Scientific Production Company “Doza”

WIDE RANGE GAMMA AREA MONITOR
DBG-S11D

User manual
FVKM.412113.042RE

Content

This User Manual contains information on design, principle of operation, characteristics of the product and instructions essential for correct and safe use of this product (intended use, maintenance, servicing, storage and transportation), as well as information regarding the utilization of the product.

1 DESCRIPTION AND OPERATION OF THE PRODUCT

1.1 Product functionality

Wide range gamma area monitor DBG-S11D are designed for continuous measurement of ambient dose equivalent rate of gamma radiation (hereinafter – ADER).

Dosimeters are used for radiation monitoring at industrial facilities, nuclear plants, and enterprises for radioactive waste conditioning and management and nearby areas.

Dosimeters can be used as standalone units or as part of a systems, complexes and installations for radiation monitoring.

Dosimeters are available in three modifications, which differ by measurement range and dimensions.

1.2 Technical characteristics

1.2.1 Energy range of measured gamma radiation ……..…… 0.05 to 3.0 MeV.

1.2.2 Measurement range of the ADER of gamma radiation:

- basic modification ……..…..…… 0.1 μSv·h^{-1} to 10 mSv·h^{-1};
- modification 01 …… 0.1 μSv·h^{-1} to 10 Sv·h^{-1};
- modification 02 ……..…… 0.1 μSv·h^{-1} to 100 Sv·h^{-1}.

1.2.3 Limits of the permissible basic relative measurement error of ADER of gamma radiation:

- in the range 0.1 μSv·h^{-1} to 1 μSv·h^{-1} ……..…… ± (15+1/H) %;
- where H is a dimensionless quantity numerically equal to the measured value of the ADER of gamma radiation expressed in μSv·h^{-1}
- in the range 1 μSv·h^{-1} to 10 Sv·h^{-1} ……..…… ±15 %;
- in the range 10 μSv·h^{-1} to 100 Sv·h^{-1} ……..…… ±20 %.

1.2.4 Energy dependence of sensitivity of dosimeters relative to ^{137}Cs (662 keV) …..… ±25 %.

1.2.5 Dosimeter warm-up time …… 1 min.

1.2.6 Continuous operation without limitation of number of turning on/off …..…… 24 hours.

1.2.7 Instability during 24 hours of continuous operation relative to the mean value of readings for this period ……..…… ±10 %.

1.2.8 Dosimeters are capable to transfer current value of measured quantity, estimation of its statistical uncertainty and self-diagnostics data to the external information network in accordance with the DiBUS protocol using the interfaces RS-485, USB.

Description of data exchange registers of the DiBUS protocol is given in Appendix E.

1.2.9 Power supply voltage ……..……..…… 12^{+6}_{-3} V.

1.2.10 Current consumption at voltage 12 V ..……..……..……..…….. 50 mA.

1.2.11 Operating conditions:

- operating temperature …… minus 60 to +80 °C;
- relative humidity ……..……..……..…… 98 % at +35 °C;
- atmospheric pressure ……...……..… 84.0 to 106.7 kPa;
- content of the corrosive agents in the ambient air corresponds to the values in Table 1.1.

Table 1.1

Type of atmosphere		Content of the corrosive agents
Designation	Designation	
I	Relatively clean	Sulfur dioxide gas not more than 20 mg/(m^2·day) (not more than 0.025 mg/m^3); Chlorides not more than 0.3 mg/(m^2·day)
II	Industrial	Sulfur dioxide gas not more than 20 to 250 mg/(m^2·day) (not more than 0.025 to 0.31 mg/m^3); Chlorides not more than 0.3 mg/(m^2·day)
III	Maritime	Sulfur dioxide gas not more than 20 mg/(m^2·day) (not more than 0.025 mg/m^3); Chlorides – 30 to 300 mg/(m^2·day).

1.2.12 Limits of complementary error of the ADER of gamma radiation:

- due to deviation of temperature from normal value to the limiting values of operation conditions ……..…….…… ±10 %;
- due to increasing of relative humidity up to 98 % at +35 °C …….…… ±10 %.

1.2.13 Dosimeters withstand short (with duration up to 5 minute) overload of gamma radiation with the following ADER:

- basic modification ……..…… 0.1 $Sv \cdot h^{-1}$;
- modification 01 …… 100 $Sv \cdot h^{-1}$;
- modification 02 …… 200 $Sv \cdot h^{-1}$.

1.2.14 Radiation durability of dosimeters:

- at ADER of gamma radiation less than 10 $mSv \cdot h^{-1}$ ……..…… not less than 30 Sv;
- at ADER of gamma radiation higher than 10 $mSv \cdot h^{-1}$ ……..…… not less than $1 \cdot 10^4$ Sv.

1.2.15 Dosimeters withstand sinusoidal vibrations in the frequency range from 1 to 120 Hz: with displacement amplitude of 1 mm within the range 1 to 13 Hz or with 1 g acceleration within the range 13 to 120 Hz.

Limits of complementary error of the ADER of gamma radiation under influence of vibration ……..……..……..…… ±10 %.

1.2.16 Dosimeters are stable against seismic impacts with magnitude 9 according to the MSK-64 scale, being installed on the building structures of the industrial site at 70 to 30 m relative to the grade level.

1.2.17 Dosimeters withstands the impact of falling aircraft (IFA) and the air blast (AB) with parameters corresponding to the broadband random vibration.

1.2.18 Degree of protection provided by dosimeter's casings against ingress of solid items and water ……..…… IP68.

1.2.19 Dosimeters are stable against electromagnetic interference of grade 3 according to IEC 1000-4-8-93, IEC 1000-4-9-93, IEC 61000-4-2-2008, IEC 61000-4-3:2006, IEC 61000-4-4:2004, IEC 61000-4-5-95, IEC 61000-4-6-96, IEC 61000-4-12-95 meet the requirements of interference emission stated in IEC 22-2006 for Class A equipment.

1.2.20 Dosimeters' protection against electric shock complies with IEC 61010-1:2001.

1.2.21 Dosimeters are fire-safe devices with the probability of causing fire less than 10^{-6} $year^{-1}$.

1.2.22 Dosimeters withstand the exposure to decontaminating solutions:

1) paint coatings: № 1 caustic soda (NaOH) – 50 g/L, potassium permanganate ($KMnO_4$) – 5 g/L;

2) units and blocks of stainless steel and glass: № 2 oxalic acid ($H_2C_2O_4$) – 10 ÷ 30 g/L, nitric acid (HNO_3) – 1 g/L;

3) connectors and contacts: № 3 5 % citric acid solution in ethanol C_2H_5OH (density 96 %).

1.2.23 Weight of the dosimeter:
- basic modification ……..……...…… 0.65 kg;
- modification 01 ……..……...…… 0.70 kg;
- modification 02 ……..……...…… 0.70 kg;
- mount ……..……. 2,24 kg.

1.2.24 Overall dimensions of the dosimeter, not more than:
- basic modification ……..…… Ø68×141 mm;
- modification 01 ……..…… Ø68×179 mm;
- modification 02 ……..…… Ø68×179 mm;
- mount ……..……..……..……. 200×122×117 mm.

1.2.25 Length of communication cable up to:
- RS-485 interface ……..……...…… 1200 m;
- USB interface ..……..……...…… 5 m.

1.2.26 Mean time to failure ……..……..…… not less than 30 000 hours.

1.2.27 Mean life time ……..…… not less than 5 years.

1.3 Configuration

1.3.1 Dosimeter is a complete unit, both functionally and structurally, placed inside an aluminum alloy case.

1.4 Design and operation

1.4.1 Dosimeter is comprised of two monoblocks, control board and interface board.

Outline drawing are presented in the Appendix A.

1.4.1.1 The monoblock includes Geiger counter, high voltage board and signal conditioner. The monoblock is place inside plastic case and is filled with protective compound. The basic modification of the dosimeter uses two monoblocks with counters Beta-4; the modification 01 uses one monoblock with counter Beta-4 and another one – with counter Gamma-1-1; the modification 02 uses one monoblock with counter Beta-4 and another one – with counter Gamma-2-1.

In the dosimeters of basic modification and modifications 01 and 02, monoblocks with counters Beta-4, Gamma-1-1 and Gamma-2-1 as described above comprise the first and the second measurement channels, accordingly. In basic modification there is no switching between channels; in modification 01 switching between channels is performed automatically at ADER equal to 10 $mSv \cdot h^{-1}$; in modification 02 automatic switching occurs at ADER equal to 30 $mSv \cdot h^{-1}$.

1.4.1.2 The control board receives signals from monoblocks, controls power supply of monoblocks, calculates the value of ADER of gamma radiation and performs testing of monoblocks.

To control board controls two parameters to test the monoblocks' operability. The parameters are presented as potentials: one of them is responsible for the potential of counters, the other - for counters' current consumption. If these parameters fall outside the preset range, the control board considers correspondent monoblock as faulty and switches it off.

1.4.1.3 The interface board is intended for data exchange using RS-485 and USB interfaces.

1.4.2 Dosimeter performs processing of data received from monoblocks, testing of their state and control.

Processing of measurement information is carried out by converting arithmetic average of the number of pulses to ADER of gamma radiation $\dot{H}^*(10)$ by the formula

$$\dot{H}^*(10) = \frac{N - T \cdot K_f}{T - N \cdot K_t} \cdot K \qquad (1.1)$$

where N is the total number of pulses received during the current measurement cycle;

T is the duration of the current measurement cycle;

K_f is the intrinsic background of monoblock's detector, cps;

K_t is the dead time, s;

K is the conversion factor.

Factors K_f, K_t and K are set for each measurement channel.

1.4.3 Data exchange with dosimeter is carried out using the DiBUS protocol. The physical medium for data transfer can be represented by RS-485 or USB lines. Selection of RS-485 or USB line is performed automatically after switching the dosimeter on. In case RS-485 is used for data exchange, the module is successively scans those lines until it detects a broadcast or personal inquiring from the device with address 01.01.01 ("master"). The dosimeter further uses this line during the entire working period. Changing the line during the working period is not possible. After a restart due to power failure or other reasons, the dosimeter performs a new search of communication line until the currently active line is found. Simultaneous use of two or three communication lines is not possible.

1.4.4 Dosimeter performs mathematical processing of both individual monoblock data and joint data, thus forming the measurement result. Dosimeter analyzes statistical parameters of the received sequence of pulses; when a deviation of the last measurement (or moving group of measurements) from the previous statistics is detected, the restart of measurement channel is performs. This method is optimal for the current monitoring tasks.

The resulting value is calculated as the weighted average of two samples with a single expectation in case the channels's identifiers are identical. In this case, the statistical error of the calculated value is less than errors for separate measurement channels.

