Detective® *X*

Portable Radionuclide Identifier

User's Manual

Software Version 3.1.0.5

WARRANTY

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

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

Quality Control

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

Repair Service

If it becomes necessary to return this instrument for repair, it is essential that Customer Services be contacted in advance of its return so that a Return Authorization Number can be assigned to the unit. Also, ORTEC must be informed, either in writing, by telephone [(865) 482-4411], or by facsimile transmission [(865) 483-2133], of the nature of the fault of the instrument being returned and of the model, serial, and revision ("Rev" on rear panel) numbers. Failure to do so may cause unnecessary delays in getting the unit repaired. The ORTEC standard procedure requires that instruments returned for repair pass the same quality control test that are used for new-production instruments. Instruments that are returned should be packed so that they will withstand normal transit handling and must be shipped PREPAID via Air Parcel Post or United Parcel Service to the designated ORTEC repair center. The address label and the package should include the Return Authorization Number assigned. Instruments being returned that are damaged in transit due to inadequate packaging will be repaired at the sender's expense, and it will be the sender's responsibility to make claim with the shipper. Instruments not in warranty should follow the same procedure and ORTEC will provide a quotation.

Damage in Transit

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

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TABLES

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.

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XV

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1. GETTING STARTED

Congratulations on purchasing the ORTEC® Detective® X Handheld Radionuclide Identifier. The Detective X is unparalleled in the detection and identification of threat and innocent radionuclides, even in shielded and masked configurations. Although it is a precision scientific instrument, the Detective X is designed for continuous, hard use in the heaviest weather, seas, air, and terrain. It delivers rapid, accurate screening of vehicles, containers, vessels, buildings, rooms, objects, people, and areas, providing an "expert in a box" for radionuclide identification. Operators can detect radiation, verify radiation alarms, localize the source, identify the radioactive material (even measuring it together with blank and unknown samples for additional rigor and quality assurance), and assess the threat status of the detected material. The straightforward **Send to Reachback** function can provide a link to technical experts for assessment and adjudication assistance.

This chapter introduces the main features of the Detective X, 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 DETECTIVE X TRANSPORT CASE AND CONTENTS

The Detective X 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 Detective X transport case as delivered from the factory.

Figure 1. Transport Case

(Figure 1 shows the optional neutron detector already attached to the front of the unit. If the neutron detector was not purchased, the unit ships with the detector cover attached, and the cavity for the detector cover is empty.) The case includes an inset for a pair of extra batteries (purchased separately from ORTEC). Note that the instrument is shipped with the *COOLER OFF* to prevent

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damage from overheating. ***NEVER operate the cooler when the unit is enclosed in the transport case or wrapped in other insulating material.***

1.2   DETECTIVE X FEATURES

Figure 2 through Figure 6 show the major features of the Detective X. Features and operating details are discussed in detail in Chapters 3 through 7.
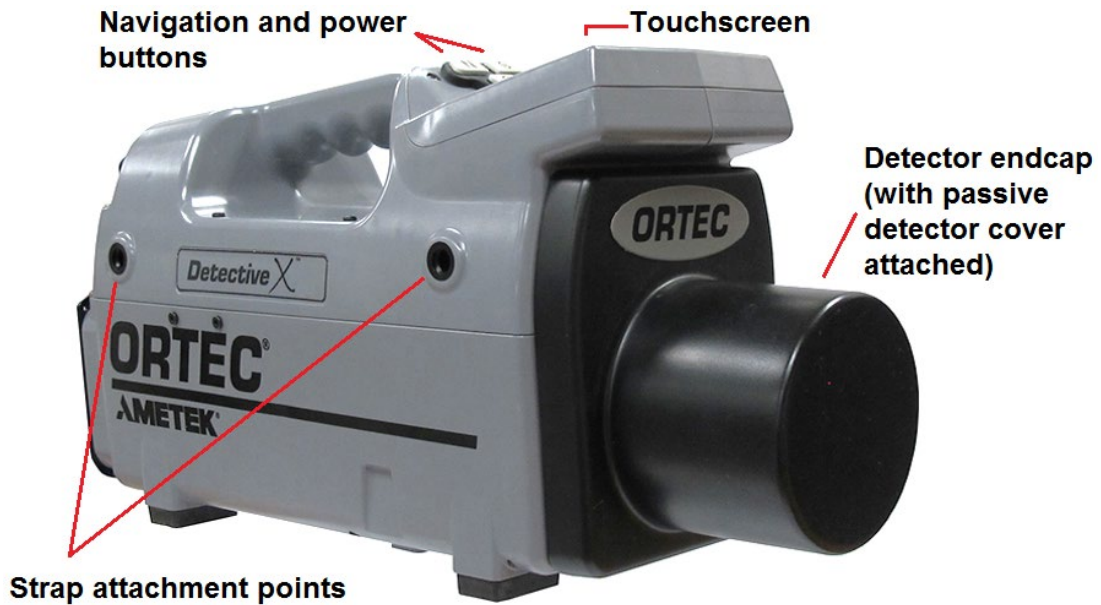
Figure 2. Detective X Side View (with Passive Detector Cover Attached)

Figure 3. Top View

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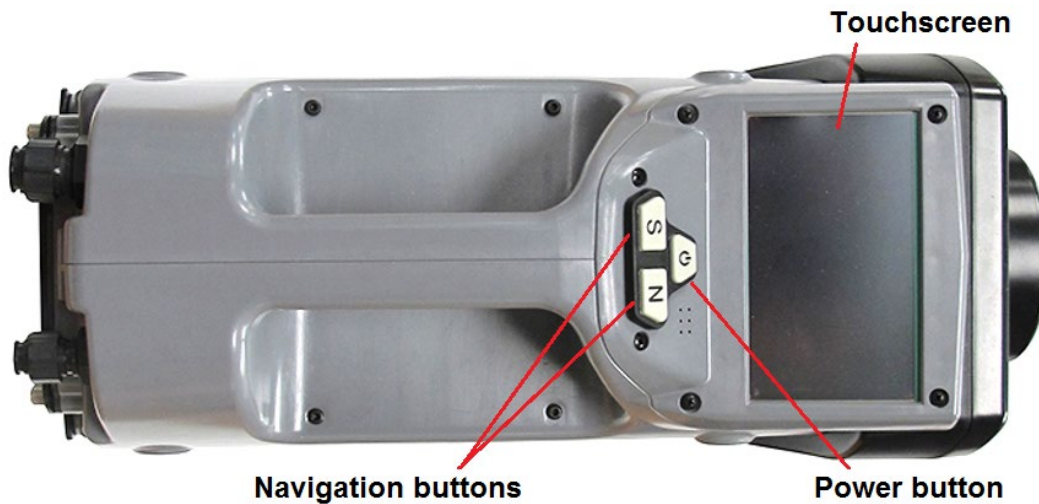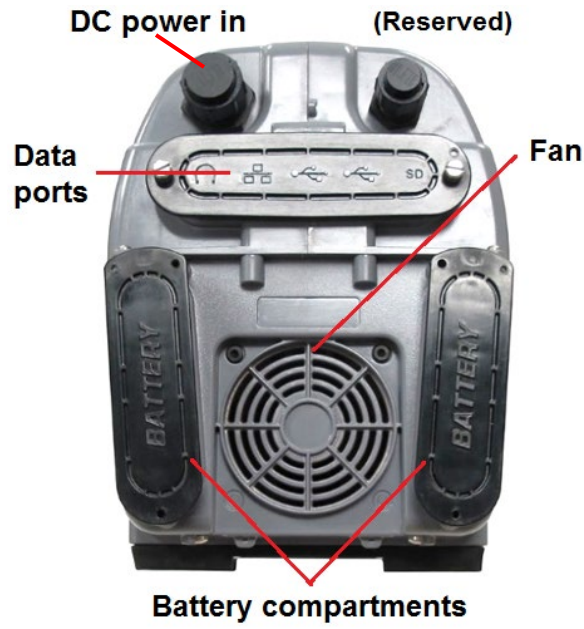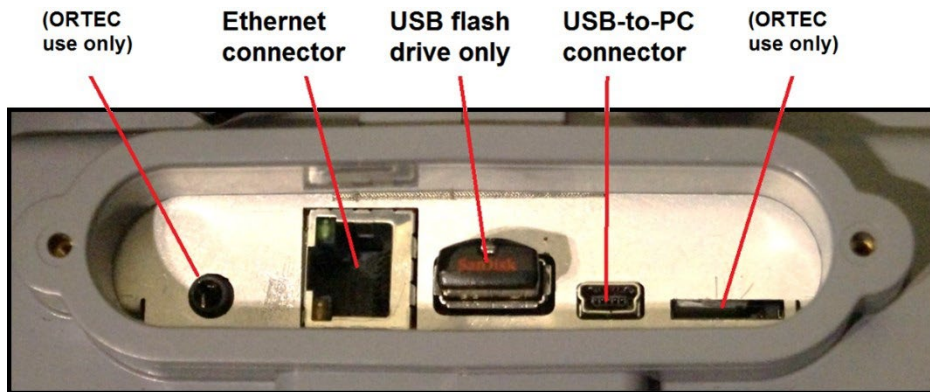
Figure 4. Rear Panel

Figure 5. Rear-Panel Data Connectors (Original Design)
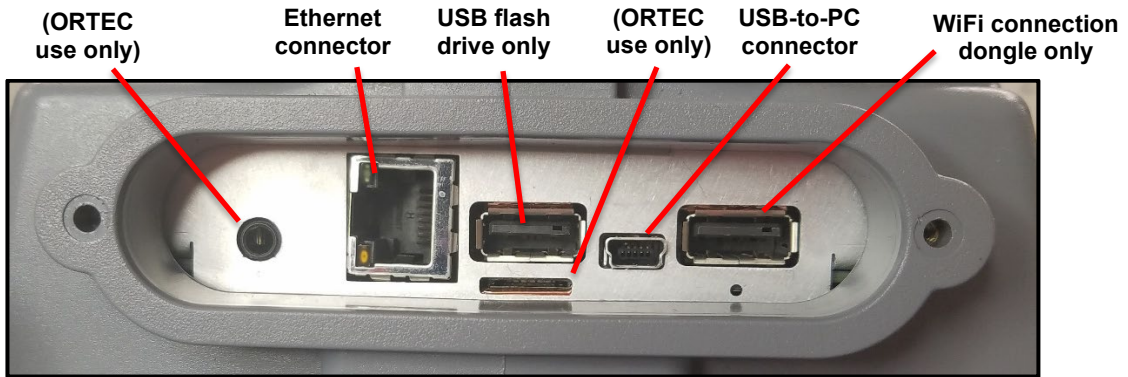
Figure 6. Rear-Panel Data Connectors (Enhanced Communication Design)

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1.3　UNPACKING

1. Remove the Detective X, the power adapter with DC cable, and the mains adapter package from the case.

Figure 7. Adapter Accessories

2. Referring to Figure 8, on the upper-left 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.***
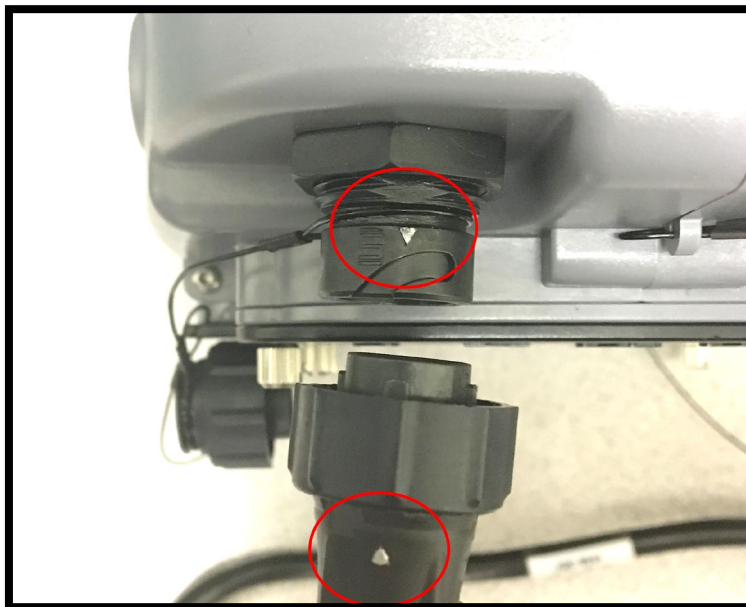
Figure 8. Arrows Show Proper Power Connector Orientation

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3. 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 middle button on the top of the Detective X is the power button. To power up, press and hold the button for at least 5 seconds. The touchscreen will illuminate, and the unit will begin its boot-up sequence, which takes just a few seconds. (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.)

Figure 10. Power

When the boot-up sequence is complete, the instrument will start Launcher. If an application is selected to "Run at Startup", the sequence will continue on to start the selected application. Factory default is set to remain in the Launcher application for the Trans-SPEC only instrument and to start the Detective X application for all other models.

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 'traditional' Detective X user interface upon system power up. This behavior can be modified to start other onboard applications (i.e., Sleuth, RAPiD, Trans-SPEC, Mobile MCB Server, or Launcher). If the instrument settings have been modified to start an alternate program, please refer to Chapters 3 (Launcher), 5 (Sleuth), 6 (RAPiD), 7 (Mobile MCB Server) and 8 (Trans-SPEC).

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1.5　TURNING THE COOLER ON

> **NOTE**　If the instrument is to be used with ORTEC PC-based application software, then refer to Section 7 after the detector is cold and operational.

1.5.1　Detective X Application Cooler Operation

When boot-up is complete, the Detect Mode home screen will be displayed, as shown in Figure 11. Note the **Status: NOT Ready** indicator, and the red error message, **The Cooler is turned off!** The next step will be to turn on the cryogenic cooler.
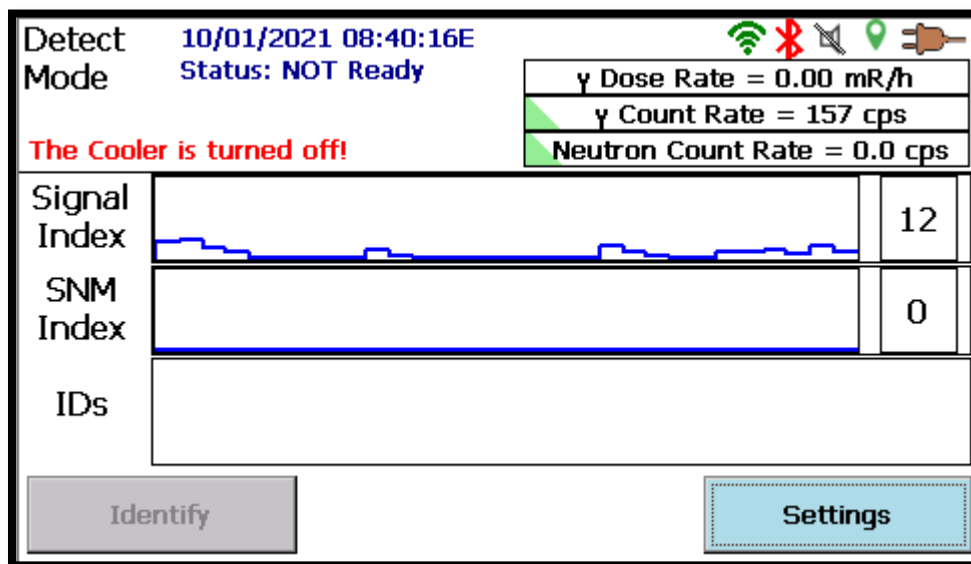
Figure 11. Screen After Initial Power Up

1.　In the lower right corner, tap the **Settings** button to open the **Settings** page (Figure 12). Then tap **Turn Cooler ON**. Note that this is an on/off toggle, and the button label changes with the cooler state.

> **NOTE**　Once turned on, the cooler stays on, even if the Power button 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 2.13 for more information.

2.　At this point, the "**The Cooler is turned off!**" error message will no longer be displayed, and the instrument status will say **Status: Cooling Phase 1** (Figure 13).
3.　The instrument may be temporarily disconnected from external power and moved to a different location if desired.
4.　Cooling will continue through four phases before the status message changes to **Status: READY**.

There is no need to continue displaying the Settings page during cooldown, although the user may wish to tap the **Status** button to display system temperatures and track cooldown progress.
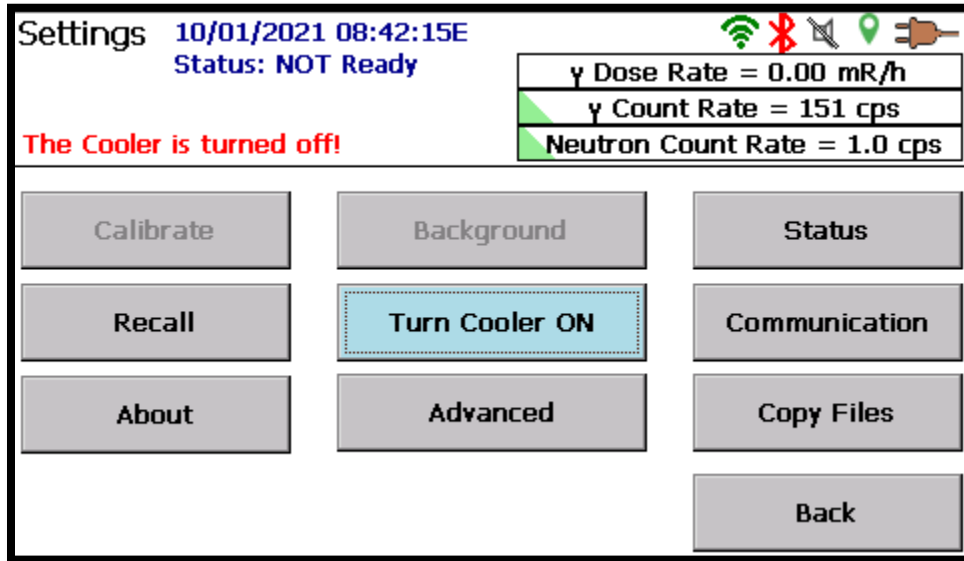
Figure 12. Turn Cooler On
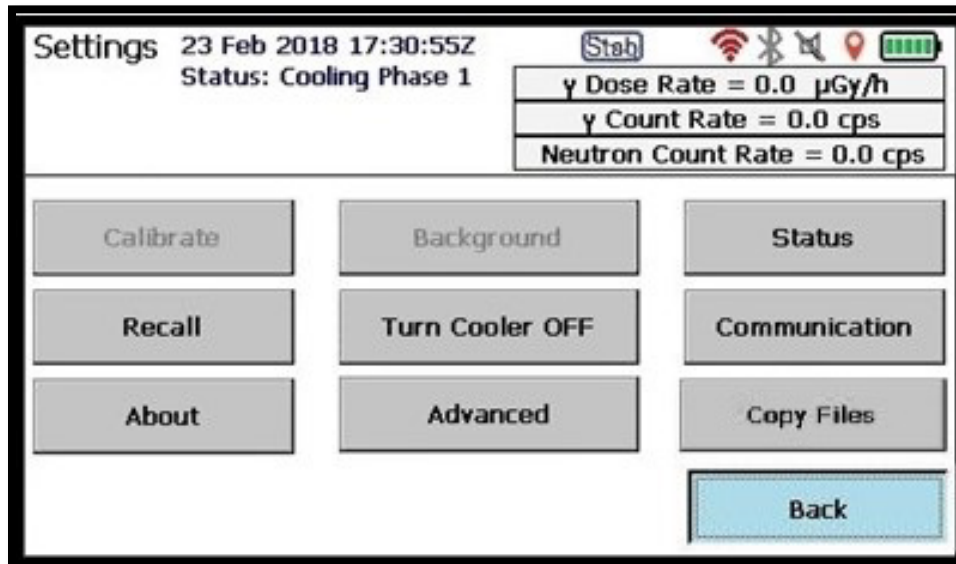
Figure 13. Status: Cooling

Cooldown from room temperature typically takes less than 6 hours. This is a good time to become familiar with the Detective X's features and operating instructions. Be sure to see the operating cautions and notes in Section 2.12.

1.5.2   Trans-SPEC Only Cooler Operation

If this instrument is a Trans-SPEC only model, the instrument will power up into the Launcher screen. Located directly on the Launcher screen is a Turn Cooler On button. Press this button to activate the cooler. The button text will change to Turn Cooler Off.

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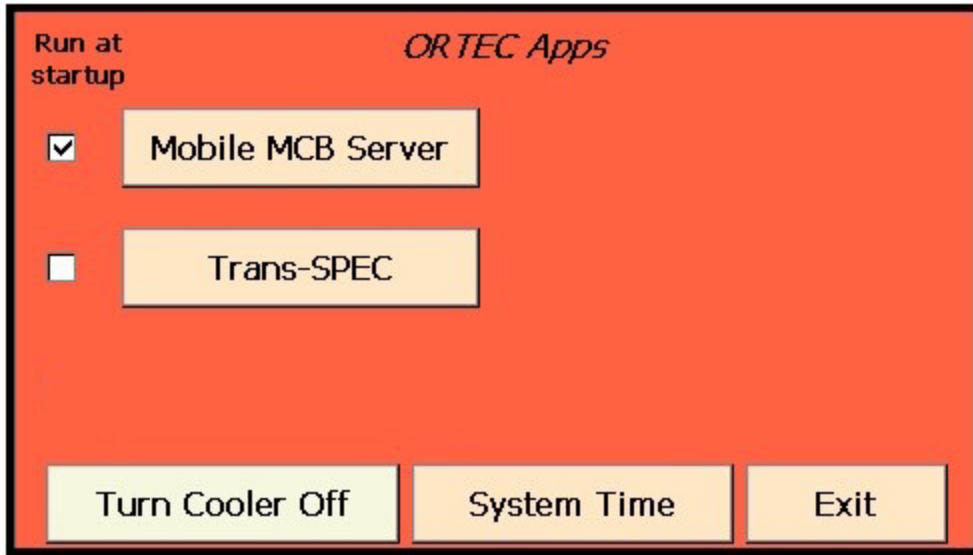
Figure 14. Trans-SPEC Only Launcher Screen with Cooler Activated

After the cooler has been turned on, enter the Trans-SPEC application by pressing the **Trans-SPEC** button.
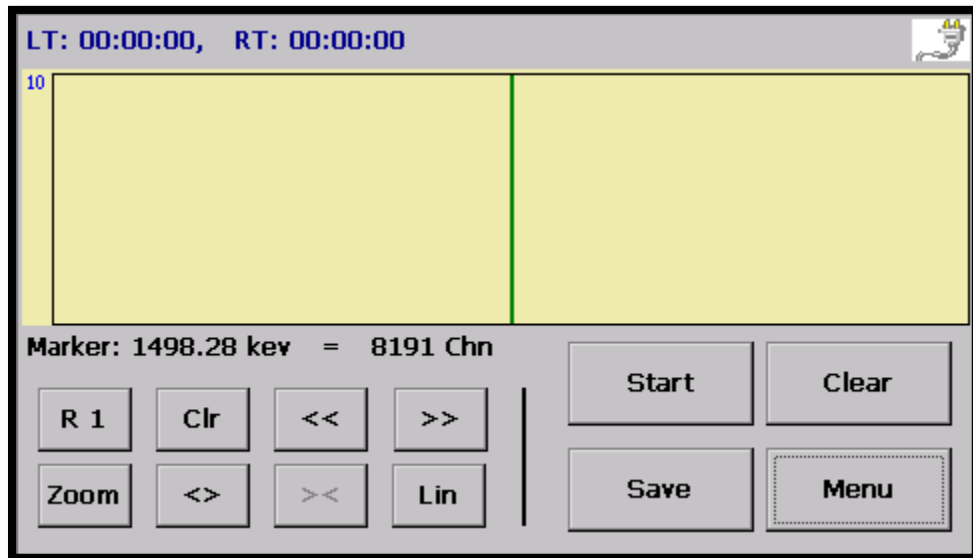
Figure 15. Trans-SPEC Home Screen

Press the **Menu** button and select the **View Status** button to display the instrument status. Monitor the detector temperature (Detector Temp) until it reaches 118.00. Once the temperature is stabilized, the instrument is ready for operation. The instrument may be operable above 118 degrees; however, gain shifts may occur.

Figure 16. Trans-SPEC View Status

1.6 DETECTIVE X ACCESSORIES

The following standard accessories are supplied with the Detective X 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

- Bluetooth® headset and charger

- 12-V automobile power adapter

- USB cable (USB A to USB mini B, 3 m)

- Detector cover (see text)

1.6.1 Power Supply

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

1.6.2 Strap

The shoulder strap (Figure 17) is connected by quick-release fasteners that clip to diagonal corners of the Detective X (see Figure 18). (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
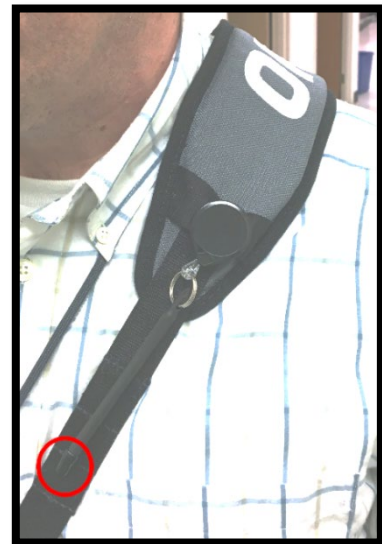
Figure 17. Strap with Retractable Stylus

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gloves, and for entering alphanumeric information. When not in use, the stylus is held against the strap with an embedded magnet. (Note that the stylus ships from the factory with a protective rubber boot over the end [red circle in Figure 17] that may be discarded.)

Figure 18. Strap Quick Disconnect

NOTE	Assembling the strap adds to the maximum overall dimensions of the Detective X.

1.6.3   Bluetooth Headset

Figure 19. Headset with Boom Open

The Bluetooth headset (Figure 19) can be used to listen to the audible alarms and indicators privately or in a noisy environment. The headset is paired to the unit at the factory and is ready for use. Simply remove the headset from its packaging and power it on by holding the button on the side. Verify that the sound and Bluetooth are active on the instrument. Double tap the side button to activate the audio on the headset. It will connect automatically, and all sounds from the Detective X speaker will be rerouted to the headset. To route the sounds back to the instrument speaker, simply power down the headset. The headset has its own mains charger, included in the headset packaging.

NOTE	If the instrument has an RF Secure sticker on the back above the serial label, this instrument does not have Bluetooth capability. The Bluetooth headset is not provided.

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1.6.3.1   Configure a New Bluetooth Headset

This section details how to join a new headset to the Detective X. Bluetooth settings and information are available via the Communications button on the Settings menu. The Bluetooth tab for this page is shown in Figure 20.

1. Power up the new headset. A blue blinking light will appear. Continue to hold the button until the blue light becomes solid.

2. On the Detective X user interface, select **Scan**. The new headset should be found and added to the available devices list ("Jabra Talk 5").
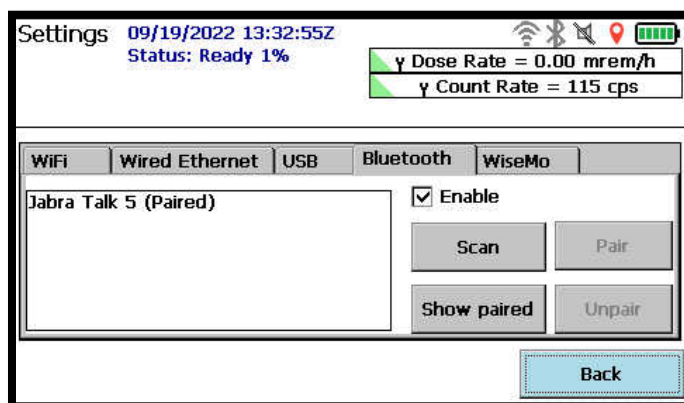
Figure 20. Pairing a New Bluetooth Headset with the Detective X

3. Select the new headset from the detected devices list, then select **Pair**. The headset should indicate a status similar to "Pairing Complete." If a password is required, enter "**0000**" on the display.

4. The blue light will go out when the headset is paired. Instead, it will start intermittent blinking.

5. On the Detective X, select **Show paired**. The newly paired headset should be displayed with a status of **(Paired)**.

6. Cycle power to headset. Once it is powered back on, double press the button on the side of the headset. If the Detective X audio capability is enabled (go to Settings | Advanced | Audio), then the sounds such as Geiger counter clicks, etc., should now be audible through headset.

7. When headset is turned off, sounds will once again be emitted by the Detective X onboard speaker.

1.6.4   USB Cable

The Detective X is supplied with a 3m (~10ft) USB cable for connecting the unit to a PC running Microsoft Windows 7, 8.X, or 10; or Linux (see Figure 5 or Figure 6). When the cable is used to connect the Detective X to a PC, the Detective X appears as a USB flash drive in the PC's folder structure, so files can be easily transferred with no special software. As is good practice with any flash drive to prevent data corruption, it is recommended to eject the Detective X prior to removing the cable, either with the "Eject" command in Windows File Explorer or the "Safely Remove Hardware and Eject Media" option.

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1.6.5   USB Flash Drive and MicroSD Card

The Detective X can store survey data on the rear-panel USB flash drive (see Figure 5 or Figure 6) that makes file transfer to other devices fast and easy. To access the data, either insert the USB flash drive directly into a computer or extract its microSD card (Figure 21) and insert it into a microSD card reader. *Be sure to replace the microSD card before re-mounting the flash drive on the Detective X rear panel.* **Be careful to orient the card correctly, then seat it gently but firmly.**

Figure 21. MicroSD USB Flash Drive Adapter

Note that the software can also be configured to save survey data to the internal "My Documents" folder on the embedded computer (see Section 4.4.2).

1.6.6   Detector Cover, Optional Collimators, Filter, and Neutron Detector

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 mates to the Detective X via the connector shown in Figure 22. The Detective X 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 discussion, see Sections 2.9, 2.10, and 4. Note that the N42.42 file is a data file automatically generated by the system utilizing the ANSI N42.42 format.
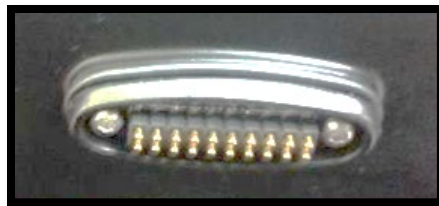
Figure 22. Collimator/Filter/Neutron Detector Connector

2. SYSTEM OVERVIEW

The Detective X 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 Detective X 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 Detective X applications are operated either by the Select **(S)** and Navigate **(N)** buttons, located just above the power button (⏻), or by using the touchscreen. These two input methods give the user versatility in operation. Responders wearing protective gloves will find the buttons easy to use.

2.2 GAMMA-RAY DETECTORS

Detective X uses a large, coaxial, P-type high purity germanium (HPGe) detector crystal. 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 Detective X uses three detectors to determine the gamma-ray exposure rate over a wide range from <0.05 milliroentgen (mR)/h to >1 R/h, an exposure rate range of around 6 powers of 10. 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 Detective X switches between these detectors automatically to report dose rate. (NOTE: In RAPiD, the detector being utilized is reported with the current dose rate reading.)

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2.3   MODULAR NEUTRON DETECTOR

The optional Detective X 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 22) that the Detective X 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	The Detective X is capable of detecting neutron sources even without a dedicated neutron detector as the system is equipped to detect gamma rays emitted through neutron activation of common surrounding materials. This is especially true for units configured for an 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 Detective X 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 is varying 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 23 and Figure 24 show the detector reference points; note that they are not marked on the enclosure.

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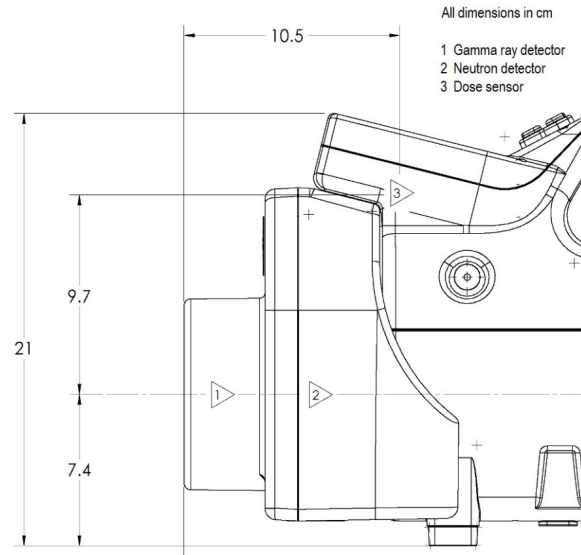
Figure 23. Detector Vertical Reference Points
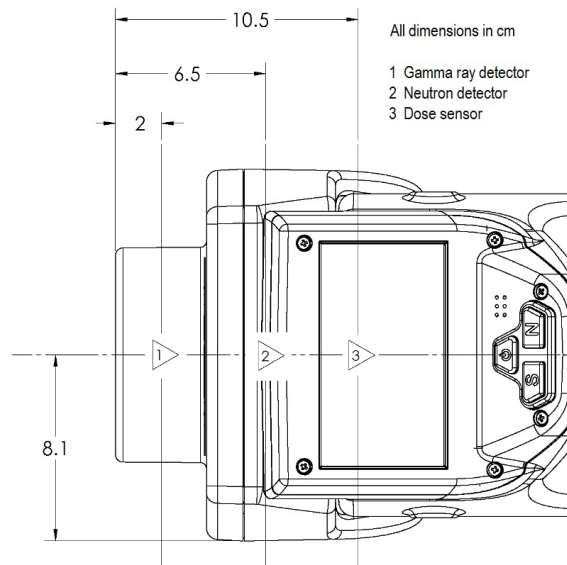
Figure 24. Detector Horizontal Reference Points

NOTE	Units for Figure 23 and Figure 24 are in cm, configured with NDN.

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2.5   THE INTERNAL BATTERIES

The Detective X uses two high-capacity lithium-ion (Li-ion) batteries, which charge whenever the unit is connected to external mains or 12-V power. The Detective X 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 5 hours.

A 5-bar LCD display on the end of the battery opposite the charging blades (Figure 25) shows its state of charge and can be used to distinguish spent batteries from charged ones. The instrument provides audible and visual alerts when the batteries are roughly 90% depleted (approximately 45 minutes remaining). The internal circuitry will not overcharge the batteries, so the Detective X may be left on external power indefinitely.

NOTE	The Detective X 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.
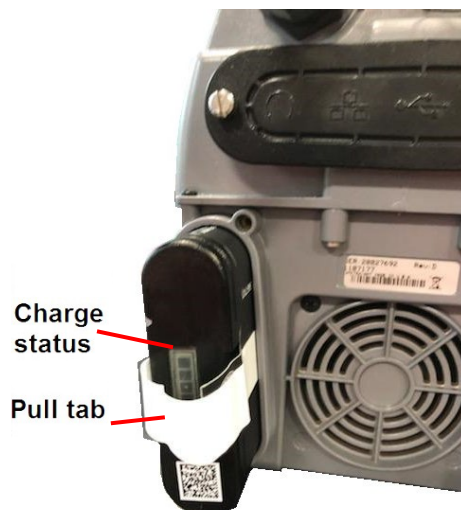
Figure 25. Charge Status Indicator and Pull Tab

Spare batteries are available from ORTEC (see Section B.7), and the transport case has cutouts for a spare pair. An external dual-battery charger is also available (P/N DETECTIVE-X-ACC-DUAL-CHGR[1]).

---

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

To change a battery:

1. Loosen the captive thumbscrews on the rear-panel battery 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 2.13.1.

2.6   VEHICLE POWER ADAPTER CABLE

The 12V vehicle power adapter cable lets the user charge the Detective X from a standard 12V automobile power receptacle. The plug allows the retention for to be adjusted with a slider on the side of the plug (see Figure 26). 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 Detective X from a worn or damaged receptacle.

Figure 26. 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 Detective X to operate for up to a total of 16 hours without external power or a battery swap. The part number is DETECTIVE-X-ACC-2590-CABLE.

Please note that the Detective X transport case is not designed for the shipment of these high-capacity batteries.

2.8   INSTRUMENT ENCLOSURE

The Detective X 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 Detective X enclosure is watertight. The Detective X is not certified for use in explosive atmospheres.

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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 Detective X 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 COLLIMATORS (GREEN AND PEACH)

ORTEC offers two standard collimators for the Detective X:

- DETECTIVE-X-ACC-COL-ST 4mm Stainless Steel (colored green; see Figure 27)

- DETECTIVE-X-ACC-COL-W 4mm Tungsten (colored peach)

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

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 227) that is read by the Detective X 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 4.15). Until this background has been ran, the status area on the screen will say "No 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.

Figure 27. Stainless Steel Collimator

2.10 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 (see Section 4.5).

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

- DETECTIVE-X-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 Detective X maintains different ambient background correction files for configurations with and without the low-energy filter. The filter's connector (Figure 22) identifies it to the Detective X. 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 4.15).

2.11 RF SECURE MODELS

If the instrument purchased has an RF Secure sticker on the back above the serial label (as seen in Figure 28), the instrument is shipped without WiFi, GPS, or Bluetooth. The Bluetooth headset is not provided.

Figure 28. RF Secure Sticker Positioning

2.12 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 Detective X and power adapter are clean and dry before connecting to the input power supply.

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CAUTION   The Detective X enclosure is waterproof. If all covers and seals, including the detector cover (or neutron detector), are in place, the instrument will operate even after *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 Detective X. 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 Detective X contains *no user-serviceable parts*. Only the batteries can be changed/replaced. The Detective X is to be opened only by ORTEC-authorized service personnel.

CAUTION   The Detective X 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 Detective X 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 Detective X reaches an internal temperature of greater than 70°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 70°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.

- If unintended changes are made on a Detective X screen and the user does not remember how to restore original value(s), the safest course of action may be to cycle the power off/on rather than pressing the **Back** button.

- The integrated computer that controls the ORTEC Detective X is intended exclusively for the tasks detailed in this operator's manual. Using this computer for any other purpose *may void the warranty*.

- 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 Detective X requires service, contact ORTEC before returning the instrument. If the original foam-lined transport case is not available, *ORTEC will supply a suitable container*.

2.13 PREPARING THE DETECTIVE X FOR SHIPPING

CAUTION   When shipped in either the transport case or alternative packaging, the Detective X 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.

Detective X 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 5 seconds. Once the power up sequence is complete, press the power button again. The

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instrument will display the message in Figure 29. Make sure that the Leave Cooler Running check box is not selected. Then press **Yes** to shut down the cooler and prepare for shipment.
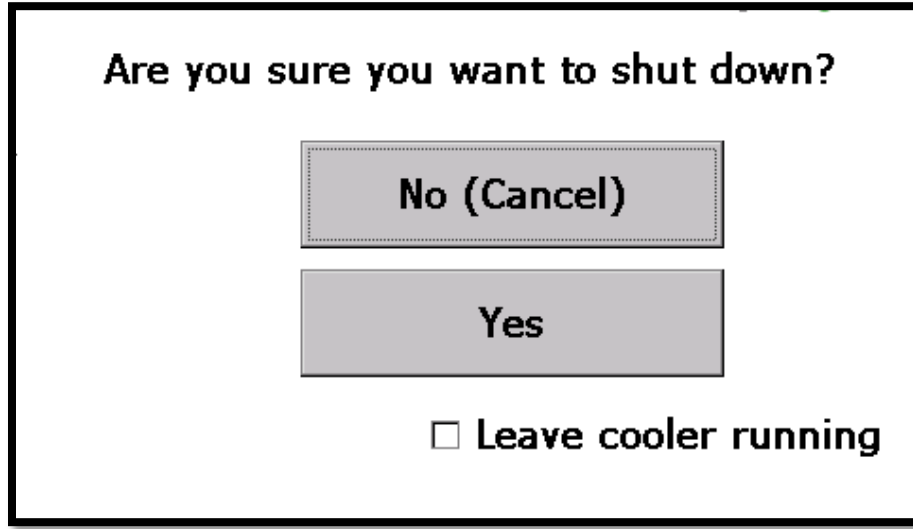
Figure 29. System Power Down Message

In instances where the Detective X is being shipped back to the factory for service, remove both batteries from the unit and place them in the spare-battery cutouts in the transport case.

NOTE	The Detective X 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).

2.13.1 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.)

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As of January 2017, the Detective X 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 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 30. 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.
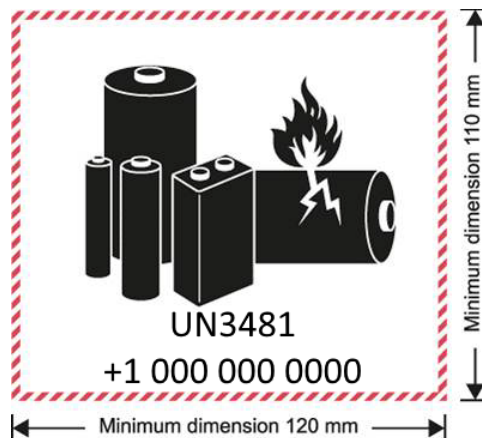
Figure 30. Li-ion Battery Shipping Label

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

2.14 SYSTEM SOFTWARE APPLICATIONS

The Detective X comes with six applications pre-installed at the factory. Following is a brief discussion of each application:

1. **Launcher** (see Chapter 3) – Launcher allows users to quickly and easily start the other Detective X applications.
2. **Detective X** (see Chapter 4) – The Detective X application is the "traditional" interface for this instrument. This application gives users the most flexibility in configuring the instrument and collecting surveys.
3. **Sleuth** (see Chapter 5) – Sleuth is a simplified user interface. Sleuth provides for a very limited set of common user operations. In situations where operators must multi-task, it minimizes opportunity for error.
4. **RAPiD** (see Chapter 6) – 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.
5. **Mobile MCB Server** (see Chapter 7) – Mobile MCB Server application governs communication between the Detective X and a host computer when the Detective X is used as a high-performance, benchtop gamma spectrometer in conjunction with ORTEC spectroscopy applications such as MAESTRO©, MAESTRO-PRO©, or GammaVision©.
6. **Trans-SPEC** (See Chapter 8) – The Trans-SPEC application provides the basic MCA emulation functions necessary to use the instrument as a standard spectrometer system, including the ability to change hardware settings, establish an energy calibration, and acquire spectra.

