PERSONAL RADIATION DETECTORS

PM 1710A
PM 1710C
PM 1710GNA
PM 1710GNC

OPERATION MANUAL

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Appendix A Detector operation modes and factions order chart 24

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

Personal Radiation Detector
PM1710A,
PM1710C,
PM1710GNA,
PM1710GNC

Further referred to as "detector" is designed for the search and localization of radioactive (**PM1710A and PM1710C**) and nuclear (**PM1710GNA** and **PM1710GNC)** materials using the method of impulse count analysis when registering gamma and neutron radiation with the visualization on the built-in LCD of the following information:

- gamma radiation ambient **Dose Equivalent Rate** ö*(10) for ^{137}Cs (further referred to as "DER");
- average gamma radiation count rate;
- average neutron radiation count rate (only for **PM1710GNA** and **PM1710GNC).**

The detectors can be used both indoors and outdoors by a wide range of users who in their everyday work deal with the search and localization of radiation sources.

PM1710C and **PM1710GNC** detectors can be powered from an external energy source and have a PC connection interface, whereas **PM1710A** and **PM1710GNA** do not possess these features. Using the PC connection it is possible to create radiation control systems on the basis of **PM1710C** and **PM1710GNC** detectors.

All operations history is stored in the detector's permanent memory, protecting the data even when the battery is removed. The stored data can also be transferred from the detector to a personal computer via its infrared interface.

2 Delivery options

Consult the table 2.1 to find out which modes and features are enabled in your particular Gamma or Gamma-Neutron Radiation Detector.

Enabled features are marked by ”1”.

Table 2.1

Description, type	Quantity per model			
	PM1710A	PM1710C	PM1710GNA	PM1710GNC
Personal radiation detector PM1710A	1			
Personal radiation detector PM1710C		1		
Personal radiation detector PM1710GNA			1	
Personal radiation detector PM1710GNC				1
Battery cell Panasonic XTREME POWER LINE AA (LR6)[1)]	1	1	1	1
Remote vibration alarm	1	-	1	-
Wrist band	1	-	1	-
IR communication adapter (ACT-IR220L or IR210B)[2)]	1	1	1	1
Telescopic tube[2)]	1	-	1	-
Software on CD	1	1	1	1
Switch module [3)]	-	1	-	1
Processing module [4)]	-	1/10	-	1/10
Operating manual	1	1	1	1
User packing box	1	1	1	1

[1)] Other similar batteries can be used, but not smaller than 2700 mA/h;
[2)] Is ordered separately;
[3)] Is ordered separately to build a radiation control system;
[4)] Is ordered separately (1 for 10 detectors) to build a radiation control system

3 Specifications

Table 3.1

3.1 Detectors: - gamma - neutron	 CsI(Tl) scintillator ^{3}He
3.2 Gamma Sensitivity	5 cps/(μR/h) (500 cps/(μSv/h)) — for ^{241}Am 5 cps/(μR/h) (500 cps/(μSv/h)) — for ^{137}Cs 2 cps/(μR/h) (200 cps/(μSv/h)) — for ^{60}Co
3.3 Neutron Sensitivity (only for PM1710GNA, PM1710GNC)	0.1 (counts·cm^2)/neutron - for Pu- α -Be; 7.0 (counts·cm^2)/neutron - for thermal neutrons 1.0 (counts·cm^2)/neutron - for Pu- α -Be on a phantom
3.4 Energy Range of gamma radiation	from 0.045 to 3.0 MeV
3.5 Energy Range of neutron radiation (only for PM1710GNA, PM1710GNC)	from thermal to 14.0 MeV
3.6 Mean neutron count rate indication range (only for PM1710GNA, PM1710GNC)	001 - 999 s^{-1}
3.7 Photon radiation indication range	1 – 3000 μR/h (0.01 – 30 μSv/h)
3.8 Accuracy of DER indication (at ^{137}Cs) in the range of 0.1 – 20 μSv/h (10 – 2000 μR/h), no less than	± (20 + K/$\dot{H}$) %; where $\dot{H}$ is the indicated DER, K – a coefficient of 1 μSv/h
3.9 At preset coefficient **n = 4.5** (**number of mean-square deviation of current radiation background**) and gamma-radiation background level is no more than 0.25 μSv/h, the detector should detect gamma radiation sources and samples from nuclear materials according to Table 3.2 below with the probability more than 0.5	According to the P 51635 II H_{Y20} standard
3.10 At preset coefficient n (number of mean-square deviation of current radiation background) at which the false alarms rate is no more than 1 per 10 min, the detector in the chamber-moderator should detect neutron radiation sources ^{252}Cf with flux density 1.5·10^4 s^{-1} and moving speed 0.5 m/s at the distance 1 m from the detector effective center with the probability more than 0.5 (only for PM1710GNA, PM1710GNC)	According to the P 51635 IY H_{n100} standard
3.11 False alarms rate in the gamma radiation detection mode at the level of radiation background not more than 25 μR/h (0.25 μSv/h) with gamma channel coefficient **n=5.3** **n=4.5**	 no more than 1 per 10 hours of continuous operation; no more than 1 per 10 minutes of continuous operation
3.12 False alarms rate in the neutron radiation detection mode with neutron channel coefficient **n=5.0** **n=4.0** (Only for PM1710GNA and PM1710GNC)	 no more than 1 per 10 hours of continuous operation; no more than 1 per 10 minutes of continuous operation

