

## **PERSONAL RADIATION DETECTORS**

**PM 1703M-O**

**PM 1703GNO**

**PM 1703MA**

**PM 1703GNA**

**PM 1703MB**

**PM 1703GNB**

**PM 1703M-O1 v.10**

**PM 1703M-O1 v.12**

**Operation manual**

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**Thank you for purchasing a Polimaster Personal Radiation Detector.**

**Before operating this unit, please review this guide thoroughly and retain it for future reference.**

**! After the localizing of a radiation source observe the rules and regulations of working with radiation sources, and take all the necessary radiation precaution measures.**

## **1 GENERAL INFORMATION<sup>1)</sup>**

### **1.1 The personal radiation detector**

- **PM 1703M-O**
- **PM 1703MA**
- **PM 1703MB**
- **PM 1703GNO**
- **PM 1703GNA**
- **PM 1703GNB**
- **PM 1703M-O1 v.10**
- **PM 1703M-O1 v.12**

(hereinafter referred to as the indicator) is intended for searching (detection and localization) of radio active (and nuclear materials)<sup>2)</sup> by means of the analysis of the counting speed of impulses delivered from the detector outlet at registration of gamma (and neutron)<sup>2)</sup> radiation with indication on a LCD:

- the average counting speed of gamma radiation;
- the average counting speed of neutron radiation (in the devices having the detector of neutron radiation<sup>2)</sup>;
- power of the ambient equivalent of a dose of gamma radiations  $\dot{D}^*(10)$  along the line  $^{137}\text{Cs}$  in the collimated radiation or power of the ambient equivalent of a dose of gamma radiations  $\dot{D}^*(10)$  for PM1703M-O1 v.10, PM1703M-O1 v.12 (hereinafter referred to as "DER").

The indicator is not a meter.

The indicator can be operated both in premises and in the open air. The indicator can be used by a wide circle of consumers, who are by their mode of activities related to detection and localization of sources of the ionizing emissions.

The history of indicator operation is retained in the power-independent storage and can be transferred to a personal computer (PC) via the infra-red (IR) communication channel.

**Attention! PM 1703MB, PM 1703GNB operating with the power battery close to critical discharge with bluetooth turned on, automatic instrument restart may occur.**

**The reason for it being the bluetooth that considerably increases the instrument energy consumption. In this case, it is recommended to change the battery.**

**Also, it is advisable to change the battery in advance, if the instrument is planned to be operated with the bluetooth, sound and vibro alarm turned on in the areas with DER exceeding the natural radiation background.**

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<sup>1</sup> In the process of indicator manufacture amendments may be entered to the electric circuit, construction, external execution and software, which do not influence the technical and metrological specifications and, therefore, not reflected in the present manual.

<sup>2</sup> PM1703GNO, PM1703GNA, PM1703GNB

1.2 The indicator is manufactured in 7 modifications (see Table 1.1).

Table 1.1

Peculiar features of modifications								
Detector type	PM1703M-O	PM1703M-O1 v.10	PM1703M-O1 v.12	PM1703MA	PM1703MB	PM1703GNO	PM1703GNA	PM1703GNB
• $\gamma$ - CsI (Tl) scintillator 3 cm <sup>3</sup>	●	●	●			●		
• $\gamma$ - G-M counter		●	●					
• $n$ - LiI (Eu) scintillator 1 cm <sup>3</sup>						●		
CsI (Tl) scintillator 4 cm <sup>3</sup> Increased pulse sensitivity of $\gamma$ -detector				●	●		●	●
LiI (Eu) scintillator 2 cm <sup>3</sup> Increased pulse sensitivity of $n$ -detector							●	●
Information transmission to a Pocket PC (PPC) by a radio channel of Bluetooth type Possibility of identification of the radio nuclide composition of the substance with the aid of PPC					●			●

#### ATTENTION!

The indicators may differ by the totality of included (activated) operation modes.

Operation modes are switched on/off by the manufacturer according to the preliminary order of the customer (user) in accordance with the chart of modes.

Certain modes may be independently switched on/off by the customer (user) by using the software included to the set of indicator delivery.

Descriptions of all modes which are possible for devices of PM1703 series are shown in "Operation modes".

The chart of operation modes of your indicator is shown in Attachment A.

## 2 DELIVERY KIT

Delivery kit of the indicator corresponds to the table 2.1.

Table 2.1

Description, type	Quantity per model							
	PM 1703M-O	PM 1703M-O1 v.10	PM 1703M-O1 v.12	PM 1703MA	PM 1703MB	PM 1703GNO	PM 1703GNA	PM 1703GNB
Personal radiation detector <b>PM1703M-O</b>	1	-	-	-	-	-	-	-
Personal radiation detector <b>PM1703M-O1 v.10</b>	-	1	-	-	-	-	-	-
Personal radiation detector <b>PM1703M-O1 v.12</b>	-	-	1	-	-	-	-	-
Personal radiation detector <b>PM1703MA</b>	-	-	-	1	-	-	-	-
Personal radiation detector <b>PM1703MB</b>	-	-	-	-	1	-	-	-
Personal radiation detector <b>PM1703GNO</b>	-	-	-	-	-	1	-	-
Personal radiation detector <b>PM1703GNA</b>	-	-	-	-	-	-	1	-
Personal radiation detector <b>PM1703GNB</b>	-	-	-	-	-	-	-	1
Disk (software on CD)	1	1	1	1	1	1	1	1
Flash Card (software for radionuclide identification)	-	-	-	-	1	-	-	1
Panasonic POWER LINE AA (LR6) power supply cell	1	1	1	1	1	1	1	1
Holster <sup>1)</sup>	1	1	1	1	1	1	1	1
IR communication channel adapter (ACT-IR220L or IR210B) <sup>1) 2)</sup>	1	1	1	1	1	1	1	1
Pocket PC iPAQ series 69XX <sup>1),2)</sup>	-	-	-	-	1	-	-	1
Operation manual	1	1	1	1	1	1	1	1
Consumer's package	1	1	1	1	1	1	1	1
Transport package	1	1	1	1	1	1	1	1
<sup>1)</sup> Available as an option by special order;								
<sup>2)</sup> Use of other similar by parameters ones is allowed								

### 3 SPECIFICATIONS

3.1 Sensitivity of the indicator to gamma radiation, at least

PM 1703M-O		70 s <sup>-1</sup> /(μSv/h) (0.7 s <sup>-1</sup> /(μR/h))– for <sup>241</sup> Am; 100 s <sup>-1</sup> /(μSv/h) (1.0 s <sup>-1</sup> /(μR/h))– for <sup>137</sup> Cs
PM 1703M-O1 v.10 PM 1703M-O1 v.12 PM 1703GNO		
PM 1703MA PM 1703MB PM 1703GNA PM 1703GNB		100 s <sup>-1</sup> /(μSv/h) (1.0 s <sup>-1</sup> /(μR/h))– for <sup>241</sup> Am; 100 s <sup>-1</sup> /(μSv/h) (1.0 s <sup>-1</sup> /(μR/h))– for <sup>137</sup> Cs

3.2 Sensitivity of the indicator to neutron radiation, at least

PM 1703GNO		0.035 (counts·cm <sup>2</sup> )/neutron - for Pu- α -Be; 1.3 (counts·cm <sup>2</sup> )/neutron-for heat neutrons
PM 1703GNA PM 1703GNB		0.07 (counts·cm <sup>2</sup> )/neutron - for Pu- α -Be; 1.5 (counts·cm <sup>2</sup> )/neutron-for heat neutrons

3.3 Range of powers of gamma radiation registration

from 0.033 to 3.0 MeV

3.4 Range of powers of neutron radiation registration

PM 1703GNA  
PM 1703GNO  
PM 1703GNB

From heat to 14.0 MeV

3.5 Range of indication of DER of photon radiation

PM 1703M-O1 v.10		0.01 - 9999 μSv/h (1 μR/h – 1000 mR/h)
PM 1703M-O1 v.12		0.01 μSv/h - 13 Sv/h (1 μR/h – 1300 R/h)
PM 1703M-O PM 1703GNO PM 1703MA PM 1703MB PM 1703GNA PM 1703GNB		0.01 - 99.99 μSv/h (1 – 9999 μR/h)

3.6 Range of indication of the counting speed of impulses of photon radiation

PM 1703GNA PM 1703GNO PM 1703GNB	001 – 999 c <sup>-1</sup> (by request 0.01 – 999 s <sup>-1</sup> )
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3.7 Relative error of DER measurement, no more:

PM 1703M-O1 v.10

- in the range from 0,1 to 9999 μSv/h (10 μR/h–1000 mR/h)

± 30 %

PM 1703M-O1 v.12

- in the range from 0,1 μSv/h to 10 Sv/h

±(15 + K<sub>1</sub>·` + K<sub>2</sub> · `) %, where ` - DER value, mSv/h;  
K<sub>1</sub> – coefficient 0.0045 (mSv/h);  
K<sub>2</sub> – coefficient 0.015 (mSv/h)<sup>-1</sup>

PM 1703M-O  
PM 1703GNO  
PM 1703MA  
PM 1703MB  
PM 1703GNA  
PM 1703GNB

- in the range from 0,1 to 70 μSv /h (10 – 7000 μR/h)  
(by line <sup>137</sup>Cs in the collimated radiation)

