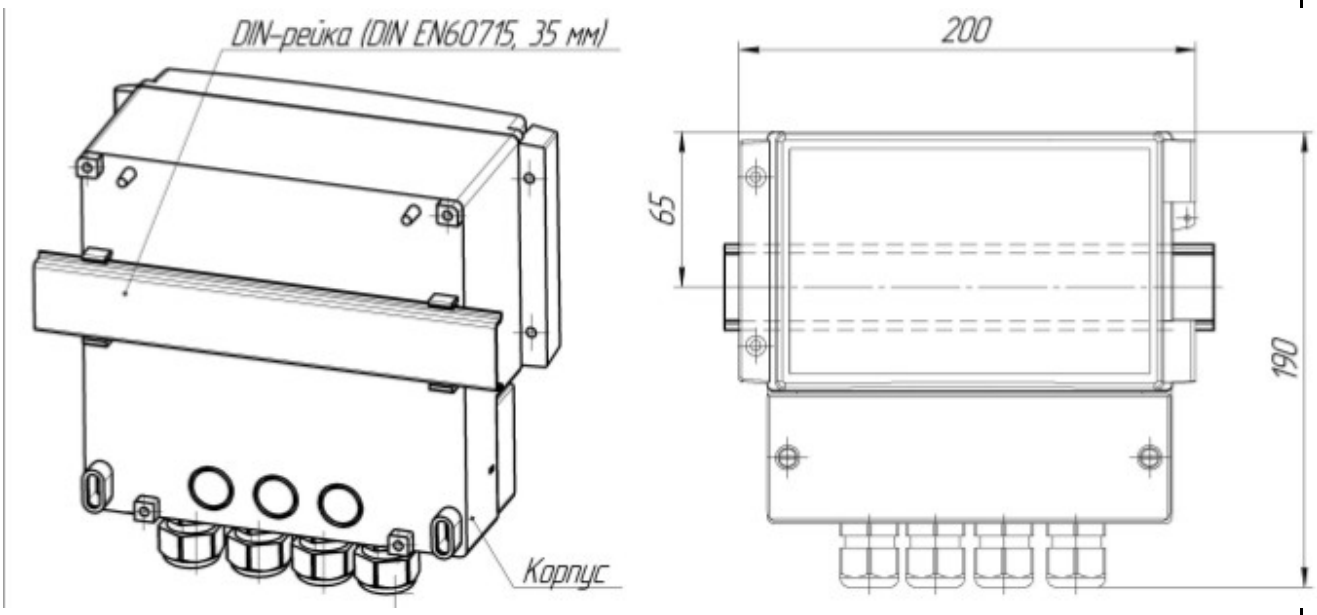


Figure A.3 - Fixing a wall mounting measuring device using a DIN-rail.