1.5 Marking and sealing

1.5.1 The following information is presented at the dosimeter’s case:

- trademark and name of the manufacturer;
- reference designation of the dosimeter;
- works number of a dosimeter according to the manufacturer's system of numeration;
- degree of ingress protection IP;
- made in Russia.

1.5.2 Location and method of marking and font size correspond to the design documentation.

1.5.3 Dosimeters are sealed in accordance with the design documentation.

1.6 Packing

1.6.1 Dosimeters package complies with the design documentation and provides protection against ingress of atmospheric precipitations and aerosols, splashes of water, dust, sand, solar ultra-violet radiation and limits the ingress of water vapor and gases.

2 INTENDED USE

2.1 Operational limitations

2.1.1 Dosimeters can be used with devices that have the appropriate communication interfaces and provide DC power supply to dosimeters.

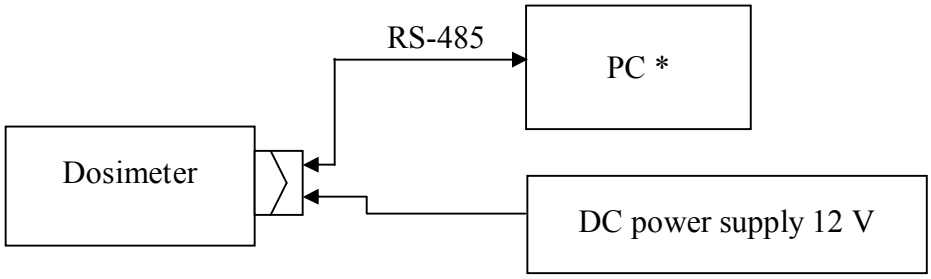
2.1.2 The following is not allowed:

- use of dosimeters in electrical substations of medium (6 – 35 kV) and high (above 35 kV) voltage;
- use of the dosimeter as parts of high power electrical installations;
- placing mobile phone at a distance of less than 10 m from the dosimeter.

2.2 Preparation of the product for use

2.2.1 Connect dosimeter to PC using the communication cable as shown in Figure 2.1 or 2.2, depending on the interface used.

Output connector pin assignment is presented in Appendix B, the wiring diagram is presented in Appendix C.



* - If necessary, use the interface converter RS-485/RS-232.

Figure 2.1 – Wiring diagram (RS-485)

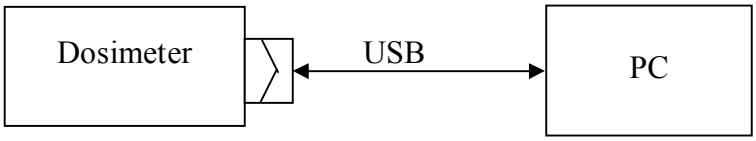


Figure 2.2 - Wiring diagram (USB)

2.2.2 Run the "DWPTest" software on PC with the instrument description file "dbg-s11d common.rst" according to "DWPTest" software user manual (see Appendix E) and make sure that the software has read parameters of the dosimeter.

The software allows communicating with a dosimeter in two modes:

- the first mode (operational) – sending requests to connected dosimeter and receiving replies in automatic mode; in this mode, the operator cannot enter data from PC;
- the second mode (setting, calibration, adjusting): this mode allows authorized user to enter in the dosimeter certain data, setup coefficients and constant parameters.

To work in this mode, the user is supplied with the instrument description file "dbg-s11d calibrator.rst", providing the access to enter necessary information, which also serves as the access key for the authorized user.

2.3 Use of the product

2.3.1 Dosimeter performs detection of gamma radiation and calculation of ADER in automatic mode. During operation the dosimeter does not require any servicing.

2.3.2 Measurements and self-test data (status variables of the dosimeter) are transferred to external data exchange channel on request and displayed in the information field of the "DWPTest" software.

2.4 Adjustment

2.4.1 When the dosimeter needs adjusting, prepare it for use in accordance with 2.2.

2.4.2 Adjust the conversion factor and dead time as described in Appendix E.

3 MAINTENANCE

3.1 General notes

3.1.1 Maintenance is performed with the purpose of ensuring reliable, long-term operation of dosimeters.

3.1.2 No special requirements are established for the personnel qualification and workplaces arrangement.

3.2 Safety precautions

3.2.1 Before beginning to work with dosimeters familiarize yourself with this User Manual.

3.2.2 Follow occupational and radiation safety requirements of current safety instructions in the company (enterprise) during all operations with the dosimeters.

3.2.3 It is recommended to perform all connections and disconnections of communication cable when power is off. When a dosimeter is used as part of measuring systems or installations, "hot" connections and disconnections of communication cable are allowed, i.e. without shutting down the system.

3.3 Maintenance routine

3.3.1 Maintenance is divided into routine and periodic.

3.3.2 Routine maintenance

3.3.2.1 Routine maintenance is carried out during regular operation; it includes inspections of the dosimeters for timely detection and elimination of factors which can compromise their operability and safety.

3.3.2.2 The following main types and periodicity of routine maintenance are recommended:

- visual inspection ……..…….…… every month;
- cleaning of external surfaces (decontamination) ……..…… every year.

3.3.2.3 During visual inspection cables, connectors and fixings are checked.

3.3.2.4 Decontamination of dosimeters is performed in accordance with work schedule at the company (facility), but at least once a year in the following order:

- external surfaces of dosimeters are decontaminated using solutions 1) and 2) of 1.2.22; after cleaning surfaces using cloth moisten with decontaminating solution it is necessary to wipe surfaces using cloth moisten with distilled water and then dry using filter paper;
- cable connectors are to be decontaminated using solution 3) of 1.2.22, the norm of solution consumption is 10 ml per dosimeter, no additional treatment with distilled water and drying with filter paper is required.

Dry cleaning can be performed with any periodicity.

Disconnect from power supply before starting decontamination.

3.3.3 Periodic maintenance

Periodic maintenance consists of calibration of dosimeters.

4 CALIBRATION ROUTINE

4.1 General requirements

4.1.1 Calibration of dosimeters is carried out in accordance with the requirements of IEC 61453:2007.

4.2 Preliminary arrangements

4.2.1 Operations performed during calibration, and necessary equipment, are listed in the Table 4.1.

Table 4.1 – List of calibration operations

Operation	Section
External examination	4.5.1
Testing	4.5.2
Determination of basic relative measurement error of ADER of gamma radiation	4.5.3

4.2.2 Calibration equipment used for calibration is shown in the Table 4.2.

Table 4.2 – Calibration equipment

Section	Calibration equipment, its technical characteristics, regulatory document
4.5.2, 4.5.3	National primary standard of absorbed dose and absorbed dose rate of photon and electron radiation GET 38-95. Absorbed dose rate range 10^{-3} to 10^{2} Gy/h, SD not more than $2 \cdot 10^{-3}$, residual bias not more than $4 \cdot 10^{-3}$ (P = 0.99) (conversion of the absorbed dose unit $Gy \cdot h^{-1}$ into ADER unit $Sv \cdot h^{-1}$ is performed by calculation)
4.5.2, 4.5.3	Calibration benches SPG-04-02. Measurement range $2 \cdot 10^{-5}$ to 16 $Sv \cdot h^{-1}$
4.5.2, 4.5.3	Calibration installation (gamma radiation) UPGD-2M-D. Range of ADER $5 \cdot 10^{-7}$ to $5 \cdot 10^{-2}$ $Sv \cdot h^{-1}$, error ±5 %
4.5.2, 4.5.3	PC with a set of technical means necessary to use appropriate interface, with installed "DWPTest" software
4.5.2, 4.5.3	Programmable DC Power Supply, type PSM-3004. Output voltage 0-15 V; 0-30 V. Output current 0-7 A; 0-4 A
4.5.2, 4.5.3	Stopwatch with measurement range 1 to 3600 seconds
4.5.2, 4.5.3	Thermometer with measurement range 0 to 30 °C and scale interval 0.1 °C
4.5.2, 4.5.3	Psychrometer with measurement range 20 to 90 %, error ±6 %
4.5.2, 4.5.3	Barometer with measurement range 60 to 120 kPa and scale interval 1 kPa
Note - It is allowed to use other tools and equipment with similar characteristics ensuring determination of metrological characteristics of detectors with required precision.	

4.3 Safety precautions

It is necessary to follow safety requirements described in section 3.2 and in documentation accompanying calibration tools and equipment.

4.4 Conditions

4.4.1 Calibration should be carried out under the following conditions:

- air temperature ……..……..……. +(20 ±5) °C;
- relative air humidity ……..……...……..…..…..… from 30 to 80 %;
- atmospheric pressure ……..…… 86.0 to 106.7 kPa;
- natural background of gamma radiation ……..… not more than 0.15 $\mu Sv \cdot h^{-1}$.

4.5 Procedure

4.5.1 External examination

The items to be checked during external examination:

- proper completeness;
- absence of defects which could affect dosimeter operation.

4.5.2 Testing

4.5.2.1 To test the dosimeter:

- connect the dosimeter to PC as shown in Figure 2.1 or Figure 2.2;
- check operability of dosimeter.

4.5.2.2 To test the operability of dosimeter, run "DWPTest" software on PC and make sure that status parameters and ADER value are read from the dosimeter as shown in the Figure 4.1.

