The World's Sixth Sense®

FLIR identiFINDER® R425

Digital Handheld Gamma Spectrometer with Radionuclide Identification

User Manual

ISO 9001

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1 Welcome

1.1 The FLIR identiFINDER R425

The FLIR identiFINDER® R425 is a digital all-in-one, hand-held, battery-powered instrument that enables you to take an advanced spectroscopy laboratory into the field.

The device features capabilities to:

- search for sources of gamma radiation or scan areas contaminated with gamma radionuclides
- identify radionuclides by analysis of gamma ray spectra
- measure gamma dose and dose rate
- detect neutron radiation with count rate and accumulated counts (available only for variants equipped with a neutron detector)

The identiFINDER R425 is the modern successor of the identiFINDER R400. It is well-known around the globe and in daily use by thousands of users hunting for sources of ionizing radiation.

The R425 is designed to survey objects ranging from small packages to large objects such as freight containers. It is used to search for illicit trafficking of radioactive material and scan containers for radiation leaks, monitor medical waste or scrap metal. If the type or quantity of radioactive material exceeds preset alarm levels, the device notifies you through several methods of feedback.

In particular, the technology in the identiFINDER R425 is devised to identify threat objects. A threat object is defined as radioactive material whose signature is consistent with that of material that could be used for terrorist purposes. Threat materials are usually those used in a nuclear explosive device or which could be used in Radiological Dispersive Devices ("dirty" bombs).

The identiFINDER R425 incorporates advanced physics algorithms that enable sophisticated high quality scientific measurements to be made. However, the user interface is designed to be successfully operated by personnel with a minimum of training. The high degree of automation enables successful operation via a few tactile-enhanced buttons, even in a distracting and hostile environment.

The instrument is robust and stable, even in the most demanding of conditions.

Other features include:

- brilliant color display with 400x240 pixels
- large database capacity for more than half a million spectra or other data
- GPS receiver to log incident locations
- wired communication via standard USB-C interface
- wireless communication via Bluetooth for reachback
- web interface for monitoring and configuration of the instrument without additional software

See "A.1: identiFINDER R425 Specifications" on p. 154 for more information.

The advances in this innovation have not strayed from FLIR's commitment to the identiFINDER workhorse and its familiarity to its loyal users. It is still the same rugged instrument, just with more advanced technology.

The R425 builds on FLIR's trusted algorithms with advanced heuristics and hybrid identification techniques, and remains fully functional in high gamma fields, where other instruments could be overwhelmed. It is reliable, rugged, and accurate beyond the contemporary standard.

1.2 About this Manual

This section describes special typeface and symbols that are used in this document to convey specific meanings.

Ordinary Text looks like this.

`Constant Width` is used for URLs, file names, path names, or text you have to enter.

Boldface and italics

- *Italics* is used when introducing a specialized term.
- **Boldface** is used to indicate the name of a command or menu selection that appears on the R425 screen or a R425 web interface page.
- A menu path on the R425 or in the web interface is indicated by the following notation : **Menu Name | Submenu Name** (if applicable) **| Menu Item**.

For example:

Select **Radiation | Alarm Settings | Alarm Indicators** to choose what type of indicators will be used for an alarm.

Sometimes **boldface** or *italics* may also be used for emphasis.

Other symbols

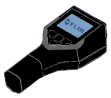
WARNING: Information concerns possible danger to operator.

CAUTION: Information concerns a risk to instrument or data.

A tip describes significant details about or alternative methods of performing tasks.

This symbol indicates background information about the operation of the instrument.

A diamond symbol indicates information related to specific variants of the product.



This image is used to indicate commands or menu paths (for example, **Device | Settings**) available on the identiFINDER R425 device itself.

This image is used to indicate commands or menu paths (e.g., **Home | Info | System**) found on the identiFINDER R425 web interface, when the R425 is connected to an external device.

Cross-references

If you are reading this manual as a PDF document, you can click on cross-references ("see page . . ."), as well as items in the table of contents, links to internet sites, and other links to immediately view the linked item.

1.3 Safety Warnings

The FLIR identiFINDER® R425 is designed for indoor and outdoor use. When operated in accordance with the operating instructions, it should not present any hazard to the operator.

The housing is essential to the integrity and safe operation of the instrument. Under no circumstances should the housing be tampered with, penetrated, or otherwise removed except for normal access to the external connectors (see chapter 7).

The identiFINDER R425 is not certified for use in explosive environments.

The power adapter 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.

Objects being surveyed with the identiFINDER R425 could emit radioactive radiation with hazardous intensity.

1.3.1 Instrument Safety

The FLIR identiFINDER® R425 uses a scintillation crystal to detect gamma radiation.

Scintillation detector crystals are extremely brittle. Handle the instrument with utmost care, and never drop it.

Scintillation detector crystals may fracture when exposed to rapid temperature changes. The instrument should NOT be exposed to a sudden jump in temperature of more than 30 °C (54 °F). This should be considered if the instrument is being transported in a vehicle with a climate control system in regions where extremely high or low temperatures may occur.

1.4 Unit Overview

The R425 is a Linux-based microcomputer, with dedicated sensors for gamma radiation detection (and neutron detection, for neutron-equipped models). The R425 also has some auxiliary sensors such as a receiver for the NAVSTAR global positioning system (GPS).

All data acquired by the sensors are recorded, processed, and evaluated by a sophisticated software that discriminates innocent from threatening radiation even when operated by personnel with minimal

training. The instrument is both FCC- and CE- compliant, and does not require external devices for detection and analysis. It is also ANSI N42.34 compliant and does not use an internal source for calibration.

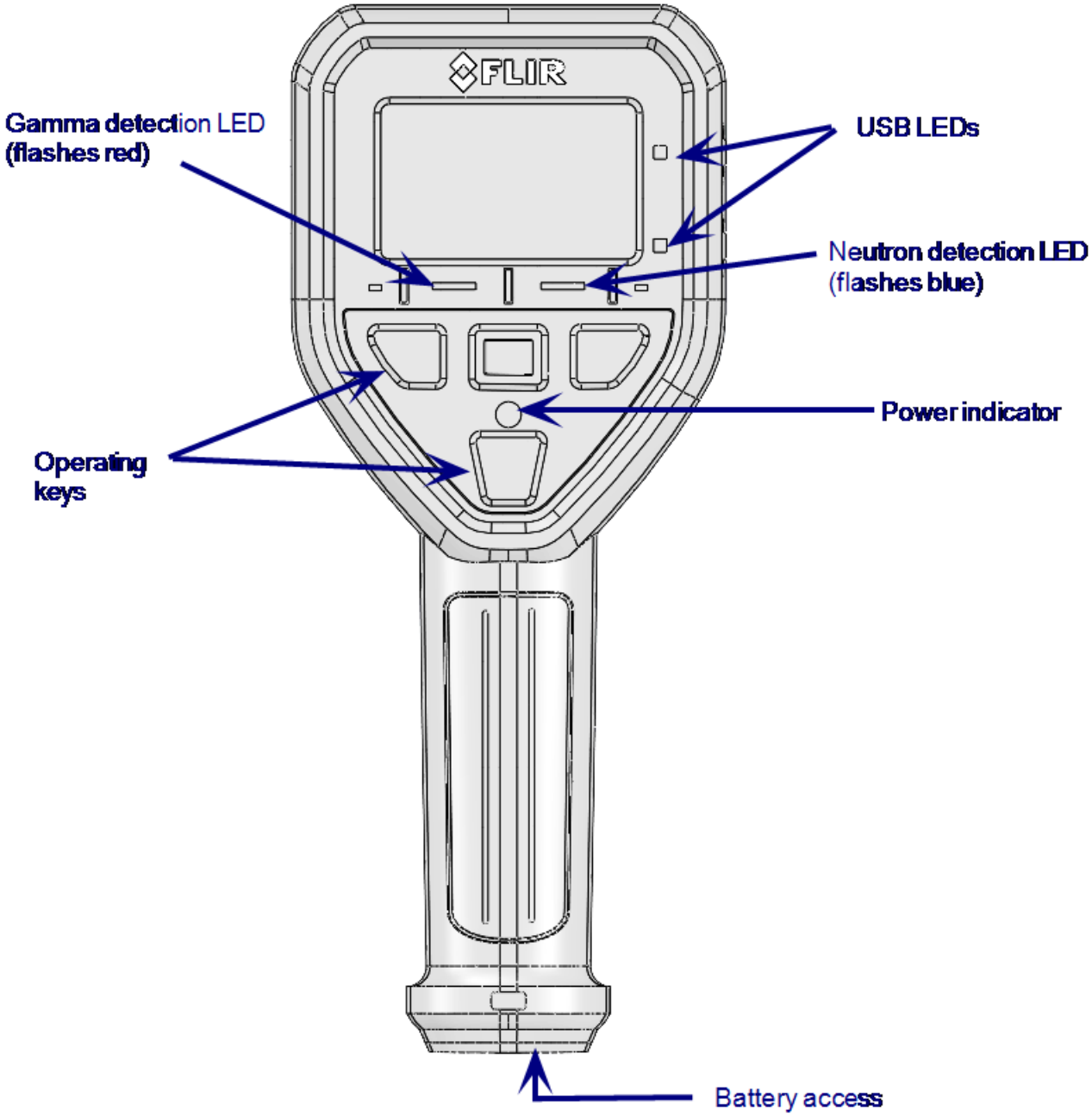


Figure 1-1: Map of the identiFINDER R425 (front view)

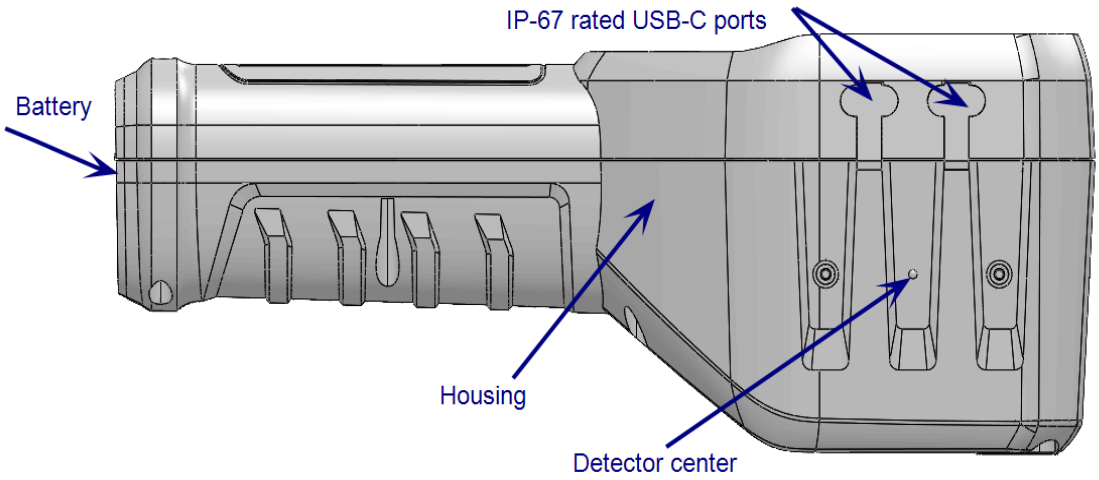


Figure 1-2: Map of the identiFINDER R425 (side view)

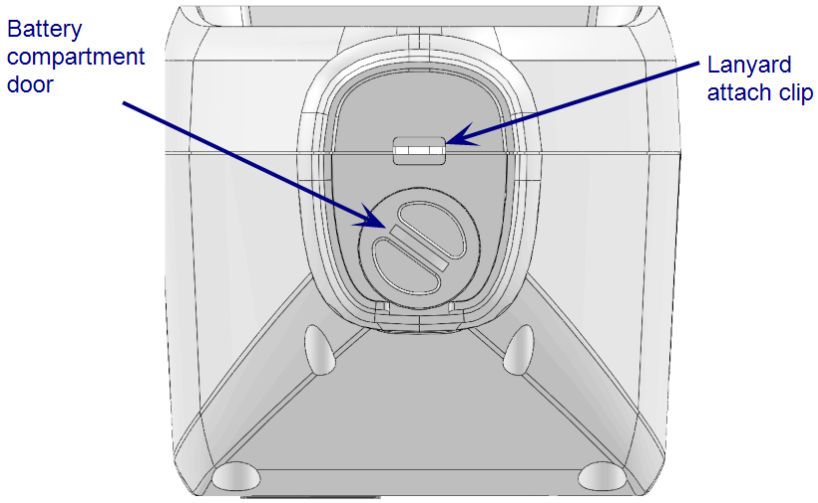


Figure 1-3: Map of the R425 (top view)

The identiFINDER R425 is rated IP67. The battery compartment (Figure 1-3) is isolated from internal components; however the CR123A / 16650 battery door needs to be installed and fully secured so the compartment will not require cleaning and drying after exposure. For more information, see "Replacing Batteries" on p. 151.

The two USB-C ports may be used to connect the identiFINDER R425 to an external computer for charging, mass storage, or displaying the web interface (Chapter 8).

The back panel of the R425 (Figure 1-4) is labeled with the model, variant and serial number of the device. You will need this information if you contact FLIR Detection Customer Support. See "B.3: Service and Support," p. 167.

FLIR labels are designed so that they remain affixed after normal decontamination procedures (water and mild, non-abrasive detergent).

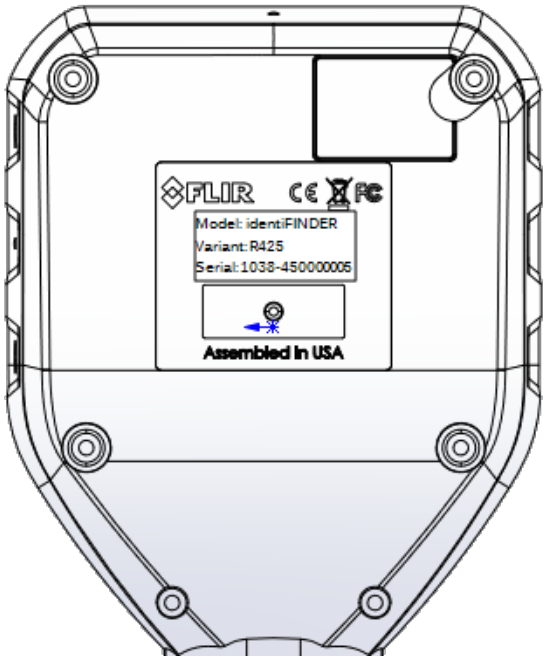


Figure 1-4: R425 back panel

1.5 Unpacking and Identifying Accessories

The R425 is available in two variants (see "A.1: identiFINDER R425 Specifications" on p. 154). Each variant comes with the set of accessories identified in Figure 1-5 and the list following.

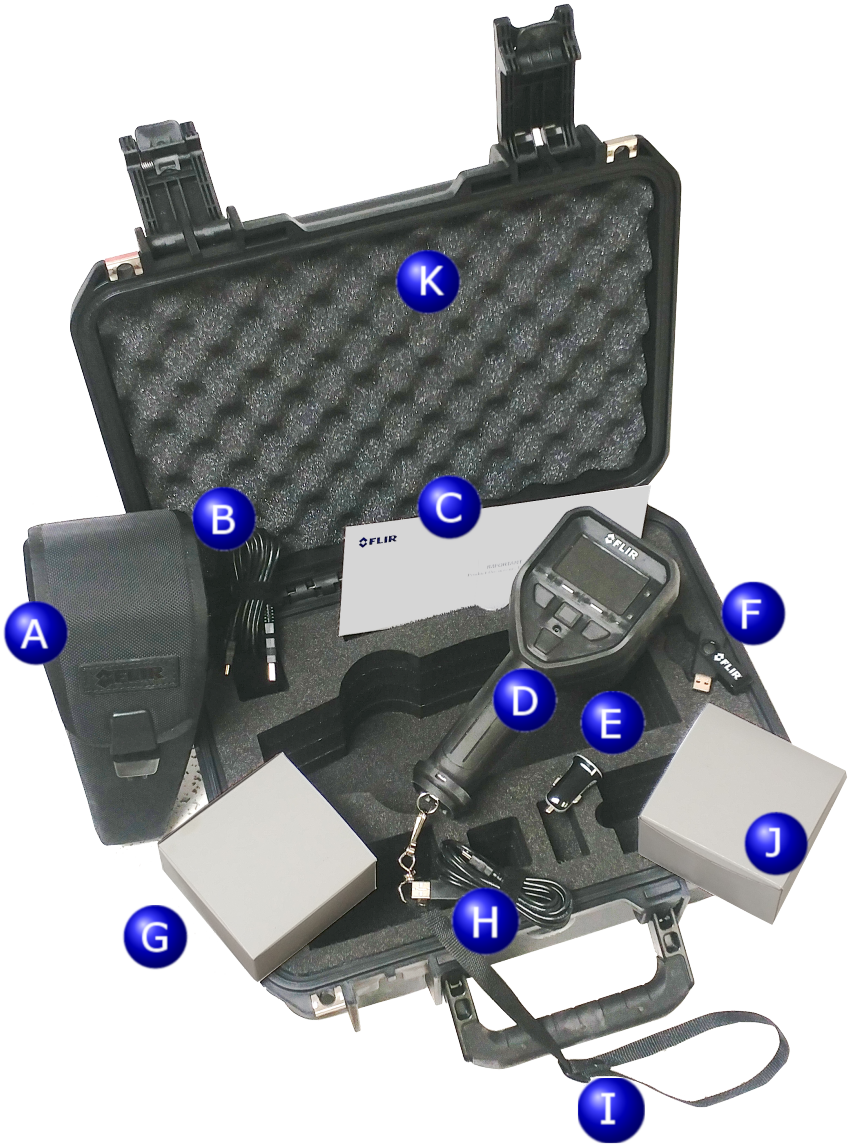


Figure 1-5: FLIR identiFINDER® R425 kit

A R425 Holster

B Data / charging cable

C	Information envelope / R425 Inspection report
D	FLIR identiFINDER® R425
E	12 volt to USB adapter (automotive (car) charger)
F	USB stick (including drivers and *User Manual*)
G	Device charging
H	Charging cable
I	Lanyard
J	External batteries, charging station; international power supply adapter kit
K	Carrying case and foam

Review the parts and components received. If you cannot locate a component, contact the appropriate support organization "B.3: Service and Support," p. 167.

1.6 Before First Use

Complete the following items before you begin to use the identiFINDER R425.

- Charge the battery of the identiFINDER R425.

The two CR123A batteries may be used as backup, but do not require charging.

- Take note of the serial number printed on the back of the detector (Figure 1-4). It is sometimes used to identify the device in a computer network.
- Read this manual and become familiar with the identiFINDER R425.
- Set the current time and time zone. See section 6.4.5, "Clock Settings" on p. 77 for more information.

2 Getting Started

This chapter describes basic operations of the identiFINDER R425.

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2.1 The R425 Display

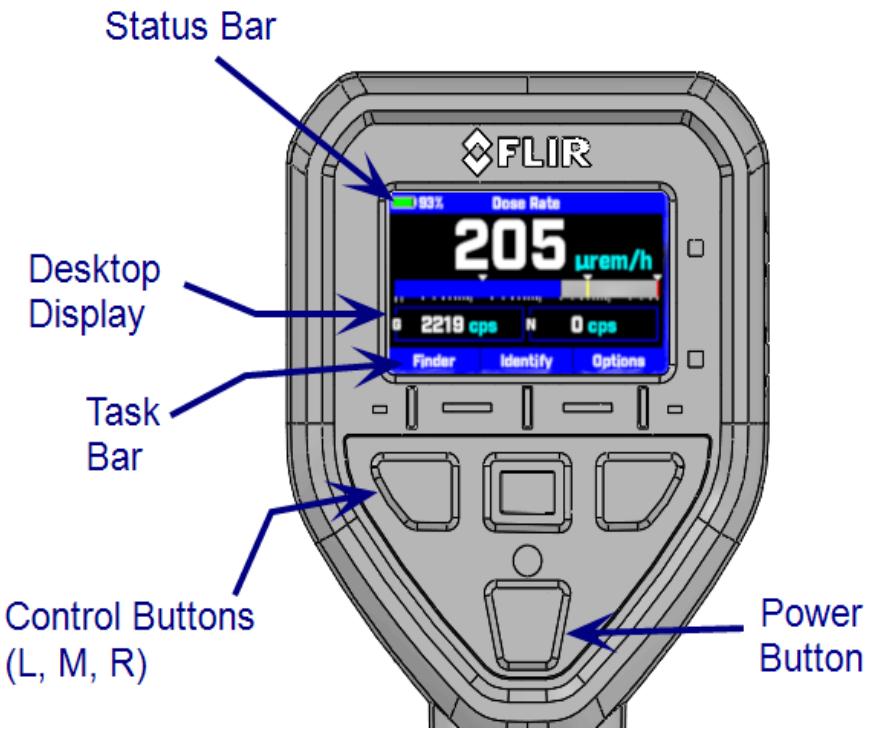


Figure 2-1: R425 display and keypad

The R425 display consists of a color LCD screen and LEDs between the keys. The R425 color LCD screen (Figure 2-1) is divided into three main areas:

2.1.1 TOP: Status Bar

The center of the *status bar* contains a brief title of the currently performed operation or the current mode the instrument is in. When a warning or an alarm is raised, the alarm information is shown in the status bar, alternating with the title.

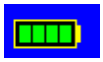
The *battery indicator* is located at the left side of the status bar.

The right side of the status bar displays the status of any active peripherals (Bluetooth, GPS) as well as the time.

For more information on status bar icons, see below.

2.1.1.1 Battery Indicator

The battery indicator displays in one of two differing icons: a "continuous drain" icon  indicates a rechargeable battery is installed in the unit, and a "segmented" icon  denotes the CR123a disposable batteries are installed.

Appearance	Meaning
	Full rechargeable battery
	Full disposable battery
	Rechargeable battery, plugged in and charging
	Rechargeable battery, partially drained
	Rechargeable battery, drained below 75%
	Empty battery

2.1.1.2 Current Time

The current time is displayed on the right of the status bar as hours (24-hour notation, or 12 depending on user's preference and setting) and minutes.

The time is supplied by the clock built into the R425. It uses UTC for internal purposes and for time-stamping records saved in the database, for example, spectra or identification results. For correct values, ensure the correct setting of the clock and the correct specification of the local time zone where the instrument will be used. The correct time and date can be set using the GPS receiver built into the R425. If it is

switched on (and dependent on user-preference settings), the clock is updated to the high-precision UTC time received from the GPS satellites. All that must be specified is the local time zone in which the instrument will be in service and the user-preference set to update each time the instrument connects to a satellite.

If the internal clock is completely off, for example after storing the instrument with empty batteries for a few months, then you will need to adjust the internal clock and specify the time zone. For more information, see 6.4.5 , p.77

2.1.1.3 GPS Receiver Status

A map location pin symbolizes the state of the GPS receiver.

GPS receiver is switched off (factory setting).

GPS receiver is switched on.

2.1.1.4 Password Protection

A locked padlock indicates that commands and settings are currently protected by a password. You can access the protected items after entering the password. See " Locking and Unlocking Functions" on p. 30.

Password protection is automatically restored when the instrument is switched off.

2.1.2 MIDDLE: Desktop

The contents of the *desktop* vary with the current operation of the R425. The desktop may show, for example, status information after power up, menus to choose commands from, the strength of the observed gamma radiation, or corresponding alarms.

2.1.2.1 Desktop Display

Dependent on the current application (mode), this area displays the current mode—Dose Rate, Finder, or Identify—and can also display other data, such as spectra or data entry fields and system status.

2.1.3 BOTTOM: Taskbar

The taskbar is divided into three sections. The commands on the left, middle, and right of the taskbar indicate the current function of the Left, Middle and Right buttons on the keypad. See Figure 2-4 in "The Keypad" on p. 22.

2.1.4 Brightness

The identiFINDER R425 display may be adjusted to ambient light or situation conditions. To change the screen brightness:

1. From the main menu, select **Device | Settings**.
2. Press Left to move the cursor down to select **Brightness**.
3. Edit the percentage value in the Brightness field.

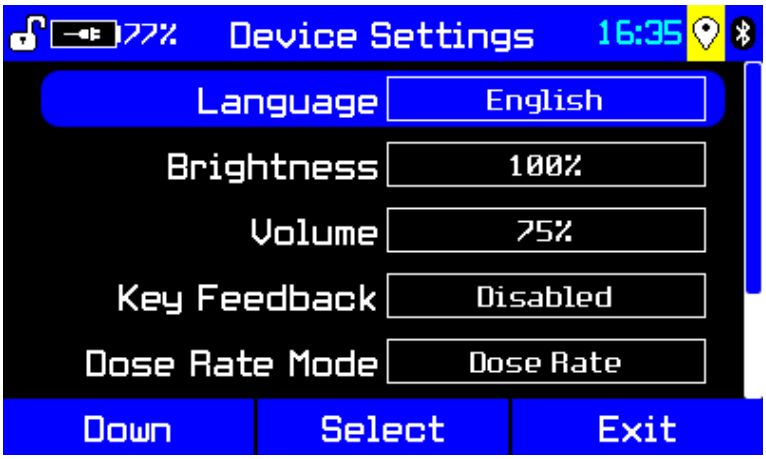


Figure 2-2: Changing display settings

The same may also be accomplished in the web interface via the **General Settings | User Interface** page.

2.2 The Keypad

The identiFINDER R425 is controlled by a simple four-button keypad (Figure 2-3). These keys can be operated with your thumb while holding the instrument.

Pressing a key makes a feedback sound, which can be switched off (see 6.4.1 , p.70).

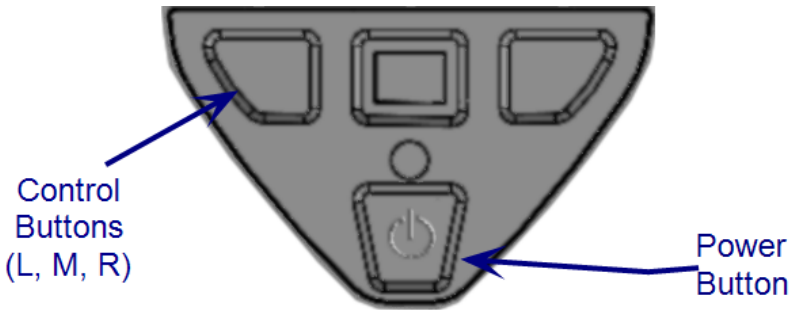


Figure 2-3: The R425 keypad

The single key at the bottom () is the Power key . It is used to switch the instrument on and off and can be used alone or in combination with another key to perform certain other functions.

The three upper buttons on the keypad, labeled **L**, **M**, and **R** (Left, Middle, and Right) correspond to commands on the *taskbar* (see p. 19). The Left, Middle, and Right buttons perform the operations indicated by the left, middle, and right commands on the taskbar. For example, in Figure 2-4:

- Press **L** to change to Finder mode (4.2 on page 57).
- Press **M** to change to Identify mode (4.3 on page 59).
- Press **R** (**Options**) to display the Main Menu.

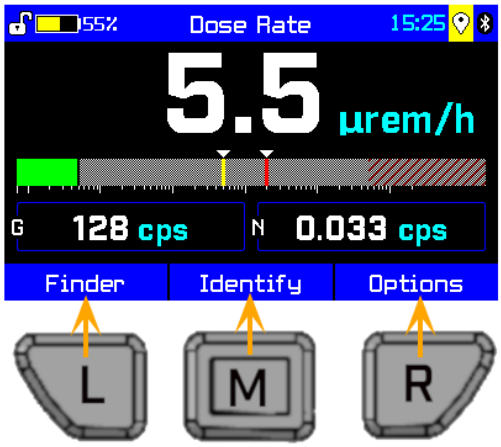


Figure 2-4: Key functions on R425 Home screen (Dose Rate mode)

The commands performed by the Left, Middle, and Right buttons will change depending on which screen is displayed on the R425 and which operations are available. For more information, see 2.6.1 on page 32.

2.2.1 Status LEDs

Several LED lights on the identiFINDER R425 indicate various statuses:

Green indicates that the instrument is powered.

Red indicates dose and dose rate alarms.

For models equipped with neutron detection, **Blue** indicates neutron alarms.

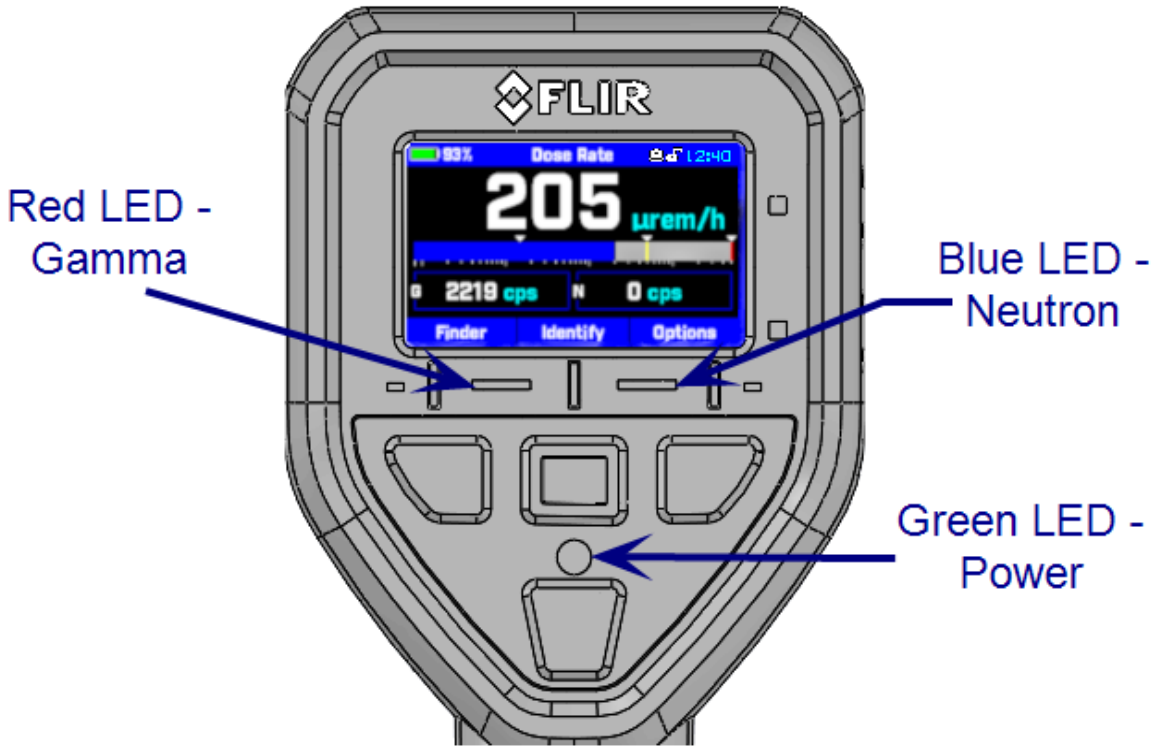


Figure 2-5: LED descriptions

2.3 Starting the R425

1. Ensure that the instrument is clean and free of visible damage.
2. Ensure the battery is charged.
3. Press the Power button briefly until the backlight appears on the display. The green status LED (see p. 23) flashes as an additional indicator that the machine is starting.
4. Release the Power button.
5. Wait a moment until the R425:
   - displays the splash (logo) screen (Figure 2-6)
   - runs through start-up procedures

- initializes the software

Figure 2-6: Powering up the R425: Product identification

When software initialization is complete, the R425 home screen (Figure 2-6) appears, in Dose Rate mode (see 4.1 on page 55).

6. Look at the status bar to verify that the instrument is sufficiently powered (2.1.1 on page 20) and that the time of day (2.1.1.2 on page 20) is correct.

If the time displayed on the status bar (p. 20) is incorrect, which is usually caused by the battery pack being empty for an extended period of time, you will need to set the clock (see section 6.4.5, "Clock Settings" on p. 77).

If the R425 malfunctions or freezes on startup, press and hold the Power button for approximately 20-30 seconds to force a hard shutdown, then attempt to restart.

For more detailed battery information, select **Device | Battery Status** to display the Battery Status screen.

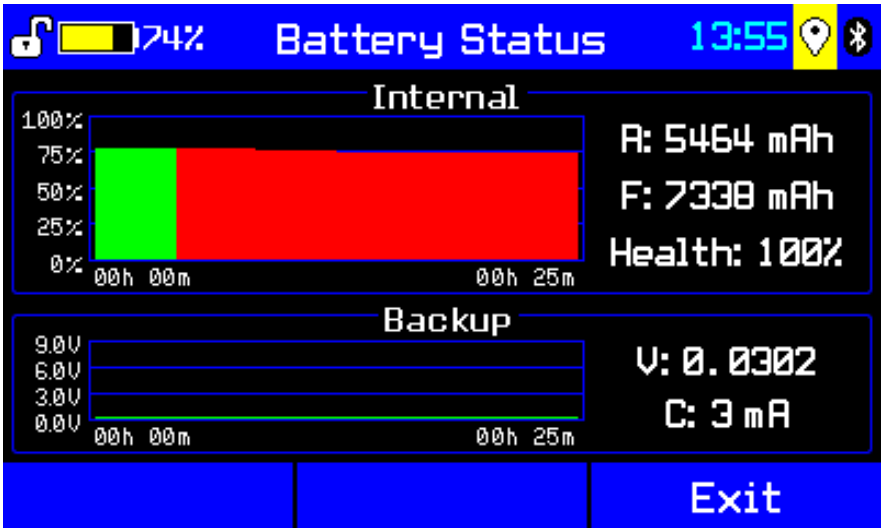


Figure 2-7: Battery Status screen

The identiFINDER R425 is now ready for use (Figure 2-8).

- To continue learning about basic operations, proceed to Section 2.4, "Choosing from Menus."
- To get started using identiFINDER R425 to detect radiation, see Chapter 2.
- For a detailed description of the options on identiFINDER R425 menus, see Chapter 6.

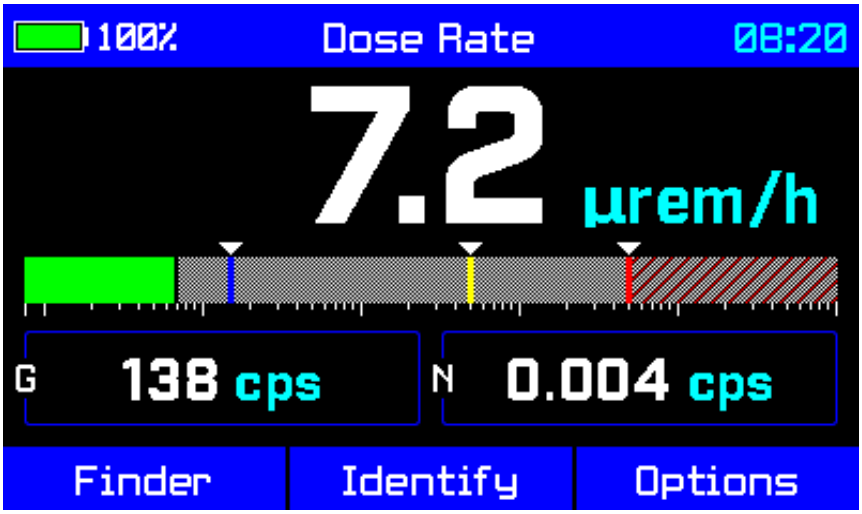


Figure 2-8: R425 home screen, Dose Rate mode

2.4 Choosing from Menus

To access most functions on the identiFINDER R425, you must select options from menus.

First, access the Main Menu by pressing **R** (**Options**) from the Home screen as described in Section 2.2, "The Keypad." The Main Menu and its key mappings are shown in Figure 2-10.

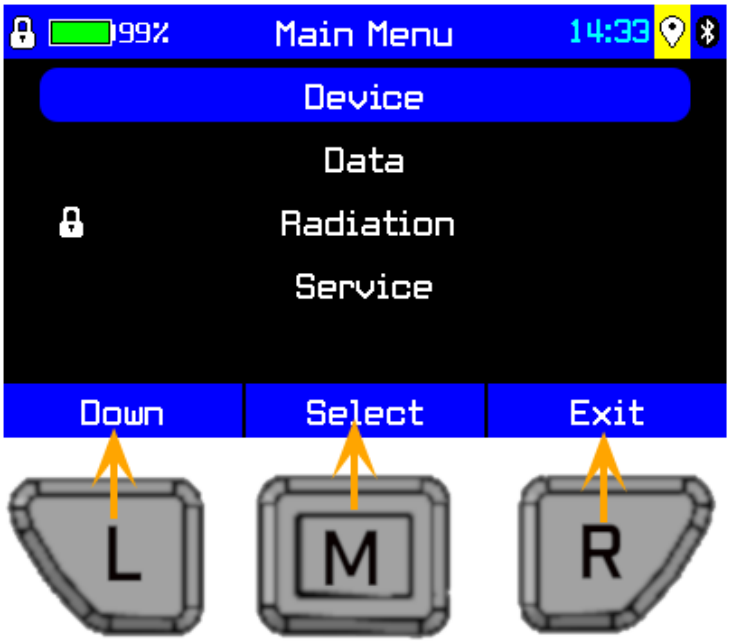


Figure 2-9: Main Menu

- Press **L** (**Down**) to move the cursor (blue highlight) down the list to highlight the option you want. When you press **L** from the bottom of the menu, the cursor goes back to the top.
- Press **M** (**Select**) to display or edit the currently highlighted option—in Figure 2-9, to display the Device menu.
- Press **R**(**Exit**) to exit the current screen and display the screen you accessed the current screen from. In this example, pressing **R** returns you to the Home screen ("The R425 Display" on p. 19).

If a padlock icon appears beside a menu option, such as the Radiation option in Figure 2-9, you need to enter a password (2.5.1 on the next page) to access the option.

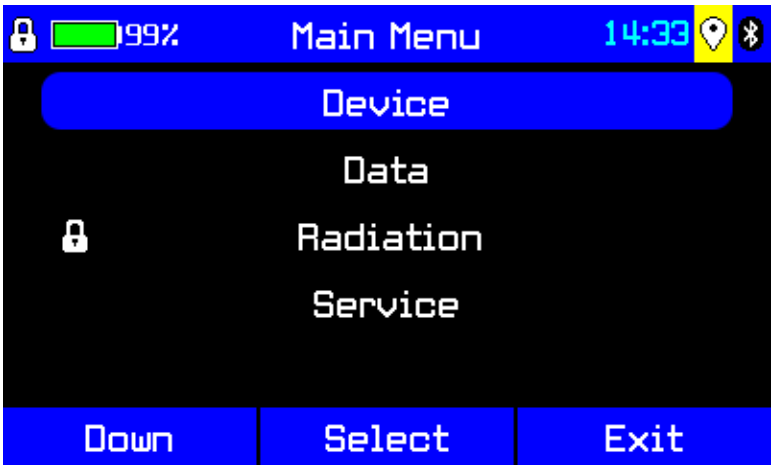


Figure 2-10: Main Menu

2.4.1 Scrolling in Menus

When a menu offers more options than the five fitting on the screen. a scroll bar appears on the right side of the screen, as shown in Figure 2-11.

When you reach the last option on the screen, continue pressing **L** (**Down**) to display more options. Press **R** (**Exit**) to go back to the top of the menu.

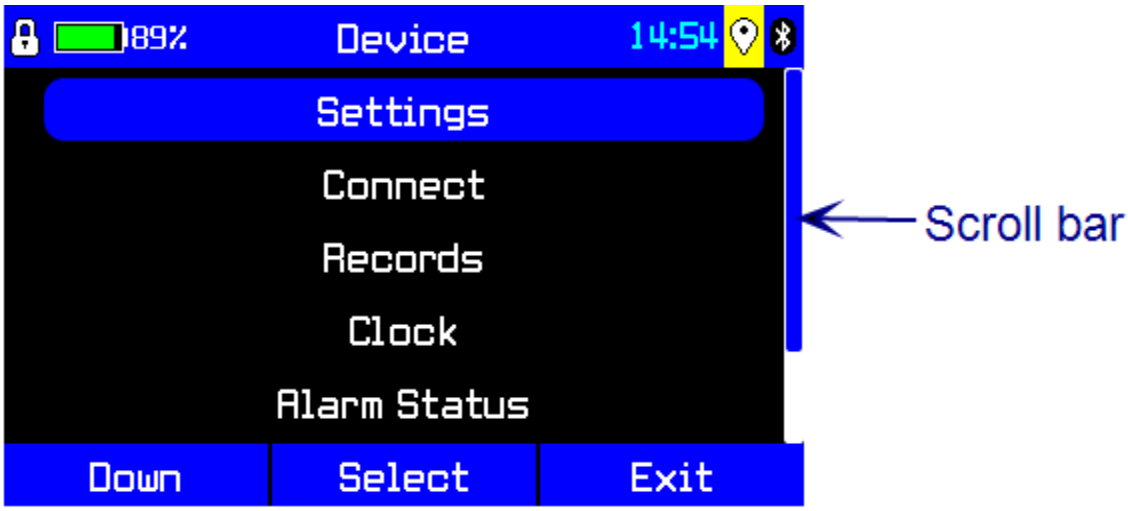


Figure 2-11: Menu with scroll bar

2.5 Locking and Unlocking Functions

2.5.1 Entering the password

A closed padlock ( ) in the status bar (2.1.1.4 , p.21) or beside a menu item (Figure 2-9, p.28) indicates that the identiFINDER R425 is password-protected. If the instrument is password-protected, you must enter the password before accessing the locked functions.

The password is a combination of keystrokes using the Left, Middle, and Right buttons. The factory default password is L M R L M R L.

For greater security, change the password (6.6.4.1 on page 104).

For quicker access to functions, you can remove the password.

Procedure

1. Enter the password by seven presses in the correct sequence: Left, Middle, Right, Left, Middle, Right, Left.
2. After the seventh press, a confirmation message appears on the screen. Press **R** (**Exit**) to dismiss the message and return to the screen you were in before being prompted for the password. The padlock icon changes to shown the instrument is unlocked ( ).

To cancel password entry during entry, press the Power button briefly. Do not hold the button too long or you will shut down the instrument.

After entering the correct password, you will not need to enter it again until the instrument is re-locked or re-started.

