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1 Welcome

This chapter offers introductory information about this manual, some important advice for your safety and that of the instrument, and an overview of the radEAGLET, its accessories, and applications.

1.1 Conventions Used in This Document

This document uses the following conventions to signify various kinds of text.

Ordinary Text
looks like this, sometimes bold or italics is used for emphasis.

Constant Width
is used for filenames, path names, Internet links, or text you have to enter somewhere.

Indicates a specific danger to yourself, your data, or the instrument. Please make sure you carefully read these passages.

Information you should carefully consider before proceeding.

Important information you should pay attention to.

Suggested commands or procedures for advanced usage. You might skip these tips on your first pass through this document.

Information related to optional features not applicable to all models of the radEAGLET.

If you read this document as a PDF file, you can click cross references, items in the table of contents, links into the Internet or similar, to immediately view the designated item.

1.2 Safety Warnings

The radEAGLET is designed for outdoor use. When operated in accordance with the operating instructions, it should not present any hazard to the operator:

The radEAGLET is not certified for use in explosive environments.

Do not unscrew the housing of the radEAGLET. There are no user servicable parts inside.

Various components inside the radEAGLET use high voltages posing a severe health risk for you.
The power adaptor is connected to line power. Normal care in handling such a line power device should be exercised. In particular this unit should not be connected to line power if it is wet.

The nature of the application is such that objects you survey with the radEAGLET could emit ionizing radiation with hazardous intensity.

### 1.3 Instrument Safety

- The detector crystals built into the radEAGLET are brittle. To enjoy a long-lasting performance of your instrument, avoid drops or other severe impacts.
- Detector crystals may fracture under rapid temperature change. This could occur, for example, when transporting the instrument in an air-conditioned vehicle and unloading it in extremely cold or hot environments. Sudden temperature change must not exceed 30.0 °C (54.0 °F) in order to avoid damages.

### 1.4 Before First Use

- We recommend charging the batteries of the radEAGLET after unpacking prior to first time use (8.2, p. 114).
- This is a good time to get familiar with the radEAGLET by reading this manual.
- Please read at least the rest of this chapter and those on basic operation (chapter 2, p. 19) before starting to experiment with the radEAGLET.

Chapter 2, p. 19 explains the principles of operating the radEAGLET.

The fundamental modes of operation of the radEAGLET are detailed in chapter 3, p. 31, followed by explanations of the radEAGLET alarms in chapter 4, p. 39.

A detailed reference on all the commands is given in chapter 5, p. 43, which you should read to know about all the features and possibilities in case you need them.

The web interface for monitoring, configuring and transferring data is detailed in chapter 7, p. 93.

Chapter 8, p. 113 details the power supply for the radEAGLET and the handling of various battery types.

The appendix comprises information about

- the nuclides the radEAGLET can identify (Appendix A, p. 117),
- a glossary of terms and technological background (Appendix B, p. 123 and C, p. 125)
- a trouble shooting guide (Appendix D, p. 129)
- an info pool (Appendix E, p. 133) with certificates, specification data etc.
Several models of the radEAGLET are available (see E.1, p. 133 for details), all of which are covered in this document. The few cases where a feature of a certain model differs from the main stream are marked in the text.

1.5 The radEAGLET

The radEAGLET is a new generation radio-isotope identification device (RIID). It consists of the following components:

- Scintillation detector using a sodium iodide NaI(Tl) crystal.
- Geiger-Müller detector
- $^3$He Neutron detector
- Multi-Channel Analyzer (MCA) for spectral data readout of the scintillation detector
- Computational subsystem that includes TFT display, keyboard, status LEDs, vibrator and speaker
- Pack for standard AA batteries
- GPS Receiver

1.5.1 Detectors

Each component has a dedicated purpose. The scintillator is the primary detector of the instrument and would be used for multiple purposes including pulse height analysis and dose rates.

1.5.1.1 Scintillation Detector

The scintillation detector is used to collect the pulse height spectrum of the gamma photons that interact with the scintillation crystal. The different radioisotopes each have specific decay schemes and some emit gamma photons that can be analyzed and used to determine the radiation source. [Scintillation Detector]

1.5.1.2 Geiger-Müller Detector

The dose rate is determined by either the scintillation detector or the internal Geiger-Müller tube. When the dose rate at the scintillator surface exceeds 200 $\mu$Sv/h, the Geiger-Müller tube will perform the dose rate measurement. This tube is suited for measuring dose rates up to 1 Sv/h. [Geiger-Müller detector]

If the Geiger-Müller detector kicks in, you are already in an extremely dangerous level of radiation. You should increase distance and shielding between yourself and the source. Additionally, you should restrict the time you stay within this field to an absolute minimum.
1.5.1.3 Neutron Detector

This item is available for radEAGLET models with a neutron detector (see E.1, p. 133). The $^3$He neutron detector continuously runs and acquires the current neutron counts per second [cps] (→Neutron Detector).

![Figure 1: Annotated top view of the radEAGLET instrument](image-url)
1.5.2 Overview

Fig. 1, p. 14 shows a top view on the radEAGLET instrument. The radEAGLET features a 3.5 in (89 mm) color display presenting the various screens of the software. The keyboard below the screen has 3 keys ( ) you can press with your thumb while holding the instrument.

1.5.3 Hardware Accessories

The radEAGLET is delivered with comprehensive accessories. The list of accessories may vary depending on what is ordered with the system. The transportation case should contain the following items (Fig. 2, p. 15):

![Figure 2: The radEAGLET in its case](image)

- **A** radEAGLET instrument
- **B** KCl Calibration box
- **C** USB cable for connecting the radEAGLET to a PC or external power
- **D** USB power adaptor for cars
- **E** PowerBank with USB charging cable
1.5.4 Connectors

The radEAGLET has several connectors.

When operating under harsh conditions, keep the connectors clean and free of dust or sand. If you experience connection problems, clean the connector with a cleanser specialized for electronic components.

**Micro USB-B at rear end**

Use this plug (Fig. 4, p. 17) to connect your radEAGLET to a computer. All common operating systems like Microsoft Windows, MacOS or Linux are supported.

The internal battery of the radEAGLET is charged while connected through this plug to, e.g., a wall power adaptor.

---

**Figure 3:** The radEAGLET with accessories

- **F** USB charger with US or European plug
- **G** 2 mm Hex key (aka "Allen" wrench) for front cover removal
- **H** Documentation
- **I** USB Stick

Please make sure the delivered parts are complete.
USB-A host connector behind front cover

Use this plug (Fig. 4, p. 17) for Wi-Fi, Bluetooth, USB-to-Ethernet adaptors, or USB storage devices (all optional).

⚠️ To remove the front cover unscrew the two screws with the hex key included with the radEAGLET (Fig. 2, p. 15).
2 Using the RADEAGLET

The RADEAGLET is designed for single-hand operation. You hold the instrument by its handle and point the detector to the object to be surveyed while observing the screen and pressing the keys with your thumb.

2.1 The RADEAGLET Display

The RADEAGLET displays information on a color LCD screen (Fig. 1, p. 14) divided into three principle areas (Fig. 5, p. 19).

![Anatomy of the RADEAGLET display]

**Top: Status Bar**

This area contains icons representing the status of several components of the RADEAGLET.

7:32 pm

The hours and minutes of the current local time are shown. The date and time are read from the internal clock of the RADEAGLET. Time stamps are written into all files saved by the RADEAGLET, for example, spectra.

⚠️ Please ensure the correct setting of the clock and your local time zone (see 5.3, p. 50)

⚠️ If the instrument’s clock is completely off, you have to set it via the web interface (see 7.6, p. 107). This could be necessary after storing the RADEAGLET with no or empty batteries for a while.
2.1 The radEAGLET Display

Battery Status

The battery status is shown by a value and a symbol.

- **Full battery (100%)**
  - ![Battery full icon]

- **Empty battery**
  - ![Battery empty icon]

While the RadEAGLET is powered by an external source (see 8.1, p. 113) providing enough power to charge the internal battery, the symbol is decorated by a bolt.

- ![Battery bolt icon]

While the RadEAGLET is powered by an external source (see 8.1, p. 113) and there is no or a non-rechargeable battery installed, this symbol is shown.

Connectivity Status

This item is available while a communication dongle is plugged into the radEAGLET’s USB-A port.

- ![WiFi network icon]
  - The RadEAGLET is logged into a Wi-Fi network.

- ![WiFi hotspot icon]
  - The RadEAGLET provides a Wi-Fi hotspot other devices can connect to.

- ![Ethernet icon]
  - The RadEAGLET is logged into a wired local area network (“Ethernet”).

- ![Bluetooth icon]
  - The RadEAGLET communicates via Bluetooth.

- ![Communication off icon]
  - Communication is off.

- ![Mass storage device icon]
  - A USB mass storage device is available.

GPS Status

This item is available for radEAGLET models equipped with a GPS receiver (see E.1, p. 133).

- ![GPS fix icon]
  - GPS is switched on and receives enough data from several satellites to calculate the position (“has fix”). Location data is included whenever you save measuring results, for example, a spectrum.

- ![GPS insufficient icon]
  - GPS is switched on but reception is (hitherto) insufficient.

- ![GPS off icon]
  - GPS is switched off.

Stabilization Status

The stabilization (see C.1, p. 125) status is indicated by this symbol.

- ![Stabilization in progress icon]
  - (Flashing) Stabilization is in progress. After about 2–3 minutes, the status should change to one of the following.

- ![Stabilization icon]
  - The instrument is stabilized. You can use the instrument.

- ![Stabilization disturbed icon]
  - The continuous stabilization process got disturbed. See appendix D.1, p. 129 for recommended remedies.

Data Logging

This symbol shows whether the radEAGLET logs data.
The radEAGLET logs data. You might want to stop logging, e.g., before you move to survey a different object or to save energy.

- Data logging is off.

**Spectrum Acquisition**

This symbol shows whether the radEAGLET currently acquires and records spectral data.

- The radEAGLET is currently recording a spectrum.
  
  You might want to stop spectrum acquisition, e.g., before you move to survey a different object or to save energy.

- Spectrum acquisition is off.

**Center: Variable Main Display**

The contents of this area change to the current mode of operation of your radEAGLET. This may be status information after powering up the instrument (Fig. 17, p. 28), menus to choose from (Fig. 30, p. 44), alarms (Fig. 28, p. 40), or measurement results (Fig. 22, p. 34).

**Bottom: Keyboard Legend**

The labels in this area name the function currently associated with each of the radEAGLET keys (Fig. 5, p. 19, Fig. 6, p. 22).

### 2.1.1 Status LEDs

Alarm and battery status LEDs are built into the keyboard of the radEAGLET (Fig. 1, p. 14, Fig. 6, p. 22).

- **γ** Gamma warnings and alarms
- **N** Neutron warnings and alarms
  
  This item is available for radEAGLET models with a neutron detector (see E.1, p. 133).
- 🚚 Battery charging, blinks when fully charged ("trickle charge").
- 🕯️ Battery failure: temperature not within the allowed range or battery completely discharged.

### 2.2 Using the radEAGLET Keys

You control the radEAGLET with the three keys (Fig. 1, p. 14) under your thumb while holding the instrument by its handle.

- Pressing a key triggers a feedback tone which you can switch off (see 5.5, p. 53).

On the instrument, the keys look like this: 📨. In oral communication they are often called “left” “center”, and “right”.

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The meaning of every key changes depending on the circumstances. The current function of the keys is shown along the bottom of the screen (Fig. 6, p. 22) at all times. Almost, exceptions are: Switching on the radEAGLET (see 2.3, p. 26) and taking screenshots (see 2.2.5, p. 26).

Chapter 5, p. 43 provides detailed descriptions of the different key functions under various conditions.

Some commands are available for a lot of the radEAGLET’s functions:

- **Down**, **Select**, and **Exit** for navigating the functions and commands.
- **On • Off**, **+ • -**, **Accept**, and **Cancel** for changing settings or entering values.

### 2.2.1 Using Command Lists

Some sophisticated features of the radEAGLET cannot be used with only the three commands you can directly access via the three keys. All the available commands are grouped into pairs mapped to the keys **☐ ☐ ☐** and **☐ ☐ ☐**, respectively.

The center key **☐ ☐ 1 ☐** is mapped to the pseudo command **Next**, which cycles through the available command pairs (Fig. 7, p. 23).

### 2.2.2 Using Menus

A menu is a list of settings or operations you can choose from. It shows several items, one of which is accented with a distinct color (Fig. 8, p. 23).
After opening a menu, the top most item is chosen. You can choose other items with \textbf{Down}. After you reached the last item of the menu, the first item gets chosen again.

Some menus offer more items than fit on the screen simultaneously. This is indicated by a scroll bar with a thumb showing the relative position in the menu (Fig. 8, p. 23). When the item you are interested in is accented, press \textbf{Select} to execute the command.

\subsection*{2.2.3 Changing Values}

You can tailor the \texttt{radEAGLET} to your needs by changing settings. Some settings are simple switches as shown in Fig. 9, p. 24.

You can toggle the state by simply pressing \textbf{Change}.

For other settings you can choose from a list of options, for example the screen brightness (see 5.4, p. 51). When you select the setting for change the list of valid settings is displayed (Fig. 10, p. 24).

