

# QUICK START OPERATION GUIDE

Electronic Personal Dosimeter  
**PM1904A POLISMART<sup>®</sup> II**

# CONTENT

READ THIS FIRST.....	5
PRECAUTIONS .....	6
WARNING .....	6
GENERAL DESCRIPTION.....	7
Delivery kit .....	8
Specifications.....	8
Instrument design and control .....	10
OPERATION.....	11
Charging PM1904A.....	12
Normal operation mode and alarms.....	13
Recording data to internal memory.....	15
COMMUNICATION WITH MOBILE DEVICE.....	16
TROUBLESHOOTING.....	16
POLISMART MOBILE APPLICATION USER MANUAL .....	17
Installation of the Application .....	17
iOS mobile devices.....	17
Android OS mobile devices.....	18
Basic function of the POLISMART App .....	20
Dashboard mode.....	20
Track mode.....	24
History mode .....	25
World Map mode.....	28
Settings mode .....	30

## READ THIS FIRST

Thank you for purchasing this Polimaster<sup>®</sup> product. Before operating the instrument, please read this manual thoroughly and retain it for future reference.

The Electronic Personal Dosimeter PM1904A POLISMART<sup>®</sup>II is designed to continuously measuring of the personal Dose Equivalent (**DE**) and personal Dose Equivalent Rate (**DER**) of gamma radiation and compares those measurements to the preset thresholds. In the event that thresholds are exceeded, PM1904A alerts the user with flashing light signals and audible alarms indicating that a radiation source is nearby or a critical dose has been accumulated.

Users do not need to be experts in health physics to operate this instrument; however, an understanding of basic principles of ionizing radiation is desirable for proper operation.

PM1904A exchanges data with your mobile device in real time via Bluetooth 4.0 LE wireless connection.

A mobile app for POLISMART<sup>®</sup> is available for iPhone<sup>®</sup>, iPad<sup>®</sup>, iPod touch (iOS) and for Android<sup>™</sup> mobile devices and can be downloaded from the App Store<sup>SM</sup> or from Google play<sup>™</sup>.

iPhone, iPad, iPod touch and the App Store logo are registered trademarks of Apple Inc.

Android and the Google play logos are trademarks of Google Inc.

POLISMART is a registered trademark of Polimaster Ltd.

Contains Transmitter Module FCC ID: QOQBLE112,  
IC: 5123A-BGTBLE112, MIC: ID R 209- J00046,  
BLE112-A: KCC-CRM-BGT-BLE112-A.

### **IMPORTANT!**

*To activate the PM1904A for the first time (to exit from the storage mode) please connect it to any USB port of a personal computer or use a wall charger with a USB slot. Before first use, please allow the battery to fully charge for at least 4 hours.*

## **PRECAUTIONS**

- Keep your PM1904A charged at all times for proper exposure measurement.
- Please observe all local regulations and safety procedures when working with sources of ionizing radiation.
- Avoid severe mechanical shocks and submerging the instrument into water.

## **WARNING**

The Manufacturer is not responsible for any damage or costs caused by improper understanding of the personal dosimeter operation(s) or reading(s). The user bears all risk in interpreting the output of the dosimeter and/or making decisions based on the dosimeter operation(s) or reading(s). Please consult local laws, regulations and standards before making decisions based on dosimeter reading(s).

## GENERAL DESCRIPTION

The Electronic Personal Dosimeter PM1904A POLISMART II belongs to Polimaster's new family of small and efficient electronic personal radiation dosimeters and radiation detectors for measuring gamma ionizing radiation from gamma emitting radiation sources. And also for transmitting data to the PC, to the mobile devices and to the appropriate radiation protection networks.

When on, the dosimeter continuously measures the personal Dose Equivalent (**DE**) and personal Dose Equivalent Rate (**DER**) of gamma radiation and compares those measurements to the preset thresholds. In the event that thresholds are exceeded, PM1904A alerts the user with flashing light signals and audible alarms indicating that a radiation source is nearby or a critical dose has been accumulated.

PM1904A can also exchange data with your mobile device in real time via Bluetooth 4.0 LE wireless connection, thus transferring actual DER (dose equivalent rate) and DE (dose equivalent) readings to your smartphone. The User Software allows the user to record tracks marked with DER and DE values using the ability of GPS-positioning of a mobile device.

The instrument may be used both indoors and outdoors by various users who need to track environmental gamma radiation and personal exposure.

## Delivery kit

- Electronic Personal Dosimeter PM1904A POLISMART II
- Cable USB -  $\mu$ USB
- Strap
- PVC badge with clip
- Quick start operation guide
- DVD with Operation Manual and User Software for PC
- Warranty Certificate
- Calibration Certificate
- Package

## Specifications

<b>Detector type</b>	Geiger-Muller tube
<b>DER Indication range</b>	0.01 $\mu$ Sv/h - 120.0 mSv/h
<b>DER Measurement range</b> DER limit of variation	1 $\mu$ Sv/h - 100.0 mSv/h $\pm (15+K_1/H)\%$ , where H - dose rate in mSv/h; $K_1 - 0.005$ mSv/h
<b>DE Measurement range</b> DE limit of variation	1.0 $\mu$ Sv - 10.0 Sv $\pm 15 \%$
<b>Energy range</b> energy response relative to 0.662 MeV ( $^{137}\text{Cs}$ ), no more than	0.059 - 1.5 MeV -29 / +30 %

<b>Alarm type</b>	Visual, audio
<b>Power</b>	Rechargeable battery (LiPo)
<b>Charge time</b>	Up to 4 hours
<b>Battery lifetime</b>	<ul style="list-style-type: none"> <li>• at average background &lt; 0.3 <math>\mu</math>Sv/h: 2,000 hours</li> <li>• with Bluetooth connection: 300 hours</li> </ul>
<b>Connectivity</b> PC Mobile Device	USB Bluetooth 4.0 LE
<b>Environmental</b>  temperature range  humidity	  from -20 to +50 °C  up to 95 % at +30 °C
<b>Ingress protection</b>	IP30
<b>Drop test</b>	1.5 m onto concrete surface (in PVC badge)
<b>Dimensions, no more than</b>	60 x 38 x 18 mm
<b>Weight, no more than</b>	33 g

#### **NOTE**

*For more detailed information please contact the manufacturer or visit <http://www.polimaster.com>*

## Instrument design and control

The instrument is equipped with a single control button (located on top) that turns ON the Bluetooth 4.0 LE module and temporarily disable the audible alarm for 5 minutes. PM1904A operates fully autonomously when the battery is charged. It automatically records all measurements in the non-volatile memory at preset intervals. There is one LED that can display the following alerts:

- Green light flashing every second: PM1904A is connected to the PC's USB port to charge the rechargeable battery.
- Green light flashing every 10 seconds: the instrument is operating normally and background radiation is below preset thresholds.
- White-green light flashing every 5 seconds: partially rechargeable battery discharge.
- Single red flash and audible alarm every second: DER threshold is exceeded.
- Double red flash and sound alarm every second: DE threshold is exceeded.
- Single blue light flashing every 10 second: PM1904A is paired to mobile device via Bluetooth 4.0 LE - the instrument is operating normally and background radiation is below preset thresholds.
- Double blue light flashing: the button is pressed - the Bluetooth 4.0 LE module activated.



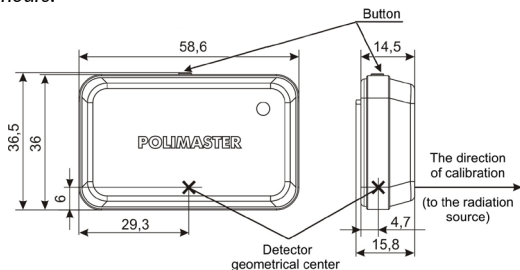
# OPERATION

The normal operation mode of PM1904A is always on. This provides continuous monitoring and accurate measurement of both personal Dose Equivalent and personal Dose Equivalent Rate of gamma radiation. When the instrument is charged and operating normally, the green LED light flashes every 10 seconds.

If the light does not flash green, but instead flashes white-green, the battery is partially discharged. If there is no light indication on the LED the battery is critically discharged. Please charge the battery of PM1904A following the procedure described below.

## NOTE

*Before the first use, please allow the battery to fully charge from a USB port for at least 4 hours.*



*Figure 1. Electronic personal dosimeter PM1904A: geometrical center and direction to radiation source*

## Charging PM1904A

To charge PM1904A please connect it to any USB port of a personal computer or use a wall charger with a USB slot. When the rechargeable battery is charged, the green light will be on continuously.

A full charging cycle requires 4 hours. This will provide 2,000 hours of instrument operation under normal background conditions. The manufacturer recommends charging PM1904A for 4 hours every month, to ensure reliable operation of the instrument for at least 1000 hours and to extend the lifetime of the rechargeable battery.

### **NOTE**

*If the battery is partially discharged a white-green LED light flashes every 5 seconds.*

### **IMPORTANT!**

*Once the partial battery discharge begins appearing the instrument will continue working for 16 hours. When using PM1904A an environment with background radiation levels higher than 0.1  $\mu\text{Sv/h}$ , it is recommended to fully charge PM1904A before operation.*

## Normal operation mode and alarms

After PM1904A is charged and disconnected from the power supply it is ready for autonomous operation. The green light flashes every 10 seconds and the instrument continuously measures DER and DE of gamma radiation and compares those measurements to preset thresholds.

If the thresholds are exceeded, a red light will flash on the LED. A red LED light flashing every second indicates that the DER threshold was exceeded; a red light flashing twice every second indicates that the DE threshold was exceeded.

The manufacturer's preset values are follows:

- DER Threshold 1: 1  $\mu\text{Sv/h}$
- DER Threshold 2: 10  $\mu\text{Sv/h}$
- DE Threshold 1: 1 mSv
- DE Threshold 2: 5 mSv

When the DER threshold is exceeded that usually means there is a source of radiation nearby and the general course of action is to leave the area (the radiation rate drops significantly as the distance from the radiation source increases). The red DER alarm will stop after background radiation drops below the preset threshold.

When the DE threshold is exceeded it doesn't necessarily mean that there is a radiation source nearby. Moreover, the red DE alarm

will not stop even if the current background radiation level returns to its normal state.

This may mean that the user has been in a field with elevated background radiation for too long and the risk of damaging effects to personal health is increased (the worldwide average natural dose to humans is about 2.4 mSv per year).

Please consult health specialists in such circumstances or in case of any uncertainty.

The red double flash of DE alarm can be reset only by connecting PM1904A to a mobile device and using the POLISMART Mobile Application or the User Software for PC.

### **IMPORTANT!**

*To set appropriate threshold values and / or to get instructions for dealing with any given value of DER/DE the user should consult authorized licensed specialists. The user assumes full responsibility for compliance with applicable laws, regulations, and standards in connection with the use of the dosimeter. Additionally, the user bears all risk in interpreting dosimeter output and / or making decisions based on dosimeter operation(s) or reading(s).*

*To set new thresholds, and/or reset the current DE value to zero, connect PM1904A to a mobile device (use the POLISMART Mobile Application) or to PC (use the Personal Dose Tracker Software).*

## Recording data to internal memory

When operating normally, PM1904A records current DER and DE values to the internal memory. The interval between recordings can be set anywhere between 1 minute and 18 hours using the supplied User Software. The manufacturer's preset value is 1 hour.

All data recorded in the instrument's memory is time stamped according to the internal clock. When the instrument is connected to the User Software it will automatically synchronize the internal PM1904A clock with the PC or the smartphone. It is recommended to synchronize the dosimeter's clock periodically to ensure that the time stamps of the DE and DER readings are correct.

### **IMPORTANT!**

*After complete rechargeable battery discharge (the LED is blank) the internal instrument time and data recording stop. At or after recharging the instrument, it is recommended to synchronize the internal clock once again with the PC or the mobile device in order to have proper time stamps on the DER and DE readings in the instrument's non-volatile memory.*

# COMMUNICATION WITH MOBILE DEVICE

The mobile app POLISMART is available for iPhone, iPad, iPod® touch (iOS) and for Android OS mobile devices and can be downloaded from the App Store or from Google play.

The PM1904A POLISMART II communicates with your mobile device using a low energy Bluetooth 4.0 LE connection (Contains Transmitter Module FCC ID: QOQBLE112, IC: 5123A-BGTBLE112, MIC: ID R 209- J00046, BLE112-A: KCC-CRM-BGT-BLE112-A).

POLISMART Mobile App allow the user to set thresholds and data recording intervals, synchronize the internal instrument time, work with the instrument over the mobile device in real-time data exchange mode.

## TROUBLESHOOTING

Most of the problems that have been analyzed can be traced to low rechargeable battery power, so troubleshooting in the field is limited to charging the rechargeable battery regularly. This is especially important if you are in an environment with elevated background radiation.

# POLISMART MOBILE APPLICATION USER MANUAL

Before working with the PM1904A, download the POLISMART Mobile App from the App Store or Google play.

## Installation of the Application

### iOS mobile devices

#### ***Via Wi-Fi from App Store***

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Open **App Store** on your mobile device.

Type **polismart** in the search box to locate the App.

Select the **POLISMART** program from the directory.

Select **INSTALL** options.

Enter your account information (name and password).

The application will be installed automatically.

#### ***iTunes, via USB***

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Connect your iPhone, iPad or iPod touch to your computer.

Launch iTunes.

Go to **iTunes Store**.

Type **polismart** in the search box to locate the app.

Select the **POLISMART** program from the directory.

Enter your account information (name and password).

The selected file will be downloaded to your computer.

Go to the **Programs** tab to see downloaded programs.

Click the **iPhone** tab.

In the top menu select the **Programs** tab and make sure the **Sync** box is checked.

Click **Apply** to synchronize programs with your mobile device.

The application will be installed automatically.

## Android OS mobile devices

Launch **Google play** on your mobile device.


Type **polismart** in the search box to locate the app.

Download **POLISMART** mobile app by clicking **INSTALL** button.

The application will be installed automatically.



## Launching the POLISMART app

Press the yellow and black radiation icon with the POLISMART inscription  to launch the POLISMART mobile app. The main application screen will appear as depicted in Figure 2a.

Locate and short press the control button on the top of the personal dosimeter PM1904A and wait up to 10 seconds until the dosimeter name and serial number appear on the screen.

Select the dosimeter (see Figure 2b). The main Dashboard screen will appear indicating the current with DER value once detector connection is complete (see Figure 2c and 2d).



Figure 2. Connecting PM1904A to mobile devices

Figure a), b) and c) given as the example based on the smartphone running Android OS.  
Figure d) DER measurement mode displays for smartphones running iOS.

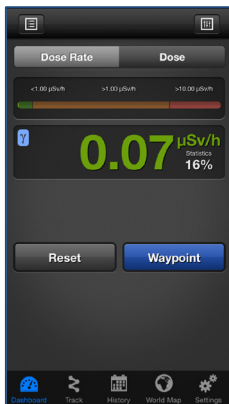
## Basic function of the POLISMART App



### Dashboard mode

The DER value appears after detector connection is complete (see Figure 3).

The measurement error of measured values will be displayed in the middle of the screen to the right of the DER value. DER values can be read when a sufficient level of accuracy, recommend no more than 20 % or less.



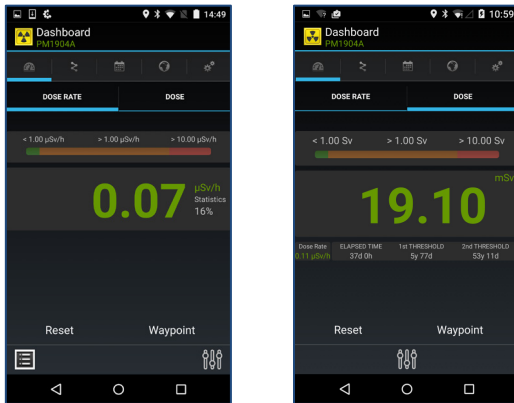



Figure 3. Dashboard Screen

The **Dose Rate** and **Dose** buttons are used to switch the detector between gamma-radiation DER measurement mode (indication units are  $\mu\text{Sv/h}$ ,  $\text{mSv/h}$ ,  $\text{Sv/h}$  or  $\mu\text{R/h}$ ,  $\text{mR/h}$ ,  $\text{R/h}$ ), and DE measurement mode (indication units are  $\mu\text{Sv}$ ,  $\text{mSv}$ ,  $\text{Sv}$  or  $\mu\text{R}$ ,  $\text{mR}$ ,  $\text{R}$ ). The DE accumulation time is displayed in days, hours and minutes.

While in DER measurement mode press the **Reset** button to reset accumulated DER statistical data and to start a new accumulation.

Press the  button to open the **Settings** window (see Figure 4). Here the user can change DER thresholds, enable or disable the sound alarm or restore the default settings. The default DER threshold settings are:

- DER Threshold 1: 1  $\mu\text{Sv/h}$
- DER Threshold 2: 10  $\mu\text{Sv/h}$

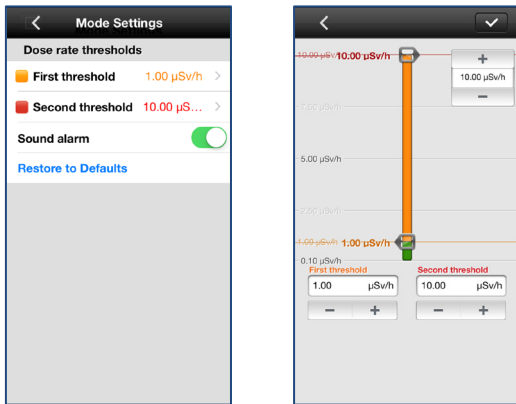




Figure 4. DER Settings for Dashboard screen given as the example based on the smartphone running iOS.

While in DE measurement mode press the **Reset** button to reset the accumulated Dose and DE accumulation time values.


Press the  button to open the **Settings** window, where the user can change DE thresholds, enable or disable the sound alarm or restore to default settings. The default DE threshold settings are:

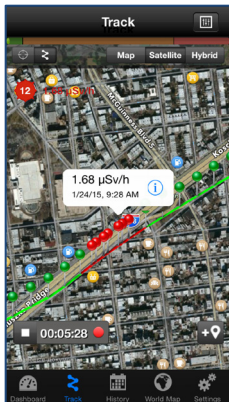
- DE Threshold 1: 1 mSv
- DE Threshold 2: 5 mSv

The **Waypoint** button  allows the user to save the current DER and DE values in the memory of your mobile device along with the user's actual GPS-position. Press the **Add** button to save the value.

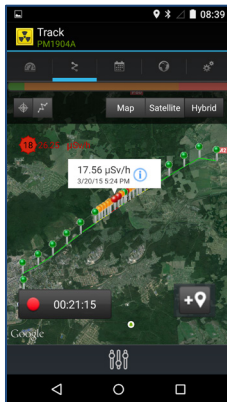


## Track mode

Press the **Track** button  to switch the device to Track mode. Press the **Record** button to save tracking records in accordance with track setting, as depicted in Figure 5.



a)




b)

*Figure 5. Tracking mode  
a) for smartphone running iOS,  
b) for smartphones running Android OS*



## History mode

Press the **History** button  to open the history window, which displays events/values stored in the mobile device memory.

Saved events are divided into three types:


- **Measurements** (radiometric data without GPS coordinates)
- **Waypoints** (radiometric data with GPS coordinates)
- **Tracks** (a route with multiple waypoints)



### Note

*Reading a large quantity of data stored in the instrument's non-volatile memory can take considerable time. You should wait until the end of the process of reading, which is illustrated by circular processing bar.*

The main **Sets** screen in **History mode** shows the general dosimetric data for a particular date. Press the date to open the screen with all events for the specified date.

At the upper part of the screen are 3 buttons displaying particular events recorded in the history: **Tracks**, **Waypoints**, and **Measurements**. Press a particular button to show the corresponding event.

Press the  button to sort saved events by time, alarm or name. The user can send saved data by e-mail, or post to Facebook® or

Twitter<sup>®</sup> by pressing the **Send** button . Press the **Delete** button  to clear the screen and the instrument memory. The User Software will recommend saving the data.

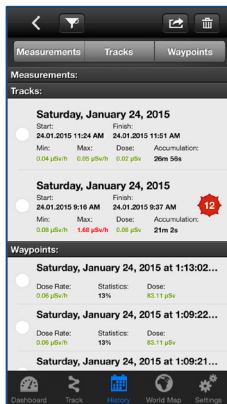
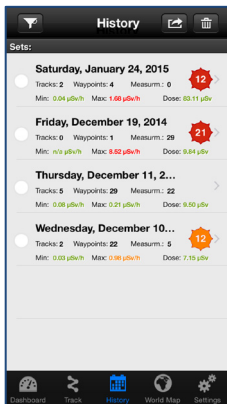


Figure 6. History mode on iOS mobile devices



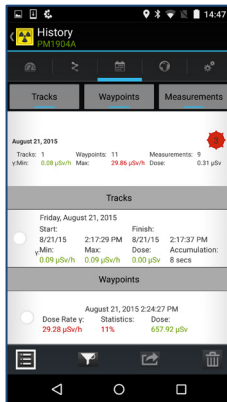
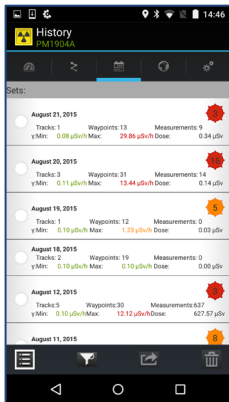


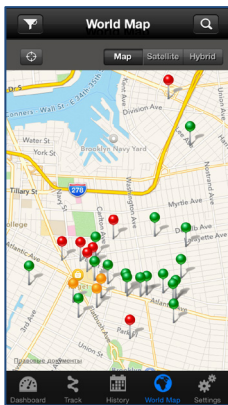
Figure 7. History mode on Android OS mobile devices



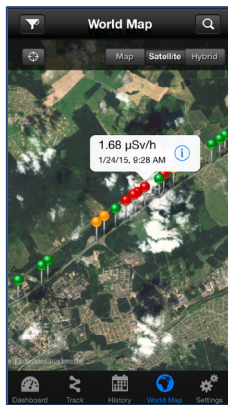
## World Map mode

Press the **World Map** button to enter the **World Map mode**. This mode displays the map with the waypoints stored in the memory of the mobile application.

Current user location is marked on the map as a blue point. To zoom the map in/out: double press or slide the fingers apart on the mobile device screen.

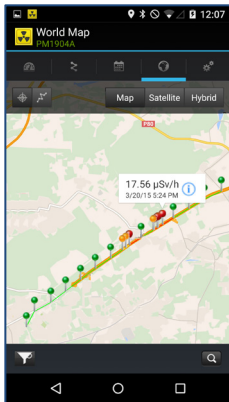


a

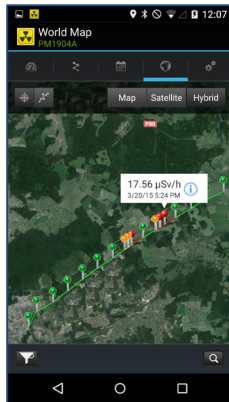


b

Figure 8. World Map for iOS mobile devices



a



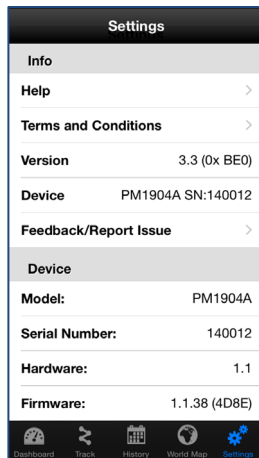
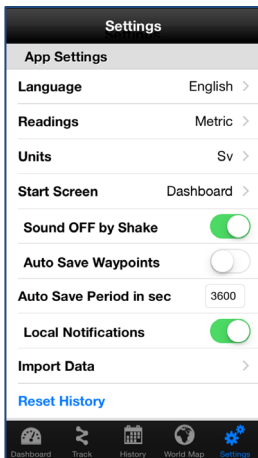
b

Figure 9. World Map for Android OS mobile devices



## Settings mode

Press the **Settings** button to open the **Settings mode**. This mode allows the user to choose following settings:



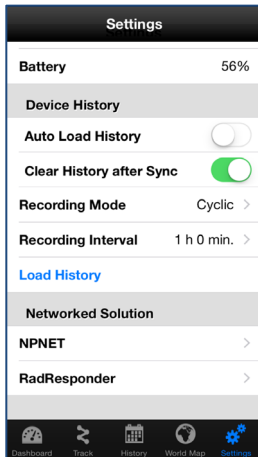
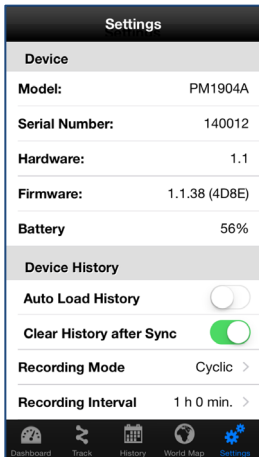


Figure 10. Window of the applications Settings mode

## App settings

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- **Language** – English / Japanese / Chinese / Russian / French / German ...
- **Readings** – select the measurement system:
  - **Imperial** – the distance measurement units (yards) shall be adjusted in the **Track** mode settings, the distance measurement units (miles) shall be adjusted in the **World Map** mode settings;
  - **Metric** – the distance measurement units (meters) shall be adjusted in the **Track** mode settings and the distance measurement units (kilometers) shall be adjusted in the **World Map** mode settings.
- **Units** – select the measurement units:
  - **Sv** (Sieverts);
  - **R** (Roentgens).
- **Start Screen** – select the start screen at initial switching on the application. The **Dashboard** mode is set by default.
- **Sound OFF by Shake** – switch off audible alarm when the mobile device is being shaken.

- **Auto Save Waypoints** – switch on/off the function of the automatic saving of the waypoints to the smartphone's memory.
- **Auto Save Period in sec.** – set an interval for waypoints automatic record into history. Interval setting discreteness is 1 second. Recommended time interval – 3600 seconds.
- **Local Notifications** – switch on/off the notifying function when the POLISMART<sup>®</sup> application is minimized.
- **Import Data** – downloading function of the radiometric data from Cloud to the smartphone's memory which have been exported as a radiometric data file earlier.
- **Reset History** – fully clear the stored historical radiometric data from the smartphone's memory.

### *Info*

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- **Help** – description of the POLISMART<sup>®</sup> application operation.
- **Terms and Conditions** – the license agreement on use of the Software together with the instrument.
- **Version** – version of the installed software and (its fingerprint).
- **Device** – instrument type and its serial number.

- **Feedback/Report issue** – click to send a report to the technical support service of the manufacturer.

### *Device*

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- **Model** – instrument's type.
- **Serial Number** – instrument's serial number.
- **Hardware** – instrument's hardware version.
- **Firmware** – instrument's firmware version and (its fingerprint).
- **Battery** – battery charge level.

### *Historic data*

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- **Auto Load History** – auto load of the historic radiometric data into the application from the instrument's non-volatile memory.
- **Clear History after Sync** – delete the instrument's operation history from its memory after the instrument is synchronized with the application.
- **Recording Mode** – select the record mode of the radiometric data into the non-volatile internal instrument's memory – cyclic / linear. In the *cyclic mode* the radiometric data shall be recorded in an endless cycle. Every next



(new) event will overwrite the “oldest” one at the moment after the maximum allowed number of records is achieved. In the *linear mode* the radiometric data will be recorded until the maximum allowed number of records is achieved.

- **Recording interval** – set an interval for radiometric data (Measurements) automatic record into the instrument’s internal memory. The range of the recording interval is from 1 min. to 18 hours. Recommended recording interval – 1 hour or larger.
- **Load History** – the ability to manually loading of the historical radiometric data (Measurements) from the instrument’s internal memory.
- **Reset Detector to Factory Defaults** – restore the default settings (preset by the manufacturer).

### ***Network Solutions***

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Automatic or manually transfer of the data's stored in the mobile device memory to the appropriate radiation protection networks.