PXRD

Pulsed X-ray Dosemeter

User Manual

Southern Scientific

EXPERIENCE & EXPERTISE

Contents

PXRD User Manual
Southern Scientific Ltd
www.southernscientific.co.uk

Important Information

Copyright Statement

Trademark Statement

Unpacking and inspection

Begin by inspecting the shipping carton for any signs of damage. Although there are no specific unpacking instructions, handle the instrument carefully to prevent damage. Once unpacked, thoroughly examine the instrument for any visible damage, such as dents, scratches, or broken components.

Technical Support

For support with applications or answers to technical queries, please either e-mail info@southernscientific.co.uk or call for support on +44 (0) 1273 497600

Warning

Unauthorised user modifications or use beyond the published specifications may lead to electrical shock hazards or improper operation. Southern Scientific will not be liable for any injuries sustained as a result of unauthorised equipment modifications.

Manufacturing Location

The PXRD is manufactured by Southern Scientific at the address listed on the back page.

Explanation of Icons


Risk of Electric Shock


Caution


Note


Inspection


Warning, Prohibition


Maintenance Action

1. Introduction

This User Manual provides essential information for the safe and effective use of the Southern Scientific Pulsed X-ray Dosemeter (PXRD).

The PXRD is a compact, portable, X-ray Dosemeter that is specifically engineered to detect and measure pulsed X-rays, emitted by portable X-ray generators such as Golden Engineering's XR150, XR200, and XRS3, as well as other compatible models.

Unlike conventional detectors, the PXRD can measure X-ray radiation from pulsed sources with a minimum pulse width of 25 ns. This makes it uniquely suited to applications where pulsed X-ray sources are in use.

The PXRD can be deployed whenever pulsed X-ray sources are in operation, including (but not limited to):

- Security Screening.
- Non-destructive testing (NDT).
- Field-based inspection and diagnostics.
- Emergency response and EOD operations.

Target Audience

This User Manual is intended for professional users, and maintenance personnel. Professional users are expected to have a good understanding of radiological protection and X-ray detection, whereas maintenance personnel are expected to be familiar with working on and repairing similar dosemeter instruments of the same type.

Compliance and Standards

The PXRD complies with the following regulations and standards:

- EN IEC 61326-1:2021
- BS EN 60529:1992+A2:2013
- FCC 47 CFR Part 15 b

See the Declaration of Conformity for full details.

Intended Use

This product is specifically designed to log and display the accumulated dose from Pulsed X-ray radiation emitted from portable X-ray Generators such as the Golden Engineering XR150, XR200 and XRS3. It can be used as a handheld dosemeter, or tripod mounted for fixed position measurements.

Pulsed X-rays are characterised as bursts of X-rays delivered in short, controlled, high-intensity pulses. The PXRD is engineered to handle the large dynamic range required for close-up measurements in the beam of the generator, and cordon measurements at the limits of the generator cordon.

The device records and displays an accumulation figure using ambient dose equivalent (H*(10)) quantity, and provides audio, visual and haptic alerts at a pre-set accumulated dose limit.

[Note:] This device may be influenced by natural background radiation, including terrestrial sources and cosmic rays. While these effects are typically minimal, they may contribute to low-level readings or baseline fluctuations in certain environments.

2. Important Safety Information

General Safety Guidance

- Read and understand this manual before operating the device.
- Only trained and authorised personnel should use the device.
- Only trained and competent calibration professionals should calibrate the device.
- Do not modify or tamper with the device in any way other than instructed how in this manual, as doing so may affect its accuracy and safety.
- Always follow local radiation safety regulations and guidelines.
- Use the detector only for its intended use (see the intended use section above; see also the device specification for device limits).
- Ensure the instrument is used within the specified environmental conditions.

Electrical Safety Guidance

- The device contains no user serviceable parts, and should not be opened by untrained professionals.
- Do not pierce, crush, or damage this product. It contains a lithium polymer (LiPo) battery, which may be hazardous if mishandled.
- Do not attempt to replace the internal battery – instead return to the manufacturer for service.
- Use only USB-C™ chargers and cables recommended by the manufacturer.
- Keep the device away from strong electromagnetic fields that could interfere with readings.

Handling and Maintenance Safety

- Inspect the device before each use for any visible damage or defects.
- If the instrument malfunctions or provides inconsistent readings, discontinue use and contact the manufacturer.
- This instrument should be calibrated on an annual basis (the device includes a built-in service reminder).
- Store the instrument in a dry place when not in use.
- Please observe all local rules for disposal of this device.