You can choose other settings from the list with \textbf{-} or \textbf{+} and set the accented value with \textbf{Set}. 
2.2 Using the radEAGLET Keys

2.2.4 Entering the Password

Some settings and operations of the radEAGLET are locked behind a password. If you try to use these items, you will be prompted to enter the password [Fig. 11, p. 25].

After successful password entry, the radEAGLET is unlocked for about 10 min.

Use the keys [IMAGE] for L, [IMAGE] for C, and [IMAGE] for R to enter the five-character password of L, C and R.

The factory password is always **L C R L C**.

Change your password [see 5.23, p. 81] after receiving the instrument to prevent unauthorized persons from manipulating the protected settings.
After pressing five keys the available commands change (Fig. 12, p. 25).

**Figure 11:** Entering the password

**Figure 12:** After entering the password

**Settings and Commands**

- **Repeat**
  - Repeat the entry in case you are not sure whether you pressed they keys in the correct sequence.

- **Cancel**
  - Cancel the password entry and quit accessing the protected settings.
2.3 Starting Up the radEAGLET

Accept

Confirm your entry and have the radEAGLET check it for correctness. If your entry was incorrect, you will be notified and the password entry will start over.

2.2.5 Saving Screenshots

You can save the contents of the radEAGLET’s display, for example, to document a certain result or for your inhouse training material.

➔ To save a screenshot...

1. Press and hold .
2. Press .

You will be informed that a screen shot was saved in the status bar of the display (Fig. 13, p. 26). This message disappears after a moment.

The screenshot is saved as *.png image. The file name is is built from the name of the current screen and the current date and time in ISO format, for example DoseRateScreen 20181018-231111.png.

![Screenshot created](image)

Figure 13: Status bar after saving a screenshot

For further processing screen images, transfer them to your computer with, e.g., Storage Management in the Web interface [see 7.10, p. 111], or a USB flash drive [see 5.10.2, p. 61].

2.3 Starting Up the radEAGLET

1. Position the instrument in a low-radiation environment.
2. Position the supplied KCl (potassium chloride) box [Fig. 14, p. 27] in front of the detector cap.

![Figure 14: Box with potassium chloride (KCl) for stabilization and calibration](image)

3. Press and hold down the \(\textbf{I}\) key [Fig. 6, p. 22].

4. After a couple of seconds the instrument begins to boot when the alarm LEDs [Fig. 1, p. 14] begin to flash.

5. You are welcomed by the start-up screen with dots appearing from left to right [Fig. 15, p. 27].

![Figure 15: Starting the RADEAGLET](image)

6. The RADEAGLET begins an initial stabilization (see C.1, p. 125 for details) [see 16, p. 28].

7. When the stabilization source is identified it is shown [see 17, p. 28].
8. After the stabilization the radEAGLET switches to Dose Rate Mode [see 3.1, p. 31].

9. Watch the stabilization status icon on the screen [see 2.1, p. 19].
2.4 Switching Off the radEAGLET

To switch off the instrument, navigate to [Advanced] and select the [Shutdown] command [see 5.29, p. 88]. You will be prompted to confirm in case you change your mind [Fig. 94, p. 89].

Another method to shut down is to hold [I] for 10 seconds or longer.
3 RADEAGLET Measuring Modes

This chapter describes the essential measuring modes of your RADEAGLET.

**Dose Rate Mode**
Observe the ambient radiation, see 3.1, p. 31

**Easy ID Mode**
Identify radiating nuclides quickly, see 3.2, p. 33

**Detect Mode**
Locate radiation sources, see 3.3, p. 34

Measuring modes might be overridden by warning and alarms, please refer to chapter 4, p. 39.

### 3.1 Dose Rate Mode

The Dose Rate Mode is the main measurement mode of the RADEAGLET. It is active after starting up the instrument.

Several representations of the current ambient dose rate [H*10] are shown (Fig. 18, p. 31):

**Digital**
Large digits show the current value and the unit. The unit adapts to the order of magnitude of the value: µSv/h, mSv/h, Sv/h. You can select a Sievert or a rem-based display, see 5.4, p. 51.
Additionally, the current gamma count rate is shown.

* If your model is equipped with a neutron detector, the current neutron count rate is shown.

**Analog**

A schematic chart modelled after a traditional LED chain shows the current dose rate along a circular axis divided into normal, warning and alarm sections.

Warning and alarm indicators are illuminated if the dose rate rises above the thresholds [Fig. 19, p. 32, Fig. 20, p. 33].

* If your model is equipped with a neutron detector, the neutron data display switches to a blue background for neutron incidents according to the specified sensitivity, see 5.17, p. 71.

STOP Neutron sources are dangerous, they are always considered as threat. If the instrument indicates the presence of neutron radiation, move away from the source immediately.

![Dose rate display with gamma warning](image)

Figure 19: Dose rate display with gamma warning

**Settings and Commands**

**Easy ID**

Switch to the Easy ID mode, see 3.2, p. 33.

**Detect**

Switch to the Detect mode, see 3.3, p. 34.

**Advanced**

Open the menu for advanced operations, see 5, p. 43.
3.2 Easy ID Mode

The Easy ID measuring mode helps you to quickly identify radiating nuclides. Your radEAGLET will acquire a spectrum for a preset duration and then analyze and save it.

During the acquisition, a chart (Fig. 5.20, p. 74) instructs you to find the best distance between the radEAGLET and the source in question.

The nuclides identified will be displayed (Fig. 22, p. 34). The recorded spectrum and the analysis results are saved. The file name is composed of the current date and time followed by an index number.
### 3.3 Detect Mode

The Detect measuring mode is a tool to locate radiation sources by giving rapid visual and audio feedback to the changing dose rate of incoming radiation. The tool starts with measuring the background radiation (Fig. 23, p. 35).

It is preferable to take the background in a low radiation environment. If you are in a facility with a high natural background or with multiple radiation sources present, the detection capability adapts to this situation.
After finishing the background acquisition, the display shows a chart with colored areas representing the count rate history of the last couple of seconds (Fig. 24, p. 35).

**Green Area**
represents radiation levels close to the background.

**Red Area**
represents increased radiation potentially caused by a source (Fig. 25, p. 36).

**Blue Area**
represents neutron incidents, if any.
3.3 Detect Mode

![Image of detect mode showing value at orientation line relative to the background]

**Figure 25:** Detect mode: Approaching a source

If the radiation level increases, the chart will be rescaled to multiples of the background determined at the beginning (Fig. 26, p. 36).

![Image of detect mode showing value at orientation line relative to the background]

**Figure 26:** Detect mode: Close to a source

**Settings and Commands**

**Reset**

Reset the maximum scaling to the background, for example, to see more detail after moving away from a source.
**New BG**

Initiate a new background measurement. This might become necessary if you changed your measurement location or the background is suspected to have changed for whatever reason.

**Exit**

Return to the superior screen.
4 RADEAGLET Warnings and Alarms

When the RADEAGLET detects radiation above preset thresholds (see 5.17, p. 71), warnings and alarms are reported via several annunciators:

**Main Display**
Details of the alarm are shown on-screen, no matter which other activity was displayed when the alarm was raised.

The screen backlight will be switched on if it timed out (see 5.4, p. 51).

The alarm details remain on the screen until you confirm them. You can turn off the confirmation, see 5.4, p. 51.

**LED**
The alarm LEDs (Fig. 1, p. 14) flash in several patterns.

**Speaker**
The speaker emits various sound patterns. You can switch the speaker on or off, see 5.5, p. 53.

**Vibrator**
The vibrator shakes the handle (and adds a little sound). You can switch the vibrator on or off, see 5.5, p. 53.

Radiation sources are dangerous to you. When dealing with radiating material, you are strongly advised to:

1. Maximize your distance to the radiation source.
2. Minimize the time you are exposed to the radiation.
3. Put as much shielding between the source and you as possible.

In addition to dangerous ionizing radiation, certain substances can pose a life-threatening risk to you, due to their chemical or biological effects. Plutonium, for example, is highly toxic, especially if ingested or inhaled. If the RADEAGLET identifies plutonium (as WGPu or RGPu), you must not touch the source under any circumstances.

4.1 Gamma Warning and Alarm Display

The warning (Fig. 27, p. 40) and alarm (Fig. 28, p. 40) messages overlay all other activities of the RADEAGLET.
4.1 Gamma Warning and Alarm Display

![Image of Gamma Warning](figure27.png)

**Figure 27:** A warning reported on screen

![Image of Gamma Alarm](figure28.png)

**Figure 28:** An alarm reported on screen

**Settings and Commands**

- **Save**
  
  Save the Alarm in the radEAGLET’s database.

- **Mute**
  
  Switch off the beeper and vibrator for the current alarm. The next alarm, if any, reactivates them.

- **Confirm**
  
  Confirm the alarm. The beeper and the vibrator are switched off (see “Mute” above) and the screen returns to the content displayed before the alarm was raised.
4.1.1 Neutron Alarm Display

This item is available for radEAGLET models with a neutron detector (see E.1, p. 133).

Figure 29: An neutron alarm reported on screen
5 RADEAAGLET Advanced Operations

Advanced operations comprise the spectrum with its comprehensive methods of analysis and a lot of settings you can change to adapt the RADEAAGLET to your personal needs and preferences.

You can reach all options outlined below via the menu shown in Fig. 30, p. 44.

- Spectrum ...................................................... see 5.1, p. 44
- Basic Settings ................................................. see 5.2, p. 49
  - Time and Date ........................................... see 5.3, p. 50
  - Display ................................................ see 5.4, p. 51
  - Feedback ............................................ see 5.5, p. 53
- Connectivity ................................................ see 5.6, p. 54
  - Wi-Fi ................................................. see 5.7, p. 54
  - Hotspot .............................................. see 5.8, p. 56
  - Bluetooth ............................................ see 5.9, p. 58
  - USB ................................................ see 5.10, p. 59
- Services ................................................ see 5.11, p. 63
- Reachback Settings ....................................... see 5.12, p. 64
- GPS ................................................... see 5.13, p. 65
- Easy Calibration ............................................... see 5.14, p. 67
- Protected Settings ........................................ see 5.15, p. 69
  - System Information .................................. see 5.16, p. 70
  - Alarm Settings ....................................... see 5.17, p. 71
  - Calibration ........................................... see 5.18, p. 72
  - ID Settings ............................................ see 5.19, p. 74
    - Easy ID Settings ................................... see 5.20, p. 74
  - Nuclide Library ....................................... see 5.21, p. 75
  - Storage Management ................................ see 5.22, p. 78
  - Set Password ......................................... see 5.23, p. 81
  - Factory Settings ...................................... see 5.24, p. 81
- Collect Reachback ........................................ see 5.25, p. 81
- Send Data .................................................... see 5.26, p. 84
- Self Test ...................................................... see 5.27, p. 86
- About .................................................... see 5.28, p. 88
- Shutdown ................................................ see 5.29, p. 88
5.1 Spectrum

The screen (Fig. 31, p. 45) shows a spectrum and provides access to commands to acquire and manage spectrum data and to influence the display and analysis of spectra.

**Settings and Commands**

- **Next**
  Cycle through the commands available to work with the spectrum. This command is always available, the commands for the other two keys change.

- **Start • Stop**
  Start or stop the acquisition of spectrum data. The current status is shown in the chart (Fig. 31, p. 45).

  - If you start recording data, the current spectrum is not cleared. To record a pristine spectrum, use Clear (see below) before Start.

- **Clear**
  Clear the current spectrum.

---

**Figure 30:** The advanced operations menu
Figure 31: The spectrum screen

**Analyze**

Let the radEAGLET apply its identification algorithm to the current spectrum. The result is shown on the screen (Fig. 32, p. 45) until you press Analyze again.

Figure 32: Result of a spectrum analysis

**Cursor Right**

Move a cursor into the spectrum diagram from lower to higher energies along the horizontal axis.

The cursor is a vertical line (Fig. 33, p. 46) labeled with the energy, the channel number, and the number of counts at this position in the spectrum.
If you move the cursor beyond the left or right end of the spectrum, it wraps around to the other end.

**Cursor Left**

Move the cursor (see above) towards the low-energy end of the horizontal axis.

**Zoom + • Zoom -**

Zoom into the spectrum in multiple steps. The command is available only while you moved a cursor into the spectrum (see above) and the zoomed diagram will be centered around the cursor position.

The current zoom state is shown in the diagram (Fig. 34, p. 46)
ROI Left • ROI Right • Clear ROI

Specify a Region Of Interest, a part of a spectrum for closer inspection. Move the cursor (see above) to the low-energy end of the region, set it as left end of the ROI, move the cursor again and set the right end. The radEAGLET fits a peak to the ROI and displays the centroid energy and the number of counts for the ROI [Fig. 35, p. 47].

Figure 35: Spectrum with Region Of Interest

Save

Save the current spectrum in the radEAGLET database. You can load saved spectra for further analysis later (see below) or transfer them to a computer for further perusal.

The file names of saved spectra are composed of the current date and time followed by an index number. They will be shown after saving [Fig. 36, p. 48].

Load

Load a saved spectrum for further processing. Choose a from a list of files saved before [Fig. 37, p. 48]. The spectrum saved most recently is listed on top.