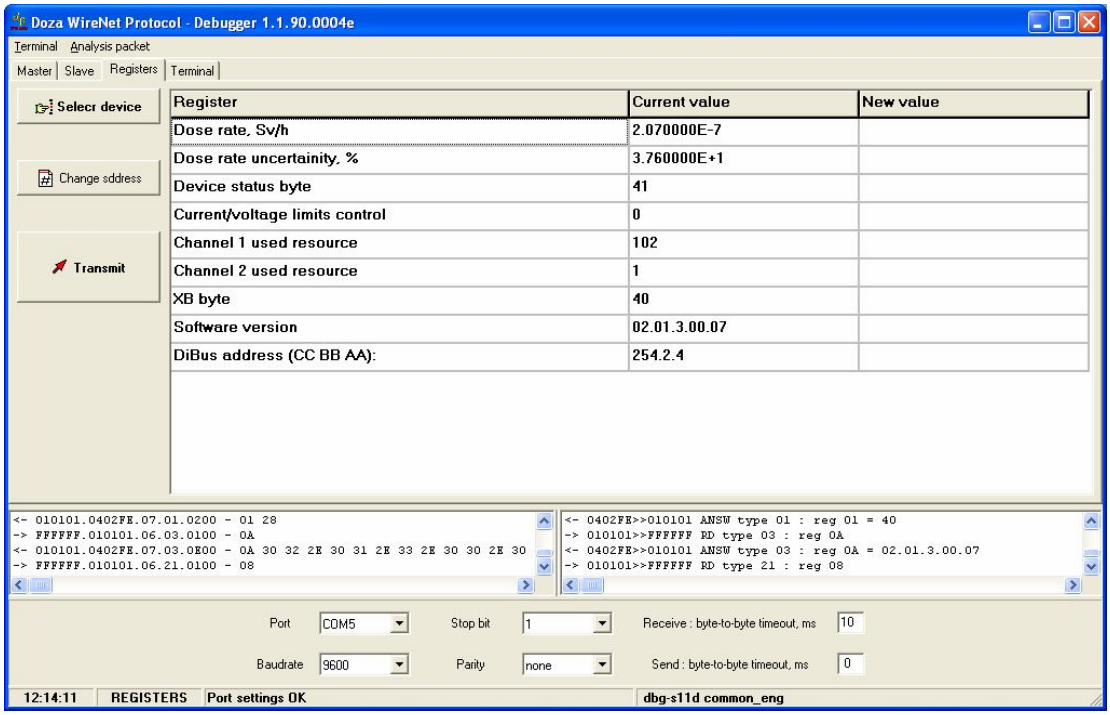


Figure 4.1

The dosimeter's operability is confirmed by the presence of measured values "Dose rate" in the window "Register" of the "DWPTest" software.

4.5.3 Determination of basic relative measurement error of ADER of gamma radiation

4.5.3.1 The basic relative measurement error shall be determined at ADER of gamma radiation in the range:

- first point – 10 to 100 μSv·h^{-1};
- second point – 1 to 10 mSv·h^{-1};
- third point – 10 to 100 mSv·h^{-1};
- fourth point – 4 to 10 Sv·h^{-1};
- fifth point – 80 to 100 Sv·h^{-1}

The first and second calibration points are used for calibration of the basic modification of dosimeters and the first measurement channel of modifications 01 and 02; the third and the fourth points are used for calibration of the second measurement channel of the modification 01; the fourth and the fifth points are used for calibration of the second measurement channel of the modification 02. Before calibrating dosimeters of modifications 01 and 02, switch to the first measurement channel manually.

The primary calibration of dosimeter modification 01 at ADER of gamma radiation in the range of 4 to 10 Sv·h^{-1} and of dosimeter modification 02 at ADER in the range of 80 to 100 Sv·h^{-1} shall be performed using national primary standard of absorbed dose and absorbed dose rate of photon and electron radiation GET 38-95.

Calibration of dosimeter modification 02 for operation at level of ADER of gamma radiation in the range 80 to 100 Sv·h^{-1} is not necessary.

4.5.3.2 To perform calibration, place the dosimeter in the collimated beam so that its longitudinal axis is perpendicular to the beam axis with the center of corresponding measurement channel placed at the axis of the collimated beam. The location of the effective center of measurement channel is presented in Appendix D. The distance between the effective center of measurement channel and calibration unit collimator is chosen to provide the desired value of ADER of gamma radiation.

4.5.3.3 Determine the measured value of ADER of gamma radiation in each point as the mean of five measurements with an interval of 100 s.

4.5.3.4 Calculate the measurement error of ADER of gamma radiation δ, in percent, by the formula

$$\delta = 1{,}1 \cdot \sqrt{\left(\frac{\dot{H}_0^* - \dot{H}^*}{\dot{H}_0^*} \cdot 100 \right)^2 + (\delta_0)^2} \qquad (4.1)$$

where $\dot{H}_0^*$ is the expected ADER value produced by calibration installation;

$\dot{H}^*$ is the ADER value measured by dosimeter;

δ_0 is the error of ADER value produced by calibration installation, %, determined during its calibration.

The results of calibration are considered positive if the basic relative measurement error of ADER of gamma radiation does not exceed the limit stated in 1.2.3.

4.5.3.5 If the measurement error is outside the acceptance range, correct the conversion factor and dead time according to Appendix E and repeat steps 4.5.3.1 - 4.5.3.4.

4.5.3.5.1 For dosimeters of basic modification adjust conversion factor and dead time for both measurements channels simultaneously. When performing adjustment using "DWPTest" software set special byte to 40; this will turn both channels on and measured values in each channel will be displayed in corresponding lines of the "DWPTest" window.

After adjustment of conversion factor and dead time, repeat steps 4.5.3.1 - 4.5.3.4.

After the adjustment is complete set special byte to 168.

4.5.3.5.2 For modifications 01 and 02 of dosimeter adjust conversion factor and dead time for measurements channels in sequence. When performing adjustment using "DWPTest" software do not change special byte, which is equal to 40; this will turn both channels on and measured values in each channel will be displayed in corresponding lines of the "DWPTest" window.

For modifications 01 and 02 of dosimeter adjust the first measurement channel than the second one, follow steps in 4.5.3.1. When adjusting one measurement channel, do not pay attention to the readings in another channel.

After adjustment of conversion factor and dead time, repeat steps 4.5.3.1 - 4.5.3.4.

After the adjustment is complete it is not necessary to change the special byte 168.

Note – When calibration of dosimeter modification 02 is performed during the operation period, the dead time for the channel No. 2 does not need adjustment; its value is taken from primary calibration results.

5 ROUTINE REPAIRS

5.1 Routine repairs are limited by restoration of damaged cable.

5.2 During warranty period failed dosimeter can be repaired at the factory or replaced.

6 STORAGE

6.1 Prior to putting into operation dosimeters shall be stored in a heated warehouse with ventilation:

- in manufacturer's package – at ambient temperatures from +5 to +40 °C and relative humidity up to 80 % at +25°C;

- unpacked – at ambient temperatures from +10 to +35 °C and relative humidity up to 80 % at +25 °C;

6.2 The storage location should be free of dust, chemical vapors, aggressive gases and other substances that may cause corrosion.

The storage location shall exclude exposure of dosimeters to the direct rays of sunlight.

7 TRANSPORTATION

7.1 Dosimeters in the original manufacturer's package can be transported by all means of transport at any distance:

- transportation by railway shall be carried out in clean boxcars;
- when transported in open trucks, boxes with equipment shall be covered with waterproof material;
- when transported by air, boxes with equipment shall be placed in air-tight heated compartment;
- when transported by water and sea transport the boxes with equipment shall be placed in the hold.

7.2 Arrangement and fastening of the boxes on transport means shall provide their steady position en route; exclude displacements and striking each other.

7.3 The requirements of the inscriptions on the transport packing shall be observed during loading and unloading.

7.4 Transportation conditions:

- temperature …….…….. from minus 50 to +50 °C;
- humidity ……..……...…..…..…..… up to 98 % at +35 °C;
- sinusoidal vibrations …….. within frequency range from 10 to 55 Hz with displacement amplitude 0.35 mm

8 DISPOSAL

8.1 On full expiry of service life of the dosimeter (its component parts) as well as prior to dispatching for repair or calibration it shall be inspected for possible radioactive contamination of its surfaces. Criteria for decision making on decontamination and further use shall comply with obligatory requirements of national standards.

8.2 Decontamination shall be attempted in cases when the dosimeter surfaces contamination (including surfaces accessible during repair) can be reduced below allowable limits.

In case the radioactive contamination exceeds allowable limits, requirements set forth for the radioactive wastes become applicable to the dosimeters.

8.3 Dosimeters accepted for operation after decontamination, are subjects for repair or replacement in case of failure. Dosimeters not suitable for operation, with radioactive contamination levels below permissible limits, should be dismantled to prevent further use and transferred to a special site for disposal of industrial wastes.

8.4 Dosimeters with expired lifetime, accepted for use after decontamination, shall undergo technical inspection. If the technical condition of a dosimeter is satisfactory, an extended operation term of the product shall be determined.

Appendix A
(Reference)

OUTLINE DRAWING

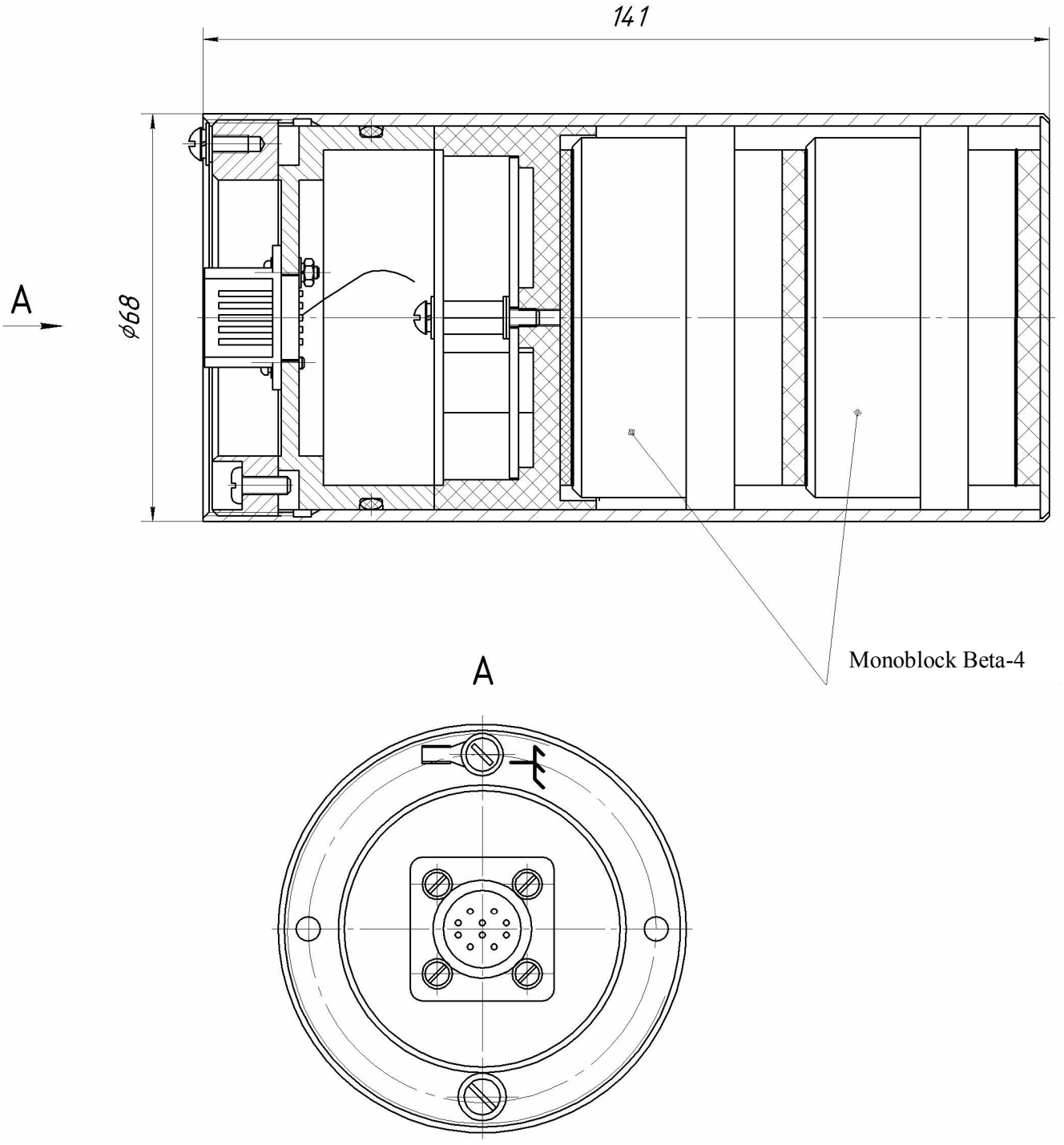


Figure A.1 - Overall and fitting dimensions (basic modification)