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3. LAUNCHER APPLICATION

The **Launcher** application automatically controls which application runs on the Detective X computer on power-up. In addition, when an application is exited, the Launcher screen presents a list of all applications that can be accessed on the instrument. The **Detective X, Trans-SPEC, Mobile MCB Server**, **RAPiD**, and **Sleuth** applications are installed by default, and the **Launcher** is configured to start the Detective X application. Figure 31 shows the default Launcher screen. It displays a button for each available application. The checked box indicates which application will run at startup the next time the Detective X is powered on. The **Launcher** interface also provides convenient control of the cryogenic cooler (NOTE - this same function is available elsewhere within the various software applications as well).

To start an application, just tap its button.
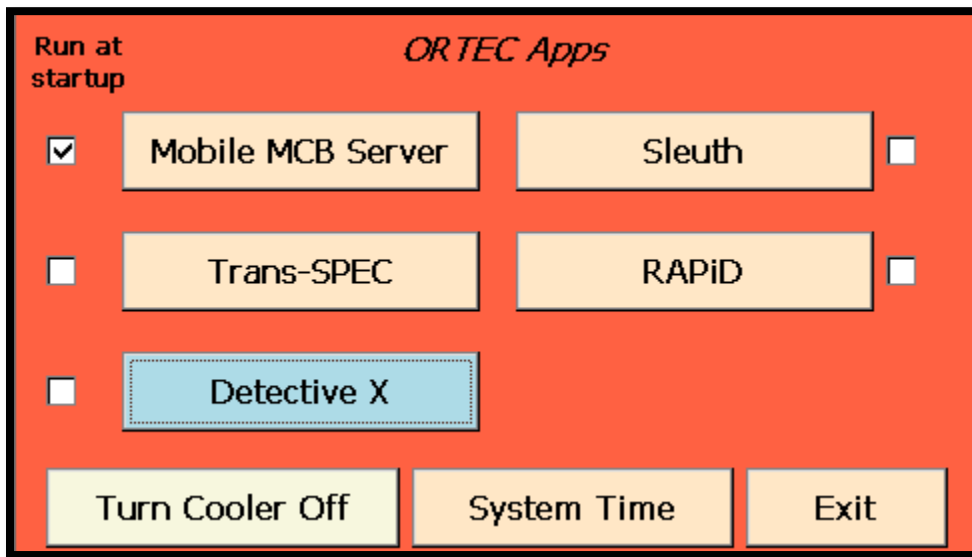
Figure 31. Launcher Screen

> **NOTE**   There are no Detective X functions outside of the Launcher. The **Exit** button at the bottom of the Launcher screen is reserved for ORTEC use.

> **NOTE**   The Detective X, Sleuth, and RAPiD applications are not available if the user purchased the model Detective-X-TS. This model only contains the Trans-SPEC and the Mobile MCB Server applications.

The Launcher also provides the opportunity to set the system date and time properties. Press the **System Time** button to open the properties screen.

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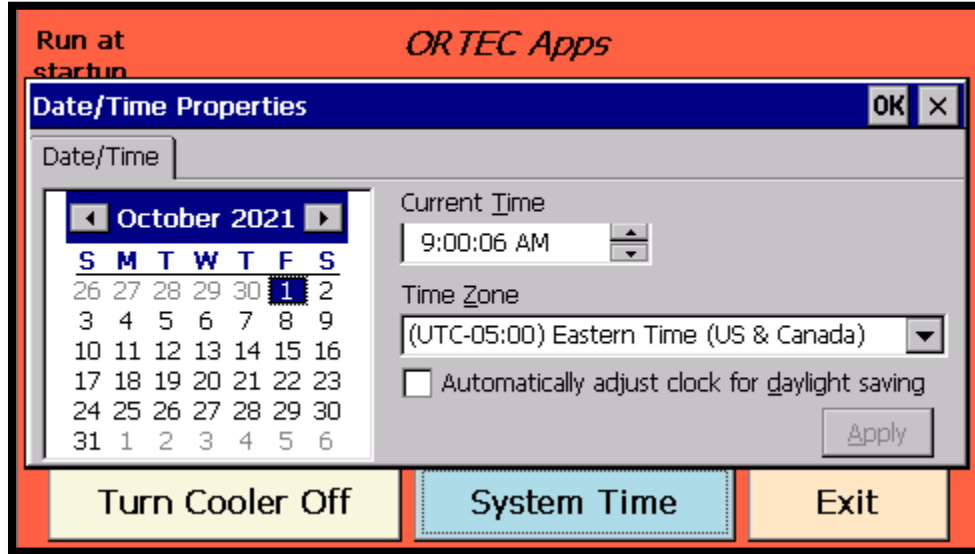
Figure 32. System Date/Time Properties

Select the desired date and time and click **Apply** to save the information.

4. DETECTIVE X APPLICATION

> **NOTE** The Detective X application is not available if the user purchased the model Detective-X-TS. This model only contains the Trans-SPEC and the Mobile MCB Server applications.

4.1 DATA MANAGEMENT AND COMMUNICATION

The networking capabilities incorporated in the Detective X allow the user to transfer and email spectra from the instrument using either wired or wireless connections. The operator can use the remote connection to control the Detective X from any popular device (see Section 4.11).

Acquired spectra are saved on the Detective X's rear-panel USB flash drive (see Figure 5 or Figure 6) or to the internal "My Documents" folder (see Section 4.4.2). The Detective X also supports automatic save and **Send to Reachback** capability using a USB dongle and available wireless network connections. If the network is unavailable, the message is saved and sent when the network is available.

4.2 USER INPUT

Most users will likely interact with the Detective X by tapping the large touchscreen buttons with a finger. Alternatively, the instrument can be operated using the **Navigate (N)** and **Select (S)** tactile buttons located on the handle, just below the power button. This is the perhaps the most practical way to operate the instrument while wearing thick gloves. The **(N)** button is used to move a highlight between onscreen buttons. The **(S)** button is then used to activate the highlighted onscreen button.
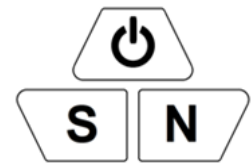
Figure 33. (N)avigate and (S)elect Buttons

In Figure 34, note the blue background color of the **Settings** button. *This blue shading indicates that the Settings button is ready to activate (i.e., this button currently has focus).*

- Pressing the **(N)** button, when the **Settings** button has the blue shading, moves the focus shading to the onscreen **Identify** button. Pressing **(N)** again switches the button shading focus back to the onscreen **Settings** button.

- Pressing the **(S)** button activates the onscreen button that currently has focus.
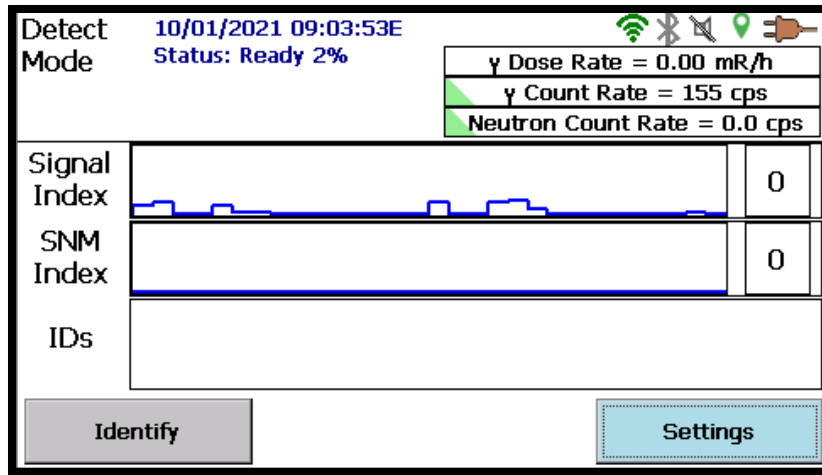
Figure 34. Detect Mode – Ready to Select

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 **(N)/(S)** buttons, it may be easier to use the supplied stylus, which is tethered to the carrying strap (Figure 17). Figure 35 shows a typical text-entry screen where the stylus may work best.

When operating the Detective X 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 4.11.
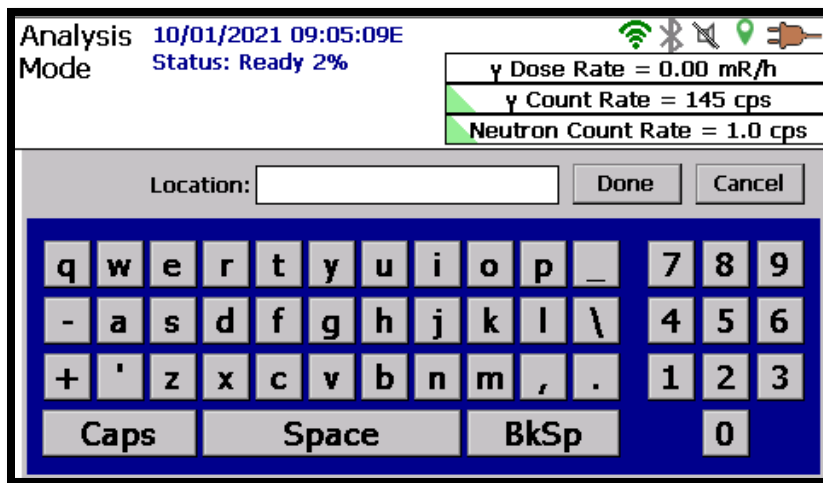
Figure 35. Text Entry Screen

4.2.1   Moving Back to the Previous Screen

Many Detective X screens have a **Back** button. When the user selects **Back**, all changes that have been made on that screen are saved without a Yes/No prompt, and the display is returned to the previous screen. (This is different than the operation of the back button on internet browsers, which typically abandons any changes unless the user clicks a "save" button.) Therefore, *if unintended changes are made on a Detective X screen and the user does not remember how to restore original value(s), the safest course of action may be to cycle the power off/on rather than pressing the **Back** button.*

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4.3   PERSONNEL SAFETY ALERTS

The Detective X alarms when the radiation level exceeds a user-defined safety threshold (see Section 4.5.2). Alerts for high gamma-ray and (where equipped) high neutron exposure rates are both visual and audible.

4.4   DETECTIVE X SOFTWARE OVERVIEW

There are two operation modes:

- **Detect Mode** – This screen 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 (see Section 4.6).
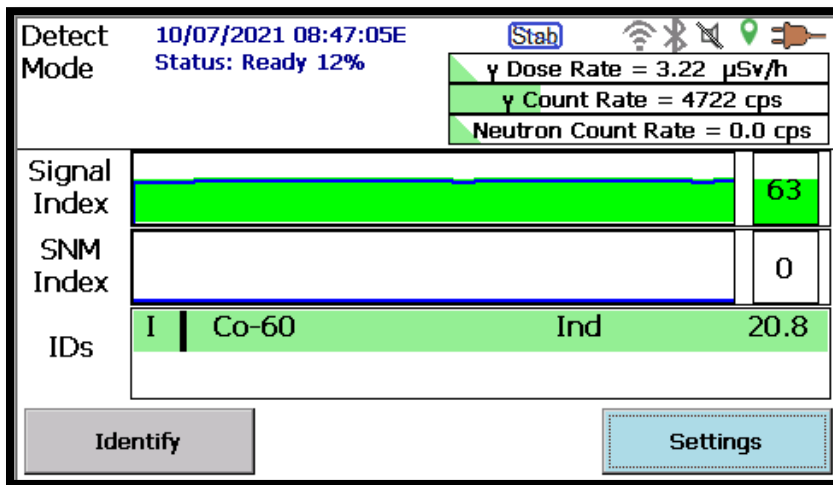
Figure 36. Detect Mode Screen

- **ID Mode** – 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 4.12).

Figure 37. ID Mode Screen

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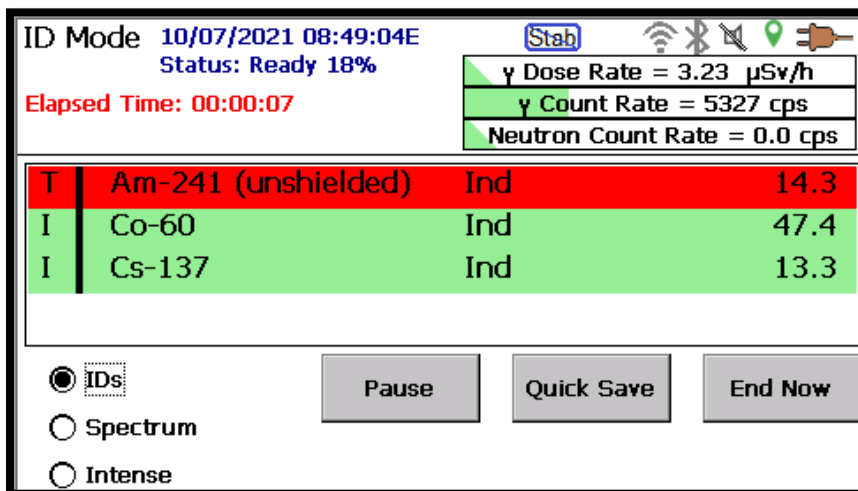
The software provides multiple free-form fields in which to document measurement conditions (see Figure 38).
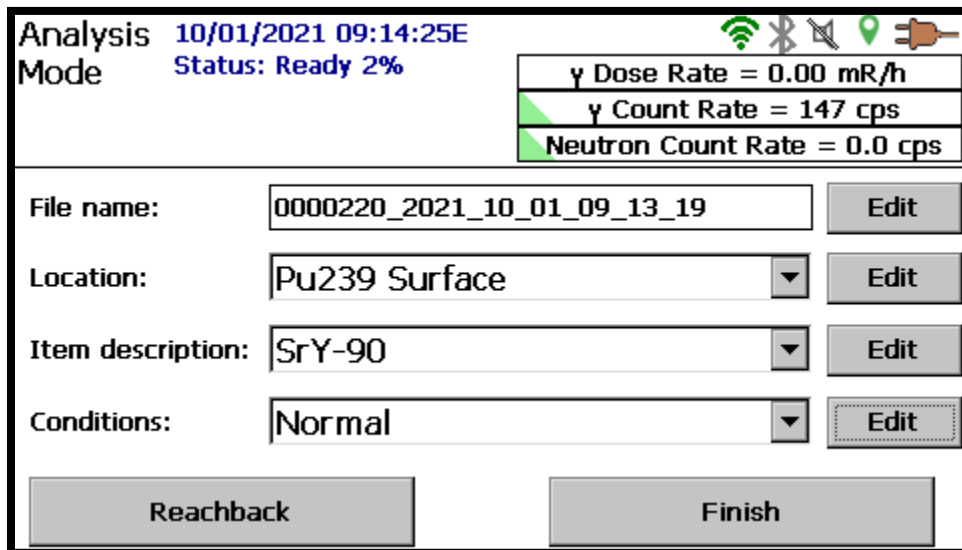
Figure 38. Optional Metadata for ID Mode Data

Additionally, the Detective X allows the collection of a set of spectra – measurement blanks, knowns, and unknowns – and packs them all into a single N42 file so Reachback personnel can be certain of the conditions under which each spectrum was collected. Measurements can be sent to Reachback automatically over a wired or wireless internet connection (Section 4.12).

Figure 39 provides a simplified roadmap of the Detective X software, as configured by default. The software starts up on the Detect Mode screen. All other screens are accessible from this screen in a hierarchical manner.

- Tapping the **Settings** button on the Detect Mode screen opens the Settings screen, which gives all users access to the major functions needed to search for and identify radionuclides.

- Tapping the **Advanced** button opens the Advanced Setup page, which accesses CONOPS-dependent configuration settings and spectrometry functions. Because of this, access to the Advanced Setup page can be password-protected (see Section 4.18).
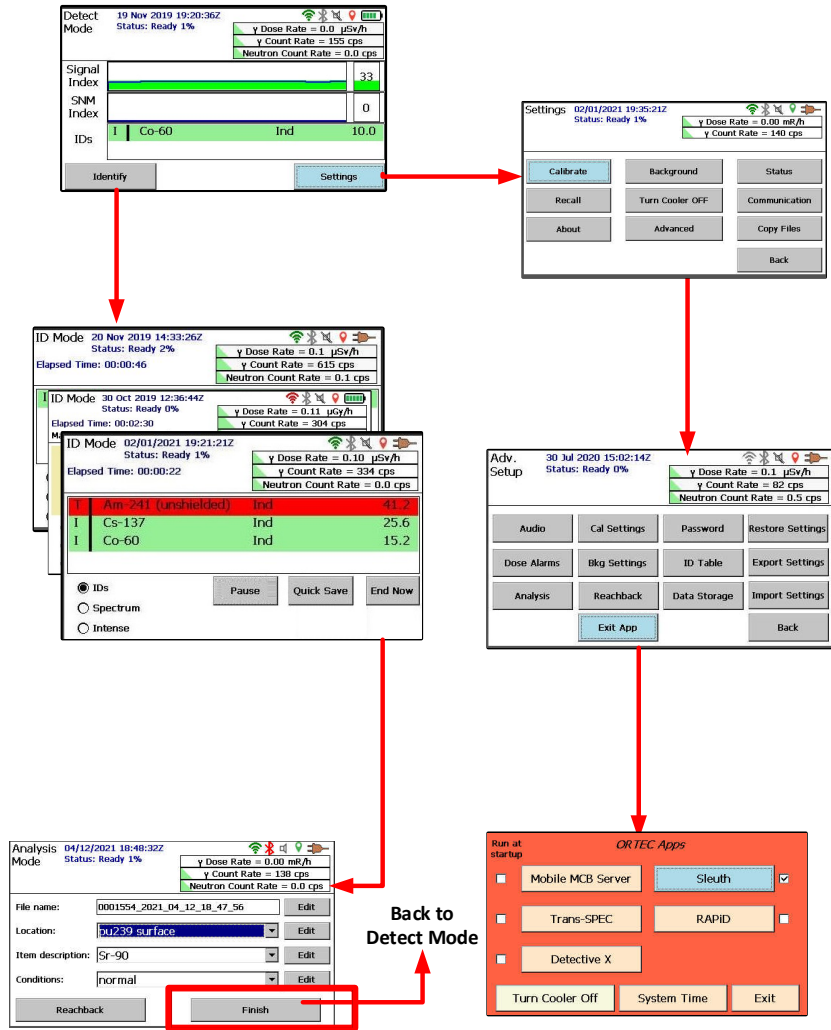
Figure 39. Basic Software Organization

Almost all Detective X screens show the status information at the top of the display. Figure 40 shows the status indicators, which are discussed in the following list.
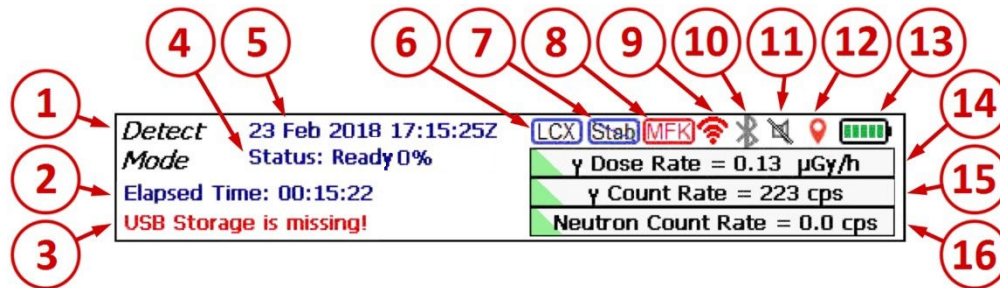
Figure 40. Detective X Status Indicators

1. Screen name.

2. Message space for elapsed time, high dose rate, and other system information.

3. System errors including gain stabilizer status, USB storage issues, and personnel hazard warnings (for the complete list of system errors, see Section 4.5.3).

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4. System readiness indicator. **Status: Ready 0%** indicates the detector is at operating temperature and all hardware and software is ready for use. The "#%" text indicates the current HPGe detector dead-time percentage. Note that dead time is only displayed when the system is in the READY state.

5. Current date and time in Coordinated Universal Time (UTC; also known as Zulu time).

6. Low-Confidence Expert (LCX) mode indicator, displayed when LCX mode is enabled (see Section 4.6.5).

7. Gain stabilizer disabled indicator. Displayed only when the stabilizer is disabled.

8. Mobile Field Kit (MFK) connection status. Displayed only when the MFK interface has been enabled. Blue indicates connected. Red indicates not connected.

9. WiFi connection status. Green indicates connected. Grey indicates no connection. Red indicates WiFi has been disabled. Note that WiFi is automatically disabled when a wired network connection is established.

10. Bluetooth headset connection status. Green indicates connected. Grey indicates no connection. Red indicates Bluetooth has been disabled.

11. Speaker enabled or disabled (disabled shows slash/enabled does not).

12. GPS location determined when green, otherwise red.

13. Power system status. External power with battery charged, external power with battery charging, or battery capacity remaining (for battery time in minutes, see the Status screen shown in Figure 95).

14. Gamma dose rate.

15. Total gamma count rate.

16. Neutron count rate (if neutron detector is connected).

The startup screen for Detective X is the Detect Mode screen (Figure 41). All other screens are accessible from this screen through a menu hierarchy. The Detect Mode screen is useful for locating and in most cases also identifying radioactive sources. The Detect Mode screen performs a complete analysis of recently collected data twice per second and shows recent history. However, data collected from the Detect Mode screen are not saved. See Section 4.6 for a detailed discussion of Detect Mode.
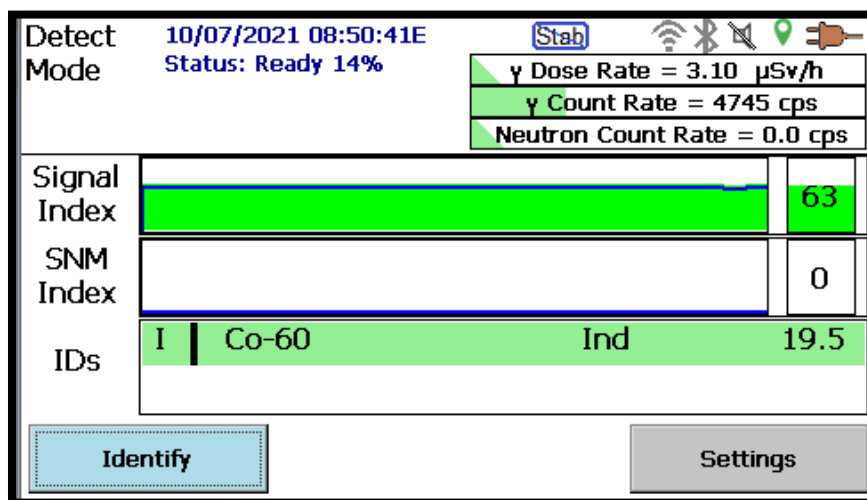
Figure 41. Detect Mode Screen

ID Mode is accessible from the Detect Mode screen via the Identify button. Data collected in ID Mode is always saved. Data collection in ID Mode works differently than in Detect Mode. While Detect Mode only analyzes recent data, ID Mode continues to accumulate data from the time the measurement is started until it is ended. In this way, ID Mode can provide a much more sensitive measurement than Detect Mode and spectral data suitable for analysis by Reachback experts. The ID Mode screen also allows the user to view spectral data and a list of the highest intensity energy lines in the gamma-ray spectrum while data is collected. Figure 42 shows the ID screen where data has been accumulating to identify a Co-60 source. Data collection is stopped when the End Now button is pressed. Then an opportunity is given to enter free form information about the measurement that will be included in the saved file. See Section 4.7 for a detailed discussion of ID Mode.
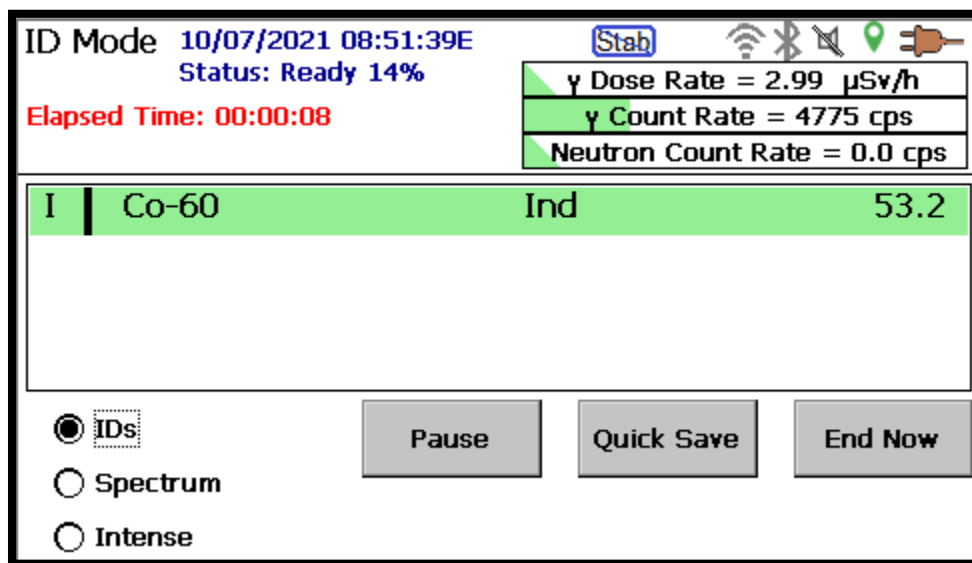
Figure 42. ID Mode Screen

The Detect and Identify Modes are each highly customizable. Through various advanced settings, the Detective X may be tailored to fit specific concepts of operation.

Here is a list of some of the configurable options the Detective X provides. These settings can easily be deployed to other Detective X instruments using export and import settings functionality. It is a good idea to review this list to determine how the Detective X might best be configured for a particular application. It is also possible to maintain different settings files for use in different applications or different user groups.

- Audible alarms versus none

- Tactile alarms (vibration) versus none

- Exposure rates at which personnel hazard alarms are triggered

- Overriding of default library classification of Innocent nuclides

- Manual or automatic file transfer to Reachback

- Reachback organization email address and email server details

- Mobile Field Kit server communication details

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- Requirement for all alarms to be acknowledged by user versus disappearing when the alarm condition ends (see Section 4.5)

- Collection of data in ID Mode for a specific duration and then end automatically versus collecting data until the user actively stops the data collection

- Allow multiple measurements to be made in ID Mode (knowns, unknowns, and blanks) and data combined in a single file

- Allow viewing spectral data on instrument versus not

- Inclusion of GPS location data in spectra files versus none

- Password protected Advanced Settings versus open

- Minimum time to be allotted for ambient background measurements

- Automatically stabilize on environmental K-40

- Duration of "recently collected data" to be analyzed and charted in Detect Mode

- Low-Confidence Expert (LCX) Mode to increase sensitivity dramatically in Detect and ID Modes, with the tradeoff of more alarms (includes a host of additional related settings)

- Nuclide to be used for energy calibration

- Requirement to measure ambient background any time an energy calibration is performed

4.4.1   Adjusting the Display Brightness, Audio, and Vibratory Alerts

Display brightness can be adjusted, audio volume can be adjusted (or turned off), and the vibration can be turned on/off. To do this, navigate to the Advanced Setup screen and tap the **Audio/Display** button. This will open the page shown in Figure 43.

Settings here are self-explanatory with the possible exception of the **Gamma tick sensitivity**, which controls the rate at which the simulated survey meter "tick" sound is produced for a given radiation field intensity.
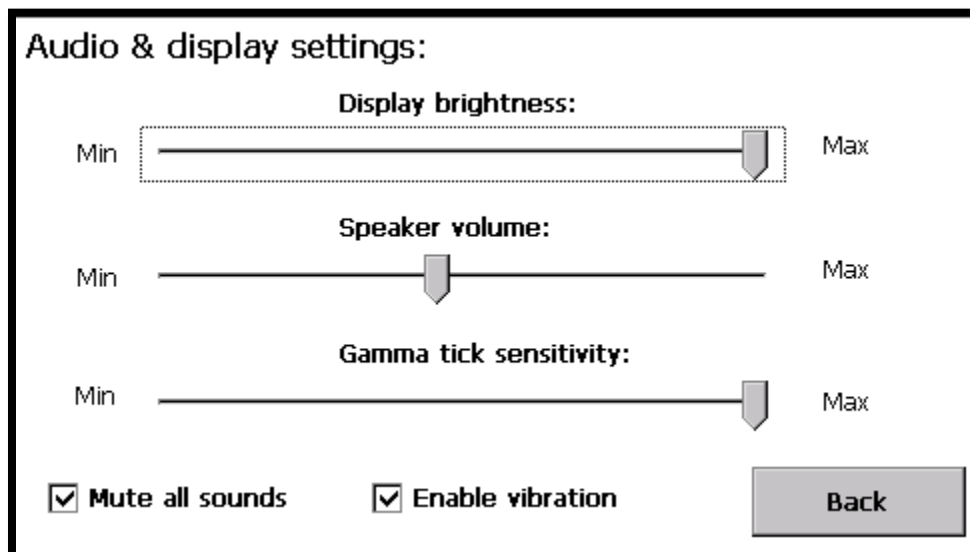
Figure 43. Audio and Display Settings

4.4.2   Data Storage Settings

The Detective X can store survey data on either the rear-panel USB flash drive (Hard Disk) (see Figure 5 or Figure 6) or the internal "My Documents" folder. This behavior is set by tapping **Data Storage** from the Advanced setup screen.
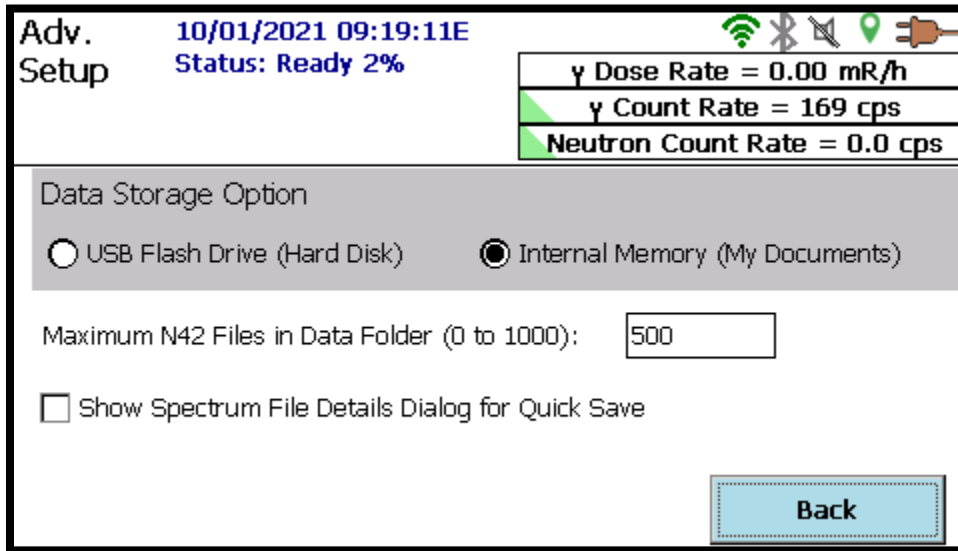
Figure 44. Data Storage

Select the desired destination ("USB Flash Drive (Hard Drive)" versus "Internal Memory (My Documents)"), then select **Back** to apply the changes. Note if USB Flash Drive is selected, a USB must be installed in the rear-panel. If the instrument being used has the enhanced communication design (the enhanced design can be identified by the presence of 2 USB ports on the communication panel as seen in Figure 6), it is recommended that the USB be installed in the port in the middle of the panel. Also note that the USB flash drive used must be an ORTEC approved flash drive. Contact an ORTEC representative for more information.

The **Data Storage** screen also provides an interface to automatically archive N42 survey files via the "Maximum N42 Files in Data Folder (0 to 1000)" field. This interface will automatically archive all survey files when the destination folder (be it "...\<USB Flash>\Data\" or "...\My Documents\Data\") reaches the number of files defined here (500 in this example). The archive will be created in a new "Data#" folder within the destination data drive (i.e., "...\<USB Flash>\Data000002\", "...\<USB Flash>\Data000003\", "...\My Documents\Data000002\", etc.). Setting this field to zero (0) disables automatic archival meaning no automatic archival is performed and the number of files in the Data folder will grow without bounds. Note that file interactions on the device may slow considerably when the number of files in the destination folder rises above 500.

This screen also allows the user to define how the "Quick Save" functionality behaves. If the "Show Spectrum File Details Dialog for Quick Save" option is enabled, then the user will be prompted to enter the metadata (i.e., File Name, Location, Item Description, Conditions) as shown in Figure 66, that will be saved along with the radiological data in the Quick Save N42.42 file. Any information here will be retained as the default information displayed when the complete survey is ended.

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4.4.3   Exiting and Restarting the Detective X Application

Tapping **Exit App**, from the Advanced Setup screen, navigates to the orange **Launcher** screen, which is discussed in Chapter 3. From the Launcher, the user can run other ORTEC applications installed on the Detective X's computer. Other available applications are the Mobile MCB Server, the RAPiD application, and the Sleuth application. See Chapter 5 for details on the simplified, user-friendly Sleuth application. See Chapter 6 for details on the enhanced RAPiD application. See Chapter 7 for details on using the Mobile MCB Server and accessing the Detective X's laboratory spectrometer functionality. To return the instrument to its standalone identifier functionality, tap the **Detective X** button on the Launcher screen (see Figure 31).

4.5   ALARM CONDITIONS

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

- Personnel Hazard
- System Errors
- Overrange
- Nuclide Identified

Alarms are indicated by messages posted to the display. 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 Detective X when the headset is powered down.

By default, alarm messages are displayed as long as the alarm condition exists and are removed when the condition no longer exist. For example, bringing a source anywhere near the instrument while in Detect Mode will likely result in a "Nuclide Identified" alarm. The Detective X will display the nuclide ID, provide a short audio alarm, and the handle will vibrate for a moment. The nuclide ID will continue to be displayed for as long as it is detected. When the source is removed from the area, the nuclide ID will be removed from the screen.

4.5.1   Require Alarms to be Acknowledged?

The user can choose whether or not to require all alarms be acknowledged. If the **Require acknowledge** option is enabled, alarms will be latched, and an **Acknowledge button**, color-coded according to the nuclide ID threat level, will be displayed at the bottom of the Detect Mode and ID Mode screens. Alarms will be presented for acknowledgment, one at a time in order of alarm priority. The alarm message will not disappear until the user taps the **Acknowledge** button. In addition, audio and vibratory indications will persist until the alarm is acknowledged.

To enable/disable alarm acknowledgement, navigate to the Advanced Setup screen and tap **Analysis**. This will open the Analysis Settings screen (Figure 45). Tap to mark/unmark the **Require acknowledge** checkbox.
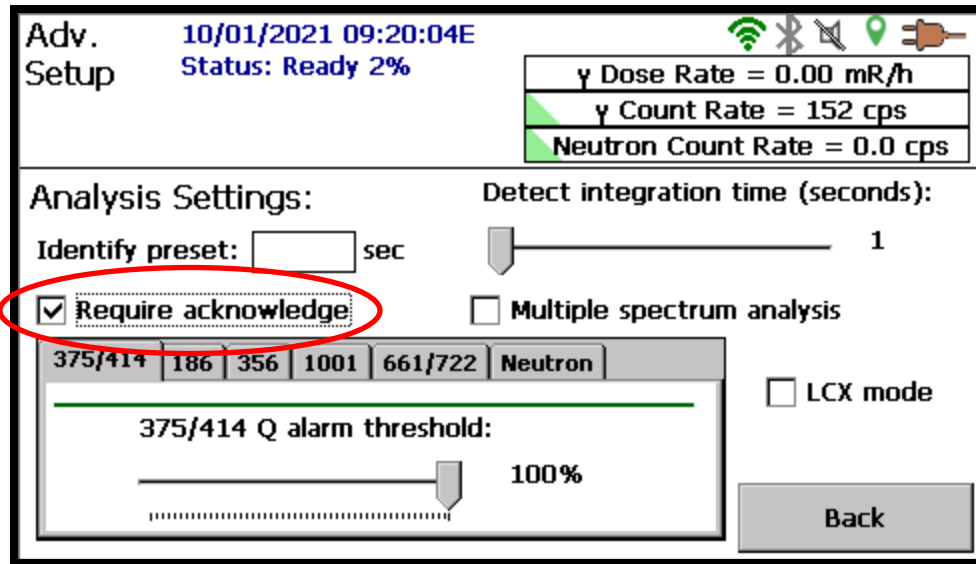
Figure 45. Setting the Require Acknowledge Flag

4.5.2   Personnel Hazard Alarm

The personnel hazard alarm is shown in Figure 46. By default, this alarm is triggered when gamma dose rate exceeds 10 µSv/hr or neutron flux rate exceeds 25 nps/cm^2. These thresholds (and units for gamma dose rate) are adjustable from the Advanced Setup page by tapping the **Dose Alarms** button (Figure 47). With the default values, the personnel hazard alarm will occur before the overrange alarm, which is fixed at an exposure rate of 2 mR/hr (about 17 µSv/hr dose).

The Detective X is calibrated with the instrument in Roentgen. The Personnel hazard alarm settings allow for the gamma dose rate units to be changed between µSv/hr, mrem/hr, µGy/hr, and mR/hr. The following is used to convert between units:

$$1R = 1.064 \text{ rem} = 10.64 \text{ mSv} = 8.73 \text{ mGy}$$

The personnel hazard alarm is indicated by messages on all screens that include the status header. It is accompanied by short-duration audio and vibratory alarms (if enabled). Note that the gamma dose-rate meter in the display header will continue to be updated with the current dose rate.

If the unit is configured to require all alarms to be acknowledged, a full-screen alarm (Figure 48) 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.

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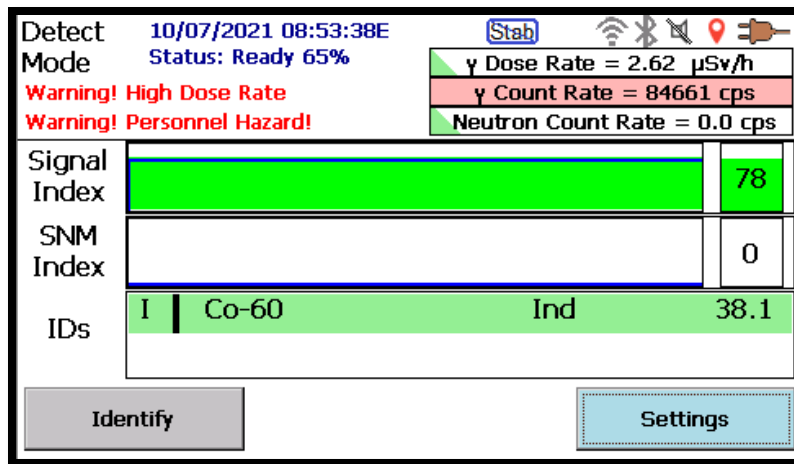
Figure 46. Personnel Hazard Alarm
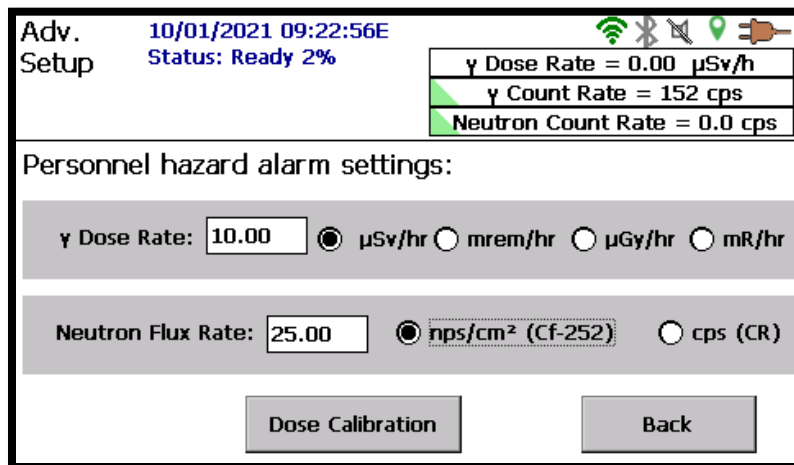
Figure 47. Personnel Hazard Alarm Settings
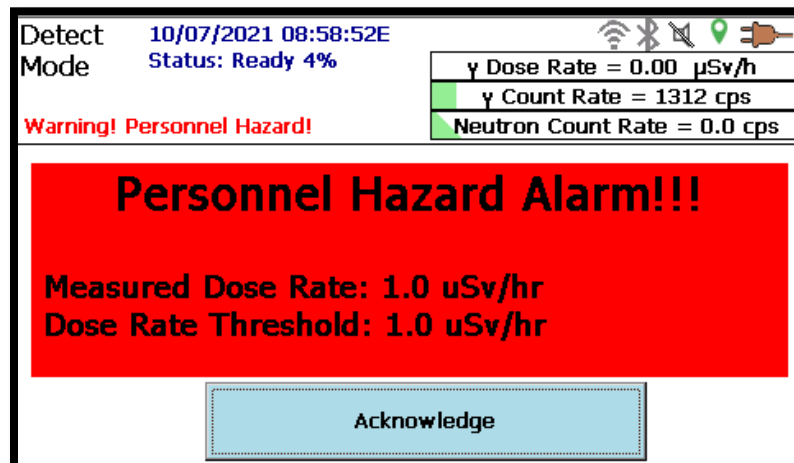
Figure 48. Personnel Hazard Full Screen Alarm

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4.5.3   System Errors

System errors refer to conditions that indicate that the system is in a degraded or non-operational state as noted below. Figure 49 shows an example of this type of error.