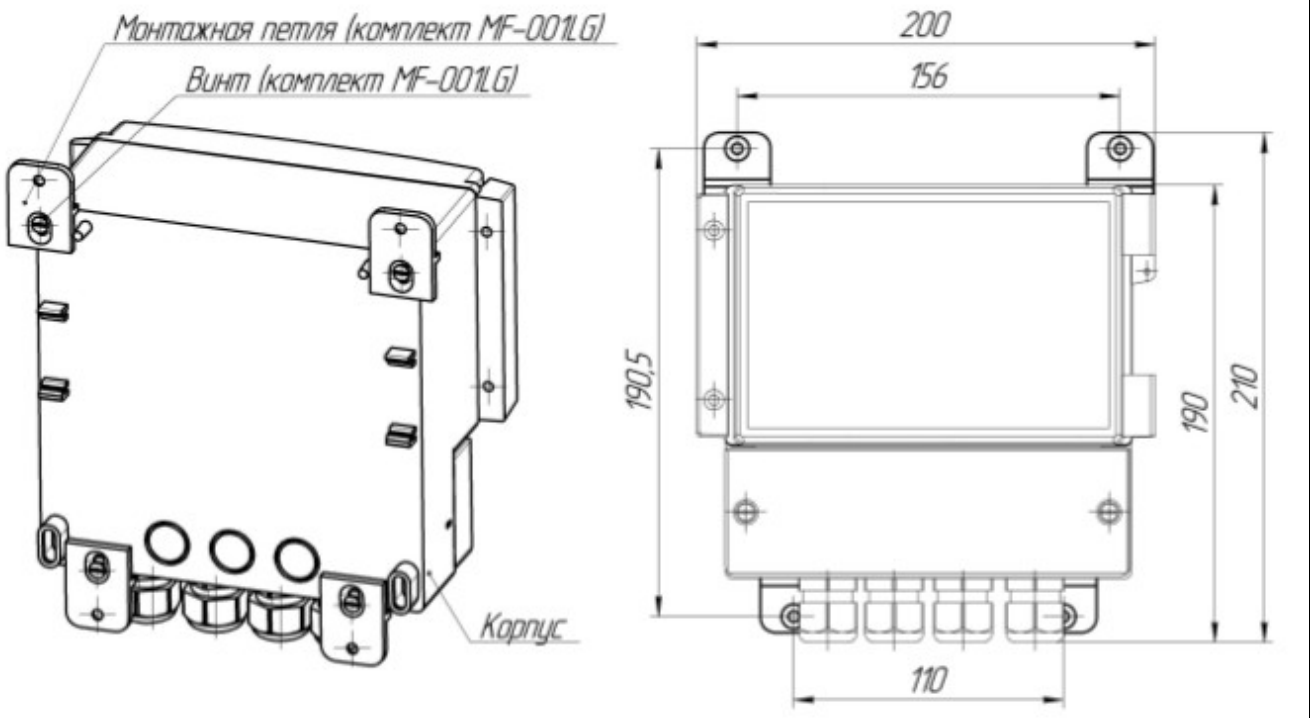
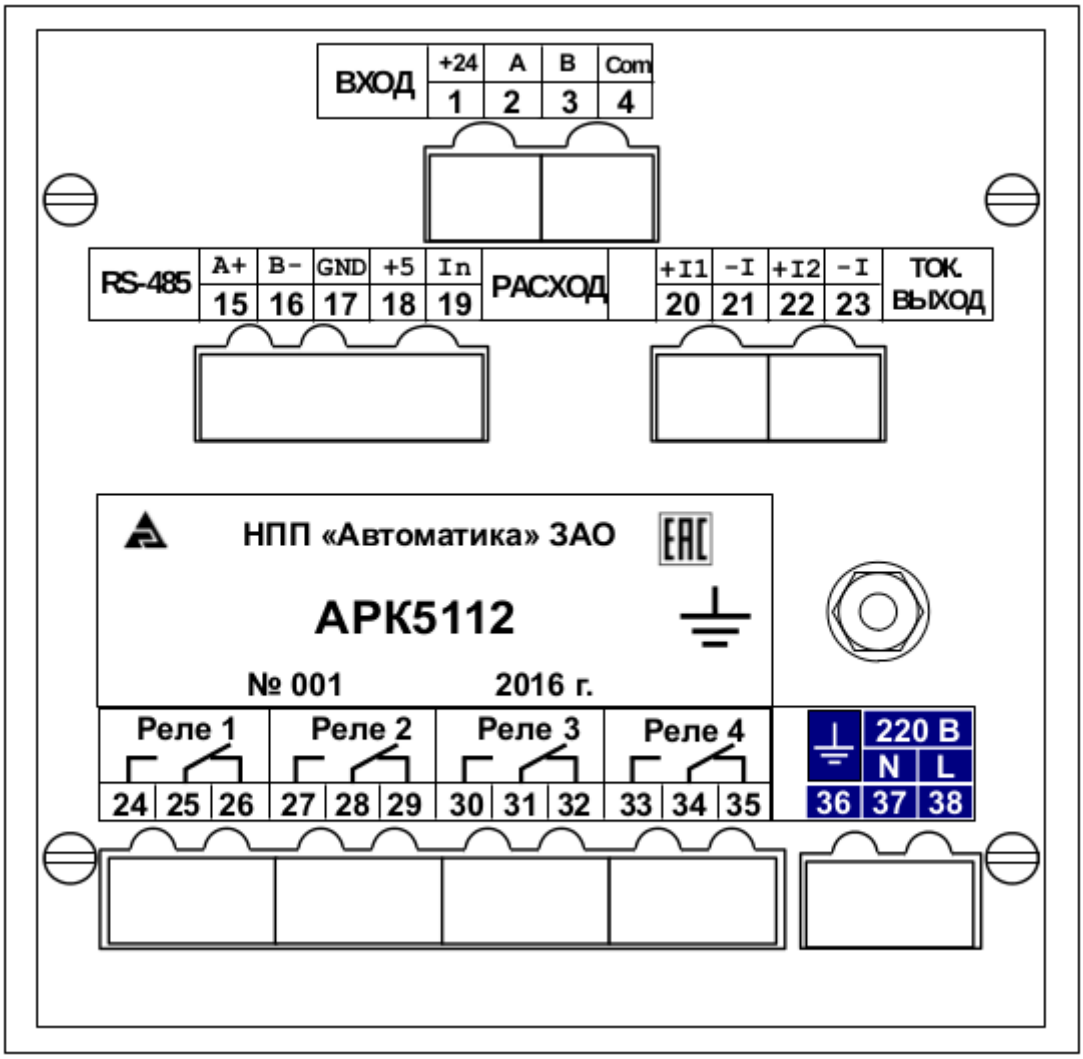