± 30 %

3.8 Time of measurement	0,25 s
3.9 Frequency of false operations in the mode of registration of gamma-emissions with the radiation background 0,2 µSv/h (20 µR/h)	No more than one response per of continuous operation: - 10 h at <b>n</b> factor set up 5,3; - 60 min at <b>n</b> factor set up 4,5
3.9.1 <b>PM 1703MA</b> <b>PM 1703MB</b> <b>PM 1703GNA</b> <b>PM 1703GNB</b> – with set <b>n</b> coefficient (the number of mean-square deviations of current radiation background) so that the false alarm frequency is no more than 1 per 60 min. and gamma radiation background is no more than 0.25µSv/h, the indicator should detect gamma radiation sources according to the table 3.1 below, with probability over 0.5	Corresponds to III H <sub>Y20</sub> State Standart P 51635-2000
3.9.2 <b>PM 1703MA</b> <b>PM 1703MB</b> <b>PM 1703GNA</b> <b>PM 1703GNB</b> - time-before-alarm while fast or slow increase of radiation background (gamma radiation) for 0.5 µSv/h (at <b>n</b> coefficient set 5.3 for gamma channel), no more	2 s (corresponds to ANSI42.32)
3.9.3 <b>PM 1703MA</b> <b>PM 1703MB</b> <b>PM 1703GNA</b> <b>PM 1703GNB</b> - alarm while gamma source transfer at the speed 0.5 m/s , with DER 0.5 µSv/h (0.06-1.33 MeV) being generated from the source in the detector reference point (at <b>n</b> coefficient set 4.5 for gamma channel), at least	45 times for 50 runs for every recommended source Corresponds to IAEA Nuclear Security Series №1
3.10 Frequency of false operations in the mode of registration of neutron emission <b>PM 1703GNA</b> <b>PM 1703GNO</b> <b>PM 1703GNB</b>	No more than one response per 10 h of continuous operation at <b>n</b> factor set up 5
3.10.1 <b>PM 1703GNA</b> <b>PM 1703GNB</b> – time to detect <sup>252</sup> Cf neutron source having flow density 2.5 s <sup>-1</sup> sm <sup>-2</sup> in the phantom-placed indicator fiducial point (at <b>n</b> coefficient set 5.0 for neutron channel), no more	2 s (corresponds to ANSI42.32)
3.11 Time of indicator continuous operation	At least 1000 h*
3.12 Calibration by background level:	- <b>automatic</b> – in case indicator switching, change of <b>n</b> factors; - <b>autocalibration</b> when the background level is changed; - <b>forced</b> calibration by pressing the push button by the user
3.13 Signaling type:	-sound; -vibration; -visual
3.14 Communication with PC via IR channel	- setting of indicator working parameters
3.15 Communication with Pocket PC by the radio channel of Bluetooth type <b>PM 1703MB</b> <b>PM 1703GNB</b>	- reading of data from storage; - radionuclide identification
3.16 Quantity of recorded events to the indicator storage	by 1000

3.17 Terms of operation:	
- range of ambient temperatures;	- from minus 30 to 50 °C (-22 °F to 122 °F) (LCD from minus 15°C to plus 50 °C)
- relative humidity	by 95 % at 35°C (+95° F)
3.18 The indicator has resistance against impact of direct and alternate magnet fields having intensity	by 400 A/m
3.19 The indicator has resistance against impact of electrostatic discharges	8 kV (air discharge), 6 kV (contact discharge)
3.20 The indicator has resistance against impact of radio frequency electro-magnetic fields (under conditions of noise emission from digital radio telephones)	10 V/m in the range of frequencies from 20 to 1000 MHz (amplitude sinusoidal modulation having depth of 80 % and frequency 1 KHz), 30 V/m in the range of frequencies from 800 to 960 kHz and from 1,4 to 2,0 GHz, (amplitude rectangular modulation having the depth of 100 % and frequency 200 Hz)
3.21 Indicator supply	1.5 V* (one cell POWER LINE AA (LR6) or similar by parameters)
3.22 Protection degree of the indicator housing	IP65
3.23 The indicator is resistant against dropping from a height to the concrete floor	0.7 m (2.3 ft) (1.5 m (4.9 ft) in a special protection holster)
3.24 Overall dimensions	
PM 1703M-O PM 1703MA PM 1703GNO PM 1703GNA PM 1703M-O1 v.10 PM 1703M-O1 v.12	72 x 32 x 87 mm (2 <sup>13</sup> / <sub>16</sub> " x 1 <sup>1</sup> / <sub>4</sub> " x 3 <sup>7</sup> / <sub>16</sub> "
PM 1703MB PM 1703GNB	75 x 35 x 89 mm (2 <sup>15</sup> / <sub>16</sub> " x 1 <sup>3</sup> / <sub>8</sub> " x 3 <sup>7</sup> / <sub>8</sub> "
3.25 Mass (without a holster), not exceeding	
PM 1703M-O PM 1703MA	180 g (6.35 oz)
PM 1703GNO PM 1703GNA PM 1703M-O1 v.10 PM 1703M-O1 v.12	200 g (7.05 oz)
PM 1703MB PM 1703GNB	230 g (8.1 oz)

*\* For power supply of the indicator a rechargeable storage battery may be used (or a supply cell differing from the shown one in specifications). It is important that the typical size should correspond to AA (LR6) and rated voltage should be within 1,1 - 1,6 V. However, in this case duration of the continuous work and the range of working temperatures may differ from the above shown.*

Table 3

Parameter	Source type		
	<sup>133</sup> Ba	<sup>137</sup> Cs	<sup>60</sup> Co
Gamma source activity, kBq (μCi) ±30 %	55,0 (1,5)	100,0 (2,7)	50,0 (1,35)
Movement velocity (source/instrument), m/s	0,5±0,05	0,5±0,05	0,5±0,05
Distance between source and sensitive surface of detector , m	0,2±0,005	0,2±0,005	0,2±0,005



## 4 CLAMP REMOVALS AND INSTALLATION

A removable clamp is provided to the indicator for wearing at the waist belt. The clamp may be removed with the aid of a screw driver, as shown in fig.4.1a. The clamp is installed according to fig. 4.1b.

By an individual order the indicator may be provided with a protecting holster made of synthetic cloth , also providing possibility of wearing at the waist belt. When the protecting holster is used, the clamp is recommended to be removed.

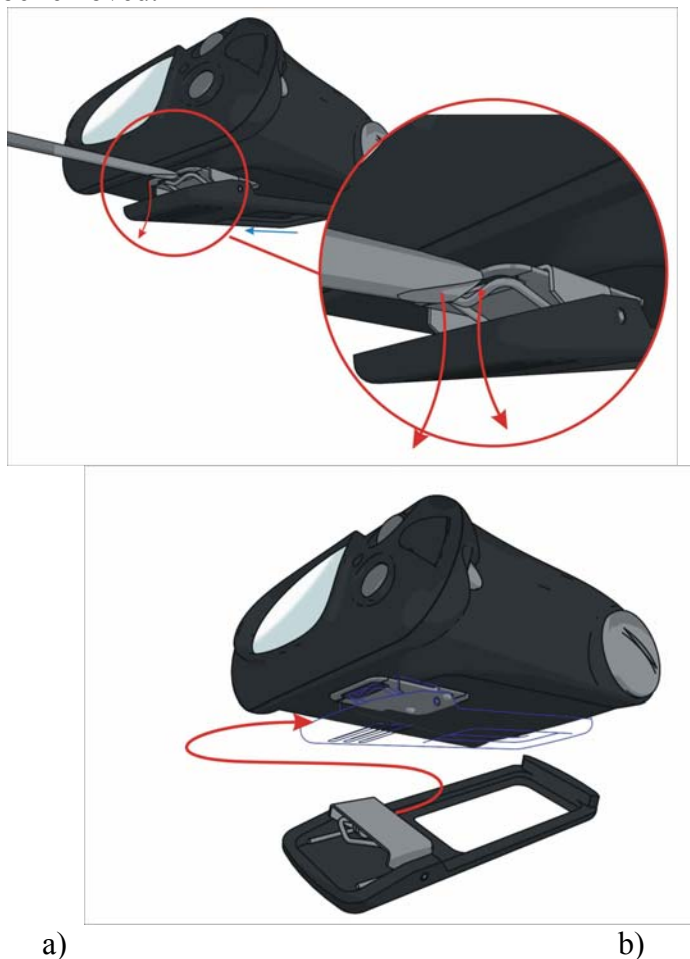


Figure 4.1

## 5 INSTALLATION AND REPLACEMENT OF POWER SUPPLY CELL

The indicator is supplied without a supply cell installed.

For installation of the supply cell a cover of the supply section is to be unscrewed (11) (figure 6.1) with the aid of a special spanner included to the supply set; to be installed to the supply cell by observing polarity (the cell electrode marked with "+", must be directed inside the indicator); the cover of the supply section is to be restored.

When the supply cell is installed the indicator is automatically switched on.

During switching on and during operation of the indicator periodic control is effected of voltage in the supply cell. If the voltage becomes lower than 1,1 V, a mark "X" is induced in the left lower part of the LCD, and a light and sound (and/or vibrating) signal is given). In this case the supply cell should be replaced.

**Note – After appearance of a discharge symbol on the LCD the device retains workability for at least 8 hours (with the normal background level).**

**The user may disconnect the indicator of the supply cell discharge for approximately 30 min by a short pressing the MODE button. Being so, signaling by operation thresholds will be switched on.**

## 6 CONTROL BUTTONS. INDICATION AT LCD

Two push buttons for the device control are located on the front panel of the indicator: (MODE) and (LIGHT) , a liquid crystal display (LCD), a window of the IR transmitter-receiver, a light diode (LED), figure 6.1.