- The Cooler is turned off!
- Internal System Error
- Error Retrieving Health
- Error Retrieving Data
- Bias Voltage Error
- Low Battery!
- Disk space too low!
- USB storage is missing!
- +12 Volt Error

- −12 Volt Error
- +3 Volt Error
- Detector Temp High
- New Background Required
- Ge Background Error
- Neutron Background Error
- Neutron State-of-Health Error
- GM Tube Background Error
- Stabilizer Error

The system constantly checks for the error conditions listed above. As long as all of these self-tests pass and the instrument is operating properly, the status is reported as **READY**.

Alarm messages are displayed under the **Status** text line in the display header and are accompanied by short-duration audio and vibratory alarms (if enabled). The instrument status changes to **NOT READY** and any affected functions are disabled. ***An alarm message persists as long as the error condition exists.*** *When there are multiple simultaneous error conditions, the Detective X cycles though the error messages one-at-a-time.*

If the unit is configured to require all alarms to be acknowledged by the user, the acknowledge button will latch the system error and audio and vibratory alarms will persist if enabled until acknowledged. The user may have to return to the Detect Mode screen to silence the alarm by acknowledging the system error. Once acknowledged, the error message in the header will persist as long as the error condition exists.
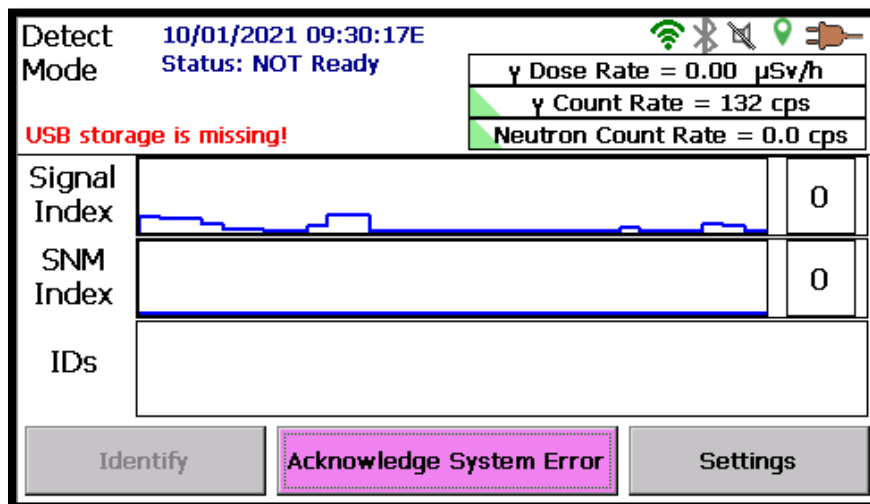
Figure 49. Example of System Error Alarm

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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 mR/h. At this exposure rate, the HPGe detector's dead time is so high that it cannot efficiently generate nuclide IDs. **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.*

The appropriate action in either case is to move away from the source to a point where the alarm is no longer triggered. Recovery from an overrange alarm is immediate; as soon as the distance is increased from the Detective X to the source enough that the overrange message disappears, the unit returns to **READY** status.

The alarm message **Warning! Over-Range!** (Figure 50) is accompanied by short-duration audio and vibratory alarms (if enabled). The alarm also shows up as a red threat ID in both Detect and ID Modes.
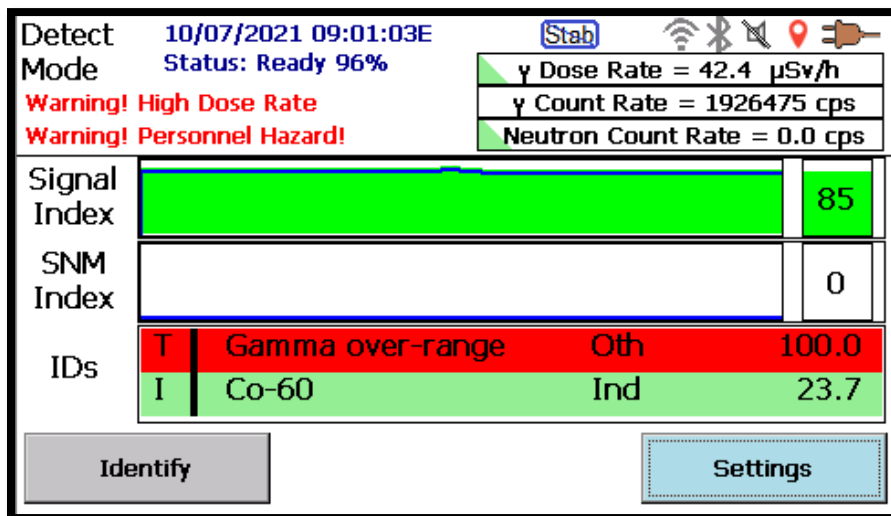
Figure 50. Over-Range Condition

If the unit is configured to require alarms to be acknowledged, a **Detector Over-Range Alarm!!!** message will overwrite the IDs Box (Figure 51) and latch the condition. Audio and vibratory alarms (if enabled) will persist until the **Acknowledge** button is tapped.

The user may then have to return to the Detect Mode screen to silence the alarm by acknowledging the condition. Once acknowledged, the **Warning! Over-Range!** message in the header will persist as long as the condition exists.

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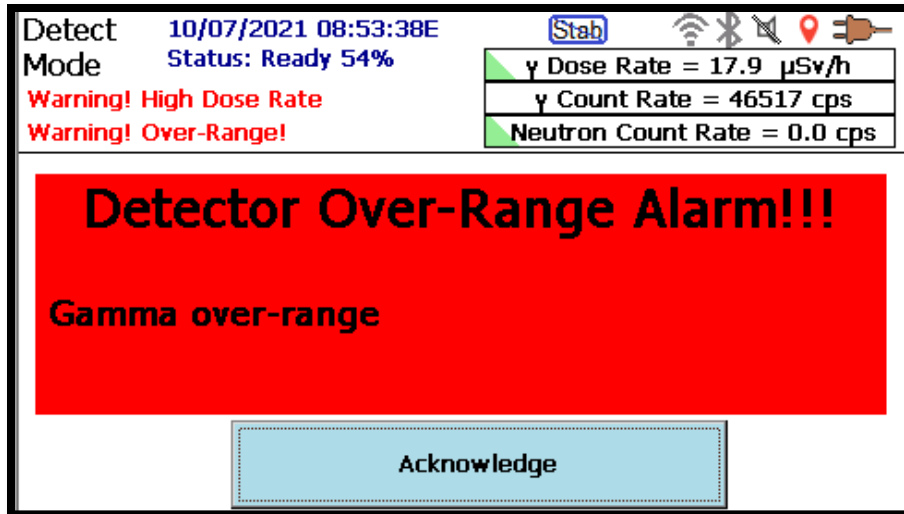
Figure 51. Over-Range Alarm with Acknowledge Button

NOTE	*The gamma dose-rate meter in the display header will continue to function up to and beyond exposure rates of 1 R/hr*, even as the instrument's ability to identify radiation sources is increasingly compromised and, at very high gamma count rates, drops to zero.

4.5.4   Nuclide-Identified Alarm

When the instrument is in either Detect Mode or ID Mode, it continuously analyzes the acquired data. When a nuclide is identified, the unit will report the nuclide name in the identification list. This will be accompanied by a short-duration audio and vibratory alarm (if enabled). The identification will remain in the list until the source is no longer in the detector's field of view.

In cases where the instrument is on the edge of a detection and the ID comes and goes, audio/vibratory alarms will not be retriggered unless the identification falls out of the list for more than 15 seconds (consistent with the duration of the Signal Index and SNM Index charts).

If the unit is configured to require the user to acknowledge all alarms, the **Acknowledge** button will latch the nuclide ID (Figure 52), and audio and vibratory alarms (if enabled) will persist until the button is tapped.

The **Acknowledge** button will either be red (indicating a Threat source), yellow (indicating a Suspect source), or green (indicating an Innocent source). When the **Acknowledge** button has focus, the color will become slightly muted. That is, red will become violet, yellow will become khaki, and green will become light green. This is intended to show which button has focus, much like the blue shading shows focus on the other user interface buttons.

In the case of multiple simultaneous IDs, the **Acknowledge** button will present the highest-priority (i.e., highest threat-level) nuclides for acknowledgment first.

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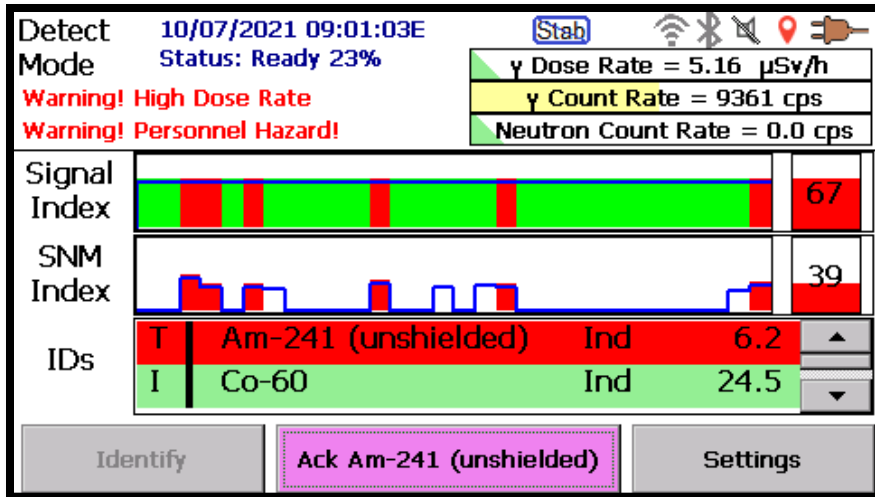
Figure 52. Am-241 Unshielded Identification Latched by the Acknowledge Button

4.6 DETECT MODE

The Detect Mode screen (Figure 53) is the startup screen. Use it to survey areas and fixed or moving objects for sources of radioactivity.

The Detect 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 4.6.1) indicates the presence, above background, of all gamma-ray emissions.

- The SNM Index (Section 4.6.2) 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.
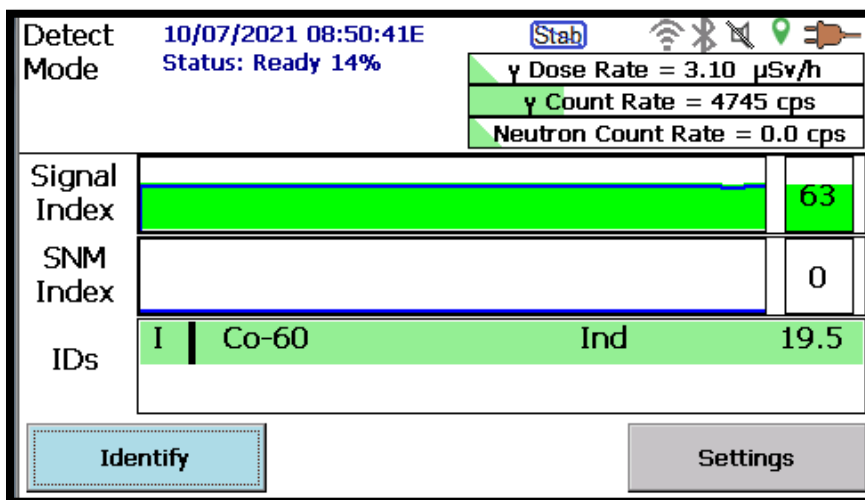
Figure 53. Detect Mode Screen

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- When radioactive nuclides are identified during the search process, the IDs appear in the section below the strip charts. Note the Co-60 identification in Figure 53. 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!*

4.6.1   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.
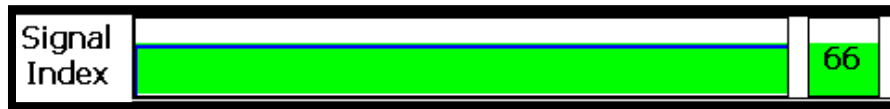
Figure 54. Signal Index Strip Chart History and Current Level

The Signal Index (Figure 54) 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 Detective X 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 alarm is generated, the background color for that section of the chart will change from white 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. Note that suspect IDs are only generated when the LCX analysis mode (Section 4.6.5) is enabled.

4.6.2   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 55) 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 55. SNM Index Strip Chart History and Current Level

4.6.3   Identification (IDs) Box

The IDs Box (Figure 56) lists all nuclides currently in the detector's field of view.

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Figure 56. 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 green 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**)
- 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.

IMPORTANT	The confidence value stored in the N42.42 file is the displayed Q value divided by 100 so the file will meet the schema requirements. Although uncommon, Q values greater than 100 all result in a maximum valid stored N42.42 file confidence value of 1.

---

[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.

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In cases where there are multiple IDs and simultaneous alarms, the index charts will display the color of the highest priority alarm, and the highest-priority (highest threat-level) alarms will be displayed first in the list, as illustrated in Figure 57.

Note that an ID will be removed from the IDs Box when the corresponding source leaves the detector field of view. However, the acknowledge button (if enabled) will continue to display the ID until it has been acknowledged. Moreover, the **Identify** button will be disabled until all alarms have been acknowledged.
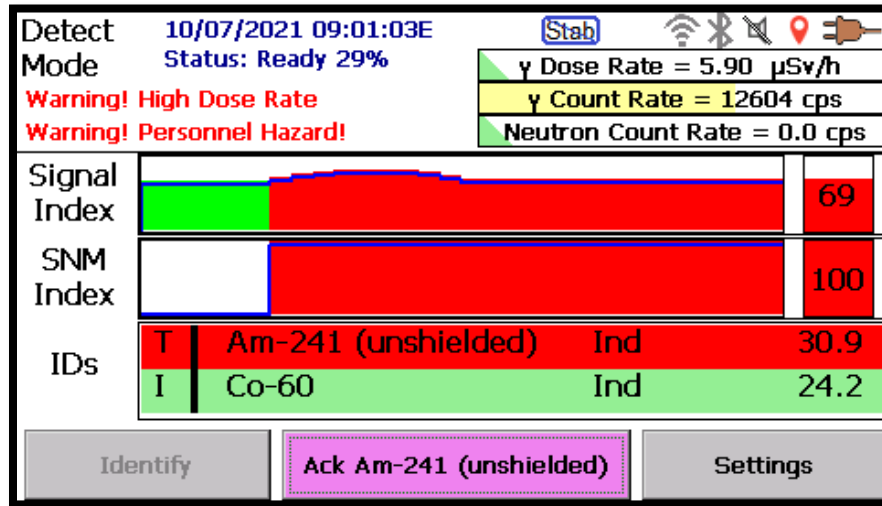
Figure 57. Threat Source Shown in ID List

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.

4.6.4   Detect Mode Integration Time

By default, Detect Mode analyzes data collected over the last 8 seconds, and repeats this every 0.5 second. Detect Mode is suited to situations where the instrument is being moved in relation to a radioactive source.

Note that the dose rate, gamma count rate, and neutron count rate (if equipped) bar charts are normalized across this integration time. Changing the integration time will make these graphs either more or less responsive.

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 1 m (3 ft) 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.

To change the **Integration time**:

- From the Advanced Setup screen, tap **Analysis** to open the page shown in Figure 58.

- Tap and drag the slider to adjust the **Integration time** from 1 to 30 seconds. *Note that this integration time has no effect in ID Mode.*

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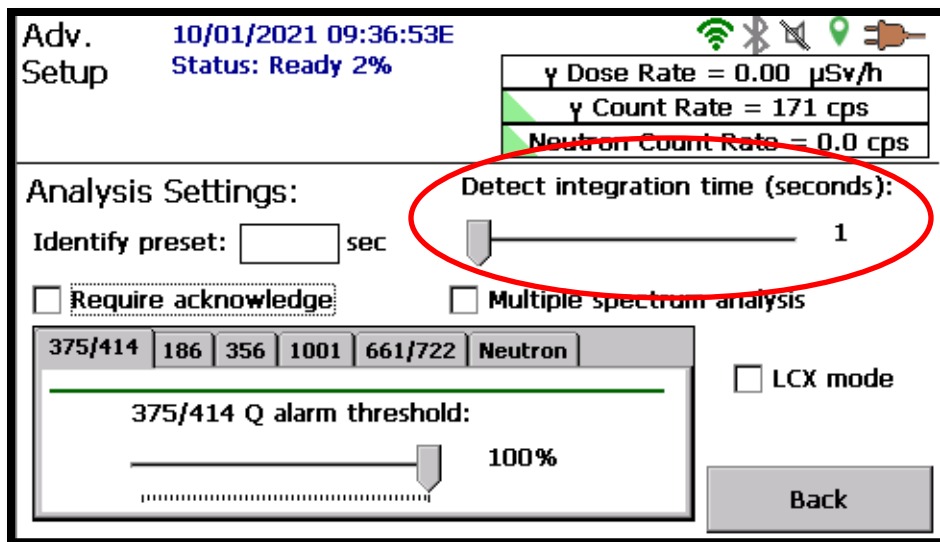
Figure 58. Detect Mode Integration Time

4.6.5   Low-Confidence Expert (LCX) Mode

For instances where false negatives must be eliminated at all cost, the Detective X provides a special "low-confidence" analysis mode, intended for use by experienced spectroscopists. In LCX Mode, a new "Suspect" class of nuclide ID alarm is presented by the Detective X. A suspect alarm is generated when a threat nuclide is identified at a lower confidence level than that required for the standard analysis mode's high-confidence threat ID alarm. When enabled, LCX Mode operates in both Detect Mode and ID Mode.

Suspect alarms are posted on the display with a yellow background, as illustrated in Figure 59. Presenting these yellow suspect alarms, in addition to the normal, high-confidence ID alarms for Innocent (green) and Threat (red) nuclides, makes it easy to determine the information being added by enabling LCX Mode.

NOTE	While these additional suspect alarms can dramatically increase detection probability, they can also increase false alarm probability. Therefore, it is strongly recommended to experiment with this mode before widely deploying it.

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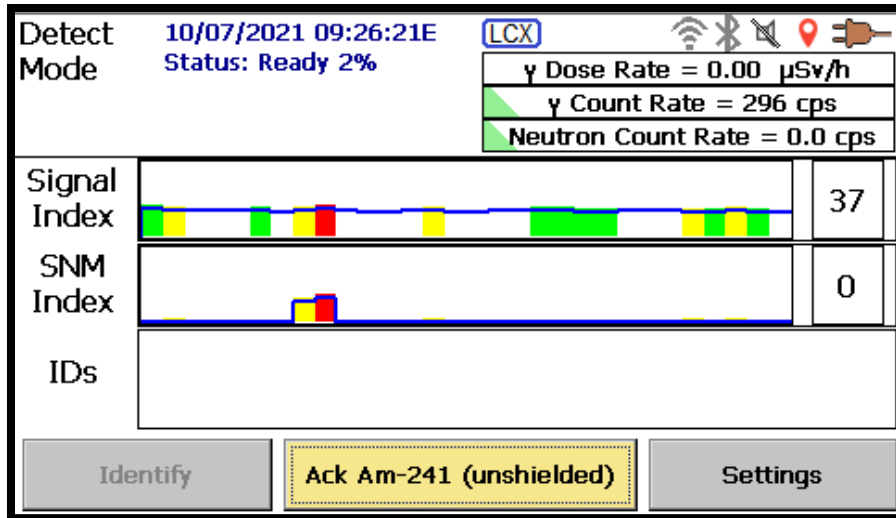
Figure 59. Suspect Nuclide Identification Alarm in LCX Mode

- To enable LCX Mode, go to the Advanced Settings screen and tap the **Analysis** button. Under **Analysis Settings**, tap the **LCX mode** checkbox (Figure 60) to mark it. The LCX status indicator (LCX) will be displayed at the top of the screen.

- To return the Detective X to the standard high-confidence analysis mode, tap to unmark the **LCX mode** checkbox. The LCX status indicator will disappear.
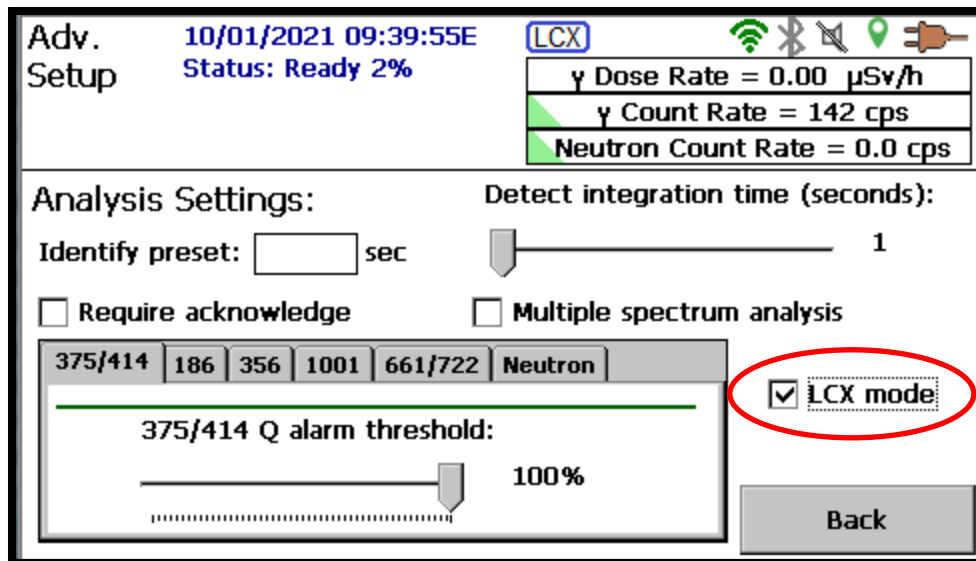
Figure 60. LCX Mode Enable/Disable Checkbox

4.6.5.1   Customizing LCX Mode

In addition to providing suspect alarms for threat nuclides, LCX Mode adds additional suspect alarms based on unqualified peaks in the energy spectrum associated with threat materials. These alarms can be used to increase sensitivity even further. Individual thresholds may be set for each item. The threshold for a yellow suspect neutron alarm can also be adjusted here, by tapping and dragging the slider, to provide more sensitivity from the neutron detector.

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> **NOTE**   These alarms indicate the presence of peaks *only*, without any interference or background corrections. For example, **186 peak detected** does not necessarily indicate that U-235 is present; it may instead be that the instrument is seeing one of several nuclides that emit a gamma ray near 186 keV.

Tabs are divided by gamma-ray energy, each of which is associated with a specific radionuclide. Some tabs include an enable/disable checkbox that allows that peak to be excluded. Unmarking the checkbox stops the peak (for example, the 1001-keV peak) from being reported at all.

Table 2 shows the nuclides associated with the energies on the tabs.

Table 2. Threat Energies

Energy (keV)	Nuclide
375/414	Plutonium
186	Uranium
356	Barium (test and demonstration)
1001	Uranium
661/722	Americium
Neutron	Any

4.7   IDENTIFY MODE

From the Detect Mode screen, tapping the **Identify** button displays the ID Mode screen (Figure 61). Use this mode to identify radionuclides by counting an object or area of interest from a stationary position for an extended time. Data is acquired for a preset time or until the acquisition is manually stopped (see Section 4.7.3).

The ID Mode screen has an IDs Box similar to that on the Detect 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 Detect Mode), *nuclide IDs rarely drop out of the IDs Box in this mode*.
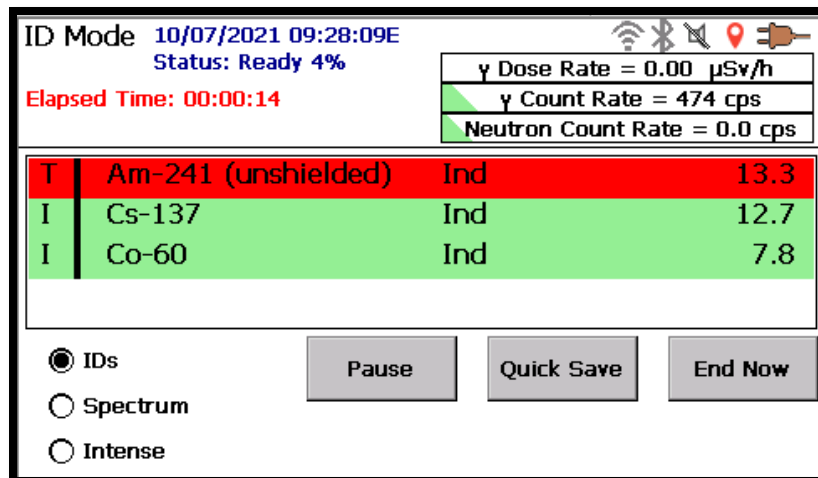
Figure 61. ID Mode Screen

- For best results, position the Detective X as close as reasonably possible to low-activity sources.

- For high-activity sources, a **WARNING! Move Back** message may be displayed above the **Status: READY** indicator if the instrument is too close. Better ID performance will be obtained if, before entering ID Mode, the instrument is moved back from the source until the message disappears.

- If alarm acknowledgement is enabled (Section 4.5.1), the **Ack** (acknowledge) button will be displayed (refer back to Figure 57) and each ID must be acknowledged before proceeding, just as in Detect Mode.

  — The **Ack** button can be red (indicating a Threat source), yellow (indicating a Suspect source), or green (indicating an Innocent source). When the **Ack** button has focus, the color becomes slightly muted. That is, red becomes violet, yellow becomes khaki, and green becomes light green. This is intended to show focus much like the blue shading shows focus on the other user interface buttons.

- While acquiring data in ID Mode, the spectrum can be viewed in real time by tapping the **Spectrum** radio button (Section 4.7.1); or tap **Intense** to view the 10 highest-confidence gamma-ray lines in real time (Section 4.7.2).

- **Quick Save** – This button is only available when **Multiple Spectrum ID Mode** is disabled. It saves the survey data as an N42 file (with background) but does not stop the acquisition. The user can then temporarily remove the USB flash drive and take it to an external PC or phone.

- **Pause** – This button allows data collection to be paused. While the pause button is activated, no spectrum data is collected or analyzed. The **Pause** button changes to **Continue**. Clicking **Continue** reactivates the data collection and continues the elapsed time.

- If the "Show Spectrum File Details Dialog for Quick Save" option is enabled within the **Data Storage** settings dialog (see Section 4.4.2), the user will be prompted to enter the metadata (i.e., Location, Item Description, Conditions) as shown in Figure 66, that will be saved along with the radiological data in the Quick Save N42.42 file. Any information here will be retained as the default information displayed when the complete survey is ended. Data acquisition will continue with the Detective X until the current survey is complete (i.e., until either the preset count time is reached, or it is manually ended by selecting **End Now**). After the current survey is complete, the instrument will continue on its normal course of events. After all survey data is acquired, metadata entered, and the USB flash drive re-mounted in the Detective X rear panel, select **Finalize**. The Detective X will save the complete survey to the USB flash drive.

4.7.1   Spectrum View

The *Spectrum* view (Figure 62) shows the histogram of the gamma-ray energy spectrum being acquired in real time. To display the spectrum, simply tap the **Spectrum** radio button. This feature gives experienced users more information about the nuclides present so more informed decisions can be made about the material under investigation.

| **NOTE** | In cases where the administrator does not want operators to view the spectrum, the **Spectrum** radio button can be disabled on the Password Settings page under Advanced Setup (Section 4.18). |

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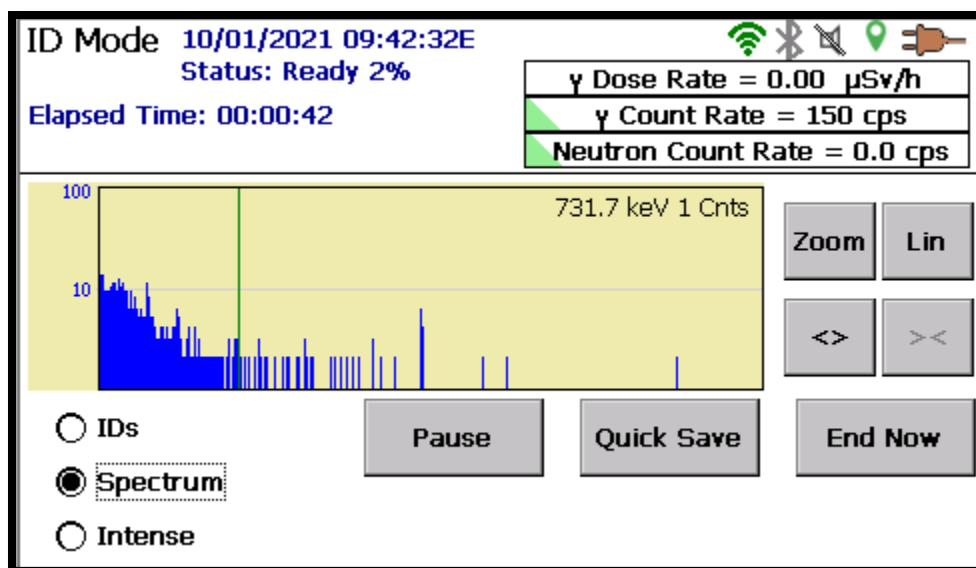
Figure 62. Entire Spectrum Displayed (Showing Marker Position and Channel Content)

The spectrum window has a vertical marker line, and the top right corner of the screen displays the position of the marker in energy (keV) and the number of counts in the marker channel. To move the marker to a different location, tap the desired position. The marker will move, and the energy and counts-per-channel will update. The operator can also tap and drag the marker left or right to a new location. These operations are typically more practical when remotely controlling the instrument from a PC (see Section 4.11).

The spectrum display control buttons are just below the spectrum window. Their function is to change the display in different ways for better interpretation of the spectrum.

The control button functions are:

- **Full/Zoom** – In the expanded view, the **Full** button restores the display to 16K channels (see Figure 62). In the full view, the **Full** button changes to **Zoom** and vice versa. When the **Zoom** button is selected, it focuses the screen to the region surrounding the marker (see Figure 63). Tapping the **Full** button returns to the 16K-channel spectrum view. In this way, the user can easily look at the peaks in the spectrum in detail or move quickly from energy to energy in Full mode.

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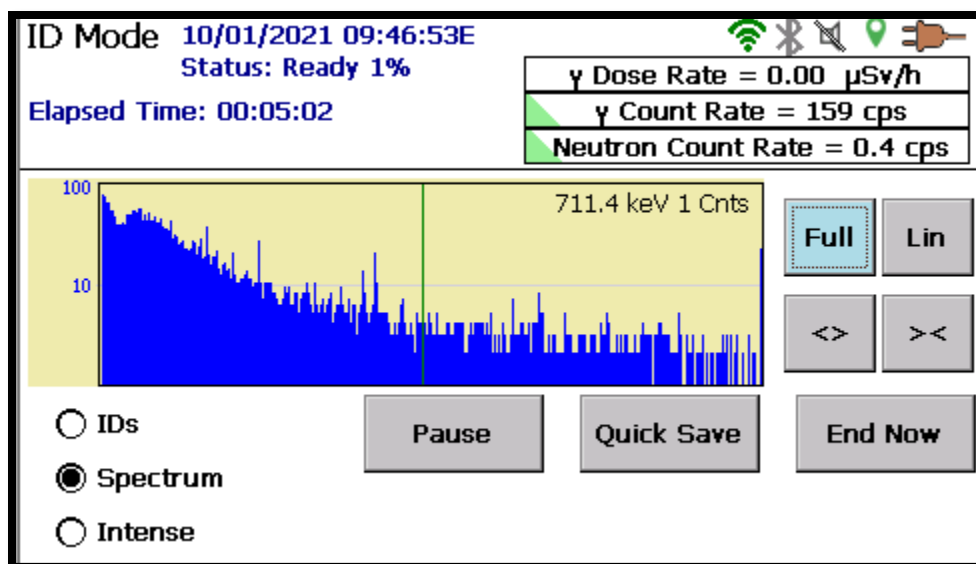
Figure 63. Expanded Spectrum with Marker Near 713.2 keV (with Logarithmic Vertical Scaling)

- **Zoom In <>** – The **<>** button expands the display by reducing the number of channels displayed in half, so the peaks appear wider. The center channel of the new display will be the marker position.

- **Zoom Out ><** – The **> <** button contracts the display by doubling the number of channels displayed, so the peaks appear narrower. The center channel of the new display will be the marker position. Channel Zero (0) is the leftmost side of the display, and Channel 16384 is the rightmost side of the display.

- **Lin/Log** – This button toggles 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.

4.7.2   Intense View

Tapping the **Intense** button displays a continuously updating list of the 8 highest-confidence peaks currently being detected. The **Energy** and **Confidence** are ordered by highest to lowest confidence level; and displayed in two columns, left-to-right then down, so all of the peaks can easily be seen at a glance (see Figure 64). 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.

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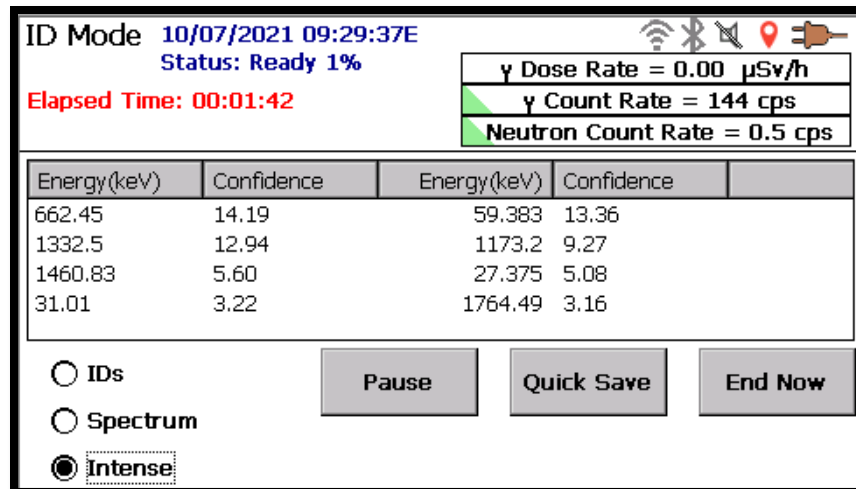
Figure 64. List of the Most Intense Peaks by Decreasing Q Value

4.7.3   Ending the ID Mode Measurement Manually or Automatically

Advanced operators can use the spectral display and top peaks list to guide them in choosing how long they need to accumulate data in ID Mode. Optionally, a fixed counting time (a *counting preset*) can be specified. This is more practical in many instances because it removes time subjectivity in making measurements. Enter the fixed counting preset on the Analysis Settings page (Figure 65), which is accessed from the Advanced Setup page. The **Identify preset** field is blank by default, indicating no counting preset has been set (or the preset can be disabled the preset by entering a value of zero [0] seconds). Tapping the **Identify preset** field pops up a numeric keypad so the user can enter the desired count time.
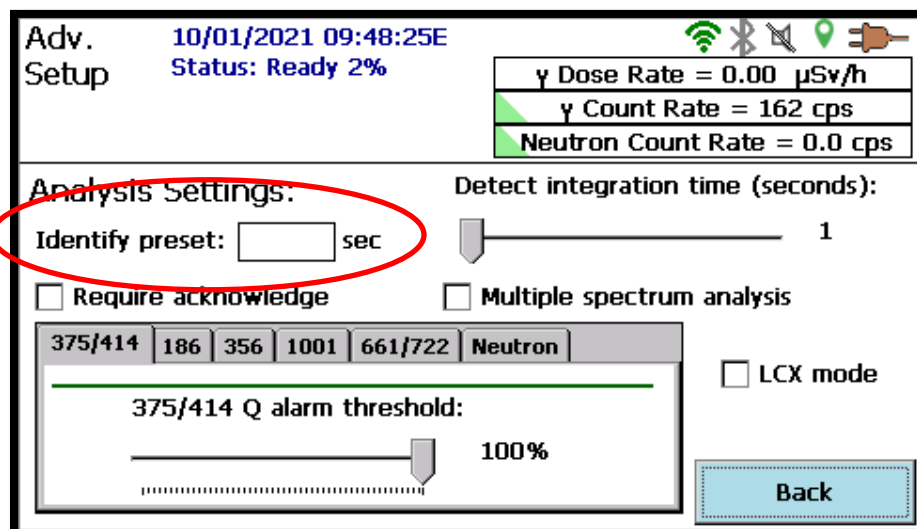
Figure 65. Setting the Fixed Count Time in ID Mode

NOTE	If a preset value is set and the audible sounds are not muted and vibration is enabled, the instrument provides a vibration alert and a buzzer sound when the preset time is reached.

4.7.3.1   Capturing Optional Metadata

The Detective X can generate a lot of data quickly. To help make sense of it later, it may be useful to capture information about the spectrum being collecting at the time it is collected. For this reason, when the ID Mode acquisition ends, the screen shown in Figure 66 opens to give the option of capturing several kinds of information that will be saved along with the radiological data in the N42.42 file.

Figure 66. Optional Metadata for ID Mode Data

To add a new **File Name**, **Location**, **Item description**, or **Condition**, tap the associated **Edit** button to open the data entry field. After that, the last 5 recent entries for each field will be available on a drop list by tapping the down arrow next to the field.

When entry of metadata is finished, tap **Finish** to save it and return to the Detect Mode screen.

Prior to setup, the **Reachback** button will be disabled (gray). Section 4.12 covers setup of Reachback data transfer for ID Mode measurements.

4.7.4   Multiple ID Measurements in One Data File

For very high levels of measurement confidence, the Detective X has a **Multiple spectra analysis** option that lets the user wrap data collected from an unknown sample with that collected from a blank sample and a known sample and save the data from each related measurement in the same N42.42 data file.

To configure the Detective X for this mode of operation:

- On the Advanced Setup screen, tap **Analysis** to open the Analysis Settings page, then tap to mark the **Multiple spectrum analysis** checkbox (see Figure 67).

- In this mode, each time ID Mode is entered, the Multi ID Mode page shown in Figure 68 will be displayed so the user can set up and annotate the multiple measurements to be made.

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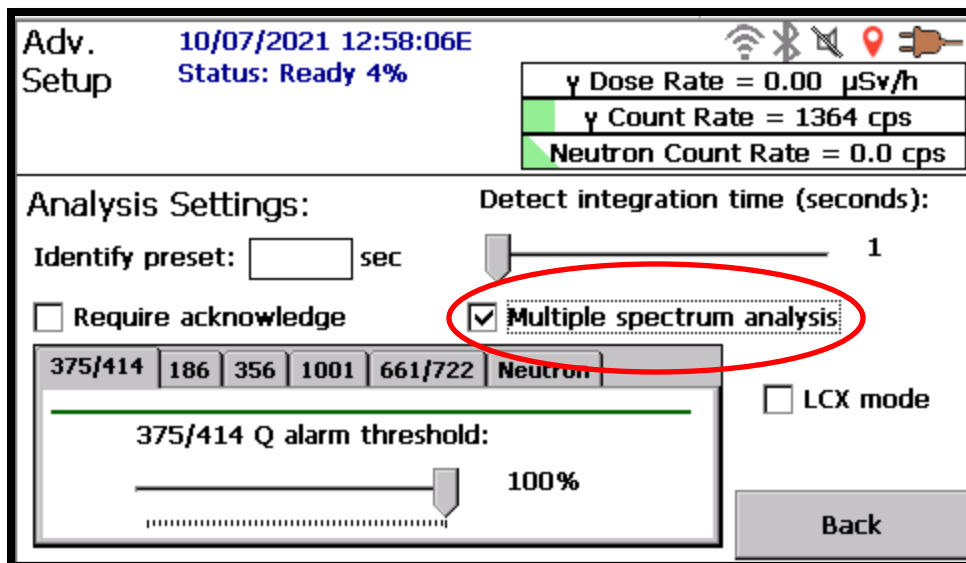
Figure 67. Enable Collection of Multiple Spectra in a Single File
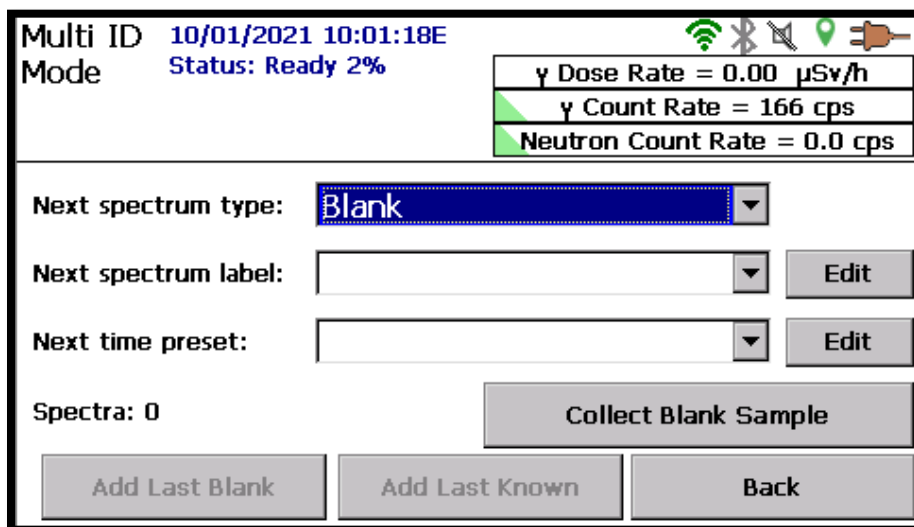
Figure 68. Set Up Parameters for Multiple Spectrum ID Mode

4.7.4.1   Setting Up and Performing Multiple Measurements

The Multi ID Mode page allows the user to define and collect a series of spectra, one at a time, until the desired data set has been collected. The software then saves all of the spectra and metadata in a single N42.42 file.

To set up and perform this type of measurement:

1. Select the desired category of spectrum from the **Next spectrum type** field. The options are **Blank**, **Known**, and **Unknown**. A typical measurement series might consist of one Blank, one Known, and one or more Unknowns. However, there are no restrictions on what type or how many of each type of spectra go into the Multi ID Mode measurement file.