Load

Load the highlighted spectrum file.

Down

Highlight the next item. Cycles to the top item after you reached the last item.

Cancel

Cancel the current command.

LT • DT • RT

Cycle through the time and duration info displayed along the spectrum [Fig. 31, p. 45]:

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5.1 Spectrum

Figure 36: Info about a saved spectrum’s file name

Figure 37: Spectrum files available for loading

LT - Live Time
The duration of data acquisition as live time.

DT - Dead Time
The dead time as a percentage of the real time.

RT – Real Time
The duration of data acquisition as real time.

The current setting is shown along the spectrum, the command indicates the setting you will get after pressing the corresponding key.

For additional information refer to appendix C.6, p. 128.
LOG • SQRT • LIN

Change the vertical scaling of the spectrum diagram (see C.7, p. 128).

LOG Logarithmic scaling.
SQRT Square Root scaling.
LIN Linear scaling (the default).

The current scaling is shown at the top of the diagram (Fig. 31, p. 45). The command indicates the setting you will get after pressing the corresponding key.

Auto ID

Switch to a waterfall display, let the instrument collect a spectrum and analyze it (Fig. 38, p. 49).

Start • Stop

Control the acquisition of data for the Auto ID waterfall diagram.

These data are live data, independent of the spectrum you might have acquired or loaded in the spectrum screen.

Exit

Return to the superior screen.

5.2 Basic Settings

You can access the basic settings of the Radeagle via this menu (Fig. 39, p. 50). You can change these settings without entering a password.
5.3 Time and Date

This screen (Fig. 40, p. 51) groups settings for the clock handling of your radEAGLET.

The clock setting affects many other important points. Spectra are typically saved with a filename based on the time and date so it is important to keep this as accurate as possible.

Settings and Commands

**Time Zone**
Specify your local time zone. To have the instrument handle daylight savings time correctly, you have to select not only the offset versus UTC, but also the correct collection of cities shown for a given offset.

**12 h Display**
Specify whether you want to have times shown in 12 or 24 hour format.

Change to the next time zone.

Switch the setting on or off.

Return to the superior screen.
5.4 Display

This screen (Fig. 41, p. 51) groups several options for the display of your radEAGLET.

![Figure 40: The clock settings](image)

![Figure 41: The display settings](image)
5.4 Display

**Settings and Commands**

**Brightness**
Specify the brightness of the display's backlight.

**Display Timeout**
Specify the duration of user inactivity after which the display backlight is dimmed to save energy.

- The backlight draws a significant amount of power; you should let it time out while running on batteries.
- After the backlight times out, you can reactivate it by briefly pressing any key. The usual functions of short key presses are ignored in this case.

**Language**
Choose a language to be used for the display.

- **English**
  - English with American spelling

- **Deutsch**
  - German

- **other**
  - *more languages which might be installed on your instrument*

Ensure you understand enough of the language you are changing to. It may be difficult to change back if you do not understand the menu language.

**Alarm Confirmations**
Specify whether you want to explicitly confirm warning and alarm messages or have the messages disappear after the warning or alarm conditions are gone.

**Dose Unit**
Specify the unit for the display of dose values in all measuring modes or other operations of the radEAGLET.

- **Sievert**
  - Sievert is a derived unit according to the International System of Units and the legally prescribed unit in many jurisdictions.

- **rem**
  - Röntgen equivalent in man. Sievert is the acknowledged international unit, but many users are familiar with doses stated in rem, mrem, µrem.

  \[ 1 \text{ Sv} = 100 \text{ rem} \]

- **+,-**
  - Increase or decrease the value.

- **On, Off**
  - Switch the setting on or off.
Accept
Make your change permanent.

Exit
Return to the superior screen.

Down
Highlight the next item. Cycles to the top item after you reached the last item.

Select
Select the highlighted item.

5.5 Feedback

This screen (Fig. 42, p. 53) groups several options for the annunciator of your RADEAGLET.

![Feedback Settings](image)

**Figure 42:** The feedback settings

**Settings and Commands**

**Speaker**
Switch the speaker on or off. This affects warning and alarm reporting.

**Vibrator**
Switch the vibrator on or off. This affects warning and alarm reporting.

**Button Tone**
Specify whether the RADEAGLET should echo all your key presses with a beep.

**On, Off**
Switch the setting on or off.
5.6 Connectivity

This menu (Fig. 43, p. 54) provides access to settings for various connection devices plugged into the USB-A host adaptor (Fig. 4, p. 17) of your radEAGLET. Items in this menu depend on the connected device. If a device is not available at a given moment, the item is dimmed (grayed). Usually only one connectivity method can be used at a given time.

- Wi-Fi .................. see 5.7, p. 54
- Hotspot ............... see 5.8, p. 56
- Bluetooth .............. see 5.9, p. 58
- USB .................... see 5.10, p. 59
- Services ............... see 5.11, p. 63

Figure 43: The connectivity menu

5.7 Wi-Fi Settings

This item is available while a Wi-Fi dongle is plugged into the radEAGLET’s USB-A port. This screen groups settings and status information to connect your radEAGLET to an existing Wi-Fi access point (Fig. 44, p. 55).

⚠️ The Wi-Fi hardware can be used for either connecting to an existing network or establishing a hotspot network but not both at the same time.
**Settings and Commands**

**Wi-Fi**
Switch the Wi-Fi dongle on or off.

- If you **radEAGLET** finds a wireless network you connected to before (see below), it will re-connect without asking for credentials.

**Connect to Network**
Let the **radEAGLET** search your site for available Wi-Fi networks.

After a moment the list of available access points is shown from which you can choose one to log in (Fig. 45, p. 55).
You will probably be prompted for a password. If in doubt, ask the administrator of the network you try to connect to.

After a moment you will be informed about the connection and the IP address the network assigned to your radEAGLET (Fig. 46, p. 56).

You can use the displayed IP address to access the radEAGLET’s Web interface from a Web browser on any device in the same network.

![Connected to a Wi-Fi network](image)

**Figure 46:** Connected to a Wi-Fi network

- **Choose**
  Choose one of the available networks.

- **Re-Scan**
  Let the radEAGLET scan for available networks again.

- **Down**
  Highlight the next item. Cycles to the top item after you reached the last item.

- **Exit**
  Return to the superior screen.

### 5.8 Hotspot Settings

* This item is available while a Wi-Fi dongle is plugged into the radEAGLET’s USB-A port.

This screen groups settings and status information to let your radEAGLET provide a Wi-Fi access point (Fig. 47, p. 57).

⚠️ The Wi-Fi hardware can be used for either connecting to an existing network or establishing a hotspot network but not both at the same time.
Settings and Commands

**On, Off**

Switch the Wi-Fi hotspot on or off. Any Wi-Fi-capable computer, tablet or smartphone can log into the WLAN created by your radEAGLET.

**HS-Info, Web-Info**

Switch between information about the Web interface address (Fig. 48, p. 57) or that for accessing the hotspot (Fig. 49, p. 58). Both are shown as text and as QR codes for devices equipped appropriately.
5.9 Bluetooth Settings

This item is available while a Bluetooth dongle is plugged into the radEAGLET’s USB-A port.

This screen groups settings and status information to pair your radEAGLET with a Bluetooth equipped device like a smart phone to access the radEAGLET’s Web interface or to share the Internet connection.

You can switch Bluetooth on or off (Fig. 50, p. 59) and start pairing with an external device. Initially the radEAGLET knows no Bluetooth devices (Fig. 51, p. 59).

Follow the instructions displayed to initiate the pairing. The paired device will be shown (Fig. 52, p. 60) and is ready for connection.

The radEAGLET remembers all devices it has been paired to. If your desired device is already known, just choose it from the list.

After the connection is established, the IP address to access the Web interface is shown (Fig. 53, p. 60) as text and as QR code for devices equipped appropriately.

Settings and Commands

Connect, Disconnect

Start or stop the connection between the radEAGLET and the Bluetooth device.
Figure 50: Bluetooth main settings RadEAGLET

Figure 51: Bluetooth instructions on a pristine RadEAGLET

Remove
Remove a device from the list of known devices.

Exit
Return to the superior screen.

5.10 USB Connectivity

* This command depends on what is connected to the various USB ports of your RadEAGLET.
5.10 USB Connectivity

5.10.1 USB Cable to Host Computer

This item is available while a cable connects the radEAGLET’s USB Mini-B port to the USB Host port of a computer or similar device.

- A cable connects the USB Mini-B port to a computer or similar device: see 5.10.1, p. 60
- A USB storage device [a.k.a. Stick] is plugged into the USB-A Port: see 5.10.2, p. 61
- A USB Ethernet adaptor is plugged into the USB-A Port: see 5.10.3, p. 63
This screen shows information about the status of the Web interface and the IP address to connect to from the Web browser [Fig. 54, p. 61].

![USB connection information](image)

**Figure 54: USB cable connection information**

**Settings and Commands**

**On, Off**
Switch the Web interface [see 7, p. 93] on or off.

**Exit**
Return to the superior screen.

### 5.10.2 USB Storage Device

This item is available while a USB storage device is plugged into the **radEAGLET**’s USB-A port.

Connect a USB mass storage device to your **radEAGLET** and transfer data from the instrument to the device.

The **radEAGLET** supports devices formatted as FAT32 without partitions.

You will be prompted to transfer data to the device or cancel the procedure [Fig. 55, p. 62].

**Settings and Commands**

**Copy**
Copy all spectra and screenshots saved in the **radEAGLET**’s database to the USB mass storage device.
The radEAGLET overwrites files having the same name existing on the USB device without warning. As filenames usually contain date and time of their creation, however, it is highly unlikely that you loose data. If in doubt, make a backup copy of the USB device before using this feature.

You will be informed about the progress of the data transfer and after it finished (Fig. 56, p. 62).

**Figure 55:** Data transfer to a USB mass storage device

**Figure 56:** Data transfer complete

Exit

Return to the superior screen.
### 5.10.3 USB Ethernet Adaptor

This item is available while a USB to LAN adaptor is plugged into the radEAGLET’s USB-A port.

The radEAGLET connects to a Local Area Network and obtains an IP address from the network’s DHCP server.

This screen shows information about the status of the Web interface and the IP address to connect to from the Web browser (Fig. 57, p. 63).

![Ethernet Connection](image)

**Figure 57:** Ethernet LAN connection information

#### Settings and Commands

- **On, Off**
  - Switch the Web interface (see 7, p. 93) on or off.

- **Exit**
  - Return to the superior screen.

### 5.11 Services

This screen shows information about the connectivity services your radEAGLET provides and lets you switch them on or off (Fig. 58, p. 64).

#### Settings and Commands

- **Web Interface**
  - Switch the Web interface (see 7, p. 93) on or off.
5.12 Reachback Settings

This screen (Fig. 59, p. 65) groups settings for a reachback SOP. Please refer to 6.4, p. 92 for details.

**Settings and Commands**

- **Background**
  Specify the duration for a background measurement.

- **Known Source**
  Specify the duration for a measurement of a known source.

- **Unknown**
  Specify the duration for a measurement of an unknown source.

- **Email Address**
  Specify the address the reachback data should be sent to. Choose from the list of addresses saved in your radEAGLET.
The complete setup for reachback mailings requires entering and editing a lot of text and thus is available and a lot more convenient in the Web interface [see 7.7, p. 108].

**Add Email Address**

Add an address to the list of addresses saved in your radEAGLET.

- **+,-**  
  Increase or decrease the value.

- **Cycle**  
  Cycle through the options for the highlighted setting.

- **Exit**  
  Return to the superior screen.

- **Down**  
  Highlight the next item. Cycles to the top item after you reached the last item.

- **Select**  
  Select the highlighted item.

### 5.13 GPS

This item is available for radEAGLET models equipped with a GPS receiver (see E.1, p. 133).

This screen [Fig. 60, p. 66] has the switch for the GPS receiver and shows your location, if available.

The current GPS status is indicated by a symbol in the status area [see 2.1, p. 19]
When you switch on the GPS receiver, it starts to determine the location. For that it needs to receive data from a sufficient number of NAVSTAR satellites. The current number is shown, see Fig. 61, p. 66, and increases after some time, see Fig. 62, p. 67.

If the GPS receiver has sufficient data from enough satellites ("has a fix"), your location is shown, see Fig. 63, p. 67.

**Settings and Commands**

- **On, Off**
  Switch the setting on or off.
Exit

Return to the superior screen.

5.14 Easy Calibration

This command lets you specify a calibration source and trigger a simple automatic calibration of the radEAGLET.

An elaborate version of calibration is available too, see 5.18, p. 72.

For additional information refer to appendix C.2, p. 126.
Please place a suitable calibration source ($^{40}$K or $^{137}$Cs) in front of the detector before proceeding.

After you let the radEAGLET know which calibration source is in front of it (Fig. 64, p. 68), it will acquire data for a while and use it for calibration (Fig. 65, p. 68).

The acquired spectrum is shown, overlayed by the theoretical peak position of the selected source and the current peak fit of the measured spectrum.

A progress percentage is shown during the data collection, sometimes in several cycles, until the peak position of the calibration source is within ±0.5% of the theoretical position (Fig. 66, p. 69).
Settings and Commands

Exit
Return to the superior screen.

