RKS-01 “STORA-ABG”
RADIOMETER-DOSIMETER

Operating Manual

CONTENTS

This operating manual (OM) is intended to inform the user about the principle of operation of RKS-01 “STORA-ABG” radiometer-dosimeter, the procedure for working with it and contains all the data necessary for full application of its technical capabilities and its proper use.

The OM includes the following abbreviations and symbols:

DER – ambient dose equivalent rate;

DE – ambient dose equivalent.

1 DESCRIPTION AND OPERATION

1.1 Purpose of use of the radiometer

RKS-01 “STORA-ABG” radiometer-dosimeter (hereinafter – the radiometer) is intended for:

- measurement of ambient DER and DE of gamma and X-ray radiation (hereinafter – photon ionizing radiation)
- measurement of surface beta-particles flux density
- measurement of surface activity of beta-emitting radionuclides
- measurement of surface alpha-particles flux density
- measurement of surface activity of alpha-emitting radionuclides
- display of pulse count rate from the alpha, beta, gamma detector.

The radiometer is used for environmental research; as visual aids for educational establishments; for radiometric and dosimetric control at industrial enterprises; to monitor radiation purity of residential premises, buildings and structures, territories adjacent to them, vehicles, household items, clothes, surface of soil on garden plots.

1.2 Technical specifications

1.2.1 Key specifications and data are presented in Table 1.1.

Table 1.1 – Key specifications and data

Name	Unit of measure	Standardized values according to specifications
1	2	3
Measurement range of photon ionizing radiation DER	μSv/h	0.1 – 100 000
Display range of photon ionizing radiation DER	μSv/h	0.01 – 100 000
Main relative permissible error limit when measuring photon ionizing radiation DER at ^{137}Cs calibration with a confidence probability of 0.95	%	15+2/M, where M is a dimensionless value that is numerically equal to the DER value measured in μSv/h

Table 1.1 (continued)

1	2	3
Measurement range of photon ionizing radiation DE	μSv	1 – 10 000 000
Display range of photon ionizing radiation DE	μSv	0.1 – 10 000 000
Main relative permissible error limit when measuring photon ionizing radiation DE at ^{137}Cs calibration with a confidence probability of 0.95	%	±15
Energy range of photon ionizing radiation being detected	MeV	0.012 – 3.00
Energy dependence of radiometer readings when measuring photon ionizing radiation DER relative to 0.662 MeV (^{137}Cs): - in the energy range from 0.012 MeV to 0.040 MeV, not more: - in the energy range from 0.040 MeV to 1.25 MeV, not more:	%	 ±35 ±25

Table 1.1 (continued)

1	2	3
Anisotropy of the radiometer at gamma quantum incidence at solid angle of ±60 relative to the main (perpendicular to the back cover of the device marked with a "+" symbol) direction of measurement, must be: - for ^{137}Cs and ^{60}Co isotopes; - for ^{241}Am isotopes **Note.** Anisotropy diagrams are given in Appendix A.	%	 ±25 ±60
Measurement range of surface beta-particles flux density	part./(cm^2·min)	5 – 999 999
Display range of surface beta-particles flux density	part./(cm^2·min)	1 - 999 999

Table 1.1 (continued)

1	2	3
Measurement range of surface activity of beta-emitting radionuclides	Bq/cm^2	0.22 – 9999 for C0 [1)] source type ($^{90}Sr/^{90}Y$)
Display range of surface activity of beta-emitting radionuclides	Bq/cm^2	0.01 - 9999
Main relative permissible error limit when measuring surface beta-particles flux density in the range from 5 part./($cm^2 \cdot min$) to 999 999 part./($cm^2 \cdot min$) at $^{90}Sr/^{90}Y$ calibration with a confidence probability of 0.95	%	20+150/F, where F is a dimensionless value that is numerically equal to the value of surface beta-particles flux density measured in part./($cm^2 \cdot min$)

Table 1.1 (continued)

1	2	3
Main relative permissible error limit when measuring surface activity of beta-emitting radionuclides in the range from 0.22 Bq/cm^2 to 9999 Bq/cm^2 at $^{90}Sr/^{90}Y$ calibration with a confidence probability of 0.95 from C0 source type	%	20+10/A, where A is a dimensionless value that is numerically equal to the value of surface activity of beta-emitting radionuclides measured in Bq/cm^2
Energy range of beta-particles being detected	MeV	0.15 – 3.00
Measurement range of surface alpha-particles flux density	part./(cm^2·min)	5 – 999 999
Display range of surface alpha-particles flux density	part./(cm^2·min)	1 – 999 999
Measurement range of surface activity of alpha-emitting radionuclides	Bq/cm^2	0.2 – 9999 for П9 [2)] source type (^{239}Pu)

Table 1.1 (continued)

1	2	3
Display range of surface activity of alpha-emitting radionuclides	Bq/cm^2	0.01 - 9999
Display range of pulse count rate from alpha, beta, gamma radiation counter	cps	0.001 – 9999
Main relative permissible error limit when measuring surface alpha-particles flux density in the range from 5 part./(cm^2·min) to 999 999 part./(cm^2·min) at ^{239}Pu calibration with a confidence probability of 0.95	%	20+150/F, where F is a dimensionless value that is numerically equal to the value of surface alpha-particles flux density measured in part./(cm^2·min)

Table 1.1 (continued)

1	2	3
Main relative permissible error limit when measuring surface activity of alpha-emitting radionuclides in the range from 0.2 Bq/cm^2 to 9999 Bq/cm^2 at ^{239}Pu calibration with a confidence probability of 0.95 from a standard П9 source type	%	20+10/A, where A is a dimensionless value that is numerically equal to the value of surface activity of alpha-emitting radionuclides measured in Bq/cm^2
Detector type	-	Alpha-, beta-, gamma-sensitive Geiger-Muller counter with a mica window
Window area	cm^2	13.8

Table 1.1 (continued)

1	2	3
Typical sensitivity to photon ionizing radiation with an energy of 0.662 MeV (^{137}Cs)	$\frac{\frac{pulses}{s}}{\frac{\mu Sv}{h}}$	4.5
Time of operating mode setting of the radiometer, not more	min	1
Time of continuous operation of the radiometer when powered from a new battery of two 1200 mAh batteries under normal conditions and given gamma background not more than 0.5 μSv/h, disabled sounding of detected gamma quanta and disabled backlight of the scale, no less	hour	2000
Unstable readings of the radiometer for 6 hours of continuous operation, not more than	%	5

Table 1.1 (continued)

1	2	3
Operating supply voltage of the radiometer power supply from two AAA batteries	V	3.0
Additional relative permissible error limit when measuring photon ionizing radiation DER, surface beta-particles flux density and surface alpha-particles flux density in the range of supply voltage from 2.4 V to 3.2 V	%	±5
Additional relative permissible error limit when measuring photon ionizing radiation DER, surface beta-particles flux density and surface alpha-particles flux density caused by changes in the environmental temperature from -20 °C to +50 °C	%	±0.5 per each 1 °C of deviation from 20 °C
Average life of the radiometer till the first major repair, no less	hour	10000

Table 1.1 (end)

1	2	3
Average service life of the radiometer, no less	year	6
Mean time to failure, no less	hour	6000
Overall dimensions of the radiometer, no less	mm	160×75×37
Weight of the radiometer, not more	kg	0.4
Weight of the radiometer in package, not more	kg	4.2 (case – 3.2)

[1)] – efficiency of C0 type sources is 0.377

[2)] – efficiency of П9 type sources is 0.490

1.2.2 The radiometer provides for automatic subtraction of gamma-component of radiation when measuring beta radiation parameters.

1.2.3 The radiometer provides for automatic subtraction of gamma- and beta-components of radiation while measuring alpha radiation parameters.

1.2.4 The radiometer provides for analogue display unit of instantaneous radiation intensity being measured. Time of information update is 500 ms.

1.2.5 The radiometer allows programming the values of alarm threshold levels for each radiation parameter being measured.

1.2.5.1 The values of threshold levels of photon ionizing radiation DER are programmed in the range from 0 mSv/h to 99.9 mSv/h in steps of 0.01 μSv/h.

1.2.5.2 The values of threshold levels of photon ionizing radiation DE are programmed in the range from 0 to 9999 mSv in steps of 0.001 mSv.

1.2.5.3 The values of threshold levels of surface beta-particles flux density are programmed in the range from 0 part./($cm^2 \cdot$min) to $999.9 \cdot 10^3$ part./($cm^2 \cdot$min) in steps of $0.01 \cdot 10^3$ part./($cm^2 \cdot$min).

1.2.5.4 The values of threshold levels of surface activity of beta-emitting radionuclides are programmed in the range from 0 Bq/cm^2 to 9999.99 Bq/cm^2 in steps of 0.01 Bq/cm^2.

1.2.5.5 The values of threshold levels of surface alpha-particles flux density are programmed in the range from 0 part./(cm^2·min) to 999.9·10^3 part./(cm^2·min) in steps of 0.01·10^3 part./(cm^2·min).

1.2.5.6 The values of threshold levels of surface activity of alpha-emitting radionuclides are programmed in the range from 0 Bq/cm^2 to 9999.99 Bq/cm^2 in steps of 0.01 Bq/cm^2.

1.2.5.7 The values of threshold levels of pulse count rate from alpha, beta, gamma counter are programmed in the range from 0 cps to 9999 cps in steps of 0.01 cps.

1.2.5.8 The programmed values of threshold values are stored in the nonvolatile memory of the radiometer and remain unchanged when the radiometer is turned on/off and its batteries are replaced.

1.2.6 The radiometer alarms about exceeding the programmed threshold levels with a two-tone sound signal and a red flashing ALARM LED. In this case, the measurement result blinks on the liquid crystal display (hereinafter referred to as LCD).

1.2.6 The radiometer alarms about exceeding the programmed threshold levels with a two-tone sound signal and a red flashing ALARM LED. In this case, the measurement result blinks on the liquid crystal display (hereinafter referred to as LCD).

1.2.7 The radiometer generates a short one-tone sound signal if gamma quantum, alpha- or beta-particle gets to the detector.

1.2.8 The radiometer stores up to 600 measurement results in its nonvolatile memory. For ease of identification, information about the date and time of measurement and a conditional three-digit number of the object of measurement, entered during recording, is added to each record.

1.2.9 The radiometer allows viewing measurement results that were previously recorded in the nonvolatile memory on its own LCD, as well as communicating this information to a personal computer via Bluetooth.

1.2.10 The radiometer has a clock mode where the current time in hours and minutes, as well as the current date, month, and year are displayed on the radiometer's LCD.

1.2.11 There is an alarm clock mode in the radiometer.

1.2.12 The radiometer provides for an option to work in the mode of intelligent detecting unit (hereinafter referred to as the IDU). In this mode, the radiometer sends the following data to the PC via Bluetooth:

- current measurement results;
- current value of supply voltage,

and receives the commands from the PC to change measurement modes and synchronize time relative to the PC clock.

1.2.13 The radiometer provides indication of low battery status.

1.2.14 The radiometer performs measurements under the following conditions:

- temperature from - 20 to +50 ºC;
- relative humidity up to (95±3)% at +35 ºC temperature;
- atmospheric pressure from 84 to 106.7 kPa.

1.2.15 The radiometer remains operational after the impact of the following external factors:

- high frequency sinusoidal vibrations (with a crossover frequency from 57 to 62 Hz) in the range of 10 to 55 Hz, 0.15 mm bias for frequency lower than the crossover frequency;
- shocks with a shock pulse duration of 5 ms, total number of shocks (1000±10) and maximum shock acceleration of 100 m/s^2;
- shocks in shipping container with an acceleration of 98 m/s^2, a shock pulse duration of 16 ms (number of shocks - (1000±10) in each direction) or equivalent shake tests;
- exposure in shipping container to ambient air temperature from - 25 to + 55 ºС and relative humidity up to (95±3) % at + 35 ºС temperature;
- photon ionizing radiation with exposure dose rate that corresponds to ambient dose equivalent rate up to 10 Sv/h during 5 minutes.