2. Assign a name to this spectrum in the **Next spectrum label** field. This is a free-form field that allows the entry of information about the spectrum to be collected. The field is initially populated

with the text used the last time this type of spectrum was acquired. Recent entries for each spectrum type are available by tapping the down arrow on the right side of the field, or a new label can be entered by tapping the **Edit** button.

3. Enter a preset count time for this acquisition, in seconds, in the **Next time preset** field, or leave the field blank or enter a zero (0) if it is intended to manually stop data collection. Note that the **Identify preset** count time on the Analysis Settings page is ignored when in multiple-spectrum ID Mode.

   The field is initially populated with the time used the last time this type of spectrum was acquired. Recent entries for each spectrum type are available by tapping the down arrow on the right side of the field, or a new label can be entered by tapping the **Edit** button.

4. The user is now ready to acquire the spectrum. Position the source (or blank), remove all other nearby sources, then tap the lower-right **Collect [spectrum type] Sample** button (the button label will depend on the spectrum type selected). The ID Mode screen (Figure 42) will be displayed. Wait for the count preset to elapse or tap **End Now** to manually stop data acquisition. Note that **Quick Save** is not available when performing a **Multiple Spectrum ID Mode** acquisition.

5. When spectrum acquisition is complete, the screen will switch to the Multi ID Mode screen (Figure 68) and wait for information to be entered for the next spectrum. The bottom-left **Spectra** counter will track the number of spectra that has been added to the file so far; and the **Back** button will change to **Finalize**.

6. Each time a spectrum is acquired on a blank sample, its spectrum is saved internally. The operator can then tap **Last Blank** to add it to the current N42.42 file, or to any subsequent file until the next blank spectrum is acquired. Known spectra are handled the same way, and the operator can tap **Last Known** to add the most recent known spectrum to the current file or to any subsequent file until the next known spectrum is collected. This feature saves the time of unnecessarily repeating blank and known measurements.

7. After all spectra have been added to the file, tap **Finalize**. This will navigate to the optional metadata page shown in Figure 66, where additional information can be entered.

8. To complete the multiple-spectrum measurement, tap the **Finish** button to return to Detect Mode.

4.8   MANUAL DATA FILE TRANSFER

The Detective X saves all data collected in ID Mode. Data files are saved in ANSI N42.42-2012 format. Files will have a background spectrum and one or more measurement spectra. The filename format is:

<div align="center">

XXXXXXX_YYYY_MM_DD_HH_MM_SSS

</div>

where the 7 Xs represent an ever-increasing counter, and the remaining string is the UTC date-time stamp.

The spectral 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 and MCA Emulator application (A66-BW).

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Data files can be accessed in several ways with Detective X. The manner in which the user will access these files will depend upon the current destination directory, be it USB Flash Drive or "My Documents" folder, as discussed in Section 4.4.2.

> **NOTE** There is a known discrepancy from the standard N42 file format in which the front accessory is described within the N42 file. This difference does not affect the usability of the N42 file.

4.8.1   Reachback File Access

Perhaps the easiest way to gain access to the files is to configure the system to email data files as discussed in 4.12. The files are also accessible via the USB port behind the IO access panel on the rear of the instrument (refer back to Figure 5 or Figure 6). Note that the Reachback interface will automatically access files within the "…\My Documents\" folder or within the External USB Flash Drive, depending upon the setting discussed in Section 4.4.2.

4.8.2   USB Flash Drive File Access

The following section discusses file access options when the device is set to store survey data on the rear panel USB Flash Drive.

With the instrument in Detect Mode, use the USB cable included with the instrument to connect a PC to the Detective X. No special drivers are required. The Detective X will then automatically relinquish control of its flash drive to the PC. The Detective X will appear as a flash drive to the PC, and files can be copied, deleted, renamed, etc., using Windows File Explorer or any other tool on the PC. Instrument status while connected to the PC will show **NOT READY** because, in this mode, Detective X file storage is available only to the PC. When ready to disconnect from the PC, do so by ejecting the Detective X in File Explorer or by using the Windows "Safely Remove Hardware and Eject Media" feature. The Detective X will be of type **Mass Storage Device**, with the **DET X FLASH** label. Then disconnect the USB cable and replace the hatch covering the data ports.

Yet another alternative for accessing data files is to physically remove the flash drive from the Detective X and plug it into a USB port on a PC. This method is not recommended because the removal of the device occurs without warning to the Detective X software, and there is a small possibility of file corruption when the flash drive is removed. This method does however ensure all collected data is completely removed from the Detective X – a feature that may be important for some users.

> **NOTE** The Detective X will show a **NOT READY** status until either the original flash drive is replaced or a new one is inserted. Spare flash drives are available from ORTEC as part number DETECTIVE-X-ACC-USBFLASH. ***Do not use an aftermarket flash drive.***

4.8.3   Mobile Device Center File Access

Users can utilize the following steps to use Microsoft Mobile Device center to transfer files from the Detective X unit.

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1. Download and install the free Windows Mobile Device Center v6.1 or higher from the Microsoft Download Center. Follow the wizard prompts, restart the PC, then start the Windows Mobile Device Center program.

IMPORTANT	Before connecting the Detective X to a PC for the first time, install Windows Mobile Device Center or ActiveSync first. Otherwise, the Detective X may not be able to communicate properly with the PC. Contact ORTEC's Global Service Center if assistance is required.

2. With the Detective X in **Data (Microsoft Mobile Center)** Mode (see Section 4.10) connect its USB port to the PC. If this is the first time the unit has been connected to this PC, Windows may display a series of "new hardware" messages indicating a mobile device (e.g., the Detective X embedded computer) has been detected and its driver installed. Windows Mobile Device Center will then take several seconds to communicate with the Detective X and indicate its integrated computer is Connected (Figure 69).

3. Click on **Connect without setting up your device**. This will prevent the host PC and Detective X from automatically synchronizing (i.e., exchanging files). Do not modify the Program and Services, transfer graphics or music to the Detective X computer, or change the Mobile Device Settings.

IMPORTANT	Remember that the Detective X is not to be used for purposes beyond the monitoring tasks described in the user manual, and no changes should be made to the operating system settings. Doing so could void the warranty.

4. Hover over **File Management** to expand its topics and click on **Browse the contents of your device** (Figure 70).
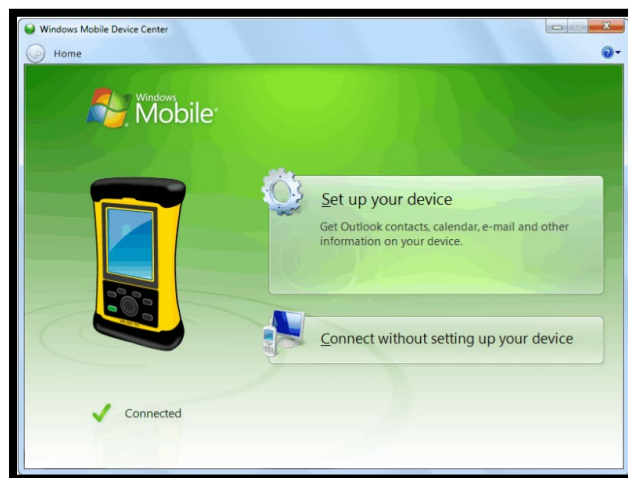
Figure 69. The Unit is Connected to the PC

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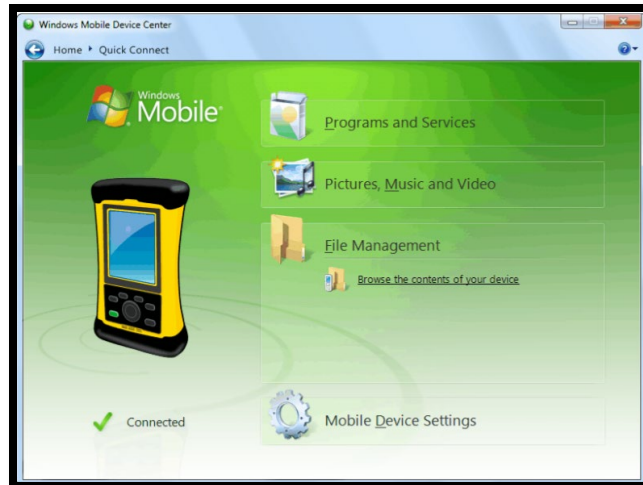
Figure 70. Choose the File Management Browse Option

5. Windows Explorer will open, and the contents of the Detective X's embedded computer file system will be listed. If files are currently being saved to the "My Documents" folder (see Section 4.4.2) they can be accessed within the "…\My Documents\" folder on the Windows Explorer interface. If files are currently being saved to the External USB Flash Drive (see Section 4.4.2) they can be accessed within the "…\Hard Disk\" folder on the Windows Explorer interface.

6. To return the Detective X to standalone service, simply disconnect it from the USB cable.

4.8.4   WiseMo File Access

When remotely controlling a Detective X from a PC, the entire file system on the unit can be accessed with the WiseMo Guest application discussed in Section 4.11. Flash drive contents are displayed under a folder named **C:\Hard Disk** (if accessing data on the external USB Flash Drive) or **C:\My Documents** (if accessing data on the internal storage). This method allows the user to access files at the same time the Detective X software is fully functional.

4.9   CONNECTING THE DETECTIVE X TO A NETWORK

Even though Detective X does not require a network connection, operation is significantly enhanced when the instrument is connected to a network, and further enhanced if the network gives access to the internet. A network can be connected either through a wired Ethernet connection or through a WiFi network. Most mobile phones can be used as WiFi hotspots; this type of internet connection is ideal from a convenience standpoint. However, if a high level of data security and portability are important, the Detective X's wired Ethernet connection can be routed to an encrypted radio or a satellite phone.

The Detective X system has been modified to include a new enhanced communication design. This design has altered the WiFi connection capabilities from operating with a built-in communication module to using an external WiFi connection through a USB dongle (see Figure 71). With this enhanced design, any time that the user wishes to ensure that WiFi communication is not available, the user only needs to remove the WiFi connection dongle.

NOTE	If the instrument has an RF Secure sticker on the back above the serial label, this instrument does not have WiFi capability. No WiFi connection dongle has been provided. However, it is still possible for the user to purchase a WiFi connection dongle later and add WiFi capability to the instrument at a later time.

USB Flash Drive   **WiFi Connection**

Figure 71. Rear Panel with USB Dongles Installed

Detective X features that require network access include Reachback email notifications, remote control, and Mobile Field Kit interactions. Data files can also be manually transferred via a network connection.

Typically, the easiest way to network enable a Detective X is to simply plug a RJ45 Ethernet cable into the unit's rear panel. The wired connection is enabled by default on the Detective X, and it will automatically obtain appropriate settings from the DHCP server on the host network. This type of connection is useful in a CONOPS where users collect data in the field, then return to an office to send queued data to the Reachback organization. After just a few setup steps (see Section 4.12 and Figure 72), the user can simply connect the Ethernet cable and the Detective X will send emails to the Reachback organization automatically. The wired Ethernet connection can also be configured for more specialized applications that require the Detective X to use a fixed IP address and associated settings.

Network settings and information are available via the **Communications** button located on the Settings page. The Wired Ethernet tab for this page is shown below for a connected Detective X. The **Configure Ethernet** button can be used in instances where DHCP should not be used to determine network settings. Notice that the WiFi status icon in the top right of the display shows red meaning disabled. All WiFi network connections are automatically disabled any time a wired connection is made to prevent bridging between networks at potentially different security levels.

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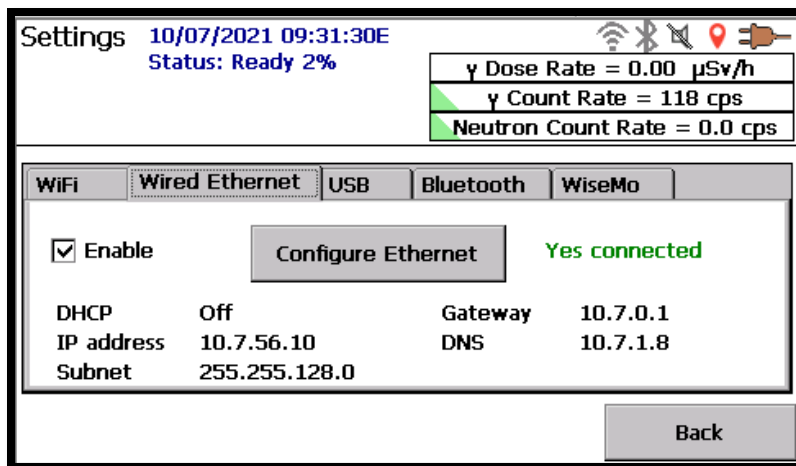
Figure 72. Wired Ethernet Settings Page

Connection to WiFi networks requires an extra step to first identify the target WiFi network. Select the WiFi tab on the communications settings tab (Figure 74). Tap to mark the **Enable** box, then tap the **Configure WiFi** button. This brings up a screen listing all available WiFi networks. Tap the button to the left of the desired network name and the system will connect (and request credentials if the network is secured). Use the **Add a network…** button to access hidden WiFi networks.

NOTE	The Enable box is automatically selected and enabled if the instrument has the Enhanced Communication design (see Figure 6) and the WiFi dongle is installed. In this case, the WiFi connection can only be disabled by removing the WiFi dongle from the instrument. If the instrument determines it is equipped with external WiFi, it will deactivate the Enable/Disable WiFi checkbox.
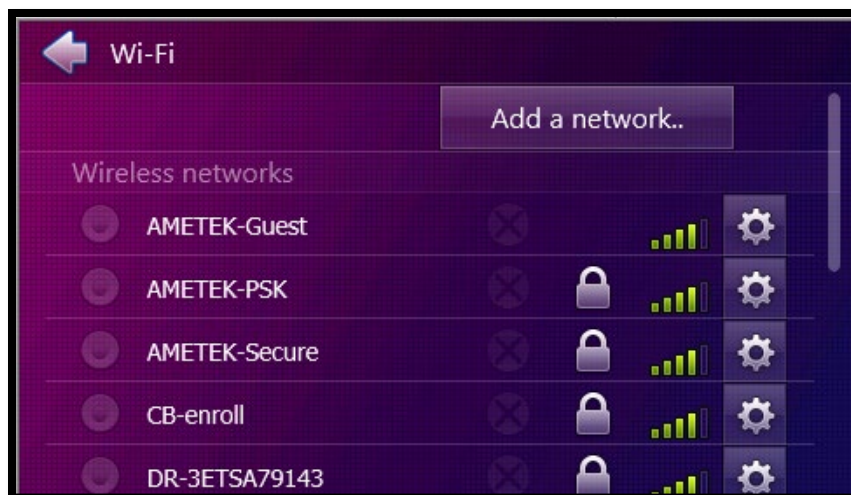
Figure 73. Typical WiFi Network Selection

Use the back arrow in the upper left corner of this screen to return to the Detective X Communications Settings page (Figure 74). The **Browser** button here can be used to verify internet access. Some public networks require credential entry from the browser prior to granting full internet access.
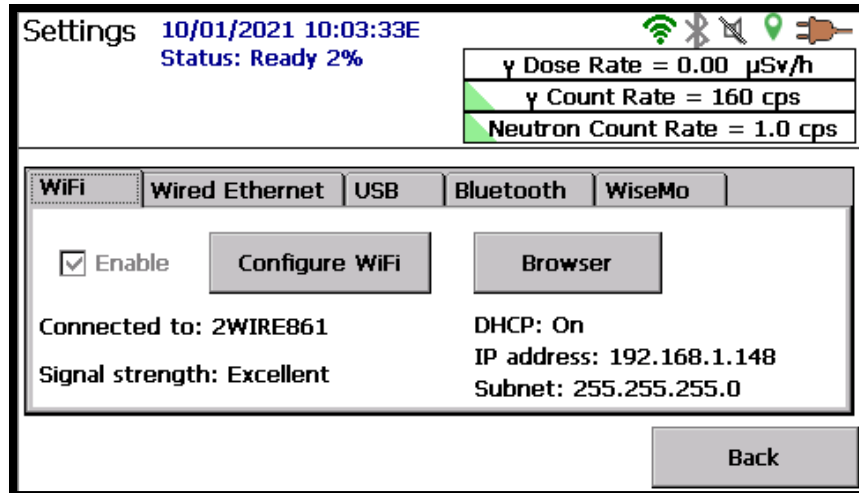
Figure 74. WiFi Connected

The IP address assigned to the Detective X and displayed on this screen will be required later in setting up remote control operation. The connection will automatically be reestablished after a power cycle of the Detective X.

NOTE	If the connection is lost due to low signal, the instrument will attempt to connect to the internet again once signal has been returned. However, it may be necessary to enter the Configure WiFi screen once again to reestablish connection.

4.10 USB INTERFACE FOR DETECTIVE X
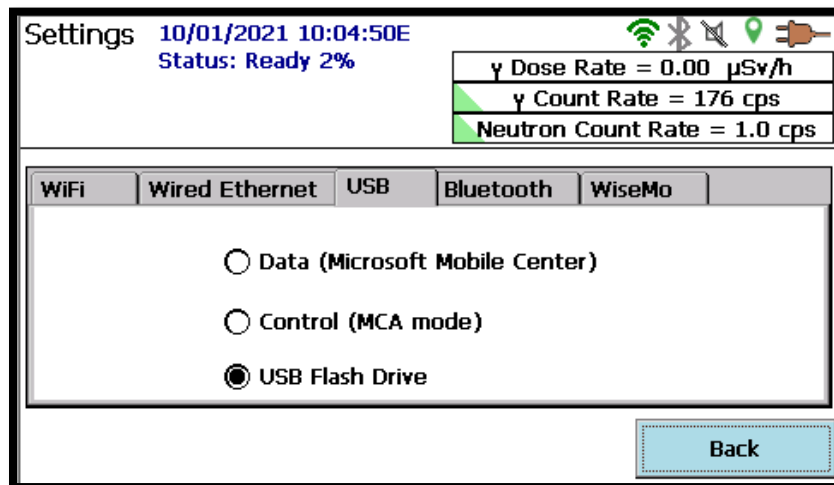
Figure 75. USB Settings Page

Figure 75 is the USB Settings Page. This screen is accessed by selecting the **Communication** button from the **Settings** menu, then selecting the **USB** tab.

This screen controls the behavior of the rear-panel USB-to-PC (see Figure 5 or Figure 6) cable connection to the Detective X unit. There are three options for this connection.

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Data (Microsoft Mobile Center) – This option allows an external PC to connect to the Detective X using Microsoft Mobile Device Center (see Section 4.8.3).

Control (MCA mode) – This option allows an external PC to connect to the Detective X using the ORTEC CONNECTIONS interface. 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.[3] This interface is called CONNECTIONS in ORTEC's other 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).

USB Flash Drive – This option allows an external PC to view the contents of the rear-panel USB Flash Drive (see Section 4.8.2).

The item selected on this page will govern how the USB port behaves when a cable is connected to the Detective X (even when not viewing this USB Settings Page). As such, when performing other Detective X actions, such as performing an Identification Mode Survey, if the user connects a USB cable the Detective X may lose either its data folder access or its connection to the onboard MCB electronics. In such circumstances, the acquisition may cease until the USB cable is removed, or the user may be prompted that file saving cannot be performed.

Note that if the user connects to the Control (MCA Mode), functions within the Detective X application are still accessible. However, the Detective X application will not be able to perform identifications, calibrations, or background readings. If the user were to exit the Detective X application and attempt to enter any application other than the Trans-SPEC, the instrument will display an error message stating that the unit is in MCA control mode and the USB cable must be disconnected before the application will continue. If the user chooses to press OK without removing the USB cable, the application will close and return to Launcher. The user will only be allowed to proceed into the Detective X, Sleuth, or RAPiD applications by removing the cable before launching the application or before pressing OK on the error message. Note this does not affect the Trans-SPEC application as the user is allowed to access the application while in MCA mode.

---

[3] "MCB" is an acronym for *multichannel buffer*, a legacy ORTEC term denoting a device that produces a counts-vs-channel histogram, where channel is linearly related to the energy deposited in the detector when the detector absorbs (or partially absorbs) a gamma-ray.
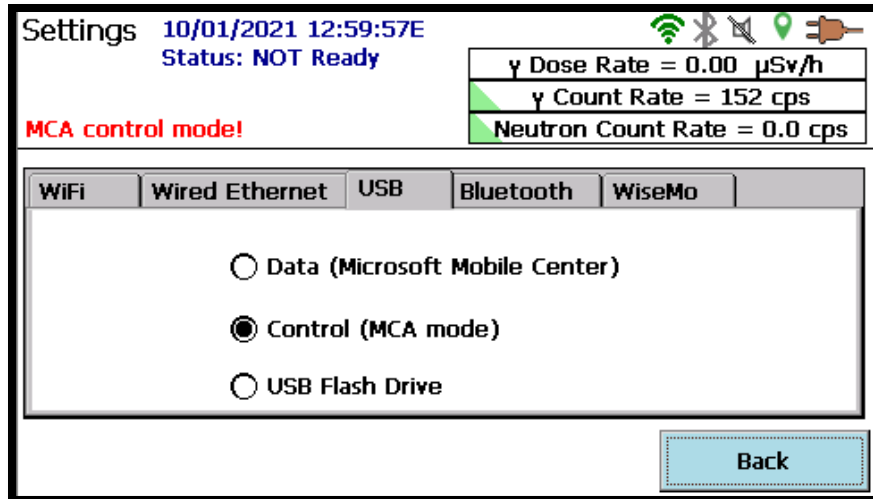
Figure 76. MCA Control Mode Error Message

4.11 REMOTE CONTROL OF DETECTIVE X

Remote control of Detective X is extremely convenient for a number of tasks. Detective X is preloaded with the WiseMo Host application which allows other devices to control it remotely over a network connection. Internet access is not necessary for remote control of the unit.

Remote control is disabled by default on the Detective X for security reasons. To enable remote control, access the WiseMo tab on the Communications settings page and check the box to enable WiseMo (Figure 77).
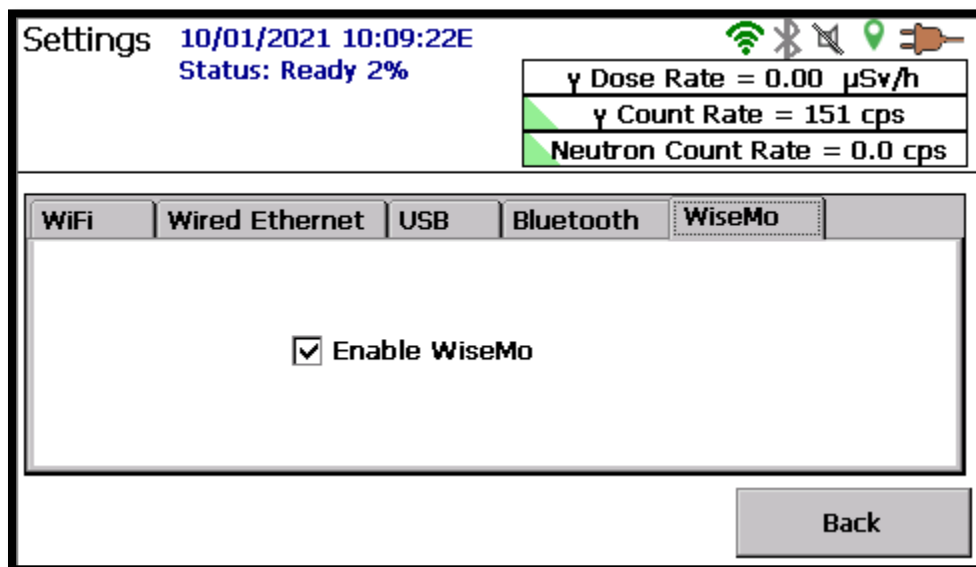
Figure 77. Enabling Remote Control Operation

When this box is checked, the WiseMo Host application will be made visible (see Figure 78). Tap the **Hide** icon to return to the Detective X software application and leave the WiseMo software running in the background, ready to connect to a WiseMo Guest application running on a remote machine.

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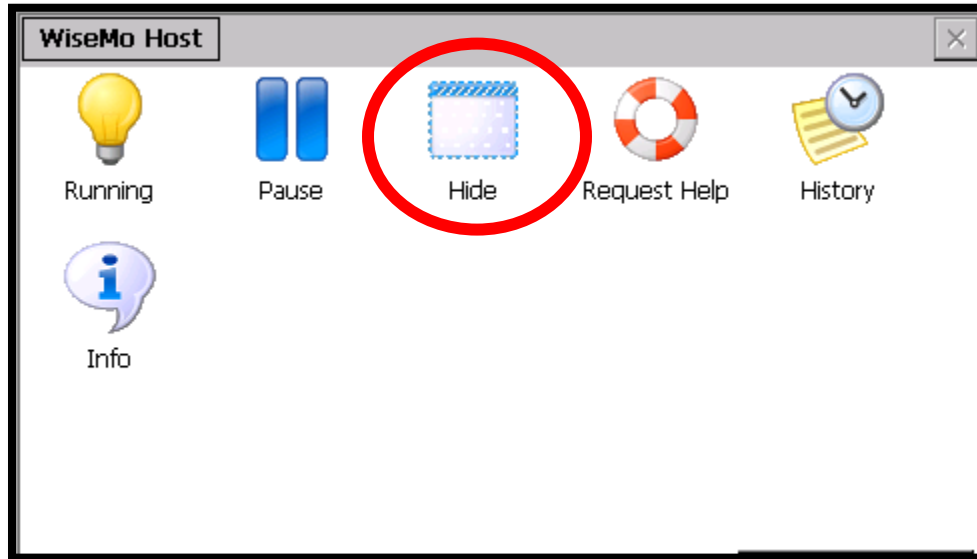
Figure 78. WiseMo Host Application

To remotely control the Detective X, it is necessary for the guest system (the system controlling the Detective X) to run a WiseMo Guest application. The application is available free for iOS devices from the Apple App Store and Android devices on Google Play. Search for "WiseMo". Free trials of the PC based guest application are available from www.wisemo.com (choose offline-only connectivity as Detective X does not support iCloud connections). Perpetual licenses are available for a very reasonable fee.

The Detective X and the PC must be connected to the same network for remote control. The main window for the WiseMo Guest application is shown in Figure 79. To connect, first click on **All connections** on the left side panel. Find the IP address reported on the WiFi tab of the Detective X Communications Settings page (or the Wired Ethernet tab, if appropriate for this connection) when the instrument is connected to the network. Enter this IP address in the Guest application window and press the connect button. When contact is made with the Detective X, a password will be requested. All Detective X instruments use the same all-lowercase password for this purpose: **ortec**
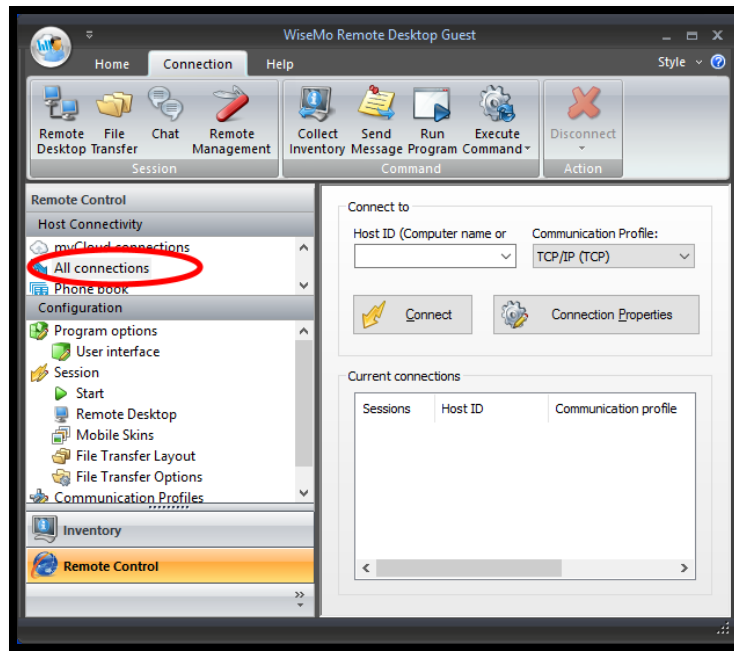
Figure 79. PC-Based WiseMo Guest Application

The remote desktop window is shown in Figure 80. The default skin is more appropriate for a mobile phone than a radionuclide identifier, but functions as needed. To remove the skin, choose **Do not use skin** on the Display tab of the WiseMo Guest Connection Properties dialog. (Connection must be reestablished before changes here take effect.)
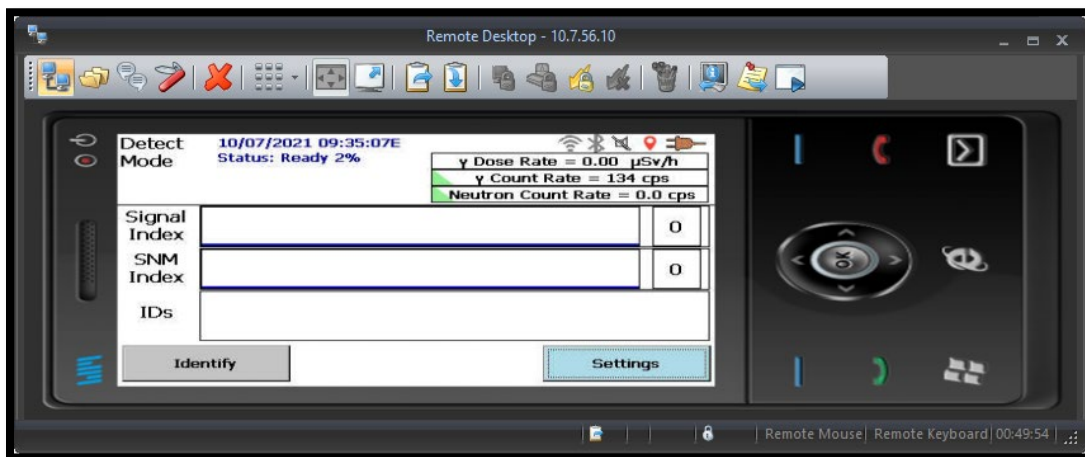
Figure 80. PC-Based Remote Desktop Window with Default Skin

The WiseMo Guest iOS app works in a manner similar to the PC-based version and is shown in Figure 81. Connecting the Detective X to a mobile phone provided WiFi hot spot and then controlling the Detective X from that phone using the WiseMo Guest app is very convenient for some applications.

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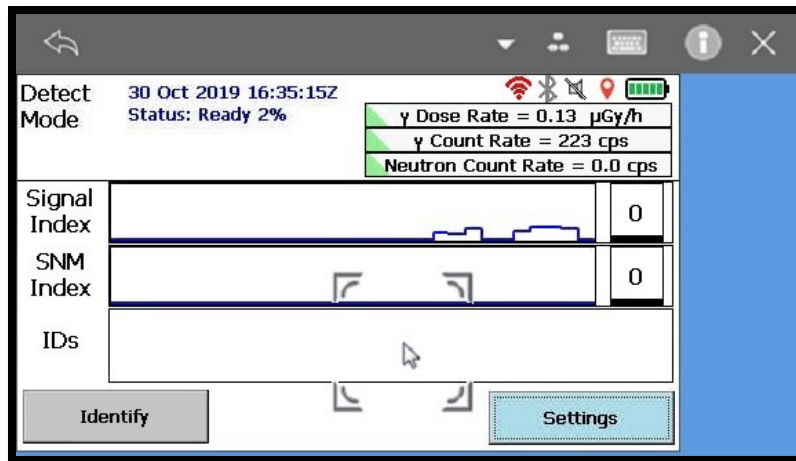
Figure 81. iOS WiseMo Guest App on iPhone Connected to Detective X

The WiseMo Guest application provides a wide range of functionality in addition to remote control. Some of this functionality can be very useful. Unfortunately, the Guest application provides full access to many items on the Detective X that is strongly recommended users do not change. For many applications, this functionality is best left disabled, when not in use, for security purposes. Remote control can be disabled on the Detective X on the WiseMo tab of the Communication Settings page. Simply unmark the **Enable WiseMo** checkbox and confirm to exit the WiseMo Host application. Functionality can be re-enabled at any time by marking the same box. This will restart the WiseMo Host application. Press the **Hide** button to return to the Detective X application (See Figure 78).

4.12 REACHBACK EMAIL SETUP

Once a Detective X is connected to the internet, it can email measurement data collected in ID Mode anywhere in the world for further analysis. When the instrument is not connected to the internet, it can queue data until a later time when it is connected.

Setup for Reachback email is simple.
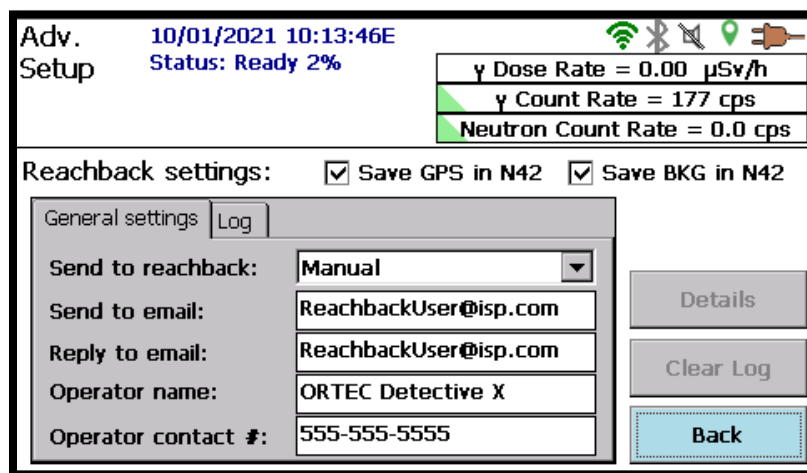
Figure 82. Reachback Settings

Figure 82 shows the Reachback settings page accessible through the **Advanced** button. All that is required to enable Reachback emails is to enter valid destination and reply-to email addresses. The reply-to email address becomes the destination of an email when the receiver chooses to reply to the message sent by the Detective X. This would typically be an email address monitored by the operator of the instrument. The operator name and operator contact numbers are optional free form fields to help the receiver identify the source of the email message. Users may select to save the GPS data or save the background data in the N42 file. By default, measurement data must be manually queued for Reachback and a button to perform this task is provided after data is collected in ID Mode. Previously collected data can also be queued for Reachback on the Recall Settings page. The instrument can also be configured to automatically send ID Mode data to Reachback.

NOTE	The Save BKG in N42 check box is enabled by default. If it is not desired to send the background data with the N42 file sent by Reachback, uncheck this box. If the box is unchecked, a background data file is automatically saved separately in the Recall folder after the first time an identification is saved. This background file can be sent to Reachback separately. This background file name will begin with BACKGROUND (see Figure 88).

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

Figure 83 shows the email as received. The attached spectrum file is saved in ANSI N42.42 format, which is compatible with the ANSI N42.42-2012 standard. The file will have a background spectrum and one or more measurement spectra. The filename format is: **XXXXXXX_YYYY_MM_DD_HH_MM_SSS**. Note that the date and time stamp used in the spectrum name is UTC (Zulu) time.

As noted earlier, the spectral 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 and MCA Emulator application (A66-BW).

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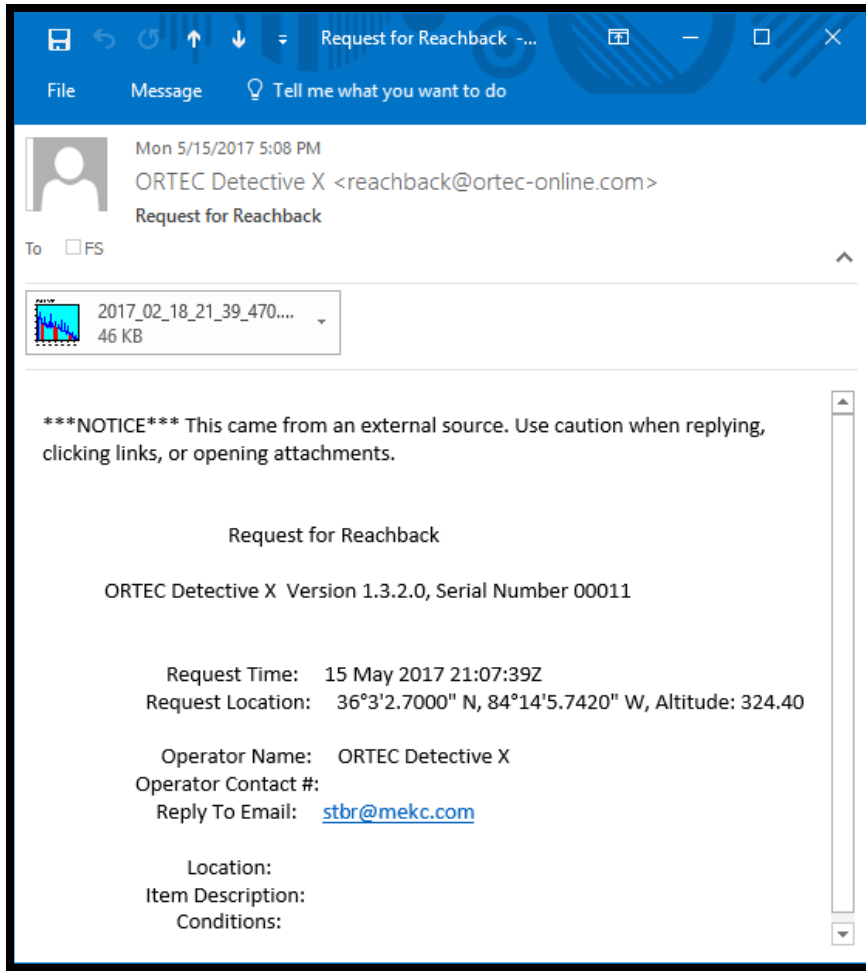
Figure 83. Reachback Email

4.12.1   SMTP Server for Reachback Email

The Detective X sends emails using a standard SMTP protocol. Detective X sends the email message to an SMTP server and then the SMTP server routes the message to its recipient. By default, messages are sent to an ORTEC managed SMTP server using the Reachback@ortec-online.com account. It is strongly recommended that the settings be modified to use a private SMTP server instead. This task need not be done during initial startup but should be completed prior to deploying the Detective X to the field.

The process for changing the SMTP server used by Detective X involves exporting the **Settings.txt** file from the Adv. Setup page (see Figure 84), editing that file to specify a new server, then re-importing the modified settings file. Relevant lines in the **Settings.txt** file are shown below, with sample values provided. Actual values will be supplied by the user's email provider.

```
DefaultEnableSsl           STRING True
DefaultSenderEmailAddress  STRING someone@somewhere.com
DefaultSmtpPassword        STRING ThePassword
DefaultSmtpPort            STRING 70
DefaultSmtpServerAddress   STRING smtpout.secureserver.net
DefaultSmtpUsername        STRING someone@somewhere.com
```

The easiest way to modify these settings is to start a PC-based remote-control session. Then select the **Export Settings** button on the **Advanced Setup** page to save a current settings file to the Detective X flash drive. In the remote-control window, click the File Transfer button (🗀) on the left side of the toolbar.
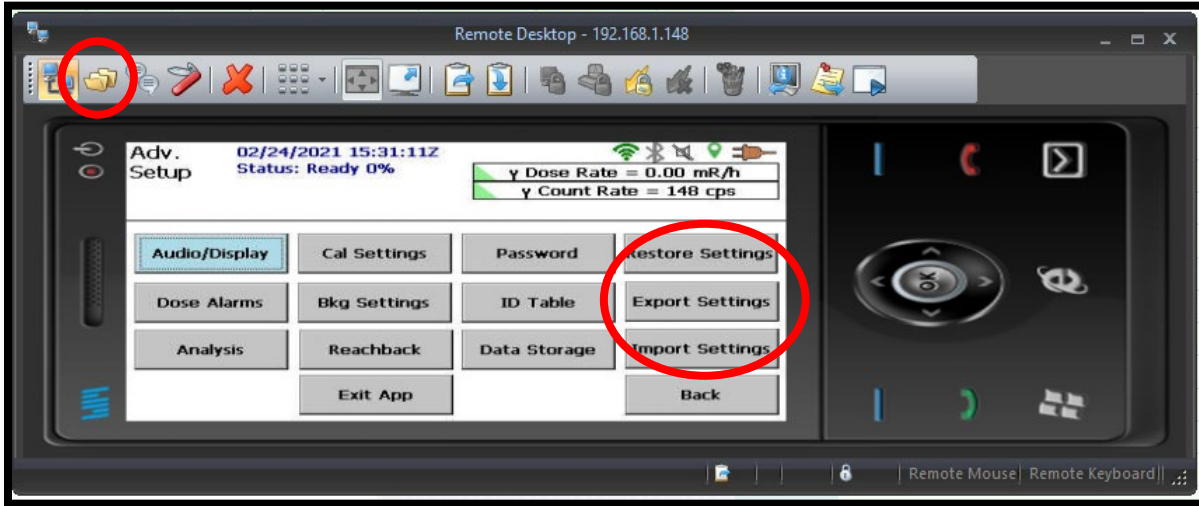
Figure 84. Remote Control Window

Find the **Setting.txt** file located in the **C:\Hard Disk** folder (Figure 85). Double-click the file to open it in Notepad and enter relevant values for the new SMTP server. Close the Notepad window and save changes.
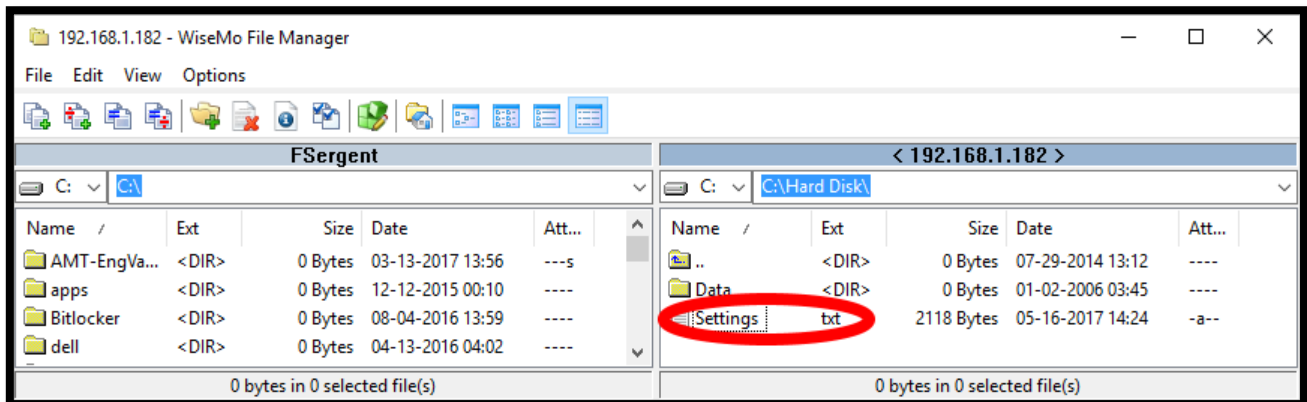
Figure 85. WiseMo File Manager

Select the **Import Settings** button to import the modified settings. Cycle power so the new settings will take effect and manually send a file to Reachback to test operation.