3. Device Specification

General	
Accumulated Dose Alarm Models	Configurable (audible, visual and vibration)
Minimum Detectable X-ray Pulse Width	25 ns
Measurement Quality	$\dot{H}'(10)$
Effective Dose Rate Range	1 µSv up to 999 mSv
Dose Accuracy	±25 %
Energy Range	40 to 250 keV
Recommended Minimum Distance from Generator	XR150/XR200: 1.5 m XRS3: 2 m
Polar Response	Vertical and Horizontal ± 45°
Dose Rate Range	Approx. 30 Sv/s - 0.3 Sv/s (Approx. 1.2 µSv - 0.02 µSv per pulse)
Ingress Protection	IP54
Battery Life	Up to 8 hrs (Continuous use)
Battery Type	Rechargeable LiPo (USB-C)
Operating Temperature Range	0°C to 40°C
Max. Relative Humidity	Up to 95% at 40°C
Dimensions	164 (L) x 81 (W) x 51 (H) mm
Mass	480 g
Detector Reference Point	Concentric to the detector, 20 mm from the front edge.

4. Shipping Contents

The basic equipment of the PXRD includes:

- Device packaging.
- PXRD Main Unit.
- Tripod mounting bracket.
- Leaflet with QR code for User Manual and other product documentation.
- USB-C to USB-C charging and Data Cable.

The following equipment are optional accessories and replacement parts:

- Protective Hardshell Peli Case with Custom Foam Cutouts.

Figure 1. Peli Case.

5. PXRD Main Components

The PXRD has six main points pertinent to user operation.

5.1. Detector Housing
5.2. Main Display
5.3. Navigation Keypad
5.4. USB-C Connector
5.5. Tripod Mounting Bracket
5.6. Audio and Haptic Alarm

Figure 2. PXRD Main Components.

5.1. Detector Housing

The PXRD detector housing contains two detectors with differing sensitivities, enabling a wide dynamic range for accurate X-ray detection. These detectors are directional, and aligning them on-axis with the X-ray beam provides the most accurate and most sensitive measurements.

5.2. Main Display

The Main Display allows the user to view and assess the **Accumulated Dose** along with other device attributes and controls. When used in conjunction with the **Navigation Keypad** (Section 5.3), the display provides access to the PXRD's measurement, settings, and logging functions through a menu-based interface.

5.3. Navigation Keypad

The Navigation Keypad consists of **four directional buttons** (UP, DOWN, LEFT, RIGHT) and **one centre button**. The centre button is used to select menu options on the Main Display (Section 5.2). It also serves as the power control to turn the device ON and OFF.

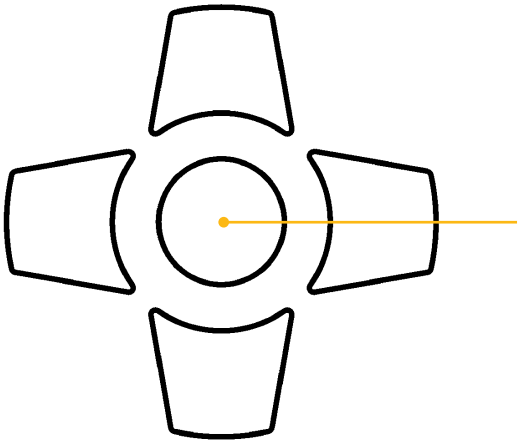

Figure 3. Keypad.

5.4. USB-C Connector

The USB-C port is used to recharge the device via standard USB Power Delivery (USB-PD) technology. It also supports USB data transfer of log files in Storage Mode (see Section 11.5.1) and serial communication for advanced interfacing.

5.5. Tripod Mounting Bracket

An optional tripod mount included with the device contains a ¼-20 brass insert compatible with standard camera tripods. This allows the device to be used in a fixed position or left unattended to monitor, log or alarm in areas of radiological concern. The tripod mount clips securely to the underside of the unit, further details in section 13(3).

5.6. Audio and Haptic Alarm

The device contains an internal audio buzzer and a vibration motor to augment the visual alerts on screen when a preconfigured **dose limit** is exceeded. The alarm can be configured to activate **audio**, **vibration**, or **both**, depending on user preference and environmental conditions.

