

POLIMASTER

PERSONAL RADIATION DETECTORS

PM 1703M-O	PM 1703GNO
PM 1703MA	PM 1703GNA
PM 1703MB	PM 1703GNB
PM 1703M-O1	PM 1703M-O1A

OPERATION MANUAL

<http://www.polimaster.com>

CONTENTS

General.....	3
Indicator composition.....	5
Specifications	6
Provision of explosion protection.....	8
FCC statement	8
Clamp removal and installation.....	9
Installation and replacement of a power supply cell	9
Control buttons. Information on LCD.....	9
Indicator operation.....	11
Indicator on/off.....	11
Operation modes.....	11
Testing mode.....	12
Calibration mode for the background level.....	12
Searching mode. Detection and localization of sources of gamma and/or neutron radiation.....	13
Measuring mode of power ambient equivalent gamma radiation dose.....	15
Measuring mode of power ambient equivalent gamma radiation dose along with the search function	15
Searching mode "0-9".	16
Gamma registration mode.....	16
Indication mode of the average speed of gamma radiation counting over the time of accumulation. ..	17
Indication mode of neutrons.	17
Indication mode of the average speed of and count of neutrons over the time of accumulation	17
Quick switching of sound or vibration indication	17
Communication mode by a radio channel with a Pocket PC.....	18
Setting mode	18
n factor setting of the gamma channel.....	19
n factor setting of the neutron channel	19
Setting of the searching threshold by power ambient equivalent gamma radiation dose for the searching mode "0-9"	20
Setting of the fixed threshold of the count of neutrons for the searching mode "0-9"	20
Mode of indication setting.	
On/off of the sound and/or vibration indication.....	21
Setting of the sound indication volume	22
Communication mode with a personal computer. Indicator parameters.	23
Technical maintenance	24
Possible malfunctions	24
Storage and transportation	24
Manufacturer's guarantees.....	25
Acceptance certificate.....	25
Limited warranty	26
Attachment A	
Chart of ordering the operation modes and functions of the device.....	27

We thank you for purchase of the personal radiation detector of “Polimaster”

Before the beginning of operation with the personal radiation detector you should get acquainted with the present manual.

! During the search of radiation sources observe the existing rules of operation with radio active materials and sources, as well as the standards of radiation safety.

GENERAL INFORMATION¹

The personal radiation detector

- PM 1703M-O
- PM 1703MA
- PM 1703MB
- PM 1703GNO
- PM 1703GNA
- PM 1703GNB
- PM 1703M-O1
- PM 1703M-O1A

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

- the average counting speed of gamma radiation;
- the average counting speed of neutron radiation средней скорости счета нейтронного излучения (in the devices having the detector of neutron radiation²);
- power of the ambient equivalent of a dose of gamma radiations $\dot{H}^*$ (10) along the line ¹³⁷Cs in the collimated radiation (hereinafter referred to as “MED”).

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 indicator is made as an explosion-proof model. The indicator relates to the explosion-proof electric equipment of group II, sub-group IIC. By the level of explosion protection the indicator relates to the especially explosion-proof electrical equipment and is intended for the use in potentially explosion-proof environments (zone 0). The type of indicator explosion protection is “the sparkle-proof electric circuit ia”.

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.

¹ 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.

² PM1703GNO, PM1703GNA, PM1703GNB

The indicator is manufactured in 7 modifications.

Peculiar features of modifications								
Detector type	modifications							
	PM1703M-O	PM1703M-O1	PM1703M-O1A	PM1703MA ANSI 42.33(1)	PM1703MB	PM1703GNO	PM1703GNA ANSI 42.33(1)	PM1703GNB
• γ - CsI (TI) scintillator 3 cm ³	●	●	●			●		
• γ - G-M counter		●	●					
•n- LiI (Eu) scintillator 1 cm ³						●		●
CsI (TI) scintillator 4 cm ³ Increased pulse sensitivity of γ -detector				●	●		●	●
LiI (Eu) scintillator 2 cm ³ 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.

INDICATOR COMPOSITION

The supply set composition of the indicator complies with the table.

Description, type	Quantity per model							
	PM 1703M-O	PM 1703M-O1	PM 1703M-O1A	PM 1703MA	PM 1703MB	PM 1703GNO	PM 1703GNA	PM 1703GNB
Personal radiation detector PM1703M-O	1	-	-	-	-	-	-	-
Personal radiation detector PM1703M-O1	-	1	-	-	-	-	-	-
Personal radiation detector PM1703M-O1A	-	-	1	-	-	-	-	-
Personal radiation detector PM1703MA	-	-	-	1	-	-	-	-
Personal radiation detector PM1703MB	-	-	-	-	1	-	-	-
Personal radiation detector PM1703GNO	-	-	-	-	-	1	-	-
Personal radiation detector PM1703GNA	-	-	-	-	-	-	1	-
Personal radiation detector PM1703GNB	-	-	-	-	-	-	-	1
Disk (software on CD)	1	1	1	1	1	1	1	1
Panasonic POWER LINE AA (LR6) power supply cell ¹⁾	1	1	1	1	1	1	1	1
Key	1	1	1	1	1	1	1	1
Housing (made of synthetic cloth) ²⁾	1	1	1	1	1	1	1	1
IR communication channel adapter (ACT-IR220L or IR210B) ²⁾	1	1	1	1	1	1	1	1
Pocket PC ^{1),2)}	-	-	-	-	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
¹⁾ USE OF OTHER SIMILAR BY PARAMETERS ONES IS ALLOWED ²⁾ SUPPLIED AS PER INDIVIDUAL ORDER								