4.12.2   Reachback Log

The Reachback setting screen maintains a log file of all N42 files that have been sent. Selecting the Log tab displays the following screen.

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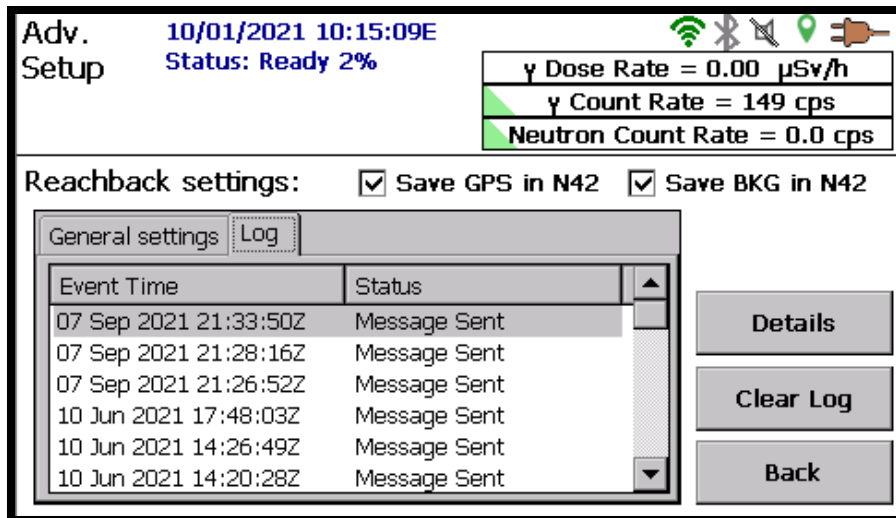
Figure 86. Reachback Log

Select any file that is listed and press the Details button to display individual information about the file.
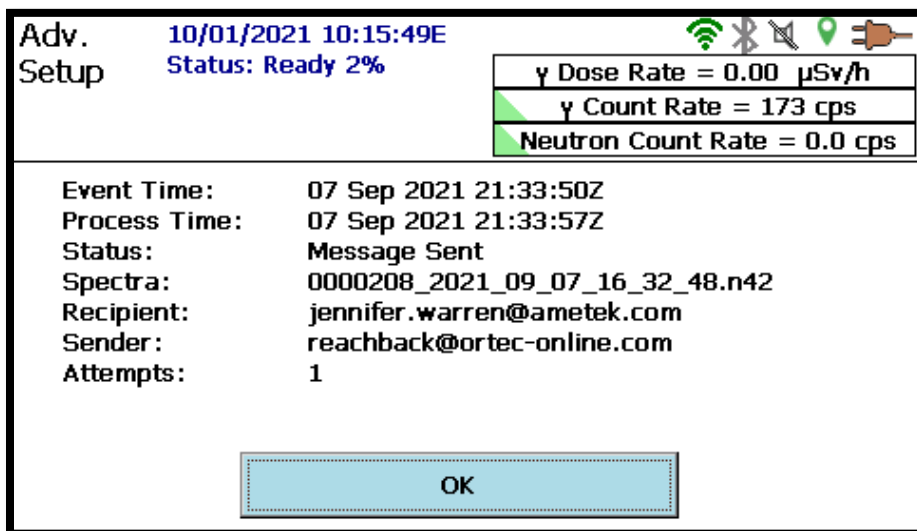
Figure 87. Reachback Log Details

Press OK to return to the Reachback Log. If it is desired, pressing Clear Log removes all events listed in the Log.

NOTE	Reachback files sent from RAPiD are logged in the same Reachback Log as files sent from Detective X.

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4.13 RECALLING PREVIOUSLY COLLECTED DATA FILES

The Recall page accessible from Settings allows the user to sort through all of the data collected in the Detective X application. Key data can be manually sent to Reachback from here, and data collected in error can be deleted.
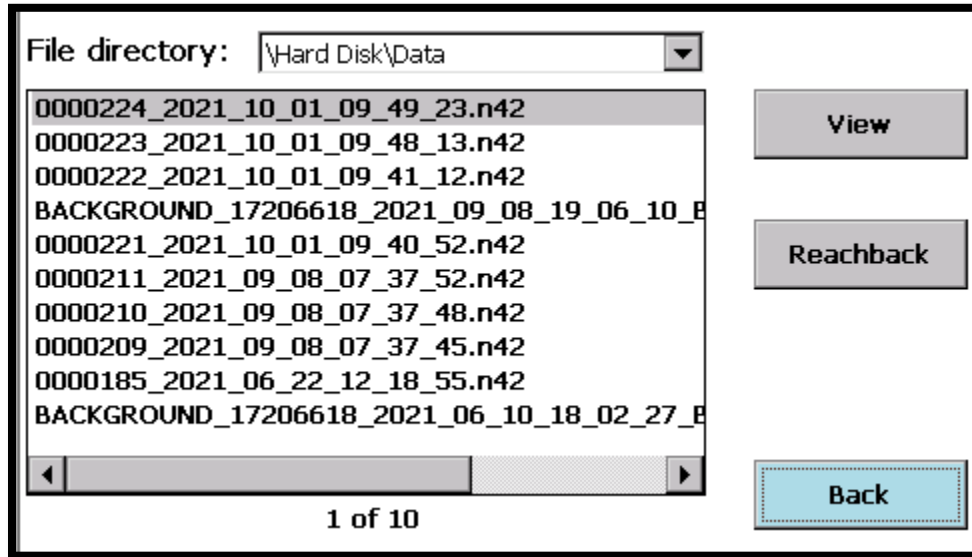
Figure 88. Recall Screen

The first Recall screen (see Figure 88) simply lists all data that resides on the machine in chronological order with newest data files at the top. The file directory can be selected at the top of the screen, allowing the user to change to any Detective X file folder where data may be stored. Remember that file names are simply the encoded time/date when the file was saved. When searching for a particular data set or group of data sets, the initial Recall screen will be used to scroll though lots of data files quickly. The operator will then select a data file with a time/date in the neighborhood of file(s) of interest and then tap the **View** button.

The Recall files screen also provides the user the ability to send file to Reachback immediately. Select a file and click **Reachback** to have the file added to the queue and sent.

The View Details screen then allows the operator to move through data sets one at a time by clicking the **>>** and **<<** buttons to zero in on particular data sets of interest (see Figure 89).

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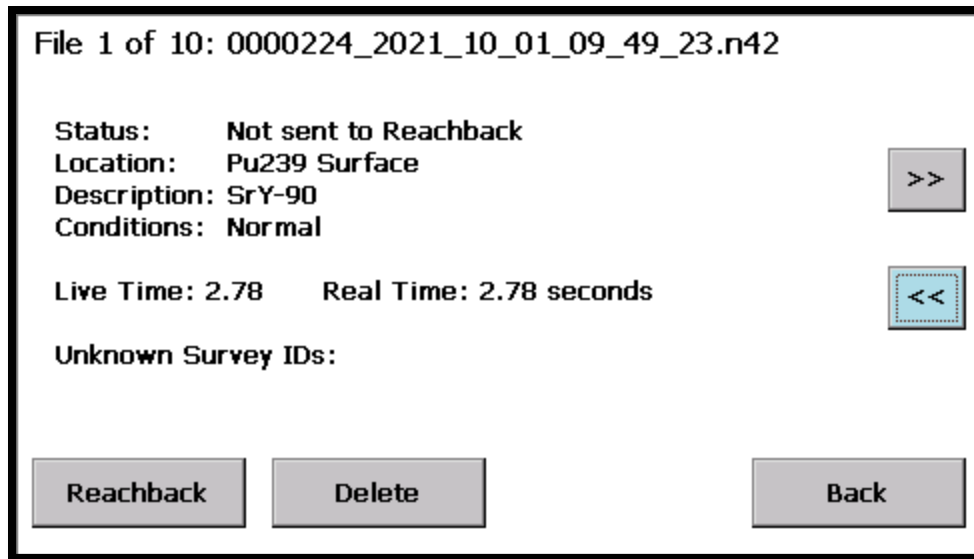
Figure 89. Recall Details Screen

Information about each data set is displayed here one data set at a time. The operator can see whether the file has already been sent to Reachback, as well as view the operator-entered metadata associated with the data set, and nuclide identifications made while collecting the data. Identifications made on Blank and Known spectrum types in multiple-spectrum mode are excluded from this list of identifications.

Clicking the **Reachback** button here cues the file to be added for sending to Reachback and changes the Status to read "Waiting to Send." Clicking the **Delete** button allows the user to choose to delete the current data record.

Clicking the **Back** button returns to the Recall files screen (Figure 88) and sends all of the files that are cued for Reachback.

4.14 COPYING FILES FROM INTERNAL STORAGE TO A USB FLASH DRIVE

In addition to sending files to Reachback, the user can copy files that have been originally stored in the Detective X My Documents storage location to a USB flash drive. On the Settings screen, click on the Copy Files button to open the copy screen (Figure 90).
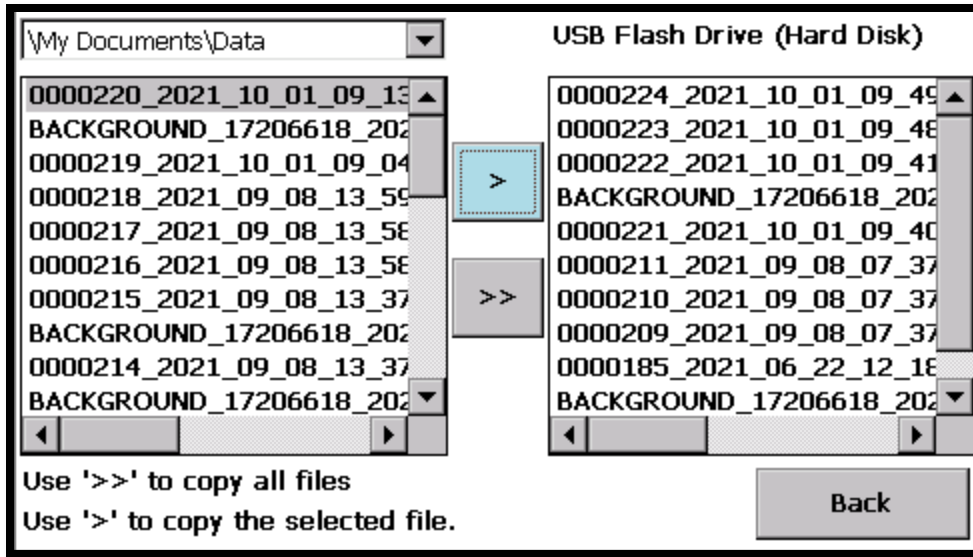
Figure 90. Copy Files Screen

Click on the **>** button to copy individual files or the **>>** button to copy all of the files to the USB flash drive. Clicking on the **>>** button copies all files located in all internal data folders, including additional folders that may have been created through the file archive system (see Section 4.4.2). If the file has already been copied to the USB flash drive, the user will be given the option to copy the file again or to skip that file.

After clicking on the **>>** button and the mass file copy is complete, the user is given the option to clear internal memory (see Figure 91). Clicking on **Clear Internal Memory** removes all files stored in the Detective X My Documents location, including any additional folders that may have been created in the file archive process.
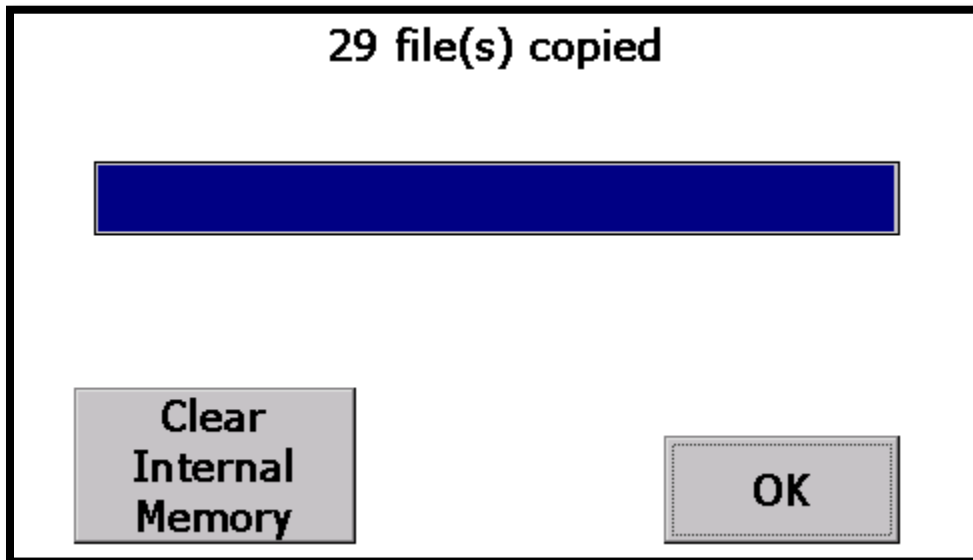
Figure 91. Clear Internal Memory

Clicking **Back** returns the user to the Settings screen.

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4.15 MEASURING AMBIENT BACKGROUND

A valid and representative background is important in the analysis of the spectrum in the Detect and Identify modes. Detective X 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 with which no background data has been collected, the unit will show a "**No Background!**" error and status will be **NOT READY** until background is collected with the particular accessory mounted. Note that Detect Mode will continue to function in this instance, but ambient background could be misinterpreted as NORM. Identify Mode cannot be entered without applicable ambient background data.

The Background Calibration screen is accessed from the Settings screen, and data collection begins immediately (see Figure 92). The screen displays a simple histogram output of the live spectra. The operator may touch the screen to select a given channel which results in the channel number and channel counts being displayed on the bottom of the screen. To abort the background collection, just tap the **Back** button and confirm. Background data from a previously completed collection will continue to be used in this case. By default, background data must be collected for at least 30 minutes before it can be saved; and data collection will continue beyond 30 minutes until the measurement is ended and saved. In general, the longer background data collection is allowed to accumulate, the better.
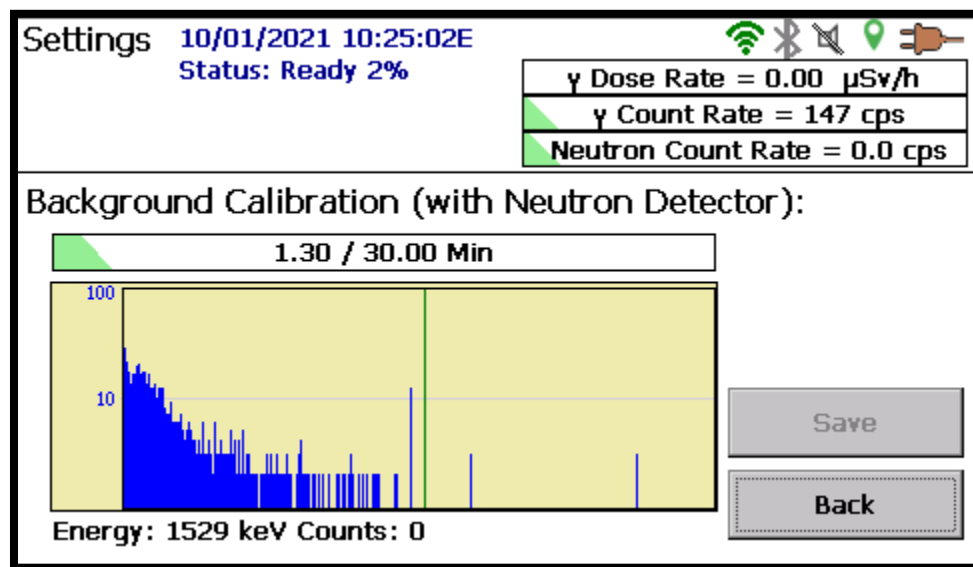
Figure 92. Background Collection for Use in Analysis

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 all 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.

Background collection can be customized on the Background Settings page accessible from Advanced Setup (see Figure 93).

For some applications, a 30-minute background collection is impractical, and a shorter time can be specified here. 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 alarm 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 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). This screen allows the system to be configured to automatically end and save background data once the minimum time has elapsed.
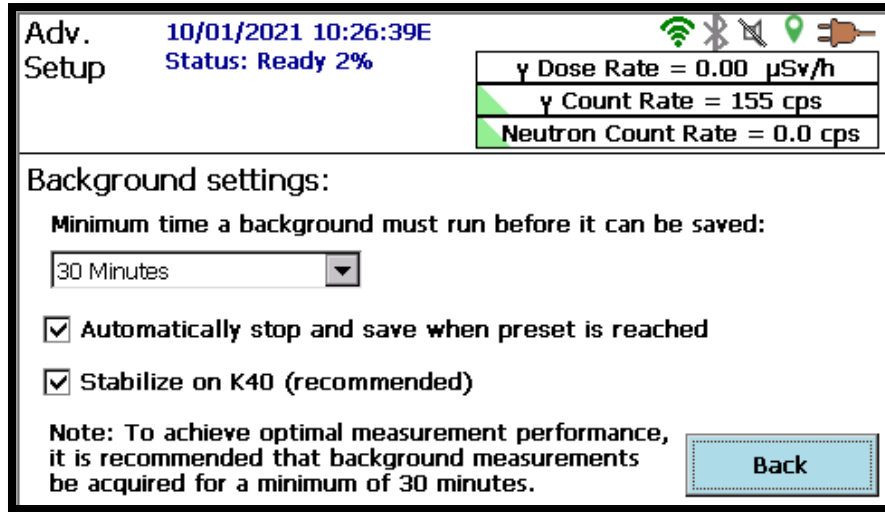
Figure 93. Background Settings

For special cases, the gain stabilizer can be completely disabled from this screen. *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.

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 94). 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 94. Neutron Background Changed

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4.16 SYSTEM ENERGY CALIBRATION

4.16.1 A Brief Introduction to Gain Stabilization

The Detective X typically maintains near-perfect energy calibration by relying on environmental K-40, which produces a dependable gamma-ray peak at 1460.75 keV. The Detective X 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 Detective X. However, the bulk temperature of the detector element will continue to change by very small increments for several hours after 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 95). This figure shows that the stabilizer has currently made an adjustment equivalent to 1.5 keV, which is 18.4% 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.

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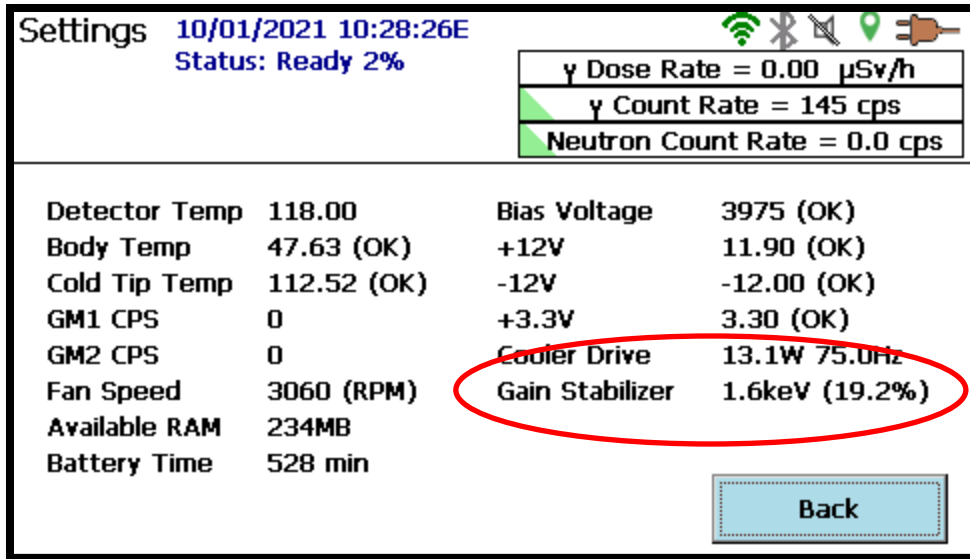
Figure 95. Current Gain Stabilizer Adjustment

4.16.2 Calibrating the Detective X

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 96.

3. Tap **Start Calibration Now**. 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 on the lower left of the screen.

4. 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 **Use Improved Calibration** to complete the process.

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

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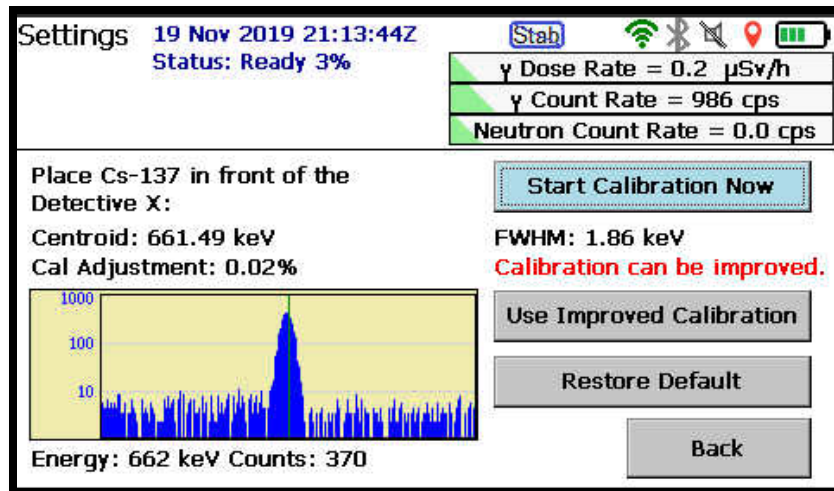
Figure 96. Calibrate Screen

The stabilizer will turn back on after calibration is complete.

The **Restore Default** 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.

4.16.2.1   Using Alternate Calibration Sources

Other sources can be used to energy calibrate the system as well. In fact, environmental K-40 can be used to calibrate the instrument. 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. From the Advanced Setup screen, tap **Cal Settings** to open the screen shown in Figure 97. Select the desired source from the **Calibration sources** list.

4.16.2.2   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 background after calibration** checkbox to mark it; this will disable ID Mode after an energy calibration until a new background spectrum is collected.

4.16.2.3   Adding More Calibration Sources

Cs-137 and K-40 are defined by default as calibration sources. The selected source in the **Calibration sources** field tells the user which source is expected on the Calibrate screen (Figure 97). If the user wishes to add other sources (up to a total of four) tap the **Setup** button to open the dialog shown in Figure 98.
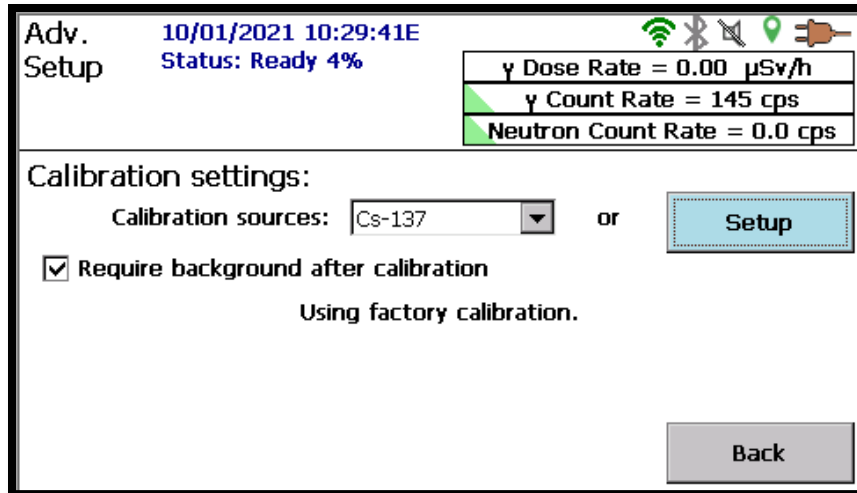
Figure 97. Calibration Settings Screen
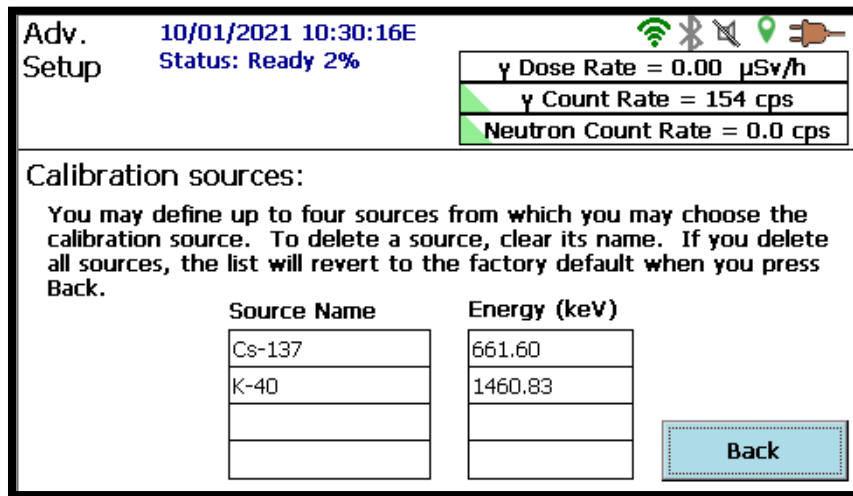
Figure 98. Define Calibration Sources

Tapping an empty cell in the table shown on this screen enables entry of a source name and energy. Good candidates for additional energy calibration sources are Co-60 (1173.24 keV) and Th-232 (2615.5 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 Detective X (P/N DETECTIVE-X-ACC-TH-CAL). Instructions for use of the calibration source can be seen in Appendix E.

NOTE	If all information is deleted from the table, the table will be repopulated with the default information for Cs-137 and K-40 after pressing the **Back** button.

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4.16.3   Calibrating the Detective X Dose Rate

The Detective X 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 18 points through the detection range.

To access the calibration wizard, navigate to the Advanced Setup screen and select the Dose Alarms button. The Personnel Hazard Alarms Screen is displayed.
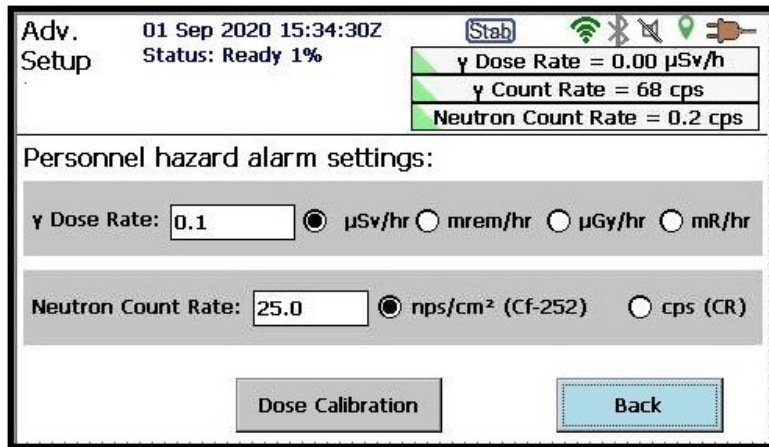
Figure 99. Personnel Hazard Alarm Settings

Select the **Dose Calibration** button to launch the calibration wizard. The wizard appears as seen below.
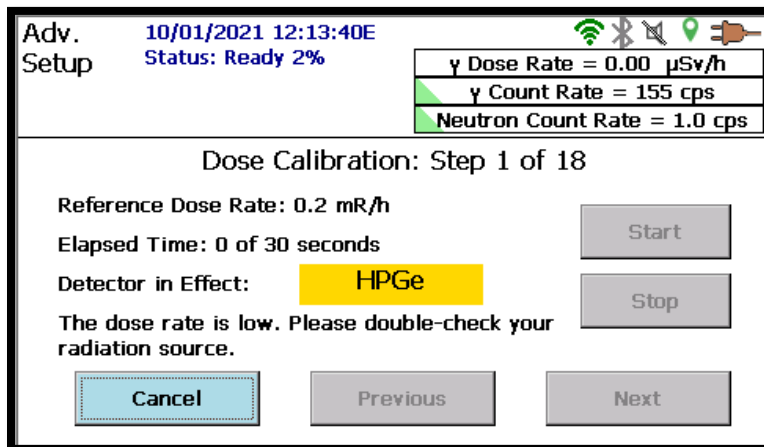
Figure 100. Calibration Wizard

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 0.1 mR/hr, the **Start** button is unavailable. Once all 18 steps are completed, the **Next** button changes to **Finalize**. Clicking **Finalize** stores the calibration data file.

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Navigating to the About screen (located on the Settings page), allows the user to view if the Detective X has been calibrated. If the unit is calibrated, the last calibration date is displayed at the bottom of the screen. Otherwise, the About screen will display No Dose Calibration.

Figure 101. About Screen Displaying Dose Calibration Date

4.17 MODIFYING NUCLIDE THREAT STATUS

Figure 102 shows the **ID Table** page, which lets the user change the innocent nuclides in the Identification Table to a threat status and back to innocent status. *Default threat 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.

- To change an innocent nuclide to threat status, tap the scrollbar or use the up/down arrow buttons (▲ ▼) to move through the list, tap to highlight the desired nuclide (Figure 103), then tap the top-right button, which will be labeled **Make Threat** (the button will be disabled for default threat nuclides). An innocent nuclide that has been changed to threat status will be marked in the list with an asterisk (*), as shown in Figure 104.

- To revert a nuclide to its default innocent status, highlight it and tap the top-right button, which will now be labeled **Make Innocent**.

- To restore all nuclides to their factory default settings, tap **Reset** and confirm the reset action. *There is no undo for the reset operation; all of the desired changes must be made again unless **Export Settings** has been performed with the modified nuclide threat values.*

- To output the list of nuclides and their current classifications to a text file that can be exported to a computer, tap **Save to File**. The file will be saved in the currently selected storage folder (either \My Documents\ or \Hard Disk\) under the filename **DataNuclides.txt**.

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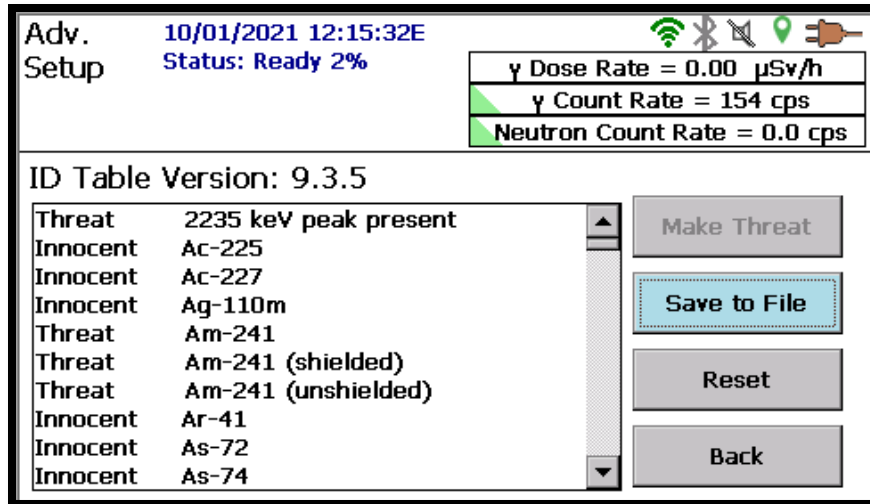
Figure 102. Default Identification Table Listing
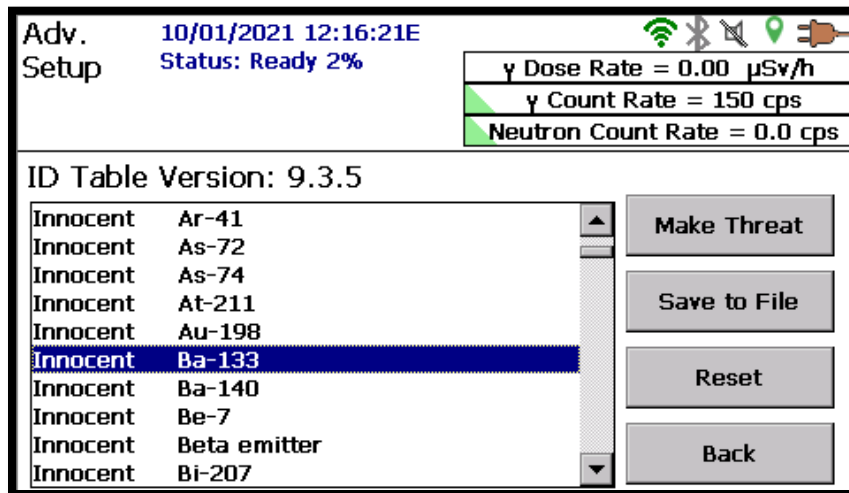
Figure 103. Preparing to Change Default Innocent Nuclide to Threat Status
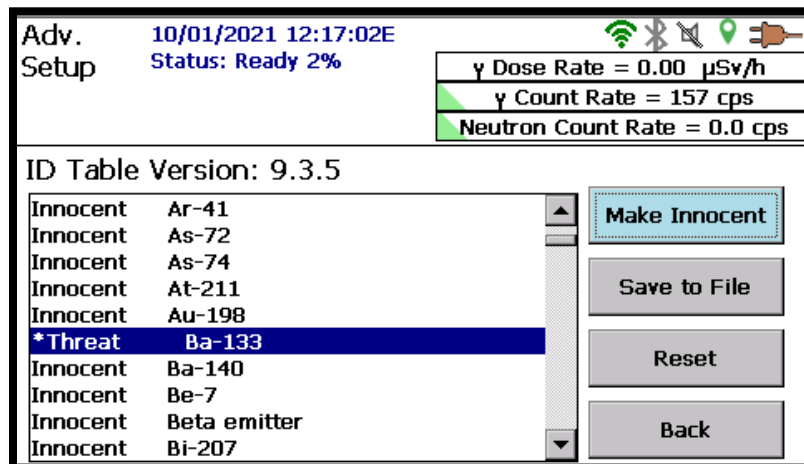
Figure 104. Default Innocent Nuclide Changed to Threat Status (and Marked with Asterisk)

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4.18 PASSWORD-PROTECTING THE ADVANCED SETTINGS AND ID MODE SPECTRUM VIEW

As shipped from the factory, the Advanced Setup is accessible to all users from the Settings screen. Because the advanced options can significantly affect how the instrument works, the Detective X software allows the user to password-protect this screen. The user can also decide whether to display the ID Mode spectrum. From the Advanced Setup screen, tap the **Password** button to open the screen shown in Figure 105.

4.18.1 Password

A blank password (all characters deleted; not a series of spaces) is the "no password" option. The password is case-sensitive, alphanumeric, may include spaces, and may be of any length. To set a password, press the blank Password square. An alpha/numeric field will open to allow the user to enter a password. Enter a password and select done. Activate the password by selecting **Set**. If **Set** is not pressed, the password will not be activated and will instead be deleted after the exiting the password settings screen.

IMPORTANT	*There is no "factory default" password.* If the password is forgotten, contact an ORTEC representative or ORTEC's Global Service Center for assistance.

4.18.2 ID Mode Spectrum

To display or hide the ID Mode spectrum, tap the **Allow display of spectrum** checkbox to respectively mark or unmark it (Figure 105).
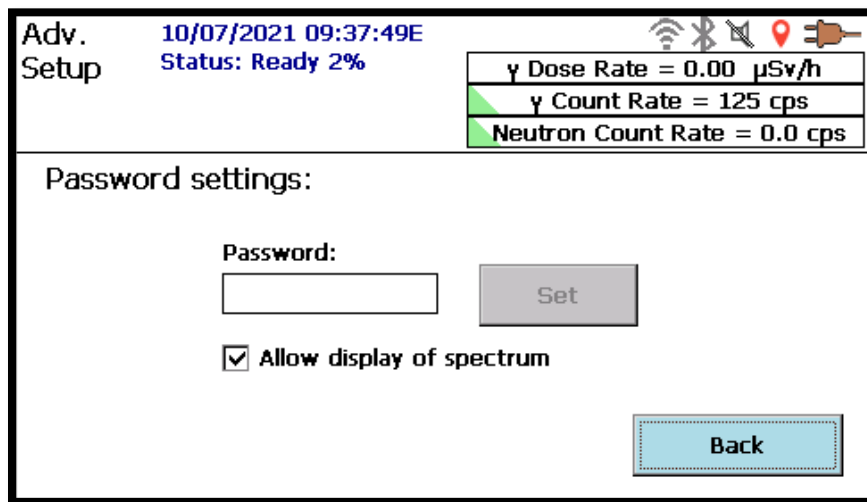
Figure 105. Password Setup Screen

4.19 DEPLOYING MULTIPLE UNITS WITH IDENTICAL SETTINGS

As this manual makes evident, the Detective X gives the user a multitude of configuration options. Manually configuring even two units identically would be an extremely challenging exercise. Setting up more than two units identically would be far more cumbersome. To make this task easier,

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Detective X allows the creation of a settings file that can be exported to multiple instruments. This will ensure all Detective X units operate identically.

To export settings:

- Select the **Export Settings** button from the Advanced Setup screen.

Figure 106. Confirmation of Saved Settings

- This will write the current settings to an ASCII text file named **Settings.txt**, *which will be saved in the currently selected storage location.* Any previous **Settings.txt** file will be overwritten (Figure 106). Change the name or save the file if it is desired to save the settings. Save this file on the USB flash drive in the root file location.

- Figure 107 shows the partial contents of a **Settings.txt** file. The contents can be viewed by connecting a PC to the micro USB connector on the rear panel (see Figure 5 or Figure 6). Simple changes can be made with a text editor if necessary.

- The user is now ready to temporarily move the first unit's USB flash drive to a second Detective X, then import the settings file by tapping the **Import Settings** button on the second unit's Advanced Setup screen. Settings will only be imported from a file named **Settings.txt** located in the root of the USB flash drive. Before the second unit's settings are overwritten, the user will be asked to confirm the overwrite.

It may be desired to maintain several sets of settings for different applications. To switch between those, just copy the desired settings file to a file named **Settings.txt** and import. Default factory settings can always be restored by tapping the **Restore Settings** button.
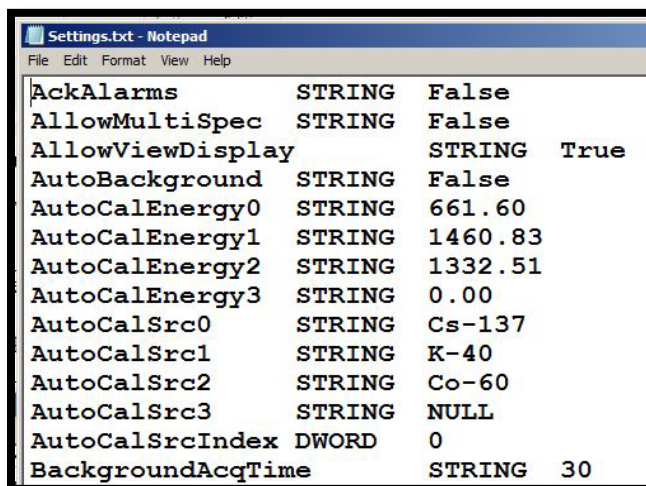
Figure 107. Partial Contents of Typical Settings.txt File

NOTE	For all settings to take affect after an import or a restore settings, the instrument should be rebooted.

5. SLEUTH APPLICATION

NOTE	The Sleuth application is not available if the user purchased the model Detective-X-TS. This model only contains the Trans-SPEC and the Mobile MCB Server applications.

Sleuth is a simplified user interface for the Detective X and is started from launcher (see Chapter 3). Sleuth provides for a very limited set of common user operations. This limits the ability of users to deviate from prescribed CONOPS. Sleuth minimizes 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.

Sleuth depends on the more feature-rich Detective X software application described in Chapter 4. Many settings entered in the Detective X software application carry over to the operation of Sleuth. It is recommended that one study Chapter 4 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. These features are not currently available in the traditional Detective X software application. 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 Detective X prior to starting data collection.

5.1 USER INPUT

Users interact with the Sleuth application only by tapping the large touchscreen buttons with a finger or stylus. When in Sleuth mode, the (N) and (S) buttons (see Figure 33) 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 17).

5.2 SLEUTH STARTUP AND DATA FILE MANAGEMENT

The Sleuth software application is accessible through the Launcher interface described in Chapter 3.

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 entering a checkmark in the box next to the Sleuth entry on the Launcher screen.