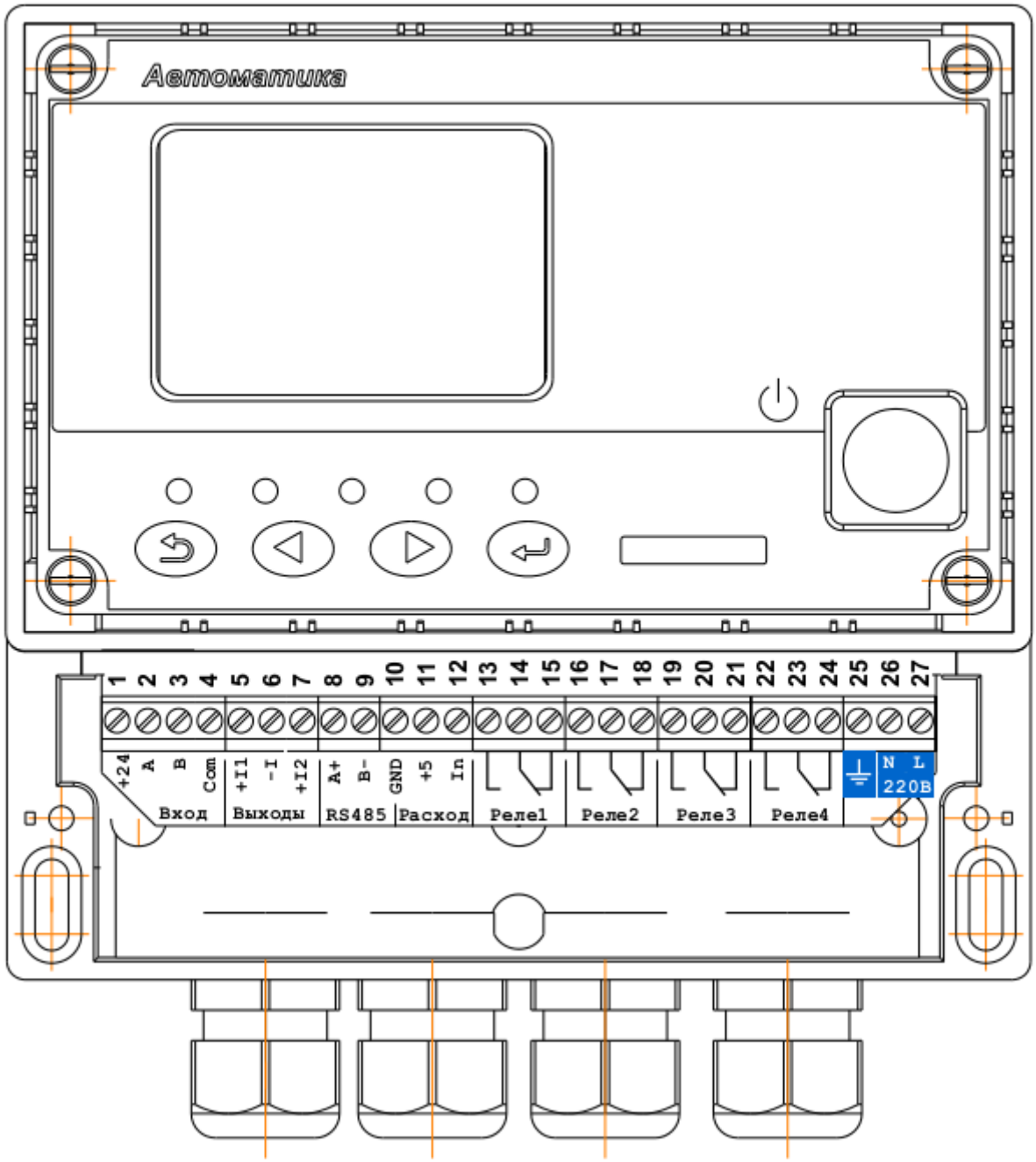


