

**THE PM1703
ALARMING RATEMETER**

OPERATING MANUAL

POLIMASTER

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1. INTRODUCTION

The PM-1703 alarming ratemeter is designed to search, to detect and to locate radioactive sources from their gamma radiation as well as for measurement of dose rate of collimated photon radiation. The ratemeter operation history is therewith stored in its non-volatile memory and may be transmitted to a personal computer.

The ratemeter can be used both indoor and outdoor by a wide scope of users whose professional activities are concerned with detecting and locating ionizing radiation sources.

2. DELIVERY KIT

Table 1.

Item	Type	Quantity		
		PM1703	PM1703-01	PM1703-02
Alarming ratemeter PM1703	14804920.021-2000	1	1	-
Alarming ratemeter PM1703-02 ¹⁾	14804920.021-2000	-	-	1
Vibration alarm device	425549.001	-	1	-
Hand strap	301359.002	-	1	-
Battery PANASONIC Power Line ²⁾	AA (LR6)	1	1	1
IR adapter ³⁾	426434.006	1	1	1
Diskette with software	305555.003			
Case	412915.018			
Enclosure ⁴⁾	301412.020	1	1	1
Operating manual		1	1	1
Case	412915.016	1	-	-
	412915.016-01	-	1	-
	412915.016-02	-	-	1
Case for shipping	305641.018	1	-	-
	305641.018-01	-	1	-
	305641.018-02	-	-	1

1) The LA6-404FB vibration alarming device is to be built – in.

2) It is allowed to use the other type of batteries with similar parametrs.

3) Available as an option to the order

4) Available as an option to the order

Note. Because POLIMASTER is constantly improving and upgrading the products, design and software of the monitor can be changed without further notice.

3. SPECIFICATIONS

Detector type	CsI(Tl) scintillator
Sensitivity, - at ^{137}Cs , no less than - at ^{241}Am , no less than	100 cps/$\mu\text{Sv/h}$ 100 cps/$\mu\text{Sv/h}$
Energy range	0.06 - 3.0 MeV
Energy response differs from typical dependence as given in Appendix 1	no more than -25%
Measurement time	0.25 s
Coefficient n (number of mean square deviations of current radiation background σ) Step	1 – 9,9 0,1
False alarm rate at n = 3	no more than 1 per minute
Detection of source , at moving velocity of the device 0,2m/s relatively to the source at n=4, at background no more than 0.25 $\mu\text{Sv/h}$, at a distance 20 ± 0.5 cm ^{133}Ba	55kBq (1,5μCi)
Measurement range (DER) of dose equivalent rate of photon radiation $H^*(10)$ at ^{137}Cs in collimated radiation	0,05-40 $\mu\text{Sv/h}$
Accuracy of DER measurement at ^{137}Cs in collimated radiation , where $H = \text{DER}$, $\mu\text{Sv/h}$	$\pm(20+1/H)\%$
Count time: in the <i>background mode</i> in the <i>search mode</i>	36 s 2 s
Number of readings stored in non-volatile memory	900
Power	One Panasonic Power Line LR6AA battery
Battery lifetime without alarms, at least	800 hours
Environmental:: temperature range humidity at 35 °C	-30 to + 50°C (LCD: -15 to +50°C) up to 95%
PC communication mode through IR-interface at a distance	0,5 m

Allowable additional relative error of DER measurement at ¹³⁷Cs, no more, %	
- at increase of environmental temperature from normal	±40
- at decrease of environmental temperature from normal	±10
- at extreme voltages	±10
- at influence of alternative or direct magnetic field up to 400 A/m	±10
- at influence of radio-frequency of electrical-magnetic field up to 10 V/m	±10
Drop test	0,7 m on concrete surface
Alarm type	audio tone vibration
Dimensions	97 x 57 x 32 mm
Weight (including battery)	270 g

4. DESIGN AND THEORY OF OPERATION

4.1. Design of the ratemeter

The ratemeter is designed as a pager-type device housed in a hermetically sealed case (Fig. 1).

A liquid crystal display (LCD), two control buttons 1 and 2, and windows 3 of an infrared (IR) transceiver are located on the front panel of the ratemeter.

The control buttons are designed for the purposes as follows:

- 1 - the button is used:
 - to turn the ratemeter ON;
 - to make the background updating
 - to select operating mode (touch the button for 1s);
 - to enter n set mode and to turn ON/OFF audible and vibration alarms of the ratemeter (touch the button for 4 s);
 - to select the parameter to be set in the set mode (touch the button for 1 s)
 - to decrease coefficient n with 0, 1 step in the set mode;
- 2 - the button is used:
 - to turn ON the LCD backlight;
 - to communicate with PC;
 - to increase coefficient n with 0, 1 step in the set mode;
 - to turn ON or OFF vibration or audible alarms in the set mode.

To turn the ratemeter OFF press the button 2. Fixing the button 2 while the backlight is ON, press and fix for 3 seconds the button 1 until the LCD displays "OFF".

The LCD indicators are designed for the following purposes:

4 - 4.5 digit 7-segment indicator displays:

- the count rate (in counts per second; cps);
- DER at Cs¹³⁷ in collimated radiation in the measurement mode (in $\mu\text{Sv/h}$);
- messages "test", "CAL", "LO", "HI", "OFF";
- coefficient n value in the set mode;
- ON/OFF of audible and vibration alarms

5 - the analog scale including 19 segments indicates:

- the time left until the self-tests are completed (a number of segments decreases);
- the time left until the background updating is completed (a number of segments increases until the scale is completely filled);
- exceeding value from the calculation value of alarm threshold.

6 - battery discharge warning sign is indicated when the battery voltage drops below 1.1 V;

7 - radiation sign is indicated when the alarm threshold is exceeded.

4.2. Component modules

The block diagram of the ratemeter is presented in Fig. 2.

The ratemeter consists of:

- detector block;
- processing block;
- audio alarm device;
- vibration alarm device;
- power module.

