ORTEC®
AMETEK

DX1™

Handheld Radionuclide Identifier

User's Manual

Software Version 1.2



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SAFETY INSTRUCTIONS AND SYMBOLS

This manual contains up to three levels of safety instructions that must be observed in order to avoid personal injury and/or damage to equipment or other property. These are:

DANGER Indicates a hazard that could result in death or serious bodily harm if the safety instruction is not observed.

WARNING Indicates a hazard that could result in bodily harm if the safety instruction is not observed.

CAUTION Indicates a hazard that could result in property damage if the safety instruction is not observed.

Please read all safety instructions carefully and make sure they are understood fully before attempting to use this product.

In addition, the following symbol might appear on the product:



ATTENTION – Consult the manual in all cases where this symbol is marked in order to determine the nature of the potential hazards and any actions that must be taken to avoid them.



DANGER – Hazardous voltage



Protective earth (ground) terminal

Please read all safety instructions carefully and make sure they are understood fully before attempting to use this product.

1. GETTING STARTED

Congratulations on purchasing the ORTEC® DX1® Handheld Radioisotope Identifier (RIID). The DX1 builds upon the legacy of the Detective-X, offering enhanced ergonomics, improved reliability, a larger PCAP (Projected Capacitive Touch) touchscreen display, a significantly improved user interface, and a robust Linux-based operating system. The DX1's performance is unrivaled among handheld RIIDs.

This chapter introduces the main features of the DX1, then walks through the procedure for powering it up and cooling it to operating temperature. More detailed information begins in Chapter 2.

1.1 THE DX1 TRANSPORT CASE AND CONTENTS

The DX1 is shipped in a rugged, foam-lined transport case suitable for shipment via common carrier or as checked baggage on commercial passenger aircraft. Figure 1 shows the loaded DX1 transport case as delivered from the factory.



Figure 1. Transport Case

(Figure 1 shows the optional neutron detector positioned in the upper right cavity. If the neutron detector was not purchased, the cavity for the neutron detector is empty.) Note that the instrument is shipped with the ***COOLER OFF***. ***NEVER operate the cooler when the unit is enclosed in the transport case or wrapped in other insulating material.*** Extra batteries can be shipped in the foam insert in the case.

1.2 DX1 FEATURES

Figure 2 through Figure 5 show the major features of the DX1. Features and operating details are discussed in detail in Chapters 3 through 7.



Figure 2. DX1 Side View (with Passive Detector Cover Attached)

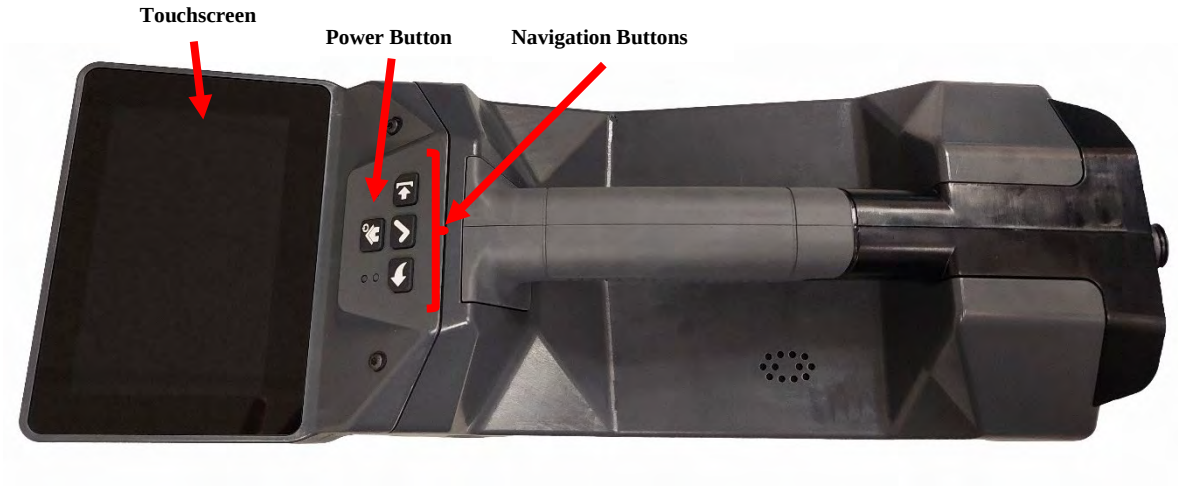


Figure 3. Top View



Figure 4. Rear Panel

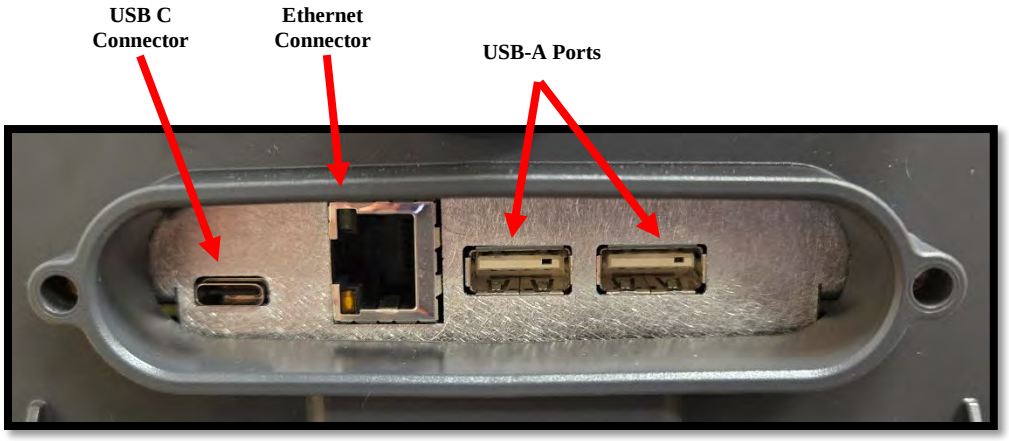


Figure 5. Rear-Panel Data Connectors

1.3 UNPACKING

1. Remove the DX1, the two batteries, the power adapter with DC cable, and the mains adapter package from the case.



Figure 6. Adapter Accessories and Batteries

2. Remove the covers and install the 2 batteries into the rear of the DX1 unit.

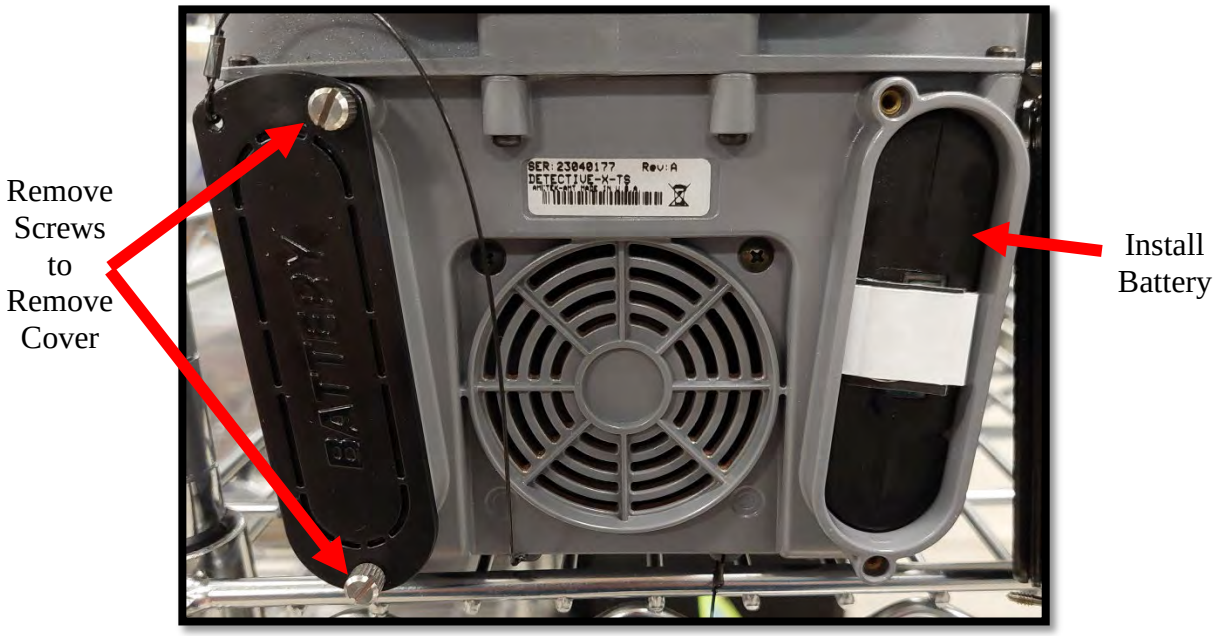


Figure 7. Battery Installation

3. Referring to Figure 8, on the upper-center of the rear panel, unscrew the protective cover from the DC power connector and plug in the DC power cable from the power supply. The connector is keyed, so use the arrows to line it up correctly, then push in and twist the ring clockwise to lock the connector in place. ***Do not force or overtighten the connection.***



Figure 8. Arrows Show Proper Power Connector Orientation

4. Find the mains power cord and the appropriate wall plug adapter for the operating location. Press the wall plug adapter onto the power cord and connect the power cord into the power supply. Finally, plug the cord into the wall outlet. The power supply is operating when the indicator LED on the power supply is lit (Figure 9). Note that the internal batteries charge any time the unit is connected to external power, whether or not the touchscreen computer/detector power button is on or off.

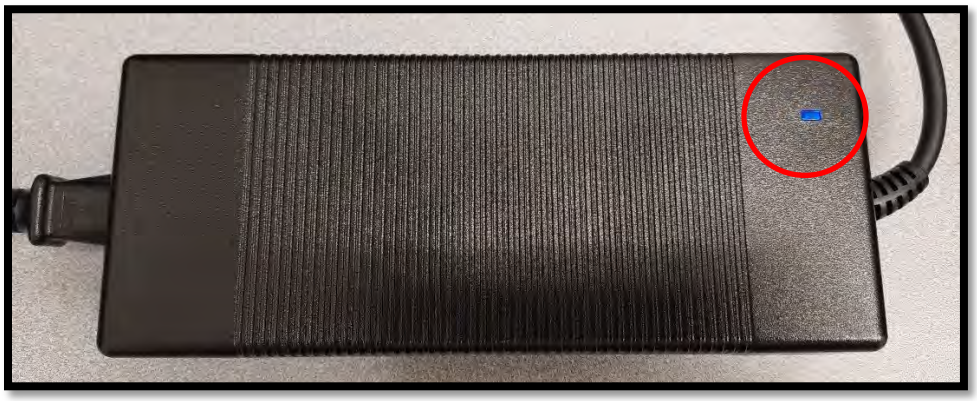


Figure 9. Power Supply Indicator LED

1.4 POWER-UP

Referring to Figure 3 and Figure 10, the top button on the DX1 keypad is the power button. To power up, press and hold the button for at least 3 seconds. If a cable is plugged into the ethernet port, it will illuminate. Approximately 5 seconds later the touchscreen will illuminate. The unit will then begin its boot-up sequence, which takes just a few seconds. The instrument should take less than 2 minutes to fully power up



Figure 10. Power

and be ready for the next operation. (Note that the unit can also be turned off by pressing and holding the power button for about 5 seconds; this interval prevents unintentional power-off.)

When the boot-up sequence is complete, the instrument will display the Home screen. If an application is selected to "Run at Startup", the sequence will continue on to start the selected application. Factory default is set to start up to the Home screen.

Once power-up is complete, the cooler must be powered on. Refer to Section 1.5 for further instructions on powering on the cooler.

NOTE	The default factory settings will be enabled to automatically start the DX1 into the Home screen upon system power up. This behavior can be modified to start other measurement applications (i.e., Sleuth, Dose Rate, Easy ID, RAPiD, or MCB Mode). See Section 4.7.2. If the instrument settings have been modified to start an alternate application, please refer to Chapters 10 (Easy ID), 11 (RAPiD), 12 (Dose Rate), 13 (Sleuth), and 14 (MCB Mode).

NOTE	If the instrument is to be used with ORTEC PC-based application software, then refer to Section 15 after the detector is cold and operational.

1.5 TURNING THE COOLER ON

1.5.1 DX1 Application Cooler Operation

When boot-up is complete, the Home screen will be displayed, as shown in Figure 11. Note the red warning symbol ( ) in the system tray at the top right of the screen. Tapping this symbol displays the system status that states, **Cooler is OFF.** The next step will be to turn on the cryogenic cooler.

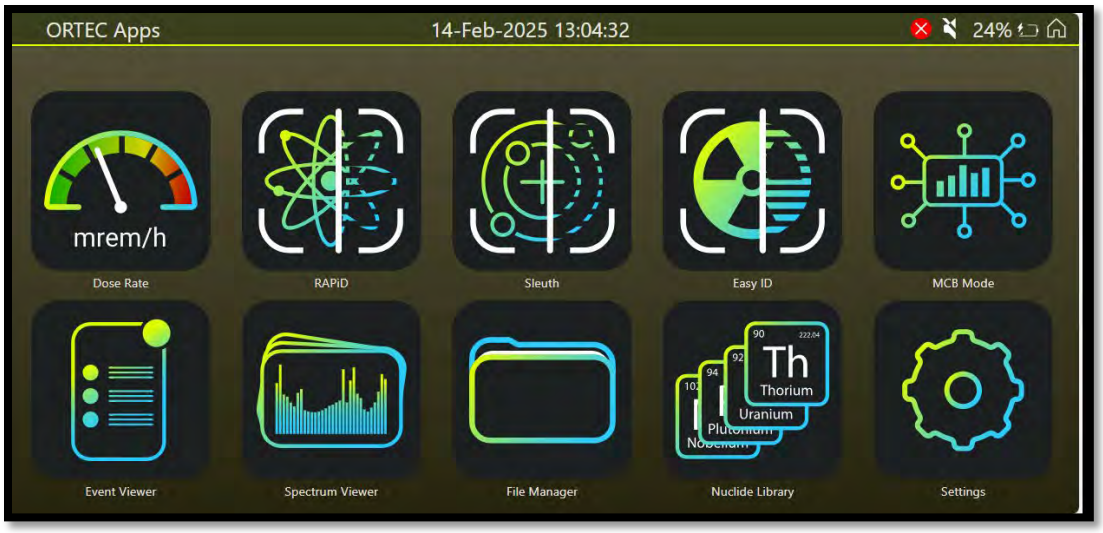


Figure 11. Home Screen



Figure 12. System Status

1. In the pop-up System Status message (Figure 12), tap **Start Cooler**. The cooler will turn on and the pop-up message will close.

> **NOTE** Once turned on, the cooler stays on, even if the instrument power is turned off. To completely shut down the instrument, press the power button on the front of the instrument. A message will be displayed asking to turn off the cooler. See Section 2.14 for more information.

2. At this point, the cooler off error message will no longer be displayed, and the instrument status will say Cooler: Phase 1 as seen in the status block in RAPiD (Figure 13).
3. The instrument may be temporarily disconnected from external power and moved to a different location if desired. However, it should remain on AC power during the cooling process. (Note batteries are not charging during the cooling process and the LED status will display a solid light indicating the batteries are not being charged.)
4. Cooling will continue through four phases before the status symbol changes to a white ready icon (✅).

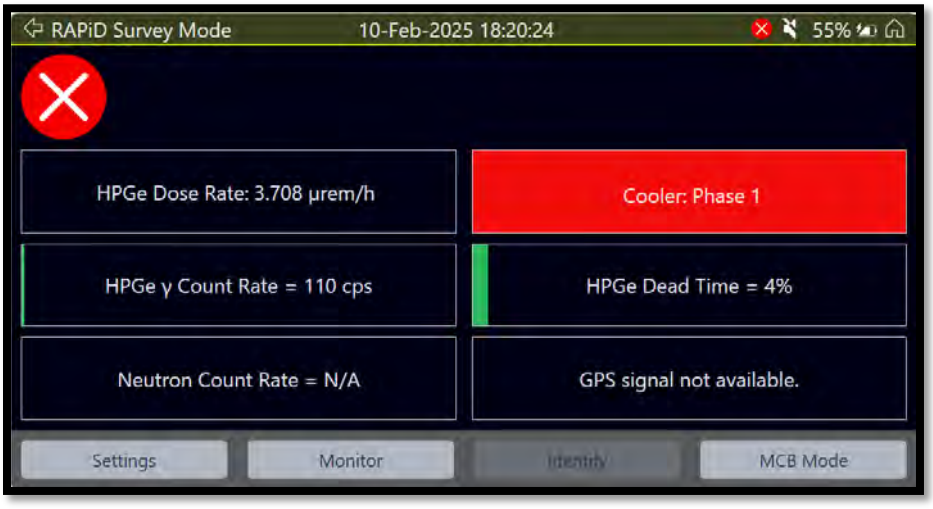


Figure 13. Cooler Phase 1 Status

The user may wish to tap the **Status** button on the Settings screen to display system temperatures and track cooldown progress.

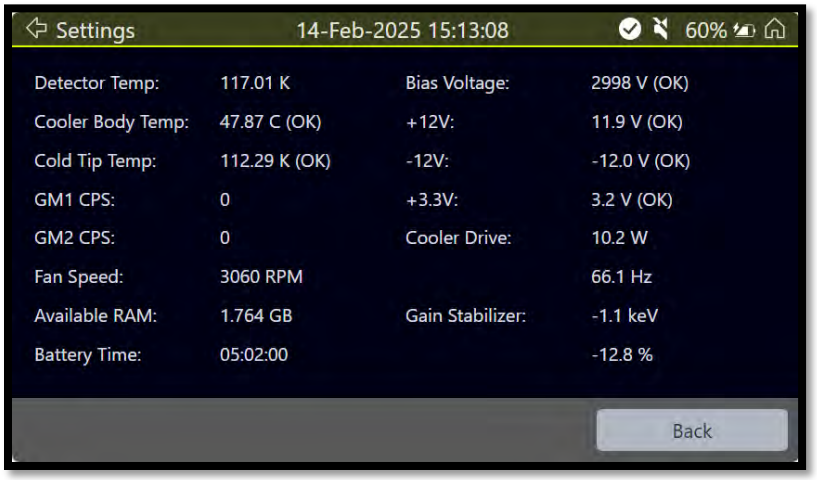


Figure 14. System Status

Cooldown from room temperature typically takes approximately 6 hours. This is a good time to become familiar with the DX1's features and operating instructions. Be sure to see the operating cautions and notes in Section 2.13.

1.6 DX1 ACCESSORIES

The following standard accessories are supplied with the DX1 and are included in the shipping container (refer to Figure 1):

- User's manual
- Universal power supply with captive DC cable
- AC mains cord with male adapters for any mains power source
- Heavy duty shoulder strap with retractable stylus
- 12-V automobile power adapter
- USB cable (USB A to USB C, 3 m)
- RJ45 cable (3m)
- Detector cover
- Screen protector

NOTE A screen protector kit is provided with the DX1. This can be added to the screen by the user if desired. Additional kits are available for purchase as needed.

1.6.1 Power Supply

The power supply is rated at 100-240 VAC and 50/60 Hz. The DC cable to the DX1 is captive, and the mains socket is IEC 320 C14 compatible.

1.6.2 Strap

The shoulder strap (Figure 15) is connected by quick-release fasteners that clip to diagonal corners of the DX1 (see Figure 16). (Figure 2 shows the attachment points on the right side of the housing; there are two on the left side, as well.) The two strap orientations give both right- and left-handed users a clear view of the display. The strap includes a stylus attached by a retractable polyaramid cord. The stylus is especially useful for operating the touchscreen if the operator is wearing protective gloves and for entering alphanumeric information. When not in use, the stylus is held against the strap with an embedded magnet.



Figure 15. Strap with Retractable Stylus

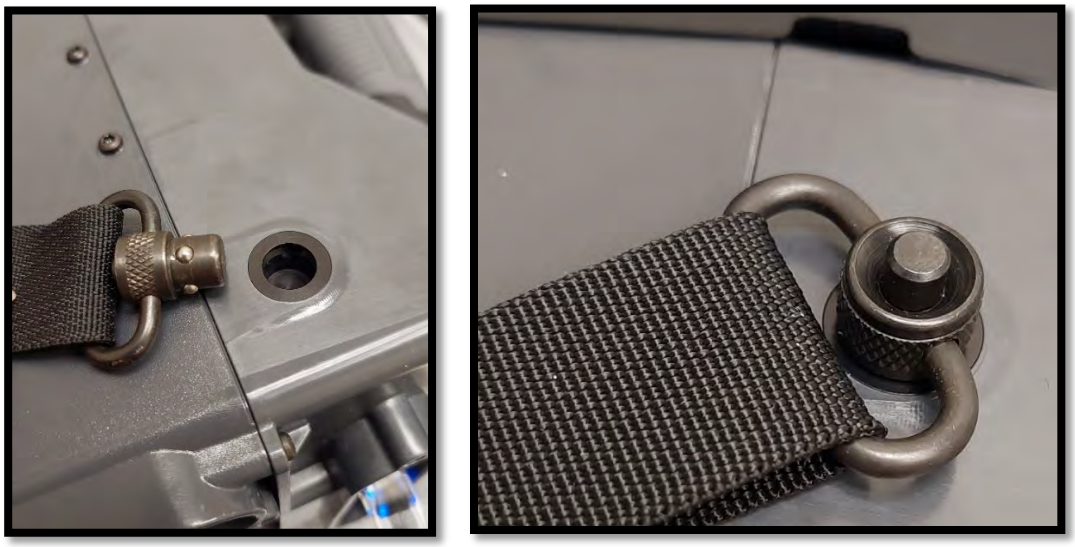


Figure 16. Strap Quick Disconnect

NOTE	Assembling the strap adds to the maximum overall dimensions of the DX1.

1.6.3 USB Cable

The DX1 is supplied with a 3m (~10ft) USB cable for connecting the unit to a PC running Microsoft Windows 11 (see Figure 5 for rear panel connections). When the cable is used to connect the DX1 to a PC, the DX1 appears as a USB flash drive in the PC's folder structure, so files can be easily transferred with no special software. Note that the USB setting "Mount as Drive on PC" must be

turned on to allow the DX1 to be connected to a PC. The DX1 drive appearing in Windows is ready only. Files may be copied to the PC, but they cannot be deleted from the DX1 via this USB interface. The DX1's file manager application should be used to delete any files from the instrument. As is good practice with any flash drive to prevent data corruption, it is recommended to eject the DX1 prior to removing the cable, either with the "Eject" command in Windows File Explorer or the "Safely Remove Hardware and Eject Media" option.

The USB cable also permits users to connect to the DX1 via the MCB Mode.

1.6.4 USB Flash Drive and MicroSD Card

The DX1 can copy or move data from the internal storage to a USB flash drive (see Figure 5 for rear panel connections) to make file transfer to other devices fast and easy. Note that only 1 flash drive will be recognized at a time by the instrument. Also note that it is encouraged to eject the flash drive in the software before removing it from the instrument. To access the data, either insert the USB flash drive directly into a computer or extract its microSD card (Figure 17) and insert it into a microSD card reader. *Be sure to replace the microSD card before re-mounting the flash drive on the DX1 rear panel.* ***Be careful to orient the card correctly, then seat it gently but firmly.***



Figure 17. MicroSD USB Flash Drive Adapter

1.6.5 Detector Attachments

The detector cover is a molded, low-density plastic cover that protects the detector endcap from impacts and moisture ingress when it is not protected by a collimator or neutron detector. The cover is held in place with magnets for easy switch-out with collimators or a neutron detector. Simply pull the cover forward and away from the endcap to remove.

The optional collimators, filter, and neutron detector replace the detector cover and protect the detector endcap from damage. Each of these devices mate to the DX1 via the connector shown in Figure 18. The DX1 software reads the connector to recognize which type of device is mounted, records that information in the N42.42 files, and uses the corresponding ambient background file for that device. For more information, see Sections 2.10, 2.11, and 4.5. Note that the N42.42 file is a spectrum file stored by the DX1's various measurement applications and utilizes the ANSI N42.42 format.



Figure 18. Collimator/Filter/Neutron Detector Connector

2. SYSTEM OVERVIEW

The DX1 is a high-resolution, handheld radioisotope identifier that uses a radioisotope's characteristic gamma-ray energies for identification. The large high-purity germanium (HPGe) detector is essential to the sensitivity and accuracy of the instrument. The high resolution of the detector, combined with the Identification Table (Appendix C) and proprietary identification algorithms, make the DX1 extremely accurate, even for materials in shielded and masked configurations.

The HPGe detector is cooled by a small, highly reliable mechanical cooler to near-liquid-nitrogen temperature. The cooler is designed for years of continuous duty, so it is always ready at a moment's notice. For a more detailed discussion, see Sections 2.2 through 2.4.

2.1 THE USER INTERFACE

The user interface is a high-resolution, color touchscreen. The various DX1 applications can also be operated by the Back/Cancel , Next , or OK/Yes  buttons. These buttons are located next to the Home/Power  button. These input methods give the user versatility in operation. Users wearing protective gloves may find these buttons easier to use than the touchscreen.

2.2 GAMMA-RAY DETECTORS

DX1 uses a large, coaxial, P-type high purity germanium (HPGe) detector crystal. The dimensions of the crystal are nominally 65 mm in diameter by 50 mm long. (See also the specifications in Appendix B.) This large diameter has the high frontal surface area necessary for excellent sensitivity to low-energy gamma rays. The large crystal depth provides stopping power for high-energy gamma rays, and the large crystal volume increases the likelihood that gamma rays will be fully absorbed by the detector, increasing the likelihood that the gamma ray can be identified.

The HPGe detector is used both for radionuclide identification and for determining low-level gamma-ray exposure rates. It can also detect beta radiation by recognizing a characteristic bremsstrahlung energy spectrum.

The DX1 uses three detectors to determine the gamma-ray exposure rate over a wide range from <0.10 milliroentgen (mR)/h to >2 R/h. For low exposure rates (below ~2 mR/h), the rate is determined from the HPGe detector spectrum. For exposure rates between 2mR/h and 104mR/hr, the low-range Geiger-Müller detector is used. For exposure rates above 104mR/hr, the high-range Geiger-Müller detector is used. The DX1 switches between these detectors automatically to report dose rate. (NOTE: In RAPiD, the detector being utilized is reported with the current dose rate reading.)

2.3 MODULAR NEUTRON DETECTOR

The optional DX1 neutron detector is a large-volume segmented lithium-6 fluoride/zinc sulfate (^{6}LiF/ZnS) detector formed in a U-shape that sits behind the HPGe detector so that it does not block the sides of the detector from absorbing gamma rays. The highest sensitivity to neutrons is in the forward direction, that is, when the front of the instrument is pointing at the radiation source. Digital pulse processing is applied separately to each segment, increasing the neutron detection probability while still maintaining a very low false-positive rate.

The neutron detector module is held in place with magnetic mounts and may be removed and replaced with the (passive) detector cover to reduce weight when neutron detection is not required. It mates via a connector (Figure 18) that the DX1 software reads to determine the device type. That information is added to the N42.42 files, and the software automatically uses the ambient background correction file for the configuration with the neutron detector. Note that removing or installing the neutron detector may trigger a neutron alarm; acknowledge it on the touch screen to clear the alarm but note that is not a true neutron alarm.

NOTE When no neutron detector is attached, the DX1 can infer the presence of neutrons by detecting gamma rays emitted from the neutron activation of surrounding materials. This capability is especially effective in systems configured for the 8 MeV energy range.

NOTE To prevent false alarms and unnecessary error messages, a 15 second delay has been added between when a Neutron detector is connected to the instrument and when the Neutron detector is displayed on the screen and available for use.

2.4 DETECTOR REFERENCE POINTS

For radiation fields from extended sources (e.g., a container full of NORM) or far-field point sources (>1 m from the instrument), the precise location of the detector the DX1 software uses to determine exposure rate is not important. When point sources are close to the instrument, the readings from the different detectors may not agree because they are in different places in the instrument enclosure, and the dose rate may vary rapidly with position.

If it is desired to test the dose-rate measurement capability with a point source, especially at close range, it is important to know the reference points of the instrument's detectors because test procedures, such as American National Standards Institute (ANSI) or International Electrotechnical Commission (IEC) tests, prescribe the use of point sources at specified distances from the detector reference point. Figure 19 and Figure 20 show the detector reference points; note that they are not marked on the enclosure.

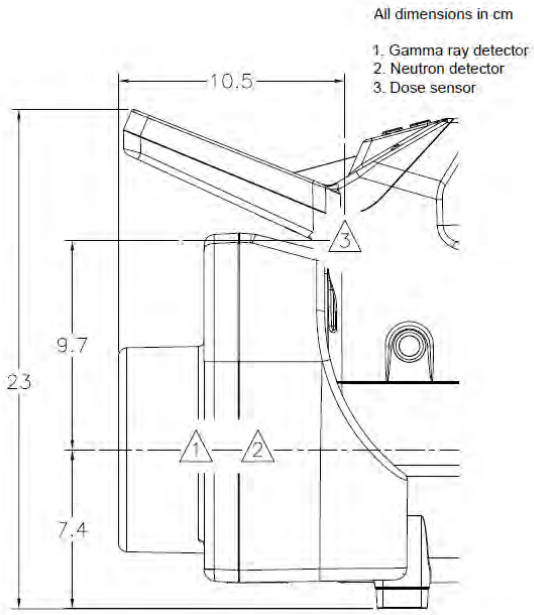


Figure 19. Detector Vertical Reference Points

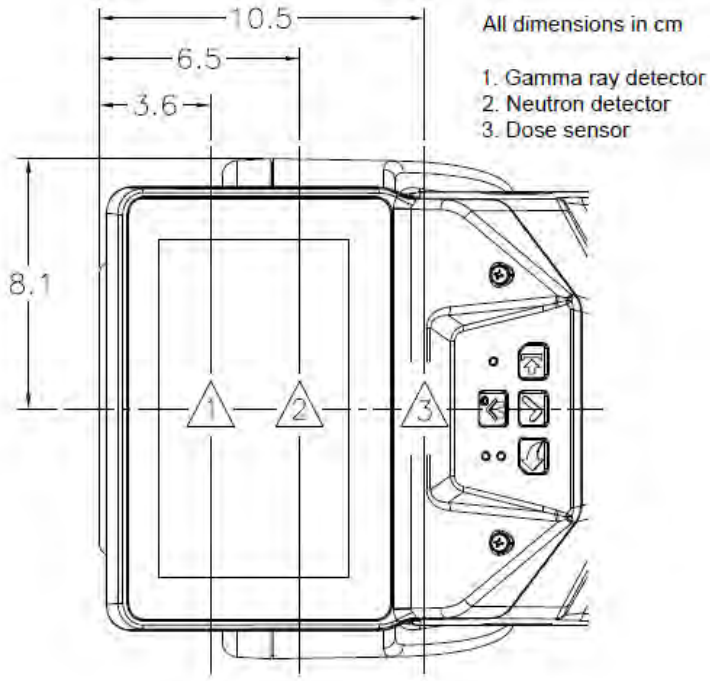


Figure 20. Detector Horizontal Reference Points

NOTE	Units for Figure 19 and Figure 20 are in cm.

2.5 THE INTERNAL BATTERIES

The DX1 uses two high-capacity lithium-ion (Li-ion) batteries, which charge whenever the unit is connected to external mains or 12-V power. The DX1 can operate for up to 8 hours on a fully charged pair at room temperature. At extremely low temperatures (−20°C), the batteries can operate for up to 6.5 hours. At extremely high temperatures (50°C), the batteries can operate for up to 5.5 hours.

A 5-bar LCD display on the end of the battery opposite the charging blades (Figure 21) shows its state of charge and can be used to distinguish spent batteries from charged ones. When the instrument reaches 20% remaining power, the battery LED on the instrument keypad turns yellow and a warning indicator in the screen header is displayed. When the instrument reaches 10% remaining power, the battery LED on the instrument keypad turns red and an alarm indicator is displayed in the screen header. When the instrument reaches approximately 3% of power, an imminent shutdown message is displayed and the DX1 begins safely shutting down the instrument unless power is applied within 30 seconds. The internal circuitry will not overcharge the batteries, so the DX1 may be left on external power indefinitely. While the instrument is charging batteries, the battery LED will flash green. When batteries are fully charged the LED will be solid green.

NOTE The DX1 may also be operated on one battery at a time, using either battery bay. This is encouraged because it makes the unit almost 1 lb. lighter. *This will of course cut the run time in half*. However, it's fast and easy to hot-swap the batteries one-at-a-time without interrupting data collection.

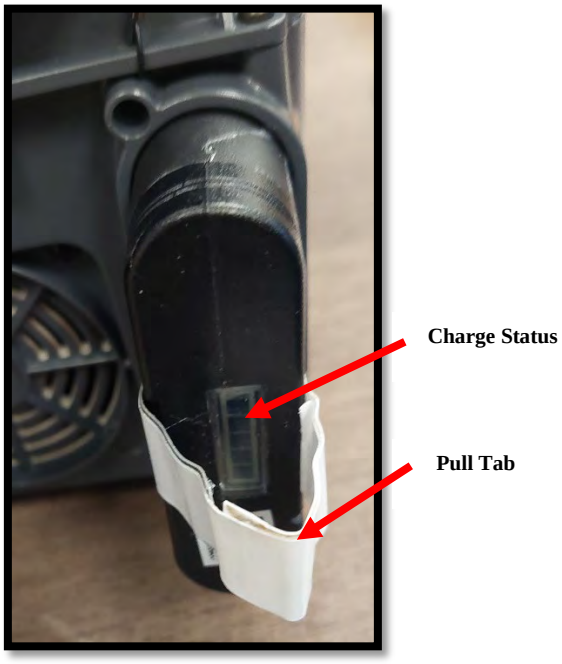


Figure 21. Charge Status Indicator and Pull Tab

Spare batteries are available from ORTEC (P/N DX1-ACC-BAT see Section B.7). An external dual-battery charger is also available (P/N DX1-ACC-DUAL-CHGR[1]).

To change a battery:

1. Loosen the captive thumbscrews on the rear-panel battery hatch and remove the hatch.
2. Grasp the pull tab loop on the end of the battery and exert a steady pull (do not yank) until it slides out.
3. Orient the fresh battery so the grooves on the side will mate with the charging blades in the battery socket.
4. Slide the battery into the socket, and gently but firmly push to seat it on the charging blades. ***Do not force the battery into the socket; recheck its orientation if it does not seat easily.***

Typical battery lifetime is 3-5 years; see Section B.7 for information on replacing the batteries. See also the discussion on shipping Li-ion batteries in Section 2.14.1.

2.6 VEHICLE POWER ADAPTER CABLE

The 12V vehicle power adapter cable lets the user charge the DX1 from a standard 12V automobile power receptacle. The plug allows the retention to be adjusted with a slider on the side of the plug (see Figure 22). Adjust it for a given receptacle so that the plug fits snugly, but not so tightly that inserting the adapter deforms the receptacle. This will provide adequate electrical contact and minimize heating of the connector. The adapter cable is fused at 10 A. Before using it, inspect the receiving receptacle for damage and excessive wear. Do not try to power the DX1 from a worn or damaged receptacle.



Figure 22. DC Plug Retention Force Adjustment Slider

2.7 EXTERNAL BATTERY POWER OPTION

ORTEC also offers an interface cable for external 2590-type batteries, commonly used for military applications, that allow the DX1 to operate for up to a total of 16 hours without external power or a battery swap. The part number is DX1-ACC-2590-CABLE. Please note that the DX1 transport case is not designed for the shipment of these high-capacity batteries.

[1] All part numbers subject to change; contact an ORTEC representative or the ORTEC Global Service Center or visit the ORTEC website.

2.8 INSTRUMENT ENCLOSURE

The DX1 enclosure is molded from high-impact polycarbonate that absorbs mechanical shock without cracking or permanently deforming, does not degrade under exposure to ultraviolet light (direct sunlight), and boasts an F1 rating per UL 746C. With all covers and caps in place, the DX1 enclosure is IP65 certified. The DX1 is not certified for use in explosive atmospheres.

An air plenum through the middle of the instrument provides an exit path for waste heat from the cryogenic cooler. The instrument has a variable-speed cooling fan that pulls cool air through the back of the enclosure and expels warm air through a vent on the bottom. Components inside the plenum (including the cooling fan) are tightly sealed against water and dust ingress. With an IP 65 rating, the DX1 can be used even in heavy rainfall.

A pressure equalization breather is located on the bottom of the instrument to ensure excessive air pressure does not build up inside the unit at high altitudes, as might be encountered during air transport.

The speed of the cooling fan increases under high heat conditions such as when initially cooling the detector, decreases under normal conditions, and turns off completely at low ambient temperatures.

Adequate airflow over the cryogenic cooler is important for efficient cooler operation. Always ensure the air can flow freely through the instrument. Failing to do so will result in excessive battery usage and excessive time to initially cool the detector. Never block the air inlet at the back of the unit or the exit vent on the bottom of the instrument. Be aware that placing the unit on a soft surface such as a sofa or even a thick carpeted floor can result in the bottom air vent becoming blocked. It is best to set the unit on its side when resting it on soft surfaces.

2.9 USB CONNECTIONS

The rear panel of the DX1 contains three USB connections – two USB-A and one USB-C. The USB-C connection is used to communicate with the instrument in the MCB Mode application. The two USB-A connections are used to insert a USB drive for file transfer. Note that a USB drive should not be entered into both ports simultaneously as the instrument only has the capability to communicate with one USB drive at a time. The additional port is designated for future expansion capabilities of the instrument.

2.10 COLLIMATORS (GREEN AND PEACH)

ORTEC offers two standard collimators for the DX1:

- DX1-ACC-COL-ST 4mm Stainless Steel (colored green; see Figure 23)
- DX1-ACC-COL-W 4mm Tungsten (colored peach)

Collimators reduce the sensitivity of the instrument to radiation sources not directly in front of the instrument, enhancing the unit's ability to locate a radiation source.



Figure 23. Stainless Steel Collimator

Both use the magnetic mounting system used for the passive detector cover and the neutron detector, so they are easy to install and remove. Both also mate via a connector (Figure 18) that is read by the DX1 software to determine collimator type. That information is added to the N42.42 files, and the correct ambient background file is used. Note that before first use of a collimator, an ambient background measurement must be taken with that collimator installed (see Section 4.5). Until this background has been run, the status area on the screen will say "Missing Background."

The tungsten collimator is the most effective of the two because tungsten is more than twice as dense as stainless steel. Unfortunately, this also means the tungsten collimator is more than twice as heavy, so it may not be as convenient to use in the field.

2.11 LOW-ENERGY FILTER (RED)

A low-energy filter is offered for applications where it is important to identify radioactive materials in the presence of very high levels of low-energy gamma rays. This situation often occurs with aged plutonium due to ingrowth of americium. The filter allows the plutonium to be correctly identified even in the presence of high levels of americium that would otherwise produce an overrange alarm.

The ORTEC part number for the low-energy filter is:

- DX1-ACC-RCFILTER Graded low-energy shield (colored red)

As with the collimators, the neutron detector, and the passive detector cover, the low-energy filter is easy to install and remove. The DX1 maintains different ambient background correction files for configurations with and without the low-energy filter. The filter's connector (Figure 18) identifies it to the DX1. That information is added to the N42.42 files, and the correct ambient background file is used. Note that before first use of the filter, an ambient background measurement must be taken with the filter installed (see Section 4.5).

2.12 RF SECURE MODELS

If the instrument purchased has an RF Secure sticker on the back above the serial label (as seen in Figure 24), the instrument is shipped without WLAN, GPS, or Bluetooth capabilities.



Figure 24. RF Secure Sticker Positioning

2.13 OPERATING CAUTIONS AND NOTES

WARNING The power adapter/charger must not be exposed to water. When in use, it should be placed on a dry, flat, dust-free surface. When not in use, it should be disconnected from the AC power supply and covered to protect it from moisture and dirt. Any covering used in storage must be completely removed from the power/charging adapter before connecting the power adapter to the input power source. Make sure the power connections for both the DX1 and power adapter are clean and dry before connecting to the input power supply.

CAUTION The DX1 enclosure is waterproof. If all covers and seals, including the detector cover (or neutron detector), are in place, the instrument will operate even after a *brief* immersion in water.

CAUTION To avoid damaging the cooler and to comply with transportation regulations, be sure the cooler is turned off before shipping the DX1. The unit can be shipped as soon as the cooler is turned off; there is no need to wait until the detector warms up.

CAUTION Breaking the seal on the case ***voids the warranty***. The DX1 contains ***no user-serviceable parts***. Only the batteries can be changed/replaced. The DX1 is to be opened only by ORTEC-authorized service personnel.

CAUTION The DX1 is designed for use at temperatures between -20°C to +50°C (-4°F to +122°F). It dissipates heat from the cooler via a heat sink enclosed in the fan cooling tunnel. The variable-speed fan pulls air in from the rear panel and exhausts from vents in the bottom of the enclosure. ***Do not place the DX1 upright in mud, loose soil or sand, standing water, dense grass; or on thick carpet or any surface that restricts this airflow.*** On surfaces such as these, the unit may be placed on its side to allow proper airflow. Whenever possible, avoid

placing it on a warm or hot surface, such as sun-heated pavement, for extended periods. ***Do not leave the instrument in a hot vehicle.***

- If the DX1 reaches an internal temperature of greater than 75°C, the unit will automatically shut down. To start the unit back up, press the power button. If the unit is still at an internal temperature of greater than 75°C for 5 seconds after the power is restored, the unit will turn itself back off. Allow the instrument to cool in a well-ventilated area before attempting to restore power.
- Keep all rear-panel covers and caps in place, when not in use, to prevent ingress by dust and water.
- For the answer to any questions about using, maintaining, or shipping this instrument, contact an ORTEC representative or ORTEC's Global Service Center first. If the DX1 requires service, contact ORTEC before returning the instrument. If the original foam-lined transport case is not available, *ORTEC will supply a suitable container*.

2.14 PREPARING THE DX1 FOR SHIPPING

CAUTION When shipped in either the transport case or alternative packaging, the DX1 cooler ***must be turned off to avoid damage from overheating***. Leaving the cooler on will cause the instrument to quickly overheat, which will damage the instrument and void the warranty.

DX1 should always be shipped in its transport case *with the cooler turned off*. To ensure that the cooler is turned off, first turn the unit on (if it is not already on) by holding the power button down for at least 3 seconds. Once the power up sequence is complete, press and hold the power button again. The instrument will display the message in Figure 25. Make sure "Shutdown cooler also" is selected (toggle is green with white background). Then press **Yes** to shut down the instrument and cooler and prepare for shipment.

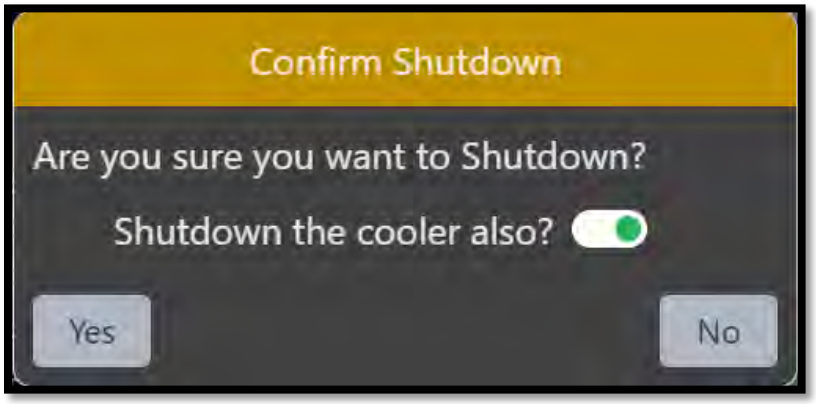


Figure 25. System Power Down Message

The DX1 should always be shipped with the dust cover in place instead of the optional neutron detector. Shipping with the neutron detector in place could lead to damage to the neutron detector connector if dropped too hard during the shipping process.

NOTE The DX1 contains no radioactive sources and no corrosive materials. The refrigeration device contains 108 cm^3 of nonflammable, nontoxic helium at a pressure of 2700 kPa, and is exempt from special handling precautions per US DOT 49 CFR 173.307(a)(4).

2.14.1 Shipping Li-ion Batteries

Be aware that Li-ion batteries have special requirements for safe shipping. This is the same battery technology used in most cell phones, laptop computers, and other portable devices. Regulations change often to meet new challenges, so be sure to know the current requirements for this type of battery prior to shipping, especially when shipping spare batteries.

The United Nations Committee of Experts on the Transport of Dangerous Goods provides guidance for shipment of Li-ion batteries contained in equipment or packed with equipment under designation UN 3481. (Shipment of Li-ion batteries not installed or packed with equipment is covered by designation UN 3480, which has different and more stringent requirements and is not discussed here.)

The DX1 with batteries installed and packed in the ORTEC-supplied transport case does not require any special labeling or shipping considerations on common carriers (e.g., FedEx, UPS, DHL) because the device contains only two Li-ion batteries with a battery capacity less than 100 Wh each. Up to two (2) spare batteries may also be shipped in the transport case by inserting them in the cutouts provided in the foam lining, if an additional Lithium Battery Mark is applied to the transport case, as shown in Figure 26. The bottom of the label should list the telephone number of the person who is responsible for the package and can be contacted to answer questions that may arise during shipping. Compliant labels are available from shipping supply vendors.



Figure 26. Li-ion Battery Shipping Label

Table 1 shows information that may be needed to determine compliance with future regulations.

Table 1. Battery Specifications (Subject to Change)

Battery Manufacturer:	Inspired Energy (www.inspired-energy.com)
Battery Model Number:	NH2054HD34
Battery Energy Capacity:	98 Wh per battery
Battery Weight:	< 0.5 kg
Instrument Battery Capacity:	2 batteries
Conformance:	Tested to UN38.3. Certificate of Compliance is available at www.inspired-energy.com

2.15 MEASUREMENT SOFTWARE APPLICATIONS

The DX1 comes with five measurement applications pre-installed at the factory. Following is a brief discussion of each application:

1. **Easy ID** (see Chapter 10) – The Easy ID application facilitates quick identifications of radionuclides with a pre-set acquisition time, analysis, and saving of relevant files.
2. **RAPiD** (see Chapter 11) – The RAPiD application offers a screen layout inspired by the Detective EX-100 interface, with quick access to monitor mode and improved pause and file saving functionality.
3. **Dose Rate** (see Chapter 12) – The Dose Rate application, with its large, intuitive dose rate indicator, serves as the primary measurement app when monitoring radiation levels while searching for radioactive sources.
4. **Sleuth** (see Chapter 13) – The Sleuth application is a simplified user interface with a very limited set of common user operations. In situations where operators must multi-task, it minimizes the opportunity for error.
5. **MCB Mode** (see Chapter 14) – The MCB Mode application governs communication between the DX1 and a host computer when the DX1 is used as a high-performance, benchtop gamma spectrometer in conjunction with ORTEC spectroscopy applications such as MAESTRO©, MAESTRO-PRO©, LVis©, or GammaVision©.

2.16 USER INPUT

Most users will likely interact with the DX1 by tapping the large touchscreen buttons with a finger. Alternatively, the instrument can be operated using the tactile buttons located on the handle, just below the power button. This is perhaps the most practical way to operate the instrument while wearing thick gloves.

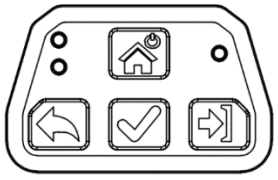


Figure 27. DX1 Keypad

- The **(** **)** button is used to move to a previous screen or action.
- The **(** **)** button is used to move forward in the screen or to the next button.
- The ( ) button is used to select the desired action.
- The ( ) button is used to turn on/off the power and to navigate directly to the home screen.

Some screens allow the user to capture alphanumeric data that will be stored in the N42.42 file along with the radiological measurement data. If the user has large hands or is wearing gloves and using the buttons, it may be easier to use the supplied stylus, which is tethered to the carrying strap (Figure 15). Figure 28 shows a typical text-entry screen where the stylus may work best.

When operating the DX1 remotely, alphanumeric data can also be entered with a PC keyboard. This is the most convenient way to enter text, especially complex text such as email addresses. Remote operation offers many benefits and is discussed in detail in Section 2.17.



Figure 28. Text Entry Screen

2.17 REMOTE OPERATION

The DX1 can be viewed remotely through a web browser. Connect the instrument and the PC to the same network, either via WLAN, USB, or Ethernet. Navigate to the Settings screen and select System.

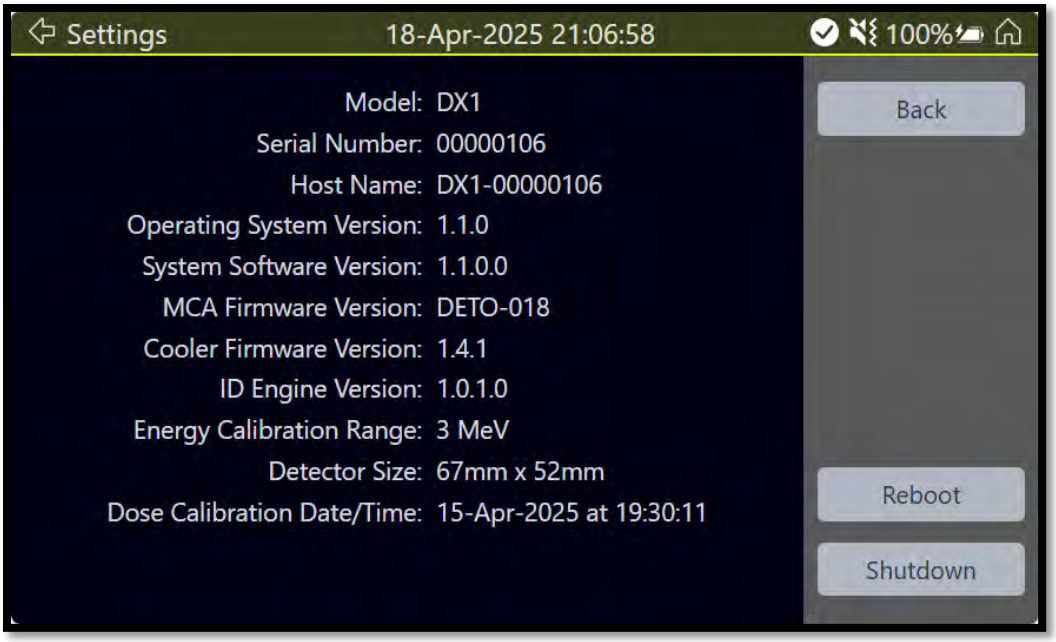


Figure 29. System Screen

Locate the Host Name on this screen. This name allows the user to connect to the instrument through a web browser. Type in the following into a PC browser's address bar to connect to the DX1:

https://HOSTNAME.local:5001/plugin

For example, using the host name seen in the image above, the web address should be:

https://dx1-00000106.local:5001/plugin

Alternatively, the instrument can also connect to the remote viewer browser using the IP address. Navigate to Settings and select Network to locate the IP address on the status screen.

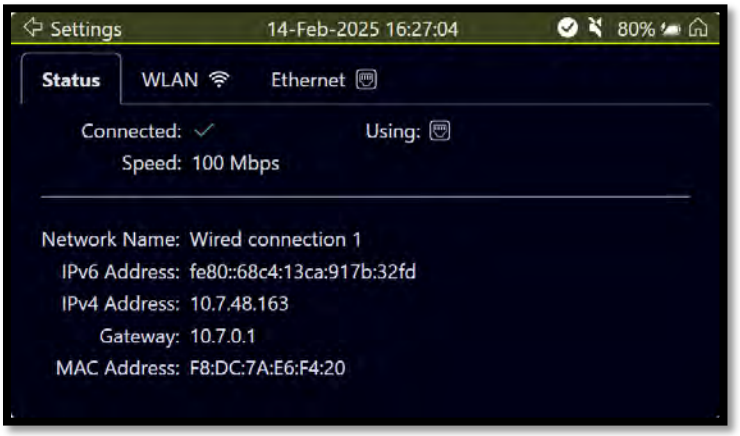


Figure 30. Network Status Screen

When using the IP address, type in the following into a PC browser's address bar:

https://IPAddress:5001/plugin

For example, using the IP address seen in the image above, the web address should be:

https://10.7.48.163:5001/plugin

When connecting through the browser, a security warning may be displayed as seen in Figure 31. The security warning is being displayed because the DX1's certificate has not been accepted in the computer browser. To take advantage of the cyber security features offered by HTTPS, the DX1's self-signed certificate needs to be added to the user's browser.

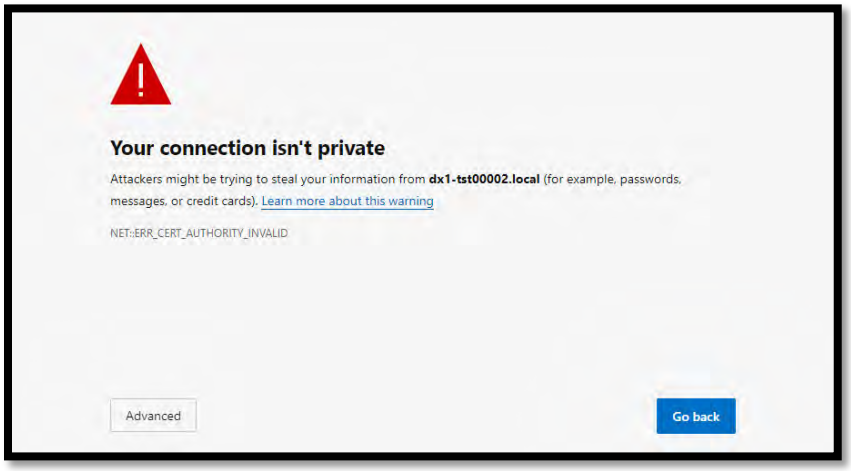


Figure 31. Connection Security Warning Message

Click on Advanced to allow the browser to connect to the DX1.

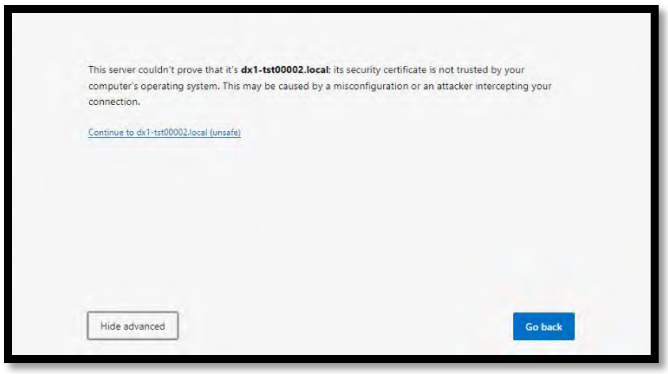


Figure 32. Advanced Warning Message

Click on the blue continue message to complete the connection to the web page.

CAUTION It is not recommended to connect to the DX1 with more than one browser window at a time as this will cause issues with instrument responsiveness.

2.18 DX1 STATUS INDICATORS

All DX1 screens show the status information at the top of the display. Figure 33 shows an example of the DX1 header bar.

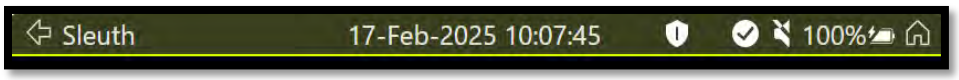
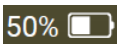


Figure 33. DX1 Header Bar

The potential icons that can be seen in the header bar are described in Table 2.

Table 2. Header Bar Icons

Icon	Status Bar Region	Description
	Battery	Powered by the power adaptor
	Battery	Powered by batteries – graphical representation of remaining charge and status
	Battery	Powered by the power adaptor with no battery installed.
	Radiation	Radiation Overrange
	Radiation	Neutron Alarm
	Radiation	Dose Rate Alarm (aka, Personnel Hazard Alarm)
	Radiation	Dose Rate Warning
	Radiation	Radiation is present
	Radiation	Radiation level is too high for the ID engine to work properly
	Radiation	Threat Nuclide Identified

Icon	Status Bar Region	Description
	Radiation	Suspect Nuclide Identified
	Radiation	Innocent Nuclide Identified
	Operational	OK – Instrument can collect data
	Operational	Overall Operation Warning – Performance may be degraded
	Operational	Overall operation not ready
	Operational	Error – Instrument cannot collect data
	General	Connected to physical (Ethernet) network
	General	Connected to WLAN network – graphical representation of signal strength
	General	WLAN is turned on but not connected
	General	Bluetooth is on but no devices are connected
	General	Bluetooth is on and devices are connected
	General	USB thumb drive is plugged in
	General	DX1 is attached to a PC via USB
	General	GPS is on but there is no “fix” on any GPS satellites
	General	GPS is on and connected to GPS satellites
	General	Advanced Mode is active (unlocked)
	General	Stabilizer is active
	General	Stabilizer is inactive
	General	MFK (Mobile Field Kit) is active
	General	Speak on, vibration off
	General	Speaker on, vibration on
	General	Speaker off, vibration on
	General	Speaker off, vibration off

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3. HOME SCREEN

The **Home Screen** application is the landing page that displays all of the available DX1 applications. The **Easy ID, RAPiD**, **Dose Rate**, **Sleuth**, and **MCB Mode** applications are installed by default. However, they can be disabled if one or more of them are not being used. Figure 34 shows the default Home screen. It displays an icon for each available application.

To start an application, just tap its icon.



Figure 34. Home Screen

The DX1 applications are described in more detail in the following sections:

- Dose Rate – Section 12
- RAPiD – Section 11
- Sleuth – Section 13
- Easy ID – Section 10
- MCB Mode – Section 14
- Event Viewer – Section 9
- Spectrum Viewer – Section 6
- File Manager – Section 7
- Nuclide Library – Section 8
- Settings – Section 4 and Section 5

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4. SETTINGS

4.1 INTRODUCTION

On the Home screen tap on the **Settings** icon to launch the Settings screen. This screen contains settings that are universal to all applications.

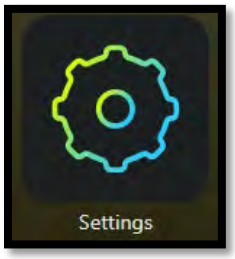


Figure 35. Settings Icon



Figure 36. Settings Screen

For each of the settings screens, tapping on the back arrow in the upper left corner returns to the previous screen (which should be the main Settings screen). Tapping on the Home button in the upper right corner returns to the Home screen where users can launch other applications.

4.2 STATUS

Tapping the **Status** button launches the Status screen.

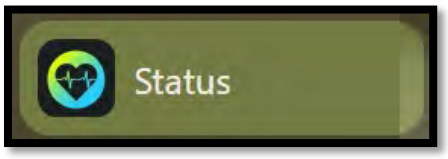


Figure 37. Status Button

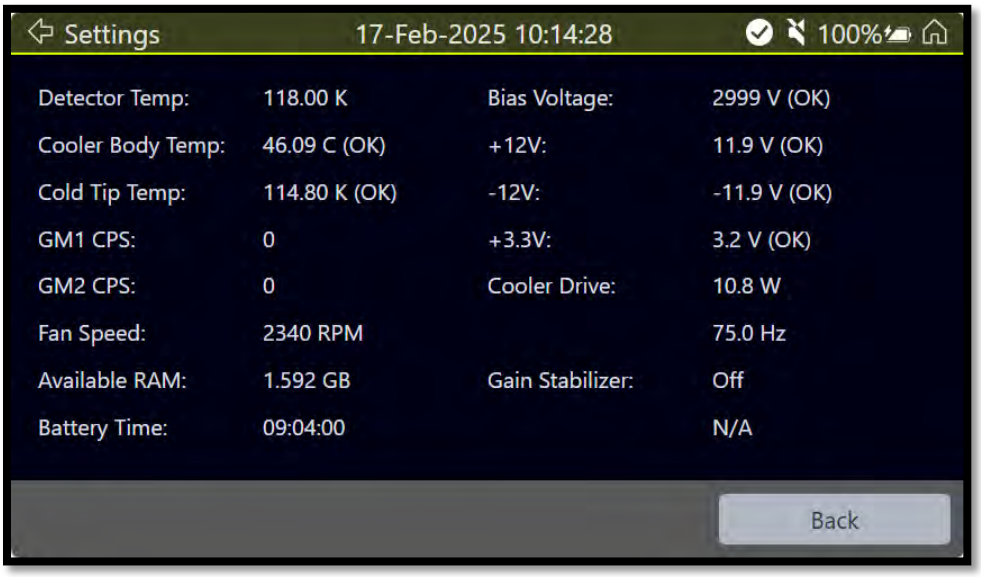


Figure 38. Status Screen

The Status screen gives real time information on the following DX1 metrics:

- Detector Temp
- Cooler Body Temp
- Cold Tip Temp
- GM1 CPS
- GM2 CPS
- Fan Speed
- Available RAM
- Battery Time
- Bias Voltage
- +12V
- -12V
- +3.3V
- Cooler Drive
- Gain Stabilizer

Tap **Back** or the left arrow in the upper left corner to return to the Settings screen.