1.3 Delivery kit

1.3.1 Delivery kit of the radiometer consists of the items and maintenance documentation presented in Table 1.2.

Table 1.2 – Delivery kit of the radiometer

Type	Item	Quantity	Note
BICT.412129.037-02	RKS-01 “STORA-ABG” radiometer-dosimeter	1 pc.	
BICT.301261.019	Cover “1”*	1 pc.	Cover (energy compensating filter) for measurement of photon ionizing radiation DER and DE
BICT.301261.020	Cover “2”	1 pc.	Cover – alpha, beta filter for gamma radiation component measurement when measuring beta radiation characteristics

Table 1.2 (continued)

Type	Item	Quantity	Note
BICT.301261.021	Cover "3"	1 pc.	Cover – alpha filter for gamma and beta component measurement when measuring alpha radiation characteristics
BICT.301261.022	Cover "4"	1 pc.	Cover – a grid to protect the counter when measuring alpha radiation characteristics
BICT.412913.006	Gaskets kit	1 pc.	30 μm (10 pcs)
BICT.412129.040-02 HE	Operating manual	1 copy	
ENERGIZER	AAA 1.5 V battery	2 pcs	Analogues permitted

Table 1.2 (end)

Type	Item	Quantity	Note
BICT.323382.004-02	Stacking bag	1 pc.	
BICT.304592.004	Telescopic rod	1 pc.	
BICT.301524.005	Holder	1 pc.	
Wing screw DIN316 M4×8	Screw	2 pcs	Stainless steel
BICT.00039 BICT.00040	Custom-made software	1 pc.	RadReaderLE.exe, RadReaderLERealtime.exe
BICT.412915.037-02	Package**	1 pc.	
BICT.381123.007-02	Packing case	1 pc.	A component of the package
* installed in the radiometer ** At the customer’s request, it is possible to pack the radiometer in a cardboard box			


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1 - RKS-01 "STORA-ABG" radiometer-dosimeter of alpha, beta, gamma radiation with installed Cover “1” (energy compensating filter) for measurement of gamma and X-rays DE and DER;
2 - Cover “2” - alpha, beta filter for measurement of gamma radiation component when measuring beta radiation characteristics;
3 - Cover “3” - alpha filter for gamma-beta component measurement when measuring alpha radiation characteristics;
4 - Cover “4” - a grid to protect the counter when measuring alpha radiation characteristics;
5 - Operating manual;
6 - Stacking bag;
7 – Gaskets kit;
8 - Holder;
9 - Screws;
10 - Telescopic rod;
11 - Custom-made software.

Figure 1.1 – Placement of the device and accessories, as well as operational documentation in the dust- and damp-proof case

1.4 Design and principle of operation

1.4.1 Design of the radiometer

The radiometer (in accordance with Figure 1.2) is designed as a rectangular parallelepiped rounded on each side. The plastic damp- and dustproof body of the radiometer (ingress protection rating IP54, category 2) consists of two parts – upper (1) and lower (2) covers. The LCD (3), ALARM light-emitting diode (4) and the keys of control (THRESHOLD (5), MODE (6), γ/β/α (7), SAVE (8), SOUND (9)) are located on the panel of the upper cover. The printed-circuit board with the electric circuit of the device is screwed with four screws to the upper cover of the radiometer. All inscriptions of the upper cover are screen-printed.

Figure 1.2 – Appearance of the radiometer (top view)

The lower cover (2) of the body (Figure 1.3) contains the battery compartment (10) with two galvanic cells installed and a Geiger-Mueller counter (11) sensitive to alpha, beta and gamma radiation. The counter is fastened to the lower cover and closed from the inside of the body with a plastic holder, which is fixed with six screws. From the outside, the detector is closed with one of the covers (13), (14), (15) or (16). The battery compartment is closed with cover (12), which is fixed with the original screw. The polarity signs are inscribed on the bottom of the battery compartment for proper insertion of batteries.

A stacking bag (6) is used for convenient use of the radiometer (Figure 1.1).

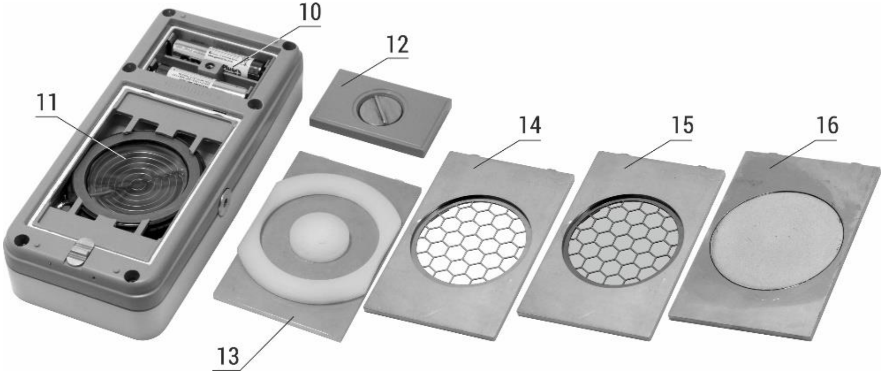

Figure 1.3 – Appearance of the radiometer (bottom view)

To perform measurements in hard-to-reach areas, a telescopic rod (10) (Figure 1.1) is used, which is fastened to the device using a holder (17) and two screws (18) (Figure 1.4).

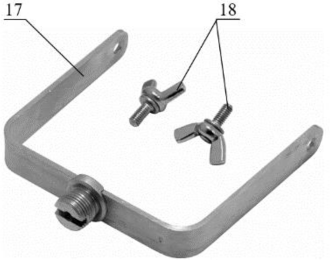

Figure 1.4 – Holder and screws for mounting to the telescopic rod and radiometer

A plastic dust- and damp-proof case is used for reliable and compact storage of the device and accessories, as well as operational documentation.

Protective gaskets are placed in the container (Figure 1.5) and used to replace damaged gaskets in Cover “3”.

Figure 1.5 – Container with protective gaskets

1.4.2 Basic operation of the radiometer

The radiometer is a monoblock unit, which contains:

– Geiger-Mueller counter with a mica window;

– printed circuit board with circuits of the anode voltage generation, digital processing, control and indication and the module of Bluetooth radio channel;

– batteries;

The Geiger-Mueller counter with a mica window, sensitive to alpha, beta and gamma rays, converts radiation into a sequence of voltage pulses, the number of which per unit of time is proportional to the radiation intensity.

Circuits of the anode voltage generation, digital processing, control and indication enable:

- generation and stabilization of the counter anode voltage;

- scaling and linearization of the counter counting response;

- measurement of photon ionizing radiation DER, surface beta-particles flux density and surface alpha-particles flux density by measuring the average frequency of pulses coming from the counter output;
- real time measurement;
- control of operating modes of the radiometer;
- display of measurement results.

The module of Bluetooth radio channel ensures interaction of the radiometer with a personal computer.

A battery of two AAA-sized cells is used to supply power to the radiometer.

1.5 Labeling and sealing

1.5.1 The upper cover of the radiometer is inscribed with the trademark, the name and the symbol of the device, the ingress protection rating, as well as the pattern approval mark of measuring instruments in accordance with the Technical regulations of the regulated means of measuring equipment.

1.5.2 A serial number and a manufacture date are inscribed on the lower cover of the radiometer.

1.5.3 Sealing is performed by the producer enterprise. The device is sealed with mastic in the recesses of the lower cover or with special film seals on the side surfaces of the device at the junctions of the upper and the lower covers.

1.5.4 Removal of seals and repeated sealing is performed by the producer company after repair and verification of the radiometer.

1.6 Packing

1.6.1 The radiometer kit (the device, accessories, and operating manual) is delivered in a plastic case.

1.6.2 The case with the radiometer kit is placed in a cardboard box and a polyethylene bag, which is welded after packing performed.

2 PROPER USE

2.1 Operating limitations

Operating limitations are presented in Table 2.1.

Table 2.1 – Operating limitations

Operating limitation	Limitation parameters
1 Ambient air temperature	below - 20 and above + 50 ºC
2 Relative humidity	above (95±3) % at + 35 ºC temperature
3 Impact of photon ionizing radiation	DER above 10 Sv/h during 5 min

2.2 Preparation of the radiometer for operation

2.2.1 Scope and order of external examination.

2.2.1.1 Before using the radiometer, unpack it and check if the delivery kit is complete. Examine for mechanical damages.

2.2.2 Rules and order of examination for operational readiness.

2.2.2.1 Study the operating manual before putting the radiometer into operation.

2.2.2.2 Open the battery compartment and make sure the two batteries are inserted, connections are reliable, and there is no leakage of salts on the batteries after durable storage of the radiometer. In case there is a salt leakage, remove the batteries. Clean them, if possible, or replace, if not. Insert the batteries and close the battery compartment.

2.2.3 Guidelines on switching on and testing the radiometer.

2.2.3.1 Press the MODE button to switch the radiometer on. The radiometer performs a test of display and signaling tools, which consists in illuminating the ALARM LED and all segments of the LCD for 2 s, as well as generation of a short-term sound signal. Upon completion of the test, the radiometer enters the mode of photon ionizing radiation DER measurement, as evidenced by "γ" symbol and the dimension of the measured value "μSv/h".

2.2.3.2 In the absence of a sound signal, and (or) the lack of illumination of ALARM LED, and (or) the lack of illumination of all segments of the LCD during the test, send the radiometer for repair.

2.2.3.3 If the low battery indication appears on the LCD (see 2.3.3.6), replace the batteries.

2.2.3.4 Press and hold MODE button (circa 6 seconds) until the radiometer turns off.

2.2.4 List of possible troubles and troubleshooting.

2.2.4.1 The list of possible troubles and troubleshooting is presented in Table 2.2. Troubles during use are recorded in Appendix D of this OM.

2.2.4.2 At failure to eliminate the troubles presented in Table 2.2, or at detection of more complicated troubles, the radiometer should be sent for repair to the manufacturer.

Table 2.2 – Possible troubles and troubleshooting

Trouble	Probable cause	Troubleshooting
The radiometer does not switch on after MODE button is pressed	1 The batteries are discharged 2 No contact between the batteries and the battery compartment clamps 3 One of the batteries is out of order	1 Replace the batteries 2 Restore the contact between the batteries and the clamps 3 Replace the defected battery

Table 2.2 (continued)

Trouble	Probable cause	Troubleshooting
There is no short sound signal during the test of display and signaling tools when the radiometer is turned on	Buzzer failure	Send the radiometer for repair to the manufacturer
ALARM LED is not highlighted during the test of display and signaling tools when the radiometer is turned on	LED failure	Send the radiometer for repair to the manufacturer

Table 2.2 (continued)

Trouble	Probable cause	Troubleshooting
Not all segments of the LCD are highlighted during the test of display and signaling tools when the radiometer is turned on.	LCD failure	Send the radiometer for repair to the manufacturer
Low battery indication is displayed on the LCD after the batteries have been replaced	1 Poor contact between the batteries and the battery compartment clamps 2 One of the batteries is out of order	1 Clean out the contacts on the clamps and the batteries 2 Replace the defected battery

Table 2.2 (end)

Trouble	Probable cause	Troubleshooting
Er01 message on the LCD of the radiometer	Alpha, beta, gamma radiation counter is out of order	Send the radiometer for repair to the manufacturer

2.3 Use of the radiometer

2.3.1 Safety measures during use of the radiometer.

2.3.1.1 All works on the use of the radiometer should be carried out in accordance with the requirements set out in the following documents:

"Norms of Radiation Safety of Ukraine" (NRBU-97). State Hygienic Standards DHN 6.6.1.-6.5.001-98,

"Basic sanitary rules of radiation safety of Ukraine" (OSPU-2005) DSP 6.177-2005-09-02.