6. Getting Started Guide

6.1. Remove the PXRD from the packaging and inspect the unit for any damage. If the device is damaged, do not continue and contact the manufacturer.

6.2. **Charge the battery:** see section 7 "Charging the battery." Typical charge time 2 - 4 hours).

6.3. When charged and ready for use, switch the device on by holding down the centre button of the Navigation Keypad.

6.4. Ensure no error messages are displayed. If any errors occur during first boot, please contact the manufacturer immediately.

6.5. The Display will switch on showing the Main screen. This shows accumulated dose value in the centre with other pertinent device information as shown below.

Figure 4. Main Screen.

6.6. To navigate through the "Settings" menu system, follow the screen instructions. For example, to set the alarm, first press the RIGHT button to access the settings menu.

By default, only "Screen" settings are available in this mode. Advanced mode enables all other available settings options. Enter "Advanced mode" by returning to the main screen and pressing UP, DOWN, UP, DOWN – see also section 11.

6.7. On the SETTINGS menu, the screen's navigation bar now shows "Scroll" indicating that the UP and DOWN keys can be used to highlight items. Press DOWN once to highlight **Alarm**, and CENTRE to bring up the Alarms Settings.

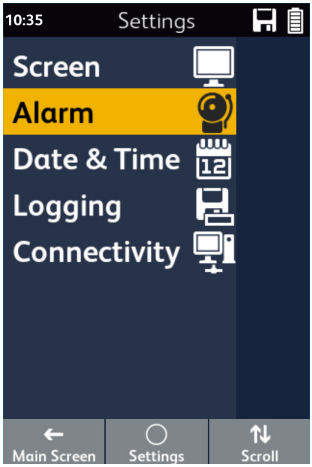

Figure 5. Settings Menu.

6.8. From this menu, further selections can be made using the Navigation Keypad to select and adjust the values of **Dose Limit Value**, **Dose Limit Unit**, and **Alarm Mode**. This is typical of the PXRD user interface structure, which will be described in greater detail in the next section of this manual.

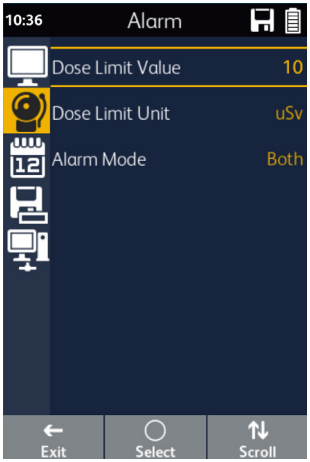

Figure 6. Alarm Settings Menu.

6.9. To Edit a setting, press the CENTRE button. In this instance, the Dose Limit Value will bring up an entry box to allow the number to be changed. Use the arrow keys to alter the value. Press CENTRE to save.

Note: This change does not take immediate effect.
Changes are effected on returning to the main screen!

Figure 7. Entering Values.

6.10. To turn off the device at any time, use the LEFT or RIGHT buttons to return to the main screen then hold down the CENTRE button for over a second. The SHUTDOWN prompt will appear. Use the RIGHT button to select "Yes" and press the CENTRE button to turn the device off.

Figure 8. Shutting Down.

7. Charging the Battery

The product ships with the LiPo battery in a partially discharged state. Before using the device ensure that it is fully charged. Use one of the recommended USB-C battery chargers and the supplied USB-C cable.

Insert the cable into the USB-C port of the device and power via the charger. Allow 2-4 hours to fully charge before use. A fully charged battery provides approximately 8 hours of operation.

The following chargers are recommended for reliable use with the PXRD. Other USB power Delivery (USB-PD) compliant rated at 30 W or higher may also be compatible. If in doubt, refer to the charger manufacturer's documentation to confirm USB-PD support and power output capability.

Brand	Model Name	Power Output	SKU
Anker	Nano II	65 W	715
Belkin	BoostCharge PPS	30 W	WCA005myWH
Ugreen	Nexode	30 W	90878 / 2569
Ugreen	Nexode	65 W	90663

The battery charges whether the unit is switched on or off. If the unit is on, the battery status is represented at the top of the screen as a block-style indicator – the number of filled blocks shows the remaining charge. While charging, a lightning bolt icon replaces the charge level indicator.

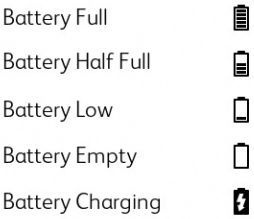

Figure 8. Battery Indications.