3.13 Background calibration:	**- automatic** – after the detector is turned ON or an coefficient n change; - **autocalibration** on background level change; **- user initiated**
3.14 Alarm Types:	- audio tone; - remote vibration (only PM1710A and PM1710GNA); -visual
3.15 PC Communications through IR channel at an up to 0.3 meter distance	- reading of the history from detector memory; - setting the detector parameters
3.16 Data Collection	1000 data points
3.17 Environmental: Temperature range Humidity	 -22 to +122 °F (-30 to +50 °C) LCD: -15 to +50 °C up to 95 % at +95 °F (+35 °C)
3.18 Constant and alternating magnetic fields resistible, field strength	up to 400 A/m
3.19 Electrostatic discharge resistible	8 kV (air discharge), 6 kV (contact discharge)
3.20 Radiofrequency electromagnetic fields resistible	30 V/m in the range of frequencies from 20 to 1000 MHz (amplitude sinusoidal modulation having 80 % depth and 1 KHz frequency), 30 V/m in the frequencies range from 800 to 960 kHz and from 1.4 to 2.5 GHz, (amplitude rectangular modulation with the 100 % depth and 200 Hz frequency)
3.21 Power Requirements	one AA battery 1.5(+ 0.1; -0.4) V
3.22 Battery Lifetime	up to 1.000 hours*
3.23 Environmental protection	IP65
3.24 Drop Test	2.3 ft (0.7 m) onto concrete surface
3.25 Dimensions: - PM1710A, PM1710C - PM1710GNA, PM1710GNC	 $6^{25\backslash 32}$ x $2^{1\backslash 4}$ x $1^{1\backslash 4}$ in. (172 x 57 x 32 mm) $7^{21\backslash 32}$ x $3^{15\backslash 64}$ x $1^{1\backslash 4}$ in. (194 x 82 x 32 mm)
3.26 Weight, no more: - PM1710A, PM1710C - PM1710GNA, PM1710GNC	 420 g (14.82 oz.) 620 g (21.87 oz.)
**** It is also possible to use a rechargeable battery to power the detector. It is only important to make sure that the battery size is the same and its voltage is in the 1.1 – 1.6 V range. In this case, however, battery lifetime and working temperatures may differ from the specified above.***	

Table 3.2

Parameter	**Source type**				
	^{133}Ba	**^{137}Cs**	**^{60}Co**	**Sample** (from Plutonium)	**Sample** (from Uranium)
Gamma source activity, kBq (μCi) ±30 %	55.0 (1.5)	100.0 (2.7)	50.0 (1.35)	-	-
Sample weight, g	-	-	-	0.1	3.0
Moving speed (source/detector), m/s	0.5±0.05	0.5±0.05	0.5±0.05	-	-
Distance between the source and the detector sensor, m	0.2±0.005	0.2±0.005	0.2±0.005	-	-

4 GENERAL DESCRIPTION

PM1710 detectors belong to Polimaster's new generation of extremely sensitive, small and power-saving, gamma and gamma-neutron radiation detectors. When ON the detector continuously monitors the environment for radiation and alerts the user with an audio, visual, and/or vibrating alarm if a radiation source is detected.

The present section contains the information about the detector design necessary for a user.

4.1 Display and Control buttons

Two control buttons for the detector operation (MODE) and (LIGHT), a liquid crystal display (LCD), IR interface window, figure 1 are located on the detector top panel.

4.2 Battery Installation

The detector is packaged without the battery installed.

To install the battery open the cover (12 in the figure 1) located on the right end of the unit with a coin or screwdriver. Once opened, insert a single AA alkaline battery (11 in the figure 1) loading the positive (+) end first. Reinstall the cover and tighten it. If the battery is properly installed, the LCD screen will display all segments.

When the battery voltage drops below 1.1 V, the Low Battery warning sign will be displayed and the detector will provide periodical audio tone indicating the need to replace the battery.

You have 8 hours (at normal background level) before the battery is completely discharged. The user can turn off the low battery warning for 30 minutes by pressing the MODE button. Turn OFF the detector and follow the previous instructions to replace the battery.

1 - MODE button:
- Switches the detector on;
- Selects a working mode;
- Performs background recalibration;
- Changes parameters in the Set mode.

2 - LIGHT button:
- Switches on LCD light;
- Enables the PC communication mode;
- Changes parameters in the Set mode;
- Turn the detector off.

3 - IR window

4 - PM1710A, PM1710GNA — remote vibration alarm connector;
PM1710C, PM1710GNC — connection cable connector.

5 - The upper LCD line is used to display the following information:
- count rate, s^{-1} (in the Search mode);
- gamma DER values, μSv/h (μR/h) (in the DER indication mode);
- messages "test", "CAL", "OL", "OFF", "P-1.3" etc.;
- alarm type (sound or vibration).

6 - The **analogue scale** of 19 segments is used for:
- indicating of time left of the internal processor tests – decrease of the segments number up to their disappearance;
- indicating of time left of calibration by the background level – increase of the segments number up to the scale filling;
- indication of threshold level exceeding for gamma channel (in the Search mode).

7 - Critical battery discharge: displayed when the battery voltage drops below 1.1 V.

8 - **Pictograms** indicating the parameters of gamma and neutron radiation.

9 - **Dimension of the indicated value**:
- «s^{-1}» – in the gamma radiation Search mode;
- «s^{-1}» – in the neutron radiation Search mode;
- «μSv/h» – in the DER indication mode (option "μR/h").

10 - The lower LCD line is used for:
- indication of the mean square error of the count indication, %;
- indication of count rate of the neutron radiation, s^{-1} (only for PM1710GNA, PM1710GNC).

11 – Battery.

12 - Battery cover.