2.3.1.2 Direct use of the radiometer is not dangerous for the service personnel and is environmentally friendly

2.3.1.3 The radiometer contains no external parts exposed to voltages hazardous for life.

2.3.1.4 The radiometer meets the requirements of DSTU 7237:2011 standard in terms of protecting a person from electric shock with a safety class 0 according to DSTU IEC 60335-1:2010 standard.

A special protective jacket is used to prevent accidental contact with conductive parts.

Ingress protection rating is IP54 according to DSTU EN 60529:2018 standard.

2.3.1.5 According to the requirements of fire safety, the radiometer meets the requirements of the current fire safety regulations and current statutory documents.

2.3.1.6 In case of contamination, the radiometer should be deactivated. Wipe its surface by a gauze tampon moistened in a standard decontaminating agent

2.3.1.7 Disposal of radiometers should be carried out according to DSTU 4462.3.01:2006, DSTU 4462.3.02:2006, Laws of Ukraine “On Environmental Protection” and “On Waste”.

2.3.2 Operating modes and submodes of the radiometer.

2.3.2.1 Operating modes of the radiometer.

The radiometer works in the following modes:

- display mode of characteristics of the ionizing radiation intensity;
- display mode of photon ionizing radiation DE and DE accumulation time;
- clock mode;
- alarm clock mode;
- Bluetooth radio channel control mode;
- mode of measurement results viewing stored in the nonvolatile memory.

2.3.2.2 Operating submodes of the radiometer.

Every operating mode of the radiometer has its submodes.

The display mode of ionizing radiation intensity characteristics consists of the following submodes:

- submode of measurement restart;
- submode of viewing and programming new values of the alarm threshold level and specified limit of statistical deviations (specified limit of expected relative statistical deviations of the measurement result given confidence probability of 0.95);
- submode of measurement result storage in the nonvolatile memory.

The display mode of photon ionizing radiation DE has the following submodes:

- submode of the new value programming of alarm threshold level;
- submode of resetting the values of DE and DE accumulation time.

The clock mode has a submode of time and date correction.

The mode of alarm clock has a submode of programming its triggering time.

The mode of measurement results viewing stored in the nonvolatile memory has a submode of measurement results clearing.

2.3.3 Operation procedure of the radiometer.

2.3.3.1 Radiometer controls.

Buttons MODE (5), THRESHOLD (6), SOUND (7), SAVE (8), γ/β/α (9) are used to operate the radiometer (Figure 1.2).

MODE button is used to turn on/off the radiometer and change its operating modes.

THRESHOLD button is used to view current and program new values of alarm threshold level and specified limit of statistical deviations, as well as to restart measurement.

SOUND button is used to enable/disable signaling of detected gamma quanta and alpha-, beta-particles.

SAVE button is used to switch to the submode of measurement result saving.

γ/β/α button is used to change the type of ionizing radiation, the characteristics of will be measured.

2.3.3.2 Switching the radiometer on/off.

Press MODE button to switch the radiometer on. Test of display and signaling tools (LCD, ALARM LED and buzzer), which lasts about 2 seconds means the radiometer is on. Upon completion of the test, the radiometer switches to the mode of display of ionizing radiation intensity characteristics – photon ionizing radiation DER.

To switch off the radiometer, press and hold MODE button circa 6 seconds until the radiometer switches off.

2.3.3.3 General algorithm of the radiometer operation control

The radiometer is controlled in the following way.

After switching on, the radiometer works in the mode of display of ionizing radiation intensity characteristics – photon ionizing radiation DER, as evidenced by "γ" symbol and the dimension of measured quantity “μSv/h” or “mSv/h”.

In this mode, a short press of γ/β/α button causes a change of ionizing radiation type, which characteristics will be measured.

Symbols of measured radiation are displayed on the LCD of the radiometer as characters "γ", "β", "α". If several characters are displayed simultaneously, it means that the total value of characteristics of several radiation types are being measured.

The display of one symbol informs that characteristics of only that one type of radiation are measured and the influence of other types of radiation is considered and subtracted from the current measurement results.

A long press of γ/β/α button (for 2 s) leads to saving the current measurement result as a radiation component, which will be further subtracted from the results of subsequent measurements. The next long press of γ/β/α button (for 2 s) leads to resetting this previously saved value.

Short presses of MODE button switch the radiometer from one mode to another in the following order:

- display mode of ionizing radiation intensity characteristics (after the radiometer is turned on – photon ionizing radiation DER);
- display mode of photon ionizing radiation DE;

- clock mode;
- alarm clock mode;
- Bluetooth radio channel control mode;
- mode of measurement results viewing stored in the nonvolatile memory (if the saved results are available).

If the nonvolatile memory contains some measurement results, a short press of MODE button switches the radiometer from the mode of Bluetooth radio channel control to the mode of measurement results viewing saved in the nonvolatile memory. By pressing MODE button when the radiometer is in the mode of measurement results viewing, you switch the radiometer to its initial mode – the display mode of ionizing radiation intensity characteristics (the measured characteristic and the type of radiation do not change). If the nonvolatile memory has no saved measurement results, a short press of MODE button switches the radiometer from the mode of Bluetooth radio channel control directly to the display mode of ionizing radiation intensity characteristics (the measured characteristic and the type of radiation do not change).

A short or a long press of THRESHOLD button in any operating mode of the radiometer changes the submodes of this operating mode.

Note. After switching the radiometer from the mode of ionizing radiation intensity characteristics display to any other mode, the selected characteristic of the selected radiation type continues to be measured. When the measurement result of the alarm threshold level is exceeded, the radiometer returns to the mode of ionizing radiation intensity characteristics display and begins to generate light and sound alarms.

A detailed description of each operating mode of the radiometer with its submodes is given below.

2.3.3.4 LCD backlight control.

Each press of any button of the radiometer activates the LCD backlight for circa 6 seconds. Press THRESHOLD button twice (time between presses should not exceed 0.5 s) to turn on a continuous LCD backlight. Press THRESHOLD button twice once again to disable continuous LCD backlight.

2.3.3.5 Batteries status control.

Irrespective of the chosen operating mode, the radiometer carries out a non-stop control of batteries status. The results of control are displayed on the LCD with a battery status symbol  (6) (Figure 2.1), which consists of four segments.

The number of blinking segments shows the level of batteries discharge. No segment of the status symbol blinks with a fully charged batteries. When batteries gradually discharge, one segment starts blinking first, then two, etc. All segments blink with fully discharged batteries.

Blinking of three or four segments is accompanied by short audio signals. This means that the batteries should be replaced.

2.3.3.6 Measurement of photon ionizing radiation intensity characteristics.

2.3.3.6.1 To measure photon ionizing radiation intensity characteristics, the window of the alpha, beta, gamma-radiation counter must be closed with Cover “1” (energy compensating filter).

The cover is fixed in the counter window with two protrusions and a movable latch. The cover closes the counter from alpha and beta radiation, as well as its application ensures energy dependence of the radiometer readings within the limits specified in Table 1.1.

The radiometer should be oriented with the metrological mark “+”, which is affixed to Cover “1”, in the direction towards the object of examination.

2.3.3.6.2 The radiometer should operate in the mode of display of ionizing radiation intensity characteristics. After turning on, the radiometer starts working in this mode. You can also switch to this mode from any other mode by shortly pressing MODE button.

2.3.3.6.3 Choose “γ” as the type of radiation. After turning on, the radiometer begins to measure the intensity characteristics of this radiation type. If another radiation type is chosen during operation of the radiometer, you can switch to measurement of photon ionizing radiation intensity characteristics by briefly pressing γ/β/α button.

2.3.3.6.4 The radiometer can measure photon ionizing radiation DER expressed in μSv/h, mSv/h (selection of measurement units takes place automatically depending on the intensity of radiation), or the pulse count rate from the alpha, beta, gamma counter expressed in in cps. Switching between DER measurement and the pulse count rate is done by shortly pressing MODE and THRESHOLD buttons simultaneously.

2.3.3.6.5 The following information is displayed on the LCD of the radiometer (Figure 2.1):

- estimated limit of the expected relative statistical deviations (1) of the measurement result (7) with a confidence probability of 0.95, hereinafter - the estimated limit of statistical deviations;
- "γ" symbol (2) – an indication of the measured radiation type;
- instantaneous value indicator of the radiation intensity (3);
- sound symbol (4) (if audio signaling of detected gamma quanta is switched on);
- alarm clock symbol (5) (if the alarm clock is on);
- battery status symbol (6);
- measurement result (7);
- dimension of measurement result (8) μSv/h, mSv/h or cps;
- current time (9).

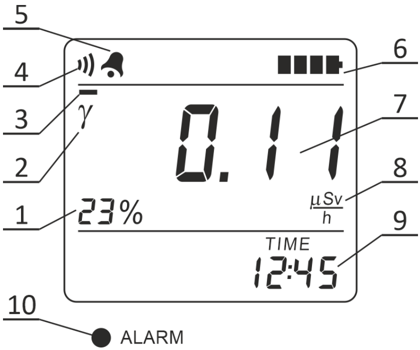

Figure 2.1 – LCD of the radiometer
(display mode of ionizing radiation intensity characteristics: measurement of photon ionizing radiation DER)

2.3.3.6.6 As soon as the measurement is started, the measurement results (7) and the estimated limit of statistical deviations (1) that corresponds to these results begin to be generated on the LCD.

2.3.3.6.7 If the measurement results exceed the alarm threshold level, the radiometer sends a two-tone sound signal and starts blinking with the red ALARM LED (10). Measurement results start blinking on the LCD of the radiometer. Periodic and gradual (from left to right) highlighting of the sound symbol segments (4) serves as an indication of the threshold level exceeding as well (Figure 2.1).

2.3.3.6.8 The radiometer works with the two independent threshold levels. One of them is expressed in µSv/h (mSv/h), the second one in cps. Comparison of measurement results is carried out with only one threshold level - with the one, the measurement units of which correspond to the selected measurement units of the results. Only this threshold can be viewed or changed.

2.3.3.6.9 When the measurement result exceeds the upper limit of the measurement range by more than 30%, "ппппп" symbols are displayed on the LCD instead of the measurement results.

2.3.3.6.10 The twelve-segment indicator of instantaneous value (3) is used for fast evaluation of photon ionizing radiation intensity. The integration time during measurement of instantaneous intensity value and the time of information update on the instantaneous value indicator is 500 ms.

2.3.3.6.11 The instantaneous intensity value is displayed in pseudo-logarithmic scale. The first segment of the indicator becomes highlighted when the intensity corresponds to 2 cps from the alpha, beta, gamma counter. The greater the intensity of photon ionizing radiation, the more segments of the indicator become highlighted from left to right. The scale becomes fully highlighted when the intensity equals 3100 cps from the alpha, beta, gamma counter. DER is about 400 μSv/h in this case.

2.3.3.6.12 The sound symbol (4) means that sound signaling of detected gamma quanta is on. If signaling is on, the sound symbol is displayed on the LCD and each detected gamma quantum is followed by a short sound signal.

2.3.3.6.13 Enable/disable sounding of detected gamma quanta by a brief press of SOUND button.

2.3.3.6.14 Photon ionizing radiation DER is measured in the following way. As soon as the measurement is started, the measurement results and the estimated limit of statistical deviations of these results begin to appear on the LCD of the radiometer.

Initially, the estimated limit of statistical deviations of the measurement results is large. In the process of measurements, the estimated limit of statistical deviations of measurement results decreases and eventually reaches the specified limit of statistical deviations. After that, the measurement process continues, but some of the statistical information begins to be rejected. Therefore, the estimated limit of statistical deviations of all subsequent measurement results is equal to or less than the specified one.

2.3.3.6.15 The user can restart the measurement process at any time. To do this, press and hold THRESHOLD button until CLr characters appear on the LCD of the radiometer. Release THRESHOLD button as soon as CLr characters are displayed.