Figure A.4 - Fixing a wall mounting measuring device using mounting tabs

Annex B
Measuring device back panel view



Wall mounting analyzer front panel view



Annex C
External connection diagrams

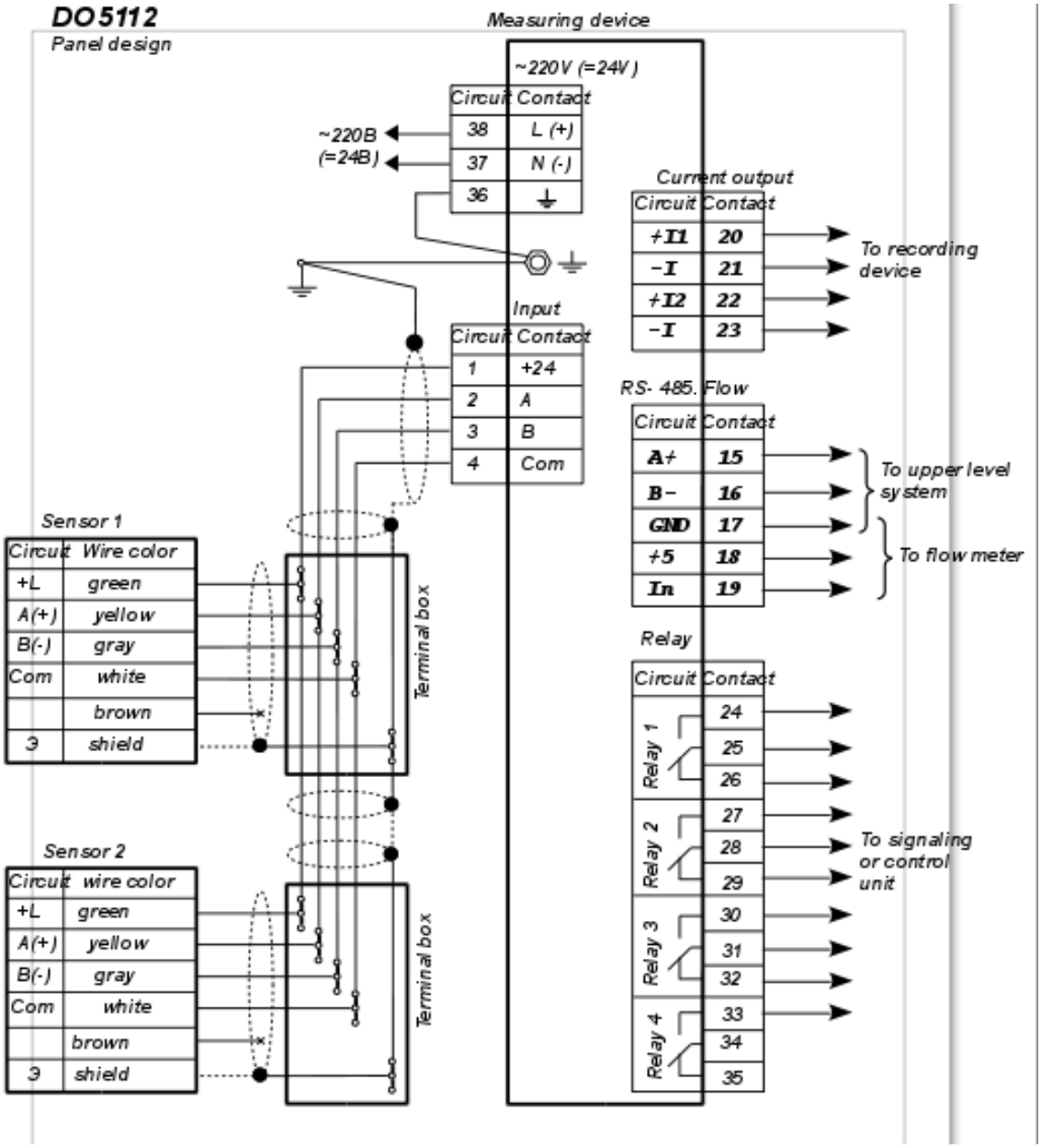


Figure C.1 – Dissolved oxygen light detectors connection diagram
to the panel mounting measuring device

Note
1 Contact 17 is a general one for interface RS-485 and flow sensor connection and therefore displayed twice.

