

User Manual

Personal Electronic Dosimeter (PED)

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1 Tracerco PEDs

1.1 Overview

Tracerco's Personal Electronic Dosimeters (PEDs) measure and record both accumulated dose and dose rate. PEDs measure the radiation equivalent dose Hp(10), accumulated in X-ray and gamma ray radiation, which is the equivalent dose at 10 mm below surface of the upper body. Therefore, PEDs must be worn on the upper body.

DoseVision™ transfers dose and dose rate data from the PEDs to a local computer. Data must be transferred periodically to clear the memory on PEDs. DoseVision™ displays data graphically and allows users to set alarm levels and other settings on PEDs.

DoseVision™ Live is a smart phone app that can connect with up to seven PEDs simultaneously using Bluetooth.

Attention: The PED-IS is certified for use in potentially explosive atmospheres (hazardous areas). Therefore, the PED-IS must be operated in accordance with the information contained in the document MN1004 Essential Safety Information.

1.2 PEDs

PEDs measure dose rates in the range 0 to 100 mSv/h (0 to 10 rem/h), with extended range PED variants also available to measure dose rates in the range 0 to 1.0 Sv/h (0 to 100 rem/h). The Tracerco PEDs are as follows:

PED Blue and PED-ER (extended range)

The PED Blue is our standard personal dosimeter packed with features as standard.

PED-IS

The PED-IS is an intrinsically safe version of the PED Blue.

PED+ and PED-ER+ (extended range)

The PED+ range have additional features such as:

- Bluetooth connection for use with DoseVision™ Live.
- Built-in GPS monitoring for logging location information along with dose data.
- Wireless battery charging.
- Pop-up alarm messages which are customisable for individual user scenarios.
- Handheld mode that allows the PED+ and PED-ER+ to be used as a portable survey meter.



PED Blue and PED-ER



PED-IS



PED+ and PED-ER+

1.3 Interface

The key interface features are as follows:



1. **System check:** Flashes green periodically while the PED is functioning correctly. The LED flashes red if the instrument is in a critical status.
2. **Dose rate alarm:** Flashes amber while the amber dose rate alarm is exceeded. Flashes red while the red dose rate alarm is exceeded.
3. **Dose alarm:** Flashes amber or red for active dose alarms and continues to flash until the data has been transferred to DoseVision™.
4. **Readings screen:** The screen can be programmed to customise the displayed information using DoseVision™.
5. **Case:** The case is a robust and durable polymer case.
6. **Button:** PEDs use a single button for navigation and selection. A long press is used to turn on the PED, open the menu system and to make selections. A short press is used to scroll. The button is also used to silence alarms
7. **Speaker:** The speaker is used for audible alarms.
8. **Geiger Müller tube window:** The Geiger Müller tube has a small window to allow increased low energy response.

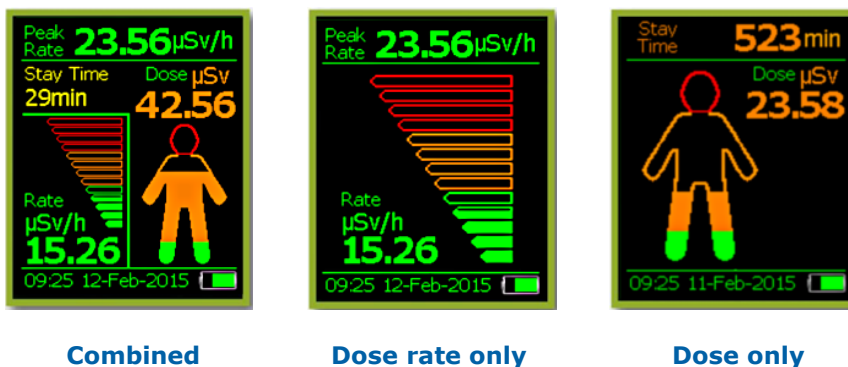
2 Functional Description

2.1 Readings screen

PEDs have the following display modes:

- Combined dose and dose rate (this is the default screen layout)
- Dose rate only (includes peak dose rate)
- Dose only (includes stay time).

PEDs also have an option to flip the screen. The display modes show as follows:



The readings screens show the following information depending on which display mode is selected:

Peak reading

The highest dose rate, $\mu\text{Sv/h}$ or mrem/h , detected since the last time the readings were transferred to DoseVision™.

Stay time

An estimate of the time left at current dose rate, until you reach the next dose alarm. The stay time is displayed in minutes with a range of 0 to 999 minutes.