2.3.3.6.16 The radiometer can automatically determine the specified limit of statistical deviations depending on the radiation intensity (Appendix A). The user can also do that in the submode of the alarm threshold level programming.

A blinking "%" symbol means that the user determined the specified limit of statistical deviations.

2.3.3.6.17 If the specified limit of statistical deviations is determined automatically by the radiometer, its value is blinking on the LCD until it remains greater than the value of the main relative permissible error limit of photon ionizing radiation DER measurement (Table 1.1). If the specified limit of statistical deviations is determined by the user, its value is blinking on the LCD until it remains greater than the value of the specified limit of statistical deviations.

2.3.3.6.18 While the estimated limit of statistical deviations keeps exceeding 99 %, the LCD displays the "ππ%" symbols.

2.3.3.6.19 Press THRESHOLD button to view the specified limit of statistical deviations and the alarm threshold level. The specified limit of statistical deviations and the alarm threshold level are displayed on the LCD (Figure 2.2) while THRESHOLD button is being pressed and held down (but not longer than 2 s). If a zero value is displayed it means that the radiometer determines it automatically depending on the radiation intensity.

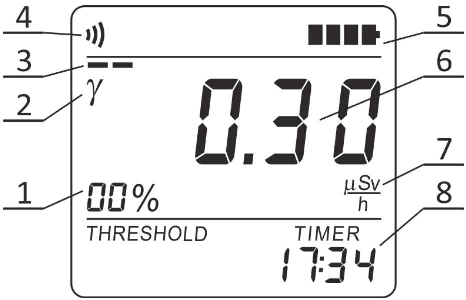

Figure 2.2 – LCD of the radiometer (viewing the value of specified limit of statistical deviations and alarm threshold level)

2.3.3.6.20 If THRESHOLD button is being held down for more than two seconds, the LCD displays the “Clr” symbols (Figure 2.3). This means that you can restart the measurement process.

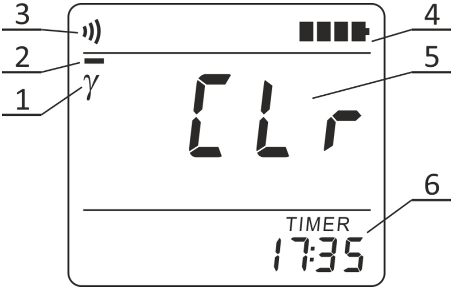

Figure 2.3 – LCD of the radiometer (measurement restart)

2.3.3.6.21 If THRESHOLD button is released when CLr symbols are displayed on the LCD, then the measurement process becomes restarted (Figure 2.4).

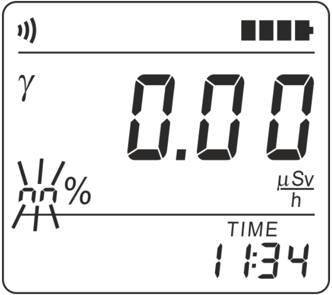

Figure 2.4 – LCD of the radiometer (measurement restart)

2.3.3.6.22 If you keep holding down THRESHOLD button, then during the next four seconds the radiometer proceeds to the submode of viewing and programming the new values of the alarm threshold level and specified limit of statistical deviations (Figure 2.5). A stripe (1) “moving” across the instantaneous value indicator and a blinking low-order digit (2) of a new threshold level serve as an indication of this submode. After that release THRESHOLD button.

When a digit is blinking, it means that its value can be programmed. Use THRESHOLD button to set the required value of the blinking digit. Successive short presses and releases of THRESHOLD button change this value per unit. A long press of THRESHOLD button starts automatic change of this value, which stops after THRESHOLD button is released.

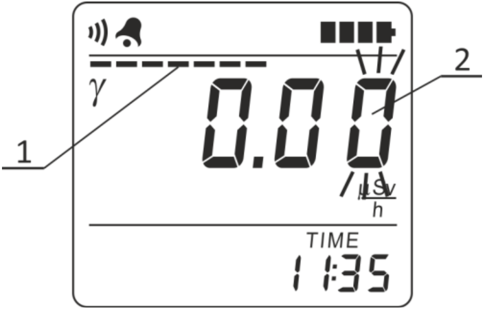

Figure 2.5 – LCD of the radiometer
(submode of the alarm threshold level programming)

A short press of MODE button saves the value of the digit (it stops blinking) and allows changing the value of the next digit, which starts blinking at that.

All other digits are programmed likewise.

If there is no need in programming all digits of the new threshold level, you can finish programming the threshold level and proceed to programming the new specified limit of statistical deviations by shortly pressing SAVE button.

2.3.3.6.23 As soon as all digits of the new threshold level are programmed, the LCD of the radiometer displays the specified limit of statistical deviations (Figure 2.6). Its low-order digit is blinking, which means that its value can be programmed.

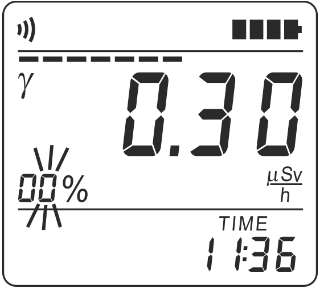

Figure 2.6 – LCD of the radiometer
(submode of programming the alarm threshold level: programming the specified limit of statistical deviations)

Programming a new value of the specified limit of statistical deviations is done in a similar way to programming the new value of alarm threshold level and finishes after programming all digits or after pressing SAVE button. By pre-setting a zero value, you switch on automatic determination by the radiometer of the specified limit of statistical deviations depending on the radiation intensity.

2.3.3.6.24 As soon as the alarm threshold level and the specified limit of statistical deviations are programmed, their values blink three times on the LCD. It means they are saved in the nonvolatile memory of the radiometer. After that, the radiometer returns to the mode of displaying the measured characteristics of ionizing radiation.

Important! If the submode of programming the new values of the alarm threshold level and the specified statistical error and switching on/off sounding of detected gamma quanta is paused for more than 30 seconds (i.e., the user presses no buttons of the radiometer), the latter automatically returns to the mode of photon ionizing radiation DER measurement. All changes made in the submode of new values programming will be cancelled.

Note. A zero value of the threshold level makes the alarm inactive.

2.3.3.6.25 To save the measurement result in the nonvolatile memory, shortly press SAVE button in the mode of displaying the measured characteristics of ionizing radiation. The radiometer will switch to the submode of measurement result saving. “Arch” (2) characters on the LCD of the radiometer are the indication of this submode (Figure 2.8).

2.3.3.6.26 If “FULL” characters are displayed on the LCD of the radiometer after you press SAVE button (Figure 2.7), there is no free space in the nonvolatile memory of the radiometer, and, correspondingly, the next measurement results cannot be saved.

2.3.3.6.27 To clear space in the nonvolatile memory, delete its saved measurement results. Measurement results can be cleared during data communications with the PC (2.3.3.12 of the OM) or in the mode of measurements results viewing (2.3.3.13 of the OM).

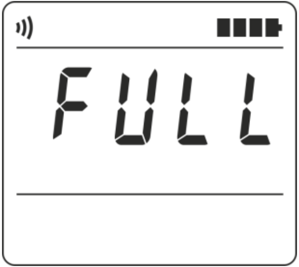

Figure 2.7 – LCD of the radiometer
(submode of measurement result saving – no free space in the nonvolatile memory)

2.3.3.6.28 In the submode of measurement result saving, the LCD displays the measurement result (1) and the measurement object number (3) that will be saved in the nonvolatile memory.

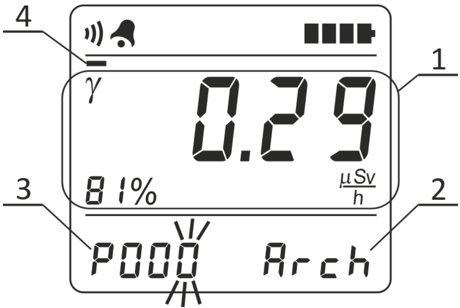

Figure 2.8 – LCD of the radiometer
(submode of measurement result saving)

The nonvolatile memory status is displayed on the instantaneous value indicator (4). If the nonvolatile memory contains no data, only the first segment is highlighted on the indicator. If the memory is full, all segments are highlighted.

2.3.3.6.29 The low-order digit of the object number is blinking and shows that its value can be programmed. Use THRESHOLD button to set the required value of the blinking digit. Successive short presses and releases of THRESHOLD button change this value per unit. A long press of THRESHOLD button starts automatic change of this value, which stops after the button is released.

A short press of MODE button saves the value of the digit (it stops blinking) and allows changing the value of the next digit, which starts blinking at that. All other digits are programmed likewise.

2.3.3.6.30 As soon as the required digits of the measurement object number are programmed, a short press of SAVE button saves the measurement result, the measurement object number and the time and date of measurement in the nonvolatile memory.

The fact that this information is saved is evidenced by a triple blinking on the LCD of the radiometer of the measurement result being saved, and return of the radiometer to the mode of display of the measured characteristics of ionizing radiation.

Important! If the submode of measurement result saving is paused for more than 30 seconds (i.e., the user presses no buttons of the radiometer), the latter automatically returns to the mode of display of the measured ionizing radiation characteristics without saving the measurement result.

2.3.3.7 Measurement of beta radiation intensity characteristics.

2.3.3.7.1 To measure characteristics of beta radiation intensity, the radiometer should work in the mode of ionizing radiation intensity characteristics display.

After turning on, the radiometer starts working in this mode. This mode can be entered from any other operating mode of the radiometer with the help of a short press of MODE button.

2.3.3.7.2 Shortly press γ/β/α button to select “β” as the type of radiation. Symbols “β” and “γ” will be displayed on the LCD of the radiometer.

The display of “γ” symbol indicates that the measurement result consists of beta and gamma-components of radiation at the same time. The alpha, beta, gamma radiation counter window should be closed with Cover “3” (alpha filter), which closes the counter from alpha radiation and lets beta and gamma radiation through.

2.3.3.7.3 To measure the intensity characteristics of beta radiation alone, it is necessary to measure and save the value of gamma radiation component in the immediate vicinity to the surface to be examined. In the future, this value will be automatically subtracted when measuring beta radiation intensity characteristics. When measuring gamma radiation component, the window of the alpha, beta, gamma counter should be closed with Cover “2” (alpha, beta filter), which closes the counter from alpha and beta radiation, but slightly attenuates gamma radiation.

2.3.3.7.4 Measurement of gamma radiation component must be performed with sufficient accuracy.

2.3.3.7.5 As soon as gamma radiation component is measured, it is necessary to save its result. To do this, press and hold down γ/β/α button for circa 2 s until the saved value blinks three times, and "γ" symbol fades away on the LCD of the radiometer.

2.3.3.7.6 After saving the gamma radiation component, it is necessary to replace Cover "2" with Cover "3" (alpha filter), which closes the counter from alpha radiation and lets beta and gamma radiation through.

2.3.3.7.7 When the object of examination is changed, it is necessary to reset the stored value of the gamma radiation component and measure and save the new value of the gamma component in the immediate vicinity to the new surface to be examined.

To reset the stored value of the gamma component, press γ/β/α button and hold it down until the measurement result blinks three times and "γ" symbol is displayed on the LCD of the radiometer.

2.3.3.7.8 When measuring characteristics of beta radiation intensity, the LCD of the radiometer displays the following information (Figure 2.9):

- the estimated limit of statistical deviations (10) of the measurement result (7);
- "β" symbol (1) - an indication of the measured radiation type;
- "γ" symbol (2) - is displayed if measurement takes place without subtraction of gamma radiation component;
- instantaneous value indicator (3);
- sound symbol (4) (if sound signaling of detected gamma quanta and beta particles is switched on);
- alarm clock symbol (5) (if the alarm clock is on);
- battery status symbol (6);
- measurement result (7);
- dimension of measurement result (8) $10^3/(cm^2 \cdot min)$, cps or faded away, if the dimension is Bq/cm^2;
- current time (9).