4.3 DISPLAY

Tapping on the **Display** button opens the Display Settings screen.

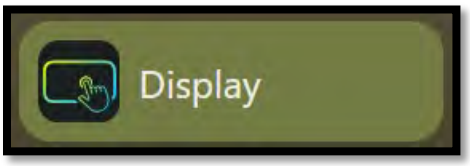


Figure 39. Display Button

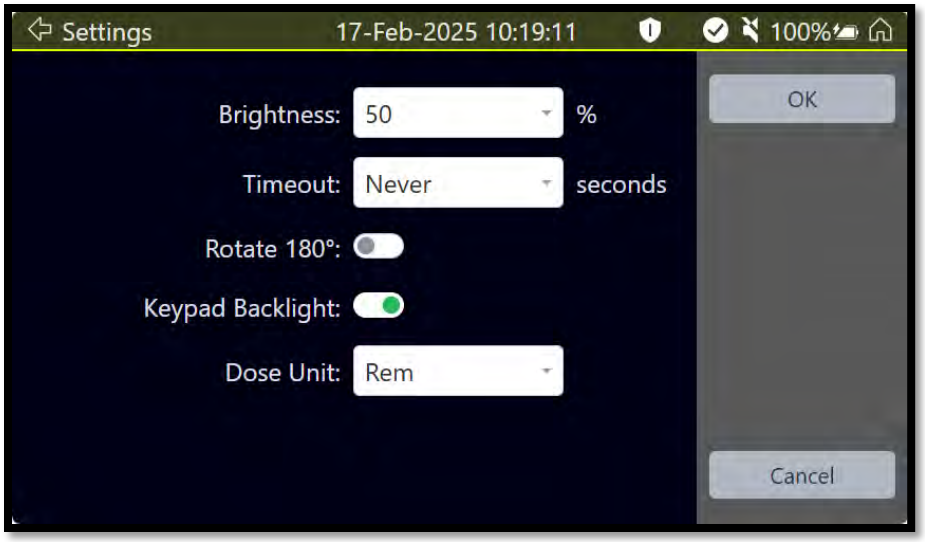


Figure 40. Display Settings Screen

Press **OK** to save changes made on this screen or **Cancel** to return to the previous screen without making any changes.

4.3.1 Brightness Setting

The brightness setting controls how bright the screen appears. The setting can be changed from 10% to 100%. Note that it is not possible to completely dim the screen to off.

4.3.2 Display Timeout

The display timeout controls how long the screen is active before dimming to power saving mode. Users can choose between 10, 30, 60, 120, 300, or 600 seconds or never dimming the display.

After changing the display timeout, a warning message will be displayed that states the display settings will not be effective until the instrument is rebooted. Select **Yes** to reboot the instrument immediately.

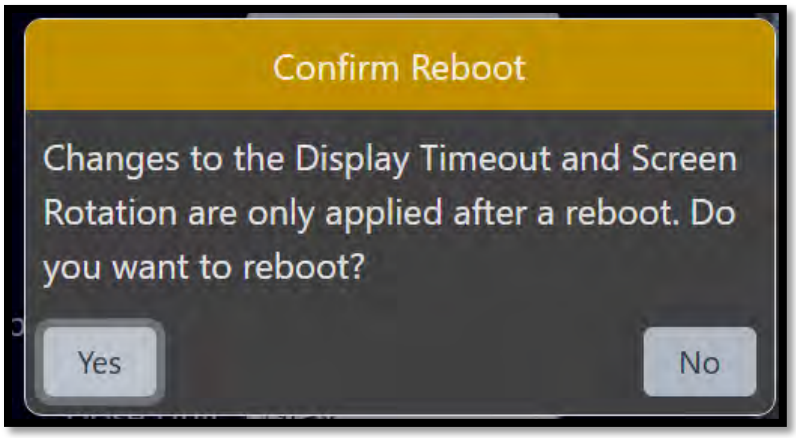


Figure 41. Reboot Message

4.3.3 Rotate 180 Degrees

Pressing the Rotate 180° toggle allows the user to flip the screen 180 degrees from the current screen orientation. Press the toggle to activate the setting (the toggle will change to green with a white background).

After changing the rotation, a warning message will be displayed that states the display settings will not be effective until the instrument is rebooted (see Figure 41). Select **Yes** to reboot the instrument immediately.

4.3.4 Keypad Backlight

Pressing the Keypad Backlight toggle turns on/off the keypad backlight. When the toggle is green with a white background, the keypad backlight will be activated when the buttons are pressed.

4.3.5 Dose Unit

The dose unit setting controls what units are displayed on the screen for every instance that dose rate is reported. Units can be selected between Sievert, Rem, Gray, and Roentgen. The following is used to convert between units:

$$1R = 0.933 \text{ rem} = 9.33 \text{ mSv} = 9.33 \text{ mGy}$$

4.4 SYSTEM

Tapping the **System** button launches the System screen.

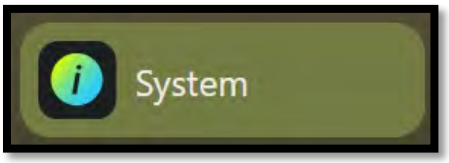


Figure 42. System Button

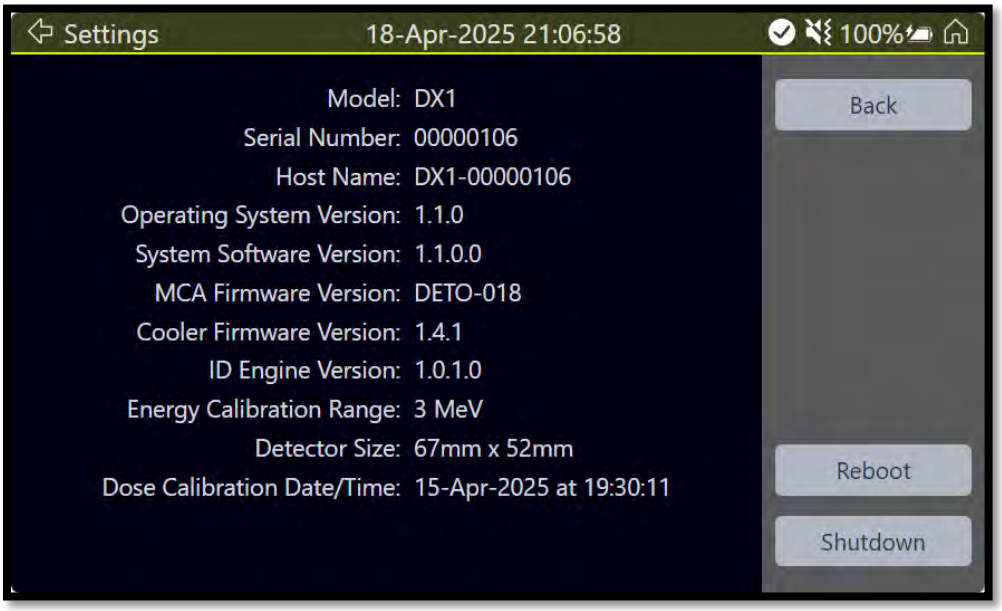


Figure 43. System Information Screen

The system screen displays the instrument Model, Serial Number, Host Name, software/firmware version numbers, and Dose Calibration Date. Users are given the option to **Reboot** or **Shutdown** the instrument by tapping the buttons in the lower right corner. Tapping Reboot displays a message confirming it is desired to reboot the instrument. Tapping Shutdown displays a message confirming it is desired to shut down the unit and supplying the option to leave the cooler running. Tapping **Back** returns to the Settings screen.

NOTE:	The host name found on this screen allows the user to connect to the instrument via a web browser.

4.5 BACKGROUND

Tapping the **Background** button launches the Background screen. A valid and representative background is important for accuracy of spectrum analysis. The DX1 maintains separate background data for each accessory potentially mounted to the front of the unit (neutron detector, collimators, passive detector cover). If an accessory is mounted to the front of the unit for which no background data has been collected, the unit will show a "**Missing Background**" warning.

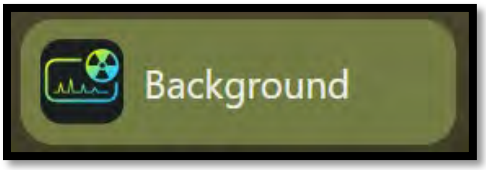


Figure 44. Background Button

The Background screen is displayed.

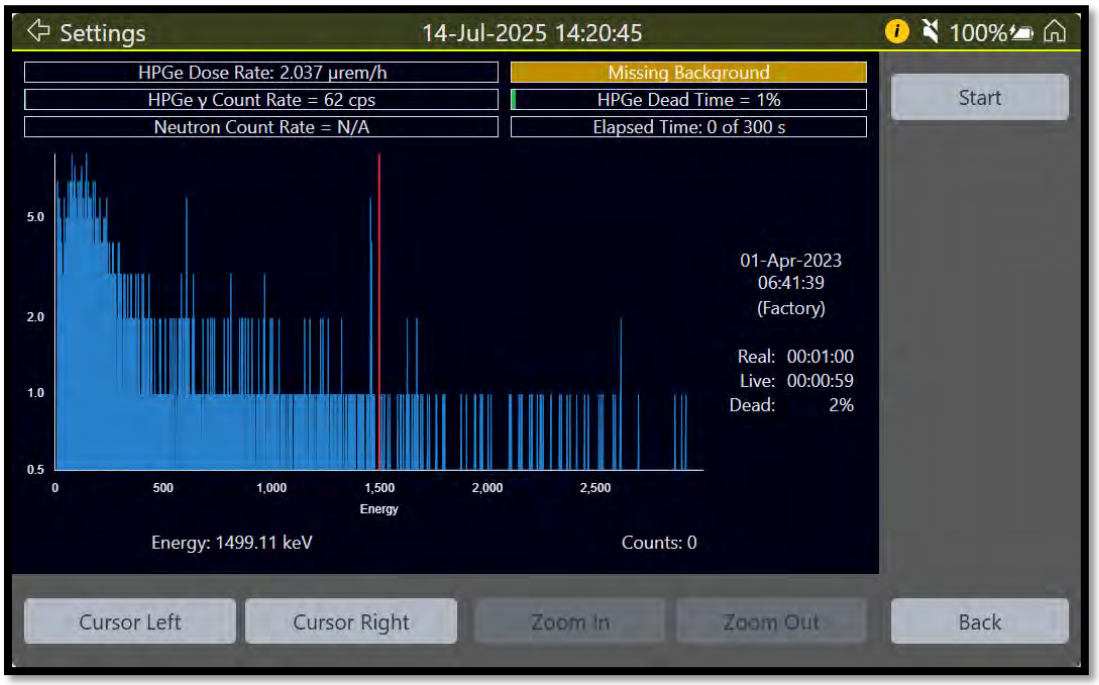


Figure 45. Background Settings Screen

By default, the background counting time is 300 seconds. To change this value, see the instructions in Section 5.9. Prior to starting background data collection, verify there are no radiation sources near the instrument. Tapping the **Start** button starts the background data collection.

To abort the data collection, tap the **Back** button. A warning message will appear asking if it is desired to leave. Tap **Yes** to return to the Settings screen without saving a background. Tap **No** to continue with background data collection.

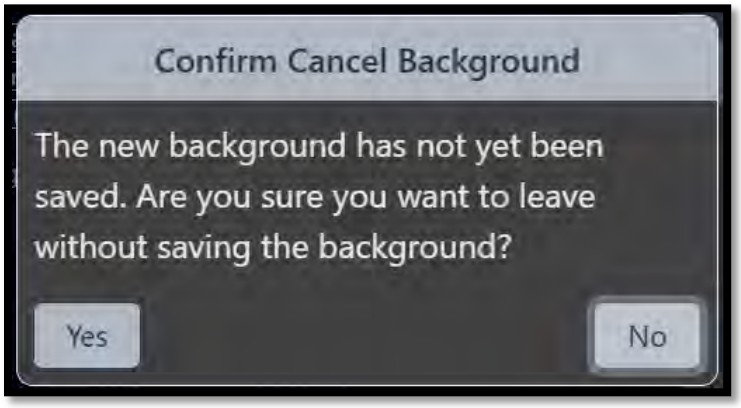


Figure 46. Background Exit Warning Message

While the background data is being collected, the energy spectrum is displayed on the screen in real time.

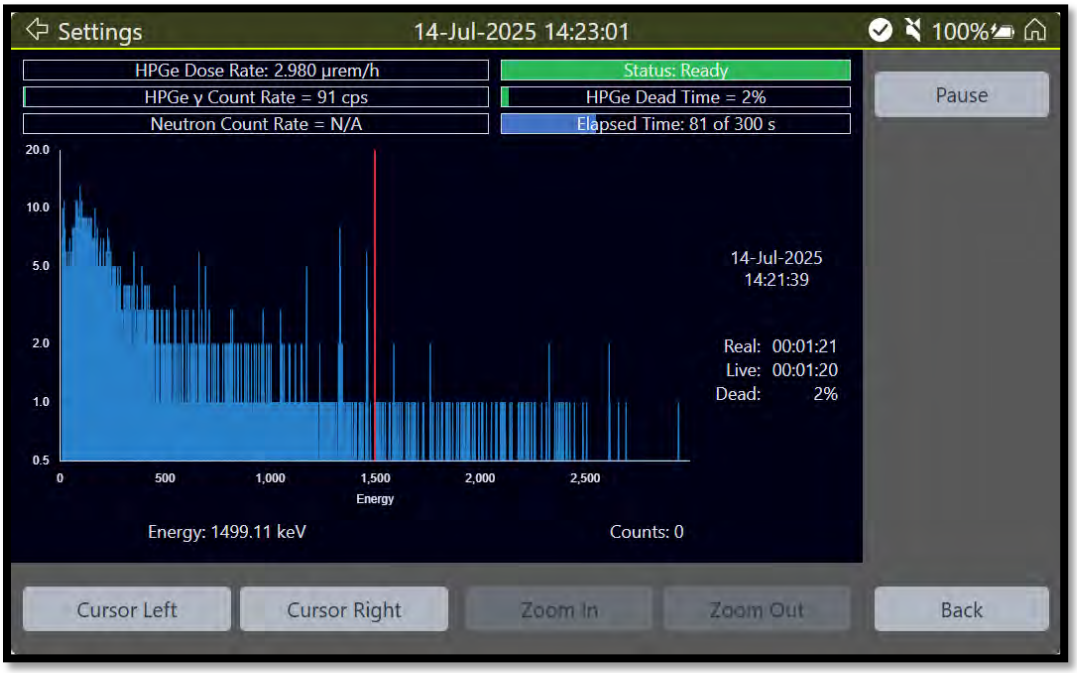


Figure 47. Background Energy Spectrum

Use the Zoom In, Zoom Out, Cursor Left, and Cursor Right buttons to analyze the background spectrum. Once the background collection starts, the Start button changes to a Pause button. Tapping **Pause** stops all data collection and stops the count time from increasing. The Pause button then changes to Continue. Tapping **Continue** resumes data collection.

The real time, live time, and dead time are displayed on the right side of the spectrum. The date and time of the last active background is displayed above the times. If an active background has not been ran, the background recorded in the factory is displayed as the last active background.

When the background collection is started, the count time begins counting up to the preset time. A blue bar begins filling in the Elapsed Time square. Once the elapsed time is reached, if the user has selected for the file to save automatically (see Section 5.9), the counting stops and the screen changes back to the Settings screen. If the user has selected not to save the file automatically, the elapsed time changes to a solid green bar and the Pause button changes to Save. However, the background does not stop collecting data and the elapsed time continues to increase. Once the user taps **Save**, the data collection stops, and the results are stored as the background file.

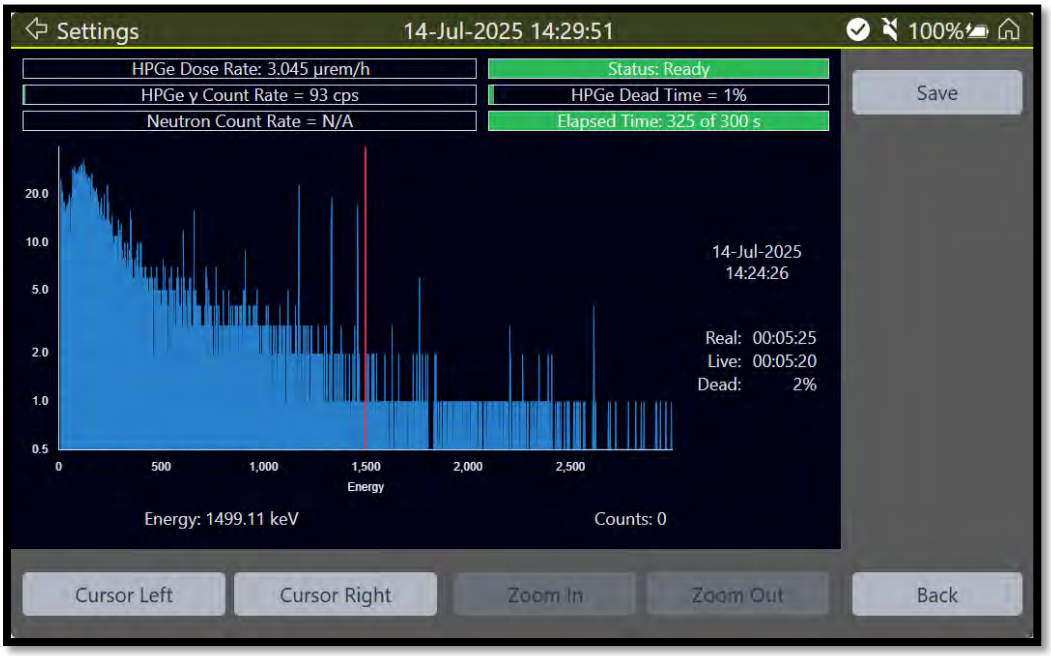


Figure 48. Background Collection Elapsed Time Complete

When the background collection is complete, the system analyzes the spectrum to determine if there is enough K-40 in the background to enable the system gain stabilizer. This will be the case for most situations with maritime applications presenting the potential exception. If sufficient K-40 is not found in the background spectrum, the gain stabilizer will be disabled.

When saving background data for an instrument that is equipped with a neutron detector, a check is made that the measurement background is statistically in line with the previous background measurement. If the current measurement is significantly lower or higher than the previous measurement, a message will be posted stating such (Figure 49). The message may indicate there is a neutron source in the vicinity (perhaps a test source that is not well shielded in its container). This message is also typically displayed when new background data is measured at a different altitude than a previous measurement.

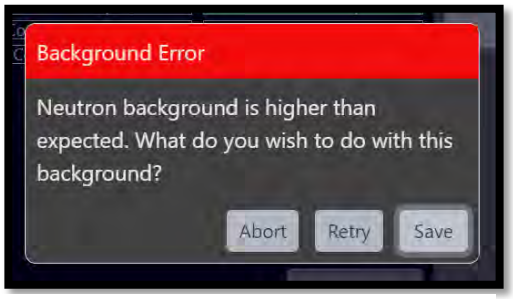


Figure 49. Neutron Background Error Message

Tap **Save** to save the file and return to the Settings screen. Tap **Back** to just return to the Settings screen without saving the file.

4.6 DATE & TIME

Selecting **Date & Time** allows the user to set the date and time information for the instrument.

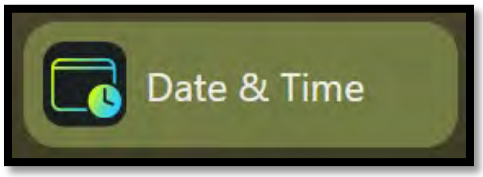


Figure 50. Date & Time Button

The Date & Time settings screen can be seen in Figure 51. There are two options available for setting the date and time, Set Date and Time Automatically or set the information manually.

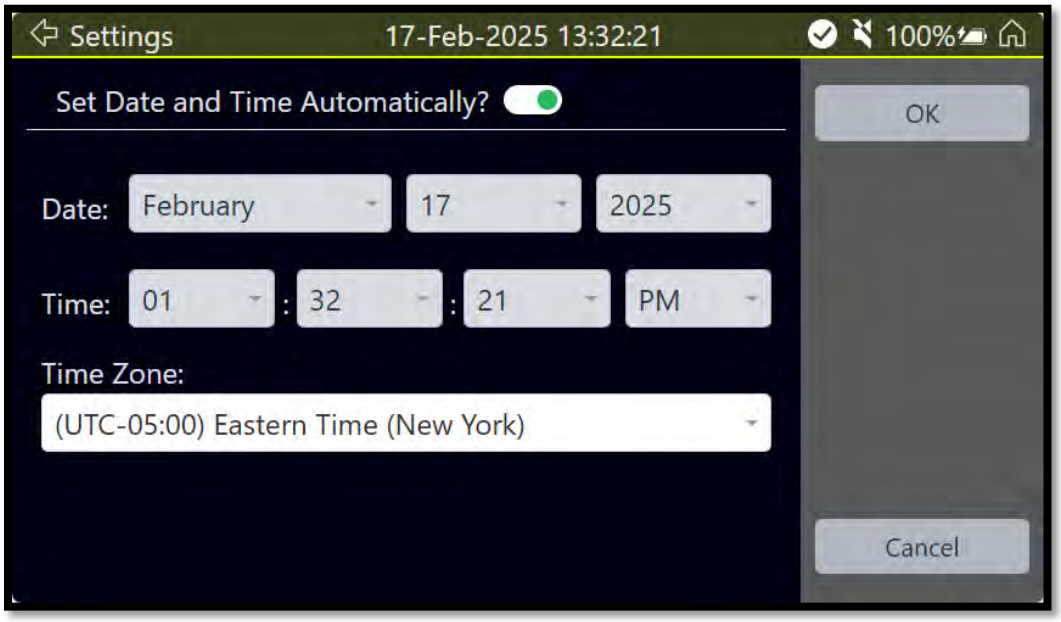


Figure 51. Date & Time Settings Screen

If the Set Date and Time Automatically toggle is selected, the instrument sets the date/time information whenever the DX1 connects to a network. Date/Time information is automatically adjusted to match the network settings if the DX1 is connected either via Ethernet or wireless. The toggle turns green with a white background when automatic is selected.

If the user chooses to set the date and time manually, use the drop-down menus to select the correct information.

Tap **OK** to save the date/time changes. The screen will return to the Settings screen. Note that changes will not take effect until OK is tapped. Until that point, the date/time in the screen header will continue to reflect the old information. If it is not desired to save changes, tap **Cancel**.

4.7 APPS

Tapping the **Apps** icon launches the Application Manager screen. This screen allows users to see information about the installed applications, add/remove applications, and select which application to run for startup.

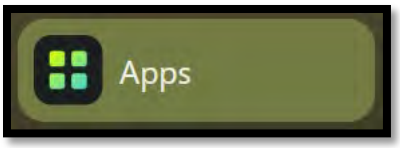


Figure 52. Apps Settings Icon

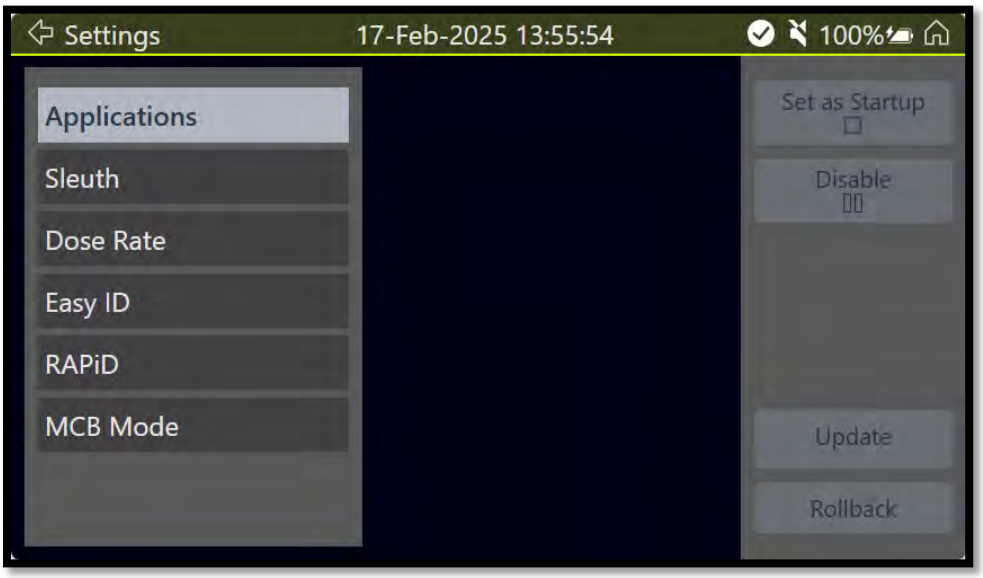


Figure 53. Apps Screen

4.7.1 About Application Information

The installed applications will be shown in the column on the left. Click on the application name to display more information about that application in the center column.

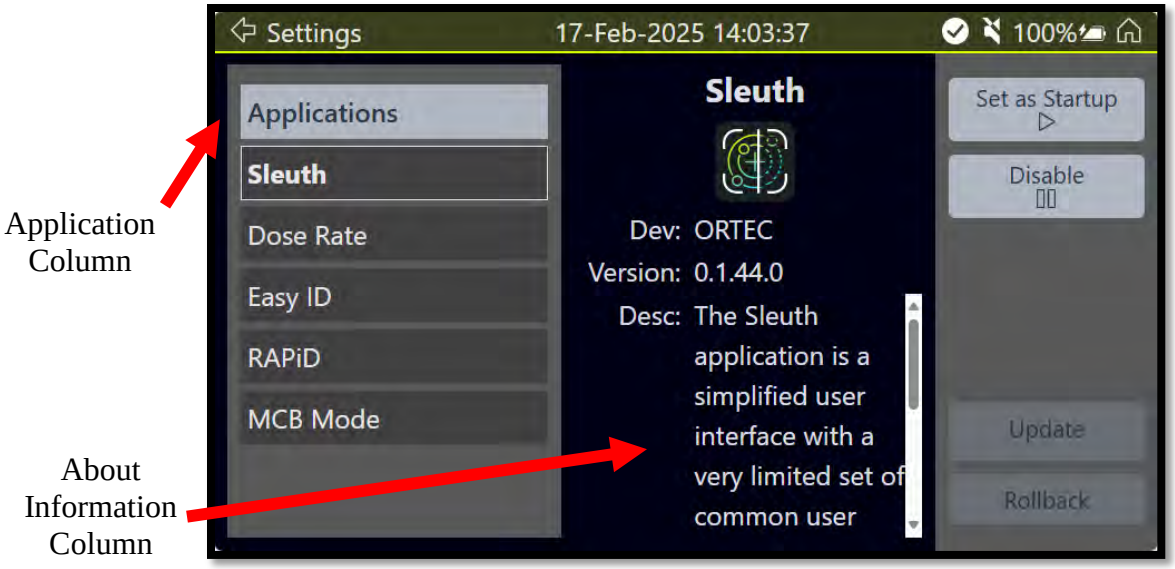


Figure 54. Application Screen

4.7.2 Set as Startup

Tapping on the **Set as Startup** button on the top right of the screen sets the selected application as the application that automatically launches when the instrument is first booted up. When an application is selected for launching at startup, an arrow is displayed beside that application name.



Figure 55. Application Set as Startup Arrow

When an application is designated as Set as Startup, the Set as Startup button changes from having a triangle to a square.



Before Set as Startup After Set at Startup

Figure 56. Set as Startup Button

Tapping the **Set as Startup** button when it has the square icon disables the automatic launch feature for the selected application. Instead, until another application is designated for automatic launch, the DX1 starts at the Home screen.

Note that when an application is set for startup, the Disable button in the right column is unavailable because an application cannot both be disabled and used for startup at the same time.

4.7.3 Disable

Tapping on the **Disable** button disables the selected application from use. When an application is disabled, a pause symbol is displayed beside the application name.

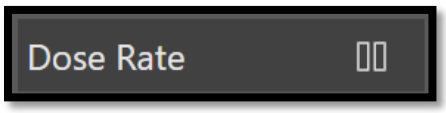


Figure 57. Application Disabled Pause Symbol

A disabled application is no longer displayed as an icon to choose on the Home page. To reenable the application, select the application name and tap **Enable**.

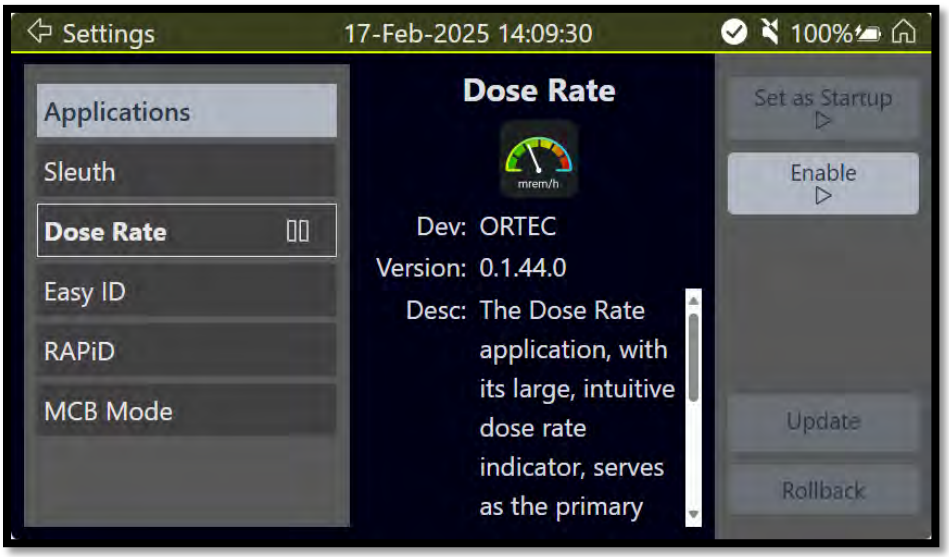


Figure 58. Enabling a Disabled App

4.7.4 Update/Rollback

If an issue is identified that requires an application to be updated, an application specific hotfix file that has been digitally signed by ORTEC will be released. If a USB is installed into the DX1 that contains the valid update file, the Update button will become available. Files are checked for cyber security purposes to prevent modifications prior to the instrument allowing the user to proceed with the updated. Users must be in Advanced Mode to be able to change an application. If Advanced Mode is not already active, the user will be prompted to enter the passcode.

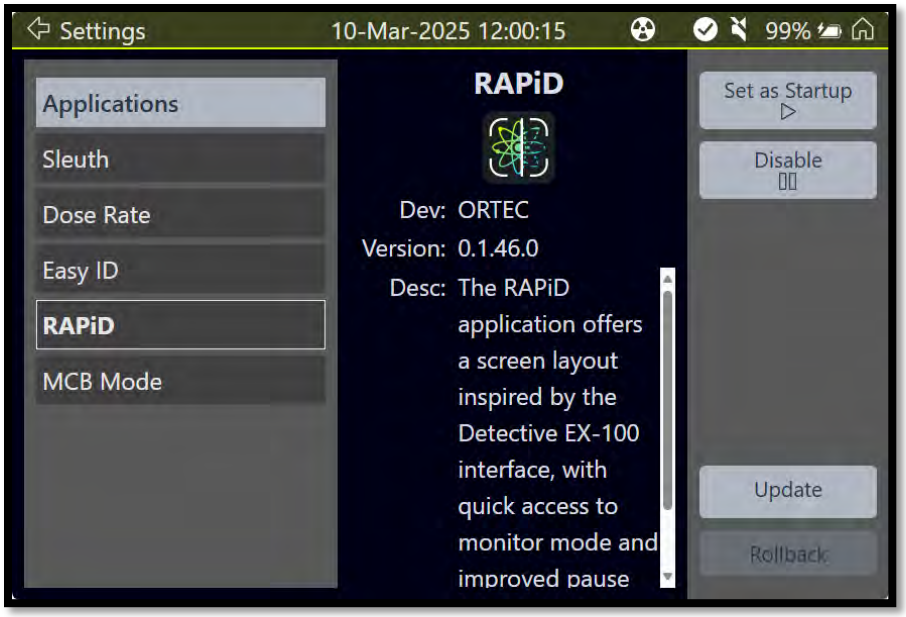


Figure 59. Update Application

Tap the **Update** button to start the update for the selected application. Once the update is complete, a pop-up message is displayed that requires the user to reboot the instrument. Tap the **Reboot** button to complete the updating process. Once the application is updated, the version number for the application will be changed.

NOTE:	There must be only 1 update file per application located in the root folder for the USB for this update to work correctly.

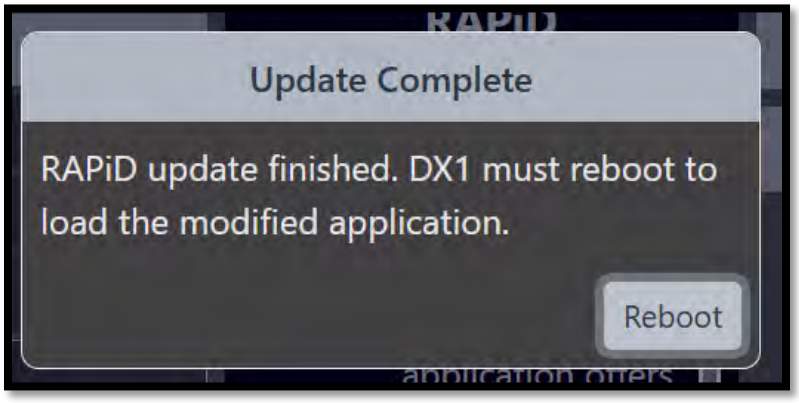


Figure 60. Update Pop-up Message

If an application has been updated, the Rollback button becomes available. Tapping the Rollback button allows the user to revert back to the previous application version.

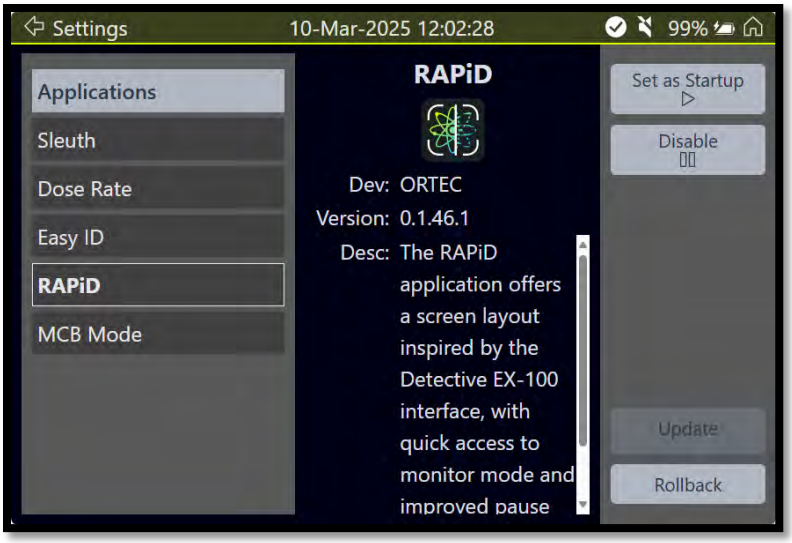


Figure 61. Rollback Application

Once the rollback is complete, a pop-up message is displayed to require the user to reboot the instrument. Tap the **Reboot** button to complete the rollback process.

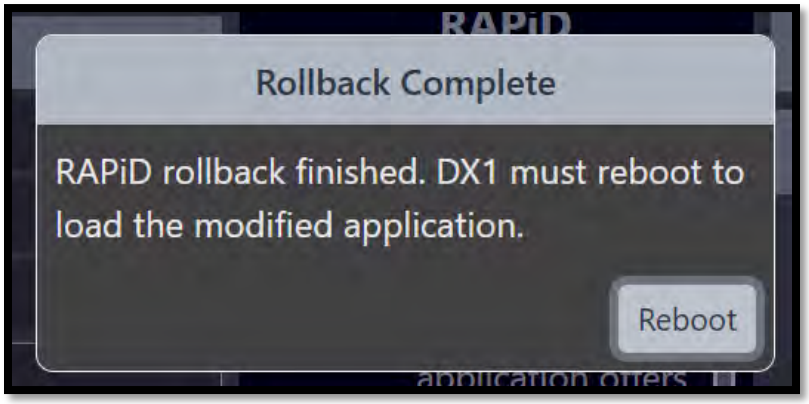


Figure 62. Rollback Pop-up Message

4.8 CALIBRATE

Tapping the **Calibrate** button launches the calibration screen.

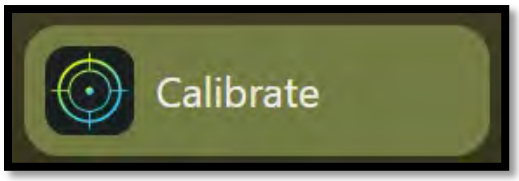


Figure 63. Calibrate Button



Figure 64. Calibration Screen

4.8.1 A Brief Introduction to Gain Stabilization

The DX1 typically maintains near-perfect energy calibration by relying on environmental K-40, which produces a dependable gamma-ray peak at 1460.75 keV. The DX1 automatically adjusts the detector's amplifier gain to keep this reference peak in a known region of the spectrum histogram. With the 1460.75-keV peak in a known location, the software "knows" the relative positions of all other gamma rays in the Identification Table.

Several factors can cause the system gain to change, and the K-40 reference peak to shift slightly such that the automatic circuitry must re-center the peak in its expected histogram region. The most significant of these are detector temperature and long-term electronics drift. Both of these changes occur at an extremely slow rate. This means these changes can be accurately tracked by the gain stabilizer, even when the concentration of environmental K-40 is very low. Note that detector temperature is regulated in the DX1. However, the bulk temperature of the detector element will continue to change by very small increments for several hours after the system has reached the threshold operating temperature and the status has changed to **READY**. The gain stabilizer can easily correct for this slowly moving effect.

The gain stabilizer typically makes adjustments very gradually. Note, however, that if the instrument is subjected to a significant mechanical shock, the gain can change instantaneously, forcing the stabilizer to quickly correct for the situation. Rapid movement of the stabilizer is an indication that the system is still working to put the K-40 peak in the correct location. This condition is indicated by a "**Stabilizer rapid movement**" system error, and the status is **NOT READY** until the stabilizer zeroes on its new value. *Reestablishment should take no more than 30 minutes.*

The gain stabilizer can adjust the amplifier gain to move the K-40 peak the equivalent of 7.5 keV either up- or down-channel, as needed, which is more than enough under normal circumstances.

However, in atypical circumstances (such as the shock mentioned above), ±7.5 keV may not be sufficient. The **Stabilizer out of range** error will be displayed and the status will change to **NOT READY**. This error will typically be preceded by a "**Stabilizer rapid movement**" error as adjustments are applied quickly in an effort to correct the situation. The current **Gain Stabilizer** adjustment is shown on the Status screen accessible from **Settings** (see Figure 65). This figure shows that the stabilizer has currently made an adjustment equivalent to -0.3 keV, which is -4.1% of the available range. If this value is beyond about 60%, it is time to consider recalibrating the unit. Otherwise, the gain stabilizer may reach the limit of its ability to correct the K-40 peak position while the user is out in the field, in which case, the status will change to **NOT READY** until the unit is recalibrated.

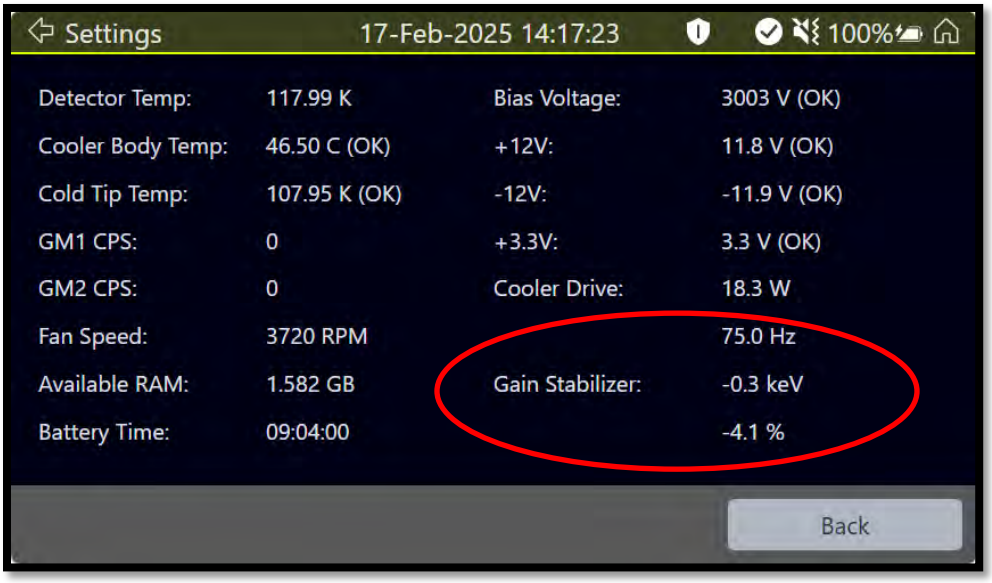


Figure 65. Current Gain Stabilizer Adjustment

4.8.2 Calibrating the DX1

The energy calibration is a single-point calibration that simply adjusts the system gain. The shape of the calibration curve is fixed and has been determined at the factory. Calibration is easy to perform with a user-supplied, nominal 1-microcurie (μCi) cesium (Cs)-137 check source. The process typically takes less than 5 minutes.

1. Place the source in front of the instrument to obtain a gamma count rate of approximately 500 cps.
2. Tap **Settings** to open the Settings screen, then tap **Calibrate** to display the screen shown in Figure 66.
3. Verify the source that was placed in front of the instrument matched the source name being displayed in the center of the screen. If it is not the same source, see Section 5.7 to change the selected source.
4. Tap **Start**. The stabilizer will turn off and the current stabilizer adjustment (if any) will be reset to zero. The acquisition will begin, and the spectrum will be displayed.

5. When enough counts have been accumulated to accurately determine the centroid of the Cs-137 peak, the system will report the degree of adjustment necessary. Tap **Apply** to complete the process.

> **NOTE** If the **Back** or **Abort** button is tapped before tapping **Apply**, the old calibration will be retained, and the new one will be discarded.

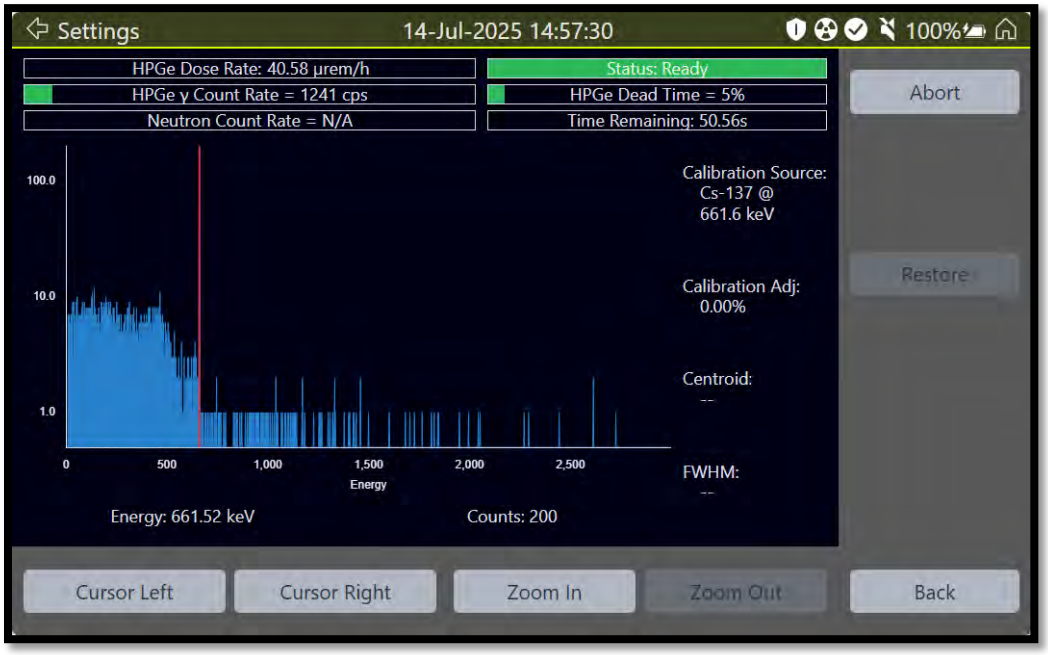


Figure 66. Calibrate Screen Calibration in Process

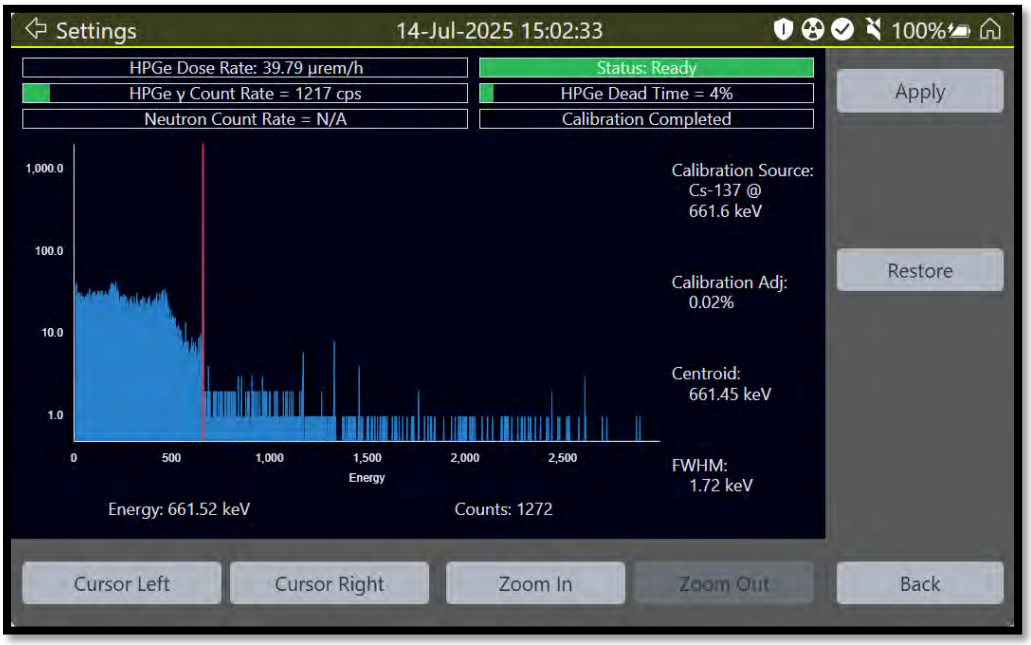


Figure 67. Calibration Complete

The stabilizer will turn back on after calibration is complete.

If it is not desired to save the new calibration, tap **Back**. A warning message will be displayed asking for confirmation. Tap **Yes** to not save the new calibration and tap **No** to return to the calibration screen and save the new calibration.

The **Restore** button reinstalls the factory calibration, which is useful for diagnostic purposes; however, the factory calibration is typically not optimum for an instrument once it leaves the factory.

4.8.2.1 Using Alternate Calibration Sources

Other sources, including environmental K-40, can be used to energy calibrate the system in addition to Cs-137. This is useful when no Cs-137 check source is available. Calibrating with K-40 can take a long time in some environments (note that seawater contains essentially no K-40). Therefore, the user may wish to purchase an inexpensive potassium chloride “salt substitute” from a grocery store. See Section 5.7 for more information on adding additional calibration sources.

4.9 NETWORK

Tap the **Network** button to open the Network settings screen. This screen allows users to define how the instrument will connect to networks.

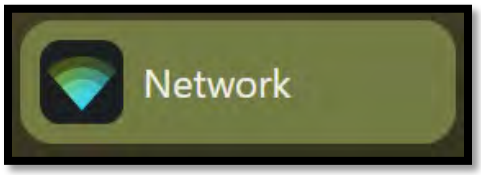


Figure 68. Network Icon

The network settings screen has three tabs: Status, WLAN, and Ethernet. Press the left arrow button in the upper left corner to return to the Settings screen.

4.9.1 Status Tab

The Status tab shows if the instrument is connected to a network and the quality of the connection speed and strength.

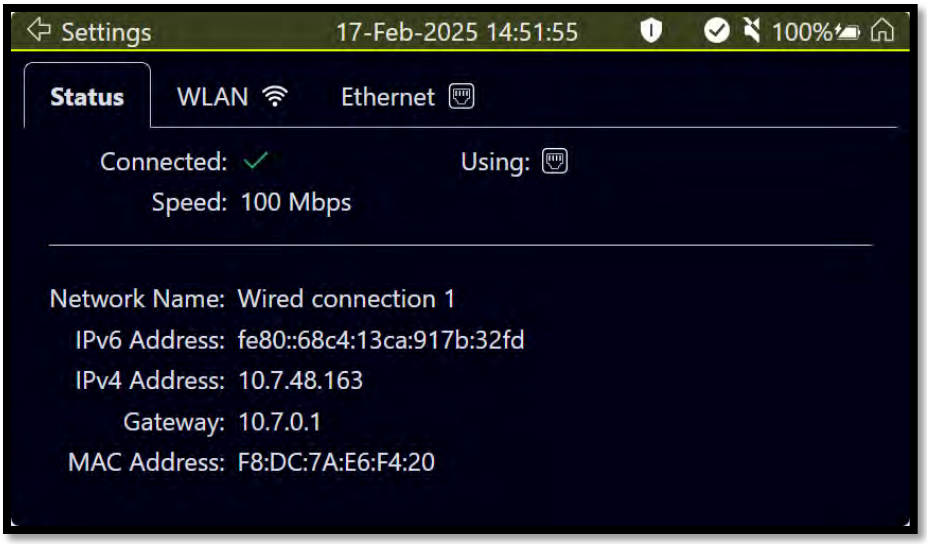


Figure 69. Network Settings Screen

4.9.2 WLAN Settings

Tapping on the WLAN (Wireless LAN) tab allows the user to enable WLAN and sign into WLAN networks. Tap the enable WLAN toggle to turn on WLAN. The toggle will turn green with a white background when WLAN is enabled. Available networks will be displayed in the table below the WLAN button. Tap the **Connect** button for the desired WLAN network. For most WLAN networks, a network login screen will be displayed. Upon successful network password entry, the screen will show a green Connect toggle indicating the network is successfully connected.

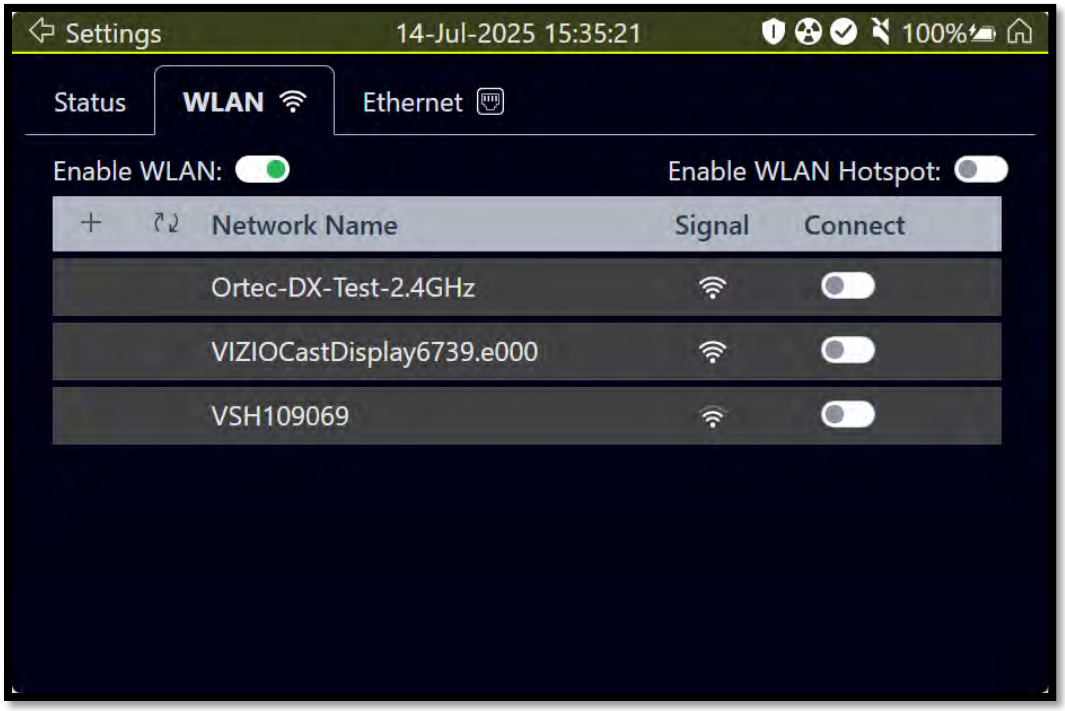


Figure 70. WLAN Settings Screen

Note that the WLAN is 2.4GHz and will not work on a 5GHz system.

Hidden SSIDs (Service Set Identifiers) can be manually entered by pressing the + key and entering the hidden network information. For most hidden WLAN networks, a network login screen will be displayed. Upon successful network password entry, the screen will show a green Connect toggle indicating the network is successfully connected.

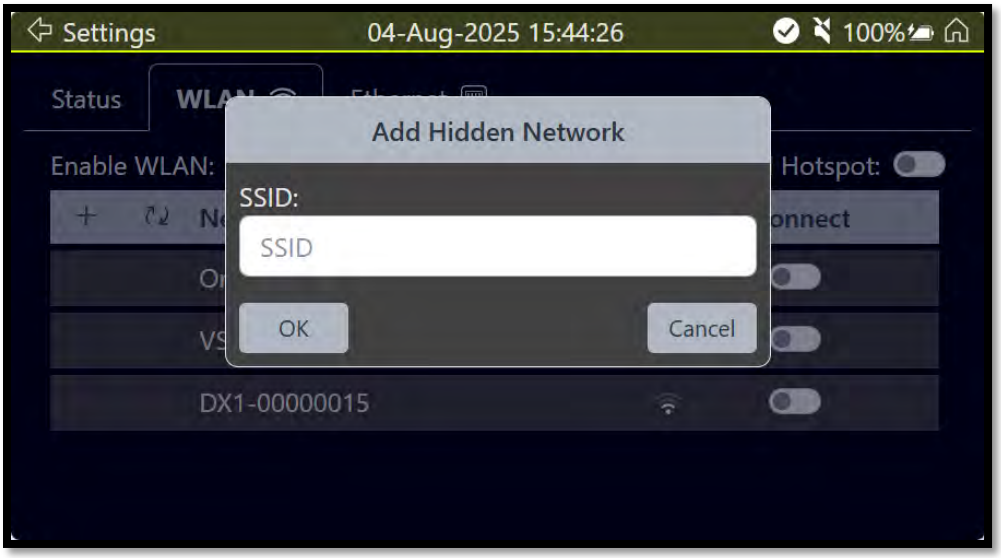


Figure 71. Hidden Network Settings

Tapping the Enable WLAN hotspot button allows users to create a hotspot using the DX1. This hotspot can be found by any device that has WLAN scanning capabilities. The SSID and Password must be defined. Users can then scan for the SSID network with their device and enter the defined password. Once connected, the user can use a web browser to mirror the instrument touchscreen.



Figure 72. WLAN Hotspot Settings

NOTE The Enable WLAN Hotspot feature must be enabled in advanced settings. See Section 5.4 for more information.

4.9.3 Ethernet Settings

Tap the Ethernet tab to enable Ethernet. Connect an Ethernet cable or a USB cable to the instrument. Tap the **Enable Ethernet** toggle to allow wired connections.

NOTE Users should not plug in both the USB cable and the Ethernet cable at the same time while trying to connect to the network. Connecting both may cause communication errors.

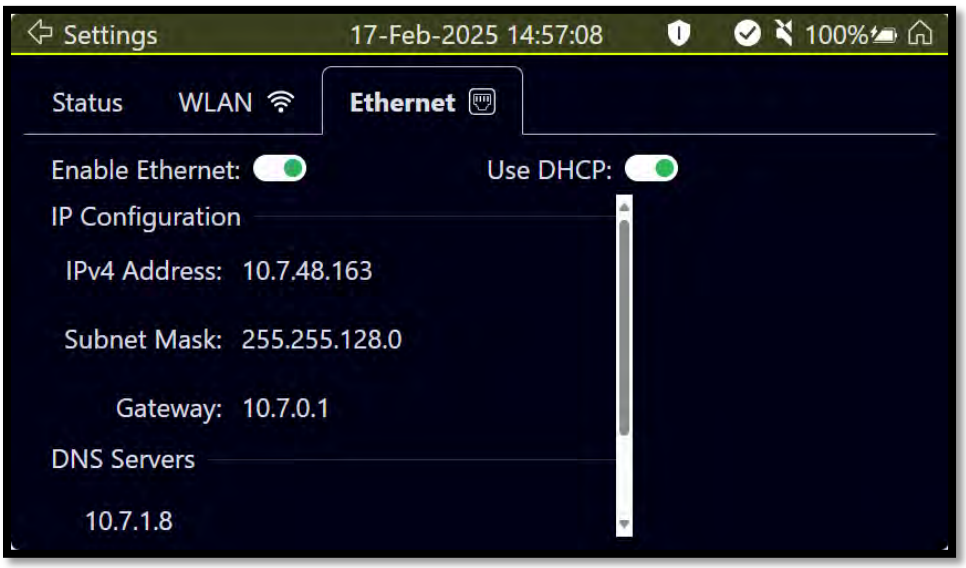


Figure 73. Ethernet Network Connected

Turning off Use DHCP allows the user to manually enter an IP Address, Subnet Mask, and Gateway.

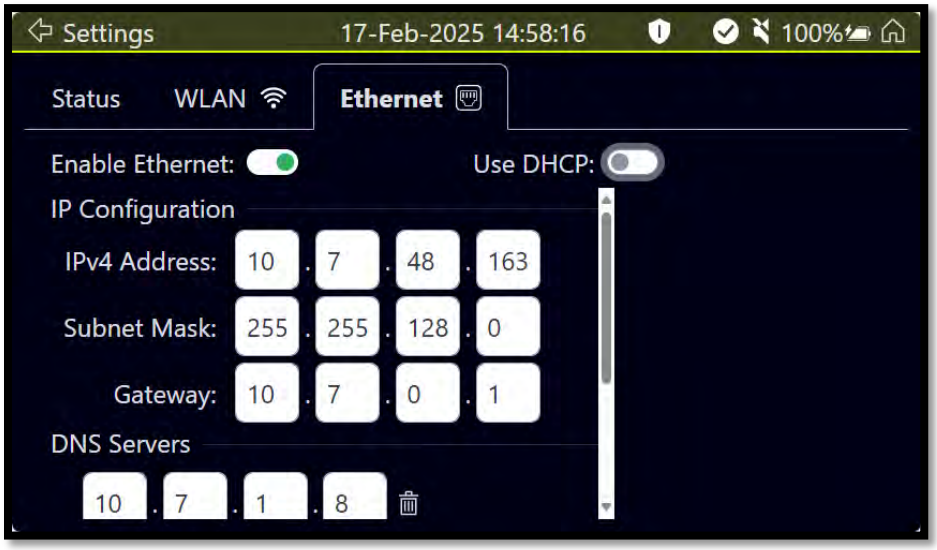


Figure 74. Ethernet Connected and Use DHCP Off

4.10 FEEDBACK

Tap the Feedback button to enter the instrument Feedback settings screen.