SPECIFICATIONS

Sensitivity of the indicator to gamma radiation,
at least

PM 1703M-O PM 1703M-O1 PM 1703M-O1A PM 1703GNO		$70 \text{ s}^{-1}/(\text{mc3v/h})$ ($0.7 \text{ s}^{-1}/(\text{mcR/h})$)– for ^{241}Am ; $100 \text{ s}^{-1}/(\text{mc3v/h})$ ($1.0 \text{ s}^{-1}/(\text{mcR/h})$)– for ^{137}Cs
PM 1703MA PM 1703MB PM 1703GNA PM 1703GNB		$100 \text{ s}^{-1}/(\text{mc3v/h})$ ($1.0 \text{ s}^{-1}/(\text{mcR/h})$)– for ^{241}Am ; $100 \text{ s}^{-1}/(\text{mc3v/h})$ ($1.0 \text{ s}^{-1}/(\text{mcR/h})$)– for ^{137}Cs

Sensitivity of the indicator to neutron radiation, at least

PM 1703GNO PM 1703GNB		$0.05 \text{ imp.}\cdot\text{cm}^2/\text{neutron}$ - for Pu- α -Be; $1.3 \text{ imp.}\cdot\text{cm}^2/\text{neutron}$ -for heat neutrons
PM 1703GNA		$0.1 \text{ imp.}\cdot\text{cm}^2/\text{neutron}$ - for Pu- α -Be; $2.5 \text{ imp.}\cdot\text{cm}^2/\text{neutron}$ -for heat neutrons

Range of powers of gamma radiation registration

from 0,033 to 3,0 MeV

Range of powers of neutron radiation registration

PM 1703GNA
PM 1703GNO
PM 1703GNB

From heat to 14,0 MeV

Range of indication of MED of photon radiation

PM 1703M-O1		0,01 - 9999 mc3v/h (1 – 1000 mR/h)
PM 1703M-O1A		0,01 mc3v/h - 13 3v/h (1 mcR/h – 1300 mR/h)
PM 1703M-O PM 1703GNO PM 1703MA PM 1703MB PM 1703GNA PM 1703GNB		0,01 - 99.99 mc3v/h (1 – 9999 mcR/h)

Relative error of MED measurement by line ^{137}Cs in the
collimated radiation, not exceeding:

PM 1703M-O1 - in the range from 0,1 to 9999 mc3v/h (10 mcR/h–1000 mP/ч)	$\pm 30 \%$
PM 1703M-O1A - in the range from 0,1 mc3v/h to 10 3v/h	$\pm(15+K_1/H+K_2H)\%$, wherein N-value of MED, m3v/h K_1 –factor equal to 0,0045 (m3v/h) K_2 - factor equal to 0,0015 (m3v/h) $^{-1}$
- in the range from 10 mcR/h–1000 mR/h	$\pm(15+K_1/H+K_2H)\%$, wherein N-value of MED , mR/h K_1 - factor equal to 0,45 (mR/h) K_2 - factor equal to 0,000015 (mR/h) $^{-1}$
- in the range from 0,1 to 70 mc3v/h (10 – 7000 mcR/h)	

PM 1703M-O PM 1703GNO PM 1703MA PM 1703MB PM 1703GNA PM 1703GNB	$\pm 30 \%$
--	-------------

Time of measurement	0,25 s
Frequency of false operations in the mode of registration of gamma-emissions with the radiation background 0,2 mc3v/h (20mcR/h)	No more than operation per 12 h of continuous operation
Frequency of false operations in the mode of registration of neutron emission PM 1703GNA PM 1703GNO PM 1703GNB	No more than operation per 12 h of continuous operation
Time of indicator continuous operation	At least 1000 h*
Calibration by background level	- automatic – in case indicator switching, change of n factors - autocalibration when the background level is changed - forced calibration by pressing the push button by the user
Signaling type:	-sound -vibration -visual
Communication with PC via IR channel	- Reading of data from storage, - Setting of indicator working parameters
Communication with Pocket PC by the radio channel of Bluetooth type PM 1703MB PM 1703GNB	Nuclide Identification and network data transmission
Quantity of recorded events to the indicator storage	by 1000
Terms of operation: - range of ambient temperatures;	From minus 30°C 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)
The indicator has resistance against impact of direct and alternate magnet fields having intensity	by 400 A/m
The indicator has resistance against impact of electrostatic discharges	8 kV (air discharge), 6 kV (contact discharge)
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)
Indicator supply	1.5 V* (one cell POWER LINE AA (LR6) or similar by parameters)
Protection degree of the indicator housing	IP65
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 housing)

Overall dimensions	
PM 1703M-O PM 1703MA PM 1703GNO PM 1703GNA PM 1703M-O1 PM 1703M-O1A	72 x 32 x 87 mm (2 13/16" x 1 1/4" x 3 7/16")
PM 1703MB PM 1703GNB	75 x 35 x 89 mm (2 15/16" x 1 3/8" x 3 7/8")
Mass (without a housing), not exceeding	
PM 1703M-O PM 1703MA	180 g (6.35 oz)
PM 1703GNO PM 1703GNA PM 1703M-O1 PM 1703M-O1A	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.*

ATTENTION! The manufacturer guarantees the technical parameters of the indicator as far as detection of sources and false operations are concerned at n factors set up at the manufacturer's. :

- for gamma radiation $n=5,3$;
- for neutron radiation $n=5^2$

PROVISION OF EXPLOSION PROTECTION

The explosion proof model of the indicators is provided by the type of explosion protection "sparkle-free electric circuit ia" as per IEC 60079-11 and execution of the indicator construction in accordance with the requirements of IEC 60079-0 owing to the following designing and circuit technical solutions:

- provision of the normal degree of mechanical strength of the indicator casing in accordance with the requirements of IEC 60079-0;
- the use of materials in the casing of the indicator excluding inflammability from electrostatic discharges;
- limitation of the short circuit current down to 1,0 A from a galvanic supply cell having voltage 1, 5 V with the aid of a current limiting resistor and a fuse;
- the use of a special key for unscrewing the cover of the supply cell and a warning note in the explosion hazard area "Do not open!";
- limitation of internal capacity of alarm to values not exceeding the intrinsic safety level;
- introduction of limiting stabilitrons, shunting the piezoceramic cell 20 mm x 0,38 mm 4 kHz;
- use of sealing by means of the voltage converter compound 1,5 V – 20 V;
- provision of the protection degree for the indicator casing IP65 as per IEC 529.