Dose

The total dose of radiation, μSv or mrem , received since the last readings were transferred to DoseVision™.

Dose body

Graphical display of accumulated dose level. The body fills from the bottom as dose is accumulated. Yellow, orange, red and crimson dose alarm thresholds are displayed on the figure depending on the alarm configuration.

Bar graph

Graphical display of current dose rate (linear scale). Orange and red dose rate alarm thresholds are displayed on the bar graph.

Rate

Current dose rate in $\mu\text{Sv/h}$ or mrem/h .

Status bar

Displays time, date and battery capacity. Alternates with PED status and warning messages, if any are current.

Attention: For the PED+ and PED-ER+, the status icons for Bluetooth or GPS features are shown alternating with the battery symbol if enabled.

2.2 Dose and dose rate measurement

PEDs measure and record the following:

Dose equivalent

Radiation equivalent dose Hp(10), accumulated in X-ray and gamma rays radiation in the energy range of 33keV to 3MeV (standard range) or 48keV to 3MeV (extended range), and is the equivalent dose at 10 mm below surface of the upper body. Alarms can be set for dose.

Dose rate

Dose rates up to 100 mSv/h (10 rem/h) or 1 Sv/h (100 rem/h) for the extended range. Alarms can be set for dose rate.

Attention: The accuracy of measured dose rates cannot be guaranteed above 100 mSv/h (10 rem/h) or 1 Sv/h (100 rem/h) for the extended range. See the section **Dose rate overload**.

2.3 Dose rate overload

PEDs operate accurately for dose rates up to 100 mSv/h (10 rem/h), or 1 Sv/h (100 rem/h) for the extended range. The accuracy of measured dose rates cannot be guaranteed above the dose rate limit. Therefore, there is potential for inaccuracies in subsequent accumulated dose values from the time of overload until the data has been cleared and a new accumulation started.

During the dose rate overload, the top of the readings screen show **Overload** and dose rate is displayed as **>100mSv/h** or **>1 Sv/h**, or the equivalent in rem/h. The dose values are still displayed, but flash to indicate possible inaccuracies. The status bar shows a warning symbol and the **Dose Error?** message. An alarm sounds continuously until the button is pressed.

Attention: The actual measured dose rate values are still recorded and readable when transferred to DoseVision™.

2.4 Alarms

PEDs have two configurable dose rate alarms and up to four dose alarm levels. The alarm settings can be viewed on the alarm levels screen. However, the alarm settings can only be changed with DoseVision™.

PEDs alert users to alarm conditions as follows:

Dose rate alarms

For dose rate alarms, the dose rate LED flashes amber when the first alarm is reached and red for the second alarm. The alarm continues until the dose rate drops below the alarm level.

Dose alarms

For dose alarms, the dose LED flashes amber when the first two alarms are reached and red for the higher two alarms. For the highest set dose alarm (red or crimson) the dose alarm LED stays on constantly. The PED also makes a loud beeping noise as an audible alarm. The alarm continues until the total dose history has been transferred to DoseVision™.

If the PED button is pressed during an alarm, the audible alarm is silenced and the vibrating stops. However, the relevant LED will remain activated.

Attention: Devices in the PED+ range allow alarm messages to be configured so that, when an alarm is triggered, a message related to the specific alarm is displayed.

2.4.1 Dose alarms

PEDs have up to four adjustable levels for dose. Alarms are set in ascending order with the ordering of yellow, amber, red, crimson. Alarm levels are checked every second. The alarm levels are set using DoseVision™.

Alarm	Sounder and vibration	Dose alarm LED
Yellow	Short pulse, low frequency	Short amber flash
Amber	Medium pulse, low frequency	Long amber flash
Red	Medium pulse, low frequency	Long red flash
Crimson	Long pulse, high frequency	Constant red

2.4.2 Dose rate alarms

PEDs have two adjustable alarm levels for dose rate. Alarms are set in ascending order with the ordering of amber and red. Alarm levels are checked every second. The alarm levels are set using DoseVision™.