The **detector block** consists of:

- a CsI(Tl) scintillator with a photodiode;
- an amplifier-shaper;
- a converter.

The scintillator-photodiode transforms gamma-quanta to electric pulses that come to the input of the amplifier-shaper.

The amplifier-shaper converts electric signals coming from the photodiode output to quasi-Gauss pulses that come at the input of the processing module.

The converter produces a bias voltage of 30 V that comes to the photodiode.

The **processing block** consists of:

- processor module;
- non-volatile memory module;
- LCD module;
- control buttons;
- IR transceiver.

The processor module is based on a 16-bit RISC processor that performs:

- testing of the ratemeter every time as it is turned on;
- mathematical processing of data received;
- control over all the operation modes;
- output of the data processing results to the LCD;
- control over the operation of the audio and vibration alarm devices;
- battery voltage control.

A non-volatile-memory is designed to store the ratemeter operation history that involves:

- the current values of the count rate in data storage intervals;
- cases when the alarm threshold was exceeded;
- cases when the ratemeter was re-calibrated;
- the time when the ratemeter was turned ON/OFF.

The non-volatile memory of the ratemeter also store the following parameters:

- the number of the ratemeter;
- information about the audio or vibration alarm device turning ON/OFF;
- the preset value of the coefficient n ;
- the current time and date;
- the preset data storage interval;
- the count time in the *background mode*;
- the count time in the *search mode*.

The LCD module is designed to display the information about the self-test, modes of the ratemeter operation and measurement results. The LCD also contains a control circuit of the luminescent backlight, which is turned on/off by the processor and is controlled by the button 2.

The IR transceiver is designed to make possible the information exchange of the ratemeter with PC (see section 4.3).

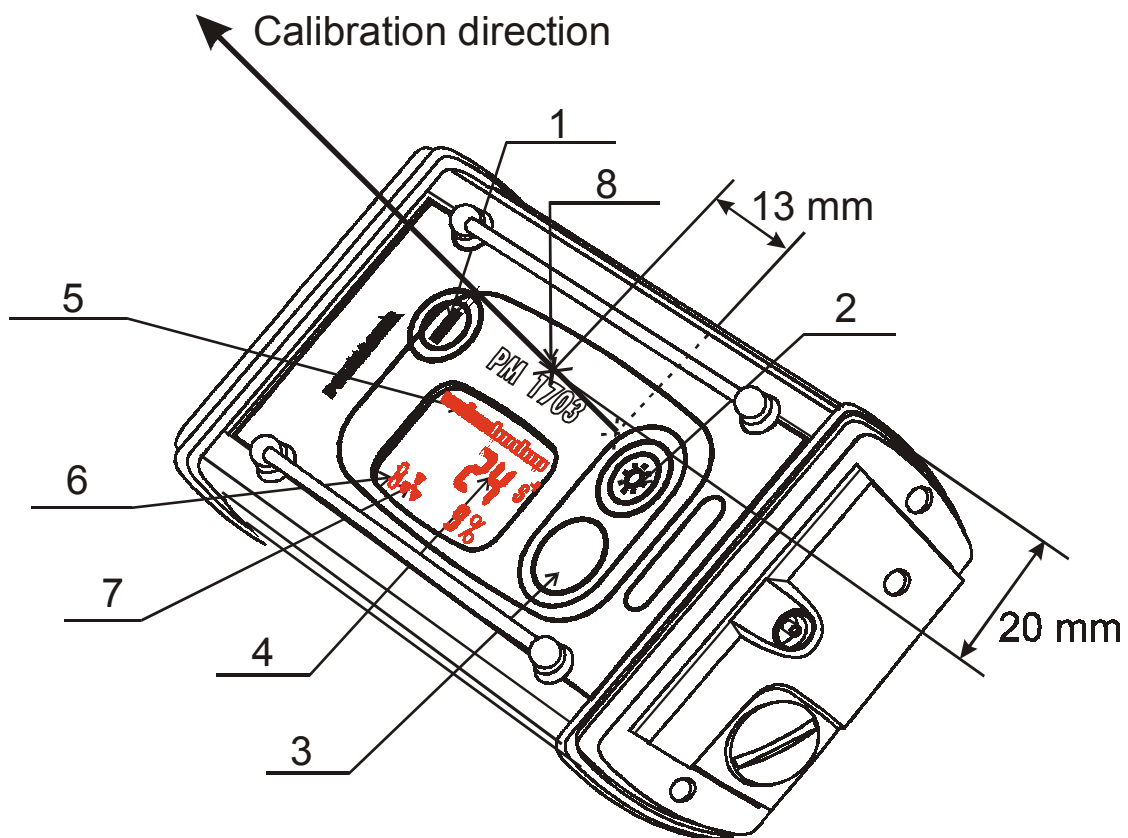


Fig. 1. The general view of the ratemeter

- 1, 2 - control buttons;
- 3 - windows of the IR transceiver;
- 4 - 4.5 - digit 7 - segment indicator;
- 5 - analog scale;
- 6 - battery discharge warning sign;
- 7 - radiation sign;
- 8 - effective center of the detector.