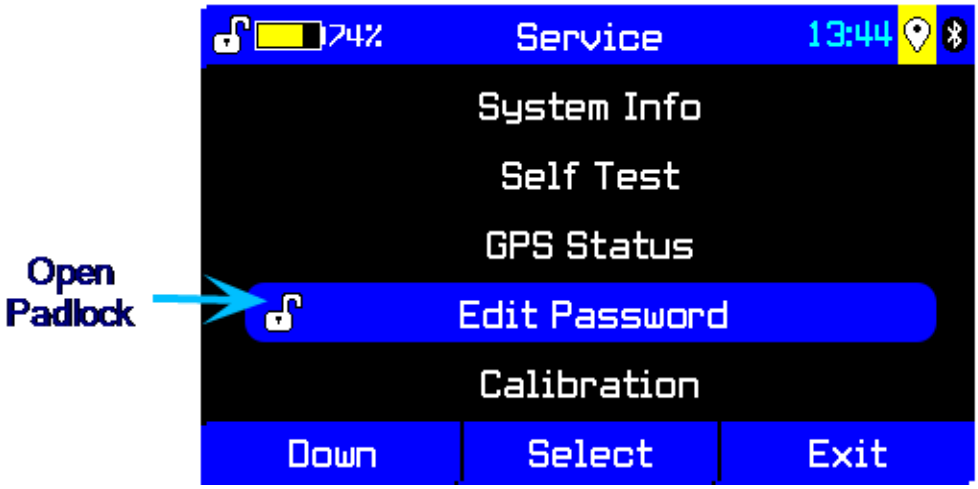


Figure 2-12: Edit Password option, unlocked

2.5.2 Locking the R425

The identiFINDER R425 can be re-locked by cycling power, or pressing the power button and right button simultaneously:

1. Press and hold the Power button.
2. While holding the Power button, press **R**.

Do not wait too long after pressing Power to press **R**, since holding down the Power button shuts down the R425.

2.5.3 Changing or clearing a password

To change a password, select **Service | Edit Password | Change Password** and follow the prompts (Figure 2-13).

To remove the password, select **Service | Edit Password | Clear Password**.

Figure 2-13: Changing or clearing a password

2.6 Changing Settings

2.6.1 Key mapping

Several different sets of taskbar commands become available when you have selected a value for editing. (See Figure 2-15, Figure 2-17, Figure 2-23 for some examples.) These commands are mapped to the **M** and **R** keys. When you have selected a value for editing, press **L** (**Skip**) repeatedly to cycle through the available sets of commands, changing the values mapped to the keys as shown in the table below.

M	R
Left	Right
+	-
Insert	Delete
Accept	Cancel

2.6.2 Selecting from lists

Many settings of the R425 require choices from a list of options.

To change a setting of this type:

1. Press **L** (**Down**) until the function you want is highlighted (Figure 2-14).

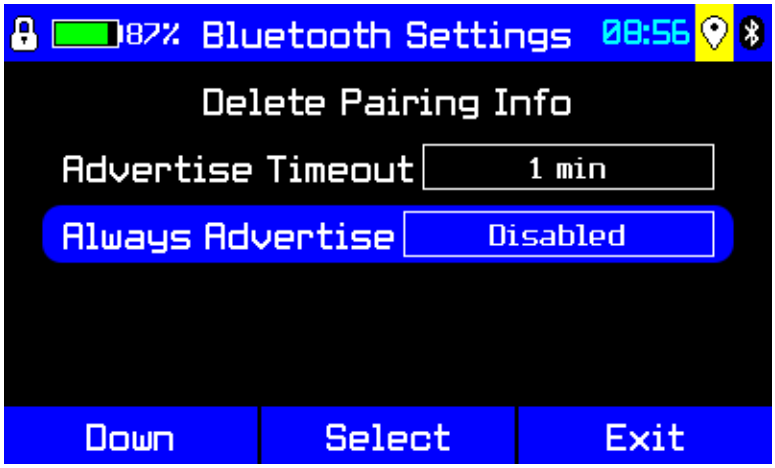


Figure 2-14: Selecting a value to change

2. Press **M** (**Select**) to display the highlighted setting.

   The color of the entry field changes and two arrows appear to indicate that there is a list of values to choose from (Figure 2-15). Note that the commands on the taskbar have also changed.

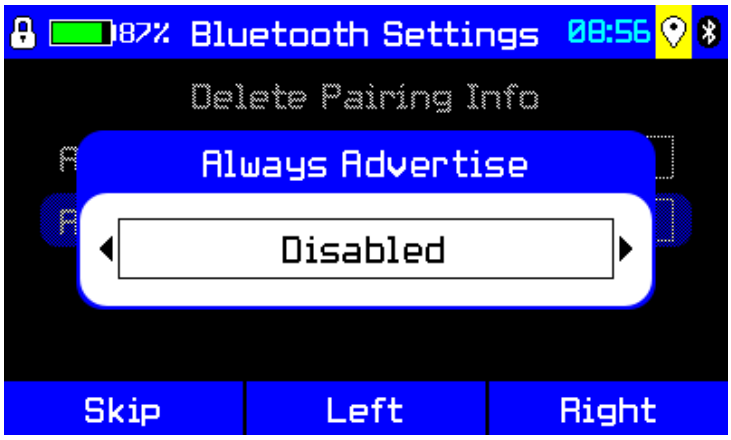


Figure 2-15: Adjusting a value

3. Move to the next item in the list by pressing **R** (**Right**) or to the previous one by pressing **M** (**Left**).
4. After editing all components that you want to change, press**L** (**Skip**), multiple times if necessary, until the **Accept** command appears in the middle position on the taskbar.
5. Press the **M** key to accept the new value and return to the original screen.

2.6.3 Canceling an edit

When an edit is in progress as shown in Figure 2-15, you can cancel it by using the following steps:

1. Press **L** (**Skip**) to change the commands on the taskbar to **Down**-**Select**-**Exit**.
2. Press **R** (**Exit**) to go back to the screen you were in when you began editing (see Figure 2-14), with the original value restored.

You can also cancel editing by briefly pressing the Power button. Do not press the button for too long, or you will turn off the R425.

2.6.4 Changing Numeric and Composite Values

Many screens, such as the Dose Rate Thresholds screen (Figure 2-16), are *composite values* containing multiple fields, often for digits.

Follow the steps below to edit a composite value. These steps begin at the point when you have already selected and displayed the value you want to edit, as described in 2.6, steps 1-2.

1. Press **M** (**Left**) or **R** (**Right**) to select the part of the composite value that you want to edit (Figure 2-16).

If you are editing a numeric value, the rightmost (least significant) digit is highlighted first, by default.

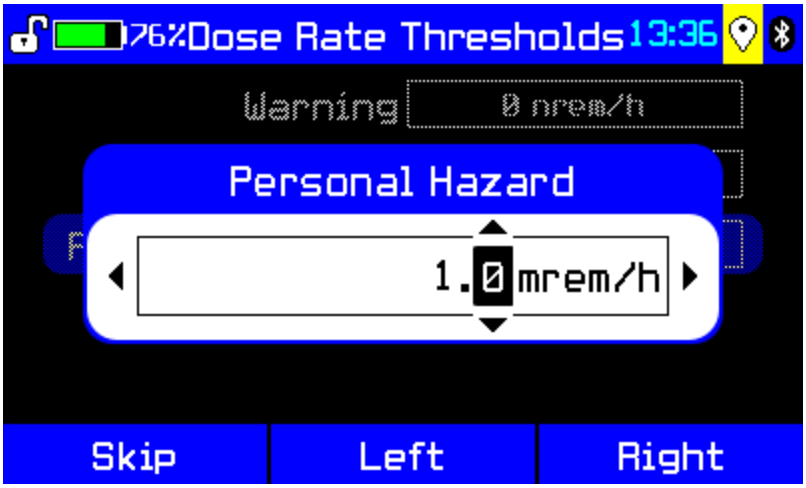


Figure 2-16: Component selected for editing

2. Press **L** (**Skip**) to change the middle and right commands on the taskbar to **+** and **-**.

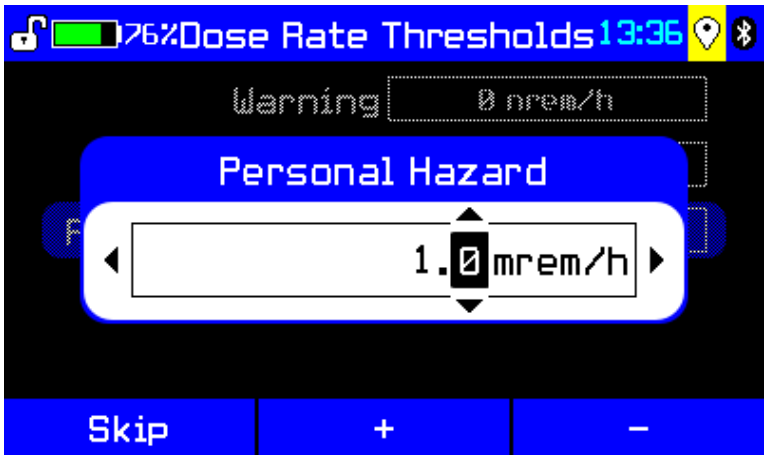


Figure 2-17: Changing the taskbar commands

3. Press **M**(**+**) to increase the value of the digit, or **R** (**-**) to decrease the value of the digit.
4. When the value you want appears, press **L** (**Skip**) until the **+** and **-** commands on the taskbar change back to (**Left**) and **Right**.
5. Press **M** (**Left**) or **R** (**Right**) to select the next digit you want to change (Figure 2-18)

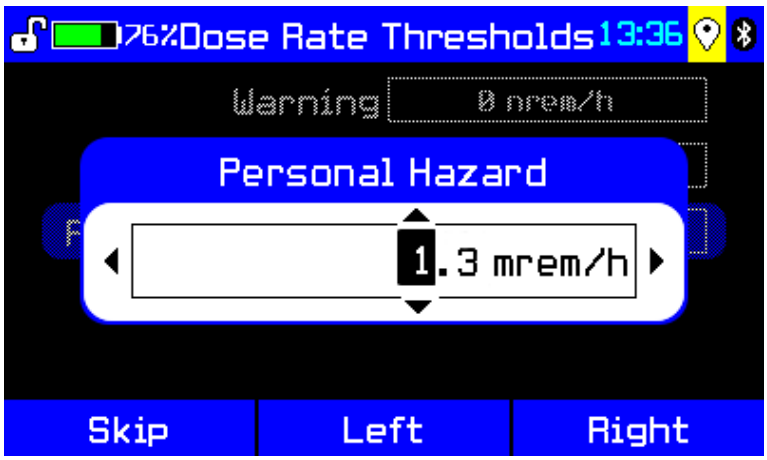


Figure 2-18: Selecting a new component for editing

6. Repeat steps 2-5 until you have finished editing.
7. After editing all components that you want to change, press**L** (**Skip**), multiple times if necessary, until the **Accept** command is available.

8. Press the **M** key to accept the new value and return to the original screen (Dose Rate Thresholds in this example; see Figure 2-19).

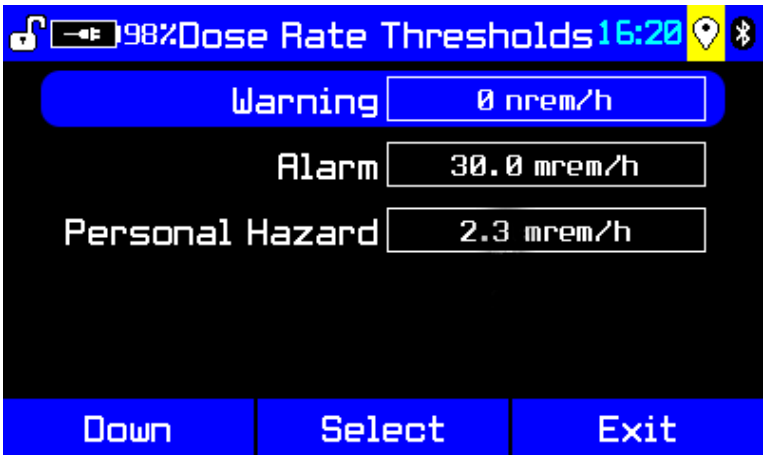


Figure 2-19: New value accepted

To cancel editing, see "Canceling an edit" on p. 33.

2.6.5 Editing Text

Sometimes you need to enter text in the identiFINDER R425, such as the operator's name, phone numbers, or settings for Bluetooth communication.

Entering and editing text with the R425's limited number of keys is similar to editing composite values as described in 2.6.4, with every character being a component.

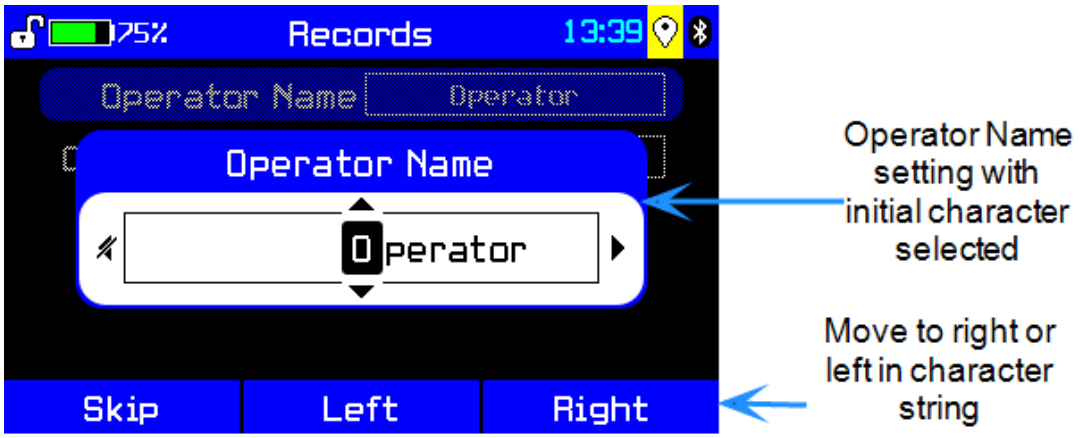


Figure 2-20: Editing text

By default, the leftmost character is selected first (Figure 2-20). For the selected character, use the **+** and **-** commands and to cycle through the available characters.

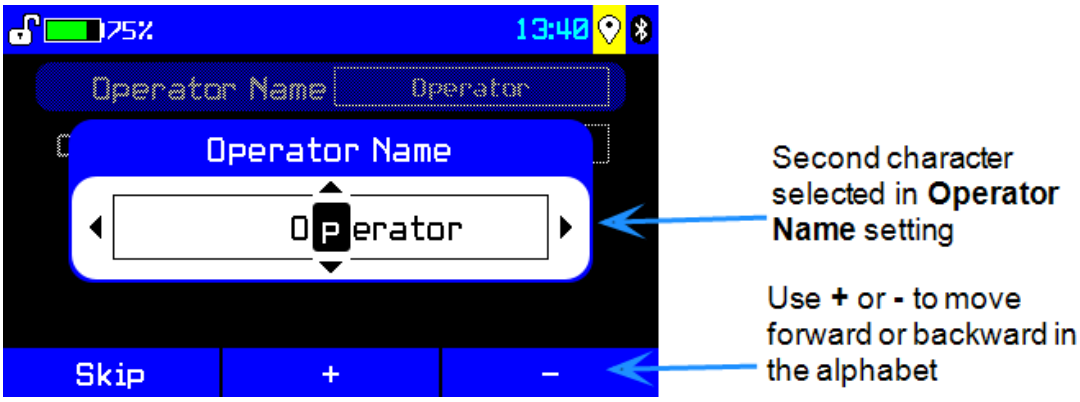


Figure 2-21: Editing text: Next character to the right is selected

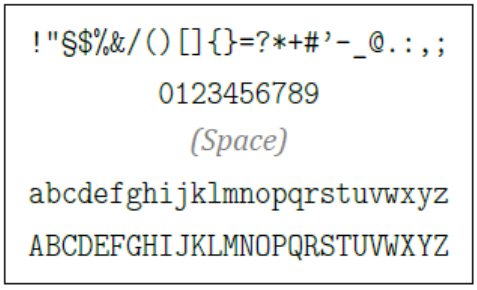


Figure 2-22: Editing text: Set of available characters

To select a different character for editing, press **M** (**Left**) or **R** (**Right**).

At the right end of the text, **Right** moves to two additional characters—spaces—to allow you to add another word to the text.

At the left end of the text, **Left** command no longer functions.

Use the web interface (seeChapter 8) to enter international characters like æ, î, ö, ñ, ß, etc.

2.6.5.1 Deleting and inserting text

To delete the selected character, press **R** (**Delete**). The characters from the selected one to the end of the text will be moved towards the beginning to fill the gap.

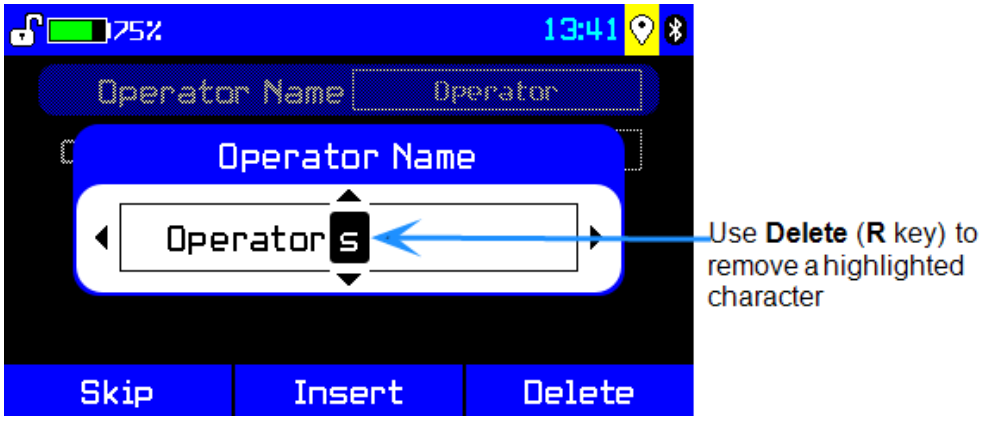


Figure 2-23: Editing text: About to delete the selected character

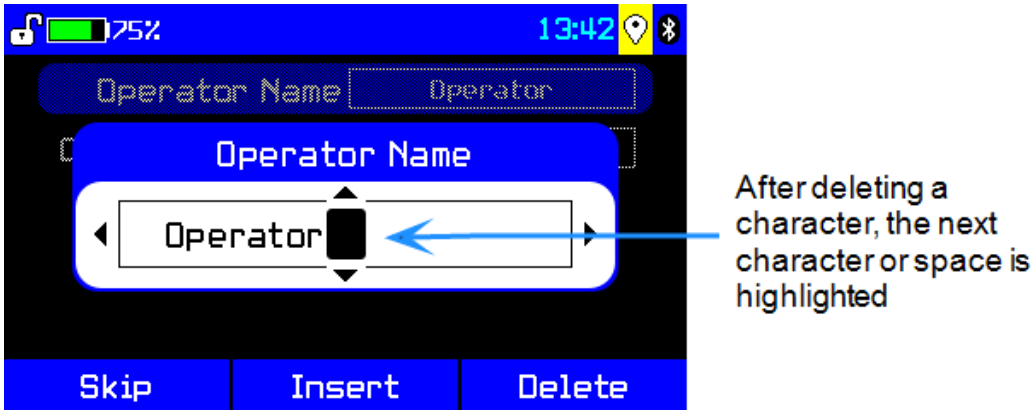


Figure 2-24: Editing text: After deleting a character, the next character is selected

To insert a character before the currently selected character, press **L** (**Insert**):

- If you select a character and use **Insert**, existing characters, including the selected one, are pushed one position towards the end of the text.
- If you select a blank space and use **Insert** (Figure 2-25: L), the blank space will be filled (Figure 2-25: R).

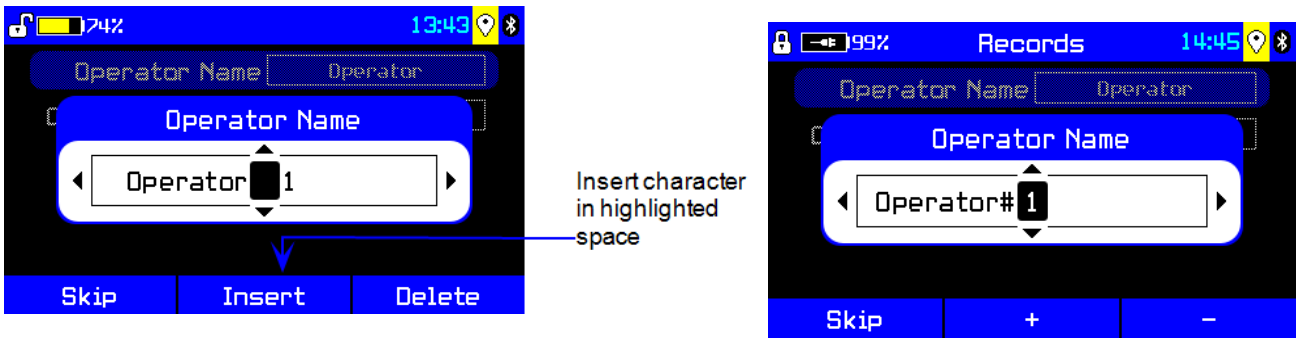


Figure 2-25: Inserting a character in a blank space

2.6.5.2 Accepting a text edit

To accept your changes, after editing the text is finished:

1. Press **L** (**Skip**) until the **Accept** command displays in the middle position on the taskbar.
2. Press **M** to accept the changes.

To cancel editing, see Section 2.6.3, "Canceling an edit."

When you accept an edit, any spaces at the start or end of the text are removed.

2.7 Taking Screenshots

You can save the contents of the identiFINDER R425's display at any time:

1. Press and hold the Power button.
2. Briefly press **L**.

Do not wait too long after pressing the Power button to press **L**, since holding the Power button down will turn off the .device.

Screenshots are saved in the R425's permanent memory as image files. To access the saved screenshots, connect the R425 to the web interface and select **Data | Screenshots** (see 8.4.3 on page 138). You can check the number of saved screenshots, download them, or erase them.

Screenshots may be useful if you need to contact FLIR Technical Support.

2.8 Low Power Conditions

If the display indicates low power conditions (Figure 2-26):

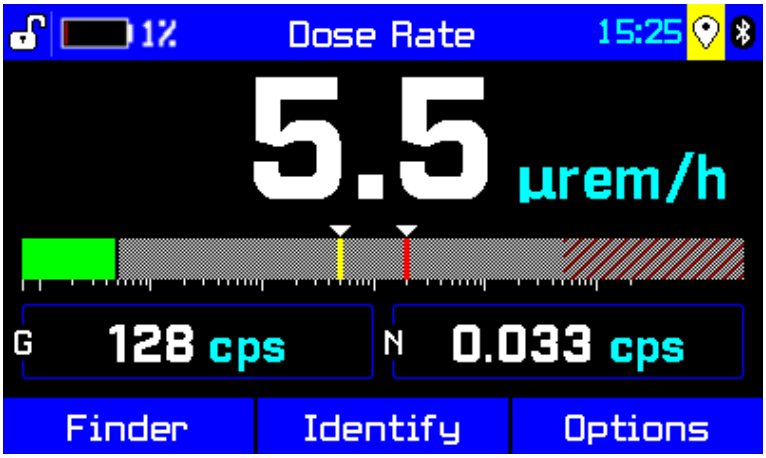


Figure 2-26: Dose Rate mode screen showing low battery condition

1. Shut down the instrument by pressing and holding the Power button (see 2.10 below).
2. Connect the R425 to an external power source (see Section 9.1, "External Power Sources."), or if using replaceable batteries, replace the batteries with fresh ones.

Use only FLIR-supplied rechargeable**16650** or PRIMARY **CR123a** batteries, or equivalent. Do **not** use rechargeable RCR123a type.

2.9 Resetting the R425

The R425 can be reset by performing a normal shut-down, start-up cycle:

All custom settings remain unchanged by this procedure.

1. Shut down the instrument by pressing and holding the Power button (2.10 below).
2. Start up the instrument (2.3 on page 24).

2.10 Shutting Down the R425

Several methods are available to shut down the identiFINDER R425.

To shut down the R425 during normal operations:

1. Press and hold the Power button.

   After a couple of seconds, the shut down screen displays (Figure 2-27).

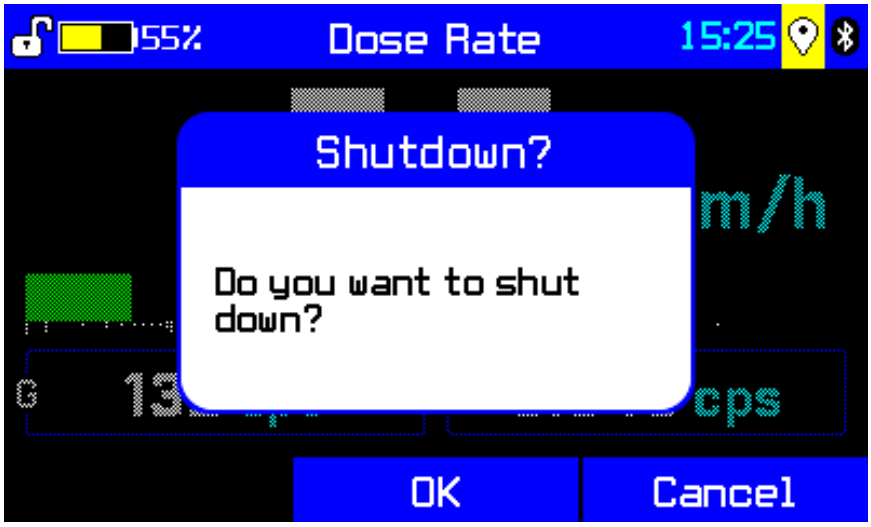


Figure 2-27: Shutting down the R425

2. Press **M** (**OK**) to confirm the shut down command.

From the shutdown prompt shown in Figure 2-27, you can press R to cancel the shutdown and resume normal operation.

If you are shutting down the identiFINDER R425 while an alarm is raised, the end time of the alarm entry is not stored in the database. Instead, the end time will reflect that the instrument was shut down before the end of the alarm.

To shut down the R425 in case of a software failure:

1. Press and hold Power for about 30 seconds. The R425 will initiate a shutdown.
2. At the prompt, press **M** (**OK**) to confirm, or **R** (**Cancel**) to continue using the instrument.

If tones are off, the beeper remains silent.

3 Operating the identiFINDER R425

This chapter provides a guide to the basic operating procedures necessary to scan an object for radiation and generate the analyzed results of the scan.

Your organization may use a Standard Operating Procedure (SOP). If so, refer to the SOP.

A typical application of the R425 is the survey of objects for radiation and to document the results of the survey. This process involves these fundamental steps (covered in the subsequent sections of this chapter):

1. Turn on and check the instrument.
2. Observe the dose rate in the environment to detect gamma radiation (p. 43).
3. Locate the source of the radiation (p. 47).
4. Identify the nuclides producing the gamma radiation (p. 48).
5. Transfer the results to a local computer for further processing (p. 52).
6. Turn off the instrument (p. 53).

Take time to become familiar with the names and positions of the R425 parts and general methods of operation before proceeding with this chapter. See especially section 1.4, "Unit Overview" on p. 12 and Chapter 2.

3.1 Power on and Check the Instrument

The following is a summary of the more detailed description of the startup procedure on p. 24.

1. Press the Power button briefly until the backlight appears on the display. The green status LED (see p. 23) flashes as an additional indicator that the machine is starting.
2. Release the Power button.
3. Wait for the identiFINDER R425 to complete its startup and software initialization processes. A series of screens will display. When the Dose Rate screen (Figure 3-1) appears on the display, the device is ready for operation.

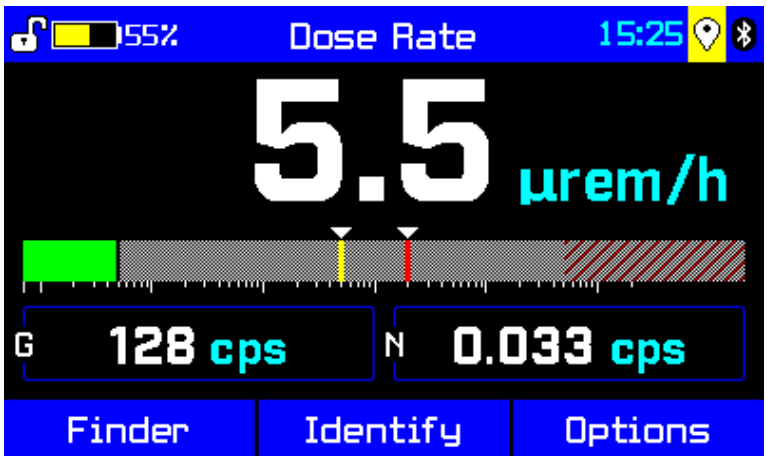


Figure 3-1: identiFINDER R425 home screen, Dose Rate mode

3.2 Observe the Environment

Dose Rate mode is the basic operation mode of the R425. See 4.1 on page 55 for a detailed description.

Once the identiFINDER R425 is booted, it will default to the Dose Rate screen (Figure 3-1).

3.2.1 Gamma Radiation Survey

Figure 3-2 : Surveying an object with the identiFINDER R425

To scan an area for gamma radiation:

1. Move the identiFINDER R425 to different locations in the environment under survey. Observe the display.

   The current dose rate is displayed in large digits and as a bar chart (Figure 3-3).

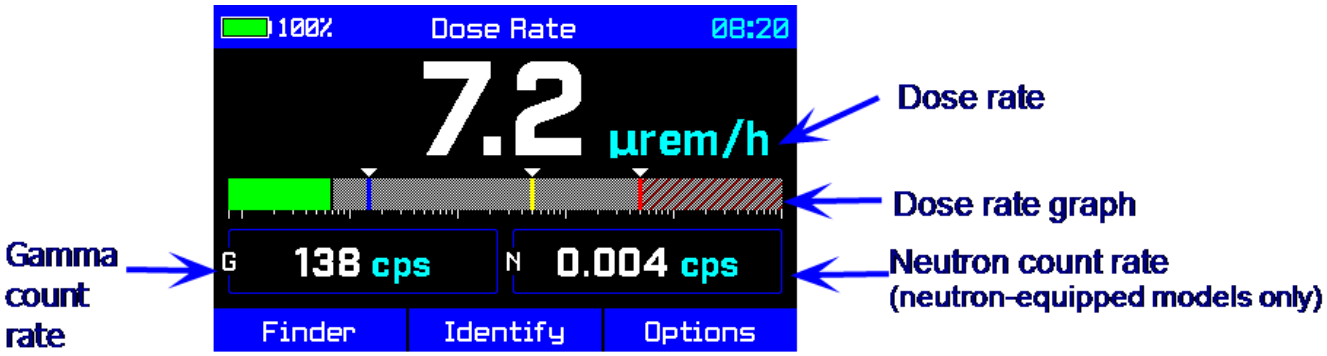


Figure 3-3: Dose Rate display

It is possible to change the dose rate unit (see "Dose Rate Settings," p. 95) and the warning and alarm thresholds (p. 92).

2. Control the instrument by pressing the keys with your thumb. The Left, Center, and Right buttons correspond to the commands on the left, center, and right of the taskbar as described in "The Keypad," p. 22.

The R425 continuously compares the radiation in the environment under survey to warning and alarm thresholds defined in the instrument's settings (6.5.4.1 on page 90; .6.5.4.3 on page 92). If the radiation exceeds one of the thresholds, the R425 initiates an alert (see p. 46). Depending on your settings, you may also be alerted by the red LED indicator (p. 23), beeping, and vibration. See 5 for details about these settings.

3.2.2 Neutron Radiation Survey

Available only for variants equipped with a neutron detector.

Surveying for neutron radiation is like surveying for gamma radiation, with the following modifications to the procedure:

1. When moving the identiFINDER R425 to different locations in the environment under survey (see p. 44, step 1), position the neutron detector close to your midsection as shown in Figure 3-4.

Figure 3-4: Optimum posture for neutron detection

2. Turn around 360 ° to detect neutrons from any direction.

For tests involving unmoderated neutron sources, a 30 cm × 30 cm × 15 cm PMMA phantom or equivalent must be placed between the source and the detector in the R425 ("A.2: Detector Positions" on p. 157) in order to provide adequate moderation of fast neutrons and to simulate the field operation instructions given here. In manned missions, the user's body acts as a moderator.

The R425 continuously compares the neutron radiation in the environment under survey to warning and alarm thresholds. If the radiation exceeds one of the thresholds, the R425 initiates an alert (see p. 46). Depending on your settings, you may also be alerted by the blue LED indicator (p. 23), beeping, and vibration. See 5 for details about these settings.

3.3 Respond to Alarms

If the radiation detected in your survey exceeds one of the thresholds defined in the identiFINDER R425's settings, the identiFINDER R425 initiates an alert. If popups are enabled in your alarm indicator settings (see section 6.5.4.5, "Alarm Indicators" on p. 95), the Alarm Status screen (Figure 3-5) will appear, displaying information about the warning or alarm condition.

You can also display the Alarm Status screen at any time, even if the R425 is not currently in a warning or alarm condition, by selecting **Device | Alarm Status**.

For more information on alarms, see Chapter 5.

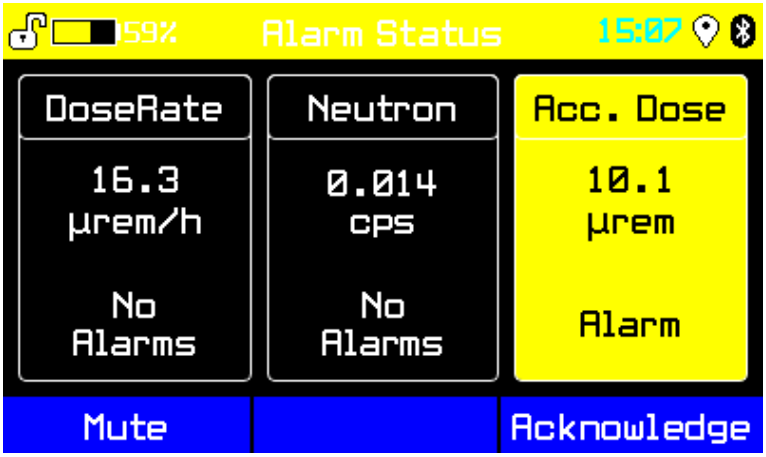


Figure 3-5: Alarm Status screen

From the Alarm Status screen:

- Press **L** (**Mute**)to silence alarm beeping and vibration.
- Press **R** (**Acknowledge**) to indicate awareness of the alarm or warning and dismiss the Alarm Status screen.

Warnings and alarms display in the status bar until the radiation drops below the set threshold. For more information, see "Dose Rate Thresholds" on p. 92.

3.4 Locate a Radiation Source

If your environmental observations indicate the presence of a radiation source, use the R425's Finder mode to determine the exact location of the source.

For more information on Finder mode, see "Finder Mode" on p. 57.

1. Press **L** from the Dose Rate mode screen to switch to Finder mode.
2. When you first enter Finder mode, a background scan will be performed to determine the background radiation in the area (Figure 3-6). Wait until the R425 finishes the background measurement.

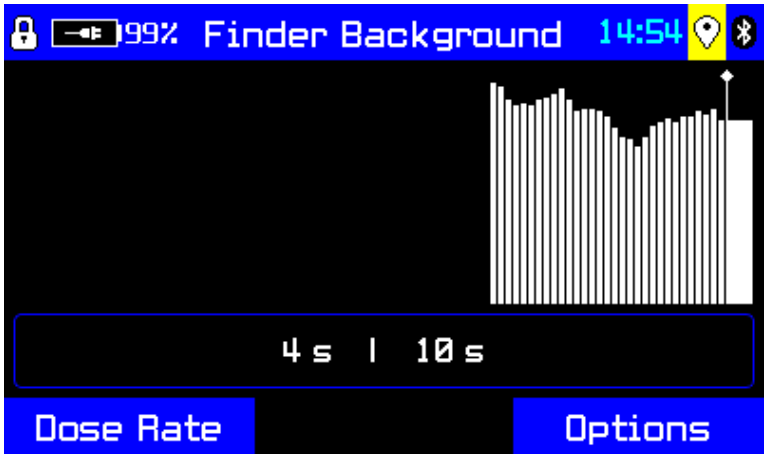


Figure 3-6: Finder mode: background scan

3. Move the instrument around to find the radiation source. Use audible indicators (beeps) and vibrations to help you look for the source while keeping your eyes on your path.

   The R425 averages the count rate for adjustable intervals. The device display acts as guide, but mainly the device helps you discover a radiation source by using sound, vibration, and flashing LEDs to indicate the presence of the source. As the R425 gets closer to the radiation source, the beeps, vibrations, and flashes get stronger and closer together.

From the Main Menu, select **Radiation | Alarm Settings** to control which types of indicators are available.

4. After the background measurement has finished, the Finder mode screen is displayed (Figure 3-7).
5. When activity of interest is observed, press **M** to switch to Identify mode (Figure 3-8).

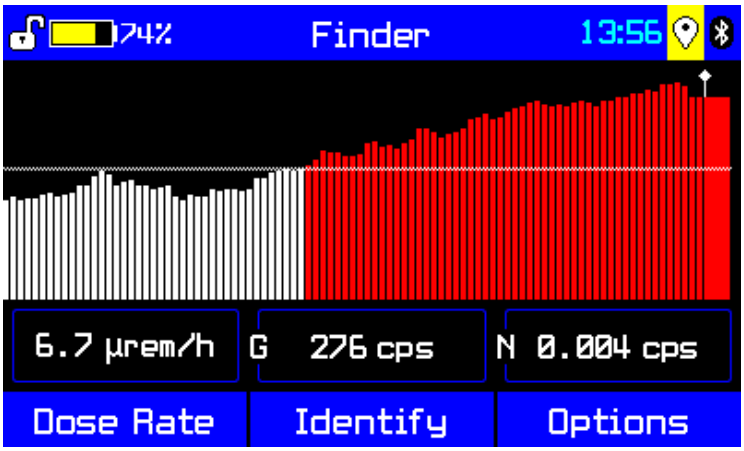


Figure 3-7: Finder mode: object scan with elevated radiation

3.5 Identify the Nuclide

The identiFINDER R425 can identify a number of nuclides by analyzing the radiation spectra they emit. After detecting a radiation source by surveying the ambient dose rate in Dose Rate mode (3.2) or by locating the source's position in Finder mode (3.4), use the R425's Identify mode to identify nuclide producing the radiation.

Use Identify mode to focus on the source, following on-screen directions until the results are displayed.

For more information about Identify mode, see 4.3 on page 59.

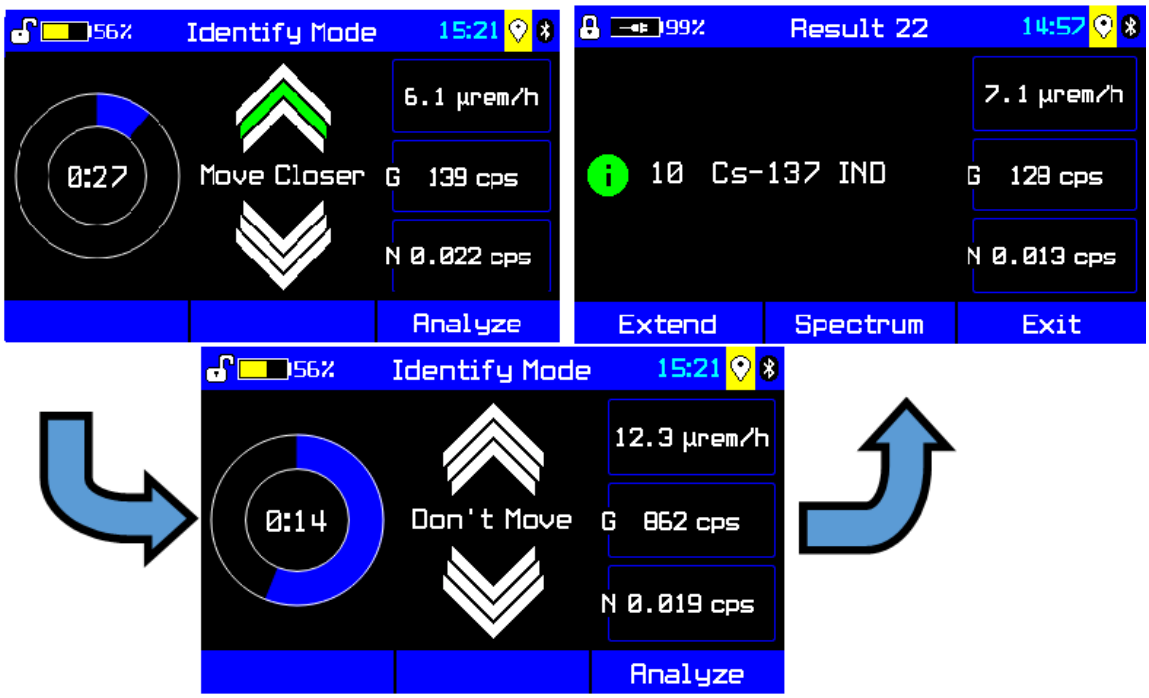


Figure 3-8: Using Identify mode

You can inspect the identiFINDER R425 Nuclide Library through the R425 web interface. You can also view and modify the nuclide library on the device itself by navigating to **Radiation | Nuclide Settings**.

To identify a source of radiation:

1. From the Dose Rate mode display, press **M** (**Identify**) to switch to Identify mode.
   The identiFINDER R425 begins to acquire a spectrum of the radiation.

   By default, identifications are performed in *static mode*, meaning there is a preset length of time for acquiring spectrum data. The instrument can also be set to *dynamic mode* (p. 86) to identify the spectrum using a minimum number of counts. For more information, see "Identify Settings" on p. 86.

2. Follow on-screen instructions (such as "Move Closer") that will place the R425 in the correct position for optimal data collection (Figure 3-9, top).

When you are in the correct position, the screen will display "Don't Move" (Figure 3-9, bottom).

Figure 3-9: Identify mode: Finding the position for best measurements

3. Wait until the identification has completed.

   The R425 applies the identification algorithm to the acquired data, and the Result screen (Figure 3-10) will display.

You can press **R** from the first Identify mode screen (Figure 3-8) to select **Analyze** and display the Result screen at any time, but the longer the elapsed time (in static mode; see above) or the higher the percentage complete (in dynamic mode, p. 86), the more data is collected, leading to a better result.

4. If necessary, press **L** (**Extend**) from the Result screen to acquire more spectrum data to improve the identification.

The R425 will acquire more data for an additional preset time interval (see "Identify Settings" on p. 86for information on the **Extended Time** setting).

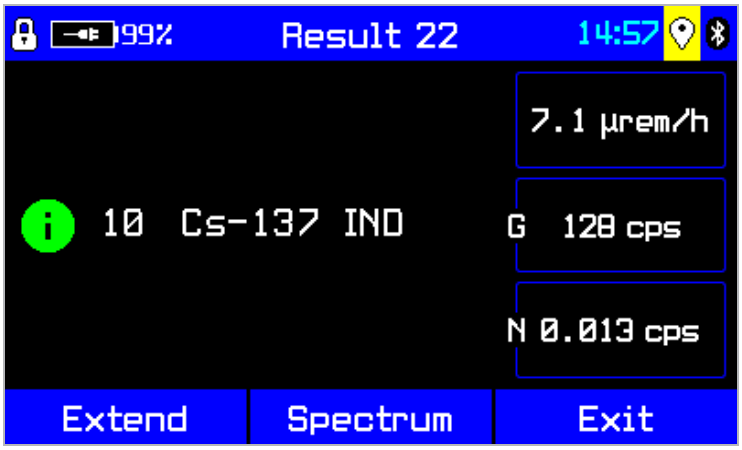


Figure 3-10: Identification results

5. Optional: You can inspect the spectrum used as the basis for identification by pressing **M** (**Spectrum**) from the Result screen. See "Saved Spectra" on p. 113 for information on the options and commands available for spectrum viewing.