13 - Sound alarm.

14 - **Markers** of the detector geometrical centers.

15 - **External vibration alarm**.

Figure 1

4.3 Clip Installation/Removal

The PM1710 detectors come with a clip which may be used to fasten the detector to a waist belt or pocket.

The clip may be easily removed from the detector by using a screwdriver or similar tool according to instructions depicted in the figure 2.

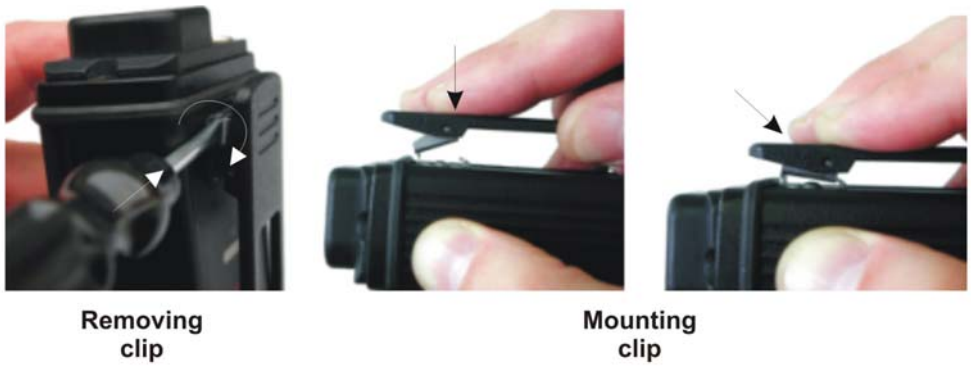


Figure 2 -Clip installation/removal

4.4 Telescopic tube. Remote vibration alarm

4.4.1 Apart from the built in light and vibration alarms, **PM1710A** and **PM1710GNA** detectors are equipped with a **remote vibration alarm** (figures 1, 3, and 4), which activated when the radiation threshold levels are exceeded. In the *Search mode* as the detector approaches a radiation source, the frequency of vibrations becomes higher so that the user could guess the direction in which the radiation source is located. This is very useful when working covertly or in a noisy environment.

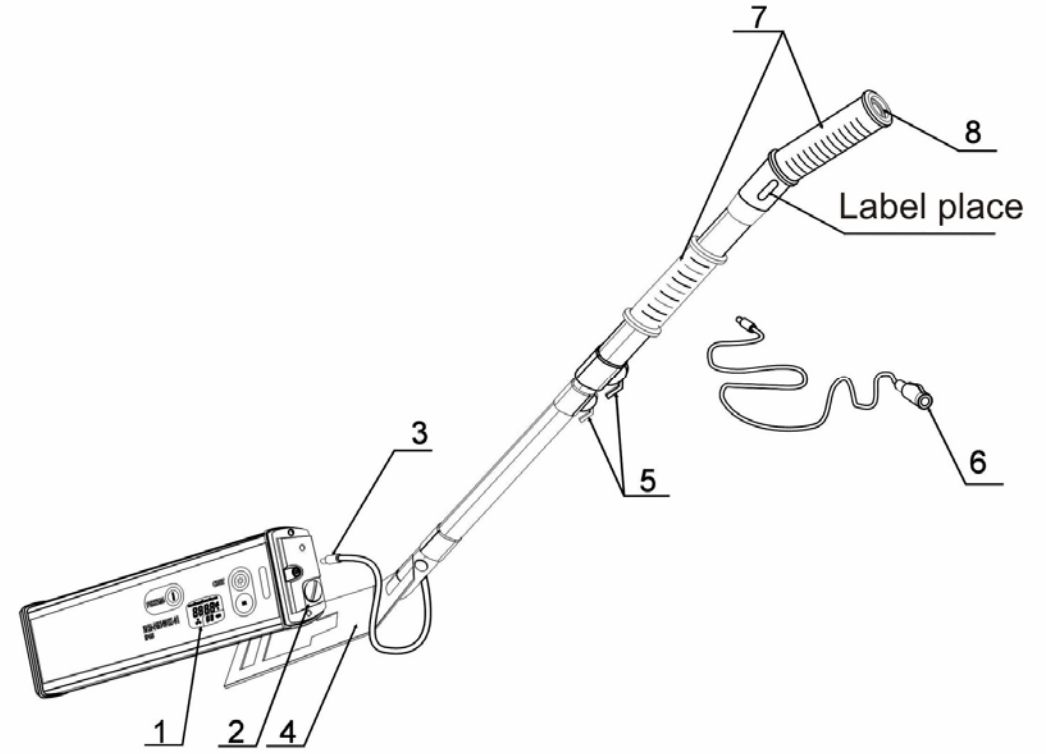
The vibration alarm can be hidden in a pocket or fastened to user's wrist using a special wrist band ***(figure 3)***.

Figure 3

4.4.2 A special telescopic tube is supplied for the search of radiation sources in places which are difficult to access.

To work with the telescopic tube (figure 4):

Insert the connector (3), and then fix the detector (PM1710A or PM1710GNA) on the telescopic tube with the help of a clip. If you want to use the remote vibration alarm (6), connect it to the connector (8). The length of the telescopic tube can be adjusted using two latches (5).



1 – PM1710A or PM1710GNA detector;
2 – Battery cover;
3 – Telescopic tube cable with a detector connector;
4 – Telescopic tube clutch used to attach a detector using its clip;
5 – Telescopic tube latch;
6 – Remote vibration alarm;
7 – Handles;
8 – Telescopic tube connector of the remote vibration alarm.