Alarm	Sounder and vibration	Dose alarm LED
Amber	Medium pulse, low frequency	Long amber flash
Red	Medium pulse, high frequency	Long red flash

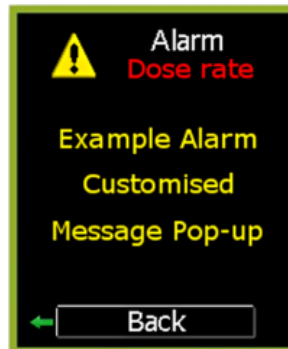
2.4.3 Default alarm levels

It is possible to have specific alarm levels set by Tracerco when purchasing a new PED. If this is not requested, alarms will be set at the following default levels:

- Amber Dose Alarm at 100µSv
- Red Dose Alarm at 2000µSv
- Amber Dose Rate Alarm at 7.5µSv/h
- Red Dose Rate Alarm at 100µSv/h

2.4.4 Alarm messages (PED+ and PED-ER+)

The PED+ range allow alarm messages to be configured so that when an alarm is triggered, a message related to the specific alarm is displayed as shown below. Messages can be used to help the user make important decisions based on their measured radiation exposure.



2.4.5 Dose rate overload

Alarms alert to dose rate overload as follows:

- Top of the readings screen shows **Overload**
- Dose rate is displayed as **>100mSv/h** or **>1 Sv/h**. (or equivalent in rem/h).
- Dose values are still displayed, but flash to indicate possible inaccuracies.
- Status bar shows a warning symbol and **Dose Error?** message.
- Alarm sounds continuously until the button is pressed.

Once the dose rate falls below 100 mSv/h (10 rem/h) or 1 Sv/h (100 rem/h), the top of the screen returns to the standard display and the dose rate returns to live values. However:

- The total dose values continue to flash.
- The status bar continues to show a warning symbol and the **Dose Error?** message.
- The alarm continues to sound until the button is pressed.

On transferring the data to a computer running DoseVision™:

- The total dose values stop flashing.
- The **Dose Error?** message is cleared.

2.5 Data logging

Dose and dose rate data is recorded in the following modes:

Periodic logging

In periodic logging mode, PEDs record the accumulated dose periodically in 60s, 30s, 10s, or 5s intervals. The default is 60s. Periodic logging at 5s intervals is used for logging GPS location data. The memory of PEDs can store up to 125,000 data points. Therefore, the memory stores around 2000 hours of operation with a 60s interval and 167 hours with a 5s interval. Tracerco recommends using periodic logging if PEDs are deployed in areas where dose rates are consistently above background or rapid dose rate fluctuations are not anticipated.

Intelligent logging

In intelligent logging mode, PEDs record the accumulated dose for every 0.01 μSv change in dose. In normal circumstances, intelligent logging uses the memory most efficiently. Intelligent logging is the default logging mode.

A status warning message alerts the user when the memory is 70% full, meaning that around 600 hours of operation remain. When the memory is 95% full, a critical malfunction warning is displayed. If the memory is completely full, PEDs continue to measure and display the true current accumulated dose. However, new date and time information is not recorded.

Data should be regularly downloaded from PEDs to the Tracerco DoseVision™ software. After downloading the data, the memory is cleared.

Attention: The memory of PEDs is non-volatile. Therefore, data is not lost in the event of the battery running out of charge.

2.6 Tasks

Tasks monitor the dose and peak dose rate for a specified time or task. Tasks are started and stopped manually. When a task is running, the readings screen shows the current dose accumulated since the task started as shown below.



PEDs can record up to 9999 tasks. The four most recent tasks can be reviewed through the task details screen.

Attention: All task data logging periods may be displayed when data is viewed in DoseVision™.

Task details can be cleared from PEDs after data has been transferred to DoseVision™.

2.7 Discrete mode

The discrete mode disables the audible and visual warnings of alarm conditions. For example, to avoid situations which may cause distress to others or could draw unwanted attention. In the discrete mode, all the LEDs are permanently switched off and the sounder is de-activated so that audible alarms are never activated. The screen is also set to a dimmer setting. However, the vibration alert still activates, and on-screen indications are still shown.

Attention: If the screen-saver feature is switched on when using discrete mode, the screen wakes on an alarm in a dimmed state.

The discrete mode must be enabled using DoseVision™. Once enabled, the discrete mode icon is shown in the main menu. When the discrete mode is switched on, a cross is added to the icon.

2.8 Handheld mode (PED+ and PED-ER+)

When set in handheld mode, the PED+ and PED-ER+ can be used as a survey meters. The PED is effectively measuring H*(10) dose rate and therefore cannot be considered to be measuring personal dose. Therefore, personal dose is not accumulated while in the handheld mode.