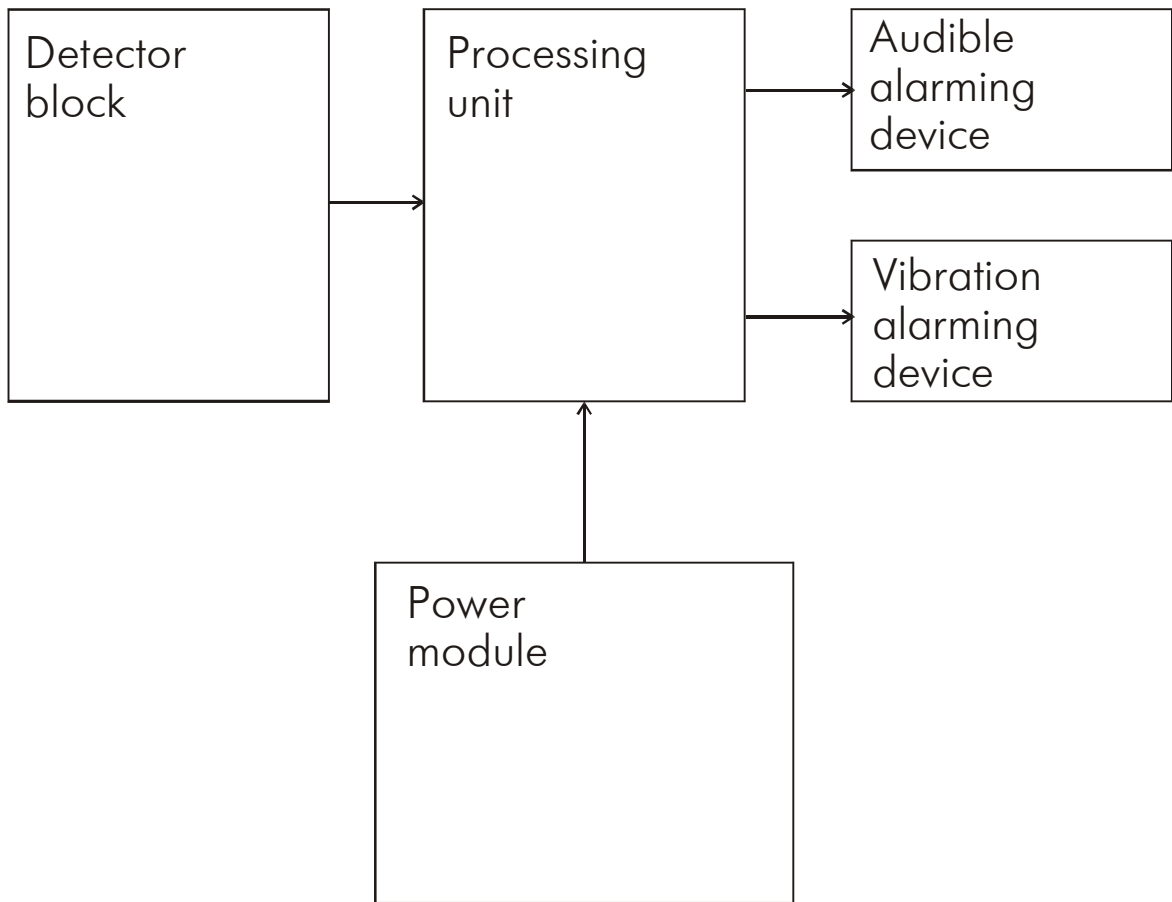


Fig. 2. Block diagram of the ratemeter

The **audio alarm device** is designed to produce audible tones to signal the *self-test mode* completion or an alarm in the *search mode*. In the *search mode* the rate at which audible tone repeats will increase when the ratemeter comes nearer to a gamma radiation source.

The **vibration alarm device** is designed to produce signals that the operator senses as mechanical pulsation inside of the ratemeter housing when the *self-test mode* is completed, or when the alarm threshold is exceeded in the *search mode*. It allows a secret search for gamma radiation sources and is good in situations when sound tones are damped by noise.

The audio or vibration alarm devices can be turned ON/OFF using software in the *mode of communication with PC* (see section 6.3) or using control buttons on the front panel of the ratemeter if this mode is not allowed in PC communication mode.

The **power module** is a built-in power source including battery and processor controlled electronic switches that supply a necessary voltage to the ratemeter blocks and modules.

4.3. Operation modes

The ratemeter operates in the following modes:

- search mode;
- background mode;
- measurement mode;
- self-test mode;
- communication with PC (using the IR transceiver);
- set mode.

The battery voltage is checked whichever mode the ratemeter operates in. If the voltage drops below 1.1 V, the battery discharge warning sign is displayed in the LCD lower left corner. In this case the battery need to be replaced (see section 8.3).

The ratemeter also controls over the detector operation. If the count rate is outside the preset range the LCD will display the corresponding message: "LO" if the count rate is below the lower limit (set by the manufacturer), or "HI" if it exceeds the upper limit (set by the manufacturer) (see also section 7).

The LCD backlight is supplied to permit use in low light conditions. To turn ON the LCD backlight while the ratemeter is operating press and release the button 2 (Fig. 1).

Self-test mode

The ratemeter will go into this mode immediately after it is turned ON, and the LCD will display the message "test". The following tests are performed:

- LCD test;
- detector test;
- processor test;
- non-volatile memory test;
- alarm test.

The time left until the self-test completion is indicated in relative units on the analog scale with decreasing number of segments.

After the ratemeter has completed the self-tests the audio or vibration alarm will be activated for approximately 1 second, and the ratemeter will go into the *background mode*.

Background mode

The unit will automatically go into this mode when the *self-tests* are completed and the LCD will display the message "CAL". In the *background mode* the measurement of the gamma radiation background is performed. The processor counts pulses coming from the detector, and the analog scale indicate the time run since the beginning of the *background mode*. A completely filled scale indicates that the background updating is completed. The background count time may be set by the user while in the *mode of communication with PC* (see section 6.4) in the range from 20 to 300 seconds with a step of 0.25 s. The manufacturer sets this value equal to 36 s. Later on when the operator makes the ratemeter to update the background, the background count time may automatically decrease with increasing the background level (see section 6.3).

The processor calculates the average count rate N_b during the background count time and the threshold value P :

$$P = N_b * T_c + n * \sigma, \quad (1)$$

with

$$\sigma = \sqrt{N_b * T_c} \quad (2)$$

where:

T_c - count time in the *search mode*;

σ - meansquare deviation of the value calculated using the equation (2) for Poisson distribution of pulses;

n - number of meansquare deviations (coefficient n).

