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MKS-UM
MULTIPURPOSE
DOSIMETER-RADIOMETER

Operating manual

CONTENTS

This operating manual, (hereinafter OM) is intended to inform the user about the principles of operation and rules of application of MKS-UM multipurpose dosimeter-radiometer (hereinafter dosimeter). The OM contains all information necessary for proper operation and full realization of its technical possibilities.

The OM contains the following abbreviations:

DE	- ambient dose equivalent;
DER	- ambient dose equivalent rate;
LCD	- liquid crystal display;
BG probe	- BDKS-01 combined detecting unit of beta and gamma radiation;
ABG probe	- BDKS-02 combined detecting unit of alpha, beta and gamma radiation;
cps	- count per second.

1 DESCRIPTION AND OPERATION

1.1 Purpose of use

The MKS-UM multipurpose dosimeter-radiometer (hereinafter the dosimeter) is designed for:

- measurement of gamma and X-ray radiation DER (hereinafter referred to as photon-ionizing radiation);
- indication of pulse count rate from photon-ionizing radiation detectors;
- measurement of photon-ionizing radiation DE;
- measurement of photon-ionizing radiation DE accumulation time;
- measurement of surface beta-particles flux density;
- measurement of surface activity of beta-emitting radionuclides;
- indication of pulse count rate from beta radiation detectors;
- measurement of surface alpha-particles flux density;
- measurement of surface activity of alpha-emitting radionuclides;
- indication of pulse count rate from the alpha radiation detector;
- archiving measurement results with reference to location coordinates.

The dosimeter can be used within the radiation monitoring system of Ukraine, including:

- State Emergency Service;
- civil defense services;
- radiological monitoring service in the field of nuclear power engineering;
- radiologic laboratories;
- radioactive waste management companies;
- other institutions dealing with radioactive materials.

1.2 **Technical Specifications**

1.2.1 Key specifications are presented in Tables 1.1 – 1.3.

Table 1.1 – Key specifications of the control unit of the MKS-UM dosimeter-radiometer (hereinafter the control unit)

Name	Measurement unit	Standardized value according to the specification
Measurement range of photon-ionizing radiation DER	μSv/h	$10^{-1} – 10^{6}$
Indication range of pulse count rate from gamma radiation detector	cps	0 – 9999
Measurement range of photon-ionizing radiation DE	mSv	0.001 to 9 999
Main relative permissible error limit during DER measurement at ^{137}Cs calibration with 0.95 confidence probability	%	15+2/$\dot{H}^{*}(10)$, where $\dot{H}^{*}(10)$ – is a dimensionless quantity, numerically equal to DER value measured in μSv/h
Main relative permissible error limit during DE measurement at ^{137}Cs calibration with 0.95 confidence probability	%	15
Energy range of recorded photon-ionizing radiation	MeV	0.05 – 3.00
Energy dependence during photon-ionizing radiation DER and DE measurement in the energy range from 0.05 MeV to 1.25 MeV, relative to 0.662 MeV energy, not more than	%	± 30
Anisotropy in the solid angle of ± 60 ^{0} relative to the basic direction of measurement, marked by "+" symbol, not more than: - for ^{137}Cs and ^{60}Co radionuclides; - for ^{241}Am radionuclide	%	 25 60
Measurement range of DE accumulation time		1 min – 9999 hrs

Table 1.1 (continued)

Name	Measure-ment unit	Standardized value according to the specification
Accuracy of DE accumulation time measurement for 24 hrs	Min	±1
Operating supply voltage of the dosimeter from Li-Ion battery	V	3.7
Additional relative permissible error limit during measurement caused by supply voltage deviation from the reference value in the voltage range from 3.4 V to 4.2 V, for all measured physical quantities, not more than	%	5
Additional relative permissible error limit during measurement caused by deviation of environmental temperature from 20ºC in the temperature variation range from –30 ºC to +55 ºC	%	5 per each 10 ºC deviation from 20 ºC
Operating mode setup time while the control unit is exposed to photon-ionizing radiation with DER equal to 5 μSv/h, not more than	min	5
Time of continuous operation of the dosimeter powered from a fully charged, Li-Ion battery of 4000 mAh capacity under normal climatic conditions: - at gamma background up to 0.5 μSv/h when ABG/BG probes are disconnected and the display backlight and GPS-receiver are switched off, not less than - at gamma background up to 0.5 μSv/h when ABG/BG probes are disconnected, the display backlight and GPS-receiver are switched on, not less than - when ABG or BG probe is connected in the mode of any radiation type measurement, the display backlight and GPS-receiver are switched off, not less than - when ABG or BG probe is connected in the mode of any radiation type measurement, the display backlight and GPS-receiver are switched on, not less than	hrs	1200 70 300 50

Table 1.1 (end)

Name	Measurement unit	Standardized value according to the specification
Unstable readings of the dosimeter during DER measurement for an 8-hour continuous operation, not more than	%	5
Dimensions of the control unit (in hard shell with solar panel), not more than	mm	166 × 70 × 132
Weight of the control unit, not more than	kg	0.7
Weight of the control unit (in hard shell with solar panel), not more than	kg	1.3

Table 1.2 – Key specifications of the BDKS-01 combined detecting unit of gamma, beta radiation (hereinafter referred to as BG Probe)

Name	Measurement unit	Standardized value according to the specification
Measurement range of photon-ionizing radiation DER	μSv/h	10^{-1} – 10^{7}
Indication range of pulse count rate from gamma radiation detector	cps	0 – 9999
Main relative permissible error limit during photon-ionizing radiation DER measurement at ^{137}Cs calibration with 0.95 confidence probability	%	15+2/$\dot{H}^{*}(10)$, where $\dot{H}^{*}(10)$ – is a dimensionless quantity, numerically equal to DER value measured in μSv/h
Energy range of recorded photon-ionizing radiation	MeV	0.05 – 3.00
Anisotropy in a solid angle of ± 60 ^{0} relative to the basic direction of measurement, marked by "+" symbol, not more than: - for ^{137}Cs and ^{60}Co radionuclides; - for ^{241}Am radionuclide	%	 25 60
Additional relative permissible error limit during measurement of photon-ionizing radiation DER caused by deviation of environmental temperature from 20°C in the temperature variation range from –30 °C to +55 °C	%	5 per each 10 °C deviation from 20 °C
Operating mode setup time while the BG probe is exposed to photon-ionizing radiation with DER equal to 5 μSv/h, not more than	min	1
Operating mode setup time when measuring surface beta-particles flux density and surface activity of beta-emitting radionuclides, not more than	min	1
Measurement range of surface beta-particles flux density	part./(cm^{2}×min)	10 – 200 000

Table 1.2 (continued)

Name	Measurement unit	Standardized value according to the specification
Measurement range of surface activity of beta-emitting radionuclides	Bq/cm^2	0.5 – 9 000 for C0 [1)] sources type ($^{90}Sr/^{90}Y$)
Indication range of pulse count rate from beta radiation detector	cps	0 – 9999
Energy range of recorded beta radiation	MeV	0.3 – 3.0
Main relative permissible error limit during measurement of surface beta-particles flux density in the range from 10 part./(cm^2×min) to 200 000 part./(cm^2×min) at $^{90}Sr/^{90}Y$ calibration with 0.95 confidence probability	%	20+200/ F_β, where F_β is a dimensionless quantity, numerically equal to surface beta-particles flux density value measured in part./(cm^2·min)
Main relative permissible error limit during measurement of surface activity of beta-emitting radionuclides in the range from 0.5 Bq/cm^2 to 9000 Bq/cm^2 at $^{90}Sr/^{90}Y$ calibration with 0.95 confidence probability from C0 type source	%	20+10/A_β, where A_β is a dimensionless quantity, numerically equal to surface activity of beta-emitting radionuclides value measured in Bq/cm^2
Area of the detector's sensitivity	cm^2	1
Beta-particles recording efficiency, not less than: - for ^{14}C isotope; - for ^{204}Tl isotope; - for $^{90}Sr/^{90}Y$ isotope	-	- - 0.25
Additional relative permissible error limit during measurement of surface beta-particles flux density and surface activity of beta-emitting radionuclides caused by variation of environmental temperature from –30 to +55 °C	%	5 per each 10°C of deviation from 20°C

Table 1.2 (end)

Name	Measurement unit	Standardized value according to the specification
Unstable readings during measurement of all physical quantities for an 8-hour continuous operation, not more than	%	5
Dimensions of the BG probe, not more than	mm	∅47 × 96 × 176
Weight of the BG probe, not more than	kg	0.3

Table 1.3 – Key specifications of the BDKS-02 combined detecting unit of alpha, beta, gamma radiation (hereinafter referred to as ABG Probe)

Name	Measurement unit	Standardized value according to the specification
Measurement range of photon-ionizing radiation DER	μSv/h	10^{-1} – 2×10^{6}
Indication range of pulse count rate from photon-ionizing radiation detector	cps	0 – 9999
Main relative permissible error limit during measurement of photon-ionizing radiation DER at ^{137}Cs calibration with 0.95 confidence probability	%	$15+2/\dot{H}^{*}(10)$, where $\dot{H}^{*}(10)$ – is a dimensionless quantity, numerically equal to DER value measured in μSv/h
Energy range of detected photon-ionizing radiation	MeV	0.05 – 3.00
Anisotropy in a solid angle of ± 60 ^{0} relative to the basic direction of measurement, marked by "+" symbol, not more than: - for ^{137}Cs and ^{60}Co radionuclides; - for ^{241}Am radionuclide	%	 25 60
Additional relative permissible error limit during measurement of photon-ionizing radiation DER caused by deviation of environmental temperature from 20°C in the temperature variation range from –30 °C to +55 °C	%	5 per each 10°C of deviation from 20°C
Setup time of operating mode while the ABG Probe is exposed to photon-ionizing radiation with DER equal to 5 μSv/h, not more than	min	1
Setup time of operating mode when measuring beta-particles flux density and surface activity of beta-emitting radionuclides, not more than	min	1

Table 1.3 (continued)

Name	Measurement unit	Standardized value according to the specification
Measurement range of surface beta-particles flux density	part./(cm^2×min)	10– 300 000
Measurement range of surface activity of beta-emitting radionuclides	Bq/cm^2	0.5 – 13500 for C0 [1)] sources type (^{90}Sr/^{90}Y)
Indication range of pulse count rate from beta radiation detector	cps	0 – 9999
Energy range of detected beta-particles	MeV	0.15 – 3.0
Main relative permissible error limit during measurement of surface beta-particles flux density in the range from 10 to 300 000 part./(cm^2×min) at ^{90}Sr/^{90}Y calibration with 0.95 confidence probability	%	20+200/ F_β, where F_β is a dimensionless quantity, numerically equal to surface beta-particles flux density value measured in part./(cm^2×min)
Main relative permissible error limit during measurement of surface activity of beta-emitting radionuclides in the range from 0.5 to 13500 Bq/cm^2 at ^{90}Sr/^{90}Y calibration with 0.95 confidence probability from standard source of C0 type	%	20+10/ A_β, where A_β is dimensionless quantity, numerically equal to surface activity of beta-emitting radionuclides value measured in Bq/cm^2
Area of the detector's sensitivity	cm^2	7
Beta-particles detection efficiency, not less than: - for ^{14}C isotope; - for ^{204}Tl isotope; - for ^{90}Sr/^{90}Y isotope	-	 - - 0.4
Additional relative permissible error limit during measurement of surface beta-particles flux density and surface activity of beta-emitting radionuclides caused by variation of environmental temperature from –30 to +55 °C	%	±5 per each 10°C of deviation from 20°C

Table 1.3 (continued)

Name	Measurement unit	Standardized value according to the specification
Measurement range of surface alpha-particles flux density	part./(cm^2×min)	10 – 300 000
Measurement range of surface activity of alpha-emitting radionuclides	Bq/cm^2	0.5 – 10 000 for П9 [2] sources type (^{239}Pu)
Energy range of detected alpha-particles	MeV	from 4.0 to 8.0
Indication range of pulse count rate from alpha radiation detector	cps	0 – 9999
Main relative permissible error limit during measurement of surface alpha-particles flux density in the range from 10 to 300 000 part./(cm^2×min) at ^{239}Pu calibration with 0.95 confidence probability	%	15+300/ F_α, where F_α is a dimensionless quantity, numerically equal to surface alpha-particles flux density value measured in part./(cm^2×min)
Main relative permissible error limit during measurement of surface activity of alpha-emitting radionuclides in the range from 0.5 to 10 000 Bq/cm^2 at ^{239}Pu calibration with 0.95 confidence probability from standard source of П9 type	%	15+15/A_α, where A_α is a dimensionless quantity, numerically equal to surface activity of alpha-emitting radionuclides value measured in Bq/cm^2
Area of the detector's sensitivity	cm^2	7
Alpha-particles detection efficiency from ^{239} Pu isotope, not less than		0.06
Additional relative permissible error limit during measurement of surface alpha-particles flux density and surface activity of alpha-emitting radionuclides caused by variation of environmental temperature from –30 ºC to +55 ºC	%	5 per each 10ºC of deviation from 20ºC

Table 1.3 (end)

Name	Measurement unit	Standardized value according to the specification
Setup time of operating mode when measuring alpha-particles flux density and surface activity of alpha-emitting radionuclides, not more than	min	1
Unstable readings during measurement of all physical quantities during an 8-hour continuous operation, not more than	%	5
Dimensions of the ABG probe, not more than	mm	72 ×186 × 53
Weight of the ABG probe, not more than	kg	0.7

[1] – efficiency of C0 sources type accounts for 0.377
[2] – efficiency of П9 sources type accounts for 0.490

1.2.2 The dosimeter ensures automatic subtraction of gamma radiation component during measurement of beta radiation parameters.

1.2.3 The dosimeter allows storing up to 1500 measurement results in the non-volatile memory. For easier identification, each measurement result is recorded with information about measurement time, geographical coordinates of measurement and a reference three-digit number of measurement object, which is entered during recording.

1.2.4 The dosimeter provides for automatic recording of photon-ionizing radiation DE accumulation history in its nonvolatile memory. The nonvolatile memory capacity ensures saving up to 2200 DE values. Saving frequency depends on DER and falls within 10 to 1 minute. DE is saved additionally when you turn the dosimeter on and off.

1.2.5 The dosimeter beeps at detection of every gamma quantum, alpha- or beta-particle.

1.2.6 The dosimeter allows viewing measurement results earlier stored in the nonvolatile memory on its own LCD, and PC communications via the infrared port.

1.2.7 The dosimeter has an analog indicator of measured radiation intensity.

1.2.8 The dosimeter allows programming the values of threshold alarm for each measured radiation parameter.

1.2.9 The dosimeter sends a light and a sound signal when the programmed threshold levels are exceeded.

1.2.10 The dosimeter is powered from lithium-ion battery of 26650 size with an integrated protection board against overcharging, prevention of discharge and short-circuit. Battery rated voltage – 3.7 V, capacity – 4000 mAh.

1.2.11 The dosimeter warns of the battery discharge.

1.2.12 The battery can be charged from:

- AC mains from of 220V voltage, frequency of 50 Hz;
- vehicle network with DC voltage from 9 V to 32 V.

What is more, the battery can be charged from the solar panel.

1.2.13 The dosimeter ensures measurements if influenced by:

- ambient air temperature from – 30 to + 55ºC;
- relative humidity up to 95 % at 35 ºC temperature, non-condensing;

Note. For operation in the temperature range from minus 21°C to minus 30°C, the dosimeter must be switched on at a temperature not lower than minus 20°C, or be powered by an external power source (power supply unit ~220 V / = 12 V or a vehicle battery).

- atmospheric pressure of 84 kPa up to 106.7 kPa;

1.2.14. The dosimeter is proof against N1 group sinusoidal vibrations with a frequency from 10 Hz to 55 Hz, with an offset amplitude for a frequency lower than 0.15 mm transition frequency.

1.2.14 The dosimeter remains operable after the influence of the following external factors:

- maximum low temperature –40 ºC;
- maximum high temperature +60 ºC;
- photon-ionizing radiation with DER of 100 Sv/hour during a 5-minute exposure of the control unit, and 100 Sv/hour during a 50-minute exposure of the BG probe, 100 Sv/hour during a 10-minute exposure of the ABG probe.

1.3 Delivery kit of MKS-UM dosimeter

1.3.1 The delivery kit of MKS-UM dosimeter includes units and maintenance documentation presented in Table 1.4.

Table 1.4 - Delivery kit of the dosimeter

Type	Name	Q-ty, pcs.	Note
BICT.468166.040	Control unit, MKS-UM	1	
BICT.418259.011	BG probe, MKS-UM	1	See note 1
BICT.418259.012	ABG probe, MKS-UM	1	
BICT.468626.003	Earpiece	1	
BICT.685662.002	Cable	1	spiral
	Li-Ion storage battery 26650 3.7V/4000mAh protected Keeppower	1	
BICT.412915.042	Package	1	
Spare parts set:			
BICT.754151.010	Protection gasket 3.6 μm	10	See note 2
BICT.754151.010-01	Protection gasket 30 μm	10	See note 2
BICT.754175.007	O-ring	1	
BICT.754175.010	O-ring	2	See note 2
BICT.754175.012	O-ring	1	See note 2
	Silicone-teflon grease Smar-TF-20 AG Termopasty	1	20 g See note 2
Tools and accessories included:			
BICT.301542.001	Hoop	1	
BICT.301547.004	Carrying strap	2	
BICT.301551.001	Telescopic tube armrest	1	
BICT.305169.001	Telescopic tube	1	
BICT.323366.001	Carrying case	1	
BICT.468353.046	USB/IrDA Adapter	1	
BICT.564113.001	Solar panel	1	
BICT.685661.002	Power cable DC	1	Vehicle
BICT.735233.001	Hard shell	1	
	Screwdriver 7810-0927 3B 1 H12X GOST 17199-88	1	

Table 1.4 (continued)

Type	Name	Q-ty, pcs.	Note
	Power Supply Unit Type 2124 24 V/0.65 A Mascot Electronics AS	1	See note 3
	AC Cord art.no 131306 Mascot Electronics AS	1	for the power supply unit
Set of operational documents:			
BICT.412129.036 РЭ	Operating manual	1	
BICT.412129.036 ФО	Logbook	1	
BICT.00023	EventReader, USB/IrDA drives	1	on CD-R mini

Note 1. Not supplied for BICT.412129.036-02 version.
Note 2. Not supplied for BICT.412129.036-01 version.
Note 3. Revised in accordance with BICT.436234.005 И21.

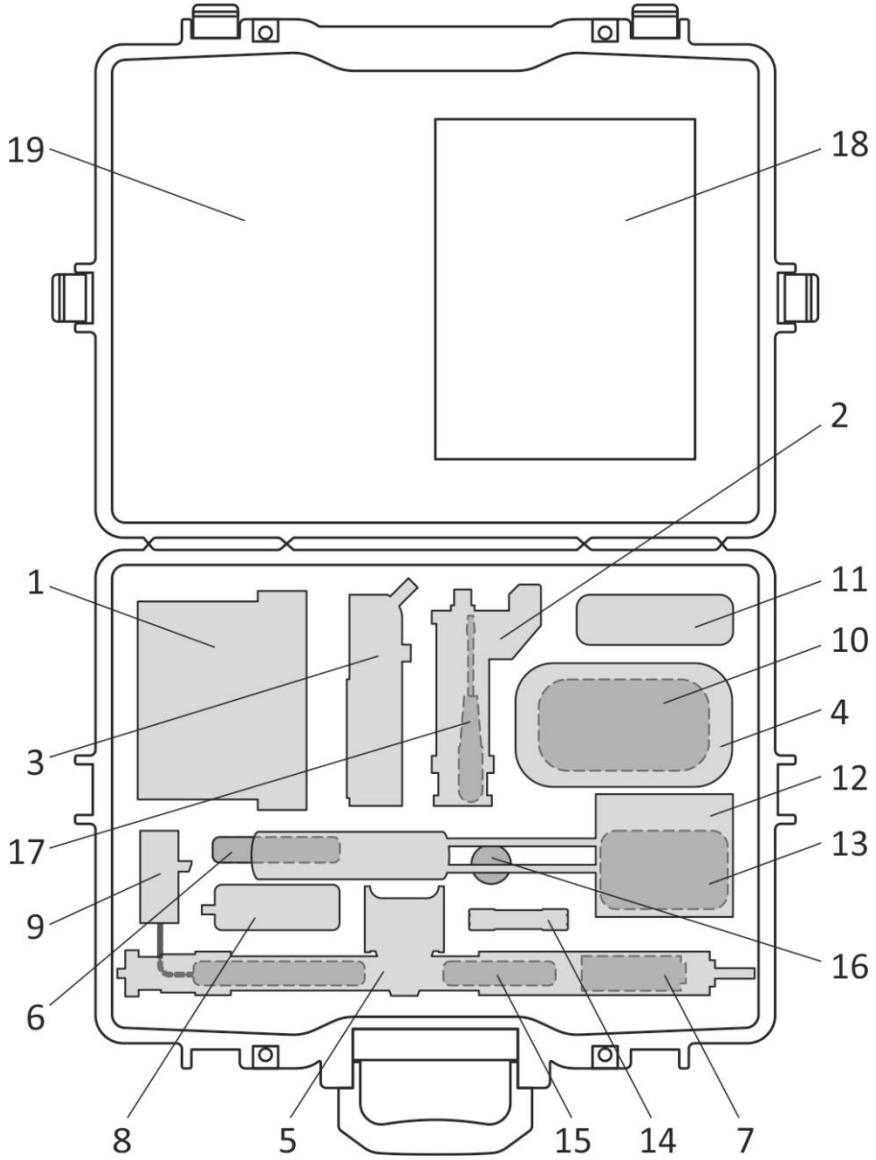


Figure 1.1 – Contents of the carrying case

1 – Control unit with hard shell and solar panel;
2 – BG probe, MKS-UM;
3 – ABG probe, MKS-UM;

4 – Probe’s spiral cable;
5 – Telescopic tube;
6 – Earpiece;
7 – Storage battery;
8 – Power supply unit, 24V DC;
9 – USB/IrDA adapter;
10 – AC cord;
11 – Power cable, DC, Vehicle;
12 – Telescopic tube armrest;
13 – Carrying straps;
14 – Pack of protection gaskets;
15 – Set of spare O-rings;
16 – Silicone-teflon grease;
17 – Screwdriver;
18 – Operating manual, logbook, CD with sotware;
19 – Carrying case.

1.3.2 The control unit of the dosimeter coupled with a hard shell, a hoop and a solar panel

The control unit of the dosimeter serves to:

- control operating modes of the dosimeter;
- measure photon-ionizing radiation DER and DE with the help of the detector built into the dosimeter's control unit;
- display measurement results on LCD;
- determine geographic coordinates;
- generate audio and light alarms;
- store measurement results in the nonvolatile memory;
- transmit measurement results through the infrared port to the personal computer;
- supply power to external probes;
- charge storage battery.

The hard shell is designed to protect the control unit from mechanical stress during the dosimeter use.

The hoop is used to fasten the straps.

The solar panel ensures battery charging under field conditions.