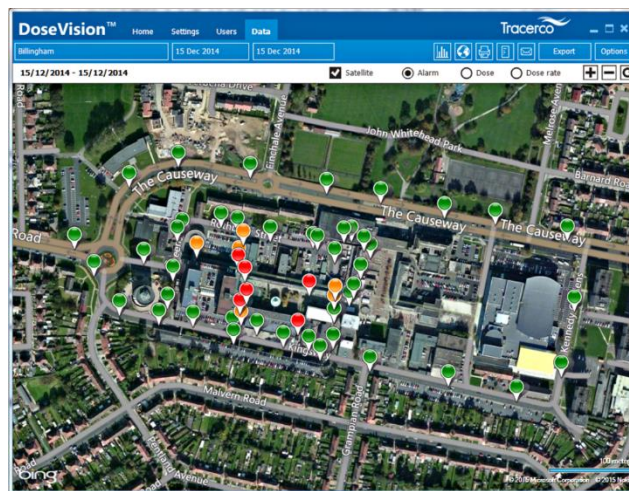
In handheld mode, the PED+ and PED-ER+ provide a measurement of dose rate which compensates for the fact that the device is no longer being worn on the body. Therefore, the device should be held away from the body whenever possible when in this mode. In handheld mode the PED is effectively measuring H*(10) dose rate and as a result cannot be considered to be measuring personal dose. Personal dose is NOT accumulated while in the handheld mode.

The PED+ automatically flips the screen when switching to the handheld mode to encourage the user to hold the device with the GM-tube window facing forwards or towards the radiation area.

2.9 GPS logging (PED+ and PED-ER+)

When the built-in GPS is enabled and a location lock has been achieved, the PED+ is able to log user location alongside measurement data. DoseVision™ can then model dose and dose rate data on maps as shown below. Note that the status of alarms is also logged as shown by the green, orange, and red data points. To switch the GPS feature on, navigate to the "Bluetooth/GPS" menu within the settings menu and ensure that the GPS option is checked.

If the GPS feature is switched on, the GPS icon will be shown alternating with the battery symbol on returning to the main readings screen. Initially the GPS symbol will be shown coloured grey to show that GPS is enabled. When a location lock is achieved, the GPS symbol will turn green to show that location logging is in progress. If no location lock can be achieved, then the dose data will still be logged normally without location data.



2.9.1 Data points

Each time the PED+ logs a dose point (see section 3.7.6 for data logging options) the location, dose rate and the status of any alarms are also logged. The DoseVision™ map shows a data point for each individual log. Each data point can be inspected by hovering the mouse pointer over the data point. This displays a hovercard which includes the date and time at which the point was logged, as well as measurement values specific to the display mode selected from the map options bar.

Alarms



Each data point is shown coloured with the highest priority alarm colour of all of the alarms active at the point when the data was logged. The hovercard for this mode displays both the dose and the dose rate logged at the location.

Dose rate



Each point is coloured according to the dose rate logged at the location. All of the points shown are colour-graded from lowest to highest dose rate with the lower dose rates being coloured grey and the higher dose rates being coloured pink. The hovercard for this mode displays the dose rate logged at the location.

Dose



Each point is coloured according to the dose logged at the location. All of the points shown are colour-graded from lowest to highest dose with the lower dose being coloured grey and the higher dose being coloured blue. The hovercard for this mode displays the dose logged at the location.

Attention: The GPS detection is limited by the constraints of GPS technology. To achieve a good signal lock the PED+ must be able to detect signals from GPS satellites. In most circumstances this means that the user must be outside to get a suitable location lock. Sometimes, a lock can be achieved when indoors near to external windows or doors. The ability to log location data is subject to a number of environmental factors, meaning Tracerco cannot guarantee that location data will be logged in all scenarios. The accuracy of the location logs is also affected by the quality of the satellite signal received and the number of satellites which can be detected. The accuracy of the location logs can typically be to within 3.5m of the actual location, though this may be extended if GPS signal is poor.

2.10 Bluetooth (PED+ and PED-ER+)

In order to use the DoseVision Live software with the PED+ the Bluetooth feature must be turned on. If the Bluetooth feature is turned off then the DoseVision Live software will not be able to detect the PED+ device.

To switch on the Bluetooth function, navigate to the "Bluetooth/GPS" menu within the settings menu and ensure that the Bluetooth option is checked. If the Bluetooth feature is switched on, the Bluetooth icon will be shown alternating with the battery symbol on returning to the main readings screen. When a connection is made to the device by DoseVision Live, the Bluetooth icon will be shown coloured blue. If there is no active connection to the device then the icon will be shown coloured grey.