The count time T_c may be set by the user in the *mode of communication with PC* (see section 6.4) in the range from 1 to 8 seconds with a step of 0.25 s. The manufacturer sets it equal to 2 s.

The coefficient n changes the threshold value according to equation (1). It is obvious that the *lower* is the coefficient n , the *lower* is the threshold value, the *higher* is the ratemeter sensitivity in the *search mode*. However, in this case the probability of false alarms will increase.

When the background accumulation is completed the ratemeter will display for several seconds the average count rate (in cps) during the background accumulation and will automatically go into the *search mode*.

To update the background value N_b , press and release the button 1 for 2 seconds. The LCD will display the message "CAL", and the background accumulation will restart.

Search mode

In the *search mode* the processor will count pulses coming from the detector in 250 millisecond periods and store in memory the sum of pulses for the count time T_c . The number of pulses for the last (recent) period is added to the sum every 250 milliseconds and the oldest count is discarded. Therefore, the number of pulses N_c stored in the processor memory is updated every 250 milliseconds.

The current value of N_c is compared to the alarm threshold P . If the current value of the pulse count exceeds the threshold value, i.e. $N_c > P$, then the audio and/or vibration alarm will be produced and the LCD will display the radiation sign. The rate at which audio tone repeats will increase, when the excess of N_c over P becomes more important, i.e. when the ratemeter comes closer to a gamma radiation source. When the audio alarm is turned on, the audible signals are produced. When the vibration alarm is turned on, mechanical vibration is produced.

In the *search mode* the LCD will indicate the current average count rate in counts per second.

Measurement mode

In this mode the ratemeter measures the dose rate of collimated photon radiation $H^*(10)$ (DER) at ^{137}Cs . The upper line of the LCD will indicate the DER value which is calculated from the formula:

$$DER = \frac{Nc}{K \cdot Tc}$$

where:

Nc – total number of the pulses taken within the time interval;

Tc – measurement time, equal to 2 s;

K – sensitivity of the detector (it is set by the manufacturer during adjusting of the ratemeter or during replacement of the detector);

During process of measurement the low line of the LCD will indicate variation coefficient value in %.

Set mode

When operating in this mode it is possible:

- to check or to set the new coefficient n value (the number of mean square deviations); the coefficient n can be set within the range from 1-9,9 with 0,1 step;
- to check the preset or to ON/OFF the audible or vibration alarms if it is permitted in PC communication mode.

The ratemeter enters this mode when the button 1 located on the front panel of the ratemeter is pressed for 4 seconds at least.

Communication with PC

The ratemeter may be switched to this mode by pressing the button 2. When operating in this mode it is possible:

- to register the ratemeter with the specific user;
- to store the time when the ratemeter was received and returned;
- to read out the information from the ratemeter memory (number of the ratemeter; time of its turning on/off; current values of the count rate in the data storage intervals set by the user; value of the coefficient n; count time in the *search mode* and in the *background mode*; time and readings of the ratemeter when the threshold was exceeded);
- to set the operation parameters of the ratemeter:
 - a) to turn on/off the audio and/or vibration alarm device;
 - b) to check the preset value or to set the new value of the coefficient n (number of meansquare deviations); the coefficient n may be set in the range from 01, to 9,9 in steps of 0.1;
 - c) to check and correct the current time and date;
 - d) to set the data storage intervals;
 - e) to select a password to open a menu of parameters.

5. PREPARATION FOR USE

Before starting the ratemeter operation it is necessary to study the current manual.

5.1. The ratemeter serviceability check up

Turn the ratemeter ON by pressing the button 1 located on the front panel of the ratemeter. If the ratemeter is operative and the voltage is normal the unit will go through a series of **self-tests**, with all segments, signs and indicators displayed on the LCD. Then the LCD will display "test" and the analog scale with decreasing number of segments.

After self-tests are completed the alarm will be activated and the ratemeter will go into the *background mode*. The LCD will display "CAL." and the analog scale with filling up segments.

After the background accumulation has been completed, the LCD will display for one second the measured count rate value, and the ratemeter will go into the *search mode*. The ratemeter is ready for operation.

If the battery voltage drops below 1.1 V, the LCD will indicate the battery discharge warning sign (Fig. 1).

Battery need to be changed!

5.2. Parameters setting

The ratemeter is supplied to the user with the preset parameters as follows:

password	1
current time and date	
data storage interval	60 min
count time in the <i>search mode</i>	2 s
count time in the <i>background mode</i>	36 s
coefficient n	4
audio alarm device	turned ON
vibration alarm device	turned ON

The user may change the following parameters using the control buttons located on the front panel of the ratemeter:

- to check the preset value or to set the new value of coefficient n (the number of meansquare deviations) within the range 1-9,9 with 0,1 step;
- to check the preset or to turn ON/OFF the vibration or audible alarming devices, if this mode is permitted in PC communication mode.

The user may change these settings being in PC communication mode(see section 6.4). For this purpose the IR transceiver and the PC software supplied on a diskette is to be used.

To set the parameters using the control buttons of the ratemeter it is necessary to enter the set mode by pressing the button 1 for 4 seconds. The LCD of the ratemeter will indicate "CAL" and then the preset coefficient n value. To change the preset value of coefficient n it is necessary to press the button 2. The value of coefficient n will flash and the user may change this value. Sequential pressing the button 1 will decrease the preset value of coefficient n by 0,1. If this button is held the value of coefficient n will be decreased automatically with the same step. Sequential pressing the button 2 will increase the preset value of coefficient n by 0,1. If this button is held the value of coefficient n will be increased automatically with the same step. After the value of coefficient n is set the ratemeter will return automatically to the background mode if the buttons were not pressed within 6 seconds.