Marking of the explosion protection at the indicator casing EEx ia IIC T4.

FCC STATEMENT

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation

² PM1703GNO, PM1703GNA, PM1703GNB

CLAMP INSTALLATION AND REMOVAL

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.1a. The clamp is installed according to fig. 1b.

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

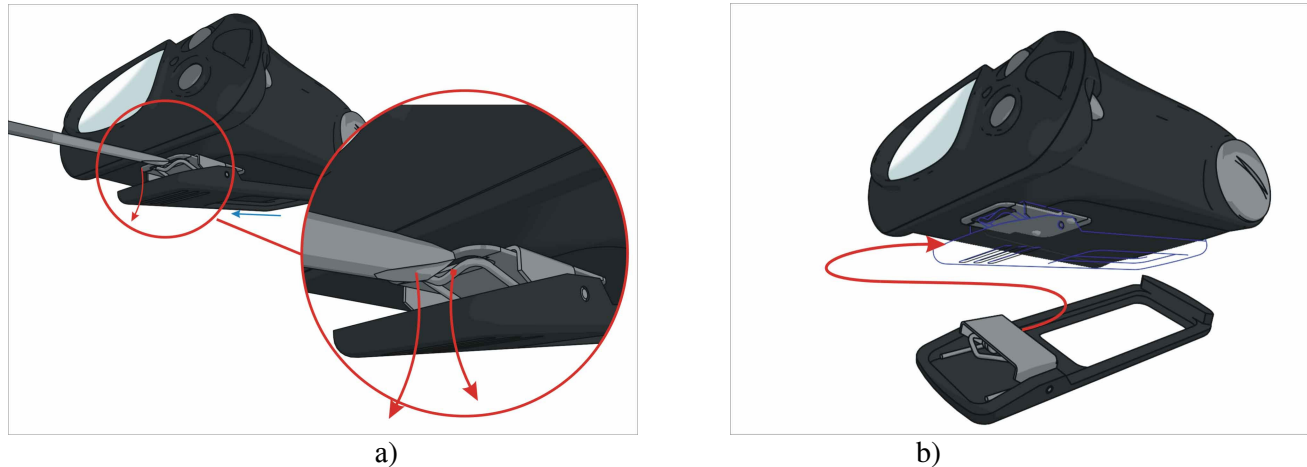


Figure 1

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 2) 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 “ ” 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 minutes by a short pressing the MODE button. Being so, signaling by operation thresholds will be switched on.

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 2.

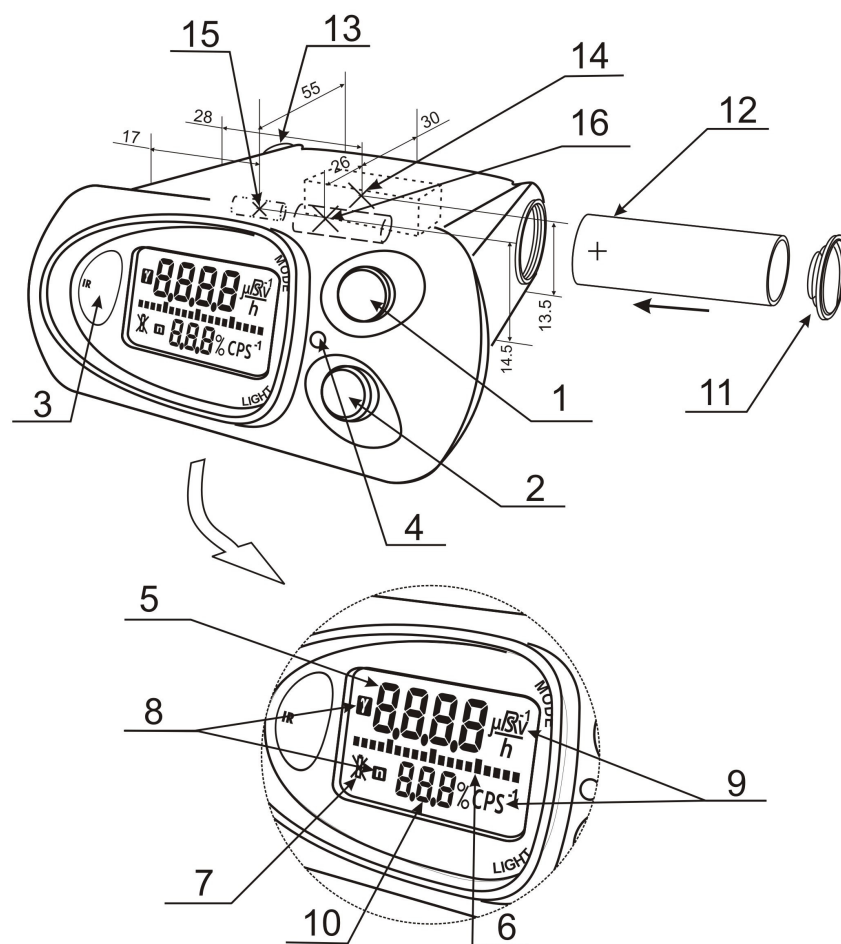


Figure 2

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);
- MED values of gamma radiation, $\mu Sv/h$ ($\mu R/h$) (in the mode of MED 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 MED level in the searching mode 0-9

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

8 – marks indicating the paramemetr²s of gamma, neutron² 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 neutron² radiation;
- « $\mu Sv/h$ » – in the MED indication mode (option " $\mu R/h$ ")

10 – the low LCD line, intended for:

² PM1703GNO, PM1703GNA, PM1703GNB

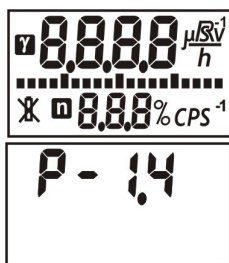
- - indication of the average statistical expected indication error of MED, %
 - - indication of the count speed of neutron² radiation, (s⁻¹)
- 11 – a cover of the power supply section
 12 – a power supply cell
 13 – a sound indicator
 14 – a geometric detector center Cesium Iodide Scintillator
 15 – a geometric detector center G-M tube
 16 – a geometric detector center of neutron radiation detector

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.