Continuation of Appendix C

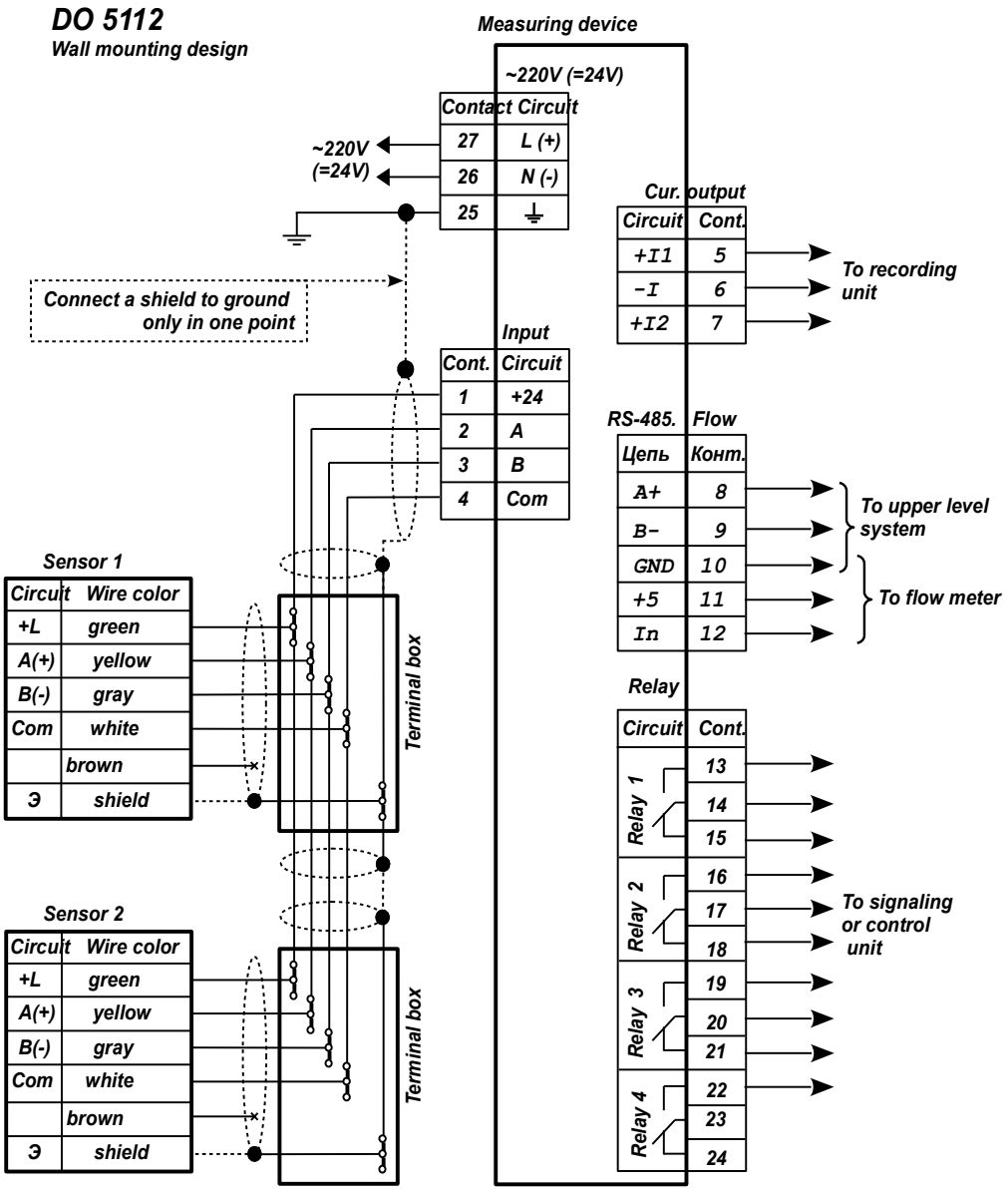
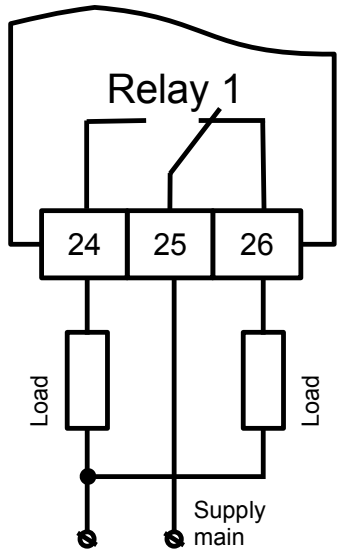
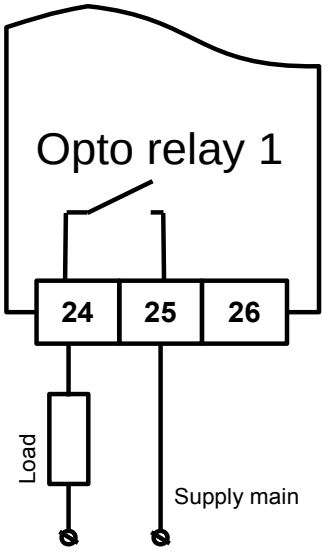


Figure C.2 - Dissolved oxygen light detectors connection diagram to the wall mounting measuring device

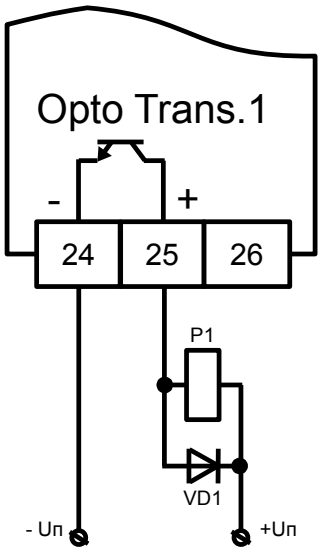
Continuation of Appendix C



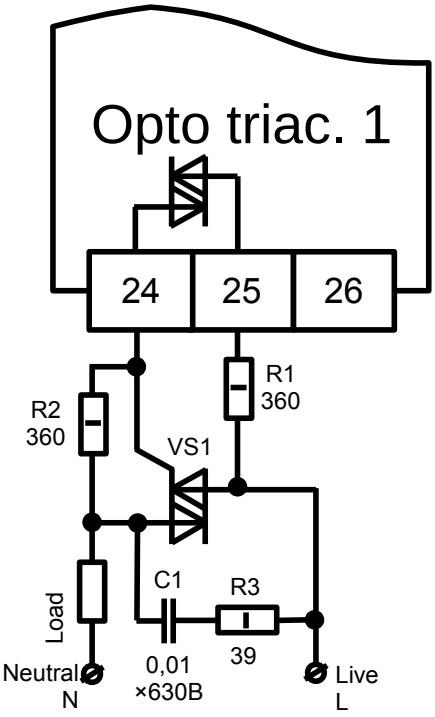
а) Load connection example to the electromagnetic relay contacts