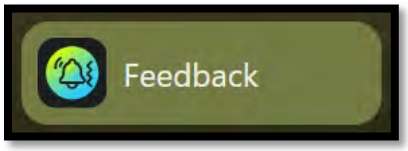


Figure 75. Feedback Button

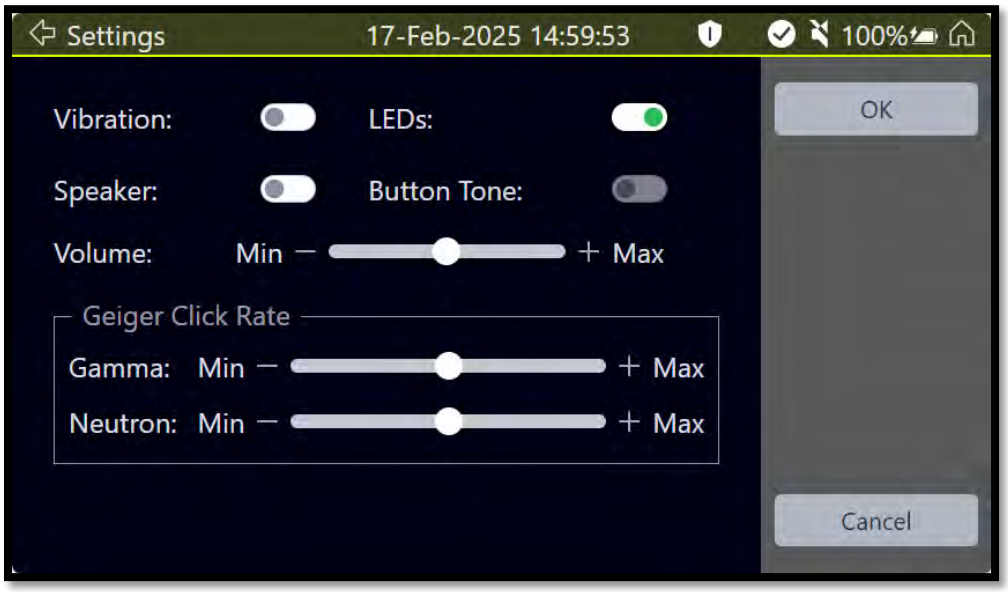


Figure 76. Feedback Settings Screen

For each of the feedback settings, the toggle turns green with a white background if the setting is turned on. The toggle turns gray with a white background if the setting is turned off.
Each of the features are explained below:

- Speaker – enables/disables the speaker which allows control of the audible alarms and other sounds
- Vibration – enables/disables the vibration that occurs with an alarm
- LEDs – enables/disables the LED function on the top of the instrument
- Button Tone – enables/disables if the buttons make a sound when tapped

Adjusting the Volume slider changes volume of any sounds annunciated by the instrument. Adjusting the Gamma and Neutron click rates change the frequency at which a click is sounded when gammas or neutrons are detected. Tap anywhere along the line to change the value.

Tap **OK** to save the settings. Tap the **Cancel** button to return to the settings screen without saving any changes.

NOTE	It is required to enter the advanced settings passcode if it is desired to disable both the speaker and vibration at the same time.

4.11 BLUETOOTH

Tap the **Bluetooth** button to open the Bluetooth settings.

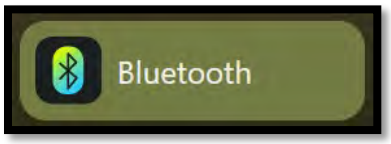


Figure 77. Bluetooth Button

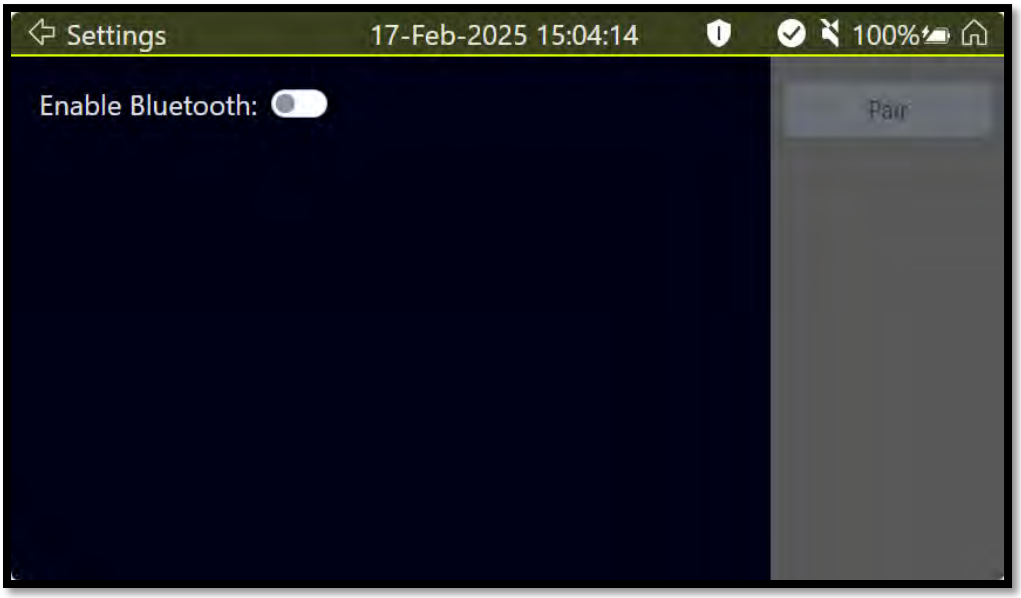


Figure 78. Bluetooth Settings Screen

Tap the **Enable Bluetooth** button to activate Bluetooth and allow the DX1 to pair with another device (for example a Bluetooth headset).

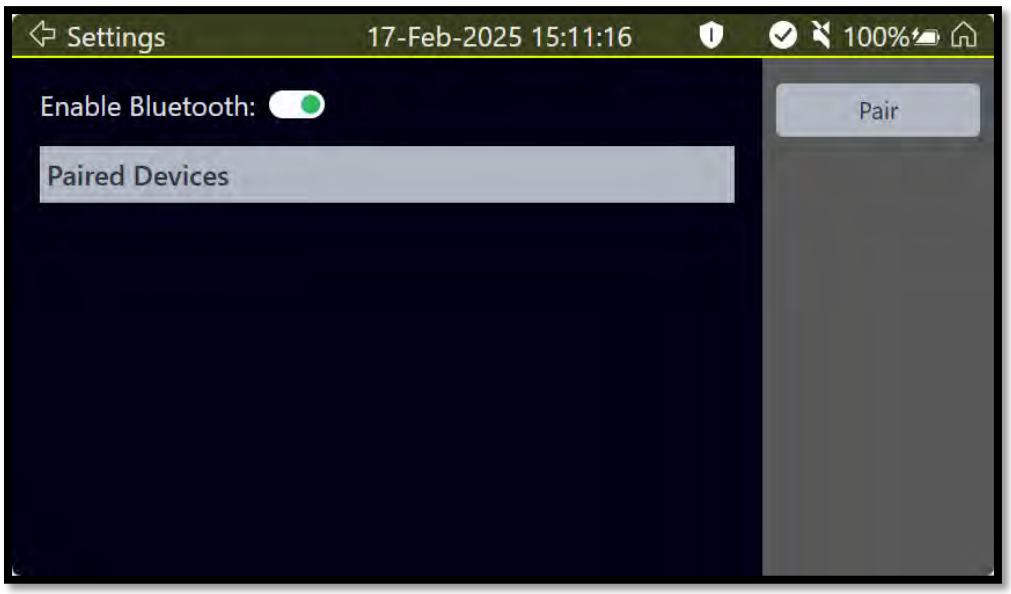


Figure 79. Bluetooth Enabled

Tap the **Pair** button to start the pairing process.

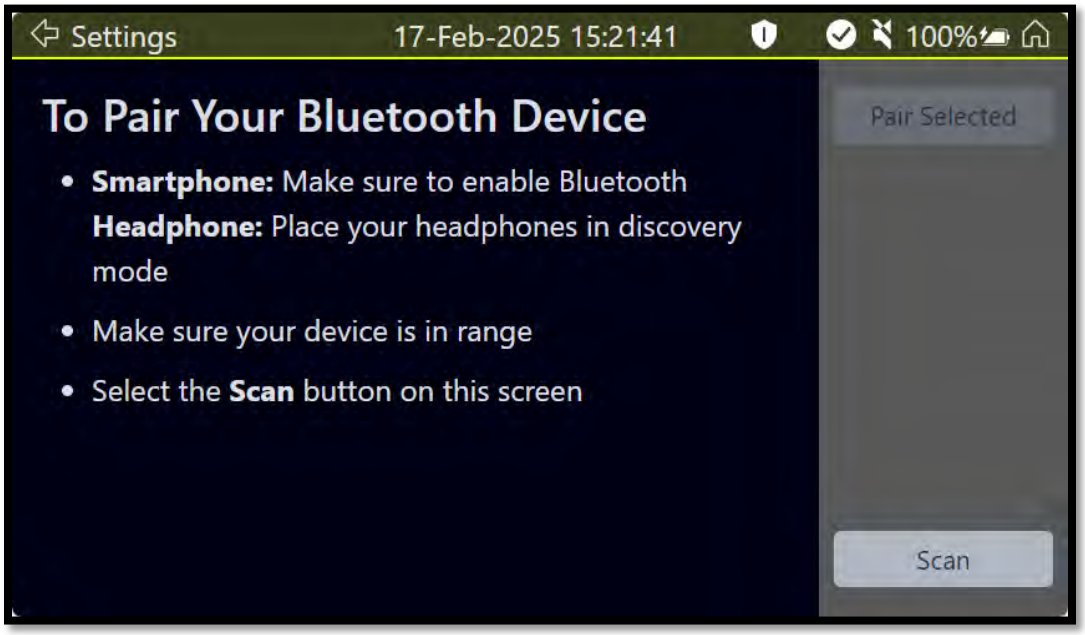


Figure 80. Pair Your Bluetooth Device Screen

Tap the **Scan** button to start the instrument scanning for available Bluetooth connections. The blue progress bar will go across the bottom of the screen. When the scan is completed, all available Bluetooth devices will be displayed in the table and “Scan Completed” will be displayed in the lower left corner.

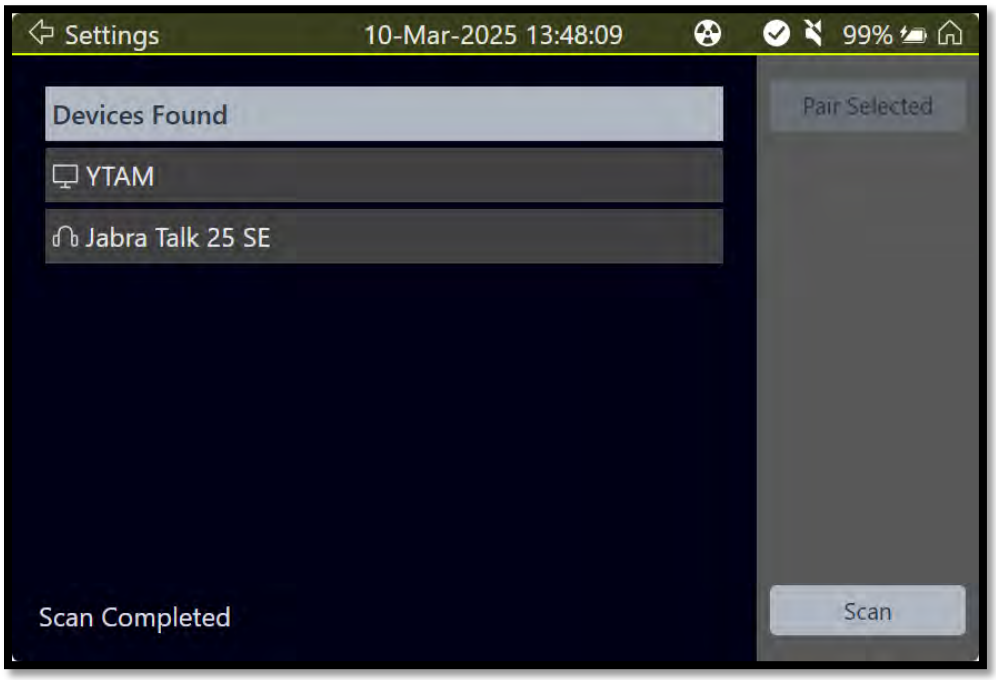


Figure 81. Bluetooth Devices Found

Tap on the desired device and tap **Pair Selected**. If the device is paired successfully, it will be displayed in the Paired Devices table. Note it may be required to interact with the Bluetooth device being paired to complete the pairing process.

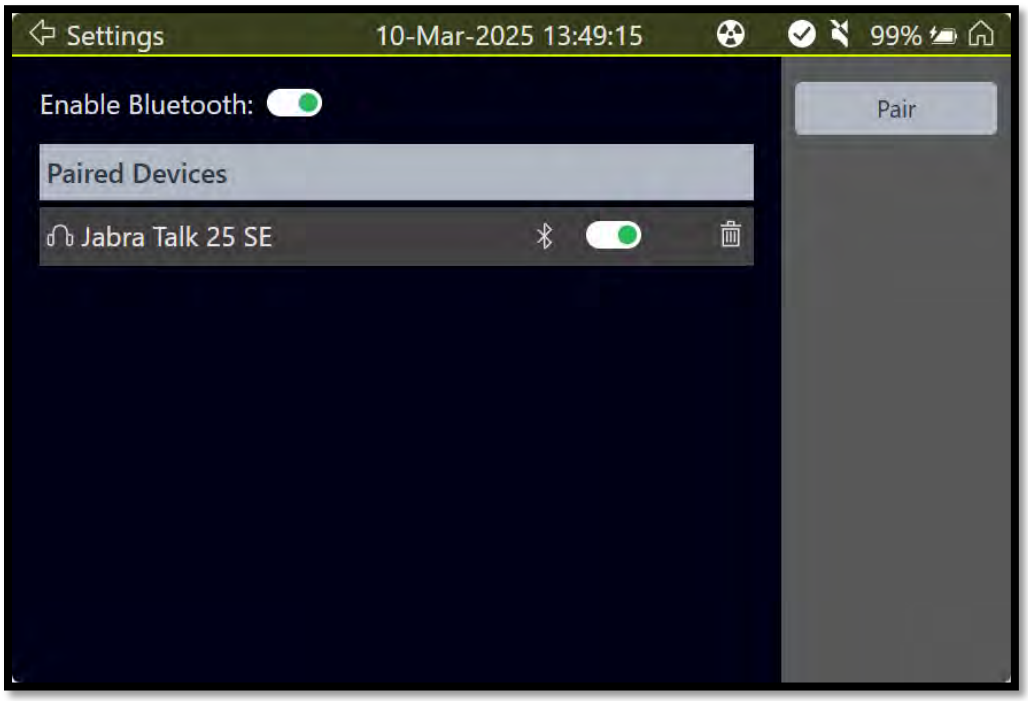


Figure 82. Device Paired Successfully

If something does not work correctly during the pairing process, a red warning will be displayed showing that the DX1 was unable to pair with the device.

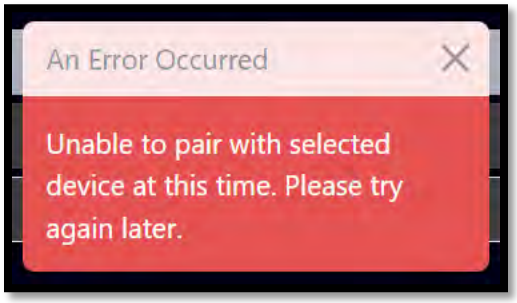


Figure 83. Pair Not Successful Message

NOTE	The device being paired with may require interaction to approve the pairing attempt.

4.12 COOLER

Tap the **Cooler** icon to turn On/Off the cooler. When tapped, the button text changes to show the action the button will perform (i.e., when the cooler is on, the button text changes to “Stop Cooler”).



Figure 84. Cooler Icon

4.13 USB

Tap the **USB** button to enter the USB settings screen.

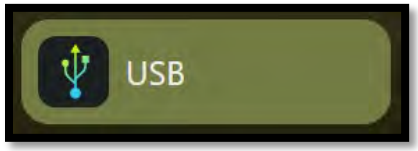


Figure 85. USB Button

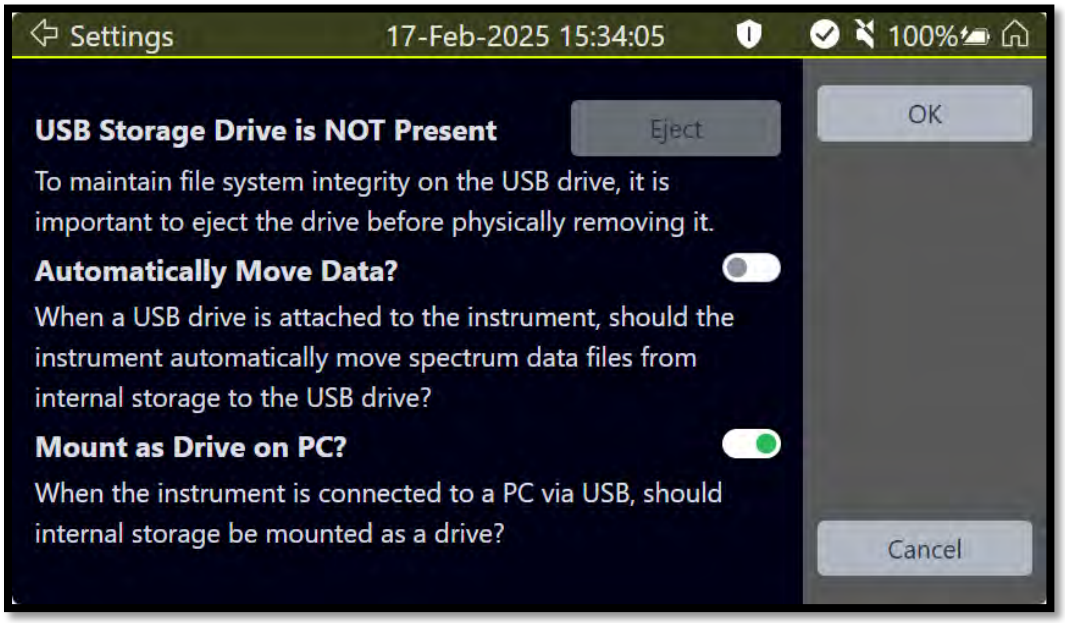


Figure 86. USB Settings Screen

When no USB storage is plugged into the DX1, the top line on this page states that “USB Storage Drive is NOT Present” and the Eject button is grayed out.

When a USB device is plugged into the DX1, the top line changes to “USB Storage Drive is Present” and the Eject button becomes activated.

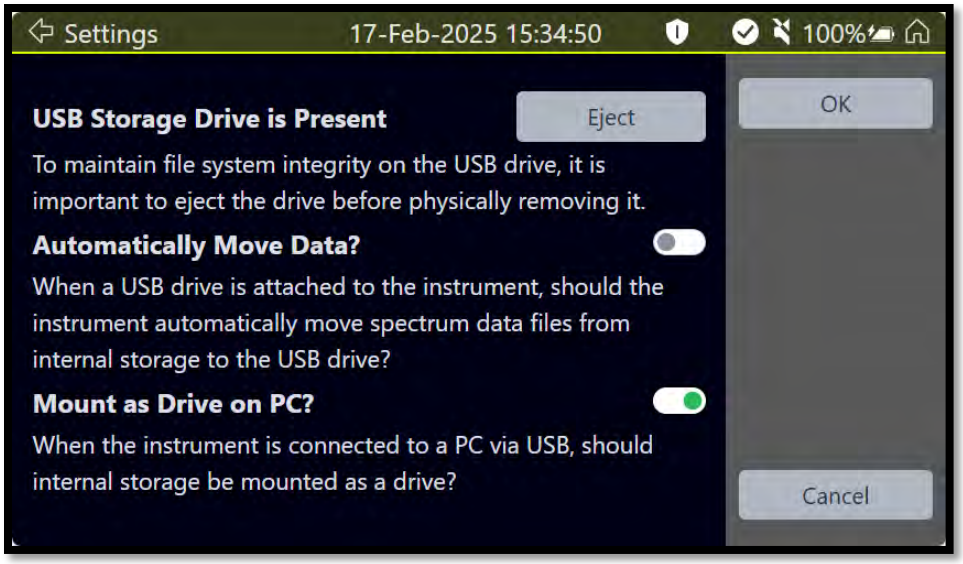


Figure 87. USB Storage Device Present

When a USB storage device is installed in the unit, it is recommended to eject the drive before removing it from the DX1. Tap the **Eject** button to remove the drive.

Tapping the **Automatically Move Data** toggle makes the instrument move the all spectrum files located on the Internal drive directly to the USB drive as soon as the drive is inserted into the instrument. The files are removed from internal storage after they are moved to the USB drive.

Enabling **Mount as Drive on PC** allows the DX1 to connect to a PC and act as a hard drive, allowing users to download files directly to the computer. This feature is read only, so files cannot be uploaded to the DX1 or removed from the DX1 via USB C. Note that USB A ports should only be used for flash drives and are not operational with a USB cable.

Tap **OK** to save the changes or **Cancel** to return to the settings screen without making changes.

5. ADVANCED SETTINGS

Tapping the Advanced button on the Settings screen displayed the Advance Settings Mode.

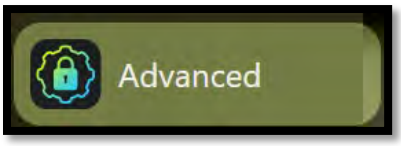


Figure 88. Advanced Settings Button

Accessing the Advanced Settings requires entry of the Advanced Mode passcode.



Figure 89. Unlock Advanced Mode

NOTE	The Advanced Mode passcode is **654321** Instructions to change the passcode can be found in Section 5.2.

5.1 WARNINGS AND ALARMS

Tap the **Warnings and Alarms** button to open the Warnings and Alarms settings screen.



Figure 90. Warnings and Alarms Button

The conditions that can cause the DX1 to alarm are listed here in order of priority, highest to lowest:

- Radiation Overrange
- Neutron Alarm
- Personnel Hazard (Gamma Dose Alarm)
- Personnel Warning (Gamma Dose Warning)

Alarms are indicated by pop-up messages posted to the display and icons shown in the system header. By default, they are accompanied by characteristic, short-duration audio alerts and vibration of the instrument's handle. When the Bluetooth headset is used, the audio is routed there; the audio is rerouted to the DX1 when the headset is powered down.

By default, alarm icons are displayed in the header as long as the alarm condition exists and are removed when the condition no longer exists. Alarm pop-up messages are displayed only for a few seconds unless the user has selected to require acknowledgement (see Section 5.1.1) For example, bringing a strong source anywhere near the instrument while on any screen will likely result in a gamma dose warning. The DX1 will display the pop-up warning, display the warning icon in the header, provide a short audio alarm, and the handle will vibrate for a moment. The pop-up message will automatically dismiss after a few seconds. The header icon will continue to be displayed for as long as it is detected. When the instrument is moved out of range of the source, the header icon will be removed from the screen.

The warning and alarm thresholds can be set by navigating to the **Warnings and Alarms** setting screen in the Advances Settings screen. The screen can be seen below:

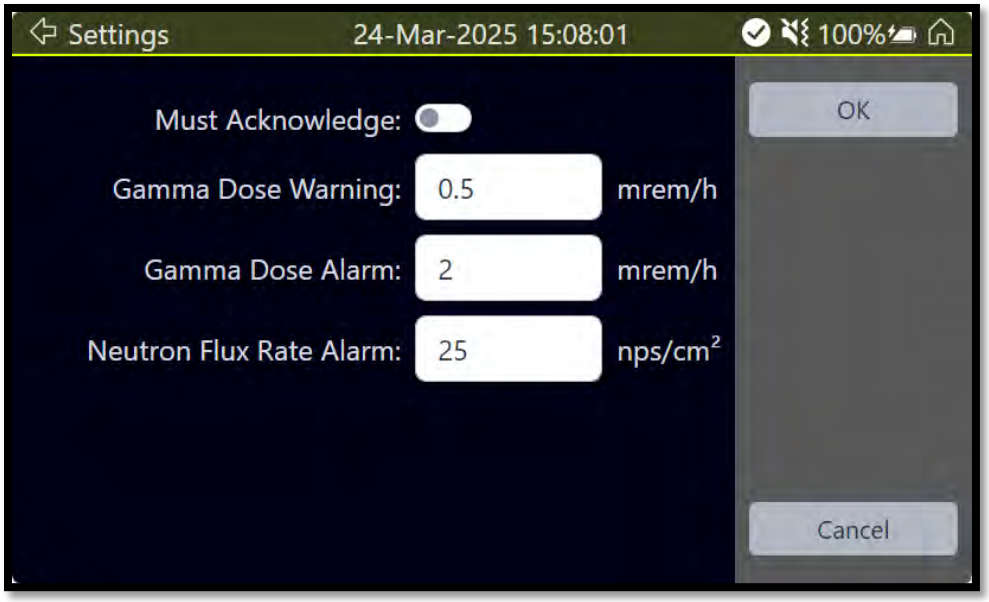


Figure 91. Warnings and Alarms Settings Screen

Press **OK** to save changes or **Cancel** to return to the previous screen without making changes.

5.1.1 Require Alarms to be Acknowledged?

The user can choose whether or not to require all radiation warnings or alarms to be acknowledged. If the **Must Acknowledge** option is enabled, when radiation warning and alarm pop-up messages are displayed, the user must tap the **Dismiss** button to close these pop-up messages. If the **Must Acknowledge** option is disabled, when radiation warning and alarm pop-up messages are displayed, they will be automatically dismissed after a few seconds. These pop-up messages will be presented for acknowledgment one at a time first in order of priority and second in order of occurrence with the newest on the top. Additionally, audio and vibratory indications will persist until the warnings/alarms are acknowledged or muted.

To enable alarm acknowledgement, tap the **Must Acknowledge** toggle. The toggle will turn green with a white background when enabled.

5.1.2 Personnel Hazard Warning and Alarm

The personnel hazard warnings and alarms are shown in Figure 92 and Figure 93. By default, the warning is triggered when the gamma dose rate exceeds 0.5 mrem/h (5 µSv/h) and the alarm is triggered when the gamma dose rate exceeds 2 mrem/h (20 µSv/hr). These thresholds are adjustable by tapping the Warning or Alarm threshold box (see Figure 91) and typing in an alarm value. It is required that the warning value be less than the alarm value. The gamma dose warning and alarm values must be set to between 0.1 and 10 mrem/h (1-100 µSv/h). Instructions for changing units can be found in Section 4.3.5.

The personnel hazard warning and alarm are indicated by messages on all screens that include the status header. It is accompanied by short-duration audio and vibratory alarms (if enabled). When the alarm is displayed, the Gamma LED is solid red.

In cases where the instrument is on the edge of a dose warning or alarm threshold and the dose rate comes and goes, audio/vibratory alarms will not be retriggered unless the dose rate value falls to lower than 97% of the threshold value for more than 3 seconds.

If the unit is configured to require all alarms to be acknowledged, a full-screen alarm will be displayed with audio and vibratory alarms if enabled that persist until acknowledged by the user. Indicators in the header will persist as long as the hazard condition exists. Tapping Mute stops the vibration and sound but does not dismiss the pop-up message.

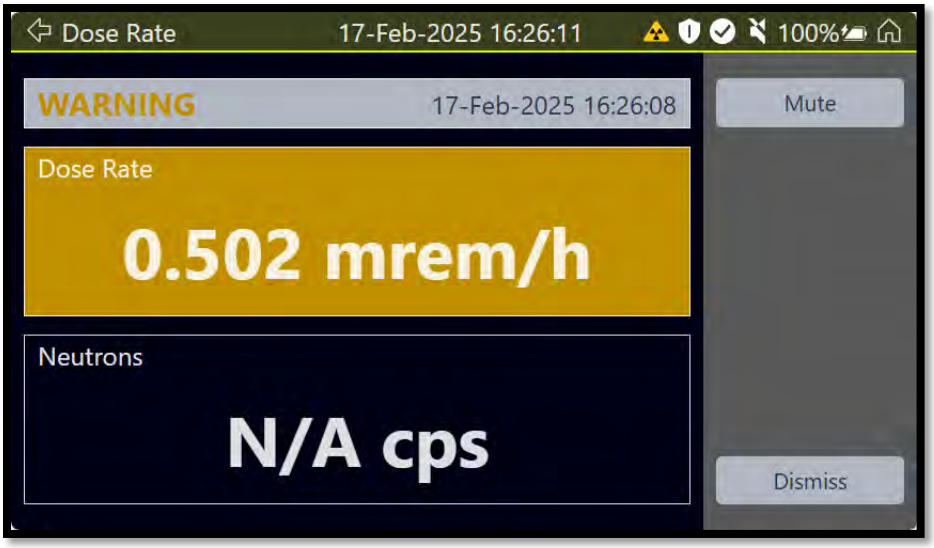


Figure 92. Personnel Hazard Warning

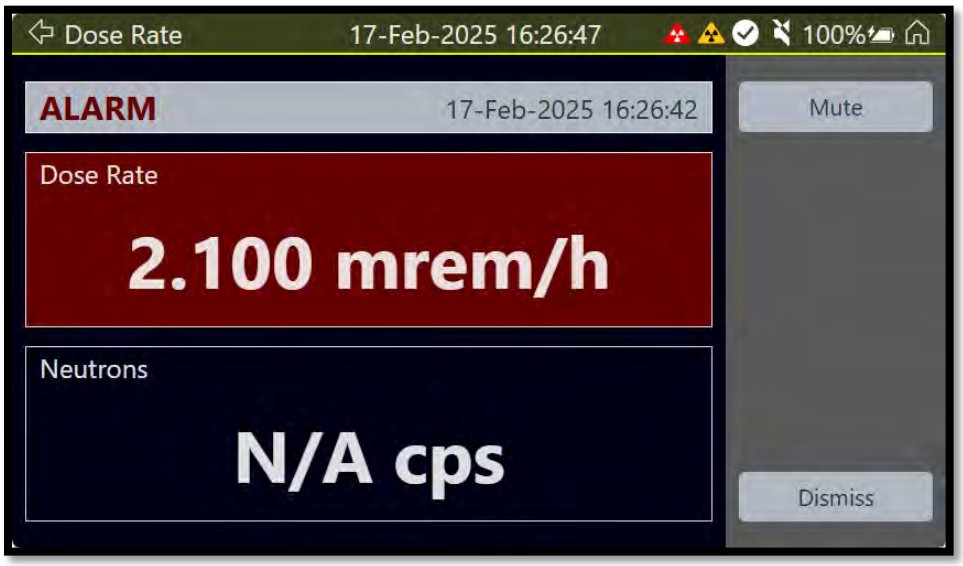


Figure 93. Personnel Hazard Alarm

5.1.3 Neutron Flux Rate Alarm

The Neutron Flux Rate alarm is displayed when the neutron flux threshold is crossed. By default, the alarm is triggered when the neutron flux rate exceeds 25 nps/cm^2. The Neutron Flux Rate alarm takes precedence over the gamma dose warnings and alarm messages. If the neutron alarm is present, the neutron LED is solid blue.

These thresholds are adjustable by tapping the alarm threshold box (see Figure 91) and typing in an alarm value. The neutron flux rate alarm value must be set to between 1 and 1000 nps/cm^2.

If the unit is configured to require all alarms to be acknowledged, a full-screen alarm will be displayed with audio and vibratory alarms if enabled that persist until acknowledged by the user. Messages in the header will persist as long as the hazard condition exists. Tapping Mute stops the vibration and sound but does not dismiss the pop-up message.

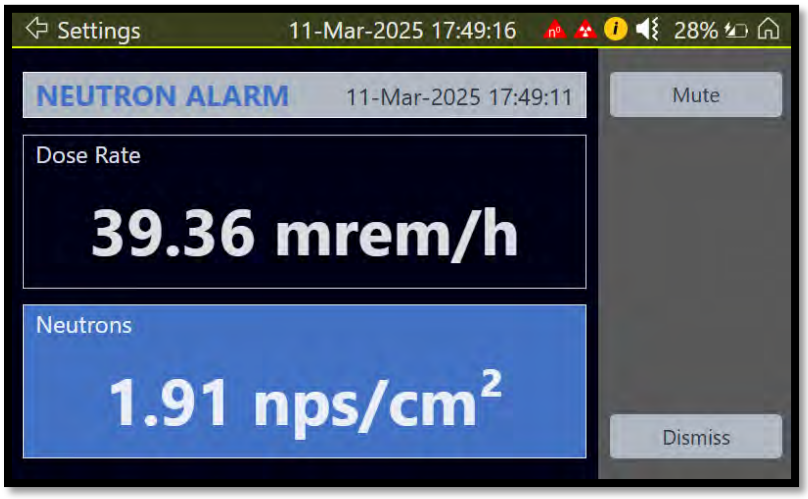


Figure 94. Neutron Flux Rate Alarm

5.1.4 Over-range Alarm

If an over-range situation occurs, a Radiation Overrange Alarm pop-up message will be displayed (Figure 95) and automatically latch the condition. Audio and vibratory alarms (if enabled) will persist until the **Dismiss** button is tapped.

Overrange alarms are indications of radiation exposure rates so high that instrument performance is degraded. **Gamma Over-range** alarms are triggered at a fixed gamma exposure rate of 2 R/h. At this exposure rate, the HPGe detector's dead time is so high that it cannot efficiently identify nuclides. **Neutron Over-range** alarms are triggered only when the neutron detector is installed, and at a neutron exposure rate greater than 1000 nps/cm^2.

CAUTION ***Neutron exposure rates in excess of this value will permanently degrade resolution of the HPGe detector after several hours.***

Tap the **Dismiss** button to silence the alarm and acknowledge the condition. The Radiation Overrange icon ()will be displayed in the header as long as the condition exists.

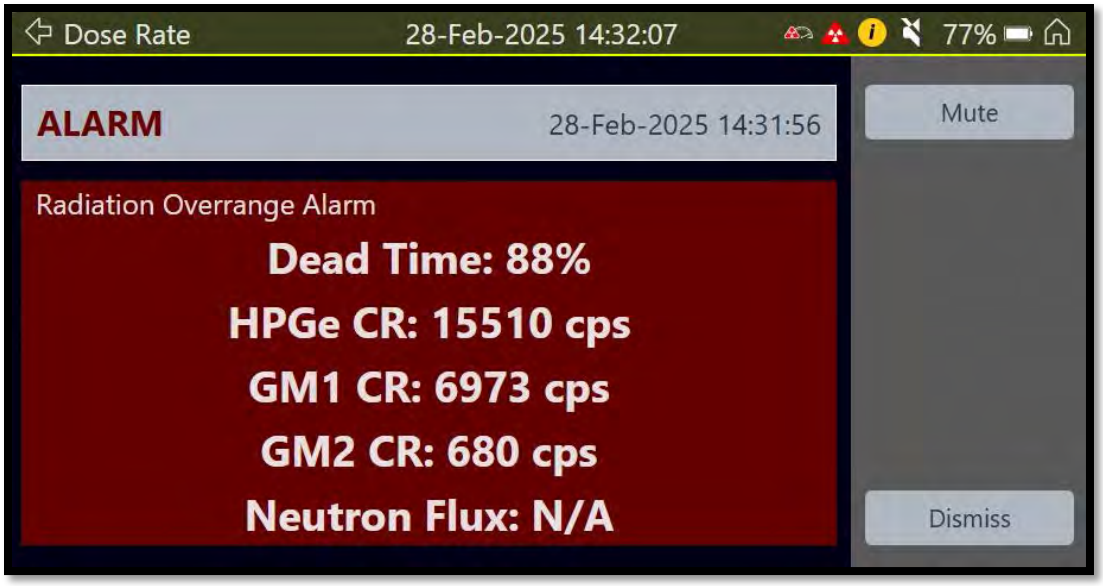


Figure 95. Over-Range Alarm

5.2 ADVANCED MODE SETTINGS

Tapping the **Advanced Mode Settings** button opens a settings screen to change the Advanced Mode passcode information.

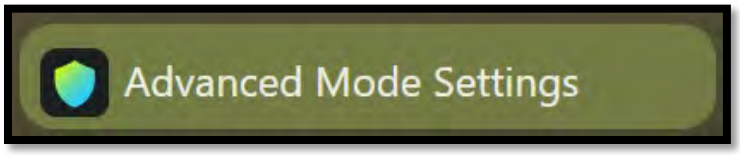


Figure 96. Advanced Mode Settings Button

The Advanced Mode settings screen allows users to change the Advanced Mode passcode and the timeout preference.

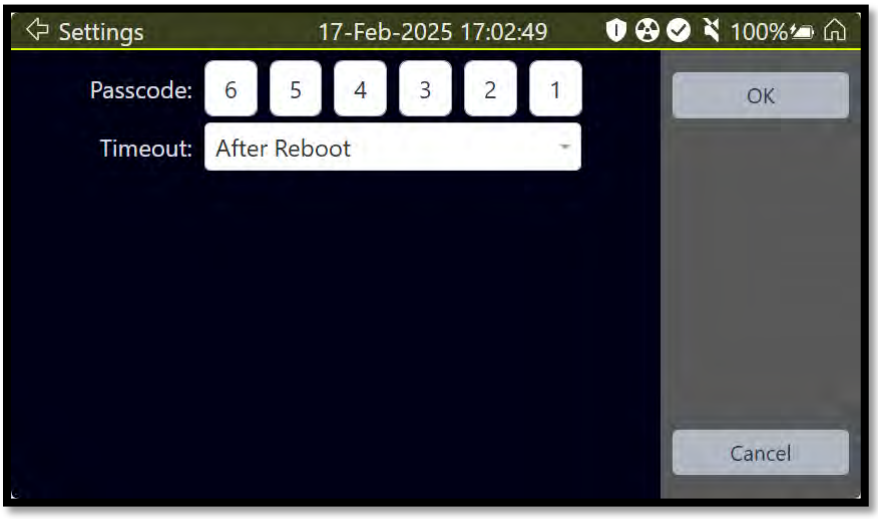


Figure 97. Advanced Mode Settings

Change the passcode from the default to any desired code by typing in a new six-digit code.

WARNING	Make sure to record the new passcode. There is not a manufacturer's override code. If the user passcode is lost, contact ORTEC's customer support for assistance.

The length of time before the instrument times out and requires reentry of the Advanced Mode passcode can be adjusted by selecting the setting from the drop-down box. The available settings are listed below:

- After Exiting Settings
- After 5 Minutes
- After 30 Minutes
- After Reboot

Tap **OK** to save the changes or **Cancel** to return to the Advanced Settings screen without making changes.

5.3 COLLECTION AND ANALYSIS

Tapping the **Collection and Analysis** button opens the Collection and Analysis settings screen to allow users to adjust the preset count time and the data integration time. This screen can also be accessed directly from the Easy ID and RAPiD applications.

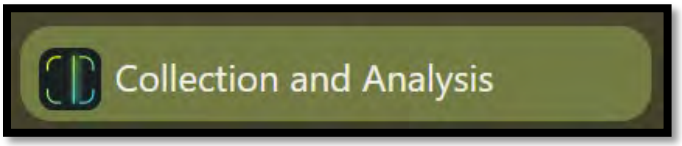


Figure 98. Collection and Analysis Settings Button

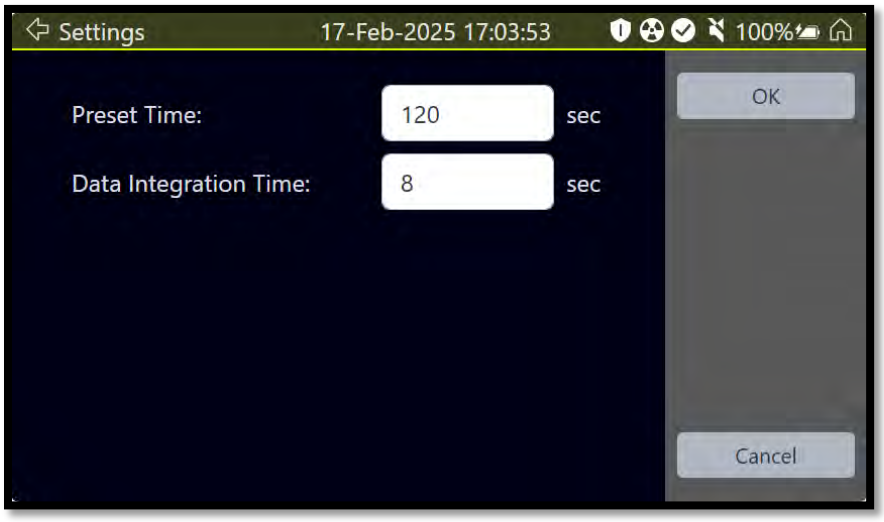


Figure 99. Collection and Analysis

Change the preset time to the new desired count time by tapping the white data box. The preset count time is used during the Easy ID and RAPiD Identify Mode data collections. Note that time is always in seconds and has a limited range from 0 to 86400 seconds. If the preset time is set to 0 seconds, data collection counts are treated as if there is not preset time and will continue to collect until manually stopped.

Change the data integration time by tapping the white data box. The data integration time is used to determine the average dose rate that is displayed on the screen. For example, the default integration time is 8 seconds. The buffer will fill with data for 8 seconds and the average dose value will be reported based on the data in the buffer. After 8 seconds, old data is continuously removed from the buffer and new data is added. Note that time is always in seconds and has a limited range from 1 to 30 seconds.

Ideally, the integration time should be matched to the amount of time a possible point source would be in the field of view of the detector. For typical search scenarios, where an operator is carrying the instrument and slowly walking past a source that is perhaps 1m (3ft) away, an 8-second integration time is a reasonable value. As distance to the source increases or as speed decreases, a longer integration time will produce better sensitivity. In scenarios where the source might be speeding past the instrument in close proximity, a shorter integration time will be better.

Tap **OK** to save the changes or **Cancel** to return to Advanced Settings without making changes.

5.4 WIRELESS AND CONNECTIVITY

Tapping the **Wireless and Connectivity** button opens a settings screen to allow users to enable/disable various capabilities.

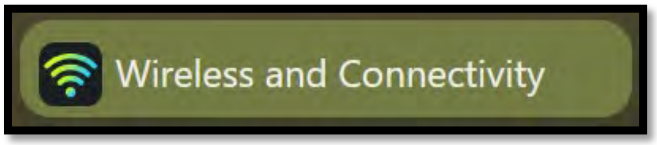


Figure 100. Wireless and Connectivity Settings Button



Figure 101. Wireless and Connectivity

For each of the items listed below, enabled settings have a green toggle with a white background. Disabled settings have a gray toggle with a white background.

- Allow GPS – turns on/off GPS tracking capabilities
- Allow Bluetooth – enables/disables Bluetooth connection capabilities
- Allow WLAN – enables/disables the ability to connect to a WLAN network
- Allow WLAN Hotspot – enables/disables the ability of the instrument to create a WLAN hotspot.

NOTE	If the instrument has an RF Secure sticker on the back above the serial label, this instrument does not have GPS, Bluetooth, or WLAN capability.

Enabling/Disabling Limit Remote Connections allows the user to specify which devices/computers on the network are allowed to connect to this DX1. Tap **Manage** to open the Remote Connections screen.

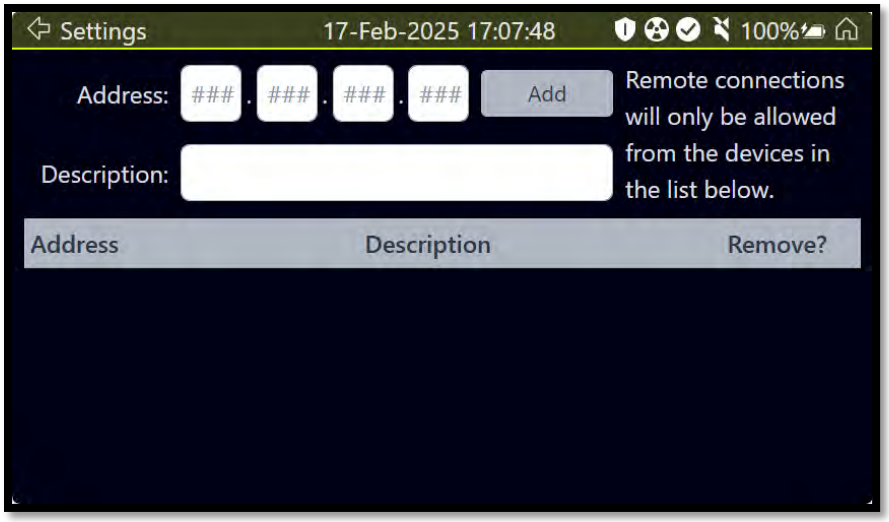


Figure 102. Remote Connections

Add an IP address by tapping on the square and entering the address numbers. Add a description of the IP address location. Tap **Add** to add the remote connection to the table. Tap the trash can icon to remove any undesired networks/computers. Tap the left arrow at the top of the screen to return to the Wireless and Connectivity screen. Note that ICMP (ping, trace, etc.) network traffic will be blocked by the DX1's built in firewall.

Tap **OK** to save changes or **Cancel** to return to the Advanced Settings screen without making changes.

5.5 NUCLIDE LIBRARY

Tapping the **Nuclide Library** button opens the Nuclide Library to allow users to modify nuclide threat level. (Note that the Nuclide Library can also be accessed from the Home Screen.)

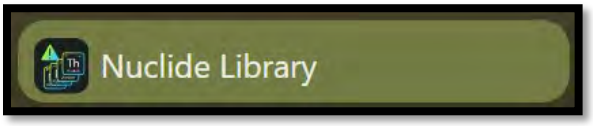


Figure 103. Nuclide Library Button

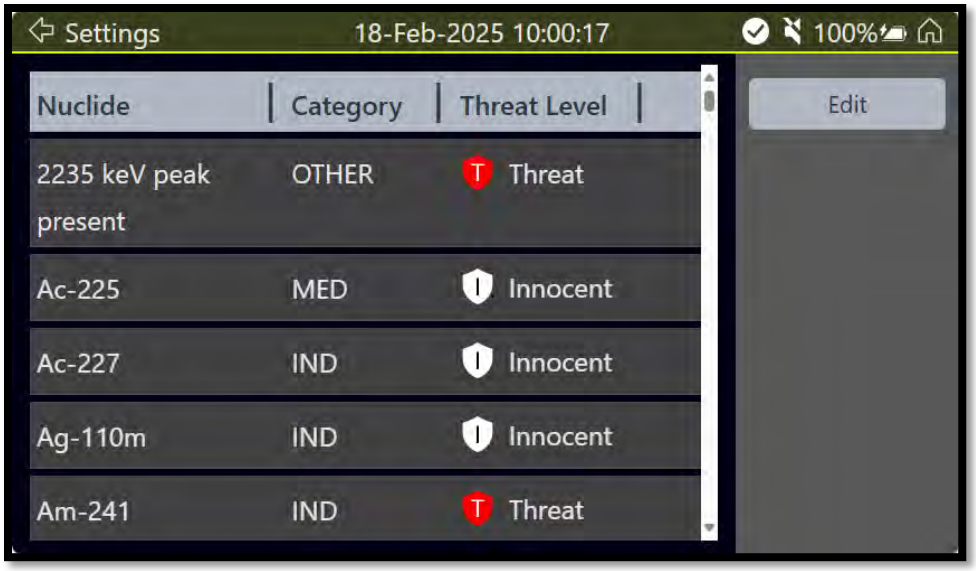


Figure 104. Nuclide Library

More information about the Nuclide Library can be found in Chapter 8.

5.6 EXTERNAL INTERFACES

Tapping the **External Interfaces** button opens the External Interfaces settings screen to allow users to enable/disable Reachback and MFK.



Figure 105. External Interfaces Button

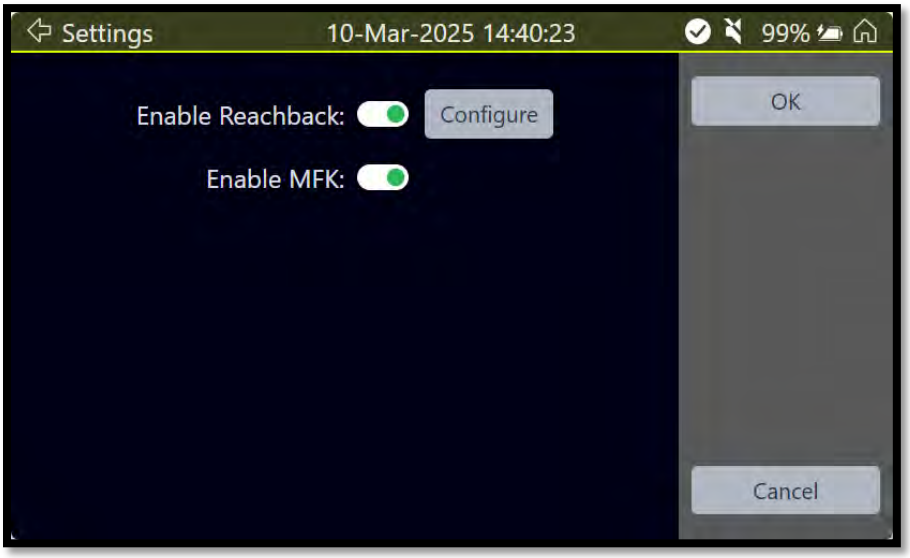


Figure 106. External Interfaces Screen

Tapping the toggle for either Reachback or MFK enables that feature. An enabled feature has a green toggle with a white background.

Tapping the **Configure** button opens the Reachback Configuration screen.

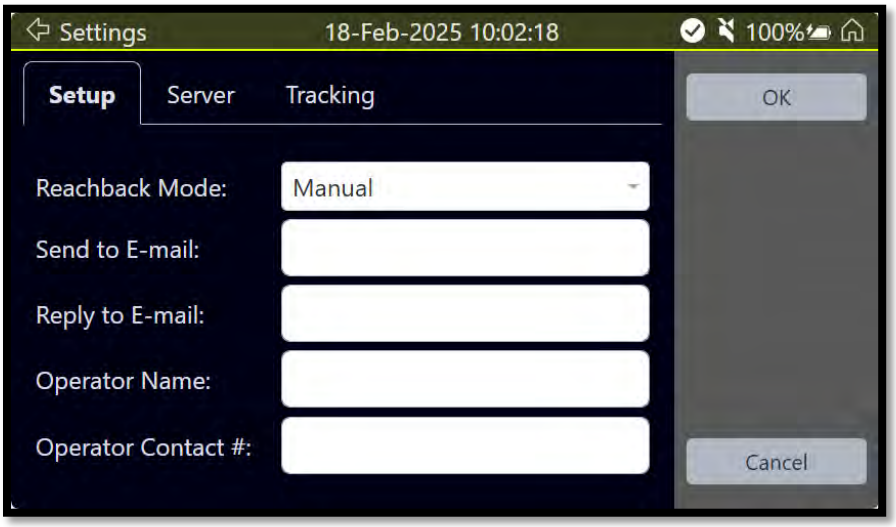


Figure 107. Reachback Configuration Screen

The Reachback Mode drop-down menu allows selection between the following to specify when the instrument automatically sends a file to Reachback:

- Manual
- All Measurements
- All IDs
- All Suspect and Threat IDs
- All Threat IDs

Change the tab to Server to enter the email server information.

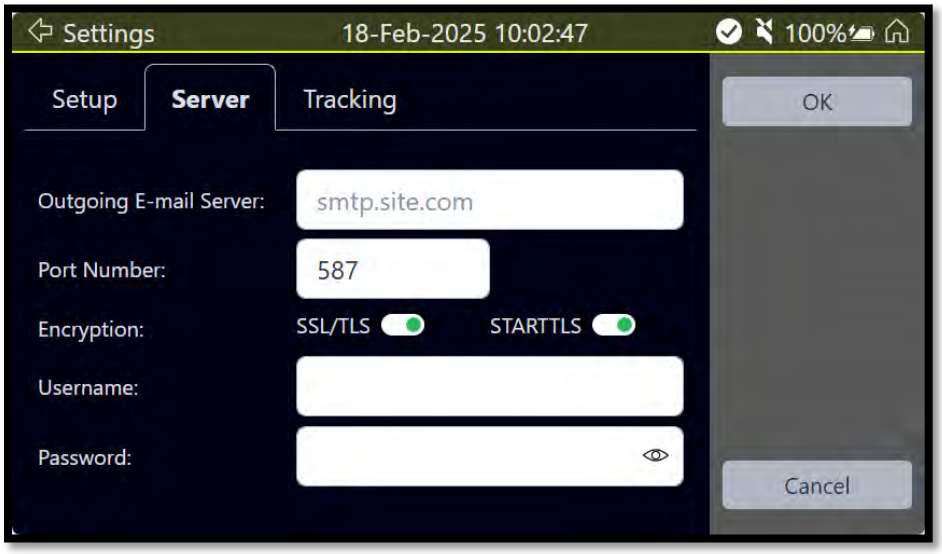


Figure 108. Reachback E-mail Server Information

Change the tab to Tracking to view the status of files queued to send via Reachback.

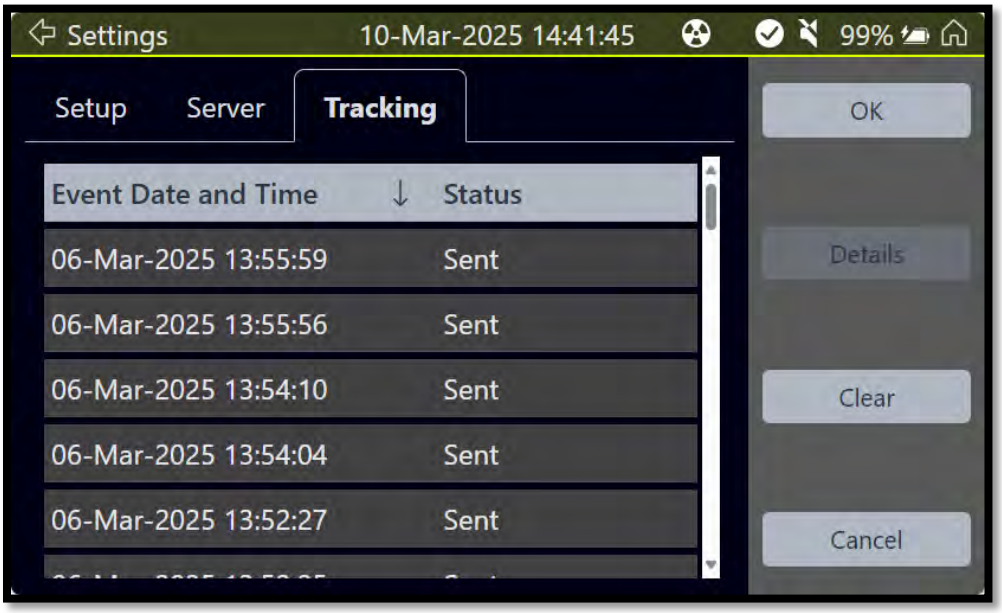


Figure 109. Reachback Tracking Tab

Select an event date/time and tap **Details** to view the information on the file that was sent.

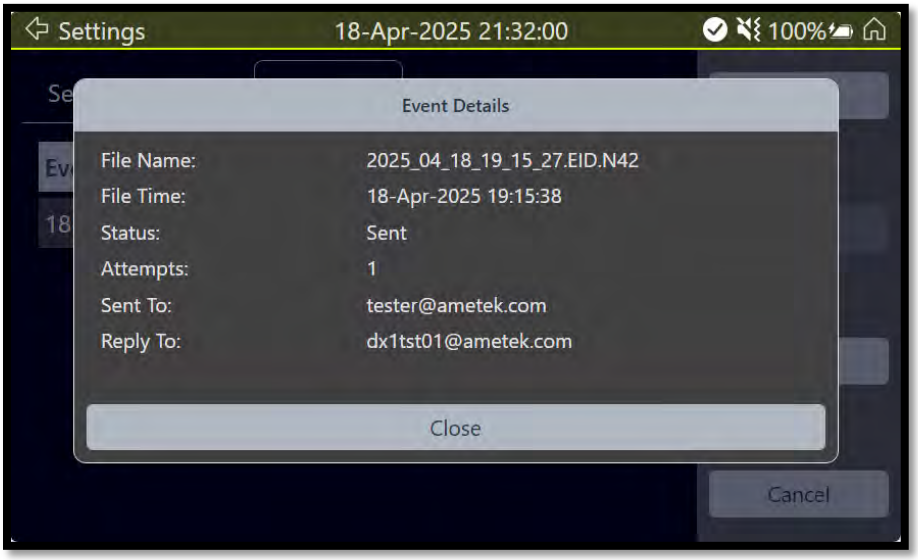


Figure 110. Reachback File Event Details

Tap the **Close** button to close the event details view.

Tapping the **Clear** button clears the Reachback Events log. A confirmation message is displayed to verify that it is desired to proceed with clearing Reachback Events. Tap **Yes** to confirm or **No** to return to the event log.

Once Reachback is enabled, files can be queued to be sent to Reachback. Queued files will send automatically once the instrument is connected to a network with internet access. The attached spectrum file will be in ANSI N42.42 format, which is compatible with the ANSI N42.42-2020 standard. The spectrum file can be viewed with U.S. government-supplied software; MCA emulation software such as Los Alamos National Laboratory's PeakEasy or Sandia National Laboratory's Cambio; or ORTEC's GammaVision® Gamma-Ray Spectrum Analysis, LVis, and MCA Emulator application (A66MP-BW). Event files can also be sent to Reachback from the Event Viewer App. Event files are sent as .json files.

NOTE:	The Reachback Request Date and Time in the received Reachback email is sent in UTC time.

Press **OK** to save or **Cancel** to return to the previous screen without saving changes.

5.7 ENERGY CALIBRATION SETTINGS

Tapping the **Energy Calibration Settings** button opens the Energy Calibration Settings screen.

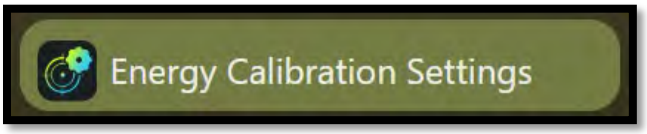


Figure 111. Energy Calibration Settings Button

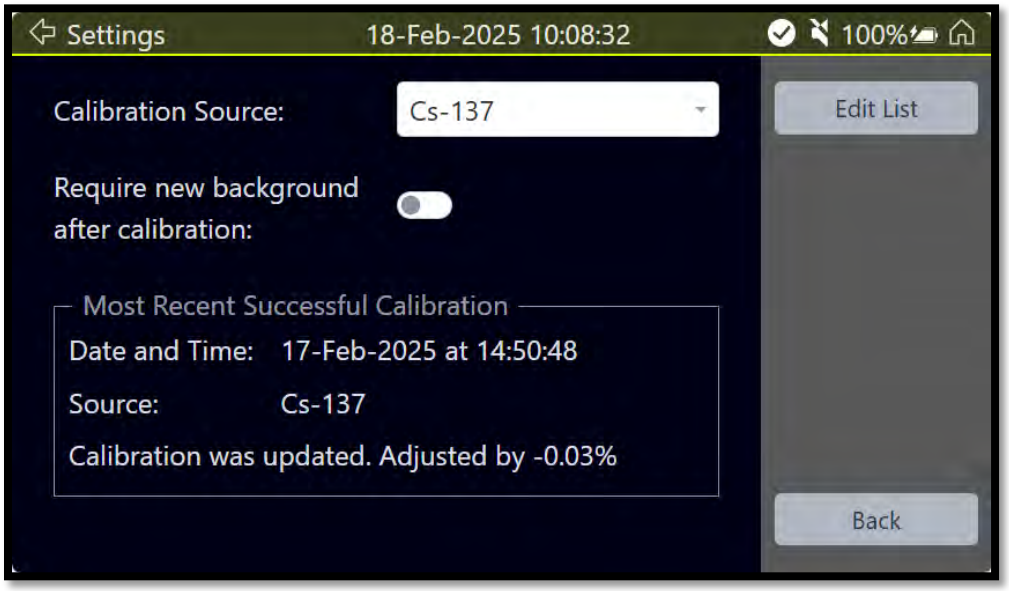


Figure 112. Energy Calibration Settings

This screen allows users to add calibration sources to be used during the energy calibration (see Section 4.8) and select if it is desired to require a new background after the instrument is calibrated. The most recent calibration date and time is displayed in the center of this screen.