INDICATOR SWITCHING ON/OFF

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.

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).

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, s⁻¹);
- the mode of MED measurement;
- the mode of MED 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)
- the mode of indication of the average count speed of gamma radiation over the time of accumulation (only for PM1703M-O1)

² PM1703GNO, PM1703GNA, PM1703GNB

- the mode of registration of neutrons²
- the mode of indication of the average count of neutrons over the accumulation time²
- the mode of fast switching of sound and vibrating signaling
- the mode of settings:
 - setting the **n** factor of gamma channel
 - setting the **n** factor of neutron channel
 - setting the threshold by MED 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);

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.



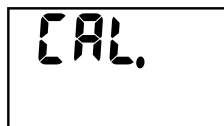
In the testing mode all required tests are fulfilled. Initially, the battery discharge level is tested. "bAtt" is indicated on the LCD, as well as quantity of segments of the analogue scale which corresponds to the battery discharge level.

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"³.

CALIBRATION MODE BY BACKGROUND LEVEL³

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 channel² 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.

² PM1703GNO, PM1703GNA, PM1703GNB

³ The said mode is unavailable in indicators with the switched on SEARCHING MODE "0-9"

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

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

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

SEARCHING MODE.

DETECTION AND LOCALIZATION OF SOURCES OF GAMMA AND NEUTRON RADIATIONS.

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 PM 1703M-O1A PM 1703M-O PM 1703MA PM 1703MB		the average statistical indication error of the average count of gamma radiation in per cents;
PM 1703GNO PM 1703GNA PM 1703GNB		the average speed of count of neutron radiation in s^{-1};
All modifications		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.
PM 1703GNO PM 1703GNA PM 1703GNB		If at indicator operation in the searching mode the average speed of count of the gamma channel exceeds the upper limit of indication, “999” blinking message is indicated on LCD.

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

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

When the installed threshold is exceeded by MED 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 MED 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**.

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 4th 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 channel² 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 channel.

In the searching mode the device resolves the problems of detection and localization of sources of gamma and neutron radiation.

Detection of sources of gamma and neutron ² radiation (II)

For II detection the device should be located so that the rear side (wherein the clamp is fixed) should be directed to the tested object. The closer the device is placed to the tested object (luggage, a human being, a container, a vehicle, etc) and the slower it travels along the object, detection efficiency is higher.

For II detection under conditions when sound signals of the indicator may be not heard (for example, excessive 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;
- the background level calculated by the indicator in the calibration mode by the background level.

In case when automatic calibration 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, automatic calibration 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.

² PM1703GNO, PM1703GNA, PM1703GNB

It should be borne in mind that in case of false operations the signals (light, sound and/or vibrating) are not systematic, and therefore, they differ from detection signals in case of II availability, with their frequency being constant and increasing as far as approaching to II.

In case of II detection or if any information is available about possible II availability, II localization is started.

Localization of sources of gamma and neutron² radiation

For II localization the indicator should be kept at the distance of not exceeding 10 cm from the object. The traveling speed in relation to the object shall not exceed 10 cm per second. By approaching II frequency of signals increases.

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.

When the limit frequency 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 indicator will calibrate by a new background level, after what II localization can be continued. If necessary, these actions can be repeated several times up to location of II.

During localization of the source of neutron² or mixed gamma and neutron radiations the sound and vibrating indication can not be used, as the indicator will send signals typical for exceeding the speed threshold of counting the neutron channel without any reaction to source approaching and removing. In this case localization should be visual by observing the readings of count speed (or MED) in the upper line of the LCD (gamma channel) or count speed in the lower line of the LCD (neutron channel).

MODE OF MED MEASUREMENT.

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



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

MED MEASURING MODE ALONG WITH SEARCHING FUNCTION.

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

The following is indicated in the lower line:

PM 1703M-O1 PM 1703M-O1A PM 1703M-O PM 1703MA PM 1703MB	The image shows a digital LCD display with two lines. The top line displays '00.12' followed by the unit 'μSv/h'. The bottom line displays '06%'.	• average statistical error of MED indication in percents
PM 1703GNO PM 1703GNA PM 1703GNB	The image shows a digital LCD display with two lines. The top line displays '00.12' followed by the unit 'μSv/h'. The bottom line displays '0.01' followed by the unit 's⁻¹'.	• average speed of count of neutrons in 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

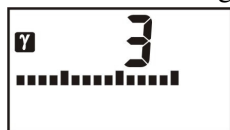
² PM1703GNO, PM1703GNA, PM1703GNB

the searching function is additionally included in the measuring mode (see the order chart – attachment A).

SEARCH MODE "0-9".

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

Indicated figure	0	1	2	3	4	5	6	7	8	9
Range of indicated MEG, background to 3,6 mc3v/h	From $\geq 3,6$	$\geq 7,2$	$\geq 10,8$	$\geq 14,4$	$\geq 18,0$	$\geq 21,6$	$\geq 25,2$	$\geq 28,8$	$\geq 32,4$	$\geq 36,0$



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 MED** 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 MED is accompanied with light and sound signaling. Mechanical vibrations inside the device (casing trembling) are felt with the switched on vibrating indicator instead of sound signals. Frequency of signals increases by device approaching to the gamma radiation source.

2) The **safety threshold – the 2nd threshold by MED**, 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 – 3mR/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 MED from the safety threshold.



Compliance of speed values by neutron² channel and digits indicated on the device LCD is shown in the following table.

Indicated figure	0	1	2	3	4	5	6	7	8	9
Count speed	From backg round to 2	≥ 2 < 4	≥ 4 < 6	≥ 6 < 8	≥ 8 < 10	≥ 10 < 17	≥ 17 < 24	≥ 24 < 31	≥ 31 < 41	≥ 41

The fixed threshold of counting neutrons for the searching mode "0-9" (the range of threshold setting is equal to 1.0 – 99.0 s^{-1} , recommended – 1.5 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.