Down
Highlight the next item. Cycles to the top item after you reached the last item.

Select
Select the highlighted item.

5.15 Protected Settings

You can access the protected settings of the radEAGLET via this menu (Fig. 67, p. 69).
Before accessing this menu you have to enter a password [see 2.2.4, p. 24].

System Information .................. see 5.16, p. 70
Alarm Settings ...................... see 5.17, p. 71
Calibration ........................... see 5.18, p. 72
ID Settings .......................... see 5.19, p. 74
Storage Management .............. see 5.22, p. 78
Set Password ....................... see 5.23, p. 81
Factory Settings .................... see 5.24, p. 81
5.16 System Information

This screen (Fig. 68, p. 70) shows information about your radEAGLET’s hardware status. Please have these data at hand when contacting our support.

![System Information Screen]

**Figure 68:** The hardware status

- **High Voltage**
  The value should be between 500 V and 800 V.

- **Battery Temperature**
  The value should be between 0 °C and 50 °C.

- **Crystal Temperature**
  The value should be between -20 °C and 55 °C.

- **Fine Gain**
  The value should be ±10%.

- **Last Stabilization**
  Time elapsed since the last successful stabilization of the instrument (see C.1, p. 125).
5.17 Alarm Settings

This screen (Fig. 69, p. 71) groups the settings for warnings and alarms.

These settings are designed for your personal safety. The alarm is intended to let you know you are exposed to dangerous radiation and may be accumulating a significant radiation dose. If you set the alarm levels or warning thresholds too high, this may pose a serious health risk to you.

You can set the unit used for these thresholds under 5.4, p. 51.

**Warning Threshold**

The dose rate threshold for warnings. The value must be lower than that for alarms.

**Alarm Threshold**

The dose rate threshold for alarms. The value must be higher than that for warnings.

**Neutron Sensitivity**

Set sensitivity for neutron alarms in several steps.

This item is available for radEAGLET models with a neutron detector (see E.1, p. 133).
### 5.18 Calibration

This screen (Fig. 70, p. 73) shows a partial spectrum and some additional information you can use to inspect and trigger the calibration of your radEAGLET.

For additional information refer to appendix C.2, p. 126.

A simpler version of calibration is available too, see 5.14, p. 67.

Please place a suitable calibration source (\(^{40}\)K or \(^{137}\)Cs) in front of the detector before proceeding.

<table>
<thead>
<tr>
<th>Setting</th>
<th>Neutrons</th>
<th>Integration Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>-5</td>
<td>4</td>
<td>4 sec</td>
</tr>
<tr>
<td>-4</td>
<td>4</td>
<td>10 sec</td>
</tr>
<tr>
<td>-3</td>
<td>4</td>
<td>15 sec</td>
</tr>
<tr>
<td>-2</td>
<td>4</td>
<td>20 sec</td>
</tr>
<tr>
<td>-1</td>
<td>4</td>
<td>30 sec</td>
</tr>
<tr>
<td>Default</td>
<td>±0</td>
<td>40 sec</td>
</tr>
<tr>
<td>+1</td>
<td>4</td>
<td>80 sec</td>
</tr>
<tr>
<td>+2</td>
<td>4</td>
<td>100 sec</td>
</tr>
<tr>
<td>+3</td>
<td>4</td>
<td>140 sec</td>
</tr>
<tr>
<td>+4</td>
<td>4</td>
<td>180 sec</td>
</tr>
<tr>
<td>+5</td>
<td>4</td>
<td>220 sec</td>
</tr>
</tbody>
</table>

- **+, -**: Increase or decrease the value.
- **Accept**: Make your change permanent.
- **Exit**: Return to the superior screen.
- **Down**: Highlight the next item. Cycles to the top item after you reached the last item.
- **Select**: Select the highlighted item.

#### Settings and Commands

- **Next**: Reveal the next available command for the left key.
- **Source**: Specify the source to be used for calibration. Available are \(^{40}\)K and \(^{137}\)Cs.
Place a calibration source containing the specified nuclide in front of the detector.

Clear
Clear the spectrum acquired hitherto and restart data collection.

Default
Reset the gain to the factory default. The spectrum will be cleared and the instrument will start recalibration from the beginning.

Calibrate
Save the fine gain value determined by the calibration procedure and have it used for
future measurements. (Only available after enough data for a calibration have been collected, see Fig. 71, p. 73).

Exit

Return to the superior screen.

5.19  ID Settings

You can access the identification settings of the radEAGLET via this menu (Fig. 72, p. 74).

Easy ID Settings .................. see 5.20, p. 74
Nuclide Library ................... see 5.21, p. 75

Figure 72: The ID settings menu

Settings and Commands

Exit

Return to the superior screen.

Down

Highlight the next item. Cycles to the top item after you reached the last item.

Select

Select the highlighted item.

5.20  Easy ID Settings

This screen (Fig. 73, p. 75) groups the settings for the Easy ID mode.

Settings and Commands

Preset Time

Specify the measurement time for the easy ID mode [see 3.2, p. 33].

Increase or decrease the value.

Exit

Return to the superior screen.

Down

Highlight the next item. Cycles to the top item after you reached the last item.

Select

Select the highlighted item.
5.21 Nuclide Library

This screen (Fig. 74, p. 75) groups information about the nuclides your radEAGLET knows about.

Several properties are associated with each nuclide known to the instrument:

**Name**

The simplified name of the nuclide

**Category**

The category a nuclide belongs to:
NORM
Naturally Occurring Radioactive Material

IND
INDustrially used material

MED
MEDically used material

SNM
Special Nuclear Material

Threat Level
The severity of the nuclide:
- Innocent
- Suspicious
- Threatening

On, Off
Should the radEAGLET consider this nuclide during analysis and identification procedures.

You can change these properties for every nuclide in the list. The available nuclides are shown as a revolving list with one nuclide highlighted in the center.

When you enter the settings screen, $^{241}$Am is highlighted (Fig. 74, p. 75).

![Figure 75: The nuclide library with $^{131}$I selected for editing its category](image)

Settings and Commands

**Down**
Highlight the next item. Cycles to the top item after you reached the last item.
Up
Highlight the nuclide above the one currently highlighted. [Not available while $^{241}$Am is highlighted.]

Select
Select the highlighted nuclide for editing. One of the properties is even more highlighted for changing [Fig. 75, p. 76].

Cycle
Cycle through the options for the highlighted setting. [Only available when a nuclide is selected for editing, Fig. 75, p. 76.]

[Next]
Highlight the next property of the nuclide. [Only available when a nuclide is selected for editing, Fig. 75, p. 76.]

Accept
Make your changes to the highlighted nuclide permanent. [Only available when the On/Off property of a nuclide is highlighted for editing, Fig. 76, p. 77.]

Cancel
Discard your changes, if any, to the highlighted nuclide. [Only available when a nuclide is selected for editing, Fig. 76, p. 77.]

Exit
Return to the superior screen. [Only available while $^{241}$Am is highlighted.]

Figure 76: The nuclide library with $^{131}$I selected for editing its On/Off property
5.22 Storage Management

This screen (Fig. 77, p. 78) provides an overview of all the data you saved in the radEAGLET’s database during your surveys.

Shown is summary about free space and the number of various file groups. You can delete data individually or by their age.

A similar feature is available in the Web interface (see 7.10, p. 111).

![Storage Management Screen]

Figure 77: Storage management: Summary

Settings and Commands

User Folders

Show a list of folders containing various types of stored data (Fig. 78, p. 79) The number of files stored in each group is given in parentheses.
Figure 78: Storage management: List of folders with different types of data

**data type**

Open the commands available for every data type [Fig. 79, p. 79].

![Figure 78: Storage management: List of folders with different types of data](image)

Figure 79: Storage management: Commands for a type of data

**Open**

Open a list of all files in the group [Fig. 80, p. 80].

**Delete**

Delete the file highlighted in the list [Fig. 80, p. 80].

The file is deleted immediately after you press the key. There is no additional warning.

![Figure 79: Storage management: Commands for a type of data](image)
5.22 Storage Management

Delete by Age…

Open a menu and choose which files to delete. You can specify a minimum age or have all files deleted (Fig. 81, p. 80).

Delete older than …

... 1 day
... 7 days
... 30 days
All

Figure 80: Storage management: List of files of a certain type

Figure 81: Storage management: Specify files to be deleted

Exit

Return to the superior screen.

Down

Highlight the next item. Cycles to the top item after you reached the last item.

Select

Select the highlighted item.
5.23 Set Password

You can (and should) change the password of your radEAGLET to prevent unauthorized changes of protected settings.

After you confirmed that you want to set a new password (Fig. 82, p. 81) just enter the new password as described in see 2.2.4, p. 24.

Make sure to remember your changed password. Passwords cannot be deciphered at the factory.

![Setting the password](image)

**Figure 82:** Setting the password

5.24 Factory Settings

This command re-establishes the factory settings of your radEAGLET. You have to confirm this command (Fig. 83, p. 82).

- **Reset**
  
  Discard all your changes to the settings of the radEAGLET and re-establish the factory settings.

  This includes the password for the protected settings (see 2.2.4, p. 24).

- **Exit**
  
  Return to the superior screen.

5.25 Collect Reachback

This command initiates a collection of measurements for a reachback SOP. Initially, the collection is empty.
To collect reachback data...

1. Press New to add a measurement.

2. Choose the type of measurement (background, known source, or unknown source, Fig. 84, p. 82).

3. Specify the duration of the measurement (To change default values 5.12, p. 64).

4. Start the measurement. The elapsed time is shown during the measurement Fig. 85, p. 83).

5. The name of the finished measurement file is appended to the collection.
6. Add more measurements ad libitum (Fig. 86, p. 83).

7. Press **Finish** to close the collection.

   All the listed measurements, both in *.spe and *.n42 format, will be combined into a *.zip archive named after the date and time of the measurement.

   You will be informed about the saved collection.

   All measurements are stored in the radEAGLET's database and can be accessed via the usual methods, for example, the Web interface [see 7.10, p. 111] or sent by mail [see 5.26, p. 84].
5.26  Send Data

You can sent saved spectra (see 5.1, p. 47) or reachback data sets (see 5.25, p. 81) via e-mail with this command.

Sending mail is possible only while your radEAGLET is connected to the Internet, so this is checked first, Fig. 87, p. 84.

![Image](https://example.com/image.png)

Figure 87: Checking the Internet connection

If there is no connection you are routed to the appropriate settings screens to configure a connection, Fig. 88, p. 85 (see 5.6, p. 54).
If there is a connection, you can specify which type of files to mail (Fig. 89, p. 85).

From the list of available files you can select those to be included in the mail attachment (Fig. 90, p. 86).

**Send**

Send the marked files. The files will be combined into a *.zip* archive and sent as an attachment to the address you specified (5.12, p. 64). You have to confirm (Fig. 91, p. 86) and will be informed about success.

**Select**

Select the highlighted item.
5.27 Self Test

This command initiates a test of several components of the radEAGLET. The test is divided in several sections (Fig. 92, p. 87).
Several features of these components are tested and the result is shown after a while:

**Passed**
No problems detected.

**Failed**
Problems detected. Please take a note of the circumstances and displayed messages and contact our service department. See p. 2 for addresses.

**Check Calibration**
You should check the calibration of your instrument (see D.1, p. 129).

**Battery**
The battery checked and the result is shown after a while.

**Passed**
No problems detected.

**Failed**
Problems detected. Please take a note of the circumstances and displayed messages and contact our service department. See p. 2 for addresses.

**Display, LEDs, Vibrator, Speaker**
These tests activate the annunciators of the instrument and expose several visual and audible patterns.

Vibrator and speaker are activated regardless of your settings (see 5.5, p. 53).
Please verify that the radEAGLET behaves as announced.
If not: Please take a note of the circumstances and displayed messages and contact our service department. See p. 2 for addresses.
5.28 About

This screen (Fig. 93, p. 88) shows information about your radEAGLET. Please have these data at hand when contacting our support.

![Instrument Information Screen]

Figure 93: The instrument information

Settings and Commands

Exit

Return to the superior screen.

5.29 Shutdown

This screen (Fig. 94, p. 89) is shown when you switch off your radEAGLET.

Settings and Commands

Yes

Shut down the instrument.

No

Cancel the shutdown procedure and continue using the instrument.
Figure 94: Shut down verification
6 Accessing radEAGLET Data

The radEAGLET can save a lot of your measurement results in its database, for example, spectra \([5.1, p. 44]\), alarm logs \([4, p. 39]\), or screenshots \([2.2.5, p. 26]\).

6.1 Storage Management

An overview of data stored on the radEAGLET is available on the instrument \([5.22, p. 78]\) or in the Web interface \([7.10, p. 111]\).

6.2 Data Transfer

You can transfer data from the radEAGLET to other devices, usually computers, for printing, further processing, evaluation, or archival.

Data can be transferred directly via a connection to another device or indirectly with a removable storage medium.

**USB Mass Storage**

You can connect a USB mass storage device, for example, a USB stick, to your radEAGLET and move or copy all available data to it \([5.10.2, p. 61]\).

**USB Cable**

Connect the USB Micro-B socket of the radEAGLET (Fig. 4, p. 17) to a USB-A host connector of your device.