5.7.1.1 Require New Background After Calibration

Although not necessary for the onboard nuclide identification algorithm, it may be desired to force collection of a new background spectrum each time a new energy calibration is performed. Tap the **Require new background after calibration** toggle to activate it. This will delete all existing backgrounds and create a Missing Background operational status that will be displayed in all status locations.

5.7.1.2 Adding More Calibration Sources

Cs-137 and K-40 are defined by default as calibration sources. The selected source in the **Calibration Source** field tells the user which source is expected on the Calibrate screen (Figure 66). If the user wishes to add other sources tap the **Edit List** button to open the dialog shown in Figure 113.

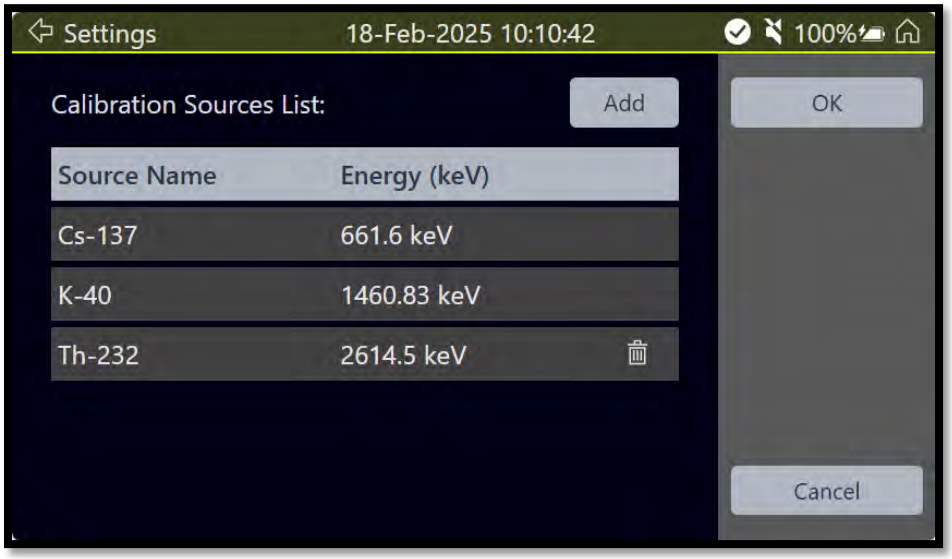


Figure 113. Calibration Sources Screen

Tap **Add** to add another source to the list (Figure 114). The new source appears at the bottom of the table as New Nuclide. Tap on the source name to change the name and energy. Tap the trash can symbol to delete the added source (note that Cs-137 and K-40 may not be deleted). Tap **OK** to save or **Cancel** to return to the previous screen without saving changes.

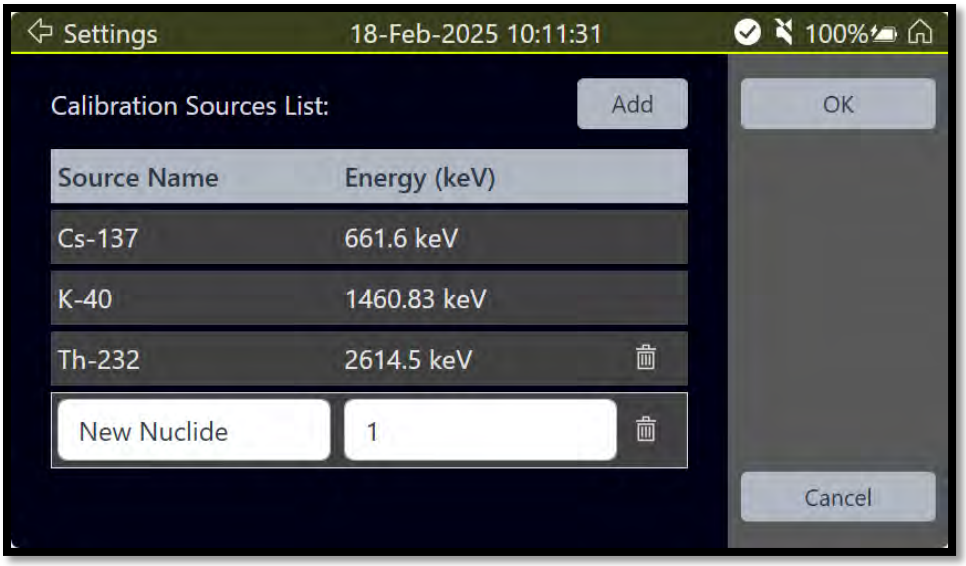


Figure 114. Add New Calibration Source

Good candidates for additional energy calibration sources are Co-60 (1173.24 keV) and Th-232 (2614.5 keV for 208Tl daughter). Low-energy sources (less than 500 keV), such as Ba-133, should be avoided because they force a high fraction of the total energy range to be extrapolated instead of interpolated. If it is intended to use the system with the gain stabilizer permanently disabled, then calibrating with Th-232 is highly recommended.

An optional Th-232 calibration source can be purchased for calibration of the DX1 (P/N DX1-ACC-TH-CAL). Instructions for use of the calibration source can be seen in Appendix E.

5.8 DATA STORAGE

Tapping the **Data Storage** button opens the Data Storage settings screen.

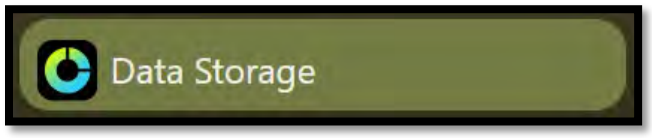


Figure 115. Data Storage Settings Button

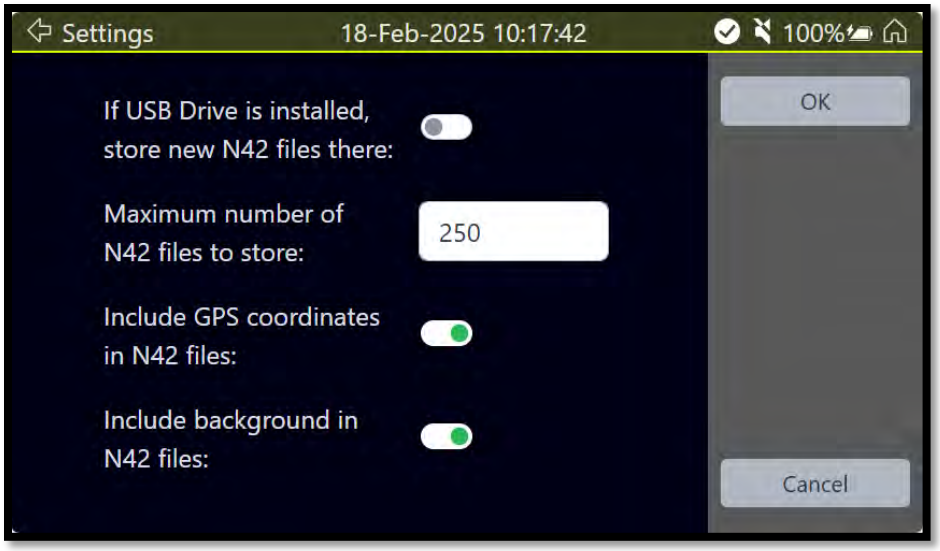


Figure 116. Data Storage Settings

For each of the items listed below, enabled settings have a green toggle with a white background. Disabled settings have a gray toggle with a white background.

- If USB Drive is installed, store new N42 files there – stores N42 files directly onto the USB drive and not in internal storage. Note that a USB storage drive must be installed, otherwise files are stored internally.
- Include GPS coordinates in N42 files – embeds the GPS data in the N42 file.
- Include background in N42 files – embeds any backgrounds associated with the count in the N42 file.

The "Maximum number of N42 files to store" allows the user to set the storage limit up to 500 files for each the internal and external storage drive. After 90% of the file capacity has been reached, users will be given a warning that they are approaching the file limit. After the file limit has been reached, the user will be given warning that files must be removed before additional data can be collected. Removing files means that they can be moved to a USB drive (see Section 7 – File Manager) or can be sent via Reachback and deleted from the device (see Section 5.6). If files are being written directly to the USB drive, then they must be moved out of the current storage folder to make room for additional files, or a different USB drive should be inserted into the instrument. Note that the DX1 only recognizes one USB drive and should never have two inserted into the instrument.

Tap **OK** to save the changes or **Cancel** to return to the Advanced Settings screen with no changes.

5.9 BACKGROUND SETTINGS

Tapping the **Background Settings** button opens the Background settings screen.

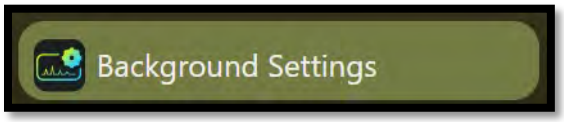


Figure 117. Background Settings Button

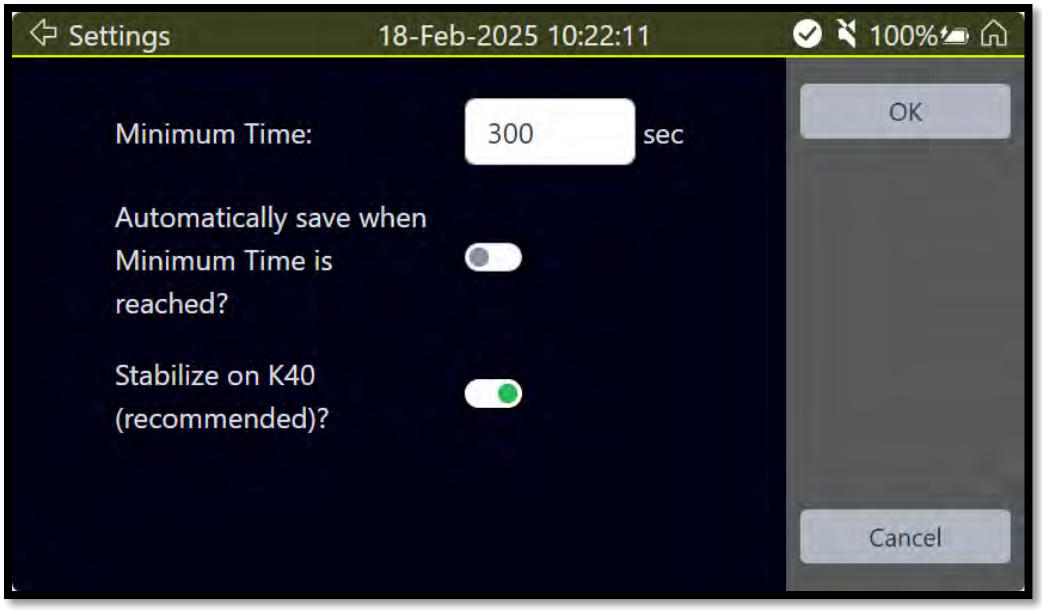


Figure 118. Background Settings

For each of the items listed below, enabled settings have a green toggle with a white background. Disabled settings have a gray toggle with a white background.

- Automatically save when Minimum Time is reached? – Once the minimum time has elapsed, the background data collection stops, the file is saved, and the background data collection screen closes returning to the settings screen (see Section 4.5 for more information about background data collection).
- Stabilize on K40 (recommended)? – When this is selected, the system uses the K-40 found in the background to stabilize the spectrum.

The Minimum Time setting allows users to define how long the background data collection should be acquired. Tap on the box and enter in a value between 60 and 86400 seconds. Realize that shorter background times carry with them a risk in that ambient background may not be optimally characterized. Short background times may not allow optimization of detection probability and false positive probability for naturally occurring nuclides (including uranium). Also, very short background times may not allow accurate determination of K-40 activity and so the gain stabilizer may not be enabled in instances where it really should be enabled.

By default, the system will automatically save when the minimum count time is reached. If desired, users can change this to allow the DX1 to continue to acquire background data until the operator specifically ends the acquisition recognizing that more time is better. In some instances, this behavior may not be preferred. The longer data is acquired prior to saving, the more opportunity exists for things to go wrong (such as a coworker passing by the instrument with a check source in hand or batteries expiring).

For special cases, the gain stabilizer (stabilize on K-40) can be completely disabled. *Gain stabilization is highly recommended where ID performance is important.* However, if spectral data is being collected simply for analysis by a Reachback organization, where known and blank spectra are

collected along with spectra from the object of interest, ID performance is less important and gain stabilization across these measurements becomes an undesired data collection parameter change.

Tap **OK** to save the changes or **Cancel** to return to the Advanced Settings screen with no changes.

5.10 FACTORY RESET

Tapping the **Factory Reset** button opens the Factory Reset settings screen.

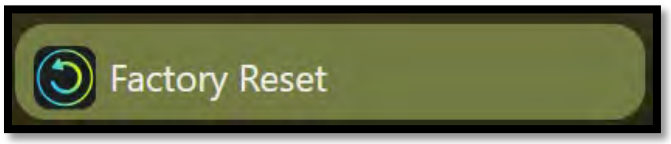


Figure 119. Factory Reset Button

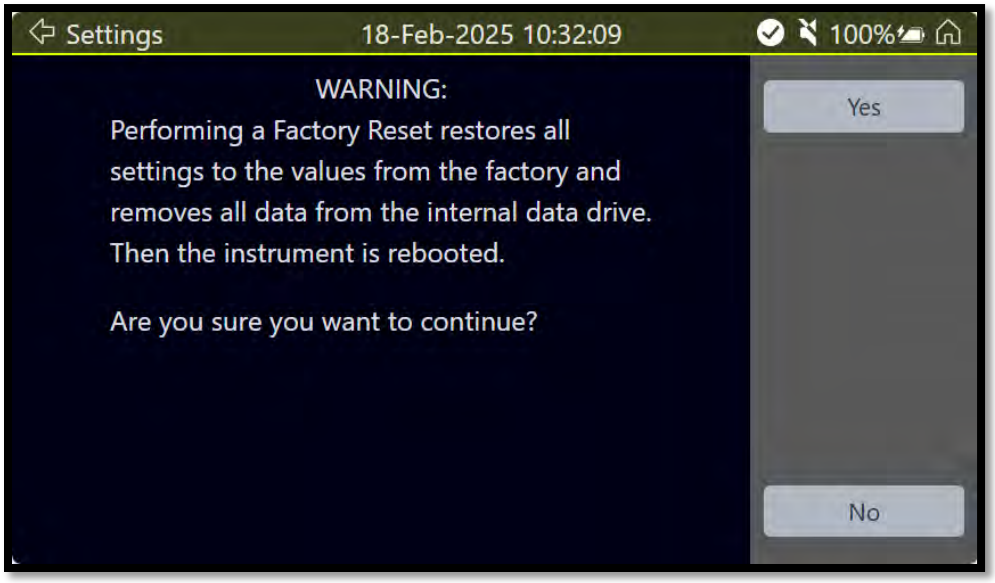


Figure 120. Factory Reset Screen

Performing a factory reset restores all settings to the factory default values. Note that once a factory reset has been performed, users should also perform a new energy calibration by navigating to Settings and tapping Calibrate (see Section 4.8 for more information).

WARNING This action is not reversible and will require users to manually restore any settings previously changed. All data will be removed from the internal data drive.

Tapping the **Yes** button opens a confirmation message confirming the desire to proceed with the factory reset. Tap **Yes** to proceed or **No** to cancel.

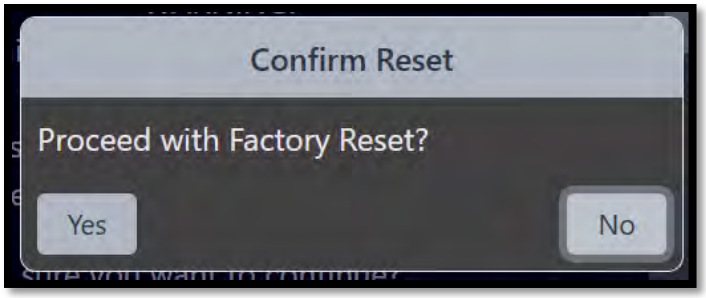


Figure 121. Confirm Reset Message

5.11 CALIBRATE DOSE

Tapping the **Calibrate Dose** button opens the Calibrate Dose screen.

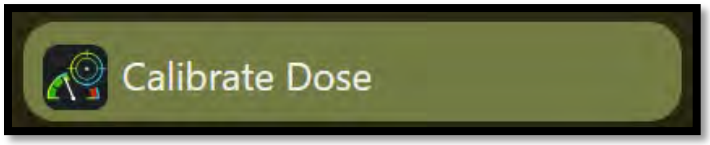


Figure 122. Calibrate Dose Button

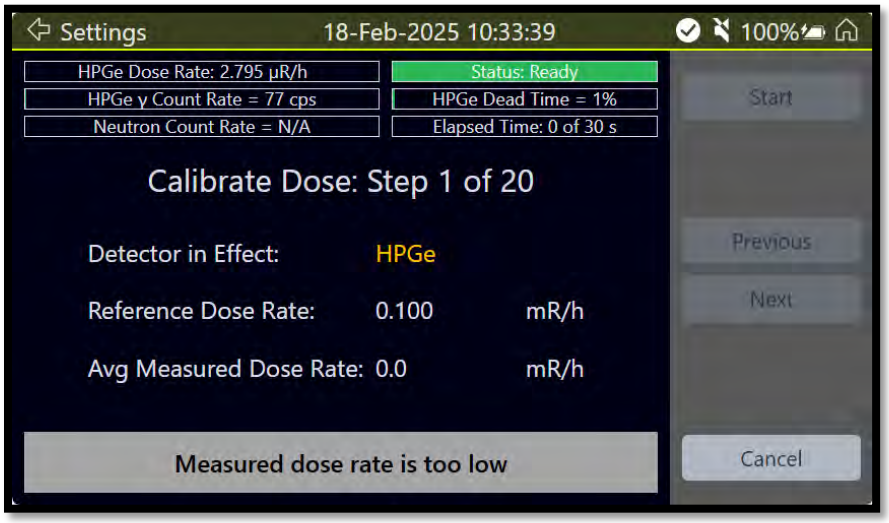


Figure 123. Calibrate Dose Wizard

The DX1 dose rate can be calibrated from 100µR/hr to 2R/hr to compensate for variations in radiation detection tube performance. Calibration requires access to a Cs-137 dose rate calibration range with capability from 100µR/hr to 2R/hr. Calibration is performed using a calibration wizard designed to take timed readings of 20 points through the detection range.

The calibration wizard is designed to prevent a step from starting if the wizard does not detect at least 50% of the expected value. For example, on Step 1, if the wizard did not detect at least 0.05 mR/hr, the **Start** button is unavailable. Once all 20 steps are completed, the **Next** button changes to **Finalize**. Clicking **Finalize** stores the calibration data file.

Navigating to the System screen (located on the Settings page), allows the user to view if the DX1 has been calibrated. If the unit is calibrated, the last calibration date is displayed at the bottom of the screen. Otherwise, the System screen will display N/A.

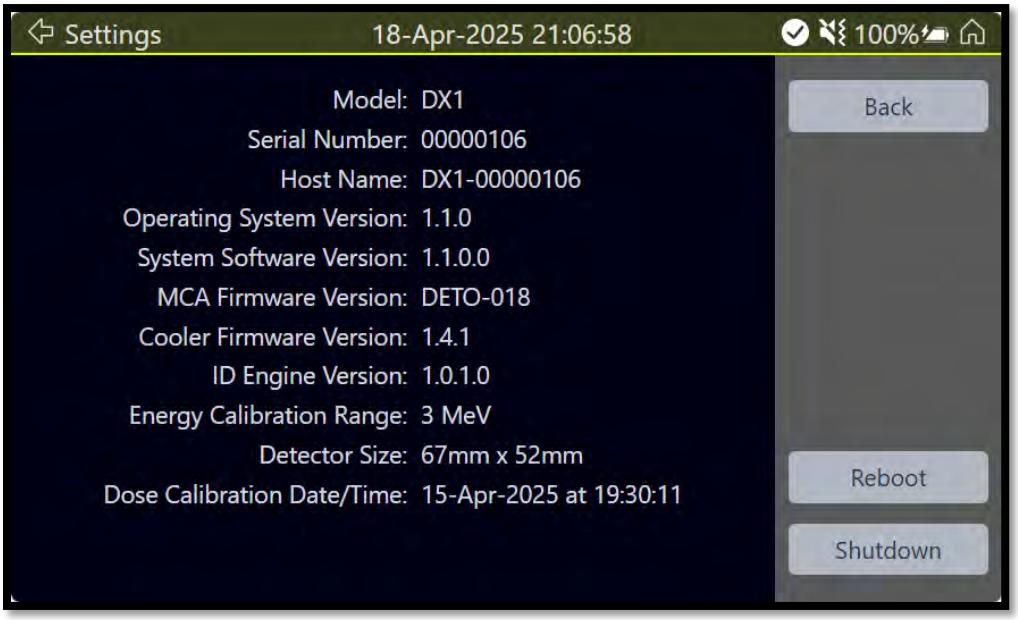


Figure 124. System Screen Displaying Dose Calibration Date

5.12 SYSTEM SOFTWARE UPDATE

Tapping the **System Software Update** button opens the System Software Update screen.

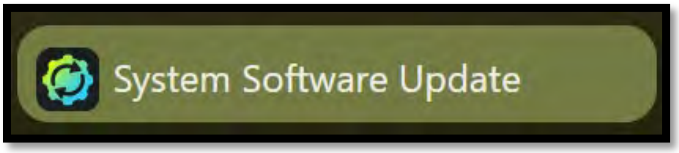


Figure 125. System Software Update Button

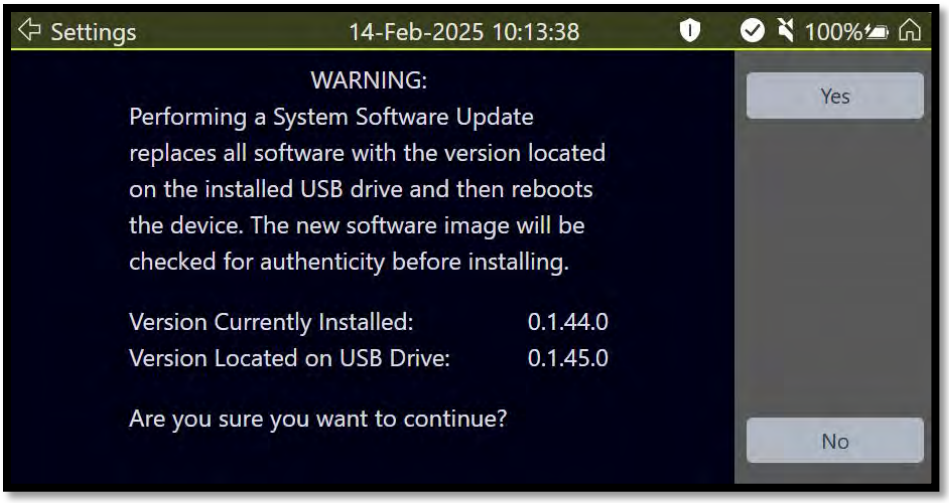


Figure 126. System Software Update Screen

If an update has been made to the system software, a software update file that has been digitally signed by ORTEC will be released. If it is desired to update the system software, insert a USB drive that contains the new software at the root location (not placed inside a folder on the drive) into the DX1. The new software version number will be displayed as the Version Located on the USB Drive. The DX1's currently installed software version number is displayed as the Version Currently Installed. Files are checked for cyber security purposes to prevent modifications prior to the instrument allowing the user to proceed with the updated. Press the **Yes** button to start the updating process. A confirmation screen is displayed to confirm it is desired to proceed with the system update. Press **Yes** to confirm or **No** to cancel.

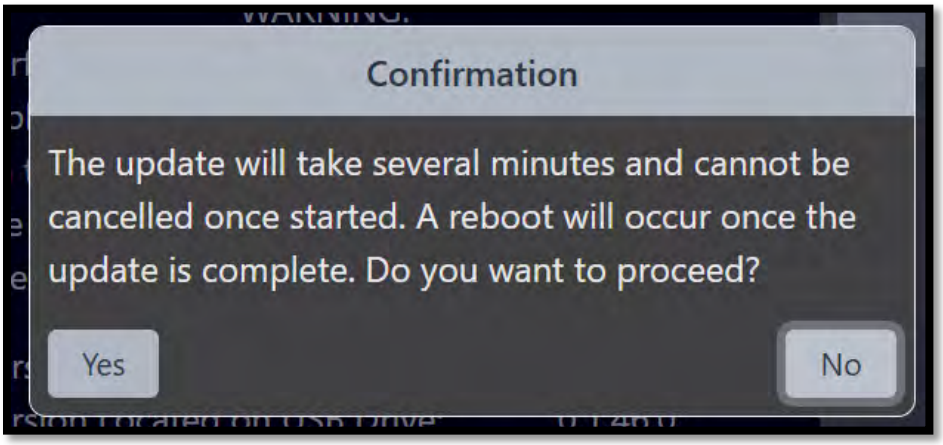


Figure 127. System Software Update Confirmation

Once the software update begins, it takes several minutes for the process to be completed. Progress updates for the 5 updating steps are shown at the bottom of the pop-up screen. Upon completion the instrument will automatically reboot. When the Home screen is displayed again, navigate to Settings and select System. Confirm that the updated software version number is now displayed on the system page.

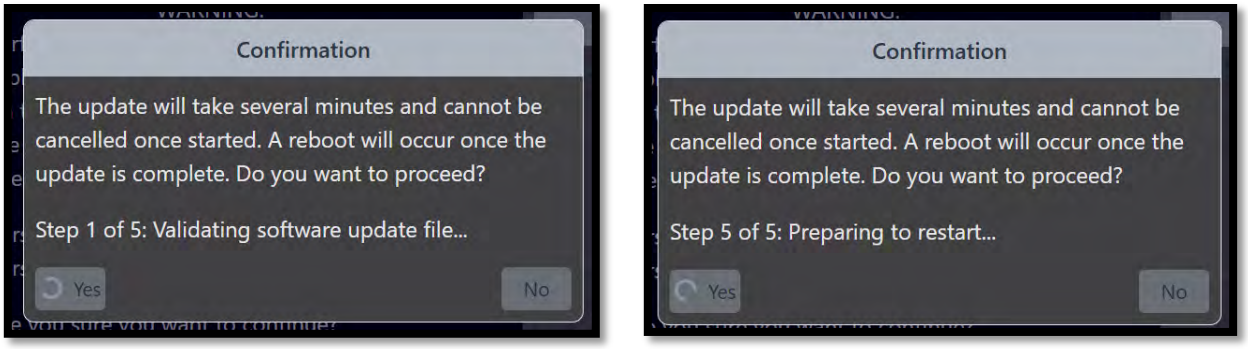


Figure 128. Software Update Step Progress

NOTE The system software update can be used to advance to the next software version or to revert to the previous software version.

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6. SPECTRUM VIEWER

The Spectrum Viewer can be accessed from the Home screen.

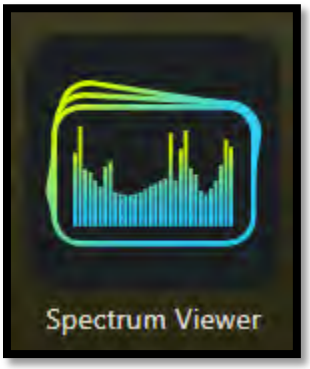


Figure 129. Spectrum Viewer Icon

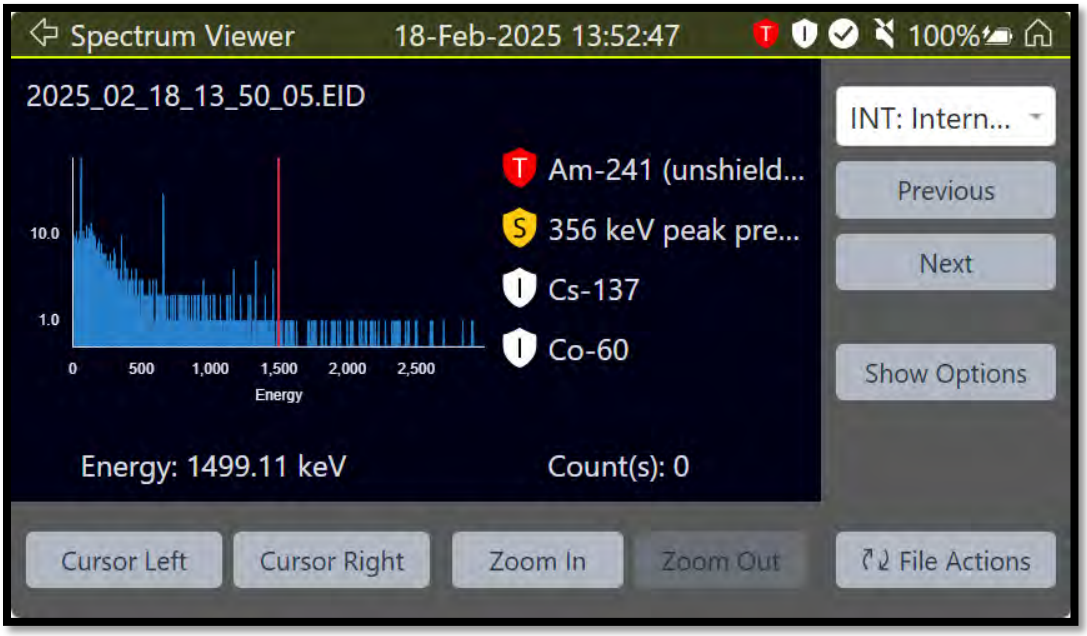


Figure 130. Spectrum Viewer

The Spectrum Viewer allows users to navigate to a specific file and view the recorded spectrum. The cursor marking the current point of interest is displayed by a red line. The cursor can be moved on the screen by either tapping the **Cursor Left** or **Cursor Right** buttons or by tapping directly on the spectrum.

Tapping the **Zoom In** button zooms in on the region surrounding the cursor. Keep tapping **Zoom Out** to return the view to the default setting. Tapping and holding the buttons will accelerate the rate at which the cursor moves.

Using the **Next** and **Previous** buttons, users can navigate to other files located on either the internal drive or the USB drive (depending on what is selected in the drop-down menu). Tapping the button will change the file to either the next or previous one in the file order.

Tapping **Show Options** allows the user to customize the information shown on the spectrum plot. Tap **Hide Options** to close the options screen and display the changes.

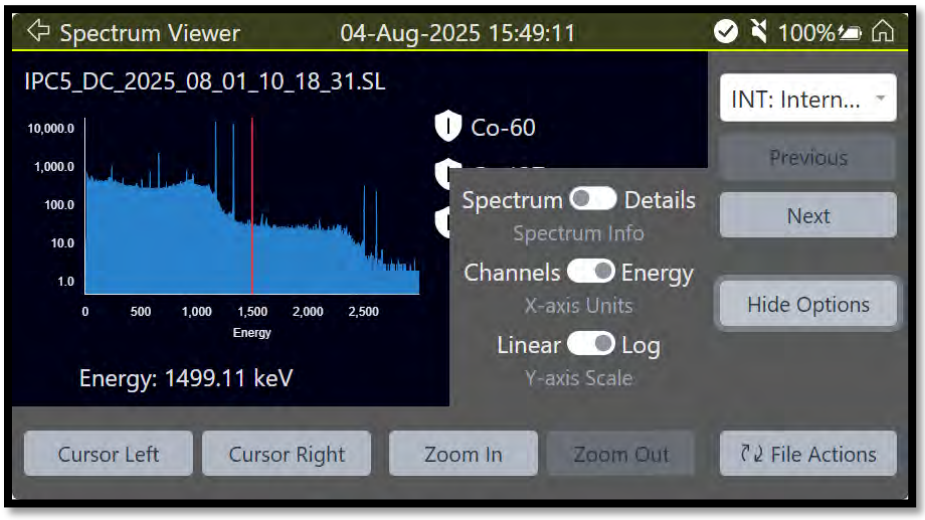
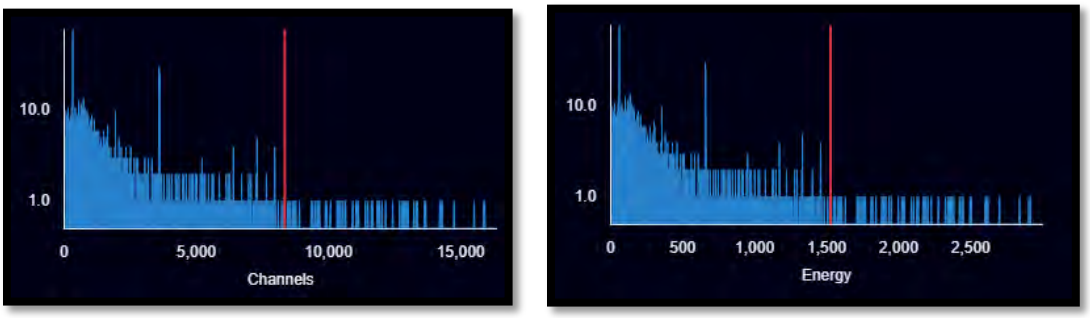


Figure 131. Show Options Screen

Tapping the toggle switch between Spectrum and Details changes the view from displaying the spectrum collected to the details about the data collection.

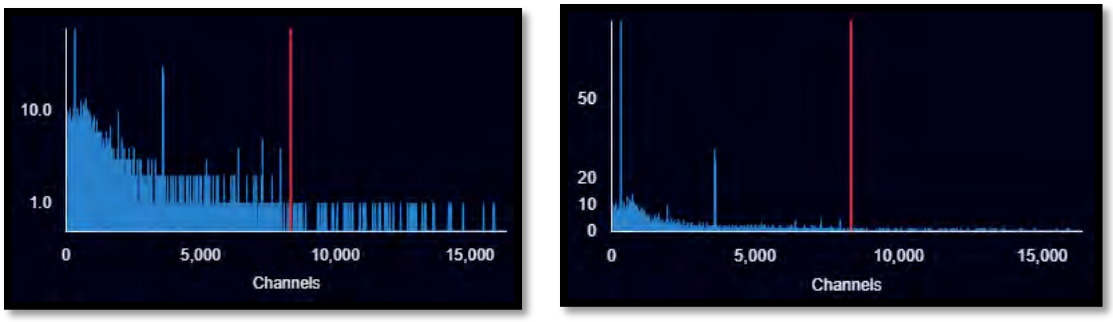
Tapping the toggle switch between Channels and Energy changes the view from displaying the energy as the X axis to the number of channels as the X axis.



Channels Energy

Figure 132. Channels vs Energy

Tapping the toggle switch between Linear and Log changes the view from displaying the counts in linear as the Y axis to the log as the Y axis.



Log Linear

Figure 133. Linear vs. Log

Tapping **File Actions** changes the bottom row of buttons from actions that affect the spectrum view to actions that affect the N42 spectrum file. When the File Actions button is selected, it changes to Plot Actions to allow the user to change the buttons back to those that affect the spectrum view.



Figure 134. File Actions Button View

The function of each file action button is described in File Manager (Section 7).

Tap the left arrow button in the upper left corner of the screen to return to the previous screen.

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7. FILE MANAGER

From the Home screen, select the File Manager icon to open the file management system.

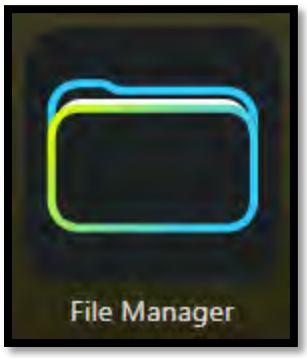


Figure 135. File Manager Icon

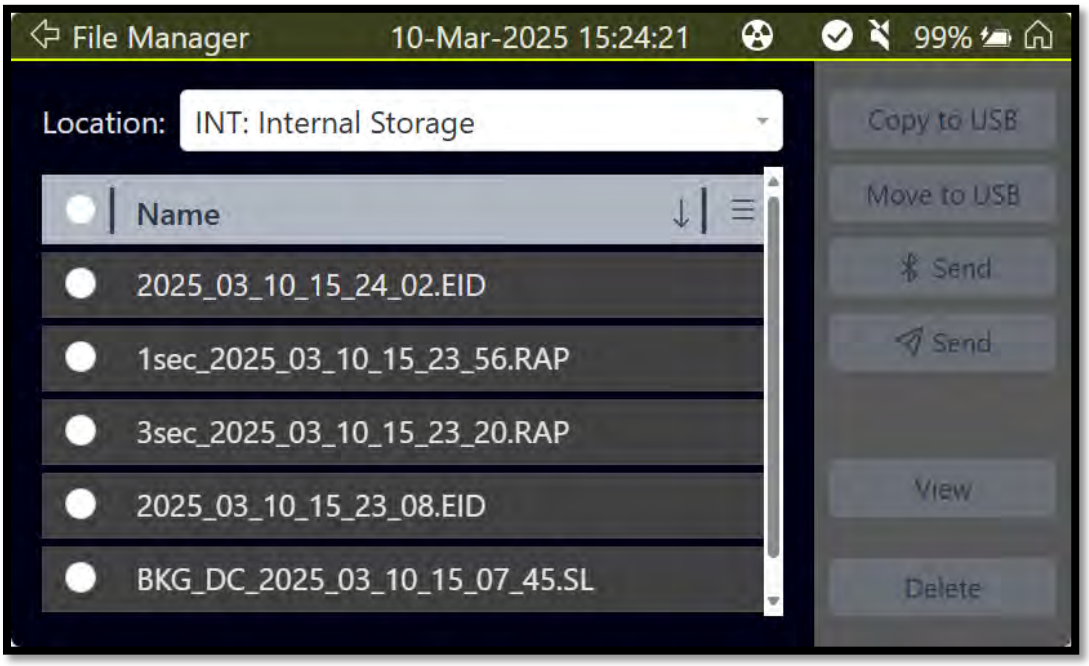


Figure 136. File Manager Screen

All spectrum files saved by the DX1 are stored with a .N42 extension, which is not displayed in the file management system. The displayed extensions that are added to the file name in addition to the .N42 extension are defined below:

- .EID – Easy ID
- .RAP – RAPiD
- .SL – Sleuth

7.1 COPY OR MOVE FILE TO USB

Note the default storage location in the INT: Internal Storage. To copy or move files from internal storage to a USB drive, complete these steps:

- Insert a USB into the DX1.
- Select any file by tapping on the circle to the left of the file name. Note that all files can be selected by tapping on the circle at the top in the gray bar.
- Selecting a file will enable the action buttons on the right side of the screen seen in Figure 137.
- To copy a file to the installed USB drive, tap **Copy to USB**. This will only copy the selected file(s), allowing the file(s) to remain on the DX1.
- If a file with the same name already exists on the USB drive, a warning message will be displayed confirming the desire to overwrite the file (see Figure 138). Tap **Overwrite** to copy the file or **Cancel** to return to the File Manager screen without making any changes.
- To move a file to the USB drive, tap **Move to USB**. This will add the file to the USB and remove it from the internal storage drive.

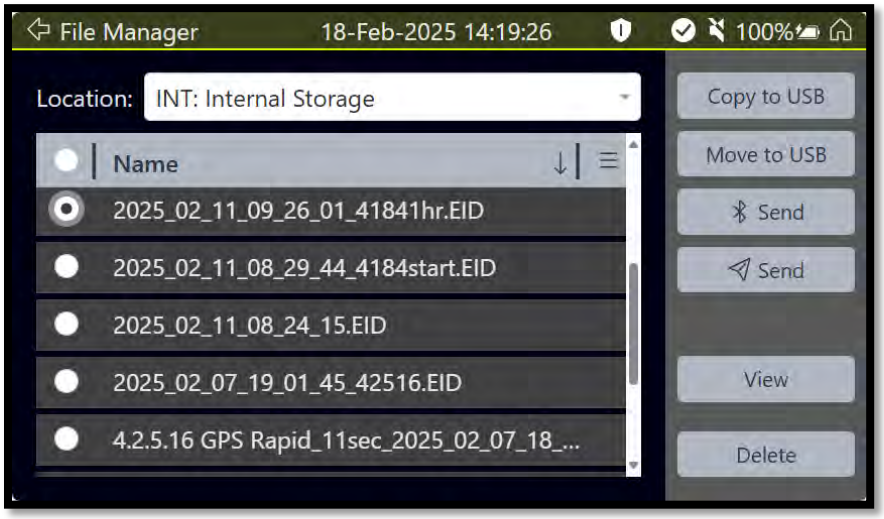


Figure 137. File Manager with Active Buttons

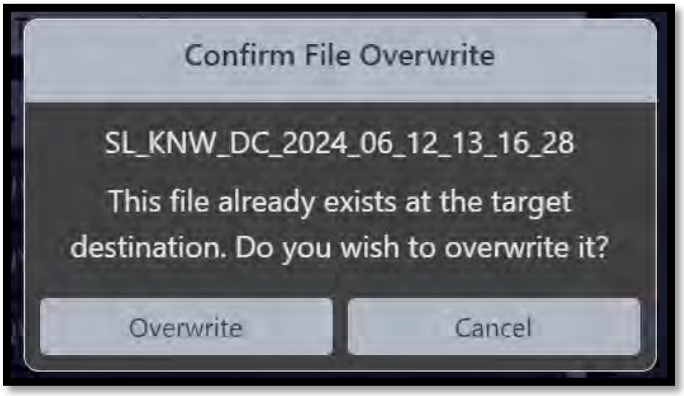


Figure 138. Confirm File Overwrite

NOTE On the USB drive, all .N42 are stored in a \DX1 folder. If no \DX1 folder is located on the USB drive, one will be created automatically. N42 files located in any other folder (including subfolders under \DX1) will not be recognized by the DX1.

7.2 SENDING A FILE WITH BLUETOOTH

The DX1 has the ability to send a file directly to a device via a Bluetooth connection. Prior to tapping the Bluetooth Send button, complete the steps found in Section 4.11 to connect the desired device to the DX1. Note this can also be completed by tapping the Settings button on the Confirm Bluetooth File Transfer screen (see Figure 140).

NOTE	Bluetooth file transfer only works for Windows PCs and Android mobile devices. This does not work for iOS mobile devices due to restrictions of the iOS operating system.

Once a device is connected, tap the **Bluetooth Send** button in the navigation column.

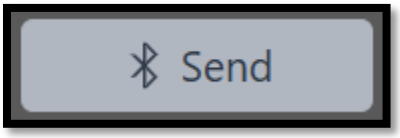


Figure 139. Bluetooth Send Button

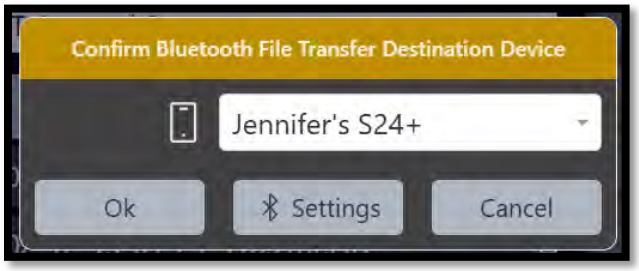


Figure 140. Confirm Bluetooth Transfer Screen

Tap **OK** to confirm the attempt to send a file via Bluetooth. A message for "Connecting to selected device" will be displayed.

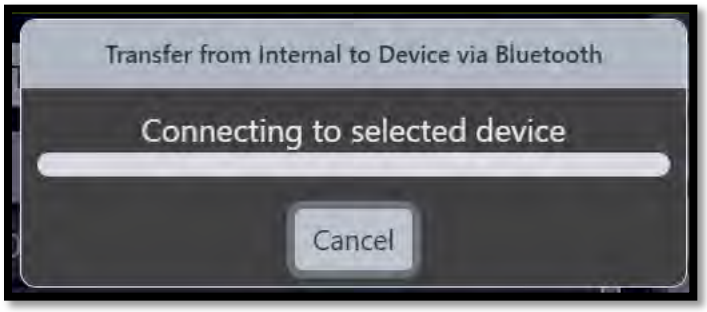


Figure 141. Connecting to Selected Device Screen

Once the device connects, the DX1 will attempt to send the file and display a "Waiting for transfer to be accepted" message. The connected device may require interaction to receive the transferred file.

NOTE:	If the user is attempting to transfer the file to a PC, the PC will need to be put into file receiving mode prior to starting the transfer process.

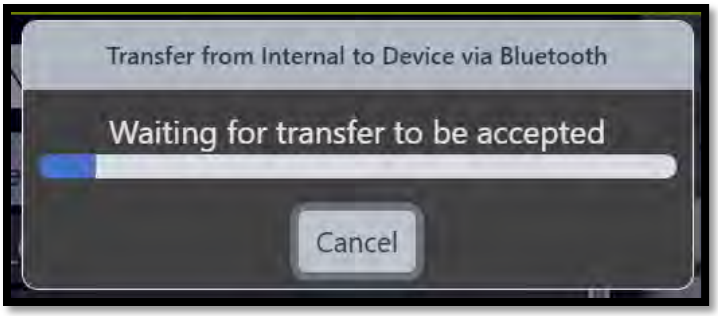


Figure 142. Waiting for Transfer to be Accepted

Once the device accepts the transfer, the file is copied to the Bluetooth device but not removed from the DX1. If a failure to transfer happens, the DX1 gives a "File transfer failed" error message. Tap **Cancel** to close this screen and return to the File Manager.

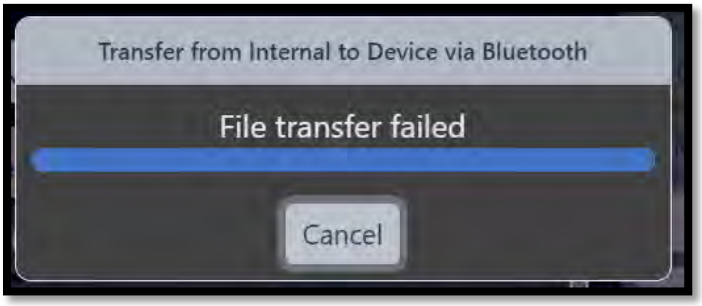


Figure 143. File Transfer Failed

7.3 SENDING A FILE WITH REACHBACK

The DX1 has the ability to send a file using Reachback email. Prior to entering File Manager, complete the steps found in Section 5.6 to set up Reachback. Once Reachback is configured, the Reachback Send button (Figure 144) is active. Tap the Reachback Send button to automatically send all selected files to Reachback. A green confirmation message is shown on the screen if the file is successfully added to the Reachback queue. Once the DX1 is connected to a network with access to the configured e-mail server (either via Ethernet cable or WLAN) the files in the queue are sent to the Reachback contact email address.

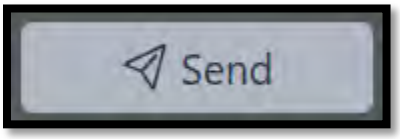


Figure 144. Send to Reachback Button



Figure 145. Files Sent to Reachback Queue

7.4 STORAGE LOCATION

The default storage location displayed in the File Manager is the Internal Storage. When a USB drive is installed into the DX1, an additional storage location is available. Use the drop-down to change from the internal storage drive to the USB drive.

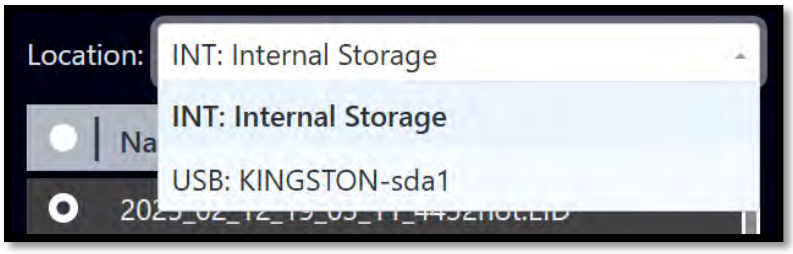


Figure 146. Location Drop-Down Selection

When the USB drive is selected, the buttons on the right side of the screen change to allow the user to copy files from the USB drive to the internal storage.

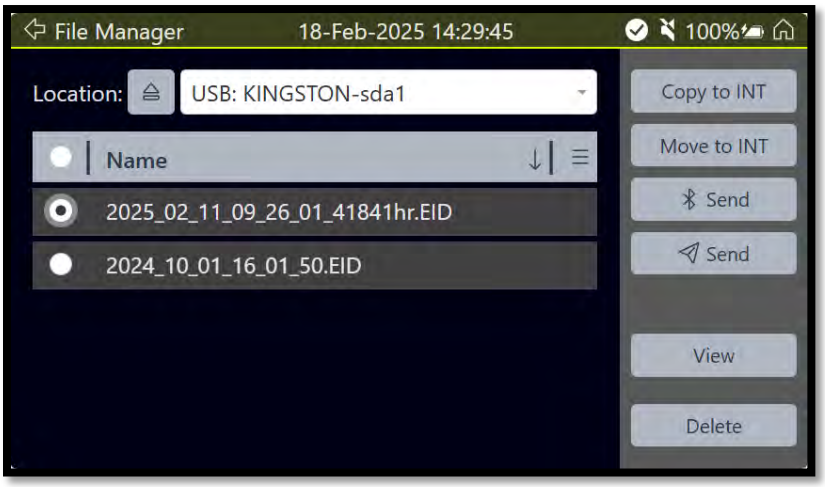


Figure 147. File Manager USB Selected

The copy and move functions work the same as described in Section 7.1. The Bluetooth Send button operation is defined in Section 7.2 and the send to Reachback button operation is defined in Section 7.3.

7.5 DELETING A FILE

Selecting a file (or files) and tapping the **Delete** button permanently deletes the selected file(s) from the DX1. A confirmation warning message is displayed to remind the user this action cannot be undone. Tap **Yes** to confirm deletion and **No** to cancel and return to the File Manager.

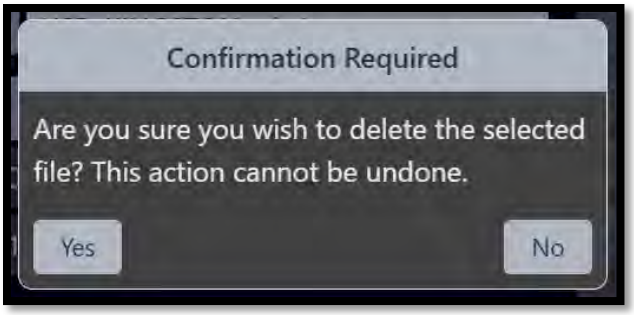


Figure 148. Confirmation for File Deletion

7.6 VIEW

Tapping **View** opens the current file in the Spectrum Viewer. The Spectrum Viewer operation is described in Section 6.

7.7 FILE SORTING AND FILTERING

Clicking on the 3 lines to the right of Name to open the Sorting and Filtering options screen.

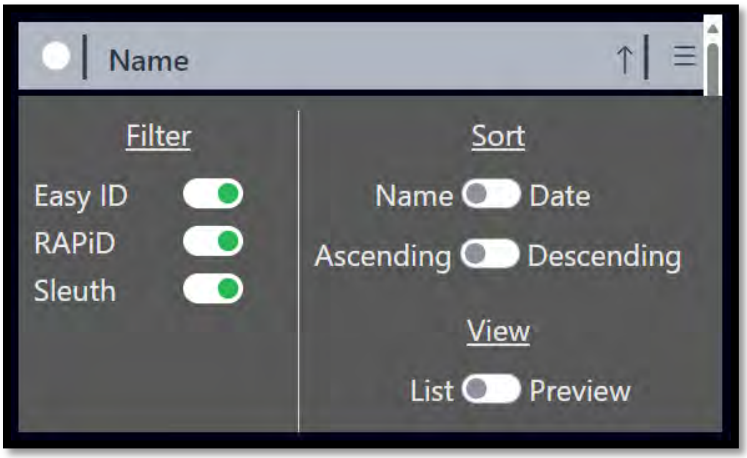


Figure 149. Sorting and Filtering Options Screen

Files can be sorted by Name or Date by selecting the toggle. Selecting Date sorts the files into the order they were collected. Selecting Name sorts the files into alphabetical order.

Files can also be sorted by ascending or descending order in 2 ways. One way is to select the toggle for either sorting direction. The second way is to click on the arrow to the right of Name. When the arrow is pointing up the sorting direction is ascending. A downward arrow signifies that the sorting direction is descending.

Changing the View from List to Preview changes the information displayed in the file table. List view only shows the file name. Preview view displays an image of the spectrum plot and the file real time, dead time, and any nuclides identified during the scan.

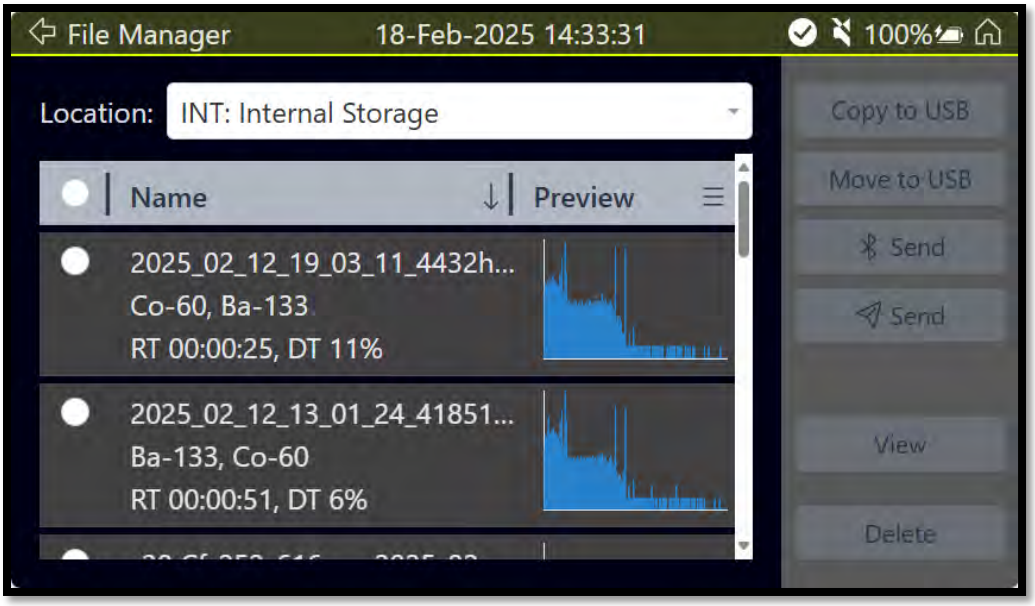


Figure 150. File Manager in Preview View

Filters can be applied to the file list to force the instrument to only display files from a specific application. Users can select to show files from Easy ID, RAPiD, or Sleuth using the toggle for the desired application. Toggles for selected file types are green with a white background.

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8. NUCLIDE LIBRARY

The Nuclide Library can be accessed from the Home screen.

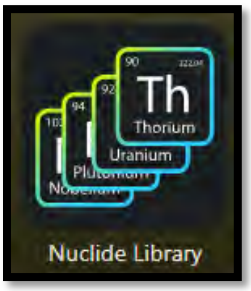


Figure 151. Nuclide Library Icon

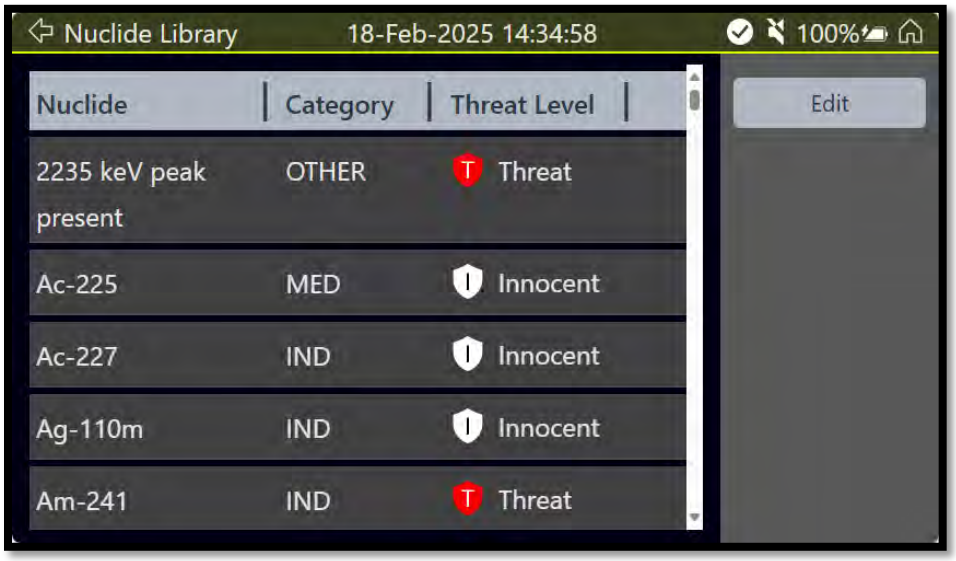


Figure 152. Nuclide Library

The nuclide library displays a list of all nuclides that can be identified by the DX1. The list includes the nuclide category and threat level assigned to the nuclide. A full list of the nuclides in the Nuclide Library can be found in Appendix C.

Users can change the innocent nuclides in the Identification Table to a threat status and back to innocent status using the nuclide library. *Default threat nuclides and suspicious nuclides cannot be changed to innocent status.* They are always categorized as threats because of their association with Special Nuclear Material or bremsstrahlung caused by a shielded, high-activity beta emitter. Note also that the list of nuclides in the Identification Table is fixed; nuclides cannot be added or removed.

NOTE	The instrument must be in Advanced Mode to edit the Nuclide Library. If not already in Advanced Mode, users will be prompted to enter the Advanced Mode passcode prior to being given access to edit the table.

- To change an innocent nuclide to threat status, press the **Edit** button on the right side of the screen. Tap the scrollbar or use the up/down arrow buttons (▲ ▼) to move through the list, tap to highlight the select nuclide (Figure 153), then tap the drop-down menu to change the selection from Innocent to Threat. An innocent nuclide that has been changed to threat status will be marked in the list with a pencil ( ), as shown in Figure 154.
- To revert a nuclide to its default innocent status, tap the **Edit** button, highlight the nuclide and change the selection in the drop down. Tap **Save** to save the changes or **Cancel** to close the edit screen without saving changes.
- To restore all nuclides to their factory default settings, tap the **Edit** button, tap **Reset** and confirm the reset action. *There is no undo for the reset operation; all of the desired changes must be made again.*

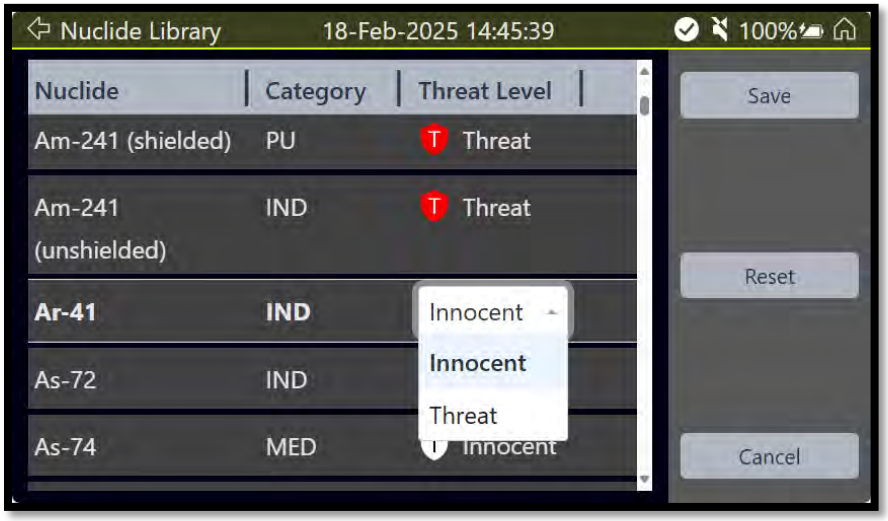


Figure 153. Changing a Threat Status

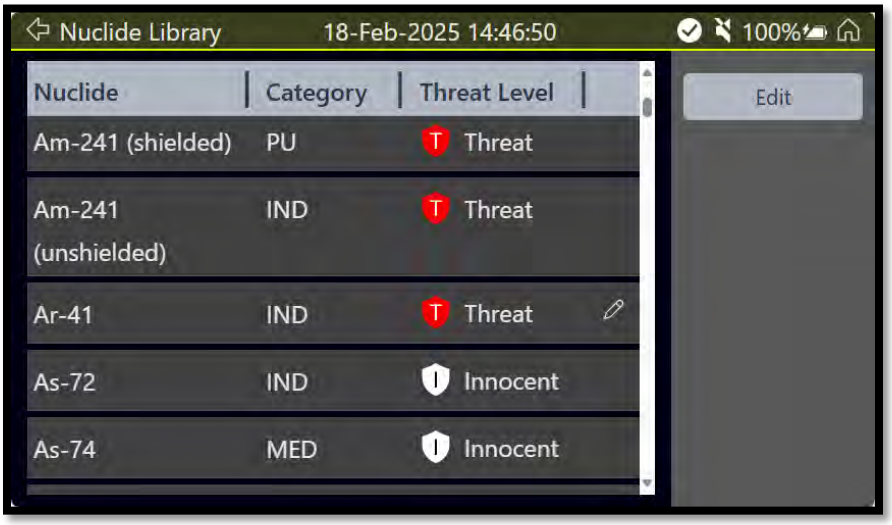


Figure 154. Default Innocent Nuclide Changed to Threat Status (and Marked with Pencil)

Press the left arrow button in upper-left corner to return to the Home screen.