8. User Interface: Main Screen Features

Figure 9. Main Screens (Simple and Complex).

The main Screen can be set to display in Simple or Complex mode, in Simple mode, some advanced parameters are omitted for a clean easy to read appearance. This can be configured from Settings>Screen>User Mode, see section 11.1.2

a. **Current time:** Displayed in HH:MM, in 24 hour format.
b. **Logging Status:** Indicates Logging is ready, indicates logging is disabled, see also section 10.
c. **Battery Status:** Charge indicator for battery – see section 7 "Charging the battery".
d. **Dose:** Shows dose that has accumulated during the period between present time and measurement and logging started (either from device start, or from restarting with the CENTRE button).

The PXRD will automatically display the most appropriate unit of measure, either in microsieverts (µSv), or millisieverts (mSv).

Important: 1 millisievert (mSv) is the equivalent of 1,000 microsieverts (µSv), so it is critical to consider the metric prefix of the SI unit (µ, or m) in conjunction with the numeric figure shown.

e. **Total Pulses (complex mode only):** Indicates how many X-ray pulses have been detected.
f. **Circular scale:** graphical representation of accumulated Dose as a percentage of Dose Limit.
g. **Dose Limit (complex mode only):** Shows the currently set limit as configured per section 11.2.

h. **Last alarm area:** Shows the time the Dose limit was reached and the unit's alarm became active. While the alarm is inactive, this area will not contain any text. See section 9 on alarms for further detail.

i. **About:** Press LEFT button to bring up the ABOUT information screen. See section 12.

j. **Clear:** In this screen just "Clear" is available in the navigation bar indicating the CENTRE button. Pressing CENTRE will reset the dose to 0 and restart the process of accumulating the dose value.

k. **Settings:** Pressing the RIGHT button opens the SETTINGS menu, detailed in section 11.

9. Dose Limit and Alarms

The **Dose Limit** is a configurable parameter that can be set from Settings>Alarm, see 11.2. for detail.

As the unit receives radiation, the circular scale will indicate progress as a percentage of the currently set **Dose Limit** (Max. Accumulation). The **Alarm** will become active when the **Dose** reaches the **Dose Limit** value.

The display will change the circular scale to RED in colour and continue to show 100%, but the values shown can continue to increase. While **Alarm** is active, the buzzer or speaker will sound if configured to do so (See section 11.2.3.) until the dose is cleared by the CENTRE button:

Figure 10. Unit in Alarm, Dose limit exceeded.

10. Logging

In normal operation, the PXRD logs the final dose to an internal filesystem. Upon clearing the accumulated dose using the CENTRE button on the main screen, a new log entry will be created on the internal filesystem of the PXRD.

The filesystem contains CSV (comma separated values) files, which can contain multiple log entries. Up to 2000 log entries can be written to the file system, after which older entries will be overwritten.

The logging status area on the top bar shows one of the following icons:

Icon	Meaning
	Filesystem is ready – Logging enabled
	Log info is currently being written to the filesystem
	Processing / Working
	Logging cannot be written (e.g. In storage mode) – see note below

To access the log files by computer, the PXRD can be put into USB **Storage** mode using Settings>Connectivity>Output Mode>Storage, see **UI Settings menu** 11.5.1. The device will be seen as a USB drive when connected via the USB-C cable, allowing file transfer between the PXRD and the computer. This mode will be forgotten when the unit is turned off.

To access log files on a computer:

1. On the PXRD, go to Settings > Connectivity > Output Mode > Storage (see also section 11.5.).
2. Connect the device to the computer using a USB-C cable. The PXRD will appear as a USB drive.
3. Transfer files between the PXRD and the computer.

In **Storage** mode LOGGING IS DISABLED, and the logging status will show  in the top right hand corner of the screen. Ensure the output mode is returned to “off” or “Serial” to re-enable logging on the device.

Storage mode is temporary and will reset when the unit is turned off.

11. User Interface: Settings Menu Structure

The “Settings” menu structure can be accessed from the Main Screen by using the RIGHT buttons on the Navigation Keypad from the main screen.

By default, only Screen settings (Section 11.1) are available.
Advanced mode unlocks all additional settings options (11.2 - 11.5).

To Enter “Advanced mode”

- Return to the main screen.
- Press the following button sequence UP, DOWN, UP, DOWN.