It is possible to turn ON/OFF the audible or vibration alarms using the buttons 1 and 2 if it is enabled in PC communication mode. In this case follow the procedures given below in order to turn ON/OFF the audible or vibration alarm signals:

- enter the set mode. For this purpose press and hold the button 1 within 4 seconds. The LCD will indicate "CAL" and then the set value of coefficient n;
- touch the 1 button. The LCD will indicate "**1-oF**" or "**1-on**". 1 – indicates audible alarm, "oF" indicates that it is turned OFF, "on" indicates that it is turned ON. To turn this alarm ON/OFF use the button 2. The ratemeter automatically exits this mode if the buttons are not pressed during 6 seconds or when the button 1 is pressed.
- after the repeated touch of the button 1 the LCD will indicate "**2-oF**" or "**2-on**". 2 indicates vibration alarm, "oF" indicates that it is turned OFF, "on" indicates that it is turned ON. To turn ON/OFF this alarm follow the procedures given above.

6 OPERATION PROCEDURES

6.1 General guidelines

- In the **search mode** the ratemeter can **detect** and **locate** the gamma radiation sources.
- The ratemeter will perform the above operations using the parameters set by the manufacturer (see section 5.2). To set the other values of the parameters and to read the history it is necessary to use the IR adapter and a software for the PC.
- When the ratemeter operates at a temperature below $-10\text{ }^{\circ}\text{C}$, the LCD may display erroneous readings. In this case the audio or vibration alarm devices should be used to detect and locate radiation sources. When the normal conditions with temperatures higher than $-10\text{ }^{\circ}\text{C}$ are restored, the LCD will resume its normal operation.

6.2 Detection of gamma sources

When detecting gamma radiation sources the ratemeter should be held so that the effective center of the detector shown in Fig. 1 is directed onto the scanned object.

When detecting gamma radiation sources under conditions when the audible signals produced by the ratemeter are not heard as are damped by noise, the vibration alarm device should be used.

The efficiency of detecting gamma radiation sources is dependent on the close proximity of the ratemeter to the article or person to be searched and the velocity of its movement along the object.

It should be remembered that both the sensitivity of the unit, and the rate of false alarms depend not only on the set coefficient n as indicated in section 4.3, but also on the background value, which the ratemeter stored while in the *background mode*. As the changes of the natural background level may be significant, it is advised to perform the background updating just before inspection of persons, articles and vehicles. For this purpose press and release the button 1 when the ratemeter is turned ON, the unit will automatically perform the background updating.

It should be noted that false signals (sound or pulsation) are not regular and, therefore, may be easily distinguished from alarm signals (produced when a gamma radiation source is detected) when the rate at which the audio tone repeats will increase as the ratemeter moves closer to the gamma radiation source.

6.3 Locating gamma sources

When the gamma radiation source is detected or a fixed control system sounds, the gamma radiation source is to be **located**.

To **locate** the gamma radiation source the ratemeter should be held within 10 cm of the object to be searched and moved slowly (no faster than 10 cm per second) along the scanned object. As the ratemeter moves closer to the gamma radiation source, the rate at which audio tone or pulsation (in the case when the vibration alarm device is turned on) repeats will increase.

When the maximum rate is achieved a continuous audio alarm will sound, but the rate of pulsation (if the vibration alarm device is turned on) will not change. In this case the background updating is required before the gamma radiation source locating will be continued. It is necessary to press the button 1 (Fig. 1) **keeping the distance to the object unchanged**. The monitor will automatically perform the background updating and then the gamma radiation source locating may be continued.

6.4 Measurement of DER of photon radiation

Enter the measurement mode. For this purpose touch the button 1. The upper line of the LCD will indicate DER value in $\mu\text{Sv/h}$ (at ^{137}Cs) and the low line will indicate variation coefficient (in %) at 0,95 confidence level. When the needed variation coefficient is achieved the DER value can be read.

If during operation of the ratemeter in the measurement mode the DER value exceeds $50 \mu\text{Sv/h}$ the LCD will indicate "HI".

- NOTE:**
1. The ratemeter is designed for fast detection of photon (gamma and X-ray) radiation sources.
 2. The ratemeter is not energy compensated, therefore it is highly sensitive in the low energy range (60-300keV) and this allows more effective the detection of special nuclear materials.
 3. The ratemeter is calibrated **only at ^{137}Cs** , so its readings in the measurement mode may differ from the DER value measured with other dosimeters, but it does not mean that the ratemeter is defective.

6.5 Communication with personal computer

6.5.1 General guidelines

When the ratemeter operates in this mode an IR adapter (see section 2) and an application program PM1703.EXE supplied on the diskette together with the adapter are to be used.

Minimum requirements to a computer:

- PC 486, 66 MHz;
- 8 Mb RAM;
- monitor resolution 800X600;
- Windows 95/98 (small font);
- 2 Mb free on the hard drive + a free space for a database.

Connect the cable of the **IR adapter** to a communication port of the personal computer.

To load the application program insert the diskette into the diskette drive. Run the program SETUP.EXE. Following the instructions given in the program, install PM1703.EXE into the computer. Run the program PM1703.EXE. An application window PM1703 including a database field and a menu will appear on the monitor. The database field includes the main list of users and the hidden list of users (see section 7.3.2). The menu includes the following submenus: "Database", "Parameters", "System" and the "Register" button. Press the "Port" button. Select the communication port which the IR adapter is connected to, and press "OK". If the port is selected erroneously, the message "Port initialization error." will be displayed. Press "OK" and repeat the operation.

6.5.2 Creation and change of the list of users

To **create** the list of users, data of each of users are to be entered. For this purpose select the "Database" submenu using the mouse and click the mouse left button on "Add new" (this operation may be also performed in the database field by clicking the mouse right button). The "User's info" window will open, and a cursor will automatically appear in the "Last name" window. Fill in the window using the mouse, or "TAB" and "ENTER" keys of the keyboard. To save the information, press the "WRITE" button. To cancel the information saving, select the "CANCEL" button.