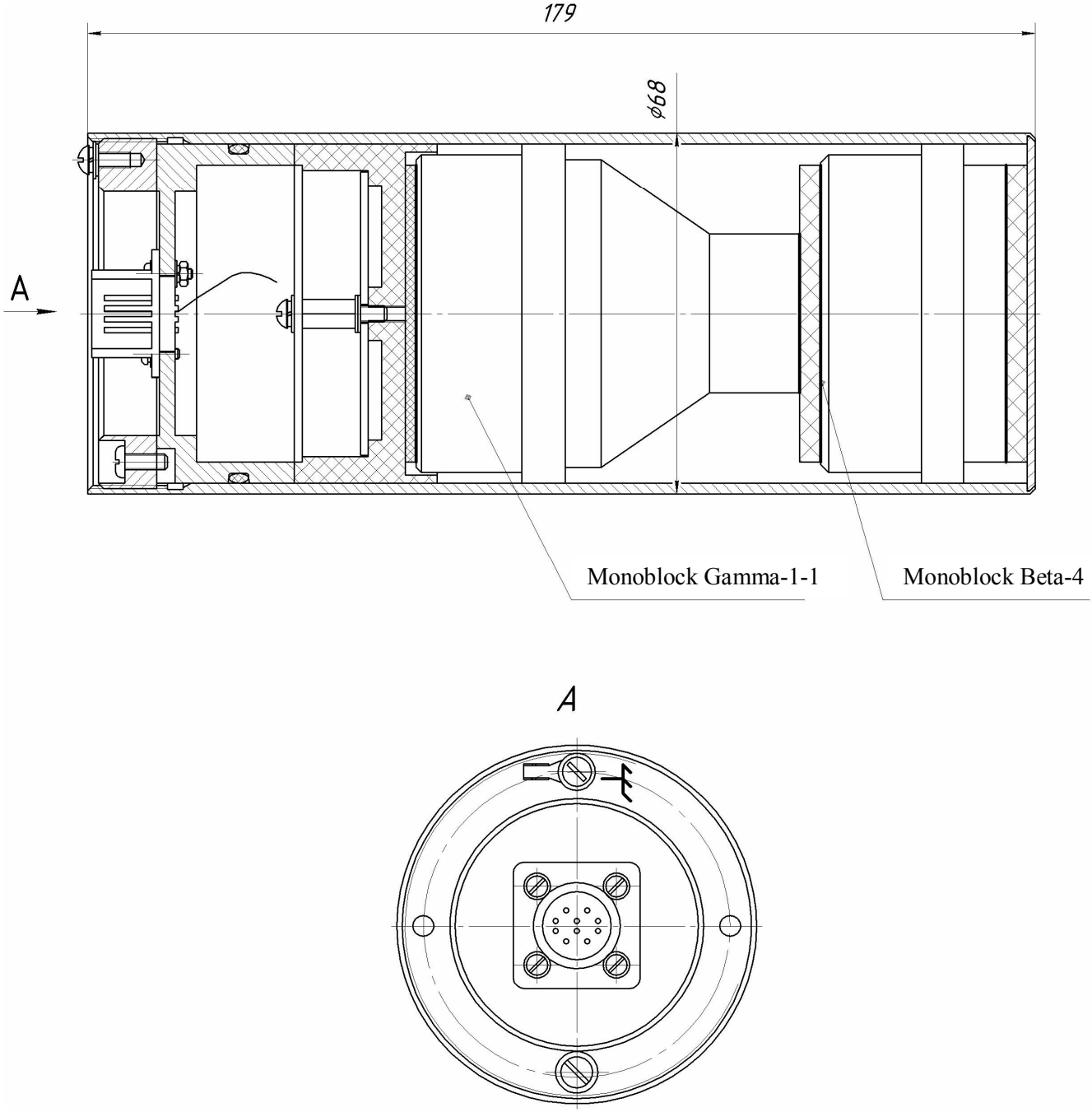


Figure A.2 - Overall and fitting dimensions (basic modification 01)

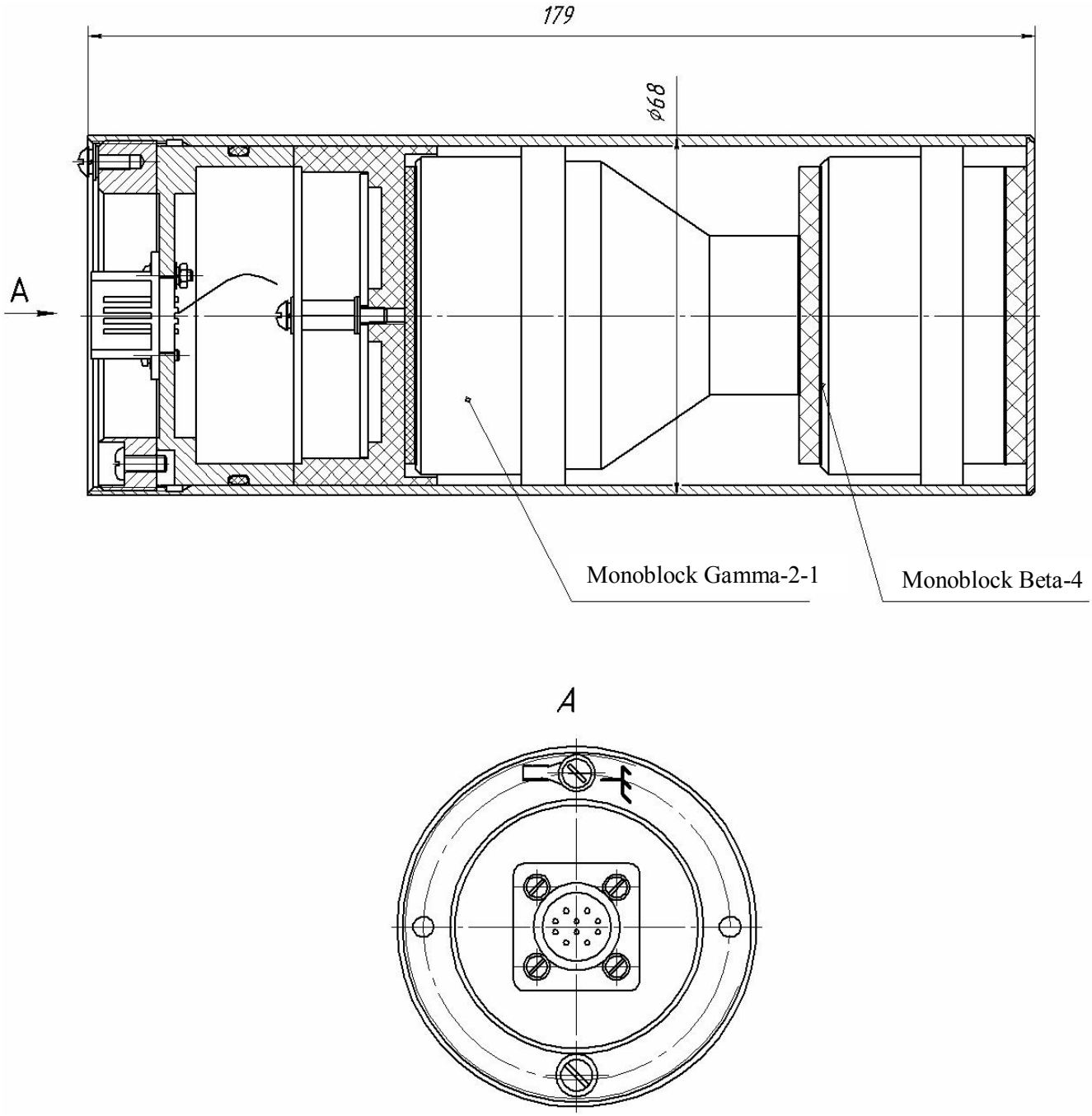


Figure A.3 - Overall and fitting dimensions (basic modification 02)

Appendix B
(Obligatory)

OUTPUT CONNECTOR PIN ASSIGNMENT

X1

←	Circuit	Pin
RS-485	Data+	1
	Data-	2
	+12V	3
	Reserved	4
	Reserved	5
	GND	6
USB	Data+	7
	Data-	8
	VBUS	9
	GND	10

Appendix C
(Reference)