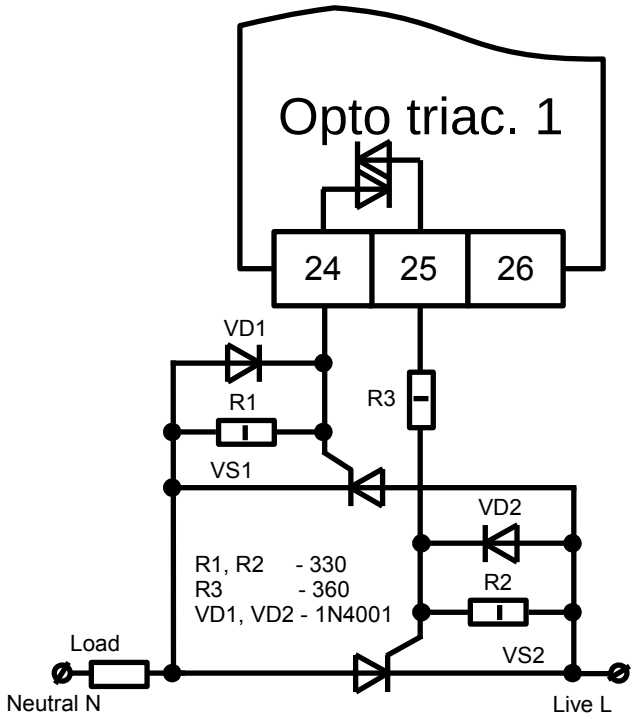
б) Load connection example to the solid state relay contacts



в) Relay P1 connection example to the transistortd optocoupler contacts



г) Triac optocoupler contacts connection example into the control loop powerful triac VS1



д) Triac optocoupler contacts connection example into the control loop with a pair of counter-parallel-connected thyristors VS1, VS2

Figure C.3 - Examples of connection to the panel mounting measuring device discrete outputs

End of Annex C

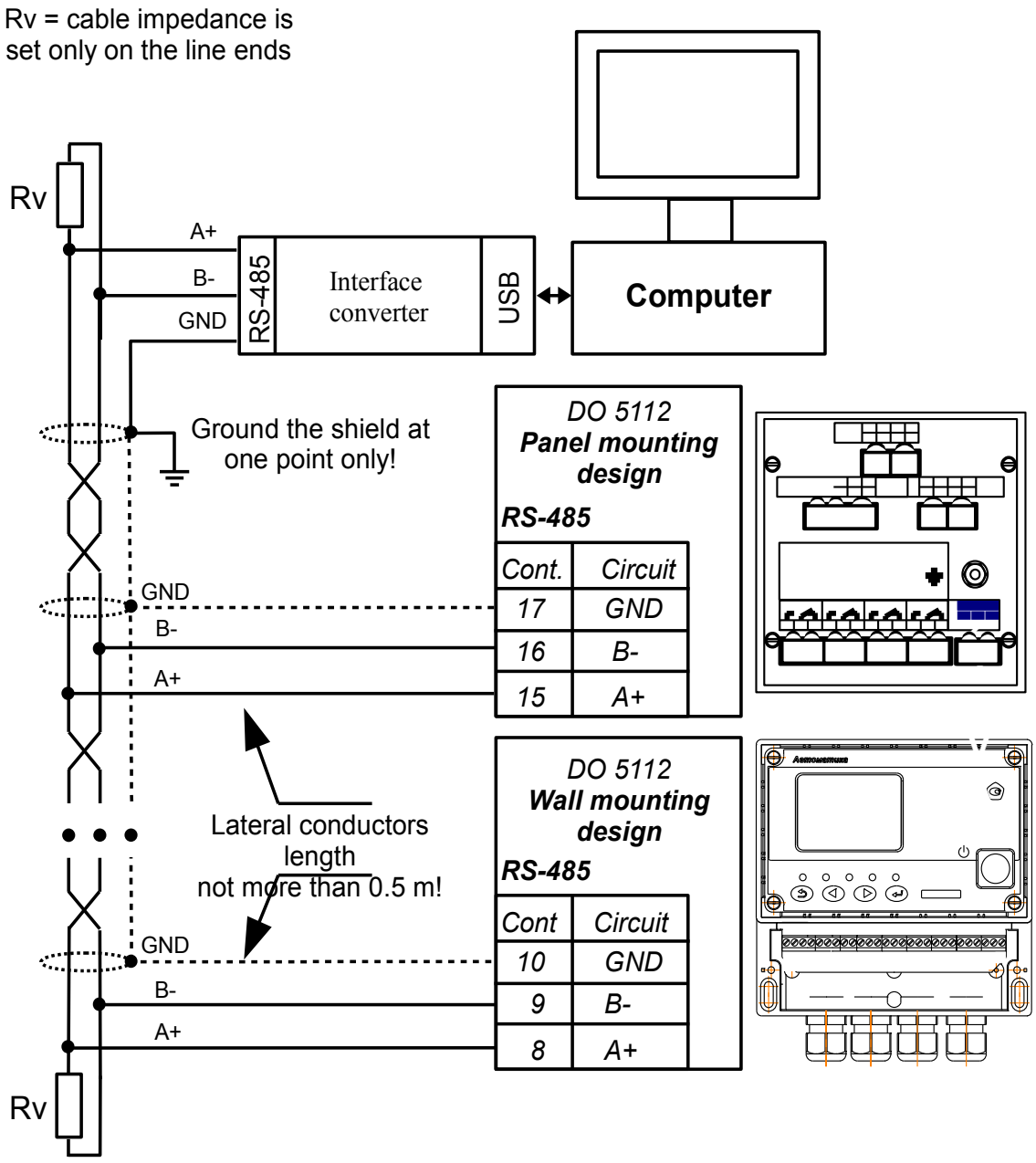


Figure C.4 - Switching-on the devices with interface RS-485 into the local network