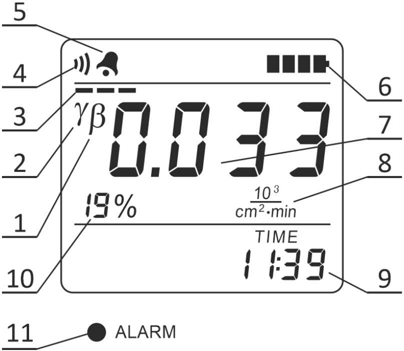

Figure 2.9 – LCD of the radiometer
(display mode of ionizing radiation intensity characteristics: measurement of surface beta-particles flux density)

2.3.3.7.9 The radiometer can measure beta-particles flux density expressed in $10^3/(cm^2 \cdot min)$, surface activity of beta-emitting radionuclides, expressed in Bq/cm^2, or the pulse count rate from the counter of alpha, beta, gamma radiation, expressed in cps. By briefly pressing MODE and THRESHOLD buttons simultaneously, you can switch between measurement of flux density, surface activity and pulse count rate.

If surface activity measurement is carried out in Bq/cm^2, then “Act” characters are periodically displayed on the LCD of the radiometer and the dimension of the measurement result goes blank (8) (Figure 2.9).

2.3.3.7.10 Further work with the radiometer during measurement of beta-radiation intensity characteristics is similar to that used when measuring photon ionizing radiation intensity characteristics as set out in 2.3.3.6.6 ... 2.3.3.6.30 of this OM.

2.3.3.7.11 Segments of the instantaneous value indicator during measurement of beta radiation intensity characteristics are highlighted as follows.

Given the intensity, which corresponds to the pulse frequency of 2 cps from the alpha, beta, gamma counter, the first segment of the indicator is highlighted. The greater the intensity of beta radiation, the more segments of the indicator become highlighted from left to right. The scale becomes fully highlighted when the intensity equals to 3100 cps from the alpha, beta, gamma counter. Beta-particles flux density is about $250 \times 10^3/(cm^2 \cdot min)$ in this case.

2.3.3.8 Measurement of alpha radiation intensity characteristics.

2.3.3.8.1 To measure characteristics of alpha radiation intensity, the radiometer should work in the display mode of ionizing radiation intensity characteristics. After turning on the radiometer starts working in this mode. This mode can be entered from any other operating mode of the radiometer with the help of a short press of MODE button.

2.3.3.8.2 Shortly press γ/β/α button to select "α" as the type of radiation. Symbols "α", as well as "β" and "γ" will be displayed on the LCD of the radiometer.

The display of "β" and "γ" symbols indicates that the measurement result consists of gamma, beta and alpha-components of radiation at the same time. The alpha, beta, gamma radiation counter window should be closed with Cover "4" (grid), which protects the counter from mechanical damage and lets alpha, beta and gamma radiation through.

2.3.3.8.3 To measure the intensity characteristics of alpha radiation alone, it is necessary to measure and save the value of gamma- and beta-component in the immediate vicinity to the surface to be examined.

In the future, this value will be automatically subtracted when measuring alpha radiation intensity characteristics. When measuring gamma and beta radiation component, the window of the alpha, beta, gamma counter should be closed with Cover "3" (alpha filter), which closes the counter from alpha radiation but slightly attenuates gamma and beta radiation.

2.3.3.8.4 Measurement of gamma and beta radiation component must be performed with sufficient accuracy.

2.3.3.8.5 As soon as gamma and beta radiation component is measured, it is necessary to save its result. To do this, press and hold down γ/β/α button for circa 2 s until the saved value blinks three times, and “β” and “γ” symbols fade away on the LCD of the radiometer.

2.3.3.8.6 After saving gamma and beta radiation component, it is necessary to replace Cover “3” with Cover “4” (grid), which protects the counter from mechanical damage and lets alpha, beta and gamma radiation through.

2.3.3.8.7 When the object of examination is changed, it is necessary to reset the stored value of the gamma and beta radiation component and measure and save the new value of gamma and beta component in the immediate vicinity to the new surface to be examined.

To reset the stored value of the gamma and beta component, press γ/β/α button and hold it down until the measurement result blinks three times and “β” and “γ| symbols are displayed on the LCD of the radiometer.

2.3.3.8.8 When measuring intensity characteristics of alpha radiation, the LCD of the radiometer displays the following information (Figure 2.10):

- estimated limit of statistical deviations (10) of the measurement result (7);
- "α" symbol (1) - an indication of the measured radiation type;
- "γβ" symbol (1) - is displayed if the measurement takes place without subtraction of gamma-beta radiation component;
- instantaneous value indicator (3);
- sound symbol (4) (if sound signaling of detected gamma quanta, beta and alpha particles is switched on);
- alarm clock symbol (5) (if the alarm clock is on);
- battery status symbol (6);
- measurement result (7);
- dimension of measurement result (8) $10^3/(cm^2 \cdot min)$, cps or faded away, if the dimension is Bq/cm^2;
- current time (9).

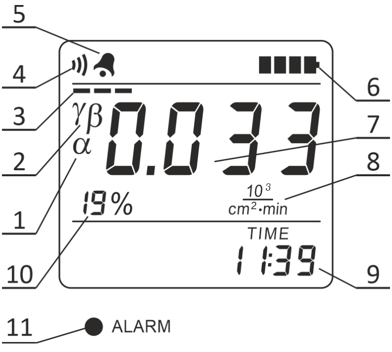

Figure 2.10 – LCD of the radiometer
(display mode of ionizing radiation intensity characteristics: measurement of surface alpha-particles flux density)

2.3.3.8.9 The radiometer can measure alpha-particles flux density expressed in $10^3/(cm^2 \cdot min)$, surface activity of alpha-emitting radionuclides, expressed in Bq/cm^2, or the pulse count rate from the counter of alpha, beta, gamma radiation, expressed in cps. By briefly pressing MODE and THRESHOLD buttons simultaneously, you can switch between measurement of flux density, surface activity and pulse count rate.

If surface activity measurement is carried out in Bq/cm^2, then “Act” characters are periodically displayed on the LCD of the radiometer and the dimension of the measurement result goes blank (8) (Figure 2.10).

2.3.3.8.10 Further work with the radiometer during measurements of alpha radiation intensity characteristics is similar to that used when measuring photon ionizing radiation intensity characteristics as given in 2.3.3.6.6 ... 2.3.3.6.30 of this OM.

2.3.3.8.11 Segments of the instantaneous value indicator during measurement of alpha radiation characteristics are highlighted as follows. Given the intensity, which corresponds to the pulse frequency of 2 cps from the alpha, beta, gamma counter, the first segment of the indicator is highlighted.

The greater the intensity of alpha radiation, the more segments of the indicator become highlighted from left to right. The scale becomes fully highlighted when the intensity equals to 3100 cps from the alpha, beta, gamma counter. Alpha-particles flux density is about $420 \times 10^3/(cm^2 \cdot min)$ in this case.

2.3.3.9 Display mode of photon ionizing radiation DE

You can switch to this mode from any other operating mode of the radiometer by shortly pressing MODE button. This mode follows the mode of display of ionizing radiation intensity characteristics. In this mode, the accumulated DE value of photon ionizing radiation and the DE accumulation time are displayed.

To correctly measure photon ionizing radiation DE, the window of the alpha, beta, gamma counter must be closed with Cover “1” (the energy compensating filter).

2.3.3.9.1 The following information is displayed on the LCD of the radiometer (Figure 2.11):

- “dOSE” symbols (1) – an indication of the mode;
- “γ” symbol (2) – an indication of the measured radiation type;
- alarm clock symbol (3) (if the alarm clock is on);
- battery status symbol (4);
- measurement result (5);
- dimension of measurement result (6) μSv, mSv or Sv;
- DE accumulation time or “StOP” symbols (7).

Figure 2.11 - LCD of the radiometer
(display mode of photon ionizing radiation DE)

2.3.3.9.2 The DE value is displayed in μSv, mSv or in Sv. DE accumulation time is displayed in two formats. As long as the DE accumulation time is less than 100 hours, it is displayed in the "HH:MM" format, where HH is the hour value and MM is the minute value of DE accumulation time. Hour values and minute values are separated by a non-blinking ":" symbol.

When the DE accumulation time exceeds 100 hours, it is displayed in the "HHHH" format, where HHHH is the hour value of DE accumulation time. The ":" symbol is missing.

2.3.3.9.3 The accumulation process of photon ionizing radiation DE begins since the radiometer is turned on and it takes place in all modes of its operation, while in the mode of measuring the characteristics of ionizing radiation intensity, "γ" radiation type is selected. When you change the type of radiation from "γ" to another one – the process of DE accumulation stops.

When you change the type of radiation to “γ” – the process of DE accumulation is restored. “StOP” symbols (7) on the LCD of the radiometer mean that the DE accumulation process was stopped (Figure 2.11).

2.3.3.9.4 When the DE value exceeds the alarm threshold level, the radiometer starts generating a two-tone sound signal and the ALARM LED flashes red (10). Measurement results start blinking on the LCD of the radiometer. Periodic and gradual (from left to right) highlighting of the sound symbol segments (4) serves as an indication of the threshold level exceeding as well (Figure 2.1).

2.3.3.9.5 To view the alarm threshold level, press the THRESHOLD button. The threshold level is displayed on the LCD (Figure 2.12) for as long as the THRESHOLD button is pressed and held (but not more than 2 s).

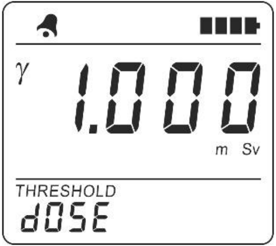

Figure 2.12 - LCD of the radiometer
(viewing the value of the DE alarm threshold level)

2.3.3.9.6 If you continue holding down THRESHOLD button, the radiometer enters the programming submode of the new value of the alarm threshold level (Figure 2.13). A stripe (1) “moving” across the instantaneous value indicator and a blinking low-order digit (2) of a new threshold level serve as an indication of this submode. After that release THRESHOLD button.

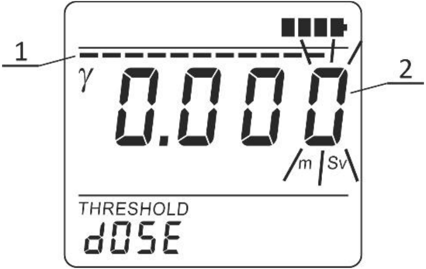

Figure 2.13 – LCD of the radiometer
(submode of programming the DE alarm threshold level triggering)

When a digit is blinking, it means that its value can be programmed. Use THRESHOLD button to set the required value of the blinking digit. Successive short presses and releases of THRESHOLD button change this value per unit. A long press of THRESHOLD button starts automatic change of this value, which stops after THRESHOLD button is released.

A short press of MODE button saves the value of the digit (it stops blinking) and allows changing the value of the next digit, which starts blinking at that. All other digits are programmed likewise.

If there is no need to program all digits of the new threshold level, you can complete the programming of the threshold level and proceed to programming of a new specified limit of statistical deviations by briefly pressing SAVE button.

2.3.3.9.7 After programming the alarm threshold level, its value flashes three times on the LCD, which means that the radiometer saved it in the nonvolatile memory. After that, the radiometer returns to the display mode of photon ionizing radiation DE.

Important! If the submode of the new value programming of the alarm threshold level is paused for more than 30 seconds (i.e., the user presses no buttons of the radiometer), the latter automatically returns to the mode of photon ionizing radiation DE display. All changes made in the submode of new value programming will be cancelled.

Note. Programming a zero value of the threshold level turns off the alarm.

2.3.3.9.8 To switch to the submode of resetting DE and DE accumulation time, press and hold MODE and THRESHOLD buttons simultaneously until “CLr” and “dOSE” symbols are displayed on the LCD of the radiometer (Figure 2.14).

To cancel the reset, briefly press THRESHOLD button or do not press the buttons for 30 s – the radiometer will automatically return to the mode of photon ionizing radiation DE display.