To **change** the information about an existing user, select his name from the list of users, open the "Database" submenu and click on the "Change" button (this operation may be also performed in the database field by clicking the mouse right button). Make the necessary changes in the form. To save the

changes, select the "WRITE" button. To cancel the information saving, select the "CANCEL" button.

Attention! *It is not possible to delete the name of user from the database.*

The users may be divided into two lists : "Main list of users" and "Hidden list of users". The name of a new user can be entered in the main list only. To move the name of a user from the main to the hidden list, the following operations are to be performed:

- select the name of specific user from the main list by clicking on it by the mouse left button;
- use the "User's info" button in the "Database" submenu (this operation may be also performed in the database field by clicking the mouse right button); "User's info" window will appear on the monitor. Press the "Move to hidden list" button in the lower left corner of the window. The name of the user will move to the hidden list.

To move the name of a user from the hidden list to the main list it is necessary to perform the following operations:

- select the name of specific user from the hidden list by clicking the mouse left button;
- select the "User's info" button in the "Database" submenu (this operation may be also performed in the database field by clicking the mouse right button). The "User's info window" will appear on the monitor. Press the "Move to main list" button in the lower left corner of the window. The name of the user will move to the main list.

Attention: *It is not possible either to register a ratemeter and to read its history if its user is found in the hidden list, or to move a user with his registered ratemeter to the hidden list.*

To view the hidden list of users, select the "View hidden list" button in the "Database" submenu. To return to the main list, select the "View main list" button in the "Database" submenu (this operation may be also performed in the database field by clicking the mouse right button).

The list of users may be viewed using the keys of the keyboard: ↓, ↑, PageUp, PageDown, as well as by clicking with the mouse on the scroll bar in the field right part.

6.5.3 Registration of a ratemeter

To register a ratemeter with the specific user from the main list, select the user by clicking with the mouse left button. Select the "Register" button. The message "Wait..." and the time countdown will be displayed on the monitor.

During the time countdown press the button 2 of the ratemeter and bring its transceiver windows (Fig. 1) within 10-20 cm of the IR adapter. Held the ratemeter in this position for approximately 2-3 seconds. If the communication is correct, the message "All correct" will appear, press "OK". The "*" sign will appear left of the user's name in the database field, and this name will be highlighted. If the communication is incorrect, the message "Information transmit error. Please repeat" will be displayed on the monitor. The operation should be performed once again

In the case if the ratemeter to be registered has been already registered to the other user, the message "This unit was already registered" will appear on the monitor.

For canceling the previous unit registration see section 7.4.6 ("Reading the history").

WARNING! *When the information exchange between the ratemeter and PC is completed it is necessary to move off the ratemeter from the IR-adapter or to turn the ratemeter OFF.*

6.5.4 Parameters setting

The ratemeter is supplied to a user with the preset parameters (see section 6.2), however the user can change these parameters. For this purpose open the "Parameters" submenu by clicking on it with the mouse left button. The "Enter password" window will be displayed. To have access to the menu of the parameters setting, enter a password (the manufacture's setting for password is "1") and press "Enter" key.

To change the password, select the "New password" button in the open window. Enter the old password and press "OK", then enter a new password and press "OK" if the password will be changed, or "Cancel" if the password will not be changed. Then confirm a new password entering by pressing "OK" to confirm the password changes, or "Cancel" to cancel the password changes. If all the operation are correct, the message "Password has been changed" will be displayed, then press "OK".

To change or to view the preset parameters, press "Parameters" with the mouse left button. The "Parameters" window will be displayed.

Press the "Reset" button, the parameters preset by the manufacturer will be indicated.

To view the parameters of the unit, press the "Read" button in the lower left part of the menu. The message "Wait..." and the time countdown will be

displayed. During the time countdown press the button 2 of the ratemeter and bring its transceiver windows (Fig. 1) within 10-20 cm of the IR adapter. Held the unit in this position for about 2-3 seconds. If the operation is incorrect, the monitor will display "Communication error. Please repeat". The operation is to be performed once again. If reading was correct, the message "All correct" will be displayed, then press "OK". After the parameters have been read, the "Parameters" menu will indicate the values of parameters set in the ratemeter.

It is possible to move along the lines in the window using the key "TAB" of the keyboard, as well as using the mouse.

The "Parameters" menu include two tabs: "General" and "Indication". The "General" tab includes the following lines:

- "Device number" shows the number of the ratemeter;
- "Date" compares **date** in the computer and in the ratemeter; in the case of time difference the "Warning" message will be displayed. To synchronize the date, check and if necessary set the accurate date in the computer;
- "Time" compares the **time** in the computer and in the ratemeter. When the difference is greater than two minutes, "Warning" will be displayed. To synchronize the time, check and if necessary set the accurate time in the computer;
- "History interval" permits setting of the **history interval** at which the current count rate values will be stored in the non-volatile memory of the unit. The interval may be set in the range from 1 to 1440 minutes in increment of 1 minute. The manufacturer sets it equal to 60 minutes (see section 5.2);
- "Count time" permits the **count time** reading in the *search mode*. The manufacturer sets it equal to 2 seconds (see section 6.2);
- "Background time" permits the **count time** reading in the *background mode*. The manufacturer sets it equal to 36 seconds (see section 6.2).
- "Coefficient n" permits setting of the **coefficient n** (number of meansquare deviations), which determines the alarm threshold value. The manufacturer sets it equal to 4 (see section 5.2). The **coefficient n** changes the **threshold value** according to the equation (1). It is obvious that *the smaller* is the value of the coefficient **n**, *the smaller* is the threshold value, and *the higher* is the ratemeter sensitivity in the *search mode*. However, the probability of false alarms increases with this;

The "Indication" tab contains the following lines:

- "Settings" allows to turn **ON/OFF** the indication the variation coefficient value (%) and enables/disables to turn ON/OFF the audible and vibration alarm devices (alarm) using the control buttons located on the front panel of the ratemeter (see Section 5.2).