Annex D
Analyzer calibration

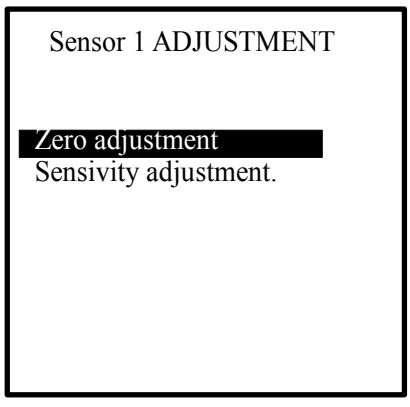
Calibration of the analyzer should be performed in the following cases:
- after routine repairs,
- after cleaning of electrodes;
- in compliance with the calibration interval in 1 year after the last test.

Sensitivity calibration is performed by the air oxygen, saturated with water vapor.
The sensitivity calibration is performed the sensor zero adjustment.
The zero calibration is done by the zero solution, after sensitivity calibration.
The key assignment in the calibration mode (its designation is displayed in the calibration window):

- Exit - backtracking to the last window;
- Adjustment - sensor calibration;
- **Save** - mode exit of the current measurement of the calibrated parameter with the measured values storage for the next calculations in the nonvolatile memory.

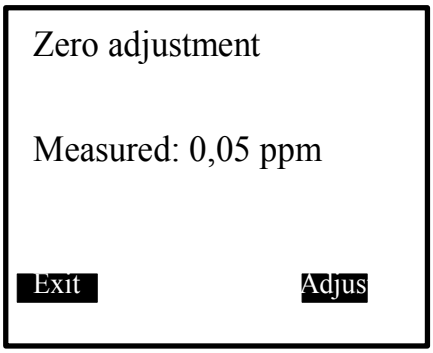
Zero adjustment

Prepare a control solution with "zero" oxygen content. For this purpose dissolve 80 g of sodium sulfurous anhydrous in 400 ml of distilled water.
Withstand the solution for 4 hours.
Place the sensor in the zero solution.
Press **я-key** to move to the menu analyzer sensor 1 zero adjustment,
Press **ч-key** to move to the menu analyzer sensor 2 zero adjustment.
At this time an adjustment window appears on the display; see figure:

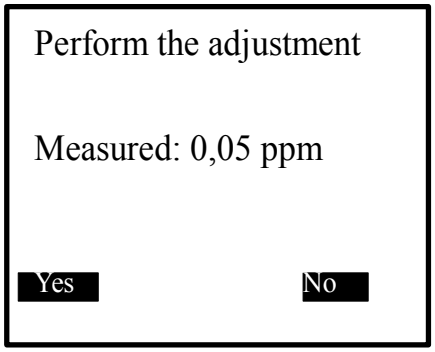


Select «Zero adjustment» and press key (**}**).

At this time a calibration window appears on the display; see figure:

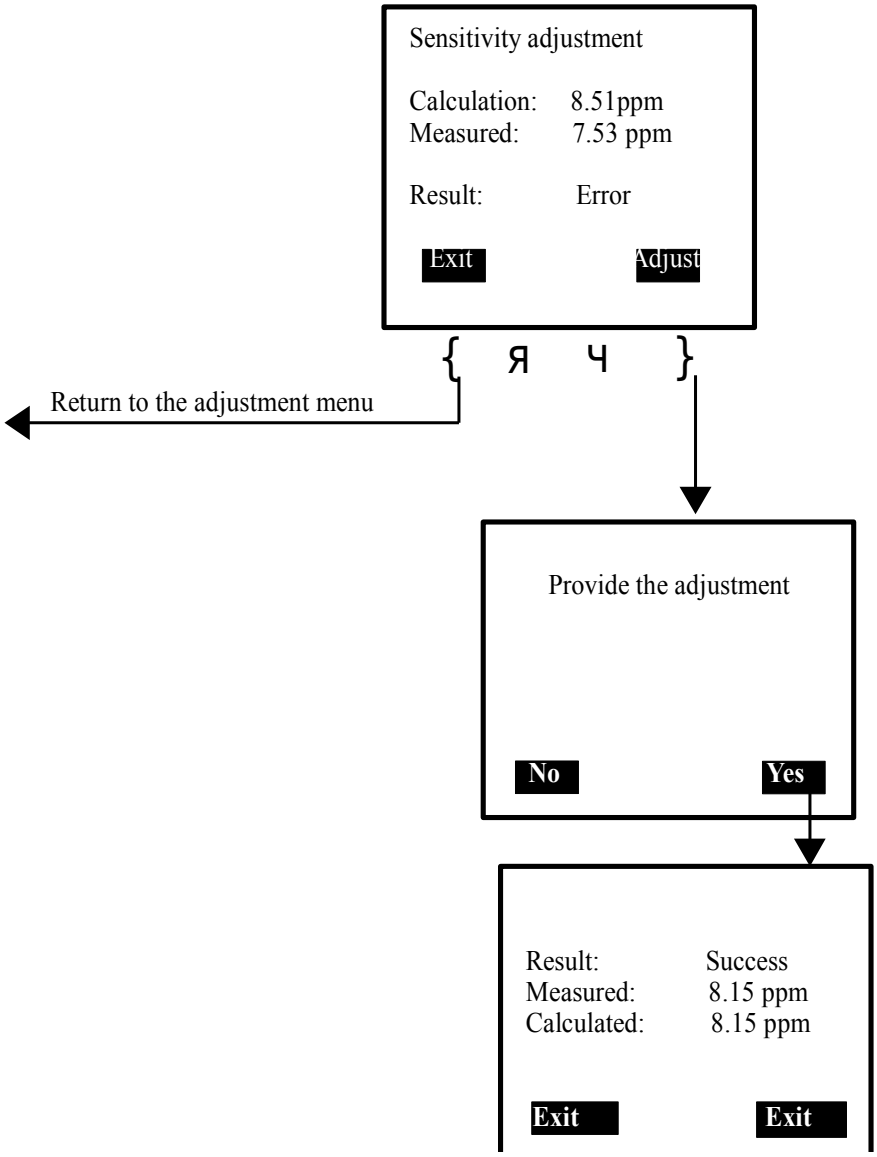


To move to the calibration menu press key Adjust.



where:
«Measured: 0,05 ppm" — analyzer reading in the «zero» solution;
After reaching a stable reading, perform the zero correction by pressing the key Yes .
To exit the calibration without saving the changes, press the button Exit (**{**).

Analyzer slope calibration (sensitivity)
To calibrate the slope of analyzer, use the air oxygen saturated with water vapor, the sensor is placed in the air above the water.
Press the button **я** to move to the analyzer slope calibration menu, at this time the previous calibration window will appear on the display.
Move to the mode «Sensitivity adjustment», pressing the buttons (**ч**) and (**}**).
The window «Sensitivity adjustment» displays:



The message "Result: Success" means that the sensor sensitivity parameter is switched to a new value.

The message "Result: Error" means that the adjustment is not performed and the sensor saves the previous sensitivity value.

The message "Adjustment is not provided" means that the parameter is switched to the default value (factory sensitivity setting).

Annex E

Oxygen equilibrium concentration values by the water saturation with air at 760 mm Hg, depending on the temperature, mg / dm3.

°C	мг/л	°C	мг/л	°C	мг/л	°C	мг/л	°C	мг/л	°C	мг/л
0	14,62	8,5	11,73	17,0	9,74	25,5	8,30	34,0	7,20	42,5	6,35
0,5	14,43	9,0	11,59	17,5	9,64	26,0	8,22	34,5	7,15	43,0	6,30
1,0	14,234	9,5	11,56	18,0	9,54	26,5	8,15	35,0	7,10	43,5	6,25
1,5	14,03	10,0	11,33	18,5	9,44	27,0	8,08	35,5	7,05	44,0	6,20
2,0	13,84	10,5	11,21	19,0	9,35	27,5	8,00	36,0	7,00	44,5	6,15
2,5	13,65	11,0	11,08	19,5	9,26	28,0	7,92	36,5	6,95	45,0	6,10
3,0	13,48	11,5	10,96	20,0	9,17	28,5	7,85	37,0	6,90	45,5	6,05
3,5	13,31	12,0	10,83	20,5	9,08	29,0	7,77	37,5	6,85	46,0	6,00
4,0	13,13	12,5	10,72	21,0	8,99	29,5	7,70	38,0	6,80	46,5	5,95
4,5	12,97	13,0	10,60	21,5	8,91	30,0	7,63	38,5	6,75	47,0	5,90
5,0	12,80	13,5	10,49	22,0	8,83	30,5	7,57	39,0	6,70	47,5	5,85
5,5	12,64	14,0	10,37	22,5	8,76	31,0	7,50	39,5	6,65	48,0	5,80
6,0	12,48	14,5	10,26	23,0	8,68	31,5	7,45	40,0	6,60	48,5	5,75
6,5	12,33	15,0	10,15	23,5	8,61	32,0	7,40	40,5	6,55	49,0	5,70
7,0	12,17	15,5	10,05	24,0	8,53	32,5	7,35	41,0	6,50	49,5	5,65
7,5	12,02	16,0	9,95	24,5	8,46	33,0	7,30	41,5	6,45	50,0	5,60
8,0	11,87	16,5	9,84	25,0	8,38	33,5	7,25	42,0	6,40	-	-

Annex F
Options for sealing the analyzer case

Sheets of registration changes

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