Briefly press MODE button to confirm resetting DE and DE accumulation time values.

Zeroing will be indicated by three flashes of “CLr” characters on the LCD of the radiometer and the return of the radiometer to the mode of photon ionizing radiation DE display.

Important! If the submode of DE and DE accumulation time value resetting is paused for more than 30 seconds (i.e., the user presses no buttons of the radiometer), the latter automatically returns to the mode of photon ionizing radiation DE display.

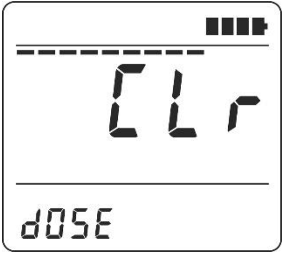

Figure 2.14 - LCD of the radiometer
(DE and DE accumulation time reset submode)

2.3.3.10 Clock mode

This mode can be entered from any other operating mode of the radiometer by shortly pressing the MODE button. This mode follows the mode of displaying the photon ionizing radiation DE.

The radiometer LCD displays the following information in the clock mode (Figure 2.15):

- alarm clock symbol (1) (if the alarm clock is on);
- battery status symbol (2);
- time (3);
- day (4);
- month (5);
- year (6).

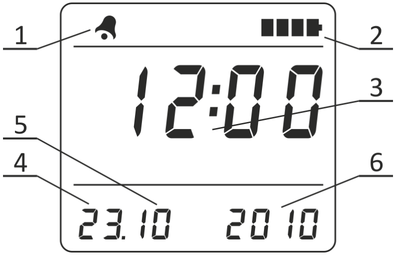

Figure 2.15 – LCD of the radiometer
(clock mode)

To proceed to the submode of time and date correction, press and hold THRESHOLD button until a stripe (1) “moving” across the instantaneous value indicator appears on the LCD, and the digits of minutes (2) start blinking (Figure 2.16).

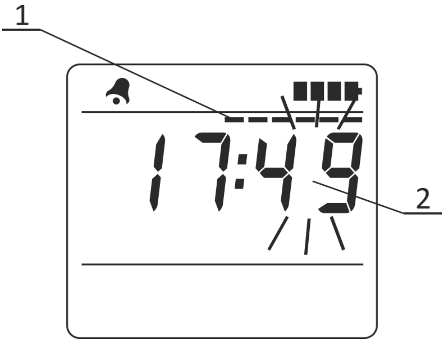

Figure 2.16 – LCD of the radiometer
(submode of time and date correction – time programming)

When digits are blinking, it means that their values can be programmed. Use THRESHOLD button to set the required value. Successive short presses and releases of THRESHOLD button change this value per unit. A long press of THRESHOLD button starts automatic change of this value, which stops after the button is released.

A short press of MODE button saves the values of the minute digits (they stop blinking) and allows changing the values of the hour digits, which start blinking at that. The hour digits are programmed with the help of THRESHOLD button in a similar way to the minute digits programming.

A short press of MODE button saves a new time value in the radiometer memory. The new time value blinks three times on the LCD of the radiometer to show that it has been saved. The year value is then displayed on the LCD (Figure 2.17).

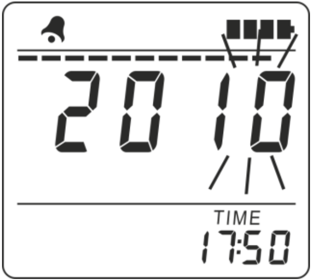

Figure 2.17 – LCD of the radiometer
(submode of time and date correction – year programming)

When the low-order digits of the year are blinking, it means that their values can be programmed. They are programmed with the help of THRESHOLD button in a similar way to the minute digits programming. The year value can be set within the limits from 2010 to 2099.

A short press of MODE button saves a new value of the year in the radiometer memory. The new value of year blinks three times on the LCD of the radiometer to show that it has been saved. The date (1) and month (2) are then displayed on the LCD (Figure 2.18). When the month digits are blinking, it means that their values can be programmed. They are programmed with the help of THRESHOLD button in a similar way to the minute digits programming.

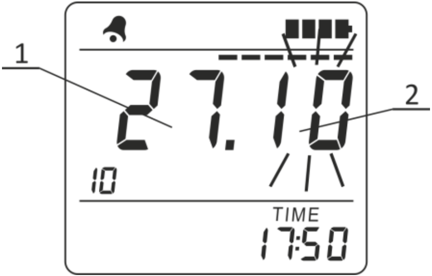

Figure 2.18 – LCD of the radiometer
(submode of time and date correction – date programming)

A short press of MODE button saves the values of the month digits (they stop blinking) and allows changing the values of the date digits, which start blinking at that. The date digits are programmed with the help of THRESHOLD button in a similar way to the hour digits programming.

A short press of MODE button saves a new value of date and month in the radiometer memory. The new value blinks three times on the LCD, and the radiometer returns to the mode of clock.

If there is no need to correct all time and date fields, you can finish the submode of correction at any time by briefly pressing SAVE button. In this case, all corrected values will be saved and the radiometer will return to the clock mode.

Important! If the submode of date and time correction is paused for more than 30 s (the user presses no buttons of the radiometer), the radiometer automatically returns to the clock mode. All changes made and not saved in the radiometer memory will be cancelled.

2.3.3.11 Alarm clock mode

This mode can be entered from any other operating mode of the radiometer by shortly pressing the MODE button. This mode follows the clock mode.

In the mode of alarm clock, the radiometer LCD displays the following information (Figure 2.19):

- alarm clock symbol (1) (if the alarm clock is on);
- battery status symbol (2);
- time of the alarm clock triggering (3);
- current time (4).

To proceed to the submode of programming the alarm clock triggering time, press and hold THRESHOLD button until a stripe (1) "moving" across the instantaneous value indicator appears on the LCD, and the minute digits of alarm clock triggering (2) start blinking (Figure 2.20).

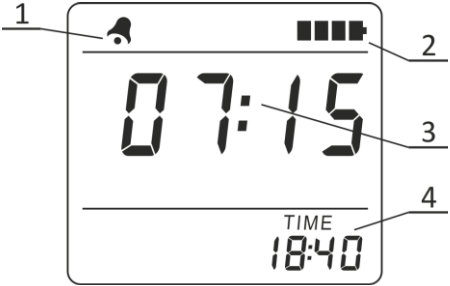

Figure 2.19 – LCD of the radiometer
(alarm clock mode)

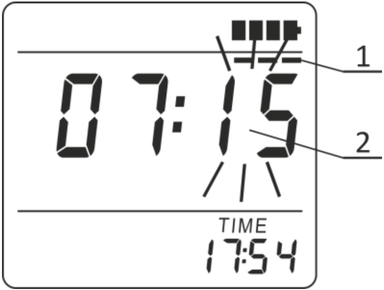

Figure 2.20 – LCD of the radiometer
(submode of the alarm clock triggering time programming)

Minutes and hours of the alarm clock triggering are programmed in a similar way to time correction in the clock mode.

As soon as the alarm clock triggering time is programmed, the alarm clock symbol (1) starts blinking on the LCD of the radiometer (Figure 2.21).

Thus, it becomes possible to turn on/off the alarm clock triggering at a time set in advance. Successive short presses of THRESHOLD button turn the alarm clock on/off.

Each press of THRESHOLD button changes the alarm clock symbol status. The highlighted unblinking alarm clock symbol shows that the alarm clock is on, and the faded one shows that it is off.

Important! If the submode of alarm clock triggering time programming is paused for more than 30 s (the user presses no buttons of the radiometer), the radiometer automatically returns to the alarm clock mode. All changes made in the submode of alarm clock triggering time programming will be cancelled.

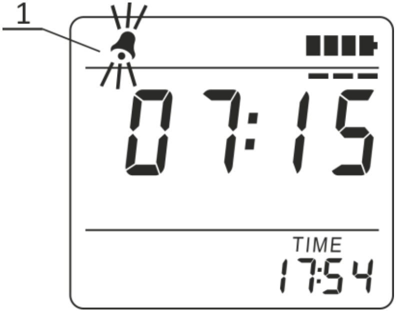

Figure 2.21 – LCD of the radiometer
(submode of the alarm clock triggering time programming)

If the alarm clock is on, and the current time coincides with the alarm clock triggering time, in any of the modes and submodes of the radiometer, except for the time and date correction mode, the alarm clock triggers and the radiometer starts generating typical sound signals – alarm clock signals. The alarm clock symbol will be blinking at that. The alarm clock goes off even if the radiometer is off.

The alarm clock signal can be switched off with a short press of MODE or THRESHOLD button in any operating mode or submode of the radiometer, but for the submodes of new threshold level values programming and the mode of measurement results viewing. If the alarm clock signal is not disabled using the buttons, it turns off automatically in 1 minute after triggering.

If the radiometer was off before the alarm clock goes off, the radiometer enters the clock mode. The radiometer automatically turns off as soon as the alarm clock signal stops ringing (in 1 min). If the user turns off the alarm clock signal before it stops ringing, the radiometer remains on.

2.3.3.12 Bluetooth radio channel control mode

2.3.3.12.1 This mode can be entered from any other operating mode of the radiometer by shortly pressing the MODE button. This mode follows the alarm clock mode.

In the mode of Bluetooth radio channel control the radiometer LCD displays the following information (Figure 2.22):

- alarm clock symbol (1) (if the alarm clock is on);
- battery status symbol (2);
- “PC” symbol (3);
- current time (4).

2.3.3.12.2 To enable the Bluetooth radio channel, briefly press the THRESHOLD button. At the same time, the Bluetooth symbol will be displayed on the radiometer LCD, the “PC” symbols will start flashing and the radiometer will become available for connection via BluetoothLE.

The radiometer name will be displayed as “Stora #1234567”, where 1234567 is the device serial number. You can work with the radiometer using the GSEcotestLE (for Android) and RadReaderLE.exe, RadReaderLERealtime.exe (for Windows).

In case of successful connection with the PC and start of data communications, the radiometer LCD displays a stripe (1) (Figure 2.23), “moving” across the instantaneous value indicator.

The measured value of photon ionizing radiation DE and the DE accumulation time; measurement results stored in non-volatile memory can be transferred from the radiometer to the PC during information exchange.

You can reset the DE value and DE accumulation time; erase the measurement results stored in nonvolatile memory; set the radiometer clock according to the PC clock.

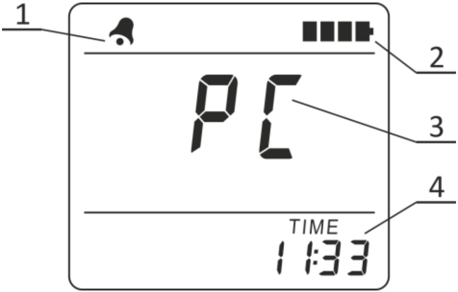

Figure 2.22 – LCD of the radiometer
(Bluetooth radio channel control mode)

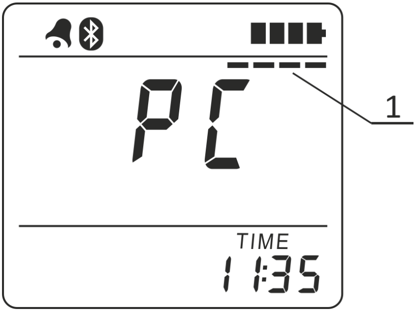

Figure 2.23 – LCD of the radiometer
(Bluetooth radio channel control mode)

During data communications, the radiometer can operate in the mode of IDU. The radiometer sends to the PC the following:

- current measurement results;
- current value of the accumulated DE of photon ionizing radiation, as well as the DE accumulation time;
- current value of the supply voltage,

and also receives commands from the PC to change the measurement modes.

You can set the radiometer time according to the PC clock and the alarm thresholds for future independent operation.

In the event of a loss of connection with the PC, the radiometer LCD displays the symbols “Er05”. A short press of the MODE button returns the radiometer to the Bluetooth radio channel control mode.