**Wi-Fi Hotspot**

Activate the Wi-Fi hotspot \([5.7, p. 54]\), and use your device to log into the Wi-Fi network with the credentials shown.

This item is available while a Wi-Fi dongle is plugged into the radEAGLET’s USB-A port.

**Wi-Fi Client**

Log your radEAGLET into an existing Wi-Fi network \([5.7, p. 54]\) with the credentials you received from that network’s administrator.

This item is available while a Wi-Fi dongle is plugged into the radEAGLET’s USB-A port.

This can be any type of Wi-Fi network, established by a traditional access point, as a hotspot established by your smart phone or a dedicated surf stick.

The radEAGLET remembers networks it has been logged into and reconnects automatically when they become available.
6.3 Web Interface

Bluetooth
Your radEAGLET can be paired with other devices, for example, smart phones, via Bluetooth. You can access the Web interface and share the internet connection.

This item is available while a Bluetooth dongle is plugged into the radEAGLET's USB-A port.

Internet sharing and Web interface access must be supported by the other device.

LAN Cable
Connect the radEAGLET to a Local Area Network with a running DHCP server. It will automatically obtain an IP address.

This item is available while a USB to LAN adaptor is plugged into the radEAGLET's USB-A port.

6.3 Web Interface

While a device such as a desktop computer or a tablet is connected (6, p. 91) to the radEAGLET, you can access the Web interface of the radEAGLET.

Look up the IP address of the radEAGLET in the connection settings screen (5.6, p. 54) and point your browser to it.

You can browse and inspect saved spectra (7.4, p. 96) or manage or download all saved data to your device (7.10, p. 111).

6.4 Sending Data via E-Mail

While your radEAGLET is, via cable or wireless, connected to a network with Internet access data can be transferred via email.

You can setup the connections and addresses on the instrument (see 5.6, p. 54 and 5.12, p. 64) or, more convenient, in the Web interface (7.7, p. 108)

For details about sending data refer to 5.26, p. 84.
7 RADEAGLET Web Interface

The Web interface is available when you use a recent Web browser on your computer, tablet or smart phone to navigate to the IP address given in the connectivity settings (see 5.6, p. 54).

⚠️ For some computers or operating systems a special driver software is needed to connect to the RADEAGLET.

These drivers and installation instructions are available via the Internet. Please refer to

https://beagleboard.org/static/beaglebone/latest/README.htm#step2

or visit our website to find current information on driver software under

http://www.innoriid.com/drivers/

The Web interface is divided into several sections listed below.

To navigate between sections open the menu (Fig. 95, p. 93) by clicking always available at the top (Fig. 96, p. 94).

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device Info</td>
<td>93</td>
</tr>
<tr>
<td>Wi-Fi Info</td>
<td>94</td>
</tr>
<tr>
<td>Remote Screen</td>
<td>96</td>
</tr>
<tr>
<td>Spectrum Browser</td>
<td>96</td>
</tr>
<tr>
<td>Spectrum File Viewer</td>
<td>107</td>
</tr>
<tr>
<td>Device Settings</td>
<td>107</td>
</tr>
<tr>
<td>Reachback Settings</td>
<td>108</td>
</tr>
<tr>
<td>Software Update</td>
<td>110</td>
</tr>
<tr>
<td>Documents</td>
<td>111</td>
</tr>
<tr>
<td>Storage Management</td>
<td>111</td>
</tr>
</tbody>
</table>

Figure 95: The menu overlay of the Web interface

7.1 Device Info

The device info section (Fig. 96, p. 94) of the Web interface shows general information about your RADEAGLET and its status.
7.2 Wi-Fi Info

This section (Fig. 97, p. 94) provides information about status, access path and credentials of the radEAGLET’s Wi-Fi hotspot.

Figure 97: The Wi-Fi hotspot info in the Web interface [off]
Figure 98: The Wi-Fi hotspot info in the Web interface [on]
7.3 Remote Screen

This section (Fig. 99, p. 96) shows the current contents of your RADEAGLET’s screen. The image changes when you operate the instrument.

You can control the instrument remotely by clicking the key descriptions in the Web interface.

⚠️ If the RADEAGLET’s screen is dimmed after a while of inactivity, your first click only restores the screen backlight. So if the instrument does not react after a moment, click again.

![Remote RADEAGLET's screen in the Web interface](image)

Figure 99: The remote RADEAGLET’s screen in the Web interface

7.4 Spectrum Browser

This section (Fig. 100, p. 97) provides access to the spectra stored on the RADEAGLET. You can inspect, download or delete them.

The spectra are listed with several info columns:
• Record number
• File name derived from the recording date in ISO 8601 format
• Recording date and time in plain language

Initially all records are listed by ascending record numbers.

→ To change the sorting criterion...

1. Click the column title.
2. Click again to switch between ascending and descending order.

→ To filter the list...

1. Type part of the file name or part of the date into the box next to Q.
   The list shows only records matching that criterion in any of the columns.

You can browse the list page by page with < or > and change the length of the list to accommodate your screen size with ▼.

Figure 100: The spectrum browser in the Web interface

Several commands are available for the individual records:

❖ Inspect the spectrum plus a lot of additional information (see 7.4.1, p. 98).

✎ Download the record.

☒ Delete the record.
7.4.1 Spectrum Inspector

The spectrum inspector shows a spectrum diagram for visual inspection (see 7.4.1.1, p. 98), offers various methods for peak analysis, and provides several additional details about the spectrum data.

You can access the Features with buttons along the top:

- Download the spectrum.
- Delete the spectrum.
- Manual Peak Analysis, see 7.4.1.2, p. 100.
- Automatic Peak Analysis, see 7.4.1.3, p. 100.
- Generate a PDF Report, see 7.4.1.5, p. 105.
- Show spectrum details, see 7.4.1.4, p. 103.

7.4.1.1 Spectrum Diagram

![Spectrum Diagram in the Web Interface](image)

**Figure 101:** Spectrum diagramm in the Web interface

⇒ To see coordinates of a specific position...

1. Move the pointer within the chart area and watch the coordinates of the current position shown above the chart (Fig. 101, p. 98).
To zoom into a region of interest...

1. Click and hold at one end of the ROI.
2. Drag to the other end of the ROI. The region will be accented (Fig. 102, p. 99).

3. Release the mouse button. The enlarged region shows up (Fig. 103, p. 100)

To return to the complete spectrum...

1. Double-Click in the chart area.
7.4.1.2 Manual Peak Analysis

→ To analyze a peak...

1. Click 🔃.

2. Click and hold at one end of the peak.

  _clr:  This also works in the zoomed diagram (see 7.4.1.1, p. 98).

3. Drag to the other end of the peak. The region will be accented [Fig. 104, p. 101].

4. Release the mouse button. The peak is colored in the diagram and the results are shown below it [Fig. 105, p. 101].

7.4.1.3 Automatic Peak Analysis

→ To trigger an automatic peak analysis...

1. Click 🔃.

   The spectrum will be scanned and all recognized peaks are accented in color. Details for the peaks will be shown below the diagram [Fig. 106, p. 102].
Figure 104: Marking a peak for analysis

Figure 105: Results for a manually marked peak
Figure 106: Results of an automatic peak analysis
7.4.1.4 Spectrum Details

To show detailed information for the spectrum...

1. Click \(\text{\textdegree}\). Details will be shown in several subsections below the diagram.
2. Click the triangles to expand or collapse subsections. (Fig. 108, p. 104).

You can change the vertical scaling of the spectrum diagram.

- **LIN** Linear scaling (the default).
- **SQRT** Square Root scaling.
- **LOG** Logarithmic scaling.

The current scaling is accentuated below the diagram (Fig. 107, p. 103).

![Spectrum with scaling methods and detail overview](image)

**Figure 107:** Spectrum with scaling methods and detail overview

You can add a comment to the spectrum in the last subsection (Fig. 109, p. 105). This comment will be appended to the PDF report (see 7.4.1.5, p. 105).
The comment is not saved with the spectrum permanently. It is lost when you leave the spectrum inspector.
7.4.1.5 PDF Report Creation

- To create a PDF report...

1. Click 📑. Depending on your Web browser configuration, the pdf document will be opened in the browser or downloaded into the usual location for downloads.

   An example is shown in Fig. 110, p. 106.

**Report Date:** 16.10.2018 03:25:39  
**Model Name:** RADEAGLET  
**Model:** RT 2SG-H-GPS  
**Serial Number:** 18181

**Spectrum Information**
- **Start Time:** 2018-08-18 18:17:46  
- **Stop Time:** 2018-08-18 18:18:18  
- **Real Time:** 32 s  
- **Live Time:** 32 s

**Rate Information**
- **Dose Rate:** 84.700 µSv/h  
- **Gamma Rate:** 2 cps

**Nuclide Analysis**

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>Confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ba133</td>
<td>9.0</td>
</tr>
<tr>
<td>Co60</td>
<td>10.0</td>
</tr>
<tr>
<td>Cs137</td>
<td>10.0</td>
</tr>
</tbody>
</table>

*Figure 110: PDF report of a spectrum*
7.5 Spectrum File Viewer

This section (Fig. 111, p. 107) provides access to the spectrum inspector (see 7.4.1, p. 98) for spectra not saved in the instrument but on your PC, tablet or similar. You can either drop a spectrum file on the page or click the button to choose a spectrum with the standard file selection method of your device.

![Figure 111: The spectrum file viewer in the Web interface](image)

7.6 Device Settings

This section (Fig. 112, p. 107) provides access to some settings of your RadeEAGLET. Changes you make here are transferred to the instrument.

![Figure 112: The RadeEAGLET settings in the Web interface](image)
7.7 Reachback Settings

This section (Fig. 113, p. 108) provides access to the settings for reachback methods described in see 6.4, p. 92. Entering addresses and passwords is way more convenient via the Web interface using a real keyboard than on the instrument itself.

![Image of the reachback settings in the Web interface]

**Figure 113:** The reachback settings in the Web interface

To make your changes permanent, you have to press 📊. If you leave the reachback settings without doing so, all your changes are lost.

The settings are grouped into subsections you can expand or collapse as needed (Fig. 114, p. 109).

You can send reachback messages to various recipients. The radEAGLET remembers a list of addresses so you don’t have to enter them again and again but choose from a list. You can manage this list here by adding and deleting addresses (Fig. 115, p. 109). The currently selected recipient is documented with a checkmark ✔ (Fig. 114, p. 109). Click 🔄 to select another recipient from the list.
Figure 114: The reachback settings in the Web interface

Figure 115: Adding a recipient for reachback messages
7.8 Software Update

You can upload updates or additional software to your radEAGLET in this section of the Web interface (Fig. 116, p. 110).

You can either drop an appropriate file on the page or click the button to choose a file with the standard file selection method of your device.

![Image of software update interface]

**Figure 116:** Update software on the radEAGLET in the Web interface

The file will be transferred to the radEAGLET, checked and prepared for installation (Fig. 117, p. 110).

![Image of software transfer interface]

**Figure 117:** Transfer software to the radEAGLET in the Web interface

After the file is checked and identified, you are ready to launch the installation by clicking ➔ (Fig. 118, p. 110).

![Image of software update ready interface]

**Figure 118:** Ready to install the transferred software

You will be informed about the result (Fig. 119, p. 111) and the instrument will be restarted if necessary.
7.9 **Documents**

This section (Fig. 120, p. 111) provides access to documents available on your instrument, for example, this manual in several languages.

Click an entry to access the document. Depending on your Web browser configuration, the pdf document will be opened in the browser or downloaded into the usual location for downloads.

7.10 **Storage Management**

This section (Fig. 121, p. 112) provides access to all the data you saved in the RadeAGLET’s database during your surveys.

The remaining storage space for more data is displayed above subsections for every type of data showing the number of stored files and the following commands:

- Download all records of this type compressed into a single *.zip archive.
  
  The filename of the archive comprises the type of data and the current date and time, for example **logs-20180818-181818.zip**.

- Delete all records of this type. You will be asked to confirm this command.
Figure 121: Managing the storage in the Web-interface

Use this command in case you need space or to maintain data confidentially before you pass on the instrument to another user.
8 Powering the radEAGLET

The radEAGLET has a built-in rechargeable Li-ion battery which is charged when the instrument is connected via the USB plug at the rear end (Fig. 4, p. 17). For charging, you can connect to a wall power adaptor, or an external battery pack with a USB-A plug.

8.1 External Power Sources

You can connect the radEAGLET to external power sources via the connector on the rear side of the instrument Fig. 4, p. 17.

Included with the radEAGLET are:

- Wall power supply [8.1.1, p. 113]
- Car adaptor
- USB Powerbank [8.1.2, p. 113]

You can also use standard USB power supplies or standard USB power banks as external power source [see 8.2.1, p. 114].

⚠️ While the radEAGLET is powered by an external source providing enough power to charge the internal battery, the the battery symbol (Fig. 1, p. 14) is decorated by a bolt.

8.1.1 Wall Power Supply

Every power supply shipped with the radEAGLET can handle common international AC voltages and frequencies.

Some models come with a fixed plug for a certain country. You can use a common traveler’s kit to mechanically adapt the plug to various international wall outlets.