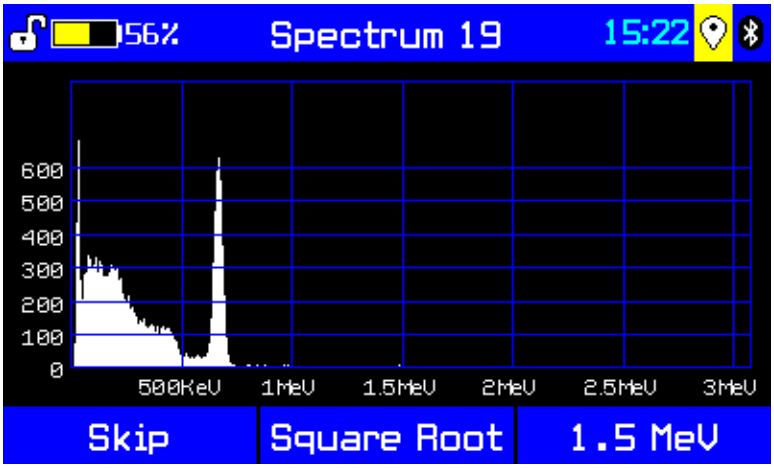


Figure 3-11: Viewing the acquired spectrum

3.6 Transfer Results to a Local Computer

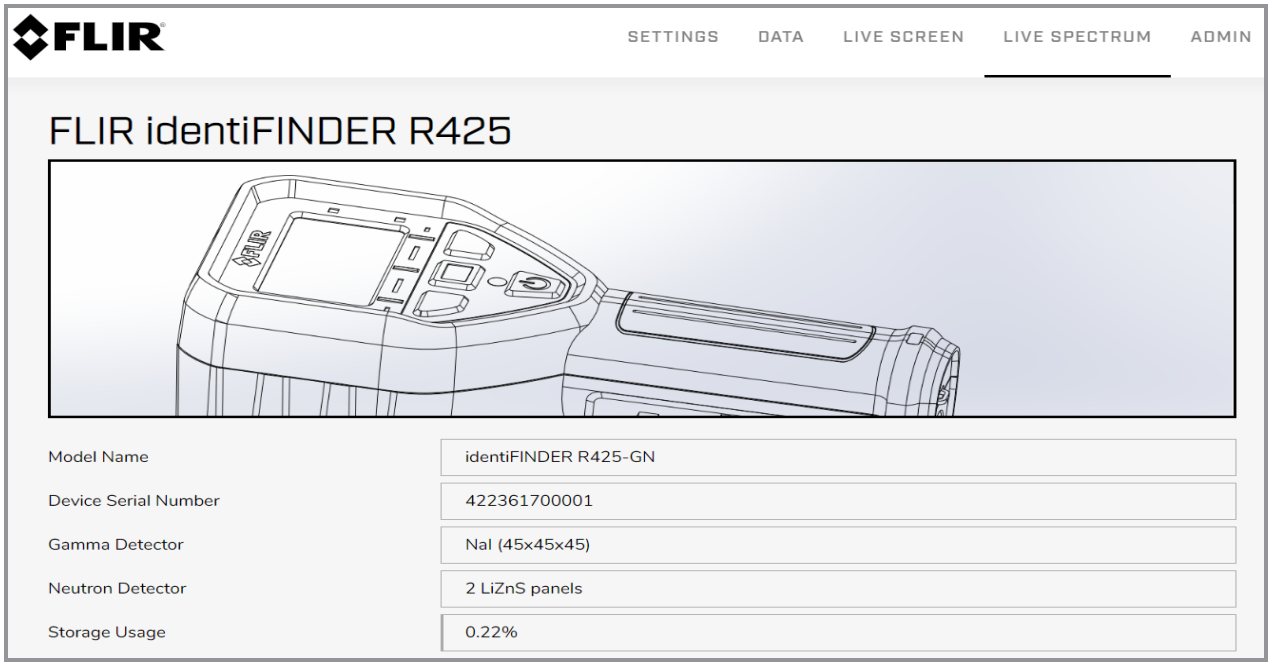


Figure 3-12: R425 Web interface home page

These instructions assume that the computer is correctly prepared. See "Connecting to an External Computer" on p. 123 or consult an IT administrator for help.

1. Connect the identiFINDER R425 to a computer with the included USB cable via one of the two USB ports on the device, as described in Chapter 7.
2. Open one of the following supported web browsers and navigate to http://r425.local to display the home page (Figure 3-12):
   - Microsoft® Internet Explorer® (IE), version 11 or above
   - Mozilla Firefox®
   - Google Chrome™
3. Follow the appropriate menu path to view the data you are interested in; for example, follow the path **Data |Spectra** to view the spectra records shown in Figure 3-13.
4. To help you look for the data you want, click the sorting button in one of the column titles (Figure 3-13).

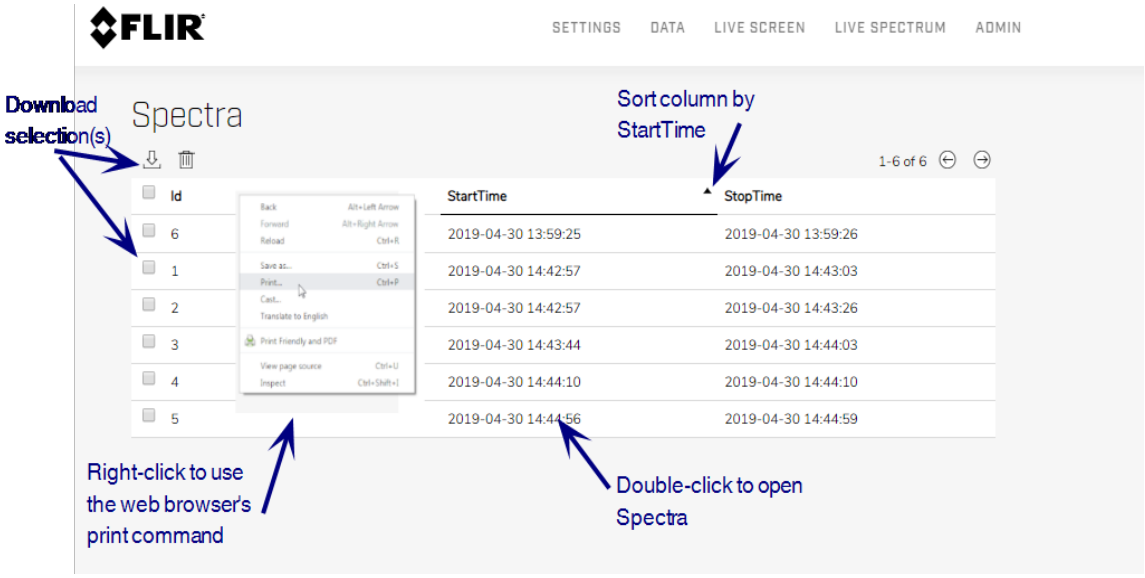


Figure 3-13: Spectra table sorted by Start Time

5. Once you have located the record you want, click the download icon to the left of the record and follow the instructions in your browser to download the associated file to the connected computer. You will be prompted to set parameters for the file such as the compression type and file type.

3.7 Switch Off

After completing all measurements, shut down the identiFINDER R425. Other scenarios for shutting down are described in "Shutting Down the R425" on p. 40. The basic shutdown procedure is:

1. Press and hold the Power button.
   After a couple of seconds, the shutdown screen displays.

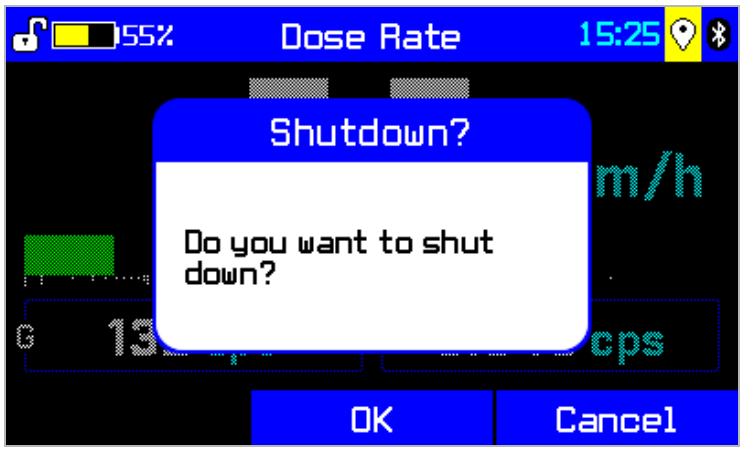


Figure 3-14: Shutting down the R425

2. Press **M** (**OK**) to confirm the shutdown command.

Store the R425 in its case when not in use.

4 Modes

This chapter provides more information on the R425's essential measuring modes, which were introduced in Chapter 3

4.1 Dose Rate Mode 55
4.2 Finder Mode 57
4.3 Identify Mode 59

4.1 Dose Rate Mode

The Dose Rate mode is the basic operation mode of the R425. It is activated after starting up the instrument.

The dose rate display (Figure 4-1) shows two representations of the gamma dose rate:

- **Analog:** A colored horizontal bar along a logarithmic axis ranging from 0 µSv/h to 1 mSv/h (0 mrem to 100 mrem) displays across the upper part of the screen.

  A vertical line marks the position of dose rate alarm threshold (see section 6.5.4.1, "Dose Thresholds" on p. 90 for information on setting the threshold). If the dose rate rises above the threshold, the color of the bar representing the current dose rate changes.

- **Digital:** Large digits and a dose rate unit of measure display in the center of the screen.

  The base unit of measure (rem or Sievert) is determined in the R425's settings. The unit is adjusted to the order of magnitude of the dose rate (micro(µ)-, milli(m), etc.).

The gamma dose rate is normally computed from the spectrum registered by the R425's scintillation crystal. Intense radiation hitting the crystal renders the registered data uninterpretable.

If the dose rate rises above the overload threshold (see "A.1: identiFINDER R425 Specifications" on p. 154), the instrument's results are unreliable. This condition is displayed on the screen (Figure 4-3).

You **must retreat immediately** from environments with radiation at a level that causes an overload condition on the identiFINDER R425.

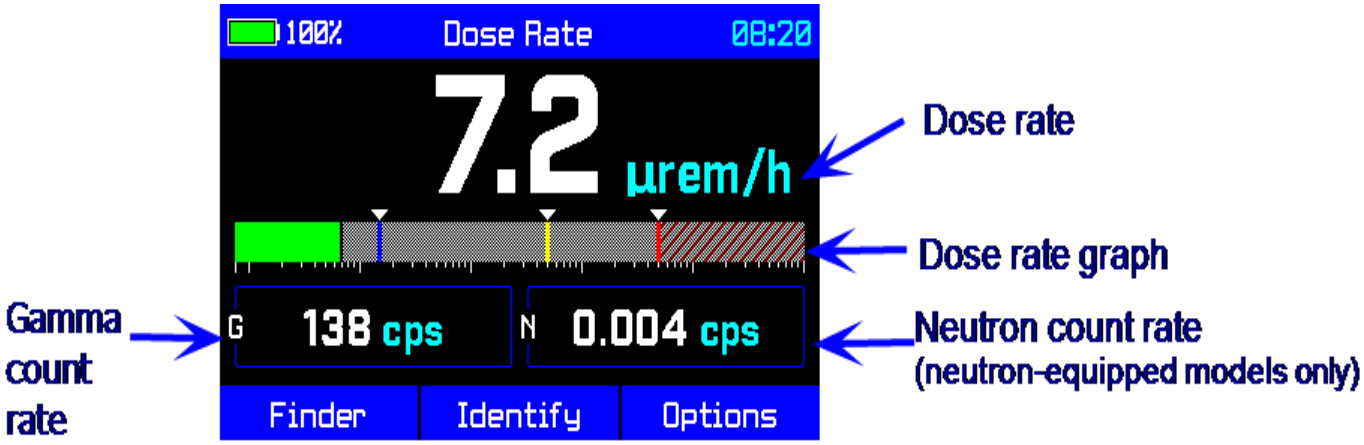


Figure 4-1: Dose Rate mode display

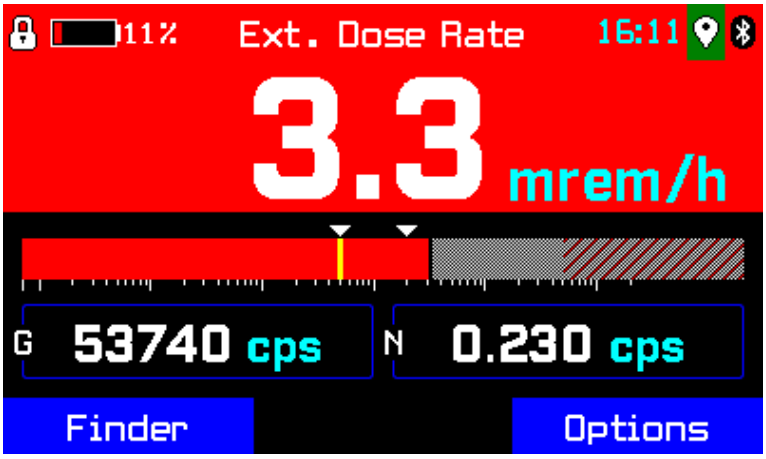


Figure 4-2: Extended Dose Rate mode

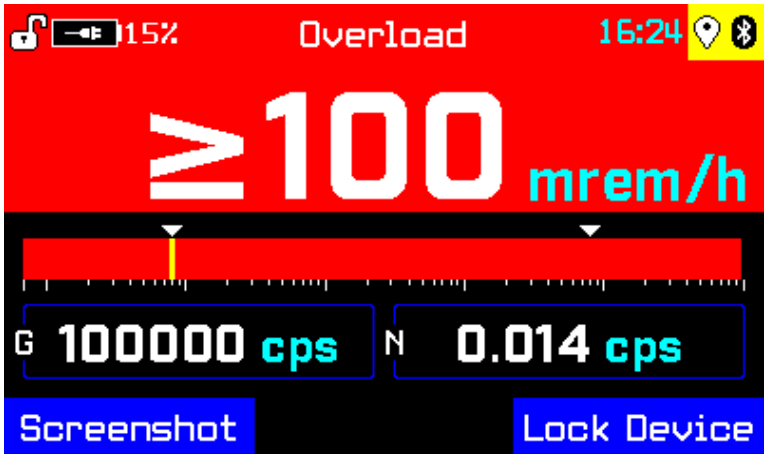


Figure 4-3: Dose Rate indicating detector overload

Settings and Commands -Dose Rate mode screens	
Alarms	Select this with the button to view the Alarm Status screen (p. 63).
Finder	Switches the display to Finder mode.
Identify	Switches the display to Identify mode.
Options	Displays the Main Menu (see p. 69).

4.2 Finder Mode

Use the identiFINDER R425 in Finder Mode to locate a radiation source.

Immediately after switching to Finder mode, the R425 begins a background measurement (Figure 4-4).

Move the instrument around the vicinity of a suspected source and monitor the device display and any other indicators that are enabled in your settings (LEDs, vibration, and beeper) for changes. The vibration and sound get more intense and vibration, sounds, and flashes get closer together as the instrument gets closer to the radiation source.

For better results, move the R425 away from suspected radiation sources during the background measurement.

The duration of the background measurement is displayed below the chart containing the measurements.

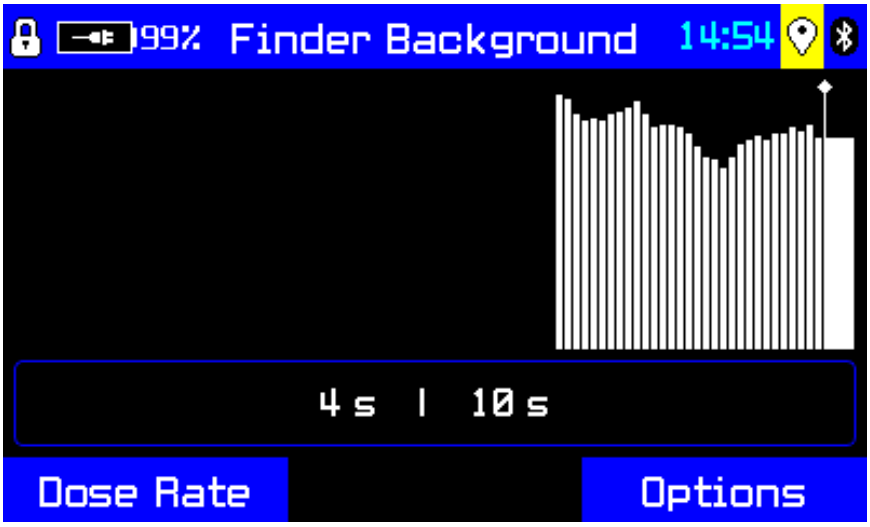


Figure 4-4: Finder mode: Initial background measurement

If a background has been measured during a session (i.e., since you switched on the identiFINDER R425) and there is no time to measure a new background, it is possible to cancel the current background measurement. The R425 will then use the most recent previous background measurement. However, this approach to background measurement is not recommended and should only be used in extraordinary circumstances.

After the background measurement has finished, the Finder mode screen is displayed (Figure 4-5).

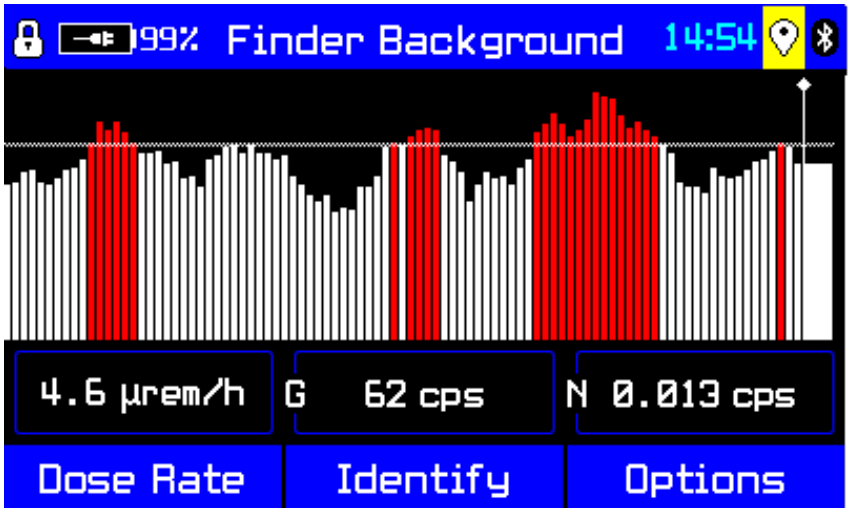


Figure 4-5: Finder mode: Continuous measurement

The current count rate is averaged for a period specified in the device settings (see "Finder Settings" on p. 80). The average of the most recent period is depicted as a wide column along the right edge of the screen.

Narrow columns representing older periods fill the screen's center from right to left, pushing the oldest periods off the screen's left edge.

The vertical scaling of the chart is adjusted continuously to make best use of the available screen height. A dashed line above the chart indicates the adjustable threshold for audible feedback. If the count rate rises above this level, user is notified by the LED, the vibration, and the beeper. The sound frequency is proportional to the count rate, that is, the closer the instrument gets to the source the higher the tone.

You can mute the alarm sound by pressing the Power button briefly. Muting remains in effect until you exit and re-enter Finder mode.

Settings and Commands - Finder mode screens	
Dose Rate	Switch to Dose Rate mode.
Identify	Switch to Identify mode.
Options	Display the Main Menu (see p. 69).

4.3 Identify Mode

From Finder mode, switch the identiFINDER R425 to Identify mode to analyze the source of gamma radiation and determine the nuclide(s) emitting it.

The R425 acquires a gamma spectrum for a duration specified in the instrument's settings (see "Identify Settings" on p. 86) and displays the progress and some parameters of the measurement.

The R425 achieves better identification results if the count rate is within a certain range displayed in the center of the indicator. The screen indicates the correct proximity to the source for identification. While the current count rate is outside the desired range, the screen directs you to move closer or move away, depending on whether the count rate is too low or too high for accurate identification. At the appropriate distance for identification, the screen will display "Don't Move."

On the left side of the screen, progress displays as a countdown during time-limited data acquisition at optimal distance for acquisition.

Figure 4-6: Identify mode: Progress display during time-limited data acquisition

The acquisition of data stops after the duration or count criterion is met or after you select **Analyze**. The R425 applies the identification algorithm and saves and displays the result.

If nuclides were identified, the results are saved. The reference number of the saved record is displayed in the title bar so it can be easily found for future use.

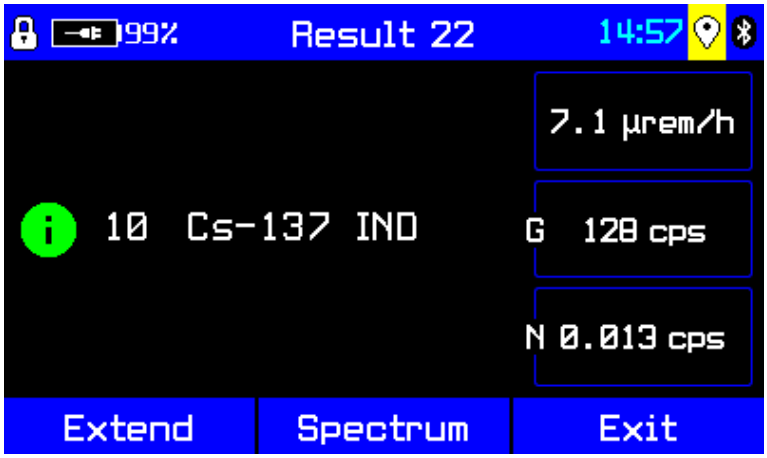


Figure 4-7: Identify mode: Identified radionuclide

If insufficient data was acquired, a screen similar to Figure 4-8 will display.

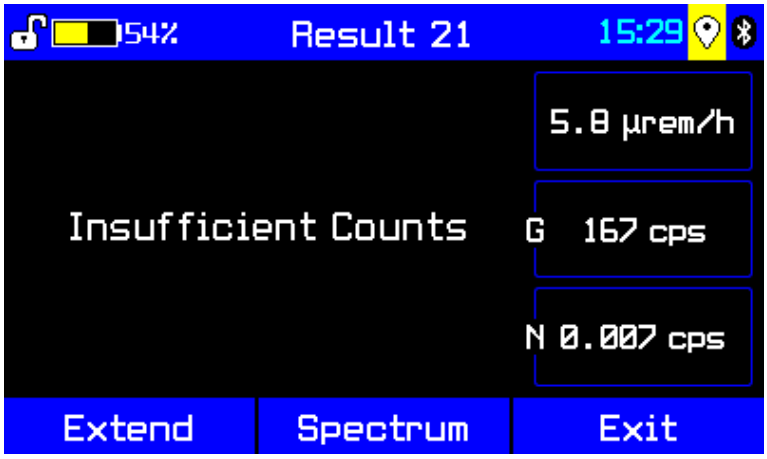


Figure 4-8: Identify mode: Count rate too low for best results

Settings and Commands - Identify mode screens	
Extend	Select **Extend** to acquire more data to improve the identification. When you use this command, data acquisition continues for the **Extended Time** amount specified in the instrument's settings (see section 6.5.3, "Identify Settings" on p. 86). It does not matter whether the initial data acquisition period was measured using duration (*static mode*, the default measurement method) or number of counts (dynamic mode, p. 86).

Settings and Commands - Identify mode screens	
Spectrum	 This command is available only after the password is entered or if password protection is turned off. Select **Spectrum** to inspect the acquired spectrum. See "Saved Spectra" on p. 113 for information on more options and commands for spectrum viewing.
Exit	Select **Exit** to leave Identify mode and return to the home screen.

5 Alarms

When radiation passes through the identiFINDER R425, this radiation signature, when above certain thresholds the user specifies (see "Dose Thresholds" on p. 90), triggers an alarm signal that is generated by the detector.

5.1 Alarm Indicators

The R425 communicates warnings and alarms to you in several ways, most of which can be adjusted in the device's settings:

Alarm indicator	Description
Main display	If pop-ups are enabled, details of the alarm are displayed in the Alarm Status screen (Figure 5-1), replacing whatever was displayed at the time the alarm condition was met. The screen backlight will be switched on if it timed out (see "Device Settings" on p. 70). Alarm details remain on the screen until dismissed.
Status bar	If the alarm details pop-up, or alarm pop-ups in general, are disabled, then the alarm and warning information is displayed in the status bar (2.1.1 , p.20). The alarm notification alternates with the normal information displayed in the status bar.
LEDs	LEDs will display Red for Gamma and Blue for Neutron radiation.
Audible indicators	The R425 can produce audible alarm signals through its speaker.
Vibration	The R425 provides haptic feedback through vibration. The vibration also produces a buzzing sound.

All alarms are stored in the R425's database, including their date and time. GPS coordinates are also included if the GPS is switched on and available (see "GPS Status" on p. 103).

You can review saved alarms via the web interface (see "Alarms " on p. 136).

To delete alarms, see "Clear Alarms" on p. 119.

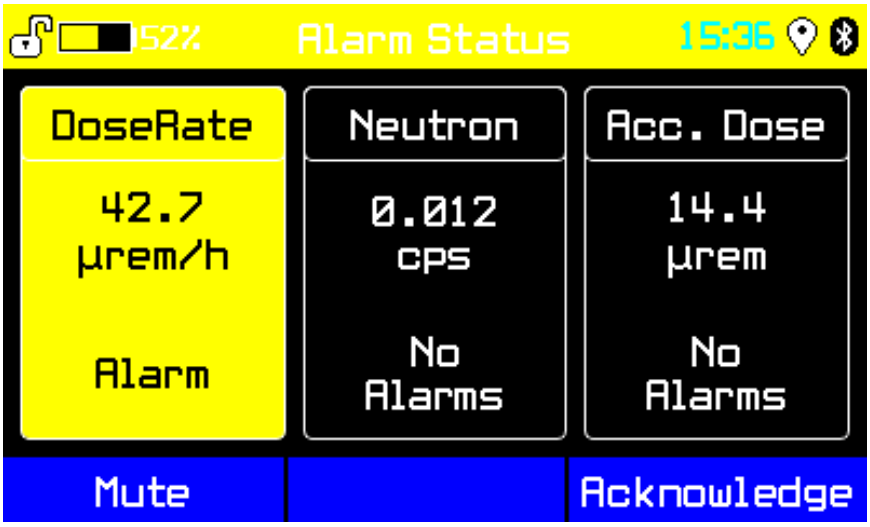


Figure 5-1: Alarm Status screen

Settings and Commands - Alarm Status screen (Alarm mode)	
Mute	Switches off the beeper and vibration for the current alarm. The next alarm, if any, reactivates sound and vibration.
Acknowledge	Acknowledges the alarm. The beeper and vibration are switched off and the screen returns to the content displayed before the alarm was raised. The alarm details continue to alternate with the standard information in the status bar until radiation drops below the alarm threshold.

5.2 Gamma Alarms

The R425 continuously compares detected gamma radiation against the thresholds defined in the instrument's settings:

- dose warning and dose alarm (see Section 6.5.4.1, "Dose Thresholds.") .
- dose rate warning and dose rate alarm (see Section 6.5.4.3, "Dose Rate Thresholds.").

When a threshold is exceeded, an appropriate warning or alarm is raised and reported.

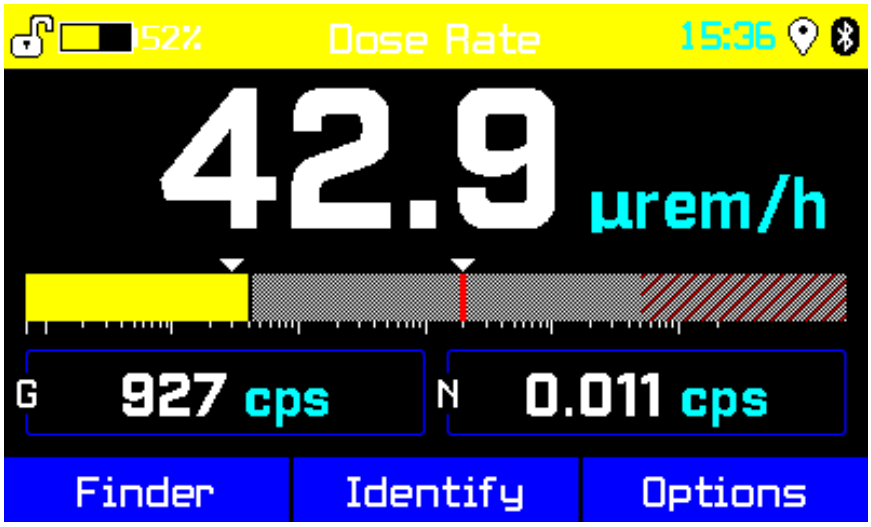


Figure 5-2: Alarm display: Dose Rate Warning

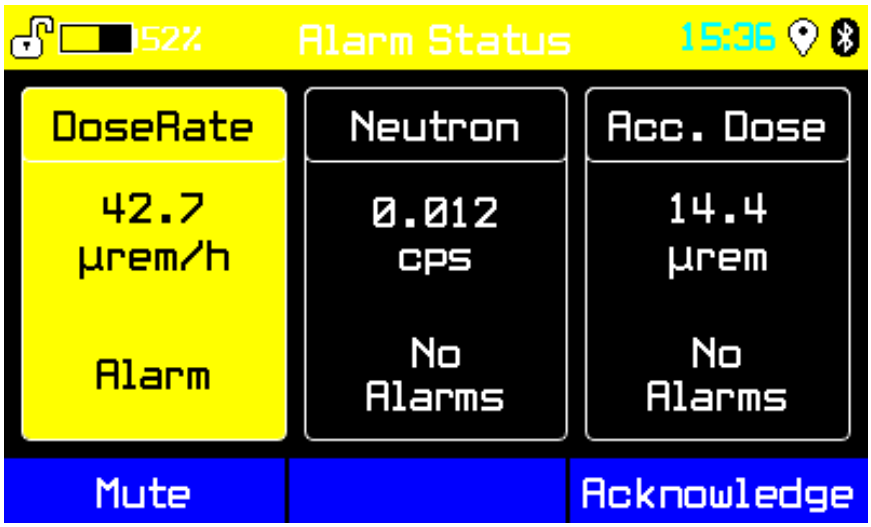


Figure 5-3: Alarm display: Dose Rate Alarm

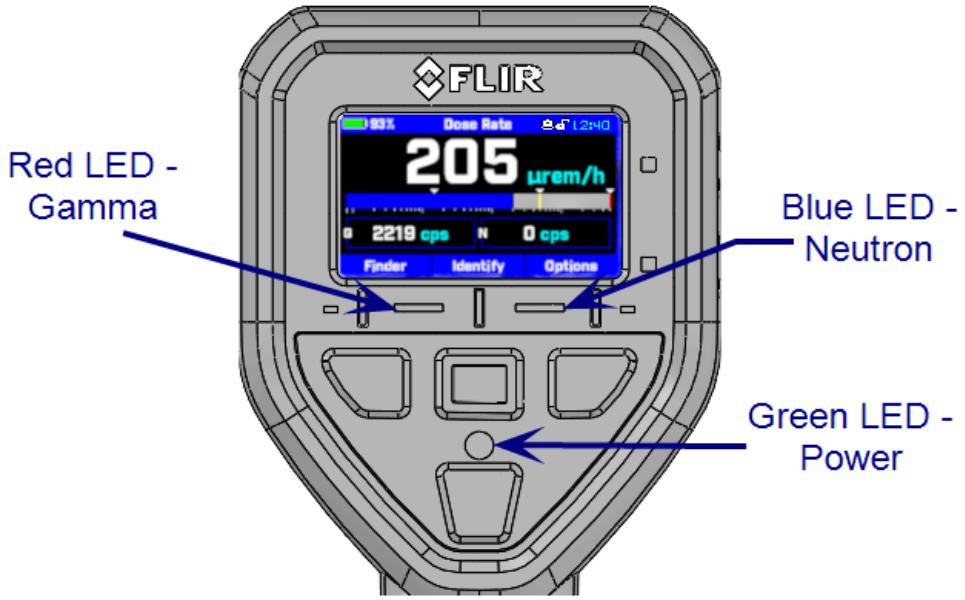


Figure 5-4: Gamma and neutron alarm indicators

5.3 Neutron Alarms

Available only for variants equipped with a neutron detector.

The identiFINDER R425 continuously compares the number of detected neutrons per given period against thresholds specified in the instrument's settings (see section 6.5.4.2, "Neutron Thresholds" on p. 91. When a threshold is exceeded, an appropriate warning or alarm is raised and reported visually on the screen (Figure 5-5) and by the blue neutron LED, depending on your alarm indicator settings.

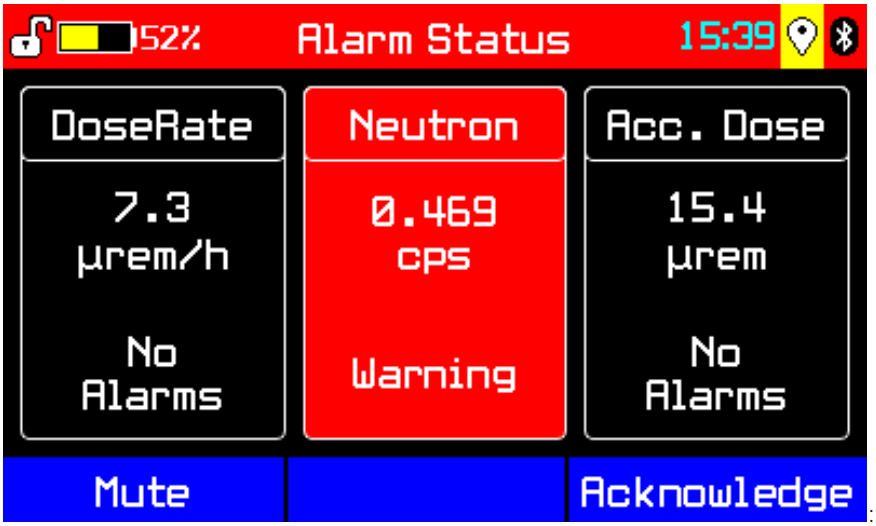


Figure 5-5 : Alarm Status screen: Neutron warning

Figure 5-6: Neutron alarm indicated by display and blue LED

6 Menu Reference

This chapter provides detailed descriptions of settings that control the FLIR identiFINDER® R425's configuration and commands used for expert analysis and advanced operations.

You can access these commands and settings by navigating through menus.

6.1 Menu Navigation 68
6.2 Device Menus and Web Interface Menus 68
6.3 Main Menu 69
6.4 Device Menu 69
6.5 Radiation Menu 79
6.6 Service Menu 97
6.7 Data Menu 110

6.1 Menu Navigation

For navigation and selection in menus, use the following commands:

Down	Move down menu lists. Past last item and highlight starts at top of list.
Select	This button selects the current highlighted item.
Exit	This button exits the current menu and returns to the superior menu, or screen.
Skip	Use this button to skip the current command set (task bar) and return to previous set.
Left	For fields with arrows at each side (e.g., ◂ rem ▸; using Left, Right to scroll between options).
Right	For fields with arrows at each side (see above).

6.2 Device Menus and Web Interface Menus

Most settings and commands on the R425's menus can also be accessed through the R425 web interface.

In this chapter, this image is used to indicate commands or menu paths (for example, **Device | Settings**) available on the

identiFINDER R425 device itself.

This image is used to indicate commands or menu paths (for example, **Settings | General**) found on the identiFINDER R425 web interface, when the R425 is connected to an external device. For more information, see Chapter 8.

Settings in the web interface do not always have exactly the same name or appear in the same order as on the device itself.

6.3 Main Menu

The categories of commands and settings on the R425's Main Menu are:

- **Device** (p. 69)
- **Data** (p. 110)
- **Radiation** (p. 79)
- **Service** (p. 97)

These categories are covered in the sections that follow.

If a padlock appears beside a menu item, you must enter the device password (p. 30) to access the settings and commands on that menu.

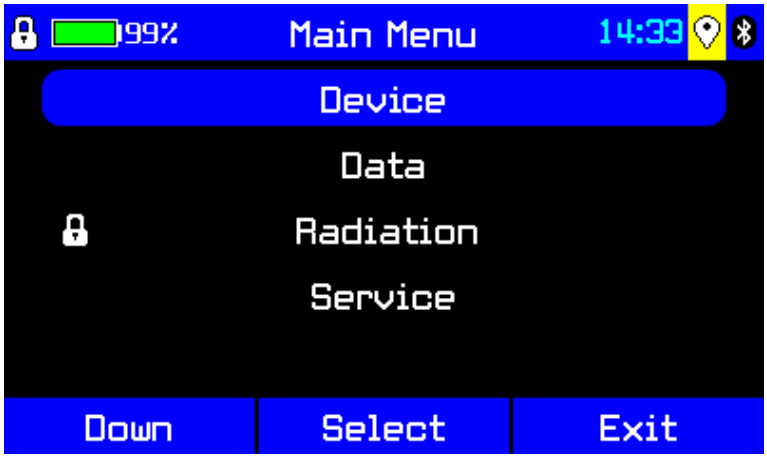


Figure 6-1: Main menu

6.4 Device Menu

The Device menu contains the following commands:

- **Settings** (p. 70) allows you to configure language, display, and other device settings.
- **Connect** (p. 72 allows you to configure connections to external devices.
- **Records** allows you to enter a user profile.
- **Clock** (p. 77) allows you to set time and time zone.
- **Alarm Status** (p. 78) takes you to the Alarm Status screen.
- **Battery Status** (p. 79) takes you to the Battery Status screen.

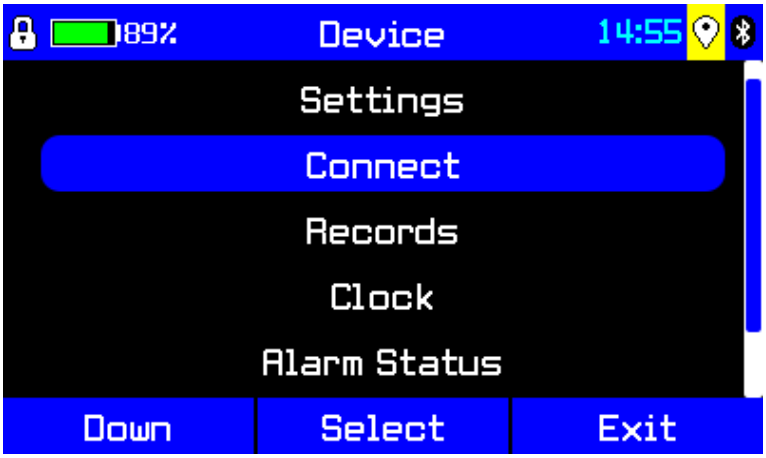


Figure 6-2: R425 Device menu

6.4.1 Device Settings

Device | Settings

Settings | General | User Interface

This screen contains several options that influence the display of the identiFINDER R425.

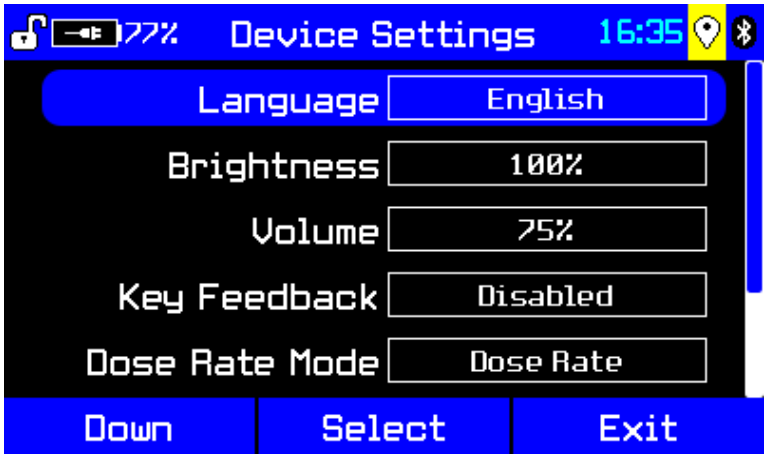


Figure 6-3: Device settings

You can access these settings in the R425 web interface (Figure 8-4) by selecting **Settings | General | User Interface**.

Settings and Commands - Device Settings	
Language	Select the language for the device display from a list of available languages. Be sure to select the correct language. It may be difficult to change back if you do not have adequate literacy in the language chosen.
Brightness	Select the level of brightness (in %)for the device display.
Volume	Select the volume (in %) for audible alerts.
Key Feedback	Select **Enabled** to play a tone when keys are pressed. Select **Disabled** to turn off the tone that plays when keys are pressed.
Dose Rate Mode	Select the mode you want to display on the home screen at startup. Options are the default **Dose Rate Mode** or **Level Mode** (see "Level Thresholds," p. 94).
Screen Flip	Use this option to set the display orientation for the R425. Select **Auto** to have the display automatically invert when the R425 is positioned upside down. Select **Force Off** to disable screen inversion. Select **Force On** to invert the screen manually.

Settings and Commands - Device Settings	
GPS	Select Enabled to allow the GPS to receive location information from satellites and write the location data to spectrum or data log files. Select Disabled to turn off GPS and location functions.
Bluetooth	Select Enabled to make the R425 discoverable for connectivity to mobile devices via Bluetooth. Select Disabled to turn off Bluetooth connectivity.

6.4.2 Connect Menu

Device | Connect

This screen gives you access to the R425's Bluetooth and Network settings.

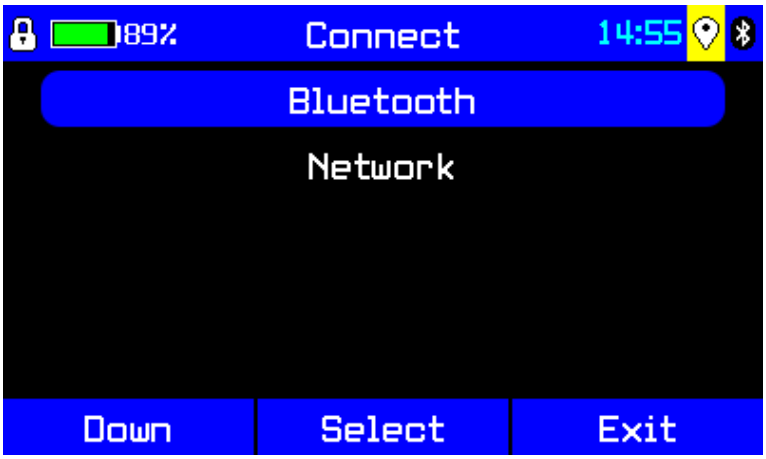


Figure 6-4: Connect menu

6.4.2.1 Bluetooth Menu

This item is available for R425 variants equipped with Bluetooth.

Device | Connect | Bluetooth

The R425 supports Bluetooth Serial Port Protocol (SPP). Bluetooth SPP supports a command set for system integrators to develop custom remote interfaces. For more information on this command set, see Appendix A.4 on p. 159.