WIRING DIAGRAM

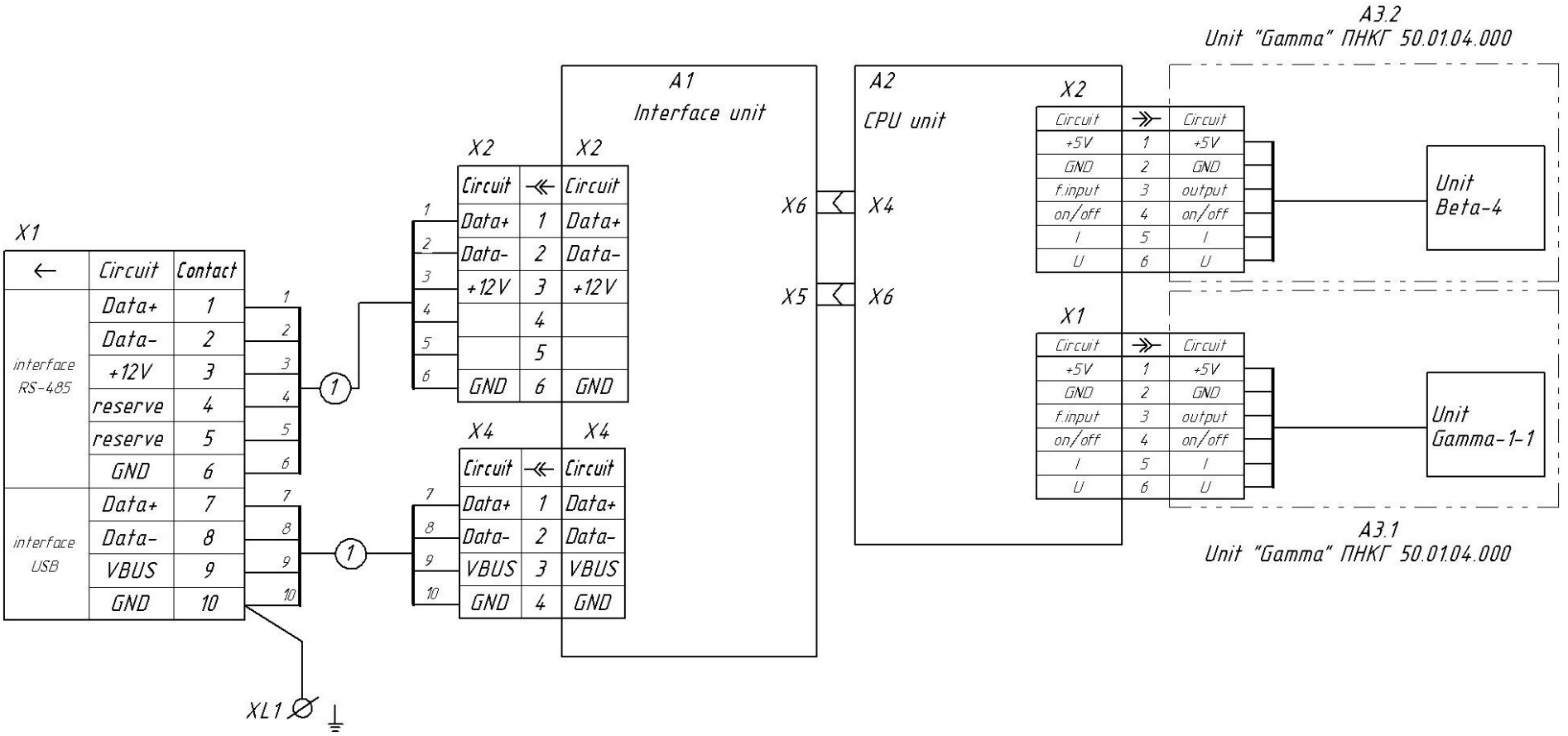


Figure C.1 – Wiring diagram for basic modification

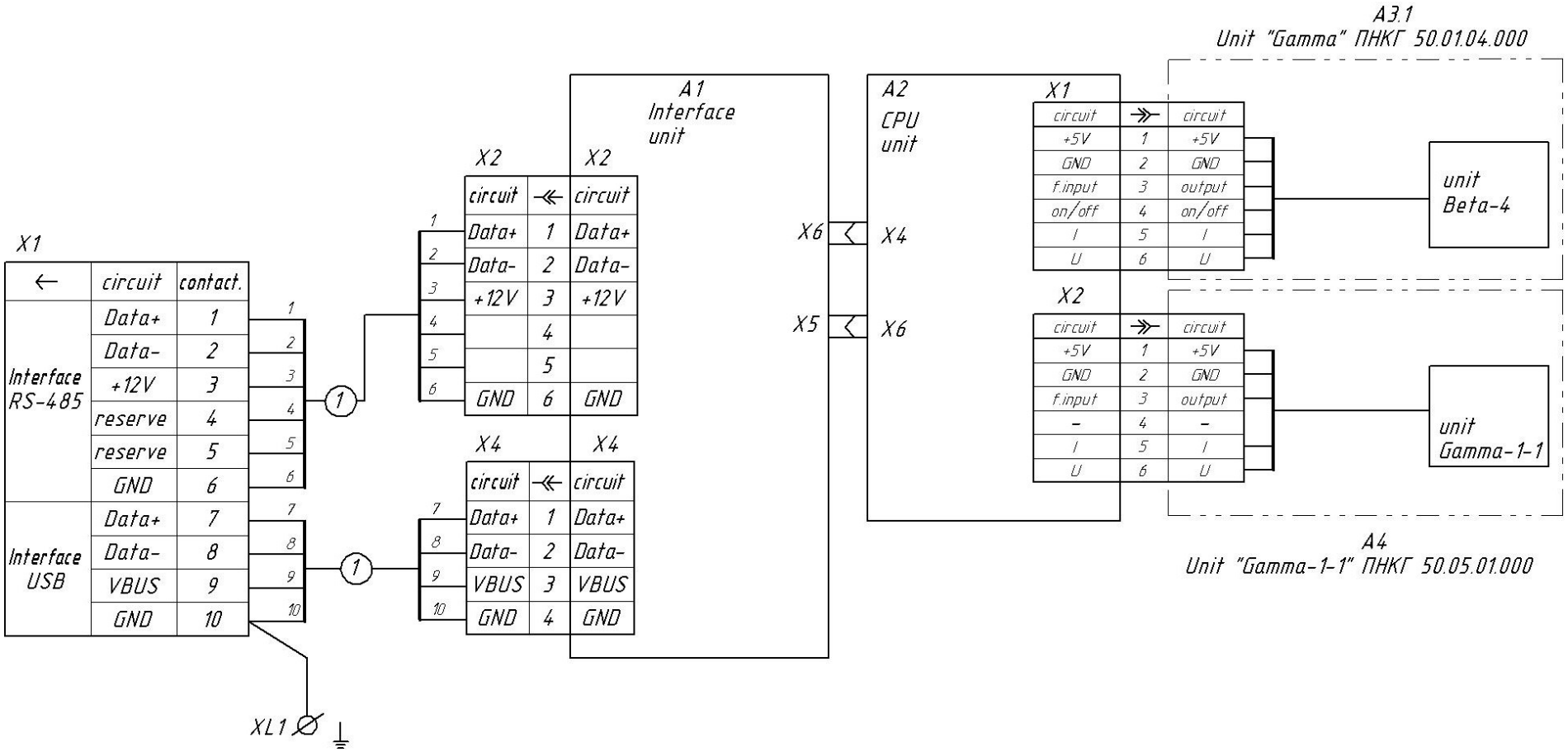


Figure C.2 – Wiring diagram for modification 01

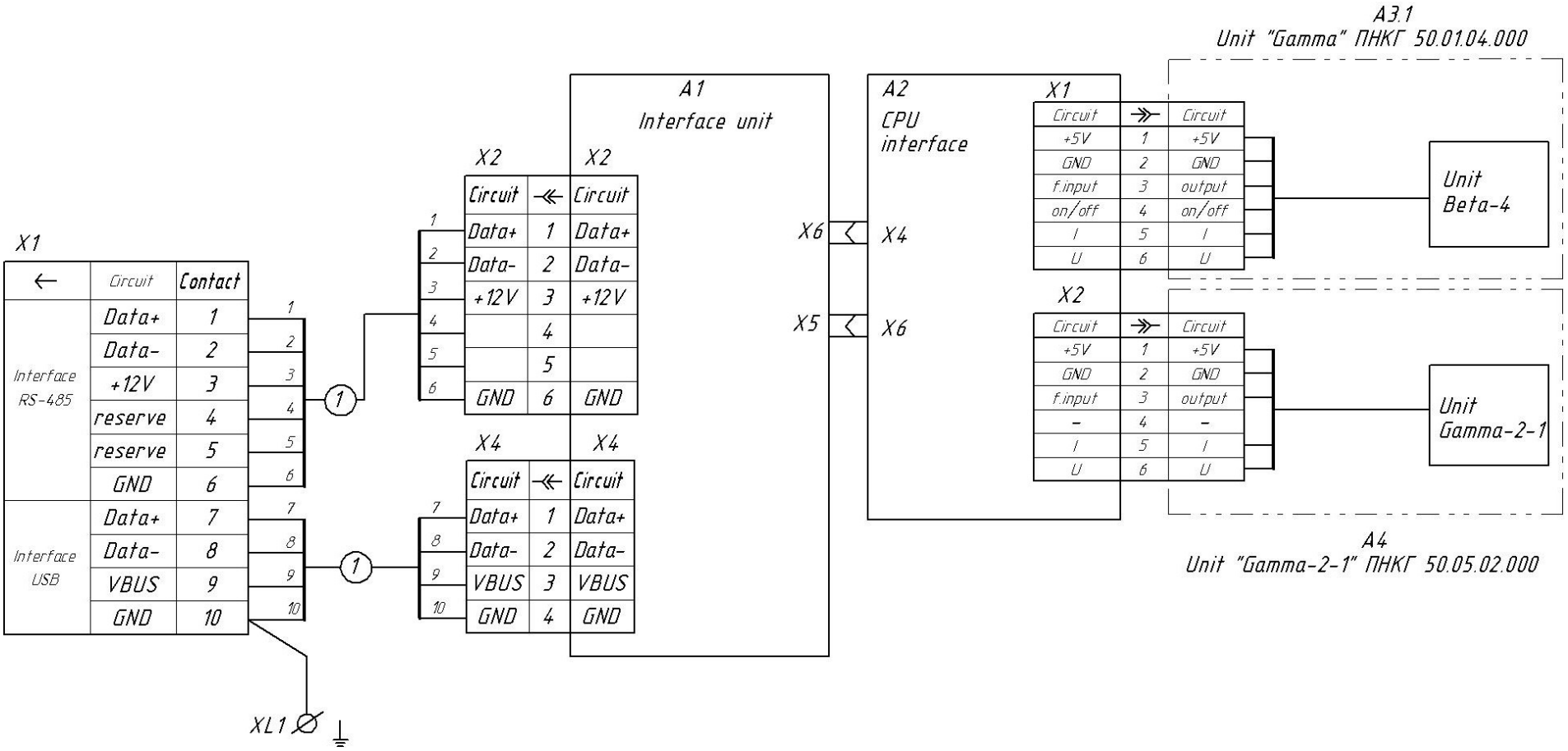


Figure C.3 – Wiring diagram for basic modification 02

Appendix D
(Obligatory)