9. EVENT VIEWER

The Event Viewer can be accessed from Home screen.

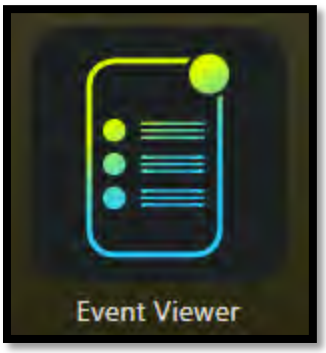


Figure 155. Event Viewer Icon

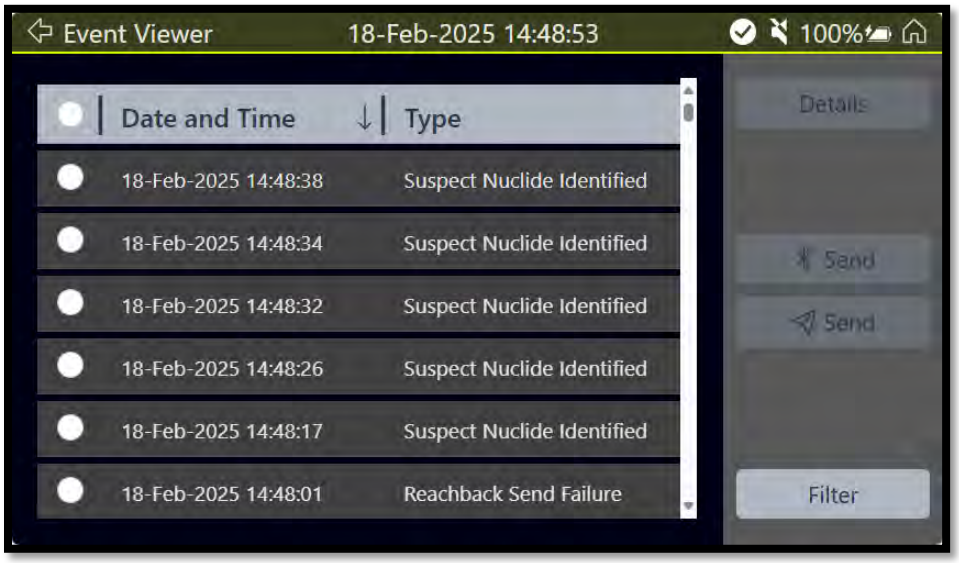


Figure 156. Event Viewer

Most events that occur on the DX1, including identified nuclides and alarm events, are recorded in the Event Viewer. The event list can be filtered by tapping the **Filter** button.

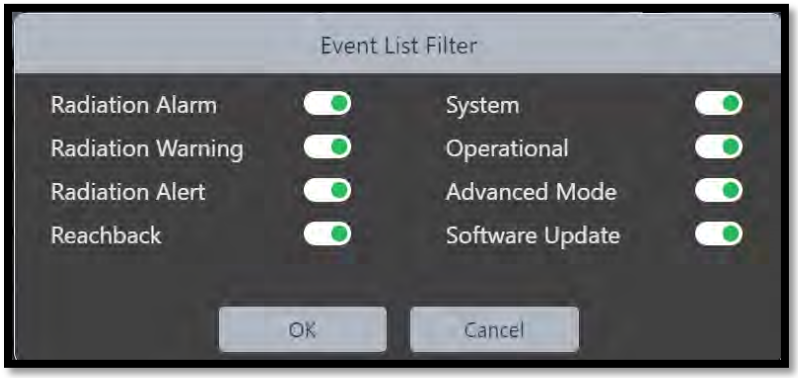


Figure 157. Event Viewer List Filter

To select/deselect an event category, tap the toggle. Selected events have a green toggle with a white background. Deselected events have a gray toggle with a white background. Tap **OK** to save or **Cancel** to close the event list filter and return to the event list.

Select any event by tapping on the circle to the left of the event name. Note that all events can be selected by tapping on the circle at the top in the gray bar. Selecting an event enables the Bluetooth and Reachback send buttons. See Sections 7.2 and 7.3 for more information on using the Bluetooth and Reachback send buttons.

Selecting an individual event enables the Details button. Tap the Details button to see more information about the logged event.



Figure 158. Event Details

Tapping **Previous** and **Next** navigates to different events. Tap **Close** to close the event details pop-up and return to the Event Viewer.

The Event Viewer will store up to 5000 events. Once the 5001 event is recorded, the first 500 events in the log will be deleted to make room.

Tap the left arrow button in the upper left corner to return to the Home screen.

NOTE:	In the case of a nuclide ID with a confidence of less than 10, no entry will be made in the Event Viewer. However, these IDs will still be presented in the RIID applications.

10. EASY ID

Easy ID is an application that allows users to quickly line up a measurement, optimize it for distance, and perform a count. Easy ID can be accessed from the Home screen.

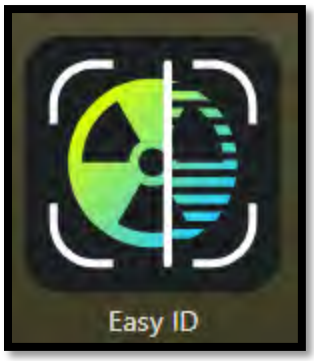


Figure 159. Easy ID Icon

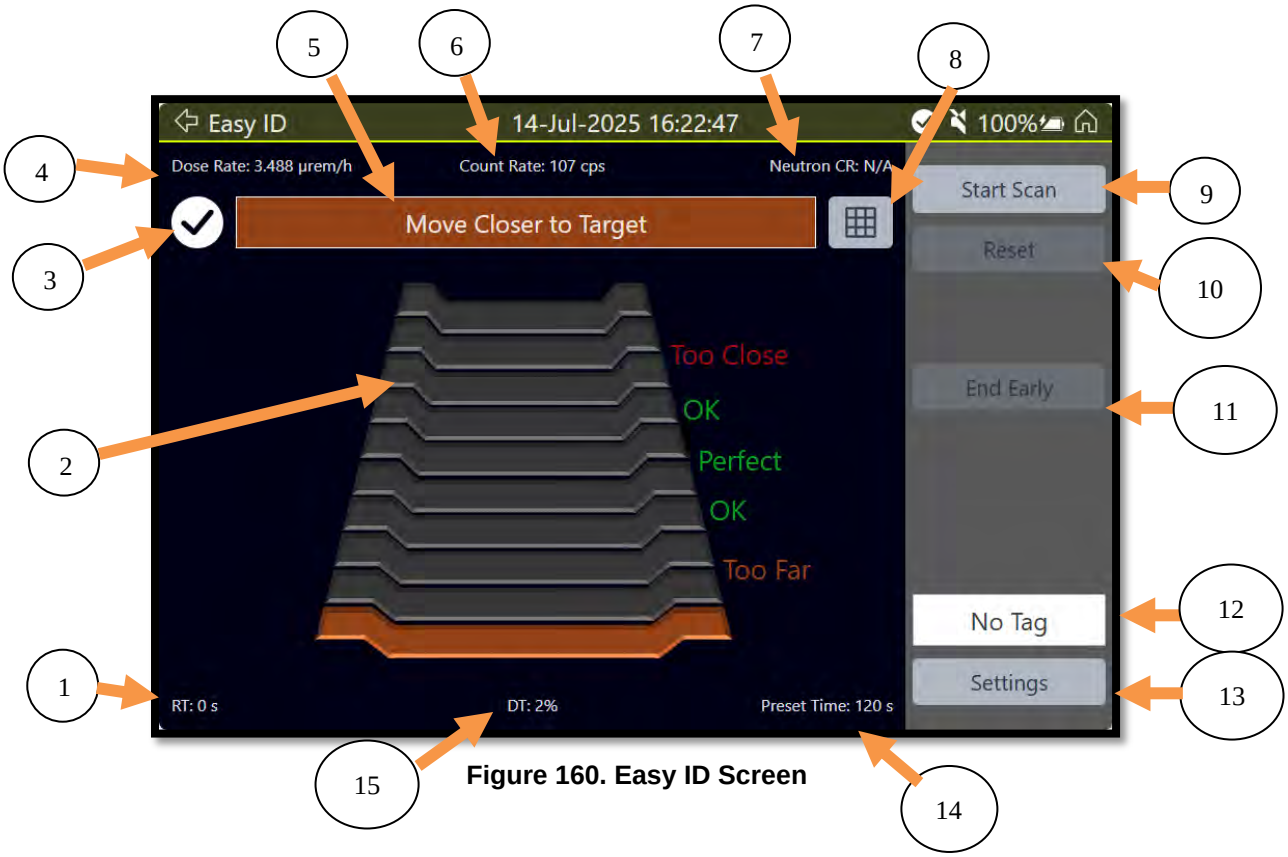


Figure 160. Easy ID Screen

The parts of the Easy ID screen are described below:

1. Real time reading – shows the current length of time the count has been running, counting up to the preset time
2. Source position locater – allows the user to optimize the position of the instrument relative to the object of interest based on the strength of the count rate and dead time percentage
3. Instrument status – indicator of current operational status of the DX1
4. Dose rate reading – current dose rate being monitored by the instrument

5. Distance Indicator – provides instructions on moving closer to/farther away from target
6. Count rate reading – current count rate being monitored by the instrument
7. Neutron count rate reading – current neutron count rate being monitored by the instrument (only shown if neutron detector is installed onto DX1, shows N/A if not installed)
8. ID Grid/Distance Indicator toggle – changes between the distance indicator screen and the grid displaying identified nuclides
9. Start Scan – initializes ID scan
10. Reset – resets timer, clears buffer, and restarts ID scan
11. End Early – ends the ID scan before the preset time is reached
12. Measurement Tag – appends an optional tag to the file name
13. Settings – allows adjustment of preset time and integration time
14. Preset Time – settable scan count time
15. Dead Time – current instrument dead time reading

Tapping the ID Grid/Distance Indicator icon changes the view to show the identified nuclides.

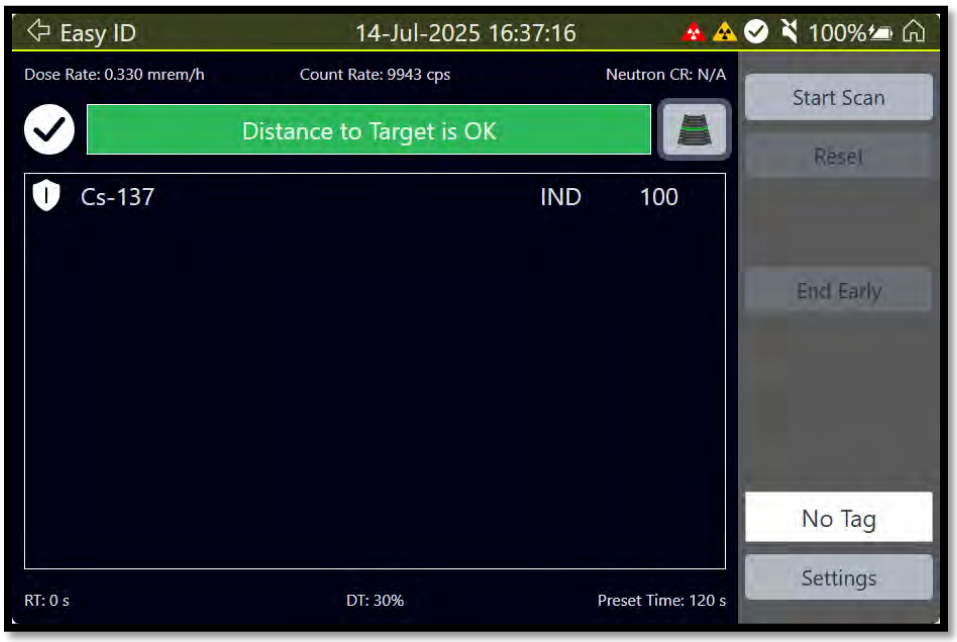


Figure 161. Easy ID Identified Nuclides View

10.1 SETTINGS

The preset time is by default set to 120 seconds. This time can, however, be adjusted using the Settings button in the lower right-hand corner. This is a protected feature that requires the user to enter the Advanced Mode passcode to change the preset time.

Tap **Settings** and enter the Advanced Mode passcode. The default passcode is 654321. Instructions for changing the default passcode can be found in Section 5.2.

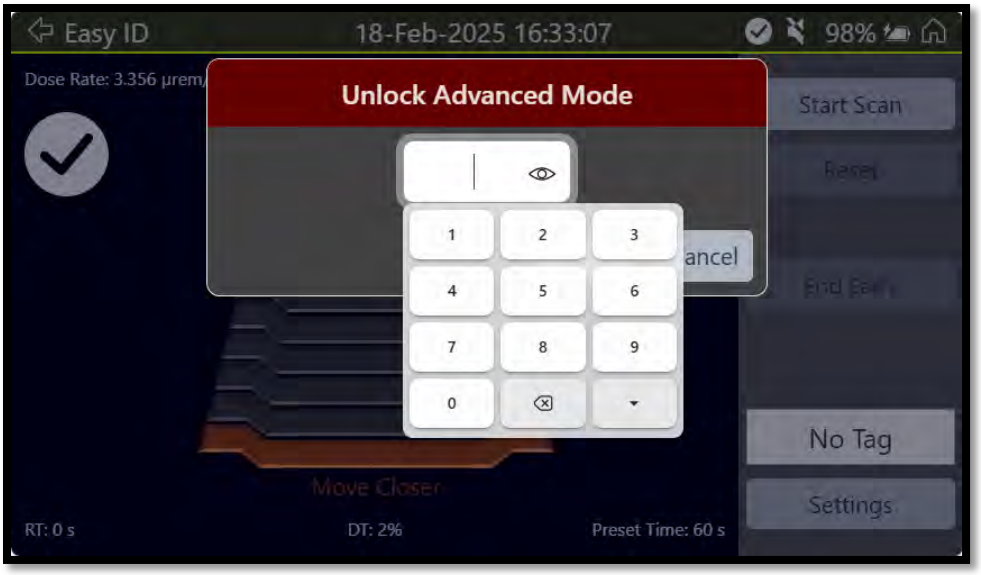


Figure 162. Unlock Settings Feature

Once the passcode is entered, change the settings time to the new desired count time. Note that time is always in seconds and has a limited range from 0 to 86400 seconds.

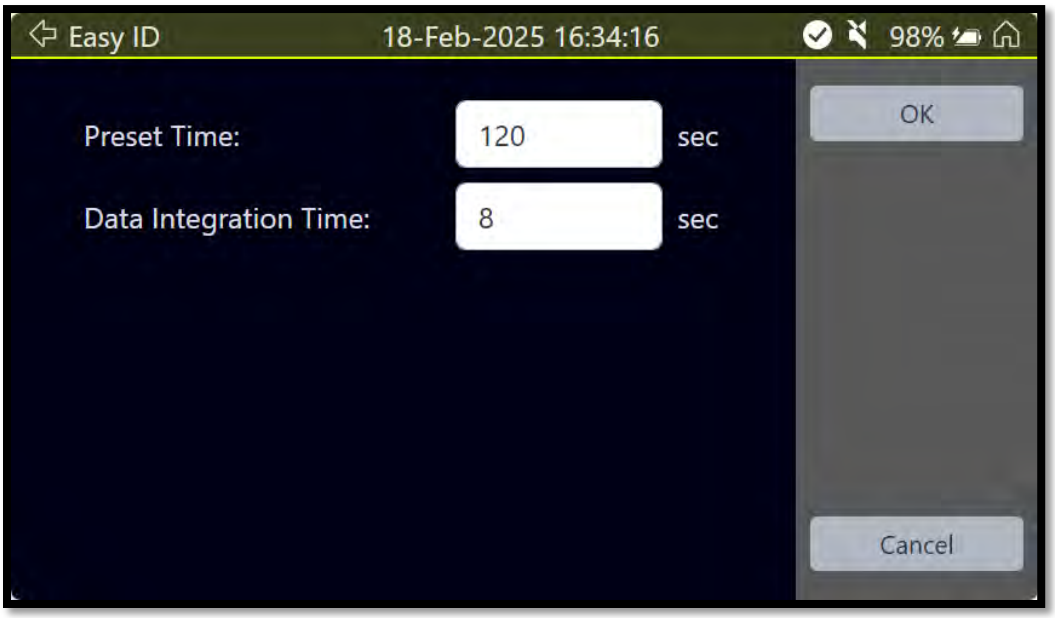


Figure 163. Preset Time Settings Screen

Tap **OK** to save the changes or **Cancel** to return to Easy ID without making changes.

10.2 MEASUREMENT TAG

Data files saved with Easy ID can be given a descriptive measurement tag to help identify the data collection situation. Tapping the button with the white background just above settings (by default it reads No Tag but that will change based on the information entered) opens the measurement tag screen. This button is available both on the Easy ID main screen and on the ID table screen.



Figure 164. Measurement Tag Screen

The following are options for adding tags:

- No Tag – this does not include a tag on the file name
- Background – this includes Background at the end of the file name
- Known – this includes Known at the end of the file name
- Unknown – this includes Unknown at the end of the file name
- User entry field – this allows the user to type in a desired tag name up to 10 characters

10.3 INSTRUMENT STATUS

A box on the left side of the screen displays the current status of the instrument.



Figure 165. Instrument Status

Status options that could be presented are:

	DX1 is operationally functional and ready for measurement
	DX1 is ready but there is an operational warning
	DX1 is not ready due to an operational issue
	DX1 is not ready due to an operational error

Clicking on the status box if it has a warning or error indicated displays the status details. Any operational problems that the DX1 is experiencing are displayed in the status details pop-up. Tap **Close** to close the pop-up and return to the Easy ID screen.

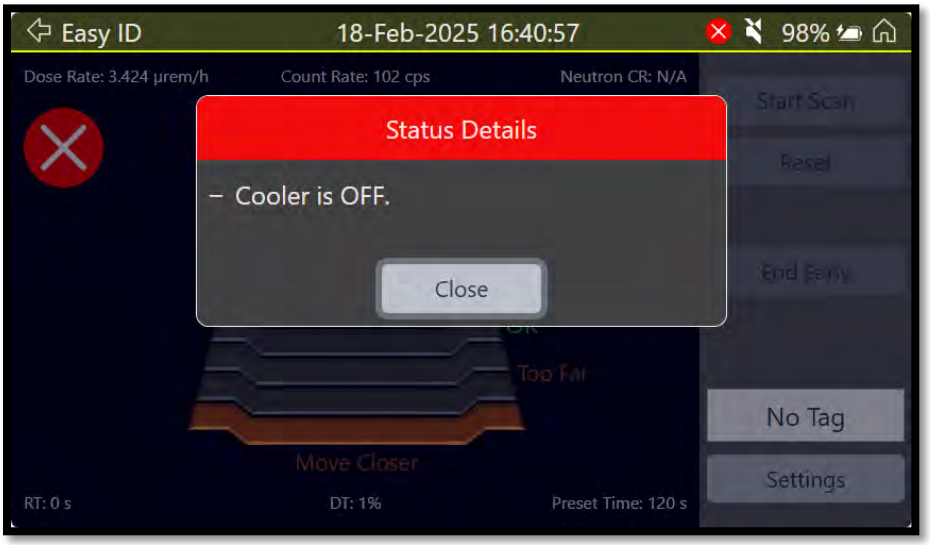


Figure 166. Status Details Pop-up

10.4 PERFORMING A SCAN

Before starting a scan, adjust the distance between the DX1 and the object of interest until the source position locater is within the OK to Perfect positions. Note the locater is orange in color when it is too far from the object. It is red when it is too close to the object. It is green when it is in the OK distance zone.

When the distance is positioned correctly, tap the **Start Scan** button. The DX1 will start collecting data and building a spectrum. The Reset and End Early buttons will become active when the DX1 is scanning. The Start Scan button changes to Pause Scan. If something goes wrong during this scan (e.g. someone walks by with an additional source), tap the **Reset** button to reset the timer and clear the spectrum buffer. If the count needs to be temporarily stopped, tap the **Pause** button. The button will change to Resume Scan, and the timer and data collection will stop. Tap **Resume Scan** to continue with the data collection. If enough data is collected to identify the source and it is desired to

stop the count early, tap the **End Early** button to stop counting and proceed to the ID Results. If the sound and vibration are activated on the instrument, a buzzer will sound, and the instrument will vibrate when the preset time is reached.

When the instrument reaches the preset count time or End Early is tapped, the ID results table is displayed.

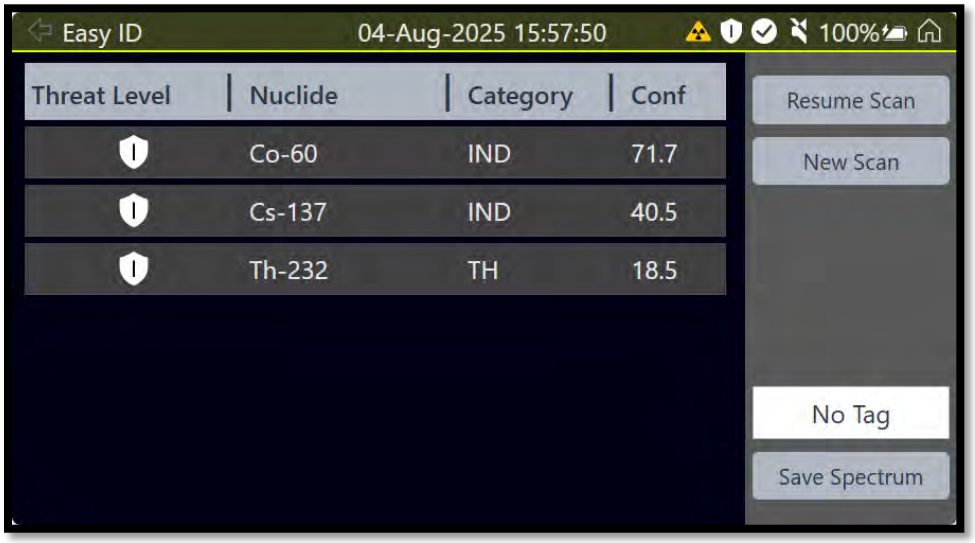


Figure 167. Nuclide ID Table

The ID table will show all of the nuclides found during the counting period, a confidence indicator, the nuclide category (e.g. Norm, Medical, etc.), and a threat level (e.g. Innocent, Suspect, or Threat). If no nuclides were identified, a "No Nuclides Found" message will be displayed instead.

After the Save Spectrum button is pressed, the file name is displayed at the bottom of the screen. The name ends with the defined tag. The file name is given the extension .EID, which stands for Easy ID. The file is always saved in N42 format.

The file is not officially saved as a record until the **Save Spectrum** button is tapped. If the user taps the New Scan button without tapping Save Spectrum, a warning message is displayed asking if it is desired to exit without saving the current data. Tap **Yes** to confirm starting a new scan or **No** to return to the ID table and save the data.

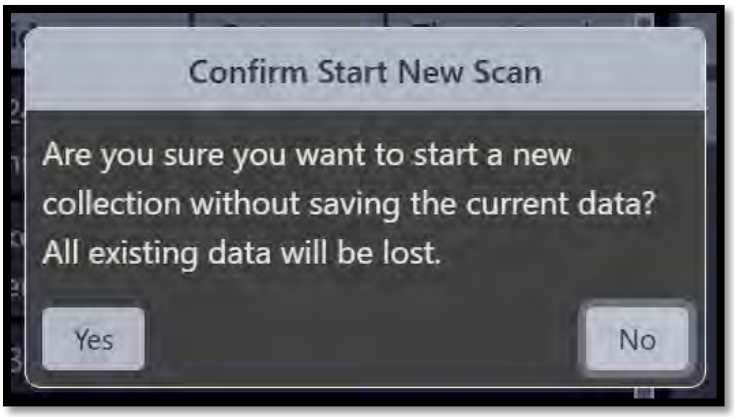


Figure 168. Data Not Saved Warning Message

If the user determines that there is not enough data, tapping **Resume Scan** returns to the Easy ID main screen and continues scanning. The time continues in one of two ways, either additional time is added to the preset timer (the additional time is the same as the original timer, for example if it was set to 10s it will now be 20s) or the timer resumes where it was stopped if End Early was pressed.

When the user is ready to start a new scan, tap **New Scan** to return to the Easy ID main screen, clear the buffer, and reset the timer.

If no radionuclides are found during the scan, no table is shown. Instead, a No Nuclide(s) Found message is displayed in the middle of the screen. The buttons on the right-hand side of the screen still behave the same way as if nuclides were located.

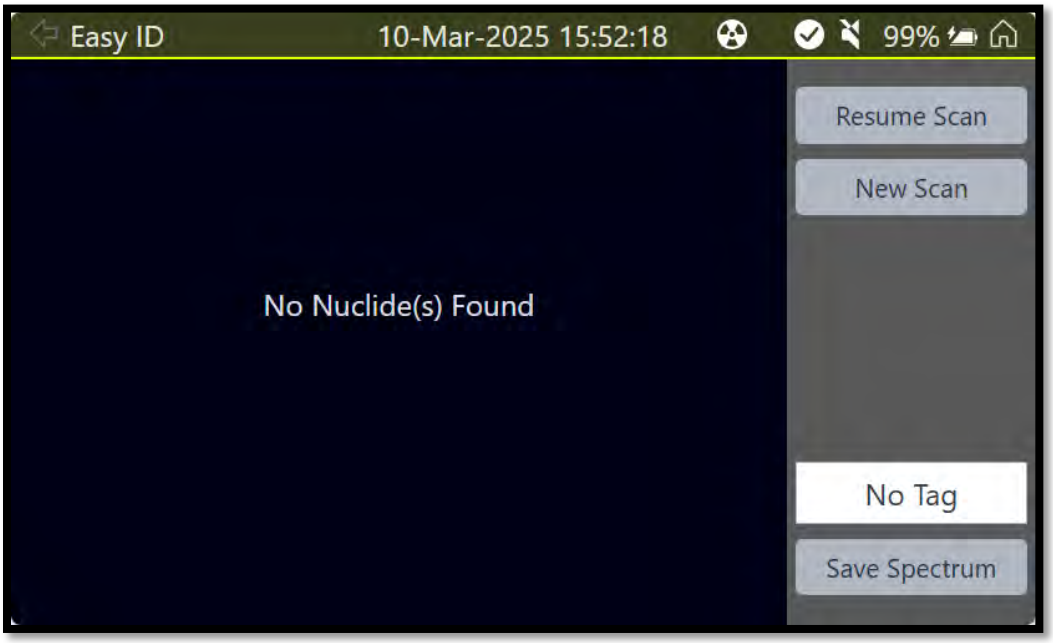


Figure 169. No Nuclides Found

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11. RAPID APPLICATION

The RAPiD (Radiological Assistance Program iDentification) application is designed to meet specific customer needs to streamline data collection while minimizing pesky alarm notifications. The RAPiD application offers an enhanced home screen layout inspired by the Detective EX-100 interface, with quick access to monitor mode and improved pause and file saving functionality.

RAPiD adds some special features created specifically for its target audience. RAPiD offers a streamlined Survey Mode view that provides a more accessible view of the count rate, status, deadtime, and GPS location. RAPiD provides the ability to not save an identification measurement at the conclusion of the measurement. RAPiD also allows the user to continue collecting data after the identification's preset time was reached.

11.1 RAPID HOME SCREEN

RAPiD can be accessed from the Home screen.



Figure 170. RAPiD Icon

Tapping the RAPiD icon opens the RAPiD main screen. The RAPiD main screen is the basic survey mode.

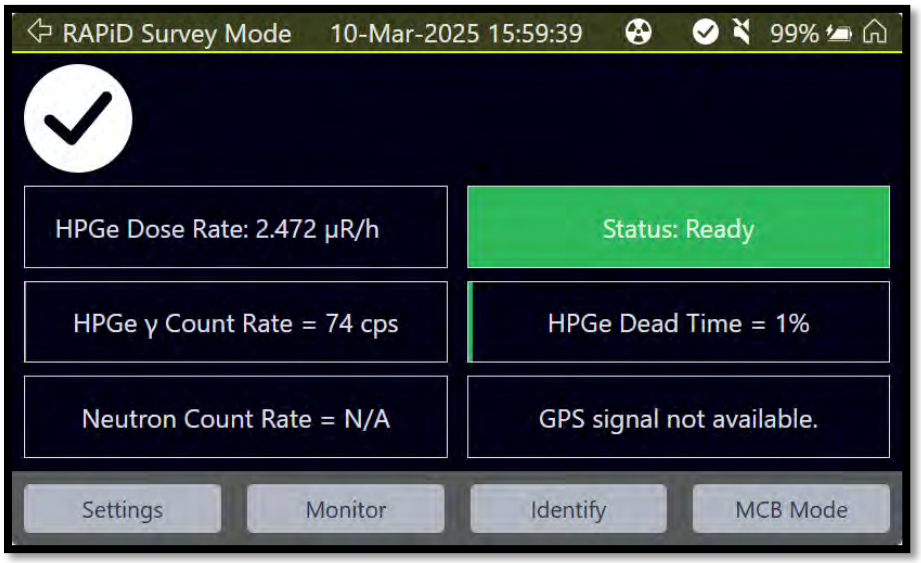


Figure 171. RAPiD Home Screen

The RAPiD main screen provides a quick view of the count rate, status, deadtime, and GPS location. The current dose rate measurement provides additional information for which of the three detectors is providing the reading, high-purity germanium (HPGe), low-range Geiger-Mueller detector (GM1), or high-range Geiger-Mueller detector (GM2).

The operational status of the instrument is quickly visible on the left side of the screen. Status options that could be presented are:

	DX1 is operationally functional and ready for measurement
	DX1 is ready but there is an operational warning
	DX1 is not ready due to an operational issue
	DX1 is not ready due to an operational error

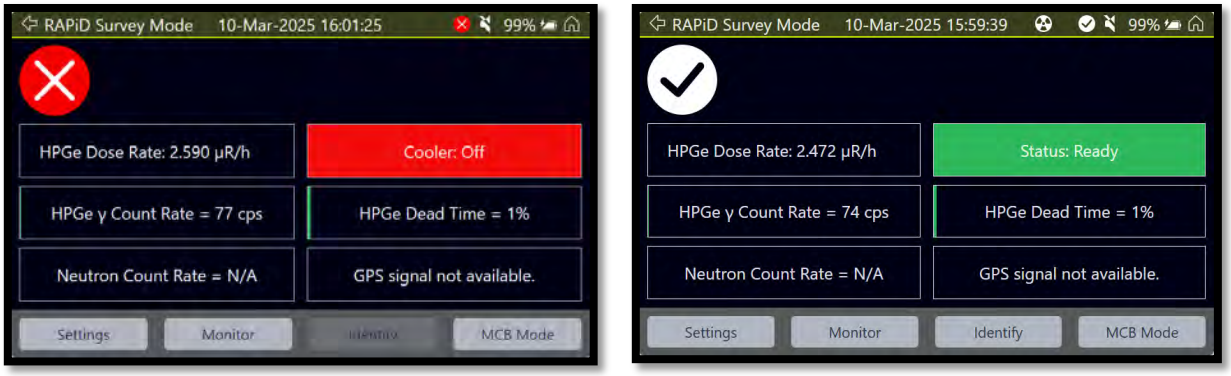


Figure 172. System Status Display

A status summary of the instrument is displayed in a box on the right side of the screen. In addition to status ready messages, the status box will display the detector cooling phase (Cooling Phase 1, 2, 3, or 4) and system warning or error messages.

Tapping on the status icon or status summary box when a warning or error is present expands the status message to provide more detail about all active warning and error statuses. Tap the **Close** button to close the Status Details pop-up box.

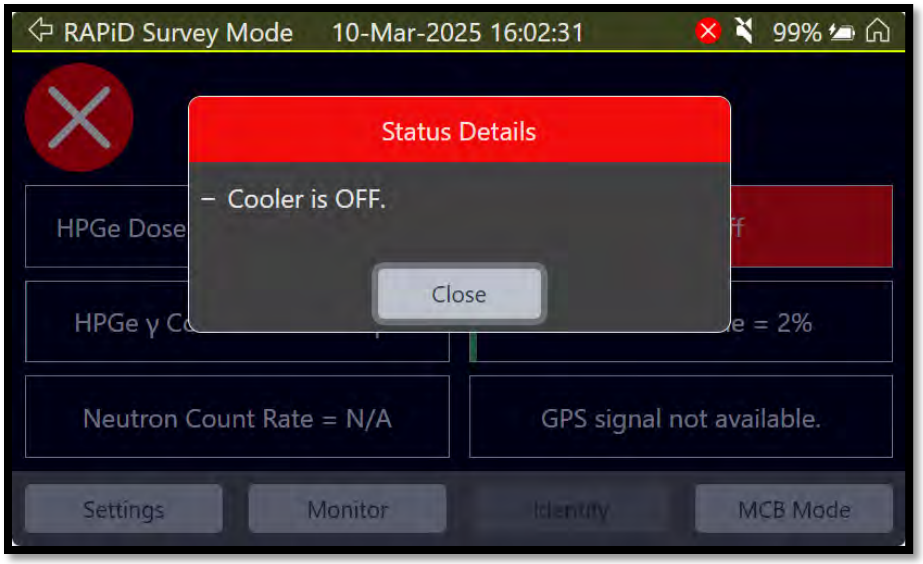


Figure 173. Expanded Status Message

Monitor Mode, Identify Mode, and MCB Mode can all be accessed from the RAPiD main screen by tapping the respective buttons.

11.2 MONITOR MODE

Tapping the **Monitor** button on the main screen starts the RAPiD Monitor Mode operation. Monitor Mode is a general survey tool for locating radioactive material. The Signal Index quickly shows changes in radiation levels allowing the user to follow the signal strength to locate and then accurately identify (ID) a source.

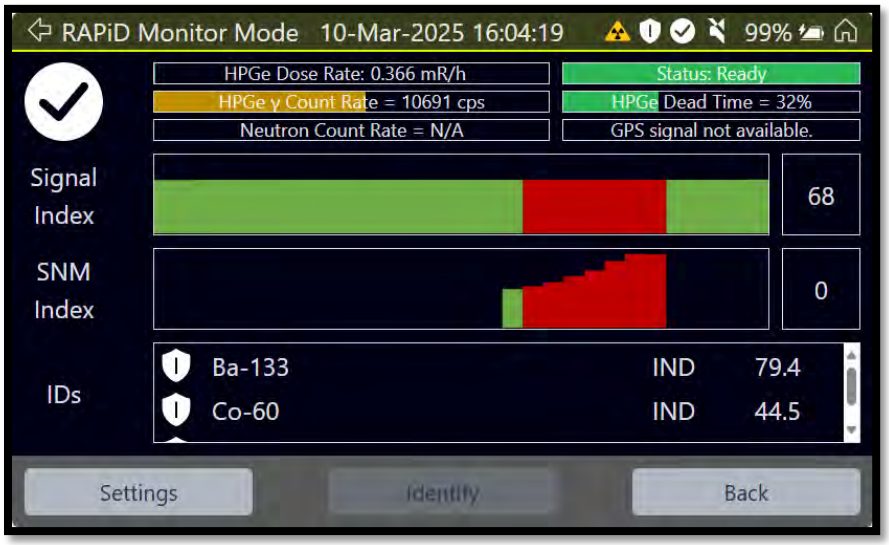


Figure 174. Monitor Mode

The Monitor Mode header provides easily viewable status information. In addition, the dose rate, gamma count rate, and neutron count rate (when attached), deadtime, and GPS reading (when fixed) are also always displayed.

The Monitor Mode screen displays Signal Index and SNM Index strip charts in the middle of the screen. They are real-time indicators of the presence of radioactive material, updating every 0.5 second and scrolling from right to left.

- The Signal Index (Section 11.2.1) indicates the presence, above background, of all gamma-ray emissions.
- The SNM Index (Section 11.2.2) indicates whether detected gamma-ray emissions are characteristic of Special Nuclear Material. If the neutron detector is attached, the neutron flux is included in the SNM Index calculation.
- When radioactive nuclides are identified during the search process, the IDs appear in the section below the strip charts. Note the Ba-133 and Co-60 identifications in Figure 174. These IDs are present as long as the material remains in the detector field of view, then are removed from the screen.

IMPORTANT ***These strip charts are indirect indicators to be used as quick visual tools, not as count-rate or dose-rate meters for the protection of human health!***

11.2.1 The Signal Index

The Signal Index reflects the level of the gamma ray flux, as the detector receives more or fewer gamma ray interactions the signal index increases and decreases.



Figure 175. Signal Index Strip Chart History and Current Level

The Signal Index (Figure 175) is based on the total background-subtracted gamma-ray count rate for all threat and innocent nuclides, as well as gamma rays emitted by radionuclides that may not be included in the software's identification table. The vertical scale is logarithmic, and the peak height increases as the distance between the DX1 and a gamma-ray source decreases (whether the operator is moving closer to the source or vice versa). The index value on the right is dimensionless and is provided for comparison purposes only. The horizontal scale is linear in time for a total time of 15 seconds.

When a nuclide ID alert is generated, the background color for that section of the chart will change from black to red for a threat ID, green for an innocent ID, or yellow for a suspect ID. This background color will persist for as long as the radionuclide is present in the detector's field of view.

11.2.2 The SNM Index

The SNM Index is a function of the maximum confidence factor (Q value) for all SNM indicators in the Identification Table. These include U, Pu, Np, Am, and neutrons. The SNM Index (Figure 176) works the same way the Signal Index does but is filtered to reflect only those gamma (and neutron) IDs characteristic of the Special Nuclear Material radionuclides in the ID tables.

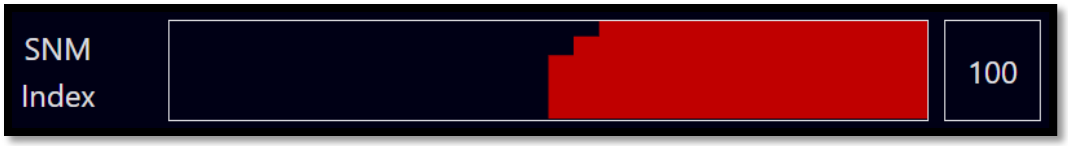


Figure 176. SNM Index Strip Chart History and Current Level

11.2.3 Identification (IDs) Box

The IDs Box (Figure 177) lists all nuclides currently in the detector's field of view.



Figure 177. IDs Box

Each row in the IDs Box contains the following:

Classification, ID String, Sub-Classification, Q Value[2]

Classification values are defined as:

- Innocent (reported as **I**), with a white background
- Suspect (reported as **S**), with a yellow background
- Threat (reported as **T**), with a red background

ID String:

- Nuclide name from the Identification Table (see Appendix C)

Sub-Classification values are defined as:

- Bremsstrahlung (reported as **Brem.**)
- Industrial (reported as **Ind.**)
- Medical (reported as **Med.**)
- Neptunium (reported as **Np.**)
- NORM (reported as **NORM**)
- Other (reported as **Oth.**)
- Plutonium (reported as **Pu**)
- Thorium (reported as **Th**)

[2] Ronald M. Keyser, Frank Sergent, Timothy R. Twomey, Daniel L. Upp, *Minimum Detectable Activity Estimates for a Germanium-Detector Based Spectroscopic Portal Monitor*, INMM, July 2006.

- Uranium (reported as **U**)

The Q value (confidence factor) will be displayed to 1 decimal place on the right side of the ID listing. For nuclides with only one primary peak, this confidence level is the net counts in the peak divided by the peak uncertainty. As the net counts in the peak increase, the uncertainty decreases, and the confidence level correspondingly increases.

In cases where there are multiple IDs and simultaneous alerts, the index charts will display the color of the highest priority alerts, and the highest-priority (highest threat-level) alerts will be displayed first in the list, as illustrated in Figure 177.

Note that an ID will be removed from the IDs Box when the corresponding source leaves the detector field of view.

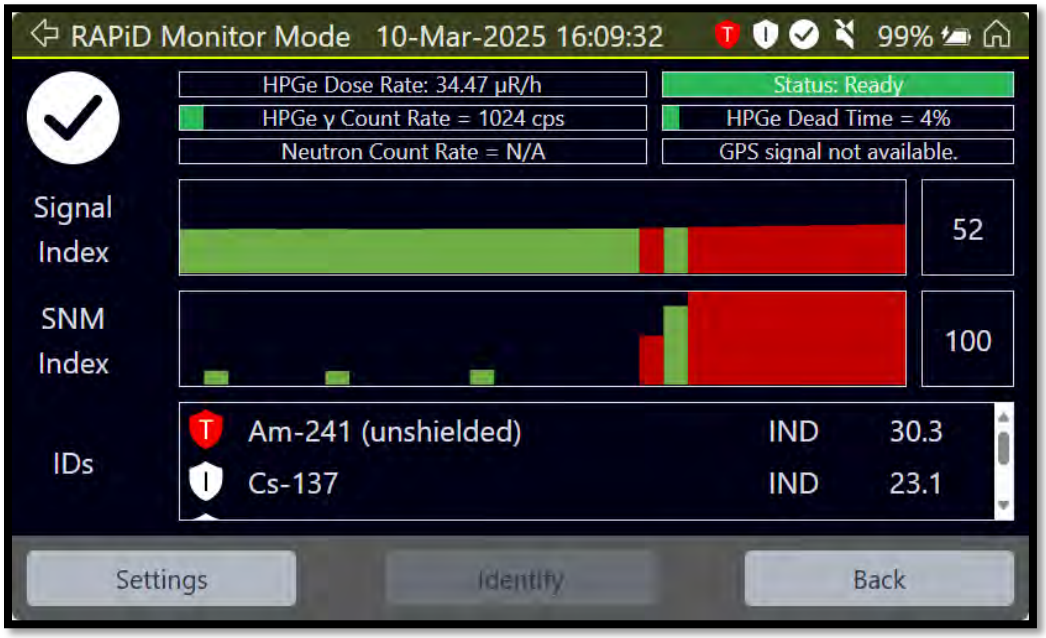


Figure 178. Threat Source Shown in ID List

If more than 2 nuclides are identified, a scroll bar will be displayed on the right edge of the box so the user can scroll down and view all entries (as seen in Figure 178).

From this screen, click **Back** to return to the RAPiD main screen, click **Settings** to open the Settings screen, or click **Identify** to launch the Identify Mode.

11.3 IDENTIFY MODE

The ID Mode can be accessed by pressing **Identify** either on the RAPiD main screen (see Figure 171) or on the Monitor Mode screen (see Figure 174). When a nuclide ID is displayed or when the Signal Index rises, tap the **Identify** button to begin collecting one or more spectra from the item of interest. These spectra are analyzed locally and may be sent to Reachback for a more in-depth study (see Section 5.6).

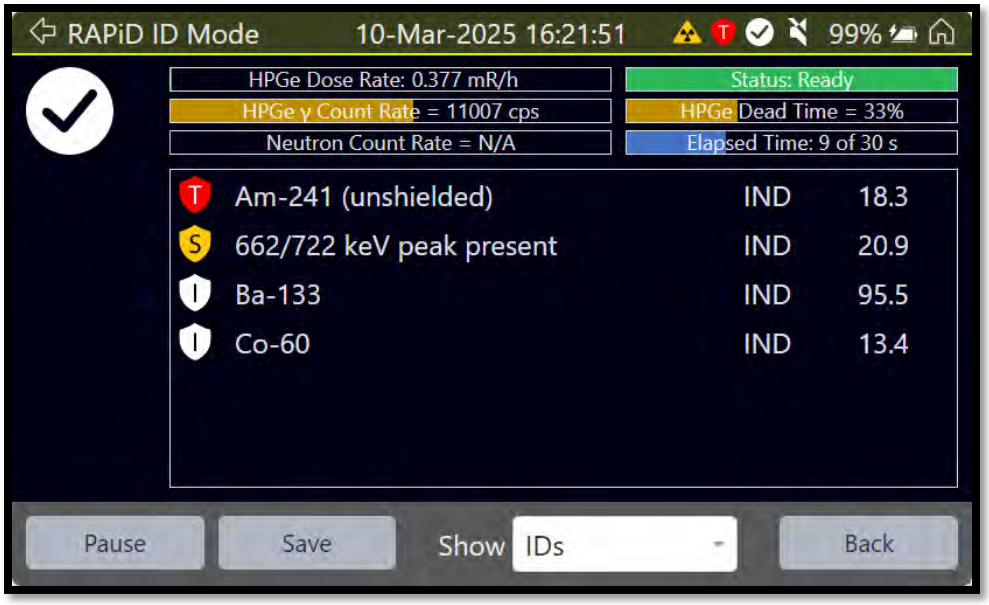


Figure 179. RAPiD ID Mode

The ID Mode screen has an IDs box similar to that on the Monitor Mode screen. However, because all of the data accumulated from the start of this ID Mode session is analyzed (rather than only the last few seconds of data, as in Survey Mode), nuclide IDs rarely drop out of the IDs Box in this mode.

Note that the ID Mode screen uses the same common header as the Monitor Mode screen. The only difference is that instead of displaying the GPS location, the elapsed count time is displayed. The elapsed time will display the current time of the preset time (see Figure 179). The background of the elapsed time has a colored blue bar that increases as the time approaches the total elapsed time. When the count is finished, the background changes to solid green. If the sound and vibration are activated on the instrument, a buzzer will sound, and the instrument will vibrate when the preset time is reached.

If the count is paused a pop-up screen is displayed providing options to continue the count, save the current results, or exit Identify Mode. Tap **Continue** to return to the count and continue counting, tap **Save** to save the results and navigate to the save file screen or tap **Exit** to exit back to the RAPiD Survey Mode main or Monitor Mode screens.

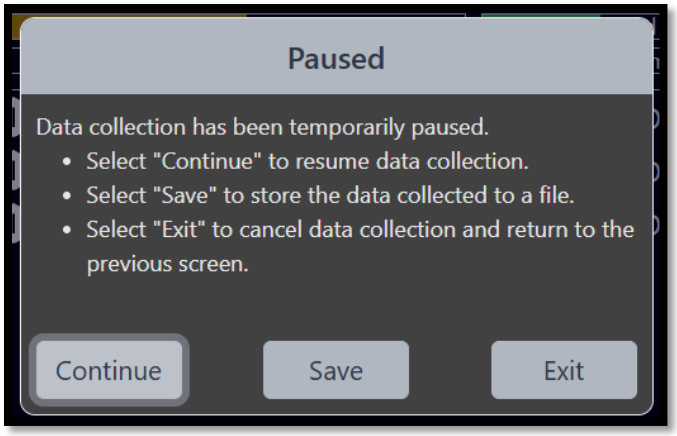


Figure 180. ID Mode Paused

RAPiD's ID Mode allows the user the opportunity to Exit the ID without saving the results. Selecting **Back** returns to the previous screen (RAPiD Monitor Mode or RAPiD main screen).

If the user desires to save the results, tap **Save** to open the Save File screen.

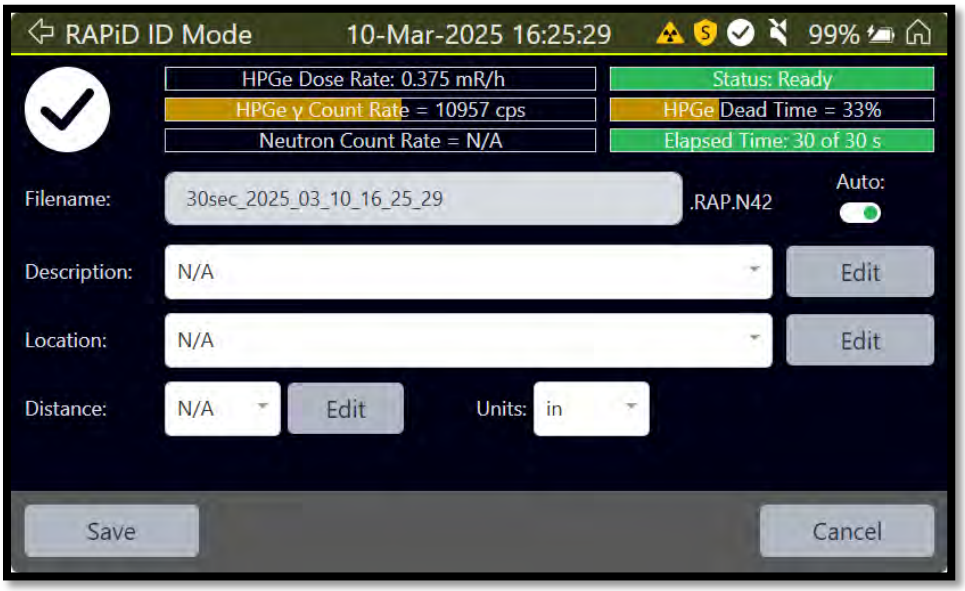


Figure 181. Save File Information

The file saving process provides the user with the ability to enter metadata specific to that data collection event. The user can enter a file name, description, location, or distance all by clicking the **Edit** button for each. The edit button opens a pop-up to edit the list that populates the drop-down box.

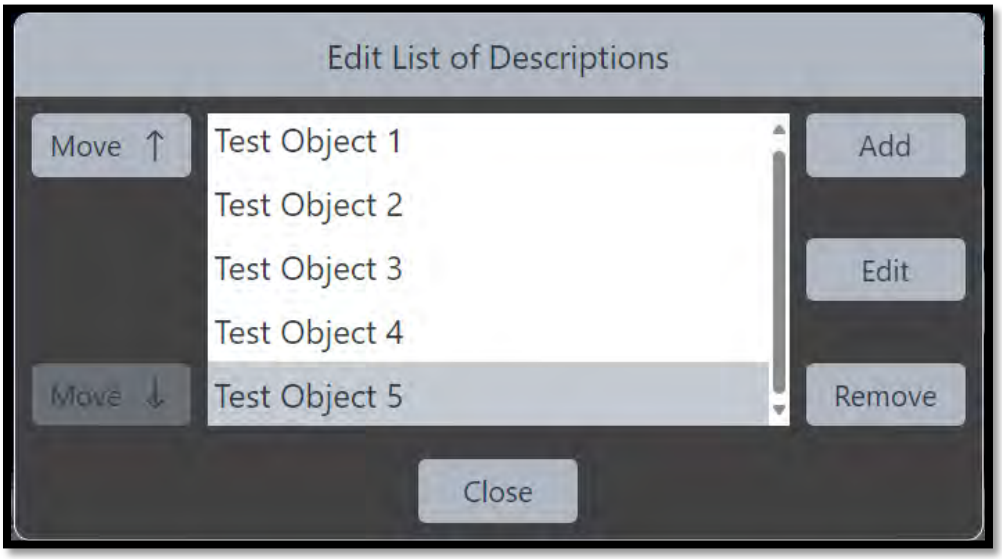


Figure 182. Pop-up for Adding Metadata

Tap **Add** to add a new item. Select an already added item and tap **Edit** to change it, **Remove** to delete it, or move it up and down the list by tapping the buttons on the left.

Distance units can be selected between inches, feet, yards, centimeters, and meters. Note that to manually enter a file name, the **Auto** feature must be turned off (toggle shows gray with white background). If the **Auto** feature is activated, the file name is automatically populated with the metadata information entered. The file name format is as follows:

Description_Location _ Count Time _Distance and Units_ YYYY_MM_DD_HH_mm_ss.RAP.N42

Where

- Description, Location, Distance, and Units are user entered fields
- Count time is the total elapsed time at the time the preset time is reached or the time the final save button is pressed if no preset is set
- YYYY is a 4-digit year value
- MM is a 2-digit month value
- DD is a 2-digit day value
- HH is a 2-digit hour value in 24-hour format
- mm is a 2-digit minute value
- ss is a 2-digit second value

NOTE	All distance units are converted to meters for storage in the N42.42 file.

After the file is saved, a pop-up is displayed asking if it is desired to continue on with this data collection, start a new collection, or exit back to the RAPiD Survey Mode or Monitor Mode screens.

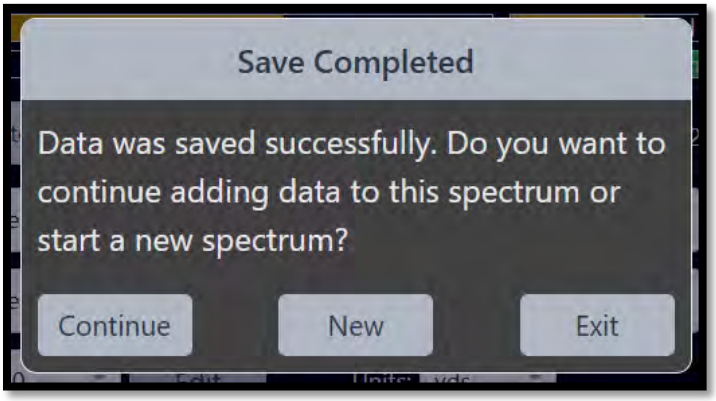


Figure 183. Successful Save Pop-up

In ID Mode, the user has the ability to select Spectrum or Intense to change the information that is being displayed. Selecting **Spectrum** from the Show drop-down menu displays the screen seen in Figure 184. Spectrum operates as described in Section 11.3.1.

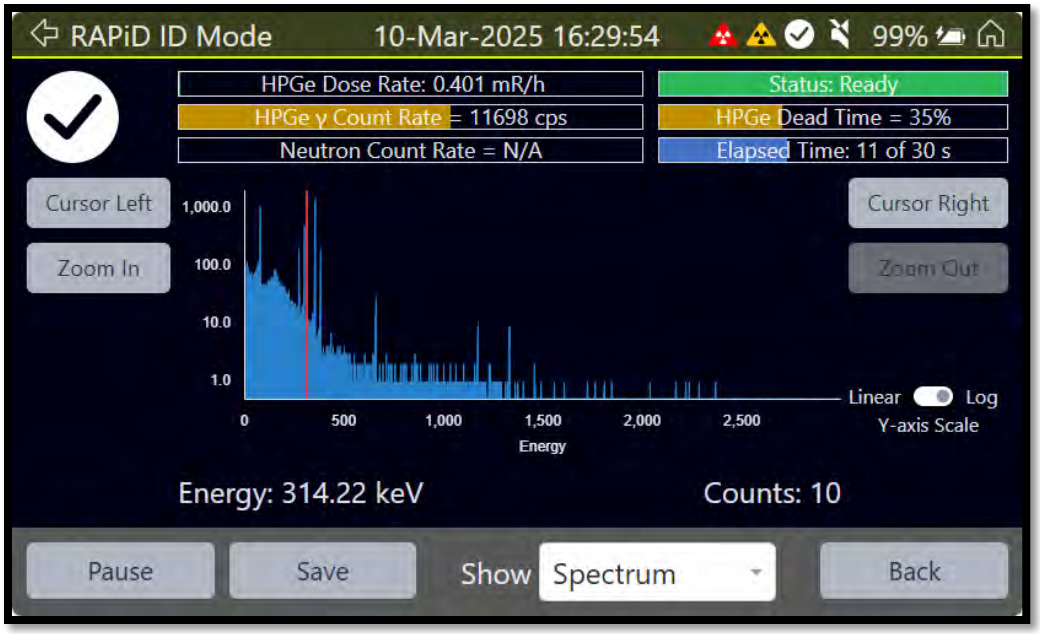


Figure 184. RAPiD ID Mode Spectrum

Selecting **Intense** from the Show drop-down menu displays the screen seen in Figure 185. Intense operates as described in Section 11.3.2.

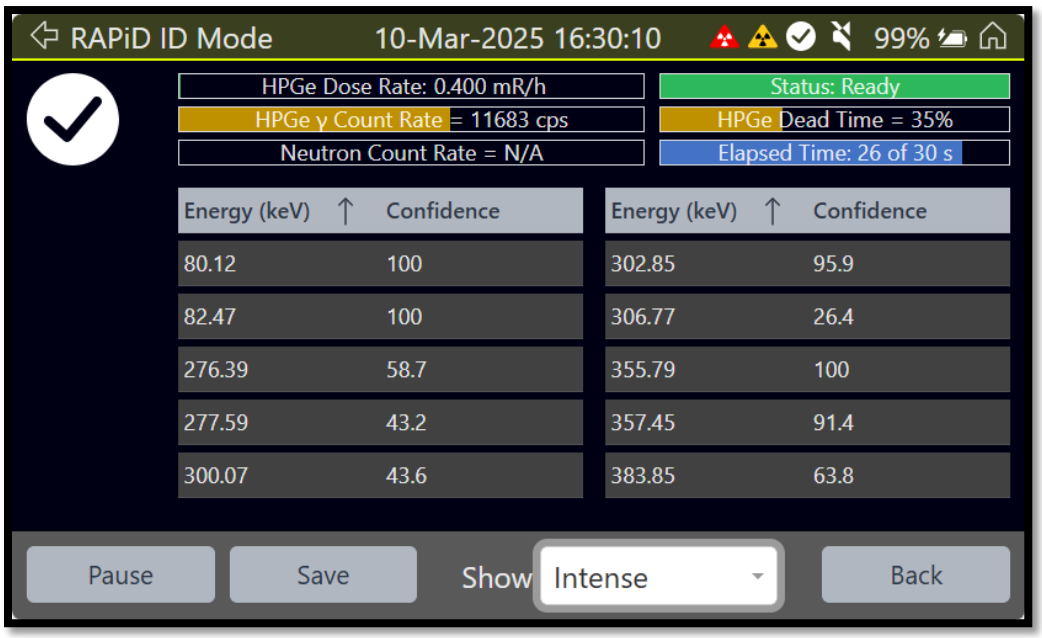


Figure 185. RAPiD ID Mode Intense

11.3.1 Spectrum View

The *Spectrum* view (Figure 186) shows the histogram of the gamma-ray energy spectrum being acquired in real time. To display the spectrum, select **Spectrum** from the drop-down menu. This feature gives experienced users more information about the nuclides present so more informed decisions can be made about the material under investigation.