Before establishing a connection with the PC, the Bluetooth radio channel can be turned off by a short press of the MODE button. At the same time, the Bluetooth symbol will disappear from the radiometer LCD and the "PC" symbols will stop flashing.

When the connection with the PC is established, control of the radiometer is completely transferred to the PC. Data communication can only be completed using the controls of the application that is connected to the radiometer.

2.3.3.13 Mode of measurement results viewing stored in the nonvolatile memory.

2.3.3.13.1 If the nonvolatile memory of the radiometer contains saved measurement results, this mode can be entered from any other operating mode of the radiometer by shortly pressing the MODE button. This mode follows the Bluetooth radio channel control mode.

In the mode of measurement results viewing stored in the nonvolatile memory, the radiometer LCD displays the following information (Figure 2.24):

- “rEAd” (1) and “Arch” (2) symbols (an indication of this mode);
- alarm clock symbol (3) (if the alarm clock is on);
- battery status symbol (4);
- number of measurement results saved in the nonvolatile memory (5).

Press shortly the THRESHOLD button to view the measurement results saved in the nonvolatile memory. The LCD of the radiometer displays the following information (Figure 2.25):

- indicator of measurement results location in the nonvolatile memory (1);
- alarm clock symbol (2) (if the alarm clock is on);
- battery status symbol (3);
- measurement result (4);
- measurement object number (5);
- measurement time (6).

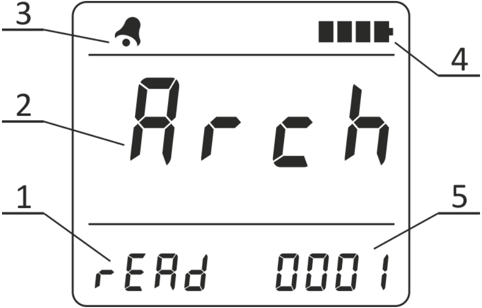

Figure 2.24 – LCD of the radiometer
(mode of measurement results viewing saved in the nonvolatile memory)

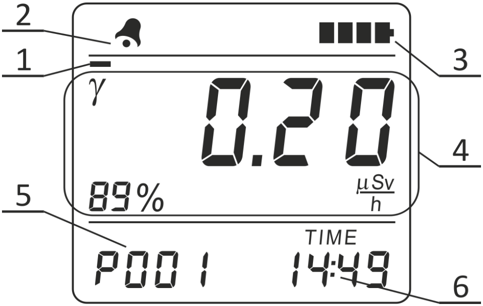

Figure 2.25 – LCD of the radiometer
(measurement results viewing)

During viewing, if the user presses no buttons of the radiometer, zones (5) and (6) of the LCD alternatively display the measurement object number and measurement time, or the date and year of measurement.

The indicator of location (1) shows a place of the measurement result (4) in the nonvolatile memory. The leftmost position of the location indicator corresponds to the beginning of the nonvolatile memory, i.e. the oldest measurement result (the measurement result that was saved first). The rightmost position corresponds to the end of the nonvolatile memory, i.e. the newest measurement result (the measurement result that was saved last). If the nonvolatile memory contains only one measurement result, all segments are highlighted on the location indicator.

Shortly press MODE and THRESHOLD buttons to handle measurement results viewing. A short press of the MODE button allows you to view the next measurement result, which was saved later than the measurement result currently displayed on the LCD.

A short press of THRESHOLD button allows you to view the previous measurement result, which was saved before the measurement result currently displayed on the LCD.

The LCD of the radiometer displays the measurement object number and the time of measurement along with each measurement result.

To exit the mode of measurement results viewing stored in the nonvolatile memory, press and hold THRESHOLD button (circa 6 seconds) until the radiometer enters the mode of photon ionizing radiation DER measurement.

To clear measurement results stored in the nonvolatile memory, simultaneously press and hold MODE and THRESHOLD buttons until “CLr” and “Arch” symbols appear on the LCD of the radiometer (Figure 2.26).

Figure 2.26 – LCD of the radiometer
(submode of measurement results clearing stored in the nonvolatile memory)

To cancel clearing, shortly press THRESHOLD button or do not press the buttons during 30 s (the radiometer will automatically enter the mode of measurement results viewing stored in the nonvolatile memory).

To confirm clearing of measurement results stored in the nonvolatile memory, shortly press MODE button.

“CLr” symbols that blink three times on the LCD of the radiometer, and return of the radiometer to the mode of photon ionizing radiation DER measurement mean that the values have been cleared.

Important! If the submode of measurement results clearing stored in the nonvolatile memory is paused for more than 30 s (the user presses no buttons of the radiometer), the radiometer automatically returns to the mode of measurement results viewing without measurement results clearing.

3 TECHNICAL MAINTENANCE

3.1 Technical maintenance of the radiometer

3.1.1 **General instructions**.

The list of operations performed during technical maintenance (hereinafter called TM) of the radiometer, the order and peculiarities of operational phases are presented in Table 3.1.

Table 3.1 – List of operations during technical maintenance

Operations	TM type			OM item No.
	During		During long-term storage	
	Everyday use	Periodical use (annually)		
External examination	+	+	+	3.1.3.1
Delivery kit completeness check	-	+	+	3.1.3.2
Operability check	+	+	+	3.1.3.3
Batteries switching off and their status control	-	-	+	3.1.3.4
Verification of the radiometer	-	+	+	3.2

Note. "+" means the operation is applicable for this type of TM; "-" means the operation is not applicable.

3.1.2 **Safety measures**

TM safety measures fully comply with safety measures stated in item 2.3.1 of the present OM.

3.1.3 **Maintenance procedure of the radiometer**

3.1.3.1 External examination

External examination of the radiometer should be performed in the following order:

a) check the technical condition of surface, inspect for integrity of seals, absence of scratches, traces of corrosion, surface damage;

b) check the condition of clamps in the battery compartment.

3.1.3.2 Delivery kit completeness check

Check if the delivery kit is complete according to Table 1.2.

3.1.3.3 Operability check of the radiometer

3.1.3.3.1 Operability check of the radiometer is performed according to item 2.2.3 of the present OM.

3.1.3.3.2 Order of pre-repair fault detection and rejection

Use the following criteria to evaluate the necessity of sending the radiometer for repair and the type of repair:

- for mid-life repair:

a) deviation of parameters from reference values during periodical verification of the radiometer;

b) minor defects of the LCD that do not affect the correct readings of measurement results;

c) no LCD backlight;

d) no sound alarm;

- for major repair:

a) at least one non-operating measurement channel;

b) defects of the LCD that affect the correct readings of measurement results;

c) serious mechanical damages of the component parts that affect the security access to the radiometer circuit.

3.1.3.4 Batteries switching off and their status control

The batteries should be switched off each time before a long-term storage of the radiometer. Do this as follows:

- switch off the radiometer;
- open the lid of the battery compartment;
- remove the batteries;
- examine the battery compartment, check the contact clamps accuracy, clean the battery compartment from contamination and contact clamps from oxides;
- make sure there is no humidity, no salt spots on the surface of batteries, and no damages of the insulated coating.

3.1.3.5 Replacing the protective gasket of Cover “3” (alpha filter).

In the case of damage to the protective gasket, it should be replaced with the new one included in the delivery kit.

Do the following:

- unscrew the four screws securing the holder and the protective grids with the gasket in the lowering of the cover and remove them;
- replace the damaged gasket between the two grids;
- install the grids with a new gasket in place and fix them with the holder and screws.

3.2 Verification of the radiometer

The radiometers should be verified after manufacture, repair or during use (periodically, at least once a year).

3.2.1 Verification operations

During verification, the operations presented in Table 3.2 should be performed.

Table 3.2 – Verification operations

Operation	Verification technique No.
External examination	3.2.4.1
Testing	3.2.4.2
Calculation of the main relative error during photon ionizing radiation DER measurement	3.2.4.3
Calculation of the main relative error during photon ionizing radiation DE measurement	3.2.4.4
Calculation of the main relative error during measurement of surface beta-particles flux density	3.2.4.5
Calculation of the main relative error during measurement of surface alpha-particles flux density	3.2.4.6

3.2.2 **Verification facilities**

The following measuring instruments and equipment should be used for verification:

- УПГД-3В testing equipment with standard ^{137}Cs gamma radiation sources;
- standard sources of 4СО type on a hard pad, containing ^{90}Sr + ^{90}Y radionuclides;
- standard sources of 4П9 type on a hard pad, containing ^{239}Pu radionuclide;
- gamma radiation source ^{137}Cs of ОСГИ type (sample spectrometric gamma sources);
- standard stop-watch.

All verification facilities should obtain valid Verification Certificates or State Metrological Certification.

Note. Use of other standard measuring equipment with the accuracy prescribed in 3.2.2 is allowed.

3.2.3 **Verification conditions**

Verification should be performed in compliance with the following conditions:

- ambient air temperature range within (20±5) °C;
- relative air humidity from 30 to 80 %;
- atmospheric pressure from 86 kPa to 106.7 kPa;
- natural background level of gamma radiation should not exceed 0.30 μSv/h;
- power supply voltage within (3.0± 0.2) V.

3.2.4 **Verification procedure**

3.2.4.1 External examination

During external examination, the radiometer should meet the following requirements:

- the delivery kit should be completed as stated in item 1.3.1 of the present OM;
- labelling should be accurate;

- Quality Control Department seals should not be violated;
- the radiometer should be free from mechanical damage that may affect its performance.

Note. The delivery kit completeness is checked only at manufacture.

3.2.4.2 Testing

Switch on the radiometer and program zero values of audio alarm threshold levels of each measuring channel. Afterwards switch on the mode of photon ionizing radiation DER measurement and place the radiometer near ^{137}Cs gamma radiation source of ОСГИ type. Observe an increase of DER readings on the LCD upon the background level and sound signaling at detecting gamma quanta by the counter.

3.2.4.3 Calculation of the main relative error during measurement of photon ionizing radiation DER.

Prepare the УПГД-3В testing equipment for operation according to its operating manual.

Prepare the radiometer for photon ionizing radiation DER measurement (hereinafter called DER) according to item 2.3.3.6 of the OM. Program 3 % value of the specified limit of statistical deviations.

Secure the radiometer in the УПГД-3В carriage holder so that the mechanical center of the gamma ray beam coincides with the center of the detector.

Place the УПГД-3В carriage together with the radiometer in the position, where DER from ^{137}Cs source is 800 μSv/h, and wait until the estimated level of statistical deviations of DER measurement results goes down to the value of not more than 3 %. Then enter five DER measurement results with 5 s interval in the report.

Calculate the average DER value and the main relative error during measurement, expressed as a percentage, according to the recommendations of DSTU GOST 8.207:2008 standard.

The radiometer is acknowledged to have passed the verification if the relative main error in percentage when measuring DER does not exceed 15+2/M, where M is a dimensionless value that is numerically equal to the value of measured DER in μSv/h.

3.2.4.4 Calculation of the main relative error during measurement of photon ionizing radiation DE.

Prepare the УПГД-3В testing equipment for operation according to its operating manual.

Prepare the radiometer for photon ionizing radiation DE measurement according to item 2.3.3.9 of the OM. Reset the values of DE and DE accumulation time.

Secure the radiometer in the УПГД-3В carriage holder so that the mechanical center of the gamma ray beam coincides with the detector center.

Place the УПГД-3В carriage together with the radiometer in the position, where DER from ^{137}Cs source is 800 μSv/h.

Record the initial DE value of and turn on the stopwatch at the same time.

Take the DE measurement result after 60 min (by stopwatch) of irradiation, subtract the initial DE value, calculate the main relative error during measurement, expressed as a percentage, in accordance with DSTU GOST 8.207:2008, and enter these values in the report.

The radiometer is acknowledged to have passed the verification if the main relative error when measuring DE does not exceed ±15 %.