2.11 Battery life

Tracerco PEDs contain high capacity batteries which allow for long periods of use between charges. However, the battery life is affected by how PEDs are used. The key factors that can reduce battery life are as follows:

- Keeping the display on. That is, having the screen saver switched off.
- Keeping the PED in elevated radiation fields. That is, higher than background dose rates.
- Enabling and connecting through Bluetooth (PED+ and PED-ER+).
- Enabling the GPS feature (PED+ and PED-ER+).

2.11.1 PED Blue, PED-ER, and PED-IS

For the PED Blue and PED-IS variants, Tracerco recommends using the screensaver whenever possible. The table below gives estimates for the battery life when working at background radiation levels:

Screensaver	Battery life expected from fully charged
On	300 hours (approx.)
Off	70 hours (approx.)

2.11.2 PED+ and PED-ER+

For the PED+ variants, Tracerco recommends using the screensaver whenever possible and switching off Bluetooth and GPS when not required. The table below gives estimates for the battery life when working at background radiation levels.

Screensaver	Bluetooth	GPS	Battery life expected from fully charged
On	Off	Off	300 hours (approx.)
On	On	Off	80 hours (approx.)
Off	Off	Off	70 hours (approx.)
Off	On	On	20 hours (approx.)

3 Operation

Attention: The PED-IS is certified for use in potentially explosive atmospheres (hazardous areas). Therefore, the PED-IS must be operated in accordance with the information contained in the document MN1004 Essential Safety Information.

3.1 Setting up the PEDs

Before using your PED, set the alarm levels, logging options, units and assign users using the DoseVision™ software.

The devices can then be configured with following user preferences on the **Settings** menu:

Language

Language of the displayed text.

Activity sounder

Typical background radiation will produce approximately 12 counts per minute. The divide options allow the user to manage the 'click' event interval.

Selecting ÷ 1 means that a 'click' is generated every time a radioactive particle is detected.

Selecting ÷ 30 will give a 'click' interval of about 2.5 minutes in background radiation.

Time zone

It is possible to change the displayed time to current local time through the time zone selection in the time zone screen.

3.2 Start up and shut down

To start the PED, press and hold the button for a few seconds until the status bar shows 100% as shown below (left).



During the start-up, the screen shows the assigned user, assuming there are no alarms or warnings present, followed by a button operation message. The alarms are tested when the PED is starting up, so the PED should flash, vibrate and make a loud beep sound. The readings screen is displayed after start-up.


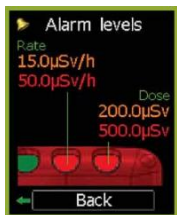








Attention: If the dose stored on the PED is higher than the dose alarm level, the PED bypasses the start-up screens to show the readings screen and sound the alarm.

Shut down the PED by selecting **Switch off** in the main menu.

3.3 Navigating the menus










Holding the PED button opens the **Main** menu. The **Settings** menu is then opened from the main menu.

3.3.1 Main menu

Icon	Description
	<p>Alarm levels</p> <p>Displays the amber and red alarms levels for the dose and dose rate. Note that the alarm levels are set in DoseVision™.</p> 
	<p>Tasks</p> <p>Opens the tasks screen.</p>
	<p>Flip screen</p> <p>Flips the screen to rotate the screen through 180 degrees.</p>
	<p>Screen saver</p> <p>By default, the screensaver activates after 30 seconds. You can set the period before the screensaver activates. Tracerco recommends that the time for screensaver activation is as short as practical. Long periods of screen activity reduce the life of the screen and deplete the battery quickly.</p> 
	<p>Settings menu</p> <p>Opens the settings menu.</p>
	<p>Exit menu</p> <p>Return to dose readings screen.</p>
	<p>Discrete mode (if enabled in DoseVision™)</p> <p>Disables the audible and visual warnings of alarm conditions.</p>
	<p>Handheld mode (PED+ and PED-ER+)</p> <p>The PED+ should be held away from the body where possible when in handheld mode. If a constant personal dose measurement is required, set the device to the personal mode.</p>
	<p>Switch off</p>


3.3.2 Settings menu

The table below details the **Settings** menu.