LOCATION OF THE EFFECTIVE CENTER OF MEASUREMENT CHANNEL

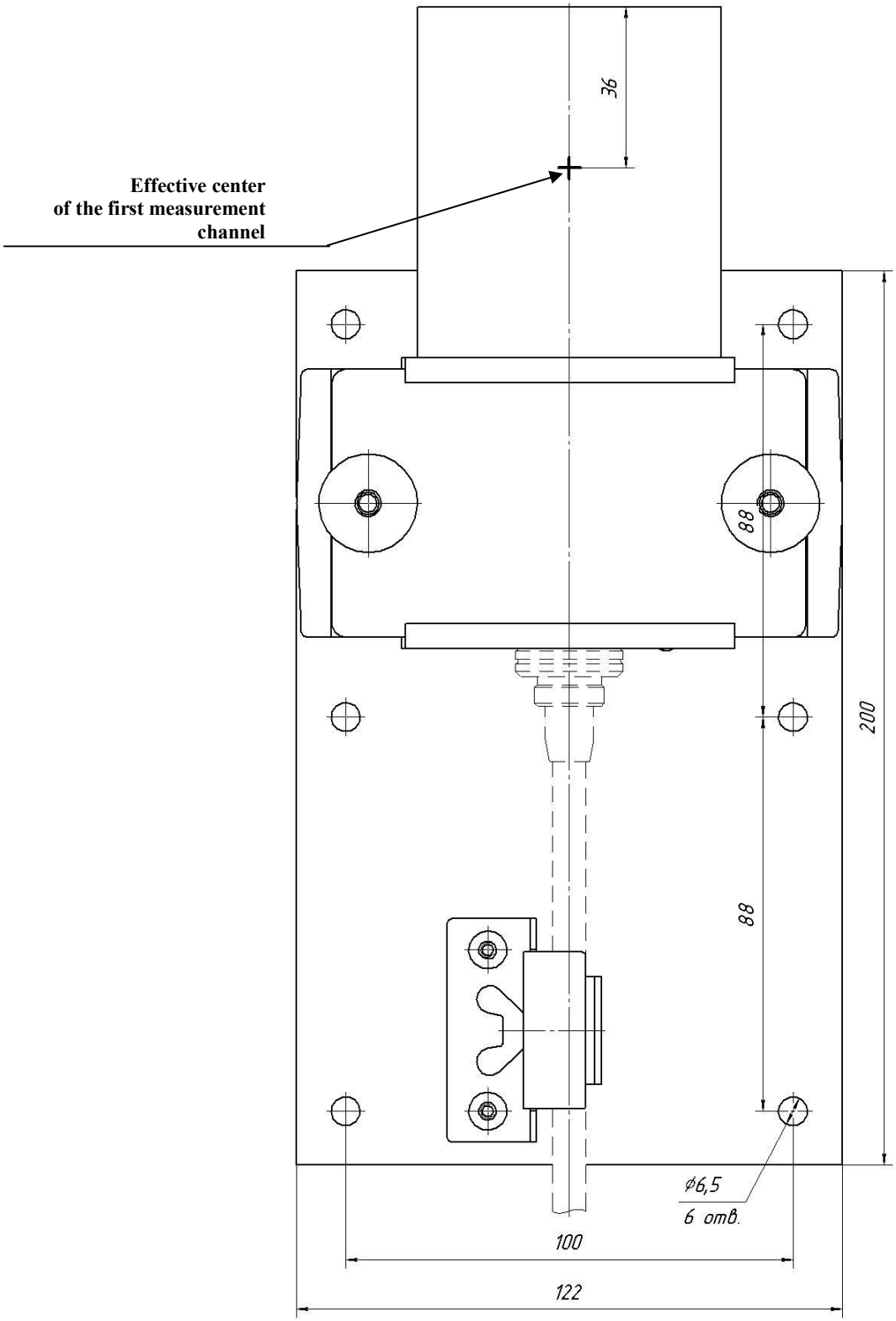


Figure D.1 – Location of the effective center of the first measurement channel
(dosimeters of basic modification)

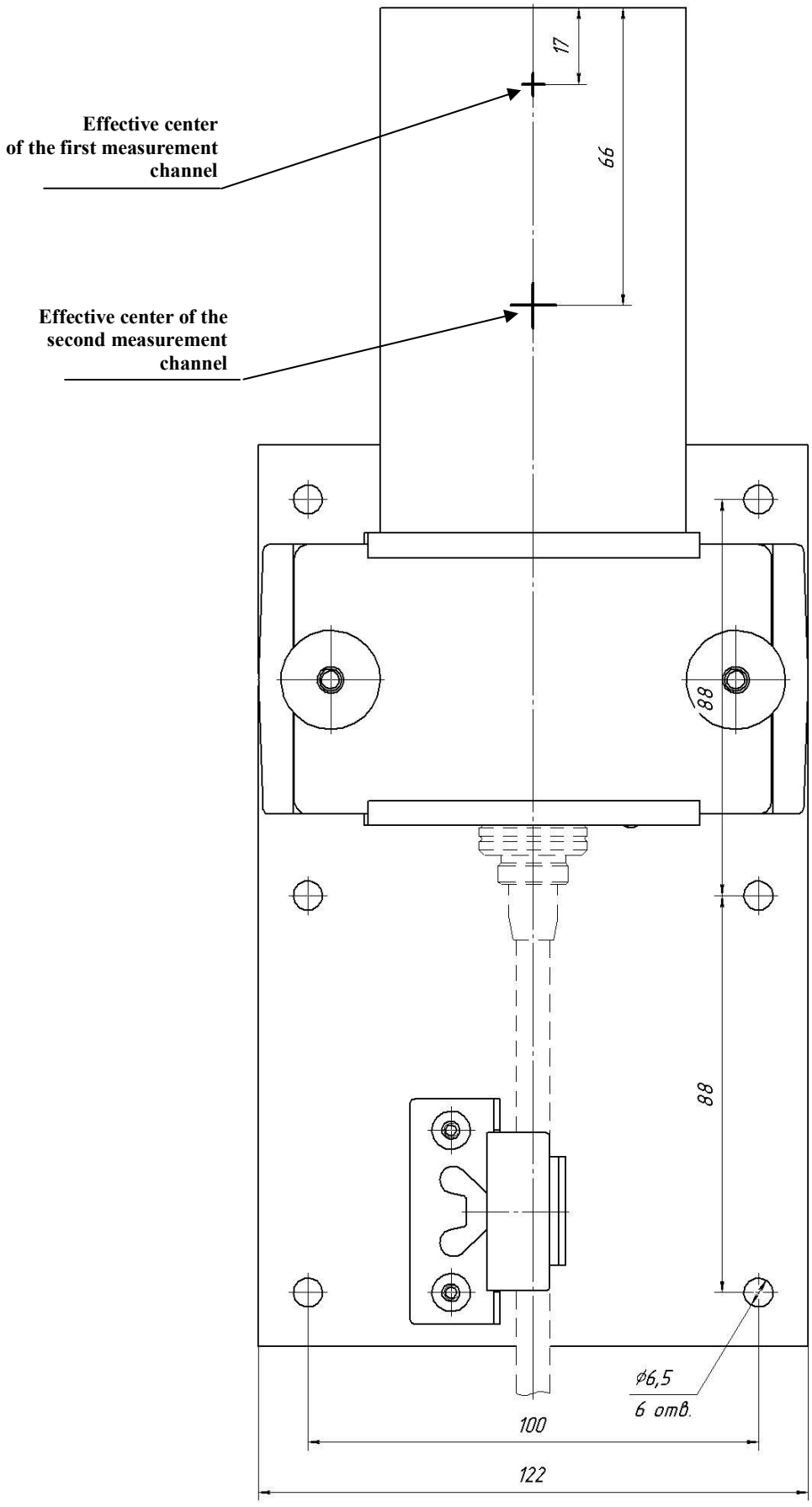


Figure D.2 – Location of the effective center of the first measurement channel (modification 01 of dosimeter)

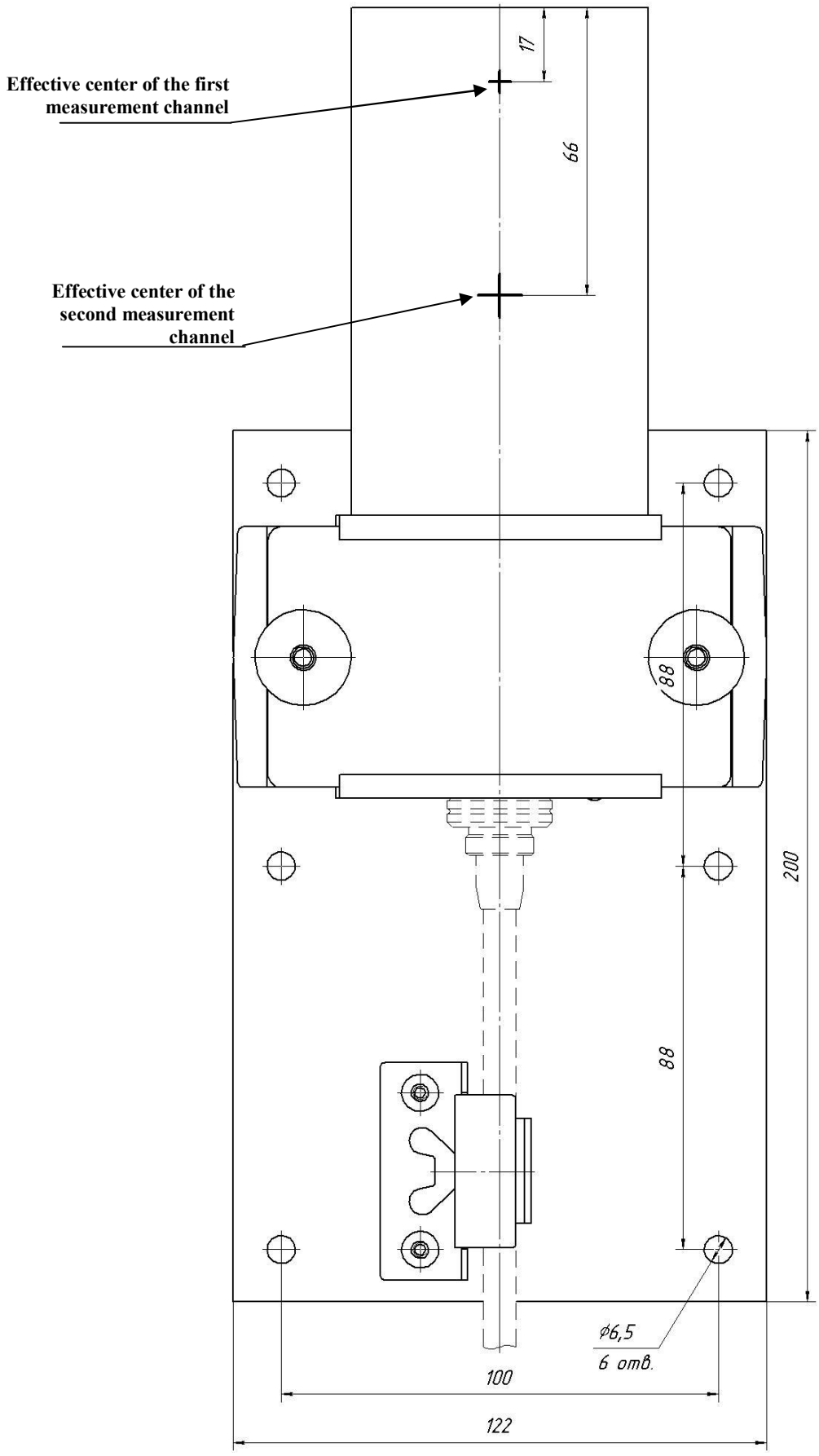


Figure D.3 – Location of the effective center of the first measurement channel (modification 02 of dosimeter)

Appendix E
(Obligatory)

"DWPTest" SOFTWARE MANUAL

Content

This User Manual describes the purpose and features of the software "DWPTest" (FVKM.004001) for using with dosimeters, as well as how to use the software.