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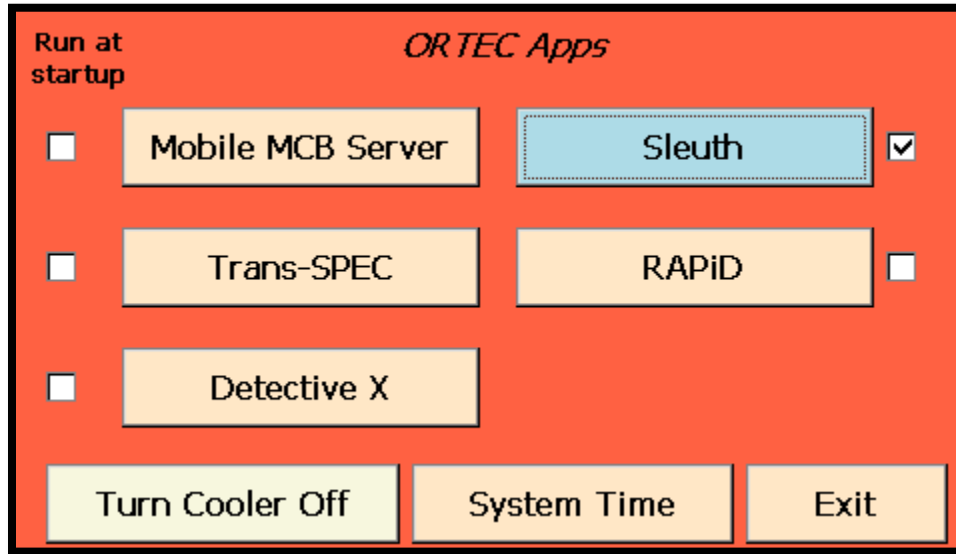
Figure 108. Starting Sleuth from the Launcher Interface

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 Launcher 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 109).
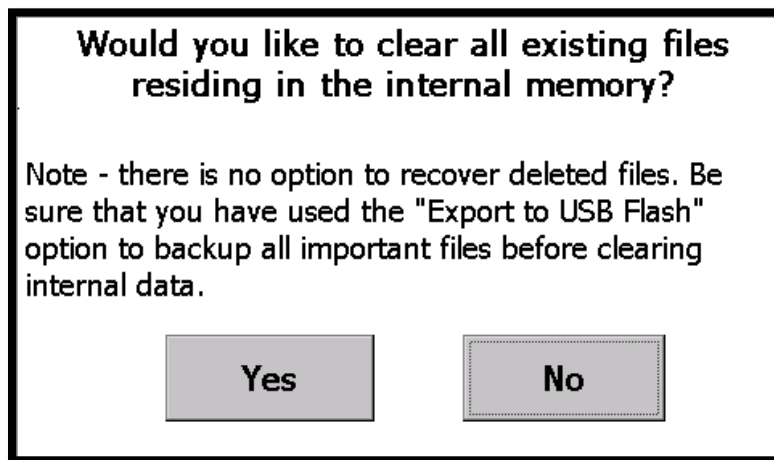
Figure 109. Delete Sleuth Data Message

If the user selects **Yes**, an additional message will be displayed confirming the choice. Selecting **Yes** a second time deletes all data in the Sleuth application. If the user selects **No**, the system moves on to the Sleuth home screen.
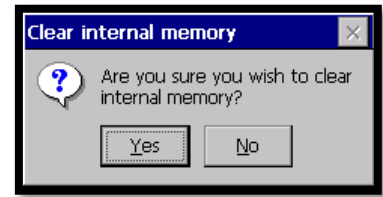
Figure 110. Clear Internal Memory Confirmation

NOTE	Clearing data in Sleuth does not clear data in the Detective X or RAPiD applications.

5.3   SLEUTH HOME SCREEN

The home screen for Sleuth is shown in Figure 111. For simplicity, Sleuth only has one screen to learn about. This is very similar to the home screen for the main Detective X software application (also known as Detect mode). Most of the information displayed here has previously been covered in Section 4.4 and will not be discussed again here. However, there are differences, as discussed in the following sub-sections.
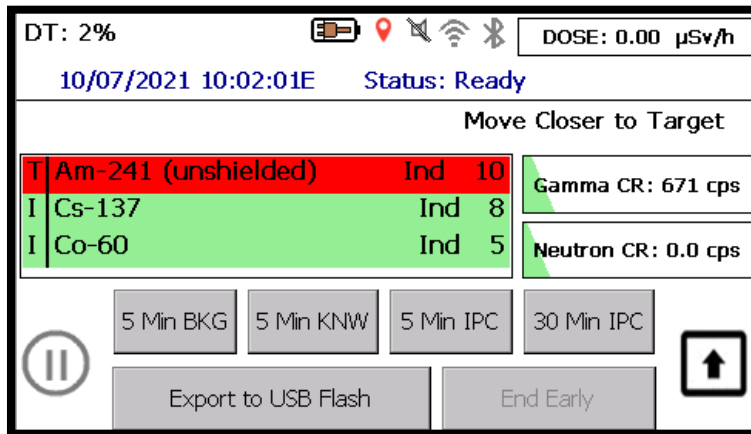
Figure 111. Sleuth Home Screen

5.3.1 Dead Time Display

Unlike the Detective X software application's Detect mode screen which periodically displays deadtime, Sleuth continuously displays this value in the upper left corner of the screen (Figure 112). Operators can be trained to use this value to collect optimal data for later analysis by a Reachback facility.
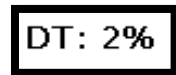
Figure 112. Sleuth Dead Time Display

5.3.2 Missing System Background File

Figure 113. Missing System Background Icon

Unlike the Detective X software application, Sleuth is perfectly happy to collect data without valid system background information. See Section 4.15 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.

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In order to warn of this situation a new status icon is introduced for Sleuth (Figure 113). This warning icon 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, launching the Detective X software application and collecting ambient background data as discussed in Section 4.15. Customers should consider their CONOPS when providing training regarding this icon.

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 Detective X 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.
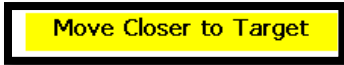
A valid and representative "System Background" is important in the analysis of the spectrum in the Detect and Identify modes of the traditional Detective X interface. Detective X maintains separate background data for the system based upon each accessory potentially mounted to the front of the unit (neutron 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 Detective X interface to perform a "System Background".

5.3.3 Distance Optimization

New to Sleuth is the 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 114. Move Closer

If deadtime is less than 25% or gamma count rate is less than 15,000 cps, the operator is directed to move closer (see Figure 114). This indicator flashes yellow.

Figure 115. Distance OK

If deadtime is greater than 40% or gamma count rate is greater than 20,000 cps the operator is directed to move back (see Figure 116). This indicator flashes red.

Figure 116. Move Back

Otherwise, the indicator shows "Distance from Source OK" (see Figure 115) in green.

Figure 117. Distance Entered

Note that once an operator initiates an IPC measurement actual distance will be requested and this indicator will show that entered value (see Figure 117). Also note that this is a passive indicator only and it in no case actively prevents collection of data.

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NOTE	In general, users should use the distance indicator on the Sleuth "Home" screen (Figure 111) to optimize the distance to the IPC. This means that for "5 Min KNW", "5 Min UNK", and "30 Min UNK" the user should expect to see the "Distance from Source OK" (Figure 115) 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 114) indicator is displayed on the Home screen before starting the measurement.

5.3.4 Other Icons and Settings

The other Sleuth status icons (not described above) serve the same function(s) that they have in the Detective X software application. They are also controlled by settings in the Detective X software application. For instance, the gain stabilizer may be disabled for Sleuth by switching to the Detective X software application and unchecking the "Stabilize on K-40" box discussed in Section 4.15. Similarly, refer to Sections 4.6.4 and 4.6.5 to select integration times for nuclide identifications and to enable suspect nuclide identifications.

Many settings available within the Detective X software application are nonsensical for Sleuth and so are ignored. For instance, Sleuth has no facility to require alarm acknowledgements as discussed in Section 4.5.1. For similar reasons, an "Identify Preset" and enabling "Multiple spectrum analysis" in the Detective X software application will be ignored by Sleuth (see Sections 4.7.3 and 4.7.4).

Sleuth does support audio and vibratory alert setting discussed in Section 4.4.1 and personnel hazard alarms discussed in Section 4.5.2. Sleuth also supports nuclide threat level promotion settings discussed in Section 4.17.

A comparison of the advanced settings and the use of each setting in both Detective X and Sleuth modes can be seen in Table 3.

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Table 3. Advanced Setting Options

Advanced Setting Option	Detective X Mode	Sleuth Mode
All Audio Settings	X	X
Cal Settings*	X	
Password	X	
Restore Settings	X	X
All Dose Alarms Settings	X	X
Bkg Settings** – Min Time	X	
Bkg Settings – Automatically Stop	X	
Bkg Settings – Stabilize on K-40	X	X
All ID Table Settings	X	X
Export Settings	X	
Analysis – Require Acknowledge	X	
Analysis – Multiple Spectrum Analysis	X	
Analysis – Integration Time	X	X
Analysis – Identify Preset	X	
Analysis – LCX Mode	X	X
Analysis – Alarm Thresholds	X	X
Reachback	X	
Data Storage	X	
Import Settings	X	X

*Cal Settings – The instrument calibration results are used in Sleuth mode. However, the actual calibration is performed in Detective X mode so the settings are only valid then.

**Bkg Settings – Backgrounds are performed in Detective X mode only. However, Sleuth mode uses the background collected in Detective X mode and displays a symbol on the screen (⊘) when a background is not present.

5.4   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.

 While collecting data, the operator can temporarily suspend data collection with the pause button (see Figure 118). The operator can also terminate an acquisition early with the "End Early" button.

**Figure 118.
    Pause**

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Once a measurement is complete, nuclide identification results remain on the screen. The button that was used to begin the acquisition now becomes a "Home" button and once that button is pressed, the operator can initiate the next measurement (as shown in Figure 119).
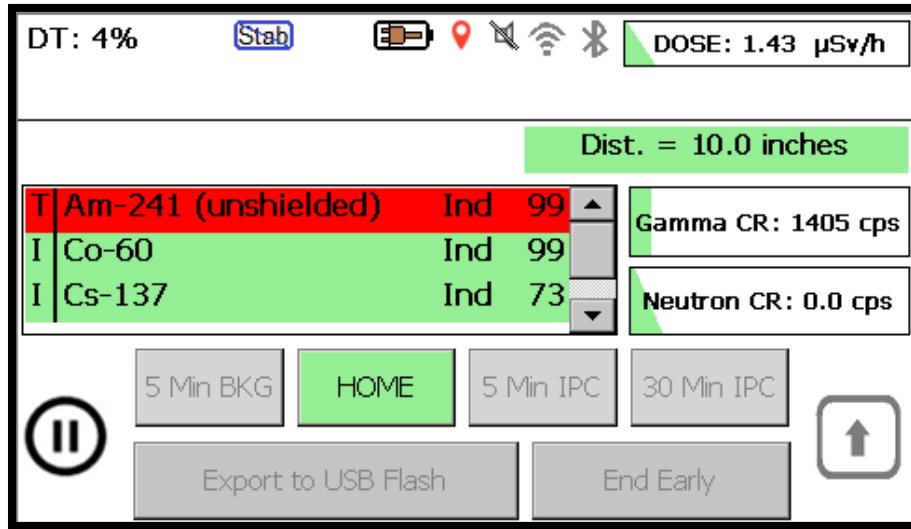
Figure 119. Measurement Complete

5.5   EXPORTING AND DELETING DATA

Unlike the traditional Detective X software application where storage location of data files is user selectable, Sleuth always stores the data files it generates in internal memory. 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 the 'traditional' Detective X user interface) on the unit is exported.
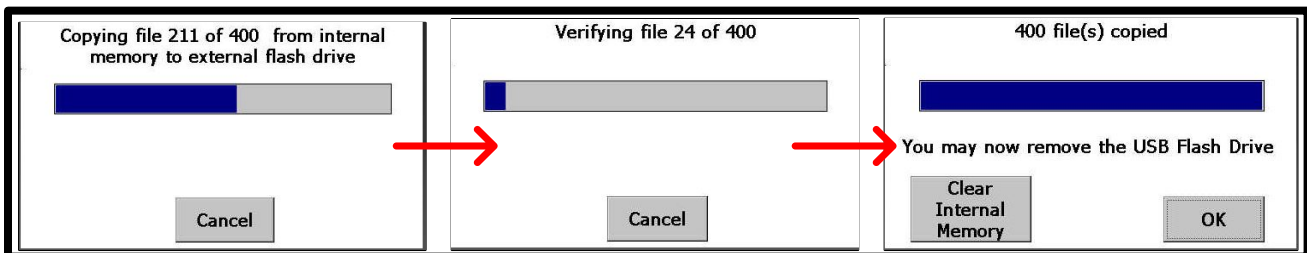
Figure 120. Export in Progress

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 120) that also contains a button to delete all files in the internal storage ("Clear Internal Memory").

> **NOTE**   In most use-cases, "Clear Internal Memory" 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).

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5.6 EXITING SLEUTH

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 2.13).

**Figure 121.
Home Button**

Alternatively, the **Home to Launcher** button (see Figure 121) can be selected when a Sleuth measurement is not in process. This **Home to Launcher** button will then check to see if any data remains in the internal memory, ask the user if it is desired to delete found data, and return the user to the Launcher screen (see Section 5.2).

5.7 SLEUTH DATA FILES

In the simplified spirit of Sleuth, and unlike Multi Spectrum Analysis mode in the Detective X software application (see Section 4.7.4), 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:

<div align="center">

<MEAS>_<COL>_YYYY_MM_DD_HH_mm_ss.n42

</div>

where the <MEAS> and <COL> components correspond to Measurement Type (MEAS) and Collimator Type (COL), and YYYY_MM_DD_HH_mm_ss is the UTC date-time stamp.

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

Data files created by Sleuth are similar to files created by the Detective X software application, with one notable omission and one notable addition. Sleuth data files do not include the system background (used by the nuclide identification algorithm). This is simply to prevent confusion in reviewing data later. 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 (note – this is converted to meters within the N42 file). If the user left the source distance field as unknown, this element will not be included in the file (see external document Part Number 1111792 Detective X File Formats).

6. RAPID APPLICATION

NOTE	The RAPiD application is not available if the user purchased the model Detective-X-TS. This model only contains the Trans-SPEC and the Mobile MCB Server applications.

The RAPiD (Radiological Assistance Program iDentification) application is started from launcher (see Chapter 3). RAPiD 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 shares many of the Detective X software application settings with the exception of a few items detailed in this chapter. It is recommended that one study Chapter 4 to understand the available system settings prior to deploying instruments for RAPiD-based operation.

RAPiD adds some special features created specifically for its target audience. These features are not currently available in the Detective X software application. 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. The Detective X application requires that all ID measurements be saved to exit the ID Mode screen. RAPiD also allows the user to continue collecting data after the identification's preset time was reached.

6.1 RAPID HOME SCREEN

Launching the RAPiD application from the Launcher (see Chapter 3), opens the RAPiD Home screen. The Home screen is the basic survey mode.
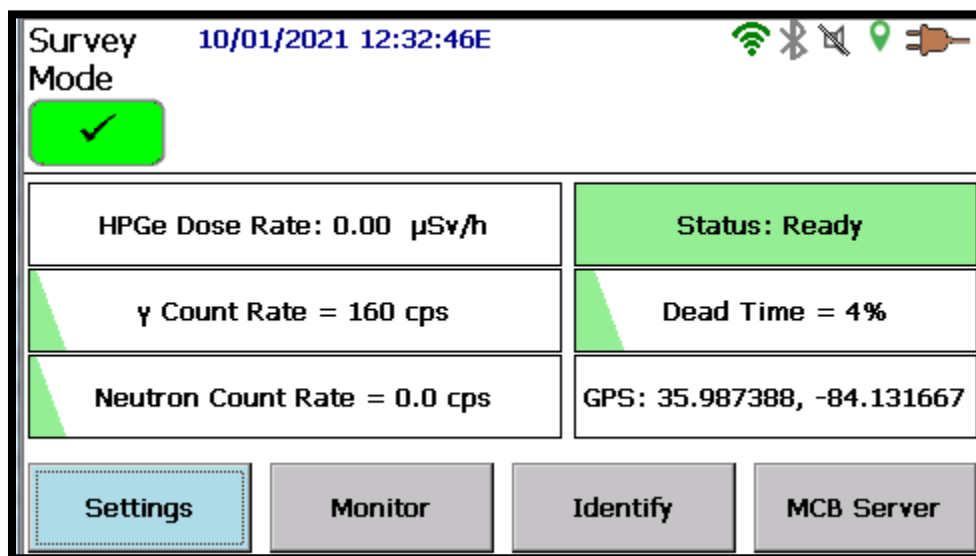
Figure 122. RAPiD Home Screen

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The RAPiD Home screen provides a more accessible 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 (L-GM), or high-range Geiger-Mueller detector (H-GM).

The operational status of the instrument is quickly visible with a green check box, yellow exclamation box, or red exclamation box displayed on the left side of the screen.
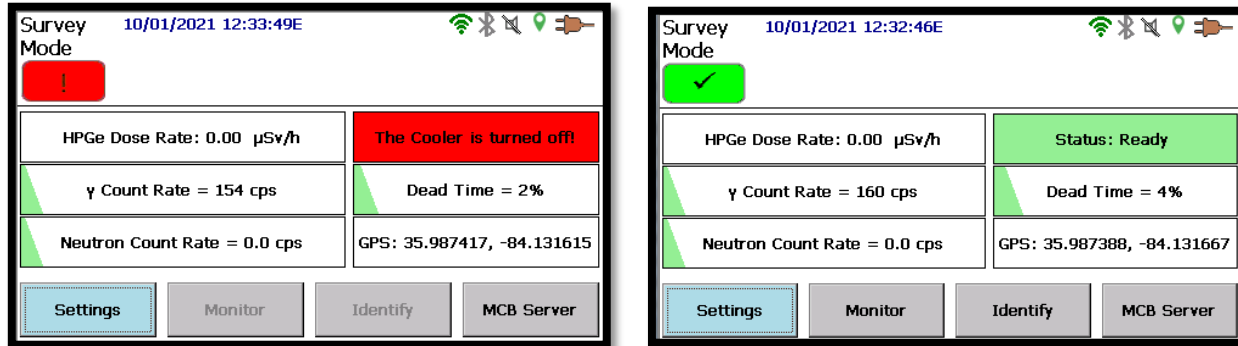
Figure 123. System Status Display

The status of the instrument is also 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 error messages.

Pressing on an exclamation point when displayed expands the status message to provide more detail on the system warning or error message. Press the screen a second time to close the expanded message.
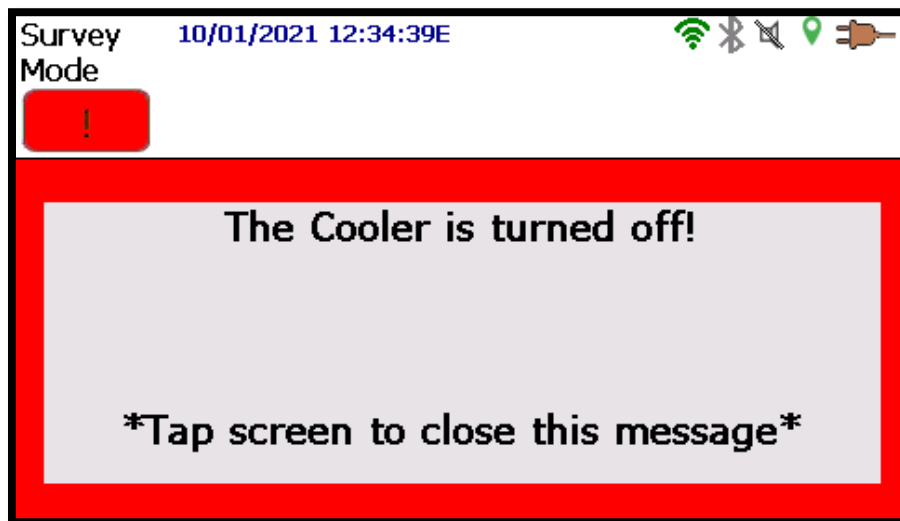
Figure 124. Expanded Status Message

The icons displayed around the top of the RAPiD Home screen work in the same manner as those detailed in Section 4.4 and Figure 40.

The Monitor Mode, Identify Mode, and MCB Server can all be accessed from the Home screen by pressing the respective buttons.

6.2   MONITOR MODE

Pressing the **Monitor** button on the Home screen starts the RAPiD Monitor Mode operation. Monitor mode works much like that of the Detective X application (described in Section 4.6) with the addition of easily viewable count rates, dead time readings, and GPS coordinates.
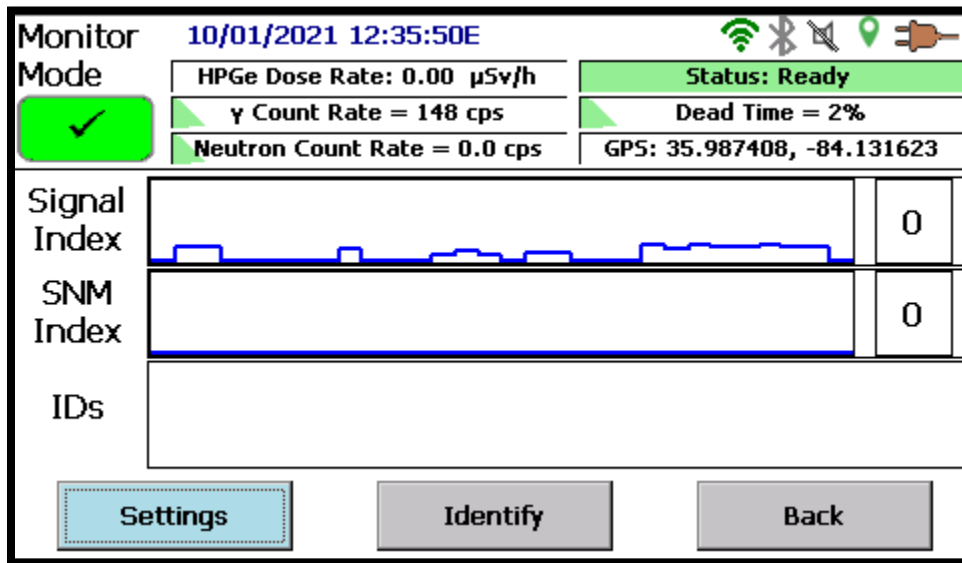
Figure 125. Monitor Mode

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

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

6.3   IDENTIFY MODE

The ID Mode can be accessed by pressing **Identify** either on the Home screen or on the Monitor Mode screen. The ID Mode works much like that of the Detective X application in that it provides a detailed list of identified isotopes (see Figure 126).

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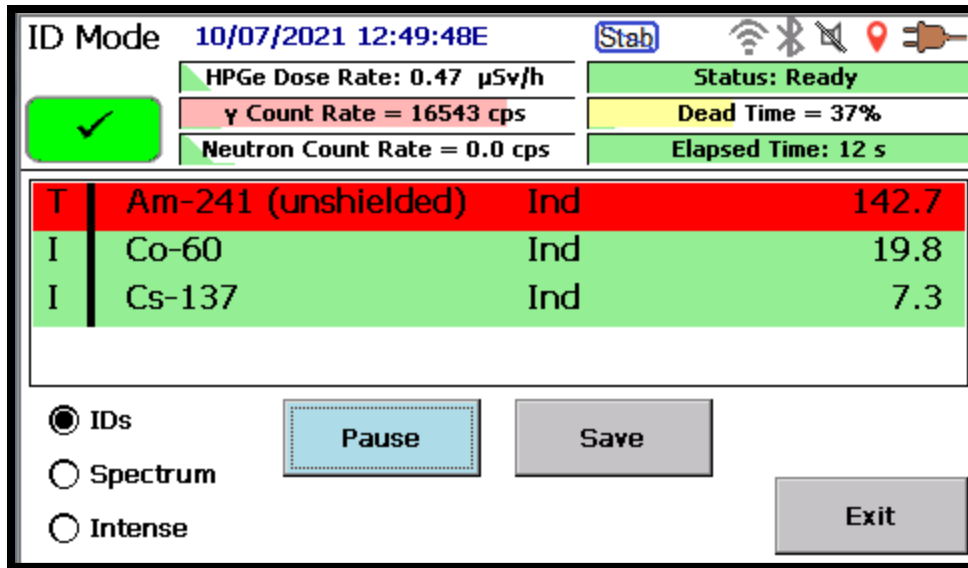
Figure 126. RAPiD ID Mode

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. If a preset count time has been defined, the elapsed time will display the current time of the preset time (see Figure 127). The background of the elapsed time has a colored green block that increases as the time approaches the total elapsed time. If the count is paused or the preset time is reached, the background color changes to red. 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.

RAPiD's ID Mode differs from that of Detective X by allowing the user the opportunity to Exit the ID without saving the results. Selecting **Exit** provides the user with the ability to choose to continue the data collection or to exit the identification without saving the results. If **Continue** is selected, the screen will return to the ID mode screen and continue collecting data. If **Exit** is selected, the screen will return to the previous mode ID was selected from (either the Survey Mode or Monitor Mode screen).
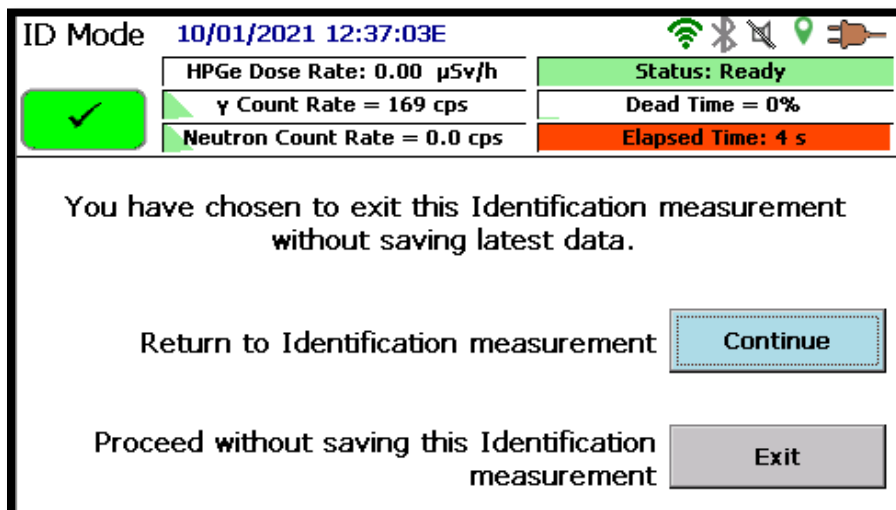
Figure 127. ID Mode Exit Screen

In ID Mode, the user has the ability to select Spectrum or Intense to change the information that is being displayed. Selecting **Spectrum** displays the screen seen in Figure 128.
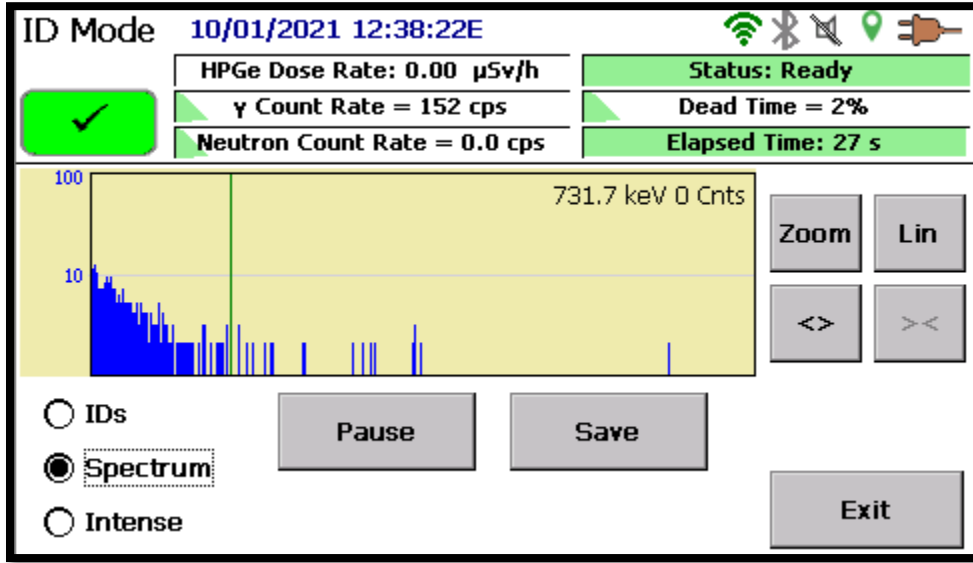
Figure 128. RAPiD ID Mode Spectrum

Spectrum operates as described in Section 4.7.1. Selecting **Intense** displays the screen seen in Figure 129.
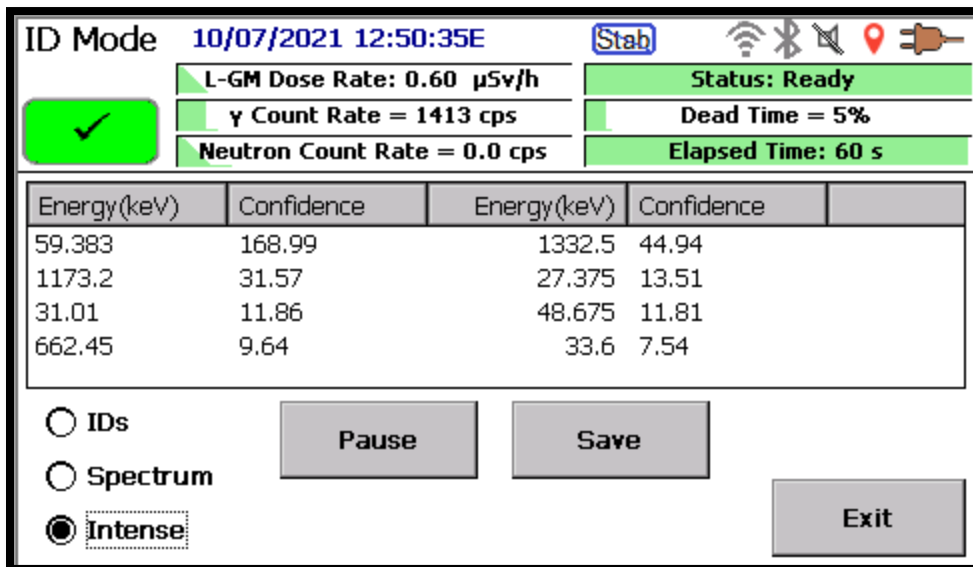
Figure 129. RAPiD ID Mode Intense

Intense operates as described in Section 4.7.2.

ID Mode offers the user a pause function. By pressing **Pause**, the data collection completely stops collecting and the screen changes to the one displayed in Figure 130.

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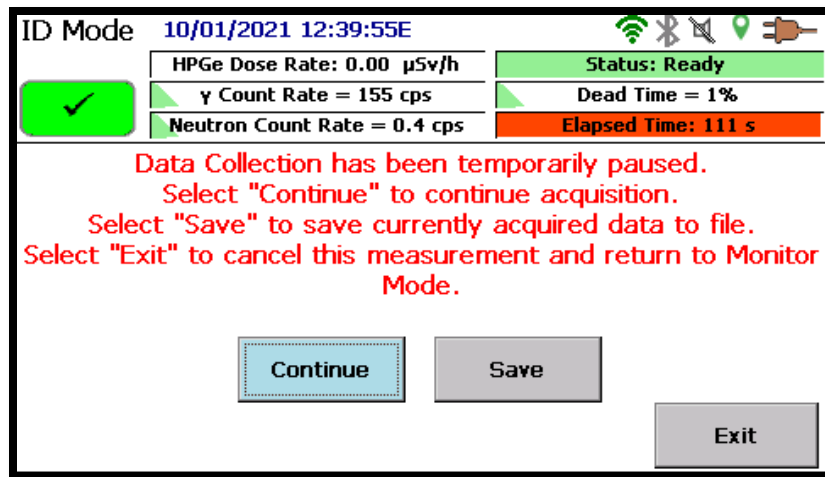
Figure 130. RAPiD ID Mode Pause Screen

From this screen the user can select to the following options:
- **Continue** – data collection will start back, and the screen will return to the previous display.
- **Save** – data collection will be concluded, and the screen will change to that seen in Figure 131.
- **Exit** –data collection will be concluded, and the screen will change to that seen in Figure 127 with the data not being saved.

Pressing Save from either the ID Mode View or the pause screen view displays the file data save screen.
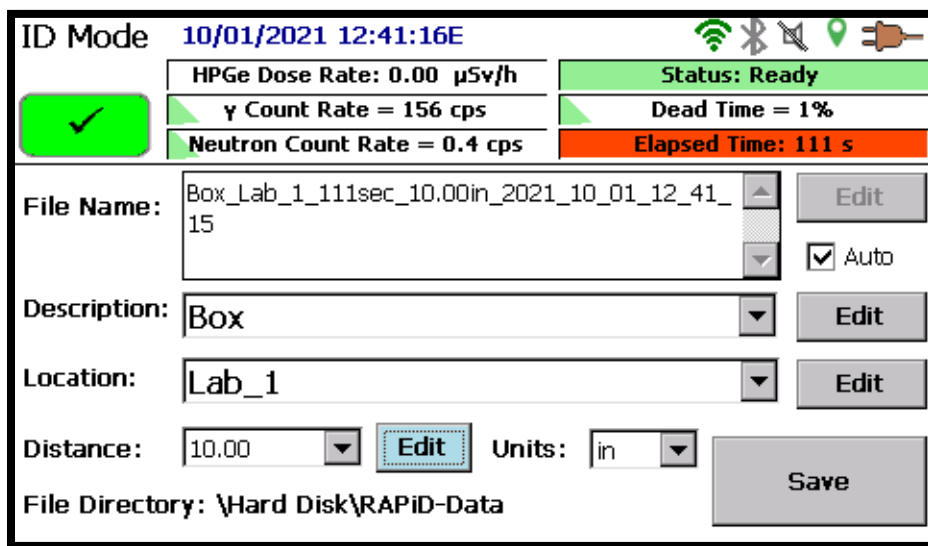
Figure 131. RAPiD ID Mode Save

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 that category. The drop-down box maintains the last 3 Descriptions and Locations entered for easy selection. Distance units can be selected between inches, feet, yards, centimeters, and meters. Note that to manually enter a file name, the **Auto** selection box must be unchecked. If

the **Auto** selection box is checked, 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.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 reach 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 selected units are converted to meters for storage in the N42.42 file.

Once Save is pressed, the screen changes to that seen in Figure 132. Press Continue to return to the initial ID Mode screen (ID, Spectrum, or Intense) or press Exit to exit back to the previous mode (Monitor Mode or Survey Mode).
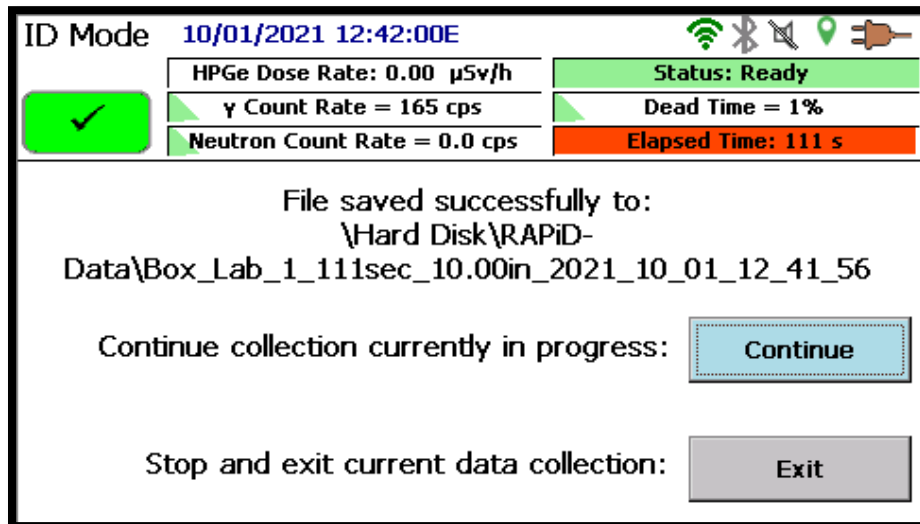
Figure 132. RAPiD ID Mode Final Save Screen

6.4 SETTINGS AND ADVANCED SETTINGS

The RAPiD settings screen can be accessed from either the Survey Mode (Home) screen or the Monitor Mode screen. The RAPiD application allows the same setting modifications that the Detective X application provides (see Chapter 4) except for those listed below.

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> **NOTE**   Any settings changed in the RAPiD application also change the settings in the Detective X and Sleuth applications.

6.4.1 Background

Selecting Background from the settings screen displays the following:
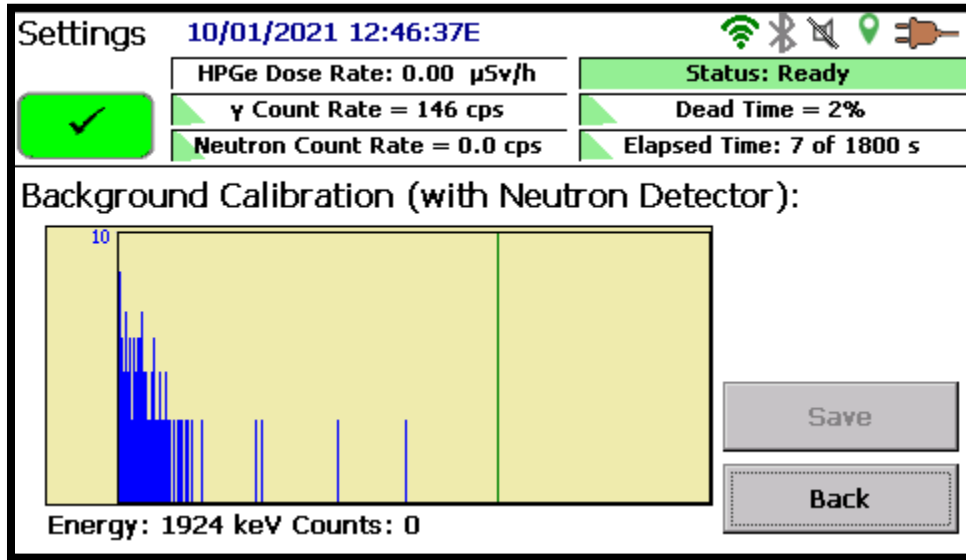
Figure 133. RAPiD Background

RAPiD background operates slightly different from the Detective X in that the Elapsed time is displayed within the common header instead of directly on the background page. System backgrounds collected in the RAPiD application are used in both Detective X and Sleuth.

6.4.2 Recall

Selecting Recall from the Settings screen displays the following:
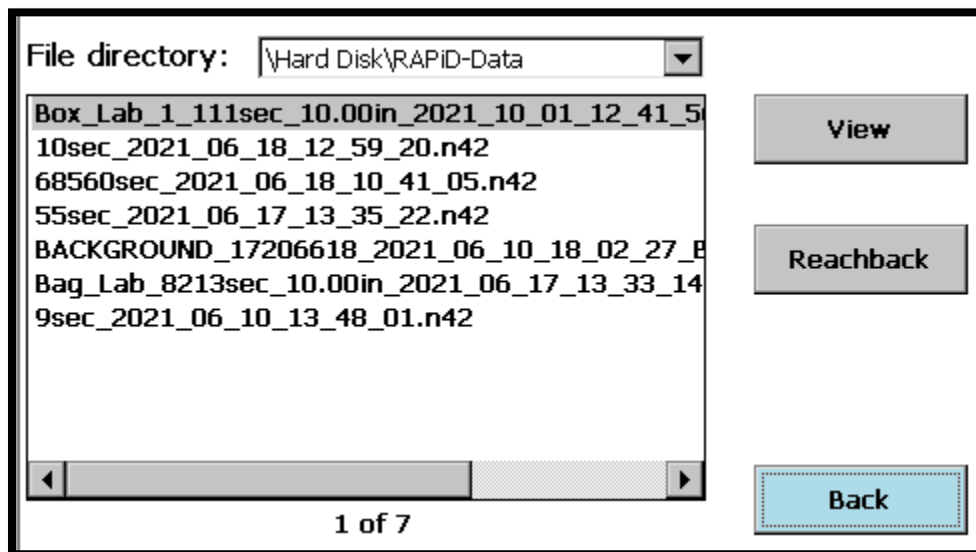
Figure 134. RAPiD Recall Screen

The main recall screen operates much like that of Detective X (see Section 4.13). Only data created using the RAPiD application is visible in the RAPiD recall screen. Pressing on the **View** button enters the File view screen, which is where RAPiD differs from the Detective X application. RAPiD offers users the ability to view the spectrum and IDs of each individual data file. Pressing the **View** button opens the following screen. This screen displays any identifications that were made for the selected data file.
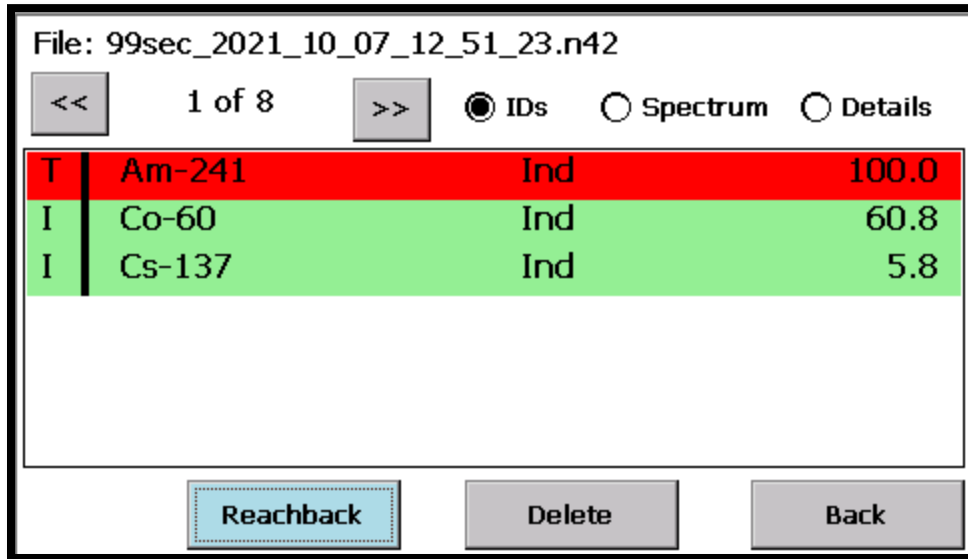
Figure 135. Recall Data – View IDs

Selecting the **Spectrum** radio button changes to the Spectrum view for the selected data file.
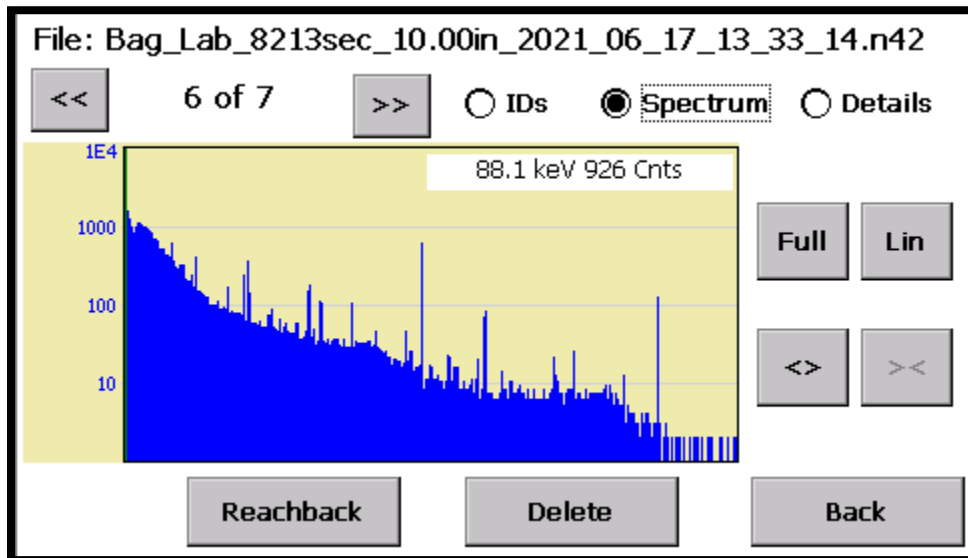
Figure 136. Recall Data – View Spectrum

Selecting the **Details** view displays specific details for the selected file.