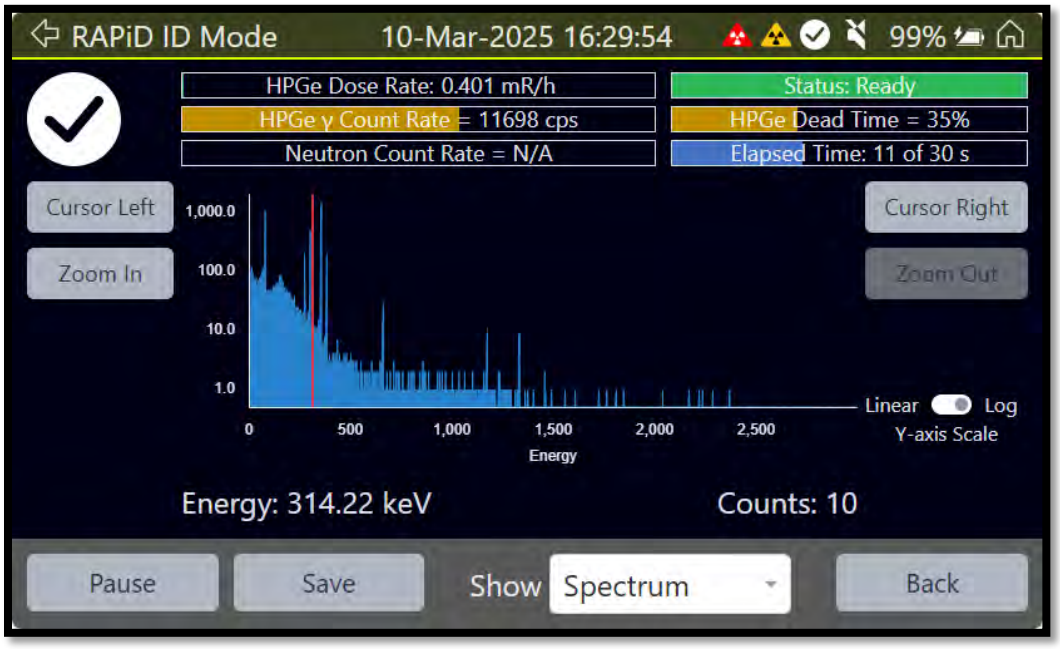


Figure 186. Entire Spectrum Displayed (Showing Marker Position and Channel Content)

The spectrum window has a vertical cursor line, and the lower left corner of the screen displays the position of the cursor in energy (keV). The number of counts in the cursor channel is displayed on the lower right. To move the cursor to a different location, tap the desired position. The cursor will move, and the energy and counts-per-channel will update. The cursor can also be moved by tapping Cursor Left and Cursor Right. Tapping and holding the button accelerates the rate at which the cursor moves.

The spectrum display control buttons are located around the spectrum window. Their functions are to change the display in different ways for better interpretation of the spectrum.

- **Zoom In** – The Zoom In button zooms in on the area located around the cursor, so the peaks appear wider.
- **Zoom Out** – The Tapping the Zoom Out button zooms out on the around the cursor, so the peaks appear narrower.
- **Linear/Log** – This toggle swaps the spectrum's vertical scale between linear mode, which automatically adjusts the vertical scale limit based on the tallest peak in the spectrum, and logarithmic mode.

11.3.2 Intense View

Tapping the **Intense** button displays a continuously updating list of the 10 highest-confidence peaks currently being detected. The Energy and Confidence columns can be sorted independently by tapping on the column header. An arrow will be displayed showing the column being sorted and the direction of sorting (see Figure 187). As discussed earlier, the confidence level is the net counts in the peak divided by the peak uncertainty. As the net counts in the peak increase, the uncertainty decreases, and the confidence level increases proportionally.

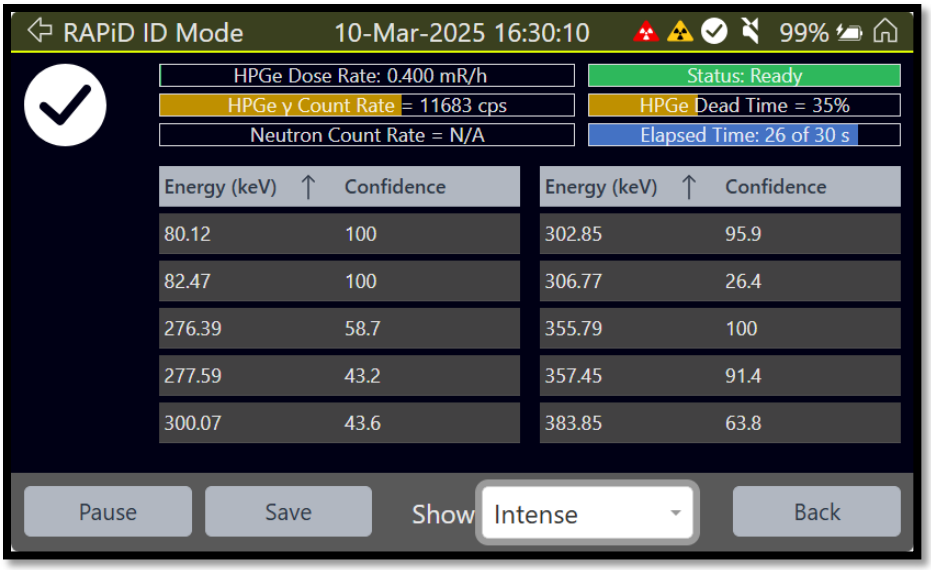


Figure 187. List of the Most Intense Peaks by Decreasing Q Value

11.4 SETTINGS

The RAPiD settings screen can be accessed from either the Survey Mode (main) screen or the Monitor Mode screen. The RAPiD application allows many of the same setting modifications that the DX1 Settings application provides (see Chapter 4 and Chapter 5) except for those listed below.



Figure 188. RAPiD Settings Screen

11.4.1 Recall/Copy Files

Selecting Recall/Copy Files from the Settings screen displays the following:

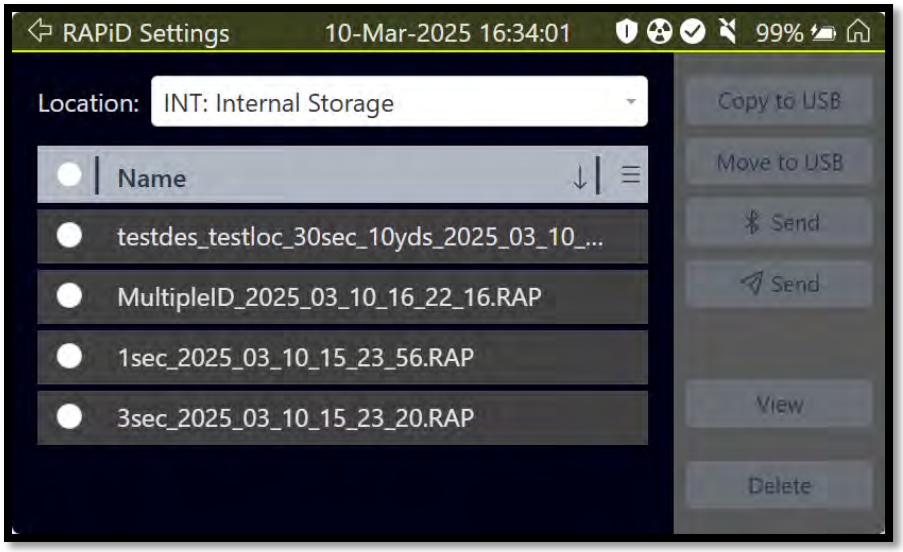


Figure 189. RAPiD Recall Screen

The main recall screen operates much like that of the File Manager application (see Section 7). The only difference is that only data created using the RAPiD application is visible in the RAPiD recall screen.

11.4.2 About

The RAPiD About screen displays the information seen in Figure 190.

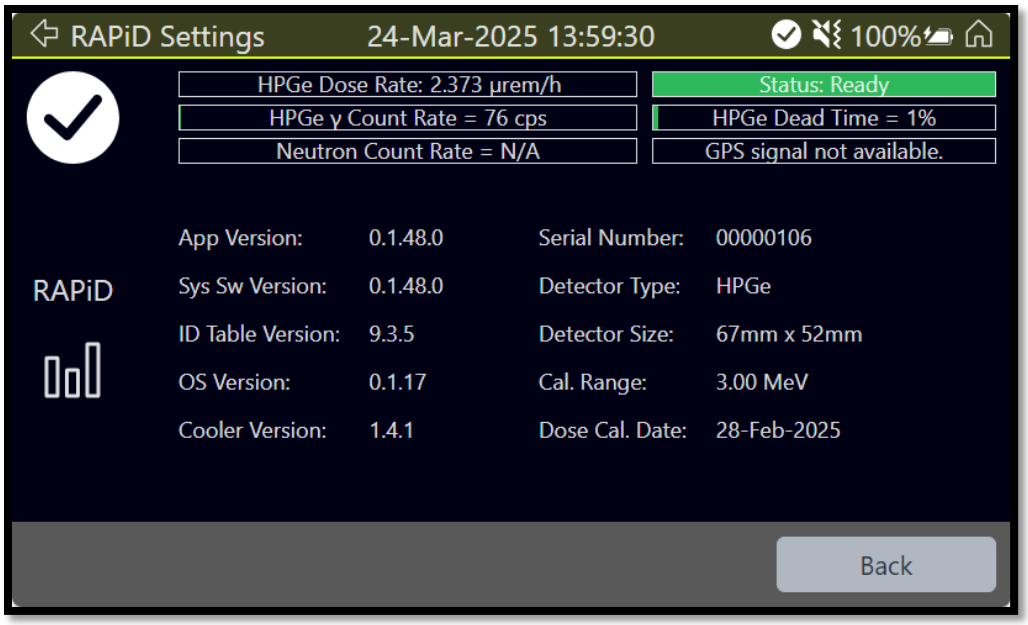


Figure 190. RAPiD About Screen

11.5 ADVANCED SETTINGS

11.5.1 Audio/Display

The RAPiD Audio/Display settings combine commonly used settings from the Display and Feedback screens in the Settings application.

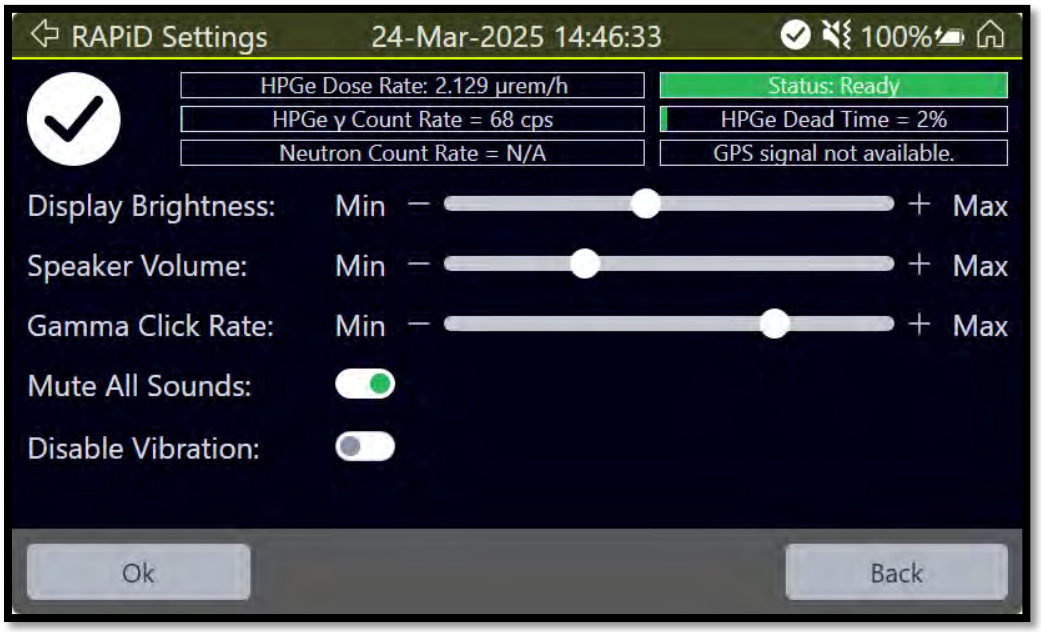


Figure 191. RAPiD Audio/Display

Tap on the slider bar for Display Brightness, Speaker Volume, or Gamma Click Rate to adjust the values. To mute all sounds or disable vibration, tap the corresponding toggle. When active, the toggle is green with a white background.

11.5.2 Passcode Settings

The Passcode settings screen works the same as with the Settings application (see Section 5.2). It is important to note here though that any passcode changes in RAPiD also change the Settings application.

NOTE	If a passcode is set in RAPiD it will also be used in the Settings application. The same is true for if the passcode is changed in the Settings application, these changes are reflected in the RAPiD application.

11.5.3 Dose Units

Dose Units can be found in the Advanced Settings screen. This screen is identical to the Display screen in the Settings application.

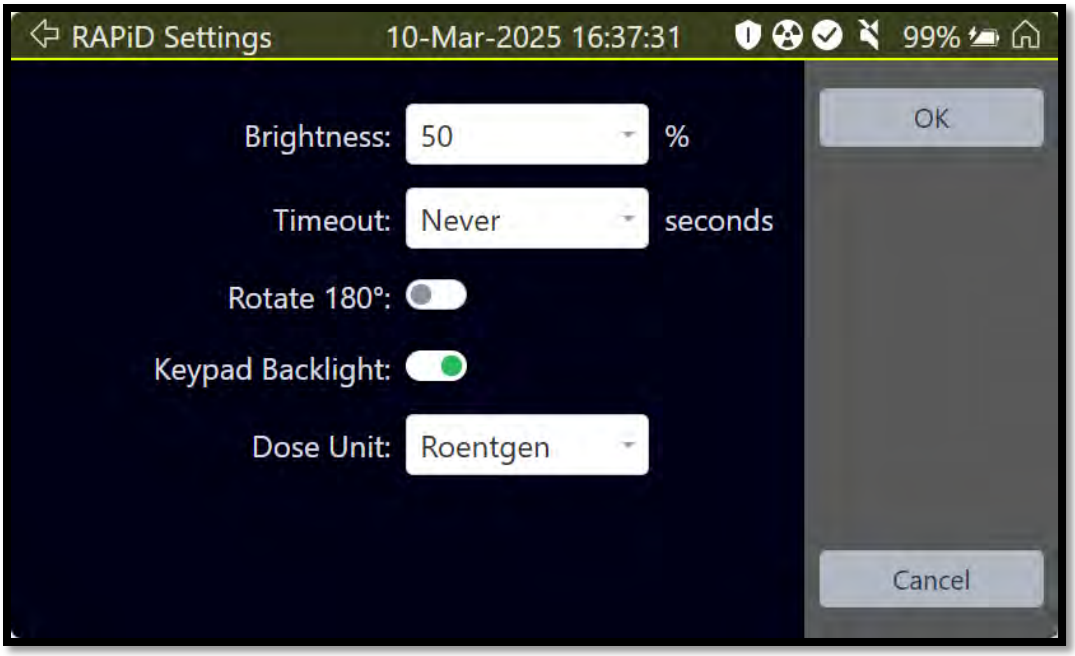


Figure 192. RAPiD Dose Units

NOTE	Changes to the dose unit in RAPiD will also affect the Easy ID, Dose Rate, and Sleuth applications.

11.5.4 Export Settings

When a USB is plugged into the instrument, Export Settings becomes available. Tapping export settings copies a file to the USB that contains all of the instrument settings (user defined and those left as default). This file can then be used to quickly set up other instruments identical to this one.

11.5.5 Import Settings

After exporting a settings file to a USB, the file can be imported to set up an instrument or restore settings to an instrument after it has been reset to factory default. Tap Import Settings to import the settings file.

11.6 MCB MODE

Selecting **MCB Mode** on the RAPiD main screen launches the MCB Mode application. This operates the same as described in Chapter 14 except that when selecting **Close** the instrument returns to the RAPiD application instead of the DX1 Home screen.

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12. DOSE RATE

The Dose Rate application, with its large, intuitive dose rate indicator, is designed to serve as the primary measurement app when monitoring radiation levels and searching for radioactive sources. From the Home screen, tapping on Dose Rate opens the dose monitoring screen.

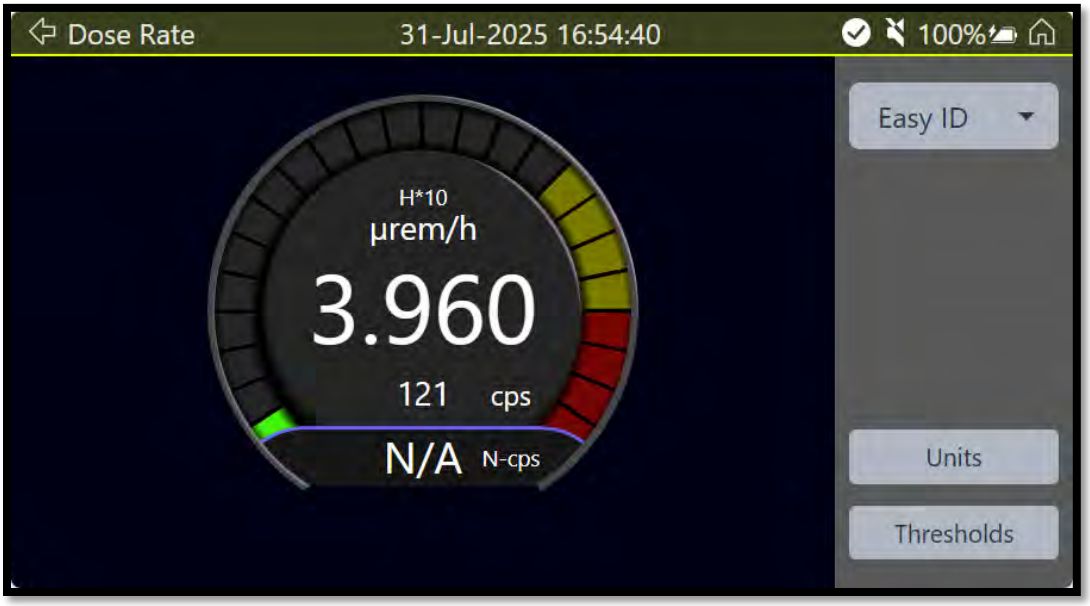


Figure 193. Dose Rate Screen

The center of the dial displays the current dose rate being calculated by the instrument. The units can be changed in the Settings application (see Section 4.3.5). The current counts per second (cps) being detected by the DX1 are seen in smaller font directly beneath the dose rate. At the bottom of the screen the neutron counts are displayed in N-cps. If a neutron detector is not present, the instrument displays N/A instead.

The dial is rimmed in green, yellow, and red colored blocks. As the intensity of the radiation increased, the blocks fill in a clockwise manner. The blocks start out green for safe levels of radiation. They turn yellow and then red based on the warning and alarm thresholds that are defined by the user (see Section 5.1).

When the instrument is experiencing an operational warning or error, the corresponding status icon and alert message are displayed beneath the dose rate dial. If the situation is an operational error that will prevent the instrument from reliably collecting data, the center of the dial changes to Not Ready and will no longer display dose rate information. If the HPGe detector receives enough counts to create 100% deadtime, the detector will be unable to perform identifications. In that case the screen displays a “Cannot ID Nuclides” warning message beneath the dial but dose rate can still be monitored.



Figure 194. Dose Rate Not Ready Operational Warning

If the situation is an operational warning that does not prevent data collection, a message is displayed beneath the dial, but dose rate data can still be monitored.

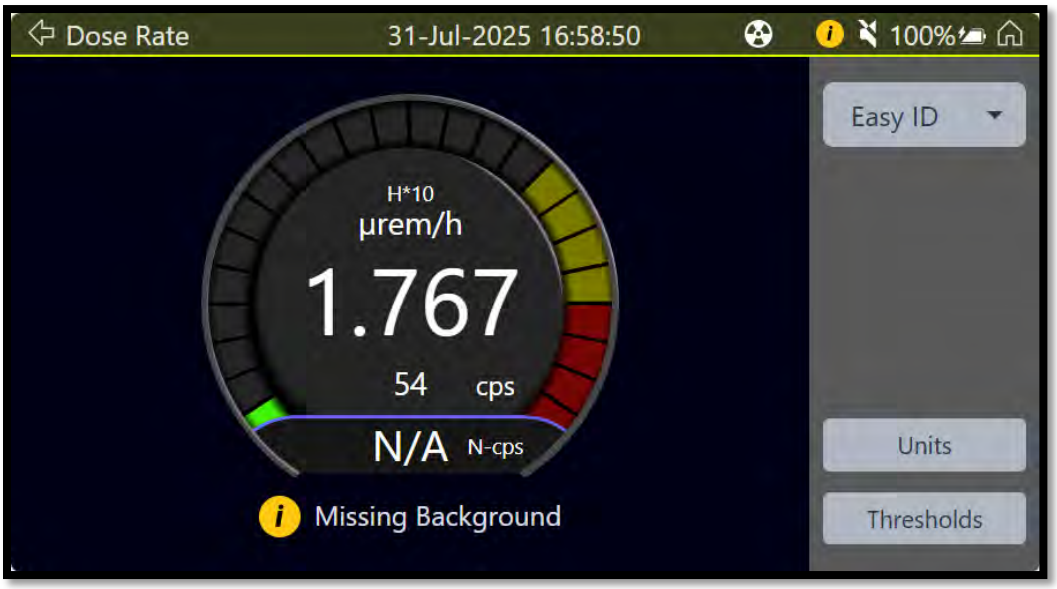


Figure 195. Dose Rate Operational Alert

Users can navigate directly to other applications by selecting the application from the drop-down button on the right side of the screen and then pressing the button. The application will immediately change to the newly selected application after pressing the button. Pressing the back button in that application will return the screen to Dose Rate.

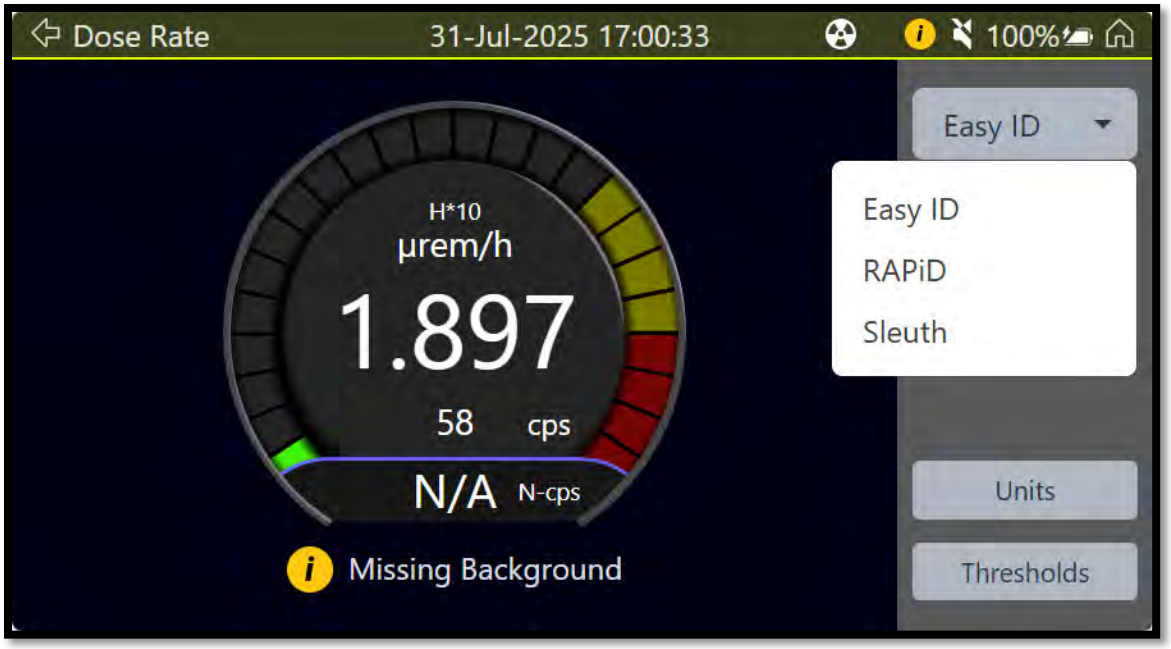


Figure 196. Dose Rate Application Selection Menu

On the right side of the screen, select the Units button to open the Display Settings screen. The Display Settings screen is explained in Section 4.3. Pressing OK or Cancel on this screen returns to the Dose Rate application.

On the right side of the screen, select the Thresholds button to open the Warnings and Alarms setting screen. If the instrument is not already in Advanced Mode, a prompt will be displayed to enter the passcode. More information about the Warnings and Alarms screen can be found in Section 5.1. Pressing OK or Cancel on this screen returns to the Dose Rate application.

Tapping the back arrow in the upper left corner returns to the Home screen.

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13. SLEUTH APPLICATION

Sleuth is a simplified user interface for the DX1 and is started from the Home screen. Sleuth provides for a very limited set of common user operations. This limits the ability of users to deviate from prescribed CONOPS. Sleuth minimizes the opportunity for error in situations where operators must multi-task to quickly and accurately assess the threat level posed by an item of primary concern (IPC). Because of its limited user interface, Sleuth can greatly simplify training protocols for operators as well.

Many of the settings entered in the Settings application carry over to the operation of Sleuth. It is recommended that one study Chapter 4 and Chapter 5 to understand the available system settings prior to deploying instruments for Sleuth-based operation.

Sleuth adds some special features created specifically for its targeted audience. Sleuth has special data handling capabilities to ensure all survey data collected is concise and unambiguous. Sleuth also allows data collection to be paused such that other potentially interfering measurements of the IPC can be made without spoiling a time-consuming gamma ray spectrum acquisition. Sleuth includes features that allow the operator to optimally position the DX1 prior to starting data collection.

13.1 USER INPUT

Users interact with the Sleuth application only by tapping the large touchscreen with a finger or stylus. When in Sleuth, the keypad buttons on the device handle are disabled.

Some screens allow the user to capture alphanumeric data that will be stored in the N42.42 file along with the radiological measurement data. If the user has large hands, it may be easier to use the supplied stylus, which is tethered to the carrying strap (Figure 15).

13.2 SLEUTH STARTUP AND DATA FILE MANAGEMENT

The Sleuth software application is accessible through the Home screen.



Figure 197. Sleuth Icon

Tapping the Sleuth icon opens the Sleuth main screen, which is the basic survey mode.

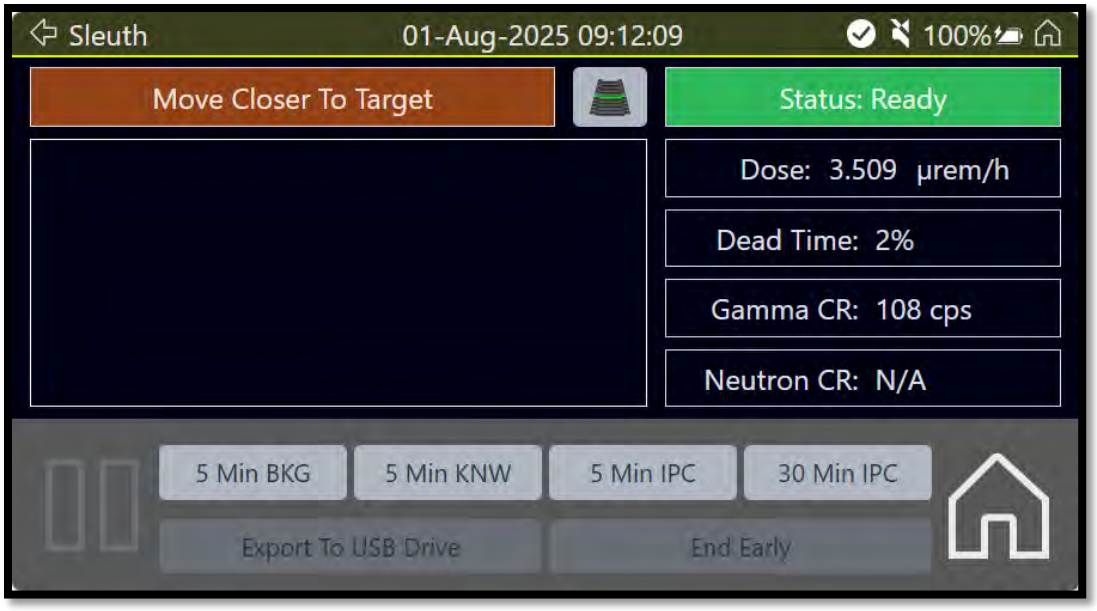


Figure 198. Sleuth Home Screen

Instruments that will only be used in Sleuth mode can be configured to automatically start Sleuth during a system reboot/power-up. This is accomplished by navigating to Settings and selecting Apps. Tap **Sleuth** and then **Set as Startup**. An arrow will be displayed by Sleuth to show that it is being launched at startup.



Figure 199. Assigning Sleuth to Launch at Startup

If the instrument's cooler was not already turned on, it starts automatically when the Sleuth application is launched. This feature is in line with Sleuth's goal of making the system foolproof in operation. A unit that is set up to automatically launch Sleuth upon power-up will automatically turn the cooler on when it is powered up.

Once data is collected, a USB flash drive can be inserted into the unit and the **Export to USB Flash** button will copy all files to the USB flash drive. The USB flash drive can then be removed, and data can be transferred to Reachback facilities for analysis. Note that this action does not remove the original copies of the data file from internal memory unless specifically requested.

Upon startup of Sleuth (and shutdown to exit back to the Home screen), the system will check to see if any data is present in the Sleuth data storage folder stored in internal memory. If data is present, a message will be displayed asking the user if it is desired to delete all Sleuth data (see Figure 200).

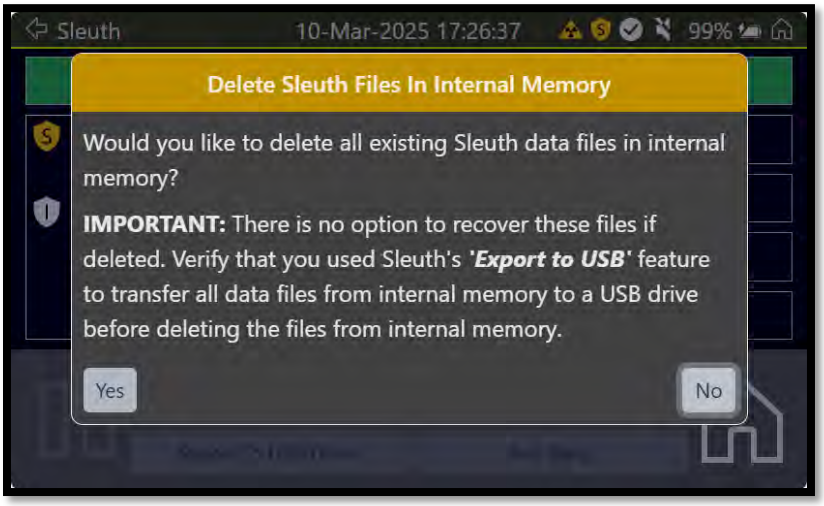


Figure 200. Delete Sleuth Data Message

NOTE	Clearing data in Sleuth does not clear data from the Easy ID or RAPiD applications.

13.3 SLEUTH MAIN SCREEN

The main screen for Sleuth is shown in Figure 201.

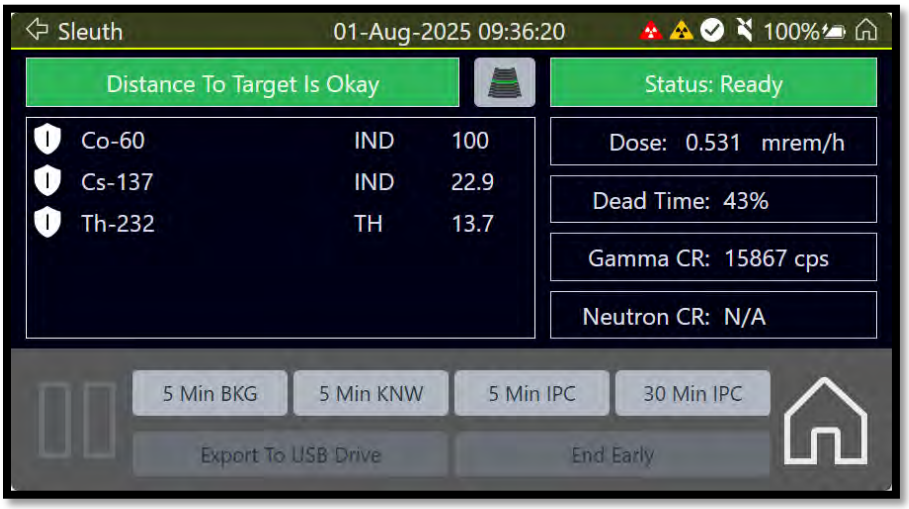


Figure 201. Sleuth Main Screen

Tapping the ID Grid/Distance Indicator icon ( ) changes the view to show the source position locator.

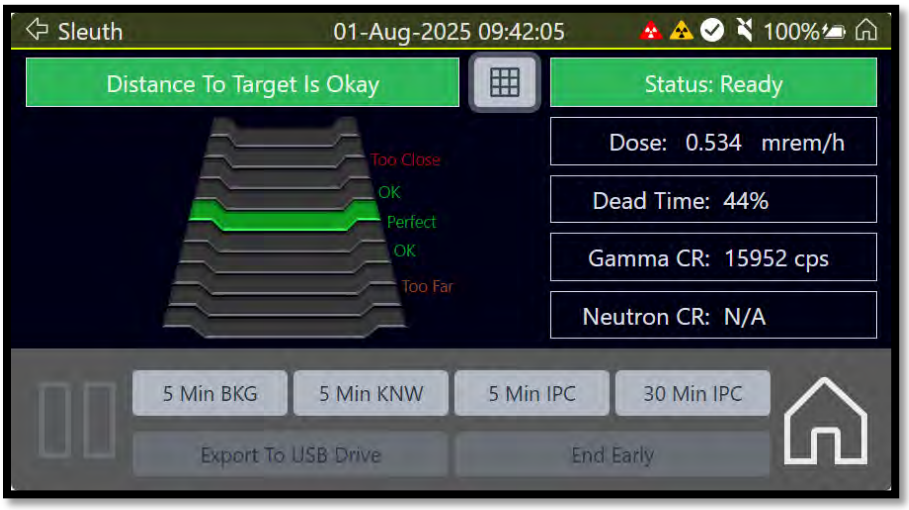


Figure 202. Sleuth Main Screen Source Position Locator View

13.3.1 Detector Status

Sleuth is continuously monitoring the instrument status and displays the current operational state of the instrument in the upper right corner block. This status block will change to Counting when the instrument is collecting data. A blue progress bar is displayed to show the approximate length of count time remaining. Once the count is complete, the status changes to show the spectrum is automatically saved. If any status warnings or errors occur, such as Missing Background, those will also be shown in this block.

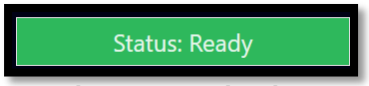


Figure 204. Sleuth Operational Status



Figure 203. Sleuth Counting Status

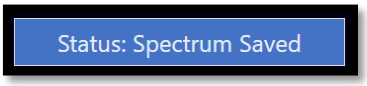


Figure 205. Sleuth Status Spectrum Saved

13.3.2 Dose Display

Sleuth continuously displays the dose rate being received by the detector whether the instrument is actively counting or sitting idle. Dose rate units displayed here can be changed by navigating to Settings and selecting Display.



Figure 206. Sleuth Dose Rate Display

13.3.3 Dead Time Display

Sleuth continuously displays deadtime in the third block on the right side of the screen (Figure 207). Operators can be trained to use this value to collect optimal data for later analysis by a Reachback facility.



Figure 207. Sleuth Dead Time Display

13.3.4 Gamma Count Rate

Sleuth continuously displays the gamma count rate in the Gamma CR box on the right side of the screen. The gamma count rate is always displayed in counts per second.



Figure 208. Sleuth Gamma Count Rate Display

13.3.5 Neutron Count Rate

When the neutron detector is attached to the DX1, the neutron count rate is always displayed on the right side of the screen. The neutron count rate is always displayed in counts per second. When the neutron detector is not connected, N/A is displayed.



Figure 209. Sleuth Neutron Count Rate Display

13.3.6 Missing System Background File



Figure 210. Missing System Background Icon

Sleuth is perfectly happy to collect data without valid system background information. See Section 4.5 for a discussion on the importance of collecting ambient background data for the system. As discussed there, the system's nuclide identification depends on accurate background data. However, with Sleuth, accuracy of the nuclide identification is de-emphasized in favor of the ability to very quickly collect data and transfer it to a Reachback facility.

In order to warn of this situation a missing background message is displayed in the status block. This warning is issued as information to users that nuclides identified by the system may be less accurate than a system would be with a valid system background. The operator can remove this warning by exiting Sleuth, navigating to Settings, and collecting ambient background data as discussed in Section 4.5. Customers should consider their CONOPS when providing training regarding this message.

NOTE Regarding "System Background" versus "5 min BKG" Nomenclature:

The "5 Min BKG" referred to by the Sleuth application is sometimes called a "Blank" measurement by various organizations. The term "System Background" is used elsewhere in the DX1 system to denote a 30-minute (ideally) measurement made to help setup Stabilizer values, establish expected count rates, reduce false-positives on NORM IDs, and ensure a properly running system.

A valid and representative "System Background" is important in the analysis of the spectrum in the Easy ID, Dose Rate, and RAPiD modes. The DX1 maintains separate background data for the system based upon each accessory potentially mounted to the front of the unit (neutron detector, collimators, passive detector cover).

While the Sleuth application does not require the user to perform a traditional System Background prior to other Sleuth measurements, it should be noted that the user may experience nuisances such as false-positive NORM IDs or stabilizer issues.

These issues can be corrected by utilizing the Settings application to perform a "System Background".

13.3.7 Distance Optimization

Sleuth operates using a source distance optimizer indicator. This indicator suggests that operators move closer to a source or farther away from it in order to optimize data collected for analysis at the Reachback facility.



Figure 211. Move Closer

If deadtime is less than 20%, the operator is directed to move closer with a message that states “Move Closer To Target” (see Figure 211).

If deadtime is greater than 51% the operator is directed to move back with a message that states “Move Away From Target” (see Figure 213).

Otherwise, the indicator shows “Distance To Target Is Okay” (see Figure 212) in green.

Note that once an operator initiates an IPC measurement, actual distance will be requested, and this indicator will show that entered value (see Figure 214). Also note that this is a passive indicator only and it in no case actively prevents collection of data.



Figure 212. Distance OK

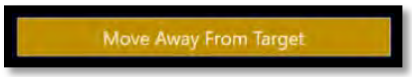


Figure 213. Move Back



Figure 214. Distance Entered

> **NOTE** In general, users should use the distance indicator on the Sleuth main screen (Figure 201) to optimize the distance to the IPC. This means that for “5 Min KNW”, “5 Min IPC”, and “30 Min IPC” the user should expect to see the “Distance from Source OK” (Figure 212) indicator prior to beginning the measurement.
>
> When performing a “5 Min BKG”, users should be trained to move far away from any potential radiation sources such that the “Move Closer to Target” (Figure 211) indicator is displayed on the Home screen before starting the measurement.

13.3.8 Other Icons and Settings

The other Sleuth status icons (not described above) serve the same function(s) that they have in the other DX1 software applications. They are also controlled by settings in the Settings application. For instance, the gain stabilizer may be disabled for Sleuth by switching to the Settings application, navigating to Advanced and Background Settings, and deselecting the “Stabilize on K-40” button discussed in Section 5.9.

Many settings available within the Settings application are nonsensical for Sleuth and are ignored. For instance, the Preset Time is be ignored by Sleuth (see Section 5.3) because count times are already built into the scanning routines.

Sleuth does support audio and vibratory notifications discussed in Section 4.10 and personnel hazard alarms Section 5.1.2. Sleuth also supports Reachback functionality whenever Reachback is set to modes other than manual as discussed in Section 5.6.

13.4 COLLECTING DATA

In a typical scenario, Sleuth will be used to collect a background spectrum, a known spectrum, and one or more spectra at optimum distance from the IPC. Quick-acting measurement buttons are provided for each of these operations. All of these are optional and more than one of any type can be

collected without overwriting previously collected data. The specific set of measurements collected is driven entirely by operator training and/or specific instructions to the operator.

Five-minute background and five-minute known spectra are collected to provide Reachback facilities with baseline data. These measurements can be used as reference data to assess instrument state of health, actual energy to channel conversion, and detector efficiency. This data can often be used to make sense of collected data even if the instrument is poorly calibrated or needs service.



Figure 215. Pause

While collecting data, the operator can temporarily suspend data collection with the **Pause** button (see Figure 215). The operator can also terminate an acquisition early with the **End Early** button.

Once a measurement is complete, nuclide identification results remain on the screen. The button that was used to begin the acquisition now becomes a **Done** button and once that button is tapped, the operator can initiate the next measurement (as shown in Figure 216).

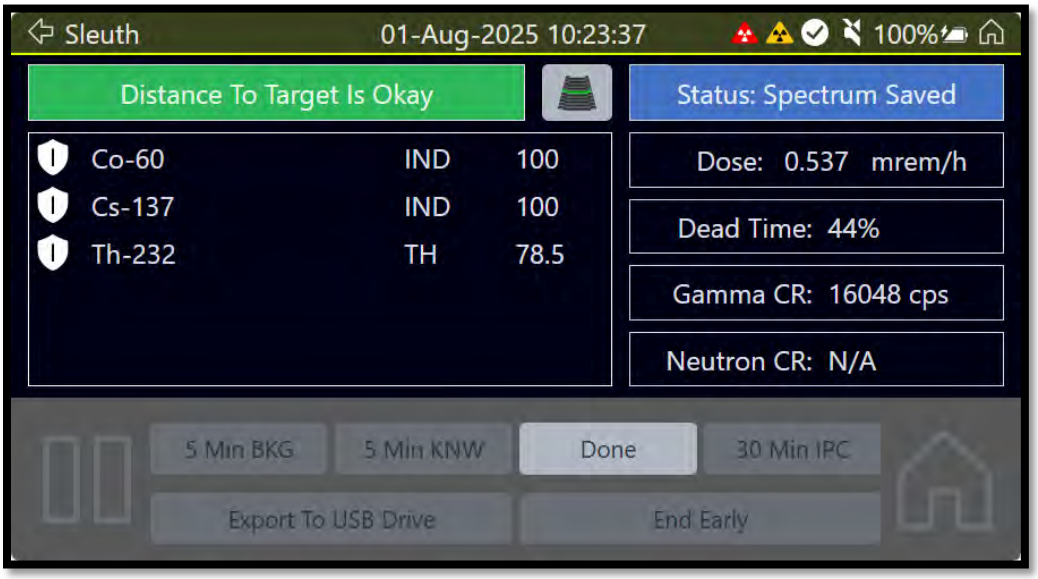


Figure 216. Measurement Complete

13.5 EXPORTING AND DELETING DATA

The operator can copy data files stored in internal memory to a USB flash placed in the rear of the instrument with the **Export to USB Flash** button. Note that the export functionality is disabled when a measurement is in progress. Also note that only Sleuth data is exported in this process. No other data (i.e., acquired via Easy ID or RAPiD) on the unit is exported.

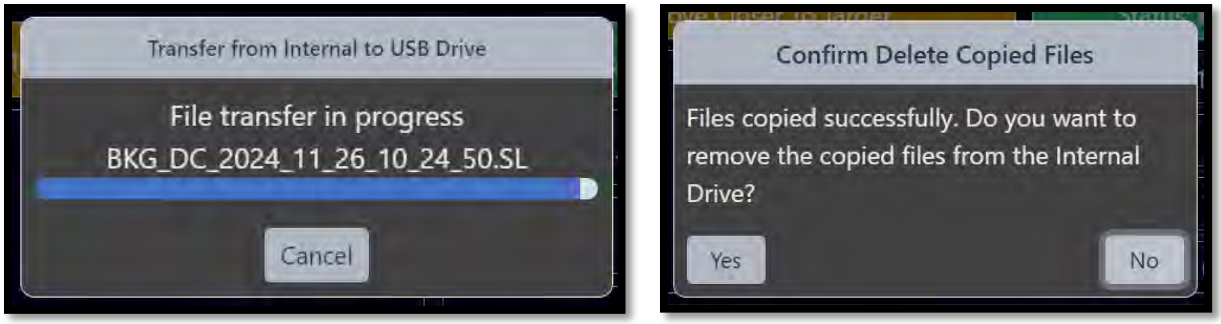


Figure 217. Export in Progress

Data files remain in internal storage following an export until they are specifically deleted by the operator. After an export is complete, the operator is shown a confirmation screen (Figure 217) that contains a button to delete all files in the internal storage.

> **NOTE** In most use-cases, choosing Yes to remove the copied files from the internal drive is almost always the correct choice following a file export. Clearing the internal memory serves to remove old and irrelevant data collected for a different purpose (perhaps by a different operator, on a different day, or at a different location).

13.6 EXITING SLEUTH



Figure 218. Home Button

Once all measurements have been taken and data exported, the operator can simply press the power button to shut down the instrument. The instrument will ask the user if it is desired to turn off the cooler (see Section 2.14).

Alternatively, the **Home** button (see Figure 218) can be selected when a Sleuth measurement is not in process. This **Home** button will then check to see if any spectrum files remain in the internal memory, ask the user if it is desired to delete found data, and return the user to the DX1 Home screen.

13.7 SLEUTH DATA FILES

In the simplified spirit of Sleuth each measurement performed with Sleuth creates a separate N42.42 data file. Sleuth attempts to keep the number of data files and the complexity of data files manageable in order to prevent potential confusion as data is transferred to the Reachback facility. Sleuth data files are simple in that they only include one spectrum. File name formatting is used to distinguish one file from another. Each file will have a filename formatted as follows:

<MEAS>_<COL>_YYYY_MM_DD_HH_mm_ss.SL.n42

Where the <MEAS> and <COL> components correspond to Measurement Type (MEAS) and Collimator Type (COL), YYYY_MM_DD_HH_mm_ss is the UTC date-time stamp, and SL stands for Sleuth.

Potential values for Measurement Types are:

- BKG – denoting a 5-minute Background (e.g., ‘Blank’) Measurement
- KNW – denoting a 5-minute Known Measurement
- IPC5 – denoting a 5-minute IPC Measurement
- IPC30 – denoting a 30-minute IPC Measurement

Potential values for the Collimator Types are:

- DC – denoting “dust cap” (or no collimator)
- ND – denoting a Neutron Detector is connected
- RC – denoting the Red Cap Collimator
- ST – denoting the Steel Collimator
- W – denoting the Tungsten Collimator

If the operator entered any value for distance to source (other than unknown), the Sleuth N42 file will include that value in the file for the <DistanceValue> element which will be the user entered distance converted from inches to meters. If the user left the source distance field as unknown, this element will not be included in the file (see external document Part Number 1117859 DX1 File Formats).

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14. MCB MODE APPLICATION

The Mobile MCB application (Figure 219) governs communication between the DX1 and a host computer when the DX1 is used as a high-performance, benchtop gamma spectrometer in conjunction with ORTEC spectroscopy applications such as MAESTRO, GammaVision, or LVis. The user manual for any user-owned, PC-based ORTEC spectroscopy product contains complete instructions on installing and configuring all of the software necessary to communicate with and use the DX1 as a benchtop spectrometer.



Figure 219. Mobile MCB UI from the Launcher Application

Users simply have to place the DX1 into this screen to turn on MCB Mode. When this screen is displayed, users will be able to find the instrument on the network or USB using the CONNECTIONS software (see Section 14.1).

WARNING	When the DX1 is in MCB Mode, features such as battery life monitoring and system alarms are not active and will not be presented on the screen. The instrument should always be plugged in while in MCB mode since the battery life cannot be monitored.

14.1 THE CONNECTIONS/MCB PROPERTIES LAYER

All ORTEC spectroscopy applications use a standardized interface layer to communicate with supported gamma spectrometers. This interface reveals properties particular to a given spectrometer through a multi-tab "MCB Properties" dialog. This interface is called CONNECTIONS in other ORTEC product literature, and the core of its functionality is a component called the Universal MCB

Interface (UMCBI). The ORTEC Programmer's Toolkit (P/N A11-BW) allows knowledgeable users to write custom applications that use the UMCBI to communicate with generic MCBs (contact an ORTEC representative for more information).

The MCB Properties dialog allows the user to adjust the DX1 spectrometer's properties such as the conversion gain, bias voltage, the zero and gain stabilizer settings, counting presets, etc. These properties are maintained in an ID Mode settings bank that is kept separate from the standard operating settings.

If the user chooses to operate in MCB Mode with the ID Mode settings, any changes made to the settings will remain in effect only as long as the DX1 is connected to the PC. When the unit is disconnected and any RIID application restarts (Easy ID, Dose Rate, Sleuth, or RAPiD), all factory settings will be restored, and the instrument will return to its normal, standalone operation mode.

Note that only the spectrometer interface is exposed when the DX1 is connected to a host computer via the MCB Mode. The operator cannot access the applications, the nuclide IDs, or any other information calculated by the DX1's onboard computer. The MFK interface described in Appendix A provides a much higher-level connection to the DX1 that may be needed in some instances.

14.2 ACCESSING THE DX1 VIA NETWORK

Once the DX1 is connected to a host computer via Ethernet, WLAN, or the WLAN Hotspot, CONNECTIONS makes it possible for multiple users on the same local network to access the instrument via ORTEC spectroscopy applications.

> **NOTE** See Section 4.9 for detailed instructions on how to connect a DX1 to the network.

When connecting to the network, the user should select Network from the Connect Using drop-down menu. This allows the instrument to be found on the network through the Ethernet connection. Note that the computer being used to connect to the MCB through CONNECTIONS must be on the same network as the DX1 (i.e. same wireless network if using WLAN).

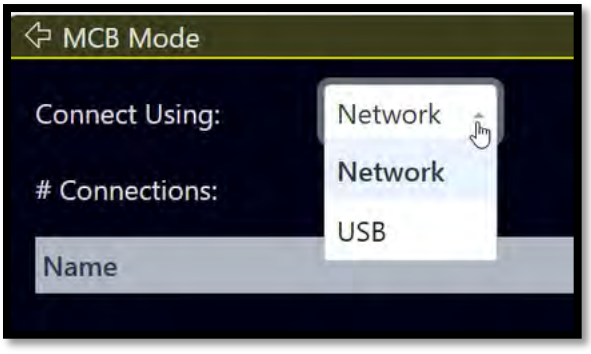


Figure 220. MCB Mode Connect Using

NOTE Users should not plug in both the USB cable and the Ethernet cable at the same time while trying to connect to the network. Connecting both may cause communication errors.

14.3 ACCESSING THE DX1 VIA USB

When connecting to the DX1 using a USB C cable, the user should select USB from the drop-down menu (see Figure 220). Users are then able to locate the DX1 using either the CONNECTIONS local option or the full network scan option. Note that if users fail to change to USB and leave Network selected, the instrument can still be found in the full network scanning option but cannot be found in the local option. Note that USB A ports are only for flash drives and are not operational for this application.

NOTE When in MCB mode and USB is selected in the drop-down menu, the screen sharing capability is disabled.

14.4 QUANTITATIVE SPECTROSCOPY WITH GAMMAVISION

The DX1 does not measure or store efficiency calibration information in the files it creates. To use the DX1 files in quantitative calculations in programs such as GammaVision, it is necessary to collect spectra from reference sources and perform the calibration in GammaVision. The GammaVision user manual includes detailed instructions on this procedure.

WARNING MCB Mode should be exited before shutting down the instrument. To exit MCB Mode, press the **Home** button or the **Close** button in the upper right corner.

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15. MCB PROPERTIES USING SOFTWARE APPLICATIONS

This section discusses the hardware setup dialogs seen within ORTEC software applications (such as GammaVision, MAESTRO, etc.) while using the **MCB Properties…** command on the **Acquire** screen. The MCB Properties dialog contains all of the instrument controls including acquisition presets, high voltage, hardware status indicators, and amplifier settings. To view the hardware parameters and identification mode reports for spectra downloaded from the DX1, simply move from tab to tab. Click on **Close** when finished.

When setting up a data acquisition, note that as characters are entered in the data-entry fields the characters will be underlined until another field is selected or until 5 seconds have lapsed without keyboard input. During the time the entry is underlined, no other program can modify this value.

NOTE The changes made on most property tabs take place immediately. There is no cancel or undo option for this dialog.

In the software, the **Download Spectra** and **View ZDT Corrected** commands on the **Acquire** screen and the **Smooth** and **Strip** commands on the **Calculate** screen are disabled for this instrument.

15.1 AMPLIFIER

Figure 221 shows the Amplifier tab, which displays the **Coarse** and **Fine Gain** and **Pole Zero** controls.

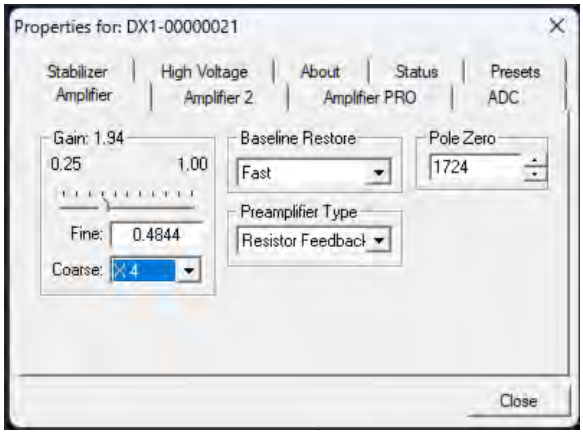


Figure 221. MCB Properties Amplifier Tab

Gain

Set the amplifier coarse gain by selecting from the **Coarse** drop-down list, then adjust the **Fine** gain with the horizontal slider bar or the edit box, in the range of 0.45 to 1.00. The resulting effective gain is shown at the top of the **Gain** section. The two controls used together cover the entire range of amplification from 0.45 to 32.

Baseline Restore

The **Baseline Restore** is used to return the baseline of the pulses to the true zero between incoming pulses. This improves the resolution by removing low frequency noise such as DC shifts or mains power AC pickup. The baseline settings control the time constant of the circuit that returns the baseline to zero. There are three fixed choices (**Auto**,[3] **Fast**, and **Slow**). The fast setting is used for high count rates and the slow for low count rates. **Auto** adjusts the time constant as appropriate for the input count rate. The settings (auto, fast, or slow) are saved

[3] U.S. Patent No. 5,912,825.

in the DX1 even when the power is off. The time constant can be manually set on the InSight Virtual Oscilloscope display on the Amplifier 2 tab.

Users can view the time when the baseline restorer is active on the InSight display as a **Mark** region. In the automatic mode, the current value is shown on the InSight sidebar. For a low-count-rate system, the value will remain at about 90. See the accompanying MAESTRO user manual for complete information on InSight Mode.

Pole Zero Adjustment

To maintain optimum energy resolution and peak position stability to high counting rates, it is important to enter the correct value for the pole-zero cancellation. Use the default value as the starting point.

To make a fine adjustment of the **Pole Zero** setting:

1) Use a radioactive source that produces a well-defined peak near the upper limits of the energy spectrum. At low counting rates, note the symmetry of the peak.

2) Move the source closer to the detector to achieve much higher counting rates. If the peak maintains the symmetry observed at low counting rates no further adjustment of the **Pole Zero** is needed. If high counting rates generate a tail on the high energy side of the peak, slightly decrease the pole-zero value until the tail disappears. If high counting rates generate a tail on the low-energy side of the peak, slightly increase the pole-zero value until the tail disappears.

3) Make a final adjustment to balance the symmetry of the peak as closely as possible to the symmetry observed at low counting rates. This will result in the optimum pole-zero adjustment.

15.2 AMPLIFIER 2

Figure 222 shows the Amplifier 2 tab, which accesses the advanced shaping controls including the InSight Virtual Oscilloscope mode.

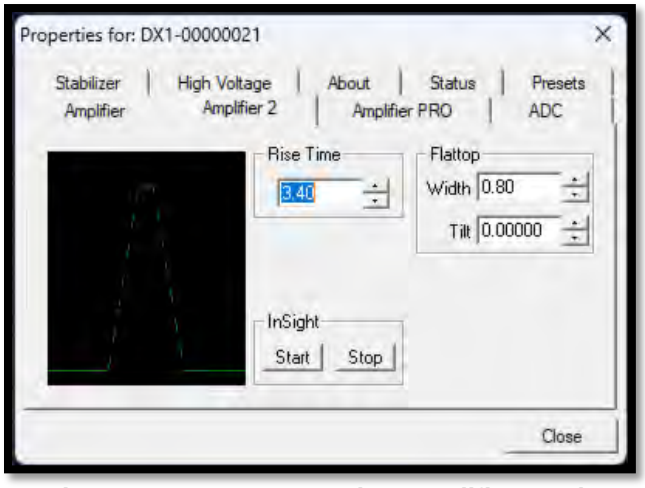


Figure 222. MCB Properties Amplifier 2 Tab

The many choices of **Rise Time** allow users to precisely control the trade-off between resolution and throughput. Starting with the default value, users should increase values of the rise time for better resolution for expected lower count rates, or when unusually high count rates are anticipated, reduce the rise time for higher throughput with somewhat worse resolution.

Use the up/down arrows to adjust the **Rise Time** within the range of 0.8 to 23.0 µs.

For the more advanced user, the InSight mode allows the user to directly view all the parameters and adjust them interactively while collecting live data. To access the InSight mode, go to the **Insight** section on the Amplifier 2 tab and click on **Start**. The InSight mode is discussed in detail in the MAESTRO-PRO user manual.

The **Rise Time** value is for both the rise and fall times; thus, changing the rise time has the effect of spreading or narrowing the quasi-trapezoid symmetrically.

The **Flattop** controls adjust the top of the quasi-trapezoid. The **Width** adjusts the extent of the flattop (from 0.3 to 2.4 μs). The **Tilt** adjustment varies the "flatness" of this section slightly. The **Tilt** can be positive or negative (range: −1.0 to +0.99219). Choosing a positive value results in a flattop that slopes downward; choosing a negative value gives an upward slope.

The dead time per pulse is $(3\ x\ Rise\ Time) + (2\ x\ Flattop\ Width)$.

When satisfied with the settings, **Close** the Properties dialog and prepare to acquire data.

Once data acquisition is underway, the advanced user might wish to return to the Amplifier 2 tab and click on the **Insight** section's **Start** button to adjust the shaping parameters interactively with a "live" waveform showing the actual pulse shape.

15.3 AMPLIFIER PRO

Figure 223 shows the Amplifier PRO tab, which contains the **Low Frequency Rejector** (LFR) filter control. Turning it off causes shifting and/or broadening of peaks in addition to the acquisition of noise in the lowest energy channels. It is strongly recommended that the LFR be enabled during all data acquisitions. Note, however, that users must turn the LFR *off* to pole-zero the DX1. Subsequent measurements can then be taken with the LFR filter on.

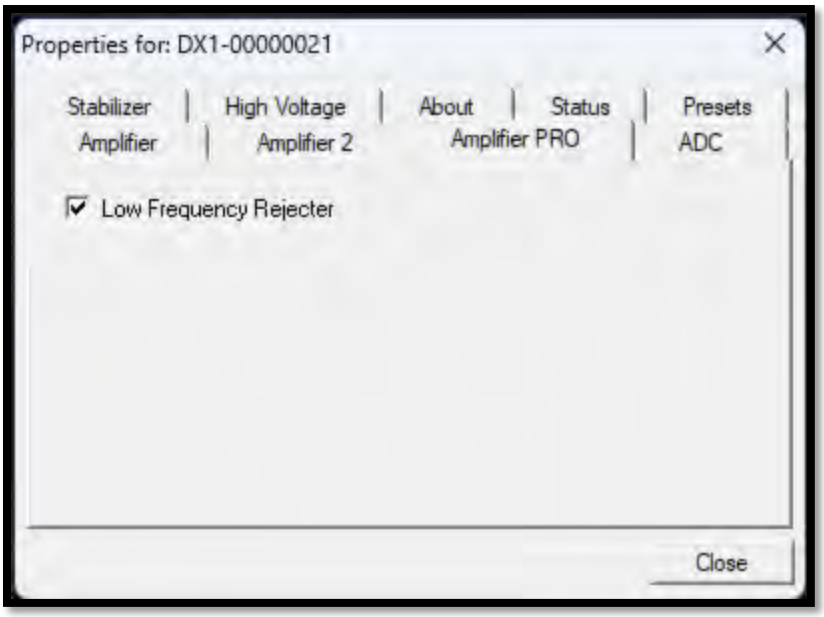


Figure 223. MCB Properties Amplifier PRO Tab

15.4 ADC

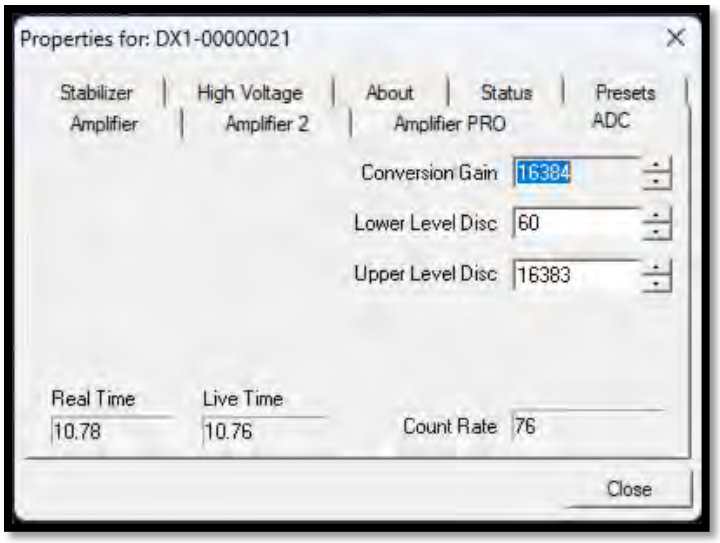


Figure 224. MCB Properties ADC Tab

The ADC tab (Figure 224) contains the **Conversion Gain**, **Lower-Level Disc**riminator, and **Upper-Level Disc**riminator controls. In addition, the current real time, live time, and count rate are monitored at the bottom of the dialog.