For information on using the **Advertise** option from this menu to pair the R425 to a wireless device via Bluetooth, see section 7, "Connecting to an External Computer" on p. 123.

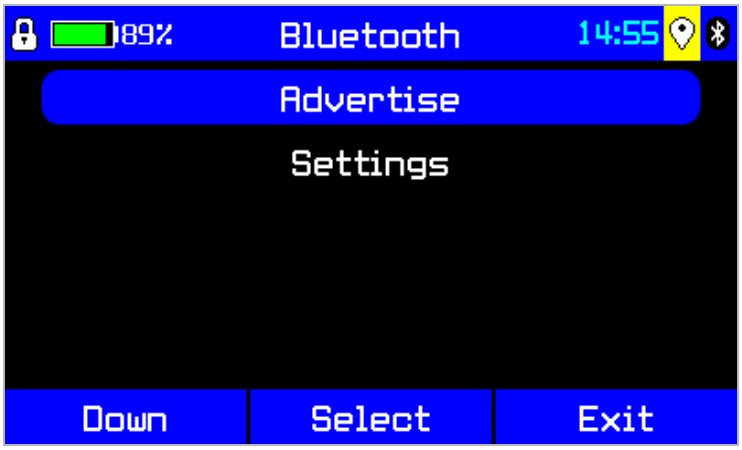


Figure 6-5: R425: Bluetooth menu

6.4.2.2 Bluetooth Settings

Device | Connect | Bluetooth | Settings

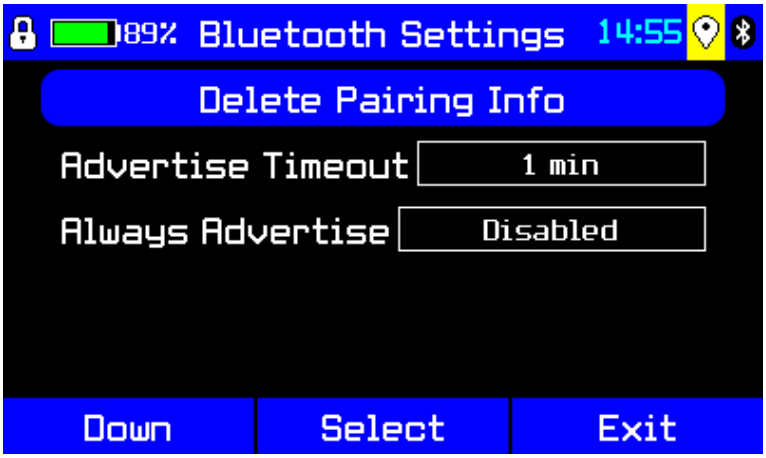


Figure 6-6: Bluetooth Settings screen

Settings and Commands - Bluetooth Settings screen	
Delete Pairing Info	The R425 stores the pairing info for any devices it has paired to. Select **Delete Pairing Info** (see Figure 6-6) to remove paired device information from the R425. When the deletion is complete, a confirmation message will appear (Figure 1-2).  **Figure 6-7**: Message confirming deletion of Bluetooth pairing information
Advertise Timeout	*Advertising* refers to the process of the R425 making itself available for pairing with another Bluetooth-enabled device. You can choose to have the R425 never available, always available, or only available for a certain period of time. See "Setting the Advertise Timeout value," p. 75
Always Advertise	When Always Advertise is enabled, the R425 will always be available for pair-

Settings and Commands - Bluetooth Settings screen	
	ing. When it is disabled, it will only be available for the duration of the Advertise Timeout setting. For details on how to change this setting, see "Selecting from lists" on p. 32.

Setting the Advertise Timeout value

1. From the Bluetooth Settings menu (Figure 1-1), select **Advertise Timeout**. A screen similar to Figure 6-6 will appear:

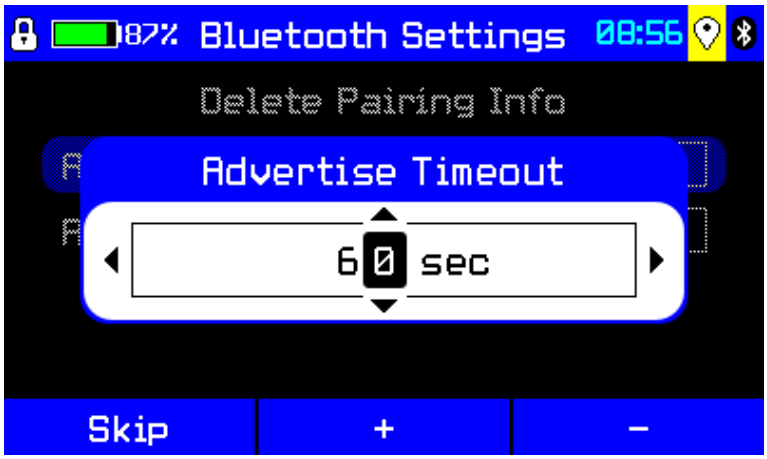


Figure 6-8: Adjusting the Advertise Timeout period

2. Enter a number of seconds from 1 to 999. When **Advertise** is selected, the R425 will broadcast for a Bluetooth connection for this number of seconds.

For step-by-step instructions on how to enter the number, see "Changing Numeric and Composite Values" on p. 34.

6.4.3 Network

Device | Connect | Network

Select **Network** from the Connect menu to display relevant network information (Figure 6-9), which you will need when connecting the identiFINDER R425 to the web interface. See Chapter 7.

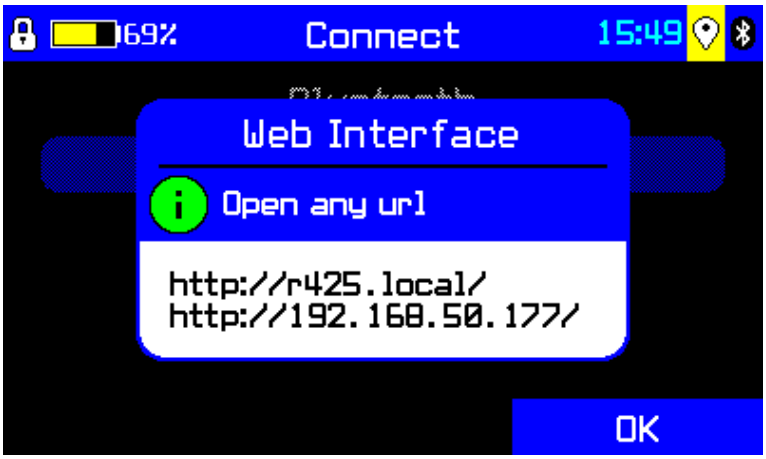


Figure 6-9: Network information

6.4.4 Records

Device | Records

On the Records screen (Figure 6-10), you can enter the name and callback number of the device operator who will be associated with reachback data.

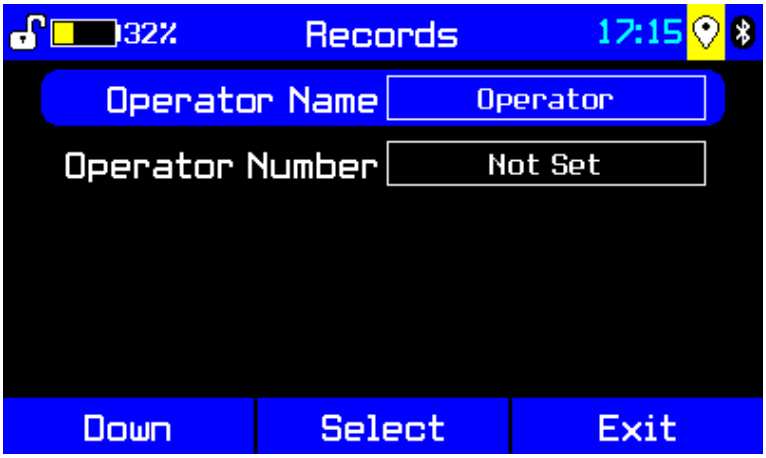


Figure 6-10: Records screen

6.4.5 Clock Settings

Device | Clock

Settings | General | Clock

Check and change the settings of the R425's clock in Clock Settings screen (Figure 6-11).

If the clock setting seems questionable when switching on the R425 (for example, after battery has been drained for an extended period), the Clock Settings screen displays along with a prompt requesting you to enter the correct date, time, and time zone settings.

If the GPS receiver is switched on (see "GPS Status" on p. 1032), the received time sets the clock of the R425 and the only setting required to specify is the time zone where the instrument will be operated.

If GPS date and time information become available while you are editing the date or time in the Clock Settings screen, editing will be canceled and the GPS clock will be used.

Figure 6-11: Clock Settings screen

Settings and Commands - Clock Settings screen	
Set TimeZone	Select the time zone in which the instrument will operate from the list built into the R425.

Settings and Commands - Clock Settings screen	
	Time zones are specified as offset from UTC/GMT. Periods for daylight savings time, however, might be different for the same offset from UTC in various regions. To have the R425 consider the correct daylight savings time for the time zone in question, make sure to check the region info when selecting the offset.
Clock Type	Select 12-hour or 24-hour time.
Adjust for DST	Select **Enabled** to automatically adjust for Daylight Savings Time. Select **Disabled** to adjust for Daylight Savings Time manually.

6.4.6 Alarm Status

Device | Alarm Status

This screen (Figure 6-12) is identical in format to the alarm screen that automatically displays when a warning or an alarm is raised, but it displays the current dose rate, neutron count, and accumulated dose when there are no current alarms.

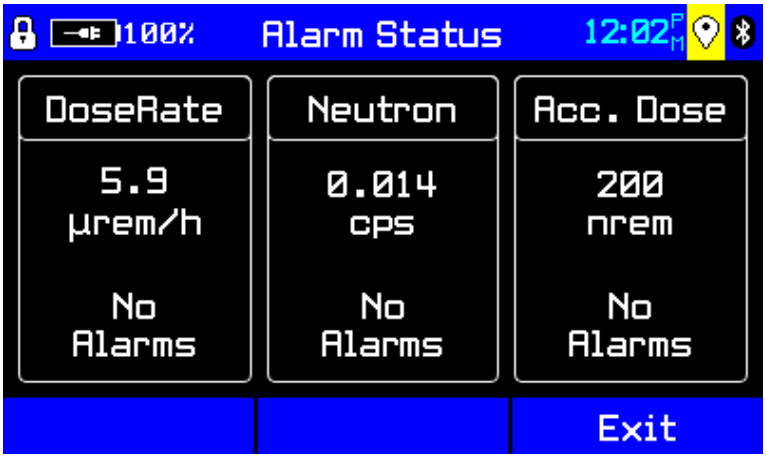


Figure 6-12: Alarm Status screen - no current alarms

Settings and Commands - Alarm Status screen (No current warnings/alarms)	
Exit	Exits the Alarm Status screen and returns to the Device menu.

6.4.7 Battery Status

Device | Battery Status

Use this screen to check the details of battery status at startup or during operation.

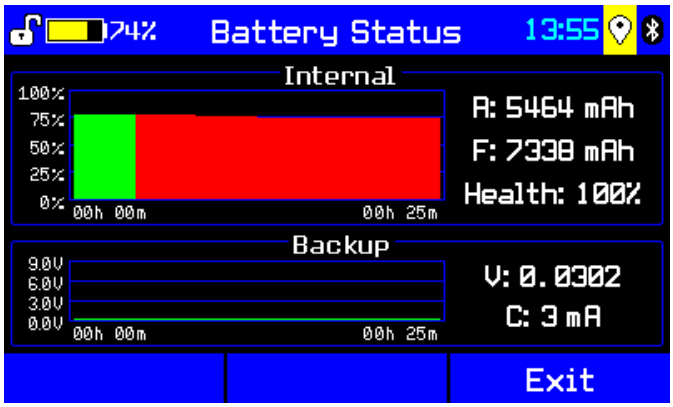


Figure 6-13: Battery Status screen

6.5 Radiation Menu

The Radiation menu contains the followingitems:

- **Finder Settings** (p. 80)
- **Nuclide Settings** (p. 82)
- **Identify Settings** (p. 86)
- **Alarm Settings** (p. 87)
- **Dose Rate Settings** (p. 95)

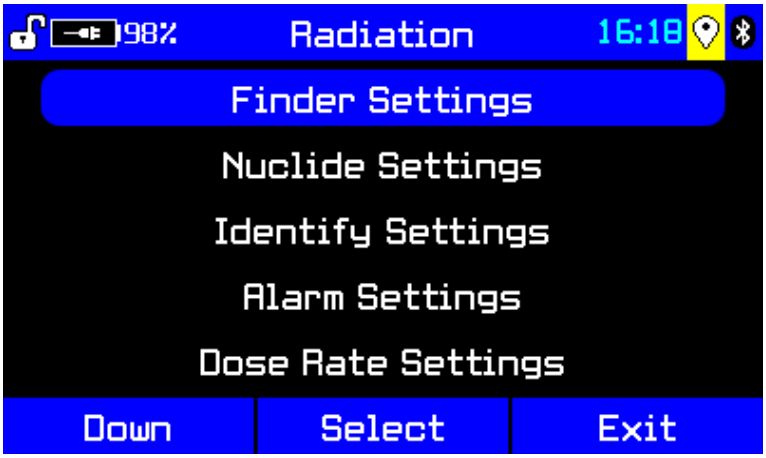


Figure 6-14: R425 Radiation menu

6.5.1 Finder Settings

Radiation | Finder Settings

Settings | General | Finder

This screen controls identiFINDER R425's behavior in Finder mode. For more on Finder mode, see sections 3.4 on page 47 and 4.2 on page 57

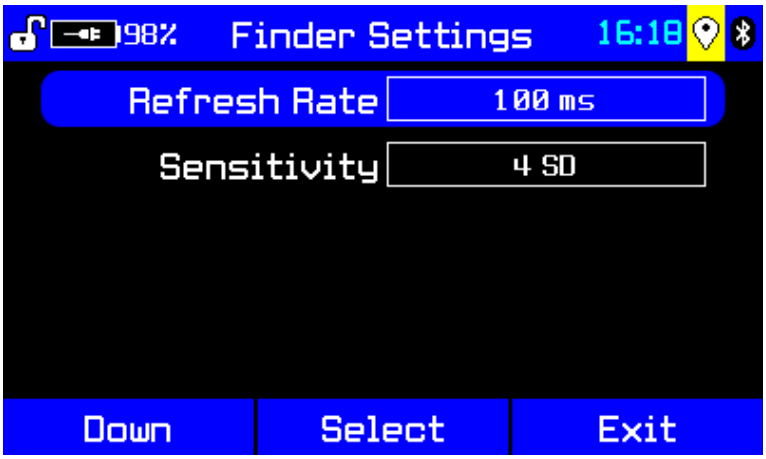


Figure 6-15: Finder settings

Settings and Commands - Finder Settings screen	
Refresh Rate	Specify a Refresh Rate value from 100 to 5000 milliseconds (0.1 to 5.0 seconds). The Refresh Rate value is the time interval represented by one column in the history chart of the Finder mode (see Figure 6-16). The identiFINDER R425 averages the count rate for the Refresh Rate value specified. At the end of each period, a column is added to the Finder mode graph (see p. 59) representing the result.  A small Refresh Rate value will lead to a more active Finder mode display. A large value increases the possibility of finding weaker radiation sources.
Sensitivity	This setting determines the sensitivity level for audible feedback in Finder mode. While in Finder mode, the R425 emits sound when the count rate rises above a threshold which is represented by the dashed line across the top of the Finder display (Figure 6-16). The Sensitivity value specifies how many standard deviations (SD) above the background radiation level the threshold is set to (for more on background measurement, see p. 57). A lower standard deviation indicates greater sensitivity; a higher standard deviation indicates lower sensitivity.

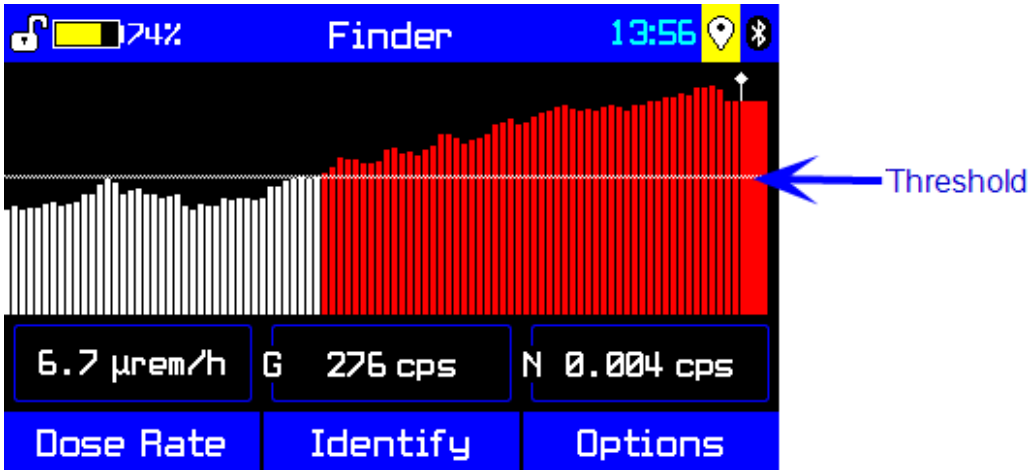


Figure 6-16: Finder mode display indicating radiation above threshold

6.5.2 Nuclide Settings

Radiation | Nuclide Settings

Settings | Advanced | Nuclides

The identiFINDER R425 contains a built-in library used to identify the nuclides causing gamma radiation.

The Nuclide Settings menu option allows you to control which information from the Nuclide Library is displayed during identification.

See "Appendix C: Nuclide Library" on p. 169 for more information about the nuclides in this library, including severity and usage information.

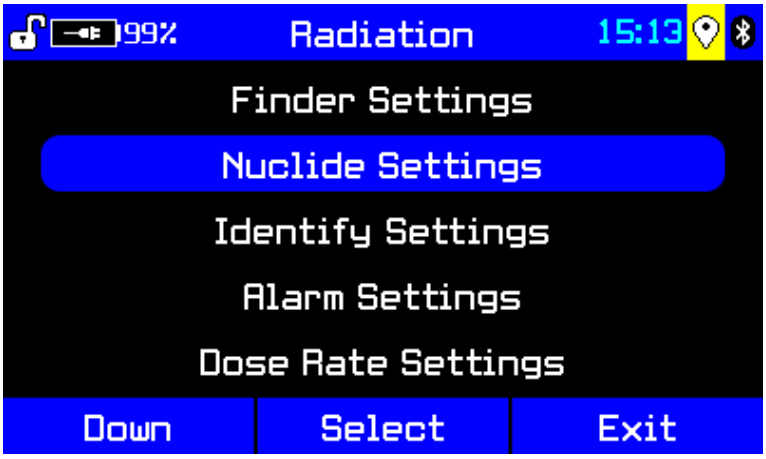


Figure 6-17: Nuclide Settings option on Radiation menu

6.5.2.1 Setting Nuclide Visibility

The **Visibility** setting (Figure 6-18) allows you to specify which nuclides from the library should be included in the display of identification results. Possible values for this setting are **Visible** or **Hidden**.

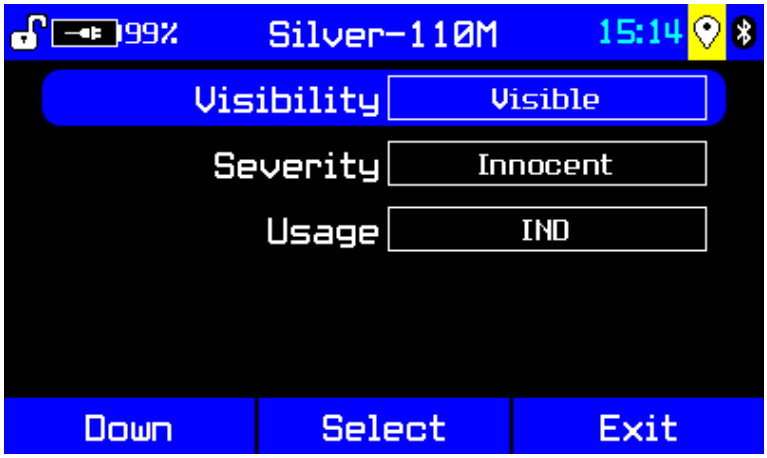


Figure 6-18: With Visibility highlighted, press M (Select) to set nuclide visibility

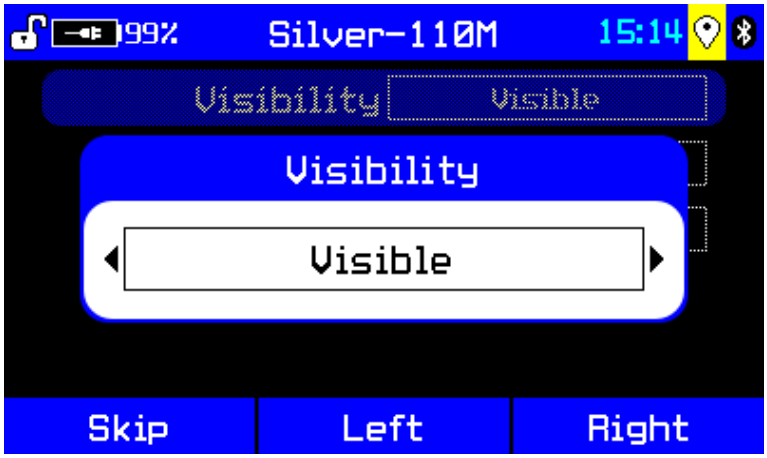


Figure 6-19: Setting visibility: Use Skip, Left , and Right commands to navigate and change settings

For step-by-step instructions on changing this kind of setting, see section 2.6.2, "Selecting from lists" on p. 32.

6.5.2.2 Setting Nuclide Severity

Every nuclide has associated information about its potential danger which may be displayed in identification results. You can adjust this information for the nuclides in the library according to your needs, using the **Severity** setting. Severity options are **Innocent**, **Suspicious**, or **Threat**.

The severity information for some nuclides is fixed and cannot be changed. In these cases, the Severity setting will not be editable.

For step-by-step instructions on changing this kind of setting, see section 2.6.2, "Selecting from lists" on p. 32.

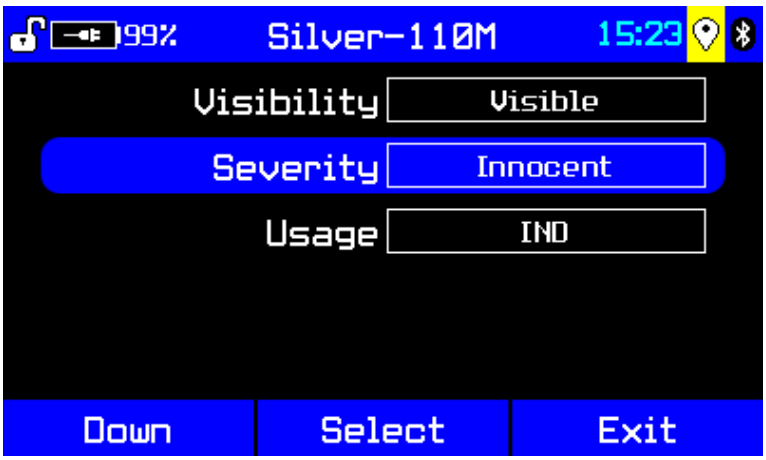


Figure 6-20: With Severity highlighted, press M (Select) to set nuclide severity

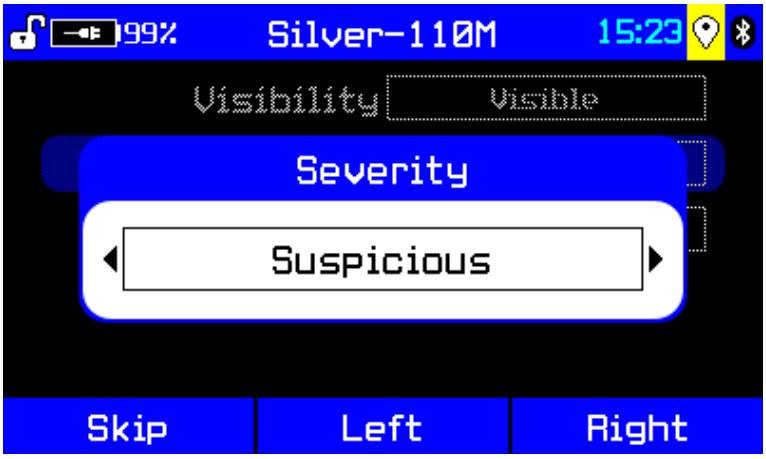


Figure 6-21: Setting nuclide threat level: Use Skip, Left, and Right commands to navigate and change settings (see 2.6.2)

6.5.2.3 Nuclide Usage

Every nuclide in the nuclide library has associated information about its occurrence or field of application which may be displayed in identification results. Adapt this usage information according to your specific needs with this command. Options are **IND** (industrial), **MED** (medical), **NORM** (naturally occurring radioactive material), or **SNM** (special nuclear material).

For step-by-step instructions on changing this kind of setting, see section 2.6.2, "Selecting from lists" on p. 32

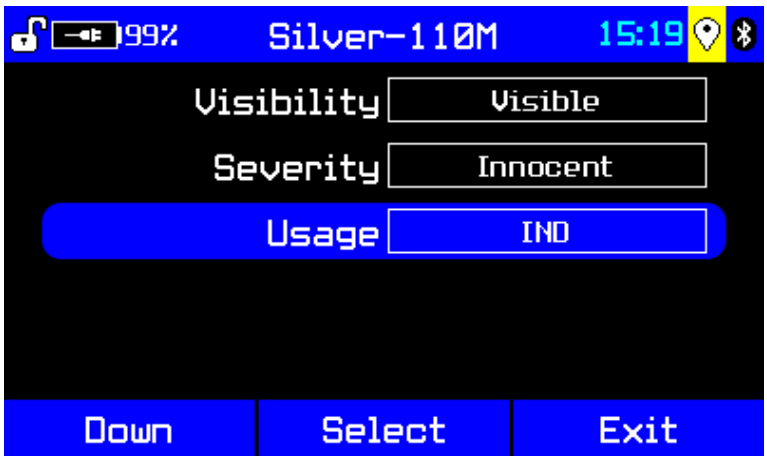


Figure 6-22: With Usage highlighted, press M (Select) to set nuclide usage category

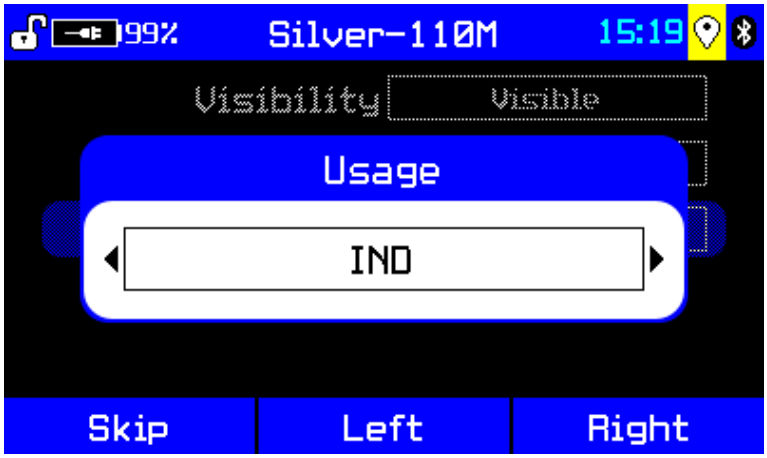
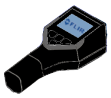


Figure 6-23: Setting nuclide usage: Use Skip, Left , and Right commands to navigate and change settings

6.5.3 Identify Settings



Radiation | Identify Settings

Settings | Advanced | Identify

This screen contains options that influence the identification of nuclides (see "Identify Mode" on p. 59).

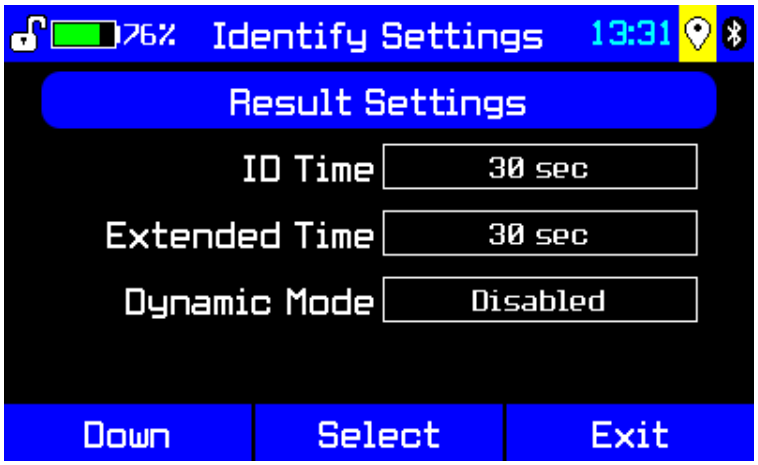


Figure 6-24: Identify settings

Settings and Commands - Identify Settings screen	
Result Settings	Displays the Result Settings screen (p. 86).
Extended Time	Enter a value from 1 s to 1200 s (20 m). Specifies the duration of continued data collection for nuclide identification. This extended time is applied when using the **Extend** command in identification mode (see "Identify Mode" on p. 59), no matter whether a time period or the minimum number of counts (see "Dynamic Mode," below) was used for the initial data collection.
Dynamic Mode	Select **Enabled** or **Disabled**. If Dynamic mode is enabled, the identiFINDER R425 is programmed to collect data until 8000 gamma counts have been registered, instead of for a specific time period. This may take a while, especially in cases where the background and source radioactivity levels are nearly the same.

6.5.3.0.1 Result Settings

Settings on this screen control the information that displays on the Result screen (p. 61) when a nuclide is identified.

Settings and Commands - Result Settings screen	
Confidence	Specify whether or not the confidence level is displayed in the identification result.
Nuclides	Specify whether the long name (for example, Cesium-137) or short name (Cs-137) of a radionuclide is displayed in identification results.
Usage	Specify whether the usage of an identified nuclide is displayed or hidden in identification results (for more information, see "Nuclide Usage" on p. 85).
Severity	Specify whether the threat level of an identified nuclide is displayed or hidden in identification results (for details refer to "Setting Nuclide Severity" on p. 83). Severity is represented by icons: green circle=innocent; yellow triangle=suspicious; red hexagon=threatening.

6.5.4 Alarm Settings

Radiation | Alarm Settings

Settings | Advanced | Alarm

The identiFINDER R425 reports various events with on-screen messages. You can also set it to report events, especially alarms, with other methods. You can set each of the alarm indicators independently.

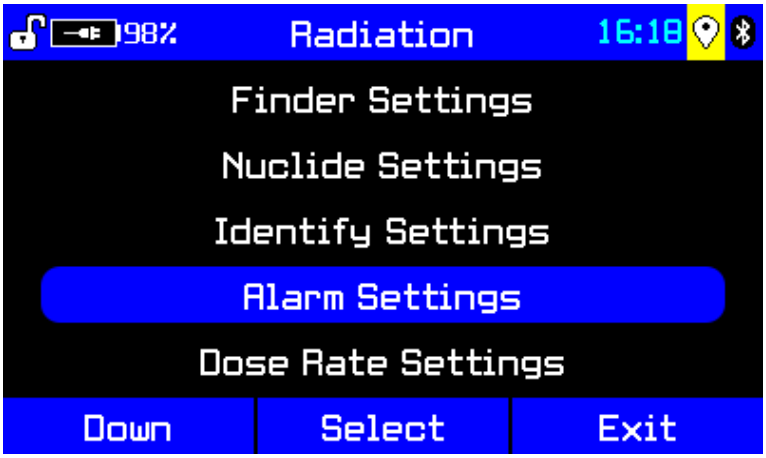


Figure 6-25: Alarm Settings menu item

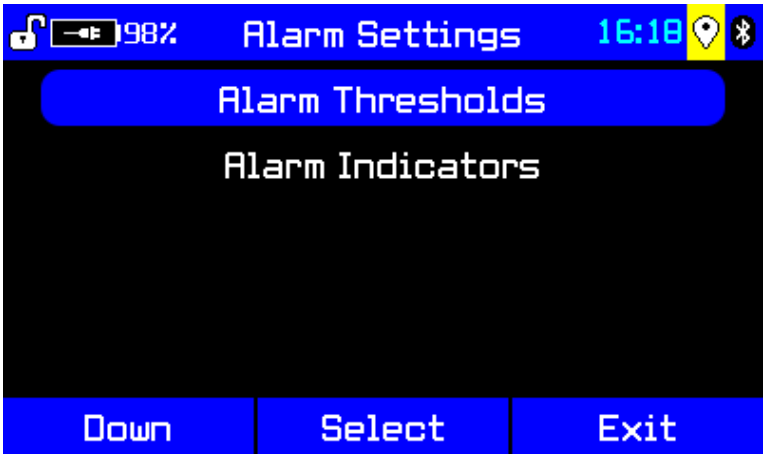


Figure 6-26: In Alarm Settings, set Thresholds and Indicators

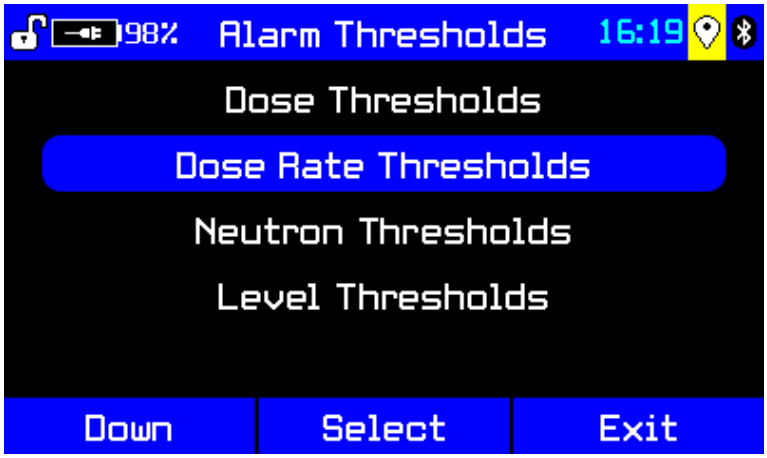


Figure 6-27: Alarm Thresholds menu

You must set the Personal Hazard threshold (Figure 6-28) from the Dose Rate Thresholds settings (see 6.5.4.3). The other Alarm Thresholds screens do not have a personal hazard setting. For more information, see "Dose Rate Thresholds" on p. 92.

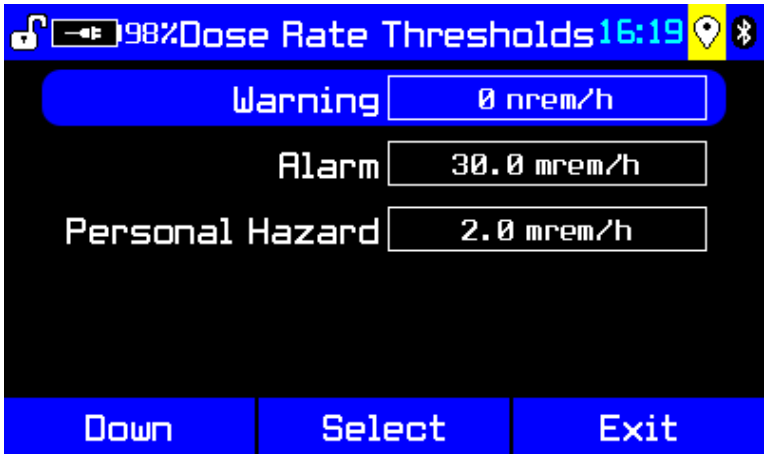


Figure 6-28: Dose Rate Thresholds screen

The signals used to report alarms are described in "Alarms" on p. 63.

6.5.4.1 Dose Thresholds

Alarm Settings | Alarm Thresholds | Dose Thresholds

This screen displays the settings for dose warning and alarm thresholds. Specify the thresholds by setting a value with a unit. The base unit (Sv or rem) available here reflects personal preferences.

Specify values between 1 nSv and 1 Sv (100 nrem to 100 rem).

For meaningful alerts, set the alarm threshold above the warning threshold so that the warning will report *before* achieving the alarm level.

For step-by-step instructions on changing this kind of setting, see section 2.6.4, "Changing Numeric and Composite Values" on p. 34.

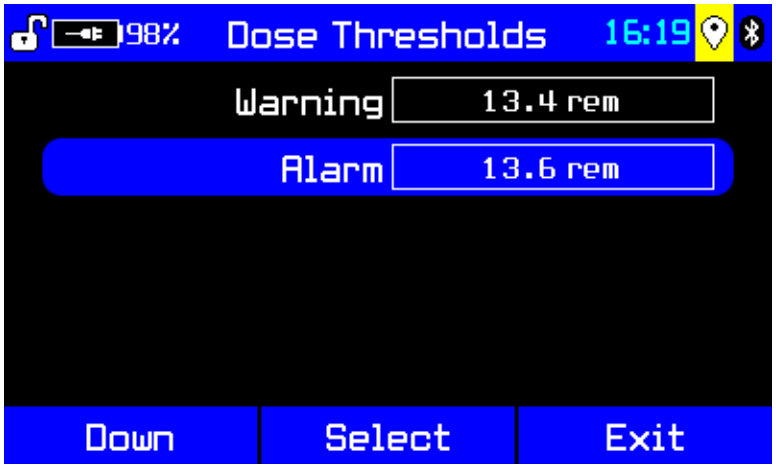


Figure 6-29: Dose threshold settings

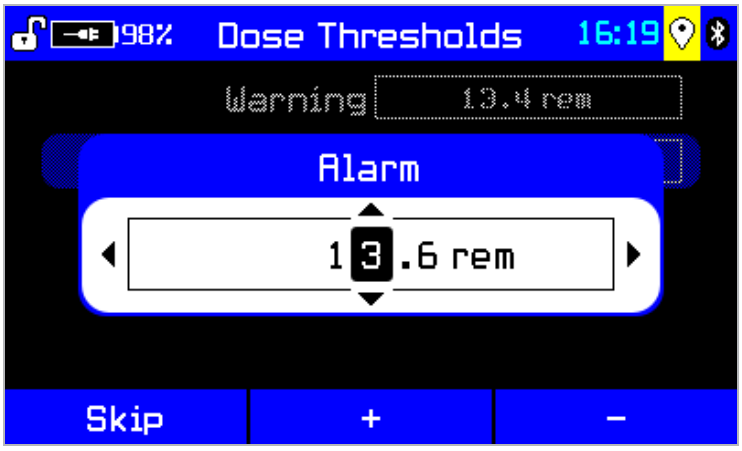


Figure 6-30: Adjusting the dose alarm threshold

Settings and Commands - Dose Thresholds screen	
Warning	The value with unit for the warning threshold. Select **Off** (the lowest value) to suppress this warning. Available units are: **nSv**, **µSv**, **mSv**, **Sv**, **nrem**, **µrem**, **mrem**, **rem**.
Alarm	The value with unit for the alarm threshold. Select **Off** (the lowest value) to suppress this alarm. Available units are: **nSv**, **µSv**, **mSv**, **Sv**, **nrem**, **µrem**, **mrem**, **rem**.

6.5.4.2 Neutron Thresholds

Radiation | Alarm Settings| Alarm Thresholds | Neutron Thresholds

Settings | Advanced | Alarms

This screen displays the settings for neutron warning and alarm thresholds. Both the warning and alarm thresholds are expressed as a fraction of neutrons per interval of time (in seconds).

For meaningful alerts, set the alarm threshold above the warning threshold so that the warning will report *before* achieving the alarm level.

For step-by-step instructions on changing this kind of setting, see section 2.6.4, "Changing Numeric and Composite Values" on p. 34.

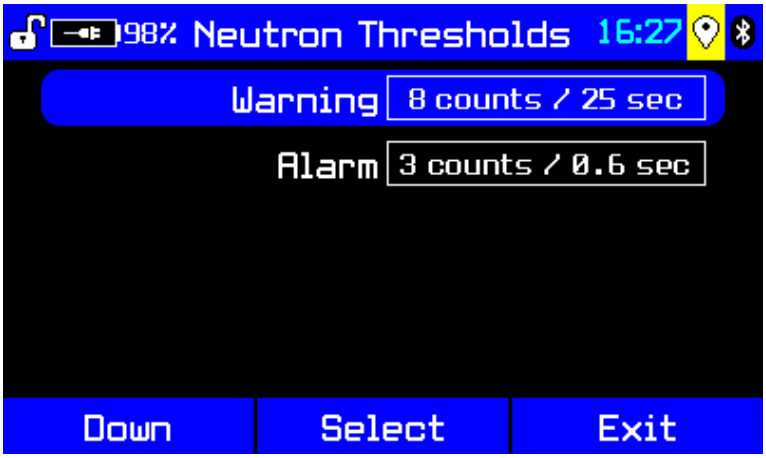


Figure 6-31: Neutron alarm threshold settings

Settings and Commands - Neutron Thresholds screen	
Warning	The minimum number of neutrons within the specified time period that will trigger a warning. Choose a neutron count from 1 to 16. Choose a time period from 0.1 to 60 seconds.
Alarm	The minimum number of neutrons within the specified time period that will trigger an alarm. Choose a neutron count from 1 to 16. Choose a time period from 0.1 to 60 seconds.

6.5.4.3 Dose Rate Thresholds

Radiation | Alarm Settings | Alarm Thresholds | Dose Rate Thresholds

This screen lets you define the thresholds for dose rate warnings and alarms.

Specify the thresholds by setting a value with a unit. The base unit (Sv/h or rem/h) available here is determined by the unit that was established in the Dose Rate Settings menu (see p. 95).

Specify values between 1 nSv/h and 1 mSv/h (100 nrem/h to 100 mrem/h).

For meaningful alerts, set the alarm threshold above the warning threshold so that a warning will be reported *before* an alarm.