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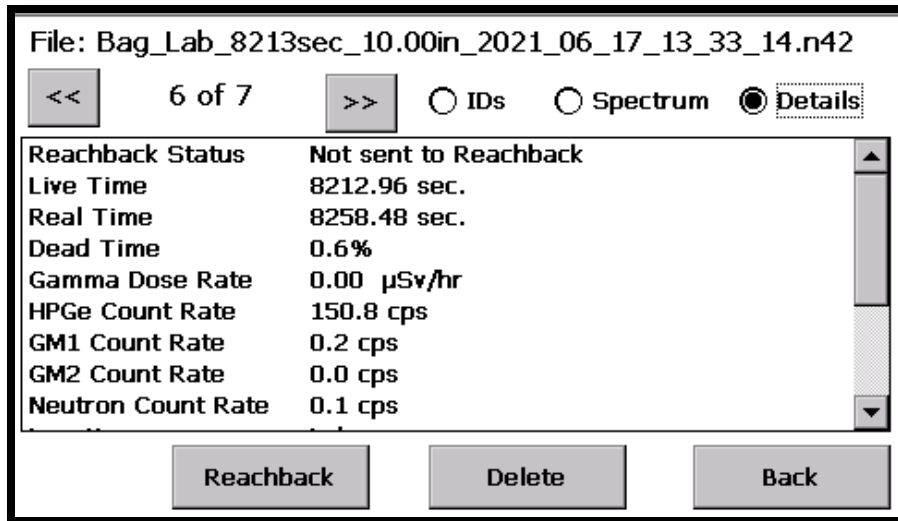
Figure 137. Recall Data – Details View Part 1
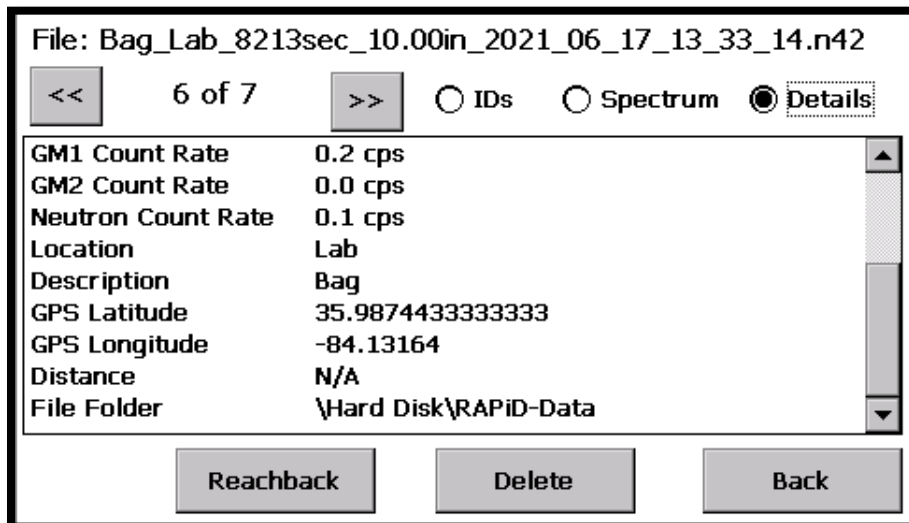
Figure 138. Recall Data – Details View Part 2

Selecting the **Reachback** button at any time while in the Recall screens queues the selected file to be sent to the defined Reachback email. Note that any defined Reachback details, such as send to email, are the same for RAPiD as those defined in the Detective X Reachback Settings menu.

NOTE	Unlike the Detective X application, Recall is the only way to manually send a file to Reachback when the Reachback frequency is set to manual. In the Detective X application, setting the Reachback frequency to manual enables a button in the ID Mode that can be pressed to queue the file for Reachback. In the RAPiD application, this button is not available.

6.4.3 Password Settings

In the Detective X application, the Password Settings screen provides a check box just below the password to allow the user to opt not to display the spectrum in the ID Mode screen. The RAPiD

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Password Settings screen (found in the Advanced Settings menu) does not provide the user the option to not display the spectrum. Spectrums are always displayed in RAPiD.

Figure 139. RAPiD Password Settings

NOTE	If a password is set in RAPiD it will also be used in the Detective X application.

6.4.4 Dose Units

Dose Units can be found in the Advanced Settings screen. Personnel hazard alarms are not active in the RAPiD application. Therefore, the Dose Alarms setting options do not allow alarm limits to be set. Instead, only options to change the displayed gamma dose units are provided.
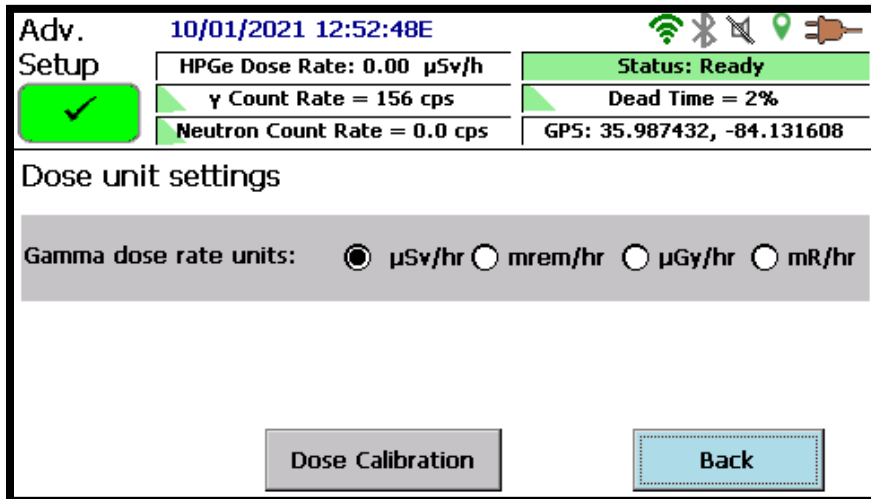
Figure 140. RAPiD Dose Units

NOTE	Changes to the dose unit in RAPiD will also affect the Detective X and Sleuth applications. Any dose alarm levels set in Detective X will be ignored by RAPiD.

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6.4.5 Analysis Settings

The Analysis Settings (found in the Advanced Settings menu) differ from those in the Detective X application by not having the ability to enable multiple spectrum analysis or require alarms to be acknowledged. The RAPiD application does not provide the ability to perform either of these operations.
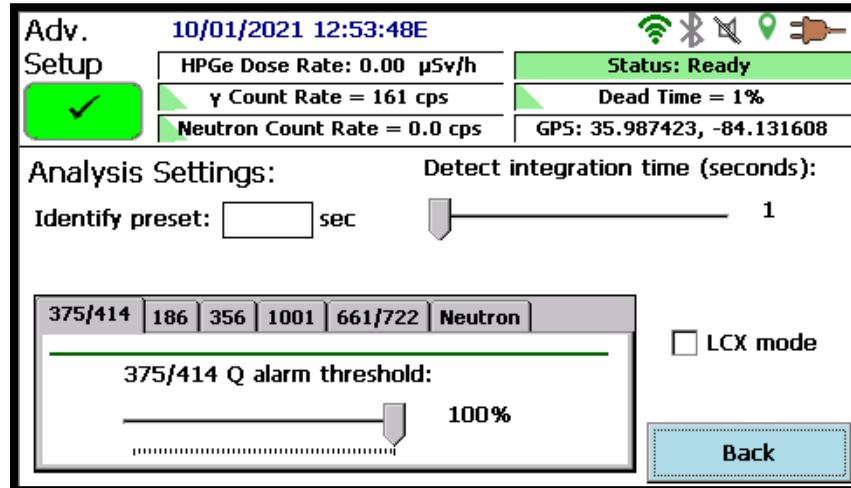
Figure 141. RAPiD Analysis Settings

6.4.6 Data Storage

The Data Storage Option screen (found in the Advanced Settings menu) does not allow the user to disable the ability to show the spectrum details dialog. RAPiD always provides the user the ability to enter file data when saving a file.
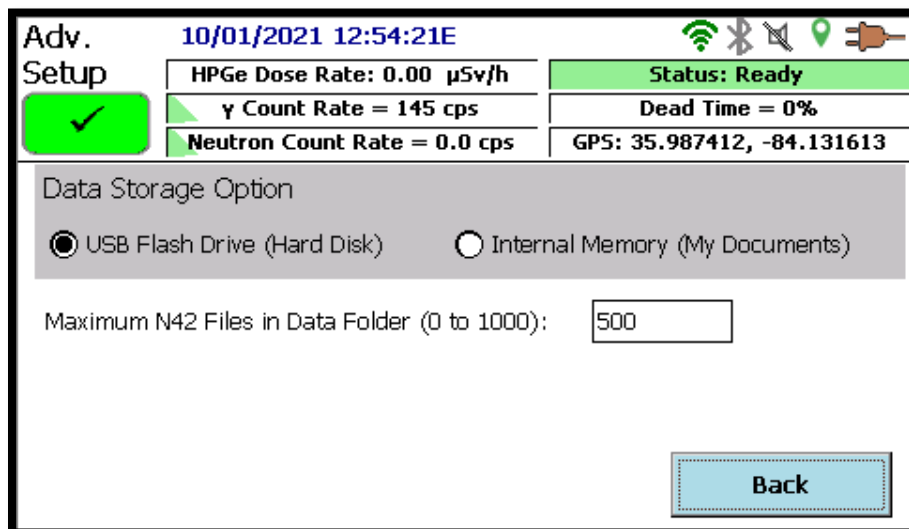
Figure 142. RAPiD Data Storage Option

6.5   MCB SERVER

Selecting **MCB Server** on the Home screen launches the MCB Server application. This operates the same as described in Chapter 7 except that when selecting **Exit App** the instrument returns to the RAPiD application instead of the Launcher screen. Also, the user is not allowed to reboot the instrument from this application.

6.6   EXITING AND RESTARTING THE RAPID APPLICATION

Tapping **Exit App**, from the Advanced Setup screen, navigates to the orange **Launcher** screen, which is discussed in Chapter 3. From the Launcher, the user can run other ORTEC applications installed on the Detective X's computer. Other available applications are the Detective X application, Mobile MCB Server, and the Sleuth application. To return the instrument to the RAPiD application functionality, tap the **Detective X** button on the Launcher screen (see Figure 31).

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7. MOBILE MCB SERVER APPLICATION

The Mobile MCB Server application (Figure 143) governs communication between the Detective X and a host computer when the Detective X is used as a high-performance, benchtop gamma spectrometer in conjunction with ORTEC spectroscopy applications such as MAESTRO or GammaVision. 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 Detective X as a benchtop spectrometer.
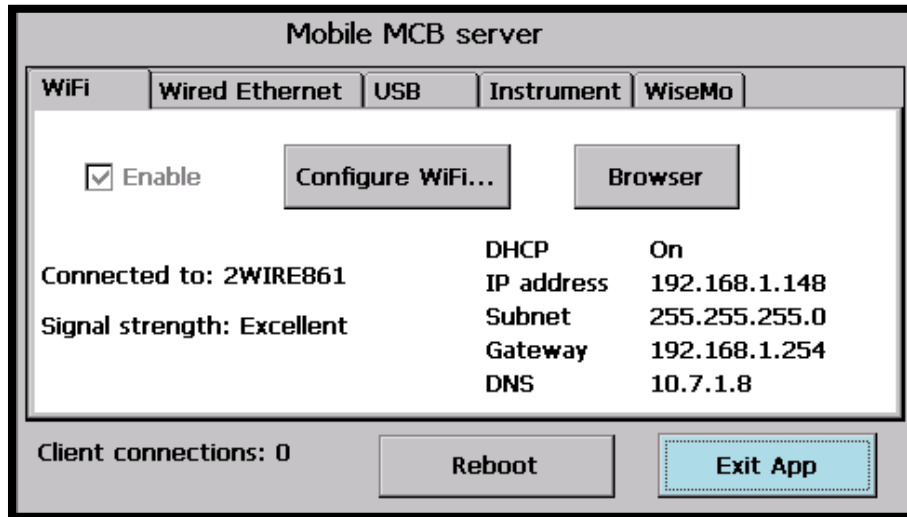
Figure 143. Mobile MCB Server UI from the Launcher Application

7.1 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 Detective X spectrometer's properties such as the conversion gain, bias voltage, the zero and gain stabilizer settings, counting presets, etc. The user has the opportunity to choose between the Trans-SPEC and the ID Mode settings banks. If the user chooses the Trans-SPEC settings bank, the settings will remain in effect while the user exits the Mobile MCB Server application and enters the Trans-SPEC application. Any changes made to Trans-SPEC settings will always be maintained, whether or not the instrument is connected to a computer.

If the user chooses to operate the Mobile MCB Server with the ID Mode settings, any changes made to the settings will remain in effect only as long as the Detective X is connected to the PC. When the

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unit is disconnected and any ID application restarts (Detective X, 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 Detective X is connected to a host computer via the Mobile MCB Server. The operator cannot access the Detective X application, its nuclide IDs, or any other information calculated by the Detective X's onboard computer. The user can, however, access the Trans-SPEC application while still connected to a computer by exiting the Mobile MCB Server application and selecting Trans-SPEC. The user is not required to disconnect from the computer to operate the Trans-SPEC application. The MFK interface described in Appendix A provides a much higher-level connection to the Detective X that may be needed in some instances.

7.2   ACCESSING THE DETECTIVE X VIA NETWORK

Once the Detective X is connected to a host computer via USB, CONNECTIONS makes it possible for multiple users on the same local network to access the instrument via ORTEC spectroscopy applications. Alternatively, the Detective X can be directly connected to the local network using Ethernet or WiFi with the same result. Network connections are established via the Mobile MCB Server application the same way they are established in the Detective X application.

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

7.3   QUANTITATIVE SPECTROSCOPY WITH GAMMAVISION

The Detective X does not measure or store efficiency calibration information in the files it creates. To use the Detective X 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 manual includes detailed instructions on this procedure.

7.4   INSTRUMENT SETTINGS TAB

In the Mobile MCB Server application, the Instrument tab contains a choice between the Trans-SPEC settings and ID settings. The Trans-SPEC settings selection changes the settings bank that is accessed by external applications such as GammaVision to those used specifically by the Trans-SPEC application. Changing to the Use ID Settings selection switches the settings to a bank that is accessed by the Detective X, Sleuth, and RAPiD applications.
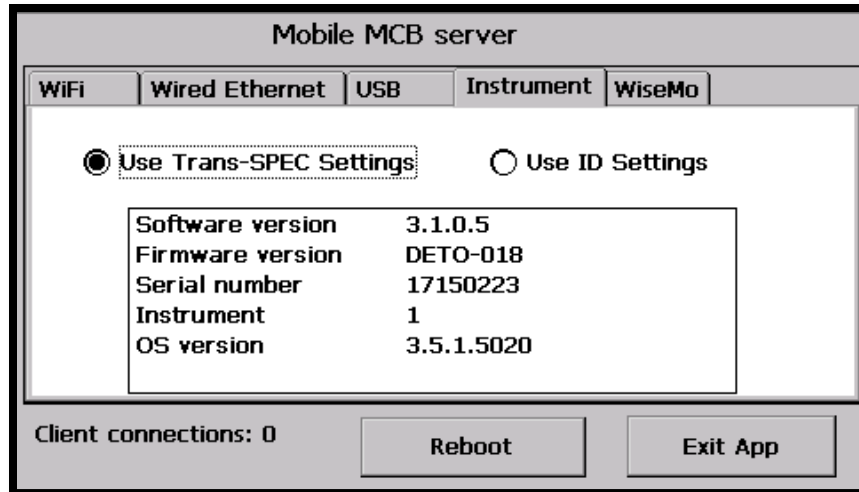
Figure 144. Mobile MCB Server – Instrument Settings

NOTE	Standard operation of the various applications (Detective X, Sleuth, etc.) automatically utilizes the correct bank of settings. The settings selection in Mobile MCB Server only applies for when the instrument will be connected to computer software.

7.5 USB TAB SELECTIONS

Selecting the USB tab allows the user to have a choice between ways that the USB port functions on the instrument. Operation of these selections is fully explained in Section 4.10 above.

It should be noted though that operation differs slightly from the Detective X Communication function. With the Detective X communication function, if the user connects to the Control (MCA Mode) and connects a USB cable to the instrument while in the Detective X application, functions within the application are still accessible by the user. The instrument does display an error message stating that the instrument is in MCA mode and does prevent the user from performing data acquisitions. This also applies to the RAPiD application.

The instrument operates differently if the user connects the instrument to a computer through the Mobile MCB Server application. If the user exits the Mobile MCB Server application and attempts to enter Detective X, Sleuth, or RAPiD while still connected to a computer, an error message is displayed on the screen. The error message states that the unit is in MCA control mode and the USB cable must be disconnected before the application will continue. If the user chooses to press OK on the message without removing the USB cable, the application will close and return to Launcher. The user will only be allowed to proceed into those three applications by removing the cable before launching the application or before pressing OK on the error message. Note this does not affect the Trans-SPEC application as the user is allowed to access the application while in MCA mode.

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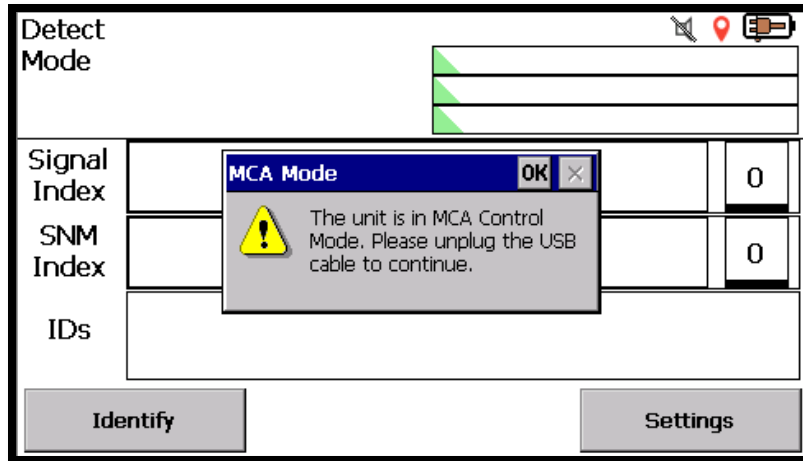
Figure 145. USB Cable Connected Error Message

8. TRANS-SPEC APPLICATION

The Trans-SPEC application is started from launcher (see Chapter 3). The Trans-SPEC application provides the basic MCA Emulation functions necessary to use the instrument as a standard spectrometer system. This includes the ability to change hardware settings, establish an energy calibration, and acquire spectra. When using the Trans-SPEC application, the hardware settings configured on a remote computer are retained to allow field measurements to be made with the same configuration as established in software applications such as MAESTRO, GammaVision, Isotopic, etc. These hardware settings are also independent of the isotopic identification applications (Detective X, Sleuth, and RAPiD), so completely different configurations can be established when using the instrument in standard spectrometer mode rather than an isotopic identifier.

8.1 TRANS-SPEC HOME SCREEN

Launching the Trans-SPEC application from the Launcher (see Chapter 3), opens the Trans-SPEC Home screen. The Home screen is the standard operation mode.

Figure 146. Trans-SPEC Home Screen

The icon in the upper right corner of the screen (Figure 147) shows whether the Detective X instrument is operating on battery power or the charger.

Directly above and below the spectrum graph display are the Status and Marker lines respectively. Each of these text lines can be modified to display different information. See Section 8.2.5.7 for more information.

Figure 147. Power Source Indicators

A panel of spectrum navigational control buttons is displayed on the left of the screen (see Section 8.1.3). A panel of operational buttons is displayed on the right of the screen (see Section 8.1.1).

8.1.1 Data Acquisition Controls

The Data Acquisition Control Panel can be found on the lower right corner of the Home screen.

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Figure 148. Data Acquisition Control Panel

The **Start** button controls data acquisition in conjunction with the real time and live time presets (if any are entered). After pressing **Start**, the button label changes to **Stop**. Press the **Stop** button to immediately stop data acquisition.

The **Clear** button deletes the spectrum and all associated information except marked ROI channels.

To pause an acquisition, press **Stop** without pressing **Clear**. As long as the spectrum is not cleared, the spectrum will be retained in live-spectrum memory.

The **Save** button is only active when the unit is not acquiring data. This saves the current spectrum information to the current **Data Location** in the current **Save File Format** (see Section 8.2.6.2 to change data location and format).

The **Menu** button opens the operational menu that controls all of the settings in the instrument (see Section 8.2).

8.1.2   Spectrum Window

The spectrum window is the displayed in the center of the home screen.
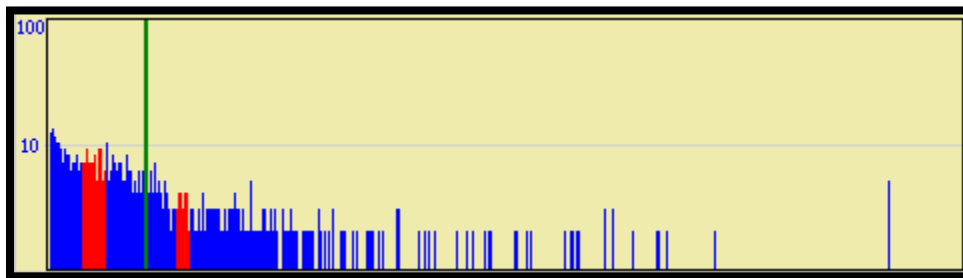
Figure 149. Spectrum Window

The spectrum window is patterned after the MAESTRO display. Users can select logarithmic or linear vertical scaling, mark ROIs, move from one ROI to ROI, zoom in/out, and check ROI peak information.

Note the vertical marker line in the spectrum window. To move the marker, tap the desired position. The marker will jump to that location and the Status Line values will update correspondingly. Users can also press on the display area and drag the marker left or right to the new location.

8.1.3   Spectrum Display Controls

The Spectrum Display Control Panel can be found on the lower left of the Home screen. These controls can be used to show the spectrum in different ways for better interpretation of the spectrum.
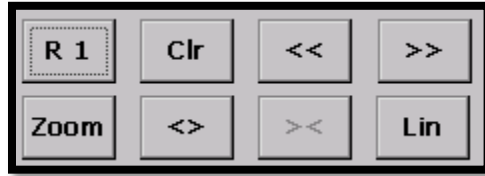
Figure 150. Spectrum Display Control Panel

Zoom / Full **Zoom** expands the spectrum around the current view's center channel. After **Zoom** is pressed, the button changes to **Full**. **Full** restores the display to a view of all channels in the spectrum. In this way, users can easily look at the peaks in the spectrum in detail (Zoom in) and move quickly from energy to energy in Full mode.

Zoom In The **Zoom In** button expands the display by halving the number of channels in the current spectrum view, so the peaks appear wider. The marker position becomes the center channel of the new view. The vertical scaling does not change.

Zoom Out The **Zoom Out** button contracts the display by doubling the number of channels, so the peaks appear narrower. The marker position becomes the center channel of the new view. The vertical scaling does not change.

Lin / Log This button toggles between logarithmic vertical scaling and linear mode with automatic vertical limits. The Lin button changes to Log in the linear mode, and vice versa.

R1 / R2 The Trans-SPEC application allows users to mark any number of ROIs in the spectrum. To do this, tap to position the cursor at one end of the region, then tap **R1**. The button label will change to **R2**. Tap to position the cursor at the other end of the region, then tap **R2**. The ROI will be indicated in red and will be saved in the spectrum file.

NOTE   Marked ROI channels remain active until unmarked with the **Clr** button. If a spectrum is cleared in which ROIs are marked, the ROI channels will still be marked in the next spectrum acquired. In addition, they will remain active if the instrument is switched to MCA Mode and connected to a computer running MAESTRO or similar applications. Likewise, if users mark ROIs in MCA Mode, then disconnect and return to standalone mode, those ROIs will remain active on the Home screen until unmarked.

Next/Previous ROI Tap to move to the next lower-energy (**<<**) or higher-energy (**>>**) ROI.

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Clr	**Clr**	To unmark an ROI, tap or press **<<** or **>>** to position the cursor in the desired ROI, then tap **Clr**.

8.2   TRANS-SPEC MENU

The Trans-SPEC menu screen can be opened by pressing the **Menu** button on the Home screen.
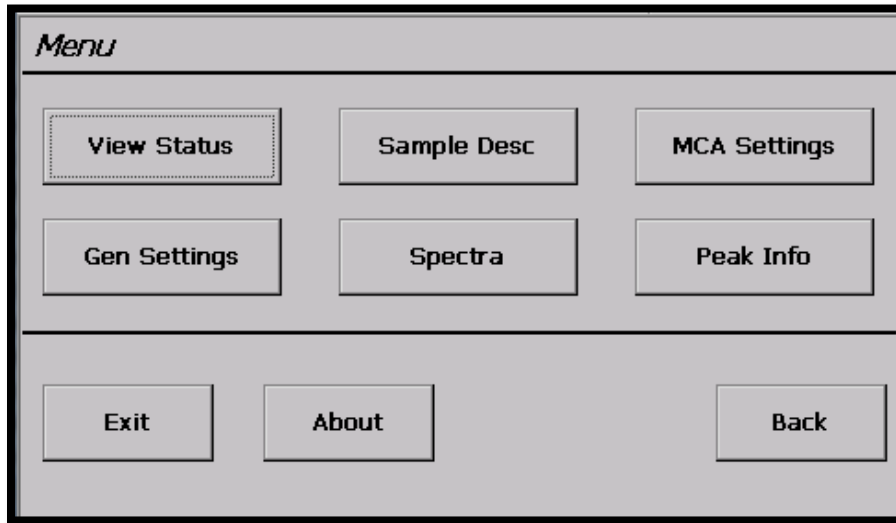
Figure 151. Menu Screen

The **Exit** button closes the Trans-SPEC application and exits to the Launcher screen. After pressing **Exit**, a confirmation message will be displayed confirming that it is desired to exit the application.

The **Back** button returns to the Home screen.

8.2.1   About

Pressing the **About** button displays the following screen.
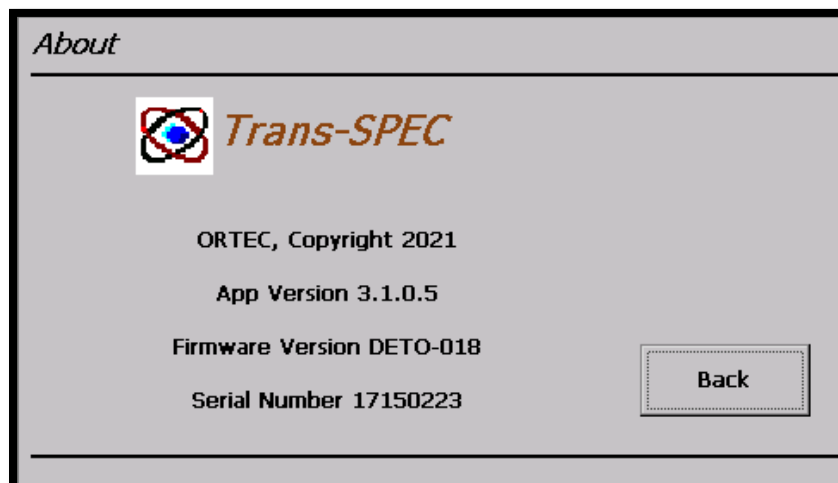
Figure 152. About Screen

Press **Back** to return to the Main Menu screen.

8.2.2   View Status

Pressing the **View Status** button opens the Status screen to display all of the major MCA settings at one time.
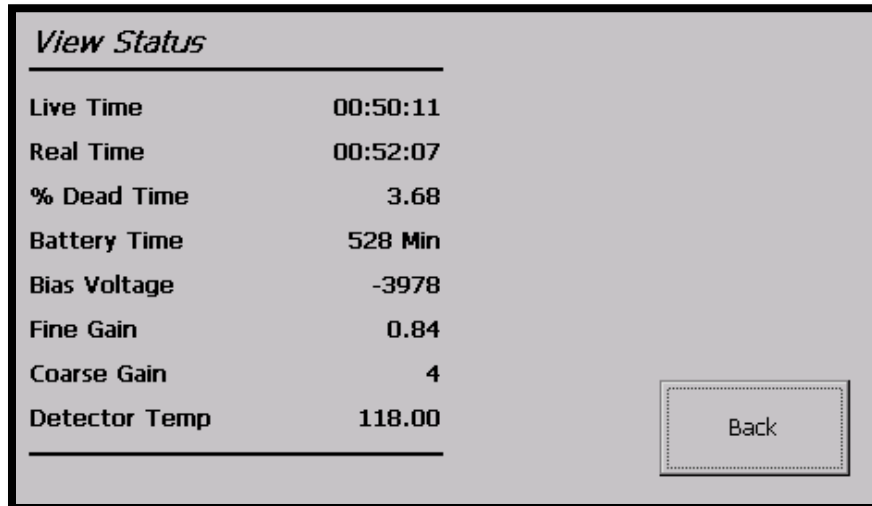
Figure 153. View Status

Press **Back** to return to the Main Menu screen.

8.2.3   Sample Desc

Pressing the **Sample Desc** button displays the Sample Description entry screen.
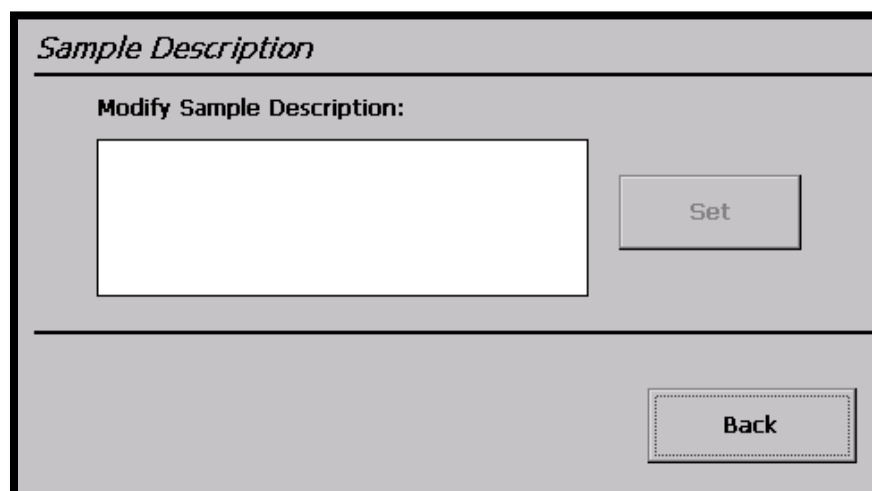
Figure 154. Sample Description

The Sample Description entry screen allows users to enter an alphanumeric identifier, up to 63 characters long, to describe the sample. If users mark the **Ask for Sample Description** option on the Spectra Settings screen (see Section 8.2.6.1), the description entered here will be displayed, for optional modification, each time a spectrum is saved. If users choose not to mark the **Ask for**

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Sample Description option, the sample description will automatically be used as it is entered for all samples collected. Leave this field blank to choose not to have a sample description.

Tap in the field to open the soft keyboard, then tap **Set** to complete the entry and close the keyboard. Press **Back** to return to the Main Menu screen.

8.2.4　MCA Settings

Pressing the **MCA Settings** button displays the MCA Settings menu.
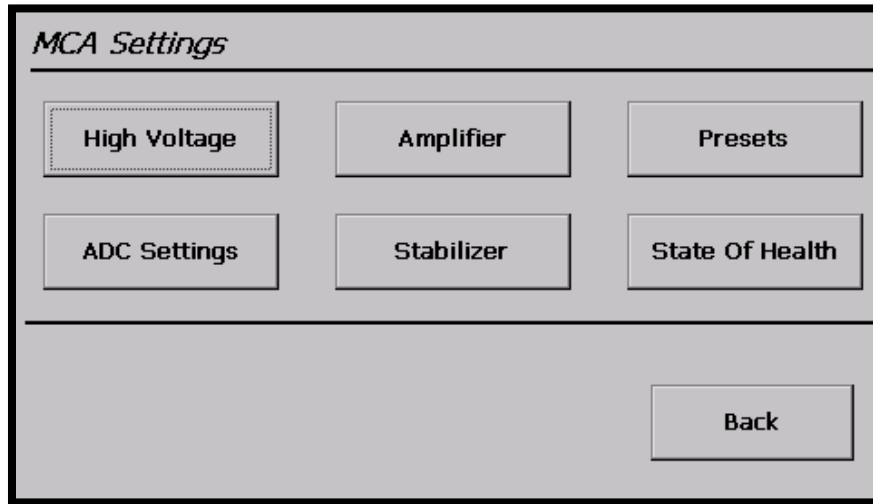
Figure 155. MCA Settings Menu

The MCA Settings allows the user to define settings that affect the operation of the instrument. Press **Back** to return to the Main Menu screen.

8.2.4.1　High Voltage

Pressing the **High Voltage** button displays the High Voltage Settings screen.
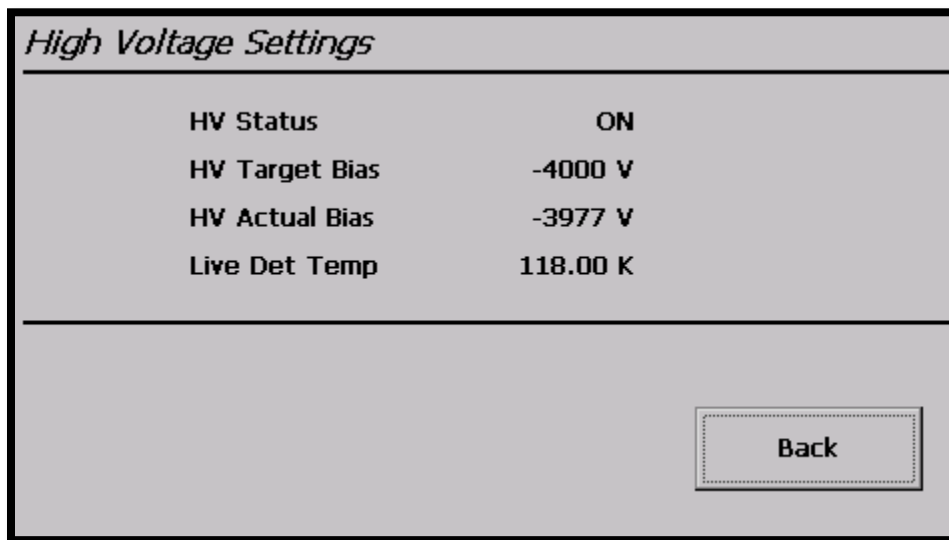
Figure 156. High Voltage Settings

This dialog displays the HV on/off setting, the target and actual bias, and the live detector temperature. Press **Back** to return to the MCA Settings menu.

8.2.4.2   Amplifier Settings

Pressing the **Amplifier Settings** button opens the Amplifier Settings menu.
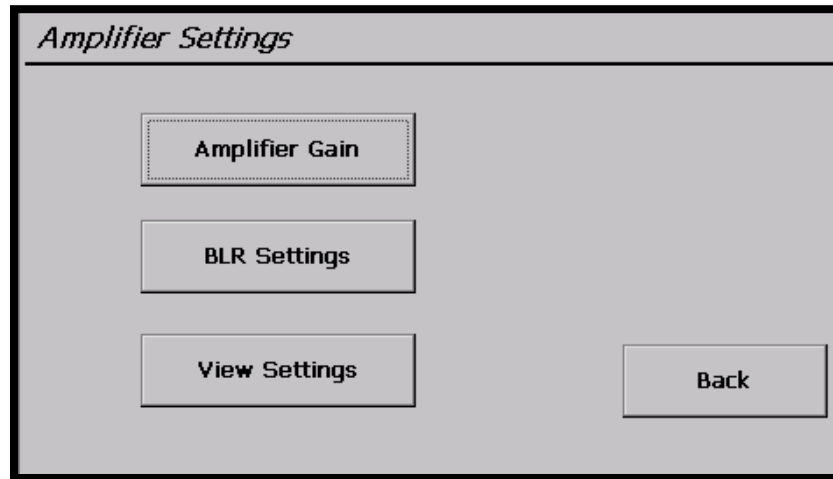
Figure 157. Amplifier Settings Menu

Press the **Back** button to return to the MCA Settings menu.

<u>**Amplifier Gain**</u>
Pressing the **Amplifier Gain** button displays the Amplifier Gain screen.
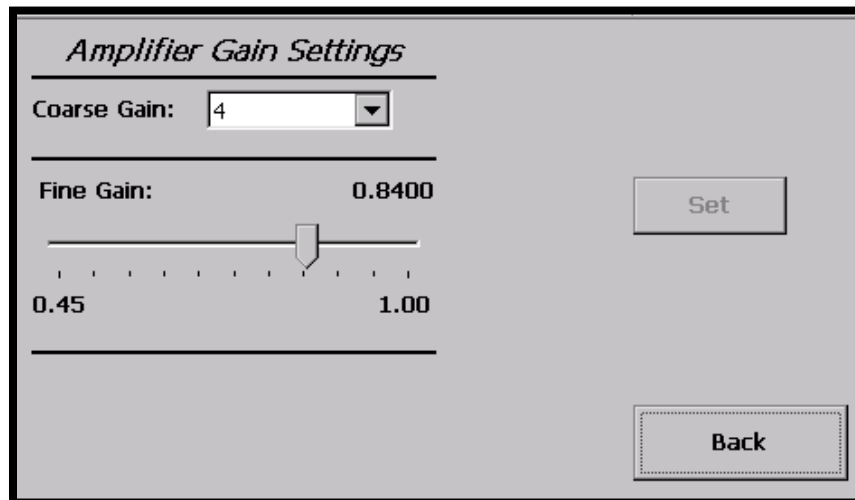
Figure 158. Amplifier Gain Settings

This screen allows the adjustment of the amplifier gain before or during acquisition. Click the up/down arrows to set the **Coarse Gain** to ×1, ×2, ×4, ×8, ×16 or ×32. Tap or click-and-drag the slider to set the **Fine Gain** to any value between 0.45 and 1.00. Press the **Set** button to save the settings. Press **Back** to return to the Amplifier Settings menu.

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BLR Settings

Pressing the **BLR Settings** button displays the Baseline Restore Settings screen.

Figure 159. Baseline Restore Settings

Choose a BLR setting by selecting the correct Radio button and pressing the **Set** button. **Auto** is the normal setting, **Fast** is typically used for high-count-rate situations, and **Slow** is typically for low-count-rate situations. Press **Back** to return to the Amplifier Settings menu.

View Settings

Pressing the **View Settings** button displays the View Amp Settings screen.
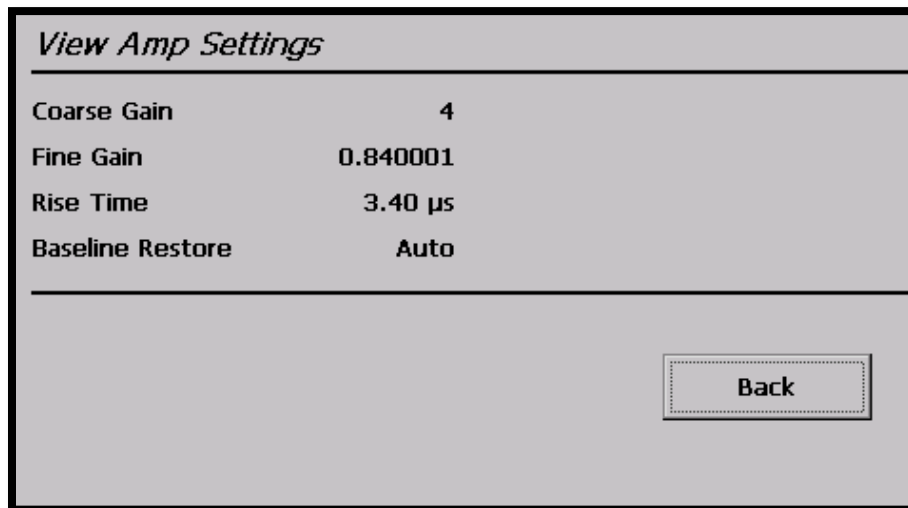
Figure 160. View Amp Settings

This screen is a view only screen that displays all the current amplifier settings. The Rise Time can be adjusted in MCA Mode with MAESTRO. Press **Back** to return to the Amplifier Settings menu.