Other models feature swappable adaptors for several international wall outlet standards.

The power supply features two USB-A connectors so you can charge your radEAGLET and the power bank [8.1.2, p. 113] at the same time.

8.1.2 USB Powerbank

The rechargeable powerbank extends the operating hours of your radEAGLET away from power lines.

The powerbank provides power through its USB-A host connector and can be charged via its Micro USB-B connector.
Batteries must be handled and disposed of properly as required in your jurisdiction.

To charge the radEAGLET...

1. Connect the included USB cable to the USB-A port (OUT) on the powerbank and the other end to the micro USB port of the radEAGLET. Press the powerbank’s function button to start the charging process.

2. If a device is charged with the powerbank and the powerbank has almost reached its capacity limits, this is signalled by flashing of the last status LED. Please recharge the powerbank.

3. Please note that, when charging a device with a powerbank nearly 30% of total capacity is consumed by the charging process alone. This is caused for example by the loss of power from circuit heat and voltage conversion.

To recharge the Powerbank...

1. Connect the included Micro USB cable to the micro USB port (IN) of the powerbank, and connect the other end of the USB cable to a wall power adapter. The charging status is indicated by the LED status lights. If the powerbank is fully charged, the LED status lights remain illuminated.

2. For optimal performance, the powerbank must be used regularly. If this is not the case, fully charge the powerbank at least every quarter.

8.2 Charging the Battery

While your radEAGLET is connected to an external power source (see 8.1, p. 113) the internal battery will be charged.

Charging is reported by a green LED (see 2.1.1, p. 21, Fig. 1, p. 14), which goes off when the battery is fully charged.

8.2.1 Charging Durations

The charging duration depends a lot on the current the USB power source can provide.

For faster charging you should connect the radEAGLET to a wall power supply or similar which delivers a higher current than the 500 mA required by the USB standard.

8.3 Battery Power Saving Tips

If you need to save energy, especially when running the radEAGLET from battery power, you can optimize a few settings to reduce power consumption.
This section lists power-demanding features which you might not need all the time or for certain type of applications, beginning with the more energy-demanding features.

**Screen Brightness and Timeout**

The backlight of the screen draws a significant amount of power. Reduce the backlight brightness [see 5.4, p. 51] to what you really need in your environment.

Let the backlight time out after the shortest period of inactivity [see 5.4, p. 51] convenient for your workflow.

**Wi-Fi**

Switch off the Wi-Fi hotspot while you not using it to communicate [see 5.7, p. 54].

**USB Drive**

Disconnect any USB drive while you are not transferring data.

**GPS Receiver**

Switch off the GPS receiver [see 5.13, p. 65] if you don’t need coordinates to be saved with, for example, identification results or spectra.

Switch off the GPS receiver while you work at places with poor or no GPS reception (inside buildings, underground, etc.).

**Detect Mode**

The detect mode causes high-volume data transfer between the components of the radEAGLET. Switch to another mode while not using the detect mode.
### A Nuclide Library

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>Usage, Severity, Half Life</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$^{241}$Am</td>
<td>SNM, Threat 432 a</td>
<td>Americium has several isotopes and $^{241}$Am is a radioactive isotope. It is a typical companion found in various plutonium nuclide compositions and therefore it is regarded as threat. This nuclide can also be found in components of smoke detectors, where a small americium source acts as an ionizer.</td>
</tr>
<tr>
<td>$^{18}$F, $^{14}$O, $^{15}$O, $^{11}$C, $^{13}$N, $^{26}$Al, $^{22}$Na, $^{121}$I, others, +</td>
<td>IND, (MED), Innocent</td>
<td>Several nuclides emit + particles. These particles may recombine with negative particles in the detector material, typically depositing a photo energy of 511 keV. Some of these isotopes are used for positron emission tomography (PET). The RAD EAGLET displays the identification result + when confronted with such a source because all sources share the 511 keV line and cannot be differentiated further (except $^{22}$Na).</td>
</tr>
<tr>
<td>$^{110m}$Ag</td>
<td>IND, Innocent 250 d</td>
<td>Isotope of the chemical element silver. It has industrial applications and may be found in scrap metals.</td>
</tr>
<tr>
<td>$^{133}$Ba</td>
<td>IND, Innocent 10.75 a</td>
<td>Barium is used in some industrial applications and may be used as test source. It has peaks relatively close to $^{239}$Pu.</td>
</tr>
<tr>
<td>$^{207}$Bi</td>
<td>MED, Innocent 32.9 a</td>
<td>Isotope that is a follow-up from the alpha decay of $^{211}$At. Sometimes found in medical applications, but mostly used in industrial context.</td>
</tr>
<tr>
<td>$^{109}$Cd</td>
<td>IND, Innocent 463 d</td>
<td>Cadmium is an industrially used radiation source.</td>
</tr>
</tbody>
</table>

*to be continued...*
<table>
<thead>
<tr>
<th>Nuclide</th>
<th>Usage, Severity, Half Life</th>
<th>Description</th>
</tr>
</thead>
</table>
| $^{57}\text{Co}$ | IND (MED)  
  $\text{Co}^{57}$  
  Innocent  
  $272\text{d}$ | This isotope of cobalt is often found in medical applications to estimate the size of organs. In industry, it is used as low energy emitter. |
| $^{60}\text{Co}$ | IND  
  $\text{Co}^{60}$  
  Innocent  
  $5.3\text{a}$ | A high energy emitting isotope that can be used for transmission or absorptions spectroscopy. Its industrial applications include sterilization of surgical equipment and food. Depending on end user conops, $^{60}\text{Co}$ may be considered a threat. |
| $^{51}\text{Cr}$ | IND  
  $\text{Cr}^{51}$  
  Innocent  
  $27\text{d}$ | Short living industrial source. Sometimes encountered in medical research on blood cells. |
| $^{134}\text{Cs}$ | IND  
  $\text{Cs}^{134}$  
  Innocent  
  $2\text{a}$ | The cesium isotopes are fission products of nuclear reactors and are often encountered in fall-out following nuclear power plant accidents (Chernobyl, Fukushima). This specific nuclide is sometimes also used for leak detection. |
| $^{137}\text{Cs}$ | IND  
  $\text{Cs}^{137}$  
  Innocent  
  $30\text{a}$ | Cesium $^{137}\text{Cs}$ is perhaps the most prominent nuclide because it is used as a calibration or test source throughout the world. Like $^{134}\text{Cs}$, it is a direct fission product of nuclear reactors and, therefore, is also seen after a nuclear plant accident (fall-out) or a nuclear detonation. Depending on end user conops, $^{137}\text{Cs}$ may be considered a threat. |
| $^{152}\text{Eu}$ | IND  
  $\text{Eu}^{152}$  
  Innocent  
  $13.5\text{a}$ | Europium $^{152}\text{Eu}$ is a source with many photo peaks. In the past, this isotope was used within the control system of nuclear power plants. The multitude of peaks makes europium an ideal candidate for calibrations and specific spectroscopic experiments. |
| $^{68}\text{Ga}$ | MED  
  $\text{Ga}^{68}$  
  Innocent  
  $68\text{m}$ | Gallium is used in nuclear medicine as a generator of radio-pharmaceutical isotopes for positron emission tomography (PET) scanners. |

*to be continued...*
<table>
<thead>
<tr>
<th>Nuclide</th>
<th>Usage, Severity, Half Life</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$^{123}\text{I}$ I123</td>
<td>MED, Innocent 13 h</td>
<td>Iodine isotopes are frequently applied in nuclear medicine. This specific isotope is used for diagnostics regarding thyroid functionality.</td>
</tr>
<tr>
<td>$^{125}\text{I}$ I125</td>
<td>MED, Innocent 60 d</td>
<td>Medical isotope for diagnostics on hormone levels and cancer treatment.</td>
</tr>
<tr>
<td>$^{131}\text{I}$ I131</td>
<td>MED, Innocent 8 d</td>
<td>Iodine $^{131}\text{I}$ is widely used for thyroid diagnostics and treatment as well as kidney and liver studies. It is a fission fragment in nuclear reactors and may be expected after a reactor accident.</td>
</tr>
<tr>
<td>$^{111}\text{In}$ In111</td>
<td>MED, Innocent 2.9 d</td>
<td>Indium is used for research on brain cells and for infection rate analysis.</td>
</tr>
<tr>
<td>$^{192}\text{Ir}$ Ir192</td>
<td>IND, (MED), Innocent 74 d</td>
<td>Iridium $^{192}\text{Ir}$ is used in different applications. It is a source for cancer treatment and it is also used for inspections of pipelines (to investigate the quality of their welding). Sometimes, the weld can have small fractures, posing a threat that the pipeline could leak. $^{192}\text{Ir}$ sources are also used to detect such fractures and to perform thickness measurements. The radEAGLET has two possible indications for iridium, $^{192}\text{Ir}$ and $^{192s}\text{Ir}$, the latter referring to shielded sources because safe industrial usage requires very heavy shielding, often using depleted uranium as a shield.</td>
</tr>
<tr>
<td>$^{40}\text{K}$ K40</td>
<td>NORM, Innocent 1.28 Ga</td>
<td>Potassium $^{40}\text{K}$ is part of the naturally occurring radiation materials (NORM), yielding a very clear photo peak at 1460keV. This peak is commonly used for calibration without additional calibration sources. The identification result K40 will appear when analyzing radiation of ceramics, tiles and fertilizer. You may also denote its presence when running a long-term acquisition with your radEAGLET. An identification result for this source is always possible and it is absolutely safe.</td>
</tr>
</tbody>
</table>
### Nuclide Library

#### radEAGLET User Manual

... continuation

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>Usage, Severity, Half Life</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$^{54}$Mn</td>
<td>IND, Innocent 312 d</td>
<td>The amount of manganese in waste water can be estimated by analyzing this isotope. Therefore, it is a reliable predictor for heavy metal pollution in the water of mining activities.</td>
</tr>
<tr>
<td>$^{99}$Mo</td>
<td>IND, Innocent 2.8 d</td>
<td>Generator for technetium $^{99m}$Tc.</td>
</tr>
<tr>
<td>$^{22}$Na</td>
<td>IND, Innocent 2.6 a</td>
<td>$^{22}$Na features a high energetic line beneath its $^+$ emission and is well-suited to investigate pipeline leakage or welding quality. Some further applications are found in medicine. The identification result for this isotope will display Na22 and additionally $^+$Na22 because the $^+$ emission is a natural part of the isotopes radiation profile.</td>
</tr>
<tr>
<td>$^{237}$Np</td>
<td>SNM, Threat 2.14 Ma</td>
<td>Neptunium is used to produce $^{238}$Pu. It is considered to be a major SNM threat, as are uranium and plutonium.</td>
</tr>
<tr>
<td>$^{239}$Pu WGPu, WGPu_HS, RGPu, RGPu_HS</td>
<td>SNM, Threat 6560 a</td>
<td>Plutonium is a severely dangerous material. It is extremely poisonous and poses a deadly risk for humans. The radEAGLET distinguishes four mixtures of $^{239}$Pu with $^{240}$Pu. The abbreviation RGPu stands for reactor-grade plutonium (yielding a higher amount of $^{240}$Pu in the composition). Weapons-grade plutonium (WGPu) has a higher amount of $^{239}$Pu and a lower amount of $^{240}$Pu. The denotation “HS” marks a source with heavy shielding where only few or none of the lower energy gammas of plutonium may be found in the spectrum. It is common for both reactor-grade or weapon-grade plutonium to be accompanied by an ID of $^{241}$Am.</td>
</tr>
</tbody>
</table>

... to be continued...
<table>
<thead>
<tr>
<th>Nuclide</th>
<th>Usage, Severity, Half Life</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$^{226}\text{Ra}$</td>
<td>NORM Innocent 1600 a</td>
<td>Radium is a specific stage in the decay of uranium which naturally occurs in the earth’s shell. When it decays down, it becomes $^{226}\text{Ra}$. Radium is one of the most frequently encountered radiation signatures and is considered naturally occurring radiation. Tiles and rocks are very likely to receive radium identification results. Also, sources denoted as uranium ore are typically identified as $^{226}\text{Ra}$ sources.</td>
</tr>
<tr>
<td>$^{99m}\text{Tc}$</td>
<td>MED Innocent 6 h</td>
<td>Widely used and frequently applied medical radiation substance. Used for imaging of the heart, liver and kidneys.</td>
</tr>
<tr>
<td>$^{201}\text{TI}$</td>
<td>MED Innocent 3 d</td>
<td>Used for diagnosing arterial diseases and problems associated with blood flow.</td>
</tr>
<tr>
<td>$^{232}\text{Th}$</td>
<td>NORM Innocent 14.05 Ga</td>
<td>A naturally occurring material found in rocks. It is used in lantern mantles and welding rods.</td>
</tr>
<tr>
<td>$^{232}\text{U}$</td>
<td>SNM Threat 69 a</td>
<td>This is a fissile isotope of Uranium that was formerly used in nuclear weapons. Today this uranium isotope is used primarily in nuclear reactors. It is still considered a threat material.</td>
</tr>
<tr>
<td>$^{233}\text{U}$</td>
<td>SNM Threat 160 ka</td>
<td>This is a fissile isotope of Uranium that was formerly used in nuclear weapons. Today this uranium isotope is used primarily in nuclear reactors. It is still considered a threat material.</td>
</tr>
<tr>
<td>$^{235}\text{U}$</td>
<td>SNM Threat 704 Ma</td>
<td>$^{235}\text{U}$ is a very important isotope of uranium used in commercial nuclear power reactors. Uranium used in reactors is typically 3-5% enriched (the $^{235}\text{U}$ content). Low Enriched Uranium has &lt;20% $^{235}\text{U}$ content. Highly Enriched Uranium (&gt;20% and sometimes as high as 90% or more) can be used in nuclear weapons and is an important threat material to detect.</td>
</tr>
<tr>
<td>Nuclide</td>
<td>Usage, Severity, Half Life</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>---------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>$^{238}\text{U}$</td>
<td>SNM, Threat, 4.468 Ga</td>
<td>$^{238}\text{U}$ is the primary constituent of natural uranium (about 99.3%). Depleted uranium has an even higher $^{238}\text{U}$ content. It is a threat because it may be used in nuclear weapons.</td>
</tr>
<tr>
<td>Unknown</td>
<td>—, Threat</td>
<td>The radEAGLET can have a nuclide is unknown. This will appear when a) a nuclide is found that is deactivated in the current library of the instrument or b) whenever a source is measured whose spectrum does not match any of the references. Unknown sources are considered to be a threat.</td>
</tr>
<tr>
<td>Neutron Source</td>
<td>SNM, Threat</td>
<td>A neutron source is identified whenever the neutron detector detects the presence of neutrons. Neutron sources are very dangerous and should be treated with extreme care.</td>
</tr>
</tbody>
</table>
B Glossary

The glossary contains key technical terms used throughout this manual.