E.1 PURPOSE OF THE SOFTWARE

The software is intended for using with dosimeters that use asynchronous serial communication channel and corporate data exchange protocol for instrumental networks DiBUS of SPC "Doza".

The software allows doing the following:

- send requests to connected dosimeters and receive responses in automatic mode;
- enter user defined settings and save them during the process of calibration or adjustment of dosimeters.

The software is used for servicing only; it is not involved in the measurement process and does not affect metrological characteristics of dosimeters.

Russian or English can be chosen as the interface language of the software.

E.2 REQUIREMENTS FOR RUNNING THE SOFTWARE

E.2.1 System requirements

Minimum requirements for hardware and software:

- operating system Windows ME/2000/XP;
- processor Pentium with clock frequency 120 MHz;
- RAM 64 Mb;
- free space on hard drive at least 60 Mb;
- monitor 15", 800×600 pixels;
- mouse;
- serial port.

E.2.2 Connecting dosimeters to PC

For communication with dosimeters RS-485 or USB interface can be used; USB or RS-485 is chosen automatically after power on.

E.3 INPUT AND OUTPUT DATA

The input data for the software is measurement and other information sent by dosimeter in reply to the software request.

The output data of the software are values of measurement, adjustment and other parameters sent by authorized user to dosimeter.

The software does not store the measured values of ADER of gamma radiation. Settings for working with dosimeter are stored in the file "dwpt.ini".

E.4 RUNNING THE SOFTWARE

E.4.1 Software structure, installation and start

The software contains the following files:

- DWPtest.exe – executable file;
- dbg-s11d common.rst – instrument description file for dosimeter for use in operating mode;
- dbg-s11d calibrator.rst – instrument description file for use in setting, calibration and adjustment modes (file similar to dbg-s11d common.rst, for authorized users only);
- package of instrument description files for reading / writing data of fixed set of parameters of memory registers of dosimeters (it used in conjunction with dbg-s11d calibrator.rst).

When the software is launched for the first time, it creates a file "dwpt.ini" with its settings in the system folder of Microsoft Windows.

To install the software, simply copy all files provided by the manufacturer in the folder selected for installation.

The software does not require installation. To run the software, launch DWPtest.exe.

To exit the software, enter "Terminal" menu and click "EXIT". To save the configuration, click "Save" button in the pop-up window.

E.4.2 Using the software

E.4.2.1 Setting the software

Before you begin, connect the dosimeter to PC as described in section 2.2. Figure E.1 shows the main window of the software.

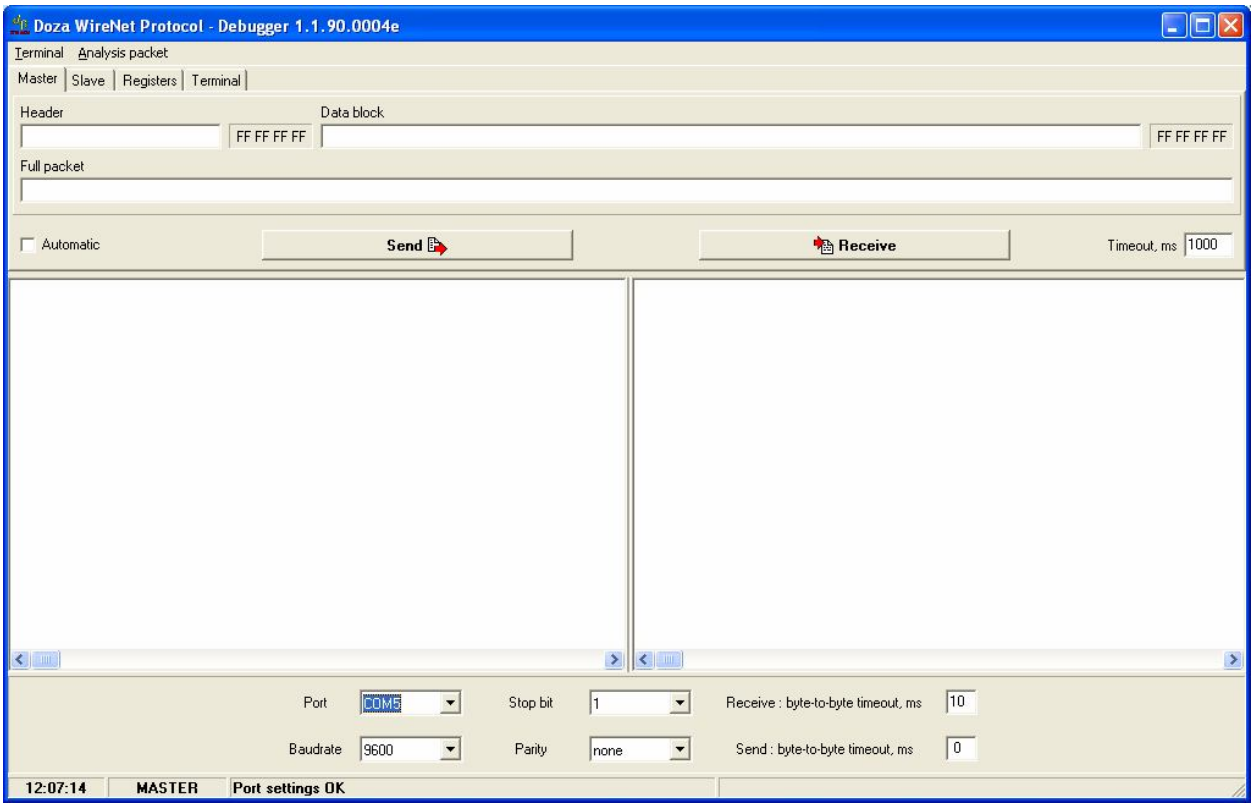


Figure E.1 – Main window of the software after launch

To perform operations with the dosimeter, select "Registers" tab in the main window as shown in the Figure E.2.

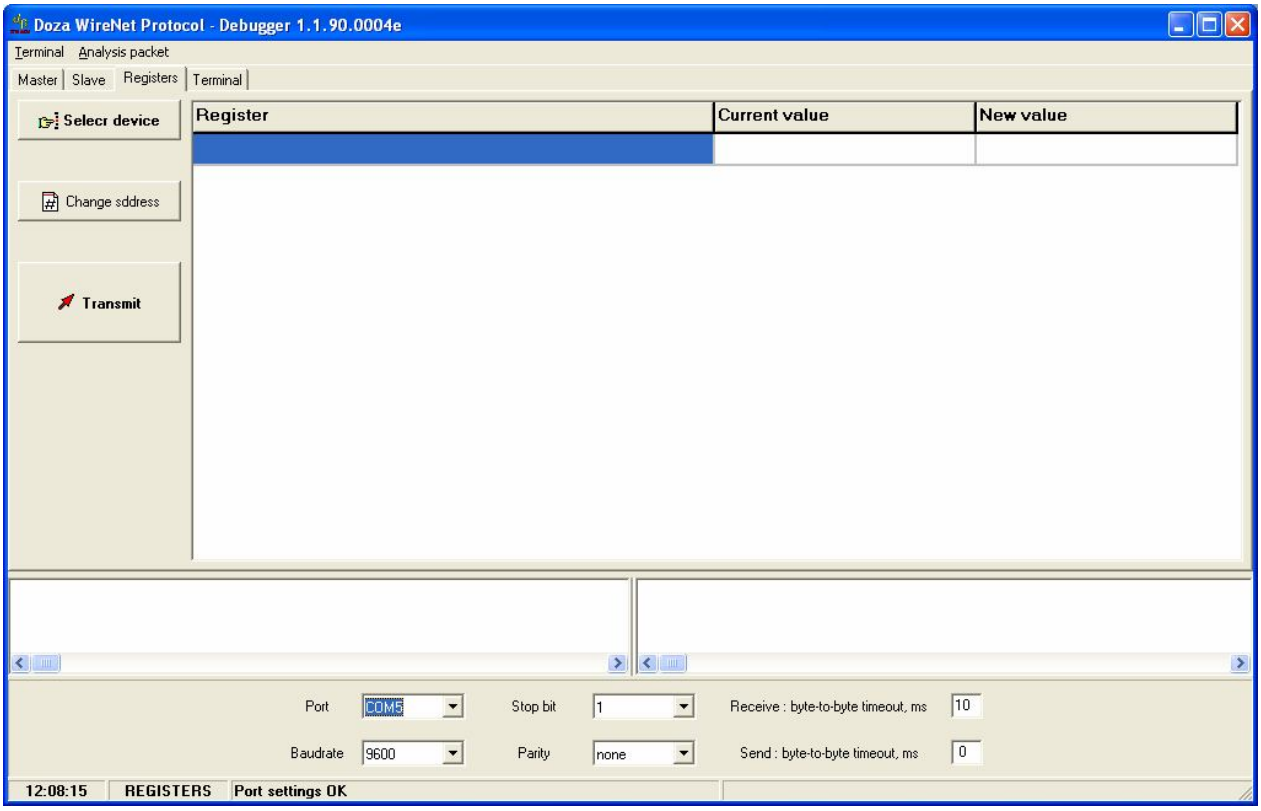


Figure E.2 – "Registers" tab

"Registers" tab allows the operator to send requests to the connected dosimeter and receive its answers in automatic mode. This mode is adapted for users who have no special knowledge and skills for working with the data exchange interfaces.

Before starting to work with the dosimeter, configure the asynchronous communication port by performing the following in the bottom part of the main window

1) select the asynchronous port number from the drop-down list; the default port is COM1;
2) select the data rate from the drop-down list; the default value is 9600 bps;
3) select the number of stop bits;
4) select the parity mode; by default there is no parity bit;
5) set the parameter "Receive: inter-byte range, ms" - the time interval between received bytes of the same packet; by default the interval is 1 ms;
6) set the parameter "Send: inter-byte range, ms" - the time interval between received bytes of the same packet; by default the interval is 0 ms.