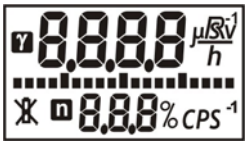
Figure 4

5 OPERATION

Caution! When using the detector in ambient temperatures below minus 15 °C the normal operation of the detector LCD is not guaranteed. In this case you can still use it by monitoring sound and vibration alarms. The LCD functioning will be restored after its returning to normal operation temperature.

5.1 Turning the detector on/off

5.1.1 To turn detector, press the MODE button



Immediately after that the LCD backlighting will be switched on and all LCD segments will be activated at the same time approximately for 1 s, alarm (audio and/or vibration) will be switched on, and the detector will enter the *Test mode*.

5.1.2 To turn detector off, press and hold the LIGHT button for 5 seconds until the LCD screen displays the "OFF" message.

Attention! The detector is automatically turned off ("OFF" is displayed on the LCD) after reading the detector operation history in the *PC communication mode*).

5.2 Operation modes

Operation modes included by the manufacturer in your particular detector comply with the order chart (see Appendix A).

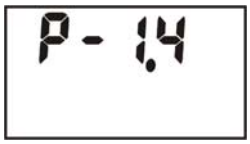
The detector has the following operation modes:

- the Test mode;
- the Background calibration mode;
- the Search mode (indication of an average count rate, s^{-1});
- the DER indication mode;
- the Set mode:
    - set the coefficient **n** of gamma channel;
    - set the coefficient **n** of neutron channel;
    - selection of the audio and/or vibration alarms.
- PC communication mode through IR channel;
- Neutron registration mode (by order);
- mode of displaying the average count rate of neutron radiation for the accumulation time (by order).

Selection of the operation modes is performed by the MODE button.

5.2.1 Test mode

The detector enters this mode just after turned on.



Before the beginning of the *testing* process the alarms (audio and/or vibration) are activated approximately for 1 s. All marks, segments will be indicated on the LCD. Then the LCD shoes the firmware version (P-X.X) for several seconds.

In the *Test mode* all the required tests are fulfilled. Initially, the battery discharge level is tested. The "bAtt" message is indicated on the LCD, remaining battery power in relative units on the analogue scale.

Then the "test" message is indicated and the decreasing analogue scale. The tests are performed. The time to test completion is displayed in relative units in the form of the decreasing analogues scale.

Upon the test completion the detector enters the *Background calibration mode*. The analogue scale is indicated on the LCD with the number of segments increasing in time, as well as the "CAL" message.

5.2.2 Background calibration mode

5.2.2.1 The detector enters this mode automatically after completion of the *Test mode*, at this the "CAL" message is indicated on the LCD.

In the *Calibration mode* the detector performs the analysis of the background level of **Attention! Below you will find the principles of work of the detector gamma channel. Functioning of the neutron channel is much more complicated and is not described in this manual.**

The processor counts the number of pulses coming from the detection block during the preset calibration time, while analogue scale on the LCD shows time elapsed from the beginning of the calibration process in relative units. 100 % filling of the analogue scale means that calibration has been completed. When the detector is calibrated on user demand the calibration time depends on the background radiation level - the higher is the background level, the less time is required for detector calibration.

The processor calculates the **gamma channel threshold value** by the following formula

$$\textbf{Alarm threshold} = \mathbf{2N} + \mathbf{n} \cdot \sqrt{2N},$$

where **N** is the average count rate during the time of calibration, s^{-1};

n - the number of mean square error (gamma channel coefficient n).

Coefficient **n** t changes the **alarm threshold** value (minimal detection level). The less the coefficient **n**, the less the threshold value is and the higher the detector sensitivity is. However decreasing the coefficient n also increases the probability of false alarms. Coefficient **n** is specified in the *Set mode* if it is allowed by the administrator when he/she adjusts the global settings after connecting the detector to a PC (factory-preset value of the coefficient n accordance with the Appendix A). The coefficient can be specified in the range between 1 and 9.9 with step 0.1.

To recalibrate a detector according to a changed background it is necessary to press the **MODE** button and hold it for 2 seconds until "CAL." is displayed on the LCD, where an analogue scale is also displayed showing the calibration progress.

The Autocalibration function can be enabled in the PC communication mode. This function makes it possible to retain the high sensitivity of the detector in the conditions of lowering background radiation level and avoid false alarms at its gradual rising.

When background calibration is finished the detector is ready for operation.

5.2.2.2 Getting a new background

The user may run background calibration to adjust the alarm threshold for the new background during the normal operation of the detector. It is recommended to run the background calibration any time the radiation background significantly changes, e.g. upon entry or exit from the building, changing locations, etc.

If the detector's background radiation level is not updated, the alarm may be set off more frequently in the *Search* even without the presence of any radioactive sources. Or conversely, the detector's ability to alarm to the presence of a radiation source may become worse. Under these circumstances it is necessary to run the background calibration so that the detector recalculates the alarm thresholds based on the new environment.

To update the background radiation levels and recalculate the thresholds, press and hold down on the MODE button until the message "CAL" appears on the display. The unit is now acquiring new background. In total, this process requires 36 seconds. When the LCD screen display returns to the normal numeric display, the unit has modified its background radiation levels to the new environment and is ready for normal operation.

The detector is able to perform calibration automatically. It provides more convenient detector usage and decreases false alarm probability when radiation background is changed. To use the autocalibration function, a user should activate this function by using Polimaster Software.

5.2.2.3 Alarms

Alarm levels in the *Search* are derived from the ambient background. When the detector runs through background calibration, it acquires a background reading and calculates the alarm levels automatically based on the value of **coefficient n** set by the user.