**1 (MODE)** – a push button for :

- switching on the device;
- selection of operation modes;
- recalibration by the background level;
- change of parameters in the mode of settings

**2 (LIGHT)** – a push button for:

- switching on the LCD illumination;
- switching on the IR communication with the PC;
- change of parameters in the mode of settings;
- switching off the device

**3**- a window of the IR transmitter-receiver

**4** – a LED

**5** – the upper LCD line is intended for display of:

- count speed,  $s^{-1}$  (in the searching mode);
- digits from 0 to 9 (in the searching mode);
- DER values of gamma radiation,  $\mu Sv/h$  ( $\mu R/h$ ) (in the mode of DER measurement);
- information "test", "CAL", "OL", "OFF", "P-1.3" etc.;
- an indication type (sound or vibration)

**6** – the analogue scale consisting of 19 segments is intended for:

- time indication to completion of the internal processor tests – reduction of the number of segments up to their disappearance;
- time indication to completion of calibration completion by the background level – increase of the number of segments up to the full scale filling;
- visual display of the DER level in the searching mode 0-9;

**7** – a mark of supply cell discharge "X";

**8** – marks indicating the paramemetrns of gamma, neutron <sup>3)</sup> emissions

**9** – an indicator of the size of the induced value

- « $s^{-1}$ » – in the mode of searching the gamma radiation;
- « $s^{-1}$ » – in the mode of searching the neutron <sup>1)</sup> radiation;
- « $\mu Sv/h$ » – in the DER indication mode (option " $\mu R/h$ ")

**10** – the low LCD line, intended for:

- - indication of the average statistical expected indication error of DER, %;
- - indication of the count speed of neutron <sup>1)</sup> radiation, ( $s^{-1}$ )

**11** – a cover of the power supply section

**12** – a power supply cell

**13** – a sound indicator

**14** – a geometric detector center Cesium Iodide Scintillator

**15** – a geometric detector center G-M tube

**16** – a geometric detector center of neutron radiation <sup>1)</sup> detector

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<sup>1)</sup> PM1703GNO, PM1703GNA, PM1703GNB

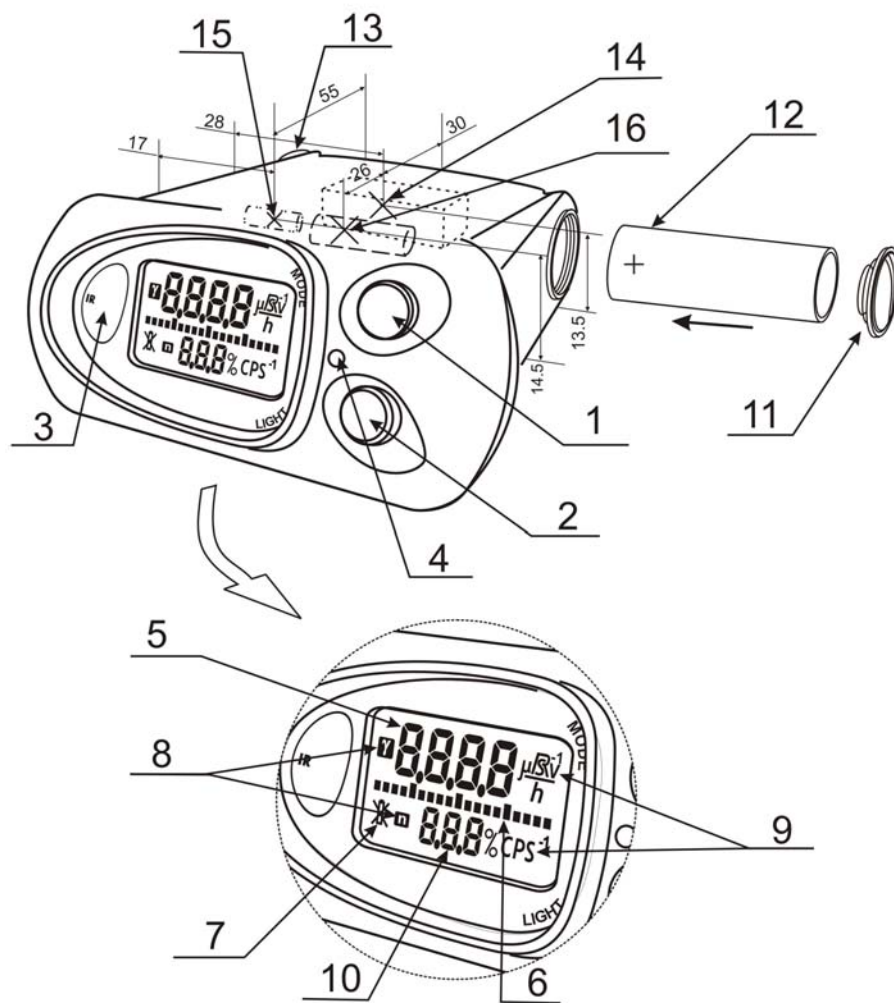


Figure 6.1

## 7 INDICATOR OPERATION

**Attention! In case of the indicator operation at temperature below minus 15 °C normal operation of the LCD is not guaranteed. In this case only sound or vibrating indicators should be used as the source detecting indicator. When the indicator returns to the conditions with the temperature above minus 15°C the normal operation of the LCD is restored.**

### 7.1 Safety precautions

During the instrument adjustment, repair and maintenance, if 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.

### 7.2 Indicator on/off

7.2.1 **For switching the indicator ON** in the process of operation the MODE button should be pressed.



Immediately after switching on the LCD illumination must be switched on and all LCD segments must be illuminated at the same time approximately for 1 s signaling (sound and/or vibrating) must be switched on, the device must be shifted to the testing mode. In the testing mode a number of the software version (P-1.4) is indicated at the LCD for several seconds.

After completion of the tests the indicator must be shifted to the calibration mode by the background level (except for devices having the search mode "0-9"), the analogue scale is indicated on LCD with the number of segments increased in time, as well as the "CAL" message.

After calibration completion the indicator must be shifted to the working mode in accordance with the order chart (see Attachment A).

The indicator is ready for operation.

7.2.2 **For switching off the indicator** a LIGHT button is to be pressed and kept for more than 5 s.



Being so, the "OFF" appears.

**Attention! The indicator is automatically switched off ("OFF" is indicated at the LCD) after reading the indicator operation history in the mode of communication with a PC).**

### 7.3 Operation modes

**Operation modes included by the manufacturer in the given indicator modification comply with the order chart (see attachment A).**

**The indicator provides the following operation modes:**

- the testing mode;
- the calibration mode by the background level;
- the searching mode (indication of the average count speed,  $\text{s}^{-1}$ );
- the mode of DER measurement;
- the mode of DER measurement along with the search function;
- the searching mode "0-9" (indication of digits 0-9);
- the mode of gamma registration (only for PM1703M-O1 v.10)
- the mode of indication of the average count speed of gamma radiation over the time of accumulation (only for PM1703M-O1 v.10)
  - the mode of registration of neutrons<sup>4)</sup>
  - the mode of indication of the average count of neutrons over the accumulation time<sup>1)</sup>
  - the mode of fast switching of sound and vibrating signaling
  - the mode of settings:
    - setting the **n** factor of gamma channel;

<sup>1)</sup> PM1703GNO, PM1703GNA, PM1703GNB

- setting the **n** factor of neutron channel;<sup>1)</sup>
- setting the threshold by DER for the searching mode "0-9"
- setting the threshold of neutrons count for the searching mode "0-9"
- the mode of indication settings:
  - selection of the sound and/or vibrating indication;
  - setting the sound volume of the indication;
- communication mode with PC via IR channel.
- Communication mode by radio channel with Pocket PC (PM1703MB, PM1703GNB).

### 7.3.1 Testing mode

The device enters this mode just after switching on.

Before the beginning of the testing process the indication (sound and/or vibrating) is switched on approximately by 1 s. All marks, segments and pointers must be indicated on the LCD. Then on the LCD a number of the software version (P-1.4) is indicated on the LCD for several seconds.



In the testing mode all required tests are fulfilled. Initially, the battery discharge level is tested. "bAtt" is indicated on the LCD, as well as quantity of segments of the analogue scale which corresponds to the battery discharge level.

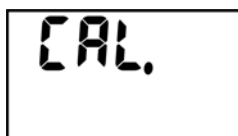
Then the "test" message is indicated and the reducing analogue scale. Tests

are performed. The time to completion of the test is displayed in relative units on the analogue scale in the form of the reducing number of the indicated segments.

After the test completion the device is shifted to the calibration mode by the background level. The analogue scale is indicated on the LCD with the number of segments increasing in time, as well as the message "CAL"<sup>1)</sup>.

### 7.3.2 Calibration mode by background level<sup>5)</sup>

The indicator enters this mode automatically after completion of the testing mode, and being so, "CAL" message is indicated on the LCD



In the calibration mode the analysis of the background level of gamma (and neutron) emission is carried out.

**Attention! Find below the principles of operation of the device gamma channel. Functioning of the neutron channel<sup>6)</sup> is subordinate to a more complicated operation algorithm and is not shown in details in the present**

**manual.**

The processor counts the number of impulses passed from the detection block over the preset calibration time, and the time is indicated on the analogue scale in relative units from the calibration beginning in the form of increasing number of the indicated segments. In case of recalibration of the indicator by the user during operation the recalibration time may automatically be reduced along with growth of the background level, when calibration is fulfilled.

The processor counts the value of **the gamma channel operation threshold**

$$\text{Operation threshold} = N + n * \sqrt{N},$$

**N** – average speed of counting impulses over the calibration time

**n** – number of mean square deviations ( **n** factor of the gamma channel).

**n** factor changes the value of **the operation threshold** (the minimum detection level), the less **n** factor, the less threshold value is and the higher indicator sensitivity is. **n** factor is set by the user in the mode of settings, if this is permitted in the communication mode with PC by the user-administrator (the manufacturer sets the value of **n** factor equal to 5,3). The range of factor setting is equal from 1 to 9,9 with discreteness 0,1.

For recalibration of the indicator by the background level the **MODE** button should be pressed (to be kept pressed for more than 2 s), until "CAL" message is indicated on the LCD, then the push button

<sup>1)</sup> The said mode is unavailable in indicators with the switched on SEARCHING MODE "0-9"

<sup>2)</sup> PM1703GNO, PM1703GNA, PM1703GNB

should be released. The analogue scale will also be indicated on the LCD along with the number of segments increasing in time.

The auto background may be switched on in the mode of communication with the PC. Auto background makes it possible to automatically retain the high sensitivity at reduction of the background level and avoid false operations with its slow increase.

