"SCAN ELECTRONICS" LLC

RADIOACTIVITY INDICATOR
RADIASCAN-501(601, 701)

OPERATIONS MANUAL

C O N T E N T S

1 QUICK START

The appearance of RadiaScan 501(601, 701) **Indicator** is on Fig. 1.

1 – mini USB port for connection with a computer or a charger.
2 – LED indicator
3 – "Power" button (switch on/off the **Indicator**'s power supply)
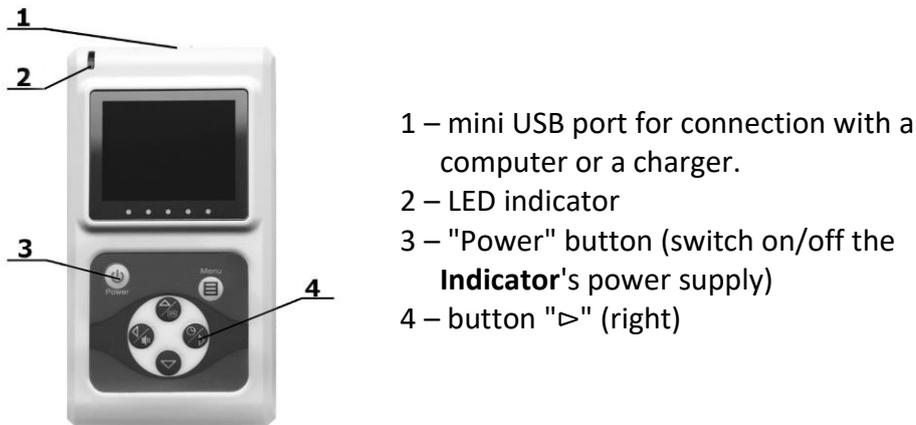4 – button "▷" (right)

Fig. 1 Appearance of RadiaScan 501(601, 701) **Indicator**

1.1 Before switching on for the first time

Unpack the rechargeable batteries from the delivery pack and set them in the battery compartment of the RadiaScan-501(601, 701) Indicator, paying attention to their polarity.

Attention: the rechargeable batteries are not charged. It's necessary to charge them before usage.

1.2 Rechargeable batteries charge

Attention: please use a charger from the delivery pack or a computer USB port to charge the batteries.

Please perform the following steps to charge the batteries:

- in the Indicator settings please choose rechargeable batteries as a power supply (in the factory settings, the rechargeable batteries are selected by default. When switching on for the first time please skip this step);
- make sure that the Indicator is switched off (if you push any button shortly, it shouldn't affect the device and if it does, please switch off the Indicator by pressing long on Power button (Fig. 1 mark 3);
- use the USB cable from the delivery set and apply the external power to the Indicator (Fig. 1 mark 1) using the charger or a computer USB port.

Attention: the charging **won't start** in case the external power is applied to the **Indicator** that is already switched on.

The red light in the LED window (Fig. 1 mark 2) will appear after several seconds from the start of the external power supply – it indicates that the charging has started. At the same time, a flashing green signal indicates that the device is powered from an external source.

After a few hours, the batteries will be fully charged. The device will automatically complete the charging process and turn off the red indicator.

If the red signal turned on and then switched off after a short time, it means that the battery compartment is either empty or the non-rechargeable batteries are being charged.

During the charging process it's possible to switch the device on by pushing long the Power button, and the charging won't stop. The charging process will be indicated in the top right corner of the display by an icon ⚡.

It's possible to start/stop the charging by pushing long the "▷" button (Fig. 1, mark 4) while device turned off or in GAMMA mode.

Important: the rechargeable batteries will gain maximum capacity after 3-4 full charge-discharge cycles

To achieve maximum battery life, follow these guidelines:

- charge the batteries only when they are completely discharged;
- do not switch off the external power supply of the device until the batteries are fully charged.

1.3   Low battery operation

If the device is switched on, the following signals will appear to indicate that the batteries are discharged excessively:

- displays a red flashing low battery indicator;
- beeps intermittently.

In this case the device will be turned off if you press any button. If a button is not pressed within 30 seconds, the device will turn off automatically.

The device consumes more power in the process of switching on rather than in a switch on state. When the battery is low, if you turn off the device by pressing the Power button and then try to switch it on again, it might not turn on as the batteries will give an insufficient inrush current.

1.4   PC software

The PC software distributive (for Windows) **RadiaScan.exe** can be downloaded here: scan-electronics.com/en/radiascan/downloads

When connected with the device via USB the software allows:

- update the device firmware included in the distribution set;
- remotely control the device without pressing its buttons;
- adjust the device settings;
- read the Indicator log, view and save it in the database;
- take display screenshots and save them as graphic files on a hard drive.

2   DESCRIPTION AND OPERATION OF INDICATOR RADIASCAN-501(601, 701)

2.1   Purpose and Scope of Application

Portable stand-alone radioactivity indicator RadiaScan-501(601, 701) (hereinafter referred to as the Indicator or product) is intended to alert the user of potential radiation hazard of the surrounding area, or individual items.

The Indicator is designed for:

- assessment of current radiation situation;
- assessment of the level of radiation by magnitude of ambient dose rate (hereinafter referred to as the dose rate) of photon (gamma and X-ray) radiation;
- assessment of integral ambient dose (hereinafter referred to as the dose) of photon radiation;
- assessment of random error of each measurement in confidence interval 0.95;
- issuing alarm signals when the background radiation exceeds the defined thresholds;
- assessment of the beta particles flux density (only RadiaScan-701);
- assessment of alpha particles flux density (only RadiaScan-701);

- search of radiation contaminated areas and objects (only RadiaScan-501 and RadiaScan-701).

2.2   Software and operations manual versions

As the firmware (FW) of the Indicator allows updating (see item 2.5.2), different versions of this FW are available. The different FW versions may correspond to different versions of the operations manual. This operations manual corresponds to the FW version not lower than **4.18**.

2.3   Models and modifications

There are 2 models of the Indicator: **RadiaScan-501**, **RadiaScan-601** and **RadiaScan-701**.

The basic model is RadiaScan-501. It has a good sensitivity to photon radiation, is weakly sensitive to beta particles and has no sensitivity to alpha particles.

The RadiaScan-601 model, in comparison with the base one, has a reduced sensitivity to photon radiation and is not sensitive to beta and alpha particles. Moreover, this model is designed to operate in powerful fields of photon radiation (up to 3 Sv/h).

Model RadiaScan-701, in comparison with the base one, has better sensitivity to X-rays, sensitivity to beta particles and a weak sensitivity to alpha particles.

For each model its modification with a built-in module for charging the batteries from a power source connected to the USB port is available – RadiaScan-501A, RadiaScan-601A and RadiaScan-701A.

2.4   Specifications

RadiaScan-501(601, 701) has the specifications shown in Table 1.

Table 1

Parameter	Value
Dose indication range, mSv	from 0,001 to 1000
Dose rate indication range, µSv/h	[1] from 0,01 to 10000
	[2] from 0,01 to 3000000
Range of photon energies, keV	from 65 to 30000
[3] beta particles flux density indication range (by ^{90}Sr+^{90}Y), part/(cm^2·min)	from 5 to $3 \cdot 10^4$
[3] lower threshold of energy of registered beta-radiation (by medium energy of beta-spectrum ^{14}C), MeV, not more than	0,05
[3] alpha particles flux density indication range (by ^{239}Pu), part/(cm^2·min)	from 5 to 30000
Operating mode setting time, min, not more than	1
Amount of dose thresholds for issuing alarm signals	2
Range of values of dose thresholds, mSv	from 0,001 to 999,999
Amount of thresholds of dose rate for issuance of alarm signals	2
Range of values of dose rate thresholds, µSv/h	from 0,1 to 9999,9
Time of assessment of photon radiation dose rate, sec	from 1 to 30
[3] Range of values of thresholds of beta particles flux density, part/(cm^2·min)	from 1 to 29999
[3] amount of thresholds of beta particles flux density for issuance of alarm signals	2
[3] Range of values of thresholds of alpha particles flux density, part/(cm^2·min)	from 1 to 29999

Parameter	Value
[3] amount of thresholds of alpha particles flux density for issuance of alarm signals	2
Connection with computer	USB
Log volume, amount of records, not less than	2000
Powered from USB	Available
Batteries, pcs	2 (rechargeable Ni-MH 1100 mAh or alkaline batteries) of type AAA

Duration of continuous operation at the background of less than 0,30 µSv/h, not less than, h:
   − When powered from batteries[4] (display is always powered on with contrast level 50%)
   − When powered from batteries[4] (display is mostly off)
   − When powered from USB
	
	10
	
	55
	unlimited

Total voltage of batteries, V	from 1,9 to 3,2
Possibility for charging the rechargeable batteries from a power source, connected to the device USB port	Only for modifications RadiaScan-501A, RadiaScan-601A and RadiaScan-701A
Means of indication	Color OLED display, LEDs, buzzer
Display lifetime at a specified contrast:	
5%, hours, not less than	12000
20%, hours, not less than	3000
100%, hours, not less than	300
Current consumed from USB, mA, not more than	500

Current consumed from batteries at deactivated USB:
   − Indicator is off, µA, not more than
   − Indicator is on, µA, not more than
	
	50
	500

Reverse current of batteries at activated USB, Indicator µA, not more than	100
Work temperatures range, °C	from minus 20 to +50
overall dimensions, mm	110x60x23
Weight without batteries, g, not more than	110

[1] only for RadiaScan-501 and RadiaScan-701.
[2] only for RadiaScan-601.
[3] only for RadiaScan-701.
[4] rechargeable Ni-MH 1100 mAh or alkaline batteries

2.5   Design and operation

2.5.1 Design

Inside the Indicator housing are located: an ionizing radiation detector, a microcontroller, an audio speaker and the batteries.

Appearance of the front side of RadiaScan-501(601, 701) is shown in Fig. 2.

1 – USB slot
2 – LEDs
3 – OLED display
4 – "Power" button – Indicator power supply on/off
5 – "Δ" (up) button
6 – "◁" (left) button
7 – "∇" (down) button
8 – "Menu" button
9 – "▷" (right) button
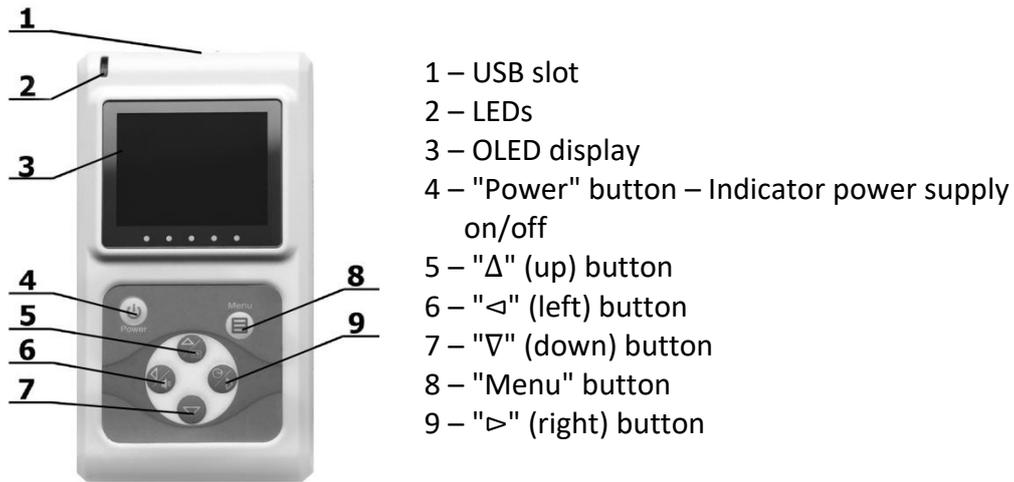
Fig. 2 Appearance of the front side of RadiaScan-501(601, 701)

Appearance of the rear side of RadiaScan-501(601, 701) with installed filter-cover is shown in Fig. 3.a, with removed cover – Fig. 3.b.

1 – Removable (for RadiaScan-701 only) filter-cover
2 – marks of the axis of the detector
3 – detector window
4 – mark of the metal filter
5 – mark of the filter without metal
6 – cover of the battery compartment

a   b
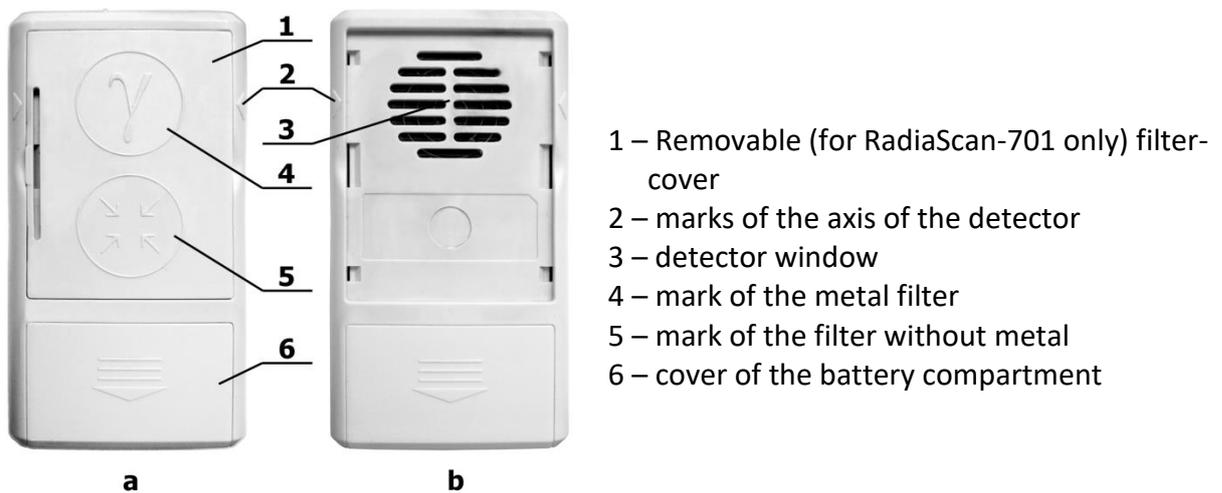
Fig. 3 Appearance of the rear side of RadiaScan-501(601, 701)

Removable cover can be installed in one of two positions, at which:

- detector window is covered with metal filter, as shown in Fig. 3.a;
- detector window is covered with the filter without metal.

2.5.2 General information

Terminal Geiger-Muller counter is used in the Indicator as radiation detector. The flux of photons of gamma and X-ray radiation, flux of alpha particles and beta particles are converted by the detector into the sequence of electrical signals. These signals are formed by duration and amplitude, and then are delivered to microprocessor registration circuit which provides automatic processing and displaying the measurement results.

During measurement, the readings on the display are changed automatically, at the same time the microcontroller averages the measurement results and calculates a random measurement error in the trust interval of 0.95.

The indicator has firmware (hereinafter - FW), written in the non-volatile memory of the microcontroller at the manufacturing stage.

Additionally, at the request of the customer, external software RadiaScan.exe can be supplied, which allows:

- to update FW of the Indicator;
- to download, view and save in the database on the computer all the log entries of the Indicator;
- to adjust the parameters of the indicator;
- to control the operation of the Indicator.

The latest version of the software for the computer (external software) with Windows OS can be downloaded from the manufacturer's website. The firmware is included in the distributive set of external software.

After installing external software, launching RadiaScan.exe and connecting the Indicator to the computer with a USB cable, RadiaScan.exe checks the built-in version of the Indicator. If this version does not match the version from the distributive set, the program RadiaScan.exe will offer to reprogram the firmware of the Indicator.

2.5.3 Displaying of measuring data on the display

Depending on the selected measurement mode, the display shows:

- averaged numerical value of the dose or dose rate with indication of units of measurement;
- averaged numerical value of beta-particles flux density with indication of units of measurement;
- averaged numerical value of alpha particles flux density with indication of units of measurement;
- time from the beginning of the current measurement;
- graphic representation of measured value and user defined alarm thresholds;
- current random measurement error in confidence interval of 0.95;
- current alarm level;
- current time or date;
- prompts, if measurement technique requires any additional actions by the user.

2.5.4   Signal of registration of particles

The indicator makes sound signals (clicks) on registration of photons, or particles of ionizing radiation. The higher is the level of radiation, the higher is the average frequency of clicks. These signals can be disabled using the settings of the Indicator.

2.5.5 Alarm signals

When any alarm threshold is exceeded the Indicator makes a corresponding sound. Alarm signals can be disabled using the settings of the Indicator.

2.6   Indicator operating modes

Setting of the Indicator is done in setting mode. To evaluate the level of radiation, automatic or manual measurements are used.

Measurements in automatic modes will start immediately after their activation in the main menu of setting modes. Measurements are made continuously and are completed with the activation of another measurement mode. Automatic modes are:

- Mode for constant control of gamma-radiation (hereinafter referred to as GAMMA mode);
- radiation sources search mode (hereinafter referred to as SEARCH Mode) – only for RadiaScan-501 and RadiaScan-701.

GAMMA is the main mode. The indicator switches to this mode after switching on.

Measurements in manual modes start only after the user presses the corresponding button, they are stopped either automatically or upon pressing of a button. Manual modes are:

- Mode of evaluation of beta particles flux density (hereinafter referred to as BETA mode) – only for RadiaScan-701;
- Mode of evaluation of alpha particles flux density (hereinafter referred to as ALPHA mode) – only for RadiaScan-701;
- Radiation sources DETECTION mode (hereinafter referred to as the DETECTION mode) – only for RadiaScan-501 and RadiaScan-701.

2.6.1 GAMMA mode

It is intended for assessment of cumulative dose and dose rate of the current level of gamma and X-ray radiation.

This is the basic mode of operation. It is activated immediately after the Indicator switching-on.

The graphical interface of the mode, setting of parameters and order of use are described in chapters 2.8.1, 3.17. and 5.7 correspondingly.

2.6.2 SEARCH mode

The mode is used for search for sources of radiation on the area by moving the Indicator above the surface being examined and for defining areas with the highest readings. This mode is much more responsive to changes in radiation background compared to GAMMA mode, but due to significant decrease in the accuracy of readings.

The graphical interface of the mode, setting of parameters and order of use are described in chapters 2.8.2, 3.19 and 5.8 correspondingly.

2.6.3 BETA mode

The mode is intended for assessment of beta-particles flux density by two measurements. Measurements are taken over long intervals of time (from several minutes to several hundred minutes). Duration of one measurement can be limited explicitly or implicitly by specifying the required level of random error.

The graphical interface of the mode, setting of parameters and order of use are described in chapters 2.8.3, 3.20 and 5.9 correspondingly.

2.6.4 ALPHA mode

The mode is intended for assessment of alpha particles flux density by two measurements. Measurements are taken over long intervals of time (from several minutes to several hundred minutes). Duration of one measurement can be limited explicitly or implicitly by specifying the required level of random error.

The graphical interface of the mode, setting of parameters and order of use are described in chapters 2.8.4, 3.21 and 5.10 correspondingly.

2.6.5 DETECTION mode

The mode is used to detect the fact of radioactive contamination of the surfaces of objects, food products, and other objects, by two measurements. Measurements are taken over long intervals of time (from several minutes to several hundred minutes). Duration of the measurement can be limited explicitly or implicitly by specifying the required level of random error.

The graphical interface of the mode, setting of parameters and order of use are described in chapters 2.8.5, 3.22 and 5.11 correspondingly.

2.7 Displaying and alarm

To display the special statuses of the Indicator and specific events recorded by it, LEDs, buzzer and display are used. With the help of these means the Indicator gives the following signals to the user:

2.7.1 Signal of LED explicit power on/off

In this case, the green LED lights up for 2 seconds once, and goes out.

2.7.2 Signal of LED passive state at presence of power supply at USB-slot

Green LED generates short pulses of minimum brightness with the frequency of 1 pulse per 4 seconds. In this state, the Indicator does not perform any measurements and is waiting for explicit or implicit power-up.

If the battery charging process is in active state at this moment, then the red LED is constantly on.

2.7.3 Signal of LED implicit switching on

If the Indicator is off, then for conduct of measurement by schedule it may switch on implicitly, and green LED generates short pulses with minimum brightness at the frequency of 2 pulses per second.

If the battery charging process is in active state at this moment, then the red LED is constantly on.

2.7.4 Battery discharge signal

Upon detection of excessive battery discharge the Indicator delivers the following signals with the frequency of 2 times per second:

- red LED lights up and goes out;
- buzzer emits short tone signals;
- low battery symbol lights up and goes out on the display.

These signals are issued for 30 seconds or until the user presses any button, then the Indicator turns off.

2.7.5 Signal of registration of alpha, beta particles and photons of ionizing radiation

Upon a photon or particle registered by the detector:

1. LEDs form a light pulse:
   - Green, if none of the alarm thresholds is exceeded;
   - Red, if at least one alarm threshold is exceeded or radioactive contamination was detected in DETECTION mode;
2. The buzzer makes a click.

2.7.6 Signal of manual measurements start / ending

The buzzer emits a short single tone signal.

2.7.7 Alarm signals

Upon exceedance of any of the thresholds of the current measurement mode, or upon detection of radioactive contamination in DETECTION mode, the buzzer emits a particular (for each type of alarm) sequence of tone signals.

The procedure for testing alarms is described in paragraph 3.13.

2.8   Elements of Graphical Interface

Graphical interface of the Indicator is represented by the following screens:

- measurement modes screens;
- menu screens;
- settings screens (dialogues);
- tip screens (prompts).

The screens are divided into zones. In the top part of the display there is the line of header of the screen (hereinafter referred to as the header), at the bottom there are one or two message bars. Between the header bar and message bar there is the screen work area where the measurement results, menu, dialogues elements and background information are displayed.

2.8.1 GAMMA mode screen.

In GAMMA mode the screen looks as shown in Fig. 4.

1 – screen header
2 – screen work area
3 – message bar
4 – icons, representing the type of displayed readings
5 – random error of the measured value
6 – measurement units
7 – meaning of the measured value
8 – analog indicator
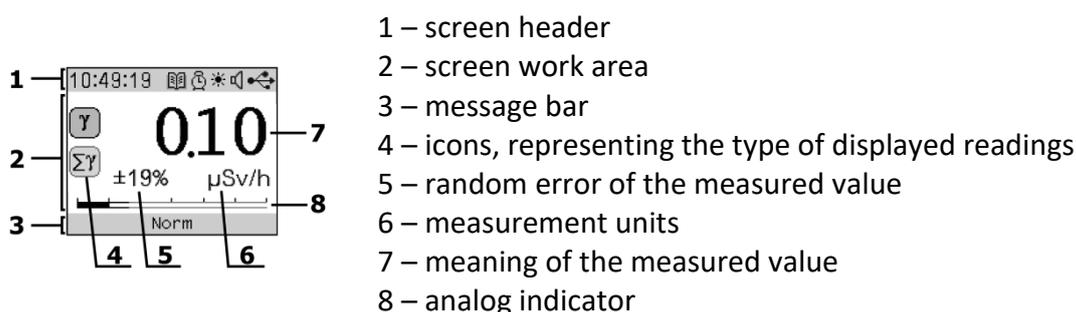
Fig. 4 GAMMA mode screen

Header

In GAMMA mode the screen title has the following elements (listed from the left to the right).

1. Time/date display field (current time is displayed by default, and when pressing and holding "▷" (right) button – current date is displayed) – the time and date formats are set in the settings described in paragraphs 3.4.2 and 3.4.3.

2. The degree of filling of the log memory is displayed by the following icons:

- icon ⬓ – active, if there are less than 17% pages open in the log;
- icon ⬓ – active, if there are from 17 to 33% pages open in the log;
- icon ⬓ – active, if there are from 33 to 50% pages open in the log;
- icon ⬓ – active, if there are from 50 to 67% pages open in the log;
- icon ⬓ – active, if there are from 67 to 83% pages open in the log;
- icon ⬓ – active, if there are from 83 to 98% pages open in the log;
- icon ⬓ – active, if the last page of the log is open;

- icon ⬛⬛ – inactive, if the log is fully filled.
3. Icon ⏱ – active, if schedule-based Indicator operation mode is allowed.
4. Icon ☀ – active, if LED indication is allowed.
5. Icon 🔊 – active, if sound indication is allowed.
6. State of power supply source is indicated as follows:
    - 🔋 – the battery is fully discharged;
    - 🔋 – the battery is discharged;
    - 🔋 – the battery is charged;
    - ⊏ – powered from USB, connection with computer is not set;
    - ⟷ – powered from USB, connection with computer is set;
    - ⚡ – powered from USB, the battery is charging (the battery charging is terminated after pressing the "▷" (right) button for 3 seconds, while the device is in GAMMA mode).

Work area

On the left side of the screen there are two icons showing the type of displayed readings:

- If icon ⟨γ⟩ is active, the dose rate of gamma radiation is displayed;
- If icon ⟨Σγ⟩ is active, the integral dose of gamma radiation is displayed.

If "∇" (down) button is pressed, the integral dose is displayed, otherwise the dose rate is displayed.

Large digits (see. Fig. 4, field 7) show the numerical value of the dose or dose rate. If the random error exceeds the limit of ±50% (value is not valid), gray dashes are displayed instead of the numbers. Values below the first threshold are shown in green. Values higher than the first, but lower than the second threshold are shown in yellow, values above the second threshold are shown in red.

Along with value (of dose or dose rate), the screen displays the corresponding random error (field 5), and measurement units (field 6).

At the bottom of the screen the measured value is displayed on analog display with logarithmic scale. One indicator scale division corresponds to tenfold change of displayed value. Green, yellow and red areas correspond to the levels of alarm.

Message bar

The message bar (see. Fig. 4) shows the current alarm level. The following are the messages displayed in descending order of priority:

- "No data" – the measured value is invalid;
- "Dangerous" or "Alarm level 2" – the value is greater than or equal to the second threshold;
- "Radiation" or "Alarm level 1" – value is greater than or equal to the first threshold and less than the second threshold;
- "Norm" – value is less than the first threshold.

"Radiation" and "Dangerous" messages are issued for the values of the dose rate, and "Alarm level 1" and "Alarm level 2" messages are issued for values of the cumulative dose.

2.8.2 Screen of SEARCH mode (only for RadiaScan-501 and RadiaScan-701).

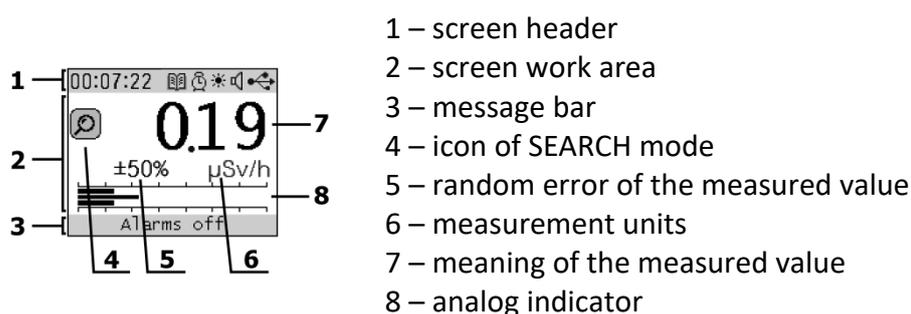In SEARCH mode the screen looks as shown in Fig. 5.

1 – screen header
2 – screen work area
3 – message bar
4 – icon of SEARCH mode
5 – random error of the measured value
6 – measurement units
7 – meaning of the measured value
8 – analog indicator

Fig. 5 Screen of SEARCH mode

Header

In SEARCH mode the screen title by its contents and behavior is similar to the title of GAMMA mode (see par. 2.8.1).

Work area

In the left part of the screen there is an icon – attribute of SEARCH mode.

Big green digits (see Fig. 5, field 7) display the numeric value of dose rate.

Besides dose rate values the screen displays the random error (field 5) and measurement units (field 6) corresponding to it.

At the bottom of the screen the measured value is displayed on the analog display with a logarithmic scale. One indicator scale division corresponds to tenfold change of displayed value. The upper and lower green stripes reflect the value of field 7, central gray bar represents the dose rate measured in the last second.

Message bar

In SEARCH mode Alarm signals are not issued, so the message line (see Fig. 5) shows either "No data", if the measured value is invalid, or "Alarms off" prompt.

2.8.3 BETA mode screen (for RadiaScan-701 only).

For assessment of beta-particles flux density two measurements need to be taken:

- measurement of the contribution of gamma radiation only (at installed back cover in position: filter with metal) – background;
- measurement of total impact of gamma radiation and beta particles (at back cover removed) – the cumulative effect.

Both at measurement of the background, and at measurement of the total impact the screen is as shown in Fig. 6.
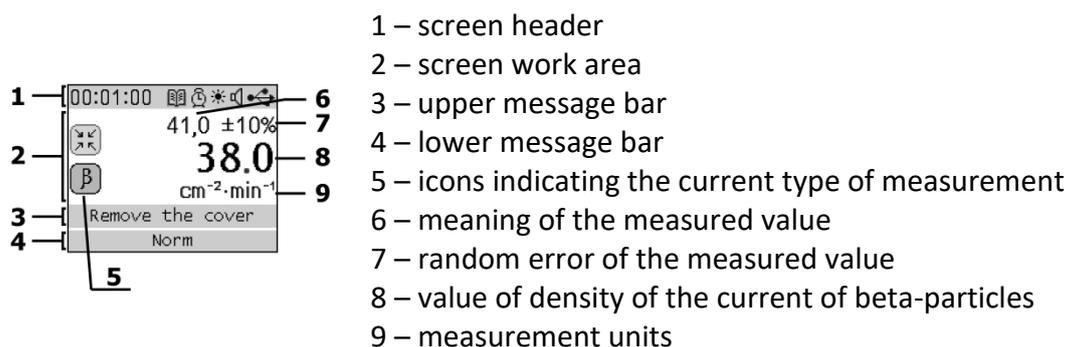

1 – screen header
2 – screen work area
3 – upper message bar
4 – lower message bar
5 – icons indicating the current type of measurement
6 – meaning of the measured value
7 – random error of the measured value
8 – value of density of the current of beta-particles
9 – measurement units

Fig. 6 BETA mode screen

Header

In BETA mode the screen title contains the same elements as the Header of GAMMA mode (see par. 2.8.1). The only difference is the type of information displayed in the time field.

Depending on the type of measurement selected and on the current stage of measurement, the following is displayed in the time field:

- in the intervals between measurements – duration of the last measurement of the background or the total cumulative impact;
- during measurement, if it is limited by time only – the time remaining until the end of the measurement;
- during measurement, if it is not time-limited, or is limited by allowable random error – the time from the start of measurement.

Work area

The left part of the work area has two icons which reflect the type of current measurement:

- if icon is active, the background measurement is selected;
- if icon is active, the mode of measuring the total impact is selected.

By clicking "Δ" (up) button you switch to background measurement mode, by clicking "∇" (down) button you switch to mode of measuring the total impact.

Field 6 (see Fig. 6) shows either the background value or the value of total exposure. Field 7 displays the random error of the value from field 6.

Numeric value of density of the current of beta-particles net of background is displayed in field 8. If the random error of the background or the sum exceeds the limit of ±50% (value is not valid), dashes are displayed in field 8.

The color of field 8 reflects the properties of the current measurement only, but not of the result calculated by two measurements. The color is chosen based on the following rules, listed according to descending priority:

1. Red – if the value is higher than the second threshold;
2. Yellow – if the value is higher than the first threshold but below the second threshold;
3. Gray – if random error exceeds the limit of ±20%;
4. Green – if the value is lower than the first threshold.

In Fig. 6 in field 9 measurement units are displayed.

Message bars

The screen has two message bars (Fig. 6).

The top bar displays user help tips on the current type of measurement:

- "Put the cover" – when you switch to the background measurement mode;
- "Remove the cover" – when you switch to the mode of measurement of total radiation exposure;
- "Measuring..." – during the measurement process;
- "Terminated" – upon completion of measurement, if random error not exceeding the limit of ±50% is achieved;
- "Finished" – upon completion of measurement, if the random error exceeds the limit of ±50%.

The bottom message bar displays alarm levels. The following are the messages displayed in descending order of priority:

- "No data" – measured value is invalid;
- "Alarm level 2" – the value is greater than or equal to the second threshold;
- "Alarm level 1" – the value is greater than or equal to the first threshold and below the second threshold;
- "Norm" – the value is lower than the first threshold.

2.8.4 ALPHA mode screen (for RadiaScan-701 only).

For assessment of the density of alpha-particles flux, two measurements at removed back cover shall be taken:

- measurement of the contribution of gamma rays and beta particles only (investigated surface is covered, for example, with a thin sheet of paper) – the background;
- measurement of the total exposure of gamma radiation and alpha particles (investigated surface is completely open) – the cumulative effect.

Both at measurement of the background, and at measurement of the total impact the screen looks as shown in Fig. 7.

1 – screen header
2 – screen work area
3 – upper message bar
4 – lower message bar
5 – icons indicating the current type of measurement
6 – meaning of the measured value
7 – random error of the measured value
8 – value of density of the current of ALPHA particles
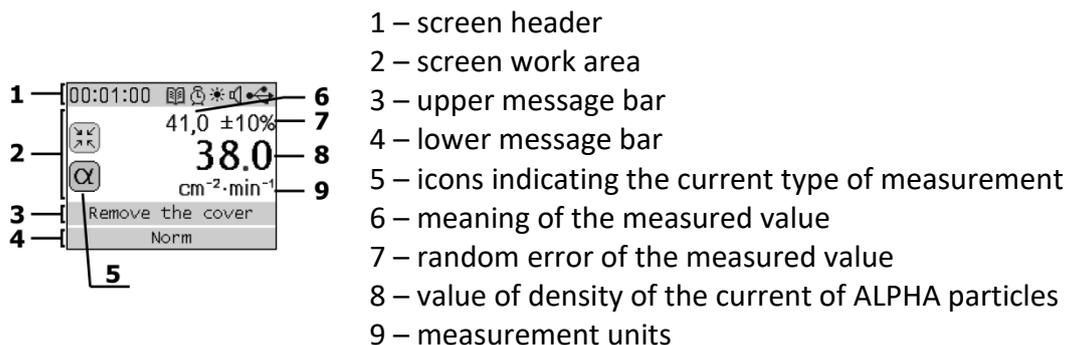9 – measurement units

Fig. 7 ALPHA mode screen

Header

Header of the window in ALPHA mode is fully consistent with the header in BETA mode (see par. 2.8.3).

Work area

The left part of the work area has two icons which reflect the view of current measurement:

- if icon ⊡ is active, the background measurement mode is selected;

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- if icon $\boxed{\alpha}$ is active, the cumulative impact measurement mode is selected.

Clicking "Δ" (up) button means switching to the background measurement mode, clicking "∇" (down) button means switching to cumulative impact measurement mode.

As for the rest, the work area of ALPHA mode corresponds to the work area of BETA mode (see par. 2.8.3).

Message lines

ALPHA mode message lines are similar to BETA mode message lines (see par. 2.8.3).

2.8.5 DETECTION mode screen (only for RadiaScan-501 and RadiaScan-701).

Method of detection of radioactive contamination of the surfaces of objects provides for conduct of two measurements:

- Measurement of the level of natural radiation background;
- Measurement of the level of radiation near the surface of the object being examined.

Both at measurement of the background and at the measurement at the object surface the screen looks as shown in Fig. 8.
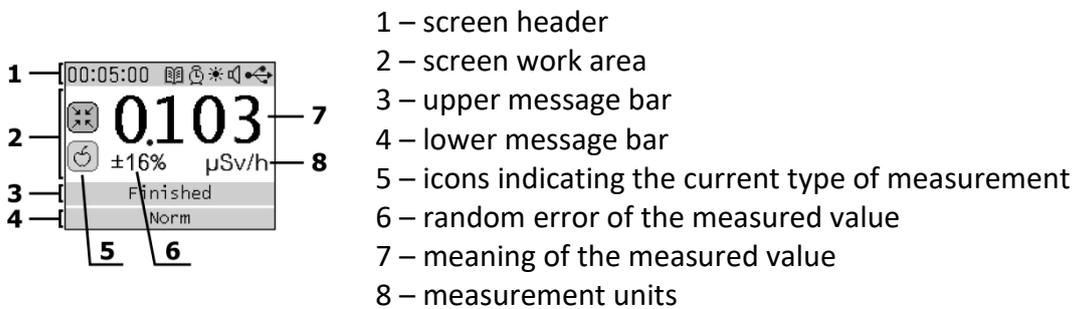

1 – screen header
2 – screen work area
3 – upper message bar
4 – lower message bar
5 – icons indicating the current type of measurement
6 – random error of the measured value
7 – meaning of the measured value
8 – measurement units

Fig. 8 DETECTION mode screen

Header

In DETECTION mode the screen title by its contents and behavior is similar to the title of BETA mode (see par. 2.8.3).

Work area

The left part of the work area has two icons which reflect the type of current measurement:

- if icon $\boxed{}$ is active, the background measurement mode is selected;
- if icon $\boxed{}$ is active, the mode of measuring radiation levels near the object is selected.

By clicking "Δ" (up) button you switch to background measurement mode, by clicking"∇" (down) button you switch to mode of measuring radiation levels near the object.

In field 7 (see Fig. 8) either the background value, or the value of the level of radiation near the object is displayed. If the random error of the current measurement exceeds the limit of ±50% (value not valid), then dashes are displayed instead of the numeric values.

Color of field 7 reflects the properties of the current measurement and is selected by the following rules, listed according to descending priority:

1. Red– if the value is higher or equal to the second threshold;
2. Yellow – if the value is higher or equal to the first threshold, but less than the second;
3. Gray – if random error exceeds the limit of ±50%;
4. Green – if the value is lower than the first threshold.

In field 6 the random error of the values from field 7 is displayed, and in field 8 measurement units are displayed.

Message bars

The screen has 2 Message bars (see Fig. 8).

In the top bar the user help tips for the current type of measurement are displayed:

- "Background" – when switching to the background measurement mode;
- "Object" – when switching to measurement of the level of radiation near the object;
- "Measuring..." – during the measurement process;
- "Finished" – upon completion of measurement if the random error specified in the settings is achieved;
- "Terminated" – upon completion of measurement, unless if the random error specified in the settings is not achieved.

The bottom message bar shows alarm levels. The following are the messages displayed in descending order of priority:

- "No data" – measured value is invalid;
- "Radiation found" – in the case of detection of radioactive contamination;
- "Alarm level 2" – the value is higher or equal to the second threshold;
- "Alarm level 1" – the value is higher or equal to the first threshold, but less than the second threshold;
- "Norm" – the value is lower than the first threshold.

2.8.6 Main menu screen.

RadiaScan-501 main menu screen looks as shown in Fig. 9.

1 – screen header
2 – screen work area
3 – message bar
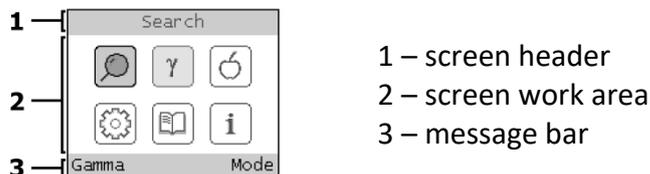
Fig. 9 RadiaScan-501 main menu screen

RadiaScan-601 main menu screen looks as shown in Fig. 10.

1 – screen header
2 – screen work area
3 – message bar
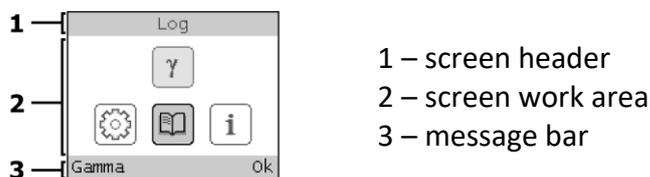
Fig. 10 RadiaScan-601 main menu screen

RadiaScan-701 main menu screen looks as shown in Fig. 11.

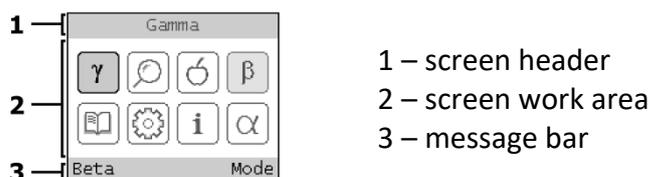1 – screen header
2 – screen work area
3 – message bar

Fig. 11 RadiaScan-701 main menu screen

The main menu:

- activates one of the allowable measurement modes;
- calls Indicator settings menu.

Header

In the header of the screen of the main menu the name of the highlighted menu item is displayed.

Work area

The work area has icons corresponding to menu items. Some of the icons are responsible for activation of the required measurement mode (mode icons):

- – activates ALPHA mode (only for RadiaScan-701);
- – activates BETA mode (only for RadiaScan-701);
- – activates GAMMA mode;
- – activates SEARCH mode (only for RadiaScan-501 and RadiaScan-701);
- – activates DETECTION mode (only for RadiaScan-501 and RadiaScan-701).

Icon is used to call up the "Options" menu.

Icon is used to call up the "Log" menu.

Icon is used to call up the "Information" menu.

One of the icons is always highlighted. Highlighting can be moved by buttons "◁" (left), "▷" (right), "Δ" (up), "∇" (down).

The icon for the current measurement mode is displayed in a specific way highlighted in yellow.

To select new measurement mode or to call "Options" menu move the highlighting to the appropriate icon and press "Menu" button.

To exit from the main menu, press "Power" button.

Message bar

Button functions are indicated in the message bar:

- Left – "Power" buttons;
- Right – "Menu" buttons.

The name of the current measurement mode is indicated as the function of "Power" button.

If by "Menu" button the measurement mode is changed, the message bar will show "Mode", and in other cases – "Ok".

2.9   Event log

The non-volatile memory of the Indicator has an event log. Both measured values and attributes of some important events and statuses of the Indicator are recorded in it. Each entry contains indication of current time. It is possible to view the log contents either using the "Log" menu of the Indicator, or through the RadiaScan.exe support program (available at the

manufacturer's website). The Support Program downloads, views and saves all the log entries of the Indicator in the database of the computer.

The following modes of the log operation are implemented:

- "Normal" – in this mode the results of measurements and characteristics of the most important events and statuses of the Indicator are logged;
- "Advanced" – in this mode the results of measurements and characteristics of all registered events and statuses of the Indicator are logged.

Memory of the log has 60 pages. After filling the current page the Indicator opens a new one and continues recording. Erasing the memory of the log is made page-by-page and can be made both automatically or manually. In the case of automatic erasure at a shortage of space for new records the Indicator empties a page with the oldest records. When manually erasing the memory the user can choose either complete erasure of the log, or specify the number of pages (with the oldest records) to be deleted. When deleted all pages with the records are lost forever.

3   SETTING UP THE DEVICE

3.1   General principles

Setting of the Indicator is done by means of menu. Some parameters can be changed directly from the menu, for others dialogues are used. Moreover, the indicator settings can be made also using support program **RadiaScan.exe** (available at the manufacturer's website).

3.1.1 Using the menu

The main menu (see par. 2.8.6) is used to select the measurement mode and configure the parameters of the device through "Options" menu.

From any measurement mode, the main menu is called by pressing "Menu" button. Return to current measurement mode is made by pressing "Power" button.

After calling "Options" menu the title of the screen displays the name of the current menu, and in the message bar displays the functions of the buttons: on the left – "Power" button, on the right – "Menu" button.

To select a menu item, use "Δ" (up) and "∇" (down) buttons.

To enter a submenu or to replace the value of the selected parameter, use "▷" (right) or "Menu" buttons.

To return from the menu to the higher level press "◁" (left) or "Power" button.

For a menu item associated with the parameter, by pressing "▷" (right) or "Menu" button either the parameter value will change or a corresponding dialogue will be brought up.

3.1.2 Use of dialogues

Dialogues usually contain one or more fields for entering values. Group of one or more characters of parameter of one of the fields is active. To change its value use "Δ" (up) and "∇" (down) buttons. "◁" (left) and "▷" (right) buttons are used to activate other groups.

To exit the dialogue use buttons:

- "Menu" – in this case, new value of the parameter will be used;
- "Power" – in this case, the old value of the parameter will still be used.

3.2   Information on the Product

To display information about the product, enter to the "Information" menu, select "About the device" and press the "Menu" button.

The certificate will be displayed containing the model name, serial number, product software version. To exit the help window, click "Power" button.

3.3 Restoring the factory settings

To restore the factory settings, go to "Options" menu, then to menu "Other", "Factory settings" and press "Menu" button. This will display a dialogue box consisting of elements "No" and "Yes." Select "Yes" and press "Menu" or "▷" (right) button.

3.4 Configuring the regional settings

3.4.1 Language of the interface

To select the interface language, enter "Options" menu, then menu "Screen", "Language". In "Language" menu select the language and press "Menu" or "▷" (right) button.

3.4.2 Selecting the time format

To select a format, enter the "Settings" menu, then in the "Screen" menu, "Time". In the menu "Time format" select the required format (24h or 12h) and press button "Menu" or "▷" (right).

3.4.3 Selecting the date format

To select the format, enter the "Settings" menu, then to the "Screen", "Date" menu. In the "Date format" menu select the desired format and press the button "Menu" or «▷» (rightwards).

For the date format fields designation the following symbol combinations are used:

- "DD" – displays the place of a two-digit field of the day;
- "MM" – displays the place of a two-digit field of the month;
- "YY" – displays the place of a two-digit field of the year;
- "YYYY" – displays the place of a four-digit field of the year.

The following date formats are available: "DD MM YYYY", "MM/DD/YYYY", "DD MM YY", "MM/DD/YY".

3.5 Setting the date

To change the date enter "Options" menu, then menu "Clock", select "Date" and press "Menu" button. This will display a dialogue box consisting of three fields:

- **day** field – marked on the bottom with "DD" letters;
- **month** field – marked on the bottom with "MM" letters;
- **year** field – marked on the bottom with "YY" letters.

The order of use of the dialogue is described in Chapter 3.1.2.

3.6 Setting the time

To change the time, enter "Options" menu, then menu "Clock", select "Time" and press "Menu" button. This will display a dialogue box consisting of three fields:

- **hours** field – marked on the bottom with letters "HH";
- **minutes** field – marked on the bottom with letters "MM";
- **seconds** field – marked on the bottom with letters "SS".
- 12-hour interval field takes the values AM or PM.

The order of use of the dialogue is described in Chapter 3.1.2.

3.7 Setting the Time Zone

To change the time zone, enter "Options" menu, then menu "Clock", select "Zone" and press "Menu" button. This will display a dialogue box consisting of one field, reflecting the time difference between selected time zone and Greenwich Mean Time (UTC).

The order of use of the dialogue is described in Chapter 3.1.2.

3.8 Enabling/Disabling Daylight Saving Time

To enable/disable daylight saving time, enter "Options" menu, then menu "Clock" and select "Daylight Saving". Pressing "Menu" or "▷" (right) button, you can enable or disable the mode of summer time. If the mode of summer time is enabled, the right side of the menu will show "On", otherwise it will read "Off".

3.9 Setting the display contrast

To change the contrast of the display, enter "Options" menu, then "Screen" menu, select "Contrast" and press "Menu" button. This will display a dialogue box consisting of two-digit numeric field. When you change the value of the field the contrast of the display will change. The order of use of the dialogue is described in Chapter 3.1.2.

Important note. In the factory settings, the display contrast is set to 20%. The contrast level used greatly affects the service life of the display. The manufacturer of displays guarantees a service life of the display not less than 16 thousand hours with a contrast level of 5%. And at a level of 100%, the display service time can be reduced to 300 hours. We recommend to use the contrast in the range of 20%. If it is necessary to set the contrast to a higher level (for example, when working in bright sunlight), as soon as possible, return the contrast setting to the level 20%.

Pressing any key of the Indicator causes an automatic increase in the image contrast by 2 times for 3 seconds. This increases the usability of the device in conditions of high ambient light and allows in most cases to avoid the need to set high level of contrast.

3.10 Automatic shutdown of the display

To set the time of automatical shutdown of the display, enter "Options" menu, then "Screen" menu, select "Turn off" and press "Menu" button. The dialogue with a list of five options will open:

- "Never" – display is always on;
- "15 sec" – turning off after 15 seconds;
- "30 sec" – turning off after 30 seconds;
- "2 min" – turning off after 2 minutes;
- "10 min" – turning off after 10 minutes.

Select the desired option and press "Menu" or "▷" (right) button.

To exit the dialogue, click "Power" button.

3.11 Enabling/Disabling the sound

To enable/disable the sound, enter "Options" menu, then "Signals" menu, "Sounds" menu and select "All sounds". Pressing "Menu" or "▷" (right) button, you can enable or disable the sound. If the sounds are on, the right side of the menu will show "On", otherwise it will read "Off".

3.12 Enabling/Disabling particular sounds

To enable/disable particular sounds enter "Options" menu, then "Signals" menu, "Sounds" menu. Select one of the items: "Buttons", "Clicks" or "Alarm". "Menu" button or "▷" (right) button enables or disables the selected sound.

 For the "Buttons" and "Clicks" items, two values displayed on the right side of the menu bar are possible:

- "On" – the sound is on;
- "Off" – the sound is off.

For the item "Alarm" three meanings are possible on the right side of the menu bar:

- "Continuous" - the alarm sounds continuously;
- "One time" - the alarm sounds once;
- "Off" - the alarm sound is turned off.

At emergence of a sound alarm signal it is possible to turn it off by pressing any button.

3.13 Testing alarm signals

To listen to the alarm signals, enter "Options" menu, then "Signals" menu, "Alarm" menu. Select one of the items: "Alarm-1" or "Alarm-2". Press "Menu" or "▷" (right) button. While the button is pressed, the Indicator will issue one-time alarm sound corresponding to the selected threshold. When you release "Menu" button, the sound will stop.

3.14 Control of LEDs

To control LEDs enter "Options" menu, then "Signals" menu and "LEDs" menu.

3.14.1 Enabling/Disabling LEDs

To enable/disable the LEDs, in "LEDs" menu choose "Enable" item. "Menu" or "▷" (right) button enables or disables the LED indication. If the indication is enabled, the right side of the menu will show "Yes", if not, it will read "No".

3.14.2 Setting brightness of green LED

To enable/disable the LEDs, select "Brightness" in "LEDs" menu and press "Menu" or "▷" (right) button. In the opening dialogue box "Brightness", set the brightness of the green LED, which will flash at the same time with the frequency of about 2 times per second.

3.15 Automatic enabling/disabling the device by the schedule

To control automatic enabling/disabling of the device, there are four configurable schedules. To set any of them enter "Options" menu, then "Clock" menu and select "Schedules" item. A menu with schedules will be displayed. In each line of the menu on the left there is schedule response time in HH: MM, and on the right there is the action performed by the schedule:

- Power on – activation of the device;
- Power off – deactivation of the device;
- No – the schedule is not active.

Each schedule can be triggered once a day at a specified (up to minutes) time.

Using "Δ" (up) and "∇" (down) buttons select the desired schedule. Using button "Menu" or "▷" (right) open the menu of settings of this schedule consisting of three points, "Enable", "Time" and "Power".

3.15.1 Enable/disable the schedule work

Select "Enable" item. Using "Menu" or "▷" (right) button set "Yes" value to enable the schedule, or "No" to disable the schedule.

3.15.2 Setting the schedule triggering time

Select "Time" item and press "Menu" or "▷" (right) button. The dialogue "Start time" will open, which consists of two fields for entry of hours (HH) and minutes (MM) of the schedule triggering time.

The order of use of the dialogue is described in Chapter 3.1.2.

3.15.3 Selecting action

Select "Power" item. Using "Menu" or "▷" (right) button set to "Off" to set up the deactivation of the device by this schedule, or the "On" to set up activation of the device.

3.16 Specifying the type of batteries

To specify the type of batteries, go to the "Settings" menu, then to the "Other" menu and the menu "Batteries".

For the "Rechargeable" item two meanings displayed in the right part of the menu line are possible:

- "Yes" - rechargeable batteries are used as batteries;
- "No" - alkaline batteries are used as batteries.

If this parameter is not set correctly, the batteries discharge degree in the screen header will not be displayed correctly (see p. 2.8.1).

The Indicator Modifications 501A, 601A and 701A allow to charge accumulators located in the battery compartment from the power source, connected to the USB port of the device.

The battery charging is possible if the menu item "Rechargeable" is set to "Yes" and the external power supply is applied to the USB connector.

If the "Rechargeable" item is set to "Yes", then the battery charging is started immediately under the conditions, listed below.

- Indicator is initially powered off and the external power is applied to its USB connector. The active state of the charging process is indicated by the red LED while the green LED is blinking.
- A long press of the "▷" button (Fig. 1, mark 4) when device is turned off or in GAMMA mode (repeated long press stops charging).
- The "Rechargeable" item state is changed from "No" to "Yes".
- If Indicator is connected to the external power continuously then the charging process will be activated every 3 days.

3.17 Parameters of GAMMA mode

To set parameters of the mode of continuous monitoring of gamma radiation enter "Options" menu, then "Modes" menu, "Gamma" menu.

3.17.1 Setting the units of measurement of the dose and dose rate

To switch the units of measurement of the dose and dose rate, select "Gamma" menu, "Dose units" item and press "Menu" or "▷" (right) button.

When "Sv" (sievert) is chosen for the dose measurement unit, then Sv/h will be used for dose rate.

When "R" (roentgen) is chosen for the dose measurement unit, then R/h will be used for dose rate.

This parameter affects the choice of the units of measurement in the SEARCH and DETECTION mode.

3.17.2 Setting alarm thresholds for dose rate

From menu "Gamma" go to "Dose rate" menu.

- To set default values, select "Factory settings" and press "Menu" or "▷" (right) button. In the opening menu, select "Yes" and press "Menu" or "▷" (right) button.
- To set the first threshold, select "Alarm-1" and press "Menu" or "▷" (right) button.
- To set the second threshold, select "Alarm-2" and press "Menu" or "▷" (right) button.

When selecting "Alarm-1" or "Alarm-2" a dialogue will be displayed for setting a new value of the corresponding threshold. The dialogue consists of one numeric field. The order of use of the dialogue is described in Chapter 3.1.2.

If for the first threshold a value greater than the second threshold is entered, the second threshold value becomes equal to the value of the first one.

If for the second threshold a value smaller than the first threshold is entered, then the value of the first threshold becomes equal to the value of the second one.

3.17.3 Setting alarm thresholds for dose

From "Gamma" menu go to "Dose" menu

- To set default values, select "Factory settings" and press "Menu" or "▷" (right) button. In the opening menu, select "Yes" and press "Menu" or "▷" (right) button.
- To set the first threshold, select "Alarm-1".
- To set the second threshold, select "Alarm-2".

When selecting "Alarm-1" or "Alarm-2" a dialogue box will be displayed for setting the new value of the corresponding threshold. The dialogue consists of one numeric field. The order of use of the dialogue is described in Chapter 3.1.2.

If for the first threshold a value greater than the second threshold is entered, the second threshold value becomes equal to the value of the first one.

If for the second threshold a value smaller than the first threshold is entered, then the value of the first threshold becomes equal to the value of the second one.

3.17.4 Setting of automatic recording of the readings in the log (capture)

From "Gamma" menu, go to "Capture" menu.

To enable/disable capturing, select "Enable" item. Using "Menu" button or "▷" (right) button set to "Yes" to allow capture. To prevent capture, set to "No".

To set the interval between captures, select "Interval" item. In the opening dialogue box, set the time interval in HH:MM:SS. The interval value can be set in the range from 1 second to 11 hours 59 minutes 59 seconds.

The order of use of the dialogue is described in Chapter 3.1.2.

3.18 Setting conduct of measurements by schedule

This option allows for automatic measurements with specified duration based on four customizable schedules. The measurement results are stored in the memory log of the device. Measurements are made on the assumption that the device is used to assess the level of gamma-radiation, and the measurement result is the dose of this radiation. This type of measurement does not depend on which measuring mode is active, it does not depend on whether the device is on or off. If the device is turned off, by schedule activation it will turn on in the background mode (the display is off), will take measurement, record the result in the log and turn off.

To configure the schedules parameters, go to "Options" menu, then to " Modes" menu, menu "Gamma", menu "Schedules". A menu with schedules will be displayed. On the left, in each row of the menu the schedules response time is indicated in HH:MM, and on the right the schedule status is displayed:

- Off – the schedule is off;
- On – the schedule is on.

Having selected the desired schedule, click "Menu" or "▷" (right) button. The opening Menu allows you to set the following schedule parameters:

- **Enable** – enables/disables the schedule operation;
- **Start** – specifies the schedules operation start time;

- **Duration** – sets the duration of one measurement;
- **Pause** – sets the time from the end of the last measurement till the next measurement, if several measurements are made on the present schedule;
- **Samples** – sets the number of measurements which must be sequentially performed after activation of the schedule.

Each schedule can not get activated more than once per day. After activation of the schedule the measurement starts. If the number of measurements is more than one, then upon completion of measurement after the time specified by parameter "Pause", next measurement will be launched. After completing the last measurement of the series the schedule goes into standby mode till the current time and the schedule operation start time coincide.

3.18.1 Allowing/disallowing operation of the schedule

In "Schedule" menu select "Enable". Using "Menu" or "▷" (right) button set to "Yes" to enable the schedule. To disable the schedule, select "No".

3.18.2 Setting the schedule operation start time

In "Schedule" menu select "Start" item and press "Menu" or "▷" (right) button. Open dialogue "Start time", consisting of two fields, and enter the hour (HH) and minutes (MM) for the schedule activation time.

The order of use of the dialogue is described in Chapter 3.1.2.

3.18.3 Setting duration of one measurement

In "Schedule" menu select "Duration" and press "Menu" or "▷" (right) button. Open "Duration" dialogue, consisting of three fields and enter the hour (HH), minutes (MM) and seconds (SS) – duration of the measurement. Measurement duration can be set in the range from 0 to 1 hour 59 minutes 59 seconds.

The order of use of the dialogue is described in Chapter 3.1.2.

3.18.4 Setting pause between measurements in a series of measurements

In "Schedule" menu select "Pause" item and press "Menu" or "▷" (right) button. "Pause" dialogue will open, consisting of three fields for entering hour (HH), minutes (MM) and seconds (SS) – duration of pause between the end of one and the beginning of the next measurement in the series of measurements. Duration of the pause can be set in the range from 0 to 17 hours 59 minutes 59 seconds.

The order of use of the dialogue is described in Chapter 3.1.2.

3.18.5 Setting the number of measurements in a series of measurements

In "Schedule" menu select "Samples" and press "Menu" or "▷" (right) button. "Samples" dialogue will open, consisting of a field for entering values from 1 to 999.

The order of use of the dialogue is described in Chapter 3.1.2.

3.19 Parameters of SEARCH mode

To configure the settings of SEARCH mode, enter "Options" menu, then "Modes" menu, "Search" menu.

3.19.1 Setting units of measurement

As the units of measurement in the SEARCH mode, you can select either the current units of the dose rate of the GAMMA mode (see par. 3.17) - roentgen per hour (R/h) or sievert per hour (Sv/h), or units of counting speed (cps). If units of counting speed are selected, then the average number of pulses displayed by a Geiger-Muller counter in one second is displayed on the instrument display.

To switch the units of measurements, select "Units" item in "Search" menu and press "Menu" or "▷" (right) button.

This parameter does not affect the choice of units of measure for other modes.

3.19.2 Setting the time of sampling

Select "Sampling time" in "Search" menu, and press "Menu" or "▷" (right) button. A dialogue will be displayed for setting a new value of the sampling time. The dialogue consists of a two-digit numeric field. The order of use of the dialogue is described in Chapter 3.1.2.

This parameter specifies the time interval during which till the current moment the number of events on the detector have been counted. The longer is the sampling time, the slower the Indicator reacts to changes in the radiation situation, but it gives less variance in readings.

This parameter affects the behavior of the output numerical value of the dose rate and to two outer bands of analog indicator (see fields 5 and 8, Fig. 5).

The range of allowable values – from 4 to 60 sec.

3.20 Parameters of BETA mode

To set the parameters of BETA mode enter "Options" menu, then " Modes" menu, "Beta" menu.

3.20.1 Setting random error of one measurement

Select "Error" item and press "Menu" or "▷" (right) button.

A dialogue will be displayed for setting a new value of the appropriate level of accuracy. The dialogue consists of a numeric field. The order of use of the dialogue is described in Chapter 3.1.2.

The value of the level of accuracy ±0% corresponds to a situation where this parameter is not used (off). The dialogue displays dashes instead of numbers, and the following prompt is displayed: "Do not consider". To enable this option, it is enough to set any non-zero value by pressing "Δ" (up) button.

The value of the parameter affects the duration of a single measurement. The measurement will not be automatically completed until the random error of the measurement is higher than the value of the parameter.

The range of valid values of the parameter – from ±0 to ±20%.

3.20.2 Setting duration of one measurement

Select "Duration" item and press "Menu" or "▷" (right) button.

A dialogue will be displayed for setting a new value of measurement duration. The dialogue consists of one numeric field. The order of use of the dialogue is described in Chapter 3.1.2.

The value of duration 0 min corresponds to the situation where this parameter is not used (off). In this case, in the dialogue there are dashes instead of numbers, and the following prompt is displayed "Unlimited". To enable this option, it is enough to set any non-zero value by pressing "Δ" (up) button.

The value of the parameter affects the duration of one measurement. The measurement will not be completed automatically as long as the measurement time is less than the value of the parameter.

The range of valid values of the parameter – from 0 to 999 min.

3.20.3 Setting alarm thresholds

Setting alarm thresholds is made from menu "Beta".

- To set default values, select "Factory settings" and press "Menu" or "▷" (right) button. In the menu, select "Yes" and press "Menu" or "▷" (right) button.
- To set the first threshold, select "Alarm-1" and press "Menu" or "▷" (right) button.
- To set the second threshold, select "Alarm-2" and press "Menu" or "▷" (right) button.

When selecting "Alarm-1" or "Alarm-2" a dialogue will be displayed for setting the new value of the corresponding threshold. The dialogue consists of one numeric field. The order of use of the dialogue is described in Chapter 3.1.2.

If for the first threshold a value greater than the second threshold is entered, the second threshold value becomes equal to the value of the first one.

If for the second threshold a value smaller than the first threshold is entered, then the value of the first threshold becomes equal to the value of the second one.

3.21 Parameters of ALPHA mode

To set ALPHA mode parameters, enter "Options" menu, then "Modes" menu of "ALPHA" menu. Set of parameters of ALPHA mode and ranges of their values are similar to the corresponding parameters and their ranges in BETA, as described in Chapter 3.20.

3.22 Parameters of DETECTION mode

To configure the parameters of DETECTION mode, enter "Options" menu, then "Modes" menu, "Detection" menu.

3.22.1 Unit of measure selection

As the units of measurement in the DETECTION mode, you can choose either the current units of the dose rate of the GAMMA mode (see par. 3.17) - roentgen per hour (R/h) or sievert per hour (Sv/h), or units of count rate (cps). If units of count rate are selected, then the average number of pulses displayed by a Geiger-Muller counter in one second is displayed on the instrument display.

To switch between the units, select "Units" in the "Detection" menu and press the "Menu" button or the "▷" button (to the right).

This parameter does not affect the choice of units of measure for other modes.

3.22.2 Setting random error of one measurement

Similarly to setting in BETA mode (see 3.20.1).

3.22.3 Setting duration of one measurement

Similarly to setting in BETA mode (see 3.20.2).

3.22.4 Setting alarm thresholds

To set alarm thresholds, enter "Thresholds" menu.

- To set default values, select "Factory settings" and press "Menu" or "▷" (right) button. In the menu, select "Yes" and press "Menu" or "▷" (right) button.
- To set the first threshold, select "Alarm-1" and press "Menu" or "▷" (right) button.
- To set the second threshold, select "Alarm-2" and press "Menu" or "▷" (right) button.

When selecting "Alarm-1" or "Alarm-2" a dialogue will be displayed for setting a new value of the corresponding threshold. The dialogue consists of one numeric field. The order of use of the dialogue is described in Chapter 3.1.2.

If for the first threshold a value greater than the second threshold is entered, the second threshold value becomes equal to the value of the first one.

If for the second threshold a value smaller than the first threshold is entered, then the value of the first threshold becomes equal to the value of the second one.

4 VIEWING AND CONFIGURING LOG

4.1 Event Log parameters

To configure the log mode parameters, enter "Options" menu, then "Other" menu, "Event Log" menu.

4.1.1 Log operation mode

To set the log operation mode select "Mode" item and press "Menu" or "▷" (right) button. Select the desired mode – "Normal" or "Extended" in "log mode" menu.

4.1.2 Size of the log

The value of the right part of menu item "Size" reflects the total number of pages of non-volatile memory reserved for the log. This value is displayed only for reference.

4.1.3 Size of the filled part of the log

The value in the right part of menu item "Used" represents the total number of pages of nonvolatile memory which contain records. This value is displayed only for reference.

4.1.4 Log erase mode

To set log erase mode, select "Erasing" and press "Menu" or "▷" (right) button. In the menu, select the desired mode – "Auto" or "Manual".

4.1.5 Erasing the log page-by-page

To erase a specific number of pages of the log, select "Erase" and press "Menu" or "▷" (right) button. In the opening menu, select "Erase pages" and press "Menu" or "▷" (right) button. In the dialogue box, specify the number of pages and click "Menu" button. As a result, the number of filled pages will be decreased by the specified value or will be zeroed.

The order of use of the dialogue is described in Chapter 3.1.2.

4.1.6 Erasing the log completely

To completely erase the log, select "Erase" item and press "Menu" or "▷" (right) button. In the opening menu, select "Erase All" and press "Menu" or "▷" (right) button. In the opening dialogue confirm the operation by selecting "Yes" and press "Menu" button. As a result, all log entries will be deleted.

4.2 Viewing the GAMMA mode measurement results

To view the measurement results from the "Log" menu using the "Gamma" item, enter the "Gamma Log" menu.

There are several reasons for logging the values measured in GAMMA mode. The menu items "Button", "Alarm", "Capture" and "Schedule" are used to indicate the list of reasons for the recording.

The "View" item opens the "Gamma Log" dialogue, in which it is possible to view the measured values corresponding to the specified list of reasons.

The output format of the measured values is described in paragraph 3.5 below.

4.2.1 Viewing records made by pressing a button.

To enable or disable viewing of records made at the button pressing, use the "Button" item. The meaning "Yes" enables viewing, "No" - disables.

4.2.2 Viewing records made by changing the alarm status.

In the right part of the "Alarm" item the reasons for logging are indicated, corresponding to the changes in the alarm status:

- 0 – the appearance of reliable data (random error reached the level of ±50%) after the start of measurement;
- 1 – exceeding the first alarm threshold;
- 2 – exceeding the second alarm threshold;
- No – if none of the above mentioned reasons is indicated.

At selecting "Alarm", the "Alarm types" menu appears, where it is possible to enable or disable viewing of records made by changing the alarm status:

"Accuracy ±50%", "Alarm 1" and "Alarm 2". The meaning "Yes" enables viewing, "No" - disables.

4.2.3 Viewing captured records.

To enable or disable viewing of records made using automatic recording of the Indicator readings to the log (by capture), use the "Capture" item. The meaning "Yes" enables viewing, "No" - disables.

4.2.4 Viewing scheduled records.

To enable or disable viewing of records made on a schedule, use the "Schedule" item. The list of selected schedules is displayed in the right part of the item:

- 1…4 – schedule from 1 to 4 respectively;
- No – if no schedules are specified.

    At selecting "Schedule", the "Selecting schedules" menu will appear, where it is possible to enable or disable viewing of records made by each of the four schedules. The meaning "Yes" enables viewing, "No" - disables.

4.3   Viewing the SEARCH mode measurement results

To view the measurement results from the "Log" menu using the "Search" item, call up the "Log Search" dialogue.

4.4   Viewing BETA, ALPHA, and DETECTION modes measurement results

To view the results of measurements made in the BETA, ALPHA and DETECTION modes in the "Log" menu, use, respectively, "Beta", "Alpha" and "Detection" items. Each of these items calls up a dialogue ("Beta Log", "Alfa Log" and "Detection Log"), allowing to view the results of the corresponding measurements.

The output format of the measured values is described in paragraph 3.5 below.

4.5   Measurement results viewing dialogues

To view the measurement results dialogues ("Gamma Log", "Search Log", "Beta Log", "Alfa Log" and "Detection Log" are used.

4.5.1 Log navigation

At the moment of opening any of the dialogues of viewing the measurement results, the Indicator scans the log, numbers the records of the selected type and determines their quantity.

The top line of the dialogues contains a four-digit field containing the number of the displayed record of the selected type. Number 0001 is assigned to the oldest record. At the moment of opening the dialogue, the field contains the number of the most recent record, equal to the

quantity of records of this type found. If this field contains 0000, then the message "Records of the selected type are not found" is displayed below.

One of the digits of the record number is highlighted. Buttons "▷" (rightwards) and "◁" (leftwards) move the selection and allow to choose any digit of the number. Buttons "Δ" (up) and "∇" (down), accordingly, increase and decrease the value of the field by the value of the weight of the selected digit (on 1, 10, 100 or 1000). Number of the displayed record can be chosen in the range from 1 to number of the last (at the time of dialogue opening) record. If new records appear during the log view, they will only appear after the log is re-scanned.

If during the log viewing there was an automatic deleting of old pages, when trying to display the contents the Indicator will show the message: "Record is deleted! Scan the log again?". The "Power" button allows to refuse transition to outdated record. The "Menu" button starts a re-scan of the log and re-numbers the records.

4.5.2 Displaying the date and time the record was created

In the dialogues for viewing the measurement results, the record date and time are displayed under the record number (hereinafter the record time). If at the moment of recording the Indicator clock contained a set by a user value, the recording time is displayed with yellow symbols. If at the moment of recording the Indicator clock was shot down, the recording time is displayed with gray symbols.

4.5.3 Dialogue "Gamma Log"

In the third line of the dialogue (under the record time) the record reason is displayed: "Button", "Accuracy ±50%", "Alarm 1", "Alarm 2", "Capture", "Schedule 1", "Schedule 2", "Schedule 3" or "Schedule 4".

The fourth line displays the value, the random error, and the unit of measurement of the photon radiation dose rate. The data is displayed with yellow symbols on a black background - if there is no alarm, or on a red background - in case of a dose rate alarm.

The fifth line displays the value, the random error, and the units of measurement of the dose of photon radiation. The data is displayed with yellow symbols on a black background - if there is no alarm, or on a red background - in case of a dose rate alarm.

4.5.4 Dialogue "Search Log"

The format of the displayed data is the same as in the "Gamma Log" dialogue. The only difference is the ability to view (in the fourth line) not only the dose rate values, but also the values of the average count rate, if indicated in the current settings of the SEARCH mode (see par. 3.19.1).

4.5.5 Dialogues "Beta Log" and "Alpha Log"

At the third line of the dialogue to the right of "Background:" the value and its random error, obtained by measuring the background are displayed.

At the fourth line of the dialogue to the right of "Hist:" the value and its random error, obtained by measuring the total impact are displayed.

At the fifth line, the beta particle flux density calculated from the two measurements and the units of measurement are displayed.

If the record contains values that are obtained only in the measurement of the background, then in the fourth and fifth lines dashes are displayed instead of the values.

4.5.6 Dialogue "Log Detect."

At the third line of the dialogue to the right of "Background:" either the level of the alarm that occurred during the background measurement, or an empty field is displayed.

At the fourth line of the dialogue, the value, random error and units of measurement obtained when measuring the background are displayed.

At the fifth line of the dialogue to the right of "Hist:" either the level of the alarm that occurred during the measurement of the total impact, or an empty field is displayed.

At the sixth line of the dialogue, the value, random error and units of measurement obtained when measuring the total are displayed.

If this record contains values obtained only when measuring the background, then dashes are displayed in the sixth line.

In the fourth and sixth lines of the dialog, depending on the current settings of the DETECTION mode (see par. 3.22.1), either the dose rate or the average count rate are displayed as measurement results.

5 INTENDED USE

5.1 Operational restrictions and safety measures

5.1.1 Opening the device

To avoid exposure of the detector to high voltage and failure of the circuit elements never open the device!

5.1.2 Detector window

Avoid contact of mica window of the detector with foreign objects. It can make the detector inoperative.

5.1.3 Battery compartment

Keep the battery compartment and contacts connecting to the batteries in clean state.

5.1.4 Batteries

Perform timely replacement of discharged power sources.

5.1.5 Contamination by radioactive isotopes

When radioactive substances contact the body of the Indicator, its background readings may increase. Check it by making measurements in another room or area.

5.2 Preparation to work

5.2.1 Powered from USB

To prepare the Indicator to work powered from USB it is enough to connect the Indicator to a PC using the USB cable. Location of the mini USB slot on the Indicator is shown in Fig. 2.

5.2.2 Installation of batteries

To prepare the Indicator for operation powered from the batteries, proceed as follows:

- remove the cover of battery compartment (see Fig. 2);
- install the batteries with the correct polarity;
- install the battery cover back in its place.
- turn on the Indicator (see p. 4.3) and specify the type of installed batteries in the settings (see p. 3.16).

5.3   Order of activation of the Indicator

To turn the Indicator on press "Power" button and hold it down until the initial screen will appear on the display.

Note: If the Indicator does not turn on (USB is not connected) within approximately 5 seconds, you shall REMOVE the batteries and, if possible, replace them with new ones.

If power supply to the Indicator is cut off at the same time both from USB, and from the battery, the internal clock of the Indicator will be reset. In this case, at first activation, the Indicator will set the date and time of the last log entry, or – if the log is empty – the date of January 1, 2013, and at 0 h. 0 min. 0 sec.

After turning on the Indicator is switched to GAMMA mode.

5.4   Procedure for switching off the Indicator

To turn off the Indicator, exit the menu, press "Power" button and hold it down until the display turns off.

5.5   Order of connection to USB

When connecting the Indicator to the PC USB-port or when connecting external power supply to mini USB-port the Indicator automatically switches to power from USB. In this case, the power consumption of the battery (batteries) is suspended. Switching to power from USB does not violate the indicator operation.

In case of 501A, 601A or 701A models and if the "Rechargeable" item is set to "Yes" in the "Batteries" menu, then the batteries charging process may start when the external power supply is applied to the USB connector. (see. par. 3.16).

5.6   Order of disconnection from USB

When disconnecting the device from USB the Indicator automatically switches to power from batteries. If the batteries are already discharged, the Indicator power supply circuit may fail. Therefore, before switching off the Indicator from USB, either turn it off using "Power" (see par. 5.4) button, or wait for the automatic shutdown of the display (see par. 3.10).

In case of 501A, 601A or 701A models you should turn off the charging process (if it is enabled) before disconnecting Indicator from USB. To do that press the "▷" (right) button for 3 seconds at least.

5.7   GAMMA mode

In this mode, the Indicator evaluates the levels of dose and dose rate of gamma and X-ray radiation. This mode of operation is activated right after energizing of the Indicator.

In GAMMA mode, the following buttons can be used:

- long-term (up to 3 seconds), pressing "Power" button switches off the Indicator;
- any pressing "Power" button restarts measurement of dose rates;
- When "∇" (down) button is pressed the current value of the integral dose is displayed, this value is held for 4 more seconds after the button is released;
- long press of the button "∇" (down) turns off the Indicator display;
- Pressing "Δ" (up) button switches on maximum brightness of the display for 5 seconds, and makes recording of current values of dose rate and dose into the log;
- If "▷" (right) button is pressed the current date is displayed in the header of the screen;
- Pressing the "▷" (right) button for 3 seconds turns off the battery charging process;
- Short-term pressing of "◁" (left) button turns on/off the sound (similar to par. 3.11);
- long press of the "◁" (left) button activates the SEARCH mode;

- Short-term pressing of "Menu" button calls the main menu.

In this mode, the Indicator solves the following tasks:

- determination of the dose rate by average frequency of pulses from the sensor during the time interval from the start of measurement;
- determination of random error of measurement;
- automatic restart of the measurement of dose rate in the event of change of the radiation environment.

When using RadiaScan-701 to obtain more accurate values of dose and dose rate of gamma and X-ray radiation the detector window must be closed with metal filter, located in the cover on the rear wall of the Indicator (see Fig. 3).

5.8   SEARCH mode (only for RadiaScan-501 and RadiaScan-701)

Both sound indication and analog indicator, shown on the display can be used for search for radiation sources.

The method is: by moving the Indicator above the investigated surface, find the area with the highest level of radiation background. Move the Indicator on the same distance from the surface, back side down. With approaching to the source of radiation, both the frequency of clicks and the numerical value shown on the display in dose units, increase.

In this case the analog indicator shows the values of two measurements:

- "Slow" – obtained within the time specified by parameter "sampling time" (see par. 3.19.2) and displayed by two green stripes;
- "Fast" – obtained in the last second and displayed as a gray stripe in the center.

With approaching to the source the central strip becomes primarily longer than the extreme ones, and as the source is further the central strip becomes shorter. Analog indicator gives good results at levels of dose rate of 0.5 µSv/h (50 µR/h).

The less the distance to the surface and the lower the speed of the Indicator movement are, the higher may be the precision of source localization.

When using RadiaScan-701 to increase the sensitivity you need to fully open the detector window, by removing the cover from the rear wall of the Indicator (see Fig. 3).

In SEARCH mode, the following buttons can be used:

- long-term (up to 3 seconds) pressing "Power" button switches off the Indicator;
- Pressing "Δ" (up) button activates maximum brightness of the display for 5 seconds;
- at pressed "▷" (right) button the current date in the header of the screen is displayed;
- short pressing of "◁" (left) button turns on/off the sound (similar to par. 3.11);
- long press of the "◁" (left) button activates the GAMMA mode;
- Short pressing of "Menu" button calls the main menu.

5.9   BETA mode (only for RadiaScan-701)

In this mode, the Indicator estimates the beta-particles flux density in two measurements:

- background measurement;
- measurement of the cumulative effect of beta-particles and the background.

When measuring the background the detector window must be closed with back cover installed in the position of the filter with the metal, and during measurement of the cumulative impact the detector window shall be open (cover removed).

At the top of the work area of the screen the current value and the random error of the selected measurement is displayed.

Beta-particles flux density is calculated by the subtraction of the background from the value of the flux density of the cumulative effect of background and beta-particle.

Using "Δ" (up) button background measurement mode is selected, using "∇" (down) button the cumulative effect measuring mode is selected. There are help tips in the message bar: "Put the cover" and "Remove the cover".

The selected measurement is started by "▷" (right) button, "Measuring..." message is displayed. "Δ" (up), "∇" (down), "▷" (right) and "Menu" buttons are blocked till the end of the measurement. When pressing these buttons "Measuring…" message disappears, and reappears a little after.

During the measurement by the predetermined thresholds (see par. 3.20.3) the level of alarm is monitored. The current level is displayed in the message bar (see par. 2.8.3).

Measurement can be stopped either by using the button "Power" (short pressing), or automatically, if the specified random error (see par. 3.20.1) is achieved, and duration of the current measurement is not less than the duration specified in the settings (see par. 3.20.2). Rules of indication of the result are described in par. 2.8.3.

In BETA mode, the following buttons can also be used:

- Long (up to 3 seconds) pressing "Power" button switches off the Indicator;
- Short pressing of "◁" (left) button turns on/off the sound (similar to par. 3.11);
- Short pressing of "Menu" button calls the main menu.

5.10 ALPHA mode (only for RadiaScan-701)

In this mode, the Indicator estimates the alpha particles flux density by two measurements:

- background measurement;
- measurement of the cumulative effect of background and alpha-particles.

When measuring the background and when measuring the cumulative effect of the background and alpha particles, the cover with the filter must be removed.

When measuring the background the studied surface must be covered with a thin filter, e.g., a sheet of paper, and when measuring the cumulative impact the filter must be removed.

As for the rest, ALPHA mode is similar to BETA mode described in Chapter 5.9.

5.11 DETECTION mode (only for RadiaScan-501 and RadiaScan-701)

The mode is intended for detection of the fact of radioactive contamination of surfaces of objects, food products, and other objects of research.

Conclusion on presence or absence of contamination is taken based on two measurements:

- measurement of the level of natural background radiation;
- measurement of the level of radiation near the surface of the object of research.

Both measurements must be performed at the same values of the level of natural radiation background. The best way to achieve it is to make all the measurements in the same place and at the same orientation of the Indicator in space.

If RadiaScan-701 is used both measurements are made at an open window of the detector (cover removed) to provide maximum sensitivity of the Indicator.

The specific feature of this mode is that the measurements are performed over a sufficiently long period of time (tens of minutes and more). The longer is the measurement, the less is its random error and higher is the precision of decision making, but on the other hand, the requirements to identity of conditions of two measurements are stricter.

Measurement of the background is carried out in the absence of the object of research. The value is stored by the Indicator in non-volatile memory and can be used in examination of multiple objects. Replacing the old value of the background with the new one is only possible if random error specified in settings (see par. 3.22.1) for the new value is reached. If the error is not specified in the settings, the value ±20% is used.

During examination of the object the Indicator shall be located as close to the surface of the object as possible without touching it. During measurement the Indicator roughly estimates the presence of radiation by comparing the current value of the dose rate with the background value. Upon completion of the measurement a more accurate check is carried out, with confidence level 0.95 (false alarm in 5 cases out of 100 is allowed), and final conclusion about the presence or absence of radioactive contamination of the object is issued.

In the work area of the screen the current value, the random error and the selected units of measurement are displayed.

Using "Δ" (up) button background measurement mode is selected, using "∇" (down) button cumulative impact measuring mode is selected. There are prompts: "Background" and "Object" in the message bar.

Selected measurement is started by "▷" (right) button, "Measuring..." message is displayed. Till the end of the measurement "Δ" (up), "∇" (down), "▷" (right) and "Menu" buttons are blocked. When any of them is pressed, message "Measuring..." disappears, and reappears a little after.

During measurement by predetermined thresholds (see par. 3.22.4) the level of alarm is monitored. The current level is displayed in the message bar (see par. 2.8.5).

The measurement can be completed either by using "Power" button (short pressing), or automatically, if specified random error (see par. 3.22.1) is achieved, and duration of the current measurement is less than the duration specified in the settings (see par. 3.22.3). Rules of indication of the result are described in par. 2.8.5.

In DETECTION mode the following buttons can also be used:

- long (up to 3 seconds) pressing the button "Power" switches off the Indicator;
- short pressing of "◁" (left) button turns on/off the sound (similar to par. 3.11);
- short pressing of "Menu" button calls the main menu

6 PACKAGE

The package ensures safety of the device during transportation and storage under normal weather conditions.

7 MAINTENANCE

7.1 Safety measures

7.1.1 Getting familiarized with the operations manual

Prior to commencement of works with the product, carefully read this operations manual.

7.1.2 Opening the Product

NEVER open the Product or make repairs because there is high voltage (about 400 V) inside it. For repairs, send the Product to the Manufacturer.

7.2 Maintenance procedure

Maintenance of the Product is carried out to ensure its efficiency during operation, and is performed by persons working with the Product; safety measures of par. 6.1 shall be observed.

Preventive maintenance works are performed during maintenance, they include check of completeness and inspection of external condition of the Product, removal of dust from the

outer surface of the Product, timely replacement or recharging of batteries and check of its performance.

7.2.1 Completeness check

Completeness check is carried out based on the list in the data sheet.

7.2.2 Inspection of external condition

When inspecting external conditions of the product, make sure there are no chips and cracks on the body of the product, and inscriptions of buttons are legible.

7.2.3 Dedusting

When removing dust wipe the display using a soft cloth only.

7.2.4 Intervals in service

If there will be an interval in operation of the product for more than 2 weeks, the batteries must be removed.

7.2.5 Check of serviceability

The workability of the product is checked in normal conditions by estimating the dose rate of the natural radiation background in the GAMMA mode. The duration of each measurement should be at least 5 minutes. The check is carried out for two ways of power supply of the device:

- from the batteries;
- from the external power, applied to the USB connector.

If the value of the dose rate measured in normal conditions is in the range from 0.07 to 0.30 µSv/h, the product is suitable for use. Otherwise, the product is subject to additional verification or repair.

8 TRANSPORTATION AND STORAGE

Transportation of the Product can be carried out by any mode of transport to any distance.

During transportation, the Product shall be protected from precipitation.

Conditions of transportation of the Product shall conform to the requirements:

- Ambient temperature from –40 to +60°C;
- Relative humidity at +25°C not more than 90%.

Before putting into operation the product shall be stored in a warehouse in the factory packing at ambient temperature from –5 to +40°C and relative humidity of less than 80% at +25°C. The product shall not be stored unpacked!

The product which was stored at a temperature below 0°C for a long time, shall be kept at room temperature for 2 hours before it is put into operation.

9 DISPOSAL

Special requirements to disposal of this product are not represented.

10 INFORMATION ABOUT THE DEVELOPERS

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