To change the parameters, select the appropriate value in the window of the parameter to be changed by clicking twice the mouse left button, or using the "TAB" key of the keyboard. Input a new numerical value of the parameter using the keys of the keyboard. To turn ON ("V" is displayed) or OFF ("V is not displayed) the alarm devices, use the mouse left button.

- "Alarm" gives the possibility to **turn ON/OFF** the audio and vibration alarm devices. Click the mouse left button on the window of an appropriate alarm device, and the symbol "V" will appear indicating that the device is **ON**. Click the mouse left button on the window with "V", the symbol will disappear indicating that the device is **OFF**;

To save the parameter changes in the ratemeter memory, press the "Write" button in the lower part of the menu. The message "Wait..." and the time countdown will be displayed on the monitor. During the time countdown press the button 2 of the ratemeter and bring its transceiver windows (Fig. 1) within 10-20 cm of IR adapter. If the parameters are read incorrectly, the monitor will display the message "Communication error. Please repeat". The operation is to be performed once again. If reading is correct, the message "All correct! To operate with these parameters, please, turn the unit OFF and then turn it ON again" will appear, then press "OK". To close the menu of parameters, click with the mouse on the "Cancel" button in the lower right corner of the menu. The set parameters will become effective, when the unit is turned OFF (see section 6.5) and then turned ON again (see section 5.1).

6.5.5 Viewing, printing and saving the history

For viewing the operation history of the ratemeter assigned to a specific user:

- click twice the mouse left button on the name of the user, or highlight it with cursor and press the key "ENTER" of the keyboard;

OR

- select the "Database" submenu and press the "History" button (this operation may be also performed in the database field by clicking on it the mouse left button).

Data of history of the selected user will be displayed in the database field:

- number of the ratemeter;
- time when the unit was received and returned;
- time when the unit was turned ON/OFF;
- coefficient n ;
- count time in the *search mode*;
- current count rate values in the history intervals;
- time and reading of the unit at the moment when the alarm threshold is exceeded.

The user's history may be viewed using the control keys ↓, ↑, PageUp, PageDown, as well as by clicking the mouse on the scroll bar in the database field right part.

To **print** and to **save** a fragment of the history it is necessary:

- to label the beginning of the fragment by clicking twice the mouse left button in the history window, to select the fragment by clicking the mouse left button. To cancel the fragment selection, click twice the mouse left button in the history window;
- to select the "System" submenu.

To **print** the history fragment,

- press the "Print" button;
- select a printer from the existing ones in the open window;
- press "OK" to confirm printing of the selected history fragment, or "CANCEL" to cancel printing.

To **save** the history fragment,

- press the "Save" button;
- select a directory which the selected fragment should be written in;
- type the file name;
- press "OK" to confirm saving of the selected history fragment, or "CANCEL" to cancel saving.

To **exit** from the user's history window it is necessary:

- to press the "Escape" key; or

- to press the "List of users" button in the "Database" submenu (this operation may be also performed in the database field by clicking with the mouse right button); or
- to select with the mouse the red horizontal arrow to the left in the upper left corner of the history window.

6.5.6 History reading

The history of the ratemeter operation is stored in its non-volatile memory since the time of previous reading.

Up to **1000** information messages can be stored in the unit memory. This is comparable with the quantity of messages of the ratemeter **during two months** of its operation on an eight-hour day (provided that the current count rate value is saved not more than once per hour, and the alarm threshold is exceeded not more than once per hour).

The history of the ratemeter may be read in the PC database only after the unit is assigned to a specific user from the main list.

To read the history press the button 2 of the ratemeter and bring its transceiver windows (Fig. 1) within 10-20 cm of the IR adapter. Held the unit in this position for about 2-3 seconds. If the history is read incorrectly, the monitor will display "Communication error. Please repeat". The operation is to be performed once again. If the history is read correctly, the monitor will display "The history has been read. User is... . Do you want to cancel registration?". Press "Yes" to cancel the registration of the unit with the specific user, the "*" sign left of the user's name in the database field and highlighting of the user's name will disappear. Press "No" to save the unit registration with the specific user.

WARNING! *When the information exchange between the ratemeter and PC is completed it is necessary to move off the ratemeter from the IR-adapter or to turn the ratemeter OFF.*

The cursor in the field of the main list will automatically move to the name of the user whom this ratemeter is registered with.

6.5.7 Additional services

To change the **font**, select the "Font" button in the "System" menu (this operation may be also performed in the database field by clicking the mouse right button in it). Change the font and press "OK" to save changes, or "Cancel" to cancel changes.

To change the way the menu windows are opened, open the "Options" menu and click the mouse left button in the "Animation" window. If the symbol "V" is displayed, windows of the menus will open in succession.

To quit the *communication with PC mode*, select the "Exit" button in the "System" menu, or use the techniques of Windows.

6.6 Ratemeter turning OFF

To turn the ratemeter OFF, press the button 2, and fixing it while the backlight is turned on press and fix for 2-3 s the button 1. When the unit is turned OFF, the LCD will display "OFF".

7 TROUBLESHOOTING

Trouble	Possible cause	Solution
1. In any mode the LCD displays "LO".	1. Detector is faulty. 2. Processing block is faulty.	Send the ratemeter to the manufacturer for repair or replacement.
2. In any mode the LCD displays "HI".	1. Detector is faulty. 2. Processing block is faulty. 3. A gamma radiation source is in close proximity.	1 and 2. Send the ratemeter to the manufacturer for repair or replacement. 3. Remove a source.
3. Vibration alarm device is faulty.	Vibration alarm device is faulty.	Send the ratemeter to the manufacturer for repair or replacement.
4. LCD displays the battery discharge warning sign.	Battery is discharged.	Change the battery (see section 9.3).

8 MAINTENANCE

8.1 The maintenance of the ratemeter is provided by the user and involves the inspection of the unit, replacement of discharged battery and check up of the unit normal operation.