The device is highly sensitive to the change of radiation level. The alarm may be produced, e.g. the device being moved from the open air (street) to the premises with materials containing natural radioactive isotopes (potassium, thorium, radium, uranium) producing heightened natural radiation level. Such materials are mainly concrete and similar construction materials containing sand, natural stone (especially facet), ceramic tile, glass, etc. In this case, the device auto calibration will be not switched on, that is why it is recommended to re-calibrate it manually to adjust it to the modified background. Also, the coefficient **n** may be altered to change the sensitivity threshold.

After auto background completion the indicator is automatically shifted to the operating mode in accordance with the chart of orders (see attachment A).

### 7.3.3 Searching mode. Detection and localization of sources of gamma and/or neutron radiations<sup>7)</sup>

7.3.3.1 Being in the searching mode the indicator shows the speed of counts of the gamma channel in the LCD upper line,  $s^{-1}$ .

The following is indicated in the lower line:

PM 1703M-O1 v.10 PM 1703M-O1 v.12 PM 1703M-O PM 1703MA PM 1703MB		<ul style="list-style-type: none"> <li>the average statistical indication error of the average count of gamma radiation in per cents;</li> </ul>
PM 1703GNO PM 1703GNA PM 1703GNB		the average speed of count of neutron radiation in $s^{-1}$ ;
All modifications		<ul style="list-style-type: none"> <li>If at indicator operation in the searching mode the average speed of count of the gamma channel exceeds the upper limit of indication, "OL" is indicated on the LCD.</li> </ul>
PM 1703GNO PM 1703GNA PM 1703GNB		<ul style="list-style-type: none"> <li>If at indicator operation in the searching mode the average speed of count of the gamma channel exceeds the upper limit of indication, "999" (by request "99") blinking message is indicated on LCD.</li> </ul>

In this mode the indicator operation is carried out to the following thresholds:

1) The fixed **threshold by DER**, set up in the communication mode with the PC by the user-administrator;

When the installed threshold is exceeded by DER the indicator sends light, sound and/or vibrating signals. Being so single-tone periodical signals are sent with the constant interval and duration 1 s by making it possible for the user to acknowledge indication when threshold by DER is exceeded from the operation threshold.

2) The **gamma channel operation threshold** (the minimum detection level) calculated in the calibration mode and taking into account the changes in the background level. When the gamma channel threshold is exceeded the indicator light, sound and/or vibrating signals. Being so, frequency of the received signals is constant and is increased along with the exceeded **gamma channel operation threshold**.

<sup>1)</sup> PM1703GNO, PM1703GNA, PM1703GNB

The whole range of energies of the indicator gamma radiations is divided into four energy channels. Three channels correspond to areas of interest for low, middle and high energies, and the 4<sup>th</sup> one – to the whole range of energies of the gamma radiation. **The operation threshold** is calculated for every channel.

The processor counts impulses every 0,25 s by each channel from the detection block, and it keeps the amount of impulses during the counting. Being so, every 0,25 s the number of impulses over the last (new) interval is added to the current amount, and the number of impulses during the first (the oldest) interval is deducted from the sum of impulses (the current average). So, the number of impulses stored in the processor for each channel is renewed every 0,25 s.

The current average number of impulses is compared every 0,25 s with **operation thresholds** for each channel, **which are calculated in the calibration mode (clause 2.2.3)**. If the current average value of the number of impulses by any channel exceeds the threshold value, indication (light, sound and/or vibrating) is switched on.

**3) The operation threshold for the neutron channel<sup>1)</sup>** c (The minimum detection level), calculated in the calibration mode and taking into account the changes in the background level. If the operation threshold is exceeded the indicator sends light, sound and/or vibrating signals. Being so, double signals are sent with the permanent interval and duration, what making it possible for the user to find indication when the operation threshold of gamma channel exceeds operation of the neutron <sup>1)</sup> channel.

In the searching mode the device resolves the problems of detection and localization of sources of gamma and neutron <sup>1)</sup> radiation.

### 7.3.3.2 Detection of gamma and neutron <sup>1)</sup> radiation sources

When detecting radiation sources the instrument should be held so that the rear side (where the clip is attached) is directed onto the scanned object. The efficiency of detecting radiation sources is the higher, the closer is the instrument to the scanned object (article, person, container, vehicle, etc) and the smaller is the velocity of its movement along the object.

When detecting radiation sources under conditions when the audible signals produced by the instrument are not heard (for example, are damped by noise) the vibrating and light indicator should be used.

One should remember that indicator sensitivity and frequency of false operations depend on:

- the preset value of n factor by the gamma channel;
- the preset value of n factor by the neutron channel <sup>1)</sup>;
- the background level calculated by the indicator in the calibration mode by the background level.

In case when auto background is switched on in the communication mode with a PC, the indicator will automatically take into account slow changes of the background level and calibrate by a new background level approximately after every ten minutes with the reduction of the background level or after somewhat bigger intervals during increase of the background level. However, auto background will be carried out under conditions of absence of indicator operations or sharp changes of the background level over certain intervals defined by the algorithm.

It should be noted that false signals (light, sound and/or vibrating) are not regular and, therefore, may be easily distinguished from alarm signals produced by the existing radiation source as far as their rate is constant or increases when the instrument moves closer to a radiation source.

When the radiation source is detected by the instrument or by a stationary system, the radiation source is to be **located**.

### 7.3.3.3 Locating gamma and/or neutron <sup>1)</sup> radiation sources

To **locate** the radiation source the instrument should be held at a distance no more than 10 cm from the scanned object. The velocity of movement along the scanned object should not be more than 10 cm per second. As the instrument moves closer to a gamma radiation source, the rate of the signals will increase.

With the switched on sound indication sound signals are heard accompanied with blinking of a red LED. With the switched on vibrating indicator mechanical vibrations are felt inside the indicator (casing trembling) accompanied with a red LED.

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<sup>1)</sup> PM1703GNO, PM1703GNA, PM1703GNB



When the maximum rate of light, sound and/or vibration signals have been reached the further localization becomes impossible without calibration by a new background level. For this purpose, if possible, a MODE button should be pressed **without changing the distance to the object**, and this is to be retained by appearance of "CAL" message on the LCD. The instrument will automatically perform the background updating and then the gamma radiation source locating may be continued. If necessary this procedure may be repeated several times until a gamma radiation source is located.

If necessary to locate neutron <sup>1</sup>) radiation source or combined gamma and neutron radiation source it is not allowed to use sound and vibration alarm devices, as the instrument will produce the signals characterizing exceed of neutron count rate threshold, without a reaction to the source approach or removal. In this case it is recommended to perform source locating by observing the count rate change (or DER) on the LCD upper scale (gamma radiation channel) or the count rate change the change of segments number on the LCD lower scale (neutron channel).

### 7.3.4 Mode of DER measurement

Staying in the DER measuring mode the device in the upper LCD line indicates the DER of photon radiation  $\dot{H}^*(10)$ , in  $\mu\text{Sv/h}$ . The lower line indicates the average statistical DER indication error in percents.





If during device operation in the measuring mode the DER value exceeds the upper limit of the measuring range by more than 1.3, "OL" message is shown on the LCD.

### 7.3.5 DER measuring mode along with searching function

Staying in this mode the device in its upper line of LCD induces the photon radiation DER  $\dot{H}^*(10)$ ,  $\mu\text{Sv/h}$ .

The following is indicated in the lower line:

PM 1703M-O1 v.10 PM 1703M-O1 v.12 PM 1703M-O PM 1703MA PM 1703MB		• average statistical error of DER indication in percents
PM 1703GNO PM 1703GNA PM 1703GNB		• average speed of count of neutrons in $\text{s}^{-1}$

**Attention! The indicator may perform the searching and localizing functions of the ionizing radiation in this mode. This is stipulated in the devices, wherein the searching mode is unavailable, or the searching function is additionally included in the measuring mode (see the order chart – attachment A).**

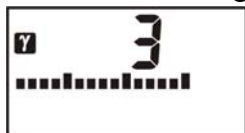
### 7.3.6 Searching mode "0-9"

In the searching mode "0-9" digits from 0 to 9 are indicated on the LCD display. Compliance of DER values by  $\gamma$  - channel and digits indicated on the indicator LCD is shown in the table 7.1.

Table 7.1

Indicated figure	0	1	2	3	4	5	6	7	8	9
Range of indicated DER, $\mu\text{Sv/h}$	From background to 0,37	$\geq 0,37$ $< 0,45$	$\geq 0,45$ $< 0,59$	$\geq 0,59$ $< 0,90$	$\geq 0,90$ $< 1,20$	$\geq 1,20$ $< 2,50$	$\geq 2,50$ $< 5,82$	$\geq 5,82$ $< 9,58$	$\geq 9,58$ $< 23,50$	$\geq 23,50$
Range of indicated DER, $\text{mR/h}$	From background to 0,037	$\geq 0,037$ $< 0,045$	$\geq 0,045$ $< 0,059$	$\geq 0,059$ $< 0,090$	$\geq 0,090$ $< 0,120$	$\geq 0,120$ $< 0,250$	$\geq 0,250$ $< 0,582$	$\geq 0,582$ $< 0,958$	$\geq 0,958$ $< 2,350$	$\geq 2,350$

The analogue scale is in parallel filled in. The number of illuminating segments of the analogue scale is proportional to the digit induced on the LCD.



In the searching mode "0-9" operation of the indicator is carried out in the following thresholds:



1) The searching **threshold by DER** is set in the mode of settings from the front panel of the indicator, as well as in the mode of communication with a PC by the user-administrator. The range of threshold setting is equal to 15 – 7777  $\mu\text{R/h}$  (0.15-77.77  $\mu\text{Sv/h}$ ), recommended – 30  $\mu\text{R/h}$  (0,3  $\mu\text{Sv/h}$ ). The preset searching threshold exceeding by DER is accompanied with light, sound and vibration signaling (by user's option). Frequency of signals increases by device approaching to the gamma radiation source.