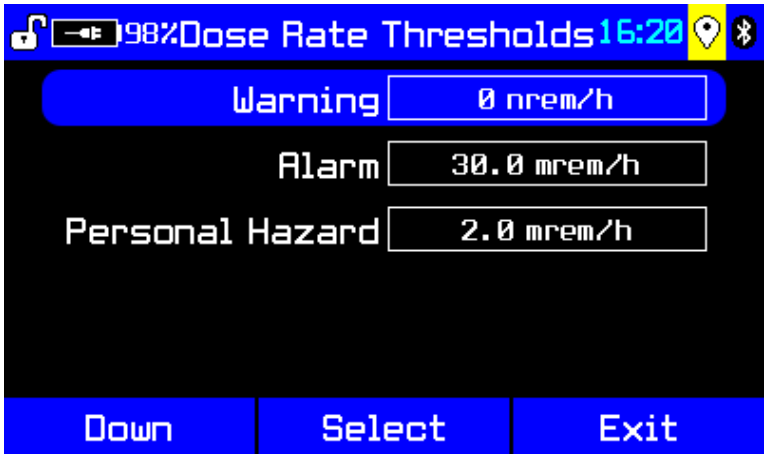


Figure 6-32: Dose rate warning and alarm threshold settings

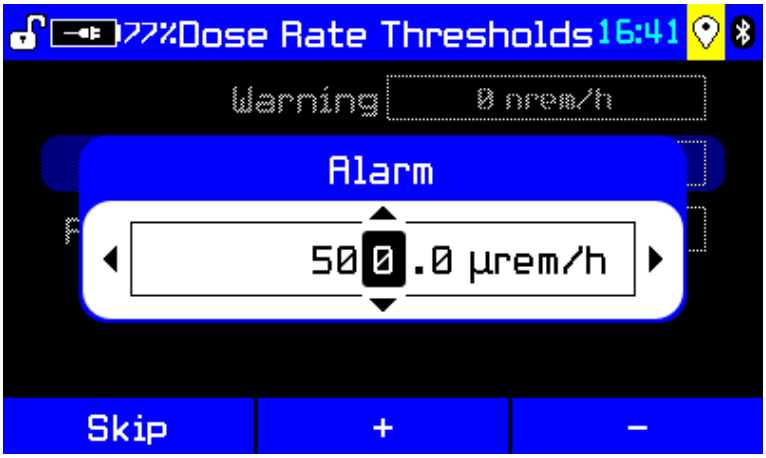


Figure 6-33: Adjusting the dose rate alarm threshold

Settings and Commands - Dose Rate Thresholds screen	
Warning	The value with unit for the warning threshold. Select **Off** (the lowest value) to suppress this warning. Available units are: **nSv/h**, **µSv/h**, **mSv/h**, **Sv/h**, **nrem/h**, **µrem/h**, **mrem/h**, **rem/h**.
Alarm	The value with unit for the alarm threshold. Select **Off** (the lowest value) to suppress this alarm. Available units are: **nSv/h**, **µSv/h**, **mSv/h**, **Sv/h**, **nrem/h**, **µrem/h**, **mrem/h**, **rem/h**.
Personal Hazard	The personal hazard alarm threshold. Defaults to 2 mrem/h.

6.5.4.4 Level Thresholds

Alarm Settings | Alarm Thresholds Level | Thresholds

Settings | Advanced | Level Mode

This screen contains fields for defining nine levels of dose rate values. These values are completely customizable by the user. When the identiFINDER R425 is in Level mode, the defined level numbers, instead of units of measure, will display on the screen to indicate the current radiation level.

Define the levels by setting a value with a unit.

Figure 6-34: Level threshold settings

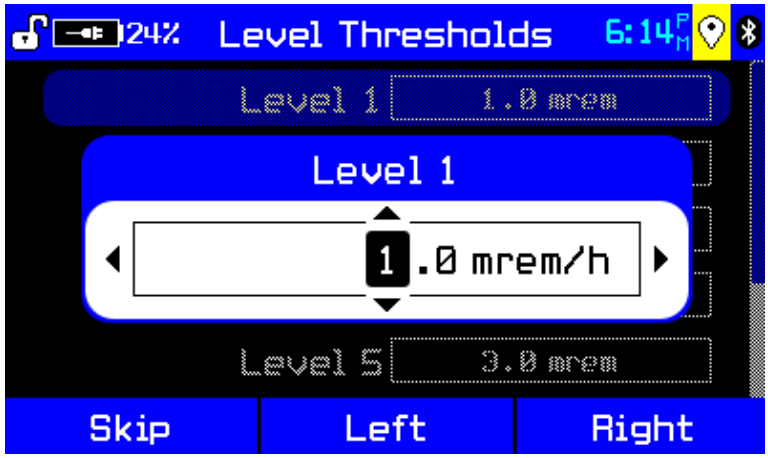
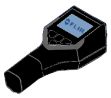


Figure 6-35: Adjusting a level

6.5.4.5 Alarm Indicators



Radiation | Alarm Settings | Alarm Indicators

Settings | General

This screen and web page section allow you to turn the different kinds of alarm indicators on the identiFINDER R425 on or off.

Settings and Commands - Alarm Indicators screen	
Audible	Turns the beeper on or off.
Tactile	Turns vibration on or off.
Visual	Turns the alarm LEDs on or off. This setting does not affect the power indicator LED, which cannot be switched off.

6.5.5 Dose Rate Settings

Radiation | Dose Rate Settings

The Dose Rate Settings screen displays options that control the display of dose and dose rate values.

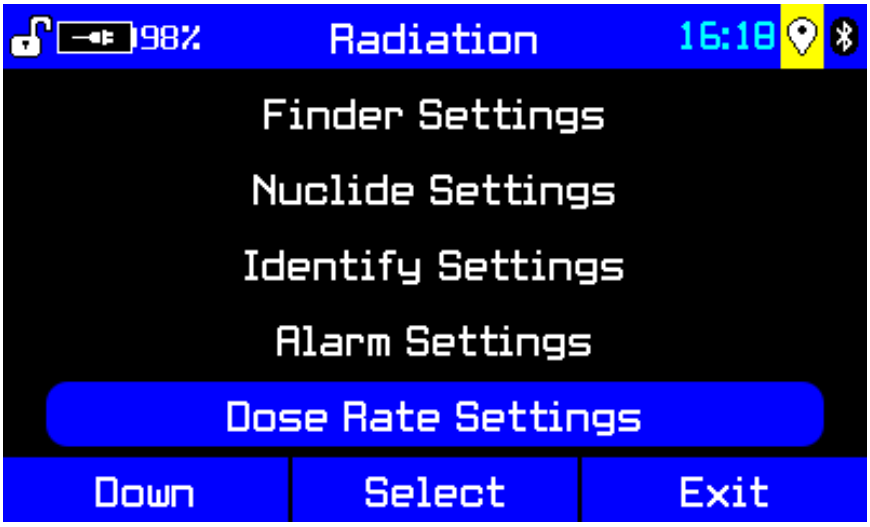


Figure 6-36: Navigating to Dose Rate Settings screen

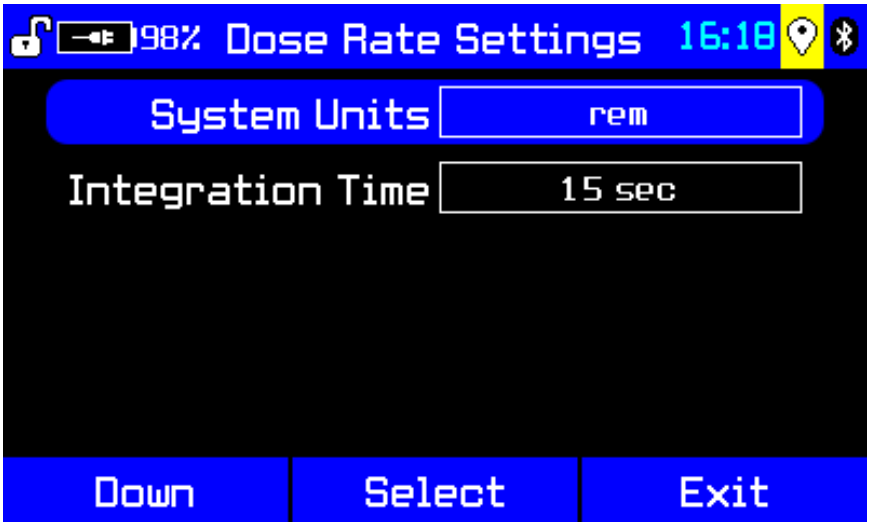


Figure 6-37: Dose Rate Settings screen

Settings and Commands - Dose Rate Settings screen	
System Units*	Select the base unit for the display of dose rates. This setting influences **all** displays of dose and dose rate values, such as the display of dose alarm thresholds. Options are: • **Sievert** is a derived unit according to the International System of Units and the legally prescribed unit in many jurisdictions. • **rem** (Röntgen equivalent man) combines the amount of energy (from

Settings and Commands - Dose Rate Settings screen	
	any type of ionizing radiation that is deposited in human tissue) along with the medical effects of the given type of radiation. For beta and gamma radiation, the dose equivalent is the same as the absorbed dose. By contrast, the dose equivalent is larger than the absorbed dose for alpha and neutron radiation, because these types of radiation are more damaging to the human body. The dose equivalent (in rems) is equal to the absorbed dose (in rads) multiplied by the quality factor of the type of radiation [see Title 10, Section 20.1004, of the Code of Federal Regulations (10 CFR 20.1004), "Units of Radiation Dose"].  100 rem = 1 Sv *Information from United States Nuclear Regulatory Commission website, https://www.nrc.gov/reading-rm/basic-ref/glossary/rem-roentgen-equivalent-man.html, 2019.
Integration Time	The identiFINDER R425 calculates a moving average to reduce fluctuation in the dose rate display. Choose the interval for the averaging in seconds. Specify a value between 1 s and 50 s. The longer the duration, the less fluctuation is displayed. The recommended value is 3 s.  If dose rates go up to high values fast, the R425 drops the averaging so that alerts will be produced more quickly.

6.6 Service Menu

The Service menu contains the following commands:

- **System Info** displays information about your identiFINDER R425 unit.
- **Self Test** (p. 101) allows you to conduct different system tests.
- **GPS Status** (p. 103) displays geospatial information and date/time from the GPS unit.
- **Edit Password** (p. 104) enables you to change or remove the device password.
- **Calibration** (p. 106) allows you to check the instrument's calibration and adjust the gain if necessary.

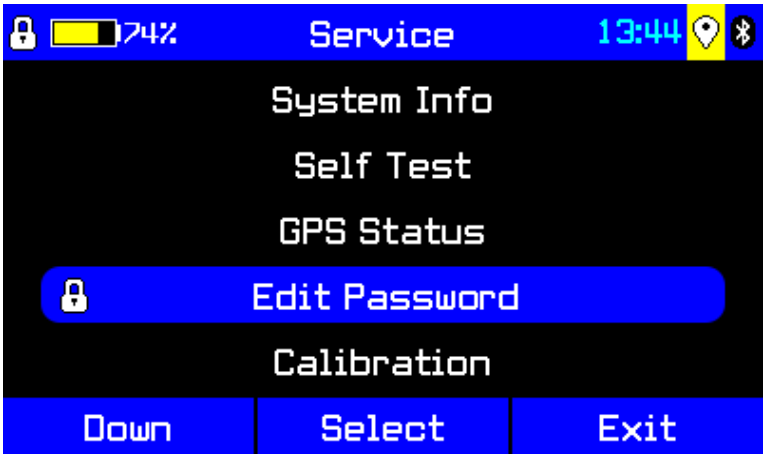


Figure 6-38: identiFINDER R425 Service menu

6.6.1 System Info

Service | System Info

This command displays system status and version information for the identiFINDER R425. Use the **L** (**Down**) and **M** (**Up**) commands to scroll through the information.

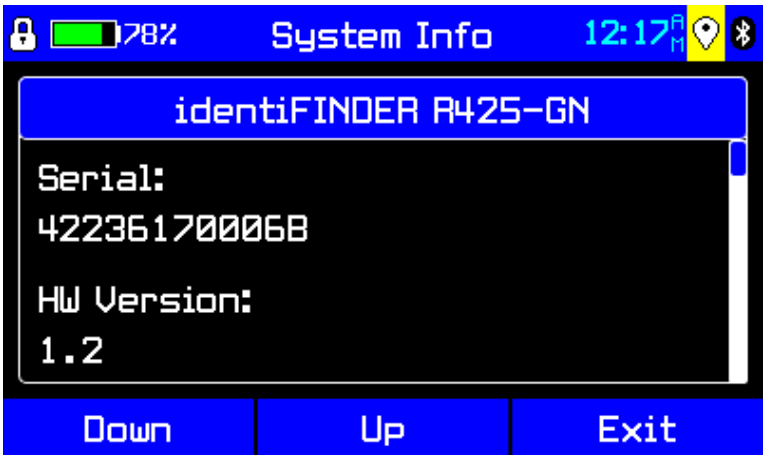


Figure 6-39: System Info screen 1: Serial number and hardware version

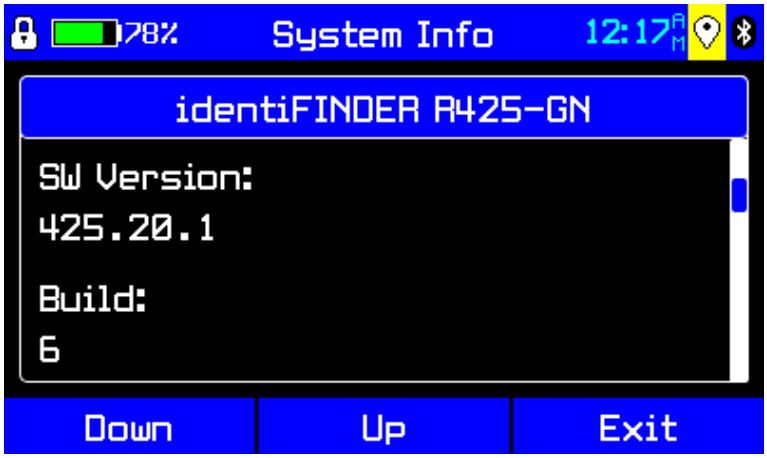


Figure 6-40: System Info screen 2: Software version and build numbers

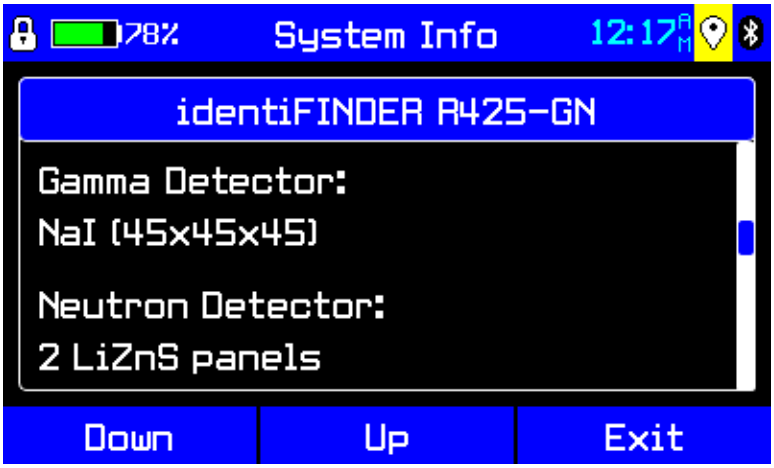


Figure 6-41: System Info screen 3: Gamma and neutron detector information

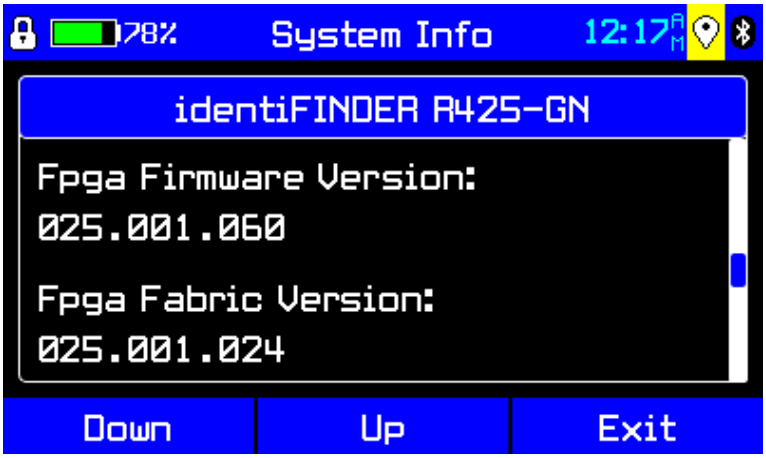


Figure 6-42: System Info screen 4: FPGA firmware and fabric versions

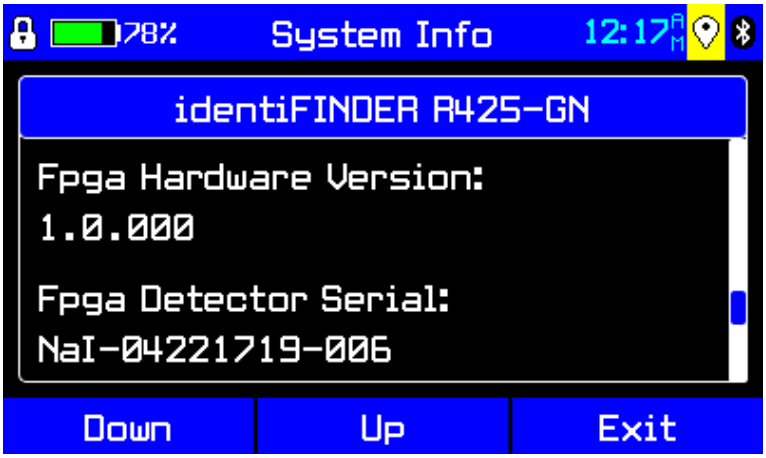


Figure 6-43: System Info screen 5: FPGA hardware and detector serial number

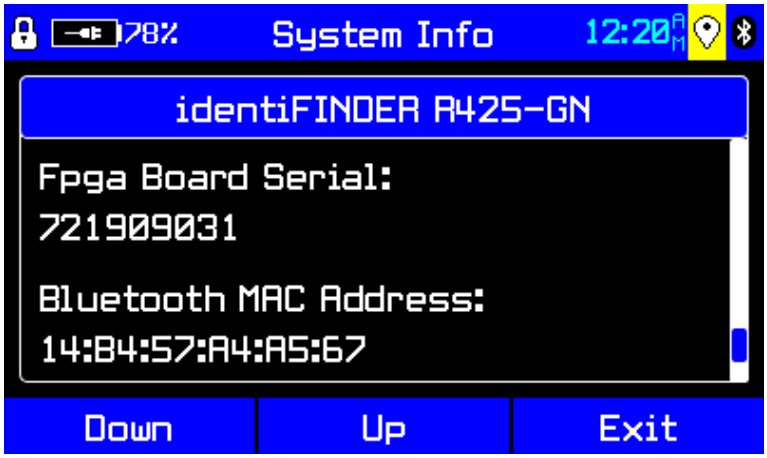


Figure 6-44: System Info screen 6: FPGA board serial number and Bluetooth MAC address

6.6.2 Self Test

Service | Self Test

This command tests the display screen and activates all types of alarm indicators to demonstrate their proper operation.

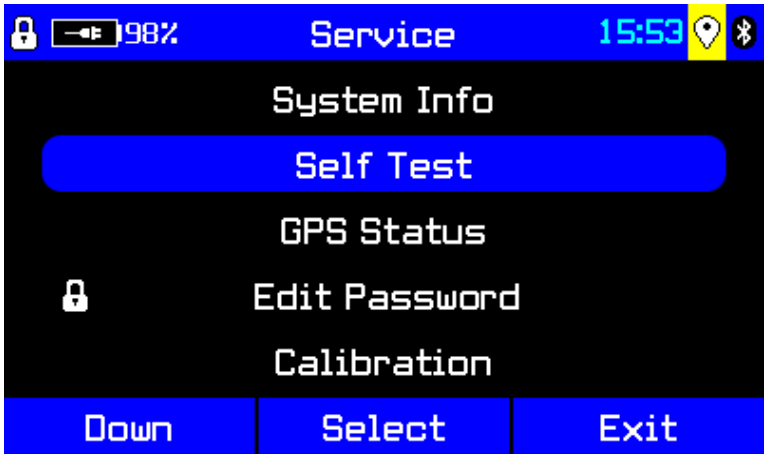


Figure 6-45: Self Test command on Service menu

Figure 6-46: Select **All** to test all functions listed below, or select an option to test individually

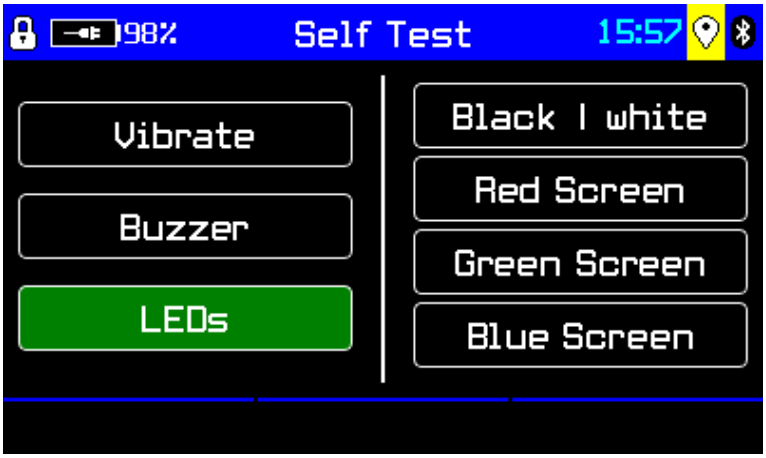


Figure 6-47: Testing the LEDs individually

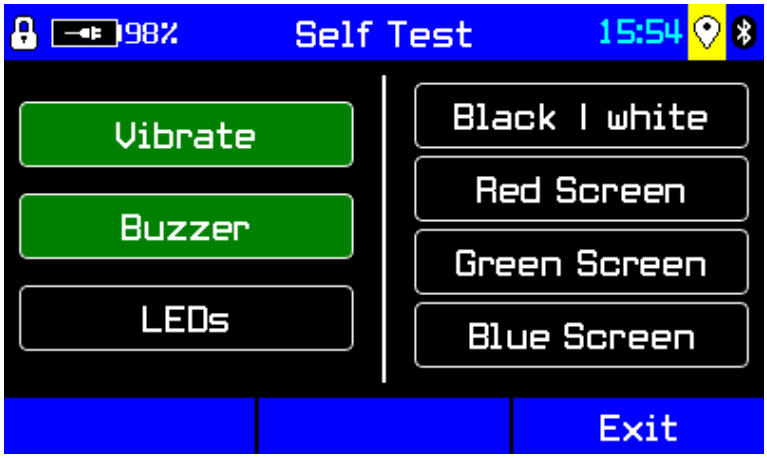


Figure 6-48: Testing all notifications:
The system has cycled through Vibrate and is verifying the buzzer

6.6.3 GPS Status

Service | GPS Status

Settings | General | Communications

This screen contains settings related to the identiFINDER R425's GPS receiver.

The GPS receiver draws a significant amount of power. Switch it off if it is not needed, especially while running on batteries.

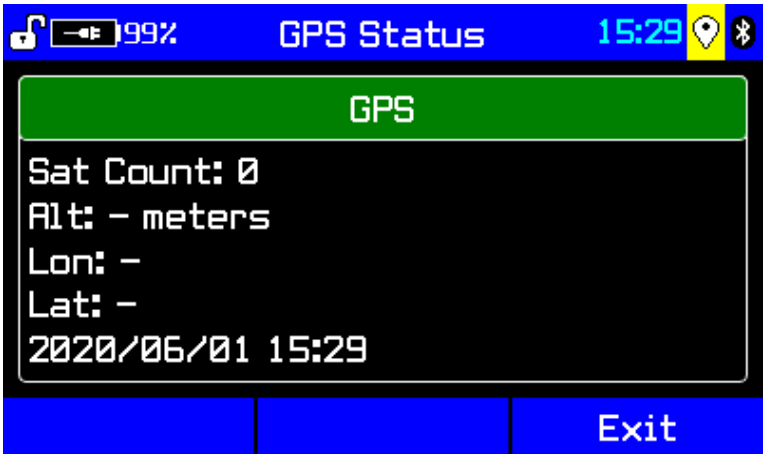


Figure 6-49: GPS Status screen

If the GPS receiver is on and the reception is good enough, the GPS coordinates of the current location are stored with alarms, spectra, identification results, etc.

If the GPS reception is not good enough, for example inside buildings, the current location cannot be determined. If a location could be determined from GPS data since you switched on the identiFINDER R425, the last valid location is used. Otherwise, the position of the intersection of the Greenwich Meridian with the Equator is used (0° N, 0° E).

Additionally, the clock of the R425 is set according to the high-precision time received from the GPS satellites.

6.6.4 Edit Password

Service | Edit Password

6.6.4.1 Change Password

Service | Edit Password | Change Password

Settings | Advanced | Change Password

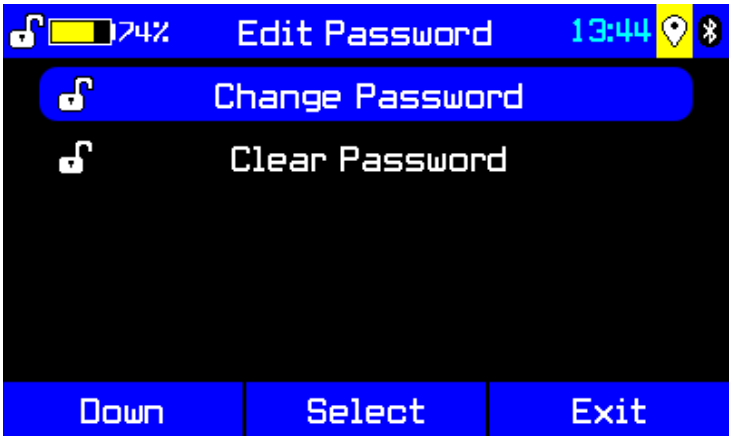


Figure 6-50: Edit Password menu

The **Change Password** command (Figure 6-50) lets you enter a new password consisting of seven key-strokes: different configurations of the direction keys, Left (L), Middle (M), and Right (R).

The default password for the identiFINDER R425, set at the factory, is `LMRLMRL`.

For better protection against unwanted changes of instrument settings, change the password to something else. If protection is not a requirement but faster access to the menus is desired, remove the password (see "Clear Password" on p. 105).

Make sure to remember the password that is set. There is no way to access the protected options and commands without it. A password cannot be deciphered at the factory.

To cancel entry of the password during entry, press the Power button briefly.

After the entry is complete, press **M** to change the password or **R** to cancel the password modification.

6.6.4.2 Clear Password

Service | Edit Password | Clear Password

This command removes the password. If you clear the password, all commands normally requiring a password to be accessed will be freely available.

When you select **Clear Password** from the Edit Password menu, a prompt displays asking you to confirm with yes or no (Figure 6-51). Press **M** to clear the password or **R** to cancel and return to the Edit Password menu.

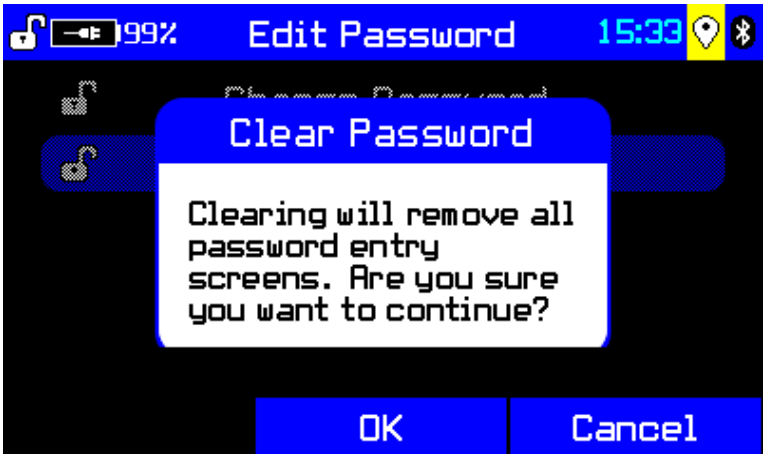


Figure 6-51: Removing the password

6.6.5 Calibration

Service | Calibration

The calibration menu enables you to select from a list of reference sources to both check the energy calibration of the identiFINDER R425 and adjust it if needed.

Due to the advanced internal calibration and stabilization technology of the R425, it is not necessary to routinely calibrate the instrument. However, FLIR recommends that the calibration be checked periodically and adjusted if needed, especially if the instrument has been in storage. Adding a calibration check to routine maintenance functions or quality assurance check lists is also a good practice.

6.6.5.1 Calibration procedure

To execute a calibration check and adjustment:

1. Place a source of 37 kBq (≈1 µCi) about 5 cm (2 in.) in front of the detector as shown in Figure 6-52. If the source is weaker or stronger, you can adjust the distance to achieve a desired count rate.

Figure 6-52: Recommended arrangement for calibration with an external ^{137}Cs source

2. Highlight the name of the source you are using on the Calibration menu (Figure 6-53).

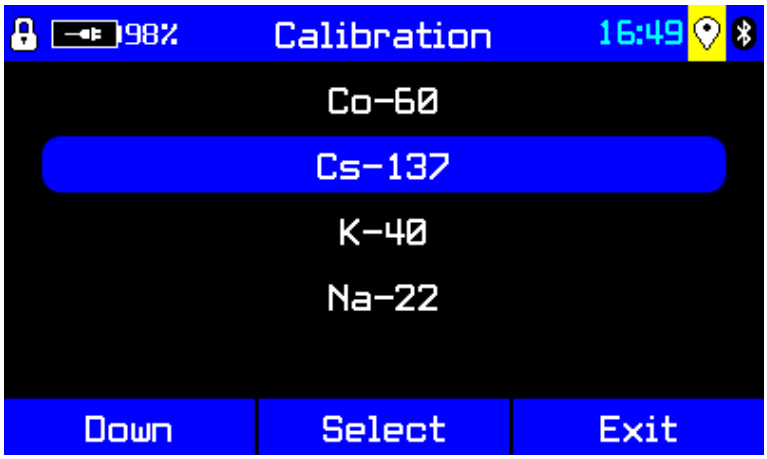


Figure 6-53: Calibration menu

^{40}K is a naturally occurring nuclide that contributes significantly to natural background radiation and can be used for detector calibration. However, the^{40}K concentration on the Earth's surface is low, meaning the calibration measurement will require more time (~5 minutes or more) to obtain a level of counts in the 1460 keV peak that will allow you to make a reliable assessment of the calibration status and any needed adjustment.

See "Appendix C: Nuclide Library" on p. 169 for more information about the nuclides.

3. Press the **M** key to select the source you want from the menu. When the source is detected, a screen similar to Figure 6-54 appears.

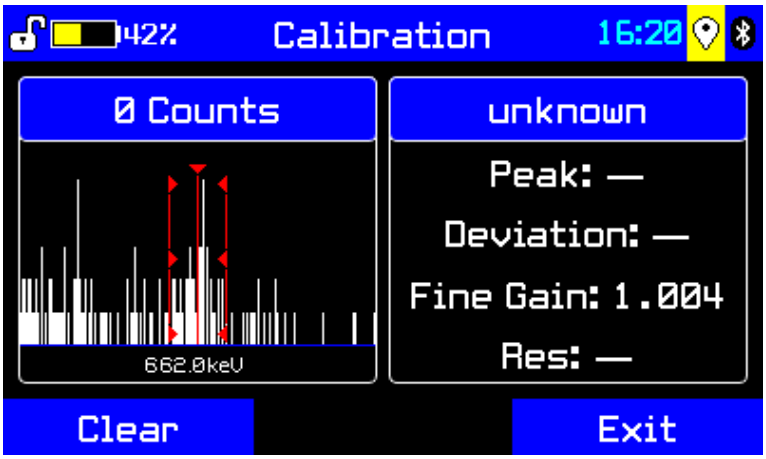


Figure 6-54: Calibration check begins

4. Wait for the R425 to allow sufficient counts to accumulate to ensure a good centroid calculation for a calibration adjustment (if needed). As the region of interest in the left pane becomes filled and the peak has enough counting statistics, the peak centroid, deviation, fine gain, and resolution will display in the right pane and the **Calibrate** button will enable (Figure 6-55). For more information on the calculations displayed, see
   - You can press **L** (**Clear**) to clear the histogram, allowing a fresh set of data to be collected, or **R** (**Exit**) to return to the previous menu with no effect on the calibration.

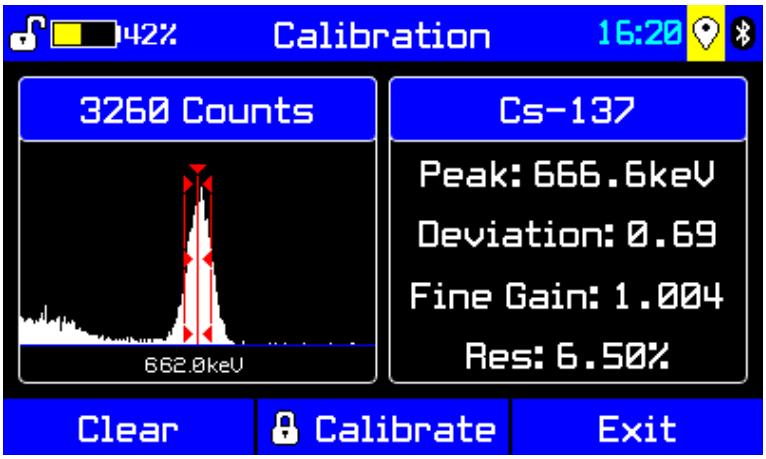


Figure 6-55: Calibration parameters calculated

5. In Figure 6-55, we can see that the peak position has shifted by 4.6 keV from the desired location of 662 keV. To make the adjustment, select **Calibrate** and enter the password at the prompt.
6. A message will display to confirm that the calibration adjustment is complete (Figure 6-56). Select **OK** to dismiss the message and view the calibration adjustment (Figure 6-57).

Figure 6-56: Calibration adjustment completed

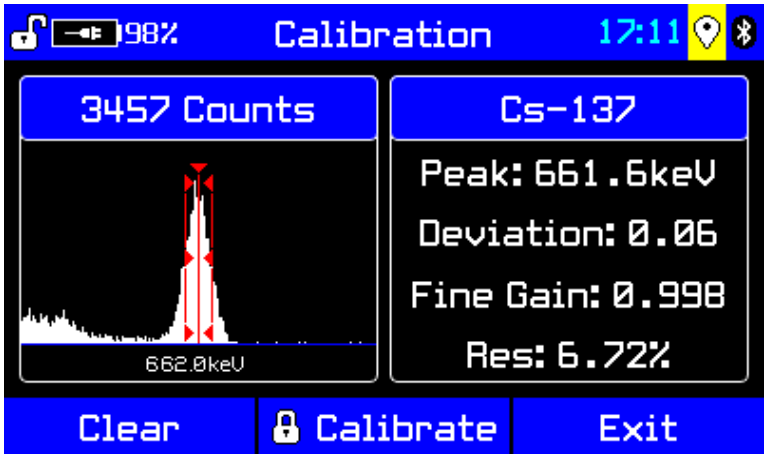


Figure 6-57: Calibration adjustment successful

Calibration Parameters	
Peak	Position of the measured peak (in keV).
Deviation	Deviation of the peak's measured position from its theoretical position.

Calibration Parameters	
Fine Gain	Fine gain is the software adjustment applied to correct deviations between the measured and theoretical peak position. The fine gain is impacted by temperature, age, and crystal material characteristics. The optimal fine gain value at room temperature is 1. An alert will display if the fine gain is outside the optimal range established at the factory. Contact the service team if this occurs (see "B.3: Service and Support" on p. 167).
Resolution	Also referred to as the FWHM (Full-Width at Half-Maximum), the resolution is a peak characteristic that can be used to assess the quality of a detector.

6.7 Data Menu

The Data menu contains the following items:

- **Settings** (p. 115)
- **Saved Spectra** (p. 113)
- **Counters** (p. 110)
- **Data Logging** (p. 115)
- **Clear Data** (p. 117)

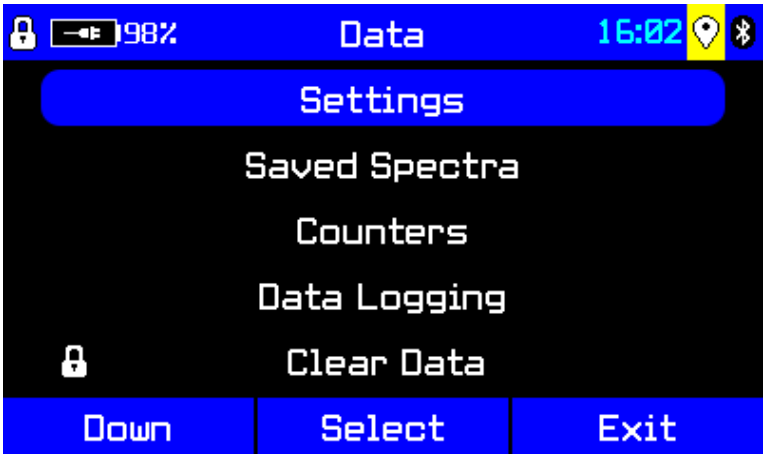


Figure 6-58: Data menu

6.7.1 Radiation Counters

Data | Counters

This command displays gamma, neutron (if available on your model), and accumulated dose counters.

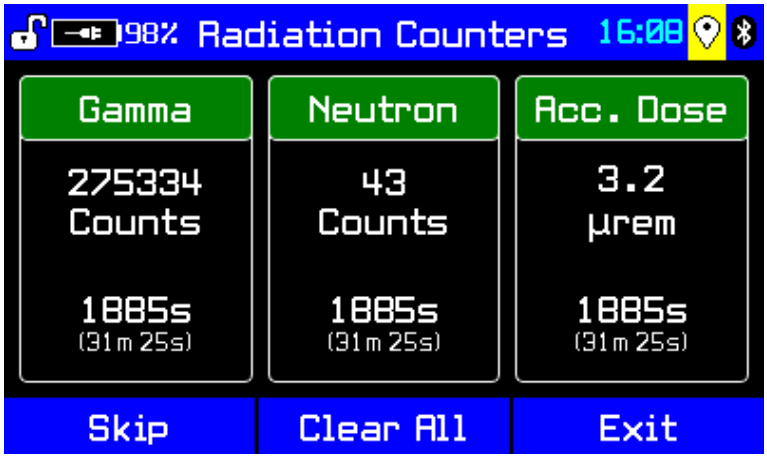


Figure 6-59: Radiation Counters screen: Use **Clear All** to clear all counters

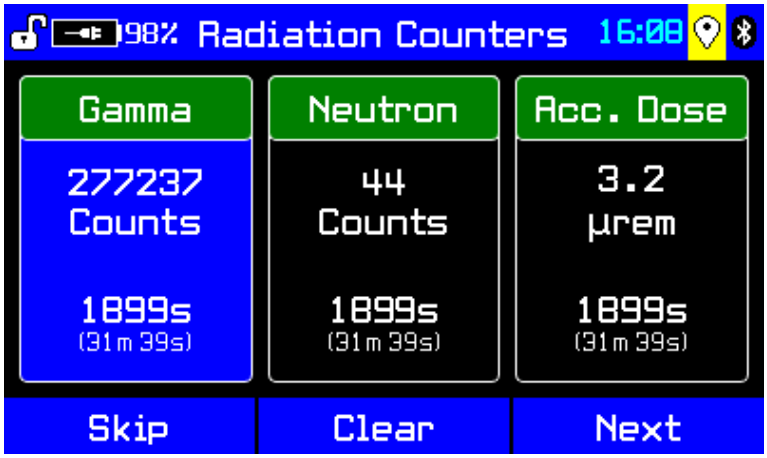


Figure 6-60: Gamma counter information (highlighted in blue)

Use **Clear** to restart the count at zero, or **Next** to highlight a different counter. **Skip** provides more options.

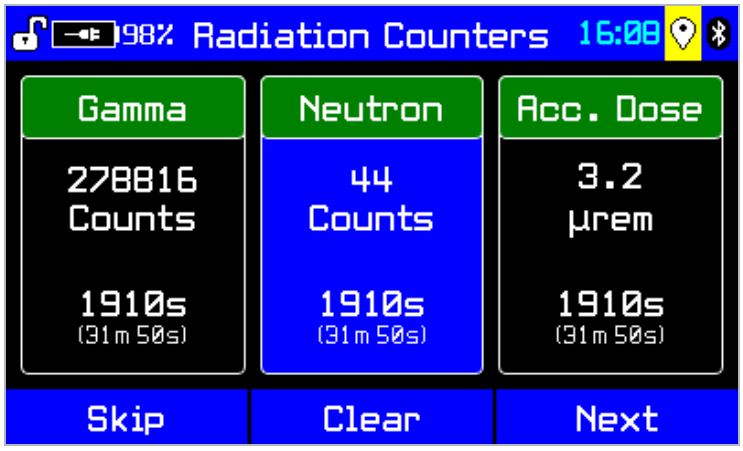


Figure 6-61: Neutron counter information (highlighted in blue)

The counters for gamma and neutrons (if available) are reset when the identiFINDER R425 is switched off, or when the **Clear** or **Clear All** command is used (see below).

The accumulated dose counter keeps accumulating data until the **Clear All** command is used (see below).

Settings and Commands - Radiation Counts screen	
Gamma Counts	The accumulated gamma counts.
Neutrons*	The accumulated neutron counts.
Accumulated Dose	The accumulated gamma dose rate during operation of the R425.
Counting Duration	The time interval over which gamma and neutron* counts and gamma dose are accumulated.
Clear	Clears the accumulated counts and time for the selected counter.
Pause All	Pauses accumulation for all counters.
Clear All	Clears the accumulated counts and time for all counters.

*Available on models with neutron detection.

6.7.2 Saved Spectra

Data | Saved Spectra

This command allows you to view previously collected spectra directly from the identiFINDER R425 without connecting to an external computer and using the web interface.

Selecting the **Saved Spectra** command from the Data menu displays a list of saved spectra (Figure 6-62).

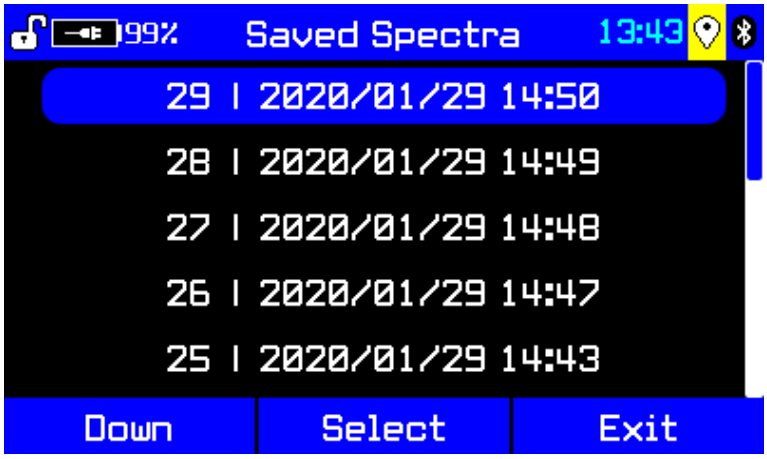


Figure 6-62: Saved Spectra screen

Select a spectrum from the list to view the identification result for the spectrum (Figure 6-63).