The value of coefficient n may be set in the range of 1.0 to 9.9 through every 0.1. The smaller is the value of coefficient n, the more sensitive is the detector to changes in background radiation, however this also increases the rate of false alarms (false positives). The larger is the value of coefficient n, the less sensitive unit becomes to minor changes in radiation background and responds only to large radiation field variations (intensive radiation sources nearby) and probability of false alarms decreases.

5.2.2.4 False Alarms

All radiation detection systems experience false alarms. The number of false alarms depends on many factors including changes in the ambient background radiation level as well as changes to the system setup. Under normal conditions and using the manufacturer's settings, the user should expect a maximum of two false alarms per every eight hours of operation.

Occasionally, the detector will "chirp" signaling to the user that the unit is still functioning. Such alarms are irregular and can, therefore, be easily distinguished from true alarm signals produced by the gamma and neutron radiation sources.

5.2.3 Search mode. Detection and localization of gamma and neutron radiations sources

5.2.3.1 Being in the *Search mode* the detector shows the gamma channel count rate in the LCD upper line, s^{-1}.

The following is indicated in the LCD lower line:

	Mean square error of gamma channel count rate in percents. (only for PM1710A, PM1710C)
	Mean neutron channel count rate in s^{-1} (only for PM1710GNA, PM1710GNC)

Overload indication:

	If the mean gamma channel count rate exceeds the upper limit of the indication range you will see **"OL"** message on the LCD
	If the mean neutron channel count rate exceeds the upper limit of the indication range you will see a blinking "999" message on the LCD (only for PM1710GNA and PM1710GNC)

In this mode the detector automatically compares the average count rate with the following threshold values:

1) **The Fixed DER threshold (safety threshold)** specified during the *PC communication mode*. When this preset threshold is exceeded, the detector will produce the light single-tone audio and/or vibration periodic signals with constant 1 second interval, which allows the user to distinguish between situations of exceeding the **DER threshold** and **Alarm threshold.**

2) **Gamma channel alarm threshold** (minimum detection level) is calculated in the *Calibration mode* and takes into account the changes in the background level. When this threshold is exceeded, the detector produces audio, light and/or vibration signals, the frequency of which is increased as the detector is moved closer to the gamma radiation source. The whole detectable energy range of gamma radiation is divided into four energy channels. Three channels correspond to the zones of low, average, and high energies, whereas the forth one — to the whole energy range of gamma radiation. The **alarm threshold** is calculated separately for each channel.

Every quarter of a second the processor counts impulses for each of the channels coming from the detection block and retains this number in its memory. Each quarter of a second the number of impulses for the latest (newest) interval is added to the current sum, while the number of impulses for the oldest (first) interval is subtracted from the sum of impulses (the current average). Thus the number of impulses stored in the processor for each channel is updated each quarter of a second.

The current average number of impulses is compared each quarter of a second with the **alarm thresholds** calculated during the *Calibration mode*. If the current average number of impulses for any of the channels exceeds the threshold value, a light, audio, and/or vibration alarms are activated.

Neutron channel alarm threshold (only for PM1710GNA and PM1710GNC), minimum detection level is calculated in the *Calibration mode* and takes into account the changes in the

background level. When this threshold is exceeded, the detector produces audio, light and/or vibration double signals with a constant interval between them which allows the user to distinguish between situations of exceeding of the **Gamma** and **Neutron** channel thresholds.

In the *Search mode* the detector resolves problems of detection and localization of gamma and neutron radiations sources.

5.2.3.2 Detection of gamma and neutron radiation sources

To detect a radiation source the detector should be held so that its back side (with clip) is always directed at the inspected object (luggage, person, car, container, etc.). The closer is the detector to the inspected object and the slower it is moved along it, the higher will be the detection effectiveness.
Use vibration and light alarms in situations when audio alarms cannot be heard (noisy environment).
You have to remember that detector sensitivity and the frequency of false alarms depend on:

- the current preset gamma channel coefficient **n**;
- the current preset neutron channel coefficient **n**;
- the background level calculated by the detector in *Calibration mode* by the background level.

If autocalibration is enabled in *PC communication mode*, the detector automatically considers slow background changes and recalibrates each 10 minutes if the background level is decreasing, or in a little longer periods of time when the background radiation level is increasing. However, the automatic recalibration is performed only if there were no alarms or rapid radiation level change during algorithm-defined periods of time.

You can encounter false alarms during the detection process, but they can be easily distinguished because they appear very seldom and irregularly, whereas real alarms are regular and their frequency increases as the detector is moved closed to a radiation source.

After a radiation source has been detected you can proceed to its localization.

5.2.3.3 Localization of gamma and neutron radiation sources

For the localization of radiation sources it is necessary to hold the detector not farther than 10 cm from the inspected object and move it along the object not faster than 10 cm/s. As the detector moves closer to the radiation source, the frequency of audio, light and/or vibrating signals increases, thus enabling the user to determine the direction toward the source location.

When the alarm signals frequency reaches the maximum value, it is necessary to run the background calibration procedure. During the recalibration it is important to keep the detector in the same place if possible. Once the background calibration is completed, the user may then continue to localize the radiation source. This procedure may be repeated as many times as necessary until the gamma radiation source is located.

To locate a neutron radiation source or a mixed gamma and neutron radiation source, it is recommended to turn OFF the audio and vibration alarms and visually monitor the numerical values of gamma and neutron count rates on the display. The closer the detector is to the radiation source, the larger is the count rate value. In this scenario it is not necessary to run background calibration while approaching the source.