3.2.4.5 Calculation of the main relative error during measurement of surface beta-particles flux density.

Prepare the radiometer for measurement of surface beta-particles flux density in accordance with section 2.3.3.7 of this OM. Program the values of the specified limit of statistical deviations equal to 3%. With the installed Cover "2" (alpha, beta filter) measure and save the values of gamma radiation component, the estimated limit of statistical deviations of the result of this measurement should not exceed 15%. After saving the gamma component, it is necessary to replace Cover "2" with Cover "3" (alpha filter).

Place the radiometer above the surface of 4CO source, which provides a surface beta-particles flux density of 50,000 to 100,000 part./(cm^2·min) in such a way that the working surface of the detector is completely located above the active surface of the source.

Wait for the decrease of the estimated limit of statistical deviations of measurement results of surface beta-particles flux density to a value not exceeding 3 %. After that, enter five measurement results in the report with a 5-second interval.

Calculate the average value of surface beta-particles flux density and main relative error of measurement in accordance with the recommendations of DSTU GOST 8.207:2008 standard.

The radiometer is acknowledged to have passed the verification if the main relative error in percentage when measuring surface beta-particles flux density does not exceed 20+150/F, where F is a dimensionless value that is numerically equal to the value of measured beta-particles flux density in part./(cm^2·min).

3.2.4.6 Calculation of the main relative error during measurement of surface alpha-particles flux density.

Prepare the radiometer for measurement of surface alpha-particles flux density in accordance with section 2.3.3.8 of this OM.

Program the value of the specified limit of statistical deviations equal to 3 %. With the installed Cover “3” (alpha filter) measure and save the values of gamma and beta radiation component, the estimated limit of statistical deviations of the result of this measurement should not exceed 15%. After saving the gamma, beta component, it is necessary to replace Cover “3” with Cover “4” (grid).

Place the radiometer above the surface of 4П9 source, which provides a surface alpha-particles flux density of 50,000 part./(cm^2·min) to 100,000 part./(cm^2·min) in such a way that the working surface of the detector is completely located above the active surface of the source.

Wait for the decrease of the estimated limit of statistical deviations of measurement results of surface alpha-particles flux density to a value not exceeding 3 %.

Calculate the average value of surface alpha-particles flux density and main relative error of measurement in accordance with the recommendations of DSTU GOST 8.207:2008 standard.

The radiometer is acknowledged to have passed the verification if the main relative error in percentage when measuring surface alpha-particles flux density does not exceed 20+150/A, where A is a dimensionless value that is numerically equal to the value of measured alpha-particles flux density in part./($cm^2 \cdot min$).

3.2.4.7 Presentation of verification results.

3.2.4.7.1 Satisfactory results of periodic verification and calibration after repair are certified in the Table of Appendix E or by issuing a certificate of verification of the legally regulated means of measuring equipment.

3.2.4.7.2. If, as a result of verification, the radiometer is found to be unsuitable for use, it gets the Certificate of Inadequacy.

4 CERTIFICATE OF ACCEPTANCE

RKS-01 “STORA-ABG” radiometer-dosimeter of BICT.412129.040-02 type with ________________ serial number meets the ТУ У 26.5-22362867-056:2018 technical requirements, is verified and accepted for use.

Date of issue ______________________

Seal here QCD representative: __________________
(signature)

5 PACKING CERTIFICATE

RKS-01 “STORA-ABG” radiometer-dosimeter of BICT.412129.040-02 type with ____________________ serial number is packed by the Private Enterprise “SPPE “Sparing-Vist Center” in accordance with the requirements specified in ТУ У 26.5-22362867-056:2018.

Date of packing ________________________

Seal here

Packed by: ____________________
(signature)

Packed product accepted by: ____________________
(signature)

6 WARRANTY

6.1 The manufacturer guarantees the conformity of the radiometer with the technical requirements if the customer observes the guidelines for its use, shipping and storage presented in the operating manual BICT.412129.040-02 HE.

6.2 The warranty period of the radiometer use shall terminate and be of no further effect in 24 months after the date of putting it into operation or after the warranty period of storage terminates.

6.3 The warranty period of storage of the radiometer is 6 months after its manufacture date.

6.4 Free of charge repair or replacement during the warranty period of use is performed by the producer enterprise if the customer observes the guidelines for its use, shipping and storage.

6.5 If the defect (according to the claim) is eliminated, the warranty period is prolonged for the time when the radiometer was not used because of the detected defects.

6.6 The batteries failure is not the reason for claim after their warranty period expires.

7 REPAIR

7.1 In case of failure or troubles during the warranty period of the radiometer, the user should contact the producer enterprise by e-mail (see below) to receive the address of the nearest service center:

PE "SPPE "Sparing-Vist Center"
Tel.: (+380 32) 242-15-15; Fax: (+380 32) 242-20-15;
E-mail: sales@ecotest.ua.

7.2 All claims are registered in Table 7.1.

Table 7.1

Date of failure	Claim summary	Action taken	Note

7.3 Warranty and post-warranty repair is carried out only by the manufacturer. Information on the repair of the radiometer is recorded in the Table of Appendix F of this OM.

8 STORAGE

8.1 The radiometers should be stored in a packing box in heated and ventilated storehouses with air-conditioning at the ambient temperature from +5 to +40°C and relative humidity up to 80 % at +25°C temperature, non-condensing. The storehouse should be free of acids, gas, vapors of organic solvents, and alkali that may cause corrosion.

8.2 The location of the radiometers in storehouses should ensure their free movement and access to them.

8.3 The radiometers should be stored on the shelves.

8.4 The distance between the walls, the floor and the radiometers should not be less than 100 mm.

8.5 The distance between the heating gadgets of the storehouse and the radiometers should not be less than 0.5 m.

8.6 The average shelf life is not less than 6 years.

8.7 Additional information on storage, check during storage and maintenance of the radiometer is recorded in Appendices B, C and G of this OM.

9 TRANSPORTATION

9.1 Packed radiometers may be transported by any kinds of closed transport vehicles under the conditions with temperature limitation in the range of -25 to 55 ºC, and according to rules and standards effective for each means of transport.

9.2 The radiometers in transport container should be placed and fixed in the vehicle to ensure their stable position and to avoid shocks (with each other and the sidewalls of the vehicle).

9.3 The radiometers in transport container endure:

- temperature from - 25 to + 55 ºC;
- relative humidity (95±3) % at + 35 ºC temperature;
- shocks with acceleration of 98 m/s^2, a shock pulse duration of 16 ms (number of shocks - (1000±10) in each direction).

9.4 Canting is forbidden.

10 DISPOSAL

Disposal of the radiometer is carried out in accordance with DSTU 4462.3.01:2006, DSTU 4462.3.02:2006, Laws of Ukraine “On Environmental Protection” and “On Waste”.

Disposal of the radiometer is not dangerous for service personnel, and is environmentally friendly.

Note. In case of contamination of the radiometer with liquid or bulk substances containing radionuclides and the impossibility of its complete deactivation, the radiometer must be disposed of as solid radioactive waste at the special enterprises (USC Radon).

APPENDIX A

Anisotropy (horizontal plane)

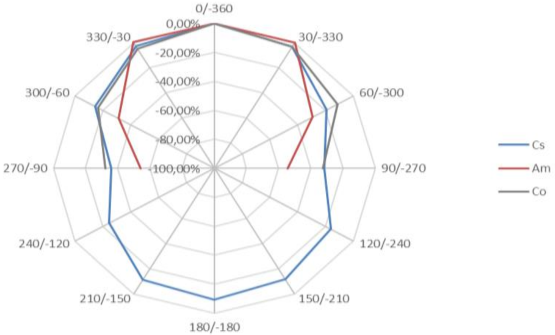

Figure A.1

APPENDIX A

Anisotropy (vertical plane)

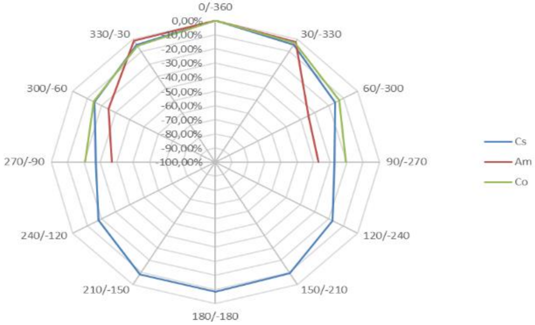

Figure A.2

APPENDIX B

PUTTING IN PROLOGED STORAGE AND REMOVAL FROM STORAGE

Date of putting in prolonged storage	Storage method	Date of removal from prolonged storage	Name or symbol of the company in charge of putting or removing from prolonged storage	Date, position and signature of the responsible person

APPENDIX C

STORAGE

Date		Storage conditions	Position, name and signature of the responsible person
of placing in storage	of removing from storage		

APPENDIX D

TROUBLE RECORD DURING USE

Date and time of failure. Operating mode	Type (manifesta-tion) of trouble	Cause of trouble, number of operation hours of the failed element	Action taken and claim note	Position, name and signature of the person responsible for solving the problem	Note

APPENDIX E

PERIODIC VERIFICATION OF KEY SPECIFICATIONS

Tested specification		Date of measurement			
Name	Value according to technical specifications	Year 20		Year 20	
		Actual value	Measured by (position, signature)	Actual value	Measured by (position, signature)
1 Main relative error of the radiometer when measuring photon ionizing radiation DER with a confidence probability of 0.95, %	15+2/M, where M is a numeric value of the measured DER, µSv/h				

APPENDIX E

E-1

Date of measurement					
Year 20		Year 20		Year 20	
Actual value	Measured by (position, signature)	Actual value	Measured by (position, signature)	Actual value	Measured by (position, signature)

APPENDIX E

Tested specification		Date of measurement			
		Year 20		Year 20	
Name	Value according to technical specifications	Actual value	Measured by (position, signature)	Actual value	Measured by (position, signature)
2 Main relative error of the radiometer when measuring surface beta-particles flux density with a confidence probability of 0.95, %	20+150/F, where F is a numeric value of measured surface beta-particles flux density, part./($cm^2 \cdot min$)				

APPENDIX E

E-2

Date of measurement					
Year 20		Year 20		Year 20	
Actual value	Measured by (position, signature)	Actual value	Measured by (position, signature)	Actual value	Measured by (position, signature)

APPENDIX E

Tested specification		Date of measurement			
		Year 20		Year 20	
Name	Value according to technical specifications	Actual value	Measured by (position, signature)	Actual value	Measured by (position, signature)
3 Main relative error of the radiometer when measuring surface alpha-particles flux density with a confidence probability of 0.95, %	20+150/A, where A is a numeric value of measured surface alpha-particles flux density, part./($cm^2 \cdot min$)				

E-3

Date of measurement					
Year 20		Year 20		Year 20	
Actual value	Measured by (position, signature)	Actual value	Measured by (position, signature)	Actual value	Measured by (position, signature)

APPENDIX E

Tested specification		Date of measurement			
		Year 20		Year 20	
Name	Value according to technical specifications	Actual value	Measured by (position, signature)	Actual value	Measured by (position, signature)
4 Main relative permissible error limit when measuring photon ionizing radiation DE at ^{137}Cs calibration with a confidence probability of 0.95, %	±15				

APPENDIX E

E-4

Date of measurement					
Year 20		Year 20		Year 20	
Actual value	Measured by (position, signature)	Actual value	Measured by (position, signature)	Actual value	Measured by (position, signature)

APPENDIX F
REPAIR

Name and type of the component part of the radiometer	Reason for repair	Date		Name of the repair organization	Number of operation hours before repair
		of arriving for repair	of repair completion		

APPENDIX F
REPAIR

Type of repair (mid-life, major, etc.)	Name of repair works	Position, name and signature of the responsible person	
		who performed repair	who accepted after repair

APPENDIX G

VERIFICATION AND INSPECTION RESULTS

Date	Verification or inspection type	Verification or inspection result	Position, name and signature of the person responsible for inspection	Note