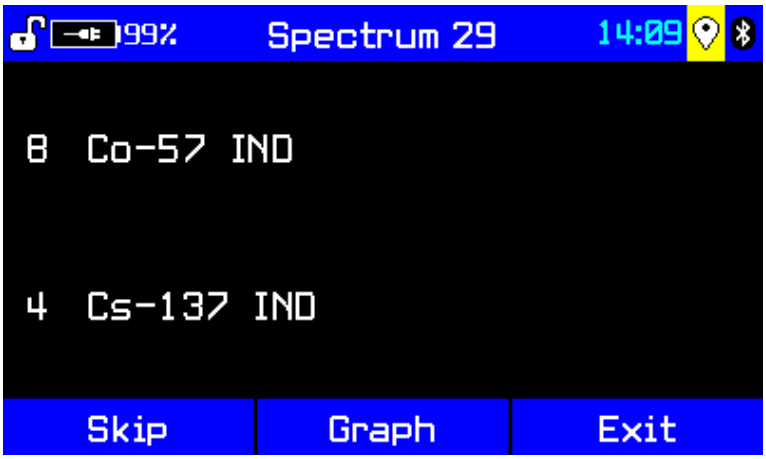


Figure 6-63: Spectrum ID result

Press **M** (**Graph**) from the ID result screen to view a graph of the spectrum (Figure 6-64).

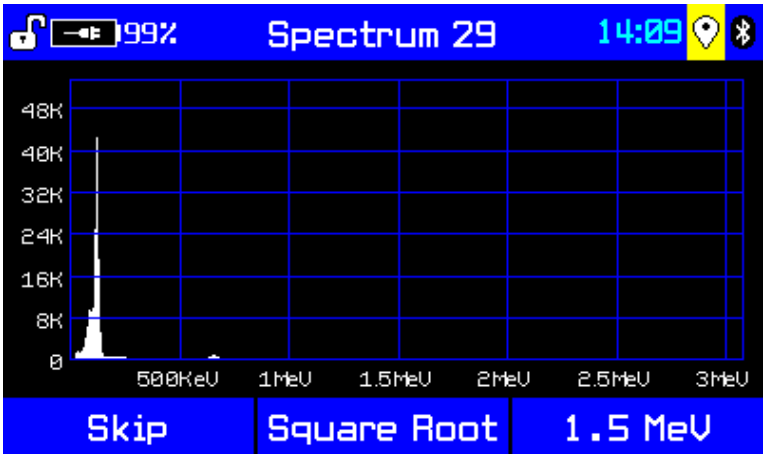


Figure 6-64: Spectrum graph

Press **L** (**Skip**) to view different commands available for viewing the spectrum, including the ability to zoom in on a peak and view associated data (Figure 6-65).

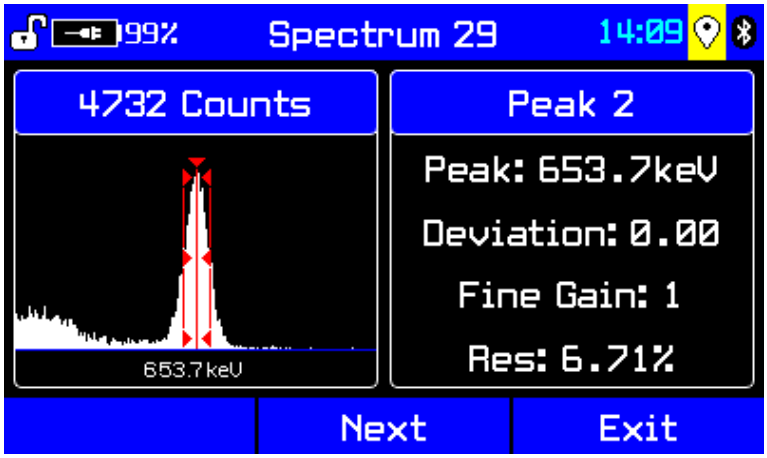


Figure 6-65: Peak data

6.7.3 Data Logger and Data Settings

Data | Data Logging
Data | Data Settings

Data | Data Logging

The identiFINDER R425 can log measured dose rate values periodically.

*If the product is equipped with a neutron detector, the neutron counts are logged as well.

The values are recorded during a period (the *datalog interval*) specified in the Data Settings screen (**Data | Settings**; see Figure 6-66). The start time, end time, minimum, average, and maximum values for each period are saved in sets of up to 1000 datalog intervals.

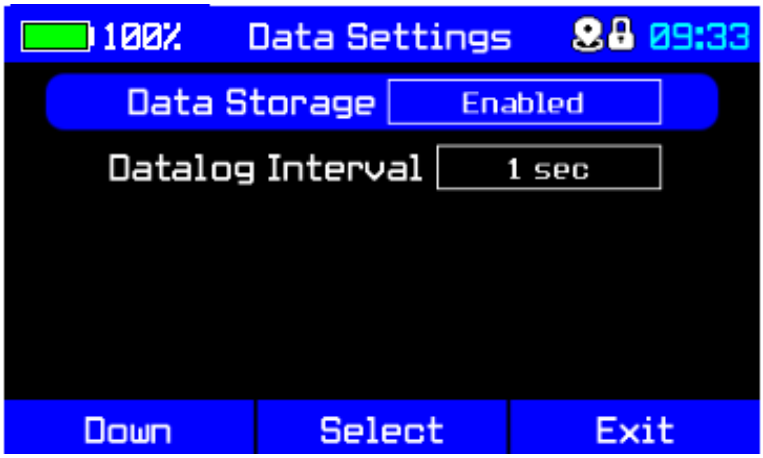


Figure 6-66: Enable or disable data storage and set the datalog interval in Data Settings

Data viewing is available on the R425 by selecting **Data | Data Logging** (see Figure 6-67), but for a better view, use an external computer connected to the R425 (see p. 140).

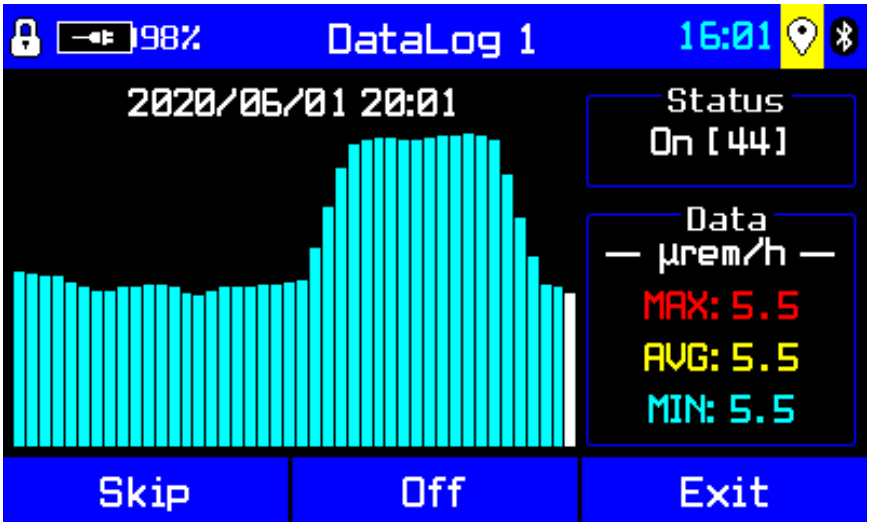


Figure 6-67: Logging data to memory: individual records are represented by the bars; use Skip, then Left or Right to scroll individual records

Refer to "Clear All Datalogs" on p. 120 for information about deleting logged data.

Settings and Commands - Data Settings screen	
Data Storage	Select **Enabled** to turn on data storage or **Disabled** to turn it off.
Datalog Interval	Choose one of the available time periods for data logging:

Settings and Commands - Data Settings screen	
	2 s, 5 s, 10 s, 20 s, 30 s, 1 min, 2 min, 5 min, 10 min, 20 min, 30 min.  It is not possible to edit the datalog interval while the data logger is running.

Settings and Commands - DataLogger screen	
Status	Displays status of Data Logger (ON or OFF).
Record Number (displayed beside Status)	The number needed to refer to this log for viewing. If the data are saved in multiple sets, the reference number of the first and last set are displayed here.
On/Off	Start the data logger. Data logging stops when you use the OFF command or when the R425 is switched off. If there is not enough free memory to log data, a prompt will display informing of the condition. Saved logs may be deleted (see p. 120) if necessary.
Left	Move the cursor to the left in the histogram. If you pass the left edge, the cursor wraps around to the right edge.
Right	Move the cursor to the right in the histogram. If you pass the right edge, the cursor wraps around to the left edge.
Neutron/ Dose Rate	Switch between viewing the dose rate and the neutron count rate* of logged data.

*Available for models equipped with neutron detection.

6.7.3.1 Clear Data

Data | Clear Data

Data | Spectra
Data | Alarms
Data | Data Logging
Data | Screenshots

Commands on the Clear Data menu (Figure 6-68) enable you to delete spectra, alarms, data saved by the data logger, and screenshots from the identiFINDER R425's permanent memory.

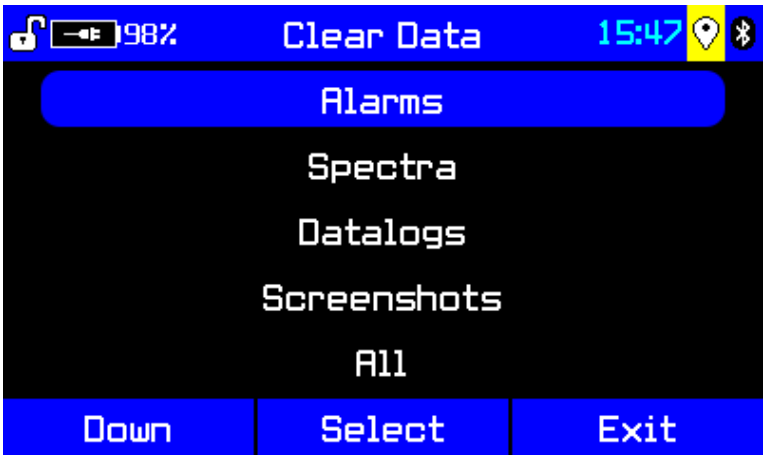


Figure 6-68: Clear Data menu

To delete data from the identiFINDER R425:

1. Select **Data | Clear Data** to display the Clear Data menu screen.
2. Press **L** (**Down** or **Up**) to highlight the category of data you want to delete. A confirmation message (Figure 6-69) will appear, asking if you want to delete the data.
3. Press **M** (**OK**) to delete the data from the R425's memory, or press **R** (**Cancel**) to cancel the deletion and return to the Clear Data menu.

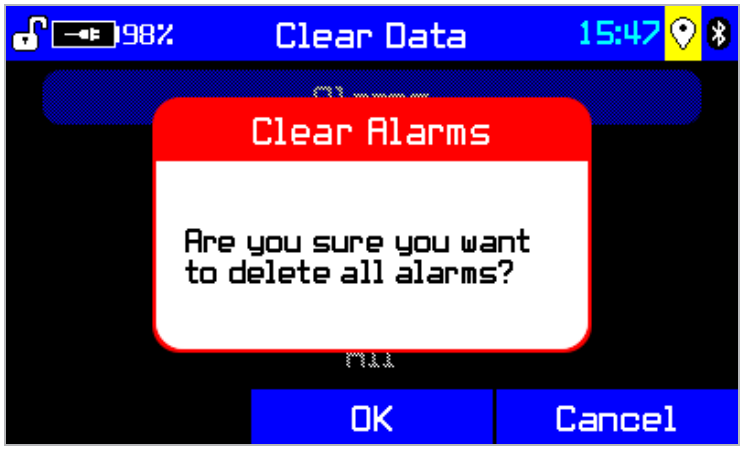


Figure 6-69: Confirmation screen for deleting alarm records

Using the web interface, you can select multiple spectra, alarms, datalogs or screenshots for simultaneous deletion or for download to an external computer. See Chapter 8.

6.7.3.1.1 Clear Alarms

Data | Clear Data | Alarms

Home | Data | Alarms

This command deletes all alarms saved in the identiFINDER R425's permanent memory.

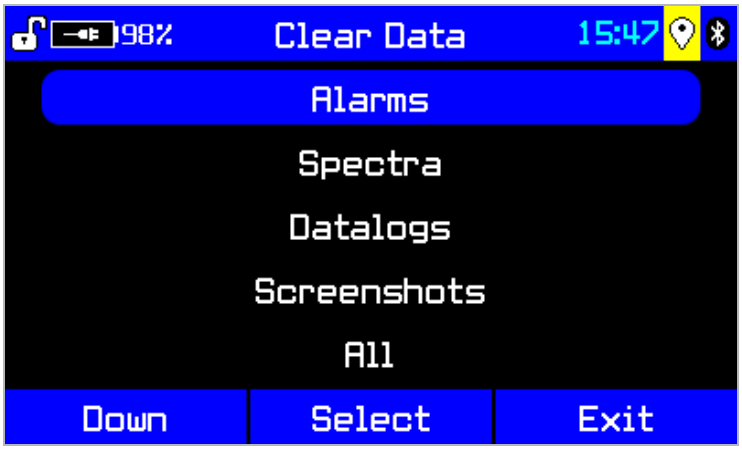


Figure 6-70: From the Clear Data menu, select Alarms to clear all saved alarms

6.7.3.1.2 Clear All Spectra

Data | Clear Data | Spectra

Home | Data | Spectra

This command deletes all spectra saved in the R425's database, including minimum/maximum/average for dose rate and neutron count*, GPS location, and identification, if any.

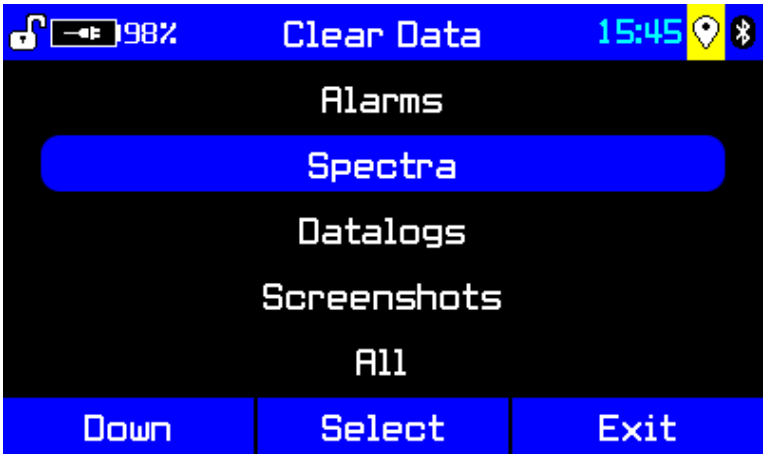


Figure 6-71: Select Spectra to clear all spectra

6.7.4 Clear All Datalogs

Data | Clear Data | Datalogs

Home | Data | Datalogs

This command deletes all data saved by the data logger from the identiFINDER R425's permanent memory.

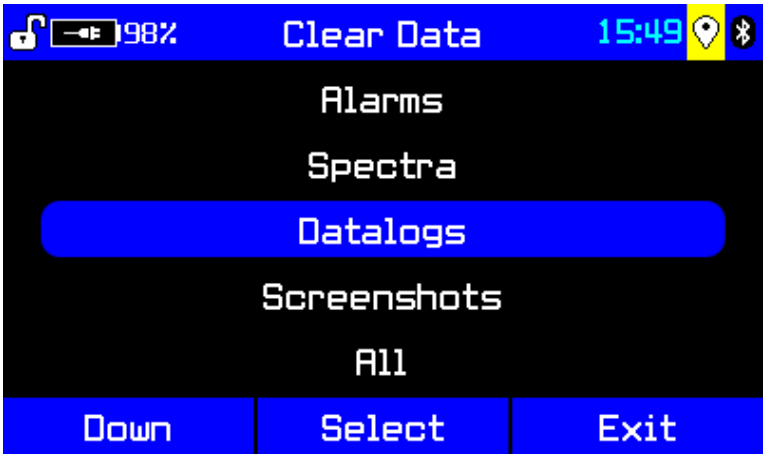


Figure 6-72: From the Clear Data menu, select Datalogs to clear all data logs

6.7.5 Clear Screenshots

Data | Clear Data | Screenshots

Home | Data | Screenshots

This command deletes all screenshots saved in the identiFINDER R425's permanent memory.

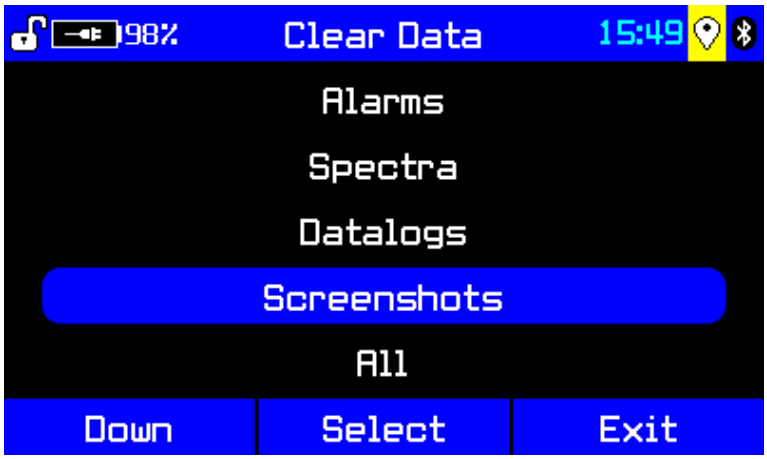


Figure 6-73: From the **Clear Data** menu list, select **Screenshots** to clear screenshots

6.7.5.0.1 Clear All Data

Data | Clear Data | All

This command deletes all spectra, alarms, data saved by the data logger, screenshots, and any inspector field calibration from the R425's permanent memory.

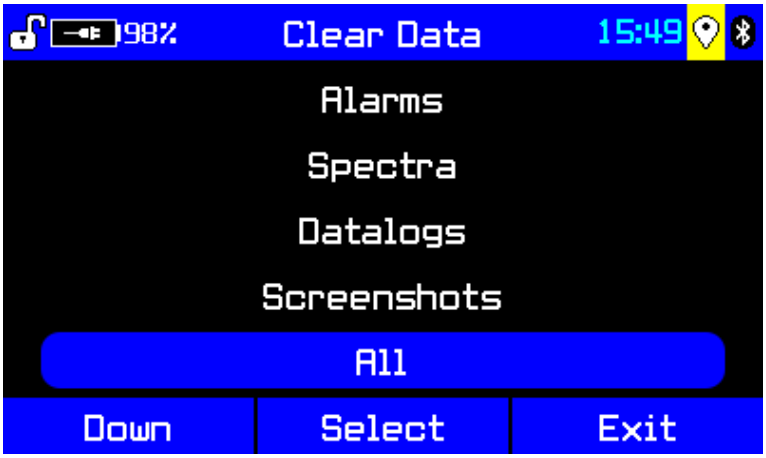


Figure 6-74: Clear all data

Figure 6-75: The system prompts the user for confirmation; press R (Cancel) to return to the Clear Data menu

7 Connecting to an External Computer

You can connect the identiFINDER R425'to an external computer via Universal Serial Bus (USB) or via Bluetooth.

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7.2 Connecting via USB 123
7.3 Connecting to a Wireless Device 124

7.1 Overview

Connections between the R425 and external devices serve several purposes:

- Energy supply: A computer or wall adapter can provide external power for running the R425 or charging the batteries. For more, see "Powering the R425" on p. 151.
- Data communication: The R425 supports several methods of data communication via USB and Bluetooth which are explained in this and the following chapter.
- Mass storage device: The R425 can be configured as a mass storage device to transfer data to the computer.
- Web server: The R425 can be configured as a web server, accessible in a web browser to download data or to operate the R425 and change its settings with the enhanced convenience of a large screen and a real keyboard. For more information on using the R425 as a web server, see Chapter 8.

Because the R425 itself acts as a web server, no special software other than a standard web browser is necessary. For some computer operating systems, however, installation of drivers for the connection is required.

7.2 Connecting via USB

The identiFINDER R425 draws a current of approximately 400 mA. Before connecting to a computer, ensure the USB outlet of the computer complies with this requirement. Some laptops or similar battery-powered devices may not be compliant.

The upper USB-C port (see Figure 7-1) on the front of the identiFINDER R425 may be used both for file transfer using a file manager (see "Mass Storage," p. 124) and for connecting to the R425 web interface.

The lower USB-C port (see Figure 7-1) may be used to connect to the web interface.

Both ports may be used for charging. See Chapter 9 for more information on powering and charging the instrument.

To connect the R425 to an external device via USB, connect the USB cable included in your identiFINDER R425 kit from one of the USB-C ports on the R425 (Figure 7-1) to a USB-A port on the computer.

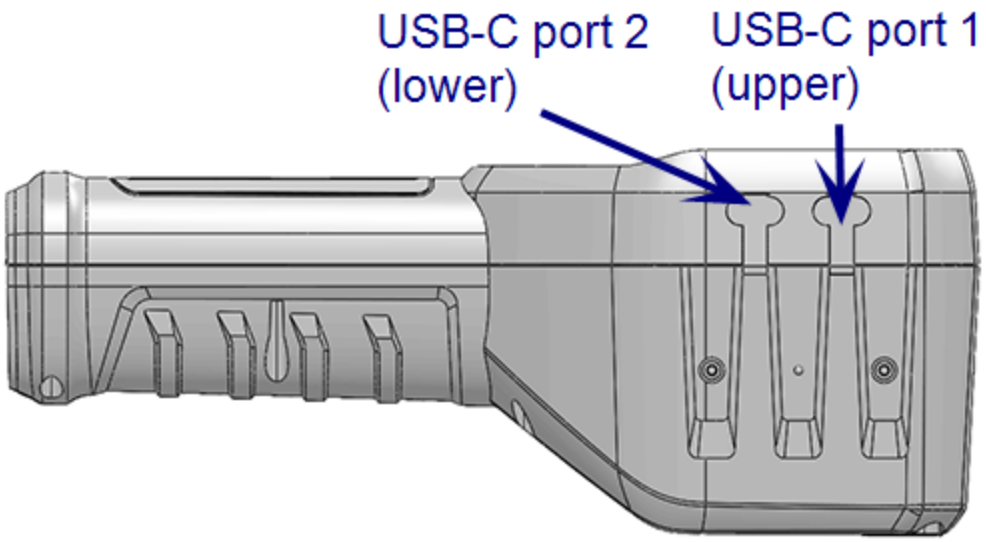

Figure 7-1: Location of USB-C ports on R425

7.2.1 Mass Storage

The R425 can be used as a mass storage device in that files such as spectra or screenshots may be moved between a PC and the device.

When using the R425 as a mass storage device, you may either manage files on the device via the web interface or manage them using a file browser such as Windows® File Explorer or GNOME® Files.

To manage stored files using a file browser, you must connect the R425 to the external device using the USB port #1, on the **front** of the instrument.

7.3 Connecting to a Wireless Device

Before connecting your R425 to a wireless device, you should review your Bluetooth settings (6.4.2.2 on page 73).

1. From the home (Dose Rate) screen of the R425, select **Options** to display the Main Menu, then select **Device | Connect** to display the Bluetooth menu (Figure 7-2).

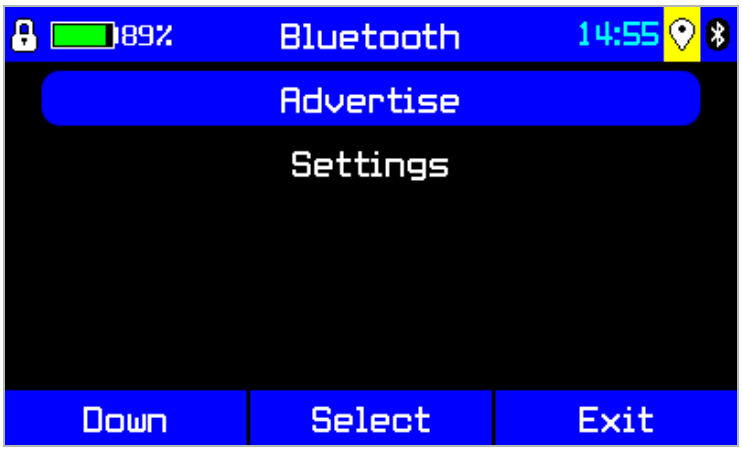

Figure 7-2: R425 Bluetooth menu

2. Select **Advertise**.
3. The screen will display the prompt "Advertise as [Device ID number]". Note the device ID number, which you will need for a later step.
4. Press **M** (**Yes**) to make the R425 available for pairing with an external device (Figure 7-3).

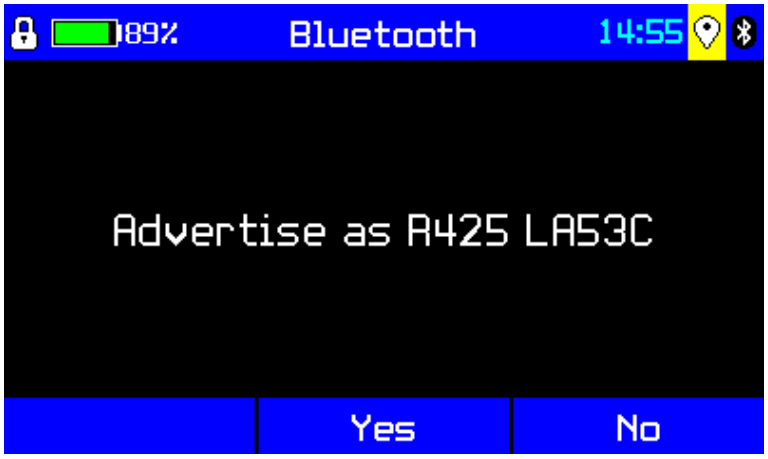

Figure 7-3: Press the M key (Yes) to make the R425 discoverable

5. A confirmation message will display. Press **R** (**Cancel**) to clear the message, then continue pressing **R** (**Exit**) until you return to the R425 home screen.
6. In the Bluetooth settings of the device you want to pair, locate the device ID from step 3 and select it to complete the pairing process.

8 Using the Web Interface

This chapter describes the identiFINDER R425 web interface. The web interface provides a way to use the R425 with the added convenience of a larger screen and a keyboard.

8.1 Accessing the Web Interface 126
8.2 The Main Menu 127
8.3 Settings in the Web Interface 128
8.4 Data Menu 134
8.5 Live Screen 144
8.6 Live Spectrum 145
8.7 Admin Menu 146
8.8 Printing Web Pages 150

8.1 Accessing the Web Interface

To access the R425 web interface:

1. Connect the identiFINDER R425 to a computer with the included USB cable via one of the two USB ports on the device, as described in Chapter 7
2. Open one of the following supported web browsers and navigate to http://r425.local to display the home page (Figure 8-1):
    - Microsoft® Internet Explorer® (IE), version 11 or above
    - Mozilla® Firefox®
    - Google Chrome™

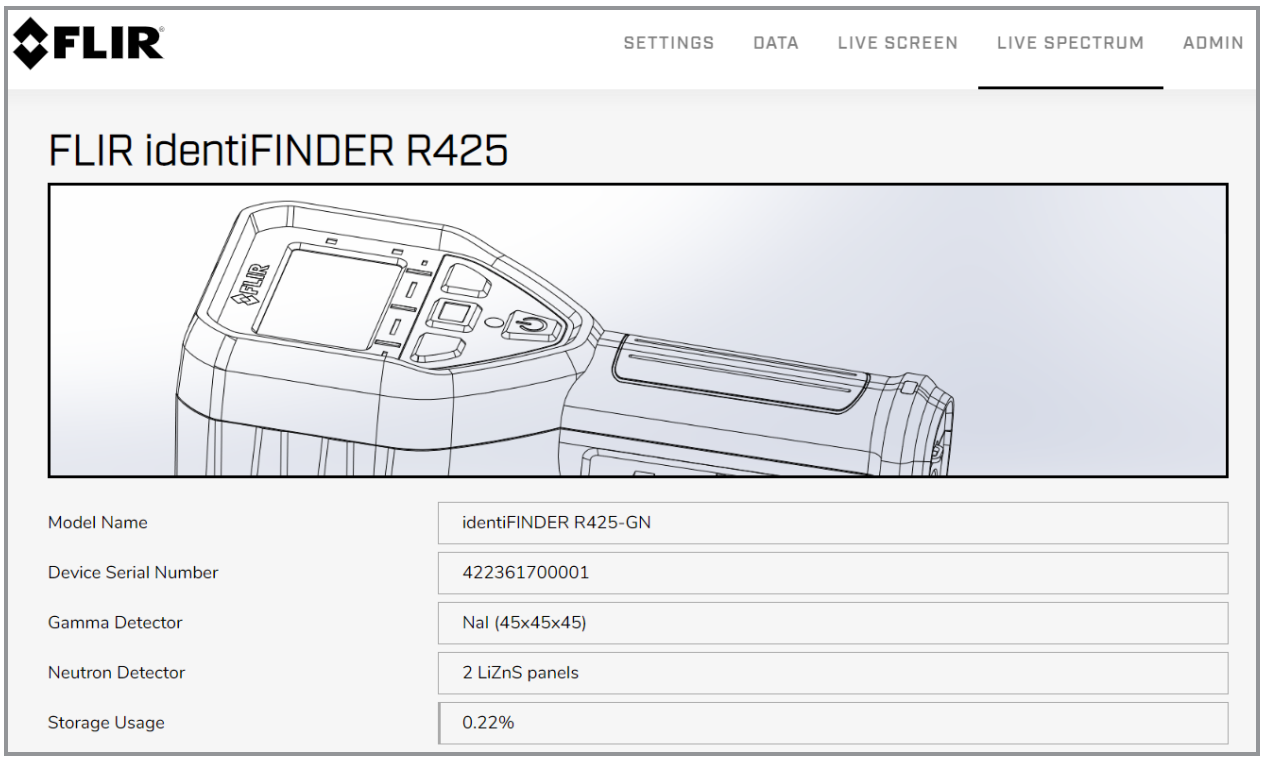

Figure 8-1: R425 web interface: Home page

8.2 The Main Menu

The following commands and submenus are included on the main menu of the identiFINDER R425 web interface (see Figure 8-1).

Settings and Commands - R425 Web Interface Main Menu	
Home	Return to the home screen at any time by clicking the FLIR logo in the upper-left corner of the page.
Settings	Categories of settings include General, Advanced, or Backup. For more information, see p. 128.
Data	Commands on the Data menu allow you to inspect and download data from the device (p. 134).
Live Screen	From this menu you can remotely control screens and buttons on the R425 (p. 144).

Settings and Commands - R425 Web Interface Main Menu	
Live Spectrum	Use this menu to view and analyze spectra on the R425 (p. 145).
Admin	Use commands on this menu to manage the R425 and install software updates (p. 146).

8.3 Settings in the Web Interface

When you click on the Settings menu from the home page of the R425 web interface, you can select from the following options:

- **General** (p. 129)
- **Advanced** (p. 132)
- **Backup** (p. 134)

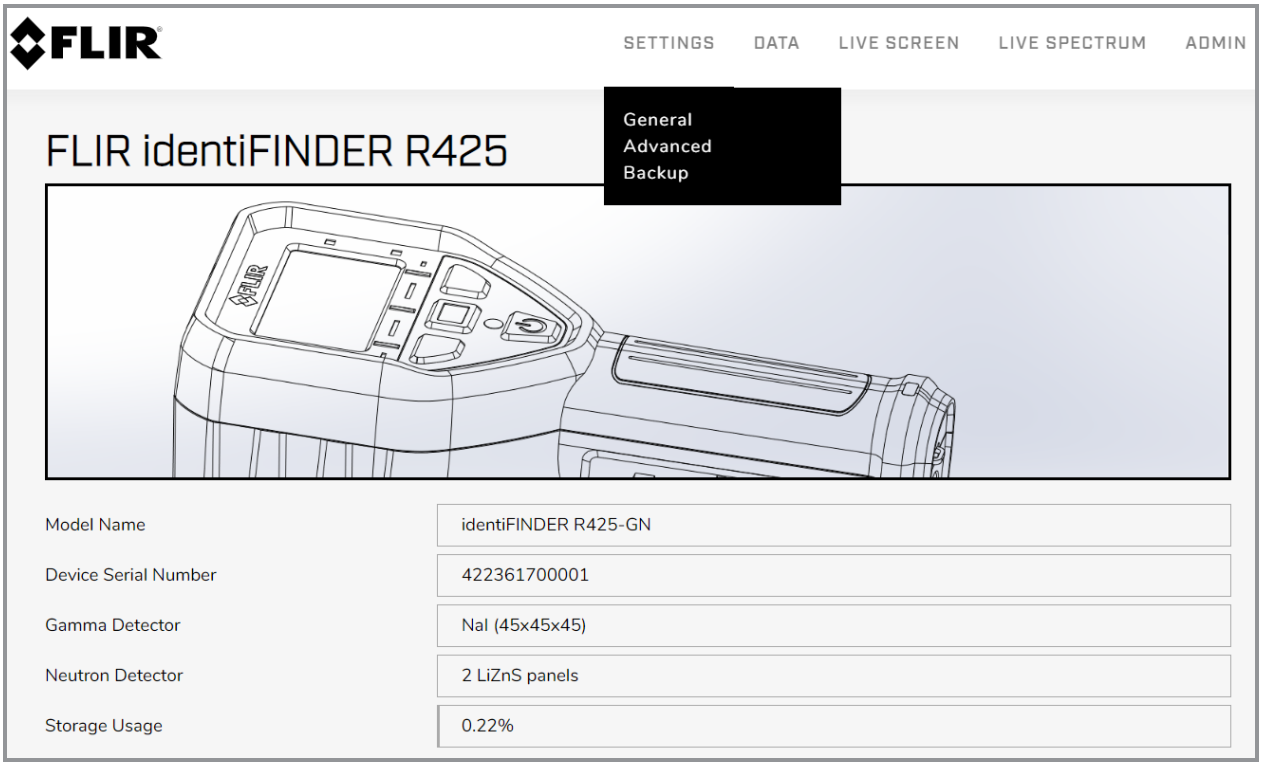

Figure 8-2: R425 web interface: Settings menu

8.3.1 Settings | General

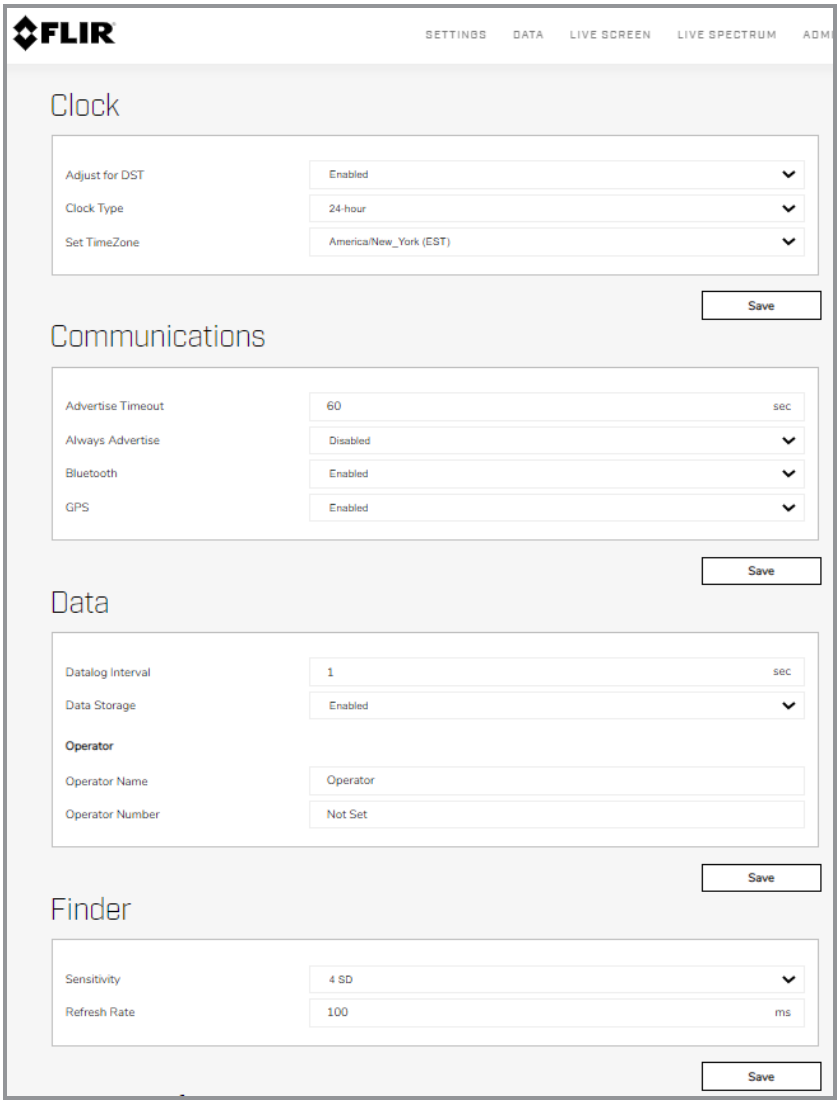

Figure 8-3: Partial view of Settings page in R425 web interface

8.3.1.1 Clock

Set the clock parameters here, including **Daylight Savings Time (DST), Clock Type** , and the **Time Zone**. For more information on these settings, see section 6.4.5, "Clock Settings" on p. 77.

8.3.1.2 Communications

Adjust communications options from this section, including Bluetooth and GPS connections. For more information, see section 6.4.2.2, "Bluetooth Settings" on p. 73 and section 6.6.3, "GPS Status" on p. 103.

8.3.1.3 Data

This section contains datalog settings (see "Data Logger and Data Settings," p. 115) and operator settings (see section 6.4.4, "Records" on p. 76).

8.3.1.4 Finder

Options available in this section include enabling or disabling **Finder Mode**, setting the **Finder Sensitivity**, and setting the**Refresh Rate**. For more information on these settings, see section 6.5.1, "Finder Settings" on p. 80.

For the following sections, refer to Figure 8-4.

8.3.1.5 User Interface

In this section, you can set controls such as:

- Language
- Key Feedback
- Brightness
- Volume
- Audible, Tactile, Visual (enable or disable these kinds of feedback)
- Dose Rate Mode (set the default boot-up mode)
- System Units

For more information on most of these settings, see section 6.4.1, "Device Settings" on p. 70. For information on System Units, see section 6.5.5, "Dose Rate Settings" on p. 95.

8.3.1.6 Sync Time

The Sync Time section of the Settings page displays the current time setting for the R425 and the external device. Click **Sync** to synchronize the R425 clock to the external device's clock.

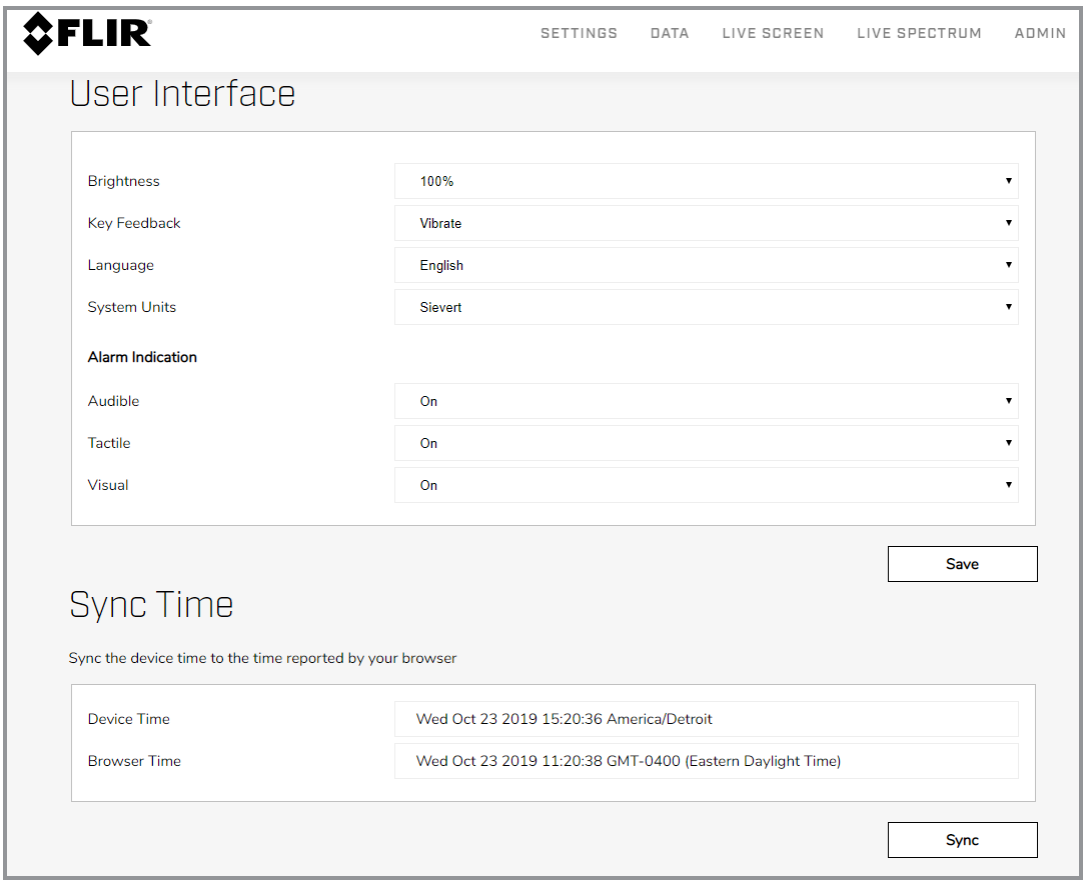

Figure 8-4: User Interface and Sync Time settings in the web interface

8.3.2 Settings | Advanced

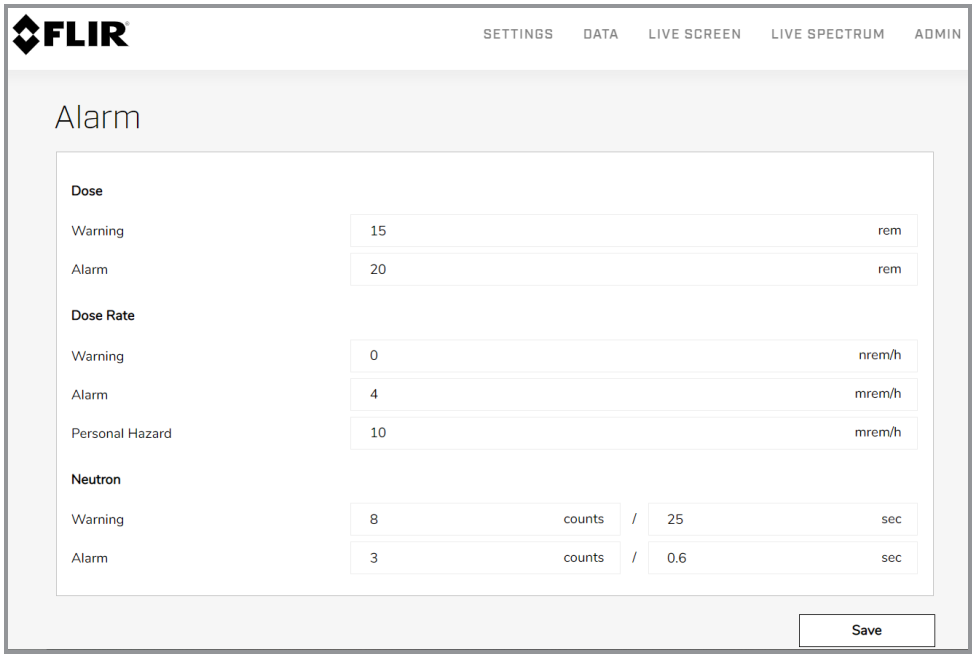

Figure 8-5: Initial view of Advanced Settings: Alarm settings

8.3.2.1 Alarm

Alarm-based parameters are set in the fields listed in this form. Items include:

- Dose warning threshold
- Dose alarm threshold
- Dose rate warning threshold
- Dose rate alarm threshold
- Dose rate personal hazard threshold
- Neutron warning threshold (counts per second)
- Neutron alarm threshold (counts per second)

8.3.2.2 Dose Rate

For more information on the settings in this section, see section 6.5.5, "Dose Rate Settings" on p. 95.