If the value of the dose rate exceeds the detector's upper indication range, the overload message on the LCD screen will display "-OL-" for gamma radiation or "-999-" for neutron radiation.

5.2.4 DER indication Mode

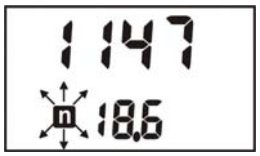
When in the DER indication mode, the upper line of the LCD screen indicates the dose equivalent rate in μSv/h (μR/h), while the lower line indicates the mean square error of DER indication in percents (PM1710A, PM1710C).

PM1710GNA and PM1710GNC detectors indicate an mean neutron count rate in the lower LCD line in this mode.

If DER value exceeds the upper limit of the indication range more than 1.3 times, the LCD will display an overload message (OL).

Attention! The detector may perform the searching and localizing functions in this mode. This is stipulated in the detector, if the searching function is additionally included in the *DER measuring mode (see the order chart – Appendix A).*

5.2.5 Neutrons registration mode (only for PM1710GNA and PM1710GNC **by order**)

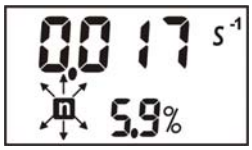


In this mode the detector registers all neutrons moving through its sensor. The number of registered neutrons is displayed in the upper line of the LCD. In case more than 9999 impulses are registered, the indication format changes to X.XEX, where X is any figure from 0 to 9, and EX is 10^x.

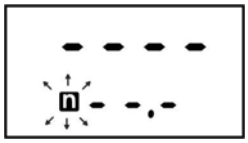
In the lower line of the LCD **n** mark is blinking and the total time of impulses accumulation is indicated in hours.

5.2.6 Displaying the average count rate of neutron registration (only for PM1710GNA and PM1710GNC **by order**)

Press the MODE button when in the *Neutrons registration mode* to display information about the average count rate of neutron registration since last reset. The average count rate of neutrons registration is displayed in the upper line of the detector LCD (s^{-1}), the lower line indicates the average error of the measured value in percents:



To reset the accumulated neutrons count press and hold the MODE button until the LCD looks as follows:



5.2.7 Set mode

To enter *Set mode* press and hold the MODE button. The "CAL" message will be displayed first. Continue to hold the MODE button until the screen displays the first setting that can be adjusted.

The number and combination of settings enabled for editing in your particular detector depends on factory pre-sets and may vary in each detector. See below the complete list of settings that may be enabled for editing in the detector:

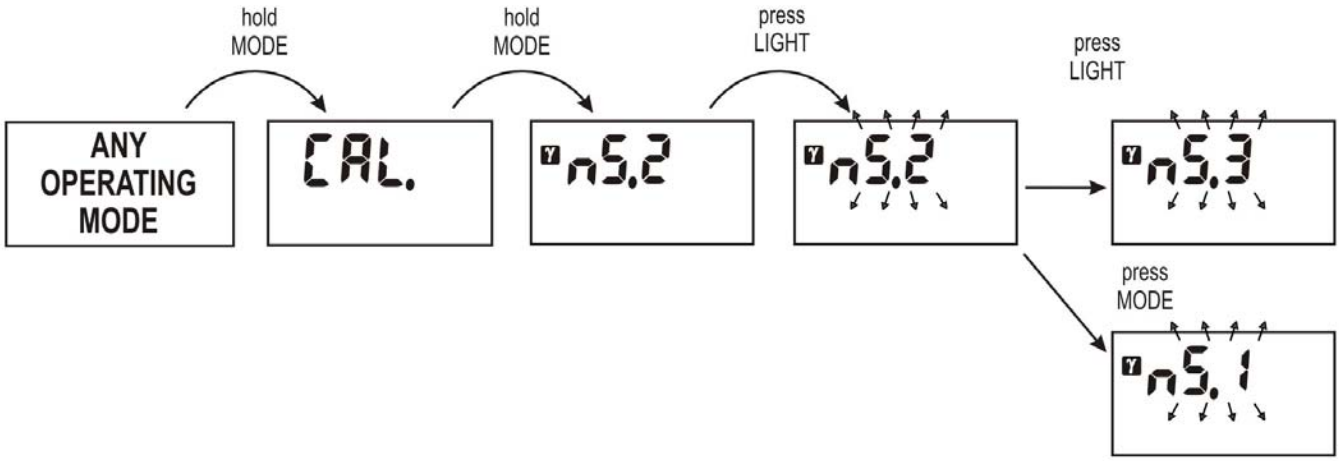
- coefficient n, gamma may be setup in the range of 1.0 to 9.9 with increment of 0.1. The manufacturer's recommended value is 5.3;

- coefficient n, neutron may be setup in the range of 1.0 to 9.9 with increment of 0.1. The manufacturer's recommended value is 5.0 (only for PM1710GNA and PM1710GNC detectors);

- enable or disable the **Audio alarm** on reaching the alarm threshold;
- enable or disable the **Vibration alarm** on reaching the alarm threshold.