11. Settings
    - 11.1. Screen
        - 11.1.1. Brightness
        - 11.1.2. User Mode
        - 11.1.3. Timeout (m)
        - 11.1.4. Auto Shutdown (h)
    - 11.2. Dose Limit Value
        - 11.2.1. Dose Limit Value
        - 11.2.2. Dose Limit Units
    - 11.3. Date & Time
        - 11.3.1. Hour
        - 11.3.2. Minute
        - 11.3.3. Set Time
        - 11.3.4. Day
        - 11.3.5. Month
        - 11.3.6. Year
        - 11.3.7. Set Date
    - 11.4. Logging
        - 11.4.1. Clear Logs
    - 11.5. Connectivity
        - 11.5.1. Output Mode

The elements within the menu structure options are further discussed below.

11.1. Screen Settings

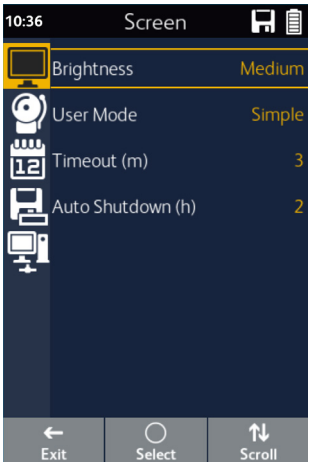

Figure 11. Screen Settings.

11.1.1. Screen > Brightness

This screen allows control over screen brightness allowing selection of Low, Medium or High Screen Brightness. Adjust this to suit the environment lighting and optimise display readability.

Note: This change does not take immediate effect.
Changes are effected on returning to the main screen.

11.1.2. Screen > User Mode

Sets the user mode to either “Complex” or “Simple”. In **Simple** mode, the main screen shows only Dose rate in it’s most simplified form. **Complex** mode shows the additional parameters **Pulses** and **Dose Limit**. See Section 8.

11.1.3. Screen > Timeout

Sets the screen dimming interval in minutes from last key press.
A value of “0” will prevent any dimming, default is 5.

11.1.4. Screen > Auto Shutdown

Allows the PXRD to switch off after a set number of hours from the last keypress.
A value of “0” will prevent the unit from automatically turning off. Default is 2.

11.2. Alarm Settings

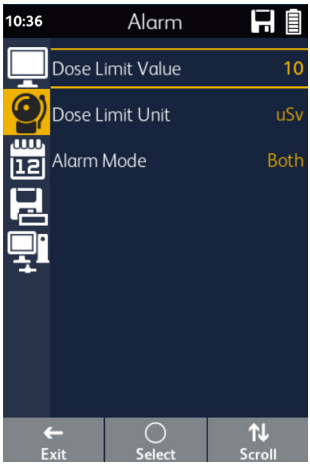

Figure 12. Alarm Settings.

11.2.1. Alarm > Dose Limit Value

Configures the dose limit value as a numeric value this is the threshold value at which the accumulated **Dose** Triggers the **Alarm**.

11.2.2. Alarm > Dose Limit Units

To be used in conjunction with the Dose Limit Value, this sets the units to be millisieverts (mSv) or microsieverts (uSv)

Important: "uSv" and "µSv" – are used interchangeably, both represent microsievert.

11.2.3. Alarm > Alarm Mode

Specifies mode of alarm deployment when threshold is reached. This can be a Haptic alarm (vibration motor), an Audio Alarm (Piezo sounder), Both, or none.

Note: This change does not take immediate effect. Changes are effected on returning to the main screen.

11.3. Date and Time Settings

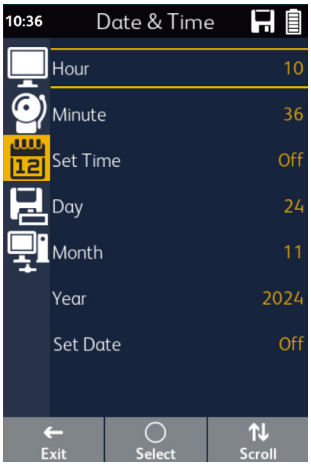

Figure 13. Date and Time Settings.

11.3.1. Date and Time > Hour

Adjust to the current Hour (24 Hour format).

11.3.2. Date and Time > Minute

Adjust to the current Minute.

11.3.3. Date and Time > Set Time

Set to "pending" to adjust the time to the HOUR and MINUTE values on exit.

Note: This change does not take immediate effect.
Changes are effected on returning to the main screen.

11.3.4. Date and Time > Day

Adjust to the current Day.