8.3.2.3 Level Mode

This section allows you to define nine dose rate levels that are used to measure radiation if the R425 is in Level mode. For more information, see section 6.5.4.4, "Level Thresholds" on p. 94.

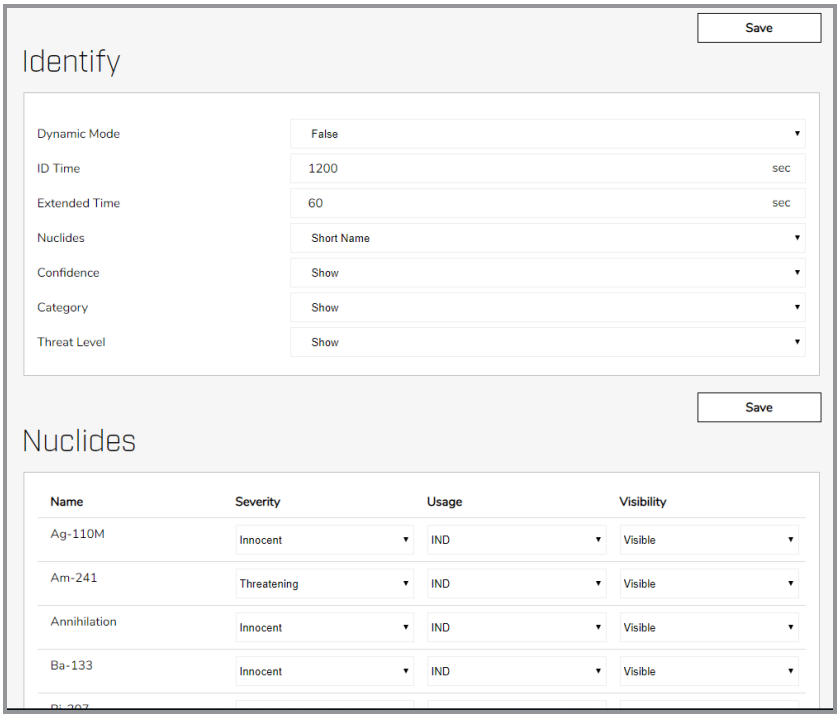

Figure 8-6: Advanced Settings page: Identify mode settings

8.3.2.4 Identify

Identify mode options include the following:

- Dynamic Mode
- ID Time
- Extended Time
- Nuclides
- Confidence
- Category
- Threat Level

For information on these settings, see section 6.5.3, "Identify Settings" on p. 86

8.3.2.5 Nuclides

Settings for ID Result screens in Identify mode can be defined here. For more information, see "Result Settings" on p. 87.

8.3.2.6 Change Password

To update the device password, enter it twice, then select **Save**. A prompt will direct you to log in again. The device password is a 7-character sequence of the characters `L`, `M`, and `R`. For more information, see

section 6.6.4, "Edit Password" on p. 104.

8.3.3 Settings | Backup

Click **Settings | Backup** to display the backup page shown in Figure 8-7.

The backup page in the R425 web interface allows you to download the settings file from the R425.Once a settings file is saved to an external device, you can upload it to other R425 devices to have consistent settings across multiple instruments.

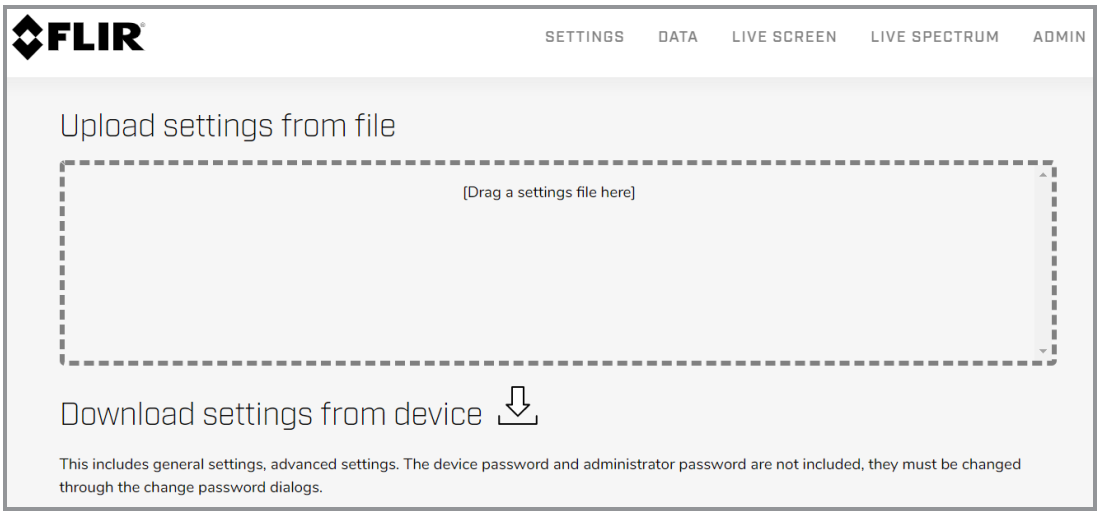

Figure 8-7: Backup page allows you to upload or download settings files

8.4 Data Menu

Items on the Data menu in the identiFINDER R425 web interface give you access to data records stored on the device. The records are organized into tables.

From the Data menu, the following pages are available

- Spectra (p. 134)
- Alarms (p. 136)
- Screenshots (p. 138)
- Datalogs (p. 140)
- Bulk Operations (p. 143)

8.4.1 Spectra

Data | Spectra

This web page displays the identification results stored in the R425's database.

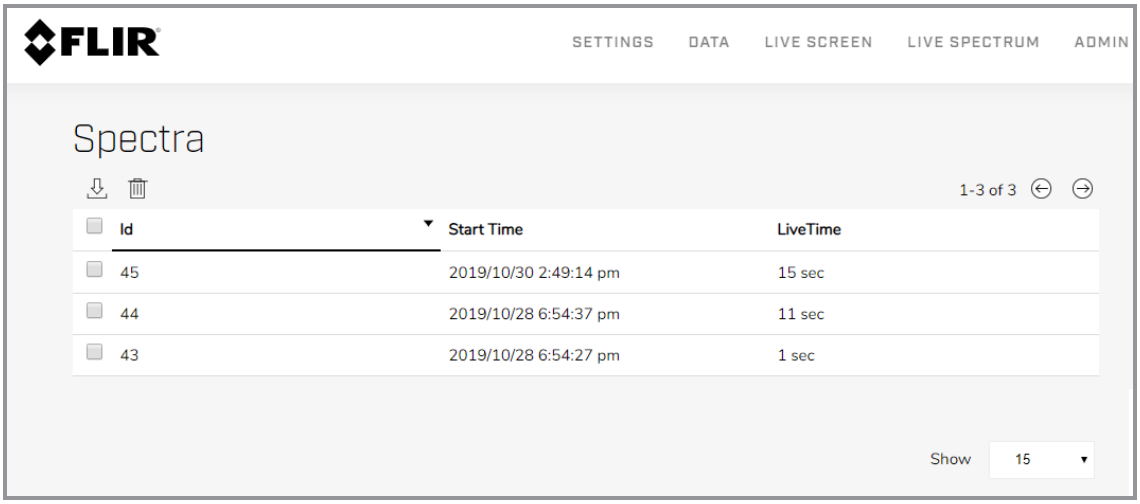

Figure 8-8: Table of identification results on the Spectra page

The Spectra table shows several columns for every spectrum record:

Columns - Spectra Table	
ID	Automatically generated reference number for the spectrum.
Start Time	The date and time data acquisition for the spectrum record was initiated.
Live Time	The amount of time the R425 was acquiring data to produce this spectrum record.

To view a spectrum record, double-click on the record in the Spectra table. A screen like the one shown in Figure 8-9 will appear.

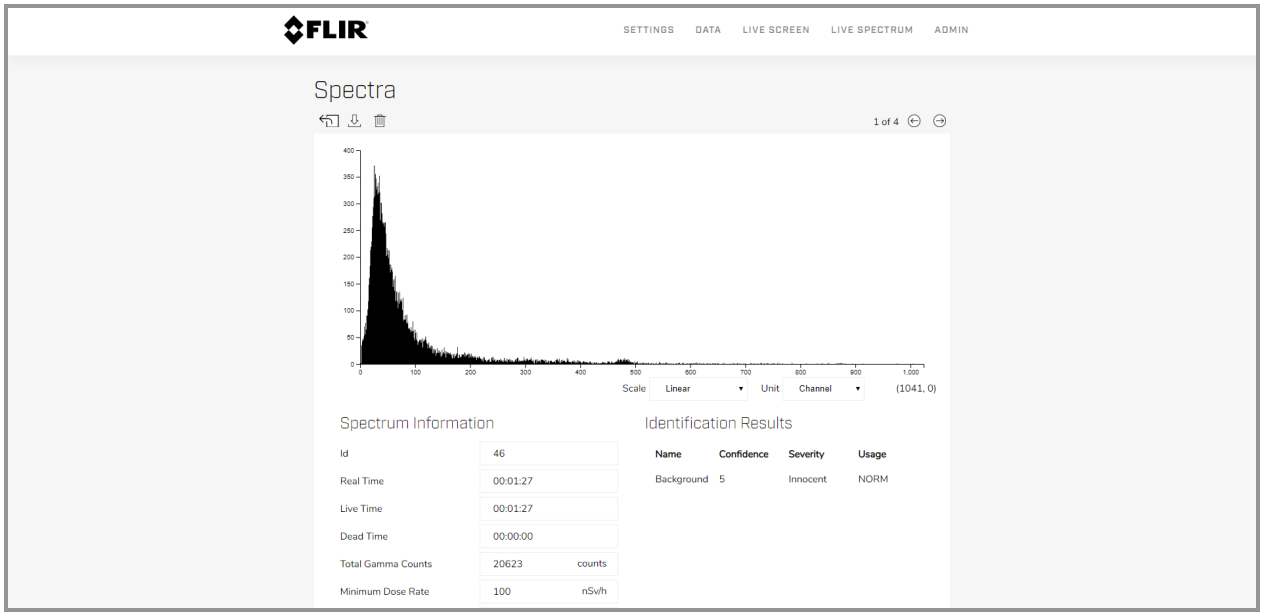

Figure 8-9: Spectrum detail view

8.4.2 Alarms

Data | Alarms

The Alarms web page displays the alarms and warnings stored in the R425's database.

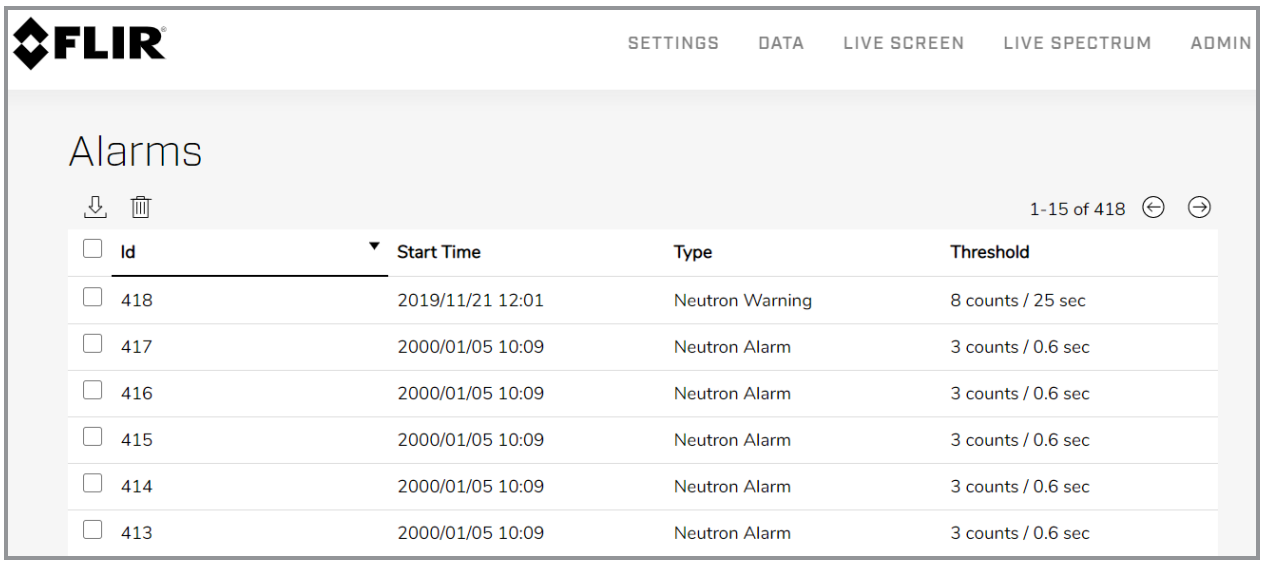

Figure 8-10: Alarms table in web interface

The table shows several columns for every record:

Columns - Alarms Table	
ID	Automatically generated reference number for the alarm record.
Start Time	Alarm start time
Type	Identifies the alarm record as **Warning** or **Alarm**. Neutron warnings and alarms are identified.
Threshold	The alarm threshold that was passed to trigger the alarm.

To view an alarm record, double-click on the record in the Alarms table. An event summary page for the alarm will display (see Figure 8-11). The summary contains details about the radiological conditions during the time the alarm was active.

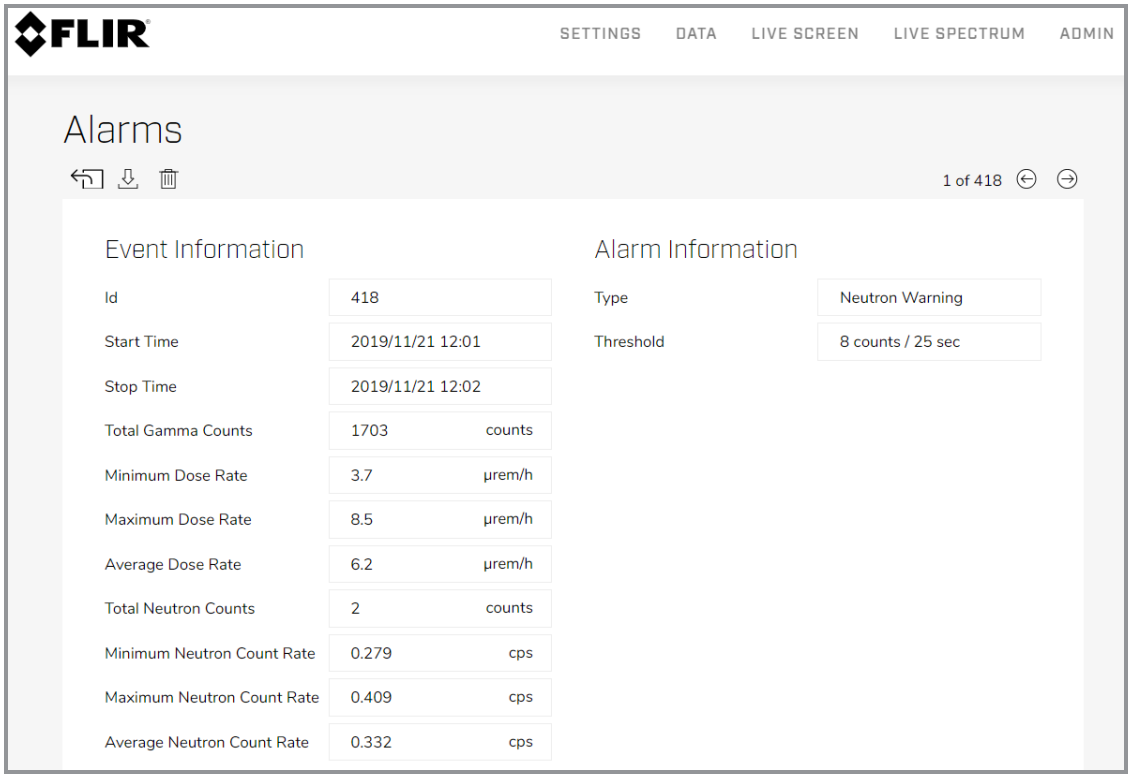

Figure 8-11: Neutron warning event summary from the Alarms page

8.4.3 Screenshots

Data | Screenshots

The Screenshots page (Figure 8-12) lists all of the screenshots are currently stored on the R425.

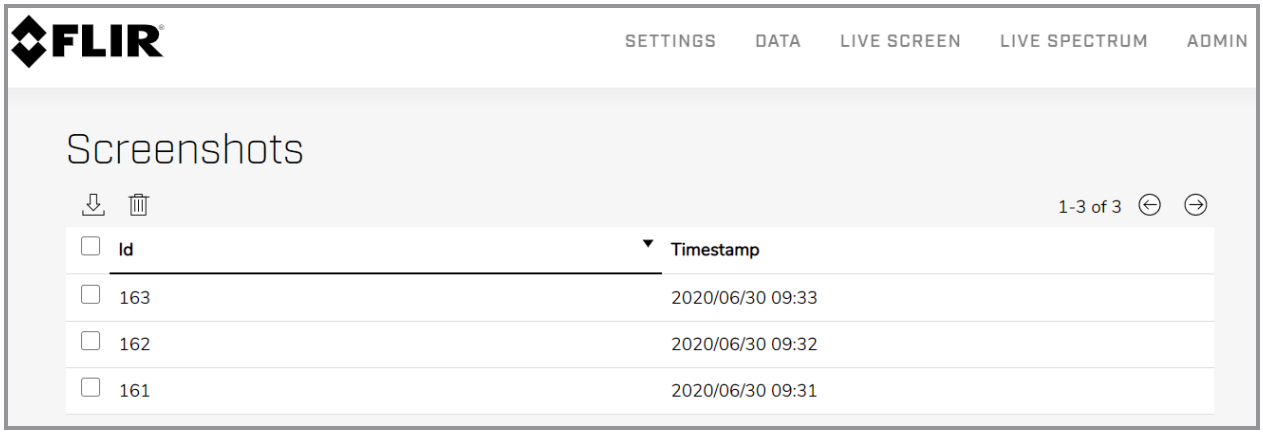

Figure 8-12: Screenshots table in web interface

Using the Screenshots page, you can:

- view screenshots within the web interface
- download screenshots to the external computer
- delete screenshots from the R425

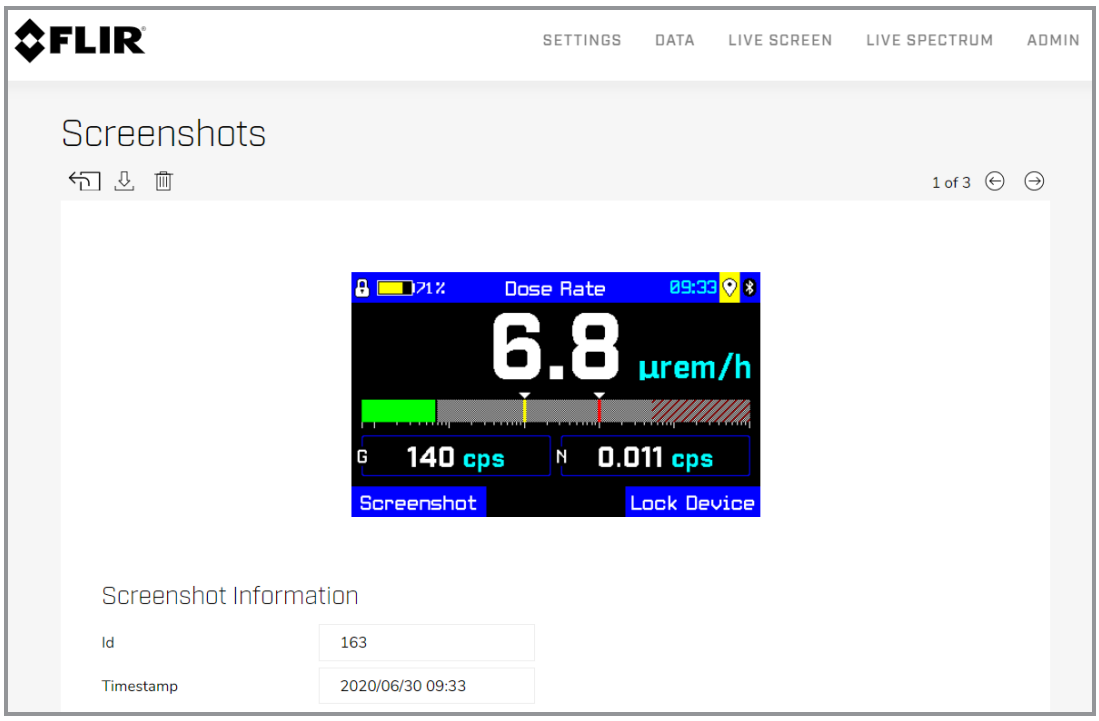

Figure 8-13: Screenshot displayed within the web interface

8.4.4 Datalogs

Data | Data Logging

The Datalogs web page (Figure 8-14) displays the datalog records stored in the identiFINDER R425's database (see section 6.7.3, "Data Logger and Data Settings" on p. 115). The start and stop times of the logs are displayed along with the automatically generated datalog ID number.

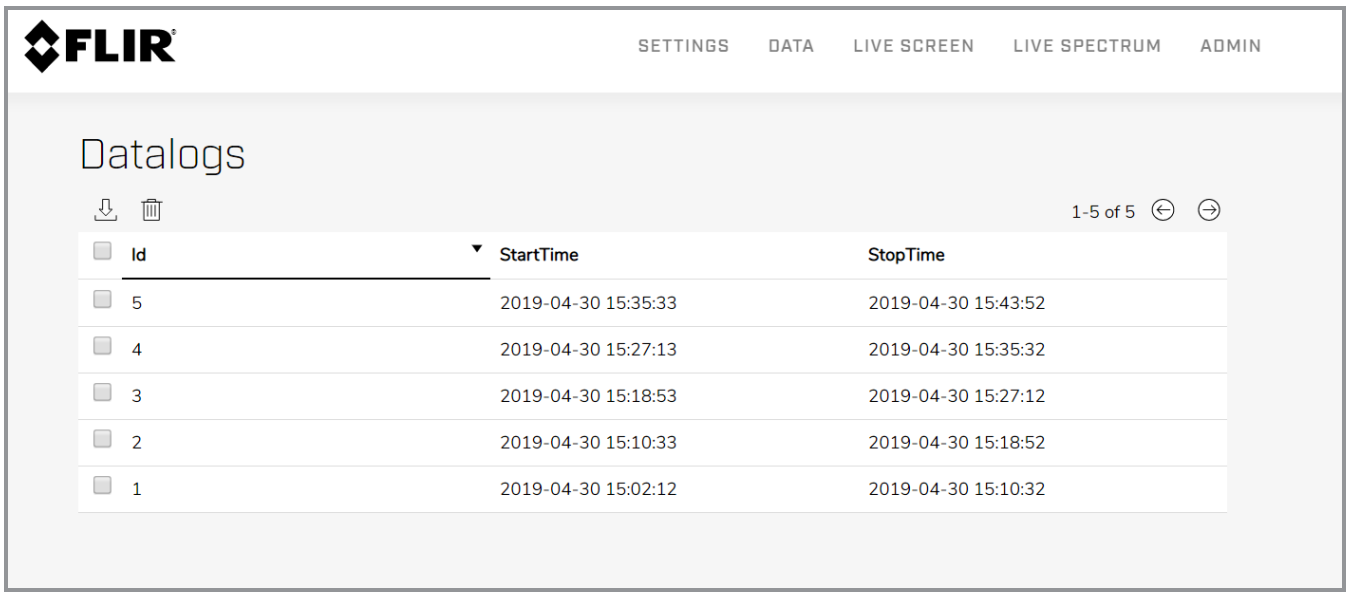

Figure 8-14: Datalogs page in web interface

To view a datalog record, double-click on the record in the Datalogs table.

Loading large records can take a while. To cancel during loading, press the Power button briefly.

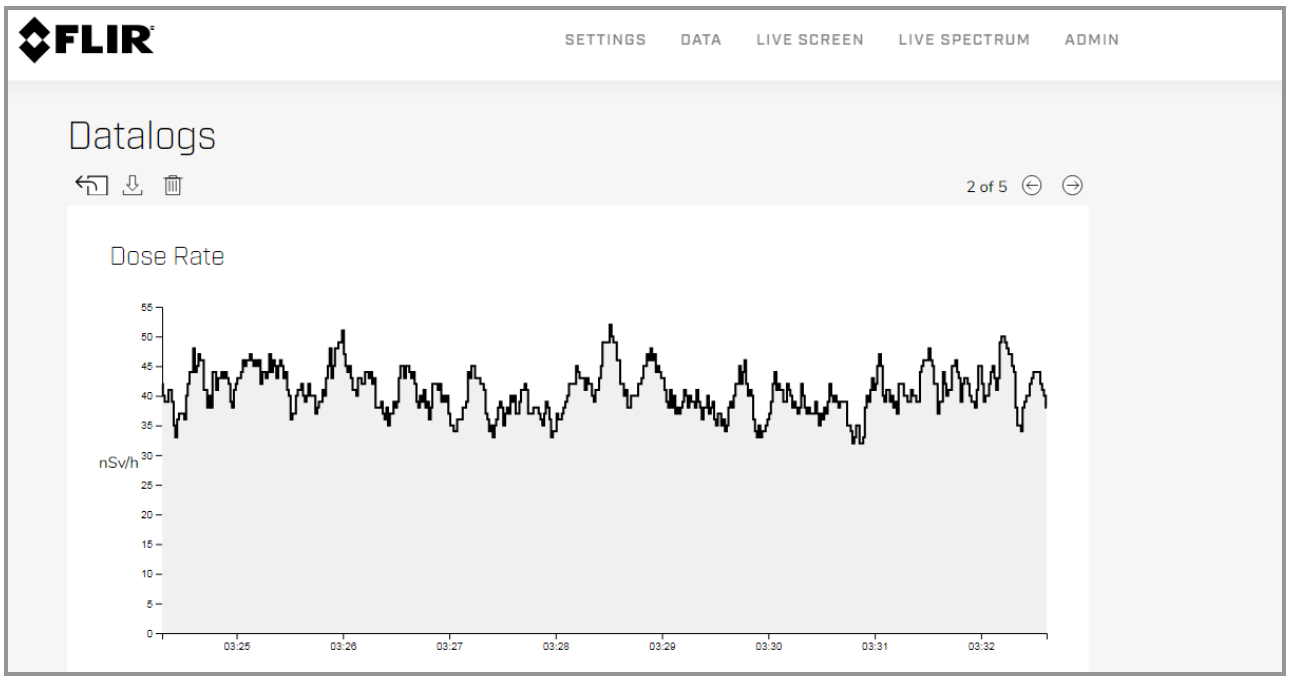

Figure 8-15: Viewing logged dose rates

Logged data are displayed with the minimum, average, and maximum dose rate per logged period (y axis) compared to the time (x axis) (Figure 8-15). The scaling is adjusted to make best use of the available screen space.

Neutron event datalogs, for models with neutron detection, produce a histogram resembling Figure 8-16.

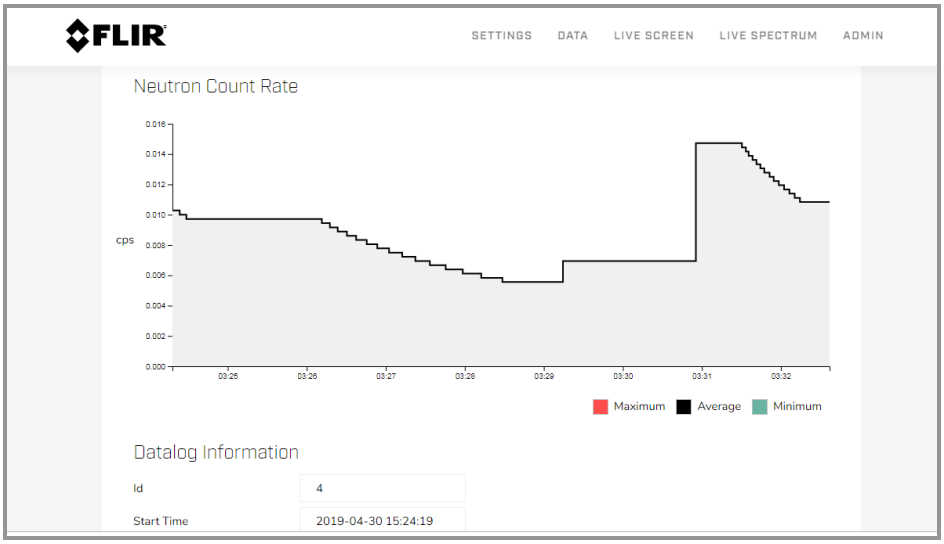

Figure 8-16: Viewing logged neutron events

8.4.5 Bulk Operations

Data | Bulk Download

The Bulk Operations page displays all the data types that are stored on the identiFINDER R425 (described in sections 8.4.1 - 8.4.3) in one location.

Using the Bulk Download page, you can:

- select multiple files of any included data type
- download multiple files of any data type to the external computer in one transaction
- delete multiple files of any data type from the R425 in one transaction

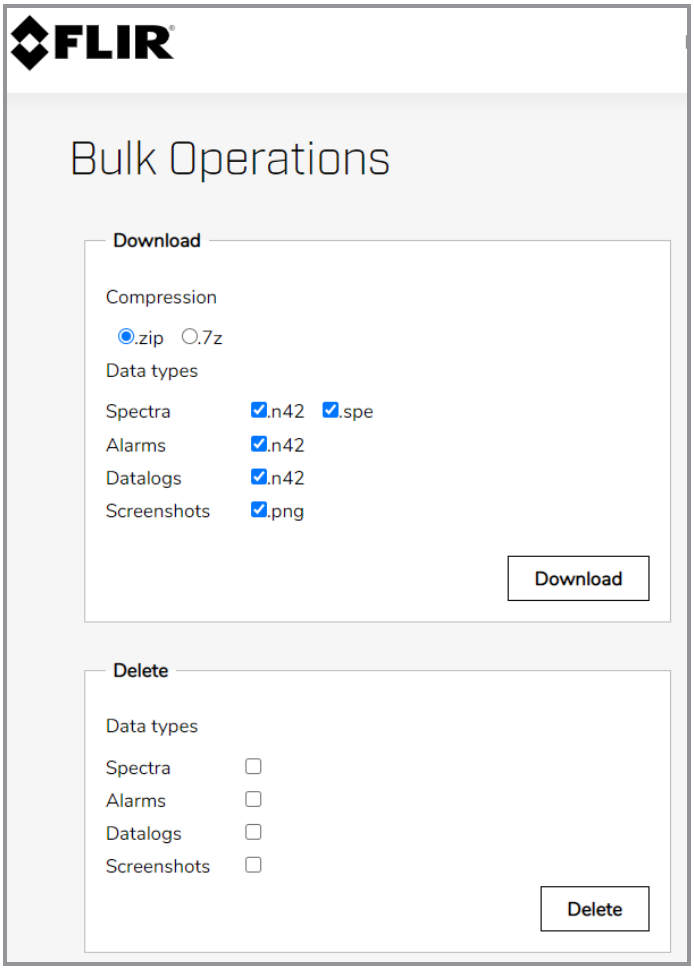

Figure 8-17: Bulk Operations page

8.5 Live Screen

Live Screen

The Live Screen command on the main menu of the identiFINDER R425 web interface allows for remote control of the R425 over USB.

Click on Live Screen to display an online model of the R425 (Figure 8-18). Click the virtual buttons in the online model to operate the R425 as if it is in your hand.

Click the camera icon in the upper right of the virtual R425 (see Figure 8-18) to capture screenshots in Live Screen mode.

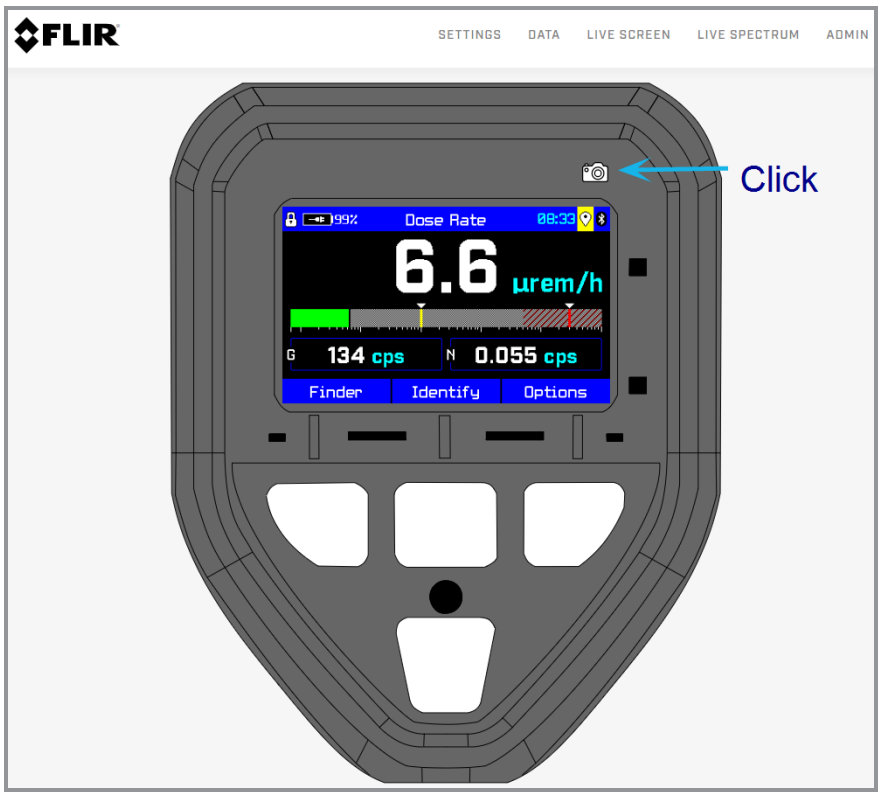

Figure 8-18: Live Screen mode in the web interface

8.6 Live Spectrum

Live Spectrum

The Live Spectrum command in the R425 web interface allows you to use the R425 as a desktop gamma spectroscopy unit (Figure 8-19). In Live Spectrum mode, you can start, stop, or clear spectrum acquisitions, save spectra, and execute identifications.

The histogram axes on the spectrum graph can give you different views of spectrum data:

- Set the x-axis to display energy or channels.
- Set the y-axis to display count values in linear, log, or square root form.

In addition to the histogram, a "heat map" of the spectrum is displayed.

When your cursor is inside the histogram area, you can hover to display the x (energy or channel) and y (counts) coordinates of its position).

After running an identification on the acquired spectrum, the ID results are displayed (Figure 8-19) along with each peak's centroid location, FWHM, and number of counts in the ROI. The peaks are also graphically indicated on the histogram by shading them in gray.

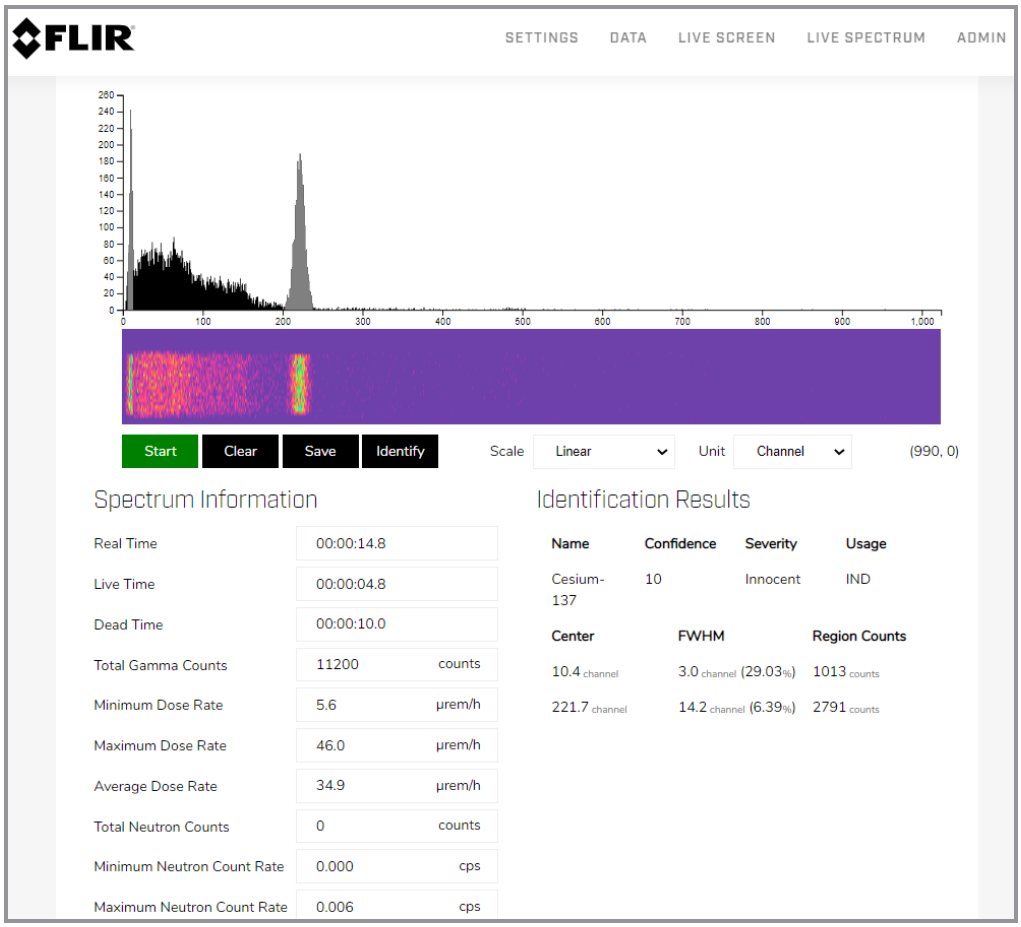

Figure 8-19: Live Spectrum mode, showing ID results

8.7 Admin Menu

Admin

The Admin command on the main menu of the identiFINDER R425 allows users with administrative privileges to access system files, download software updates, and perform other administrative actions.

When you click on the Admin command, a password prompt appears (Figure 8-20). Enter the Admin mode password at the prompt. The default password for Admin mode is `admin`.

Change the password for better protection of your instrument against unauthorized access.

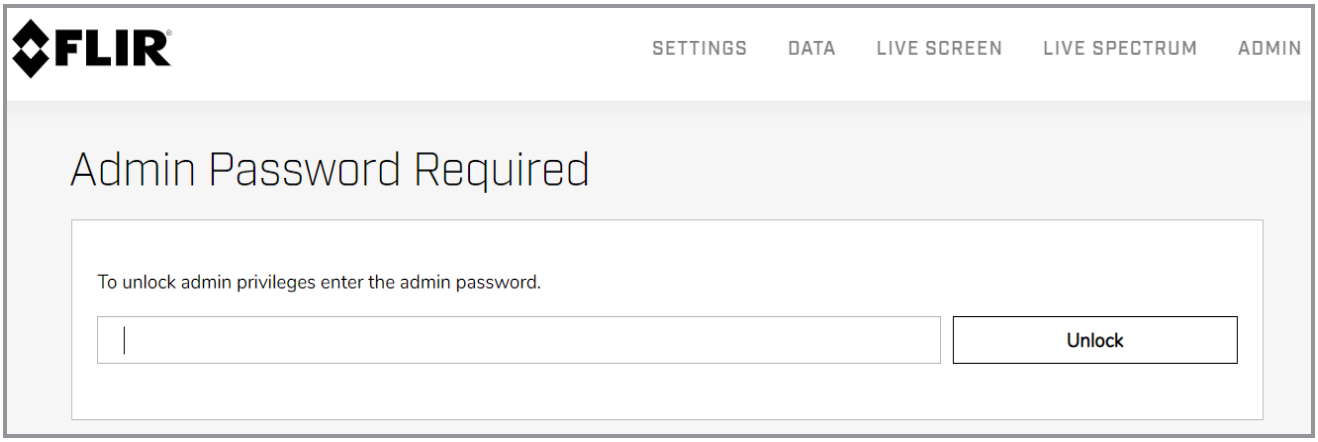

Figure 8-20: Entering the administrative password

There are four sections available on the Admin page:

- **Device Info**, p. 148
- **Download Logs**, p. 148
- **Software Update**, p. 149
- **Change Password**, p. 149

8.7.1 Device Information

The Device Information section (Figure 8-21) displays information about your identiFINDER R425.

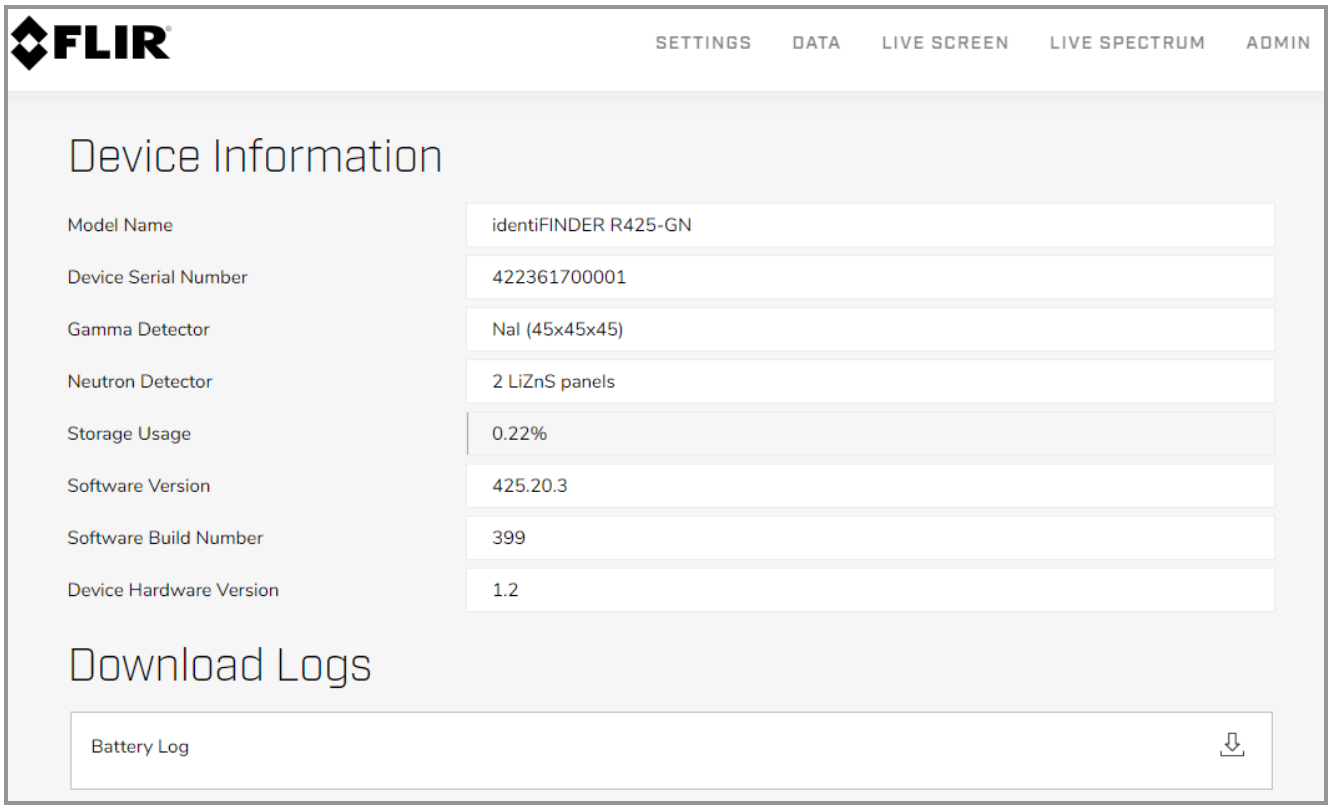

Figure 8-21: Device Information and Download Logs area of Admin pages

The Download Logs section (Figure 8-21, bottom) is where you can download any maintenance logs that are available on the R425.

8.7.2 Software Update

Use the Software Update section of the Admin page (Figure 8-22) to apply software update files for the identiFINDER R425.

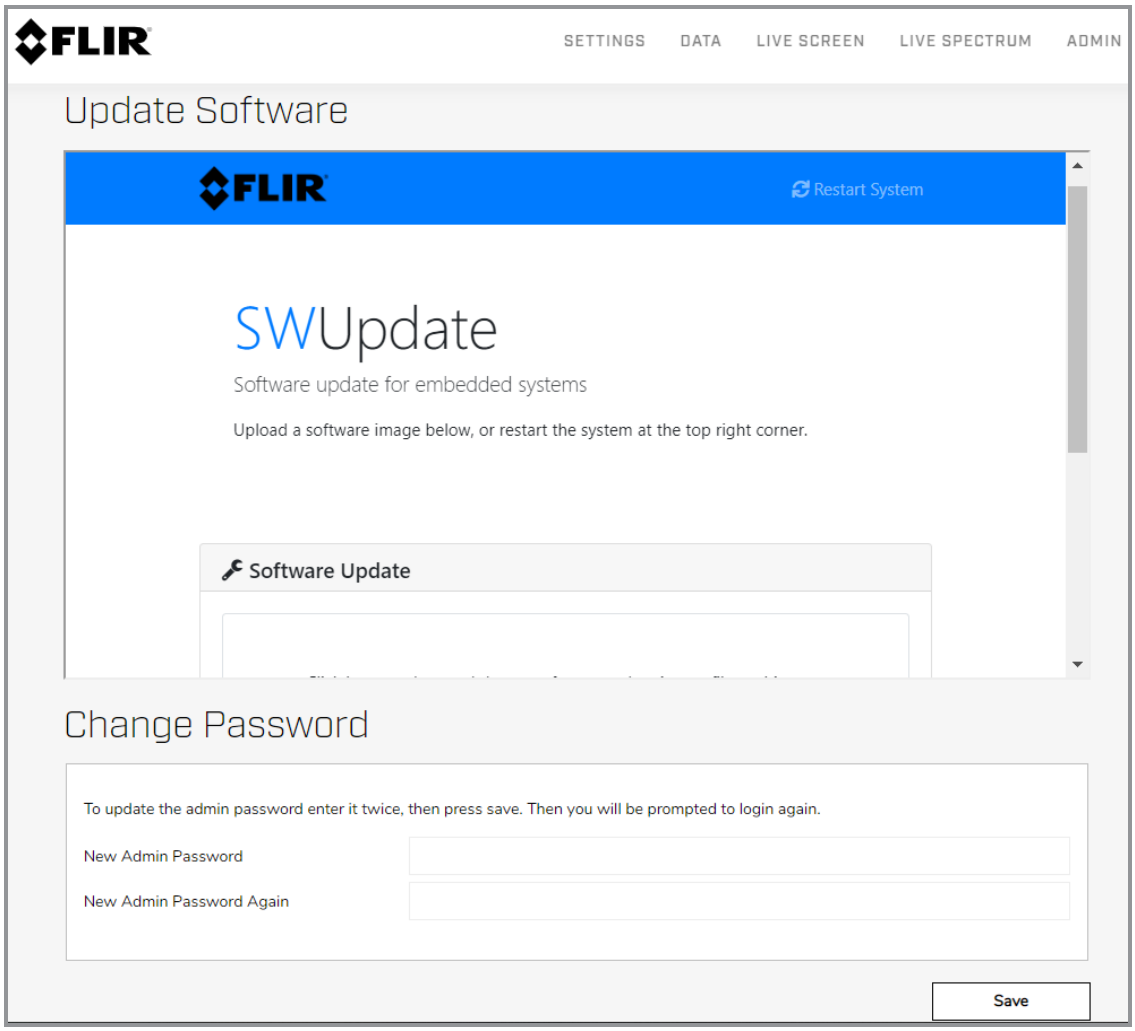

Figure 8-22: Software Update page in R425 web interface

8.7.3 Change Password

At the bottom of the Admin page is the Change Password area (Figure 8-22, bottom). Use the fields in this section to change the default admin password to something more secure.

8.8 Printing Web Pages

You can print web pages from the R425 web interface using the usual printing procedures of your web browser.

Some displayed elements are suppressed when printing web pages, for example the navigation menus or push buttons.

Many web browsers give you the option to suppress printing of background images and colors. For the best results, select the settings you want.

9 Powering the R425

You can power the R425 using any of the following methods:

- Use internal Li-ion rechargeable batteries (the standard power source)
- Plug into an external power source
- To extend run time, use either of the following in the accessible battery compartment:
  - 16550 rechargeable battery
  - two single-use CR123 batteries

Rechargeable and single-use batteries are provided in your identiFINDER R425 kit.

9.1 External Power Sources 151
9.2 Replacing Batteries 151
9.3 Charging the identiFINDER R425 153

9.1 External Power Sources

You can connect the R425 to any of the following external power sources via the top USB-C connector on the side of the device:

- wall mounted power supply with attached USB-C cable, included in the R425 kit
- USB port of a computer, using the USB-A to USB-C cable included in the R425) kit
- car adapter (sold separately), using the USB-A to USB-C cable included in the R425 kit

The R425 draws a current of approximately 500 mA. Before connecting to a computer, please make sure the USB outlet of the computer complies with this requirement. This might not be the case with some laptops or similar battery-powered devices.

See section 7.2, "Connecting via USB" on p. 123 for more information on handling cables.

9.2 Replacing Batteries

Always use FLIR-supplied batteries or the equivalent.

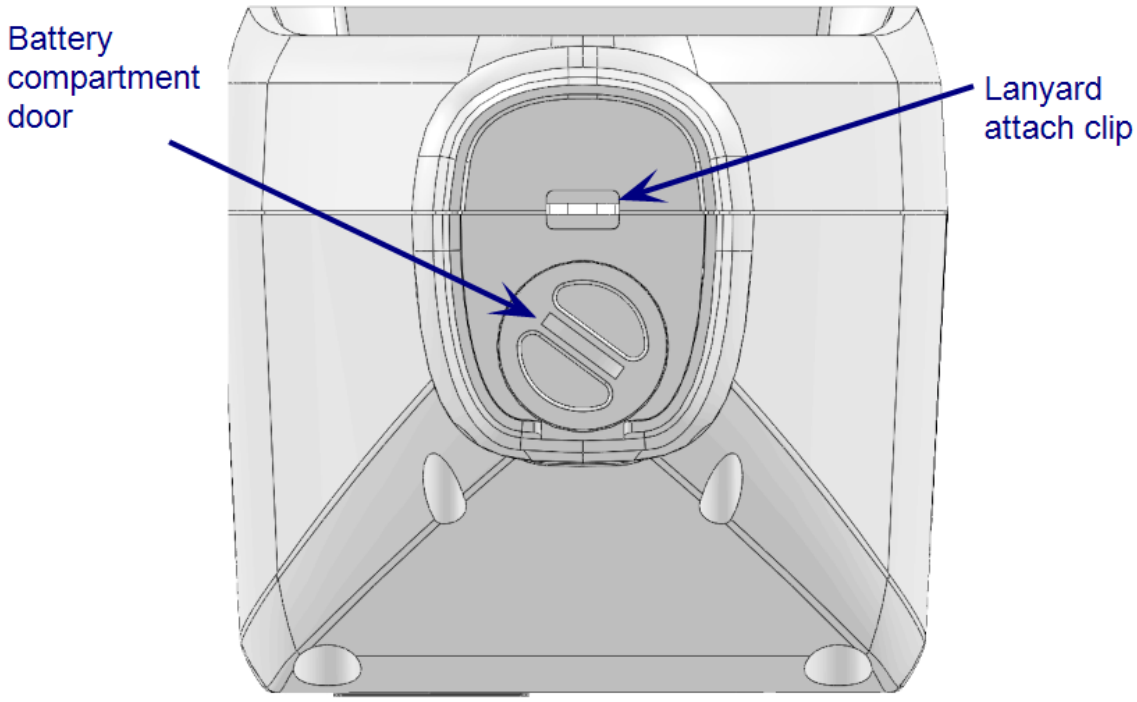

Figure 9-1: Location of battery compartment

To replace batteries:

1. Using a flat object (coin, key, screwdriver), remove the door from the battery compartment by rotating CCW (counter-clockwise).
2. Remove the existing batteries.
3. Ensure the compartment and battery door are completely dry and free of debris.
4. Insert either the rechargeable 16650 or two single-use CR123 Li-ion cell batteries.
5. Replace the compartment door, turning clockwise (CW) to tighten.

When installing (turning CW), do NOT cross-thread or over-tighten. Over-tightening can damage the compartment seal, which would require replacement of the O-ring or compartment door. If this happens, contact FLIR for replacement.

9.3 Charging the identiFINDER R425

Charge the internal battery by connecting the R425 to an external power source.

Only recharge batteries that are specially designed as rechargeable. Follow the manufacturer's recommendations on recharging.

Use FLIR-supplied cabling (preferred) or third-party cabling that meets the criteria specified in FLIR standards for detection devices for charging.

The internal system battery is checked during the recommended five-year factory maintenance, as stated in the identiFINDER R425 maintenance agreement.

To charge batteries in the R425:

1. Use the power supply to connect the R425 to a wall outlet or equivalent power source.

   or use the car charger to connect the R425 to an appropriate power source

   or use USB cable(s) to connect the R425 to a computer or other USB power supply.

2. Observe the power LED. The green LED indicates the connection to an external power source.

   or Observe the power indicator if the R425 is running while charging.

Appendices

The following appendices contain additional important information about the identiFINDER R425:

Appendix A: Instrument Data

This appendix includes the following sections:

- A.1: identiFINDER R425 Specifications, p. 154
- A.2: Detector Positions, p. 157
- A.3: identiFINDER R425 Certificates, p. 157
- A.4: Bluetooth Serial Port Profile (SPP) Communications, p. 159

Appendix B: Maintenance

This appendix includes the following sections:

- B.1: Software Installation, p. 167
- B.2: Storage, p. 167
- B.3: Service and Support, p. 167

Appendix C: Nuclide Library, p. 169

A.1: identiFINDER R425 Specifications

Version

Model	R425

General

Technology	Radionuclide Identification Device (RID)
Gamma Detector - NaI(Tl)	1.77 in x 1.77 in x 1.77 in Cube (45 mm x 45 mm x 45 mm) with Silicon Photomultiplier (SiPM)
Neutron Detector - ZnS (optional)	1.1 in x 2.3 in x 0.2 in (27 mm x 58 mm x 5 mm) moderated panels (2 ea.)
Energy Range (Gamma)	25 keV to 3 MeV
Gamma Sensitivity (Cs-137)	16.10 cps/µrem/h; 1610 cps/µSv/h

General

Neutron Sensitivity	> 4 cps/nv
Gamma Spectrum Length	1024 Channels
Dose Rate Range (Cs-137)	10 µrem/h – 100 mrem/h; 100 nSv/h – 1 mSv/h
Dose Rate Range ID Mode (Cs-137)	0.1 µrem/h – 5 mrem/h; 1 nSv/h – 50 µSv/h
Overload Dose Rate Range	100 mrem/h – 1 R/h; 1 mSv/h - 10 mSv/h
Stabilization	Sourceless Gain Stabilization
Linearization	Real time linearization of gamma energy
Typical Resolution	≤ 7% FWHM at 662 keV (20 °C)
Service Interval	5 year factory maintenance; recommended annual dose rate calibration

Sampling & Analysis

Sample Introduction	Absorption of EM gamma and neutron emissions.
Threats	Detects neutron and gamma radiation emitted from natural occurrences in the environment, special nuclear material, industrial, or medical material
Nuclide Categorization	According to ANSI N42.34
Library Categories	SNM, IND, MED, NORM
Time to Identification	From a few seconds to a few minutes

System Interface

Display & Alerts	2.7 in. diagonal (400x240 pixels); 6.86 cm
Communications	USB-C (2x), Bluetooth (BLE 5.0)
Data Storage	8 GB

System Interface

Training Requirements	< 10 minutes for operator; 1 hour for advanced user
Software	On-board web server

Power

Input Voltage	100-240V AC (wall adapter and USB-C cable supplied)
Battery Specifications	Internal Li-ion cells with user-selectable external battery (16650 Li-ion or 2 ea. CR123)
Cold Start Time	< 30 seconds from cold start
Run Time	At +20C: ≥10h At -20C: ≥4h

Environmental

Operating Temp (ambient)	-4 °F to 122 °F (-20 °C to 50 °C)
Operating Humidity	10 to 93%
Storage Temp	14 °F to 95 °F (-10 °C to 35 °C)

Physical

Dimensions (L x W x H)	9.4 in x 3.9 in x 3.7 in (23.83 cm x 9.98 cm x 9.45 cm)
Weight	2.6 lbs (≤ 1.2 kg)
Enclosure & Protection	Injection molded housing with overmold; rating IP67 according to IEC 60529

N42.42 Schema Information

For more regarding schema, see the Summary and Description from NIST.

A.2: Detector Positions

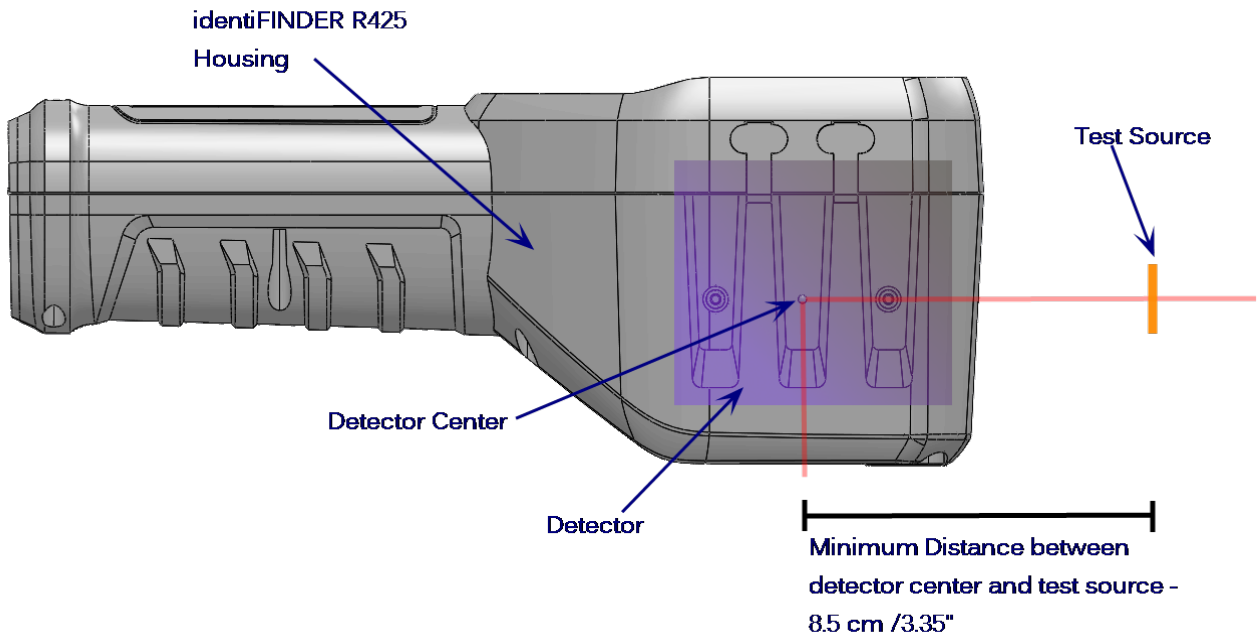

Figure A-1: Position of the detector centers of the FLIR identiFINDER® R425 (NaI scintillator, standard enclosure, drawn to scale)

A.3: FLIR identiFINDER® R425 Certificates

Standard Enclosure: Manufacturer's declaration of conformity (CE)

FCC Compliance Notice

Standard Enclosure: Manufacturer's declaration of conformity (CE)

FLIR Detection
100 Midland Rd.
Oak Ridge, TN 37830
T: (865) 220-8700

EC Declaration of Conformity

According to §7 of EMVG of 15, December 2004 and EMC Directive 2004/108/EC

Device	FLIR identiFINDER R425
Type	Radioisotope Identification Device (RID)
Serial Number	All
Year of Manufacture	2019-

Herewith we declare, that the above mentioned device complies with the following EC Directives including changes and implementation into national law.

EMC Directive 2004/108/EC

Furthermore the following harmonized European standards are exercised *

DIN EN 61326

* A complete listing is included in the technical documentation.

The mentioned device is defined for analysis of gamma radiation.

October 24, 2019
Date

Rick Wilson,
Director of Engineering

FCC Compliance

Model: identiFINDER R425

Variant: All

FLIR Detection, Inc.

100 Midland Rd.

Oak Ridge, TN 37830 USA

TEL: +1.865.220.8700

EMAIL: radiation.support@flir.com

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

A.4: Bluetooth Serial Port Profile (SPP) Communication

A.4.1 Overview

While the R425 has Bluetooth Serial Port Profile (SPP) enabled and is connected to a compatible device it will respond to properly formatted queries and can also stream data. This allows integrators to design custom interfaces and for operators to use such interfaces to either listen for or inquire about current instrument status. The following is a description of the R425's SPP data format.

A.4.1.1 Data Format

The R425 is capable of responding to commands from a device connected via a Bluetooth SPP connection. In addition, the R425 can be configured to stream data in response to an environmental or user trigger. The commands and triggers are explained in the following sections.

A.4.1.2 Conventions and Usage Notes

The format of the commands and responses make up a complete and well-formatted XML document, including the XML declaration. The character encoding of these messages shall be UTF-8 and shall not include a byte order marker (BOM).

The `NUL` character is represented in this document's example listings in C-style notation as `\0`. It is a single standard byte with the character value of zero.

For the purposes of this specification, any number of NUL (\0) bytes contained within the XML message is illegal, since NUL is used as the message delimiter after the completed XML. Every message shall be terminated with the NUL character.

XML tags are case-sensitive.

Only one command should be sent before receiving a response. If no response is received after 15 seconds, it can be assumed the command was lost or the R425 is in an unresponsive state.

The example listings use colored text and other font effects for emphasis. This is not part of the XML message. Line breaks and indentation are also for ease of reading and are not required.

The XML messages make extensive use of `AttributeName=AttributeValue` pairs. Each attribute name in the denied messages is fixed and will be shown verbatim in the example listings.

However, there is typically more than one possible value for an AttributeValue. Listings will sometimes show placeholder text for an AttributeValue in blue similar to: **(PlaceholderText)**. In actual usage, placeholder text will be replaced with the appropriate text or numerical value.

When a literal value is used in an example instead of placeholder text, it will be shown in red text such as in this attribute pair: `encoding= "utf-8"`. However, keep in mind that the literal value shown may be only one of several possible values for that AttributeValue. In many cases, other possible values will be enumerated in the description after the listing.

A.4.2 SPP Commands and Updates

A.4.2.1 Ping

The "Ping" command will generate a ping update from the identiFINDER R425. This can be used to verify SPP communication is functional and to determine the device serial number.

Ping Command Code

```
1 <?xml version="1.0" encoding="utf-8"?>
```

```
2 <Command name="Ping" />\0
```

The "Ping" command should be verbatim as illustrated in the code.

Ping Update Code

```
1 <?xml version="1.0" encoding="utf-8"?>
2 <Update name="Ping"type="identiFINDER2"id="(SerialNumber)" />\0
```

Line 1: XML Declaration

The XML declaration is the same for all messages.

Line 2: Update element

The message will contain one `Update` element as the root element.

name

A Ping update will always report `"Ping"` as the name attribute.

type

The type attribute indicates the device class sending the message. For the R425 this will be `"identiFINDER2"`.

The root `Update` element is closed, completing the XML portion of the message.

The message is then terminated with the `NUL` character at the end of line 2. This is not part of the XML specification, but is required by the R425 as a message delimiter.

A.4.2.2 Status

A Status Update message can be queried through the command specified below or is periodically transmitted during the presence of a radiation or low battery alarm.

Status Command list

```
1 <?xml version="1.0" encoding="utf-8"?>
2 <Command name = ”Status” / >\0
```

Example Status Update

```
1 <?xml version="1.0" encoding="utf-8"?>
2 <Update name = ”Status” type = ”identiFINDER2” id = ”(SerialNumber)”
3 <Property name=”BatteryLevel” value=”53”units=”pct” />
```

```
<Property name= ”Stabilization” value=”true” />
< Property name = ”GMMode” value=”true” />
< Property name =”DoseRate” value =”10”units=”µrem/h” />
< Property name =”Counts” value =”100”units=”counts” />
<Property name=”NeutronRate” value =”10”units=”cps” />
<Property name=”OperatingMode” value =”Finder” />
<Property name=”DoseRateWarningThres” value =”27”units=”µrem/h” />
<Property name=”DoseRateAlarmThres” value =”20000”units=”µrem/h” />
<Property name=”DoseWarningThres” value =”27”units=”mrem” />
<Property name=”DoseAlarmThres” value =”20000”units=”mrem” />
<Property name=”NeutronRateWarningThres” value =”27”units=”cps” />
<Property name=”NeutronRateAlarmThres” value =”20000”units=”cps” />
<Property name=”GPSValid” value =”true” />
<Property name=”Longitude” value =”-84.2625”units=”deg” />
<Property name=”Latitude” value =”36.013333”units=”deg” />
<Property name=”LastSpectrumNumber” value =”53” />
<Property name=”BatteryLow” value =”false” />
<Property name=”Overload” value =”false” />
<Property name=”Alarm” value =”false” />
<Property name=”DoseRateWarning” value =”false” />
<Property name=”DoseRateAlarm” value =”false” />
<Property name=”DoseAlarm” value =”false” />
<Property name=”NeutronCountRateWarning” value =”false” />=
<Property name=”NeutronCountRateAlarm” value =”false” />
<Property name=”SigmaGammaAlarm” value =”false” />
```

```
<Property name="SigmaNeutronAlarm" value ="false" />
</Update>\0
```

Property Elements

As illustrated in the sample code, there are multiple Property elements in a Status Update.

name

For reliability and future compatibility, a parser should not rely on the order of the Property elements but should parse the name attribute of each Property element.

value

For each Property element in a status update, the value attribute will be either textual or numerical. Many of those elements with a textual value attribute indicate a boolean state with the value being either "true" or "false" .

units

A units attribute will be included when necessary to interpret a numerical value attributes. Only some Property elements have units.

Line 2

The (SerialNumber) placeholder in the example will be replaced with the unique serial number of the R425 sending the message.

Stabilization (Line 4)

Stabilization is only available on models without LED stabilization.

Dose and Dose Rate units

Any dose units will be in either rem or Sievert (Sv) scaled units as required by the R425 settings (see Section 6.5.5, "Dose Rate Settings."). The specified base unit for some properties will be dynamically scaled according to the property value while others are statically scaled in the R425 settings.

Dose units (Lines 12 and 13)

`DoseWarningThres` and `DoseAlarmThres` use dose units. The possible scaled rem units are `"rem"` , `"mrem"` , `"µrem"` , and `"nrem"` . The possible scaled Sievert units are `"Sv"` , `"mSv"` , `"µSv"` , and `"nSv"` .

Dose units (Lines 6, 10 and 11)

`DoseRate`, `DoseRateWarningThres`, and `DoseRateAlarmThres` use dose rate units. The possible scaled rem per hour units are `"rem/h"` , `"mrem/h"` , `"µrem/h"` , and `"nrem/h"` . The possible scaled Sieverts per hour units are `"Sv/h"` , `"mSv/h"` , `"µSv/h"` , and `"nSv/h"` .

Operating Mode (Line 9)

`OperatingMode` indicates the current mode the R425 is operating in. Possible values include: `"DoseRate"` , `"Finder"` , `"Identify"` , or `"Other"`.

Neutron Information (Lines 14, 16, 26, 27, and 29)

`NeutronRateWarningThres`, `NeutronRateAlarmThres`, `NeutronCountRateWarning`, `NeutronCountRateAlarm`, and `SigmaNeutronAlarm` are only available on instruments that are equipped with an He-3 tube.

Sigma Alarms (Lines 28 and 29)

Sigma alarms are currently available only on R300 products.

A.4.2.3 Get Spectra

The "GetSpectra" information can be queried through the command specified below or is automatically transmitted upon selection of "send" on the user interface of the device.

GetSpectra Command

```
1 <?xml version="1.0" encoding="utf-8"?>
2 <Command name="GetSpectra"
3 <Argument name="Number" value="(SpectrumNumber)" /?
4 </Command>\0
```

Line3: Spectrum Number

If the "GetSpectra" command has an `Argument` element then it must contain a `name` attribute with a value of "Number" and a value attribute with a numerical value specifying the record number of the spectrum to send.

Omit the `Argument` element to retrieve the highest spectrum number.

GetSpectra Update

```
1 <?xml version="1.0" encoding="utf-8"?>
2 <Update name="GetSpectra" type="identiFINDER2" id="(SerialNumber)"
```

```
3       <Property name="Spectra" value="(base64 encoded n42 file)" /?
4   </Update>\0
```

Line3: Spectra

The GetSpectra update will contain a base64 encoded string which can be decoded into an ANSI N42.42 2006* file of the requested spectra. The encoded data is represented in the example listing with the (base64 encoded n42 file) placeholder. Base64 decoding is outside the scope of this document.

All commands and updates below this point provide properties that are already contained in the Status Update message. These are to be used if additional granularity is required.

*ANSI N42.42 An XML-based data format standard for radiation detectors used for homeland security. Sometimes a version is speciied with the year of release, for example, ANSI N42.42 2006. ANSI N42.42 formatted iles can be processed and analyzed with third-party software including, for example, applications provided by public institutions such as Cambio and GADRAS (Sandia National Laboratories, USA, http://www.sandia.gov), or PeakEasy (Los Alamos National Laboratory, USA, http://www.lanl.gov). Also known as: **N42**.

A.4.2.4 Counts

Counts Command

```
1   <?xml version="1.0" encoding="utf-8"?>
2   <Command name="Counts"\0
```

Counts Update

```
1   <?xml version="1.0" encoding="utf-8"?>
2   <Update name="Counts" type="identiFINDER2" id="(SerialNumber)"
3   <Property name="Counts" value="100" units="counts"/>
4   </Update>\0
```

A.4.2.5 Dose Rate

DoseRate Command

```
1   <?xml version="1.0" encoding="utf-8"?>
2   <Command name="DoseRate"/>\0
```

DoseRate Update

```
1   <?xml version="1.0" encoding="utf-8"?>
```

```
<Update name="DoseRate" type="identiFINDER2" id="(SerialNumber)"
<Property name="DoseRate" value="10" units="µrem/h"/>
</Update>\0
```

A.4.2.6 Neutron Rate

NeutronRate Command

```
<?xml version="1.0" encoding="utf-8"?>
<Command name="NeutronRate"/>\0
```

NeutronRate Update

```
<?xml version="1.0" encoding="utf-8"?>
<Update name="NeutronRate" type="identiFINDER2" id="(SerialNumber)"
    <Property name="NeutronRate" value="10" units="cps"/>
</Update>\0
```

A.4.2.7 Serial Number

SerialNumber Command

```
<?xml version="1.0" encoding="utf-8"?>
<Command name="SerialNumber"/>\0
```

A.4.2.8 Other Commands and Updates

Other command and update implementations can be considered upon request. Please feel free to contact FLIR Detection with any questions or comments.

Appendix B: Maintenance

This section includes the following items:

- B.1: Software Installation
- B.2: Storage
- B.3: Service and Support

B.1: Software Installation

Software like firmware or application updates can be uploaded to the identiFINDER R425 via the administration page of the web server (see p. 149).

The identiFINDER R425 only accepts uploaded files with the correct digital signature.

B.2: Storage

The identiFINDER R425 should be stored in a dry and clean location. If possible, it should be stored at room temperature.

B.3: Service and Support

Keep the device serial number and version information ready when contacting customer support.

FLIR Detection has service centers throughout the world. To locate a local service center, visit the website: http://detectionsupport.com/radiation/

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Appendix C: Nuclide Library

The R425 can identify and report some special radiation sources and a number of radionuclides as listed in this appendix.

The usage and severity association given in the table represents the factory defaults. It is possible to adapt the association of nuclides with usage (p. 85) and severity (p. 83) to the particular demands of specific use.

The table is sorted by element names and lists the following properties of radiation sources.

- Nuclide name in standard notation
- `Nuclide name` in simplified notation
- Half life
- Severity:

   Innocent

   Suspicious

   Threatening

- Usage:
  - **NORM:** Naturally occurring radioactive material
  - **MED:** Medically used material
  - **IND:** Industrially used material
  - **SNM:** Special Nuclear Material

- Remarks on occurrence or on application

Nuclide Library Key

Annihilation	*Annihilation Radiation*  *Industrially used material* Annihilation radiation is released by the electron-positron extermination caused by the beta+ decay. It has a fixed energy of 511 keV and is caused by all beta+ radiators. Common examples are ^{18}F (used for medical applications) or ^{22}Na which also emits gamma radiation.
Background	 *Naturally occurring radioactive material* The ubiquitous background radiation is emitted from a variety of mostly natural and some artificial sources such as unstable nuclides contained in most chemical elements comprising the lithosphere, biosphere, and atmosphere; cosmic radiation from outer space; and applications of nuclear technology for weapons, power plants and medicine. The background recorded by an instrument is, of course, spoiled by non-natural sources present while measuring the background.
Neutrons	 *Special Nuclear Material* Neutron radiation can have different origins, the most common types are spontaneous fission sources (e. g. 252Cf) and alpha emitters packaged in a low-Z elemental matrix (e. g. Americium-Beryllium, Americium-Lithium or Plutonium-Beryllium). Both types have a wide range of applications, including industrial and medical fields. Neutrons can also occur in the vicinity of nuclear power plants driven by neutrons that collide with the fission material, typically using one of the above sources.
Unknown	 *Unknown nuclear material* An unknown source of radiation. Further investigations are necessary.

Nuclide Library

Name / Short Name	Half-Life	Usage / Remarks
Americium		
$^{241}_{95}Am$ Am-241	433a	*Industrially-used material* Most commonly used in smoke detectors and to measure levels of toxic lead in paint samples. Also used to ensure uniform thickness in rolling processes like steel and paper production. May be combined with beryllium or lithium to produce a neutron source.
Antimony		
$^{124}_{51}Sb$ Sb-124	60d	*Industrially-used material* Used in production of electronics, metals and flame-retardant materials.
Barium		
$^{133}_{56}Ba$ Ba-133	10.75a	*Industrially-used material* Used in nuclear medicine for patient attenuation correction during an imaging technique (i.e. S.P.E.C.T. imaging) for yielding 3D information of the patient's internal organs, etc.
Bismuth		
$^{207}_{83}Bi$ Bi-207	38a	*Industrially-used material* Principle use is for research and may be found as a by-product of proton reactions with lead.
Cadmium		
$^{109}_{48}Cd$ Cd-109	463d	*Industrially-used material* Used to analyze metal alloys when checking stock and also sorting scrap.

Nuclide Library(continued)

Name / Short Name	Half-Life	Usage / Remarks
Cesium		
$^{131}_{55}Cs$ Cs-131	2.07a	*Medically-used material* Used as a tracer for radiation leaks. This nuclide is a fission product in nuclear reactors. It can occur in the radioactive fall-out resulting from hazardous incidents in nuclear power plants.
Cobalt		
$^{57}_{27}Co$ Co-57	272d	*Industrially-used material* Included in medical in-vitro diagnostic kits, it is commonly used as a radiological "marker" to estimate organ size.
$^{60}_{27}Co$ Co-60	5.3a	*Industrially-used material* Used to sterilize surgical instruments and to improve the safety and reliability of industrial fuel oil burners. Also used in cancer treatment, food irradiation, industrial gauges and radiography.
Chromium		
$^{51}_{24}Cr$ Cr-51	27 d 17 h	*Industrially-used material* Used in research in red blood cell survival studies.
Cesium		
$^{134}_{55}Cs$ Cs-134	2.07a	*Industrially-used material* Used as a tracer for radiation leaks. This nuclide is a fission product in nuclear reactors. It can occur in the radioactive fall-out resulting from hazardous incidents in nuclear power plants.
$^{137}_{55}Cs$ Cs-137	30.07a	*Industrially-used material* Used as radiotracers to measure and control the liquid low in oil pipelines and to tell researchers whether oil wells are plugged by

Nuclide Library(continued)

Name / Short Name	Half-Life	Usage / Remarks
		sand. Utilized in density and fill height sensors to ensure the correct fill level for food, drugs and other products. This nuclide is a fission product in nuclear reactors. It can occur in the radioactive fall-out resulting from hazardous incidents in nuclear power plants.
Europium		
$^{152}_{63}Eu$ Eu-152	13.5a	*Industrially used material* Used in nuclear reactor control rods. In some countries this nuclide has been substituted in place of ^{60}Co for radiation therapy.
Gallium		
$^{67}_{31}Ga$ Ga-67	3 d 6 h	*Medically used material* Used to pinpoint infections and tumors. Also used in PET scans for studying the brain and the heart functions.
Holmium		
$^{166m}_{67}Ho$ Ho-166m	1200a	*Industrially-used material* Used in physics experiments and research and can also be used in nuclear control rods used in reactors.
Indium		
$^{111}_{49}In$ In-111	2 d 19 h	*Medically-used material* Used for special diagnostic studies, e.g. brain studies, infection and colon transit studies.
Iodine		
$^{123}_{53}I$ I-123	13 h	*Medically-used material* Used to diagnose thyroid function/dysfunction. Also used in PET scans for studying the brain and the heart functions.

Nuclide Library(continued)

Name / Short Name	Half-Life	Usage / Remarks
$^{125}_{53}I$ I-125	60 d	*Medically-used material* Used in a medical procedure for detecting hormone levels in the blood. Used for cancer treatment of the brain and prostate. It is also used to diagnose deep vein blood clots in the leg and certain kinds of kidney maladies.
$^{131}_{53}I$ I-131	8 d	*Medically-used material* Used for therapy such as imaging the thyroid and treating its related cancers. Also used to diagnose abnormal liver function, kidney blood low and urinary tract obstruction. This nuclide is a fission product in nuclear reactors. It can occur in the radioactive fallout resulting from hazardous incidents in nuclear power plants. to
Iridium		
$^{192}_{77}Ir$ Ir-192	74 d	*Industrially-used material* Temporarily implanted in wire form for use as an internal radiotherapy source in cancer treatment. Also used to test the integrity of pipeline welds, boilers and aircraft parts.
$^{192}_{77}Ir$ Ir-192	74 d	*Medically-used material* Temporarily implanted in wire form for use as an internal radiotherapy source in cancer treatment. Also used to test the integrity of pipeline welds, boilers and aircraft parts.
Lanthanum		
$^{138}_{57}La$ La-138	1.05E+11 y 2	*Industrially-used material* Biological and Biomedical labeling.
Lutetium		
$^{176}_{71}Lu$ Lu-176	38.5(7)×109 y	*Industrially-used material* Biological and Biomedical labeling.

Nuclide Library(continued)

Name / Short Name	Half-Life	Usage / Remarks
$^{177}_{71}$Lu Lu-177	6d 17h	*Medically-used material* Used experimentally in targeted radionuclide therapy for neuroendocrine tumors. May be used to mask Plutonium.
$^{177M}_{71}$Lu Lu-177	160.4 d 3	*Medically-used material* Used experimentally in targeted radionuclide therapy for neuroendocrine tumors. May be used to mask Plutonium.
Manganese		
$^{54}_{25}$Mn Mn-54	312 d	*Industrially-used material* Used to study and predict emission characteristics of heavy metal pollutants within the outflow of waste water from mining operations.
$^{56}_{25}$Mn Mn-56	2.5789(1) h	*Industrially-used material* Used to study and predict emission characteristics of heavy metal pollutants within the outflow of waste water from mining operations.
Molybdenum		
$^{99}_{42}$Mo Mo-99	2 d 18 h	*Industrially-used material* Used for generating ^{99m}Tc.
Neptunium		
$^{237}_{93}$Np Np-237	2.14 Ma	Special Nuclear Material No major commercial uses except in the production of ^{238}Pu.
Niobium		
$^{95}_{41}$Nb Nb-95	35 d	*Industrially-used material*

Nuclide Library(continued)

Name / Short Name	Half-Life	Usage / Remarks
		Used in metal alloys.
Palladium		
$^{103}_{46}Pd$ Pd-103	17 d	*Medically-used material* Used in radionuclide cancer therapy.
Plutonium		
$^{mix}_{94}Pu$ Plutonium RGPu RGPu_S WGPu WGPu_S	6561 a; 24100a	Special Nuclear Material A mixture of ^{240}Pu and ^{239}Pu in various concentrations. Mixtures with low ^{240}Pu concentration are used to build most nuclear fission weapons, bombs, and warheads.
Potassium		
$^{40}_{19}K$ K-40	1.277 Ga	*Naturally-occurring radioactive material* There are no specific commercial or medical uses for this isotope of potassium, but it is occurring naturally. Typical concentrations found in food deliver 140 µSv/a–180 µSv/a. Higher 40K concentrations can present a considerable cancer-inducing risk.
Radium		
$^{223}_{88}Ra$ Ra-223	11 d	*Medically-used material* A decay product of uranium and thorium; useful in the treatment of bone cancer.
$^{226}_{88}Ra$ Ra-226	1600a	*Naturally-occurring radioactive material* A decay product of uranium and thorium, it occurs in virtually all rock, soil, and water in low concentrations. 20 % of the ^{226}Ra that is ingested via food and water is deposited into the bone. Although this makes the nuclide dangerous itself, it presents its greatest risk when it decays into ^{222}Ra, which is an odorless,

Nuclide Library(continued)

Name / Short Name	Half-Life	Usage / Remarks
		tasteless, radioactive gas that can be inhaled into the lungs.
Samarium		
$^{153}_{62}Sm$ Sm-153	47 h	*Industrially-used material* Pharmaceutically marketed as "Quadramet," it is used for relieving pain caused by secondary cancers within the bone. Also used for treating prostate and breast cancer.
Scandium		
$^{46}_{21}Sc$ Sc-46	83.8 d	*Naturally-occurring radioactive material*
Selenium		
$^{75}_{34}Se$ Se-75	120 d	*Industrially-used material* In the form of seleno-methionine this nuclide is used to investigate enzyme production in the digestive tract.
Silver		
$^{110m}_{47}Ag$ Ag-110m	249 d 19 h	*Industrially-used material* Used as a radiotracer for biological and industrial research.
Sodium		
$^{22}_{11}Na$ Na-22	2.6 a	*Industrially-used material* Used to study the sodium-potassium exchange-dynamic of nerve axons within the nervous systems of living organisms. Also used to locate leaks in industrial pipe lines and in oil well studies.
$^{24}_{11}Na$ Na-24	15 h	*Medically-used material* Used for PET scanning.

Nuclide Library(continued)

Name / Short Name	Half-Life	Usage / Remarks
Strontium		
$^{89}_{38}Sr$ Sr-89	50.5d	*Industrially-used material* Used in spacecraft, remote weather stations, navigational buoys, etc., where a lightweight, long-lived, nuclear-electric power source is required.
Technetium		
$^{99m}_{43}Tc$ Tc-99m	6 h 1 m	*Medically-used material* Used for imaging the heart muscle, lungs, brain, and the skeletal system. Other uses include imaging the kidney, liver, thyroid, spleen, gall bladder, salivary and lacrimal glands, and the heart blood pool. It is also used to investigate other medical issues, like certain types of infections. Also used for tracing sewage and liquid waste movements within city infrastructures. This nuclide is a fission product in nuclear reactors. It can occur in the radio-active fall-out resulting from hazardous incidents in nuclear power plants.
Thallium		
$^{201}_{81}Tl$ Tl-201	3 d 1 h	*Medically-used material* Used for diagnosing coronary artery disease and other heart prob-lems.
$^{202}_{81}Tl$ Tl-202	12.32d	*Medically-used material* Used for diagnosing coronary artery disease and other heart prob-lems.
$^{204}_{81}Tl$ Tl-204	3.8(2) y	*Medically-used material* Used for diagnosing coronary artery disease and other heart prob-lems.

Nuclide Library(continued)

Name / Short Name	Half-Life	Usage / Remarks
Thorium		
$^{232}_{90}Th$ Th-232/U-232	14.05 Ga	^{232}Th or ^{232}U *Naturally-occurring radioactive material* Found naturally occurring in abundance within the earth crust, it is not fissile itself, but can be used to generate the fissile element ^{233}U. Used in gas lantern mantles, ^{232}Th is also used in WIG welding rods. The spectra of ^{232}Th and ^{232}U are very similar.
Tungsten		
$^{187}_{74}W$ W-187	23.9 h	*Industrially-used material* Used in the electronics industry.
Uranium		
$^{232}_{92}U$ U-232/Th-232	68.9a	^{232}U or ^{232}Th Special Nuclear Material The spectra of ^{232}Th and ^{232}U are very similar.
$^{233}_{92}U$ U-233	160 ka	Special Nuclear Material Used in nuclear power generators. Although the United States demonstrated/detonated in 1955 a ^{233}U based bomb core, the use of ^{233}U within a weapon is not as viable of a choice for a weapon when compared to ^{235}U.
Xenon		
$^{133}_{54}Xe$ Xe-133	5 d 6 h	*Medically-used material* Used for blood flow measurements and to image the heart, lungs, and brain, for example, ^{133}Xe is used in conjunction with tomography to acquire such data.

Nuclide Library(continued)

Name / Short Name	Half-Life	Usage / Remarks
Yttrium		
$^{88}_{39}Y$ Y-88	106.616(13) d	*Medically-used material* *Industrially-used material* Used as a tracer isotope for medical and industrial application.

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