8.2 The ratemeter should be inspected for mechanical damage, scratches or other defects. To keep the ratemeter clean remove dust with soft cloth. If the ratemeter housing is contaminated by radioactive dust, decontaminate it using cloth moistened with ethyl alcohol.

8.3 To change the battery:

- turn the unit off;
- remove the back cover of the battery compartment;
- replace the exhausted battery with new one observing the polarity (the signs "plus" and "minus" of the battery should correspond to respective signs in the compartment);
- place the back cover;

NOTE: *Other battery than indicated in the Specification (Section 6) may be used. However, they should have the same parameters.*

When the battery is replaced, the LCD will display all segment and the ratemeter will go into the *self-test mode*.

Attention! When the battery is replaced, all the parameters in the ratemeter should be set (see section 7.4)

9 STORAGE

The ratemeter is to be stored in package at the air temperature from -15°C to $+50^{\circ}\text{C}$ and a relative humidity up to 95 % at 35°C .

The ratemeter without package is to be stored at the air temperature from $+10^{\circ}\text{C}$ to $+35^{\circ}\text{C}$ and a relative humidity up to 80 % at 35°C .

The storage place should be free of dust and vapors of strong chemicals that may cause corrosion.

10 SHIPPING

The ratemeter may be shipped by any kinds of transport for any distance at a temperature from -50°C to $+50^{\circ}\text{C}$ and relative humidity 100% at 40°C .

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

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

During transportation the packaged ratemeters should be firmly fixed in transport.

11 WARRANTY

11.1. The manufacturer warrants this ratemeter to be free from defects in workmanship and materials for a period of 18 months from the date of sale indicated in the warranty certificate provided that the customer followed all the safety and operation instructions given the current manual.

11.2. Warranty does not cover ratemeters:

- without the operating manual;
- subjected to the customer service;
- with mechanical damages due to violation of the storage and operation requirements.

11.3. The warranty period is prolonged for the period of warranty repair.

11.4. Warranty does not cover the battery. The claims concerning the battery quality are not accepted. The battery replacement is not considered as the warranty repair.

12 WARRANTY CERTIFICATE

The PM1703 alarming ratemeter No. _____

is manufactured « ____ » _____

Manufacturer

JV«POLIMASTER» Ltd.

Bogdanovich str., 112

220140 Minsk, Republic of Belarus

Tel/fax (375 172) 17 70 80, 17 70 81

Date of Sale « ____ » _____

Distributor's stamp _____
(signature)

13 ACCEPTANCE CERTIFICATE

The Alarming Ratemeter PM1703

factory number _____

has been manufactured and accepted according to obligatory government standart, current technical documents and it is proved to be serviceable/

QUALITY CONTROL DEPARTMENT

Stamp

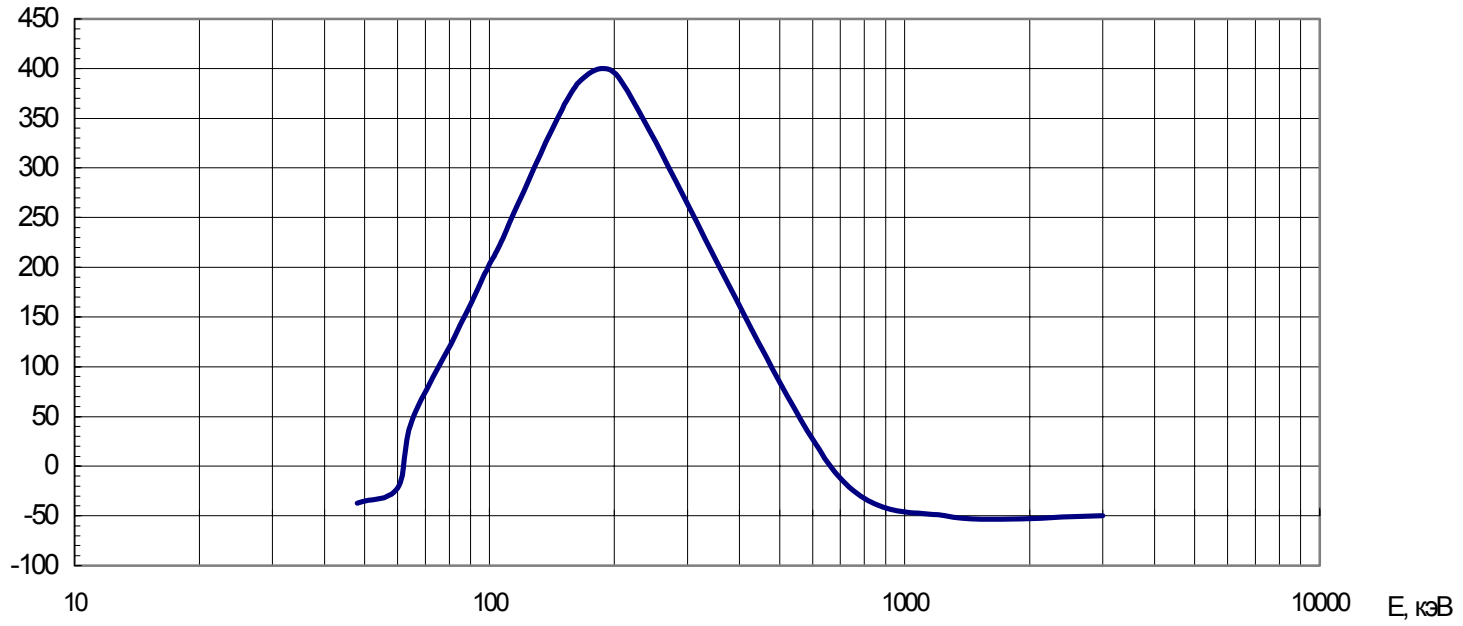
Signature Name
" _____" 200

Initial verification was carried out

Date of verification _____

State verification officer _____
(signature)

Place of a verification mark



Typical energy response of the instrument relative to 662 keV(^{137}Cs)