Icon	Description
	<p>Power status</p> <p>Fully charged PEDs can be expected to last for more than 300 hours in normal operating conditions before recharging is required. A low battery warning is displayed when only eight hours is remaining.</p> 
	<p>Monitor details</p> <p>The monitor details screen shows various useful pieces of information about the Tracerco PED and its status. Calibration contact details can also be found here.</p>
	<p>Time zone</p> <p>Sets the local time zone on the display to show the local current time.</p> <p>The time zone for the PED data is set on DoseVision™. Therefore, to ensure that the dose history data is secure, you cannot change the time and date stored on the PED.</p>
	<p>Language</p> <p>Sets the locale of the displayed text.</p>
	<p>Activity sounder</p> <p>If enabled, the PED produces approximately 12 audible 'clicks' for a typical background radiation of around 12 counts per minute.</p> <p>You can configure the number of audible clicks for the radioactive particle detected. For example, selecting divide by one (÷ 1) generates an audible click for each radioactive particle detected and selecting divide by 30 (÷ 30) generates audible click every 2.5 minutes for a typical background radiation.</p>
	<p>Display type select</p> <p>Sets the display to combined, dose rate only, or dose only mode.</p>
	<p>Reset logs (if enabled in DoseVision™)</p> <p>Clears logs from the memory.</p>
	<p>Bluetooth and GPS (PED+ and PED-ER+)</p> <ul style="list-style-type: none"> • If Bluetooth is enabled, the device can connect to the DoseVision™ Live app (Android only). • If GPS is enabled and a location lock has been achieved, location data will be logged every time dose data is logged.
	<p>Back to main menu</p>

3.4 Wearing PEDs

PEDs must be worn on the upper body, with the screen facing outwards, to function correctly as a personal dosimeter. For best performance, wear the PED on the outer layer of clothing for easy readings and to make sure alarm lights are visible. A clip may be used to fix the PED to a belt or some other area of clothing.

If required, you can flip the screen on the **Main** menu .

Attention: The PED+ variants may also be used as a handheld survey meter.



Caution

Tracerco PEDs have undergone rigorous EMC testing. However, care must be taken when using PEDs near medical devices such as pacemakers.

3.5 Working with tasks

Start a task on the **Main** menu > **Tasks** .

When a task is running, the readings screen shows the current dose accumulated since the task started on the top bar of the readings screen, alternating with the top bar information as shown below. The current tasks are highlighted by a green light. A trefoil/stop watch icon shows completed tasks. Current and completed task details may be viewed by selecting that task. The four most recent tasks may be reviewed through the task details screen




3.6 Working in the discrete mode

Enter the discrete mode on the **Main** menu > **Discrete mode** .

In the discrete mode, all the LEDs are permanently switched off and the sounder is de-activated so that audible alarms will not sound. Also, the screen is set to a dimmer setting. However, the vibration alert still activates and on-screen indications are still shown.

3.7 Using a PED+ or PED-ER+ in handheld mode

Use a PED+ or PED-ER+ in the handheld mode as follows:

1. On the **Main** menu > **Handheld mode** .

Attention: If the menu item is not available, enable the feature in DoseVision™.

2. Hold the PED+ or PED-ER+ so that the GM tube window is facing forwards or in the direction of the area being measured.
3. View the readings screen that shows the following:

Handheld mode icon

Indicates that device is in the handheld mode.

Peak dose rate

Peak dose rate experienced since the device was last reset using DoseVision™.

Dose rate bar graph

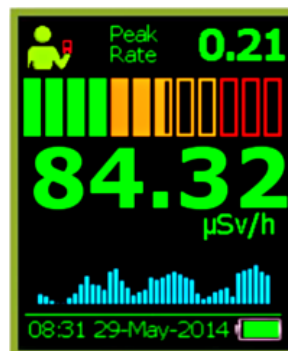
Bar graph representing the current dose rate.

Dose rate reading

Current dose rate measurement. The measurement is compensated for the device being worn away from the upper body. The value is filtered to provide a stable reading.

Activity graph

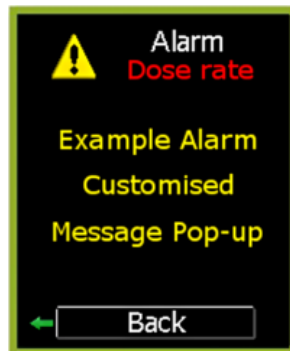
Activity graph to help detect quick changes in radiation fields. The activity graph shows a rolling 30 second chart of the activity. Each bar represents the number of counts detected within the last second.



3.8 Pop-up messages

The PED+ and PED-ER+ can display pop-up messages for specific alarms. Messages can contain instructions to help you make decisions based on your measured radiation exposure.