The **Conversion Gain** sets the maximum channel number in the spectrum. If set to 16384, the energy scale is divided into 16384 channels. This parameter is entered in powers of 2 (e.g., 8192, 4096, 2048, 1024, 512). The up/down arrow buttons step through the valid settings.

The **Lower Level Disc**riminator sets the level of the lowest amplitude pulse that will be stored. This level establishes a lower-level cutoff by channel number for ADC conversions. Because of the mechanical cooler, it is recommended to use a minimum setting of 60 (in addition to leaving the LFR on at all times).

The **Upper Level Disc**riminator sets the level of the highest amplitude pulse that will be stored. This level establishes an upper-level cutoff by channel number for storage.

15.5 STABILIZER

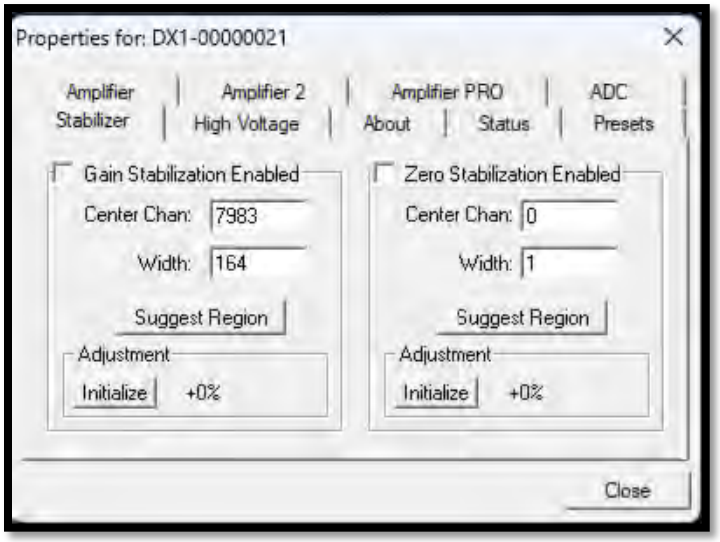


Figure 225. MCB Properties Stabilizer Tab

The DX1 has both a gain stabilizer and a zero stabilizer. See the MAESTRO-PRO user manual for a more detailed discussion of each.

The Stabilizer tab (Figure 225) shows the current values for the stabilizers. The value in each **Adjustment** section shows how much adjustment is currently applied. The **Initialize** buttons set the adjustment to 0. If the value approaches 90% or above, the amplifier gain should be adjusted so the stabilizer can continue to function. When the adjustment value reaches 100%, the stabilizer cannot make further corrections in that direction. The **Center Cha**nnel and **Width** fields show the peak currently used for stabilization.

To set up the stabilizer, enter the **Center Cha**nnel and **Width** values manually or click on the **Suggest Region** button. **Suggest Region** reads the position of the marker and inserts values into the fields. If

the marker is in a ROI, the limits of the ROI are used. If the marker is not in a ROI, the center channel is the marker channel, and the width is 3 times the FWHM at this energy.

Now click on the appropriate **Enabled** checkbox to turn the stabilizer on. Until changed in this dialog, the stabilizer will stay enabled even if the power is turned off. When the stabilizer is enabled, the **Center Cha**nnel and **Width** cannot be changed.

15.6 HIGH VOLTAGE

Figure 226 shows the High Voltage tab, which allows users to turn the bias voltage off and on and monitor the **Actual** bias. Users cannot adjust the bias voltage or polarity, nor can they change the **Shutdown** mode, which is fixed as **SMART**.[4]

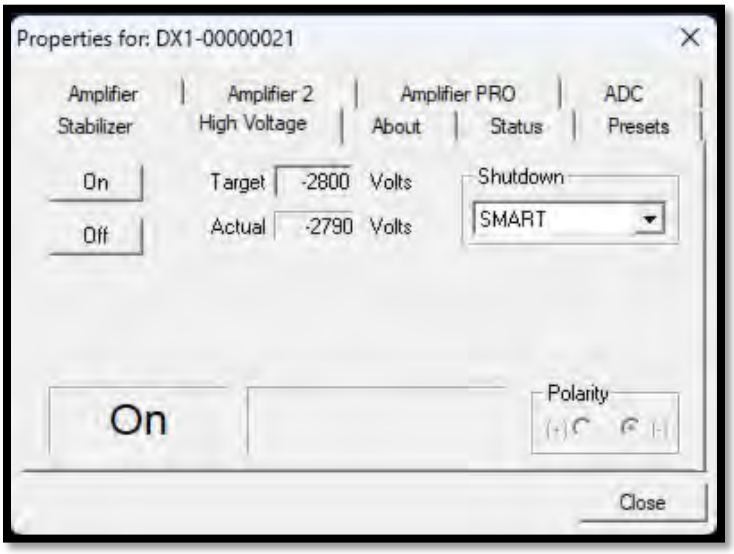


Figure 226. MCB Properties High Voltage Tab

15.7 ABOUT

This tab (Figure 227) displays hardware and firmware information about the DX1 as well as the data **Acquisition Start Time**. In addition, the **Access** field shows whether the MCB is currently locked with a password by the software. **Read/Write** indicates the MCB is unlocked, and **Read Only** means it is locked. See the MAESTRO-PRO user manual for more information.

Use the **Firmware Revision** field to determine the instrument type and firmware version. This parameter is formatted ***DETO-nnn***, where ***nnn*** is the firmware version. In the accompanying illustration, ***DETO-018*** indicates a DX1 running firmware v5. Users can also use the About tab to view this information for ***.SPC***-format spectra downloaded from the DX1.

[4] This is a reference to the SMART-1™ detector technology. For more information on SMART-1, see the ORTEC catalog or visit www.ortec-online.com

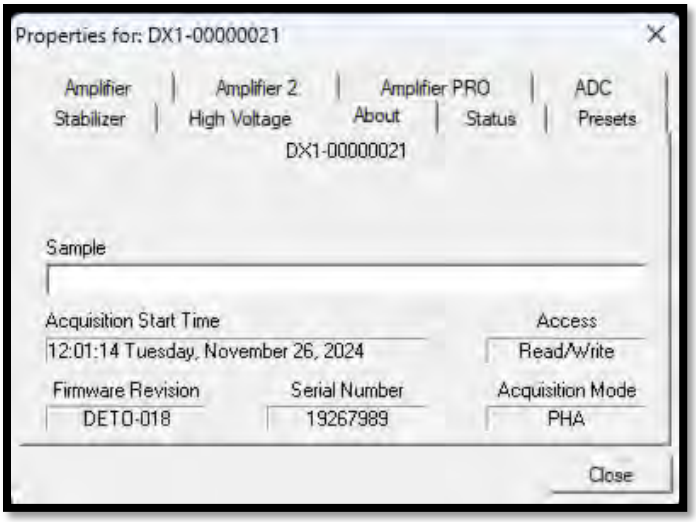


Figure 227. MCB Properties About Tab

15.8 STATUS

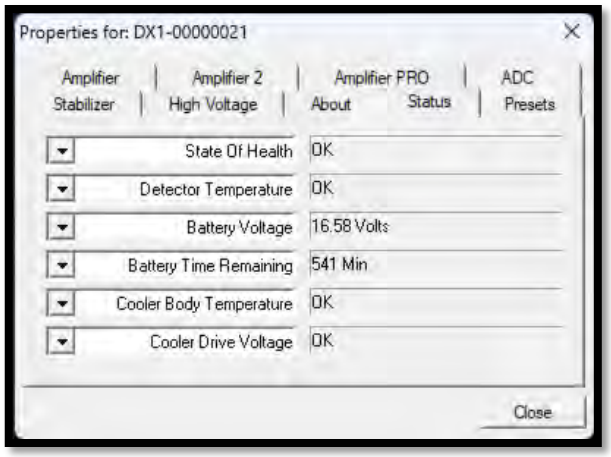


Figure 228. MCB Properties Status Tab

Figure 228 shows the Status tab. Ten parameters are continuously monitored in real time. Satisfactory status is reported as **OK** or a numerical value. A failure is reported as **ERR** or a descriptive message. Use the drop-down lists to select any six parameters to be displayed simultaneously on the Status tab. Users can change the selected parameters at any time.

The monitored parameters are:

- Detector **State of Health** – reported as **OK** or **ERR**.
- **Detector Temperature** – reported as **OK** or **ERR**.
- **Battery Voltage** – reported in volts.
- **Battery Time Remaining** – reported in minutes.
- **Cooler Body Temperature** – **OK** or **ERR**.
- **Cooler Drive Voltage** – **OK** or **ERR**.
- **Cold-Tip Temperature** – **OK** or **ERR**.
- **HV Bias** – reported in volts.
- **Ext. In** – reported in counts.
- **GM 1** – reported in counts.
- **GM 2** – reported in counts.
- **Neutron** – reported in counts.
- **Neutron Temperature** - reported in Celsius.
- **Neutron Bias** – reported in volts.
- **Front Accessory** – lists accessory type and serial number.

To resolve status problems, refer to Appendix D. For further assistance, contact an ORTEC representative or the Global Service Center.

15.9 PRESETS

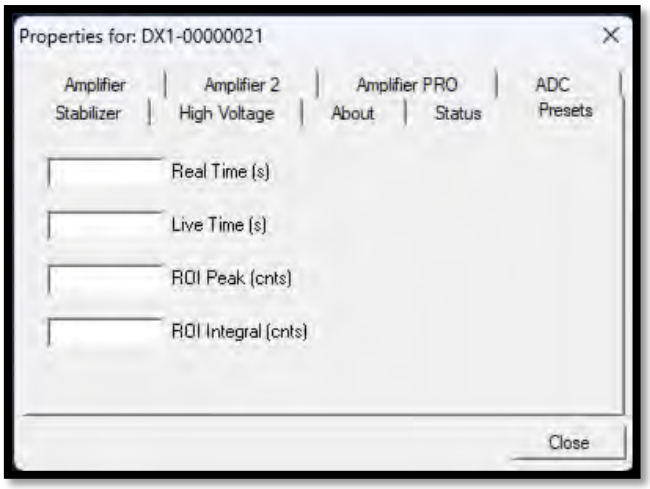


Figure 229. MCB Properties Presets Tab

Figure 229 shows the Presets tab. The presets can only be set when the DX1 is not acquiring data (during acquisition the preset field backgrounds are gray indicating that they are inactive). Any or all of the presets can be used at one time. To disable a preset, enter a value of zero. If all of the presets are disabled data acquisition will continue until manually stopped.

When more than one preset is enabled (set to a non-zero value), the first condition met during the acquisition causes the MCB to stop. This can be useful when samples of widely varying activity are being analyzed and do not know the general activity before counting. For example, the **Live Time** preset can be set so that sufficient counts can be obtained for proper calculation of the activity in the sample with the least activity. But if the sample contains a large amount of this or another nuclide, the dead time could be high, resulting in a long counting time for the sample. If the **ROI Peak** preset is set in addition to the **Live Time** preset, the low-level samples will be counted to the desired fixed live time while the very active samples will be counted for the ROI peak count. In this circumstance, the **ROI Peak** preset can be viewed as a "safety valve."

The values of all presets for the currently selected MCB are shown on the Status Sidebar. These values do not change as new values are entered on the Presets tab; the changes take place only when users **Close** the Properties dialog.

Enter the **Real Time** and **Live Time** presets in units of seconds and fractions of a second. These values are stored internally with a resolution of 20 milliseconds (ms) since the MCB clock increments by 20 ms. *Real time* means elapsed time or clock time. *Live time* refers to the amount of time that the MCB is available to accept another pulse (i.e., is not busy) and is equal to the real time minus the *dead time* (the time the MCB is not available).

Enter the **ROI Peak** count preset value in counts. With this preset condition, the MCB stops counting when any ROI channel reaches this value unless there are no ROIs marked in the MCB, in which case that MCB continues counting until the count is manually stopped.

Enter the **ROI Integral** preset value in counts. With this preset condition, the MCB stops counting when the sum of all counts in all channels for this MCB marked with an ROI reaches this value. This has no function if no ROIs are marked in the MCB.

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APPENDIX A. MOBILE FIELD KIT API

Mobile Field Kit (MFK) is a product of Asynchrony, a division of World Wide Technology. The DX1 is ready to connect to MFK, as delivered. A network connection is a prerequisite for setup and use of MFK (see Section 4.9). MFK must also be enabled in the Advanced Settings External Interfaces (see Section 5.6).

MFK must be enabled in Advanced Settings before it can be used, but there are no MFK settings on the instrument otherwise. Instead, the Asynchrony application will connect to the DX1 unit as a client. The Asynchrony application will only need to know the IP Address or Host Name of the DX1 unit.

The following sections provide detailed information on the communication protocol implemented on the DX1 to support the MFK system.

A.1 INTRODUCTION

This section is a description of REST-based APIs, used for communication and remote-control interface with ORTEC DX1 radioisotope identification devices (RIID).

A.2 VERSION

APIs Protocol v1

A.3 SIMPLE COMMAND TESTING

Note that the requests defined herein can be quickly demonstrated by using an internet browser (assuming a DX1 is available on the network). Simply start the browser and enter the URL (without 'GET' prefixes) as shown in the following examples:

https://<IP Address>:5001/mfk/v1/InstrumentStatus

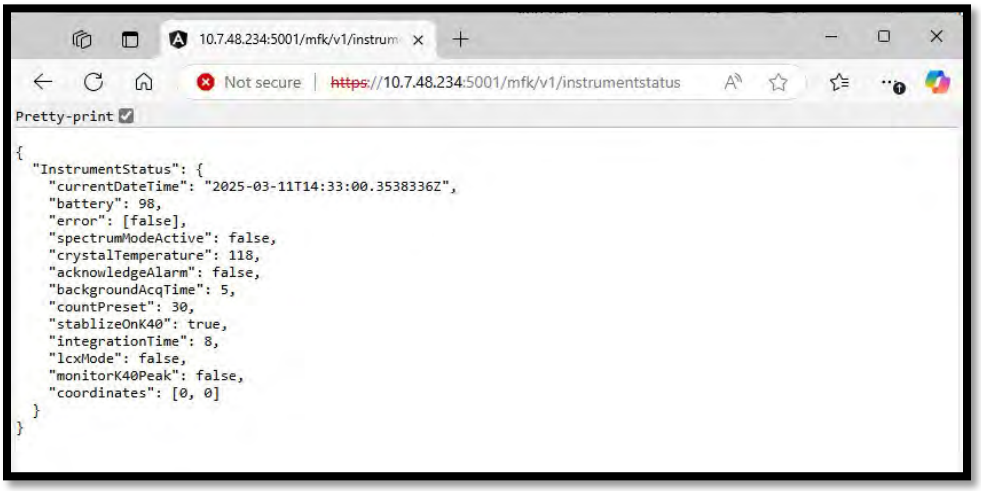


Figure 230. Example Instrument Status via Internet Browser Interface

https://<IP Address>:5001/mfk/v1/Start



Figure 231. Example Start Acquisition via Internet Browser Interface

NOTE	For all “Get” prefixes, the browser can be used for the command. For “Put” prefixes, a command prompt must be used to enter the command.

NOTE	The instrument must be in the Home screen for MFK commands to work. They will not operate if the instrument is in any of the RIID applications (i.e. Sleuth, RAPiD, Easy ID, or Dose Rate).

A.4 REQUEST

The request URL format includes a version number to assure structural stability and account for extensibility, endpoint changes, field deprecations etc.

https://<ip-address>:5001/mfk/v1/{resource-path}

The API requests are using: GET, POST, PUT and DELETE HTTP methods. When submitting a POST or PUT request, the Content-type header should be set to application/json and the charset=UTF-8 (Optional).

A.5 RESPONSE

All the API responses are in JSON format. The response uses standard HTTP status codes to indicate success or failure of API calls. Each API response is wrapped in a standard payload that contains the results of the API call, and in some cases may contain some additional information and metadata. Here is an example of a successful response:

```
{
    --- JSON payload ---
}
```

A.6 RESOURCES

The resource is based on the following functionality parts: system information, live data access, and remote control.

A.7 SYSTEM INFORMATION

GET https://<ip-address>:5001/mfk/v1/instrumentInformation

Returns instrument information record.

Available response representations:

- Record example:


```
{
 "InstrumentInformation": {
  "manufacturer": "ORTEC",
  "modelName": "DX1",
  "modelDescription": "ID Table Version: 1.0.1.0, OS Version 0.1.15, Cooler Version 1.4.1",
  "serialNumber": "17181862",
  "softwareVersion": "0.1.46.0",
  "hardwareVersion": "DETO-018",
  "probeTypes": [
   "HpGe 67mm x 52 mm",
   "With Neutron Detector",
   "GM"
  ]
 }
}
```


Table 3. System Information

Name	Type	Example	Comments
manufacturer	String	ORTEC	
modelName	String	DX1	
modelDescription	String	ID Table Version: 1.0.1.0, OS Version 0.1.15, Cooler Version 1.4.1	Contains relevant software descriptions
serialNumber	String	17181862	
softwareVersion	String	0.1.46.0	
hardwareVersion	String	DETO-018	Contains hardware Firmware revision
probeTypes	Array	HpGe 67mm x 52 mm, With Neutron Detector, GM	Contains all sensors in the device

A.8 STATUS

GET https://<ip-address>:5001/mfk/v1/instrumentStatus

Returns instrument status record.

Available response representations:

- Record example:


```
  {
   "InstrumentStatus": {
    "currentDateTime": "2025-03-11T15:01:45.0316788Z",
    "battery": 98,
    "error": [false],
    "spectrumModeActive": false,
    "crystalTemperature": 117.99,
    "acknowledgeAlarm": false,
    "backgroundAcqTime": 5,
    "countPreset": 30,
    "stablizeOnK40": true,
    "integrationTime": 8,
    "lcxMode": false,
    "monitorK40Peak": false,
```

```
    "coordinates": [0, 0]
   }
  }
```


Table 4. Status Information

Name	Type	Example	Comments
InstrumentStatus	Object		
currentDateTime	String	2025-03-11T15:01:45.0316788z	YYYY-MM-DDThh:mm:ss
battery	Integer	98	If the remaining time is over 8 hours, it's set to 100%. 100% is the maximum returned value
error	[Boolean, String]	[true, "Description of problem"]	If false, the array length is 1. If true, the error message is in the second element of the array
spectrumModeActive	Boolean	false	If true, a spectrum is currently taken and is the Detective ID mode.
crystalTemperature	Float	117.99	Unit is °K (degree Kelvin)
acknowledgeAlarm	Boolean	false	This indicates if the system is configured to require alarm acknowledgements (see 5.1.1).
backgroundAcqTime	Integer	5	This is the System Background Preset Count Time in terms of minutes.
countPreset	Integer	30	This is the ID Mode Preset Count Time in terms of seconds. Zero indicates preset count is disabled.
stabilizeOnK40	Boolean	true	This indicates if the system has been set up to stabilize on K-40 (see 5.9)
integrationTime	Integer	8	This is the rolling histogram integration time in seconds (see 5.3).
lcxMode	Boolean	false	This indicates if the instrument is set up in Low Confidence Expert mode. Not currently implemented.
monitorK40Peak	Boolean	false	This indicates if the system has been configured to monitor the K-40 peak.
coordinates	[Float, Float]	[36.4321289, 84.2391927]	[latitude, longitude]

A.9 LIVE DATA ACCESS

A.9.1 Dose Rate Count Rate

GET https://<ip-address>:5001/mfk/v1/measurement/doseCountRate

Returns Dose Rate and Count rate.

Available response representations:

- Example record:


```
{
 "Measurement": {
  "countDoseData": [
   {
    "detectorType": "Gamma",
    "detector": "HpGe 67mm x 52mm",
    "alarm": true,
    "alarmDescription": "Alarm",
    "startTime": "2025-03-11T13:40:26.5188593Z",
```

```
  "remark": "Maximum",
  "doseRate": [
   {
    "value": 11.4222313285426,
    "unit": "µSv/h"
   },
   {
    "value": 1.14222313285426,
    "unit": "mrem/h"
   }
  ],
  "countRate": {
   "value": 34425,
   "unit": "Cps"
  }
 },
 {
  "detectorType": "Gamma",
  "detector": "HpGe 67mm x 52mm",
  "alarm": false,
  "alarmDescription": "",
  "startTime": "2025-03-11T13:40:26.5188593Z",
  "remark": "Minimum",
  "doseRate": [
   {
    "value": 0.0279070477804792,
    "unit": "µSv/h"
   },
   {
    "value": 0.00279070477804792,
    "unit": "mrem/h"
   }
  ],
  "countRate": {
   "value": 88.9908460988179,
   "unit": "Cps"
  }
 },
 {
  "detectorType": "Gamma",
  "detector": "HpGe 67mm x 52mm",
  "alarm": true,
  "alarmDescription": "Alarm",
  "startTime": "2025-03-11T13:40:26.5188593Z",
  "remark": "Current",
  "doseRate": [
   {
    "value": 9.57600516693435,
    "unit": "µSv/h"
   },
   {
    "value": 0.957600516693435,
    "unit": "mrem/h"
   }
  ],
  "countRate": {
   "value": 29108.0544601082,
   "unit": "Cps"
  }
 },
 {
  "detectorType": "Li6F/ZnS",
```

```
      "detector": "Neutron",
      "alarm": false,
      "alarmDescription": "",
      "startTime": "2025-03-11T13:40:26.5188593Z",
      "remark": "Maximum",
      "countRate": {
       "value": 0.608272617081378,
       "unit": "Cps"
      }
     },
     {
      "detectorType": "Li6F/ZnS",
      "detector": "Neutron",
      "alarm": false,
      "alarmDescription": "",
      "startTime": "2025-03-11T13:40:26.5188593Z",
      "remark": "Minimum",
      "countRate": {
       "value": 0.0561797803307668,
       "unit": "Cps"
      }
     },
     {
      "detectorType": "Li6F/ZnS",
      "detector": "Neutron",
      "alarm": false,
      "alarmDescription": "",
      "startTime": "2025-03-11T13:40:26.5188593Z",
      "remark": "Current",
      "countRate": {
       "value": 0.12195124330756,
       "unit": "Cps"
      }
     }
    ],
    "measurementLocation": {
     "coordinates": [0, 0]
    }
   }
  }
}
```

Table 5. Live Data Access Information

Name	Type	Example	Comments
Measurement	Object		
countDoseData	Array		Contains 6 Objects with DoseRate and CountRate information with the tags below
detectorType	String	Gamma, Neutron	
detector	String	HpGe 67mm x 52mm	
alarm	Boolean	True, False	If false, no alarm description is available. Alarm is associated with the dose or the CR over-range type alarms, or personnel hazard alarms.
alarmDescription	String	Warning, Alarm	Gamma or neutron personnel hazard alarms
startTime	String	2025-03-11T13:40:26.5188593Z	Start time for the acquisition.
remark	String	Minimum, Maximum, Current	Minimum = minimum of the measured values since last clear command, Maximum = maximum of the measured values since last clear command, Current = current of the measured values since last clear command.
doseRate	Array	[object, object]	DoseRate array contains two objects. One with µSv/h and value, the second with mrem/h and the value.
value	Float	9.57600516693435	
unit	String	µSv/h, mrem/h	
countRate	Object		Count Rate contains the value and the unit cps
value	Float	0.0561797803307668	
unit	String	Cps	
measurementLocation	Object		
coordinates	Array	[latitude, longitude]	The same as returned from Instrument Status

A.10 SPECTRUM

GET https://<ip-address>:5001/mfk/v1/measurement/spectrum

Returns currently available measurement results from the DX1 ID mode. If ID mode is not on, nothing is returned.

Available response representations:

- Example record:

```
{
  "DX1 Analysis": {
    "spectrum": {
      "detectorType": "Gamma",
      "liveTime": "PT7.000000s",
      "realTime": "PT8.000000s",
      "type": "PHA",
      "sourceType": "Item",
      "detector": "HpGe 67mm x 52mm",
      "startTime": "",
      "channelData": []
    },
```

```
      "analysisResults": {
        "nuclideAnalysis": {
          "algorithmDescription": "DX1 Identification Algorithm",
          "nuclides": [],
          "algorithmVersion": "1.0.1.0"
        },
        "threatDescription": ""
      },
      "measurementLocation": {
        "coordinates": [0, 0]
      }
    }
  }
```


Table 6. Spectrum Information

Name	Type	Example	Comments
DX1 Analysis	Object		
spectrum	Object		
detectorType	String	Gamma	
liveTime	String	PT7.000000s	
realTime	String	PT8.000000s	
type	String	PHA	
sourceType	String	Item	
detector	String	HpGe 67mm x 52mm	
startTime	String		
channelData	Array	[int, int ,…]	Length is 16k fixed.
analysisResults	Object		
nuclideAnalysis	Object		
algorithmDescription	String	DX1 Identification Algorithm	
nuclides	Array		Length up to 20, contains nuclide identification objects
nuclide	Object		
nuclideName	String	“Cs-137, Co-60	
nuclideTypes	String	Threat, innocent, or suspect, …	
nuclideIDConfidenceIndication	Float	[0,1]	From 0 to 1.0. If the DX1 ID Q value is over 10.0, then the value reported here is 1,0 (for 100%)
algorithmVersion	String	1.0.1.0	ID table version
threatDescription	String	Innocent, Threat or Suspect	The “highest” threat classification is reported.
measurementLocation	Object		
coordinates	Array	[latitude, longitude]	The same as in the Status.

A.11 CALIBRATION

GET https://<ip-address>:5001/mfk/v1/calibration

Returns Calibration information.

Available response representations:

- Example record:

```
{
```

```
  "CalibrationType": {
    "equationModel": {
      "coefficients": [-0.095362, 0.18294, 8.324e-9],
      "model": "Polynomial"
    },
    "unit": "keV",
    "type": "Energy"
  }
}
```


Table 7. Calibration Information

Name	Type	Example	Comments
CalibrationType	Object		
equationModel	Object		
coefficients	Array	[-0.095362, 0.18294, 8.324e-9]	3 coefficients for energy calibration offset, slope, and shape
model	String	Polynomial	
unit	String	keV	
type	string	Energy	

The Calibration node is describing the relation between the spectrum index in the measurement spectrum node and their representing energy.

Without this relation, no expert will be able to analyze a recorded spectrum.

The 'CalibrationType' describes a channel -> energy function.

The energy unit is in 'keV'.

The function is a polynomial function:

f(channel) = a0 + a1 * channel + a2 * channel^2

The coefficients [-0.095362, 0.18294, 8.324e-9] are describing the polynomial coefficients a0, a1, and a2.

The relationship between channel index and its energy is fix for each detector and therefore it is sufficient to read once.

A.12 N42 SPECTRUM

GET https://<ip-address>:5001/mfk/v1/n4242

Returns the N42.42 (2012 format) spectrum information. The N42 call sends back a JSON with a String-object, which contains the n42.XML data. See external document Part Number 1111792 DX1 File Formats for a detailed description of the DX1 N42 file format.

Available response representations:

- Example record:
  {

"n42XML": "<?xml version=\"1.0\" encoding=\"utf-16\"?>\n<RadInstrumentData xmlns:xsi=\"http://www.w3.org/2001/XMLSchema-instance\" xmlns:xsd=\"http://www.w3.org/2001/XMLSchema\" id=\"b80e04d2-7722-4630-8e88-29f8d4cb2584\" xmlns=\"http://physics.nist.gov/N42/2011/N42\">\n <RadInstrumentDataCreatorName>ORTEC</RadInstrumentDataCreatorName>\n <RadInstrumentInformation id=\"cedc21aa-0611-41ef-a0df-2ce5440722de\">\n <RadInstrumentManufacturerName>ORTEC</RadInstrumentManufacturerName>\n <RadInstrumentIdentifier>00000024</RadInstrumentIdentifier>\n <RadInstrumentModelName>DX1</RadInstrumentModelName>\n <RadInstrumentDescription />\n <RadInstrumentClassCode>Radionuclide Identifier</RadInstrumentClassCode>\n <RadInstrumentVersion id=\"3cbb724d-f24a-4326-b238-5b5cbe4d48fd\">\n <RadInstrumentComponentName>SerialNumber</RadInstrumentComponentName>\n <RadInstrumentComponentVersion>00000024</RadInstrumentComponentVersion>\n </RadInstrumentVersion>\n </RadInstrumentInformation>\n <RadDetectorInformation id=\"HPGeDetector\">\n <RadDetectorCategoryCode>Gamma</RadDetectorCategoryCode>\n <RadDetectorKindCode>HPGe</RadDetectorKindCode>\n </RadDetectorInformation>\n <RadDetectorInformation id=\"GMT1Detector\">\n <RadDetectorCategoryCode>Gamma</RadDetectorCategoryCode>\n <RadDetectorKindCode>GMT</RadDetectorKindCode>\n </RadDetectorInformation>\n <RadDetectorInformation id=\"GMT2Detector\">\n <RadDetectorCategoryCode>Gamma</RadDetectorCategoryCode>\n <RadDetectorKindCode>GMT</RadDetectorKindCode>\n </RadDetectorInformation>\n <EnergyCalibration id=\"bd2cbc42-b3ae-4e09-98c0-c87a9821c682\">\n <CoefficientValues>0.11862999999999957 0.18271000000000015 9.242900111949837E-09 0 0 0</CoefficientValues>\n </EnergyCalibration>\n <FWHMCalibration id=\"18d208c2-405b-48d1-a39b-bc05c2cf33d3\">\n <EnergyValues>0 1500 3000</EnergyValues>\n <FWHMValues>7.1825 8.098932425000001 9.0269897</FWHMValues>\n <CalibrationDateTime>2024-12-11T11:29:33.6941014-05:00</CalibrationDateTime>\n </FWHMCalibration>\n <RadMeasurement id=\"2eb6f720-cbd4-416b-bfb6-a45a351eb0d9\" radMeasurementGroupReferences=\"\" radItemInformationReferences=\"\">\n <Remark />\n <MeasurementClassCode>Foreground</MeasurementClassCode>\n <StartDateTime>2024-12-11T16:29:33.434213Z</StartDateTime>\n <RealTimeDuration>PT0S</RealTimeDuration>\n <Spectrum id=\"21212ef7-2e80-4086-ad53-71d4c220593f\" energyCalibrationReference=\"bd2cbc42-b3ae-4e09-98c0-c87a9821c682\" FWHMCalibrationReference=\"18d208c2-405b-48d1-a39b-bc05c2cf33d3\" radDetectorInformationReference=\"HPGeDetector\">\n <Remark />\n <LiveTimeDuration>PT0S</LiveTimeDuration>\n <ChannelData compressionCode=\"CountedZeroes\">0 16384</ChannelData>\n </Spectrum>\n </RadMeasurement>\n <EnergyCalibration id=\"e0d00c7a-ccda-4ca5-bb1e-ba763f43d7db\">\n <CalibrationDateTime>0001-01-01T00:00:00</CalibrationDateTime>\n <CoefficientValues>0.11862999999999957 0.18271000000000104 9.242900222972139E-09 0 0 0</CoefficientValues>\n </EnergyCalibration>\n <FWHMCalibration id=\"95ceb1f5-61e9-405c-8531-64ff55148bef\">\n <EnergyValues>0 1500 3000</EnergyValues>\n <FWHMValues>7.1825 8.098932425000001 9.0269897</FWHMValues>\n <CalibrationDateTime>2024-11-12T10:27:13.9574955-05:00</CalibrationDateTime>\n </FWHMCalibration>\n <RadMeasurement id=\"13ff5587-e298-4405-8893-f0c24dc2d81e\" radMeasurementGroupReferences=\"\" radItemInformationReferences=\"\">\n <Remark>None</Remark>\n <MeasurementClassCode>Background</MeasurementClassCode>\n <StartDateTime>2024-11-12T15:26:12.8211577Z</StartDateTime>\n <RealTimeDuration>PT1M0.5999939S</RealTimeDuration>\n <Spectrum id=\"33b1ae78-4651-4c9b-a06b-da98eb15b05d\" energyCalibrationReference=\"e0d00c7a-ccda-4ca5-bb1e-ba763f43d7db\" FWHMCalibrationReference=\"95ceb1f5-61e9-405c-8531-64ff55148bef\" radDetectorInformationReference=\"HPGeDetector\">\n <Remark />\n <LiveTimeDuration>PT1M0.159992S</LiveTimeDuration>\n <ChannelData compressionCode=\"CountedZeroes\">…</ChannelData>\n </Spectrum>\n </RadMeasurement>\n <AnalysisResults id=\"8432c2b1-0299-4ebf-a764-2b648c5772a7\" derivedDataReferences=\"\" radMeasurementGroupReferences=\"\" radMeasurementReferences=\"2eb6f720-cbd4-416b-bfb6-a45a351eb0d9 13ff5587-e298-4405-8893-f0c24dc2d81e\">\n <AnalysisStartDateTime>2024-12-11T16:29:33.434213Z</AnalysisStartDateTime>\n <AnalysisAlgorithmName>ORTEC_SUPERID</AnalysisAlgorithmName>\n <AnalysisAlgorithmCreatorName>ORTEC</AnalysisAlgorithmCreatorName>\n <AnalysisAlgorithmVersion id=\"9ba05229-3479-49e1-b5f6-4cd7ecd02227\">\n <AnalysisAlgorithmComponentName>Main</AnalysisAlgorithmComponentName>\n <AnalysisAlgorithmComponentVersion>1.0</AnalysisAlgorithmComponentVersion>\n </AnalysisAlgorithmVersion>\n <NuclideAnalysisResults id=\"b469ad1d-c9d3-4dc4-9093-7637423947bb\" />\n </AnalysisResults>\n</RadInstrumentData>"

A.13 REMOTE CONTROL

A.13.1 Start Spectrum Acquisition

PUT https://<ip-address>:5001/mfk/v1/acq/start

> **NOTE:** The count time used for spectrum acquisition is defined by the Preset Time in Advanced Settings. If it is desired to not use a preset time, navigate to **Settings – Advanced – Collection and Analysis** and set the **Preset Time** to 0.

A.13.2 Stop Spectrum Acquisition

PUT https://<ip-address>:5001/mfk/v1/acq/stop

A.13.3 Clear Spectrum

PUT http://<ip-address>:5001/mfk/v1/acq/clear

A.14 WORKFLOW

The workflow below is somewhat arbitrary and is included herein for example only. Users can define different flows as needed based upon their specific CONOPS.

A.14.1 System Initialization

Example calling sequence:

GET https://<ip-address>:5001/mfk/v1/instrumentInformation

↓

GET https://<ip-address>:5001/mfk/v1/instrumentStatus

↓

GET https://<ip-address>:5001/mfk/v1/calibration

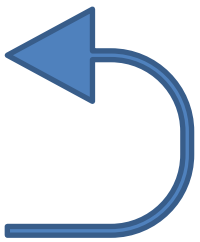
A.14.2 Dose and Count Rate Mode

Example calling sequence:

GET https://<ip-address>:5001/mfk/v1/instrumentStatus

↓

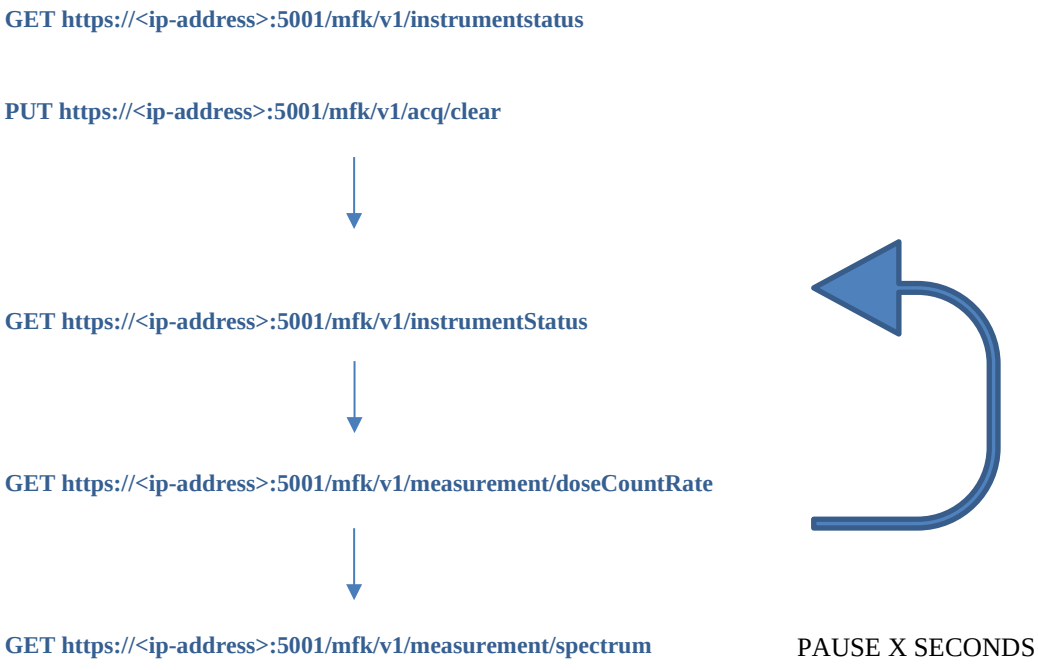
GET https://<ip-address>:5001/mfk/v1/measurement/doseCountRate



PAUSE X SECONDS

A.14.3 Start the RAPiD ID Mode

Example calling sequence:



APPENDIX B. SPECIFICATIONS AND CARE

See also Section 2.14 for additional information on the DX1's batteries and cryocooler.

B.1 DETECTORS

Nuclide Identification P-type, high-purity germanium (HPGe) crystal with coaxial construction. Crystal nominal dimensions 65 mm diameter × 50 mm length.

Cryostat and Cooler Hardened cryostat, with high-reliability, low-power Stirling cooler. The cryostat design is such that the DX1 can be switched off at any time, and power subsequently reapplied, without having to wait for a full thermal cycle (i.e., full warm-up before cooldown). This feature greatly increases system availability during measurement campaigns.

Cooldown Time The high-reliability cooler is designed for continuous operation. Between making measurements, the unit is powered from a DC supply, car battery, or other device. Initial cooldown time depends on ambient temperature, but is typically less than 6 hours at 25°C.

Gamma Dose Rate Detector Three detectors (two gm and one HPGe) determine the gamma dose rate over a wide range from >0.10 mR/h to <2 R/h. The instrument switches between the three automatically.

Neutron Detector Module The optional neutron detector is a large volume-segmented lithium-6 fluoride/zinc sulfate (Li6F/ZnS) detector that is ANSI N42.34 2021 compliant. The neutron detector has a count rate range of 0 to 15000 nps.

B.2 HARDWARE

Digital MCA and Data Processor

- **Display** 5.0-in. color IPS TFT-LCD (800 × 480 pixels), sunlight-readable, PCAP multi-touch sensitive; operates with finger or stylus
- **Data Processor** NXP i.MX 8M Plus

Data Storage

- **Media** 32GB internal memory or removable, low-profile USB flash drive. The unit is shipped with an 8 GB flash drive, which holds over 50,000 spectra
- **File Format** ANSI N42.42

Computer Interfacing USB and Ethernet TCP/IP v4 connections via standard RJ45 Ethernet connection (10/100Base-T - 10/100/1000 Mbps, autosensing). Ready for use with MFK (Mobile Field Kit for DoD users), ORTEC GammaVision, iOS devices, and Android devices. WLAN (802.11) communication software.

Wireless Connectivity IEEE 802.11 b/g/n wireless and Bluetooth 5.1

GPS The instrument is equipped with an internal GPS receiver with multiple constellation support (GPS and Galileo). The location information associated with a measurement is optionally stored in the N42 files.

Digital MCA with Internal Storage of Multiple Spectral Data

- **Digital Noise Suppression** "LFR Filter"
- **Conversion Gain** 16384 channels
- **Maximum Number of Stored Spectra** 500 files

B.3 PHYSICAL SPECIFICATIONS

Maximum Overall Dimensions

- DX1 configured without strap – 15.5in L X 5.6in W X 9.2 in H (39.4cm L x 14.3cm W x 23.2cm H)
- DX1 configured with strap – 15.5in L X 6.9in W X 9.2in H (39.4cm L x 17.5cm W x 23.2cm H)
- DX1 configured with neutron detector – 15.5in L X 6.4in W X 9.2in H (39.4cm L x 16.3cm W x 23.2cm H)

Weight 15.95 lb. (7.23 kg), gamma only; 17.35 lb. (7.87 kg) gamma/neutron

Internal Battery 2 rechargeable lithium ion, 98 Wh each, nominal. Over 8 h of battery life at 25°C when HPGe detector is cold. Internal battery is easily swapped.

External Battery Battery lifetime may be extended indefinitely by the use of optional external battery packs. An external military battery (Model 2590) weighs less than 3.25 lb. and extends lifetime to >16 hours.

Input Power 12-17 V DC from battery or DC power supply (universal mains supply included)

Power Usage Highest during cooldown and charging battery: <180 W. Cold with fully charged battery <100 W.

Operation Range

- **Temperature** −20°C to +50°C
- **Humidity** 95% non-condensing

Enclosure IP65; sealed against ingress of dust and water. All perforations (connectors, memory cards, etc.) are sealed by rubber plugs.

B.4 REGULATORY COMPLIANCE

The DX1 is compliant with the following:

1. CE/NRTL compliant in accordance with
    a. 47 CFR Part 15 Sub-Part B
    b. ANSI C63.4, ICES-001
    c. EN 61326-1:2013, EN IEC 61326-1:2021
    d. ETSI 301 489-1, ETSI 301 489-1-19, and ETSI 301
    e. 480-17
    f. EN 61000-3-2:2014
    g. EN 61000-3-3:2013
2. TAA
3. BAA
4. Berry
5. ROHS
6. ANSI N42.34-2021

B.5 COMMUNICATION SOFTWARE

The DX1 is a member of the ORTEC CONNECTIONS family. Remote MCA control, even over a network, is achieved simply by the use of ORTEC CONNECTIONS products such as MAESTRO MCA Emulation software.

Multiple spectra may be block-transferred from the instrument controller to an external PC via the USB connection. The DX1 appears as a flash drive when connected to a laptop or PC. Exported files are in the N42 format and may be read by many programs used by Reachback teams, such as CAMBIO and PeakEasy, and by ORTEC software products such as GammaVision.

The DX1 is equipped with IEEE 802.11 b/g/n wireless and Bluetooth 5.1, allowing the DX1 to be used with cell phones, laptops, and remote computer systems. The DX1 is ready to use with MFK software, ORTEC GammaVision software, iOS devices (iPhone®, iPad), and Android® devices.

B.6 MCB MODE

The MCB Mode software application enables the DX1 to communicate wired or wirelessly with ORTEC software applications such as MAESTRO, GammaVision, LVis, and Detective® Remote.

Users can develop their own applications through the use of the optional ORTEC Programmer's Toolkit (P/N A11-BW).

B.7 CLEANING INSTRUCTIONS

B.7.1 Cleaning the Exterior

- Disconnect the instrument from external power, turn off the cooler, and power off the operating system.

- Attach the caps on all power and external counter ports. Ensure the communication port cover is in place and fastened with the captive screws. Finally, make certain the battery covers are in place and fastened with their captive screws. ***Failure to secure all covers will allow water and/or dust to enter the instrument enclosure!***
- Remove loose dust on the outside of the instrument with a lint-free cloth.
- Remove remaining dirt with a lint-free cloth dampened in a mild detergent and water solution. ***Do not use abrasive cleaners.***
- Dry the instrument with a towel and turn on the computer and cooler.
- ***Allow the instrument to dry completely*** before reconnecting it to the external power supply.

B.7.2 Cleaning the Fan Compartment

The external cooling fan is in a sealed chamber to prevent water ingress through this area, and the fan itself is sealed to prevent damage from water. If the DX1 has been used in salt spray or extremely dusty conditions, follow these instructions to remove the residue by pouring a small amount of water through the fan chamber:

- Disconnect the instrument from external power, turn off the cooler, and power off the operating system.
- POUR small to moderate amounts of water through the fan chamber. ***Do not use pressurized water, as with a hose; and DO NOT IMMERSE!***
- ***Allow the instrument to dry completely*** before turning on the operating system and cooler, then reconnect it to the external power supply.

B.8 REPLACING THE LI-ION BATTERIES

The typical service life of the DX1's Li-ion batteries is 3-5 years. When the internal batteries no longer maintain a charge for a significant period, they must be replaced. Replacements are available from ORTEC as part number DX1-ACC-BAT. *It is strongly recommended to replace the batteries in pairs.*

After replacing the batteries (unless they have been pre-charged), the DX1 must be connected to external power for 3-4 hours to fully charge the new batteries. Return the old batteries to ORTEC for recycling. For more information, contact an ORTEC representative or ORTEC's Global Service Center.

B.9 SPARE PARTS AND ACCESSORIES

Table 8. Spart Parts and Accessories

Part Number	Description
DX1-ACC-2590-CABLE	DX1, Battery Cable from Military 2590 Battery
DX1-ACC-BAT	DX1, Lithium-Ion Battery
DX1-ACC-COL-ST	DX1, Steel Collimator 4mm Thick
DX1-ACC-COL-W	DX1, Tungsten Collimator 4mm Thick
DX1-ACC-DUAL-CHGR	DX1, Standalone Dual Battery Charger and Calibrator
DX1-ACC-DUST-COVER	DX1, Dust Cover
DX1-ACC-EXT-BATT	DX1, External Battery, Chrg, and Cbl
DX1-ACC-MANUAL	DX1, User's Manual
DX1-ACC-MOUNT-BRKT	DX1, Vertical Mounting BRKT for Tripod
DX1-ACC-NEUTRON-DETECTOR	DX1, Neutron Detector
DX1-ACC-PS	DX1, Universal AC Mains Power
DX1-ACC-RCFILTER	DX1, Low Energy Gamma Filter
DX1-ACC-RESERVE-COVER	DX1, Connector Dust Cap 12mm
DX1-ACC-STYLUS	DX1, Stylus
DX1-ACC-TH-CAL	DX1, Thoriated Tungsten Electrodes
DX1-ACC-TRANSPORTCASE	DX1, Wheeled Transport Case
DX1-ACC-TRIPOD	DX1, Variable Length Tripod
DX1-ACC-TRIPOD-WITH-BRKT	DX1, Variable Length Tripod with Vertical Mounting BRKT
DX1-ACC-USBFLASH	DX1, USB Mini Flash Drive
DX1-ACC-VEHCHGR	DX1, Vehicle Powered Adapter Cable

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APPENDIX C. NUCLIDE ID TABLE

The following table lists the default DX1 innocent and threat radionuclide identifications for library Version 9.3.5. Note that the user can optionally change the status of innocent nuclides to threat status (but not vice versa), as discussed in Section 8.

Table 9. Nuclide ID Table

ID String	Classification	Priority	Sub-Classification
2235 keV peak present	Threat	1	Other
Ac-225	Innocent	3	Medical
Ac-227	Innocent	2	Industrial
Ag-110m	Innocent	2	Industrial
Am-241	Threat	1	Industrial
Am-241 (shielded)	Threat	1	Plutonium
Am-241 (unshielded)	Threat	2	Industrial
Ar-41	Innocent	2	Industrial
As-72	Innocent	2	Industrial
As-74	Innocent	3	Medical
At-211	Innocent	3	Other
Au-198	Innocent	3	Industrial
Ba-133	Innocent	2	Industrial
Ba-140	Innocent	2	Industrial
Be-7	Innocent	2	Industrial
Beta emitter	Innocent	1	Bremsstrahlung
Bi-207	Innocent	2	Other
Bi-212 (Th-232/U-232 daughter)	Innocent	2	Industrial
Bi-214 (Ra-226 daughter)	Innocent	4	NORM
Br-76	Innocent	2	Other
Br-76 (heavily shielded)	Innocent	2	Other
Br-76 (shielded)	Innocent	2	Other
Br-77	Innocent	2	Industrial
Ca-47	Innocent	2	Industrial
Cd-109	Innocent	2	Other
Cd-115	Innocent	2	Industrial
Ce-139	Innocent	3	Medical
Ce-141	Innocent	3	Medical
Ce-144	Innocent	2	Industrial
Cf-252/Cf-249	Threat	1	Other
Cm-242	Innocent	2	Industrial

ID String	Classification	Priority	Sub-Classification
Cm-243	Innocent	2	Industrial
Cm-244	Innocent	2	Industrial
Co-55	Innocent	2	Industrial
Co-56	Innocent	2	Other
Co-56 (shielded)	Innocent	2	Other
Co-57	Innocent	2	Industrial
Co-57 (shielded)	Innocent	2	Industrial
Co-58	Innocent	3	Medical
Co-60	Innocent	2	Industrial
Cr-51	Innocent	3	Other
Cs-131	Innocent	3	Medical
Cs-134	Innocent	2	Industrial
Cs-137	Innocent	2	Industrial
Cu-64	Innocent	3	Other
Cu-67/Ga-67	Innocent	3	Medical
Elevated Radiation	Threat	1	Other
Enriched Uranium	Threat	1	Uranium
Eu-152	Innocent	3	Other
Eu-154	Innocent	3	Other
Eu-155	Innocent	2	Other
Eu-156	Innocent	2	Other
F-18	Innocent	3	Medical
Fe-59	Innocent	3	Other
Ga-64	Innocent	2	Other
Ga-64 (shielded)	Innocent	2	Other
Ga-67	Innocent	3	Medical
Ga-67 (shielded)	Innocent	3	Medical
Gd-153	Innocent	3	Other
Gd-159	Innocent	2	Other
Ge-68/Ga-68	Innocent	3	Medical
HEU	Threat	1	Uranium
Hf-181	Innocent	2	Industrial
Hg-203	Innocent	2	Industrial
Ho-166	Innocent	2	Other
Ho-166m	Innocent	2	Industrial
Ho-166m (shielded)	Innocent	2	Industrial
I-123	Innocent	3	Medical
I-123 (shielded)	Innocent	3	Medical
I-124	Innocent	3	Medical

ID String	Classification	Priority	Sub-Classification
I-125	Innocent	3	Medical
I-126	Innocent	2	Industrial
I-126 (shielded)	Innocent	2	Industrial
I-131	Innocent	3	Medical
I-131 (shielded)	Innocent	3	Medical
I-132	Innocent	2	Industrial
I-133	Innocent	2	Industrial
I-134	Innocent	2	Industrial
I-135	Innocent	2	Industrial
In-111	Innocent	3	Medical
Ir-192	Innocent	2	Industrial
Ir-192 (shielded)	Innocent	2	Industrial
Ir-194 (shielded)	Innocent	2	Other
K-40	Innocent	4	NORM
Kr-87	Innocent	2	Industrial
Kr-88	Innocent	2	Industrial
Kr-88 (shielded)	Innocent	2	Industrial
La-138	Innocent	4	NORM
La-140	Innocent	2	Other
Lu-172	Innocent	2	Medical
Lu-176	Innocent	4	NORM
Lu-177	Innocent	3	Medical
Lu-177m	Innocent	3	Medical
Mn-52	Innocent	2	Industrial
Mn-54	Innocent	2	Other
Mn-56	Innocent	2	Industrial
Mo-99	Innocent	3	Medical
Na-22	Innocent	3	Other
Na-24	Innocent	3	Medical
Nb-92m	Innocent	2	Industrial
Nb-94	Innocent	2	Industrial
Nb-95	Innocent	2	Industrial
Nb-96	Innocent	2	Industrial
Nb-96 (shielded)	Innocent	2	Industrial
Nd-147	Innocent	2	Industrial
Neutrons	Threat	1	Neutron
Neutrons on Al	Threat	1	Other
Neutrons on Boron	Threat	1	Other

ID String	Classification	Priority	Sub-Classification
Neutrons on Fe	Threat	1	Other
Neutrons on Hydrogen	Threat	1	Other
Neutrons on Pb	Threat	1	Other
Neutrons or H.E. Gammas	Threat	1	Other
Np-237	Threat	1	Neptunium
Os-194/Ir-194	Innocent	2	Other
Pa-231	Innocent	2	Industrial
Pb-203	Innocent	2	Industrial
Pd-103	Innocent	3	Medical
Po-210	Innocent	2	Other
Pr-144	Innocent	2	Industrial
Pu-238	Threat	1	Plutonium
Pu-239	Threat	1	Plutonium
Ra-223	Innocent	2	Industrial
Ra-226	Innocent	4	NORM
Rb-83	Innocent	3	Medical
Rb-86	Innocent	3	Medical
Rh-105	Innocent	2	Industrial
Ru-103	Innocent	2	Industrial
Ru-106/Rh-106	Innocent	3	Medical
Ru-97	Innocent	2	Industrial
Sb-124	Innocent	2	Industrial
Sb-124 (shielded)	Innocent	2	Industrial
Sb-125	Innocent	2	Industrial
Sb-127	Innocent	2	Industrial
Sc-46	Innocent	3	Medical
Se-75	Innocent	3	Medical
Sm-153	Innocent	3	Medical
Sm-153 (shielded)	Innocent	3	Medical
Sn-113	Innocent	2	Other
Sr-82/Rb-82	Innocent	3	Medical
Sr-85/Kr-85	Innocent	2	Industrial
Sr-89	Innocent	3	Medical
Ta-182	Innocent	2	Other
Tc-96	Innocent	2	Industrial
Tc-99m	Innocent	3	Medical
Te-132	Innocent	2	Industrial
Th-229	Innocent	2	Industrial
Th-230	Innocent	2	Industrial

ID String	Classification	Priority	Sub-Classification
Th-232	Innocent	4	Thorium
Tl-200	Innocent	2	Other
Tl-201	Innocent	3	Medical
Tl-202	Innocent	3	Other
Tl-204	Innocent	2	Medical
Tm-170	Innocent	3	Medical
Tm-171	Innocent	2	Industrial
U-232	Threat	1	Uranium
U-233	Threat	1	Uranium
U-235	Threat	1	Uranium
U-238	Threat	1	Uranium
Unknown Peak	Threat	1	Other
V-48	Innocent	3	Medical
W-187	Innocent	2	Industrial
W-188/Re-188	Innocent	2	Industrial
Xe-127	Innocent	2	Industrial
Xe-131m	Innocent	3	Other
Xe-133	Innocent	3	Medical
Xe-133m	Innocent	3	Medical
Xe-135	Innocent	2	Other
Y-88	Innocent	3	Other
Y-91	Innocent	2	Industrial
Yb-169	Innocent	3	Medical
Zn-62	Innocent	3	Medical
Zn-65	Innocent	3	Medical
Zr-95	Innocent	3	Medical

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APPENDIX D. TROUBLESHOOTING

D.1 DX1 APPLICATION STOPS

The DX1 incorporates an embedded operating system. Occasionally, the operating system will stop responding to external commands. Press and hold the power button until the DX1 shuts down; this will take 15-20 seconds (the mechanical cooler will continue running). Press and hold the power button for 3 seconds to turn on the DX1. This will reset the operating system and automatically relaunch the DX1 Home screen (or the default application declared, if applicable).

D.2 DX1 WAS DROPPED

Although it is a precision scientific instrument, the DX1 has been designed for field use in the most challenging conditions and should survive reasonable levels of mechanical abuse. It has been drop-tested to destruction in development and is known to have a high degree of survivability to "normal" shock and vibration.

If the instrument is dropped:

- Inspect the exterior for evidence of mechanical damage or distortion.
- Listen to the cooler: If any unusual noises are heard (rattling or pinging) from the cooler, contact an ORTEC representative or ORTEC's Global Service Center.
- Cycle the unit's power as follows: Disconnect from any external power source, disconnect any USB connection, and press and hold the On/Off button. Acknowledge the shutdown message. Wait 30 seconds, then turn the unit back on. This should reset any mechanical relays that may have been deactivated by the drop.
- If the mechanical relays do not reset, it may be necessary to remove battery power as well. Repeat the shutdown procedure. Once the instrument has turned off, open the battery compartments and remove both batteries (see Section 2.5). Wait 30 seconds, then reassemble the unit and turn the instrument back on.
- Monitor the unit for the next few hours to ensure that the display reads **Status: READY** (indicating that the cooler, bias voltage, and gain stabilizer are functioning properly). If gain stabilizer errors are indicated, perform a calibration as described in Section 4.8.

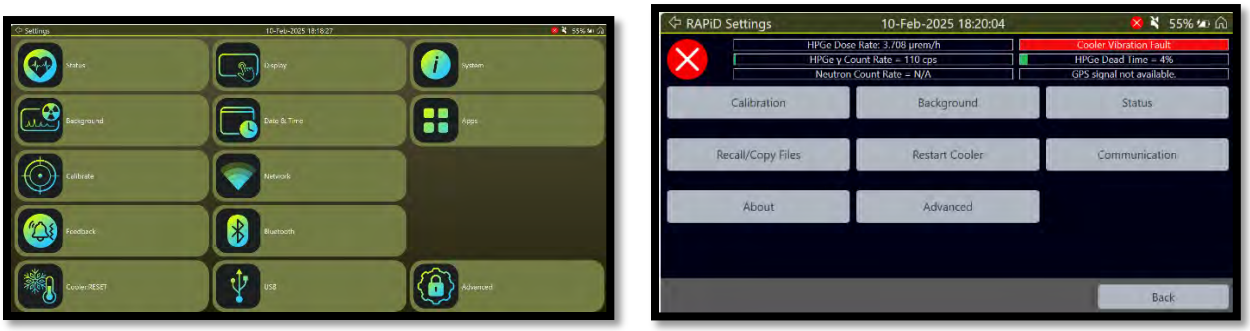
If the unit fails in one or more of these respects, or if one or more hardware diagnostic settings indicate a hardware failure, contact an ORTEC representative or ORTEC's Global Service Center for assistance.

Remember that there are no user-serviceable parts inside the DX1 and opening the case will void the warranty.

D.3 SUDDEN COOLER FAILURE

If the DX1 receives a vibration error, the cooler will automatically shut down. A vibration error could be caused by bumping or jarring the detector or inserting a collimator with too much force. With a

vibration error, the cooler will turn off but the RIID software packages will continue to think the cooler is operational. When the cooler error occurs, the instrument will go silent and the typical fan noises of the cooler will no longer be heard. The DX1 will automatically attempt to restart the cooler up to 3 times within one hour. If after the 3rd restart the cooler shuts down again, the cooler will remain off. The counting functions will automatically stop and a Cooler Vibration Fault error will be displayed. Navigate to the Settings application (or if in RAPiD navigate to RAPiD Settings). The Cooler On/Off button will display that the cooler needs to be RESET. Tap the Cooler button and the cooler should restart. The user can now resume normal operation of the instrument.



Settings Application RAPiD Settings

Figure 232. Reset Cooler Error

If after resetting the cooler it continues to turn off or the cooler begins making unusual sounds, the unit has an actual cooler failure and should be returned to the factory for repair.

D.4 DX1 WILL NOT TURN ON

Connect the DX1 to an external power source and attempt to turn it on by pressing and holding the Power button for about 5 seconds. If this fails, contact ORTEC's Global Service Center for assistance.