2) The **safety threshold – the 2<sup>nd</sup> threshold by DER**, is only set in the mode of communication with a PC by the user administrator. The range of threshold setting is equal to 10 – 7000  $\mu\text{R/h}$  (0.1-70  $\mu\text{Sv/h}$ ), the recommended one – 3 mR/h (30  $\mu\text{Sv/h}$ ). The light, sound and/or vibrating signals are provided in case of exceeding the safety threshold. Being so, single tone periodical signals are provided with the permanent interval and duration of 1 s what makes it possible for the user to differentiate the indication in case of exceeding the searching threshold by DER from the safety threshold.



Compliance of speed values by neutron <sup>9)</sup> channel and digits indicated on the device LCD is shown in the following table 7.2.

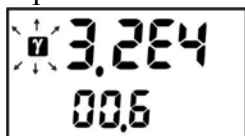
Table 7.2

Indicated figure	0	1	2	3	4	5	6	7	8	9
Count speed	From background to 1	$\geq 1$ $< 2$	$\geq 2$ $< 3$	$\geq 3$ $< 4$	$\geq 4$ $< 5$	$\geq 5$ $< 8,5$	$\geq 8,5$ $< 12$	$\geq 12$ $< 15,5$	$\geq 15,5$ $< 20,5$	$\geq 20,5$

The fixed threshold of counting neutrons for the searching mode "0-9" (the range of threshold setting is equal to 1.0 – 99.0  $\text{s}^{-1}$ , recommended – 1.5  $\text{s}^{-1}$ ) is set in the mode of settings from the front indicator panel, as well as in the communication mode with a PC by the user-administrator.

### 7.3.7 Gamma registration mode (only for PM1703M-O1 v.10)

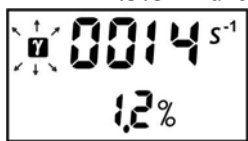
In this mode in the upper line of LCD a  $\gamma$  is shown and the quantity of accumulated count impulses is indicated in the form of:



XXXX – in case of indication by the value of 9999 impulses;  
X.XEX – in case of indication above 9999 impulses, wherein X is any figure from 0 to 9, EX is  $10^x$ .

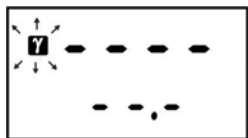
Time of accumulation of impulses in hours is indicated in the lower LCD line.

### 7.3.8 Indication mode of average speed of gamma radiation during accumulation (only for PM1703M-O1 v.10)



In this mode in the upper line of LCD a  $\gamma$  is blinking, and the average count time is shown during accumulation time ( $\text{s}^{-1}$ ).

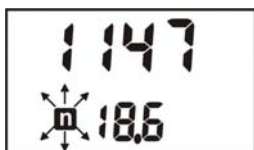
The lower LCD line shows the value of the statistical error of the average count speed in percents.



For reset of the current value of impulse counting and accumulation renewal a MODE button should firstly be pressed and retained by staying in this mode.

### 7.3.9 Mode of neutrons registration <sup>1)</sup>

In this mode the number of accumulated count impulses is indicated in the LCD upper line:



XXXX – in case of indication by the value of 9999 impulses;  
X.XEX – in case of indication above 9999 impulses, wherein X – any figure from 0 to 9, EX is  $10^x$ .

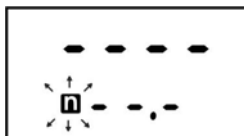
n mark is blinking in the lower line of the LCD and the time of impulses accumulation is indicated in hours.

<sup>1)</sup> PM1703GNO, PM1703GNA, PM1703GNB

### 7.3.10 Indication mode of average speed of neutron during accumulation<sup>1)</sup>

In this mode in the upper line of LCD the average count time is shown during accumulation time ( $s^{-1}$ ).

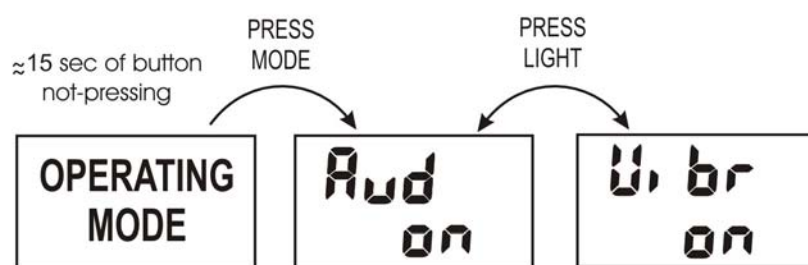
The lower LCD line shows the value of the statistical error of the average count speed in percents.



For reset of the current value of impulse counting and accumulation renewal a MODE button should firstly be pressed and retained by staying in this mode.

### 7.3.11 Quick switching of sound or vibrating indication

In this mode the user may check the preset indication or select another indication type (sound – (Aud-on) or vibrating – (Vibr-on)).



In order to enter this mode a MODE push button should be pressed for a short time in any operating mode, **provided that button pressing has not been effected during the last 15 seconds**. The current indicating type shall be displayed on the device LCD. Selection (switching) of the required

indication type is carried out by short pressing of LIGHT PUSH BUTTON.

It should be borne in mind that the user may change the sound volume in the mode of settings.

### 7.3.12 Communication mode by radio channel with a Pocket PC<sup>10)</sup>

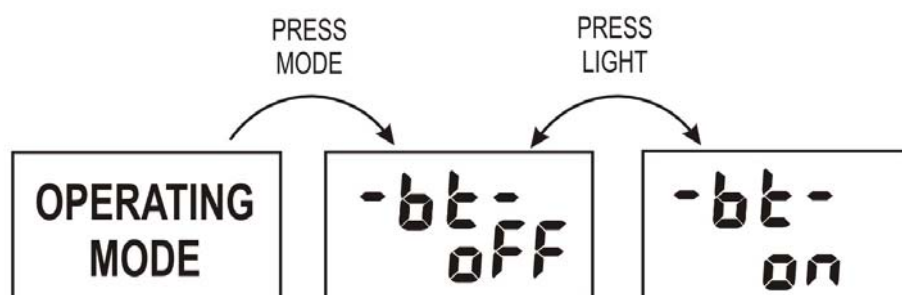
In the communication mode with PPC by radio channel, of Bluetooth type the modification indicators: **PM1703MB**, **PM1703GNB** make it possible to identify the radio nuclide substance composition.

For setting the communication between the indicator and the "Bluetooth" mode should be switched on in the indicator. For this purpose a MODE push button should be started for several times until the note [-bt-off] is indicated on the LCD. A LIGHT push button should be used for switching over

the state of «Bluetooth» to [-bt-on].

Further the user's program "Smart 2003" should be started.

Indicator operation in this mode is described in Help site and supplied on a CD.



#### Attention!

**1** In case of the indicator operation in the mode of communication with PPC access to the mode of settings of the indicator with the aid of indicator settings on the front panel will be **IMPOSSIBLE**. All settings are performed with the aid of PPC.

**2** It should also be taken into account that in case of inclusion of "Bluetooth" mode power supply of the indicator essentially increases.

**3** The spectrometric parameters (such as energy resolution) of detector become worse as ambient temperature rise 32 and above. Due to this fact, the probability of correct nuclide identification may decrease, especially regarding the nuclides with multiple pears and the mixtures of nuclides.

At switching over the "Bluetooth" mode the indicator enters after approximately 1 minute the sleeping mode, and being so, LCD will have the following forms:

<sup>1)</sup> a PPC with the Bluetooth installed should be used for indicator operation in the said mode.

	<ul style="list-style-type: none"> <li>the radio channel is on, no communication with the PPC</li> </ul>
	<ul style="list-style-type: none"> <li>the radio channel is on, communication with the PPC has been established</li> </ul>

For switching off the «Bluetooth» mode a MODE should shortly be switched on several times until [-bt-on] note is indicated. A LIGHT button is to be used for switching over the state «Bluetooth» in [-bt-off].

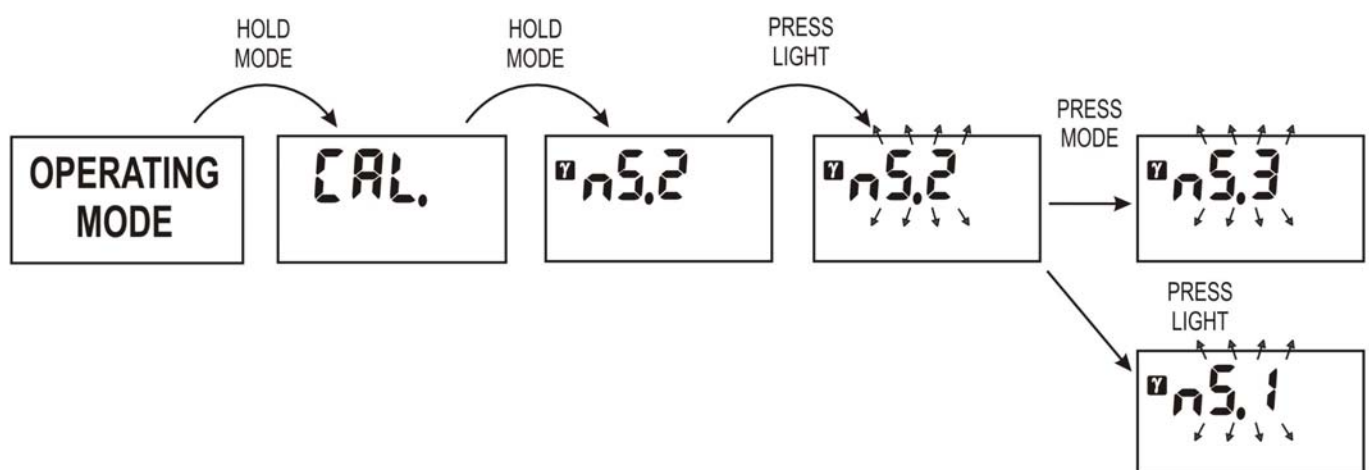
### 7.3.13 Setting mode

The indicator is included to the mode of settings at long (more than 5 s) pressings of MODE push buttons. By a short pressing of MODE button the user selects the preset parameter:

- the preset n-factor value (the number of average square deviations) should be checked or a new one is to be set up in the channel of gamma-radiation registration (the range of n factor setting is equal from 1 to 9,9 with discreteness 0,1);
- the preset n-factor value or a new one is to be set up in the channel of neutron radiation registration (PM1703GNO, PM1703GNA, PM1703GNB);
- the preset value is to be checked or a new value of the searching threshold is to be set as per DER for the searching mode "0-9" (the threshold setting range is equal to 15 – 7777  $\mu\text{R/h}$  (0.15-77.77  $\mu\text{Sv/h}$ ), recommended – 30  $\mu\text{R/h}$  (0,3  $\mu\text{Sv/h}$ ));
- the preset value is to be checked or a new value of the fixed threshold is to be set for the searching mode "0-9" (the threshold setting range constitutes 1.0 – 99.0  $\text{s}^{-1}$ , recommended – 1.5  $\text{s}^{-1}$ ) (PM1703GNO, PM1703GNA, PM1703GNB);
- the preset states of indicators of sound and/or vibrating ones are to be set, or they are to be replaced (on/off);
- the preset sound volume of the sound indicator is to be checked or changed.

#### 7.3.13.1 Gamma-channel n-factor setting

For setting **n-factor** one should be shifted to the mode of settings, for what a MODE push button should be pressed and kept pressed for more than 5 s. "CAL." will appear on the LCD, and then the installed value of n-factor of the gamma channel.



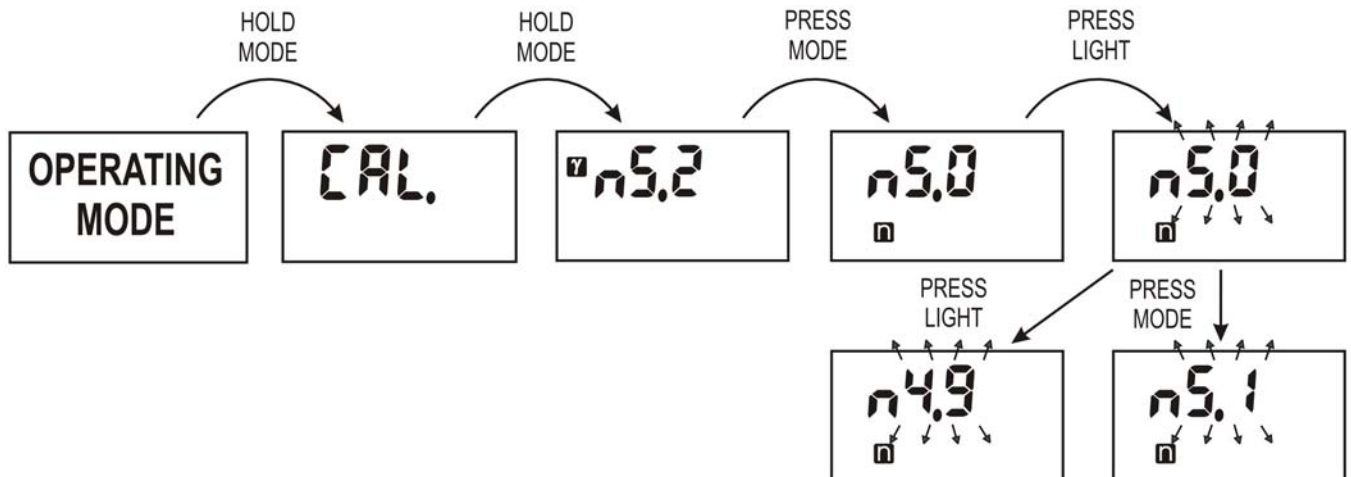
For changing the value of n-factor one should shortly press LIGHT push button during subsequent four seconds. The preset value of n-factor will blink by indicating its possible change. If the LIGHT button was not pressed during the said time interval, the indicator automatically returns to the working mode. Subsequent pressings of the LIGHT push button increase the preset value of n factor with pitch 0.1. Subsequent pressings of the MODE push button increase the preset value of n factor with pitch 0,1. If the push buttons are kept pressed the values are reduced or increased accelerated with the same pitch.

After setting the required n-factor of the gamma channel after expiry of approximately 6 s after the last pressing the push button the indicator will automatically be shifted to the calibration mode.

### 7.3.13.2 Neutron -channel n-factor setting<sup>1)</sup>

For setting **n-factor** one should shift to the mode of settings, for what a MODE push button should be pressed and kept pressed for more than 5 s. "CAL." will appear on the LCD, and then the installed value of n-factor of the gamma channel. A MODE push button should one be pressed and the value of n-factor of the neutral channel will be indicated on the LCD.

For changing the value of n-factor one should shortly press LIGHT push button during subsequent four seconds. The preset value of n-factor will blink by indicating its possible change. If the LIGHT button was not pressed during the said time interval, the indicator automatically returns to the working mode.

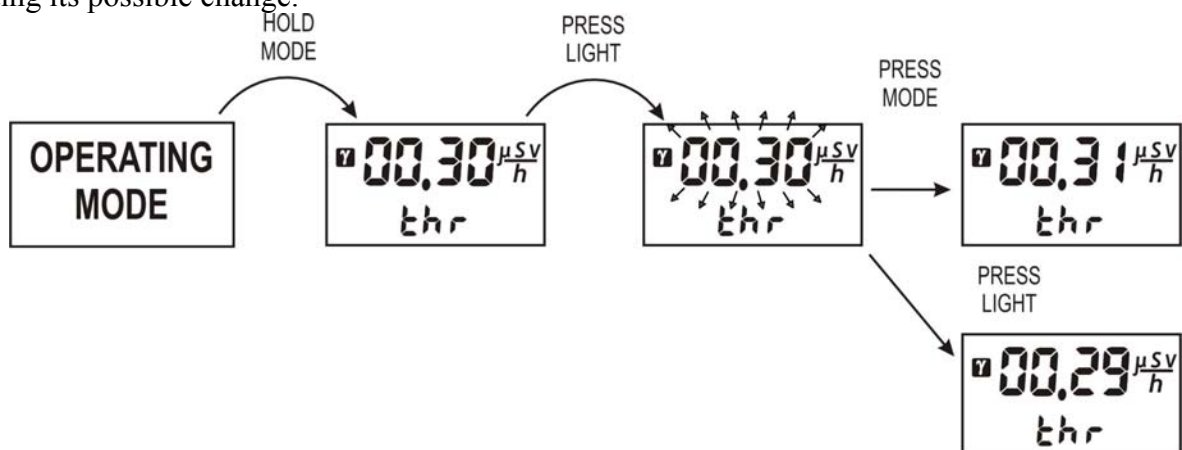


Subsequent pressings of the LIGHT push button reduce the preset value of n factor with pitch 0.1. Subsequent pressings of the MODE push button increase the preset value of n factor with pitch 0.1. If the push buttons are kept pressed the values are reduced or increased accelerated with the same pitch. After setting the required n-factor of the gamma channel after expiry of approximately 6 s after the last pressing the push button the indicator will automatically be shifted to the calibration mode.

### 7.3.13.3 Setting of searching threshold by DER for searching mode "0-9"

For setting the searching mode by DER one should shift to the mode of settings, for what a MODE push button should be pressed and kept pressed for more than 5 s. The threshold value by DER will appear on the LCD.

For changing the value of the threshold by DER one should shortly press LIGHT push button during subsequent four seconds. The preset value of the searching threshold by DER will blink by indicating its possible change.



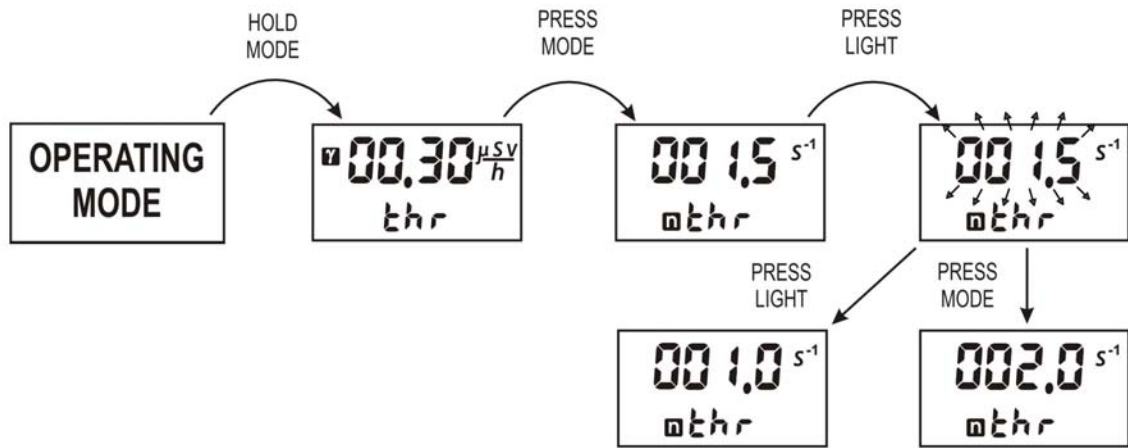
If the LIGHT button was not pressed during the said time interval, the indicator automatically returns to the working mode. Subsequent pressings of the LIGHT push button reduce the preset value of the threshold by DER with pitch 0,1. Subsequent pressings of the MODE push button increase the preset

<sup>1)</sup> PM1703GNO, PM1703GNA, PM1703GNB

value of the threshold by DER with pitch 0,1. If the push buttons are kept pressed the values are reduced or increased accelerated with the same pitch. After setting the required threshold value by DER after expiry of approximately 6 s after the last pressing the push button the indicator will automatically be shifted to the operation mode.