GAMMA REGISTRATION MODE (only for PM1703M-O1)

In this mode in the upper line of LCD a γ 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.

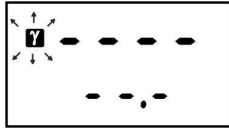
² PM1703GNO, PM1703GNA, PM1703GNB

INDICATION MODE OF AVERAGE SPEED OF GAMMA RADIATION INDICATION DURING ACCUMULATION (only for PM1703M-O1)



In this mode in the upper line of LCD a γ is blinking, and 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.

MODE OF NEUTRONS REGISTRATION²

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

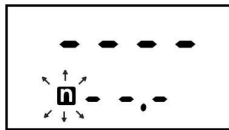
X.XEX – in case of indication above 9999 impulses, wherein X – any figure from 0 to 9, EX is 10^x .

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

INDICATION MODE OF AVERAGE SPEED OF NEUTRON RADIATION INDICATION DURING ACCUMULATION²

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

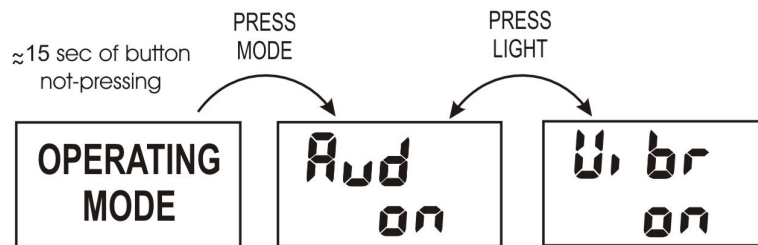
The lower LCD line shows the value of the statistical error of the average count speed in percents.



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.

FAST 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.

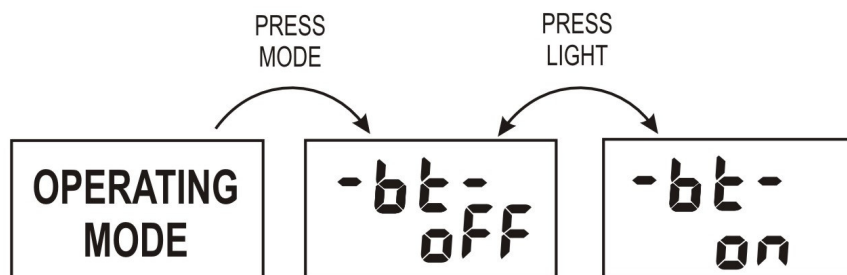
It should be borne in mind that the user may change the sound volume in the mode of settings.

² PM1703GNO, PM1703GNA, PM1703GNB

COMMUNICATION MODE BY RADIO CHANNEL WITH POCKET PC⁴.

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 "Smart2003" 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.

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:

	• the radio channel is on, no communication with the PPC;
	• the radio channel is on, communication with the PPC has been established ⁴

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].

MODE OF SETTINGS

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);

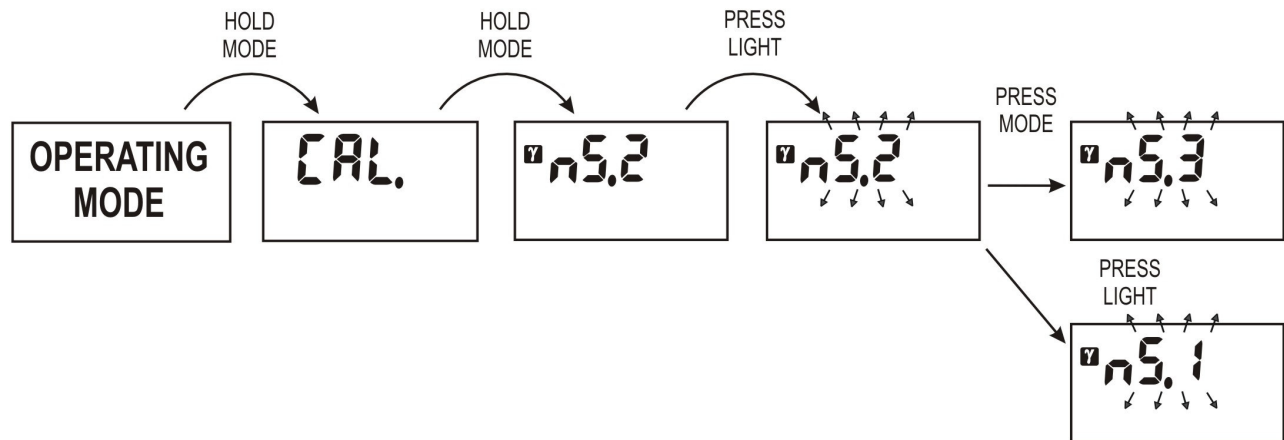
- the preset value is to be checked or a new value of the searching threshold is to be set as per MED for the searching mode "0-9" (the threshold setting range is equal to 15 – 7777 $\mu\text{R/h}$ (0.15-77.77 $\mu\text{Sv/h}$), recommended - 30 $\mu\text{R/h}$ (0,3 $\mu\text{Sv/h}$));

⁴ a PPC with the Bluetooth installed should be used for indicator operation in the said mode.

- 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 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.

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.



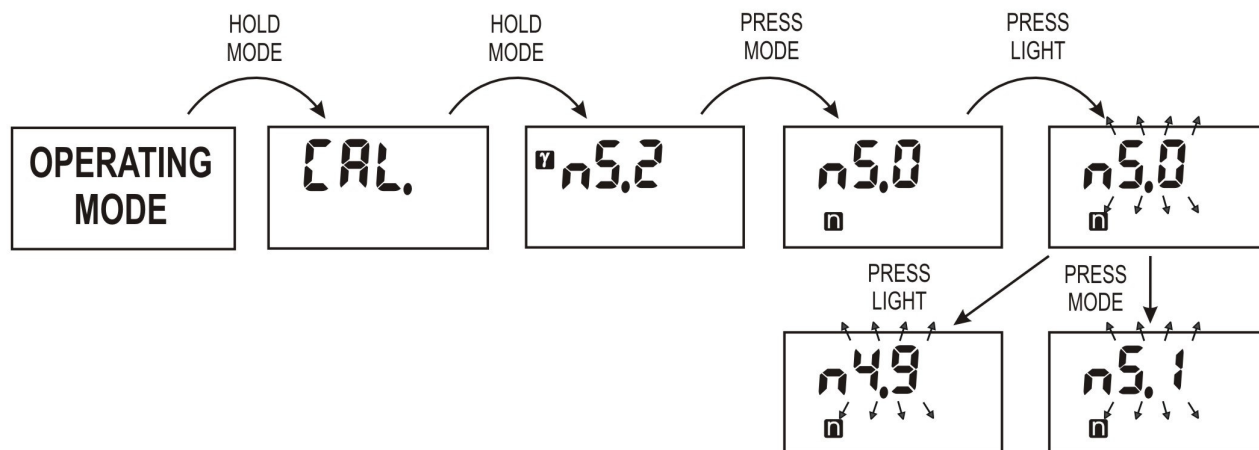
For changing the value of n-factor one should shortly press LIGHT push button during subsequent four seconds. The preset value of n-factor will blink by indicating its possible change. If the LIGHT button was not pressed during the said time interval, the indicator automatically returns to the working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

SETTING OF N FACTOR OF NEUTRON CHANNEL²

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.

² PM1703GNO, PM1703GNA, PM1703GNB

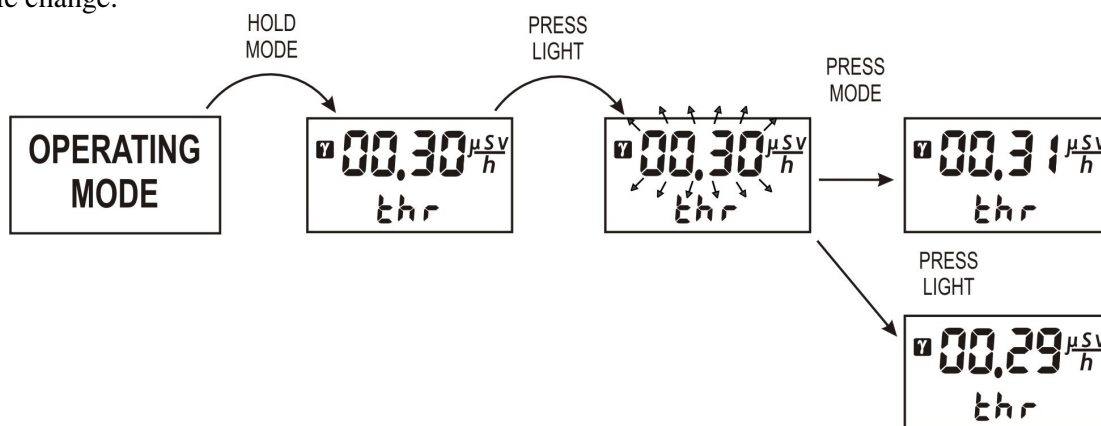


Subsequent pressings of the LIGHT push button reduce the preset value of n factor with pitch 0,1. Subsequent pressings of the MODE push button increase the preset value of n factor with pitch 0,1. If the push buttons are kept pressed the values are reduced or increased accelerated with the same pitch. 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.

SETTING OF SEARCHING THRESHOLD BY MED FOR SEARCHING MODE "0-9"

For setting the searching mode by MED 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 MED will appear on the LCD.

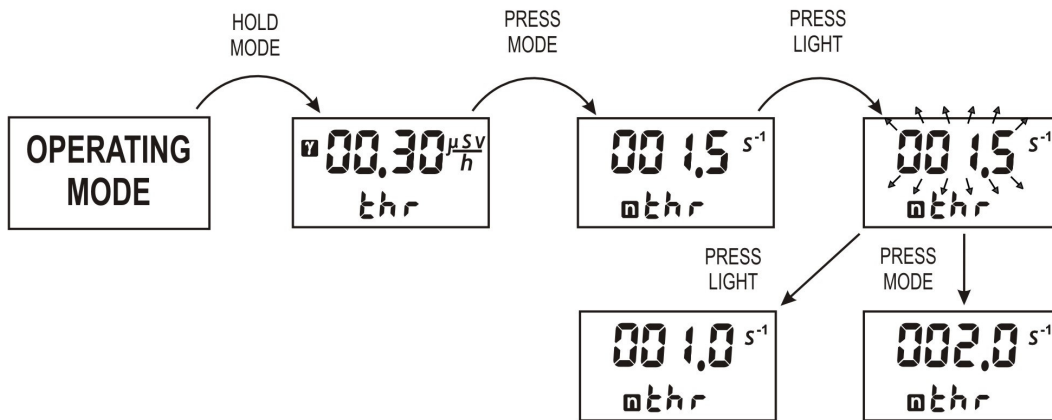
For changing the value of the threshold by MED one should shortly press LIGHT push button during subsequent four seconds. The preset value of the searching threshold by MED will blink by indicating its possible change.



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 MED with pitch 0,1. Subsequent pressings of the MODE push button increase the preset value of the threshold by MED 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 MED after expiry of approximately 6 s after the last pressing the push button the indicator will automatically be shifted to the operation mode.

SETTING THE FIXED THRESHOLD OF NEUTRONS COUNTING FOR 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 MED 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.



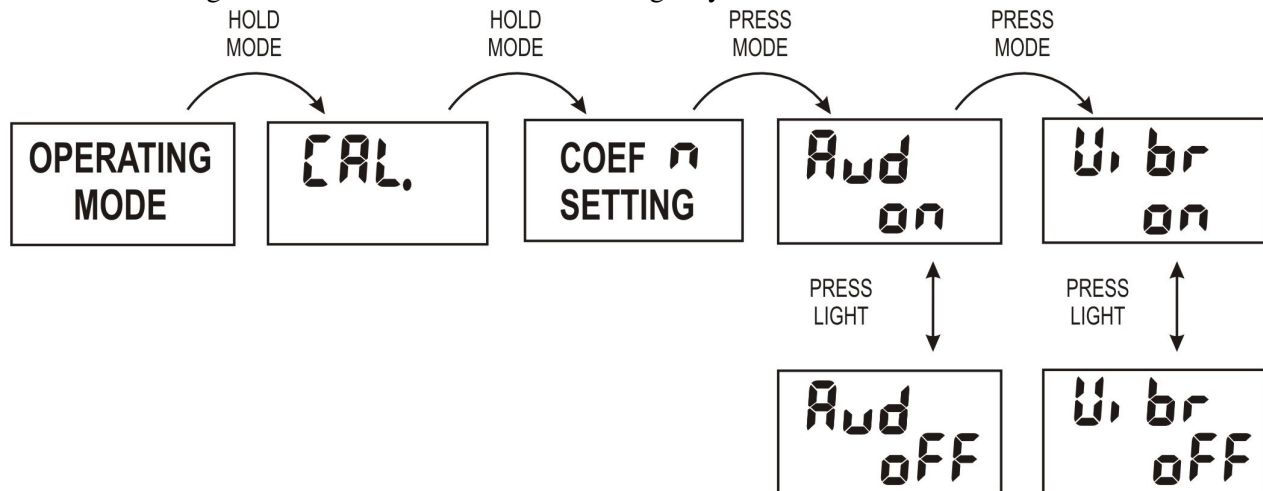
For changing the value of the threshold of the neutrons count one should shortly press LIGHT push button during subsequent four seconds. The preset threshold value will blink what shows its possible change. If the LIGHT button was not pressed during the said time interval, the indicator automatically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

MODE OF INDICATION SETTINGS

ON/OFF OF SOUND AND/OR VIBRATING 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,

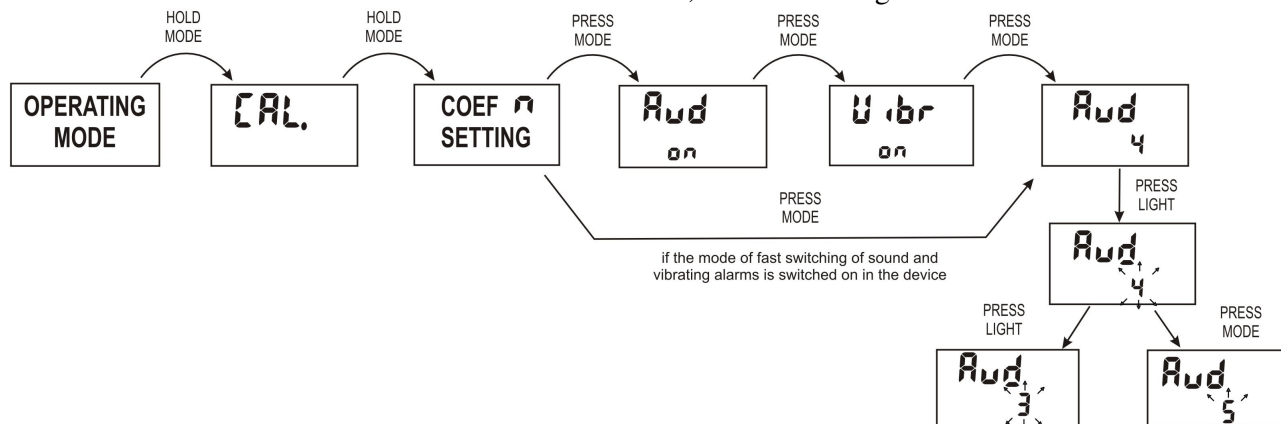
- being so, “Vibr-off” or “Vibr-on” message will appear on the LCD. The abbreviated note “Vibr” – indicates the vibrating indication, notes “off” (“on”) – the off (on) state of the vibrating indication. Setting of and removal from this mode is performed by actions similar to the aforesaid ones.

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”.

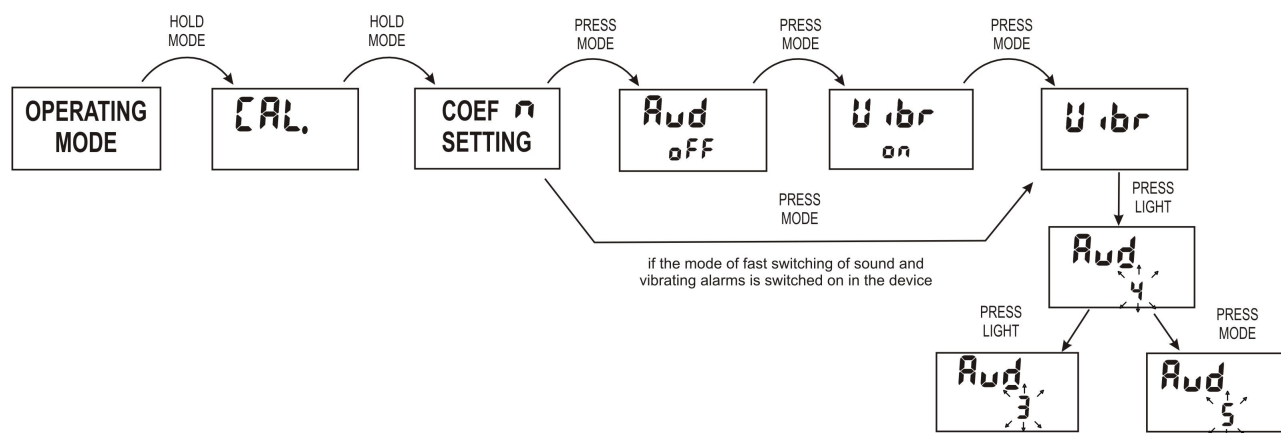
- If the sound indication is switched on in the device, then at entering the mode of sound volume



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.

COMMUNICATION MODE 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.

Communication mode 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 (ПП) 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.**

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:
 - the indicator number;
 - time of indicator on/off;
 - current MED value by the gamma channel via the consecutive time interval set up by

the user;

-time and indicator readings in case of exceeding the operation threshold of the gamma channel;
 - time and indicator readings in case of exceeding the operation threshold of the neutron 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 MED 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 MED, 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);
- automatic calibration should be switched on/off;

TECHNICAL MAINTENANCE

The technical maintenance of the indicator:

- 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.

-replacement of a supply cell in the explosion hazard area is strictly prohibited).

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.

POSSIBLE MALFUNCTIONS

Typical malfunctions	Troubleshooting
• The indicator can not be switched on	Wrong installation of the power cell
• The LDC indicates the mark "X"	The power cell is to be replaced
Other malfunctions shall be eliminated by the manufacturer.	

STORAGE AND TRANSPORTATION

Storage

Indicators must be stored at storehouses in the manufacturer's package at the ambient temperature from minus 15 to plus 50 °C and relative humidity by 95 % at temperature 35 °C. Storage duration shall not exceed the average service life of the indicator – 8 years.

Indicators without packages should be stored at the ambient temperature from 10 to 35 °C and relative humidity 80 % at temperature 25 °C.

In the storage premises there shall be no dust, vapours of acids and alkalis, aggressive gases and other harmful admixtures causing corrosion.

Transportation

Indicators in the packaged form and switched off state allow transportation by any closed transport type at the ambient temperature from minus 50 to plus 50°C.

The packed indicators must be fixed in a vehicle. Placement and fastening of the packed indicators in the vehicle shall provide their stable position, exclude possibility of shocks on each other , as well as on vehicle walls.

In case of transportation by the sea transport the indicators in the packed form must be placed to a polyethylene housing with the silica gel drier.

During transportation by air the indicators in the packed form must be located in sealed sections.

MANUFACTURER'S GUARANTEES

The manufacturer hereby guarantees compliance of the indicator with the requirements of Specifications and operation, transportation and storage rules set up in the present Operation Manual.

The warranty operation period is equal to 18 months since the date of putting the indicator into operation within the warranty storage period.

The warranty storage period is equal to 6 months since the date of acceptance of the indicator by the manufacturer's Quality Control Department representative.

The warranty and post-warranty repair is to be performed by the manufacturer or organization having the manufacturer's permit.

The warranty does not concern the indicators:

- at expiry of the warranty operation term if the indicator is purchased within the limits of the warranty storage period;

- in case of the non-warranty maintenance (if traces of indicator opening are visible);

- in case of mechanical damages and non-observance of operation and storage rules;

- in case of submitting the indicator for the warranty service without the operation manual.

The warranty operation period is to be prolonged for a period of the warranty repair.

The warranty obligations do not refer the supply cells. Replacement of the supply cell is not considered the warranty repair.

ACCEPTANCE CERTIFICATE

The personal radiation detector PM1703_____

manufacturer's No. _____,

has been made and accepted in compliance with the requirements of the state standards, the existing technical documentation and found fit for operation.

Chief of Quality Control Department

Stamp of the QCD

Signature, deciphering of the signature

" _____ " _____ .

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.

Attachment A

Order sheet of modes operation and functions of the devices:

PM1703M-O, PM1703M-O1, PM1703M-O1A, PM1703MA, PM1703MB,
PM1703GNO, PM1703GNA, PM1703GNB,

#	Modes and functions	On/off ----- set value	Note
1	Search mode (gamma, indication "s ⁻¹ ")		Can be ON autonomous or combined with modes 2 or 3
2	Measurement mode (indication $\mu\text{Sv/h}$)		Can be ON autonomous or combined with modes 1 or 5
3	Measurement mode (indication $\mu\text{R/h}$)		Can be ON autonomous or combined with modes 1 or 5
4	Gamma registration mode: Modes of storage of counting pulse (gamma, indications ¹) and average count rate at storage time		Only for device PM1703M-O1 Can be ON additionally to modes 1, 2 or 3
5	Mode 0....9: Mode of relative indication (0-9)		Can be ON autonomous or combined with modes 2 or 3
6	Auto calibration		Impossible in mode 5
7	Search in measurement mode		Possible only in combining of modes 1 and 2 Or 1 and 3
8	Installation of thresholds DER for mode 5 - Search threshold - threshold DER (threshold of safety)		threshold: 15 – 7777 $\mu\text{R/h}$ (0.15-77.77 $\mu\text{Sv/h}$) advisable 30 $\mu\text{R/h}$ (0,3 $\mu\text{Sv/h}$) threshold 10 – 7000 $\mu\text{R/h}$ (0,1-70 $\mu\text{Sv/h}$) advisable - 3mR/h (30 $\mu\text{Sv/h}$)
9	Installation of thresholds DER for modes 1-3 - threshold DER (threshold of safety))		threshold- 1 – 7000 $\mu\text{R/h}$ (0.01 – 70 $\mu\text{Sv/h}$) advisable- 3mR/h (30 $\mu\text{Sv/h}$)
10	Switch Audio/Vibr: Fast switch of alarm mode: audio-light or vibr-light		Возможность быстрого переключения вида сигнализации без входа в режим установок
11	Changing of volume level: Adjustment of level of audio alarm by buttons		Possibility of change of volume level of audio alarm in settings mode

Additional for GN - devices			
12	Registration mode of neutrons: Modes of storage of counting pulse (neutrons, indication S^{-1}) and average count rate at storage time		
13	Neutron threshold: Setting of set threshold count (neutrons)		Only for mode 5 threshold: 1.0 - 99.0 s^{-1} (with interval 0.5) advisable - 1,5 s^{-1}
Additional settings			
14	Interval of history record, min		
15	Resolution of coefficient variation n		
16	Coefficient n (gamma)		Advisable 5.3
17	Coefficient n (neutron)		Advisable 5.0
18	Resolution of alarm variation		
19	Audio alarm		
20	Vibration alarm		
21	Resolution of thresholds variation		Only for mode 5