8.2.4.3   Presets

Pressing the **Presets** button opens the Preset Settings menu.
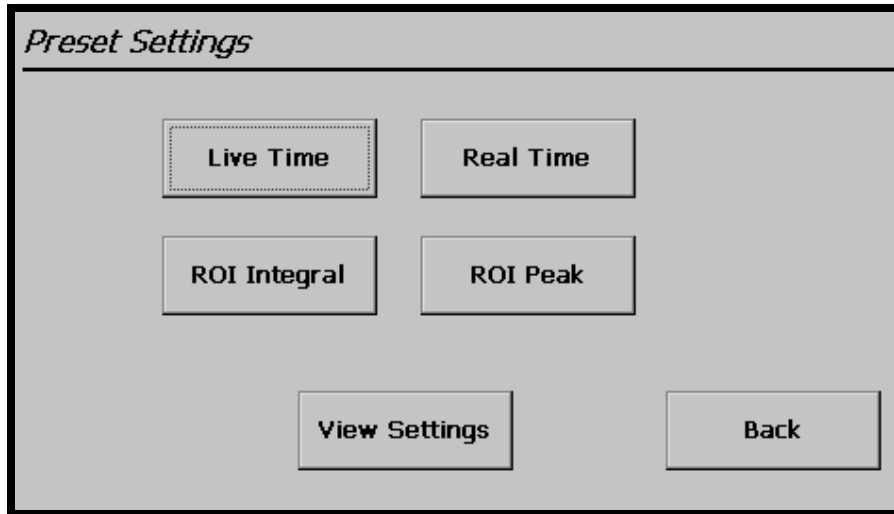
Figure 161. Preset Settings Menu

Press the **Back** button to return to the MCA Settings menu.

Live Time

Pressing the **Live Time** button displays the Live Time Preset screen.
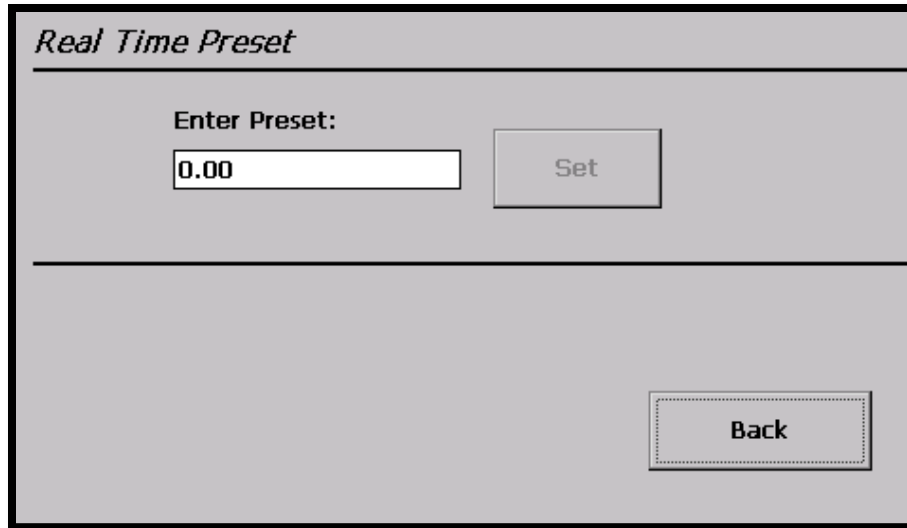
Figure 162. Live Time Preset

The **Live Time** preset stops the acquisition when the live time reaches the specified value. The preset value should be entered in seconds. Press the **Back** button to return to the Preset Settings menu.

Real Time

Pressing the **Real Time** button displays the Real Time Preset screen.

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Figure 163. Real Time Preset

The **Real Time** preset stops the acquisition when the real time reaches the specified value. The preset value should be entered in seconds. Press the **Back** button to return to the Preset Settings menu.

ROI Integral
Pressing the **ROI Integral** button displays the ROI Integral Preset screen.

Figure 164. ROI Integral Preset

The **ROI Integral** preset stops the acquisition when the sum of all counts in all ROIs in the spectrum reaches the specified value. Press the **Back** button to return to the Preset Settings menu.

ROI Peak
Pressing the **ROI Peak** button displays the ROI Peak Preset screen.

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Figure 165. ROI Peak Preset

The **ROI Integral** preset stops the acquisition when any channel in any ROI reaches the specified value. Press the **Back** button to return to the Preset Settings menu.

<u>View Settings</u>
Pressing the **View Settings** button displays the View Preset Settings screen.

Figure 166. View Preset Settings

This screen displays the values for all the current presets. Press the **Back** button to return to the Preset Settings menu.

8.2.4.4   ADC Settings

Pressing the **ADC Settings** button on the MCA Settings menu opens the ADC Settings screen.

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Figure 167. ADC Settings Screen

LLD – This is the lower-level discriminator. It should be set to reject any low-level noise but not any useful peaks.

ULD – This is the upper-level discriminator. Setting the ULD causes the system to reject any data above the set channel value. It is normally set to the one less than the conversion gain value.
Conversion Gain – This is the number of channels in the spectrum. Select from 512, 1024, 2048, 4096, 8192, and 16384. Note that when the conversion gain value is set, it automatically adjusts the LLD and ULD to values that are within the expected range for the conversion gain (i.e., when switching to 512 the ULD will automatically be changed to approximately 510).

Press **Back** to return to the MCA Settings menu.

8.2.4.5   Stabilizer

Press the **Stabilizer** button to display the Stabilizer Settings menu.

Figure 168. Stabilizer Settings

Press **Back** to return to the MCA Settings menu.

Gain Stabilizer
Pressing the **Gain Stabilizer** button displays the Gain Stabilizer Settings screen.

Figure 169. Gain Stabilizer Settings

Before setting up the stabilizer, tap **Initialize** to reset the stabilizer adjustment to zero percent.

Center – This is the center channel of the region used for the stabilization. The peak will be centered in this region by the stabilizer operation. The peak should be in the upper half of the spectrum and isolated from other peaks. Note that this value is limited to a range between the LLD+4 and ULD-4.

Width – This is the width (in channels) of the peak region to be used. It should be only *slightly* wider than the peak.

Stabilizer Enabled – When the center and width values have been entered, tap to mark this box and enable the stabilizer.

NOTE	Users are not able to make any changes to the Gain Stabilizer Settings while the Stabilizer Enabled check box is checked. Uncheck the checkbox and the settings become activated. Valid data is required to recheck the Stabilizer Enabled check box.

Press the **Back** button to return to the Stabilizer Settings menu.

Zero Stabilizer
Pressing the **Zero Stabilizer** button displays the Zero Stabilizer Settings screen.

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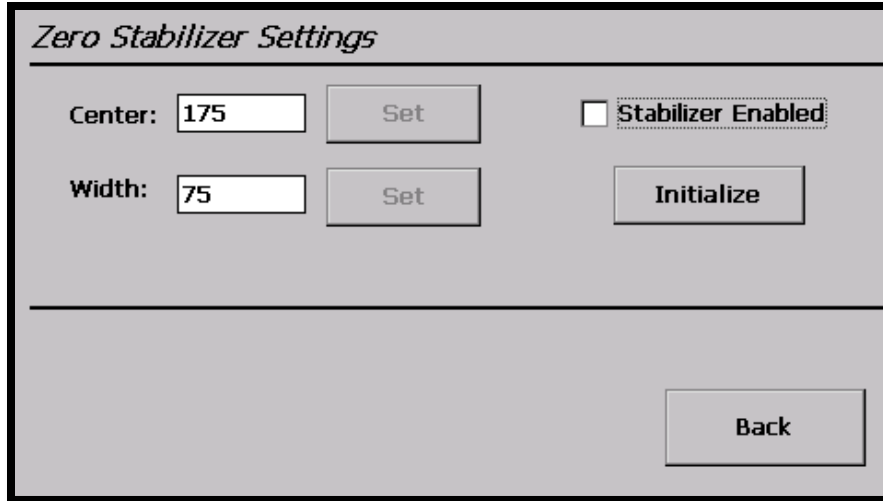
Figure 170. Zero Stabilizer Settings

The Zero Stabilization Settings screen operates exactly the same as the Gain Stabilizer Settings screen explained above. Press the **Back** button to return to the Stabilizer Settings menu.

NOTE	The Stabilizer Enabled checkbox cannot be checked until initial valid values have been entered for Center and Width. Also, users are not able to make any changes to the Zero Stabilizer Settings while the Stabilizer Enable check box is checked.

View Settings
Pressing the **View Settings** button displays the View Stabilizer Settings screen.
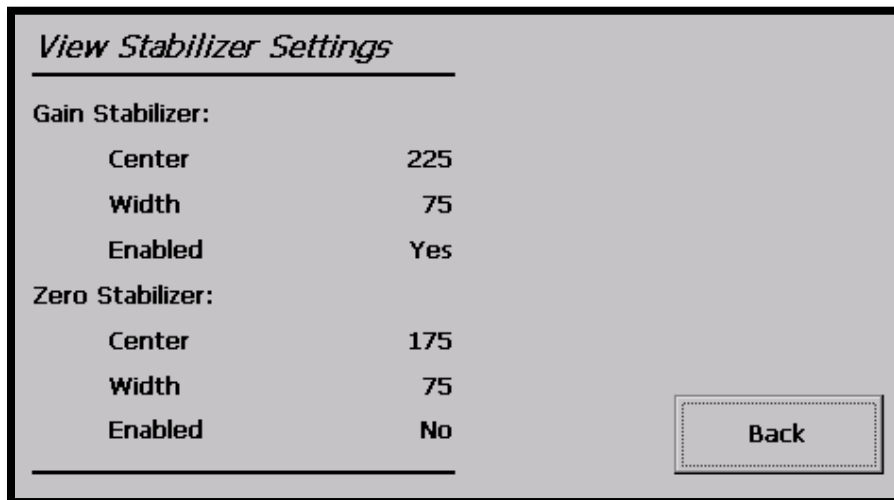
Figure 171. View Stabilizer Settings

The View Stabilizer Settings screen displayed the gain and zero stabilizer settings currently in use. Press the **Back** button to return to the Stabilizer Settings menu.

8.2.4.6   State of Health

Pressing the **State of Health** button displays the State of Health screen.

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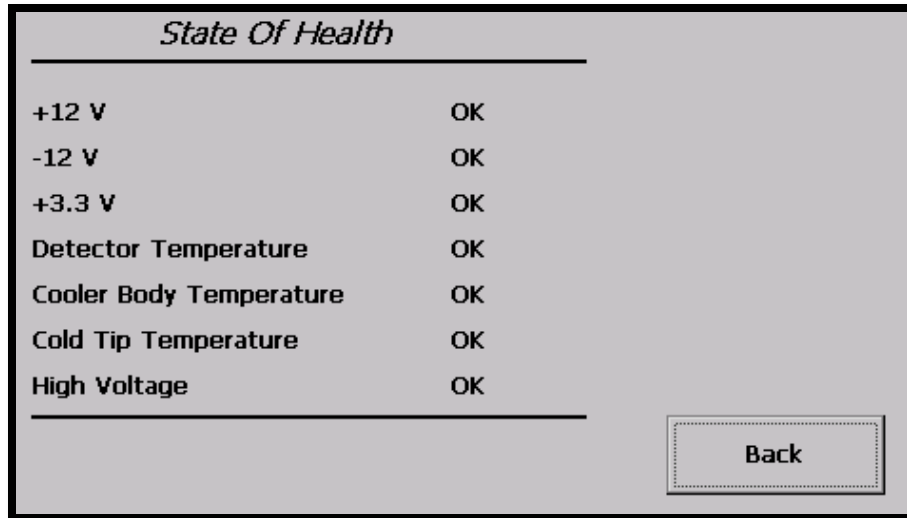
Figure 172. State of Health

The State of Health screen displays the currently Detective X diagnostic status. This screen will display if the voltage or temperature are not operating correctly. Pressing **Back** returns to the MCA Settings menu.

8.2.5   Gen Settings

Pressing the **Gen Settings** button launches the General Settings menu.
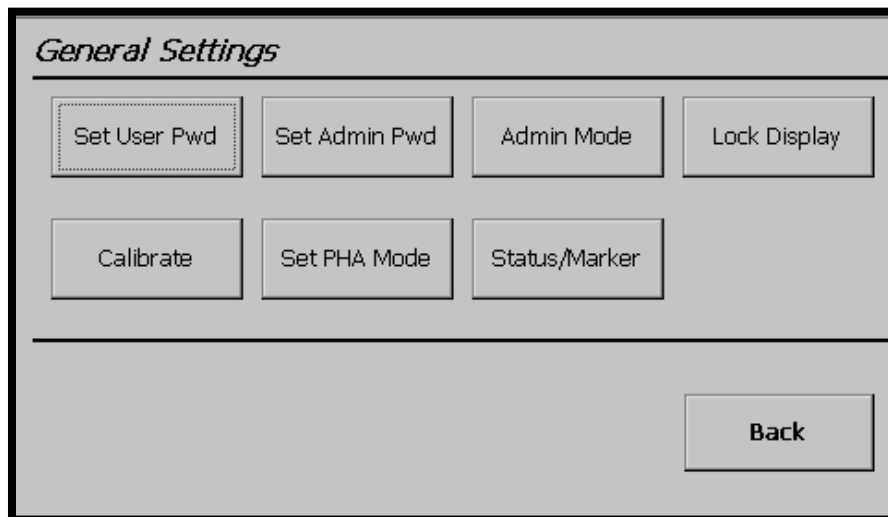
Figure 173. General Settings Menu

The General Settings menu allows the user control access, provide spectrum display security, complete calibration, and define screen display settings. Press **Back** to return to the Main Menu screen.

8.2.5.1   Set User Pwd

Pressing the **Set User Pwd** button displays the Set User Password screen.

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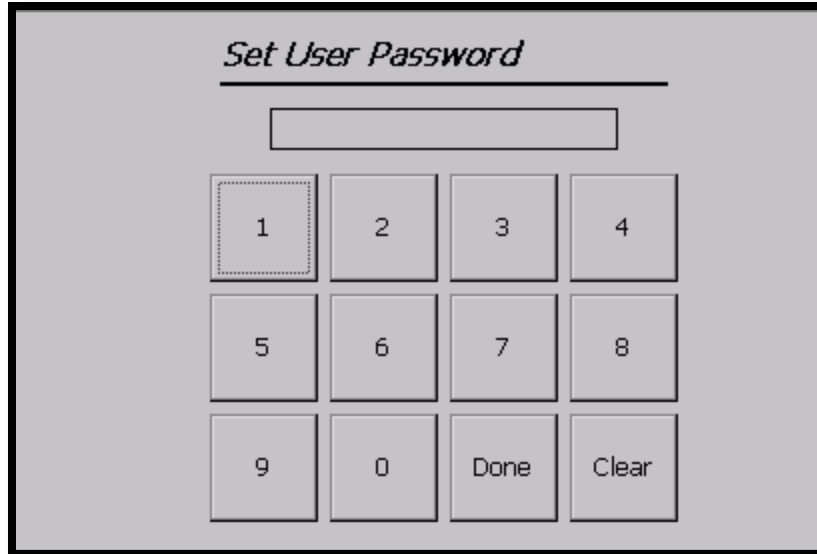
Figure 174. Set User Password

Setting the user password allows the application to be locked from the first screen. To enter a password, tap the number buttons and then press **Done.** The password is limited to 9 digits. For the password to take effect, the user must exit and reenter the Trans-SPEC application. Once the application is restarted, the following screen is displayed, requesting the user password. If the password is not entered correctly, access to the Trans-SPEC application is not allowed.
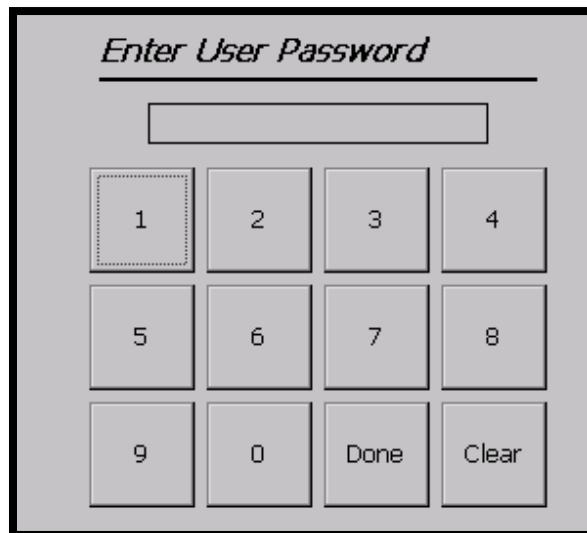
Figure 175. Enter User Password

To clear the password, tap the **Clear** button on the Set User Password screen. It is not necessary to exit and reenter the Trans-SPEC application for the password to be cleared.

NOTE	Only administrators have the rights to set and clear passwords (User and Admin). If an administrator password has not been set, the user password automatically gives admin rights.

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WARNING There is no master password. If the passwords are lost, contact an ORTEC service representative.

8.2.5.2   Set Admin Pwd

Pressing the **Set Admin Pwd** button displays the Set Admin Password screen.
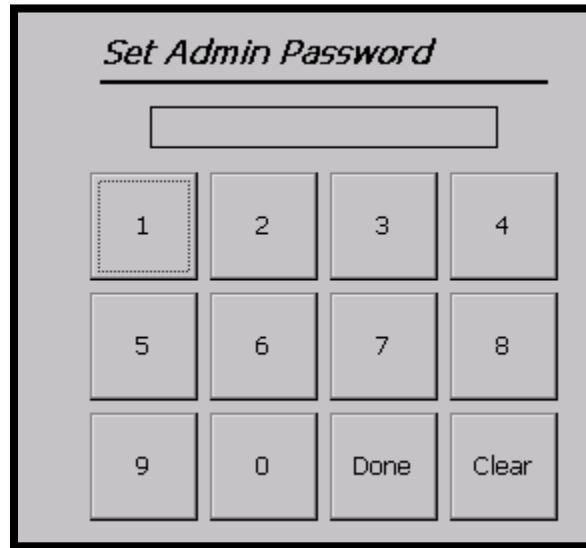
Figure 176. Set Admin Password

Setting an administrator password allows non-administrators to start the Trans-SPEC application (as long as a user password has not been set) but prevents non-administrators from changing the current Trans-SPEC settings. Setting and clearing the admin password operates the same as the user password. The application must be exited and restarted before admin passwords take effect.

When the administrator password has been set, non-administrators can view the current settings and the current spectrum, unless the display is locked. They can also start and stop data acquisition, and save, clear, and view spectra. However, any attempt to change settings causes an "Access Denied" message to be displayed.

NOTE	Only administrators have the rights to set and clear passwords (User and Admin). If the User and Administrator passwords have been set to the same value, the user automatically has admin rights.

NOTE	If the administrator password is set, entering the user password on application startup grants limited access. Entering the administrator password in the user password screen grants full access.

WARNING There is no master password. If the passwords are lost, contact an ORTEC service representative.

8.2.5.3   Admin Mode

Pressing the **Admin Mode** button allows the user to enter the administrator password and active Admin Mode, which allows the user to change settings.

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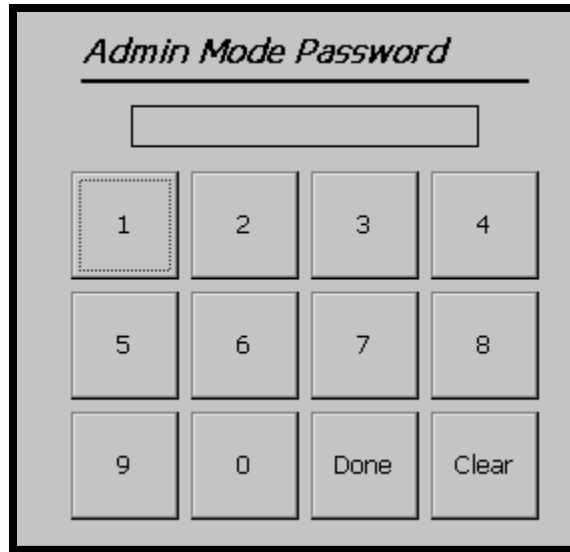
Figure 177. Admin Mode Password

Entering the correct administrator password makes the administrator rights take effect immediately. Administrator rights are not turned back off until the application is exited and reentered.

8.2.5.4   Lock/Unlock Display

Pressing the **Lock Display** button turns on or off the spectrum display lock feature. To make this feature work effectively, the instrument should have an administrator password programmed. Press the button once to activate the locked display. The button text will change to Unlock Display. Pressing the **Unlock Display** button will unlock the display and change the button back to Lock Display. Pressing the **Lock/Unlock Display** button displays the following messages:

Figure 178. Display Locked and Unlocked Messages

This feature is activated/deactivated only after exiting and reentering the Trans-SPEC application. A locked display screen only allows the user to Start, Stop, Clear, and Save a spectrum.
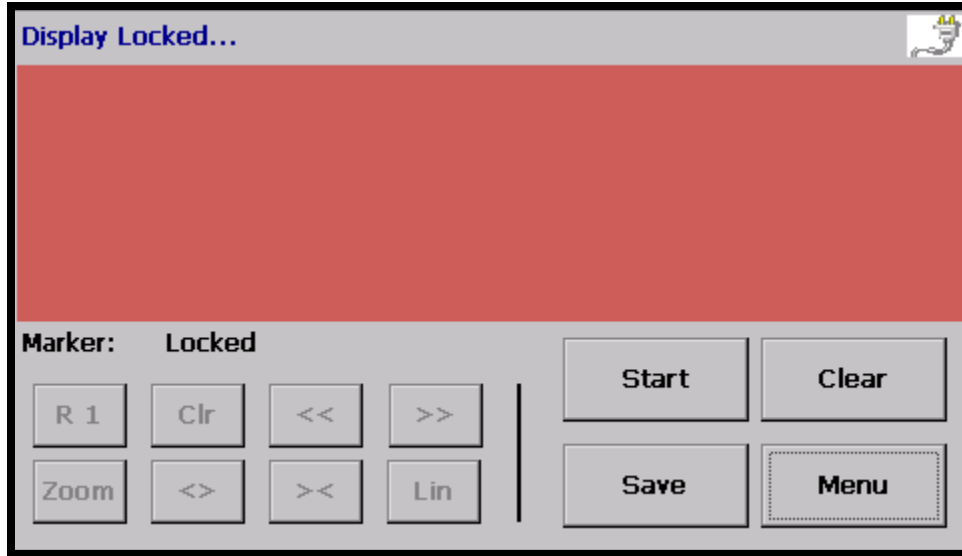
Figure 179. Locked Spectrum Display

8.2.5.5 Calibrate

Pressing the **Calibrate** button displays the Energy Calibration screen.
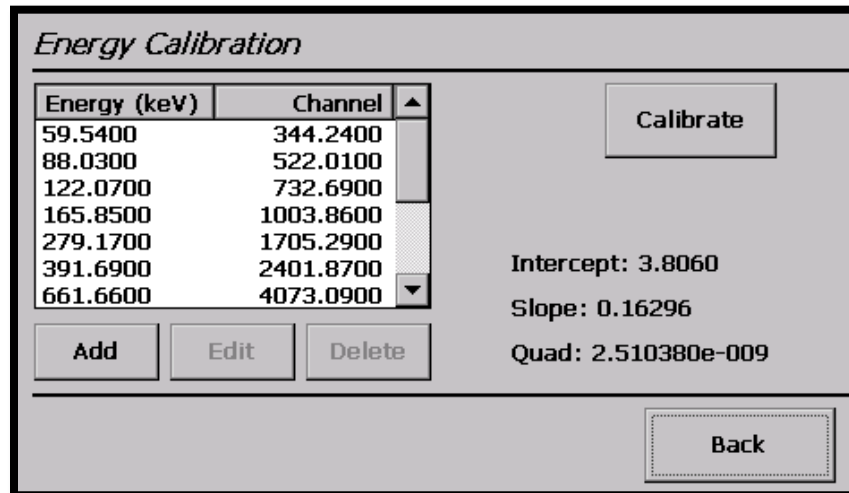
Figure 180. Energy Calibration

This function allows users to energy calibrate the Trans-SPEC from multiple peak energy/ channel pairs. When the Trans-SPEC is connected to a computer, the software application (e.g., MAESTRO or GammaVision) will read this calibration.

If the calibration is destroyed in MAESTRO or GammaVision, when the user disconnects and returns to standalone (**ActiveSync**) mode, the spectrum on the Home screen will indicate only channel numbers, and the energy for all channels will be displayed as 0.00 keV. Also note that the calibration page will remove all values from the Energy Calibration table. To recalibrate the instrument, the user will be required to enter new energy/channel values into the table and then press **Calibrate**.

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NOTE	If a calibration is loaded from an outside source and any of the slope, intercept, or quad values are greater than 1% different from the current instrument calibration results, the channel/energy pairs in the calibration table on the Trans-SPEC application will be blanked out to prevent the user from mistakenly thinking the values in the table resulted in the calibration results. These channel/energy pairs can be restored by loading a calibration that has slope, intercept, and quad values within 1% of the results from the table values.

Calibration points can be entered into the Energy Calibration table by pressing the **Add** button, which will open the Enter Calibration Point screen.
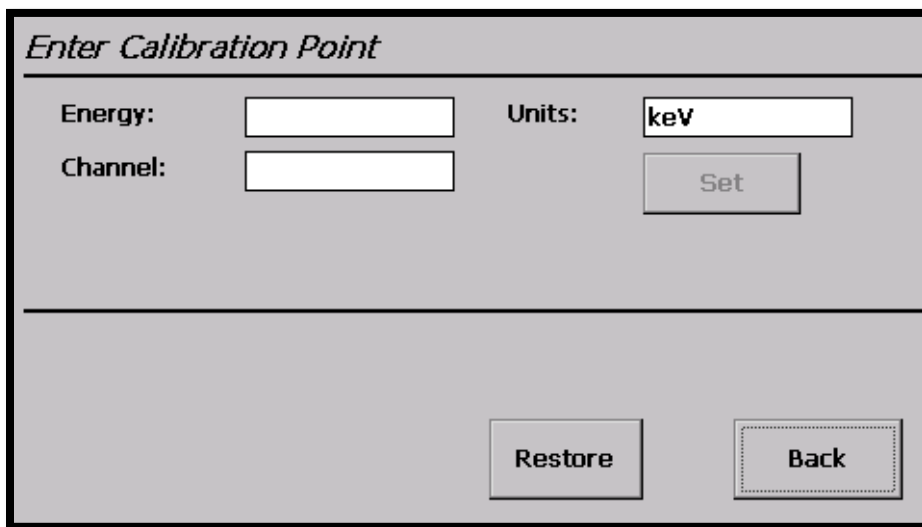
Figure 181. Enter Calibration Point

Enter the Energy and Channel the energy peak should fall into. The units field changes the units designation that can be seen at the top of the Energy Calibration table. Press **Set** to save the changes. Pressing the **Restore** button wipes out the values that were entered if this is a new entry or reverts the values back to the previous if this is an edit entry situation.

Editing Calibration Points
To edit a point in the calibration table, tap to highlight the entry, then tap Edit. Make the desired changes, then tap Set, Back, and Calibrate.

Deleting Calibration Points
To delete a point, tap the calibration table to highlight the entry, then tap **Delete**. *Note that this removes the selected entry without warning, and there is no "undo."*

There are two ways to calibrate:

1) Determine all the peak centroid energies and corresponding channel numbers to be used and enter them in the calibration table all at one time. To do this:

   For each point, tap **Add**, enter the calibration point and tap **Set**, then tap **Back**. Repeat until all values have been entered and are displayed on the Energy Calibration screen, then tap **Calibrate** before returning to the General Settings menu.

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2) Determine each peak centroid energy and channel individually and enter it in the calibration table one-at-a-time. To do this:

Obtain the peak information for the first point, then tap **Add**, enter the calibration point and tap **Set**, **Back**, and **Calibrate**. Back out to the Home screen, obtain the information for the next point, return to the calibration screen, and repeat as for the first point. Repeat until all values have been entered and added to the calibration table displayed on the Energy Calibration screen.

Press **Back** to return to the General Settings menu.

8.2.5.6   Set PHA Mode

Pressing the **Set PHA Mode** button sets the operation mode to pulse-height analysis (PHA). This is only needed when the instrument is disconnected from the host computer with the Trans-SPEC set to the ORTEC Insight™ Virtual Oscilloscope mode, which is discussed in the MAESTRO user manual.

Pressing the **Set PHA Mode** button displays a confirmation message stating that the mode has been changed.
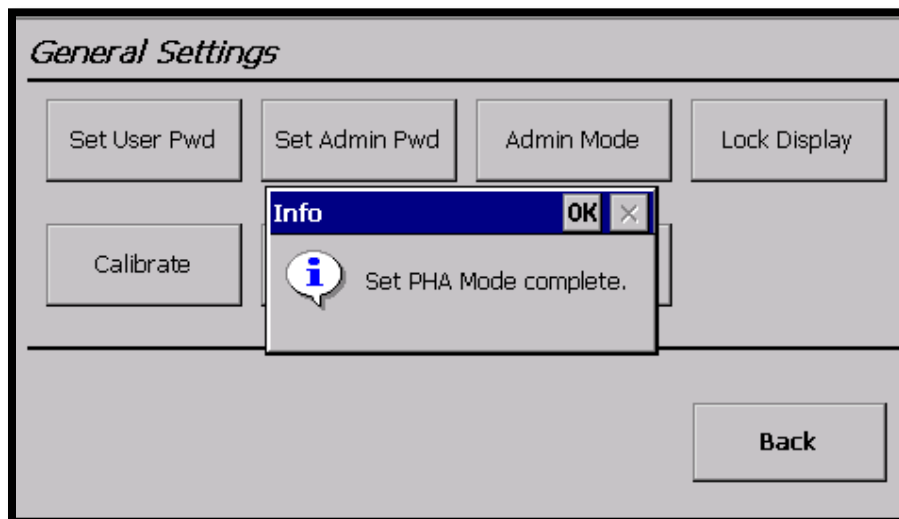
Figure 182. Set PHA Mode Confirmation

8.2.5.7   Status/Marker

Pressing the **Status/Marker** button opens the Status/Marker Line menu.

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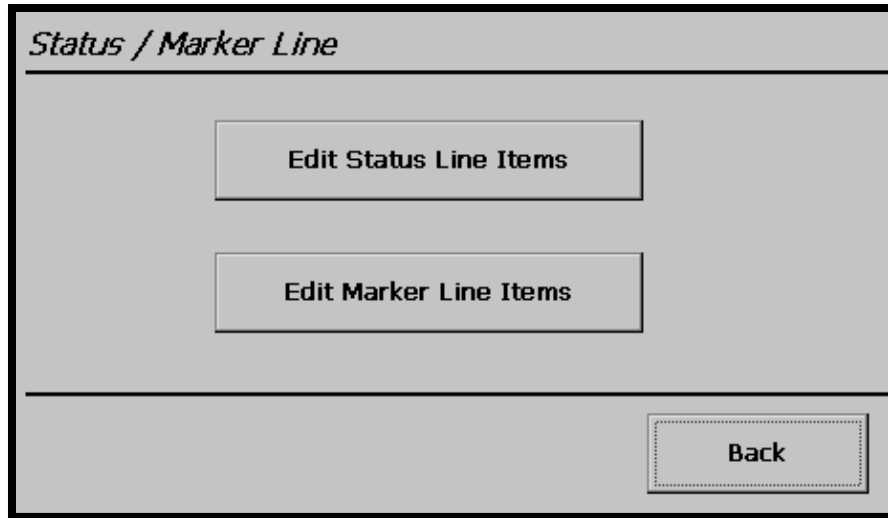
Figure 183. Status/Marker Line Menu

This menu accesses the Status Line and Marker Line setup screens. The Status Line is the text line displayed above the spectrum while the Marker Line is the line of text just below the spectrum. Each line can be configured to show up to two parameters each.

The order in which the parameters are selected determines which is displayed on the left side of the screen and which is displayed on the right. When the first item is marked, a **1** appears beside the first selection. This parameter is displayed on the left. The second item is marked with a **2** and is displayed on the right.

Edit Status Line Items
Pressing the **Edit Status Line Items** button opens the Status Line screen.
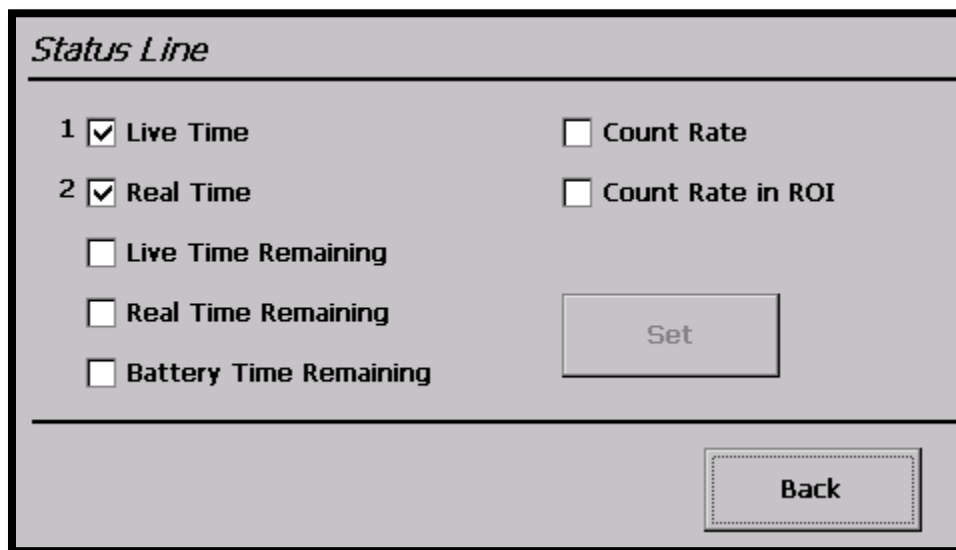
Figure 184. Status Line

Press the check boxes beside up to 2 items to be displayed and press the **Set** button to save the changes. Press **Back** to return to the Status/Marker Line menu.

Edit Marker Line Items

Pressing the **Edit Marker Line Items** button opens the Marker Line screen.

Figure 185. Marker Line

Press the check boxes beside up to 2 items to be displayed and press the **Set** button to save the changes. Press **Back** to return to the Status/Marker Line menu.

8.2.6   Spectra

Pressing the **Spectra** button opens the Spectra Settings screen.

Figure 186. Spectra Settings

These options allow the user to view and manage the spectra stored on the Detective X, select the saved file format and storage location, and specify whether or not to allow editing of the sample description each time a spectrum is saved.

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Press the **Back** button to return to the Main Menu screen.

8.2.6.1 Ask for Sample Description

If this checkbox is marked, each time a spectrum is saved the Default Sample Description will be displayed for optional modification. The default description can be modified here or on the Sample Description screen (see Section 8.2.3). Note that any changes made in this location are reflected on the Sample Description screen (and vice versa).

When this checkbox is marked, the following screen is displayed every time the **Save** button is pressed on the home screen. This screen allows the user to temporarily change the sample description for this single save event. It will not change the default description.
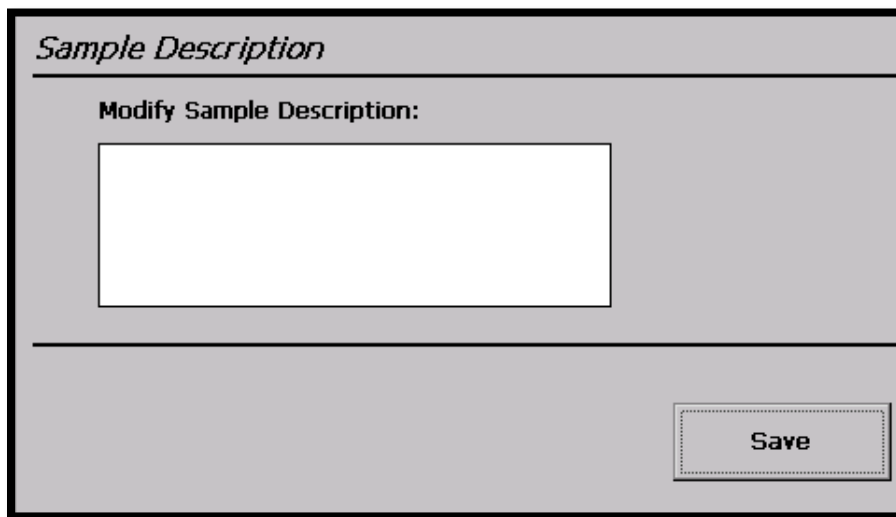
Figure 187. Sample Description Modification Screen

> **NOTE**   If the check box is not checked, the default sample description is automatically saved for all samples. If it is desired to not have a sample description saved, the default sample description variable should be left as null (empty).

8.2.6.2 Data Location

The Trans-SPEC application allows users to store spectra in the internal My Documents folder or on a removable USB storage drive. Press the arrow to open the drop-down menu to select between the following:

> My Documents\TransSPEC-Data
> USB Drive (Hard Disk)\TransSPEC-Data

Highlight the desired value to select it. It will be displayed on the Spectra Settings page and will automatically take effect.

8.2.6.3 File Save Format

The Trans-SPEC application allows files to be saved in two spectrum formats:

ORTEC Integer .SPC
ORTEC Integer .CHN.

Press the arrow to open the drop-down menu and highlight the desired value to select it. It will be displayed on the Spectra Settings and will automatically take effect.

8.2.6.4   Displaying a Stored Spectrum

Press the **Display** button to open the Display Spectrum screen.
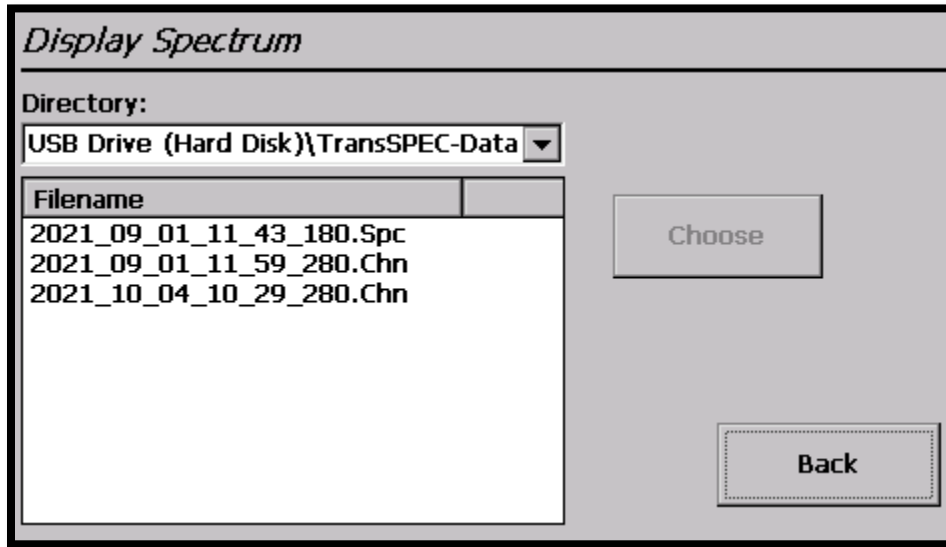
Figure 188. Display Spectrum

Select the desired storage location from the drop-down menu (My Documents or USB Drive). Tap the desired file to highlight it and then press **Choose** to display it. The display screen shows the filename and spectrum and provides a subset of the Home screen's display control buttons.
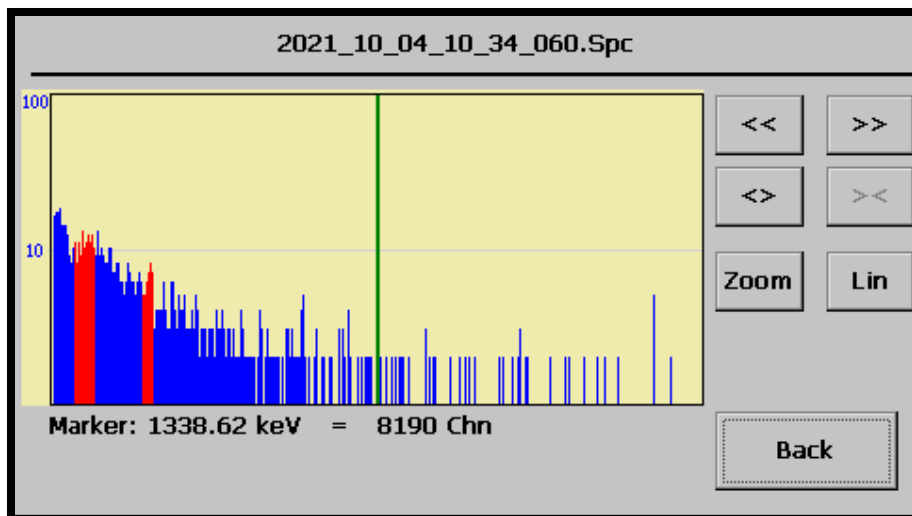
Figure 189. