

**X-RAY AND GAMMA RADIATION PERSONAL DOSIMETER  
PM1621**

**OPERATING MANUAL**



EU/UE

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ДЕКЛАРАЦИЯ СООТВЕТСТВИЯ No 3

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### **X-Ray and Gamma Radiation Personal Dosimeter PM1621**

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Minsk, February, 2002



**A. A. Antonovski**  
Managing Director

## CONTENTS

	Page
<b>1. DESCRIPTION AND OPERATION OF THE DOSIMETER .....</b>	<b>5</b>
1.1. Application of the dosimeter .....	5
1.2. Delivery kit .....	6
1.3. Specifications .....	7
1.4. Design and theory of operation .....	12
<b>2. USE OF THE DOSIMETER.....</b>	<b>15</b>
2.1. General guidelines.....	15
2.2. Safety instructions .....	15
2.3. Preparation for use .....	15
2.4. Use of the dosimeter .....	15
<b>3. MAINTENANCE.....</b>	<b>22</b>
<b>4. TROUBLESHOOTING.....</b>	<b>23</b>
<b>5. STORAGE AND SHIPPING.....</b>	<b>24</b>
<b>6. WARRANTY.....</b>	<b>25</b>
 <b>ATTACHMENT A OVERALL DIMENSIONS.</b>	
<b>EFFECTIVE CENTER OF THE DETECTOR.....</b>	<b>26</b>
<b>ATTACHMENT B DIAGRAM OF DOSIMETER ROTATION</b>	
<b>TO MEASURE ANGULAR RESPONSE.....</b>	<b>27</b>

This Operating Manual combined with the logbook and passport is intended to describe the design, operation and use of the X-ray and gamma radiation personal dosimeter PM1621 (PM1621A) (hereinafter referred to as the device or dosimeter). The Operating Manual includes the general description, specifications of the dosimeter, as well as some other information necessary for the proper operation of the dosimeter and a full realization of its possibilities.

During manufacturing of the dosimeter some changes may be introduced in its electrical scheme and construction that do not influence the specifications and metrological parameters and, therefore, may be not specified in this manual.

# 1 DESCRIPTION AND OPERATION OF THE DOSIMETER

## 1.1 Application of the dosimeter

The PM1621 (PM1621A) X-ray and gamma radiation dosimeter is designed to provide:

- continuous measurement of the personal dose equivalent (hereinafter referred to as dose equivalent or DE) of external gamma and X-ray (hereinafter photon) radiation  $H_p(10)$ ;
- continuous measurement of the time of the DE accumulation;
- continuous measurement of the personal dose equivalent rate of external photon radiation  $\dot{H}_p(10)$  (hereinafter dose equivalent rate or DER);
- communications of information accumulated and stored in a non-volatile memory through infra-red (IR) communication channel (the protocol is compatible with IrDA interface) into the personal computer (PC) using the internal or external IR adapter.

The dosimeters may be used independently or as a part of a system for everyday, efficient and emergency dosimetric control of the personnel and people at sites, production facilities and units, where there is a potential or real risk of exposure to external X-ray and gamma radiation by officers of customs and border services, personnel of nuclear facilities, radiological and isotope laboratories, officers of the emergency services, civil defense, fire brigades, police, as well as in other spheres of use where there is a necessity in measurement of the personal dose equivalent and personal dose equivalent rate, alarming of the exceeding of the preset dose and dose rate levels, information about the dose accumulation and conduct of the dose rate in time, as well as association of the measured parameters with an individual, systematization and complex analysis of the accumulated dosimetric information.

Operating conditions:

- ambient air temperature from minus 40 up to plus 60° C;
- relative humidity up to 98 % at the temperature 35° C;
- pressure from 84 up to 106,7 kPa.

The dosimeters are manufactured in two modifications:

- the PM1621 X-ray and gamma radiation personal dosimeter;
- the PM1621A X-ray and gamma radiation dosimeter, differs from the PM1621 dosimeter by an extended range of DER measurement.

## 1.2 Delivery kit

1.2.1 Delivery kit of the dosimeter corresponds to the table 1.1.

Table 1.1

Item	Type	Quantity, pcs.
X-ray and gamma radiation dosimeter PM1621 (PM1621A)	412118.027	1
Infrared communication kit <sup>1; 6)</sup>	426434.009-01	1
Battery <sup>2; 5)</sup> or Battery <sup>3 5)</sup>	PANASONIC POWER LINE LR6 AA Energizer L91BP-2 AA	1 1
Disk	305555.007	1
Operating manual <sup>4)</sup>	412118.027-01 PЭ	1
Package <sup>5)</sup>	305641.027	1
Cover <sup>1)</sup>	735231.041	1
<sup>1)</sup> Available as an option. <sup>2)</sup> Used within the temperature range of minus 20 – plus 60 °C. Usage of other batteries with similar parameters is allowed. <sup>3)</sup> Used within the temperature range of minus 40 – plus 60 °C. Usage of other batteries with similar parameters is allowed. <sup>4)</sup> Methods of calibration are included. <sup>5)</sup> On agreement with a buyer. <sup>6)</sup> Usage of other IR adapters with similar parameters is allowed.		

### 1.3 Specifications

<b>1</b> Operating mode:	<ul style="list-style-type: none"> <li>- indication of photon radiation DER;</li> <li>- indication of photon radiation DE;</li> <li>- indication of the dosimeter's number ("blind dosimeter");</li> <li>- PC data exchange;</li> <li>- set mode;</li> <li>- indication of partial and critical battery discharge;</li> <li>- audible alarming at exceeding of the preset DE or DER thresholds</li> </ul>
<b>2</b> DER measurement range	
- for the PM1621 modification	0.1 $\mu$ Sv/h - 100 mSv/h
- for the PM1621A modification	0.1 $\mu$ Sv/h – 1.00 Sv/h
DER indication range:	
- for the PM1621 modification	0.01 $\mu$ Sv/h - 200 mSv/h
- for the PM1621A modification	0.01 $\mu$ Sv/h – 2.00 Sv/h
- DER indication sub-range	0.01 – 9.99 $\mu$ Sv/h; 10.0 – 99.9 $\mu$ Sv/h; 100 - 999 $\mu$ Sv/h; 1.00 – 9.99 mSv/h; 10.0 – 99.9 mSv/h; 100 - 200 mSv/h; 100 - 999 mSv/h (PM1621A); 1.00 – 2.00 Sv/h (PM1621A)
- DER analogue scale (seven segments) in a logarithmic gauge	Number of indicated segments (from left to right) corresponds to the following DER threshold values on the LCD display: <ul style="list-style-type: none"> <li>- one segment - <math>\geq 0.1 \mu</math>Sv/h;</li> <li>- two segments - <math>\geq 1 \mu</math>Sv/h;</li> <li>- three segments - <math>\geq 10 \mu</math>Sv/h;</li> <li>- four segments - <math>\geq 100 \mu</math>Sv/h;</li> <li>- five segments - <math>\geq 1</math> mSv/h;</li> <li>- six segments - <math>\geq 10</math> mSv/h;</li> <li>- seven segments - <math>\geq 100</math> mSv/h</li> </ul>
<b>3</b> Maximum permissible intrinsic relative error of DER measurement	$\pm(15 + K_1/\sqrt{D} + K_2 \sqrt{D}) \%$ , where $\sqrt{D}$ - DER value, mSv/h; $K_1$ – coefficient 0.0015 (mSv/h); $K_2$ – coefficient $0.01 (\text{mSv/h})^{-1}$
<b>4</b> DE measurement range	1.0 $\mu$ Sv - 9.99 Sv
Maximum permissible intrinsic relative error of DE measurement	$\pm 15 \%$
<b>5</b> DE indication range	0.01 $\mu$ Sv – 9.99 Sv
Indication sub-ranges:	0.01 – 9.99 $\mu$ Sv; 10.0 – 99.9 $\mu$ Sv; 100 – 999 $\mu$ Sv; 1.00 – 9.99 mSv; 10.0 – 99.9 mSv; 100 - 999 mSv; 1.0 Sv – 9.99 Sv

<b>6</b>	Discreteness of DE accumulation time indication	1 h
<b>7</b>	The dosimeter provides inputting, storage in a non-volatile memory and continuous control of two threshold DER and DE levels within the whole measurement range, various audible alarms at exceeding of the preset first and second threshold levels. Discreteness of threshold level setting	Unit of lower-order indicated position
<b>8</b>	Registered energy range Energy response relative to 0.662 MeV ( $^{137}\text{Cs}$ ), no more than	0.01 – 20 MeV  $\pm 30 \%$

**9** Anisotropy of the device for each energy does not exceed values (in %) presented in Table 1.1, when the device is rotated in the horizontal plane (Attachment B, figure B.1) and values (in %) presented in Table 1.2, when the device is rotated in the vertical plane (Attachment B, figure B.2).

Table 1.1

Angle of detection relative to the direction of graduation, °	Energy of gamma radiation, MeV		
	Anisotropy		
	0.059	0.662	1.25
0	0	0	0
15	$\pm 5$	$\pm 5$	$\pm 5$
30	$\pm 10$	$\pm 10$	$\pm 10$
45	$\pm 20$	$\pm 15$	$\pm 15$
60	$\pm 40$	$\pm 20$	$\pm 20$
-15	$\pm 5$	$\pm 5$	$\pm 5$
-30	$\pm 10$	$\pm 10$	$\pm 10$
-45	$\pm 20$	$\pm 15$	$\pm 15$
-60	$\pm 40$	$\pm 20$	$\pm 20$

Table 1.2

Angle of detection relative to the direction of graduation, °	Energy of gamma radiation, MeV		
	Anisotropy		
	0.059	0.662	1.25
0	0	0	0
15	$\pm 5$	$\pm 5$	$\pm 5$
30	$\pm 10$	$\pm 10$	$\pm 10$
45	$\pm 20$	$\pm 15$	$\pm 15$
60	$\pm 40$	$\pm 20$	$\pm 20$
-15	$\pm 5$	$\pm 5$	$\pm 5$
-30	$\pm 10$	$\pm 10$	$\pm 10$
-45	$\pm 20$	$\pm 15$	$\pm 15$
-60	$\pm 40$	$\pm 20$	$\pm 20$

<b>10</b>	Coefficient of variation (deviation of the dosimeter's readings caused by statistic fluctuations) at DER measurement at a confidence coefficient 0,95, no more than	$\pm 15 \%$
<b>11</b>	Maximum permissible additional relative error of DER measurement: - at temperature variations from minus 40 to plus 60°C	$\pm 10 \%$



- at relative humidity of ambient air 98 % at 35 °C		±10 %
- at power voltage variations from nominal value to limiting voltage values		± 10 %
- on exposure to magnetic field of 400 A/m strength		± 5 %
- on exposure to radio frequency electromagnetic fields of 10 V/m strength		± 5 %
<hr/>		
<b>12</b>	LCD backlight at pressing LIGHT/SET button	3-5 s
<hr/>		
<b>13</b>	Instability of readings during 24 hour continuous work, no more than	± 5 %
<hr/>		
<b>14</b>	Response time when DER value is increased more than 10 times, from initial low DER value to finite fixed high DER value exceeding 10 µSv/h, no more than	5 s
<hr/>		
<b>15</b>	Response time when DER value is decreased more than 10 times, from initial high to finite fixed low DER value exceeding 10 µSv/h, no more than	10 s
<hr/>		
<b>16</b>	PC communication	- by a special program using IR communication channel adapter
<hr/>		
<b>17</b>	In the mode of data transmission to PC the dosimeter provides the following functions:	1) permission or prohibition of the following operating modes (parameters) of the dosimeter: <ul style="list-style-type: none"> <li>- DER indication;</li> <li>- indication of DER coefficient of variation;</li> <li>- indication of DER averaging time;</li> <li>- DE indication;</li> <li>- indication of DE accumulation time;</li> <li>- indication of time remaining for stay at the working place depending on the current measured DER and DE values;</li> <li>- indication of the dosimeter's number;</li> <li>- audible alarm;</li> <li>- preset of the DE and DER threshold levels using the buttons;</li> <li>- DE reset using the buttons.</li> </ul>

- 2) read-out of the following information from the dosimeter to PC:
- dosimeter's parameters;
  - DER history and DE accumulation (date, time, event, value);
  - DE (DER) values at the moment of exceeding the preset thresholds as well as time, date and month of exceeding the preset thresholds;
  - values of the preset DE and DER thresholds;
  - official information
- 3) recording of the following information from PC to dosimeter:
- dosimeter's parameters;
  - values of DE and DER thresholds;
  - interval of DER history and DE accumulation recording;
  - current time and date for forming DE accumulation history;
  - official information

<b>18</b>	Power supply	1.5 (+ 0.1; minus 0.4) V (one AA type battery)
<b>19</b>	Period of continuous operation of the dosimeter from one battery, using LCD backlight not more than 5 s/day, audible alarm – not more than 20 s/day and at an average value of the measured DER up to 0.3 $\mu\text{Sv/h}$ : - at a temperature from 0 up to 60°C - at a temperature minus 40, at least:	12 months 6 months
<b>20</b>	Protection degree of the dosimeter's case	IP67
<b>21</b>	The dosimeter is proof against the action of:	<ul style="list-style-type: none"> <li>- temperature of an ambient air from minus 20°C up to plus 60°C with indication of measurement results on LCD;</li> <li>- temperature of an ambient air from minus 40 up to minus 20°C without indication of measurement results on LCD but with recording of measurement results in a non-volatile memory;</li> <li>- relative humidity of an ambient air up to 98 % at 35°C;</li> <li>- atmosphere pressure from 84 up to 106,7 kPa</li> </ul>
<b>22</b>	The dosimeter is proof against:	<ul style="list-style-type: none"> <li>- sinusoidal vibration in the frequency range 10 – 55 Hz and bias amplitude for frequencies lower than the transition frequency 0.35 mm;</li> <li>- shocks with acceleration 100 <math>\text{m/s}^2</math>, duration of shock pulse 2-50 ms, shock rate is 60 - 180 shocks per minute</li> </ul>

<b>23</b>	The dosimeter meets drop test against a concrete surface from the height	0,7 m
<b>24</b>	The dosimeter is proof against the action of static and variable magnetic fields of strength	up to 400 A/m
<b>25</b>	The dosimeter is proof against the action of radio frequency electromagnetic fields in the frequency range 26 – 1000 MHz of strength	up to 10 V/m (rigidity degree 3 according to STB GOST 51317.4.3-95)
<b>26</b>	The dosimeter in a transport package is proof against the action of:	<ul style="list-style-type: none"> <li>- temperature from minus 50 up to plus 50<sup>0</sup>C;</li> <li>- humidity up to 100 % at 40<sup>0</sup>C;</li> <li>- shocks with acceleration 98 m/s<sup>2</sup>, duration 16 ms;</li> <li>- vibrations with frequency 10-55 Hz and bias amplitude 0.35 mm.</li> </ul>
<b>27</b>	Weight	not more than 0.15 kg
	Weight in package	not more than 0.3 kg
<b>28</b>	Overall dimensions	not more than, 87x72x35 mm
<b>29</b>	Reliability parameters:	
	- average full operating time	no less than 20000 h;
	- average service life	no less than 10 years
	- average time of recovery	no more than 60 min

Note – For addition information about dosimeter, please visit **[www.polimaster.com](http://www.polimaster.com)**.

## 1.4 Design and theory of operation

1.4.1. The dosimeter comprises the following main blocks and modules:

- radiation detector;
- microprocessor;
- LCD;
- secondary power supply;
- IR-transceiver;
- non-volatile memory.

The block diagram of the dosimeter is shown in Figure 1.1.

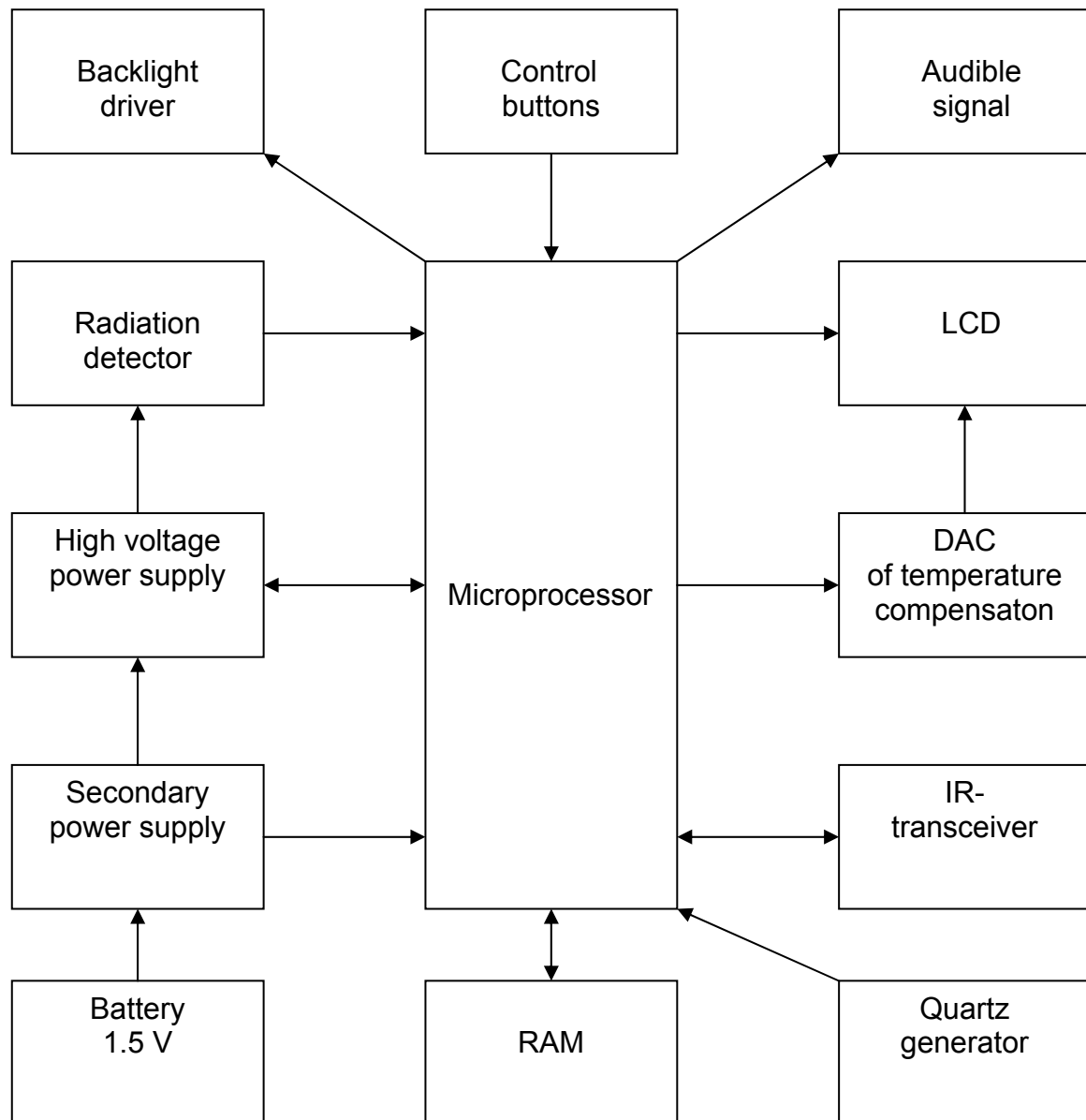


Figure 1.1 – Block diagram of the dosimeter

A Geiger-Muller tube with a filter for spatial-energy formation of sensitivity, which converts photon radiation quanta to electric pulses, is used as a radiation detector. The detector has a high-voltage power supply.

The microprocessor controls the dosimeter's operating modes, backlight device, audible alarm device, infrared communication channel, LCD, non-volatile memory, high-voltage power supply of the detector, operates the control buttons, performs all the necessary calculations, self-diagnostics.

The dosimeter's operating algorithm ensures continuity of the measurement process, statistical processing of the measurement results, a prompt adaptation to the variation of level of the photon radiation dose rate (setting the time of measurement in inverse dependence on the dose rate) and effective output of the information obtained to the LCD. The IR-communication channel provides an exchange of information with PC.

The dosimeter has an internal non-volatile memory that allows the information accumulation and storage.

Secondary power supply provides transformation of the battery's voltage 1.5. V into a stable voltage 3 V necessary for the dosimeter's power supply.

1.4.2 The device is designed as a unit housed in a plastic shock-proof case. General overview of the dosimeter and its parts are shown in Figure 1.2. Indication elements, positions **1-4**, are on the LCD (**8**).

- 1** – DER analog scale (seven segments) for effective control over radiation situation;
- 2** – DER digital panel in DER indication mode, DE in DE indication mode, year of production in the dosimeter's number indication mode, indication of IR communication channel switch on/off in the PC communication mode.
- 3** – digital panel of the coefficient's of variation indication in percents in DER indication mode, DE accumulation time's indication in thousands of hours (h) in DE indication mode, month's of production indication in the dosimeter's number indication mode;
- 4** – digital panel of indication of time of averaging DER values (in seconds) in DER indication mode, of DE accumulation time in DE indication mode;
- 5** – the **LIGHT/SET** button (the light/setting) (for switching on LCD backlight, switching on PC communication mode, entering the set mode and exiting it (see item 2.1.6).
- 6** – the **MODE** button for selecting the dosimeter's indication mode (DER, DE, the dosimeter's number, PC communication);
- 7** – audible alarm outlet;
- 8** – LCD;
- 9** – IR-transceiver window;
- 10** – detector;
- 11** – screw-cover of battery compartment.

A direction of calibration and the detector effective center relative to which the factory calibration is performed are placed at a 15 mm distance from the dosimeter detector's surface (Appendix B).

The total surface density of the walls surrounding the detector is 1 g/cm<sup>2</sup> that provides the detector shielding from the background beta radiation.

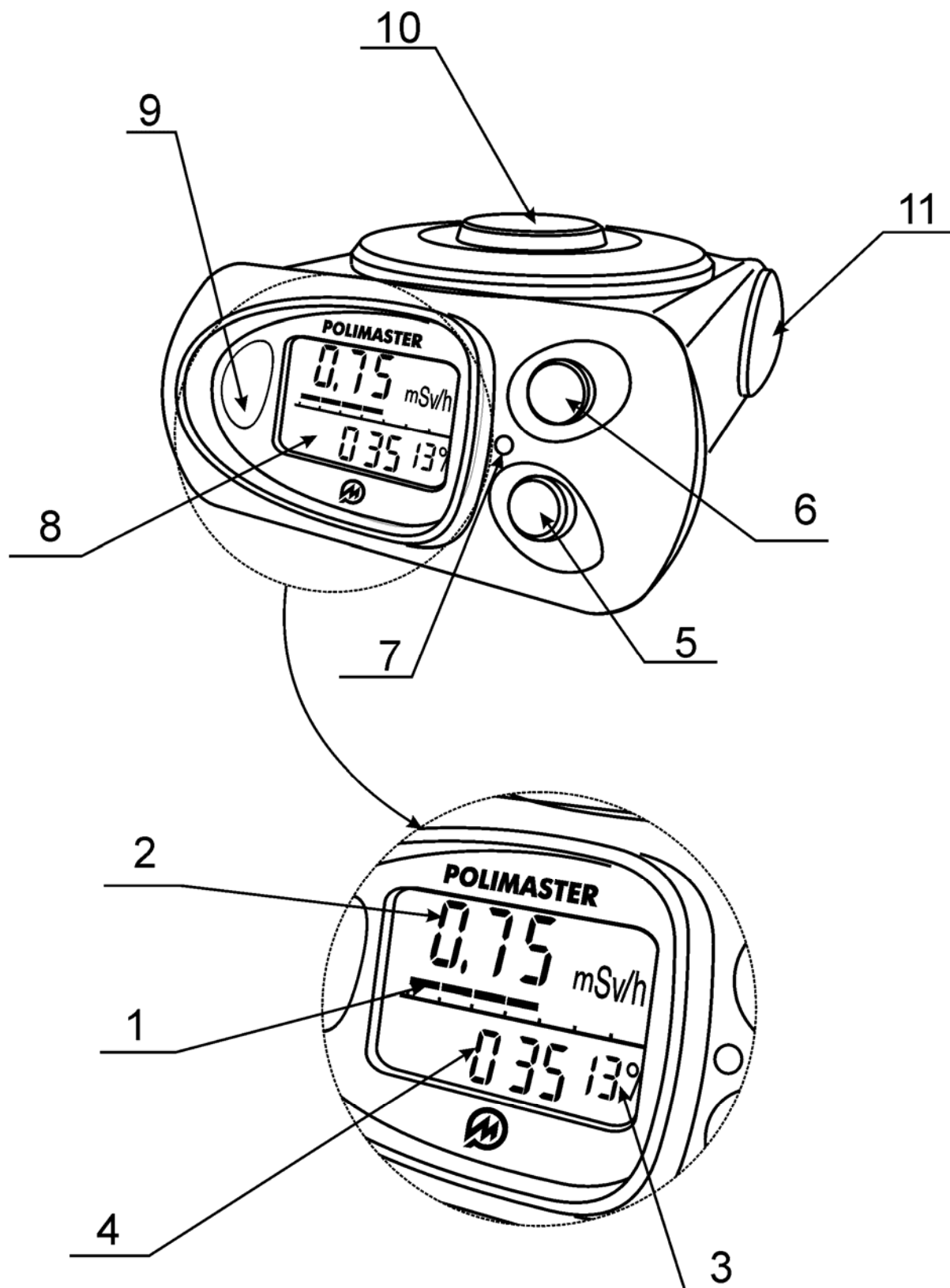


Figure 1.2 – General overview of the dosimeter

## 2 USE OF THE DOSIMETER

### 2.1 General guidelines

When purchasing the device it is necessary to check the delivery kit and the proper operation of the device in all the operation modes according to the items 2.4.3 - 2.4.5.

Protect the device from shocks and mechanical damages. Avoid exposing the device to hostile environments, organic solvents and open fire.

### 2.2 Safety instructions

During the device adjustment, checking, repair, maintenance and verification, if the radioactive sources are used, the regulations for work with radioactive materials and other radiation sources, as well as Standards of radiation safety should be followed.

### 2.3 Preparation for use

2.3.1 It is necessary to study all sections of the present operating manual before using the device.

2.3.2 Unpack the dosimeter.

2.3.3 Switching on:

- unscrew the battery compartment's cover using the screwdriver;
- insert the battery, observing the polarity (battery's electrode marked with "+" should be directed inside the dosimeter);
- fix the battery compartment's cover in its place.

Right after inserting the battery the dosimeter performs LCD testing (all the segments and graphic symbols should be displayed for about 2 s and then disappear), then the dosimeter should enter the measurement mode. One minute after inserting the battery the dosimeter is ready for use.

2.3.4 Place and fix the dosimeter, detector outwards, on a breast pocket of overalls or inside it.

***Attention! If the device is expected to be used under conditions when the dose rate value is higher than 0.1 mSv/h, it is recommended to insert a new battery.***

### 2.4 Use of the dosimeter

2.4.1 The dosimeter operates in the following modes:

- **photon radiation DER indication mode;**
- **photon radiation DE indication mode;**
- **dosimeter's number indication mode ("blind dosimeter");**
- **mode of data transmission to PC;**
- **set mode;**
- **partial or critical battery discharge indication mode;**
- **audible alarm mode at the exceeding of the preset DE or DER thresholds.**

The dosimeter's non-volatile memory ensures storage of the following values when replacing the battery for the moment of the battery's removal:

- accumulated dose (DE);
- DE accumulation time;
- DE and DER accumulation history;
- the preset DER and DE thresholds.

When using the dosimeter in a temperature range from -40°C up to -20°C the device provides performance of the dosimetric functions without displaying the result of

measurement on LCD. When returning the dosimeter into conditions with a temperature higher than –20 °C LCD operates in a normal way.

The dosimeter performs continuous DER and DE measurement, DE accumulation time counting in all modes, excluding an active mode of data transmission to PC (Ir/on).

Standard configuration of the dosimeter when shipping ensures indication of the following parameters and functions performed:

**DER indication mode – On**

On a display (2), figure 1.2 – DER values output

On a display (3) – output of the coefficient's of variation values - Off

On a display (4) – output of DER values averaging - Off

Thresholds setting enable: - Off

Audible alarm: - Off

**DE indication mode – On**

On a display (2), figure 1.2 – DE values output

On a display (3) – output of DE accumulation time values in thousands hours (symbol “h” is indicated at DE accumulation time less than a thousand hours).

On a display (4) – output of DE accumulation time values in hours - On

On a display (4) – output of the values of time remaining for staying at the working place - Off

Thresholds setting enable	On
DE reset	On
Audible alarm	On

**Dosimeter's number indication mode – On**

On a display (2), figure 1.2 – dosimeter's number;

On a display (3) - month of the dosimeter's production;

On a display (4) - year of the dosimeter's production;

Audible alarm - On

## **2.4.2 Selection of an indicated parameter**

**Modes of DER, DE, dosimeter's number and data transmission to PC indication are switched on by a successive pressing of the MODE button (figure 2.1).**

The dosimeter allows switching on/off all the above-mentioned indication modes. Change of the configuration is performed in the mode of data transmission to PC.

## **2.4.3 DER indication mode**

In the DER mode (figure 2.1) the following values are indicated on the LCD:

- DER ( $\mu\text{Sv/h}$ ,  $\text{mSv/h}$ ,  $\text{Sv/h}$ );
- DER on the analogue scale in a logarithmic gauge (seven segments);
- coefficient of variation in percents;
- averaging time of DER values (Range of the averaging time indication is from 1 up to 2999 s. If the averaging time exceeds 2999 s, the symbols “- - -” are indicated on the LCD).

If the measured DER value is over the upper limit of the DER indication range (200  $\text{mSv/h}$  for the PM1621 and 2  $\text{Sv/h}$  for the PM1621A), the LCD will show the overload symbol “OL” and noncontinuous audible signal will sound.



In the DER mode the collected statistics of DER measurement can be reset and the process of measurement can be reactivated by simultaneous pressing of the **LIGHT+MODE** buttons.

#### 2.4.4 DE indication mode

In the DE mode (figure 2.1) the following values are indicated on the LCD:

- DE ( $\mu$ Sv, mSv, Sv);
- DE accumulation time.

DE and DE accumulation time reset is possible in the set mode by simultaneous pressing of the **LIGHT+MODE** buttons (figure 2.2).

In the mode of data transmission to PC it is possible to set an inhibit for DE reset using the buttons.

There are two method of measurement of the DE accumulated over a certain period of time.

**The first method** (recommended). In the beginning of measurement the DE should be reset using the keys or the PC and the program "System of date collection and processing for the PM1621 device". Then the dose displayed at the end of the period will be the dose accumulated over the period of measurement.

**The second method.** The dose value in the beginning of the period of measurement should be deducted from the DE value displayed at the end of the period.

In the DE mode the indication (figure 1.2 display (3) and (4)) of values of time remaining for staying at the working place depending on the current measured DER and DE values is possible. Calculation of time is performed relative to the second preset DE threshold (the function may be switched on at the DE indication mode configuration).

#### 2.4.5 Set mode

Auxiliary set mode (figures 2.2, 2.3) is meant for verification and (or) setting of the threshold DE (DER) values, DE and DE accumulation time reset.

***Attention! To enter the "set" mode press and hold for about 5 s the LIGHT/SET button and the parameter to be set will be flashing.***

To chose the parameter press and release the **LIGHT/SET** button.

To change the set parameter:

- rapidly – press and hold the **MODE** button;
- for exact setting – press and release the **MODE** button.

The dosimeter will exit the "set" mode by pressing and holding the **SET** button or automatically in approximately 90 s.

Inputting the DER (DE) threshold levels into the memory

This procedure can be performed in the DER (DE) measurement mode as well as in the mode of data transmission to PC. DER (DE) thresholds are inputted during DER (DE) indication on the LCD.

Enter the set mode by pressing and holding the **SET** button (figures 2.2, 2.3).

Input successively the first and then the second threshold levels.

Exit the set mode.

In the mode of data transmission to PC it is possible to set an inhibit for changing the threshold levels using the buttons.

In case of exceeding the value of the first (second) DER (DE) threshold the dosimeter turns correspondingly into the DER (DE) indication mode and noncontinuous (frequent noncontinuous) audible signal will sound.

When DER value decreases below the preset threshold, the audible signal will shut off. Press any button to silence the alarm sound. The audible signal will shut off automatically in approximately 60 s, the repeated audible signal will sound in approximately 4 min.

#### 2.4.6 The dosimeter's number indication mode

In the **dosimeter's number** indication mode the following items are indicated on the LCD:

- the dosimeter's number on a display (2);
- year (4) and month (3) of production.

#### 2.4.7 Mode of data transmission to PC

The dosimeter allows storing and transmitting to PC a history (hereinafter "history") of DE, DER accumulation, events of exceeding the preset DE and DER threshold values, event of DE reset through IR communication channel using the buttons.

Selection of the events to be stored in the history, frequency of these recordings is performed under a special program. History data are inaccessible without IR adapter (internal or external).

The dosimeter performs data transmission to PC under a special program "System of Data Collection and Processing for the PM1621/PM1603/PM1604 Devices" through the adapter of IR communication channel over the communications protocol compatible with IrDA interface. System requirements to a computer:

A PC not lower than Pentium 100; 32Mb RAM, monitor resolution 800 x 600, printer and unit for operation with IrDA protocol for the exchange of information with the devices are necessary for comfort program running.

The program runs under OS Windows 98/2000 control.

For using the dosimeter in the **mode of data transmission to PC** it is necessary to:

- read and follow the recommendations of the file Read\_me.doc on the CD supplied with IR adapter;
- read the help file Help\_PM1621.doc;
- connect the adapter of IR communication channel to a PC COM port (using the adapter built in a PC shall be permitted);
- install the unit of IrDA communication in the system and switch on the IR connection in the mode of searching external IR connection devices (for W 98);
- install the program "System of Data Collection and Processing for the PM1621/PM1603/PM1604 Devices" from the CD, (run the program \DISK1\SETUP.EXE);
- run the program PM16XX.EXE;
- read the help section of the program "System of Data Collection and Processing for the PM1621/PM1603/PM1604 Devices";
- orient the dosimeter and adapter of IR communication channel of the PC by placing the dosimeter at a distance of 10-20 cm from the adapter of IR channel;
- choose the mode of data transmission to PC using the MODE button (figure 2.1);
- press and release the LIGHT/SET button for PC link startup through IR channel;
- perform readout of the dosimeter's information, following the program's instructions.

#### 2.4.8 Partial or critical battery discharge indication mode

The dosimeter controls battery discharge once a 10 minutes.

In case of the battery **partial discharge** (approximately  $\leq 1.1$  V) the LCD will indicate the flashing symbol "bat". **The battery is to be replaced! (see 3.3).** In case of the battery **critical discharge** (approximately  $\leq 0.9$  V) the dosimeter will turn into the DE indication mode, the symbol "bat" will become solid, the dosimeter will stop the measurements, LCD backlight and audible alarm will become locked.

**The battery is to be replaced! (see 3.3).**

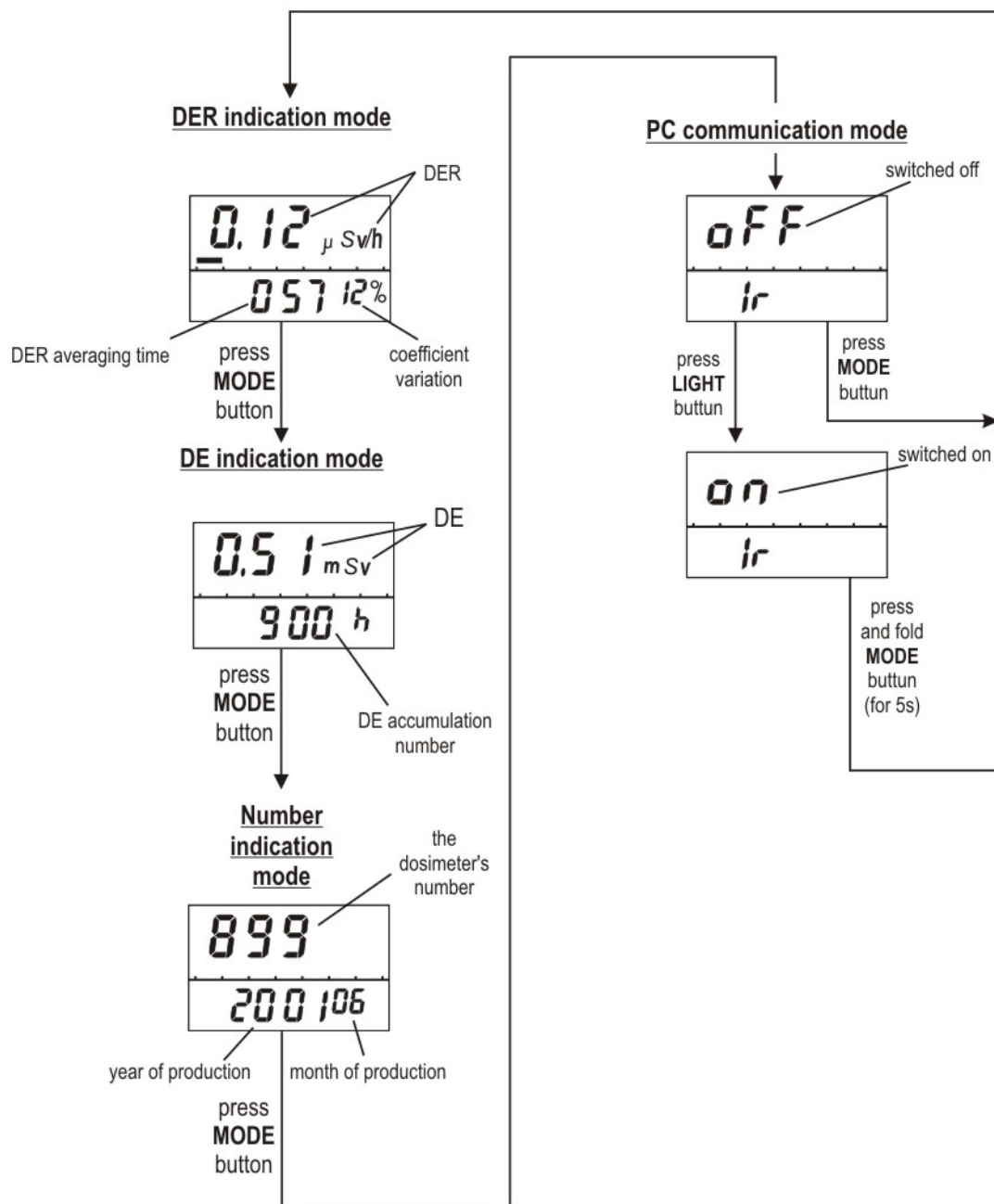


Figure 2.1 - Choice of operating mode (indication) of the dosimeter

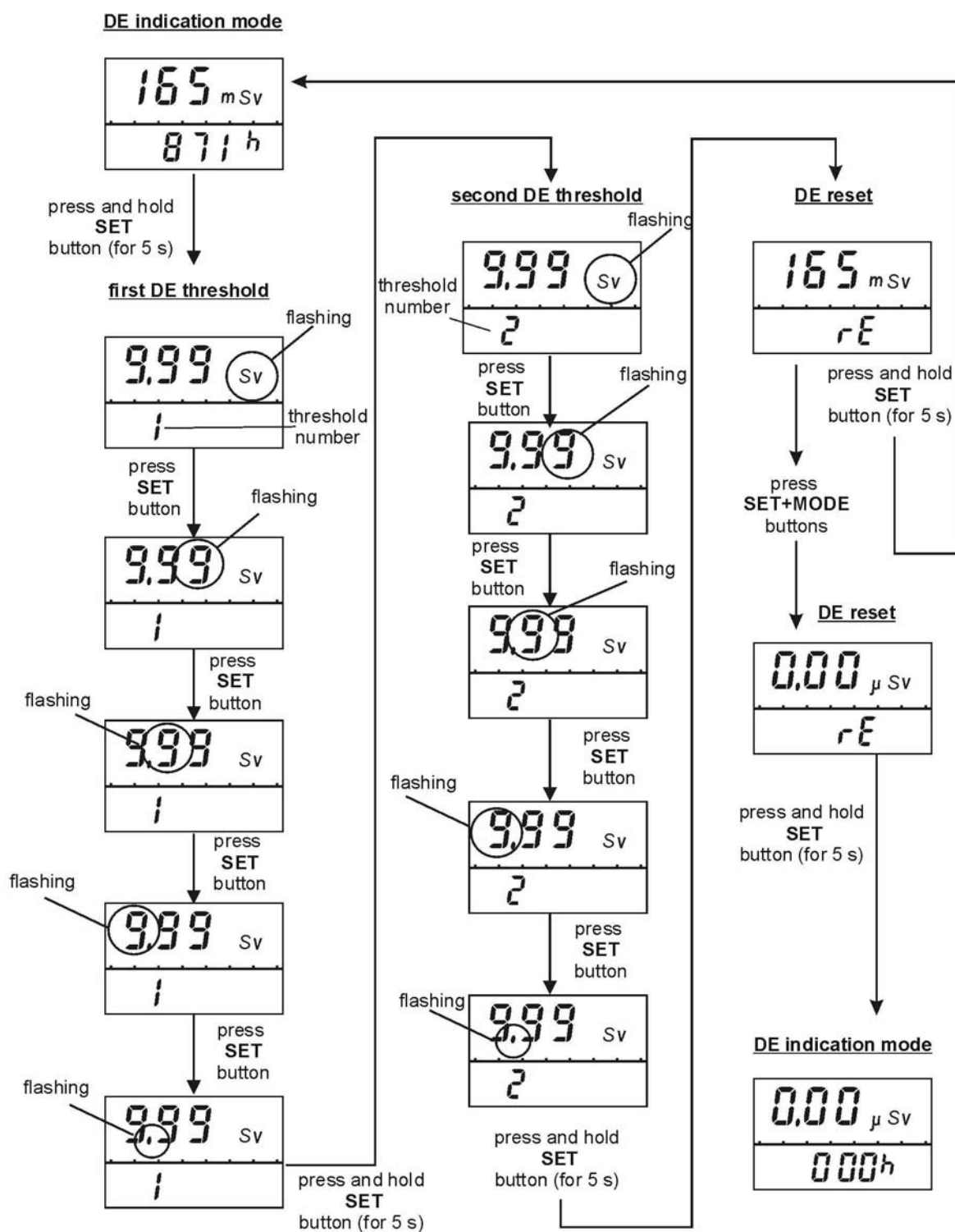


Figure 2.2 - Setting the DE threshold values

## DER indication mode

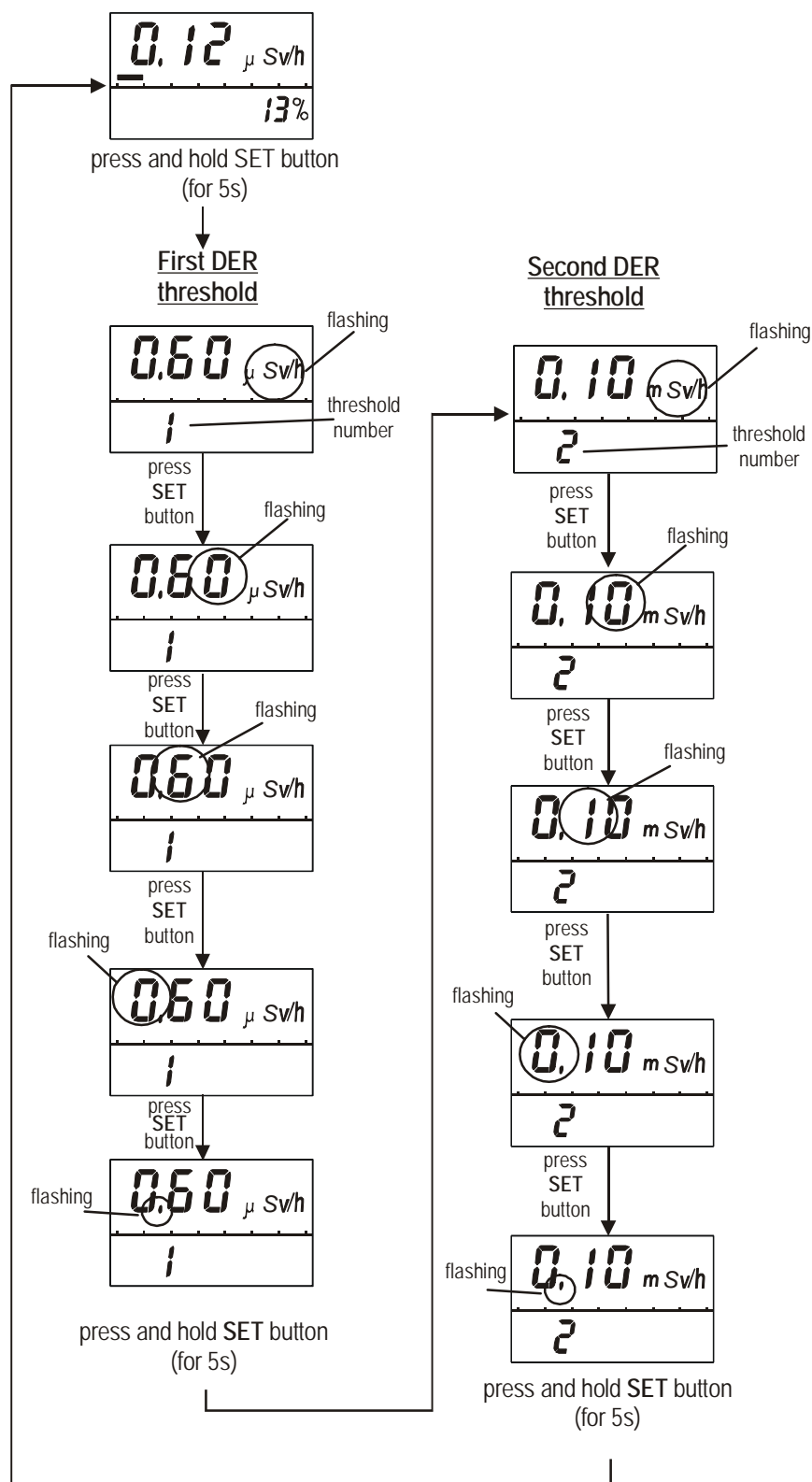


Figure 2.3 - Setting the DER threshold values

### 3 MAINTENANCE

3.1 Maintenance involves preventive services, battery replacement and regular performance check (according to 2.4.3 - 2.4.5).

3.2 Preventive services include external examination, dusting and decontamination in the event of radioactive contamination.

For decontamination wipe the case of the dosimeter using a cloth wetted with ethanol.

3.3 Battery replacement:

- unscrew and remove the cover of the battery compartment;
- remove the old battery;
- insert the new battery observing the polarity (the “+” sign of the battery should be inwardly directed);
- fix the cover of the battery compartment in its place.

After the battery is replaced, the LCD will display all segments, and then the dosimeter should enter the measurement mode. All the previous measurements and parameters necessary for proper operation of the dosimeter are stored in its non-volatile memory.

***NOTE: Insert a new battery before sending a dosimeter for calibration.***

## 4 TROUBLESHOOTING

The list of possible problems and their solutions are specified in the table 4.1.

Table 4.1

Problem	Possible cause	Solution
1. The LCD indicates “bAt” message	Battery discharge	Replace the battery
2. No indications on the LCD	Battery discharge Battery is inserted incorrectly	Replace the battery Insert the battery in the proper way
3. The device does not respond to pressing a button, the LCD indicates incorrect symbols	Microprocessor error condition	Remove the battery and insert it again in 5 minutes
4. The LCD indicates Er1-Er7	Dosimeter failure	Send the device for repair to the manufacturer's maintenance center
Note – If a defective battery is used the Er1 – Er7 message may appear.		
<b>Attention! When the Er1 – Er7 message appear, press any button. When the error message appears for the second time (approximately in 15 minutes) the dosimeter is not be used.</b>		

## **5 STORAGE AND SHIPPING**

5.1. Devices in package may be shipped by any kinds of closed transport at the air temperature from -50 °C to +50 °.

5.2. Devices in package should be arranged and fastened in the transport so that their stable position is ensured and shocks are avoided.

5.3. When carried by sea, devices in package should be placed in hermetic plastic bags with silicagel.

5.4. When carried by air, devices in package should be placed in hermetic compartments.

5.5. Devices should be stored in the manufacturer's package at the air temperature from -15 to +50 °C and air relative humidity up to 95% at a temperature of 35 °C.

5.6. Devices without package are to be stored at the air temperature from 10 °C to 35 °C and relative humidity up to 80 % at a temperature of 25 °C.

5.7. The storage place should be free of dust, vapors of strong chemicals, aggressive gases and other substances that may cause corrosion.



## **6 WARRANTY**

6.1. The manufacturer guaranties that the device meets the requirements of Technical Conditions provided that the customer will observe the guidelines of its use, shipping and storage described in this manual.

6.2. The warranty period of use is 18 months from the date of sale (placing the device in service).

6.3. The warranty period of storage is 6 month since the date of acceptance of the device by the officer of the Quality Control Department of the manufacturer.

6.4. Warranty and after-warranty repair is carried out by the manufacturer or the institutions that have a permission of the manufacturer.

6.5. Warranty does not cover the devices:

- without the operating manual;
- in case of their unauthorized opening;
- with mechanical damages;
- if the requirements of exploitation and storage were not satisfied;
- after expiration of the warranty period stated in item 7.2.

6.6. The warranty period of use is prolonged for a period of warranty repair.

6.7. Warranty does not cover the battery. The battery replacement is not considered as the warranty repair.

**ATTACHMENT A**  
(reference)

**OVERALL DIMENSIONS, EFFECTIVE CENTER OF THE DOSIMETER DETECTOR**

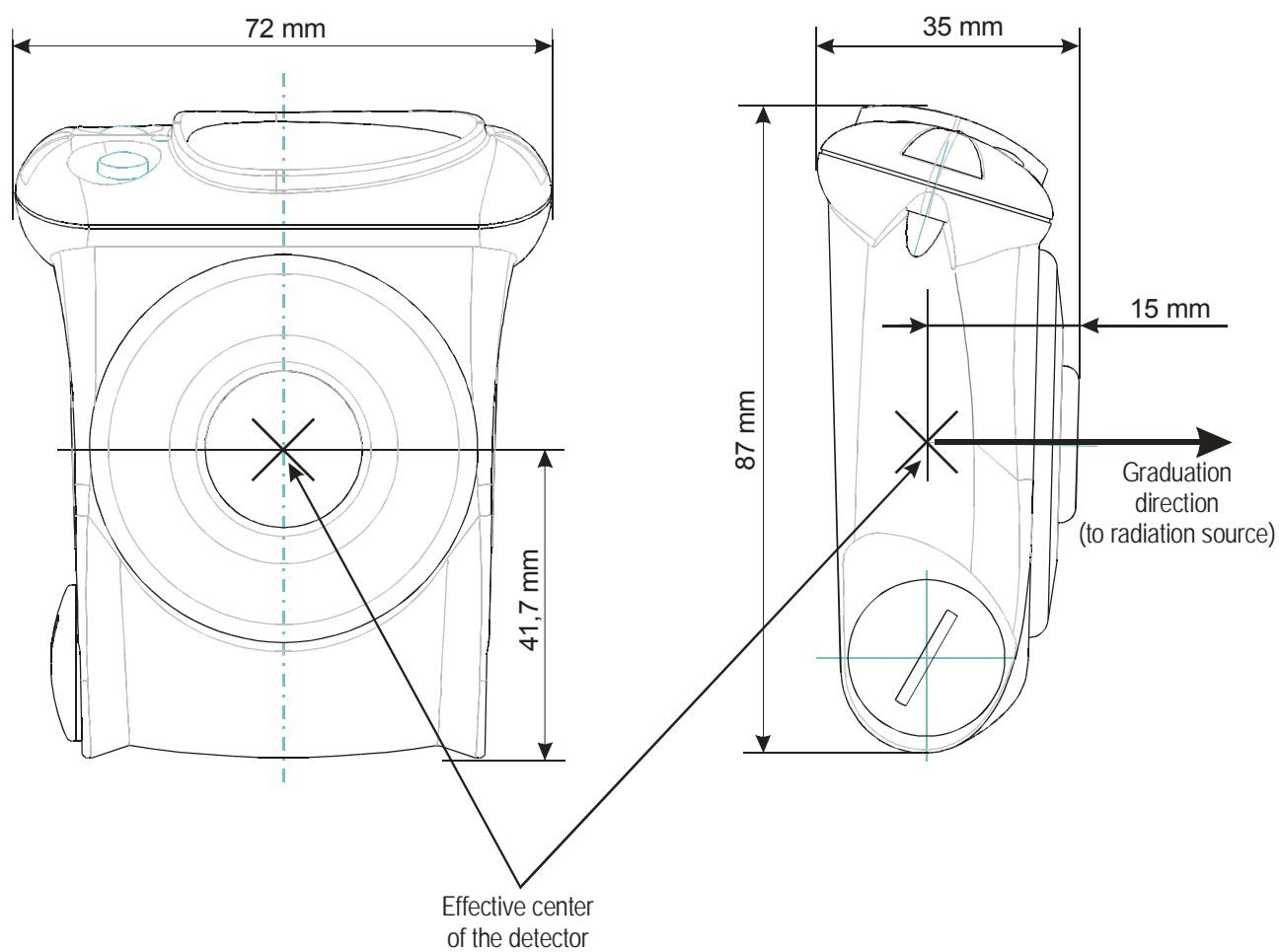


Figure A.1

**ATTACHMENT B**  
(reference)  
**DIAGRAM OF DOSIMETER ROTATION TO MEASURE ANGULAR  
RESPONSE**

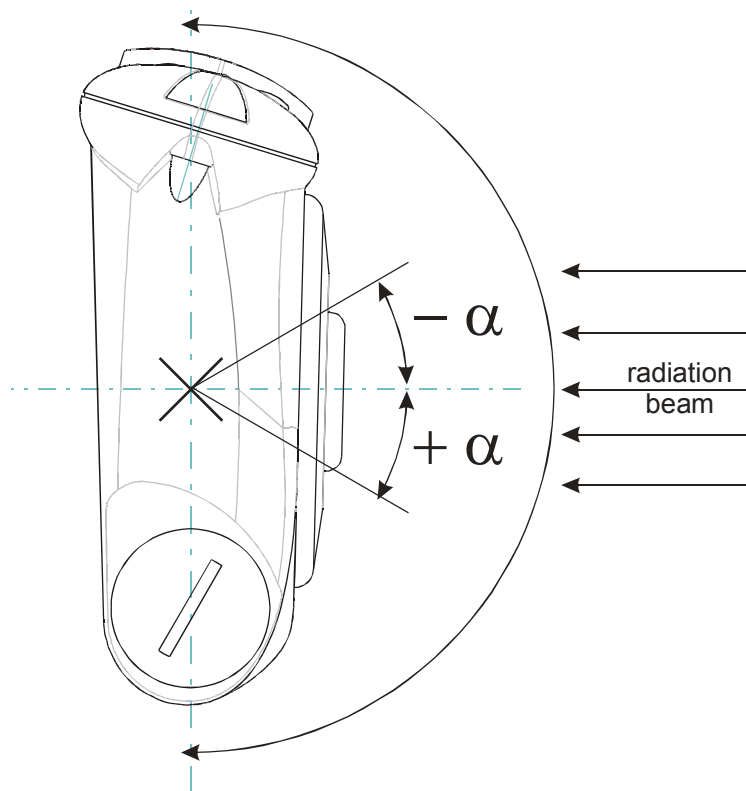


Figure B.1 –Diagram of dosimeter rotation in horizontal plane

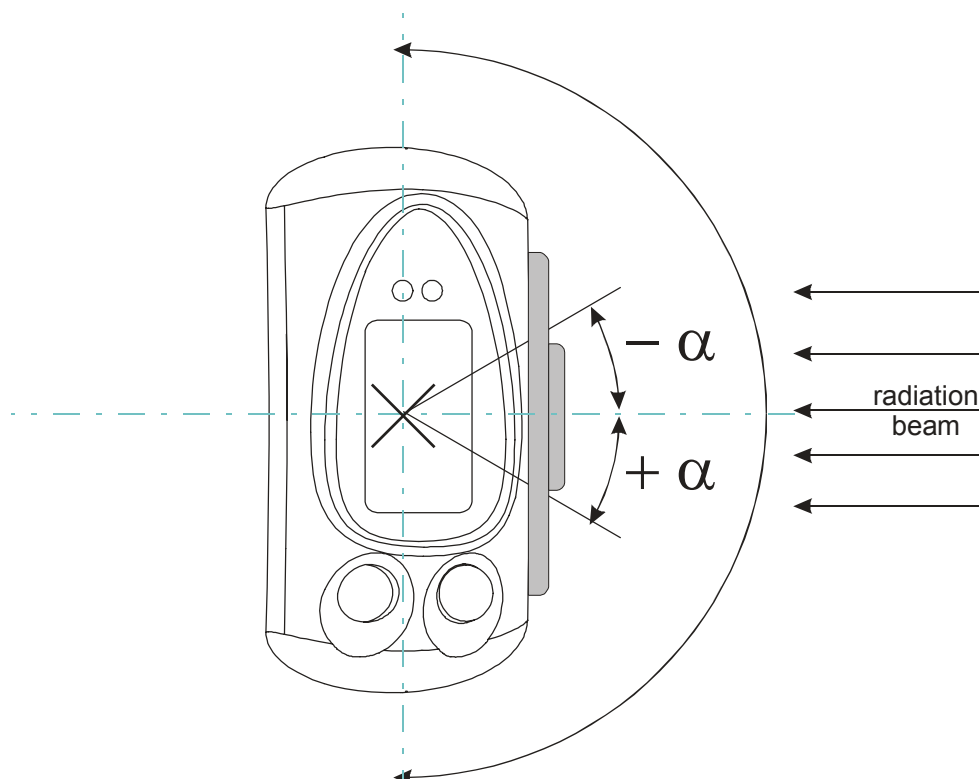


Figure B.2 –Diagram of dosimeter rotation in vertical plane