#### 7.3.13.4 Setting of the fixed threshold of neutrons counting for the searching mode "0-9"

For setting the threshold of count of neutrons one should shift to the mode of settings, for what a MODE push button should be pressed and kept pressed for more than 5 s. The threshold value by DER will appear on the LCD. A MODE push button is once to be pressed, and the value of the neutrons count threshold will be indicated on the LCD.



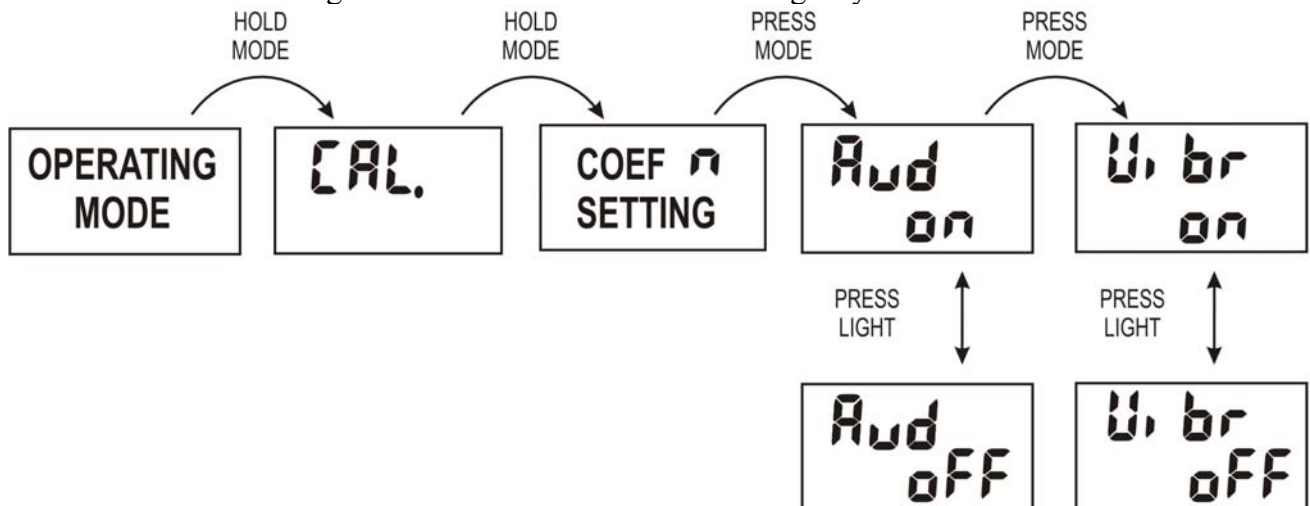
For changing the value of the threshold of the neutrons count one should shortly press LIGHT push button during subsequent four seconds. The preset threshold value will blink what shows its possible change. If the LIGHT button was not pressed during the said time interval, the indicator automatically returns to the working mode.

Subsequent pressings of the LIGHT push button reduce the preset value of the threshold with pitch 0,5. Subsequent pressings of the MODE push button increase the preset value of the neutrons count threshold with pitch 0,5. If the push buttons are kept pressed the values are reduced or increased accelerated with the same pitch. After setting the required threshold value of the neutrons count after expiry of approximately 6 s after the last pressing the push button the indicator will automatically be shifted to the operation mode.

#### 7.3.14 Mode of indication setting

##### 7.3.14.1 On/Off of sound and/or vibration indication

The state selection (on/off) of vibrating and sound indicators from the front panel is possible if this mode is allowed at setting the parameters set up in the mode of communication with a PC. If this mode is allowed sound or vibrating indication is on/off in the following way:





- the setting mode is to be switched on, for what a MODE button should be pressed and kept for more than 5 s. "CAL." will appear on the LCD, and then the installed value of n-factor;

- a MODE push button is shortly be pressed (1 or 2 times, depending on the modification), until "Aud-oFF" or "Aud-on" message appears.

The abbreviated "Aud" note indicates the sound indication,

"oFF" ("on") marks for the off (on) state of the sound indication.

For changing the state of sound indication one should, when this note appears, select the required state of the sound indication by means of the LIGHT push button. This state is left by either automatically, if during approximately 6 s the push button was not pressed, or at sort pressing the MODE,

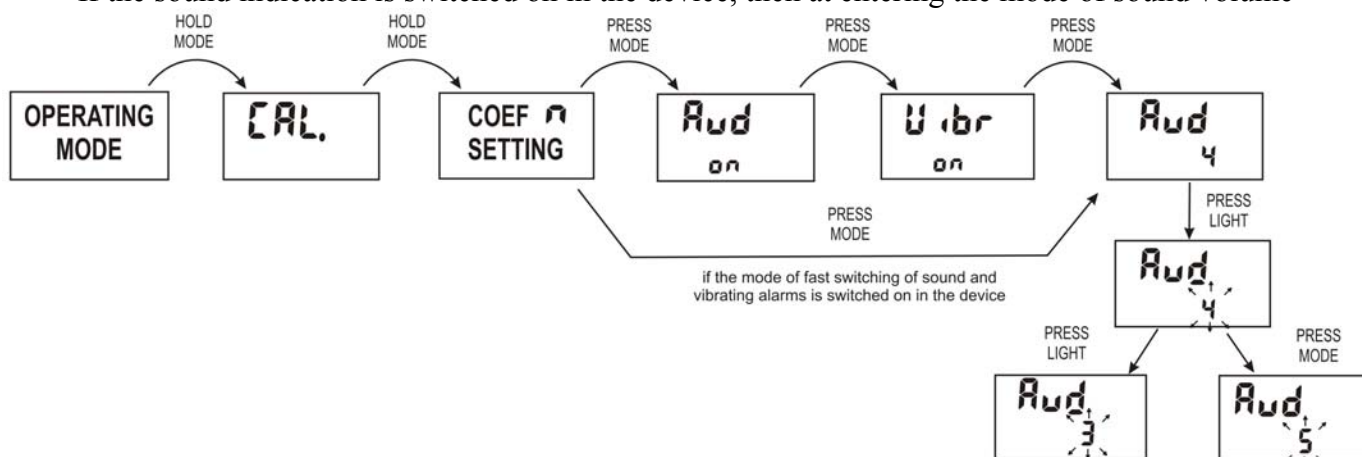
- being so, "Vibr-oFF" or "Vibr-on" message will appear on the LCD. The abbreviated note "Vibr" – indicates the vibrating indication, notes "oFF" ("on") – the off (on) state of the vibrating indication. Setting of and removal from this mode is performed by actions similar to the aforesaid ones.

### 7.3.14.2 Setting the sound indication volume

In this mode the user may set up the required sound indication level.

For changing the sound indication level one should switch on the setting mode, for what the MODE button should be pressed and retained for more than 5 s. "CAL" note will appear on the LCD, and then the device will enter the mode of n-factor settings. By a short pressing the "MODE" push button the mode of n-factor setting and the mode of setting the indication type (if switched on) are to be "looked through".

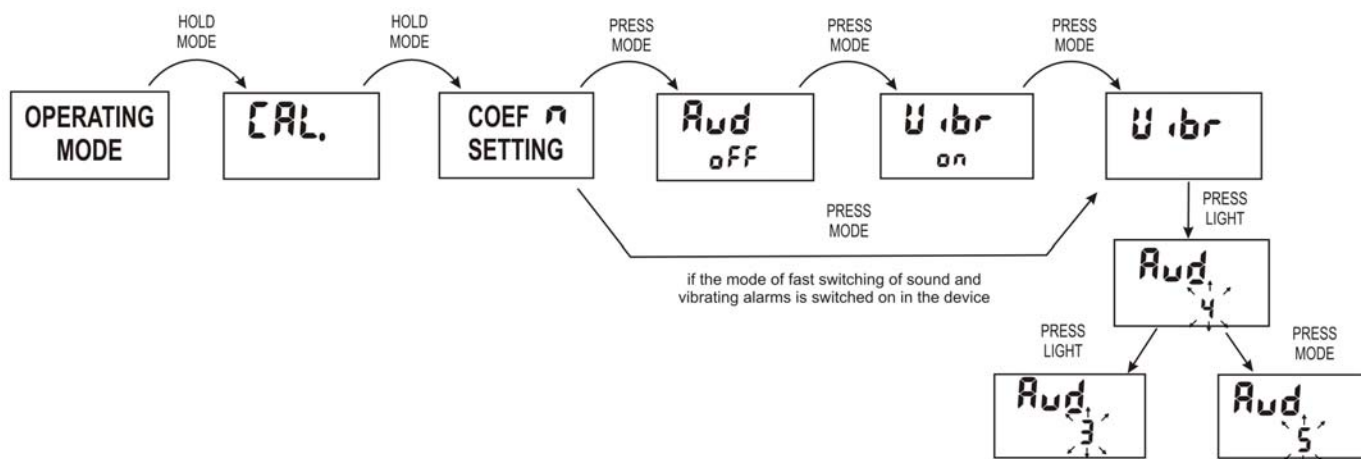
- If the sound indication is switched on in the device, then at entering the mode of sound volume



setting "Aud" note will be indicated on the LCD, as well as the preset sound indicator value from 1 to 5. For changing the sound volume a LIGHT push button should be shortly pressed. Being so, the indicated volume value must blink. The subsequent pressing of the LIGHT push button reduces the blinking value by a unit, and pressing the MODE push button increases it.

**Change of the value is accompanied with a sound signal in compliance with the sound volume.**

- If the sound indication is off in the device, then at entrance to the setting mode of the sound volume "Vibr" note will be shown at the LCD of the sound indicator. Then a LIGHT push button should shortly be pressed, and Aud note will be shown on the LCD as well as the blinking value of sound indicator from 1 to 5. The subsequent pressing of the LIGHT push button reduces the blinking value by a unit, and pressing the MODE push button increases it.