D.5 FORGOT THE PASSCODE

There is no master passcode. Contact an ORTEC representative or ORTEC's Global Service Center for assistance.

D.6 PEAK CENTROID, FWHM, OR CALIBRATION ADJUSTMENT VALUE HAS CHANGED DRAMATICALLY SINCE THE LAST CALIBRATION

This is a highly unlikely occurrence. The DX1 is an advanced digital design and is highly stable when operating correctly.

- If the energy calibration appears highly variable, contact ORTEC's Global Service Center or an ORTEC representative. Changes on the order of 0.1% are to be expected. This might simply be due to counting statistics in the spectrum. A change much larger than this, say 0.5%, bears investigation. Apparent changes in the reported FWHM calibration are most likely to be statistical variations. If the (gain) calibration adjustment value is stable, the unit is functioning properly.

- If large changes in the calibration continue to occur, contact ORTEC's Global Service Center or an ORTEC representative.

D.7 GPS ISSUES

D.7.1 Delayed Display of Location Coordinates

If the GPS has not received signals from GPS satellites for >30 days (e.g., if it has not been in use or has been used continuously indoors), it may take 10-15 minutes outdoors for the unit to update and begin displaying location information.

D.7.2 "GPS Not Communicating"

This message is displayed if the DX1 software loses contact with the GPS unit. Contact an ORTEC representative or ORTEC's Global Service Center.

NOTE	GPS signals typically do not penetrate buildings, so the DX1 will not reliably collect location information indoors.

D.8 COIN BATTERY DEAD ALARM

In case of power loss, the DX1 has an internal coin battery that maintains the memory functions that contain the system settings. This coin battery has a life span of approximately 5-7 years. When the system detects the battery is in need of replacement, a "Coin battery dead!" error message will be displayed. This error message does not prevent the user from being able to take readings with the instrument. However, the instrument will need to be returned to the factory as soon as possible to have the battery replaced.

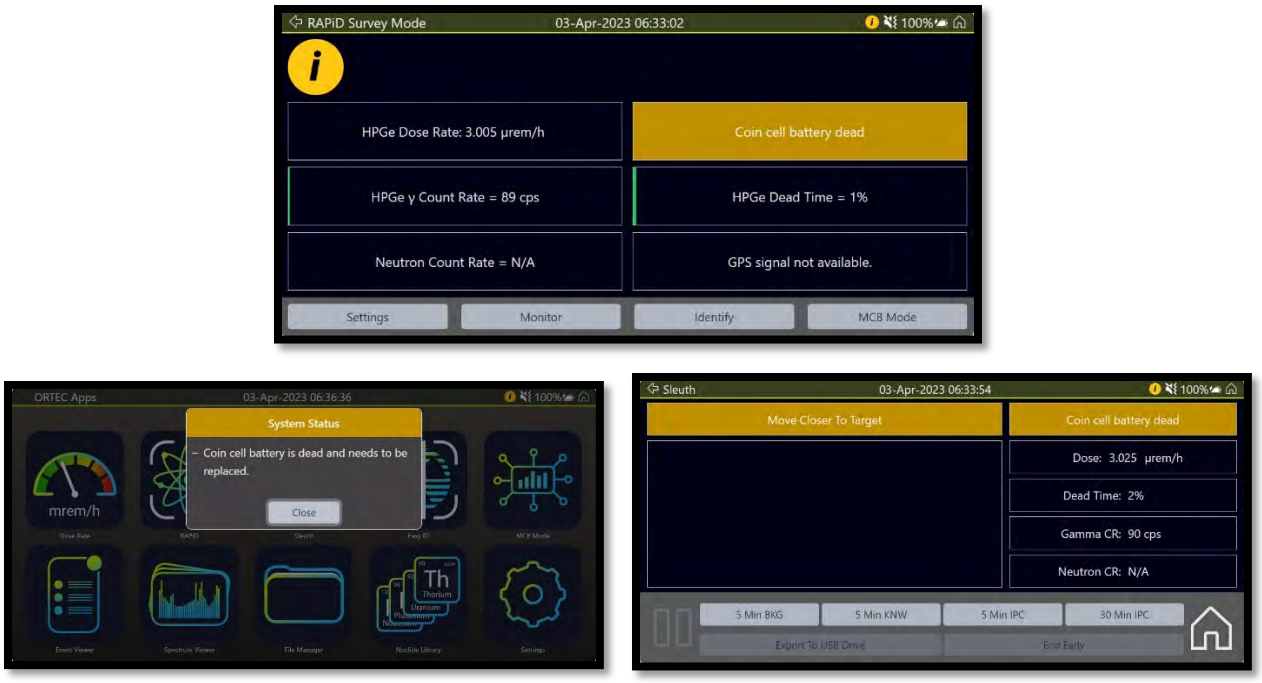


Figure 233. Coin Battery Dead Warning Examples

APPENDIX E. CALIBRATION INSTRUCTIONS USING TUNGSTEN WELDING ELECTRODES P/N DX1-ACC-TH-CAL FOR THE DX1

Thoriated tungsten welding electrodes are a safe, convenient, and reliable very low activity source of gamma rays for use in calibrating a DX1. A high energy line at 2614.5 keV is ideal for this purpose because of its high energy allowing calibration to be interpolated for lower energy lines rather than extrapolated.

E.1 ADDING TH-232 TO THE CALIBRATION SOURCES TABLE

1. Click on the **Settings** button and then select the **Advanced** button to open the advanced settings. Enter the passcode if required.
2. Select **Energy Calibration Settings** button to open the Calibration settings screen (see Figure 112).
3. Click the **Edit List** button to open the Calibration sources list (see Figure 113). Tap the **Add** button. Add Th-232 with an energy of 2614.5 keV by tapping in the New Nuclide cell. Once complete, click the **OK** button.
4. Select the Calibration Source dropdown and select the Th-232 source that was added. Select **Back** to return to the Advanced Settings screen.

E.2 CALIBRATING THE DX1 USING THE THORIUM WELDING ELECTRODES (TH-232) P/N DX1-ACC-TH-CAL

1. Place the Thorium Electrodes, P/N DX1-ACC-TH-CAL, in front of the instrument in a position to maximize the gamma count rate.
2. Tap **Settings**, if not already in the settings screen, to open the Settings screen. Then tap the **Calibrate** button to enter the Calibration screen (see Figure 66).
3. Tap **Start**. The acquisition will begin, and the spectrum will be displayed.
4. When enough counts have been accumulated to accurately determine the centroid of the Th-232 peak (may take several minutes), the system will report the degree of adjustment necessary. Tap **Apply Calibration** to complete the process.

NOTE	If the **Back** button is tapped before tapping **Apply Calibration**, the old calibration will be retained, and the new one will be discarded.

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APPENDIX F. MCB COMMANDS

This section lists each command with a description of its operation.

F.1 ERROR CODES

On each completion of the command, the MCB returns a macro error code and micro error code. The macro error code represents the general class of error with 0 meaning no error, and the micro error code represents the sub-class of error with 0 meaning no error. In case of error condition, users can use the **MIOGetLastError** (DLL interface) or **GetErrMajor**, **GetErrMinor** (ActiveX control interface). Though syntax and communication error responses may result from any command, in practice these error responses rarely occur on systems with reliable communication hardware running debugged software.

Table 10. Macro Error Codes

0	Success
1	Power-up just occurred
2	Battery-backed data lost
129	Command syntax error
131	Command execution error
132	Invalid command

Table 11. Macro Code 129 (Syntax Error) or 131 (Execution Error)

1	Invalid verb
2	Invalid noun
4	Invalid modifier
128	Invalid first parameter
129	Invalid second parameter
130	Invalid third parameter
131	Invalid fourth parameter
132	Invalid number of parameters
133	Invalid Command
134	Response buffer too small
135	Not applicable while active
136	Invalid command in this mode
137	Hardware error
138	Requested data not found

Table 12. Micro Error Codes

0	Success
1	Input already started/stopped
2	Preset already exceeded
4	Input not started/stopped
64	Parameter was rounded (for decimal numbers)
128	No sample data available

F.2 PERCENT RESPONSE RECORDS

The MCB API responds to all commands with a percent response record that signifies the completion of the command. Percent response records contain two error code numbers and a 1-byte checksum as follows:

%aaabbbccc<CR>

where % represents the ASCII % character, **aaa** represents the macro error code, **bbb** represents the micro error code, **ccc** represents the checksum and <CR> represents the ASCII carriage return character signifying the end of the record. The macro error code represents the general class of error with 0 meaning no error, and the micro error code represents the sub-class of error with 0 meaning no error. Following is a list of all percent responses for the DX1.

Unconditional Success:

%000000069<CR> No errors detected. Command executed as specified.

%000005074<CR> Device already started or stopped. The START or STOP command was ignored.

%000006075<CR> Device preset already exceeded. The START command was ignored.

%000016076<CR> START requested but amplifier not pole zeroed since last power-up. START was attempted anyway.

%000032074<CR> START requested but high voltage not enabled START was attempted anyway.

%000064079<CR> Specified parameter was rounded to the closest legal value.

Note that the above responses can be combined to indicate a combination of warnings such as:

%000048081<CR> Amplifier was not pole zeroed nor was high voltage enabled. The START was attempted anyway.

%000037079<CR> Device already started and high voltage not enabled. The command was ignored.

%000053077<CR> Device already started, high voltage not enabled, and amplifier was not pole zeroed. The command was ignored.

%000038080<CR> Device preset already exceeded and high voltage not enabled. The command was ignored.

%000054078<CR> Device preset already exceeded, high voltage not enabled, and amplifier was not pole zeroed. The command was ignored.

Power-Up Alert: Power-up just occurred and the self-test results are:

%001000070<CR> All power-up self-test passed.

%003000072<CR> Battery backed-up data lost.

Command Syntax Errors:

%129001082<CR> Invalid command verb.

%129002083<CR> Invalid command noun.

%129003084<CR> Invalid command verb and noun.

%129004085<CR> Invalid command modifier.

%129005086<CR> Invalid command verb and modifier.

%129006087<CR> Invalid command noun and modifier.
%129007088<CR> Invalid command verb, noun, and modifier.
%129132087<CR> Invalid command (verb, noun, and modifier valid but not together).

Communication Errors:
%130128084<CR> Command checksum incorrect (only when optional checksum provided).

Execution Errors:
%131128085<CR> Invalid 1st command parameter.
%131129086<CR> Invalid 2nd command parameter.
%131130078<CR> Invalid 3rd command parameter.
%131132080<CR> Invalid number of command parameters.
%131134082<CR> Invalid device or segment selected.
%131135083<CR> Command not allowed while acquisition in progress.
%131136084<CR> Command not allowed in current mode of operation.
%131137085<CR> Hardware failure detected while processing command.

F.3 DOLLAR RESPONSE RECORDS

SHOW and STEP commands respond with a single dollar response record followed immediately by a percent response record. All valid dollar response records for each command are listed in the command dictionary.

The following list provides the general form of each dollar response record for the MCB API. In this list, lower case letters represent numeric values. The letters "**ccc**" always represent an 8-bit unsigned checksum of all characters on the record up to but not including the checksum characters, and **<CR>** represents the ASCII carriage return character.

$Axxxccc<CR> xxx is a single 8-bit unsigned number.
$Cxxxxxccc<CR> xxxxx is a single 16-bit unsigned number.
$Dxxxxxyyyyyccc<CR> xxxxx and yyyyy are 16-bit unsigned numbers.
$Exxxxxccc<CR> xxxxx is a single 16-bit alarm mask.
$Fssss...<CR> ssss... is a variable length ASCII character sequence (no checksum is sent with this record).
$Gxxxxxxxxxxccc<CR> xxxxxxxxxx is a single 32-bit unsigned number.
$IT<CR> True response to a SHOW command (no checksum).
$IF<CR> False response to a SHOW command (no checksum).
$Jxxxxxyyyyy...ccc<CR> Response to SHOW_CONFIGURATION command.
$Mxxxxxxxxxx...ccc<CR> Response to SHOW_STATUS command.
$Nxxxyyyzzzccc<CR> xxx, yyy, and zzz are 8-bit unsigned numbers.

F.4 COMMAND LIST

The commands are listed in alphabetical order, each starting with a command prototype line. Uppercase letters, numeric digits, blank space, and special symbols such as the underscore "_" and comma "," in the prototype line are *literal text to be sent to the MCB exactly as they appear*. Lowercase letters in the protype line represent numeric values as described in the accompanying text;

they should not be sent literally to the MCB but should be replaced by an appropriate numeric value. In this section, the term <**CR**> represents the ASCII carriage return character, decimal value13; and the character "_" represents the ASCII underscore character, decimal value 95.

CLEAR
The channels of spectral data are set to zero. The live time and true time counters are also set to zero. This command is equivalent to the combination of CLEAR_COUNTER and CLEAR_DATA commands.

CLEAR_ALL
This command is equivalent to the combination of CLEAR_COUNTER, CLEAR_DATA, CLEAR_PRESETS, and CLEAR_ROI commands.

CLEAR COUNTER
The live time and true time counters are set to zero.

CLEAR_DATA
The channels of spectral data are set to zero. The ROI flags are not changed, nor are the presets changed.

CLEAR_HV_HEALTH
Clears (resets) the state-of-health bits

CLEAR_PRESETS
The live time, true time, ROI integral, ROI peak, and overflow presets are all set to zero (disabled).

CLEAR_ROI start_chan, number_of_chans
Clears the ROI flags for the specified channels.

DISABLE_BLRE_AUTOMATIC
Disables the automatic determination of baseline restorer time constant. See also ENABLE_BLRE_AUTOMATIC, SET_BLRE, and SHOW_BLRE.

DISABLE_GAIN_STABILIZATION
Stops stabilization of the gain peak while data is being acquired. The gain stabilization adjustment is held at its current value until either gain stabilization is reenabled with the ENABLE_GAIN_STABILIZATION command or reinitialized with the INITIALIZE_GAIN_STABILIZATION, or SET_GAIN_WIDTH command. See also SHOW_GAIN_STABILIZATION.

DISABLE_HV
Turns off the high voltage enable signal of the instrument. See the section on the bias supply for more information about the high-voltage output. See also ENABLE_HV and SHOW_HV.

DISABLE_LFR
Returns the instrument to normal operation if the LFR (Low-Frequency Rejector) filter is enabled. See also ENABLE_LFR and SHOW_LFR

DISABLE_PZ_AUTOMATIC
Disables the automatic pole zero mode. See also ENABLE_PZ_AUTO.

DISABLE_ZERO_STABILIZATION
Stops stabilization of the zero peak while data is being acquired. The zero stabilization adjustment is held at its current value until either zero stabilization is reenabled with the ENABLE_ZERO_STABILIZATION command or reinitialized with the INITIALIZE_ZERO_STABILIZATION, SET_ZERO_CHANNEL, or SET_ZERO_WIDTH commands. See also SHOW_ZERO_STABILIZATION.

ENABLE_BLRE_AUTOMATIC
Enables the automatic determination of baseline restorer time constant. See also DISABLE_BLRE_AUTOMATIC, SHOW_BLRE, and SET_BLRE.

ENABLE_GAIN_STABILIZATION
Enables the stabilization of the gain peak by the previously selected method, either Gauss mode or point mode. See also DISABLE_GAIN_STABILIZATION, SHOW_GAIN_STABILIZATION, and INITIALIZE_GAIN_STABILIZATION.

ENABLE_HV
Turns on the high voltage enable output of the instrument. See also DISABLE_HV and SHOW_HV.
Execution Errors:

%131137085<CR> The high voltage could not be enabled due to a high voltage shutdown condition.

ENABLE_LFR
Sets the instrument to LFR (Low-Frequency Rejector) mode. See also DISABLE_LFR and SHOW_LFR.

ENABLE_PZ_AUTOMATIC
Enables the automatic pole zero mode. See also DISABLE_PZ_AUTO.

ENABLE_ZERO_STABILIZATION
Enables the stabilization of the zero peak by the previously selected method, either Gauss mode or point mode. Prior to implementing this command, users must set the zero channel with SET_ZERO_CHANNEL and set the zero width with SET_ZERO_WIDTH. See also DISABLE_ZERO_ STABILIZATION, SHOW_ZERO_STABILIZATION, and INITIALIZE_ZERO_STABILIZATION.

INITIALIZE
Returns the instrument to the factory default settings. Caution this command may take up to 15 seconds to complete and the instrument will be rebooted and will lose connection between the instrument and the computer.
Execution Errors:
The INITIALIZE command simulates a power-down/power-up cycle for the MCB after a simulated loss of battery-backed-up memory.
Response:
%003000072<CR> MCB Power-up occurred/Memory lost/No self-test errors (Normal Response for INITIALIZE command).

INITIALIZE_GAIN_STABILIZATION
Resets the gain peak stabilization adjustment to unity (no adjustment). This value is reported as 0 by the SHOW_GAIN_ADJUSTMENT command. See also SET_GAIN_ADJUSTMENT, ENABLE_GAIN_ STABILIZATION, and DISABLE_GAIN_ STABILIZATION.

INITIALIZE_ZERO_STABILIZATION
Resets the zero peak stabilization adjustment to unity (no adjustment). This value is reported as 0 by the SHOW_ZERO_ADJUSTMENT command. See also SET_ZERO_ ADJUSTMENT, ENABLE_ZERO_STABILIZATION, and DISABLE_ZERO_STABILIZATION.

LIST_BLRE
Lists the valid settings of the baseline restore function.

LIST_CORR_FLAT
Lists the valid settings of the flattop width.

LIST_GAIN_COARSE
Lists the valid coarse-gain settings.

LIST_GAIN_FINE
Lists the valid fine-gain settings.

LIST_HV
Lists the valid high-voltage settings.

LIST_ROI_SAMPLE
Lists the valid ROI sample settings.

LIST_SHAP_CUSP
Lists the valid cusp shape settings.

LIST_SHAP_FLAT
Lists the valid flattop width settings.

LIST_SHAP_RISE
Lists the valid rise-time settings.

LIST_SHUT
Lists the valid shutdown settings.

SET_BLRE
This sets the baseline restorer time constant to the value baseline. Baseline is in micro-seconds with a range from 10 to 100. The specified value is only used if automatic baseline restorer mode is disabled. See also ENABLE_BLRE, DISABLE_BLRE, and SHOW_BLRE.

SET_DATA [start, chans], value
If the optional start and chans parameters are included in this command, the range of channels specified by start and chans is loaded with value. If start and chans are not specified, sets all channels of spectral data to the specified value. ROI flags are not affected.

SET_DATA_APPLICATION "string1", "string2"
This is used to store information in the instrument internal memory that can be used by other programs, such as sample descriptions and energy calibrations. The Unified MCB Interface (UMCBI) structure and ORTEC CONNECTIONS make use of this feature. String1 = the data identifier, 32 bytes maximum; string2 = the data, 128 bytes maximum.

SET_DATE day, month, year
Sets the date stored in the battery backed-up system clock to the specified values. Day can be any value from 1–31; month any value from 1–12; and year any value from 0–99. The current date and time are stored for a device when an acquisition is started. Note if the Set Date and Time functionality in the settings application is set to automatically adjust the time, users will get an execution error for the response to this command. Also note that the time zone selected in the Settings application will be the time zone used for this command. See also SHOW_ DATE, SET_TIME, and SHOW_TIME. The entry format is dd,mm,yy. Example: Date = September 21, 2021 so the Entry should be 21, 09, 21

SET_DATE_START day, month, year
Sets the start date to the specified values. Normally the start date and time are set automatically whenever a device is started with the START command. See also SHOW_DATE_START, SET_TIME_START, and SHOW_TIME_START. The entry format is dd,mm,yy. Example: Date = September 21, 2021, so the Entry should be 21, 09, 21

SET_GAIN_ADJUSTMENT value
Sets the gain stabilization adjustment to an arbitrary value from -65535 to 65535. This adjustment is usually made only by the gain stabilizer and reset to 0 with the INITIALIZE_GAIN_STABILIZATION command. See also SHOW_GAIN_ADJUSTMENT.

SET_GAIN_CHANNEL chan

Sets the center channel for the stabilizer gain peak. If a gain channel is chosen such that the beginning channel or ending channel would be below channel 0 or above the maximum channel as determined by the conversion gain, the gain peak width is reduced until the peak fits the device boundaries. A gain channel and width must be set before gain stabilization can be enabled.

SET_GAIN_COARSE num

This sets the coarse gain to num, which must be 1, 2, 4, 8, 16, or 32. See also SHOW_ GAIN_COARSE.

SET_GAIN_CONVERSION chans

Sets the conversion gain. The conversion gain defines the number of channels within the device that will used for spectral data. This has the effect of altering the resolution of the ADC from 15 bits (conversion gain = 32768) to 9 bits (conversion gain = 512) for the device. See also SHOW_GAIN_CONVERSION.

Legal Commands:

SET_GAIN_CONVERSION 0<CR>	Conversion gain set to default (16384).
SET_GAIN_CONVERSION 512<CR>	Conversion gain set to 512 channels.
SET_GAIN_CONVERSION 1024<CR>	Conversion gain set to 1024 channels.
SET_GAIN_CONVERSION 2048<CR>	Conversion gain set to 2048 channels.
SET_GAIN_CONVERSION 4096<CR>	Conversion gain set to 4096 channels.
SET_GAIN_CONVERSION 8192<CR>	Conversion gain set to 8192 channels.
SET_GAIN_CONVERSION 16384<CR>	Conversion gain set to 16384 channels.

SET_GAIN_FINE value

Sets the fine gain to value. Value is a floating point value from 0.45 to 1.0. See also SHOW_GAIN_FINE.

SET_GAIN_NEGATIVE

Sets the amplifier input polarity to negative.

SET_GAIN_POSITIVE

Sets the amplifier input polarity to positive.

SET_GAIN_PRESET count

Sets the Gauss mode stabilization preset for the gain peak. The preset represents the minimum number of incremental counts that must be collected in any one channel of the gain peak before the gain is evaluated by the stabilizer and potentially adjusted. See also SHOW_ GAIN_PRESET.

SET_GAIN_WIDTH chans
Sets the width in channels for the stabilizer gain peak. The gain width must be chosen such that the beginning channel is no lower than channel 0 and the ending channel is no higher than the maximum channel as determined by the conversion gain. The gain channel and width must be set before gain stabilization can be enabled. The absolute minimum width for the gain peak is 3 channels, and the absolute maximum width for the gain peak is 256 channels in Gauss mode. In point mode there is no maximum peak width, though the chosen width must allow the peak to fit within the device's channel limits as stated above. See also SHOW_GAIN_WIDTH, SET_GAIN_CHANNEL and SHOW_GAIN_CHANNEL.

SET_HV value
This sets the HV bias to value, in volts.

SET_INTEGRAL_PRESET count
Sets the ROI integral preset to the specified count. During data acquisition when the sum of the counts contained in the channels that have the ROI flag set reaches the integral preset count, the preset is complete, and the acquisition is stopped. The actual number of counts in the ROI integral may exceed the preset value by up to 512 counts due to the pipelined architecture of the instrument. Setting an integral preset to 0 counts disables the preset. The integral preset may be set to from 0 (disabled) to 4294967295 counts. See also CLEAR_ PRESETS and SHOW_INTEGRAL_PRESET.

SET_LIVE ticks
Sets the live-time counter to the specified number of ticks. The number represents live time in units of 20 ms (50 ticks/s). Normally this value is set by the instrument during data acquisition. See also CLEAR_COUNTERS and SHOW_LIVE.

SET_LIVE_PRESET ticks
Sets the live-time preset to the specified number of ticks (20 ms/tick). During data acquisition when the live-time counter reaches the preset number of ticks, the preset is complete and the acquisition is stopped. The preset should always be set to a multiple of 1 second. Setting a live-time preset to 0 ticks disables the preset. See also CLEAR_PRESETS and SHOW_ LIVE_PRESET.

SET_LLD chan
Sets the lower level discriminator to chan, which must be between 0 and 16383. See also SHOW_LLD.

SET_MODE_PHA
The mode is set to PHA.

SET_MODE_SAMPLE
Starts InSight Virtual Oscilloscope mode.

SET_PEAK_PRESET count

Sets the ROI peak preset to the specified count. During data acquisition when the contents of any channel of a device that has the ROI flag set reaches the peak preset count, the preset is complete, and the acquisition is stopped. The actual number of counts in the ROI peak may exceed the preset value by a small number of counts due to the pipelined architecture of the instrument. Setting a peak preset to 0 counts disables the preset. The peak preset may be set to from 0 (disabled) to 2147483647 counts. See also CLEAR_PRESETS and SHOW_ PEAK_PRESET.

SET_PZ num

This sets the pole zero to num, which must be between 0 and 4095. See also SHOW_PZ, DISABLE_PZ_AUTOMATIC, and ENABLE_PZ_AUTOMATIC.

SET_ROI start_chan,number_of_chans

Sets the ROI flags for the specified channels. This command can be used multiple times to set ROI flags without affecting previously set flags. ROI flags specify channels within a device that are considered for ROI integral and ROI peak presets.

SET_ROI_SAMPLE num

Selects which controls signals are displayed as an ROI on the captured waveform. Only a single bit can be turned on at a time. The following signals can be selected with the associated bit.

Bit 0: Pileup reject.
Bit 1: Negative baseline threshold.
Bit 2: Baseline restorer gate.
Bit 3: Positive baseline threshold.
Bit 4: Busy.
Bit 5: Gate.
Bit 6: Reserved.
Bit 7: Peak detect.
Bit 8: Reserved.

SET_SHAP_FLAT value

Sets the width of the flattop to value. Value is in microseconds, ranging from 0.3 to 2.4 in steps of 0.1. See also SHOW_SHAP_FLAT.

SET_SHAP_RISE value

Sets the rise time to value. Value is in microseconds, ranging from 0.2 to 23 in steps of 0.2. See also SHOW_SHAP_RISE.

SET_TIME hour,min,sec

Sets the time stored in the battery backed-up system clock to the specified values. hour can be any value from 0–23; min and sec can be any value from 0–59. The current date and time are stored for a device when an acquisition is started. Note if the Set Date and Time functionality in the settings application is set to automatically adjust the time, users will get an execution error for the response to this command. Also note that the time zone selected in the Settings application will be the time zone used for this command. See also SHOW_TIME, SET_DATE, SHOW_DATE, SET_TIME_START, and SHOW_TIME_START.

SET_TIME_START hour,min,sec
Sets the start time to the specified values. Normally the start date and time are set automatically whenever a device is started with the START command. See also SHOW_TIME_START, SET_DATE_START, SHOW_DATE_START, SET_DATE, and SET_TIME.

SET_TRUE ticks
Sets the true-time counter to the specified number of ticks. The number represents true time in units of 20 ms (50 ticks/sec). Normally this value is set by the instrument during data acquisition. See also SHOW_TRUE.

SET_TRUE_PRESET ticks
Sets the true-time preset to the specified number of ticks (20 ms/tick). During data acquisition when the true-time counter reaches the preset number of ticks, the preset is complete, and the acquisition is stopped. Setting a true-time preset to 0 ticks disables the preset. The preset should always be set to a multiple of one second. See also CLEAR_PRESETS and SHOW_TRUE_PRESET.

SET_ULD value
This sets the upper level discriminator to value, in channels.

SET_ZERO_ADJUSTMENT value
Sets the zero stabilization adjustment to an arbitrary value from -65535 to 65535. The total range of the adjustment value represents ±256 channels. This adjustment is usually only made by the gain stabilizer and reset to 0 with the INITIALIZE_ZERO_STABILIZATION command. See also SHOW_ZERO_ADJUSTMENT.

SET_ZERO_CHANNEL chan
Sets the center channel for the stabilizer zero peak. If a zero channel is chosen such that the beginning channel or ending channel would be below channel 0 or above the maximum channel, as determined by the conversion gain, the zero peak width is reduced until the peak fits the device boundaries. A zero channel and width must be set before zero stabilization can be enabled. See also ENABLE_ZERO_ STABILIZATION.

SET_ZERO_PRESET count
Sets the Gauss mode stabilization preset for the zero peak. The preset represents the minimum number of incremental counts that must be collected in any one channel of the zero peak before the zero offset is evaluated by the stabilizer and potentially adjusted. See also SHOW_ZERO_PRESET.

SET_ZERO_WIDTH chans
Sets the width in channels for the stabilizer zero peak. The zero width must be chosen such that the beginning channel is no lower than channel 0 and the ending channel is no higher than the maximum channel as determined by the conversion gain. The zero channel and width must be set before zero stabilization can be enabled. The absolute minimum width for the zero peak is 3 channels, and the absolute maximum width for the zero peak is 256 channels in Gauss mode. In point mode there is no maximum peak width, though the chosen width must allow the peak to fit within the device's channel limits as stated above.

SHOW_ACTIVE

Returns a 1 if the instrument is active (i.e., acquiring spectral data) or 0 if it is not active.

Responses:

$C00000087<CR> Not active.
$C00001088<CR> Active.

SHOW_BLRE

Shows the baseline restorer time constant in microseconds. See also SET_BLRE.

Responses:

BLUE 000000000000091 Time constant is 91 µs.

SHOW_BLRE_AUTOMATIC

Shows whether automatic selection of the baseline restorer constant is off or on.

Responses:

$IT<CR> Automatic baseline is enabled.
$IF<CR> Automatic baseline is disabled.

SHOW_CORRECTION_FLAT

Shows the flattop correction value.

Responses:

CORR_FLAT 000000000000000

SHOW_CRM

Returns the current reading of the count-rate meter.

Response:

$G0000050781096 Current input count rate is 50781 counts/s.

SHOW_DATA_APPLICATION "string"

If string matches "string1" in a previous SET_DATA_APPLICATION command, then string2 from that command is returned. The response is a $F record.

SHOW_DATE

Returns the day, month, and year of the current date as maintained in the battery-backed-up real time clock, in the form dddmmmyyy. The day is returned as a 3-digit integer number from 001–031, month as a 3-digit integer number from 001–012, and year as a 3-digit integer number from 000–099. See also SET_DATE_START.

Responses:

$N001001088052<CR> Date reported as Jan 1, 1988.
... **...**
$N031012099059<CR> Date reported as Dec 31, 1999.
$N001001000036<CR> Date reported as Jan 1, 2000.
... **...**
$N031012087056<CR> Date reported as Dec 31, 2087.

SHOW_DATE_START

Returns the day, month and year of the acquisition start date in the form dddmmmyyy. The day is returned as a 3-digit integer number from 001–031, month as a 3-digit integer number from 001–012, and year as a 3-digit integer number from 000–099. See also SET_DATE_ START.

Responses:

$N001001088052 <CR> Date reported as Jan 1, 1988

... **...**

$N031012099059<CR> Date reported as Dec 31, 1999

$N001001000036<CR> Date reported as Jan 1, 2000

$N031012087056<CR> Date reported as Dec 31, 2087

SHOW_DET_SNUM

This command responds with the detector serial number stored in the DIM.

Response:

$FP40175 Serial number P40175.

SHOW_FEATURES

Responds with four 32-bit masks indicating which features are present in the MCB.

Example Response:

FEATURES 00003774783 01083064332 00195036416 00017089673

SHOW_GAIN_ADJUSTMENT

Returns the gain-stabilize amplifier setting.

SHOW_GAIN_CHANNEL

Reports the current center channel for the stabilizer gain peak. See also SET_GAIN_CHANNEL.

Responses:

$C00000087<CR> Gain channel has not been set.

$C00002089<CR> Gain channel is channel 2 (lowest possible channel).

... **...**

$C16382107<CR> Gain channel is channel 16382 (highest possible channel).

SHOW_GAIN_COARSE

Returns the coarse gain for the instrument internal amplifier. In operation, the resulting signal gain is the product of the coarse gain, the fine gain, and the super-fine gain (used by stabilizer). The coarse gain is returned in terms of an integer gain multiplier.

Responses:

$C00001088<CR> Coarse gain reported as 1.

$C00002089<CR> Coarse gain reported as 2.

$C00004091<CR> Coarse gain reported as 4.

$C00008095<CR> Coarse gain reported as 8.

$C00016094<CR> Coarse gain reported as 16.

$C00032092<CR> Coarse gain reported as 32.

SHOW_GAIN_CONVERSION

This command returns the conversion gain.

Responses:

$C00512095<CR> Conversion gain reported as 512 channels.
$C01024094<CR> Conversion gain reported as 1024 channels.
$C02048101<CR> Conversion gain reported as 2048 channels.
$C04096106<CR> Conversion gain reported as 4096 channels.
$C08192107<CR> Conversion gain reported as 8192 channels.
$C16384109<CR> Conversion gain reported as 16384 channels.

SHOW_GAIN_FINE

Returns the current fine gain setting. See SET_GAIN_FINE.

Sample Response:

GAIN_FINE 0000000000000.5 Gain is 0.5.

SHOW_GAIN_POLARITY

Returns the polarity of the amplifier input as $F records.

Responses:

$INEG<CR> The amplifier input is set to negative.
$IPOS<CR> The amplifier input is set to positive.

SHOW_GAIN_PRESET

Reports the Gauss mode stabilization preset for the gain peak. The preset represents the minimum number of incremental counts that must be collected in any one channel of the gain peak before the gain is evaluated by the stabilizer and potentially adjusted. See also SET_GAIN_PRESET and CLEAR_PRESETS.

Responses:

$G0000000010076<CR> Gain preset currently 10 counts (minimum).
$G0000000011076<CR> Gain preset currently 11 counts.
... **...**
$G2147483647121<CR> Gain preset currently 2147483647 counts (maximum).

SHOW_GAIN_STABILIZATION

Reports the state of gain peak stabilization. See also ENABLE_GAIN_STABILIZATION and DISABLE_GAIN_STABILIZATION.

Responses:

$IT<CR> Gain stabilization is currently enabled.
$IF<CR> Gain stabilization is currently disabled.

SHOW_GAIN_WIDTH

Reports the current width for the stabilizer gain peak. See also SET_GAIN_WIDTH, SET_GAIN_CHANNEL, and SHOW_GAIN_CHANNEL.

Responses:

$C00001088<CR> Gain width has not been set.
$C00003089<CR> Gain width is 3 channels (lowest possible width).
$C00256100<CR> Gain width is 256 channels (highest possible width in Gauss mode).
... **...**
$C16383108<CR> Gain width is 16383 channels (highest possible width in point mode with gain channel set to 8192).

SHOW_HV

Reports the current high voltage and the status of the high voltage power supply in the form:

$Dvvvvvssssccc<CR>

Where vvvvv represents the current output voltage if the high voltage is enabled, or the rear-panel high voltage setting if the high voltage is disabled. sssss represents the status of the high voltage bias supply as a 16-bit decimal number with the following bit definitions:

Bit 0 (LSB): Bias supply polarity (0=positive, 1=negative).
Bit 1: Bias supply overload (0=overload, 1=normal).
Bit 2: High voltage enabled (0=disabled, 1=enabled).

Example Responses:

$D0200000003077<CR> 2000 V, negative, not overloaded, disabled.
$D0200000002076<CR> 2000 V, positive, not overloaded, disabled.
$D0200000007082<CR> 2000 V, negative, not overloaded, enabled.

SHOW_HV_ACTUAL

Returns the value of HV actually on the detector.

SHOW_HV_HEALTH

Returns the status of the state of health for the detector as reported by the DIM or SMART-1.

SHOW_HV_TARGET

Under normal operation, the HV will go to this value when the HV is enabled. Reports the current HV setting (see SET_HV) and the status of the HV power supply in the form:

$Dvvvvvssssccc<CR>

where **vvvvv** represents the HV setting, and **sssss** represents the status of the HV bias supply as a 16-bit decimal number with the following bit definitions:

Bit 0 (LSB): Bias supply polarity (0=positive, 1=negative).
Bit 1: Bias supply overload (0=overload, 1=normal).
Bit 2: HV enabled (0=disabled, 1=enabled).

Example Responses:

$D0200000003077<CR> 2000 V, negative, not overloaded, disabled.
$D0200000002076<CR> 2000 V, positive, not overloaded, disabled.
$D0200000007082<CR> 2000 V, negative, not overloaded, enabled.

SHOW_HV_POLARITY

This returns the HV polarity setting in the instrument as a $F record.

Responses:

$FNEG<CR> The HV is set to negative.
$FPOS<CR> The HV is set to positive.

SHOW_INTEGRAL [start_chan, number_of_chans]

Reports the sum of the specified group of spectral data channels. If start_chan and number_of_chans is not provided, SHOW_INTEGRAL reports the sum of all channels in the currently selected segment that have their ROI flag set.

Responses:

$G0000000000075<CR>	Integral reported as 0.
...	**...**
$G4294967294131<CR>	Integral reported as 4294967294.
$G4294967295132<CR>	Integral reported as greater than or equal to 4294967295 (maximum reportable value).

SHOW_INTEGRAL_PRESET

Reports the current ROI integral preset value. For more information about the ROI integral preset, see SET_INTEGRAL_PRESET. See also SHOW_INTEGRAL.

Responses:

$G0000000000075<CR>	Integral preset reported as 0.
...	**...**
$G4294967295132<CR>	Integral reported as 4294967295.

SHOW_INTEGRAL_REMAINING

Reports the current ROI integral remaining value. For more information about the ROI integral remaining, see SET_INTEGRAL_REMAINING. See also SHOW_INTEGRAL.

Responses:

$G0000000000075<CR>	Integral remaining reported as 0.
...	**...**
$G4294967295132<CR>	Integral reported as 4294967295.

SHOW_LENGTH_SAMPLE

Reports the number of points in the Insight Mode Waveform.

Response:

$C010000088 1000 points in the waveform.

SHOW_LFR

Tells whether LFR (Low-Frequency Rejector) mode is enabled.

Responses:

$IF LFR mode disabled.
$IT LFR mode enabled.

SHOW_LIVE

Reports the contents of the live-time counter in units of 20 ms (50 ticks/s). See also CLEAR_COUNTERS and SET_LIVE.

Responses:

$G0000000000075<CR> Live time reported as 0 ticks.
$G0000000001076<CR> Live time reported as 1 tick (20 ms).
... **...**
$G4294967295132<CR> Live time reported as 4294967295 ticks (over 23000 days).

SHOW_LIVE_PRESET

Reports the current live-time preset in units of 20 ms (50 ticks/s). See also CLEAR_ PRESETS and SET_LIVE_PRESET.

Responses:

$G0000000000075<CR> Live-time preset reported as disabled.
$G0000000001076<CR> Live-time preset reported as 1 tick.
... **...**
$G4294967295132<CR> Live-time preset reported as 4294967295 ticks.

SHOW_LIVE_REMAINING

Reports the current live-time remaining in units of 20 ms (50 ticks/s). See also SET_LIVE_REMAINING.

Responses:

$G0000000000075<CR> Live-time remaining reported as disabled.
$G0000000001076<CR> Live-time remaining reported as 1 tick.
... **...**
$G4294967295132<CR> Live-time remaining reported as 4294967295 ticks.

SHOW_LLD

Shows the lower level discriminator setting. See also SET_LLD.

Responses:

$C00050092 The LLD is 50.

SHOW_MODE

Reports the current mode of operation (PHA or Sample [InSight Virtual Oscilloscope]). See also SET_MODE_PHA and SET_MODE_SAMPLE.

Responses:

$FPHA<CR> PHA mode.
$FSAM<CR> Sample mode (InSight).

SHOW_MONI_LABEL num

Returns with an ASCII string label designation for the monitor num.

SHOW_MONI_MAX

Returns with the number of monitors available for viewing.

SHOW_MONI_VALUE num

Returns with an ASCII representation of the value for the monitor.

SHOW_NEXT

Used in conjunction with the SHOW_ROI command, SHOW_NEXT reports the next continuous group of channels that have the ROI flag set. The response is of the form:

$Dsssssnnnnnccc

where sssss represents an integer number that is the number of the first channel of the "next" group of channels that all have their ROI bit set, and nnnnn represents an integer number that is the number of channels in the group. If no more channels have their ROI bit set, SHOW_NEXT returns a first channel of 0 and a number of channels of 0. The SHOW_ROI command is used to report the "first" group of channels that all have their ROI bit set.

Example Responses:

$D0100000050078<CR>	Next ROI group starts at channel 1000 and is 50 channels long.
$D0215000150086<CR>	Next ROI group starts at channel 2150 and is 150 channels long.
$D0000000000072<CR>	No other ROI groups to report.

SHOW_PEAK

This command returns the contents of the ROI channel with the largest number of counts. An ROI channel is a channel that has the ROI flag set. The maximum possible value is 2147483647, which is the maximum number of counts that can be stored in a 31-bit channel.

Responses:

$G0000000000075<CR>	Maximum count in an ROI channel is zero or no ROI channels were found.
$G0000000001076<CR>	Maximum count in an ROI channel is 1.
...	**...**
$G2147483646120<CR>	Maximum count in an ROI channel is 2147483646.
$G2147483647121<CR>	Maximum count in an ROI channel is 2147483647.

SHOW_PEAK_CHANNEL

This command returns the number of the ROI channel with the largest number of counts. An ROI channel is a channel that has the ROI flag set. The lowest number ROI channel with the largest count is reported if more that one channel contains the largest number of counts. Channel 32767 is the highest numbered channel in any device.

Responses:

$C00000087<CR>	Maximum count was found in channel 0 or no ROI channels were found (see errors below).
$C00001088<CR>	Maximum count was found in channel 1.
...	**...**
$C16383108<CR>	Maximum count was found in channel 16383.

SHOW_PEAK_PRESET

Reports the value of the ROI peak preset. See SET_PEAK_PRESET for information about the ROI peak preset.

Responses:

$G0000000000075<CR> Peak preset disabled.
$G0000000001076<CR> Peak preset set to 1 count.
... **...**
$G2147483646120<CR> Peak preset set to 2147483646 counts.
$G2147483647121<CR> Peak preset set to 2147483647 counts.

SHOW_PZ

Displays the PZ setting. See also SET_PZ.

Responses:

PZ_ENA 002200 Pole zero enabled and set to 2200.
PZ_DIS 001000 Pole zero disabled and set to 1000.

SHOW_RATE_ZDT

Not used; included for backward compatibility.

SHOW_ROI

Used in conjunction with the SHOW_NEXT command, SHOW_ROI reports the first continuous group of channels that have the ROI flag set. The response is of the form

$Dsssssnnnnnccc

where sssss represents an integer number that is the number of the first channel of the “first” group of channels that all have their ROI bit set, and nnnnn represents an integer number that is the number of channels in the group. The SHOW_NEXT command is used to report the “next” group of channels that all have their ROI bit set.

Responses:

$D0100000050078<CR> First ROI group starts at channel 1000 and is 50 channels long.
$D0215000150086<CR> First ROI group starts at channel 2150 and is 150 channels long.
$D0000000000072<CR> No ROI groups to report.

SHOW_ROI_SAMPLE

Displays the ROI Sample setting. See also SET_ROI_SAMPLE.

Responses:

$C00001088

SHOW_SHAP_FLAT

Reports the width of the flattop in µs. See also SET_SHAP_FLAT.

Responses:

SHAP_FLAT 0000000000001.2

SHOW_SHAP_RISE

Displays the rise-time setting in µs. See also SET_SHAP_RISE.

Responses:

SHAP_RISE 0000000000003.2

SHOW_SHUTDOWN

Shows the type of HV shutdown selected (only SMART-1) is available.

Responses:

$F0SMA SMART-1 mode selected

SHOW_SHUT_ACTUAL

Returns the current status of the bias remote shutdown input signal. This command is valid whether the bias supply is turned on or off.

Responses:

$IT Shutdown is active (supply is shut down or can't be turned on).

$IF Shutdown is inactive (supply is on or can be turned on).

SHOW_SNUM

Responds with a $F record indicating the serial number of the instrument.

Response:

$F100 Serial number is 100.

SHOW_STATUS

Returns system status information in the following format:

$Mlllllllllltttttttttaaaaahhhhhccc

where **lllllllll** represents the live time as returned by the SHOW_LIVE command, **ttttttttt** represents the true time for the current device as returned by the SHOW_TRUE command, **aaaaa** represents the active device mask as returned by the SHOW_ACTIVE_DEVICES command, and **hhhhh** represents the hardware status, which is an ASCII representation of a 16 bit decimal number with the following bit definitions:

Bit 0 (LSB): Bias supply polarity (0=positive, 1=negative)
Bit 1: Bias supply overload (0=overload, 1=normal)
Bit 2: High voltage enabled (0=disabled, 1=enabled)
Bit 3: Unused
Bit 4: Amplifier PZ'd since initialization (0=normal, 1=needs PZ'ing)
Bit 5: Optimization since initialization (0=normal, 1=needed)
Bits 6–7: Unused
Bit 8: Amplifier automatic PZ (1=Auto PZ in progress, 0=normal)
Bit 9: Optimization (0=normal, 1=in progress)
Bits 10–14: Unused
Bit 15 (MSB): Reserve

SHOW_TIME

Reports the time from the battery backed-up system clock in the form

$Nhhhmmmssccc

where hhh represents a 3-digit integer hour (0-23), mmm represents a 3-digit integer minute (0-59), and sss represents a 3-digit integer second (0-59). See also SET_TIME, SET_DATE, and SHOW_DATE.

Example Responses:

$N010054017052<CR> Time returned 10:54:17 (10 h, 54 min, 17 s).
$N020013037050<CR> Time returned 20:13:37 (20 h, 13 min, 37 s).

SHOW_TIME_START

Reports the time of the last START command in the form

$Nhhhmmmssccc

where hhh represents a 3-digit integer hour (0-23), mmm represents a 3-digit integer minute (0-59) and sss represents a 3-digit integer second (0-59). See also SET_TIME_START, SET_DATE_START, and SHOW_DATE_START.

Example Responses:

$N010054017052<CR> Time returned 10:54:17 (10 h, 54 min, 17 s).
$N020013037050<CR> Time returned 20:13:37 (20 h, 13 min, 37 s).

SHOW_TRIG_SAMPLE

Reports the trigger source in Insight Mode.

Responses:

$F0LLD LLD is source.
$F1PKD Peak-detect is source.
$F2RANDOM Trigger happens randomly.
$F3Gate Gate Input triggers the waveform.

SHOW_TRUE

Reports the contents of the true-time counter in units of 20 ms (50 ticks/s). See also SET_TRUE.

Responses:

$G0000000000075<CR> True time reported as 0 ticks.
$G0000000001076<CR> True time reported as 1 tick (20 ms).
... **...**
$G4294967295132<CR> True time reported as 4294967295 ticks (over 23000 days).

SHOW_TRUE_PRESET

Reports the current true-time preset in units of 20 ms (50 ticks/s). See also CLEAR_PRESETS and SET_TRUE_PRESET.

Responses:

$G0000000000075<CR> True time preset reported as disabled.
$G0000000001076<CR> True time preset reported as 1 tick.
... **...**
$G4294967295132<CR> True time preset reported as 4294967295 ticks.

SHOW_TRUE_REMAINING

Reports the current true time remaining in units of 20 milliseconds (50 ticks per second).

Responses:

$G0000000000075<CR> True time remaining reported as disabled.
$G0000000001076<CR> True time remaining reported as 1 tick.
... **...**
$G4294967295132<CR> True time remaining reported as 4294967295 ticks.

SHOW_ULD

Returns the value of the ULD in channels, as a $C record.

SHOW_VERSION

Reports the instrument firmware version number in the form:

Fmmmm-vvv

where mmmm is a 4-character model designator and vvv is a 3-character version designator.

Example Responses:

$FDETH–005<CR> Firmware version 5 reported.

SHOW_ZDT

No function in the instrument; included for backward compatibility.

SHOW_ZERO_ADJUSTMENT

Returns the value of the zero offset for the zero stabilizer.

SHOW_ZERO_CHANNEL

Reports the center channel for the stabilizer zero peak. See also SET_ZERO_CHANNEL, SET_ZERO_WIDTH, and SHOW_ZERO_WIDTH.

Responses:

$C00000087<CR> Zero channel has not been set.
$C00002089<CR> Zero channel is channel 2 (lowest possible channel).
... **...**
$C16382107<CR> Zero channel is channel 16382 (highest possible channel).

SHOW_ZERO_PRESET

Reports the Gauss mode stabilization preset for the zero peak. The preset represents the minimum number of incremental counts that must be collected in any one channel of the zero peak before the zero offset is evaluated by the stabilizer and potentially adjusted. See also SET_ZERO_PRESET and CLEAR_PRESETS.

Responses:

$G0000000010076<CR> Zero preset currently 10 counts (minimum).
$G0000000011076<CR> Zero preset currently 11 counts.
... **...**
$G2147483647121<CR> Zero preset currently 2147483647 counts (maximum).

SHOW_ZERO_STABILIZATION

Reports the state of zero peak stabilization. See also ENABLE_ZERO_STABILIZATION and DISABLE_ZERO_STABILIZATION.

Responses:

$IT<CR> Zero stabilization is currently enabled.
$IF<CR> Zero stabilization is currently disabled.

SHOW_ZERO_WIDTH

Reports the current width for the stabilizer zero peak. See also SET_ZERO_WIDTH, SET_ZERO_CHANNEL, and SHOW_ZERO_CHANNEL.

Responses:

$C00001088<CR> Zero width has not been set.
$C00003089<CR> Zero width is 3 channels (lowest possible width).
... **...**
$C00256100<CR> Zero width is 256 channels (highest possible width in Gauss mode).
... **...**
$C16383108<CR> Zero width is 16383 channels (highest possible width in point mode with zero channel set to 8192).

START [seg-mask]

Starts the acquisition of spectral data. The optional segment mask is provided for compatibility with other MCBs and may be any value from 0 to 65535 but is ignored by the instrument.

STOP [seg-mask]

Stops the acquisition of spectral data. The optional segment mask is provided for compatibility with other MCBs and may be any value from 0 to 65535 but is ignored.

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APPENDIX G. RADIO MODULE

This section contains information about the DX1 radio module.

G.1 FCC DOCUMENTATION

Federal Communication Commision Interference Statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not used in accordance with the instructions, may cause harmful interference to radio communications.

However, there is no guarantee that interference will not occur in an installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

This device complies with Part 15 of the FCC Rules.

FCC Radiation Exposure Statement

This product complies with the US portable RF exposure limit set forth for an uncontrolled environment and is safe for intended operation as described in this manual. Further, RF exposure reduction can be achieved if the product is kept as far as possible from the user body.

G.2 CANADIAN DOCUMENTATION

This radio transmitter (IC: 5969A-1003) was approved by Innovation, Science and Economic Development (ISED) Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Le présent émetteur radio (IC: 5969A-1003) a été approuvé par Innovation, Sciences et Développement économique Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal. Les types d'antenne non inclus dans cette liste, et dont le gain

est supérieur au gain maximal indiqué pour tout type figurant sur la liste, sont strictement interdits pour l'exploitation de l'émetteur.

This device complies with Industry Canada's license-exempt RSSs. Operation is subject to the following two conditions:

1. This device may not cause interference; and
2. This device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

1. l'appareil ne doit pas produire de brouillage;
2. l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement

Radiation Exposure Statement

The product complies with the Canada portable RF exposure limit set forth for an uncontrolled environment and are safe for intended operation as described in this manual. The minimum separation distance for portable use is limited to 15mm assuming use of antenna with 2 dBi of gain. The further RF exposure reduction can be achieved if the product can be kept as far as possible from the user body or set the device to lower output power if such function is available.

Déclaration d'exposition aux radiations:

Le produit est conforme aux limites d'exposition pour les appareils portables RF pour les Etats-Unis et le Canada établies pour un environnement non contrôlé. La distance de séparation minimale pour l'utilisation portative est limitée à 15mm en supposant l'utilisation de l'antenne avec 2 dBi de gain. Le produit est sûr pour un fonctionnement tel que décrit dans ce manuel. La réduction aux expositions RF peut être augmentée si l'appareil peut être conservé aussi loin que possible du corps de l'utilisateur ou que le dispositif est réglé sur la puissance de sortie la plus faible si une telle fonction est disponible.

ISED ICES-003 Issue 7 Compliance Declaration

This device was originally tested to the requirements of ICES-003 Issue 6, Information Technology Equipment (Including Digital Apparatus) – Limits and Methods of Measurement; and evaluated to the updates published in ICES-003, Issue 7, Information Technology Equipment (Including Digital Apparatus). Based on this evaluation, this product continues to observe compliance to the requirements set forth by The Innovation, Science and Economic Development Canada (ISED), and complies with the updates published in ICES-003, Issue 7, Information Technology Equipment (Including Digital Apparatus).

G.3 JAPANESE DOCUMENTATION

The Sterling-LWB is approved for use in the Japanese market.

G.4 AUSTRALIAN AND NEW ZELAND DOCUMENTATION

RCM: Compliant to standards EN 300 328 V1.9.1, AS/NZS 4268: 2012-A1:2013, and EN 55022:2010/AC:2011

G.5 UKCA DOCUMENTATION

This product conforms to UKCA regulations under UK Legislation:

- Radio Equipment Regulations 2017
- Electromagnetic Compatibility Regulations 2016
- Electrical Equipment (Safety) Regulations 2016

Using the following reference standards for conformity:

Legislation	Requirement	Reference Standard(s)
Safety	Low voltage equipment safety	EN 62368-1:2020/A11:2020
	RF Exposure	IEC 62311, Edition 2 (2019)
EMC	Protection requirements – Electromagnetic compatibility	EN 301 489-1 v2.2.3 EN 301 489-17 v3.2.4
Radio Equipment	Means of the efficient use of the radio frequency spectrum (ERM)	EN 300 328 v2.2.2

G.6 EUROPEAN DOCUMENTATION

The Sterling-LWB was tested for compliance with relevant standards for the EU market.

This device complies with the essential requirements of the 2014/53/EU – Radio Equipment Directive (RED). The following test methods have been applied in order to prove presumption of conformity with the essential requirements of the 2014/53/EU – Radio Equipment Directive (RED):

- **EN 62368-1:2014/A11:2017**
  Safety requirements for audio/video, information, and technology equipment

- **EN 300 328 v2.2.2 (2019-07)**
  Electromagnetic compatibility and Radio Spectrum Matters (ERM); Wideband Transmission systems; Data transmission equipment operating in the 2,4 GHz ISM band and using spread spectrum modulation techniques; Harmonized EN covering essential requirements under article 3.2 of the R&TTE Directive

- **EN 62311:2008 | EN 50665:2017 | EN 50385:2017**
  RF exposure

- **EN 301 489-1 v2.2.0 (2017-03)**
  Electromagnetic compatibility and Radio Spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements

- **EN 301 489-17 V3.2.0 (2017-03)**
  Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 17: Specific conditions for 2,4 GHz wideband transmission systems and 5 GHz high performance RLAN equipment

- **EU 2015/863 (RoHS 3)**
  Declaration of Compliance – EU Directive 2015/863; Reduction of Hazardous Substances (RoHS)

Table 13. EU Declaration of Compliance

български [Bulgarian]	С настоящото ORTEC декларира, че това устройство DX1 е в съответствие със съществените изисквания и други приложими разпоредби на Директиви 2014/53/ЕС
Hrvatski [Croatian]	ORTEC ovim putem izjavljuje da je ovaj uređaj DX1 sukladan osnovnim zahtjevima i ostalim bitnim odredbama Direktiva 2014/53/EU
Česky [Czech]	ORTEC tímto prohlašuje, že tento DX1 je ve shodě se základními požadavky a dalšími příslušnými ustanoveními směrnice 2014/53/EU.
Dansk [Danish]	Undertegnede ORTEC erklærer herved, at DX1 overholder de væsentlige krav og øvrige relevante krav i direktiv 2014/53/EU.
Deutsch [German]	Hiermit erklärt ORTEC, dass sich das Gerät DX1 in Übereinstimmung mit den grundlegenden Anforderungen und den übrigen einschlägigen Bestimmungen der Richtlinie 2014/53/EU befindet.
Eesti [Estonian]	Käesolevaga kinnitab ORTEC seadme DX1 vastavust direktiivi 2014/53/EL põhinõuetele ja nimetatud direktiivist tulenevatele teistele asjakohastele sätetele.
English	Hereby, ORTEC, declares that this DX1 is in compliance with the essential requirements and other relevant provisions of Directive 2014/53/EU.
Español [Spanish]	Por medio de la presente ORTEC declara que el DX1 cumple con los requisitos esenciales y cualesquiera otras disposiciones aplicables o exigibles de la Directiva 2014/53/UE.
Ελληνική [Greek]	ΜΕ ΤΗΝ ΠΑΡΟΥΣΑ ORTEC ΔΗΛΩΝΕΙ ΟΤΙ DX1 ΣΥΜΜΟΡΦΩΝΕΤΑΙ ΠΡΟΣ ΤΙΣ ΟΥΣΙΩΔΕΙΣ ΑΠΑΙΤΗΣΕΙΣ ΚΑΙ ΤΙΣ ΛΟΙΠΕΣ ΣΧΕΤΙΚΕΣ ΔΙΑΤΑΞΕΙΣ ΤΗΣ ΟΔΗΓΙΑΣ 2014/53/ΕΕ.
Français [French]	Par la présente ORTEC déclare que l'appareil DX1 est conforme aux exigences essentielles et aux autres dispositions pertinentes de la directive 2014/53/UE.
Islenska [Icelandic]	Hér, ORTEC, því yfir að þetta DX1 tæki er í samræmi við grunnkröfur og önnur viðeigandi ákvæði tilskipana 2014/53/ ESB
Italiano [Italian]	Con la presente ORTEC dichiara che questo DX1 è conforme ai requisiti essenziali ed alle altre disposizioni pertinenti stabilite dalla direttiva 2014/53/UE.

Latviešu valoda [Latvian]	Aršo ORTEC deklarē, ka DX1 atbilstDirektīvas 2014/53/ES būtiskajāmprasībām un citiemar to saistītajiemnoteikumiem.
Lietuvių kalba [Lithuanian]	Šiuo ORTEC deklaruoja, kad šis DX1 atitinka esminius reikalavimus ir kitas 2014/53/ES Direktyvos nuostatas.
Nederlands [Dutch]	Hierbij verklaart ORTEC dat het toestel DX1 in overeenstemming is met de essentiële eisen en de andere relevante bepalingen van richtlijn 2014/53/EU.
Malti [Maltese]	Hawnhekk, ORTEC, jiddikjara li dan DX1 jikkonforma mal-ħtiġijiet essenzjali u ma provvedimenti oħrajn relevanti li hemm fid-Dirrettiva 2014/53/UE.
Magyar [Hungarian]	Alulírott, ORTEC nyilatkozom, hogy a DX1 megfelel a vonatkozó alapvetõ követelményeknek és az 2014/53/EU irányelv egyéb elõírásainak.
Norsk [Norwegian]	Herved ORTEC, erklærer at denne DX1 enheten, er i samsvar med de grunnleggende kravene og andre relevante bestemmelser i direktivene 2014/53/EU
Polski [Polish]	Niniejszym ORTEC oświadcza, że DX1 jest zgodny z zasadniczymi wymogami oraz pozostałymi stosownymi postanowieniami Dyrektywy 2014/53/UE.
Português [Portuguese]	ORTEC declara que este DX1 está conforme com os requisitos essenciais e outras disposições da Directiva 2014/53/UE.
Română [Romanian]	Prin prezenta, ORTEC declară că acest dispozitiv DX1 este în conformitate cu cerințele esențiale și alte prevederi relevante ale Directivelor 2014/53/UE
Slovenščina [Slovenian]	ORTEC izjavlja, da je ta DX1 v skladu z bistvenimi zahtevami in ostalimi relevantnimi določili direktive 2014/53/EU.
Slovenčina [Slovak]	ORTEC týmtovyhlasuje, že DX1 spĺňazákladnépožiadavky a všetkypríslušnéustanovenia Smernice 2014/53/EU.
Suomi [Finnish]	ORTEC vakuuttaa täten että DX1 tyyppinen laite on direktiivin 2014/53/EU oleellisten vaatimusten ja sitä koskevien direktiivin muiden ehtojen mukainen.
Svenska [Swedish]	Härmed intygar ORTEC att denna DX1 står I överensstämmelse med de väsentliga egenskapskrav och övriga relevanta bestämmelser som framgår av direktiv 2014/53/EU.

ORTEC®

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Please see the website for a complete list of the global offices and authorized agents.

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