5.2.7.1 Setting the coefficient n of gamma channel

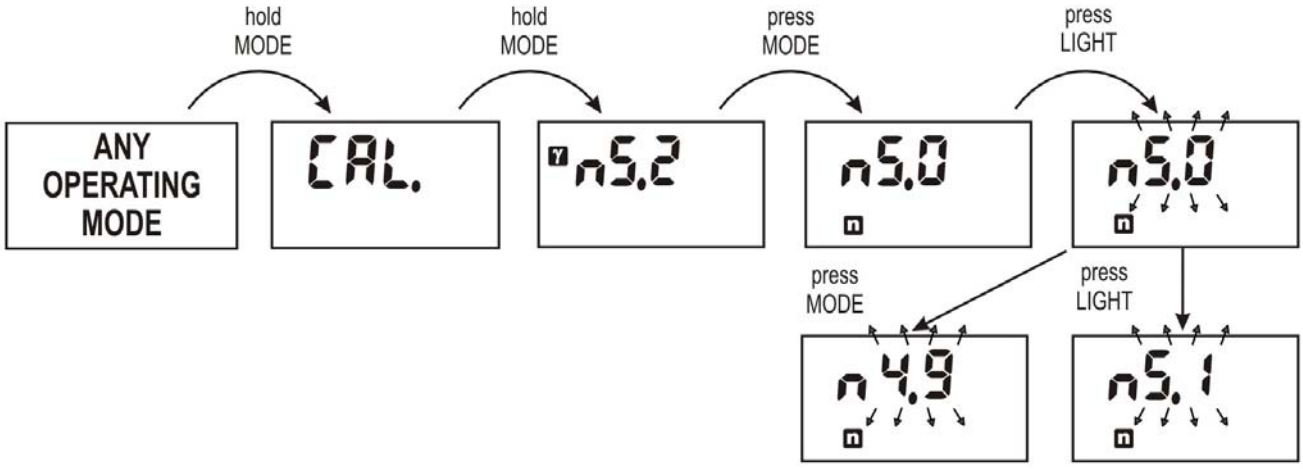
If adjusting of this setting is allowed during the connection with the Polimaster PRD Software, you will be able to find it in the settings menu. To adjust it, make sure the detector is in any of the operation modes, then press the MODE button and hold it for more than 5 seconds, "CAL" message will be displayed first. Continue to hold the MODE button down until the detector enters the settings adjustment menu and you will immediately be able to adjust the coefficient n of the gamma channel:



To change the coefficient n value you have to press the LIGHT button within four seconds after entering the menu, and then press LIGHT button to increase the coefficient value, or MODE button to decrease it. If you don't press the LIGHT button within four seconds after entering this menu, the detector will automatically return to the last operation mode. Six seconds after the last adjustment of the coefficient value the detector calibration will be performed automatically.

5.2.7.2 Setting the coefficient n of neutron channel (only for PM1710GNA and PM1710GNC)

If adjusting of this setting is allowed during the connection with the Polimaster PRD Software, you will be able to find it in the settings menu. To adjust it, make sure the detector is in any of the operation modes, then press the MODE button and hold it for more than 5 seconds, "CAL" message will be displayed first. Continue to hold the MODE button down until the detector enters the settings adjustment menu, the coefficient n of the gamma channel setting will be displayed. Press the MODE button once again to switch to the coefficient n of the neutron channel setting:

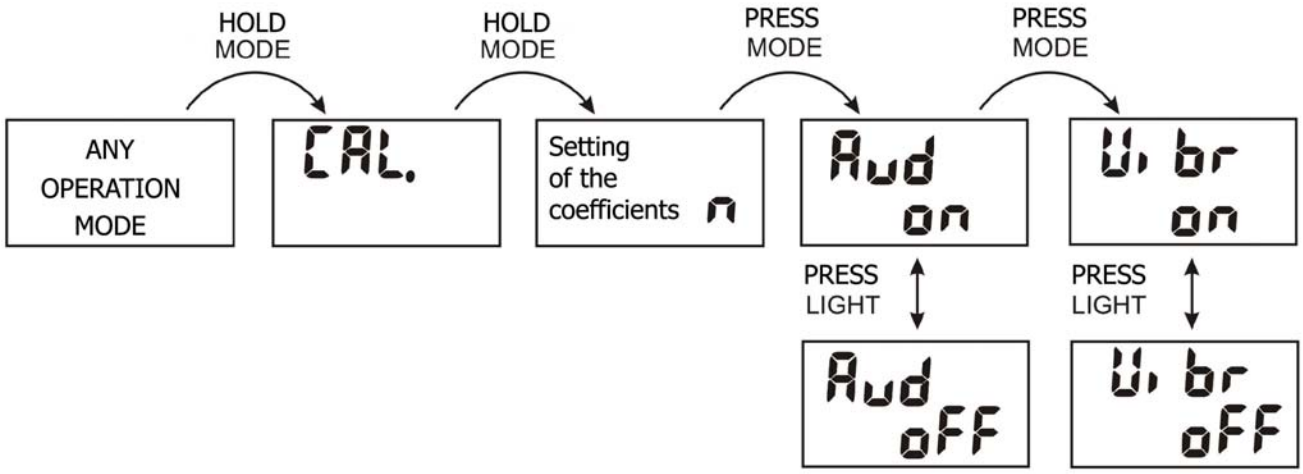


To change the coefficient n value you have to press the LIGHT button within four seconds after entering the menu, and then press LIGHT button to increase the coefficient n value, or MODE button to

decrease it. If you don't press the LIGHT button within four seconds after entering this menu, the detector will automatically return to the last operation mode. Six seconds after the last adjustment of the coefficient value the detector calibration will be performed automatically.

5.2.7.3 Setting the alarms

If adjusting of this setting is allowed during the connection with the Polimaster PRD Software, you will be able to find it in the settings menu. To enable or disable sound and vibration alerts, make sure the detector is in any of the operation modes, then press the MODE button and hold it for more than 5 seconds, "CAL" message will be displayed first. Continue to hold the MODE button down until the detector enters the settings adjustment menu. Press the MODE button twice, and you will see the Audio On/Off setting:



When the LCD displays **Aud On** (or **Off**) you can use the Light button to change the setting, i.e. switch on or off the sound signal. Then press the MODE button to do the same for the vibration signal: when the LCD displays **Vibr On** (or **Off**) you can use the Light button to change this setting as well

5.2.8 PC communication mode. Detector parameters

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

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

5.2.8.1 PC communication mode through IR communication channel

The detector is equipped with infrared data exchange capabilities. Polimaster Software must be installed on your personal computer in order to be able to communicate with the detector.

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

If your computer is not equipped with an internal IR adapter, it is recommended to use the IR adapter that is supplied by Polimaster by a separate order.

This communication allows the user to set advanced detector parameters, download event data stored in the instrument memory to the database and perform other operations. To install the Polimaster Software on your computer insert the installation disk and run **setup.exe** from the root directory.

See Polimaster Software Guide for more information.

To initialize the infrared communication, place the detector 3 to 4 inches away from the infrared adapter and press the LIGHT button. When the PM1710 enters the *PC Communication mode* the message "-IR-" is displayed on the LCD screen.

As soon as the detector's operation history is transferred it is deleted from the detector memory and **the detector is turned off automatically**. All detectors are delivered with the factory-preset settings according to the customer order chart (see Appendix A).

5.2.8.2 Detector parameters

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

The manufacturer preset default password is "1".

In the *PC communication mode* the user-administrator can perform the following actions:

In the information system

- to register a detector for a specific user;
- to remember the times of giving out the detector and its return;
- to read following information from the detector memory including its work history:
    1) detector serial number;
    2) times of detector turn on and off;
    3) current gamma channel DER value in a user defined time period;
    4) times and detector readings in case of exceeding the **gamma channel alarm threshold ;**
    5) times and detector readings in case of exceeding the **neutron channel alarm threshold** (only for PM1710GNA and PM1710GNC).

In settings of detector/program

- to check and/or set up detector working parameters;
- to switch on the audio and/or vibration alarms ;
- to synchronize the detector time and date with the current PC time and date – automatically at each communication between detector and PC;
- to set up the consecutive time intervals for storing the current DER values in the non-volatile detector memory;
- to change the administrative password (default password is "1");
- to check and set up the fixed threshold by DER(safety alarm threshold);
- to check the preset or set up new values of the coefficient n for each channel determining the alarm thresholds;
- to enable/disable the autocalibration.

6 MAINTENANCE

Detector maintenance involves:

- performance of preventive works (external inspection, dust removal and deactivation, check of detector workability (see detector on/off). Deactivation is performed by wiping with clothes moisten in ethyl spirit;
- battery replacement.

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

7 TROUBLESHOOTING

In the field, troubleshooting is limited to replacing the battery. Most of the yet encountered problems have been reported to be because of low battery or poor battery quality. To operate this detector, use only fresh, high-quality alkaline batteries. The PM1710 requires very little energy which means that while troubleshooting the unit should be allowed to stand without the battery for 1-2 minutes to allow the internal circuits to discharge. Discharging the remaining battery power is especially important if the user is experiencing problems with the unit.

8 STORAGE AND SHIPPING

8.1 Storage

When stored in a storage area the detectors must be in the manufacturer packing without batteries at ambient temperatures from minus15 to 50 °C and humidity up to 95 % at 35 °C. Storage duration should not exceed average detector life time, 8 years.

When out of the packing, the detectors can be stored at ambient temperatures from 10 to 35 °C and humidity of up to 80 % at 25 °C, without batteries.

The storage area must be clean of dust, acid and alkali vapors, aggressive gases and other agents that may cause the appearance of rust.

8.2 Shipping

Packed and turned off detectors can be transported by any closed transport at ambient temperatures from minus 50 to 50 ^{o}C.

Packed detectors must be firmly fixed during the transportation to avoid collisions with each other and walls of the transport.

When transporting in the sea the detectors must be packet to a hermetic polyethylene case with a silica gel dehumidifier.

When transported by plane the detectors must be placed to hermetic compartments.

9 LIMITED WARRANTY

Polimaster warrants to the purchaser (the "Purchaser") that the Product, including component parts, is free from material defects in material and workmanship, under normal use and service for a period of 18 months (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.

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

Appendix A
(reference)

Detector operation modes and factions order chart

Table A.1

Modes and functions	**Enabled - (V) Disabled - (-) ---------- Value**	**Note**
Search mode (indication in "s^{-1}")	**V**	The mode can be enabled autonomously or together with modes 2 or 3
DER indication mode (indication in μSv/h)	**V**	The mode can be enabled autonomously or together with mode 1
DER indication mode (indication in μR/h)		The mode can be enabled autonomously or together with mode 1
Auto calibration	**V**	
Setting of DER thresholds for modes 1–3 - DER threshold (safety threshold)		Range - 1 – 3000 μR/h (0,01 – 30 μSv/h) Recommended – 3 mR/h (30 μSv/h)
Additionally for GN detectors		
Neutron registration mode: Modes of impulses count accumulation (neutrons, indication in s^{-1}) and average count rate of neutrons registration.		
Additional settings		
History saving interval, min	60	
Changing of n-coefficient allowed	**V**	
n-coefficient (gamma)	4.5	Recommended 5.3; 4.5, see Table 3.1
n-coefficient (neutron)	4.0	Recommended 5.0; 4.0, see Table 3.1
Changing of alarm type allowed	**V**	
Sound alarm	**V**	
Vibration alarm	**V**	