Change of the value is accompanied with a sound signal in compliance with the sound volume.

### 7.3.15 Communication with PC. Indicator parameters

**ATTENTION! Operation in the communication mode with a PC is intended for a trained user or the user-administrator.**

Access to the communication mode with a PC for an ordinary user is protected with the password.

#### 7.3.15.1 Communication with a PC by IR communication channel

For indicator operation in this mode a PC with IrDA should be used or an adapter of the IR communication channel supplied along with the indicator by an individual order (see the complete set) and the user's program (IIII) PM17XX\_14XX, supplied at the CD.

Minimum requirements for the computer and its software:

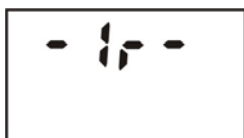
- P100;
- 32 Mbyte ROM;
- Windows 98, 2000, XP (small print in Windows set);
- 20 Mbyte of free space on HD plus the free space for the formed data base;
- monitor resolution 800x600;
- IrDA.

If the built-in IrDA is unavailable in the computer, the IR communication channel should be used which is to be supplied as per individual order. For connection of the adapter of the IR communication channel the adapter cable is to be linked with a PC communication port.

For PP setting a CD with the software should be used included to the supply set.

A **SETUP.EXE** program is to be started at the computer by using the installation document - **install.doc**. (the automatic start-up is supported).

Operation with the PP is described in the Help site in the attached textual document which are installed along with the user's software.



For switching on the communication mode with a PC an indicator should be placed at the distance of 10-12 cm from an adapter window of the (IrDA) communication channel, and a **LIGHT** push button should be pressed. As soon as the indicator enters the mode of information exchange, "Ir" message will be illuminated on the LCD.

**\*Note – The indicator is automatically switched off ("OFF" note is indicated on the LCD) after reading the indicator operation history in the mode of communication with a PC.**

#### 7.3.15.2 Indicator parameters

Indicator parameters are set up in the communication mode with a PC user-administrator (the access is protected with a password).

The manufacturer sets up the access password – 1.

The indicator is supplied to the user along with initial settings which comply with the chart of orders (see attachment A).

During operation in the communication mode with a PC the user-administrator may fulfill the following actions:

*In the information system*

- to register belonging of the indicator to a specific user;
- to remember the time of indicator sending and returning;
- \*to read information from the indicator storage, including the history of its operation:
  - 1) the indicator number;
  - 2) time of indicator on/off;
  - 3) current DER value by the gamma channel via the consecutive time interval set up by the user;
  - 4) time and indicator readings in case of exceeding the operation threshold of the gamma channel;
  - 5) time and indicator readings in case of exceeding the operation threshold of the neutron <sup>12)</sup> channel;

*In settings of indicator/program*

- to check and/or set up working parameters of the indicator;
- to switch on the sound/or vibrating indicators;
- to synchronize the time and the date of the indicator with the current time and the PC date on the moment of information exchange – automatically during every communication of the indicator with the PC;
- to set up the values of the consecutive time intervals for storing the current values of DER in the power-independent indicator storage;
- to change the password for entrance to the file of parameters (the initial password -1);
- to check and set up the fixed threshold by DER, if exceeded, the indicator provides a light, sound and/or vibrating signals;
- to check the preset or set up new values of n-factors by each channel determining the operation thresholds (minimal values of gamma and neutron radiation detection);
- to turn ON/OFF the auto background updating.

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<sup>1)</sup> PM1703GNO, PM1703GNA, PM1703GNB



## **8 MAINTENANCE**

Maintenance of the indicator involves:

- performance of preventive works (external inspection, dust removal and deactivation, check of indicator workability (see indicator on/off). Deactivation is performed by wiping with clothes moistened in ethyl spirit. Deactivation of the case is done with a tissue impregnated with ethyl alcohol;
- battery replacement.

In case of visible mechanical damages of the casing and protection glass of the LCD indicator (dents, burrs, cracks) operation of the indicator is prohibited.

## 9 TROUBLESHOOTING

9.1 The list of possible problems and their solutions are specified in Table 9.1.

Table 9.1

<b>Problem</b>	<b>Possible cause</b>	<b>Solution</b>
The indicator can not be switched on	Wrong installation of the battery	Replace the battery
The LCD displays the battery discharge warning sign	Exhausted battery	Replace the battery

Other malfunctions shall be eliminated by the manufacturer.

## **10 STORAGE AND SHIPPING**

### **10.1 Storage**

Indicators are to be stored in the manufacture's package at the air temperature from - 15 °C to + 50 °C and humidity up to 95 % at a temperature of + 35 °C. The storage time should not exceed the lifetime of the instrument, that is 8 years.

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

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

### **10.2 Shipping**

Switched OFF indicators in package may be shipped by any kinds of transport at the air temperature from - 50 °C to + 50 °C.

Indicators in package should be fastened in a vehicle. They must be arranged and fastened in transport so as to ensure their stable position and to avoid possibility of shocks against each other and the walls of a vehicle as well.

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

When carried by air, the instruments in package should be placed in hermetic compartments.

## 11 WARRANTY

The manufacturer warrants this indicator to meet specifications provided that the user observes the guidelines of the instrument operation, shipping and storage described in the operating manual.

The warranty period is 18 months since the date of placing the indicator in service within the warranty storage period.

The warranty storage period is 6 months since the date of the indicator acceptance by the quality control department officer.

Warranty and after-warranty repairs are carried out by the manufacturer or by a company authorized by the manufacturer.

Warranty does not cover indicators:

- which warranty period is expired if the instrument was purchased by the user within the limits of the warranty storage period;
- which were subjected to the user's service (the evidence of opening the instrument);
- with mechanical damages, if the requirements of operation and storage were not satisfied;
- without an operating manual.

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

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

## 12 LIMITED WARRANTY

Polimaster Inc. ("Polimaster") warrants to the purchaser (the "Purchaser") that the Product, including component parts, to be free from material defects in material and workmanship, under normal use and service for a period of one year (the "Warranty Period") *provided, however*, that the foregoing warranties are expressly contingent (and shall otherwise be void) upon use of the Products in accordance with specifications and without misuse, abuse, or abnormal use, accident, damage, alteration, or modification thereto or improper or unauthorized repairs or improper maintenance. Non-substantial variations of performance from the documentation do not establish a warranty right.

Except for the foregoing express warranties stated herein, and for any warranty, condition, representation or term to the extent to which the same cannot or may not be excluded or limited by law applicable to purchaser in his/her/its jurisdiction, the products and services hereunder are provided "as is and with all faults" and, to the maximum extent permitted by law, polimaster disclaims all other warranties, of any kind, either express, or implied, including, without limitation, implied warranties of merchantability, fitness for a particular purpose, integration, satisfactory quality, noninfringement or any warranties arising from course of dealing or course of performance. Purchaser assumes all risks and responsibilities for selection of the product to achieve his/her/its intended results, and for the installation of, use of, and results obtained from the product. Polimaster does not warrant that the products and services hereunder will meet purchaser's or users' requirements or will operate in the combinations which may be selected by purchaser or user or that the services hereunder or the operation of the products will be secure, error-free, or uninterrupted, and polimaster hereby disclaims any and all liability on account thereof to the maximum extent permissible under applicable law. Polimaster disclaims any and all liability for the loss of data during any communications and any liability arising from or related to any failure by polimaster to transmit accurate or complete information to purchaser.

Exclusive remedy. Other than termination of this agreement due to polimaster's breach, as purchaser's exclusive remedy for any defect or nonconformity in the product, purchaser shall obtain from polimaster repair or replacement of the products containing such defect or nonconformity ("affected products"). In furtherance of such undertaking, if purchaser reasonably believes that any product contains a defect or nonconformity for which polimaster is responsible, purchaser shall inform polimaster of the nature of such defect or nonconformity in reasonable detail and shall request authorization from polimaster to return the affected products to polimaster for repair or replacement. All products so returned shall be shipped prepaid or otherwise delivered to polimaster's facility or authorized service center. If polimaster fails to repair or replace the affected products within a reasonable time after purchaser has so returned them to polimaster, purchaser shall be entitled to repayment or credit of the original price of the defective or nonconforming product as its exclusive further remedy.

Exclusions of damages and liability. Purchaser assumes the entire cost of any damage resulting from the use of the product and the information contained in, gathered or compiled by the product, and the interaction (or failure to interact properly) with any other hardware or software whether provided by polimaster or a third party. To the maximum extent permitted by applicable law, in no event will polimaster or its suppliers or licensors be liable for any damages whatsoever (including, without limitation, any special, incidental, consequential or indirect damages, damages for loss of business profits, business interruption, loss of business information, loss of data, loss of goodwill, work stoppage, hardware or software disruption, impairment or failure, repair costs, time value or other pecuniary loss) arising out of the use or inability to use the product, or the incompatibility of the product with any other product, hardware, software or usage, even if such parties have been advised of the possibility of such damages.

Limitation on Liability. Notwithstanding any provision to the contrary herein and with the exception of the claims of intellectual property rights infringements and the payments obligations hereunder, the liability of Polimaster for any claim whatsoever related to the Products or this Agreement, including any cause of action sounding in contract, tort, or strict liability, shall not exceed the greater of Ten Thousand (\$10,000.00) Dollars or the total amount of payments theretofore paid by Purchaser during the previous six month period to Polimaster in connection with the Products relating to such liability. This limitation of liability shall not apply to liability for death or personal injury to the extent that applicable law prohibits such limitation. Furthermore, because some jurisdictions do not allow the exclusion or

limitation of liability for consequential or incidental damages, the above limitation, if applicable, may not apply to purchaser.

Applicability. The limitations and exclusions contained herein shall apply notwithstanding any failure of essential purpose of any limited remedy.