**Background** The term background refers to the ambient radiation present around the instrument. The background includes →Natural background and mixtures of perturbation sources surrounding the measurement site. Situations may arise, where the reduction of perturbation sources cannot be optimal, e.g. in laboratories operating with radiation sources.

**Centroid** Center of a peak. The centroid is used to measure peak position. Its numerical value is often generated by a peak fit routine. In the RadeAGLET, a peak fit is performed in the calibration screens, presenting you the centroid and resolution of the peak.

**Full-width-at-half-maximum (FWHM)** There are two points of the peak which have a height that equals half the height of the centroid position. One point on the left, another one right of the centroid. The distance between the energies of these two points is called the full-width-at-half-maximum abbreviated as FWHM. The FWHM divided by the centroid energy leads to the resolution.

**Geiger-Müller Detector (GM)** Secondary detector onboard the RadeAGLET. The GM detector consists of a pressurized tube filled with a radiation sensitive gas. Various gases can be used here, typically inert gases such as helium, argon, neon or xenon. Often these are mixed with an organic vapor or a halogen gas. GM tubes detect radiation utilizing an anode-cathode pair inside this gas. The cathode is the tube housing while the anode is a small wire in the center of the chamber. Radiation ionizes the atoms of the gas initiating a charge avalanche which drives a current towards the anode which generates a count. The number of counts is proportional to the strength of the radiation. GM detectors are non-spectroscopic.

**Natural Background** Natural background is the radiation around the instrument caused by natural processes. First, there are particles and photons coming from space, including the radiation of sun and cosmic rays. This type of natural background is called the cosmic background. There are certain materials in the earth land masses that are radioactive, such as uranium, thorium or potassium. This material is called naturally occurring radioactive material or NORM).

**Naturally Occurring Material (NORM)** Naturally occurring materials are, e.g., potassium $^{40}$K, thorium $^{232}$Th and uranium ore, which by now has arrived in its radium ground state and consequently is reflected by a radium $^{226}$Ra spectrum. NORM constitutes the terrestrial background radiation.

**Neutron detector** This item is available for RadeAGLET models with a neutron detector [see E.1, p. 133].
Several neutron detector designs exist. The $^3$He-tube is the most efficient detector for its size. It is similar in size to the Geiger-Müller tube, but it utilizes $^3$He gas that is in limited supply. Due to this limited supply, the gas prices have risen and it became much more expensive in the past years.

**Scintillation detector** The primary detector for radiation used by the radEAGLET is the scintillation detector. The scintillation detector consists of a crystal coupled to a photomultiplier. Once radiation passes through the scintillation crystal, atoms of the crystal material become excited to higher energetic levels. Once they fall back onto lower energy levels, they emit light. This light is very weak and a source of light amplification is needed to see it. A photomultiplier is such an amplifier and it allows us to observe the light emitted inside the crystal. Additionally, the light also tells us which energy the incident radiation had. Analyzing the photopeak energies of the peaks in the spectrum with the radEAGLET’s advanced algorithms provides the list of radionuclides measured.
C Technological Background, Limitations

C.1 Stabilization

The primary spectroscopic detector of RadeAGLET is the NaI scintillation crystal. This crystal produces light pulses whenever gamma photons interact with the crystal material. The light pulses are very weak so they must be amplified. Therefore, the NaI crystal requires a photo-multiplier tube (PMT) which is coupled to the crystal. This assembly allows the incident gamma photons to be digitized by the internal electronics, and the pulses (which are proportional to the energy of the incident gamma rays) form a histogram or gamma spectrum. This spectrum is stored in the embedded multi-channel analyzer.

The response of both the NaI detector and the PMT may vary based on measurement conditions such as temperature or magnetic field. The peaks in the gamma radiation spectrum may shift due to these temperature variations. As temperature changes are encountered, modern scintillation based instruments must apply some means of stabilization. Shown below is the procedure the RadeAGLET uses to correct for peak shifts and to adjust the peaks in the spectrum to their scientifically correct positions.

C.1.1 Initial Stabilization

Each time the system is turned on, during the start-up the RadeAGLET performs an initial stabilization. This process takes about 80 seconds. It runs temperature checks and searches for known peaks in the spectrum. It is strongly advised not to have check sources in the immediate area during this initial phase, because this can confuse the process.

C.1.2 Continuous Temperature Monitoring

During the manufacturing process, each RadeAGLET is tested in a climate chamber to learn the individual temperature dependencies of crystal and PMT. Both the absolute value of the temperature as well as the temperature gradients are used in this process. In the field, the instrument continuously monitors and adjusts the gain by measuring the temperature. It also distinguishes between slow temperature drifts and quick temperature shocks.

C.1.3 Continuous Spectroscopic Adjustments

Although there is not always an actual source present, the natural background spectrum often contains valuable information. The RadeAGLET uses the natural background peaks for an advanced stage of self-stabilization. When turned on, the RadeAGLET is automatically taking background spectra and analyzing them. All this happens automatically in the
C.2 Calibration

The calibration has a tremendous impact on the measurement quality of the instrument. It determines the precision of the current calibration by locating the peak at the correct position. The radEAGLET has a dedicated screen to visually inspect the calibration quality when performing a calibration, see 5.18, p. 72.

The value for the resolution is generated by dividing the FWHM by the measured centroid energy.

C.2.1 Checking the Calibration

The procedure for a visual inspection of the calibration when using a $^{137}\text{Cs}$ calibration source:

1. Place a cesium $^{137}\text{Cs}$ sample\(^1\) in front of the detector.
2. Wait until a reliable fit of the peak is established. This can take several seconds. You can identify a good fit when the calculated values show up.
3. The difference between the target value $E=661.6$ keV of $^{137}\text{Cs}$ and the calculated centroid is the calibration error.

\(^1\)Cesium $^{137}\text{Cs}$ has a photo peak at the energy $E=661.6$ keV. It is a popular radionuclide for calibration purposes. It is available as a sealed button source (check source) from radionuclide suppliers.

If you experience unusually high values in the resolution and/or a double peak phenomenon from a single peak source, this could indicate a small crack inside the NaI detector crystal. Please contact our service.

C.2.2 Re-Calibrating Using the Calibration Mode

Begin with the visual inspection of the calibration state as explained above. If you experience a deviation between the target peak position and the actual position, you can perform a manual recalibration.
After entering the calibration screen, it takes some time until the peak fit is established. The shown percentage value represents the progress of acquiring the minimum counts to establish the measured peak position. This depends on the strength of the calibration source you are using. Once the peak fit quality is sufficient and enough counts are contained in the spectrum, the **Calibration** button becomes active. You can press it to perform the manual recalibration and to definitively update the internal gain.

After recalibration, the calibration check acquisition is reset and you will get an updated view of the peak fit. You can now again inspect the results of the recalibration.

### C.3 Effective Range of Measurement

Detection and identification depend on the dose rate on the detector surface. This value can be defined by either varying the distance of the source and detector or by simply using stronger or weaker sources.

The **radEAGLET** measures spectra from 15 keV up to 3 MeV.

### C.4 Determination of the Full Width at Half Maximum

**radEAGLET** detectors have a specified FWHM, sometimes also denoted as resolution given in percentages relative to their peak position. Our usual reference is the $^{137}$Cs peak at 661.6 keV. It is the common peak to specify a resolution. The procedure used to determine this value is given as follows:

1. Acquire a background spectrum.
2. Acquire a $^{137}$Cs spectrum with at least 1 µSv/h at the detector surface.
3. Use a qualified background subtraction method to subtract the background from the cesium spectrum.
4. Perform a Gaussian fit on the peak data (using e.g. Matlab).
5. Locate both positions where the Gaussian curve reaches the half of its maximum.
6. Calculate the difference in terms of energy. The latter is the FWHM.

For sodium iodide based instruments, we specify a resolution better than 7.2% at 661.65 keV which corresponds to a FWHM of 47.6 keV.

### C.5 Over-Range Characteristics for the Scintillator and the Nuclide Identification

Nuclide identification results depend on the quality of the spectrum. For extremely high count rates, the scintillation spectrum degrades and for dose rates greater than 200 µSv/h
at the detector surface, the radEAGLET switches off the scintillation subsystem and uses the fall-back GM tube (included in all radEAGLET variants) for dose rate measurements.

A nuclide identification is possible in radiation fields up to 200 µSv/h. Though, a valid and precise ID is only given if the limits of the EASY-MODE ID are adhered to. Here, the instrument will clearly indicate, whether an over-range situation exists or not.

C.6 Live, Real and Dead Times

The Multi-Channel Analyzer (MCA) component of radEAGLET is an advanced electronics component that deploys sophisticated signal processing algorithms for signal interpretation. The MCA and electronics have a short dead-time after each pulse where no signal will be seen. This is because the electronics cannot accept a new pulse to be processed while it is already processing a pulse. The higher the incident count rate, the higher the dead time. The dead-time accumulates with the measurement time and is dependent on the detector load in terms of counts per second (cps). Consequently, two acquisition times may be displayed: the real-time, which is the true time duration of the acquisition and the live-time, which is the acquisition time corrected by the above defined dead-time. The live time will always be shorter than or equal to the real time.

C.7 Scaling of the Vertical Spectrum Axis

Scintillation detectors have a certain energy-dependent sensitivity. Peaks at low energies (e.g. 59 keV of $^{241}$Am) have a higher sensitivity than peaks at the higher end of the spectrum (e.g. 1332 keV of $^{60}$Co). When observing this type of spectra and the y-axis has a linear scale, some peaks at higher energies might not be visible. To see a better display of the higher energy peaks, you might want to look at the spectrum either using a logarithmic scale or a square root scale for the y-axis. These different scales allow the user to visually equalize the peak heights so that a wide range of the spectra can be viewed without zooming.
The RADEAGLET was developed using state-of-the-art quality standards for the system architecture and the stability of all components. Nevertheless, it may not be free of mistakes and there might exist situations that were not covered by our quality testing.

D.1 The Stabilization Icon is Red

The stabilization icon turns red when the continuous $^{40}$K stabilization fails. This does not necessarily mean the instrument is out of calibration, it simply means something is causing the routine stabilization from occurring properly.

Likely causes are:

- **Other radioactive sources in the vicinity of the instrument**
  The best course of action is to remove any other sources from the room and perform a new stabilization by rebooting the system and using the $^{40}$K box supplied with the instrument [see 2.3, p. 26].
  Radioactive sources should not be used or stored near the instrument.

- **Rapid change in temperature of the instrument**
  The best course of action is to perform a new stabilization by rebooting the instrument [see 2.3, p. 26]. After the instrument reboots, you should perform the Easy Calibration [see 5.14, p. 67] using a $^{137}$Cs source. This process typically takes less than a minute and ensures the instrument generates excellent identifications.

D.2 System Switches Back to Black Screen

Solution: Unplug all cables from RADEAGLET. Open rear battery chamber and set the “on/off” switch to “off”. Wait at least 10 seconds. Put the switch back to the “on” state. If the problem reappears, please contact our customer support.

D.3 System Keeps Running Although the Internal On/Off Switch is Set to Off

The internal on/off switch activates or deactivates the current flow between battery and main board. If the main board is connected to USB, it will be powered via USB. The system may keep on running for a short time after the battery was removed.

Solution: Unplug the USB cable. This will shutdown the power to the mainboard.
D.4 Checking the Proper Function of the System

To ensure your radEAGLET is working properly, we will supply a short checklist for successful operation.