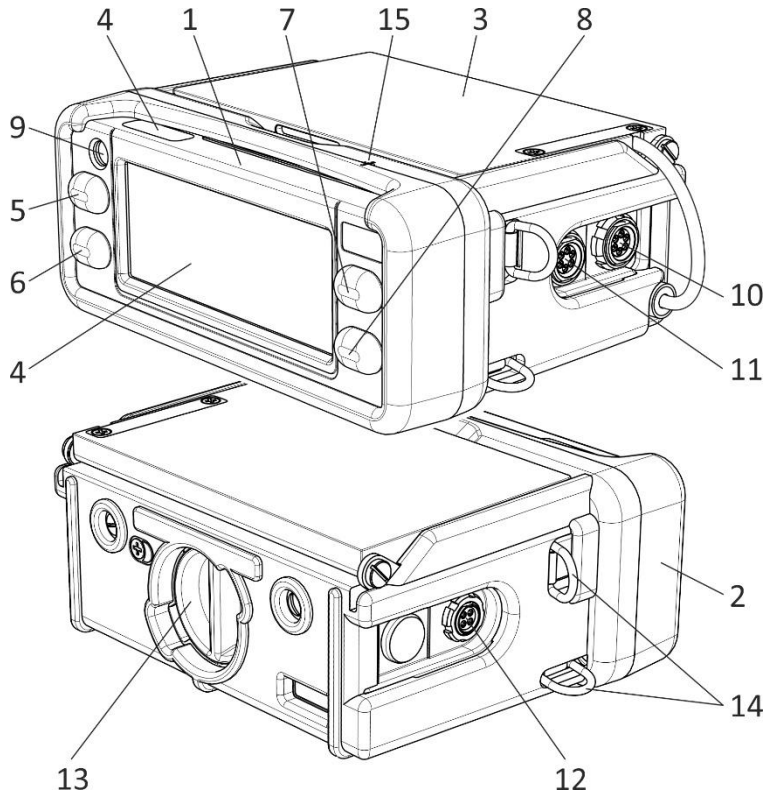


Figure 1.2 – Control unit of the dosimeter coupled with the hard shell and solar panel

1 – Control unit;
2 – Hard shell;
3 – Solar panel;
4 – LCD;
5, 6, 7, 8 – Buttons;
9 – Buzzer;
10, 11, 12 – Connectors;
13 – Battery compartment lid;
14 – Rings for carrying straps fastening.
15 – Mechanical center of gamma detector marked with “+” label.

1.3.3 BG Probe

BG Probe serves to measure:

- photon-ionizing radiation DER;
- surface beta-particles flux density;
- surface activity of beta-emitting radionuclides;

and to communicate measurement results to the control unit via RS-485 interface.

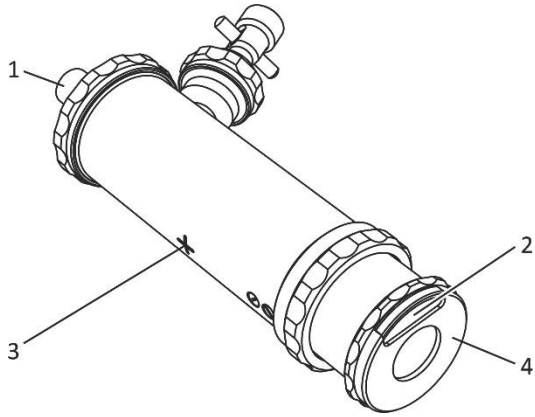


Figure 1.3 – BG probe

1 – Connector.
2 – Beta detector shutter.
3 – Mechanical center of gamma detector marked with “+” label.
4 – Mechanical center of beta detector.

1.3.4 ABG probe

ABG probe serves to measure:

- photon-ionizing radiation DER;
- surface beta-particles flux density;
- surface activity of beta-emitting radionuclides;
- surface alpha-particles flux density;
- surface activity of alpha-emitting radionuclides;

and to communicate measurement results to the control unit via RS-485 interface.

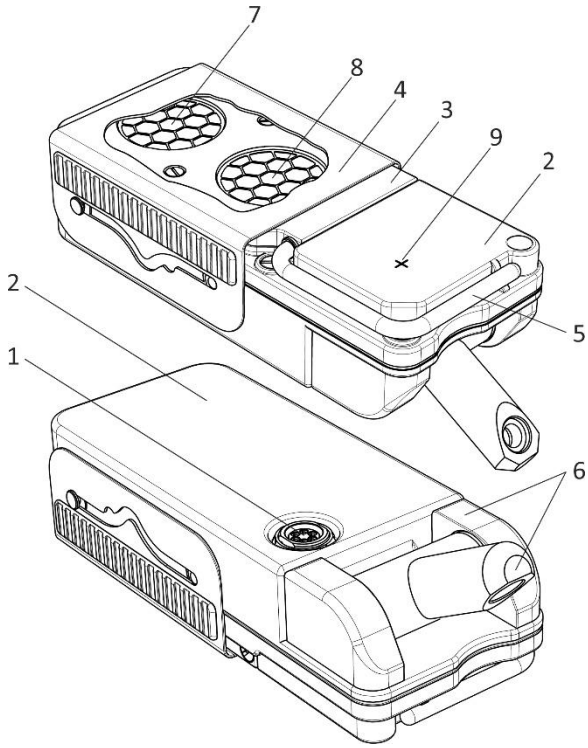


Figure 1.4 – ABG probe

1 – Connector;
2 – ABG probe's housing;
3 – Protection cover;
4 – Swinging cover;
5 – Twist limiter;
6 – Lock;
7 – Alpha detector window.
8 – Beta detector window.
9 – Mechanical center of gamma detector marked with "+" label.

1.3.5 Probe’s spiral cable

Spiral cable is used to connect BG and ABG probes to the control unit.

Figure 1.5 – Probe’s spiral cable

1.3.6 Telescopic tube with armrest.

Telescopic tube is used to operate with BG and ABG probes. Its length is adjustable from 0.45 to 1.45 m (up to 1.68 m – with the armrest).

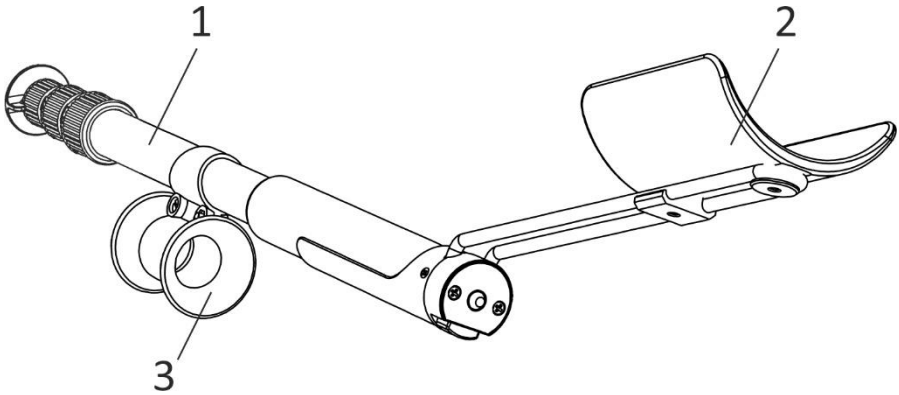


Figure 1.6 – Telescopic tube with armrest

1 – Telescopic tube.
2 – Armrest.
3 – Probe’s cable holder.

1.3.7 Earpiece

Earpiece allows searching for radiation anomalies using the dosimeter in the areas with high acoustic noise. When you connect the earpiece to the control unit, the buzzer of the latter stops generating all sound signals and similar sound signals begin to be generated by the earpiece.

Figure 1.7 – Earpiece

1.3.8 Storage battery

Li-Ion Battery of 26650 size with the integrated protection board against overcharging, prevention of discharge and short-circuit is used to power the dosimeter. Storage battery rated voltage is 3.7 V, capacity – 4 Ah.

Important! Only similar batteries with a capacity of maximum 4500 mAh can be used.

Figure 1.8 – Storage battery

1.3.9 Power supply unit, 24V DC with AC cord

Power supply unit is used to charge the storage battery and supply power to the dosimeter from 100 to 240 V AC mains at 50 to 60 Hz frequency.

Figure 1.9 – Power supply unit 24V DC with AC cord

1.3.10 Vehicle power cable DC

The power cable is used to charge the dosimeter's storage battery and to supply power to the dosimeter from the vehicle network. Connecting to the network is done via the vehicle lighter socket. The dosimeter is protected against false connection with reverse polarity.

Figure 1.10 – Vehicle power cable DC

1.3.11 USB/IrDA adapter

USB/IrDA adapter is used to communicate data from the nonvolatile memory of the dosimeter to a PC. You can find additional information about USB/IrDA adapter in 2.3.6.12 of this operating manual.

Important! To operate with the dosimeter you may use only the USB/IrDA adapter manufactured by ECOTEST.

Figure 1.11 – USB/IrDA adapter

1.3.12 Pack of ABG protection gaskets

Protection gaskets should be replaced with the damaged ones during the use of the ABG Probe. The pack consists of two parts. One part contains 3.6 μm thick gaskets to protect the alpha detector, while the other one - 30 μm thick gaskets to protect the beta detector.

Replacement of protection gaskets is described in "Technical maintenance" section of this operating manual.

Figure 1.12 – Pack of ABG protection gaskets

1.3.13 Silicone-teflon grease

Silicone-teflon grease is used for replacement of gaskets of the ABG Probe.

Replacement of protection gaskets is described in the “Technical maintenance” section of this operating manual.

Figure 1.13 – Silicone-teflon grease

1.3.14 Battery compartment lid O-ring

The battery compartment lid O-ring of the control unit is used to replace the damaged one during use of the dosimeter.

Replacement of the O-ring is described in “Technical Maintenance” section of this operating manual.

Figure 1.14 – Battery compartment lid O-ring

1.3.15 ABG probe’s protection cover O-ring

The ABG probe’s protection cover O-ring is used to replace the damaged one during use of the dosimeter.

Replacement of the O-ring is described in "Technical maintenance" section of this operating manual.

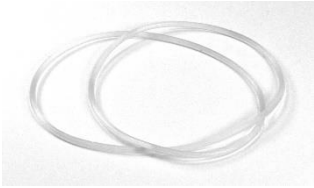


Figure 1.15 – ABG probe’s protection cover O-ring

1.3.16 O-rings for screws used to fasten ABG probe’s protection cover.

O-rings for screws used to fasten ABG probe shall replace the damaged ones during use of the dosimeter.

Replacement of the O-rings is described in "Technical maintenance" section of this operating manual.

Figure 1.16 – O-rings for screws used to fasten ABG probe’s protection cover

2 USE OF THE DOSIMETER

2.1 Operating limitations

Operating limitations are presented in Table 2.1.

Table 2.1 - Operating limitations

Operating limitation	Parameters
1 Ambient air temperature	from – 30 to +55 ºС
2 Relative humidity	up to (95±3) % at 35 ºС temperature, non-condensing
3 Low atmospheric pressure	57.2 kPa
4 Photon-ionizing radiation impact on: - Control unit - BG probe - ABG probe	 DER up to 100 Sv/h during 5 min DER up to 100 Sv/h during 50 min DER up to 100 Sv/h during 10 min

2.2 Preparation for operation

2.2.1 Safety measures

2.2.1.1 Direct use of the dosimeter is not dangerous for the staff and is environmentally friendly.

2.2.1.2 The dosimeter's surface contains no voltages hazardous for life. Protective shells are used to ensure protection against accidental contact with the conductive parts of the dosimeter.

Ingress protection rating of the dosimeter components according to DSTU EN 60529:2018 standard:

- Control unit - IP56;
- BG probe - IP57;
- ABG probe - IP57;
- USB/IrDA adapter - IP40.

2.2.1.3 The dosimeter complies with the requirements of DSTU 7237:2011 regarding the protection of people from electric shock of safety class 0 according to DSTU EN 60335-1:2017.

2.2.1.4 Ionizing radiation sources are not included in the dosimeter's kit.

2.2.1.5 When operating the dosimeter, radiation safety requirements in accordance with DGN 6.6.1-6.5.001-98 (NRBU-97), DGN 6.6.1-6.5.061-2000 (NRBU-97/D-2000), DSP 6.177- 2005-09-02 (OSPU-2005) shall be met.

2.2.1.6 The dosimeter's design, selected materials and coatings provide the possibility of decontamination by regular deactivators according to GOST 27451-87.

2.2.1.7 The dosimeter belongs to explosive and fireproof products.

2.2.2 External examination procedure

2.2.2.1 Unpack the dosimeter, and check if the delivery kit is complete.

2.2.2.2 Inspect for mechanical damage.

2.2.2.3 Check the condition of ABG probe's protection gaskets. Replace them if they are dirty or damaged.

2.2.3 Connecting to the dosimeter's connectors.

2.2.3.1 All the dosimeter's connectors that are not currently used should be covered with protective plugs. Remove the plug before you connect to the connector. Put the plug back after disconnecting from the connector.

2.2.3.2 In order to connect, insert the cable connector into the block connector until the lock is latched that mechanically connects the two connectors. At the same time the connectors' red points should coincide.

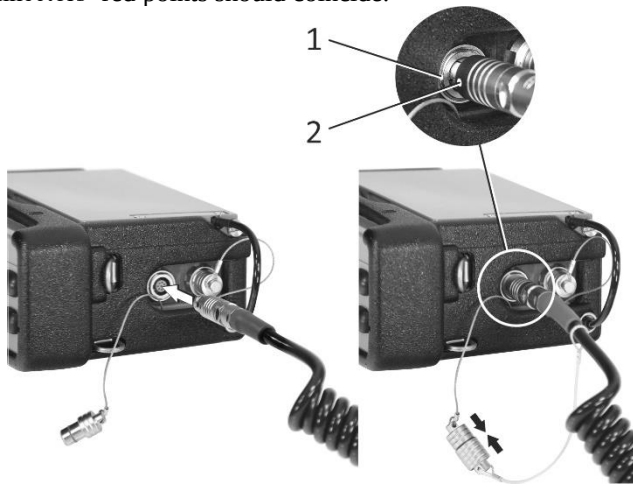


Figure 2.1 – Connecting to the dosimeter's connectors

2.2.3.3 To disconnect, remove the cable connector from the block connector by applying force to the cylindrical part of the cable connector body. By doing so, the lock, which mechanically connects the two connectors, will be disconnected. By applying force to other parts of the cable connector the lock will not disconnect and, accordingly, you will not be able to remove the cable connector.

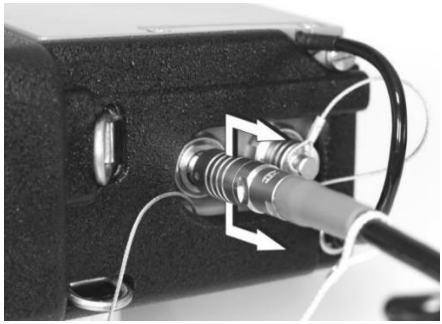


Figure 2.2 – Disconnecting from the dosimeter's connectors

2.2.4 Storage battery insertion into the battery compartment.

2.2.4.1 To insert the battery into the battery compartment do the following (Figure 2.3):

1 - open the battery compartment lid by pressing on it and turning it counterclockwise;

2 - insert the battery into the battery compartment observing the polarity;

3 - close the battery compartment lid by pressing on it and turning it clockwise.

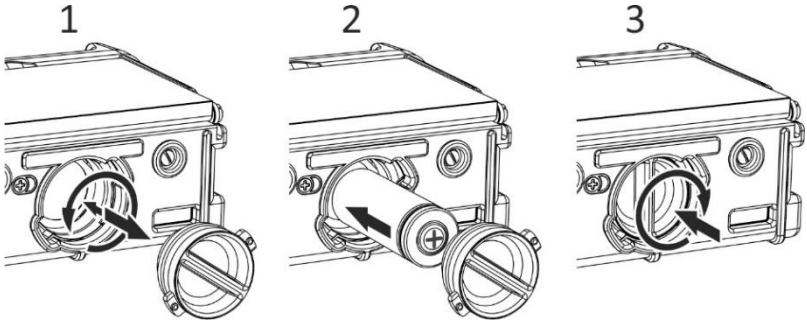


Figure 2.3 – Inserting the storage battery into the battery compartment

Important! Only Li-Ion Batteries of 26650 size, rated voltage 3.7 V, with the integrated board of protection against overcharging, prevention of discharge and short-circuit are allowed.

Note. The clock of the dosimeter is powered from the storage battery. The dosimeter's clock has no additional sources of power supply. Therefore, the first time after the battery is inserted into the MKS-UM battery compartment and it is switched on, it enters the submode of time and date correction to set their accurate values (2.3.6.9.5 of this OM).

2.2.5 Connecting BG probe

2.2.5.1 Set the required length of the telescopic tube. To do this, set the length of each of three segments of the tube (Figure 2.4):

1 - release the twist lock by turning it in the direction shown below;

2 - set the required length of the tube segment;

3 - fasten the lock by turning it in the opposite direction.

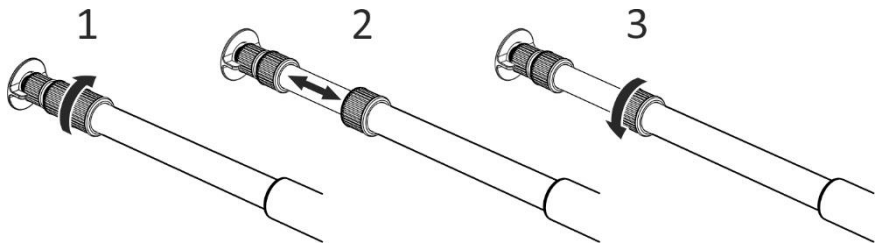


Figure 2.4 – Setting the required length of the telescopic tube

2.2.5.2 Attach (or detach) the armrest to (from) the telescopic tube (Figures 2.5, 2.6).

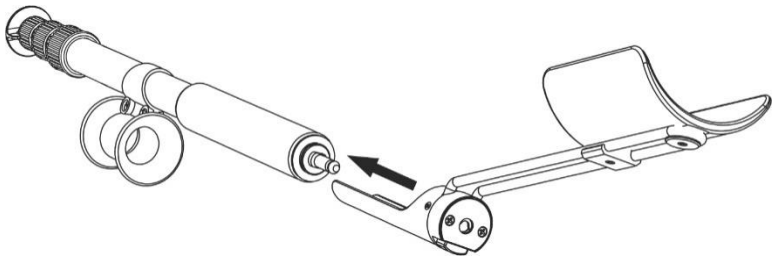


Figure 2.5 – Attaching the armrest to the telescopic tube

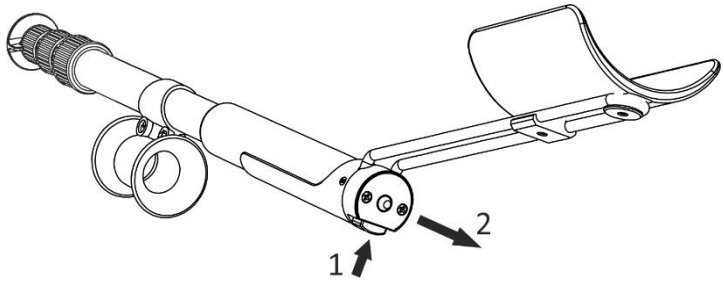


Figure 2.6 – Detaching the armrest from the telescopic tube

2.2.5.3 Lay the probe's spiral cable in the holder.

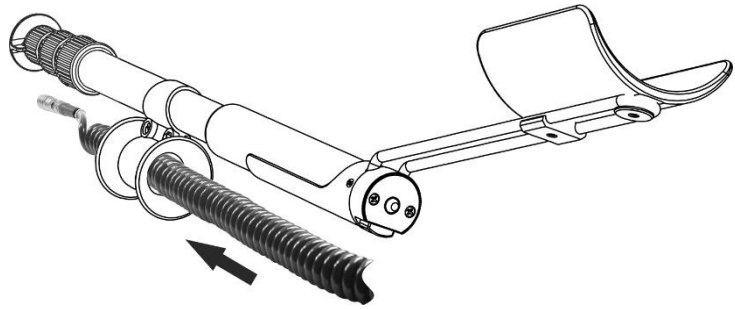


Figure 2.7 – Laying the probe's spiral cable in the holder

2.2.5.4 Screw the telescopic tube on the BG probe's holder (Figure 2.8). If necessary, use the screwdriver from the delivery kit.

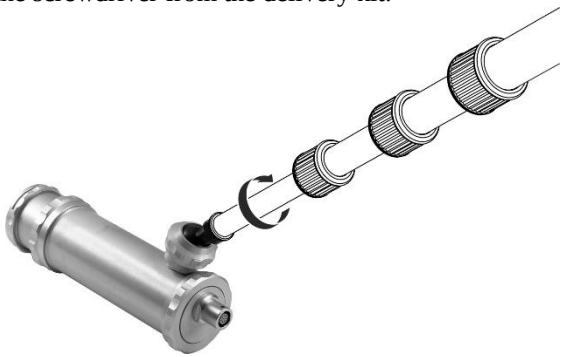


Figure 2.8 – Fixing telescopic tube to BG probe

2.2.5.5 Connect one of the connectors of the probe's spiral cable to **P** connector of the control unit, and the other one - to BG probe's connector.

2.2.6 Connecting ABG probe

2.2.6.1 Set the required length of the telescopic tube and attach or detach the armrest according to 2.2.4.1, 2.2.4.2 of this operating manual.

2.2.6.2 Lay the probe's spiral cable in the holder according to 2.2.4.3 of this OM.

2.2.6.3 Screw the telescopic tube on the ABG probe's holder (Figure 2.9)

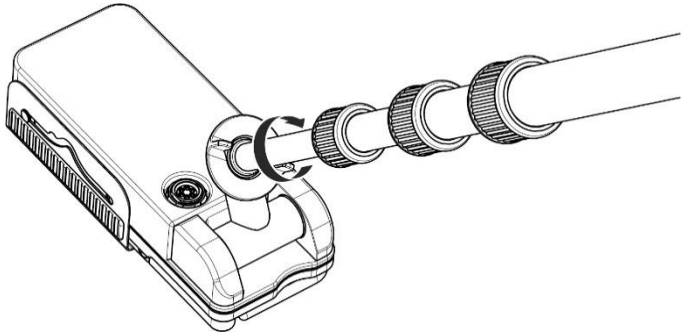


Figure 2.9 – Fixing telescopic tube to ABG probe

2.2.6.4 Connect one of the connectors of the probe's cable to **P** connector of the control unit, and the other one - to the ABG probe's connector.

2.2.7 Storage battery charging

2.2.7.1 Li-Ion storage battery of the dosimeter has no memory effect, so the battery can be charged regardless of its discharge status.

2.2.7.2 The dosimeter's battery can be charged in the range of ambient temperatures from 0 to +40 °C.

2.2.7.3 The dosimeter's battery can be charged by the charging device built into the control unit from:

- power supply 100-240V AC/24V DC;
- vehicle network of 9 to 32 V DC,

as well as from the solar panel.

2.2.7.4 The estimated time required for charging a fully discharged 4000 mAh battery from power supply or vehicle network is 5 hours.

Charging time from the solar panel is not specified.

2.2.7.5 **CHARGE** LED indicates the charging status (Table 2.2).

Table 2.2 – **CHARGE** LED showing the battery charging status

Charging status	**CHARGE** LED status
Normal charging	Blinking green light
End of charging	Non-stop green light
Charging stopped or charging error	Non-stop red light
No battery	Non-stop red light

Charging can be stopped if the battery temperature exceeded the permissible limits.

Charging error may occur if the battery could not be charged over some period of time.

2.2.7.6 To charge the dosimeter battery from AC mains, connect the power supply cable connector to the **DC** connector of the control unit of the dosimeter and plug in the power supply to the mains.

Maximum power to be used from the 100-240V AC mains does not exceed 10 W.

2.2.7.7 To charge the dosimeter battery from the vehicle network of 9 to 32 V voltage, connect the corresponding vehicle's cable connector to the **DC** connector of the control unit of the dosimeter, and the other power cable connector - to the car's lighter socket.

Maximum power to be used from the vehicle network does not exceed 9 W.

2.2.7.8 To charge the dosimeter battery from the solar panel, connect the solar panel's cable connector to the **DC** connector of the control unit.

Important notice: The integrated charging device is automatic, so the charging process stops automatically as soon as the charge level reaches 100 %, or some emergency condition occurs (see 2.2.7.5).

2.3 Use of the dosimeter

2.3.1 General information

2.3.1.1 The dosimeter consists of the control unit with built-in gamma detector, and BG and ABG probes.

2.3.1.2 The control unit has the following functions:

- control of operating modes of the dosimeter;
- measurement of photon-ionizing radiation DER and DE with the detector integrated into the dosimeter's control unit;
- obtaining measurements results from the probes;
- display of measurement results on the LCD;
- determination of geographical coordinates;
- audio and light alarms;
- saving measurement results in the nonvolatile memory;
- communicating measurement results via the infrared port to the PC;
- power supply of the probes;
- storage battery charging.

2.3.1.3 BG probe and ABG probe independently measure characteristics of alpha, beta and gamma radiation and give out ready measurement results via the RS-485 interface to the control unit.

2.3.2 Dosimeter's display and alarm tools

2.3.2.1 The LCD (1), "ALARM" (2) and "CHARGE" (3) LEDs, as well as the buttons (4), (5), (6), (7) are located on the front panel of the control unit.

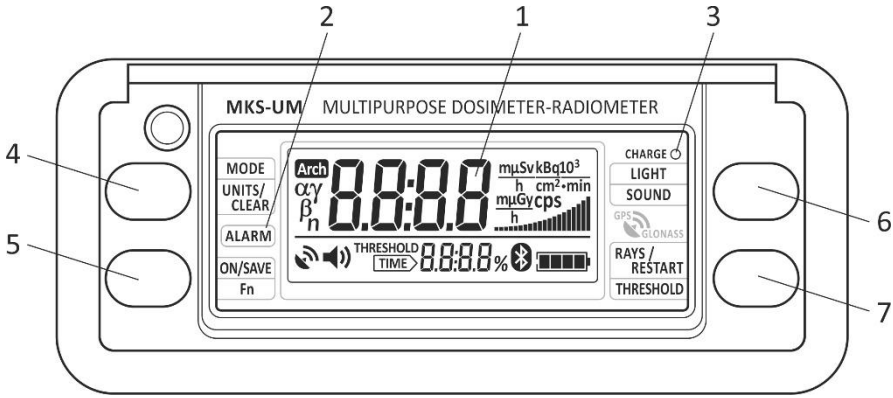


Figure 2.10 – Front panel of the control unit

The status symbols of the navigation receiver and the battery are located on the LCD.

The symbol of the navigation receiver status displays the operating condition of the navigation receiver and that reliable information received from it is available. If the navigation receiver is off, its status symbol is not highlighted. If the navigation receiver is on, its status symbol is steadily highlighted or blinking. Blinking indicates the lack of reliable information from the navigation receiver.

The battery status symbol displays the approximate remaining battery capacity of the dosimeter. The status symbol consists of four segments. All segments of the status symbol are highlighted when the battery is full. When the battery becomes discharged the segments gradually die out. When the battery is fully discharged all segments are faded.

Two-tone short beeps indicate low battery as well. When the battery is discharged to the point when the battery status symbol contains only one highlighted segment, these beeps are generated with 1 min intervals. With further discharge of the battery when all segments of the battery status symbol are faded such beeps begin to be generated at a 6 s interval.

The dosimeter battery is charged according to 2.2.6 of the OM.

"ALARM" LED informs about the presence of an alarm condition. If measurement results exceed the alarm threshold levels it is blinking at 4 Hz frequency. Blinking is accompanied by a two-tone audible signal.

"CHARGE" LED displays the progress of the dosimeter battery charging. Possible statuses of the "CHARGE" LED are shown in Table 2.2 (2.2.6.5 of this operating manual).

2.3.3 Controls of the dosimeter

2.3.3.1 The dosimeter is regulated with the help of four buttons (4), (5), (6), (7) according to Figure 2.10.

2.3.3.2 Each button is responsible for different functions depending on the mode of the dosimeter's control unit, time of holding the button down and a status of the (5) **Fn** button.

2.3.3.3 The names of the functions are printed near each button. The names are printed in two colors: white and yellow. White color is responsible for the functions that the button performs if it is the only one button pressed right now. Yellow color – if **Fn** button was pressed and held down before it was pressed (5).

2.3.3.4 To describe the user actions the operating manual will use the function names to be done by the button. For example, if it is written, "shortly press **LIGHT**", it means that you should shortly press button (6). And if it is written: "Shortly press **SOUND**", it means that you should press (5) **Fn** and while holding it down shortly press button (6).

2.3.3.5 Table 2.3 shows a brief description of the dosimeter's button functions depending on the control unit status.

Table 2.3

Mode (submode) of the control unit	Button functions						
	ON/SAVE	LIGHT	SOUND	MODE	UNITS/ CLEAR	RAYS/ RESTART	THRE-SHOLD
Off	Long press turns on the dosimeter	-	-	-	-	-	-
Display of measurement results obtained from the probe or the detector built in the control unit	Short press initiates the mode of measure-ment result recording to the archive. Long press turns off the dosimeter	Short press turns on the LCD backlight for 8 s or turns it off. Long press turns on continuous backlight of the LCD	Short press turns on or off audio signaling of registe-red gamma-quanta, alpha, beta particles. Long press – recalculates signaling divider	Changes the operating mode of the control unit	Changes the measure-ment units	Short press – restarts integration process. Long press – switches between radiation types being measured (α, β, γ)	Short press – viewing current threshold level. Long press – switches to the mode of a new threshold level program-ming
Display of the accu-mulated DE and DE accumula-tion time	Long press turns off the dosimeter	Short press turns on the LCD backlight for 8 s or turns it off. Long press turns on continuous backlight of the LCD	-	Changes the operating mode of the control unit	Long press – DE and DE accumul ation time reset	-	Short press – viewing current threshold level. Long press – switches to the mode of a new threshold level program-ming

Table 2.3 (continued)

Mode (submode) of the control unit	ON/SAVE	LIGHT	SO-UND	MODE	UNITS/ CLEAR	RAYS/ RE-START	THRE-SHOLD
Navigation receiver control	Long press turns off the dosimeter	Short press turns on the LCD backlight for 8 s or turns it off. Long press turns on continuous backlight of the LCD	-	Changes the operating mode of the control unit	-	Short press turns on or off the navigation receiver	Short press - viewing current local time offset relative to GMT. Long press - switches to the new offset program-ming mode
Current time viewing	Long press turns off the dosimeter	Short press turns on the LCD backlight for 8 s or turns it off. Long press turns on continuous backlight of the LCD	-	Changes the operating mode of the control unit	-	-	Short press – switches between display of date and month or year. Long press – enters the mode of time correction
Archive viewing	Short press – displays the previous value. Long press turns off the dosimeter	Short press turns on the LCD backlight for 8 s or turns it off. Long press turns on continuous backlight of the LCD	-	Changes the operating mode of the control unit	Long press – archive dele-tion	Short press – displays the next value	-

Table 2.3 (end)

Mode (submode) of the control unit	ON/SAVE	LIGHT	SOUND	MODE	UNITS/ CLEAR	RAYS/ RESTART	THRE-SHOLD
Measure-ment result recording into archive	Short press – records the result. Long press turns off the dosimeter	Short press turns on the LCD backlight for 8 s or turns it off. Long press turns on continuous backlight of the LCD	-	Proceeding to the next digit correction of the measure-ment object number	-	Short press – changes the corrected digit of the measure-ment object number per unit. Long press – starts automatic change of the digit under correction	-
Digital value program-ming (threshold, statistical errors limits, etc.)	Long press turns off the dosimeter	Short press turns on the LCD backlight for 8 s or turns it off. Long press turns on continuous backlight of the LCD	-	Proceeding to the next digit correction of the value under correction	-	Short press – changes the corrected digit per unit. Long press – starts automatic change of the digit under correction	-

2.3.4 **Nonvolatile memory of the dosimeter**

Nonvolatile memory of the dosimeter is arranged as two circular buffers. One buffer automatically saves photon-ionizing radiation DE accumulation history. It enables storing up to 2200 DE values. The other buffer, if the user decides so, stores measurements results of alpha, beta and gamma radiation characteristics. This buffer enables storing up to 1500 measurement results.

When the entire memory of the circular buffer is filled and new information continues to be saved, the oldest information is deleted. In order to prevent information loss, it is necessary to transfer it from the nonvolatile memory to the PC in time.

A blinking Arch symbol is indicative of critical filling of the nonvolatile memory and, therefore, of the possibility of information loss ((10) Figure 2.11). Arch symbol is briefly highlighted at a 4 second interval in all modes and submodes of the dosimeter except for the "Measurements results viewing stored in the nonvolatile memory" mode and "Measurement result saving in the nonvolatile memory" submode, if the circular buffer intended for DE accumulation history autosaving can provide for less than 10 DE records, or if information has already been lost.

Arch symbol ((1) Figure 2.15) is blinking in the submode "Measurement result saving in the nonvolatile memory", if the circular buffer intended for saving measurement results of alpha, beta and gamma radiation characteristics can provide for less than 10 records.

A blinking Arch symbol in the mode "Measurements results viewing stored in the nonvolatile memory" means that the latest stored information has been lost because of its delayed transfer from the nonvolatile memory of the dosimeter to the PC.

2.3.5 **Operating submodes and modes of the control unit**

2.3.5.1 The control unit operates in the following modes:

- display of measurement results obtained from the probes or detectors;
- display of accumulated DE and DE accumulation time;
- navigation receiver control;
- display of current time and date;
- measurements results viewing stored in the nonvolatile memory.

2.3.5.2 After switching on, the control unit always enters the mode of measurement results display obtained from the probes or detectors.

By shortly pressing MODE, you change the operating modes in the following sequence:

- measurement results display obtained from the probes or detectors;
- display of accumulated DE and DE accumulation time;
- navigation receiver control;
- display of current time and date;
- viewing measurements results stored in the nonvolatile memory.

From the mode of archive viewing the control unit goes back to the mode of measurement results display obtained from the probes or detectors.

If the nonvolatile memory contains no saved measurement results, after pressing MODE the dosimeter immediately returns from the current time display mode to the mode of measurement results display obtained from the probes and detectors.

2.3.5.3 Each of the operating modes has its submodes.

The mode of measurement results display obtained from the probes or detectors has the following submodes:

-viewing and programming of new values of the alarm threshold and specified limits of statistical deviations (specified limits of the expected relative statistical deviations of the measurement result given 0.95 confidence probability).

-measurement result saving in the nonvolatile memory;

The mode of accumulated DE and DE accumulation time display has the following submodes:

-viewing and programming of a new value of the alarm threshold level;

-accumulated DE and DE accumulation time values reset.

The mode of navigation receiver control has the following submodes:

-viewing and programming of the new local time offset relative to GMT.

The mode of current time and date display has the submodes of time and date setting.

The mode of measurements results viewing stored in the nonvolatile memory has the submode that clears measurement results.

2.3.6 **Operating procedure**

2.3.6.1 **Switching the dosimeter on/off**

2.3.6.1.1 Press ON/SAVE and hold it down for 4 s to switch the dosimeter on. Display and alarm tools (LCD, LEDs and buzzer) testing (for about 6 s) means that the dosimeter switches on. Upon completion of testing, the dosimeter starts photon-ionizing radiation DE measurement and switches to the measurement results display obtained from the probes or detectors.

Note. If the battery was removed from the dosimeter, it switches to the mode of time and date setting upon completion of display and alarm tools testing.

2.3.6.1.2 To switch the dosimeter off, press and hold ON/SAVE for 4 s.

2.3.6.2 **Switching LCD backlight on/off**

2.3.6.2.1 Press shortly LIGHT to switch the display backlight on for 8 s. The backlight switches off automatically in 8 s.

2.3.6.2.2 To switch on continuous backlight of the dosimeter LCD, press and hold LIGHT (circa 6 s) until the backlight shortly blinks for two times.

2.3.6.2.3 Press shortly LIGHT to switch off the back-lit LCD.

2.3.6.3 **Managing registered gamma quanta, alpha and beta particles signaling**

2.3.6.3.1 Signaling of registered gamma quanta, alpha, beta particles (depending on the type of the connected probe) is done only in the mode of measurement results display obtained from the probes or detectors. One can manage signaling only in this mode.

2.3.6.3.2 Shortly press SOUND to switch on signaling of registered gamma quanta, alpha, beta particles. A short audio signal will follow every detected gamma quantum, alpha or beta particle.

2.3.6.3.3 Press shortly SOUND to switch signaling off.

2.3.6.3.4 Press shortly SOUND one more time to switch signaling on again.

2.3.6.3.5 Signaling status is displayed on the dosimeter LCD with symbol  .

2.3.6.3.6 Signaling of registered gamma quanta, alpha or beta particles can be applied to searching for ionizing radiation sources. When approaching a source of ionizing radiation the amount of gamma quanta, alpha or beta particles will increase and the number of short beeps increases correspondingly. On approaching towards the source, intermittent beeps will merge into a continuous audio signal – it will become impossible to continue searching.

To continue searching, press and hold SOUND for 4 s. Not all registered gamma quanta, alpha or beta particles will be followed by signaling upon that, but each n^{th}.

The *n* number (divider of signaling) is generated in such a way that given the current ionizing radiation intensity, intermittent beeps are generated about once per second. This will make it possible to continue approaching towards the source of ionizing radiation.

If ionizing radiation intensity changes, the divider of signaling may be recalculated as many times as necessary. To bring the divider of signaling back to the initial state (n=1, each gamma quantum, alpha or beta particle is accompanied by a short signal), turn signaling on and off by shortly pressing SOUND.

2.3.6.4 **Changing measurement units of measurement results display**

2.3.6.4.1 It is possible to change measurement units in the mode of measurement results display obtained from the probes or detectors and in the mode of accumulated DE and DE accumulation time display. Shortly press UNITS to do that.

2.3.6.4.2 The dosimeter can display photon-ionizing radiation DER measurement results in Sv/h (mSv/h, μSv/h) and in Gy/h (mGy/h, μGy/h). Display of pulse count rate in cps from the detectors of photon-ionizing radiation is also possible.

2.3.6.4.3 The results of beta radiation parameters measurement can be displayed in $1/(cm^2 \cdot min)$ ($10^3/(cm^2 \cdot min)$) and Bq/cm^2 (kBq/cm^2). Display of pulse count rate in cps from the detectors of beta radiation is also possible.

2.3.6.4.4 The results of alpha radiation parameters measurements can be displayed in $1/(cm^2 \cdot min)$ ($10^3/(cm^2 \cdot min)$) та Bq/cm^2 (kBq/cm^2). Display of pulse count rate in cps from the detectors of alpha radiation is also possible.

2.3.6.4.5 The results of accumulated DE can be displayed in Sv (mSv, μSv) and in Gy (mGy, μGy).

2.3.6.5 **Measurement of photon-ionizing radiation DER**

2.3.6.5.1 **General information**

2.3.6.5.1.1 Photon-ionizing radiation DER can be measured with the help of:

- detector built in the control unit;
- BG probe;
- ABG probe.

If no probe is connected the control unit, the latter performs DER measurement using the built-in detector. If one of the probes is connected to the control unit that probe measures DER and the control unit only displays measurement results.

2.3.6.5.1.2 When photon-ionizing radiation DER is measured using ABG probe, alpha radiation presence is also monitored. When alpha radiation is registered (when the pulse count rate from alpha radiation detector exceeds the value of 1 cps), the dosimeter's LCD begins to display a blinking "α" symbol ((9) Fig. 2.11) and generates typical sound and light alarms. Open the alpha detector window for correct registration of alpha radiation (Fig. 2.21).

2.3.6.5.1.3 Connection of the probes to the control unit is done in accordance with 2.2 of this operating manual (Preparation for operation).

2.3.6.5.1.4 If DER is measured using the detector built in the control unit, direct the latter with "+" label (16) (Figure 1.2) towards the examined object.

If DER is measured using one of the probes, direct it with "+" label (13) (Figure 1.3), (9) (Figure 1.4) towards the examined object.

2.3.6.5.2 **Operating mode of the control unit "Display of measurement results obtained from the probes or detectors" during DER measurement**

2.3.6.5.2.1 When DER is measured, the control unit should be in the mode of measurement results display obtained from the probes or detectors. The control unit always enters this mode after being turned on. This mode can always be accessed from any other mode by shortly pressing MODE.

"γ" radiation type should be set in this case. Radiation type is selected (among the allowable for the connected probe) with a long press of RAYS/RESTART. Press and hold RAYS/RESTART to change the type of radiation, and then release RAYS/RESTART. If necessary, repeat these steps until "γ" radiation is selected.

2.3.6.5.2.2 DER is shown in Sv/h (mSv/h, μSv/h) or Gy/h (mGy/h, μGy/h). Display of pulse count rate in cps from the photon-ionizing radiation detectors is also possible.

Shortly press UNITS to change the measurements units (2.3.6.4 of this OM).

2.3.6.5.2.3 In this mode the dosimeter's LCD displays the following (Figure 2.11):

- "γ" symbol (1) – radiation type under measurement;
- DER measurement result (2);
- DER measurement result dimension (3);
- estimated limits of the expected relative statistical deviations (4) of the measurement result (2) given 0.95 confidence probability – hereinafter referred to as the specified limits of statistical deviations.
- indicator of instantaneous DER value (5).
- battery status symbol (6);
- navigation receiver status symbol (7);
- status symbol of registered gamma quanta, alpha or beta particles signaling (8);
- symbol of alpha radiation presence (9) (when DER is measured using ABG probe);
- sign (10) of critical filling of the nonvolatile memory of the dosimeter, where DE accumulation history is stored (2.3.4 of this operating manual).

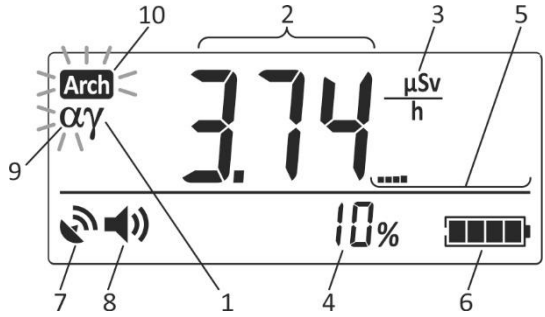


Figure 2.11 – LCD of the dosimeter
(Photon-ionizing radiation DER measurement)

2.3.6.5.2.4 Measurement results of photon-ionizing radiation DER (2) and the estimated limits of statistical deviations (4) of these results are generated on the LCD after the measurement starts. Measurement results are updated each 2 seconds.

When DER is measured using the detector that is built in the control unit, ABG or BG probe, the alarm threshold level is constantly checked for being exceeded by measurement results with an appropriate dimension. When exceeded, the dosimeter begins generating a two-tone sound signal and blinks with the ALARM LED. The measurement results are blinking on the dosimeter's LCD.

When measurement results exceed the upper limit of the measurement range by more than 30 %, "пппп" symbols are displayed on the LCD instead of the measurement results.

The dosimeter can operate with three independent threshold levels during DER measurement. The first one is expressed in Sv/h (mSv/h, μSv/h), the second one in Gy/h (mGy/h, μGy/h), while the last one - in cps. Comparison of measurement results is performed only with one threshold level, the measurement units of which correspond to the selected measurement results units. Only this threshold level can be viewed or changed.

A twenty-segment instantaneous DER value indicator (5) is intended for quick assessment of the photon-ionizing radiation intensity. Instant values are displayed in pseudologarithmic scale. The greater the DER value, the more segments are highlighted from left to right. The integration time during instantaneous DER value measuring and the time of information update on the instantaneous value indicator is 1 s when measured using the built-in detector, and 500 ms - when measured with all other detectors and probes.

The estimated DER values when the first and all segments of the indicator are highlighted are shown in Table 2.4.

Table 2.4

Probe or detector	DER	
	1st segment highlighted	All segments highlighted
Detector built in the control unit	4 μSv/h	0.6 Sv/h
BG probe	0.8 μSv/h	10 Sv/h
ABG probe	0.5 μSv/h	1 Sv/h

2.3.6.5.2.5 DER measurement using the detector built in the control unit or ABG/BG probe is done as follows. After the measurement starts the LCD of the dosimeter begins displaying measurement results and estimated limits of statistical deviations of these results. Firstly, the estimated limits of statistical deviations of measurement results are large. In the process of measurement the estimated limits of statistical deviations of measurement results decrease and eventually reach the specified limits of statistical deviations. After that the measurement process continues, but a part of statistical information is rejected. Therefore, the estimated limits of statistical deviations of all next measurement results are equal to or less than the specified one.

At any moment in time, the user can restart the measurement process by shortly pressing RAYS/RESTART.

The specified limits of statistical deviations can be determined by the dosimeter automatically, depending on the radiation intensity, or can be specified by the user in the submode of the alarm threshold level programming.

A blinking "%" symbol shows that the specified limits of statistical deviations have been set by the user.

"ппп%" symbols are displayed on the LCD as long as the estimated limits of statistical deviations exceed 99 %.

Annex A shows the dependence of the specified limits of statistical deviations determined by the dosimeter on the radiation intensity, as well as approximate time of statistical information accumulation necessary to obtain measurement results with the estimated limits of statistical deviations, which are equal to the main relative permissible error limit and the specified limits of statistical deviations determined by the dosimeter. (Typical sensitivity of the counters, which is applied to the control unit and the ABG/BG probe, was used for charts plotting).

2.3.6.5.3 **Submode of the control unit "Viewing and programming of new values of the alarm threshold level and the specified limits of statistical deviations (specified limits of the expected relative statistical deviations of the measurement result at 0.95 confidence probability)" during DER measurement**

2.3.6.5.3.1 Press THRESHOLD to view current values of the alarm threshold level and the specified limits of statistical deviations. In this case, the control unit should be in the mode of "Measurement results display obtained from the probes or detectors".

The LCD will show the following information (Figure 2.12):

- symbol of the measured radiation (1);
- alarm threshold level (2);
- threshold level dimension (3);
- specified limits of statistical deviations (4);
- THRESHOLD transparency (5), reflecting the alarm threshold level;
- battery status symbol (6);
- navigation receiver status symbol (7);

This information is displayed on the LCD while THRESHOLD is held down (but not longer than 4 sec).

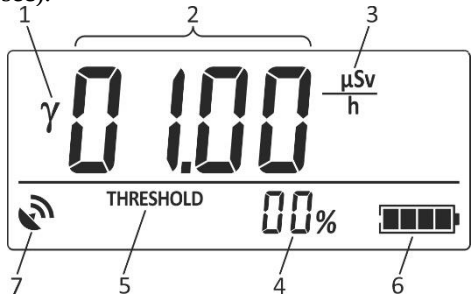


Figure 2.12 – LCD of the dosimeter
(viewing the alarm threshold level and specified limits of statistical deviations)

2.3.6.5.3.2 If you keep holding THRESHOLD for more than 4 s, the value of the alarm threshold level is returned to zero, and its low-order digit starts blinking (Figure 2.13). Then release THRESHOLD.

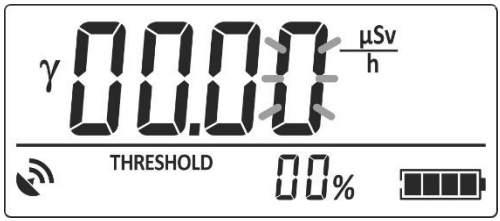


Figure 2.13 – LCD of the dosimeter
(submode of the alarm threshold level and the specified limits of statistical deviations programming)

A blinking digit shows that its value can be programmed. The required value of the blinking digit is set by pressing RAYS/RESTART. Successive short presses and releases of RAYS/RESTART change the value per unit. A long press of RAYS/RESTART starts automatic value change that stops after RAYS/RESTART is released.

Pressing shortly MODE fixes the value of the digit (in this case it stops blinking) and allows changing the value of the next digit that starts blinking. All other digit values are programmed likewise.

If there is no need in programming of all digits of a new threshold level, press ON/SAVE to complete programming of the threshold level and proceed to programming of new specified limits of statistical deviations.

Important! Programming of a zero threshold level switches off this threshold alarm.

Upon completion of a new threshold level programming, the low-order digit of the specified limits of statistical deviations starts blinking on the LCD of the dosimeter indicating that its value can be programmed.

Programming of the new specified limits of statistical deviations is done similarly to programming of the new alarm threshold level and finishes upon programming of all digits or by pressing ON/SAVE.

Zero value programming turns on automatic detection of the specified limits of statistical deviations by the dosimeter depending on the radiation intensity.

As soon as the alarm threshold level and the specified limits of statistical deviations are programmed, their values blink three times on the LCD indicating that these values are stored in the nonvolatile memory of the control unit. After that, the control unit returns to the mode of measurement results display obtained from the probes or detectors.

Important! If the submode of the alarm threshold level and the specified limits of statistical deviations programming is paused for more than 20 seconds (the user will not click any button), the control unit automatically returns to the mode of measurement results display obtained from the probes or detectors. All changes that have been made in the submode of new values programming will be canceled.

2.3.6.5.4 **Submode of the control unit "Measurement result saving in the nonvolatile memory" during DER measurement**

To save DER measurement result in the nonvolatile memory of the control unit, shortly press ON/SAVE. In this case, the control unit should be in the mode of "Measurement results display obtained from the probes or detectors".

If the nonvolatile memory (2.3.4 of this OM) has a free space for storing this measurement result, the control unit immediately proceeds to the submode of measurement object number programming (2.3.6.5.4.2 of this operating manual). If the nonvolatile memory has no space to store the measurement result, the control unit switches to the submode of the nonvolatile memory segment removal before programming the measurement object number (2.3.6.5.4.1 of this operating manual). The oldest 18 to 32 measurement results will be lost.

2.3.6.5.4.1 **Submode "Nonvolatile memory segment deletion"**

The following information will be displayed on the LCD (Figure 2.14):

- Arch symbol (1) indicates the submode of measurement result saving in the nonvolatile memory;
- "Clr" symbol (2) indicates the nonvolatile memory segment deletion;
- "OFF" symbol (3) indicates refusal to delete.

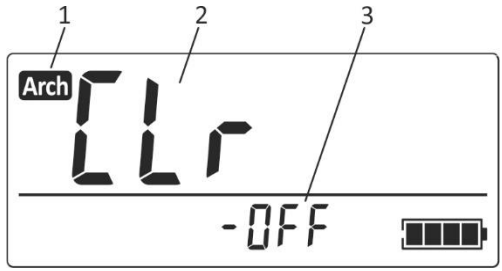


Figure 2.14 – LCD of the dosimeter
(submode of the nonvolatile memory segment deletion)

With the help of symbols (3) in this submode you should finally confirm or cancel deletion of the nonvolatile memory segment and thus the loss of 18 to 32 oldest measurement results. Status of symbols (3) changes by shortly pressing RAYS/RESTART. "-On-" that appears confirms removal, while "-OFF" – refusal to delete. To complete this submode, press ON/SAVE. If refusal to delete was chosen, the control unit returns to the mode of measurement results display obtained from

the probes or detectors. If deletion was chosen, the control unit switches to the submode of measurement object number programming.

Important! If this submode is paused for more than 20 seconds (the user will not click any button), the control unit automatically returns to the mode of "Measurement results display obtained from the probes or detectors".

2.3.6.5.4.2 **Submode "Measurement object number programming"**

The following information will be displayed on the LCD in this submode (Figure 2.15):

- Arch symbol (1) indicates the submode of measurement result saving in the nonvolatile memory;
- "P" symbol (2) indicates a number of the object being measured;
- measurement object number (3);
- indicator of nonvolatile memory filling (4);
- symbol of the navigation receiver status (5);
- battery status symbol (6).

Important! Arch symbol (1) is blinking if almost all memory capacity is filled and before the oldest data is lost, there is a possibility to save not more than 10 new results of DER measurements.

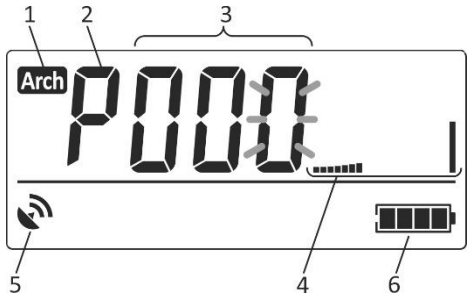


Figure 2.15 – LCD of the dosimeter
(submode of measurement result saving in the nonvolatile memory)

The low-order digit of the measurement object number will be blinking indicating that its value can be programmed. By pressing RAYS/RESTART set the required value of the blinking digit. Successive short presses and releases of RAYS/RESTART change the value per unit. Pressing RAYS/RESTART for a lomger time starts automatic change of the value that stops after RAYS/ RESTART is released.

Short press of MODE fixes the value of this digit (in this case it stops blinking) and allows changing the next digit value, which starts blinking. All other digit values are programmed likewise.

Upon completion of programming of the required digits of the measurement object number, shortly press ON/SAVE to save the DER measurement result, measurement object number, measurement time and geographical coordinates of measurement in the nonvolatile memory. A typical “running wave” displayed on the instantaneous value indicator shows that the record was saved.

Note. Geographical coordinates of measurement are saved only when navigation receiver is switched on and its reliable data is available.

Important! If this submode is paused for more than 20 seconds (the user will not click any button), the control unit automatically returns to the mode of "Measurement results display obtained from the probes or detectors".

2.3.6.6 **Measurement of beta radiation characteristics**

2.3.6.6.1 **General information**

2.3.6.6.1.1 Measurement of beta radiation characteristics such as surface beta-particles flux density and surface activity of beta-emitting radionuclides can be carried out by means of the BG and ABG probes.

2.3.6.6.1.2 When beta radiation characteristics are measured using the ABG probe, alpha radiation presence is also monitored. When alpha radiation is recorded (when the pulse count rate from alpha radiation detector exceeds the value of 1 cps), the LCD of the dosimeter begins displaying a blinking “α” symbol ((10) Figure 2.18) and generating typical sound and light alarms.

2.3.6.6.1.3 Connection of the probes to the control unit is performed according to item 2.2 of this OM (Preparation to operation).

2.3.6.6.1.4 If measurement is done using BG probe, then in order to consider the impact of gamma radiation component on the results of beta radiation characteristics measurement, one should measure and save the gamma-component value in the immediate proximity to the surface to be examined. Further, this gamma-component value will be automatically considered when measuring beta radiation characteristics. If the object of survey changes, clear the memorized value of gamma-component and conduct measurement and saving of the new value of gamma-component in the immediate proximity to a new surface to be examined. Information about gamma-component measurement and saving is given in 2.3.6.6.4 of the Operating Manual.

The ABG probe does not require any other actions when beta radiation characteristics are measured. Measurement and consideration of gamma-component is done automatically.

2.3.6.6.1.5 To measure beta radiation characteristics, open the beta detector window and place BG probe so that the window of its beta detector was in parallel and at a minimum distance to the surface to be examined.

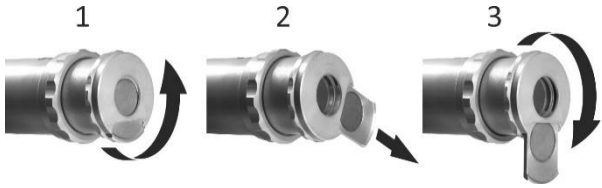


Figure 2.16 – Opening beta detector window
of BG probe

1 – ease the nut that fixes the beta detector shutter.
2 – open the beta detector window.
3 – fix the beta detector shutter open.

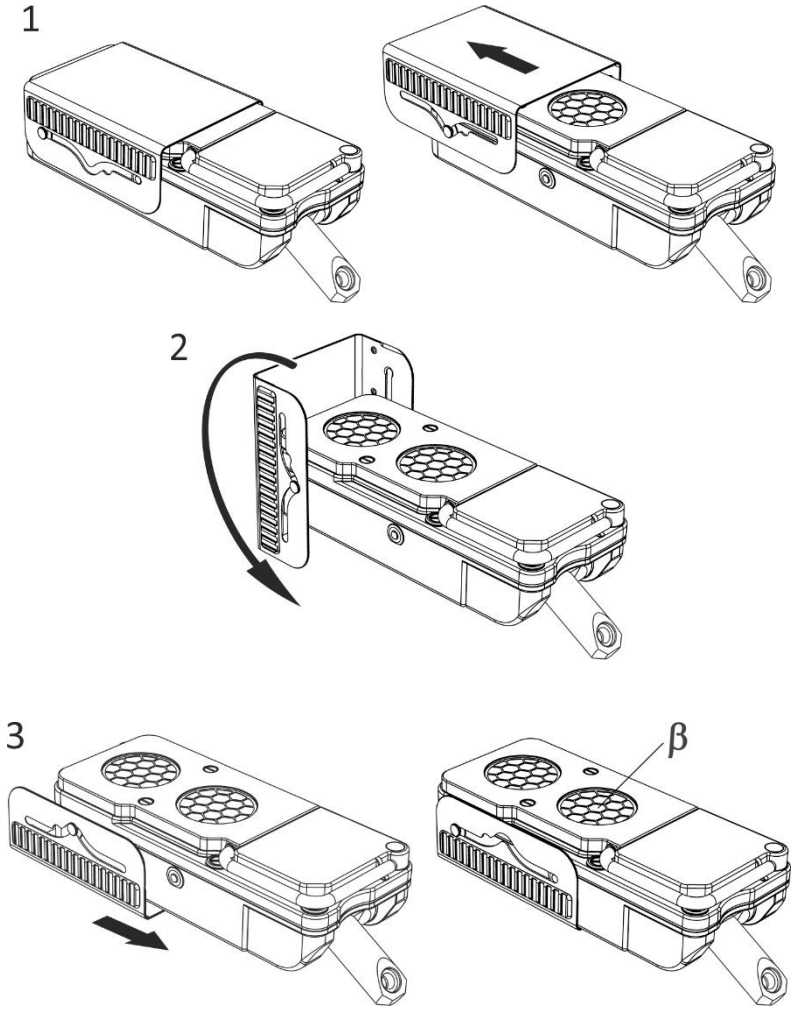


Figure 2.17 – Opening the detector windows
of ABG probe

1 – pull the cover.
2 – turn the cover through circa 180°.
3 – move the cover until you feel it is fixed.

2.3.6.6.2 **Operating mode of the control unit of the dosimeter "Measurement results display obtained from the probes or detectors" during beta radiation characteristics measurement**

2.3.6.6.2.1 When measuring beta radiation characteristics the control unit should be in the mode of measurement results display obtained from the probes or detectors. The control unit always enters this mode after it is switched on. This mode can also be accessed from any other mode by shortly pressing MODE.

In this case "β" should be set as the radiation type. Radiation type is selected (among the permissible for the connected probe) by long press of RAYS/RESTART. Press and hold RAYS/RESTART to change the type of radiation, and then release RAYS/RESTART. If necessary, repeat these steps until you choose "β".

2.3.6.6.2.2 Surface beta-particles flux density is displayed in 1/(cm^2·min), (10^3/(cm^2·min)). Surface activity of beta-emitting radionuclides - in Bq/cm^2, (kBq/ cm^2). It is also possible to display pulse count rate from beta radiation detector in cps.

Shortly press UNITS to change the measurement units (2.3.6.4 of this OM).

2.3.6.6.2.3 In this mode the following is displayed on the dosimeter's LCD (Figure 2.18):

- "β" symbol (1) – radiation type being measured;
- blinking "γ" symbol (2) – indication that when beta radiation characteristics are measured gamma-component of radiation is taken into account;
- measurement result (3);
- dimension of measurement result (4);
- estimated limits of expected relative statistical deviations (5) of the measurement result (3) given 0.95 confidence probability, hereinafter referred to as estimated limits of statistical deviations;
- instantaneous value indicator (6).
- battery status symbol (7);
- navigation receiver status symbol (8);
- symbol of sounding status of the registered gamma quanta, alpha or beta particles (9);
- symbol (10) of alpha radiation presence (when beta radiation characteristics are measured using ABG probe);
- sign (10) of critical filling of the dosimeter's nonvolatile memory, where DE accumulation history is stored (2.3.4 of this OM).

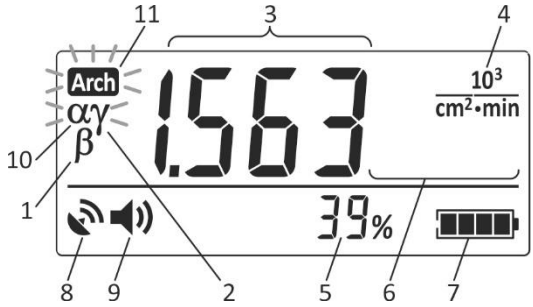


Figure 2.18 – LCD of the dosimeter
(measurement of beta radiation characteristics)

2.3.6.6.2.4 After the measurement start, measurement results of beta radiation characteristics (3) and estimated limits of statistical deviations (5) of these results begin to be generated on the LCD. Measurement results are updated every 2 seconds.

If the measurement results exceed the alarm threshold level, the dosimeter generates a two-tone audio signal and blinks with the ALARM LED. Measurement results are blinking on the LCD of the dosimeter.

If measurement results exceed the upper limit of measurement range by more than 30 %, "пппп" symbols are displayed on the LCD instead of the measurement results.

In the event of beta radiation characteristics measurement, the dosimeter can operate with three independent threshold levels. One is expressed in $1/(cm^2 \cdot min)$, $(10^3/(cm^2 \cdot min))$, the second one - in Bq/cm^2, (kBq/cm^2), the third one - in cps. Measurement results are compared only with one threshold level, the measurement units of which correspond to the selected measurement units of the results. Only this threshold level can be viewed or changed.

A twenty-segment instantaneous value indicator (6) is intended for quick assessment of beta radiation intensity. An instantaneous value of beta radiation intensity is shown in pseudologarithmic scale. The greater the intensity, the more segments of the indicator are highlighted from left to right. The integration time during measurement of instantaneous value of beta radiation intensity and the time of information update on the instantaneous value indicator is 500 ms

The estimated values of surface beta-particles flux density and surface activity of beta-emitting radionuclides, in the event of which the first and all segments of the indicator are highlighted, are shown in Table 2.5.

Table 2.5

Probe	1st segment highlighted	All segments highlighted
BG probe	0.312 kpart./(cm^2·min)	145 kpart./(cm^2·min)
ABG probe	0.035 kpart./(cm^2·min)	190 kpart./(cm^2·min)

2.3.6.6.2.5 Beta radiation characteristics are measured as follows. After the measurement starts, the LCD of the dosimeter displays measurement results and estimated limits of statistical deviations of these results. Firstly, the estimated limits of statistical deviations of measurement results are large. In the process of measurement the estimated limits of statistical deviations of measurement results decrease and eventually reach the specified limits of statistical deviations. After that, the process of measurement continues, however a part of statistical information is rejected. Therefore, all next measurement results come with estimated limits of statistical deviations equal to or less than the specified ones.

At any moment in time, the user can restart the measurement process by shortly pressing RAYS/RESTART.

The specified limits of statistical deviations can be determined by the dosimeter automatically depending on the radiation intensity, or can be specified by the user in the submode of the alarm threshold level programming.

A blinking "%" symbol shows that the specified limits of statistical deviations have been set by the user.

"пп%" symbols are displayed on the LCD as long as the estimated limits of statistical deviations exceed 99 %.

Annex B shows the dependence of the specified limits of statistical deviations determined by the dosimeter on the radiation intensity, as well as approximate time of statistical information accumulation necessary to obtain measurement results with the estimated limits of statistical deviations, which are equal to the main relative permissible error limit and the specified limits of statistical deviations determined by the dosimeter. (Typical sensitivity of the counters, which is applied to the ABG/BG probes, was used for charts plotting).

2.3.6.6.3 **Submode of the control unit "Viewing and programming of new values of the alarm threshold level and the specified limits of statistical deviations (specified limits of the expected relative statistical deviations of the measurement result given 0.95 confidence probability)" during measurement of beta radiation characteristics**

2.3.6.6.3.1 Press THRESHOLD to view the current values of the alarm threshold level and the specified limits of statistical deviations. In this case, the control unit should be in the mode of "Measurement results display obtained from the probes or detectors".

The LCD will display the following information (Figure 2.19):

- measured radiation type (1);
- alarm threshold level (2);
- dimension of the threshold level (3);
- specified limits of statistical deviations (4);
- "THRESHOLD" transparency (5) reflecting the alarm threshold level;
- battery status symbol (6);
- navigation receiver status symbol (7).

This information is displayed on the LCD while THRESHOLD is held down (but not more than 4 sec).

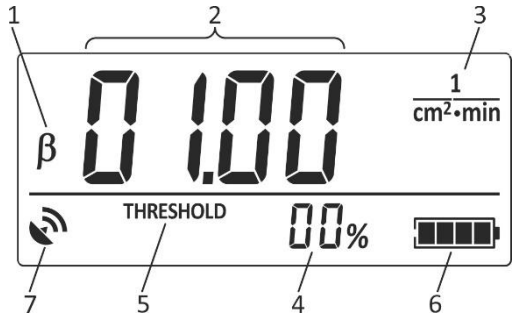


Figure 2.19 – LCD of the dosimeter
(viewing the alarm threshold level and specified limits of statistical deviations)

2.3.6.6.3.2 If you keep holding THRESHOLD for more than 4 s, the value of the alarm threshold level is returned to zero, and its low-order digit starts blinking (Figure 2.20). Then release THRESHOLD.

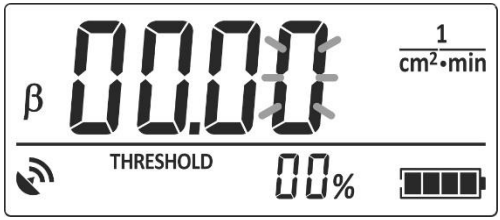


Figure 2.20 – LCD of the dosimeter
(submode of the alarm threshold level and the specified limits of statistical deviations programming)

Programming of the alarm threshold level and specified limits of statistical deviations when beta radiation characteristics are measured is similar to programming of the alarm threshold level and specified limits of statistical deviations in the event of photon-ionizing radiation DER measurement (2.3.6.5.3.2 of this OM).

Important! Programming of a zero threshold level switches off this threshold alarm.

Programming of a zero value of the specified limits of statistical deviations starts automatic determination of the specified limits of statistical deviations by the dosimeter depending on the radiation intensity.

Important! If the submode of the alarm threshold level and the specified limits of statistical deviations programming is paused for more than 20 seconds (the user will not click any button), the control unit automatically returns to the mode of measurement results display obtained from the probes or detectors. All changes that have been made in the submode of new values programming will be canceled.

2.3.6.6.4 **Measurement and saving gamma radiation component for further consideration of its impact on the results of beta radiation characteristics measurement**

2.3.6.6.4.1 ABG probe does not require any other actions with regard to measurement of gamma-component when beta radiation characteristics are measured. Gamma-component impact is automatically considered. If gamma-component exceeds the value of 2 mSv/h, measurement of beta radiation characteristics becomes impossible, and “-oG-” symbols are displayed on the LCD of the dosimeter.

2.3.6.6.4.2 Before measurement of beta radiation characteristics using BG probe, it is necessary to measure and save the value of gamma radiation component as close to the surface to be examined as possible. Further, this value will be automatically considered when measuring beta radiation characteristics. To do this, the control unit should be in the mode of "Measurement results display obtained from the probes or detectors" (2.3.6.6.2 of this OM). The selected dimension of measurement results display is not important.

Follow the procedure:

- close the beta detector window;
- place BG probe with the closed beta detector window so that it was in parallel to and at a minimum distance from the surface to be examined;
- restart the measurement process by shortly pressing RAYS/RESTART;
- wait for measurement results of gamma-component with minimum possible estimated limits of statistical deviations;
- press MODE and hold it down until a blinking "γ" symbol appears ((2) Figure 2.18) to save the result of gamma-component measurement.

If you change the object of examination, clear the saved value of gamma radiation component and measure and save the new value of gamma-component in the immediate proximity to a new surface to be examined.

Press MODE and hold it down until a blinking "γ" symbol disappears to clear the saved value of gamma-component.

2.3.6.6.5 **Submode of the control unit of the dosimeter "Saving measurement result of beta radiation characteristics in the nonvolatile memory"**

2.3.6.6.5.1 It is only possible to save the measurement result if gamma radiation component is considered during measurement of beta radiation characteristics. The LCD of the dosimeter displays a blinking "γ" symbol (2) (Figure 2.18).

2.3.6.6.5.2 Saving measurement result of beta radiation characteristics in the nonvolatile memory of the control unit is similar to saving measurement result of DER measurement (2.3.6.5.4 of this OM).

2.3.6.7 **Measurement of alpha radiation characteristics**

2.3.6.7.1 **General information**

2.3.6.7.1.1 Alpha radiation characteristics, such as surface alpha particles flux density and surface activity of alpha-emitting radionuclides can be measured using ABG probe.

2.3.6.7.1.2 Follow 2.2 of this OM (Preparation to operation) to connect the probe to the control unit.

2.3.6.7.1.3 Open the alpha detector window and place the probe so that the window of its alpha detector was in parallel to and at a minimum distance from the surface to be examined.

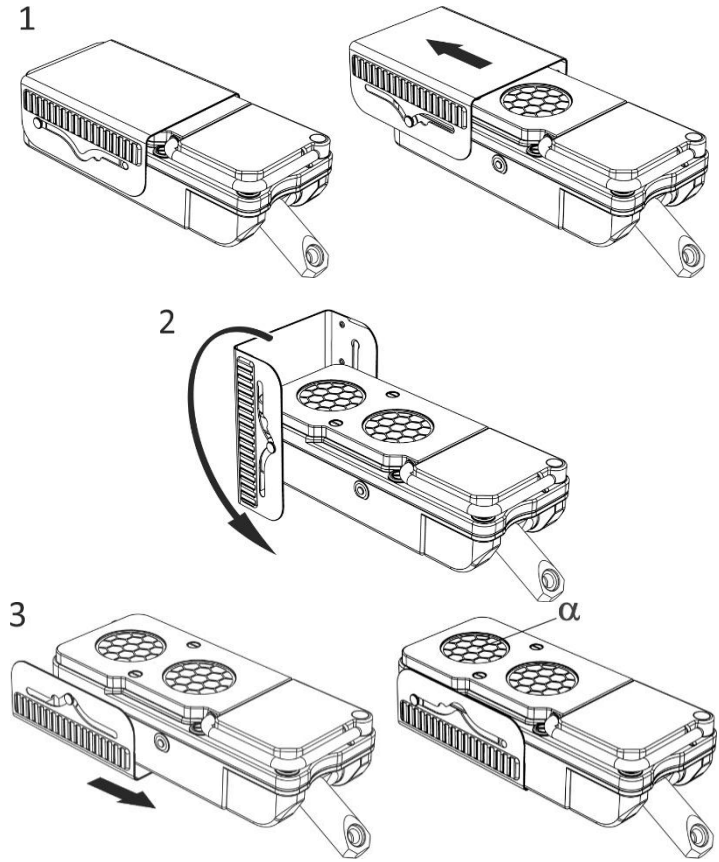


Figure 2.21 – Opening the detectors windows of ABG probe

1 – pull the cover.
2 – turn the cover through circa 180°.
3 – move the cover until you feel it is fixed.

2.3.6.7.1.4 Open the alpha detector window (Figure 2.21).

2.3.6.7.1.5 Place the probe so that the window of its alpha detector was in parallel to and at a minimum distance from the surface to be examined. You can use the twist limiter in order to maintain a stable distance between the probe and the examined surface.

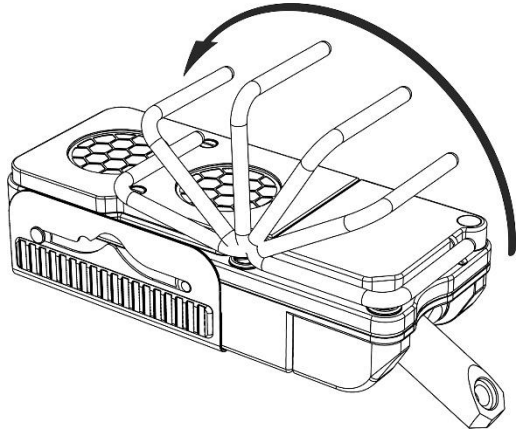


Figure 2.22 – Twist limiter of ABG probe

2.3.6.7.2 **Operation mode of the control unit "Measurement results display obtained from the probes and detectors" during alpha radiation characteristics measurement**

2.3.6.7.2.1 When measuring alpha radiation characteristics the control unit should be in the mode of measurement results display obtained from the probes or detectors. The control unit always enters this mode after it is switched on. This mode can also be accessed from any other mode by shortly pressing MODE.

In this case "α" should be set as the radiation type. The radiation type is selected (among the permissible ones for the connected probe) by long press of RAYS/RESTART. Press and hold RAYS/RESTART to change the type of radiation, and then release RAYS/RESTART. If necessary, repeat these steps until "α" is chosen.

2.3.6.7.2.2 Surface alpha-particles flux density is displayed in $1/(cm^2 \cdot min)$, $(10^3/(cm^2 \cdot min))$. Surface activity of alpha-emitting radionuclides - in Bq/cm^2, (kBq/ cm^2). It is also possible to display the pulse count rate from alpha radiation detector in cps.

Shortly press UNITS to change the units of measurement (2.3.6.4 of this OM).

2.3.6.7.2.3 The LCD of the dosimeter displays the following in this mode (Figure 2.23):

- "α" symbol (1) – radiation type being measured;
- measurement result (2);
- dimension of measurement result (3);
- estimated limits of expected relative statistical deviations (5) of the measurement result (4) given 0.95 confidence probability, hereinafter referred to as the estimated limits of statistical deviations;
- instantaneous value indicator (5).
- battery status symbol (6);
- navigation receiver status symbol (7);
- symbol of gamma quanta, alpha or beta particles sounding status (8);
- sign (10) of critical filling of the dosimeter's nonvolatile memory, where DE accumulation history is stored (2.3.4 of this OM).

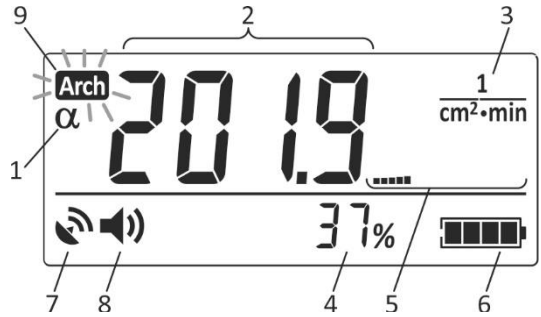


Figure 2.23 – LCD of the dosimeter
(measurement of beta radiation characteristics)

2.3.6.7.2.4 After the measurement start, measurement results of alpha radiation characteristics (2) and estimated limits of statistical deviations (4) of these results begin to be generated on the LCD. Measurement results are updated every 2 seconds.

If the measurement results exceed the alarm threshold level, the dosimeter generates a two-tone audio signal and blinks with the ALARM LED. The measurement results are blinking on the LCD of the dosimeter.

If measurement results exceed the upper limit of measurement range by more than 30 %, "пппп" symbols are displayed on the LCD instead of the measurement results.

In the event of alpha radiation characteristics measurement, the dosimeter can operate with three independent threshold levels. One is expressed in $1/(cm^2 \cdot min)$, $(10^3/(cm^2 \cdot min))$, the second one - in Bq/cm^2, (kBq/cm^2), the third one - in cps. Measurement results are compared only with one threshold level, the measurement units of which correspond to the selected measurement units of the results. Only this threshold level can be viewed or changed.

A twenty-segment instantaneous value indicator (5) is intended for quick assessment of alpha radiation intensity. Instantaneous value of alpha radiation intensity is shown in pseudologarithmic scale. The greater the intensity, the more segments of the indicator are highlighted from left to right. The integration time during measurement of instantaneous value of alpha radiation intensity and the time of information update on the instantaneous value indicator is 500 ms

Indicative values of surface alpha-particles flux density and surface activity of alpha-emitting radionuclides, in the event of which the first and all segments of the indicator are highlighted, are shown in Table 2.6.

Table 2.6

1st segment highlighted	All segments highlighted
0.3 kpart./(cm^2·min)	250 kpart./(cm^2·min)

2.3.6.7.2.5 Alpha radiation characteristics are measured as follows. After the measurement starts the LCD of the dosimeter displays measurement results and estimated limits of statistical deviations of these results. Firstly, the estimated limits of statistical deviations of measurement results are large. In the process of measurement the estimated limits of statistical deviations of measurement results decrease and eventually reach the specified limits of statistical deviations. After that, the process of measurement continues, but a part of statistical information is rejected. Therefore, all next measurement results come with the estimated limits of statistical deviations equal to or less than the specified ones.

At any moment in time, the user can restart the measurement process by shortly pressing RAYS/RESTART.

The specified limits of statistical deviations can be determined by the dosimeter automatically, depending on the radiation intensity, or can be specified by the user in the submode of the alarm threshold level programming.

A blinking "%" symbol shows that the specified limits of statistical deviations have been set by the user.

"пп%" symbols are displayed on the LCD until the estimated limits of statistical deviations exceed 99 %.

Annex C shows the dependence of the specified limits of statistical deviations determined by the dosimeter on the radiation intensity, as well as approximate time of statistical information accumulation necessary to obtain measurement results with the estimated limits of statistical deviations, which are equal to the main relative permissible error limit and the specified limits of statistical deviations determined by the dosimeter. (Typical sensitivity of the counter, which is applied to ABG probe, was used for charts plotting).

2.3.6.7.3 **Submode of the control unit of the dosimeter "Viewing and programming new values of the alarm threshold level and the specified limits of statistical deviations (specified limits of the expected relative statistical deviations of the measurement result given 0.95 confidence probability)" during measurement of alpha radiation characteristics**

2.3.6.7.3.1 Press THRESHOLD to view the current values of the alarm threshold level and the specified limits of statistical deviations. In this case, the control unit should be in the mode of "Measurement results display obtained from the probes or detectors".

The LCD will display the following information (Figure 2.24):

- measured radiation type (1);
- alarm threshold level (2);
- threshold level dimension (3);
- specified limits of statistical deviations (4);
- "THRESHOLD" transparency (5), reflecting the alarm threshold level;
- battery status symbol (6);
- navigation receiver status symbol (7).

This information is displayed on the LCD while THRESHOLD is held down (but not more than 4 sec).

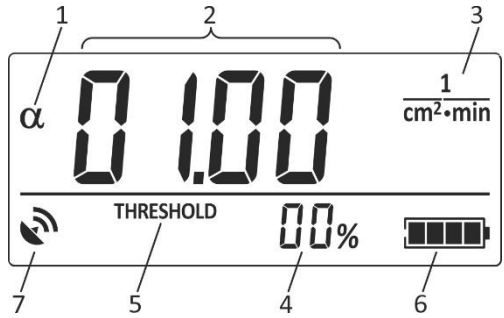


Figure 2.24 – LCD of the dosimeter
(viewing the alarm threshold level and specified limits of statistical deviations)

2.3.6.7.3.2 If you keep holding THRESHOLD for more than 4 s, the value of the alarm threshold level is returned to zero, and its low-order digit starts blinking (Figure 2.25). Then release THRESHOLD.

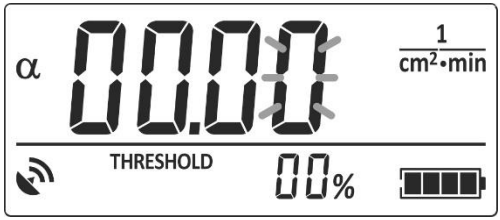


Figure 2.25 – LCD of the dosimeter
(submode of the alarm threshold level and specified limits of statistical deviations programming)

Programming of the alarm threshold level and specified limits of statistical deviations when alpha radiation characteristics are measured is similar to programming of the alarm threshold level and specified limits of statistical deviations in the event of photon-ionizing radiation DER measurement (2.3.6.5.3.2 of this OM).

Important! Programming a zero threshold level, switches off this threshold alarm.

Programming a zero value of the specified limits of statistical deviations turns on automatic determination of the specified limits of statistical deviations by the dosimeter depending on the radiation intensity.

Important! If the submode of the alarm threshold level and the specified limits of statistical deviations programming is paused for more than 20 seconds (the user will not click any button), the control unit automatically returns to the mode of measurement results display obtained from the probes or detectors. All changes that have been made in the submode of new values programming will be canceled.

2.3.6.8 **Measurement of accumulated photon-ionizing radiation DE and DE accumulation time**

2.3.6.8.1 **General information**

2.3.6.8.1.1 Accumulated photon-ionizing radiation DE is measured with the help of the detector built in the control unit.

2.3.6.8.1.2 Measurement of accumulated DE and DE accumulation time begins when the control unit is switched on, after its display and alarm tools testing finishes. Accumulated DE and DE accumulation time are measured during the entire period of the control unit operation and do not depend on its operating modes.

2.3.6.8.1.3 DE accumulation history is saved in the nonvolatile memory of the dosimeter simultaneously with measurement of accumulated DE and DE accumulation time (2.3.4 of this OM). The nonvolatile memory capacity provides for saving up to 2200 DE values. The saving interval depends on DER and falls within 10 to 1 minute. DE is also saved when you turn the dosimeter on and off.

2.3.6.8.2 **Operating mode of the control unit "Display of accumulated DE and DE accumulation time"**

2.3.6.8.2.1 This mode can be entered from any other operating mode with a short press of MODE. This mode follows the mode of measurement results display obtained from the probes and detectors.

2.3.6.8.2.2 The LCD of the dosimeter displays the following in this mode (Figure 2.26):

- "γ" symbol – measured radiation type (1);
- accumulated DE value (2);
- accumulated DE dimension (3);
-DE accumulation time (4);
- battery status symbol (5);
- navigation receiver status symbol (6);
- sign (7) of critical filling of the dosimeter's nonvolatile memory, where DE accumulation history is stored (2.3.4 of this OM).

Figure 2.26 – LCD of the dosimeter
(Display of accumulated DE value and DE accumulation time)

2.3.6.8.2.3 DE is displayed in Sv (mSv, μSv) or in Gy (mGy, μGy). DE accumulation time can be displayed in two formats. While DE accumulation time is less than 100 hours, it is displayed in "HH:MM" format, where HH – the value of hours, MM – the value minutes of DE accumulation time. The value of hours and the value of minutes are separated with a non-blinking ":" symbol.

When DE accumulation time exceeds 100 hours – it is displayed in "HHHH" format, where HHHH – the value of hours of DE accumulation time. There is no ":" symbol.

2.3.6.8.2.4 If during DE accumulation, DER exceeded the maximum permissible limit of measurement range for the detector built-in the control unit, DE dimension is blinking. It means that DE value can be inaccurate.

2.3.6.8.2.5 If accumulated DE value exceeds 90 % of the alarm threshold level, the dosimeter starts generating an intermittent single-tone audio signal, which indicates to approximation of accumulated DE to the threshold level of alarm actuation. Press ON/SAVE to switch off this signal generation.

When accumulated DE value exceeds the alarm threshold level, the dosimeter starts generating a two-tone audio signal and blinks with ALARM LED. The accumulated DE value is blinking on the LCD of the dosimeter. Change the threshold level to turn off generation of these signals.

2.3.6.8.3 **Submode of the control unit "Viewing and programming new value of the alarm threshold level" in the event of accumulated DE measurement**

2.3.6.8.3.1 Press THRESHOLD to view the current value of the alarm threshold level. The control unit should be in the mode of "Accumulated DE and DE accumulation time display".

The LCD displays the following information (Figure 2.27):

- measured radiation type (1);
- alarm threshold level (2);
- threshold level dimension (3);
- THRESHOLD transparency (4), reflecting the alarm threshold level;
- battery status symbol (5);
- navigation receiver status symbol (6).

This information is displayed on the LCD while THRESHOLD is held down (but not more than 4 sec).

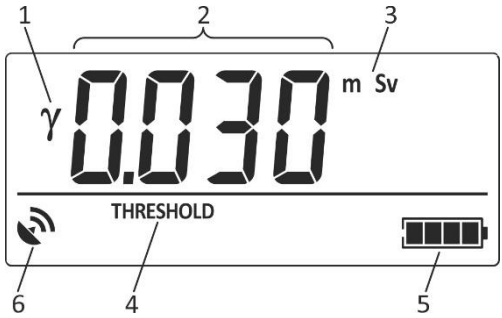


Figure 2.27 – LCD of the dosimeter
(viewing the alarm threshold level)

2.3.6.8.3.2 If you keep holding THRESHOLD for more than 4 s, the value of the alarm threshold level is returned to zero, and its low-order digit starts blinking (Figure 2.28). Then release THRESHOLD.

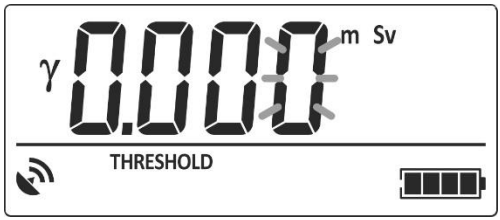


Figure 2.28 – LCD of the dosimeter
(submode of the alarm threshold level programming)

Programming of the alarm threshold level relative to the accumulated DE value is done in a similar way to programming of the alarm threshold level in the event of photon-ionizing radiation DER measurement (2.3.6.5.3.2 of this OM).

Important! Programming a zero value of the threshold level turns off the alarm of this threshold.

Important! If the submode of the alarm threshold level programming is paused for more than 20 seconds (the user will not click any buttons), the control unit automatically returns to the mode of accumulated DE and DE accumulation time display. All changes that have been made in this programming submode will be canceled.

2.3.6.8.4 **Submode of the control unit of the dosimeter "Clearing the values of DE, DE accumulation time and DE accumulation history"**

2.3.6.8.4.1 Press UNITS/CLEAR and hold it down (circa 4 s) until "CLr" symbols (1) appear on the LCD to proceed to the submode of DE, DE accumulation time and DE accumulation history values clearing (Figure 2.29). Then release UNITS/CLEAR.

In this submode you should finally confirm or cancel clearing with the help of the symbols (2). The symbol status (2) changes by shortly pressing RAYS/RESTART. If "-On-" is displayed, clearing is confirmed, if "-OFF" is displayed – it is cancelled. Press ON/SAVE to exit this submode. The control unit returns to the mode of accumulated DE and DE accumulation time display.

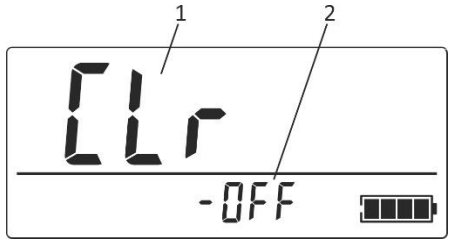


Figure 2.29 – LCD of the dosimeter
(Submode of accumulated DE, DE accumulation time and DE accumulation history clearing)

Important! If the submode of accumulated DE, DE accumulation time and DE accumulation history clearing is paused for more than 20 seconds (the user will not click any button), the control unit automatically returns to the mode of accumulated DE and DE accumulation time display.

2.3.6.9 **Determination of geographical coordinates and real time**

2.3.6.9.1 **General information**

2.3.6.9.1.1 Geographical coordinates and real time are determined with the help of the navigation receiver of GPS and GLONASS systems built in the control unit.

2.3.6.9.1.2 If the navigation receiver is switched off or a signal from navigation satellites is not available, the real time is determined by the clock built in the control unit.

2.3.6.9.2 **Operating mode of the control unit "Navigation receiver control"**

2.3.6.9.2.1 Shortly press MODE to enter this operating mode from any other modes of the control unit. This mode follows the mode of accumulated DE and DE accumulation time display.

2.3.6.9.2.2 The LCD of the dosimeter displays the following information in this mode (Figure 2.30):

- "GPS" symbols (1) – indication of the mode;
- navigation receiver status (2);
- symbol of navigation receiver status (3);
- battery status symbol (4);
- instantaneous value indicator (5);
- sign (6) of critical filling of the dosimeter's nonvolatile memory, where DE accumulation history is stored (2.3.4 of this OM).

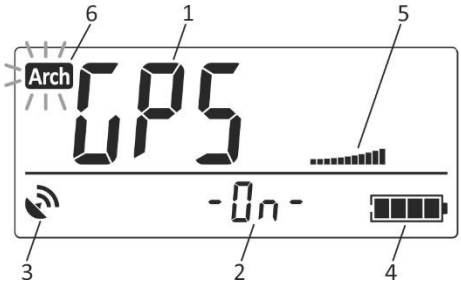


Figure 2.30 – LCD of the dosimeter (Navigation receiver control mode)

The number of highlighted segments of the instantaneous value indicator (5) displays the number of satellites, which communicate information to the navigation receiver.

2.3.6.9.2.3 To change the navigation receiver status shortly press RAYS/RESTART. If the navigation receiver is off, symbols (2) are shown as "-OFF", and the status symbol (3) is not highlighted. If the navigation receiver is on - symbols (2) are shown as "-On-", and the status symbol (3) is continuously highlighted or blinking. Status symbol blinking (3) indicates the lack of reliable information from the navigation receiver.

2.3.6.9.3 **Submode of the control unit of the dosimeter "Viewing and programming of new local time offset relative to GMT"**

2.3.6.9.3.1 If the navigation receiver is enabled, you can view the current local time offset relative to GMT and set the new offset. Press THRESHOLD to view the current offset. In this case, the control unit should be in the "Navigation receiver control" mode.

The LCD will include the following information (Figure 2.31):

- hours of local time offset relative to GMT (1);
- minutes of local time offset relative to GMT (2);
- symbol of local time offset relative to GMT (3) – "-Add" – when local time is generated, the offset is added to the time obtained from the navigation receiver; "-Sub" – offset is subtracted;
- navigation receiver status symbol (4);
- battery status symbol (5).

This information is displayed on the LCD while THRESHOLD is held down (but no longer than 4 s).

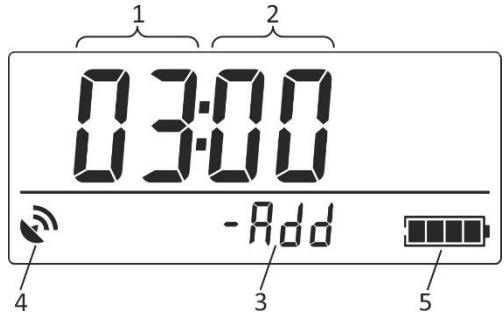


Figure 2.31 – LCD of the dosimeter
(viewing current local time offset relative to GMT)

2.3.6.9.3.2 If you keep holding THRESHOLD for more than 4 s, the value of the local time offset relative to GMT is cleared, and its low-order digit starts blinking (Figure 2.32). Then release THRESHOLD.

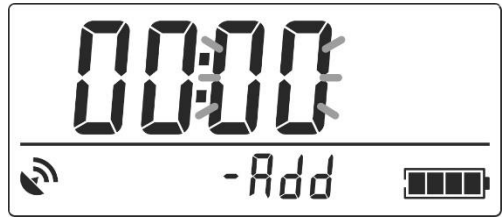


Figure 2.32 – LCD of the dosimeter
(submode of new local time offset programming relative to GMT)

Blinking values of minutes mean that there is a possibility to change them. The required value of minutes is set by pressing RAYS/RESTART. Successive short presses and releases of RAYS/RESTART change the value per 15. A long press of RAYS/RESTART starts automatic change of the value that stops when RAYS/RESTART is released.

A short press of MODE records the value of minutes (they stop blinking at that) and makes it possible to change the value of hours that start blinking. The value of hours is programmed in a similar way to the value of minutes; however the values are changed per unit.

A short press of MODE records the value of hours (they stop blinking at that) and makes it possible to change the offset symbol from “-Add” to “-Sub”. Symbols “-Add” and “-Sub” start blinking. The required value of the offset symbol is set by pressing RAYS/RESTART.

A short press of ON/SAVE closes the submode of the new local time offset programming relative to GMT. The new offset blinks three times on the LCD, which means that it has been recorded in the nonvolatile memory of the control unit. After that the control unit returns to the navigation receiver control mode.

Important! If the submode of the new local time offset programming relative to GMT is paused for more than 20 seconds (the user will not click any button), the control unit automatically returns to the mode of navigation receiver control. All changes that have been made in the submode of the new local time offset programming relative to GMT will be canceled.

2.3.6.9.4 **Operating mode of the control unit "Current time and date display"**

2.3.6.9.4.1 Shortly press MODE to enter this operating mode from any other mode of the control unit. This mode follows the mode of navigation receiver control.

2.3.6.9.4.2 The LCD of the dosimeter displays the following information in this mode (Figure 2.33):

- hours (1);
- minutes (2);
- date (3);
- month (4);
- navigation receiver status symbol (5);
- battery status symbol (6);
- sign (7) of critical filling of the dosimeter's nonvolatile memory, where DE accumulation history is stored (2.3.4 of this OM).

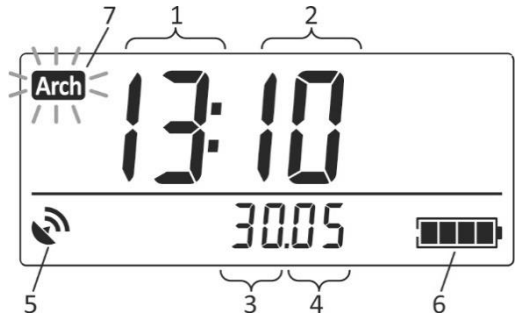


Figure 2.33 – LCD of the dosimeter
(Current time display mode)

If you shortly press MODE, a year will be displayed instead of the date and the month.

The current time values are displayed from the built-in clock or the navigation receiver. If the navigation receiver is on and reliable data is available, the current time is displayed from the navigation receiver, otherwise - from the built-in clock.

2.3.6.9.5 **Submode of the control unit "Time and date correction"**

2.3.6.9.5.1 If the navigation receiver is off and you press and hold THRESHOLD longer than for 4 s, it switches the control unit to the submode of time and date correction.

Important! If the navigation receiver is on, the submode of time and date correction is not available.

If the values of minutes are blinking, it means that the control unit is in the submode of time and date correction (Figure 2.34).

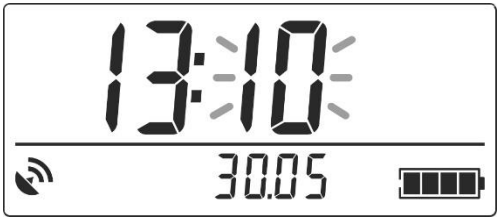


Figure 2.34 – LCD of the dosimeter
(submode of time and date correction – correction of hours and minutes)

If the value of minutes is blinking, it means that it can be changed. Press RAYS/RESTART to set the required value of minutes. Successive short presses and releases of RAYS/RESTART change the value per unit. A long press of RAYS/RESTART starts automatic change of values, which is stopped as soon as RAYS/RESTART is released.

A short press of MODE records the value of minutes (they stop blinking at that) and enables changing the value of hours that start blinking. The value of hours is programmed in a similar way to the value of minutes.

A short press of MODE records the value of hours (they stop blinking at that) and a year, a month and a date are displayed on the LCD.

Low-order digits of the year are blinking, which means that their value can be changed. Press RAYS/RESTART to correct the value in a similar way to correction of minutes. The value of the year can be set within the limits from 2014 to 2099.

A short press of MODE records the value of year (low-order digits of year stop blinking) and the LCD displays a date, a month and a year.

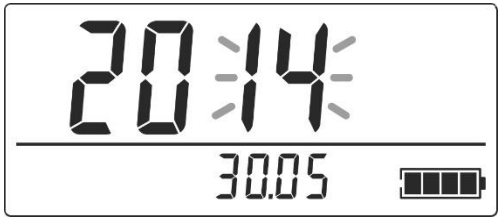


Figure 2.35 – LCD of the dosimeter
(submode of time and date correction – year correction)

Figure 2.36 – LCD of the dosimeter
(submode of time and date correction – date and month correction)

Blinking digits of the month mean that there is a possibility to correct their value. Press RAYS/RESTART to correct the value in a similar way to correction of minutes.

A short press of MODE records the value of the month (it stops blinking at that) and makes it possible to change the value of date that starts blinking. The value of date is programmed in a similar way to the value of minutes.

A short press of MODE records the value of date and closes the submode of date and time correction. The value of time blinks three times on the LCD, which means that it has been recorded in the nonvolatile memory of the control unit. After that the control unit returns to the mode of current time display.

The submode of time and date correction can be finished at the stage of each value correction. Shortly press ON/SAVE to do that. All corrected values will be recorded in the nonvolatile memory of the control unit and it will return to the mode of current time display.

Important! If the submode of time and date correction is paused for more than 20 seconds (the user will not click any button), the control unit automatically returns to the mode of current time display. All changes that have been made in the submode of time and date correction will be canceled.

2.3.6.10 **Working with measurement results and DE accumulation history**

2.3.6.10.1 **General information**

Measurement results recorded in the nonvolatile memory of the control unit can be viewed on its LCD, and communicated for further processing to the personal computer. DE accumulation history can be also viewed on the LCD of the control unit. You can work with DE accumulation history only using the PC.

The PC should be equipped with the USB/IrDA adapter manufactured by PE "SPPE "Sparing-Vist Center" and it should have the installed custom-made software.

2.3.6.10.2 **Operating mode of the control unit "Measurement results viewing saved in the nonvolatile memory"**

2.3.6.10.2.1 The mode of measurement results viewing saved in the nonvolatile memory is available only when the nonvolatile memory of the control unit contains at least one saved measurement result. This mode can be accessed from any other mode by shortly pressing MODE. This mode follows the mode of current time display.

2.3.6.10.2.2 In this mode the LCD of the dosimeter displays the following (Figure 2.37):

- Arch symbol (1) – indication of the mode of measurement results viewing saved in the nonvolatile memory;
- measurement result (2);
- indicator of measurement result location in the nonvolatile memory (3);
- measurement object number (4);
- symbol - indication of the availability of geographical coordinates of the measurement object in the memory (5);
- battery status symbol (6).

Important! Arch symbol (1) is blinking, if during operation of the dosimeter a part of the oldest information was lost (2.3.4 of this OM).

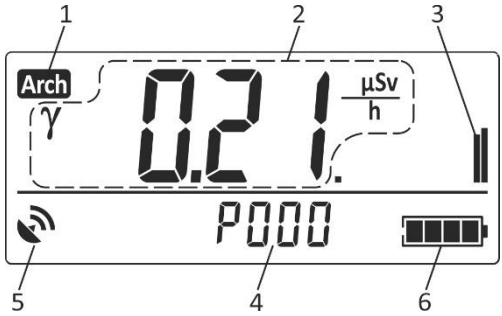


Figure 2.37 – LCD of the dosimeter
(Mode of measurement results viewing saved in the nonvolatile memory)

During viewing, unless the user clicks a button of the control unit, measurement object number or estimated limits of statistical deviations of the measurement result are alternately displayed on the LCD area (4).

 symbol is highlighted on the LCD if geographical coordinates of the measurement object are stored for this measurement result in the nonvolatile memory.

Location indicator (3) shows a conventional place of the measurement result (2) in the nonvolatile memory. Extreme left position of the location indicator corresponds to the beginning of the nonvolatile memory, i.e. the oldest measurement result (measurement result that was saved first). Extreme right position - corresponds to the nonvolatile memory end, i.e. the most recent measurement result (measurement result that was the last to be saved).

2.3.6.10.2.3 Control of measurement results viewing is done by way of short presses of ON/SAVE and RAYS/RESTART. Short presses of RAYS/RESTART enable viewing the next measurement result, the one that was saved after the measurement result displayed on the LCD now (scrolling towards the more recent results).

Short presses of ON/SAVE enable viewing the previous measurement result, i.e., the one that was saved before the measurement result displayed on the LCD now (scrolling towards the older results). However, LCD displays the measurement object number together with each measurement result.

2.3.6.10.3 **Submode of the control unit "Measurement results clearing from the nonvolatile memory"**

2.3.6.10.3.1 To proceed to the submode of measurement results clearing from the nonvolatile memory, press UNITS/CLEAR and hold it down (about 4 s) until "CLr" symbols appear on the LCD (Figure 2.38). After that release UNITS/CLEAR.

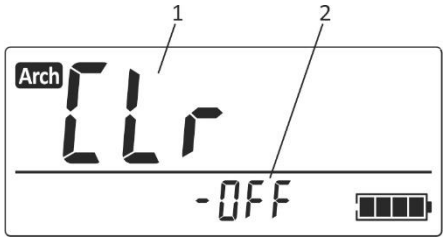


Figure 2.38 – LCD of the dosimeter
(Submode of measurement results clearing from the nonvolatile memory)

You should finally confirm or cancel deletion of the results using symbols (2) in this submode. Symbols status (2) changes with short presses of RAYS/ RESTART. If "-On-" is displayed, it confirms clearing, if "-OFF" is displayed, it means refusal from clearing. To exit this submode, press ON/SAVE. In this case, the control unit switches to the mode of measurement results display obtained from the probes or detectors.

Important! If the submode of measurement results clearing from the nonvolatile memory is paused for more than 20 seconds (the user will not click any button), the control unit automatically returns to the mode of measurement results viewing stored in the nonvolatile memory.

2.3.6.10.4 **Transfer of measurement results from the nonvolatile memory of the control unit to the PC**

2.3.6.10.4.1 To transfer the results do the following:

- switch on the control unit;
- run the custom-made software on the PC;
- place the control unit so that its infrared port is opposite to the PC's USB/IrDA adapter at a distance of 5 to 30 cm (Figure 2.39).
- enable communication function of the software according to its Manual. No additional actions are required from the control unit.

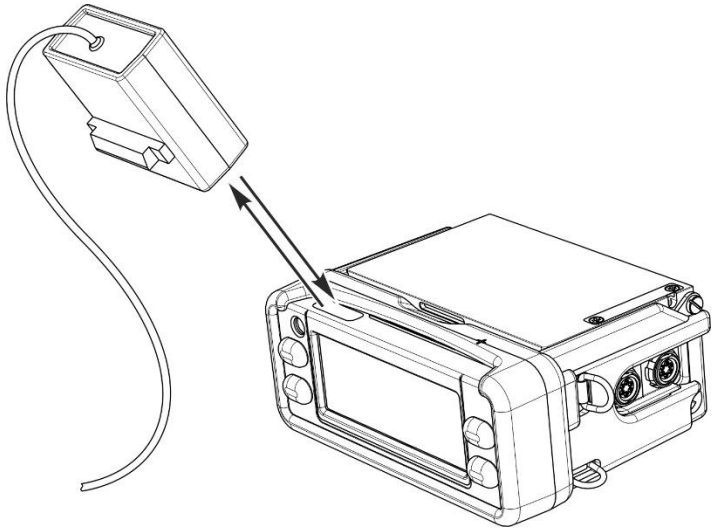


Figure 2.39 – Location of the control unit and the PC's USB/IrDA adapter to transfer measurement results to the PC

2.3.6.11 **Troubleshooting**

The list of possible failures and troubleshooting is presented in Table 2.7. At failure to eliminate the troubles presented in Table 2.7, or at detection of more complicated problems, the dosimeter should be sent to the manufacturer for repair.

Table 2.7 – Troubleshooting

Trouble	Probable cause	Troubleshooting
The dosimeter does not turn on	1 Battery discharged	1 Charge the battery
The dosimeter's LCD displays "----" when the probe is connected	1 Probe's spiral cable is damaged 2 Failure of the probe	1 Replace the probe's spiral cable 2 Replace the probe
The dosimeter's LCD displays error codes within "Er01" … "Er31" when the probe is connected	1 Failure of the probe. Error code explanation: D0 – failure of the high-sensitivity gamma detector; D1 – failure of the low-sensitivity gamma detector; D2 – failure of beta radiation detector; D3 – failure of alpha radiation detector; D4 – failure of neutron radiation detector;	1 Replace the probe
The dosimeter's LCD displays error codes "Er98" or "Er99".	1 Failure of the gamma radiation detector built in the control unit. Error "Er98" – failure of communication of microcontroller and gamma radiation detector. Error "Er99"- no pulses from gamma radiation counter	1 Replace the control unit
The dosimeter's LCD displays error code "Ert^{0}".	1 Failure of the temperature sensor built-in the control unit	1 Replace the control unit. Further operation is allowed, but at temperatures below -10^{o}C LCD symbols might be distorted

2.3.6.12 **USB/IrDA adapter**

2.3.6.12.1 USB/IrDA adapter is designed to communicate information from the nonvolatile memory of the dosimeter to the PC.

2.3.6.12.2 USB/IrDA adapter is connected to the USB-port of the PC and operates in the mode of virtual COM-port.

2.3.6.12.3 USB/IrDA adapter operates under the following conditions:

- ambient air temperature from +5 to +50 ºC;
- relative humidity up to 80 % at 35 ºC temperature, non-condensing;
- atmospheric pressure from 84 to 106.7 kPa according to GOST 12997-84 standard.

Ingress protection rating of USB/IrDA adapter is IP40 according to DSTU EN 60529:2018 standard.

2.3.6.12.4 Guidelines on switching on, drivers' installation and testing the USB/IrDA adapter

2.3.6.12.4.1 Unpack USB/IrDA adapter.

2.3.6.12.4.2 Turn on the PC, wait until operating system is ready and insert a mini-CD with the USB/IrDA adapter drivers into the CD-drive of the PC.

2.3.6.12.4.3 Connect USB/IrDA adapter to USB-port of the PC.

2.3.6.12.4.4 The operating system displays a message - "Found New hardware" and opens a window "New Hardware Wizard". The operating system suggests connecting to the Windows Update to search for the software. Here you need to choose "No, not this time" and click "Next". A new window "New Hardware Wizard" opens, which helps the operating system to install the software for this unit. Here you should select "Automatic installation (recommended)" and click "Next". While drivers are being installed, a window "Hardware installation" opens, in which the system warns that the software has not been tested for compatibility with the operating system, and you should click "Continue anyway".

2.3.6.12.4.5 The operating system searches for the drivers on the mini-CD and installs them. Drivers' files will be saved by the operating system, so there is no need to re-install them each time you use the USB/IrDA adapter on the chosen PC.

2.3.6.12.4.6 A continuous green glow of the POWER LED means the USB/IrDA adapter is ready to operation.

2.3.6.12.4.7 Select either on the PC *Start/Settings/Control Panel/System* or press the key "Pause/Break" on the keyboard holding down the "Windows" key - "System Properties" window opens. In this window, switch to the "Hardware" tab and click the "Device Manager" button. In the "Device Manager" window, choose the configuration "Ports (COM and LPT)" and remember the COM port number, which the operating system designated for the USB/IrDA adapter, for instance, **USB Serial Port (COM 4)** depending on the installed drivers.

2.3.6.12.4.8 Enter the COM port number, which the operating system designated for the USB/IrDA adapter, in the program, which will be used with that unit.

2.3.6.12.4.9 Exchange data between the dosimeter and the PC through the use of the USB/IrDA adapter. While the USB/IrDA adapter sends or receives data the yellow DATA LED is blinking.

2.3.6.13 **MKS-UM EventReader 1.0 custom-made software**

2.3.6.13.1 MKS-UM EventReader 1.0 custom-made software is designed to process measurement results that have been saved in the nonvolatile memory of the control unit on the PC running Windows 7 and 8.1. Data from the control unit is transferred to the PC using the USB/IrDA adapter.

2.3.6.13.2 **EventReader 1.0 features**

EventReader 1.0 makes it possible to:

- read up to 1500 measurement results from the nonvolatile memory of the control unit;
- display data on the map with reference to the location coordinates;
- display data in a tabular view;
- save the read data in the PC’s memory as a binary file, as a .csv file or as a report;
- printout the reports;
- view data saved as a binary file.

2.3.6.13.3 **EventReader 1.0 installation**

Run setup.exe file from the CD included in the delivery kit. As soon as all the required parameters of the installer are set, the program is installed on your PC.

2.3.6.13.4 **EventReader 1.0 interface**

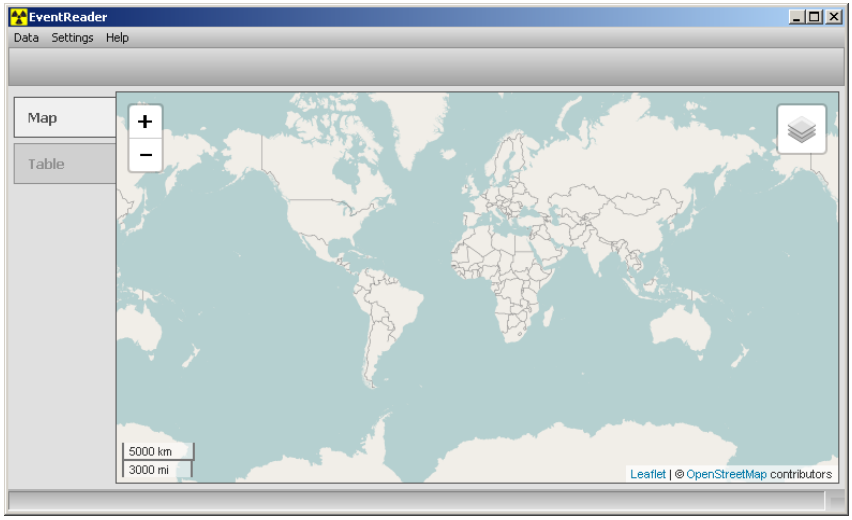


Figure 2.40 – Program window

The program window consists of:

- Program menu
- String of the dosimeter information
- Program's main field
- Status bar

Program menu

Figure 2.41 – Program menu

Actions in the program are performed using the appropriate menu options. Actions are grouped as follows:
- "Data" - data control (reading, saving, downloading, printout, export)
- "Settings" – program settings (connection setting: selecting a port that is connected to the USB/IrDA adapter, selecting the interface language)
- "Help" – information about the program

String of the dosimeter information

Figure 2.42 – String of the dosimeter information

When data is read from the dosimeter's memory or earlier saved data is downloaded, information about the dosimeter is displayed in the bar: its serial number and its set date/time.

Program's main field

The program's main field displays the read or downloaded data. There are two options of data display: on the map with reference to the location coordinates and as tables.

Status bar

Figure 2.43 – Status bar

The status bar displays the progress of operations.

2.3.6.13.5 **Working with the program**

Getting started

To read data from the dosimeter's memory, install and set the USB/IrDA adapter on the PC. To do this:
- connect USB/IrDA adapter to the PC;

- install the driver from the supplied CD;
- find the number of the serial port of the USB/IrDA adapter in the Device Manager;
- select the appropriate serial port from the program settings.

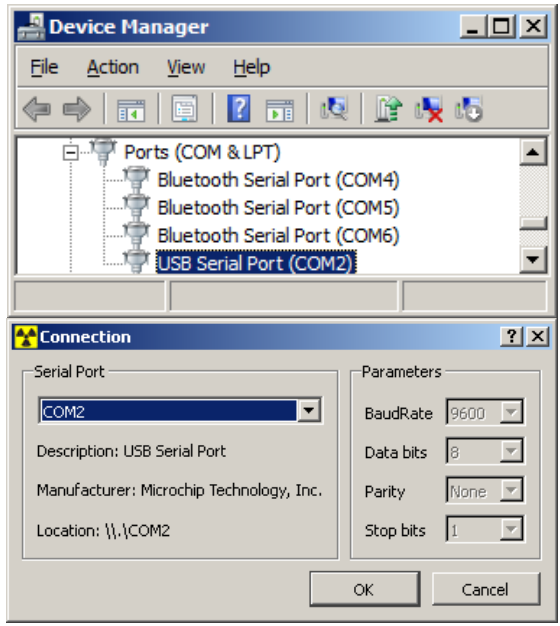


Figure 2.44 – Serial port settings

Data reading

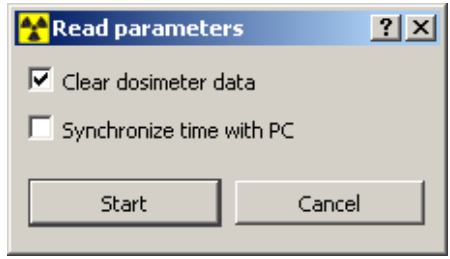


Figure 2.45 – Reading parameters

To read data from the dosimeter's memory turn on the dosimeter's control unit. Select "Data - Read" menu option in the program and place USB/IrDA adapter to the infrared port of the control unit (Figure 2.39 of this OM). The status bar displays the reading process. Upon reading completion there will be a message "Read completed" and the program's main field will display the read data.

If during reading you select "Clear dosimeter data", the data in the device will be cleared after reading. In this case you can also synchronize the dosimeter's time with the time set on the PC with the "Synchronize time with PC" option.

Data display

Read or downloaded data is displayed in the program's main field. Data can be presented as points on the map or as a table. Set the display options when selecting "Map" or "Table" tab respectively.

Map

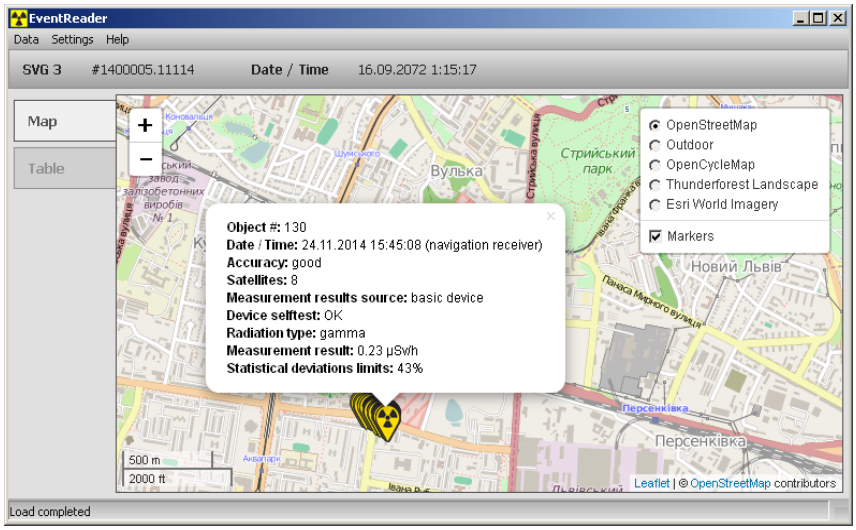


Figure 2.46 – Data display on the map

Points on the map are shown with reference to the location coordinates. Popup information windows with detailed information on the point are allocated to each point.

You may also choose the source of mapping information. This allows you to choose the type of the map that is best suited for a particular area.

Table

When displayed in a tabular form, the data is grouped in two tables placed in “Radiation” and “Dose” tabs.

The information in table cells can have text or graphical representation. Tips are provided for the table's cells, which are represented by drawings.

In the “Radiation” table the following is displayed:

- measurement object number;
- date;
- time;
- date/time source:

   - entered manually;

   - obtained from navigation receiver;
- coordinates:

   - coordinates are not specified;

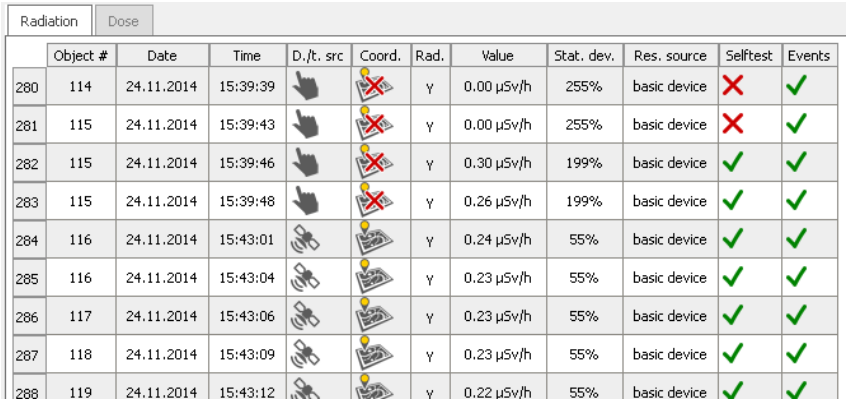
   - coordinates specified;
- radiation type: alpha, beta, gamma, fast neutrons, thermal neutrons;
- measurement result;
- statistical deviations limits;
- measurement result source: control unit, BG probe, ABG probe;
- self-testing result:

   - normal (OK);

   - error (failure of the dosimeter’s components:
  - gamma high-sensitivity detector (BG or ABG probe),
  - gamma low-sensitivity detector (BG or ABG probe),
  - beta detector (ABG),
  - alpha detector (ABG),
  - gamma detector of the control unit);
- events:

   - no;

   - DE threshold exceeding, DE warning threshold exceeding, DER threshold exceeding, DER fell outside the upper limit of the measurement range while DE has been accumulated – DE can be understated.



Radiation | Dose

	Object #	Date	Time	D./t. src	Coord.	Rad.	Value	Stat. dev.	Res. source	Selftest	Events
280	114	24.11.2014	15:39:39			γ	0.00 µSv/h	255%	basic device	✗	✓
281	115	24.11.2014	15:39:43			γ	0.00 µSv/h	255%	basic device	✗	✓
282	115	24.11.2014	15:39:46			γ	0.30 µSv/h	199%	basic device	✓	✓
283	115	24.11.2014	15:39:48			γ	0.26 µSv/h	199%	basic device	✓	✓
284	116	24.11.2014	15:43:01			γ	0.24 µSv/h	55%	basic device	✓	✓
285	116	24.11.2014	15:43:04			γ	0.23 µSv/h	55%	basic device	✓	✓
286	117	24.11.2014	15:43:06			γ	0.23 µSv/h	55%	basic device	✓	✓
287	118	24.11.2014	15:43:09			γ	0.23 µSv/h	55%	basic device	✓	✓
288	119	24.11.2014	15:43:12			γ	0.22 µSv/h	55%	basic device	✓	✓

Figure 2.47 – “Radiation” table

Entries in the "Radiation" table may contain information about the location coordinates. In this case, when you double-click on the appropriate table row, the program switches to the map tab, places the corresponding point in the center and opens a popup window with its detailed information.

In the “Dose” table the following is displayed:
- date;
- time;
- date/time source:

 - entered manually;

 - obtained from navigation receiver;
- dose;
- accumulation time;
- self-testing results:

✓ - normal (OK);

✗ - error (failure of gamma detector of the control unit);
- events:

✓ - no;

✗ - DE threshold exceeding, DE warning threshold exceeding, DER threshold exceeding, DER fell outside the upper limit of the measurement range while DE has been accumulate – DE can be understated;

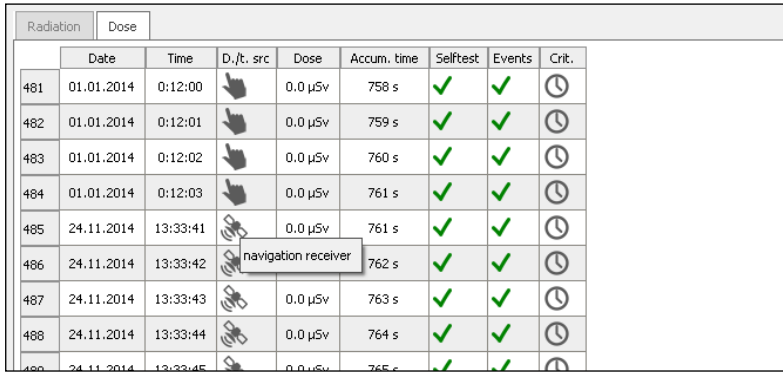
- recording criterion:

 - automatically;

 - time synchronization with PC;

 (red) - emergency device shutdown;

 (green) - regular device shutdown.



	Date	Time	D./t. src	Dose	Accum. time	Selftest	Events	Crit.
481	01.01.2014	0:12:00		0.0 µSv	758 s	✓	✓	
482	01.01.2014	0:12:01		0.0 µSv	759 s	✓	✓	
483	01.01.2014	0:12:02		0.0 µSv	760 s	✓	✓	
484	01.01.2014	0:12:03		0.0 µSv	761 s	✓	✓	
485	24.11.2014	13:33:41		0.0 µSv	761 s	✓	✓	
486	24.11.2014	13:33:42			762 s	✓	✓	
487	24.11.2014	13:33:43		0.0 µSv	763 s	✓	✓	
488	24.11.2014	13:33:44		0.0 µSv	764 s	✓	✓	

Figure 2.48 – “Dose” table

Data saving

To be able to view the read data later (especially if data was cleared from the dosimeter after reading), you can use the following options:

- Save data as a binary file (menu option "Data - Save");
- Export data in .csv file ("Data - Export - CSV File");
- Save data as a report ("Export - Report file");
- Printout the report ("Data - Print").

3 TECHNICAL MAINTENANCE

3.1 General instructions

The list of works during technical maintenance (hereinafter TM) of the dosimeter, their order and features at different stages of dosimeter operation are shown in Table 3.1.

Table 3.1 - List of maintenance works

<table>
<tr><td rowspan="3">List of works</td><td colspan="3">Maintenance types</td><td rowspan="3">OM item No.</td></tr>
<tr><td colspan="2">during</td><td rowspan="2">during long-term storage</td></tr>
<tr><td>everyday use</td><td>periodical use</td></tr>
<tr><td>External examination</td><td>+</td><td>+</td><td>+</td><td>3.1.3.1</td></tr>
<tr><td>Delivery kit completeness check</td><td>-</td><td>+</td><td>+</td><td>3.1.3.2</td></tr>
<tr><td>Performance check</td><td>+</td><td>+</td><td>+</td><td>3.1.3.3</td></tr>
<tr><td>Replacing the dosimeter’s battery</td><td colspan="3" rowspan="6">if damaged</td><td>3.1.3.4</td></tr>
<tr><td>Replacing O rings of the battery compartment lid</td><td>3.1.3.5</td></tr>
<tr><td>Replacing the protection gaskets of ABG probe’s alpha and beta counters</td><td>3.1.3.6</td></tr>
<tr><td>Replacing the ABG probe’s protection cover O rings</td><td>3.1.3.7</td></tr>
<tr><td>Replacing O rings for screws used to fasten ABG probes’s protection cover</td><td>3.1.3.8</td></tr>
<tr><td>Verification of the dosimeter</td><td>-</td><td>+</td><td>+</td><td>3.2</td></tr>
<tr><td colspan="5">Note 1. "Plus" in the table indicates that the corresponding work in this type of TM is carried out, "minus" - not carried out.
Note 2. Dosimeters during operation and after repair shall be verified.</td></tr>
</table>

3.1.2 Safety measures

Safety measures during maintenance fully comply with safety measures presented in 2.2.1 of the OM

3.1.3 Maintenance procedure of the device

3.1.3.1 External examination

Exanine the device in the following order:

a) check the technical condition of the device surface, integrity of seals, absence of scratches, traces of corrosion, and surface damage; the condition of the O ring of the battery compartment lid, the condition of the protection gaskets of ABG probe's alpha and beta counters, the condition of the ABG probe's protection cover O ring, the condition of the O rings for screws used to fasten ABG probes's protection cover;

b) check the condition of contacts in the USB connection point.

3.1.3.2 Delivery kit completeness check

Check if the delivery kit of the dosimeter is complete according to Table 1.4.

3.1.3.3 Operability check of the dosimeter

3.1.3.3.1 Checking the dosimeter's operability and its procedure is carried out in accordance with 2.3.6 of the OM.

3.1.3.4 Battery replacement

3.1.3.4.1 If the dosimeter's battery is out of order or its capacity is significantly low it should be replaced. Do the following (Figure 3.1):

1 – open the battery compartment lid by pressing it and turning it counterclockwise;

2 – remove the old battery from the compartment and insert the new one observing the polarity;

3 – close the battery compartment lid by pressing it and turning it clockwise.

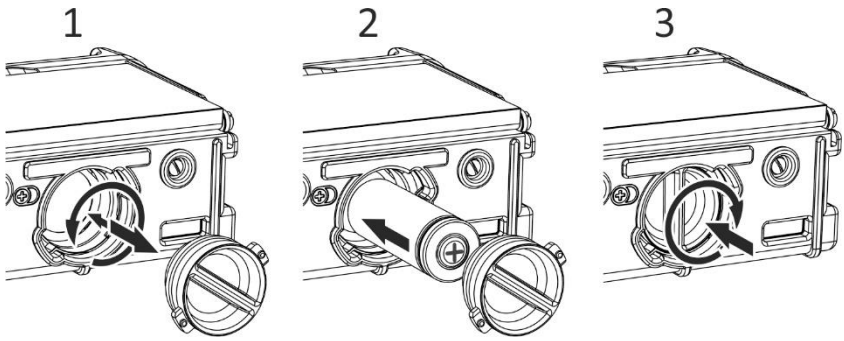


Figure 3.1 – Battery replacement

Important! Only Li-Ion Batteries of 26650 size, rated voltage of 3.7V, with the intergrated board of protection against overcharging, prevention of discharge and short-circuit are allowed.

Note. The clock of the dosimeter is powered from the dosimeter's battery. The dosimeter's clock has no additional sources of power supply. Therefore, the first time after the battery is inserted into the battery compartment and the dosimeter is switched on, it will enter the submode of time and date correction to set their accurate values (2.3.6.9.5 of this OM).

3.1.3.5 Replacement of O ring of the battery compartment lid.

3.1.3.5.1 If the O ring of the battery compartment lid is damaged it should be replaced with the new one included in the delivery kit.

3.1.3.6 Replacement of alpha and beta counters protection gaskets of ABG probe

3.1.3.6.1 If the protection gaskets are damaged they should be replaced with the new ones included in the delivery kit.

Do the following:

- loosen the two captive screws holding the protection cover and remove the cover;

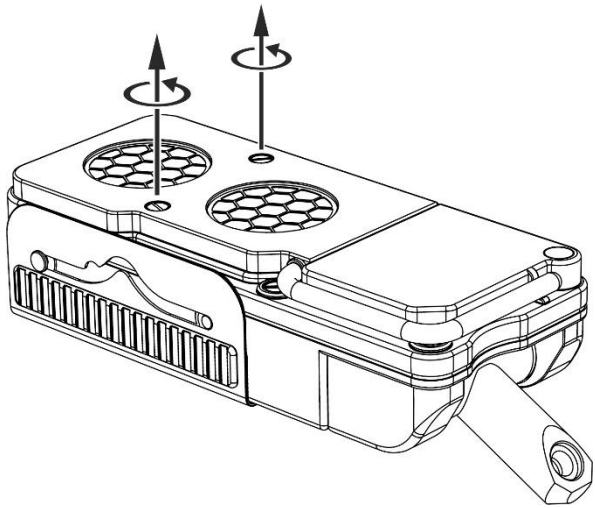


Figure 3.2 – Removing the protection cover of ABG probe

- remove the damaged protection gaskets placed between the two grids and wipe the remnants of grease;

- apply a thin layer of silicone grease on the grid surface and put protection gaskets between them by matching the thickness:

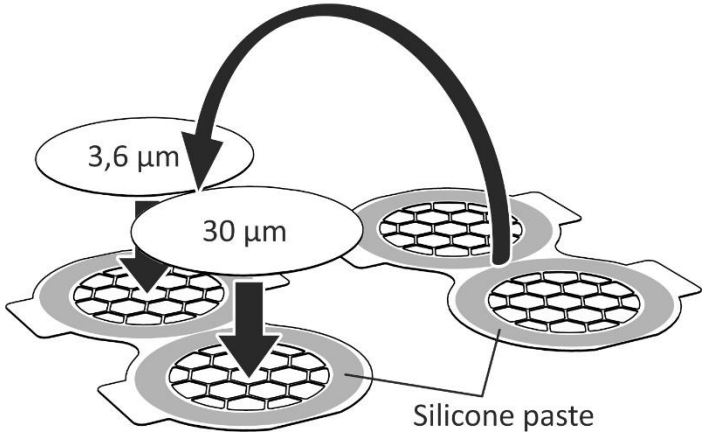


Figure 3.3 – Replacement of ABG probe's protection gaskets

- apply a thin layer of silicone grease on the inner surface of the protection cover and insert a pack with two grids and gaskets:

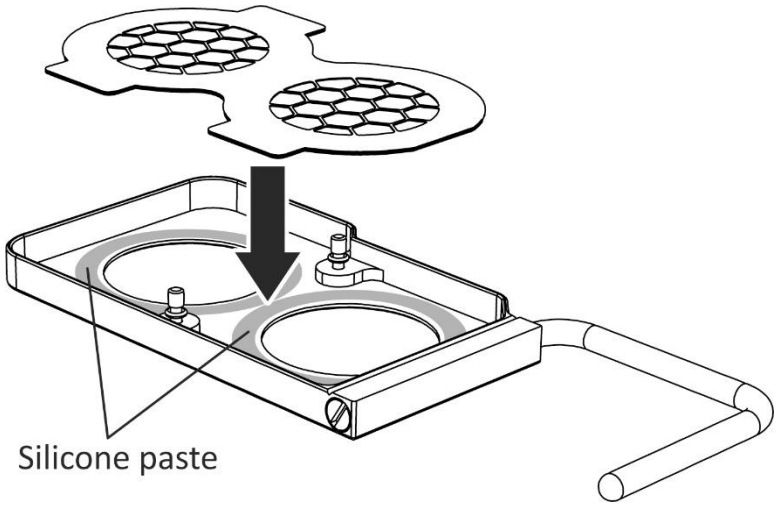


Figure 3.4 – Inserting the pack with grids into the protection cover

- firmly press the protection cover with grids and gaskets to the probe's body:

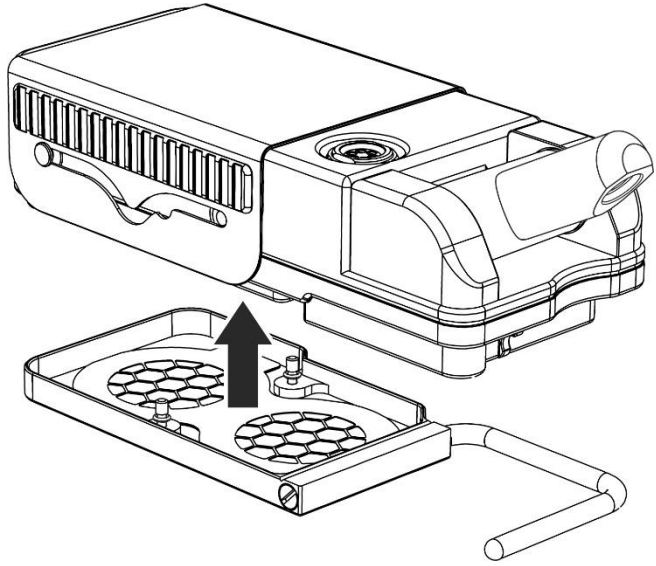


Figure 3.5 – Connecting the protection cover with ABG probe's body

- tighten the two captive screws:

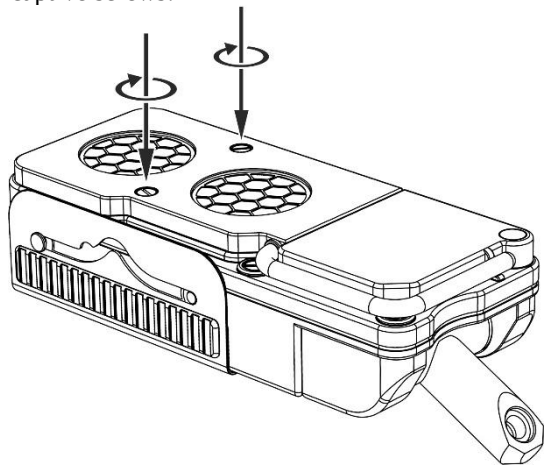


Figure 3.6 – Final clamping of the protection cover to ABG probe's body

3.1.3.7 Replacement of O ring of the ABG probe's protection cover

3.1.3.7.1 If the O ring of the protection cover is damaged it should be replaced with the new one included in the delivery kit.

Do the following:

- loosen the two captive screws holding the protection cover and remove the cover (Figure 3.2);
- replace the O ring (1):

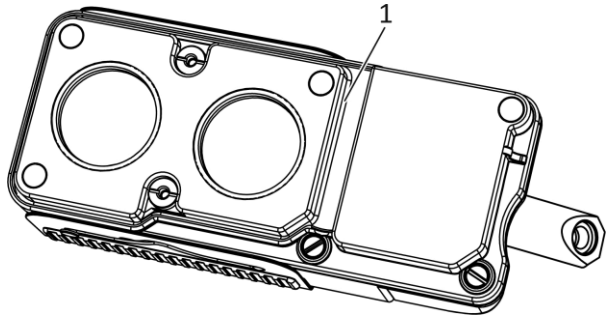


Figure 3.7 – O ring of the protection cover
of ABG probe's body

- firmly press the protection cover with grids and gaskets to ABG probe's body (Figure 3.5);
- tighten the two captive screws (Figure 3.6).

3.1.3.8 Replacement of O rings for screws used to fasten the ABG probe's protection cover

3.1.3.8.1 If the O rings for screws used to fasten the protection cover are damaged, replace them with the new ones included in the delivery kit.

Do the following:

- loosen the two captive screws holding the protection cover and remove the cover (Figure 3.2);
- replace the O rings (1):

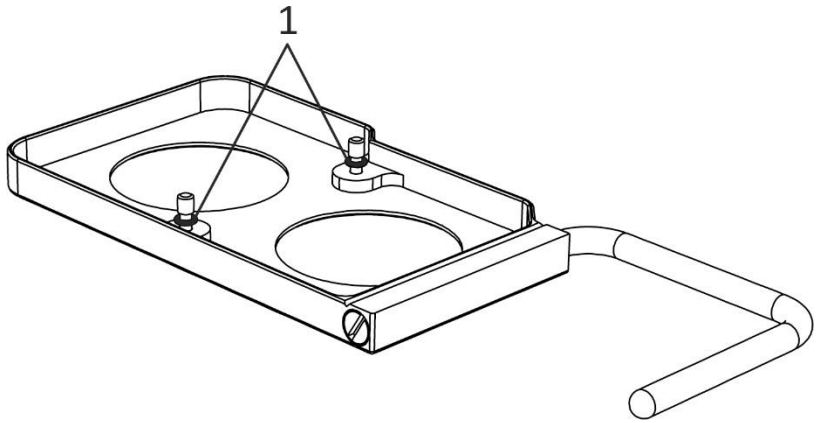


Figure 3.8 – O ring for screws used to fasten the ABG probe's protection cover

- firmly press the protection cover with the grids and gaskets to the ABG probe's body (Figure 3.5);
- tighten the two captive screws (Figure 3.6).

3.1.3.9 Removing the hard shell from the dosimeter's control unit.

3.1.3.9.1 When moisture, dirt, etc., gets in the gap between the shell and the control unit, the hard shell should be removed, cleaned and dried. To do this, loosen the two captive screws (1) and remove the shell:

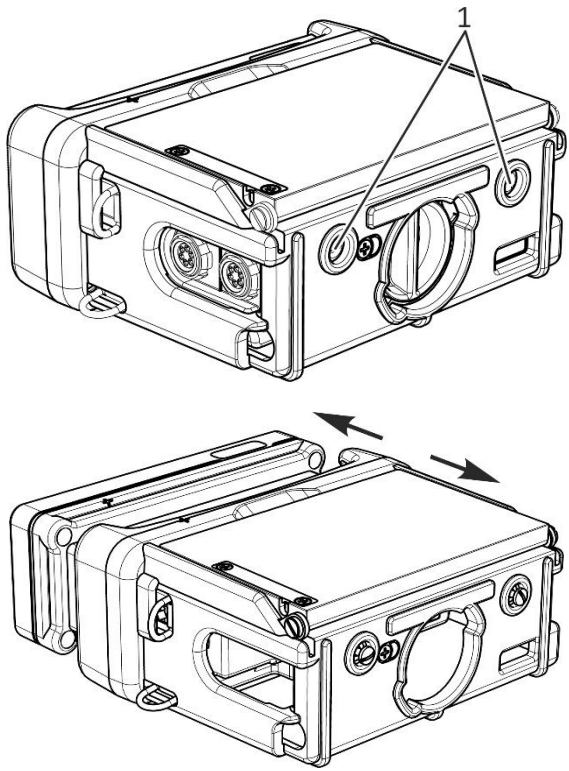


Figure 3.9 – Removing the hard shell from the control unit

3.2 Verification of the dosimeter

3.2.1 MKS-UM dosimeter-radiometer shall be verified during operation and after repair.

3.2.2 The verification interval - no more than 12 months.

3.2.3 The verification operations are listed in Table 3.1.

Table 3.1 - Verification operations

Operation	Verification technique No.
External examination of the dosimeter	3.2.7
Checking the dosimeter's performance in all modes	3.2.8
Controlling the limit of the main relative permissible error while measuring photon-ionizing radiation DER	3.2.9
Controlling the limit of the main relative permissible error while measuring photon-ionizing radiation DE	3.2.10
Controlling the limit of the main relative permissible error while measuring the surface beta-particles flux density and the surface activity of beta-emitting radionuclides	3.2.11
Controlling the limit of the main relative permissible error while measuring the surface alpha-particles flux density and the surface activity of alpha-emitting radionuclides	3.2.12

3.2.4 Verification facilities are provided in Table 3.2.

Table 3.2 - Verification facilities

Name	Regulatory document or main technical specifications
УПГД-3В standard equipment	DER range - from 0.4 μSv/h to 1 Sv/h. Eergy range - from 59 keV to 1.25 MeV. Main relative permissible error limit of DER and DE - 8% with a confidence probability of 0.95
Reference source of beta radiation of CO type	Beta-particle flux density range from 1000 to 10,000 part./cm^2×min
Reference source of alpha radiation of П9 type	Alpha-particles flux density range from 1000 to 10,000 part./cm^2×min

Table 3.2 (end)

Name	Regulatory document or main technical specifications
Aspiration psychrometer MB-4M	ЛІ82.844.000 ПС. Temperature measurement range from –30 to +50 ^{0}C. Temperature measurement error - ± 0.1 ^{0}C. Relative humidity measurement range from 10 to 100 %. Relative error of relative humidity measurement in the range from ± 12 % at t = –10 ^{0}C to 2 % at t = +30 ^{0}C
Stopwatch	Measurement range – from 1 s to 59 min
Control aneroid barometer M-67	ЛІ62.832.003 ПС. Pressure measurement range from 81.3 to 105.3 kPa (from 610 to 790 mmHg). Pressure measurement error limit is ± 0.107 kPa (0.8 mmHg)
Note 1. Measurement equipment shall be used according to laws in the field of metrology and metrological activity. **Note** 2. Measuring facilities, instruments and equipment with specifications not worse than those listed in Table 3.2 may be used.	

3.2.5 The safety precautions given in 2.2.1 of this OM must be followed during verification.

3.2.6 Verification conditions

The verification shall be carried out under the following conditions:

- ambient temperature should be within (20 ±5) 0C;
- relative humidity should be from 30 to 80%;
- atmospheric pressure should be from 86 to 106.7 kPa;
- natural background level of gamma radiation shall not exceed 0.30 μSv/h;
- battery should be fully charged, the battery voltage should be at least 4.0 V.

3.2.7 Perform an external examination of the dosimeter.

3.2.7.1. During external examination the dosimeter should meet the following requirements:

- the delivery kit should meet the requirements of Table 1.4;
- labeling should be accurate;
- QCD seals should not be violated;
- the dosimeter should be free from mechanical damage that may affect its performance.

3.2.7.2 If the delivery kit does not comply with the requirements of Table 1.4, the verification shall be stopped until the dosimeter is completed.

3.2.7.3 If the requirements of labeling, sealing are not satisfied and if there are mechanical damages on the dosimeter's surface affecting its performance, the dosimeter shall not be verified and shall be sent for repair.

3.2.8 Check the dosimeter's performace in all measurement modes in accordance with the procedure described in section 2.3.6.

3.2.8.1 If the dosimeter malfunctions in at least one mode, it shall not be verified and shall be sent for repair.

3.2.9 Control of the main relative permissible error limit while measuring photon-ionizing radiation DER is done as follows:

3.2.9.1 Switch the control panel to the mode of photon-ionizing radiation DER measurement. Program the threshold levels of DER and DE with zero values, the specified limit of statistical deviations - 3%.

3.2.9.2 Secure the control unit on the carriage of the УПГД-3В gamma ray standard equipment (hereinafter referred to as УПГД-3В unit) so that the mechanical center of the УПГД-3В collimator coincides with the mechanical center of the detector marked with "+" symbol.

Note. The distance between the mechanical center of the source and the mechanical center of the detector is considered to be the distance between the mechanical center of the source and the plane perpendicular to the direction of gamma quanta beam propagation, and passes through the mechanical center of the detector in that plane.

3.2.9.3 Put the УПГД-3В carriage with the control unit in a position where gamma radiation DER from a source containing ^{137}Cs radionuclide is $\dot{H}^*(10)$ = (8 ± 0.8) mSv/h. After reducing the estimated limit of statistical deviations of the measurement results up to 3%, record five photon-ionizing radiation DER measurements at a 5 s interval in the report. Calculate the average DER value $\overline{\dot{H}^*(10)}$ by the formula (3.1).

$$\overline{\dot{H}^*}(10) = \frac{\sum_{i=1}^{5} \dot{H}^*{}_i(10)}{5} \qquad (3.1)$$

3.2.9.4 Calculate the main relative permissible error limit of DER measurement as a percentage according to the recommendations of the methods contained in DSTU GOST 8.207-2008.

3.2.9.5 Connect the BG probe to the dosimeter's control unit. Turn on the dosimeter and switch it into the mode of photon-ionizing radiation DER measurement. Program the DER threshold level with zero value, the specified limit of statistical deviations - 3%.

3.2.9.6 Secure the BG probe on the carriage of the УПГД-3В standard equipment so that the mechanical center of the УПГД-3В collimator coincides with the mechanical center of the detector labaled by "+" symbol.

3.2.9.7 Place the УПГД-3В carriage with the BG probe in a position where photon-ionizing radiation DER from ^{137}Cs source is $\dot{H}^*(10)$ = (800 ± 80) μSv/h and after reducing the estimated limit of statistical deviations of the measurement results up to 3%, record five measured DER values at a 5 s interval in the report. Calculate the average DER value by the formula (3.1).

3.2.9.8 Calculate the main relative permissible error limit of photon-ionizing radiation DER measurement as a percentage according to the recommendations of the methods contained in DSTU GOST 8.207-2008.

3.2.9.9 Perform operations 3.2.9.6 - 3.2.9.8 for DER $\dot{H}^*(10)$ = (20 ± 0.8) μSv/h.

3.2.9.10 Connect the ABG probe to the dosimeter's control unit. Turn on the dosimeter and switch it into the mode of photon-ionizing radiation DER measurement. Program the DER threshold level with zero value, the specified limit of statistical deviations - 3%

3.2.9.11 Perform operations 3.2.9.6 - 3.2.9.9 for ABG probe.

3.2.9.12 The control results shall be considered satisfactory if the limit of the main relative permissible error of measurement of photon-ionizing radiation DER when measured by the control unit, BG and ABG probes does not exceed 15 %.

3.2.10 The limit of the main relative permissible error of photon-ionizing radiation DER measurement is controlled as follows:

3.2.10.1 Switch on the dosimeter's control unit, program the values of the DER and DE gamma radiation threshold levels with zero values.

3.2.10.2 Prepare the dosimeter's control unit for photon-ionizing radiation DE measurement, reset the control unit's reading relative to the dose.

3.2.10.3 Put the УПГД-3В carriage with the dosimeter's control unit in the position where the DER from the source with the ^{137}Cs radionuclide equals $\dot{H}^{*}(10) = (8 \pm 0.8)$ mSv/h, and simultaneously turn on the stopwatch and feed the source to the collimator.

3.2.10.4 After the measurement time of 5 min, write down the DER measurement result.

3.2.10.5 The control result is considered satisfactory if the limit of the main relative permissible error of the DE measurement does not exceed 15%.

3.2.11 The limit of the main relative permissible error of measurements of the surface beta-particle flux density and the surface activity of beta-emitting radionuclides is controlled as follows:

3.2.11.1 Connect to the dosimeter's control unit to BG probe and enable it to measure beta-particle flux density. Program the threshold level of sound and light alarms with zero value, set the limit of statistical deviations of 3%.

3.2.11.2 Place the BG probe with the open beta detector window above the surface of the reference source of beta radiation type C0 (^{90}Sr/^{90}Y) GOST 27212-87 with a surface flux density of 1000 to 10,000 part./(cm^2×min) so that the detector work surface is completely above the active surface of the source.

3.2.11.3 If the estimated limit of the expected relative statistical deviations of the measurement result is less than 3%, make five measurements of beta-particles flux density. Calculate the average value of beta-particles surface flux density.

3.2.11.4 Calculate the relative main error of the measurement according to the recommendations of DSTU GOST 8.207-2008.

3.2.11.5 Connect BG probe to the control unit of the dosimeter and perform operations 3.2.11.1 - 3.2.11.4 for BG probe.

3.2.11.6 The control results are considered satisfactory if the limit of the main relative permissible error during measurement of beta-particle flux density does not exceed 20 %.

Note. With positive results of controlling the limits of the main relative permissible error of measurements of surface flux density of beta- and alpha-particles, the control of the main relative permissible error limit of measurement of surface activity of beta- and alpha-emitting radionuclides is not carried out. This happens because surface flux density of beta-particles and surface activity of beta-emitting radionuclides, as well as surface flux density of alpha-particles and surface activity of alpha-emitting radionuclides are measured by the same detectors and the transition from surface density to surface activity is carried out by multiplying the measurement result by an appropriate factor.

3.2.12 Control of the limit of the main relative permissible error of measurements of surface alpha-particle flux density and surface activity of alpha-emitting radionuclides is as follows:

3.2.12.1 Connect ABG probe to the dosimeter's control unit and switch it on to the mode of measurement of alpha-particle flux density. Program the threshold level of sound and light alarms with zero value, specified limit of statistical deviations - 3%.

3.2.12.2 Place ABG probe with an open alpha detector window above the surface of the standard alpha-radiation source of P9 type (^{239}Pu) GOST 27212-87 with a surface flux density of 1000 to 10,000 part./(cm^2×min) so that the detector's working surface was completely above the active surface of the source.

3.2.12.3 If the estimated limit of the expected relative statistical deviations of the measurement result is less than 3%, make five measurements of alpha-particles surface flux density. Calculate the average value of alpha particles surface flux density.

3.2.12.4 Calculate the main relative error of measurement according to the recommendations of the method provided in DSTU GOST 8.207-2008.

3.2.12.5 The control results are considered satisfactory if the limit of main relative permissible error during measurement of alpha-particles surface flux density does not exceed 15%.

3.2.13 Presentation of verification results.

3.2.5.1 Positive results of periodic or after-repair verification are recorded in the Table 13.1 of the logbook or by issuing a verification certificate for the legislatively regulated measurement equipment.

3.2.5.2 If the dosimeter is acknowledged unfit for use after its verification, it gets the certificate of inadequacy.

4 REPAIR

4.1 Repair of the dosiemeter shall be done by the manufacturer.

PE "SPPE "Sparing-Vist Center"
79026, Ukraine, Lviv, 33 Volodymyra Velykoho St.
Tel.: +38 (032) 242-15-15, fax: +38 (032) 242-20-15.

5 STORAGE

5.1 Before the long-term storage of the dosimeter, remove the battery from the battery compartment (3.1 of this OM).

5.2 The dosimeter should be stored in the carrying case in heated and ventilated storehouses with air-conditioning at the environment temperature of +5 to +40°C and relative humidity up to 80 % at +25°C temperature and lower temperatures, without humidity condensation. The storehouse should be free of dust, acids, gas and alkali that may cause corrosion, and vapors of organic solvents.

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

5.4 The dosimeters should be stored on the shelves.

5.5 The distance between the walls, the floor of the storehouse and the dosimeters should be at least 100 mm.

5.6 The distance between the heating gadgets of the storehouse and the dosimeters should be at least 0.5 m.

5.7 Average shelf life is not less than 10 years.

6 SHIPPING

6.1 The packed dosimeters may be shipped by any kinds of closed transport vehicles in conformance with the rules and standards effective for each means of transport.

When shipped by railway, air, sea, or motor transport at any distances in the packing of the producer enterprise the following rules should be met:

- by railway: in clean closed cars;
- by air: in pressurized compartments or in non-pressurized if 6.3 conditions are observed;
- by sea: in dry holds;
- by car: in sedan cars;

6.2 The dosimeters in shipping container should be placed and fastened in the vehicle so that their stable position is ensured and shocks are avoided.

6.3 The dosimeters in shipping container endure:

- influence of temperature from –40 to +60°C;
- influence of relative humidity (95±3) % at 35°C temperature;

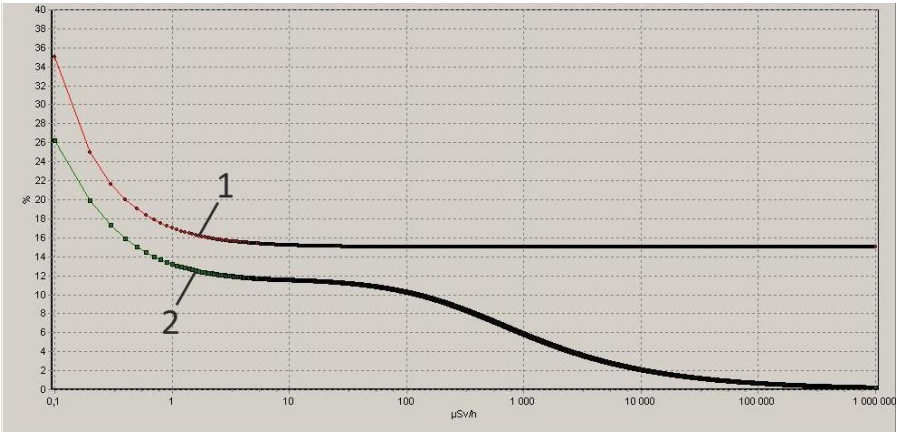
6.4 Canting is forbidden.

7 DISPOSAL

Disposal of the dosimeter is performed in compliance with the general rules, i.e. metals are recycled or melted, and plastic parts are dumped.

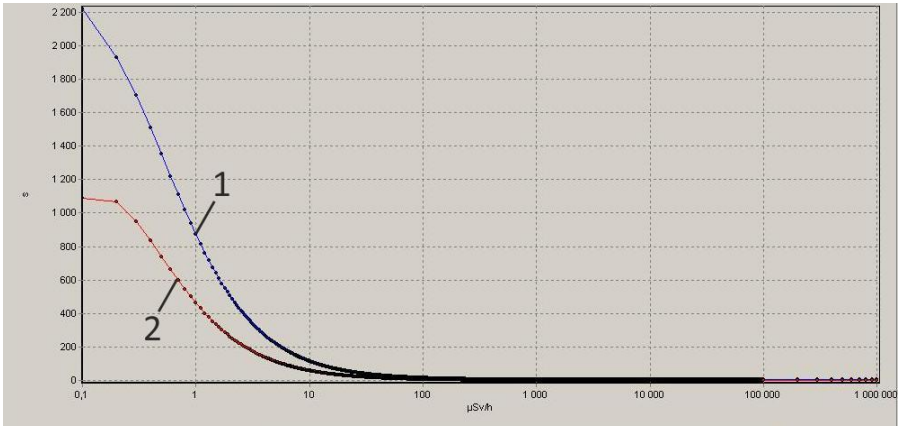
Disposal of the dosimeter is not hazardous for service personnel, and is environmentally friendly.

ANNEX A



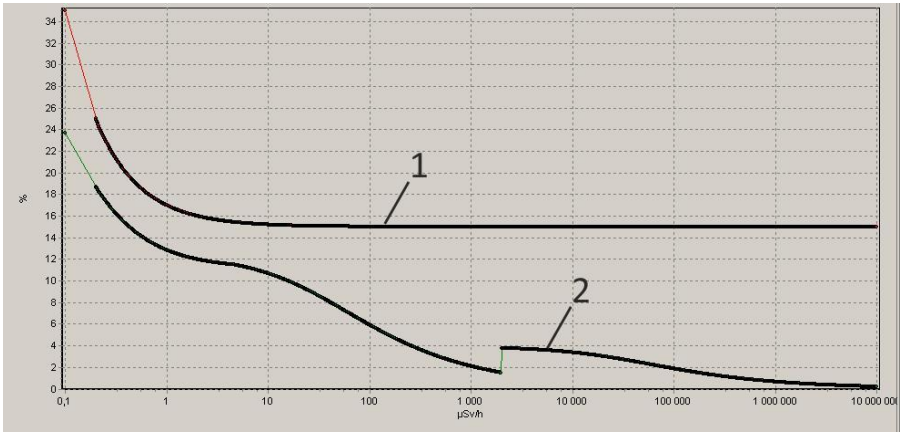
1 – Main relative permissible error limit
2 – Specified limits of statistical deviations (specified limits of expected relative statistical deviations of measurement result given 0.95 confidence probability) determined by the dosimeter.

Figure A.1 – Dependence diagram of specified limits of statistical deviations from photon-ionizing radiation DER when measured by the control unit



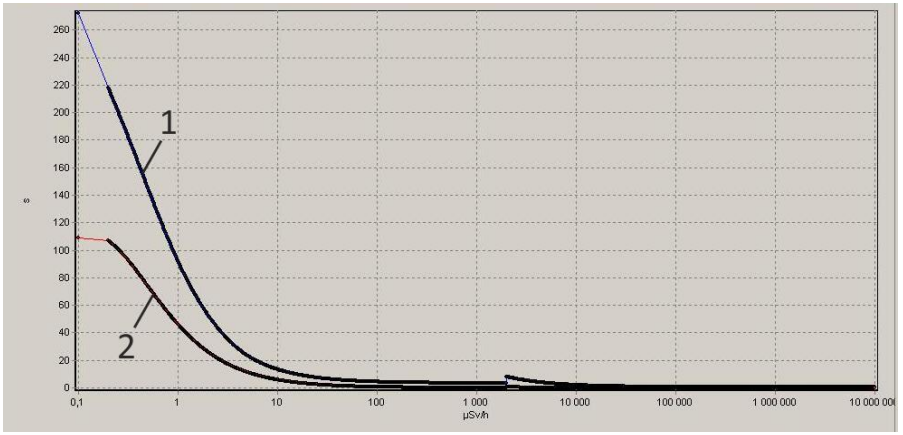
1 – Time of statistical information accumulation required to obtain measurement results with estimated limits of statistical deviations equal to the specified limits of statistical deviations determined by the dosimeter.
2 – Time of statistical information accumulation required to obtain measurement results with specified limits of statistical deviations equal to the main relative permissible error limit.

Figure A.2 - Dependence diagram of statistical information accumulation time required to obtain measurement results with estimated limits of statistical deviations equal to the main relative permissible error limit (1) and specified limits of statistical deviations (2) determined by the dosimeter from photon-ionizing radiation DER when measured by the control unit



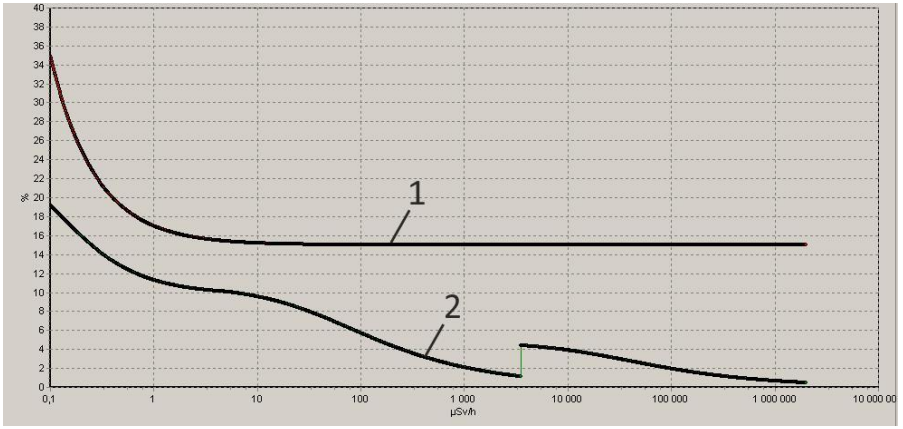
1 – Main relative permissible error limit
2 – Specified limits of statistical deviations (specified limits of expected relative statistical deviations of measurement result given 0.95 confidence probability) determined by the dosimeter.

Figure A.3 - Dependence diagram of specified limits of statistical deviations from photon-ionizing radiation DER when measured by BG probe



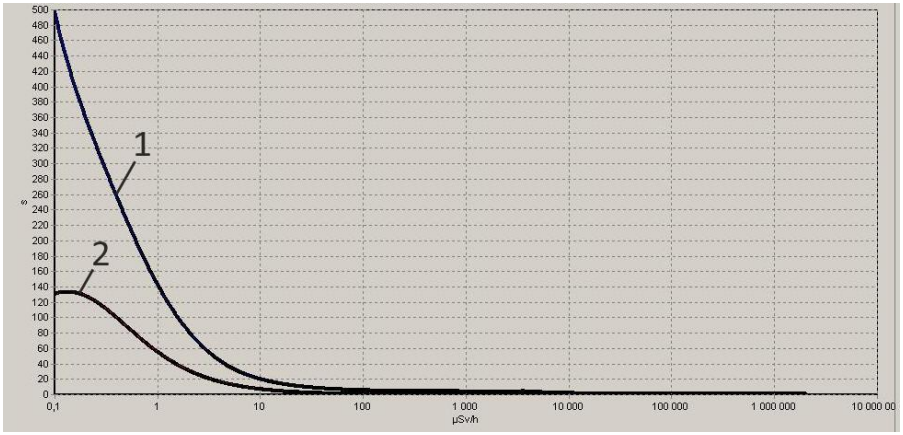
1 – Time of statistical information accumulation required to obtain measurement results with estimated limits of statistical deviations equal to the specified limits of statistical deviations determined by the dosimeter.
2 – Time of statistical information accumulation required to obtain measurement results with estimated limits of statistical deviations equal to the main relative permissible error limit.

Figure A.4 - Dependence diagram of statistical information accumulation time required to obtain measurement results with estimated limits of statistical deviations equal to the main relative permissible error limit (1) and specified limits of statistical deviations (2) determined by the dosimeter from photon-ionizing radiation DER when measured by BG probe



1 – Main relative permissible error limit
2 – Specified limits of statistical deviations (specified limits of expected relative statistical deviations of measurement result given 0.95 confidence probability) determined by the dosimeter.

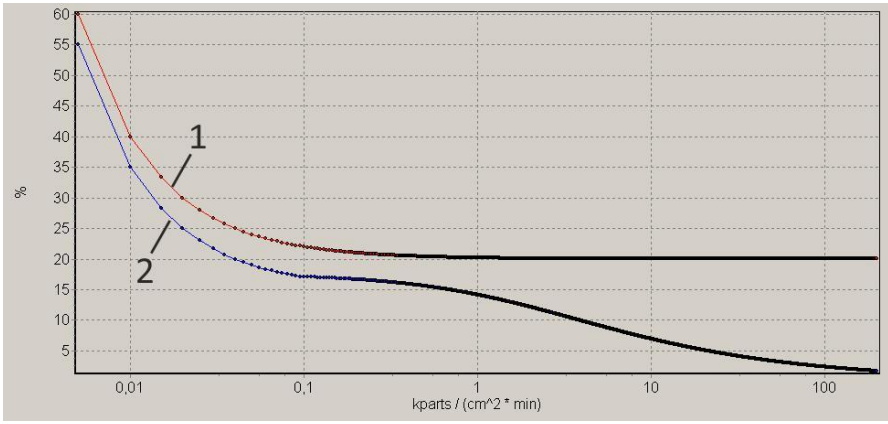
Figure A.5 - Dependence diagram of specified limits of statistical deviations from photon-ionizing radiation DER when measured by ABG probe



1 – Time of statistical information accumulation required to obtain measurement results with statistical deviations equal to the statistical deviations determined by the dosimeter.
2 – Time of statistical information accumulation required to obtain measurement results with statistical deviations equal to the main relative permissible error limit.

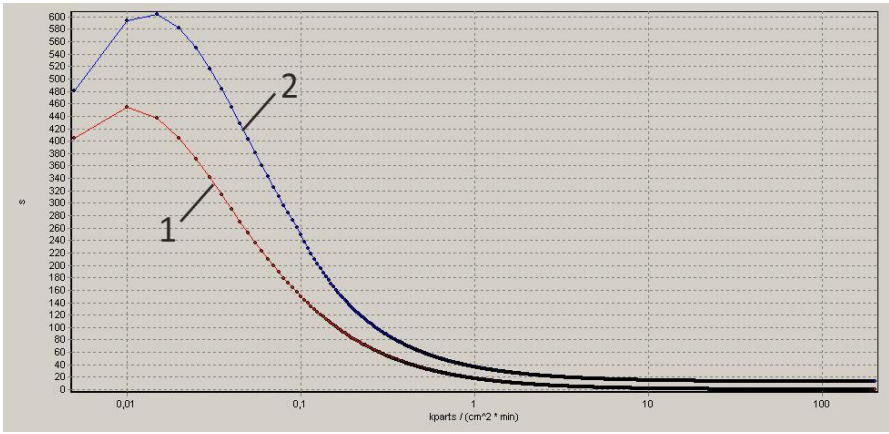
Figure A.6 - Dependence diagram of statistical information accumulation time required to obtain measurement results with estimated limits of statistical deviations equal to the main relative permissible error limit (1) and specified limits of statistical deviations (2) determined by the dosimeter from photon-ionizing radiation DER when measured by ABG probe

ANNEX B



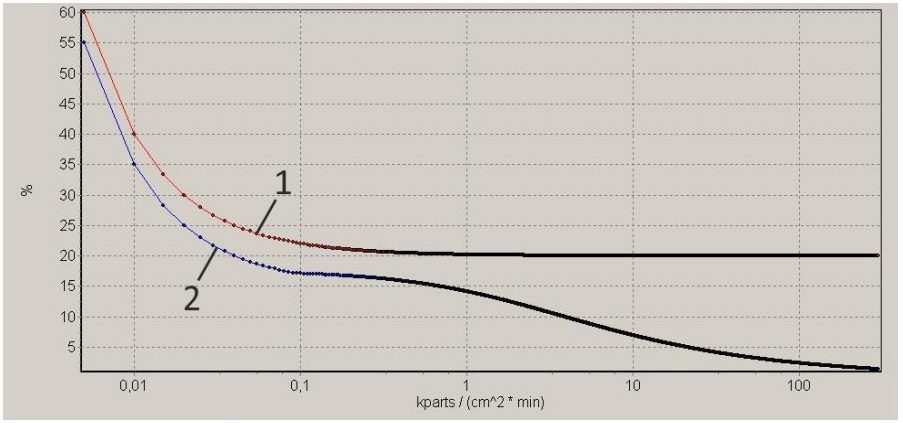
1 – Main relative permissible error limit
2 – Specified limits of statistical deviations (specified limits of expected relative statistical deviations of measurement result given 0.95 confidence probability) determined by the dosimeter.

Figure B.1 - Dependence diagram of specified limits of statistical deviations from surface beta-particles flux density when measured by BG probe



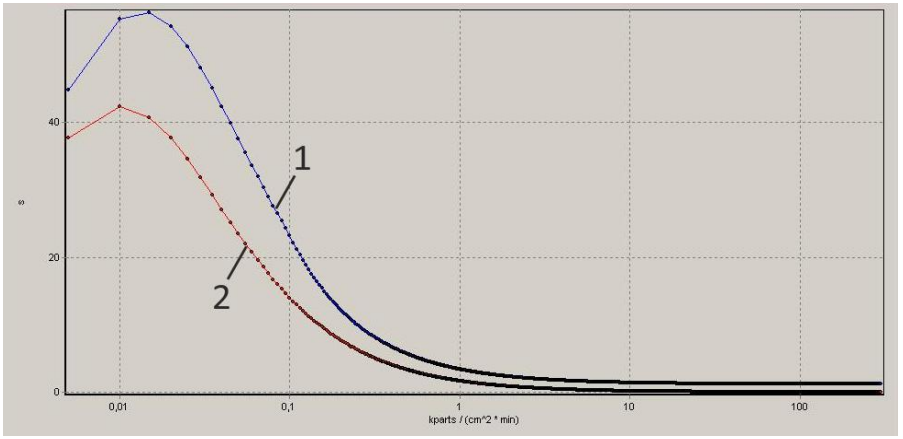
1 – Time of statistical information accumulation required to obtain measurement results with statistical deviations equal to specified statistical deviations determined by the dosimeter.
2 – Time of statistical information accumulation required to obtain measurement results with statistical deviations equal to the main relative permissible error limit.

Figure B.2 - Dependence diagram of statistical information accumulation time required to obtain measurement results with estimated limits of statistical deviations equal to the main relative permissible error limit (1) and specified limits of statistical deviations (2) determined by the dosimeter from surface beta-particles flux density when measured by BG probe



1 – Main relative permissible error limit
2 – Specified limits of statistical deviations (specified limits of expected relative statistical deviations of measurement result given 0.95 confidence probability) determined by the dosimeter.

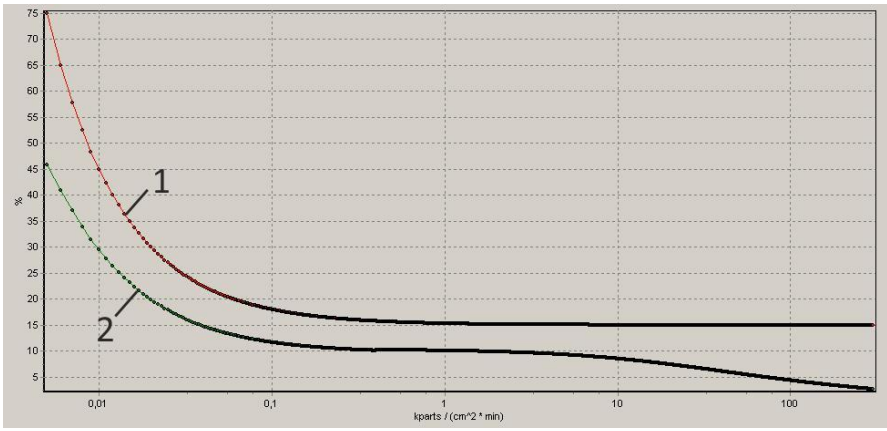
Figure B.3 - Dependence diagram of specified limits of statistical deviations from surface beta-particles flux density when measured by ABG probe



1 – Time of statistical information accumulation required to obtain measurement results with statistical deviations equal to the specified statistical deviations determined by the dosimeter.
2 – Time of statistical information accumulation required to obtain measurement results with statistical deviations equal to the main relative permissible error limit.

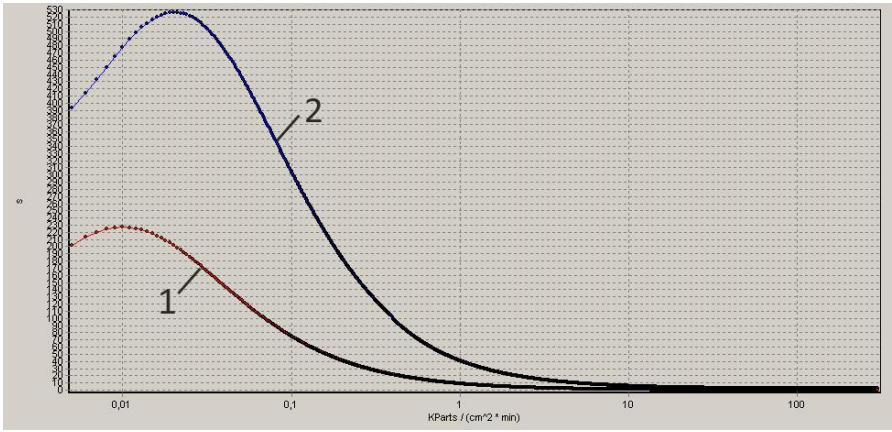
Figure B.4 - Dependence diagram of statistical information accumulation time required to obtain measurement results with estimated limits of statistical deviations equal to the main relative permissible error limit (1) and specified limits of statistical deviations (2) determined by the dosimeter from surface beta-particles flux density when measured by ABG probe

ANNEX C



1 – Main relative permissible error limit
2 – Specified limits of statistical deviations (specified limits of expected relative statistical deviations of measurement result given 0.95 confidence probability) determined by the dosimeter.

Figure C.1 - Dependence diagram of specified limits of statistical deviations from surface alpha-particles flux density when measured by ABG probe



1 – Time of statistical information accumulation required to obtain measurement results with statistical deviations equal to the specified statistical deviations determined by the dosimeter.
2 – Time of statistical information accumulation required to obtain measurement results with statistical deviations equal to the main relative permissible error limit.

Figure C.2 - Dependence diagram of statistical information accumulation time required to obtain measurement results with estimated limits of statistical deviations equal to the main relative permissible error limit (1) and specified limits of statistical deviations (2) determined by the dosimeter from surface alpha-particles flux density when measured by ABG probe.