The software automatically saves set parameters of the communication port to a file.

E.4.2.2 Working with dosimeter

Working with dosimeter is performed in the window "Registers". The software allows the operator to work with dosimeter in two modes:

- the first mode (operational) – sending requests to connected dosimeter and receiving replies in automatic mode; in this mode, the operator cannot enter data from PC;
- the second mode (setting, calibration, adjusting): this mode allows authorized user to enter in the dosimeter certain data, setup coefficients and constant parameters. To work in this mode, the user is supplied with the instrument description file "dbg-s11d calibrator.rst", providing the access to enter necessary information, which also serves as the access key for the authorized user.

To download common settings, select connected dosimeter. To do that, click the "SELECT DOSIMETER" button and in the dialog box, select file "dbg-s11d common.rst", and click "OPEN".

For loading parameters of the dosimeter, the authorized user must copy the key file provided by manufacturer "dbg-s11d calibrator.rst" in the software folder and then click "OPEN". The window "Doza WireNetProtocol – Debugger 1.1.87.0021" will open as shown in Figure E.3 and there will be a fixed set of parameters "Register"; the current values of parameters requested from the connected dosimeter will be displayed.

To enter a new value for the parameter, double-click in the "New Value" column against the selected parameter and enter a new value, then click "TRANSMIT" button. The new value will then be sent to dosimeter and saved.

If after clicking "TRANSMIT" button the received packets in the original and decoded form (lower left and right parts of the terminal area): software name and version of the firmware are displayed unchanged, this means that the information was not transferred to the dosimeter.

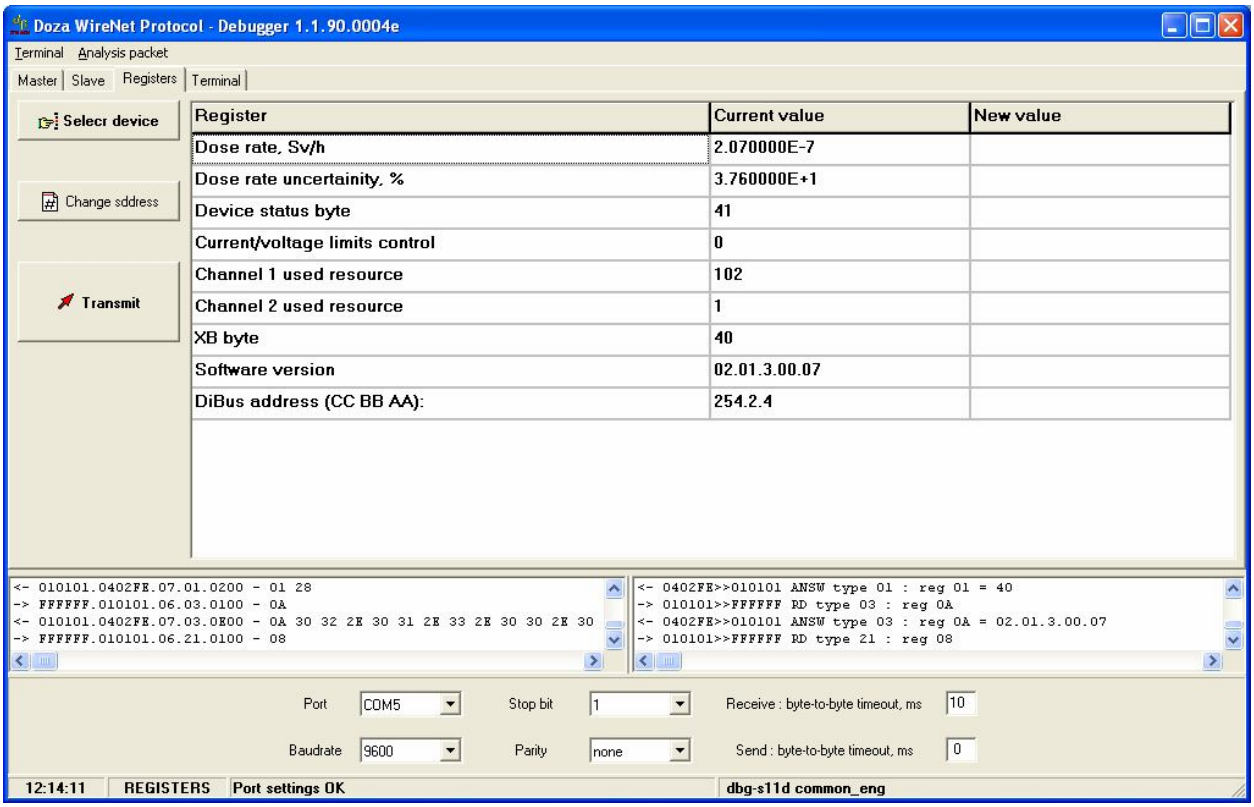


Figure E.3 – Content of register

In Figure E.4 an example is presented when unauthorized user attempts to write the changed parameter in the dosimeter memory, in this case in the right side of the terminal area "New value" the changed version of the software is displayed.

After completion of the authorized user's work the "dbg-s11d calibrator.rst" file is deleted until the next calibration or adjustment.

When it is necessary to address only one specific dosimeter instead the broadcast polling of several dosimeter, click the "CHANGE ADRESS" button and enter unique DiBus-address of this dosimeter in the window; in this case, the software will poll the specific dosimeter in the communication line.

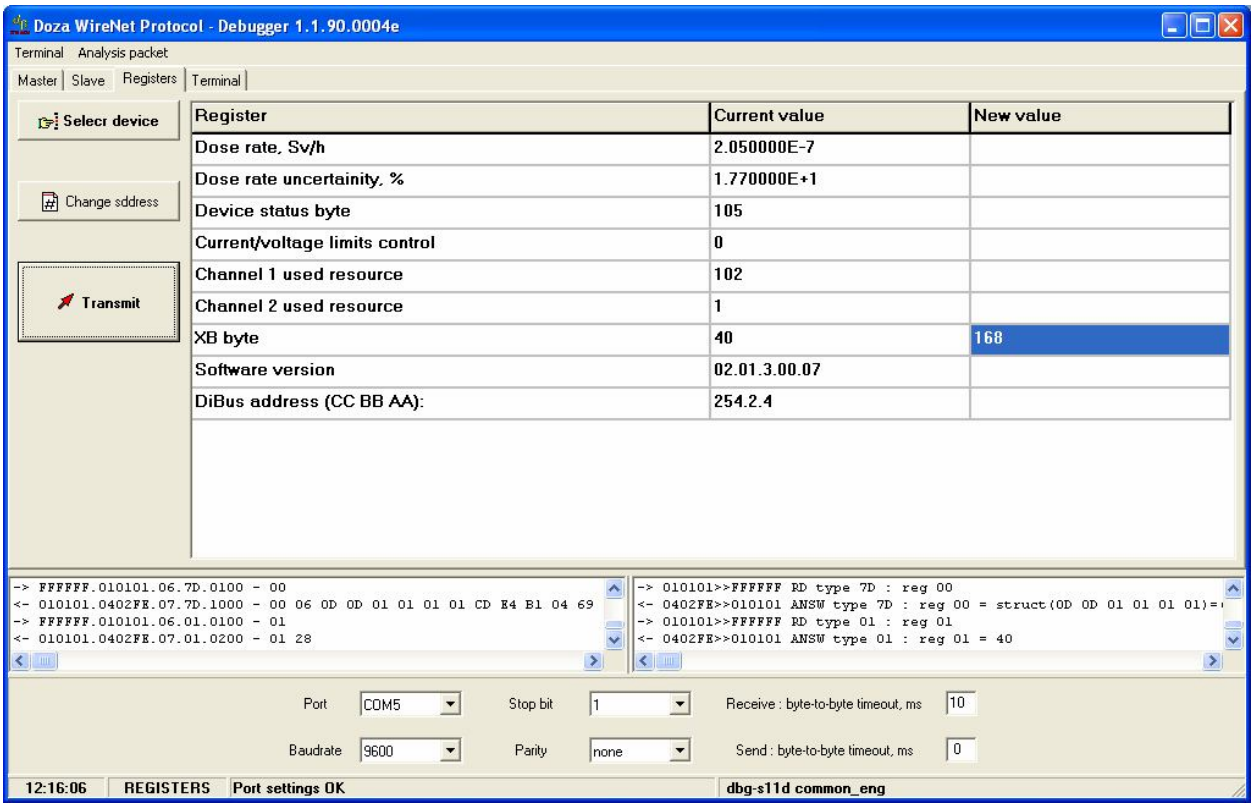


Figure E.4 – Writing the changed parameter in the dosimeter memory

E.5 PROTECTION OF THE SOFTWARE

The software does not perform any computing with received and saved data and is not involved in the measurement process.

The process of sending and receiving data is accompanied by an integrity check of data packet, both on the software side and by dosimeters.

Any authorized or unauthorized modification of the software affecting its functionally important parts makes it impossible to receive or transmit data.

The integrity of the dosimeter's software and preset parameters is confirmed by absence of change in the preset parameters checked by the operator in the measurement process, as well as presence of the authorized user access key file.

Appendix F
(Obligatory)

DESCRIPTION OF DATA EXCHANGE REGISTERS OF DiBUS PROTOCOL

Table F.1 – Data for writing to / reading from the dosimeter

Index	Description	R/W	Type Name (code)
00h	Current values: - ADER of gamma radiation, Sv/h - uncertainty ADER, % - control / status byte - control of limiting values current / voltage - selected resource of channel 1 - selected resource of channel 2	R	User-defined (7Dh) - LSingle (0Dh) - LSingle (0Dh) - Byte (01h) - Byte (01h) - Byte (01h) - Byte (01h)
01h	Byte to control operation mode XB	R/W	Byte (01h)
02h	Conversion factors of channel 1: - K – conversion factor - Kt – dead time - Kf – intrinsic background - ID – channel ID	R/W	User-defined (7Dh) - LSingle (0Dh) - LSingle (0Dh) - LSingle (0Dh) - Byte (01h)
03h	Conversion factors of channel 2: - K – conversion factor - Kt – dead time - Kf – intrinsic background - ID – channel ID	R/W	User-defined (7Dh) - LSingle (0Dh) - LSingle (0Dh) - LSingle (0Dh) - Byte (01h)
08h	Address of dosimeter	R/W	DiBUS_address(21h)
09h	Restarting measurement in channels	W	Byte (01h)
0Ah	Software version	R	Word (03h)