1. Check the status of the battery failure LED
   a) After some time, the booting screen of the radEAGLET should appear:
      • If the screen does not appear, check if the display has backlight. If not, there might be a problem with the battery. Power the instrument with the charger or check whether the problem persists.
      • If the instrument boots with power cable connected, check the status of the on/off switch in the rear battery chamber of the unit.
   b) Is the orange fault LED on?
      • If yes, there might be charging problem or some other problem with the batteries. If it is running, turn off the instrument, and try charging the batteries.

2. System boot-up and welcome screen
   a) Self-checking routines run in the background of the boot process. If a self-check fails, a corresponding error message will appear on the device and give you further advice.
   b) Once started, the system should welcome you in dose rate mode. If no source is around, the ambient dose rate is expected to be between 0.01 µSv/h and 0.08 µSv/h.
   c) The count rate in cps should be greater than 0. There are always natural radiation counts.
   d) If you have a neutron detector, the neutron cps should be close to 0.00 cps. Sometimes values of about 0.05 might occur. If you observe a neutron count rate of 0.5 cps or greater, it is likely that a neutron source is nearby.
   e) If the system was charged, the battery status bar should indicate fully charged status
   f) If the bar shows a low battery, this might point towards a problem with the batteries. Try charging the battery again. If the problem occurs again, exchange the battery.

3. Specific checks in spectrum mode
   a) Enter spectrum mode. Without a source, start a spectrum acquisition and observe the area around 1460 keV. After a few minutes, the natural potassium peak should appear at 1460 keV. You can use this peak to verify the correct positioning of the instrument even if no cesium calibration source is available. After fresh startup, the instrument should have at least a precision of around ±0.5% of the line energy or a maximum deviation of ±7 keV around the 1460 keV line.
b) After calibration, the instrument should have the potassium 1460 keV line well within ±0.25 (between 1457 keV and 1463 keV).

c) Using an external cesium calibration source: Place the source in front of the detector at a minimum distance of 10 cm. Enter calibration check and wait for the threshold sum of the peak counts to be collected. The system will then show you the report of the peak properties. The resolution should not be greater than 7.3%. The peak position deviation should not be greater than 0.5% after startup, corresponding to a shift of ±3.3 keV around the target value of 661.6 keV.

d) If the peak position deviates, press [Cal] to calibrate the instrument. Repeat the acquisition of the cesium reference in calibration mode and wait until new values for the peak assessment appear. The peak should be positioned well within 0.2%, ±1.7 keV of the target peak position of 661.6 keV.
E Info Pool

E.1 innoRIID RadeAGLET: Specifications

Several models of this product are available.

A RadeAGLET 2SG
Sodium iodide detector (NaI); Geiger-Müller tube

B RadeAGLET 2SG-H
Sodium iodide detector (NaI); Geiger-Müller tube; $^3$He tube

C RadeAGLET 2SG-GPS
Sodium iodide detector (NaI); Geiger-Müller tube; GPS receiver

D RadeAGLET 2SG-H-GPS
Sodium iodide detector (NaI); Geiger-Müller tube; $^3$He tube; GPS receiver

Specifications relevant for certain models only are labeled with the model.

| Detectors |
|-----------------|-----------------|
| Gamma: NaI      | Crystal size (Ø × L): 50.8 mm (2.00 in) × 25.4 mm (1.00 in) |
| Gamma (High Dose Rate) | Geiger-Müller detector |
| Neutrons: $^3$He Proportional Counter Tube | Size (Ø × L): 12.7 mm (0.50 in) × 64 mm (2.52 in); net: 9.4 mm (0.37 in) × 50 mm (1.97 in); 8 bar (116.03 psi) |

| Performance |
|-----------------|-----------------|
| Energy Range (Gamma) | 15 keV — 3 MeV |
| Throughput       | >250 kcps       |
| Max. Input Count Rate | 750 kcps |
| Gamma Spectrum   | 2048 channels   |
| Dose Rate Range  | 10 nSv/h — 1 Sv/h |
| dto. Geiger-Müller Detector | 100 µSv/h — 100 mSv/h |
| Thermal Neutron Sensitivity | 1.65 cps/nv ±10% |

Standard Nuclide Library

$^{110m}$Ag, $^{241}$Am, $^{133}$Ba, $^{207}$Bi, $^{109}$Cd, $^{57}$Co, $^{60}$Co, $^{51}$Cr, $^{134}$Cs, $^{137}$Cs, $^{152}$Eu, $^{18}$F, $^{67}$Ga, $^{68}$Ga, $^{123}$I, $^{128}$I, $^{131}$I, $^{111}$In, $^{192}$Ir, $^{40}$K, $^{99}$Mo, $^{54}$Mn, $^{22}$Na, $^{237}$Np, $^{239}$Pu, $^{240}$Pu, $^{241}$Pu, $^{226}$Ra, $^{75}$Se, $^{89}$Sr, $^{99m}$Tc, $^{232}$Th, $^{201}$Tl, $^{232}$U, $^{233}$U, $^{235}$U, $^{238}$U
### Standard Nuclide Library

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### Optional Nuclide Library

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### Physical Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Details</th>
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<tbody>
<tr>
<td>Dimensions (W × D × H)</td>
<td>78 mm (3.07 in) × 242 mm (9.53 in) × 85 mm (3.35 in)</td>
</tr>
<tr>
<td>Housing Material</td>
<td>Aluminium; polyoxymethylene; glass</td>
</tr>
<tr>
<td>Weight A</td>
<td>880 g (31.04 oz) including batteries</td>
</tr>
<tr>
<td>Weight B</td>
<td>910 g (2 lb 0.1 oz) including batteries</td>
</tr>
<tr>
<td>Weight C</td>
<td>900 g (31.75 oz) including batteries</td>
</tr>
<tr>
<td>Weight D</td>
<td>930 g (2 lb 0.8 oz) including batteries</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>$-20 ^{\circ}C - +55 ^{\circ}C (-4 ^{\circ}F - +131 ^{\circ}F)$</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>$+10 ^{\circ}C - +35 ^{\circ}C (+50 ^{\circ}F - +95 ^{\circ}F)$</td>
</tr>
<tr>
<td>Temperature Change</td>
<td>Sudden temperature change must not exceed 30.0 °C (54.0 °F) in order to avoid damage to the detector crystal.</td>
</tr>
<tr>
<td>Relative Humidity</td>
<td>10% — 80%, non condensing</td>
</tr>
<tr>
<td>Protection Rating</td>
<td>IP65 according to IEC 60529</td>
</tr>
<tr>
<td>Battery Type</td>
<td>Internal (Li ion, rechargeable)</td>
</tr>
<tr>
<td>Capacity</td>
<td>&gt;3350 mAh; 7.2 V</td>
</tr>
<tr>
<td>Battery Life</td>
<td>300 — 500 full charge-discharge cycles; 3 a — 5 a</td>
</tr>
<tr>
<td>Operating Duration</td>
<td>≥12 h at 20 °C (68 °F) in dose rate mode with dimmed display back light and GPS switched off</td>
</tr>
<tr>
<td>Charging Duration</td>
<td>3.5 h at 20 °C (68 °F) when instrument off and connected to USB power adaptor and ≈8 h when powered via computer</td>
</tr>
<tr>
<td>Display Type</td>
<td>Transflective color TFT LCD</td>
</tr>
</tbody>
</table>

—to be continued...
### radEAGLET User Manual

**Info Pool**

---

**Size**

3.5 in (88.9 mm); 480 pixel × 640 pixel

**Central Luminance**

250 cd/m² (typical)

**Annunciators**

<table>
<thead>
<tr>
<th>LED Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red LED</td>
<td>Gamma warning and alarm reporting; startup indication</td>
</tr>
<tr>
<td>Green LED</td>
<td>Battery charging</td>
</tr>
<tr>
<td>Amber LED</td>
<td>Battery heat failure</td>
</tr>
<tr>
<td>Vibrator</td>
<td>Warning and alarm reporting</td>
</tr>
<tr>
<td>Speaker</td>
<td>Warning and alarm reporting; keyboard feedback</td>
</tr>
</tbody>
</table>

**Memory**

- **Data Storage**: 4 GB internal memory
- **Micro SD Card**: 16 GB available for the user

**Input, Output**

- **USB**: USB 2.0; micro-B socket
- **USB Host**: USB 2.0; USB-A socket; WLAN stick included

**Software**

- **Embedded Software**: Linux Operating System
- **Download File Formats**: ANSI N42.42 and spe files compatible with third-party analysis software

**Accessories**

- **Carrying Case**: stackable; polypropylene; polyethylene
- **Calibration Source**: Box with potassium chloride (KCl); ICSC 1450; 400 g (14.11 oz); net: 200 g (7.05 oz)
- **Connection Cable**: Micro USB-B — USB-A; 1 m (3.28 ft)
- **DC Power Adaptor, Charger**: AC in: 100 V — 240 V; 0.7 A; 50 Hz — 60 Hz; DC out: 5 V; 2.4 A; USB-A
- **Car Power Adaptor, Charger**: DC in: 12 V — 24 V; DC out: 5 V; 2 × 2.4 A; USB-A
- **External Power**: Powerbank (Li ion, rechargeable); 6600 mAh; DC out: 5 V; 2.1 A; USB-A
- **Connection Cable**: Micro USB-B — USB-A; 20 cm (7.87 in)

**Standards**

- **ANSI N42.34 2015**: Performance Criteria for Handheld Instruments for the Detection and Identification of Radionuclides
- **IEC 60529**: Degrees of Protection Provided by Enclosures (IP Code)
- **ANSI N42.42 2006**: Data format standard for radiation detectors used for Homeland Security

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... continuation
<table>
<thead>
<tr>
<th>EMC - Directive 2014/30/EU</th>
<th>Regulations concerning electromagnetic compatibility</th>
</tr>
</thead>
</table>
E.2 Unmanned Neutron Detection Testing

This item is available for radEAGLET models with a neutron detector (see E.1, p. 133).

For tests involving an un-moderated neutron source, an appropriate phantom of Polymethyl Methacrylate (PMMA, \((\text{C}_5\text{H}_8\text{O}_2)_n\), acrylic glass) or equivalent must be placed between the neutron source and the instrument to accurately simulate the moderation effects of field mission environments (which always provide moderation through surrounding material).
DECLARATION OF CONFORMITY

Radio Isotope Identifying Device (RIID)
Type: RadEAGLET
Model: All
Serial Number: 17001 and up
Year of Manufacture: 2017

Herewith we declare, that the above stated instrument complies with the following EC-Directives:

EMC Directive 2014/30/EU

Furthermore, the European Standard IEC 61000-4 and the US Standard ANSI N42.34-2006

Complete listing is included in the technical manual.
The above-stated device is defined for the analysis of gamma radiation.

Grevenbroich, 2017-07-19

Peter Henke
General Manager
innoRIID GmbH
E.4  Warranty

ORTEC warrants that the items will be delivered free from defects in material or workmanship. ORTEC makes no other warranties, express or implied, and specifically NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

ORTEC’s exclusive liability is limited to repairing or replacing at ORTEC by ORTEC to be defective in workmanship or materials within one year from the date of delivery. ORTEC’s liability on any claim of any kind, including negligence, loss, or damages arising out of, connected with, or from the performance or breach thereof, or from the manufacture, sale, delivery, resale, repair, or use of any item or services covered by this agreement or purchase order, shall in no case exceed the price allocable to the item or service furnished or any part thereof that gives rise to the claim. In the event ORTEC fails to manufacture or deliver items called for in this agreement or purchase order, ORTEC’s exclusive liability and buyer’s exclusive remedy shall be release of the buyer from the obligation to pay the purchase price. In no event shall ORTEC be liable for special or consequential damages.

E.5  Quality Control

Before being approved for shipment, each ORTEC instrument must pass a stringent set of quality control tests designed to expose any flaws in materials or workmanship. Permanent records of these tests are maintained for use in warranty repair and as a source of statistical information for design improvements.

E.6  Service

If it becomes necessary to return this instrument for repair, it is essential that Customer Services be contacted in advance of its return so that a Return Authorization Number can be assigned to the unit. Also, ORTEC must be informed, either in writing or by telephone, of the nature of the fault of the instrument being returned and of the model, serial, and revision numbers. Failure to do so may cause unnecessary delays in getting the unit repaired. The ORTEC standard procedure requires that instruments returned for repair pass the same quality control tests that are used for new-production instruments. Instruments that are returned should be packed so that they will withstand normal transit handling and must be shipped via UPS to the designated ORTEC Repair Center. The address label and the package should include the Return Authorization Number assigned. Instruments being returned that are damaged in transit due to inadequate packing will be repaired at the sender’s expense, and it will be the sender’s responsibility to make claim with the shipper. Instruments not in warranty should follow the same procedure and ORTEC will provide a quotation for the repair costs.
E.7 Damage in Transit

Shipments should be examined immediately upon receipt for evidence of external or concealed damage. The carrier making delivery should be notified immediately of any such damage since the carrier is normally liable for damage in shipment. Packing materials, bills of materials, waybills, and other such documentation should be preserved in order to establish claims. After such notification to the carrier, please notify ORTEC of the circumstances so that assistance can be provided in making damage claims and in providing replacement equipment, if necessary.

E.8 Bibliography