To clear the sounder, press the PED button once. To clear the message, press and hold the PED button.

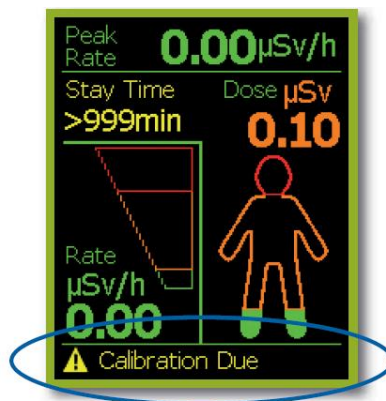


3.9 Warning messages

PEDs show non-critical warning and critical error messages in the status bar of the main display.

3.9.1 Non-critical warnings

Non-critical warning messages require action, but you can be confident that the device will still operate. The image below shows a PED with the non-critical warning **Calibration Due**.



The table below details possible warning message and the appropriate actions to take.

Non-critical warning	Description	Action
Battery low	The remaining battery life is approximately eight hours at background radiation levels and less than eight hours at higher radiation levels.	Charge the battery as soon as practical.

Non-critical warning	Description	Action
Calibration due	More than one year has elapsed since the last calibration. Tracerco recommends yearly calibration.	Return the PED to Tracerco.
Default Cal data	The default calibration values (factory setting) are set.	Return the PED to Tracerco.
Memory low	The memory is more than 70% full.	Transfer data to DoseVision™ as soon as practical.
Warning	Undefined warning.	Return the PED to Tracerco.

3.9.2 Critical errors

Critical errors indicate problems that prevent accurate operation, other than dose rate overloads as described in **2.4.5**. If the PED is switched on when a malfunction occurs, the PED indicates the error as follows:

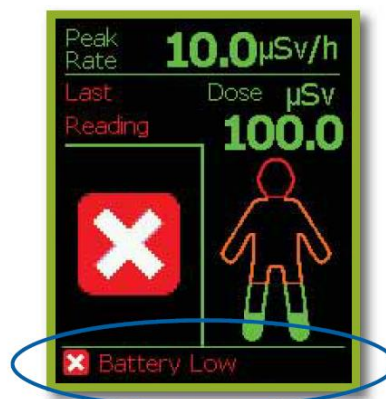
Audible alarm

An alarm sounds. The malfunction alarm sound is shorter and less frequent beep than the radiation alarm beeps.

Dose – last reading

The dose rate area of the readings screen is replaced with a white cross on a red square background, as shown below, and the error stated. The label **Stay Time** is replaced with the label Last Reading to indicate that displayed dose is the final dose reading before the critical malfunction occurred.

The image below shows a PED with the critical error **Battery Low**.



If a critical malfunction occurs while the PED is switched off, the device does not perform a full restart when switching on. Pressing the button causes the relevant malfunction message to be displayed on the opening screen. When the button is released (or after one second for a dead battery), the PED screen switches off.

The following table details possible critical error messages and the appropriate actions to take.

Critical error	Description	Action
Battery critical	The battery level is so low that the radiological performance of the PED cannot be guaranteed. The PED shuts down 10 seconds after a battery critical warning. To preserve the internal clock, do not switch on the PED before recharging.	Recharge the battery.
Calibration	Calibration factors are outside normal range.	Return the PED to Tracerco.
Clock failure	Real-time clock failure. Could be the result of completely flat battery.	Use DoseVision™ to reset the real-time clock. After resetting the clock, ensure that the PED time corresponds to the computer time running DoseVision™.
Detector failure	If no counts are recorded over 2 minutes (standard range) or 8 minutes (extended range), the PED assumes that the GM tube has failed. Also, for the extended range only, after 4 minutes the dose rate reading flashes to indicate low background and warn of a possible failure of the GM tube.	Return the PED to Tracerco if normal levels of background radiation were expected.
Error	Undefined error.	Return the PED to Tracerco.
Memory full	Memory is 95% full. When the memory is completely full, the PED continues to measure and display the accumulated dose, but date and time information is not recorded.	Transfer data to DoseVision™.
System failure	The PED is not working correctly.	Return the PED to Tracerco.

4 Maintenance

Attention: The PED-IS must never be used in a hazardous area whilst connected via USB as this would violate the certification and may create an unsafe situation.