11.3.5. Date and Time > Month

Adjust to the current Month number. In numerical format.

11.3.6. Date and Time > Year

Adjust to the current Year.

11.3.7. Date and Time > Set Date

Set to “pending” to adjust the time to the DAY, MONTH and YEAR values on exit.

Note: This change does not take immediate effect.
Changes are effected on returning to the main screen.

11.4. Logging Settings

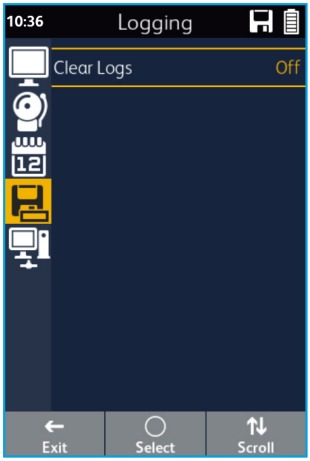

Figure 14. Logging.

11.4.1. Logging > Clear Logs

Pressing the CENTRE button while the Clear Logs parameter is highlighted will set its status to Pending.

If selected by mistake, press the CENTRE button again to return the status to Off, preventing log deletion. Upon restarting the unit with the Clear Logs parameter set to Pending, **all log files will be permanently deleted and cannot be restored**.

Important: Logs will not be deleted immediately.
They are only removed after the unit is restarted.

11.5. Connectivity Settings

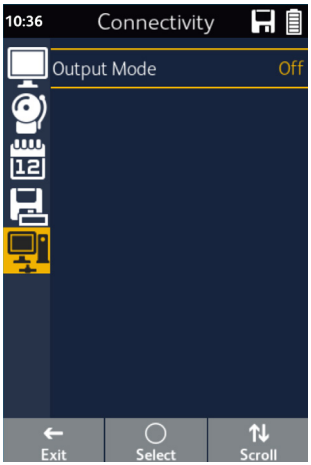

Figure 15. Connectivity.

11.5.1. Connectivity > Output Mode

This parameter allows the user to select between 3 different USB Output Modes.

OFF – The USB port provides charging only. No data connection is established with a connected device.

Storage – The device functions as a **USB Mass Storage Device**. When connected to a computer, it appears as a removable drive, allowing easy retrieval of log files stored on the device. Note that LOGGING IS DISABLED in this mode as file access is required by the host computer.

Storage mode is temporary and will reset when the unit is turned off.

Serial – The device transmits **serial data** over the USB connection. This mode is intended for use with serial terminal software or external systems requiring real-time data output.

12. “About” Screen

From the Main screen, pressing the LEFT button brings up a table containing information about the unit, including the revisions of Firmware and Hardware, Current date, and manufacture and Calibration dates.

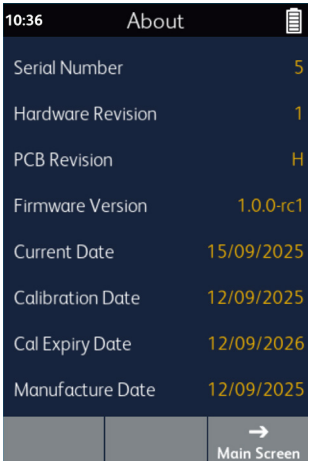

Figure 16. The ABOUT Screen.

13. Taking a Dose Measurement

(1) Ensure all the steps in the 'Getting Started Guide' (Section 6) have been completed.

(2) Set up the Dose Limit (Max. Accumulation) and Audible or Vibration alarms as required.

(3) Position the device such that it is pointing in the direction of the X-ray generator (A), by holding it, or mounting on a tripod using the supplied tripod adaptor. To fit the adaptor, clip it in place as shown in **Figure 2**, ensuring that the bracket is correctly centred to the PXRD and "clicks" into place securely.

Figure 17. Positioning the device.

(4) The PXRD should be no closer than 1.5 m from the generator to avoid saturation of the sensors which result in **counts overflow** or **detector overrange** errors, see section 16.2. Once in position and ready to measure the accumulated dose, clear any dose accumulated during setup using the CENTRE button.

(5) Expose the PXRD to the X-Ray and monitor the resultant accumulated dose. If the alarm threshold (Max Accumulation) is reached during the exposure, the Alarm will sound and/or Vibrate if configured to do so.

(6) If desired, the log files can be retrieved using a PC by putting the device into Storage mode as described in the section 10 of this guide.

If using the PXRD with portable X-ray generators such as Golden Engineering's XR150, XR200, and XRS3 and other similar devices, note that the highest possible measurement will be taken with the PXRD detector pointing on-axis with the generator. Rotating the PXRD detector housing in other directions may cause lower readings.

Always ensure personnel exposure risks have been adequately considered prior to making a measurement.

14. Storage, Handling and Transport Instructions

1. Storage

- Store the detector in a cool, dry place, ideally between 0°C and 40°C, avoiding areas with humidity over 70% RH.
- When not in use, keep the instrument in its protective storage case to protect against dust, moisture, and accidental impacts.

2. Handling

- Avoid rough handling, excessive force, or impact, as this can harm the instrument.
- Do not pierce, crush, or damage this product. It contains a lithium polymer (LiPo) battery, which may be hazardous if mishandled.
- Do not attempt to replace the internal battery – instead, return to the manufacturer for service.

3. Cleaning

- Should the instrument require cleaning, the instrument must first be powered down.
- Use an appropriate cleaning agent, such as alcohol-based wipes or a damp cloth with a gentle cleaning solution, to clean the exterior surfaces.
- Avoid using concentrated solvents (e.g., Acetone or Methanol), as they may damage the device casing.
- Gently wipe the surface, ensuring no excess liquid enters any openings or connectors.
- The device must not be immersed in any liquid as this will cause damage to the device

4. Transport

- When transporting, always secure the instrument in its original packaging to protect the device against shocks and vibrations.

15. Service Information

Annual Calibration

It is recommended that the PXRD be calibrated on an annual basis. The internal Calibration Due alert is set for 12 months from the date of calibration. The PXRD should only be calibrated by trained personnel; returning the device to the manufacturer for calibration is recommended.

User Serviceable Parts

The PXRD has no serviceable part.

16. Alerts/Error Messages

16.1. Start-up messages

On power-on, Alert and Error messages may appear, similar to the example below. Text in Yellow indicates an Alert or Informative message. All red messages are error messages. These will need to be resolved for continued use of the PXRD.

Figure 18. Example Startup Alert.

Message	Type	Suggestion
Hardware error Code <number>	Error	Contact Manufacturer
Can't clear logs		
Filesystem Error		
Invalid Factory Settings!	Error	Configuration Error: Contact Manufacturer
Invalid User Settings!		
Time not set	Alert	Set Time/Date: Section 11:3
Date not set		
Battery low	Alert	Charge Battery: See Section 7
Battery too low!	Error	
RTC Battery Low	Alert	
Clearing logs	Info	Informative: Wait for completion
Formatting Flash		
Calibration Due in <number> days	Alert	Contact Manufacturer to arrange re-calibration
Calibration Overdue by <number> days		

16.2. Pop-up warnings

Messages that occur during use – similar to the message below. Messages shown with RED outline are Error messages and yellow are informative or alert messages.

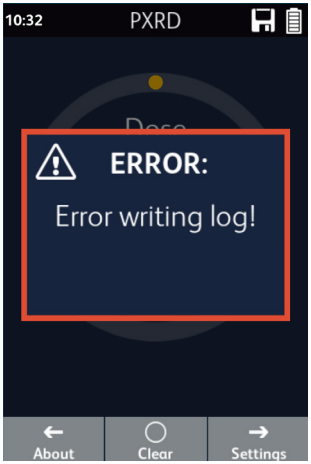

Figure 19. Pop-up warning.

Message	Type	Suggestion
Hardware error Code <number>	Error	Hardware Fault: Contact Manufacturer
Error writing log		
Counts overflow!	Error	Check distance to generator (See Section 13)
Detector Overrange		
Battery low	Alert	Charge Battery: See Section 7
Calibration Elapsed!	Alert	Contact Manufacturer to arrange re-calibration

17. Troubleshooting

Symptom	Possible Solution
Screen shows “Battery too low”	Recharge the battery using a recommended charger If problem persists, contact the manufacturer.
The display is blank or unresponsive	Ensure the device is turned on. Recharge the battery using a recommended charger and retry Contact the manufacturer if the problem continues.
Inaccurate or fluctuating readings	Confirm that the device calibration is up to date, and send the device for calibration if required. Contact the manufacturer if the problem continues.
Error messages or system errors	Refer to the error codes listed in the above section. Follow the recommended troubleshooting steps for the specific error. Contact the manufacturer if the problem continues.

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