4.1 Upgrading the firmware

Firmware upgrades to PEDs can be download from the Tracerco website (www.tracerco.com/monitors) and then installed using DoseVision™.

4.2 Battery Care

4.2.1 Charging the battery

The PED-IS must be charged using a charger dock.



Warning

The PED-IS must never be used in a hazardous area whilst connected via USB as this would violate the certification and may create an unsafe situation.

PEDs are charged using a charger dock or directly using a micro USB connection. The charger dock has a micro USB connection that allows charging from a mains supply, 12Vdc car supply, or a computer through a USB port. Tracerco recommends that only charger accessories supplied by Tracerco are used.

PEDs should always be charged in a cool environment (no greater than 35°C or 95°F) and out of direct sunlight.

Attention: Do not attempt to replace the battery.



Charging with the charger dock



Charging with a micro USB connection

During charging, an estimation of battery capacity and a lightning flash icon is displayed. When the estimated battery charge is greater than 95% the display shows full charge. Active warning messages are also displayed during charge.

Attention: PEDs do not record data while charging.

4.2.2 Charging the battery wirelessly (PED+ and PED-ER+ models T414-2 & T414-4 ONLY)

The aforementioned PED+ variants can be charged wirelessly using a Qi compatible wireless charger. To charge wirelessly, the clip must be removed from the PED and the rear surface of the PED placed in contact with the charging surface. When placed on a wireless charger, the PED may take a few seconds to recognise the charger after which the charging cycle will begin. Charging progresses in the same way as wired charging.



Attention: Depending on the charger used, wireless charging may take longer for a full charge cycle than wired charging. Due to the technology used, when charging wirelessly the device may become warm.

4.2.3 Tips to maintain good battery health

Tracerco PEDs utilise Li-ion battery technology. This provides many benefits, such as excellent charge efficiency and unparalleled energy density. Following these recommendations will, in general, give the best product experience:

- When in frequent use, for optimal battery life keep battery charge between 10 and 90%
- Charge between 0°C and 40°C, out of direct sunlight
- Use only the manufacturer supplied charging dock or cable
- If the PED is to be stored for more than 2 weeks, charge to 50-70%
- Store between -20 °C & +25°C
- After 2 months storage, check charge levels. If necessary, charge to 50-70%
- Avoid fully discharging the battery

Note: If fully discharged monitors are stored for a long period of time without use, the battery may fall into a deep discharge state, rendering the PED inoperable.

4.3 Cleaning

Clean the mould using a non-abrasive cloth, water, and a mild detergent.

The soft polymer overmould has been manufactured using materials with excellent chemical resistance and the screen is manufactured from a tough polymer.



Caution

The screen of the PED-IS has an antistatic coating to prevent the build-up of a static charge. Care must be taken when cleaning so that the antistatic coating is not removed.

To avoid damaging the antistatic coating the screen must only be cleaned using a non-abrasive cloth, water and a mild detergent.

The image below shows a PED-IS where anti-static coating has been removed by cleaning incorrectly. By viewing the PED-IS from different angles, areas of the screen where the antistatic has been removed are easily visible.



Shaded area shows the anti-static coating has been removed.

4.4 Calibration

Ionising radiation legislation recommends that all operational radiation measurement devices are subjected to regular inspection and testing. This recommendation includes performance checks and where appropriate, recalibration of the PEDs.

Tracerco PEDs must be calibrated with the display screen facing the radiation beam. The position of the GM-tube detector is clearly marked by the detector window near the bottom of the front face. An ISO phantom or suitable correction factor should be employed during calibration.

Attention: The calibration is invalid if the PED is not worn on the torso when operating as a dosimeter. The PED must not be used as a handheld device unless it is set to handheld mode (PED+ and PED-ER+).

Tracerco PEDs can display a warning message to alert that calibration is due. However, this feature is disabled by default on PED Blue, PED-ER, PED+ and PED-ER+ devices. The next calibration due date can be found in the monitor details screen if the feature is enabled. Calibration contact details are also contained here.

All Tracerco PEDs are checked and calibrated immediately prior to dispatch and the next calibration due date is set in the PED.

4.5 PED-IS repairs

Attention: Repair of a PED-IS must be carried out by suitably trained personnel only and in accordance with the applicable code of practice such as IEC/EN 60079-19. All parts used in the repair of a PED-IS must be supplied by Tracerco.

4.6 Accessories

Accessories such as transit cases, protective leather holders, travel chargers and lanyards are available. For further details, see www.tracerco.com/monitors/accessories.

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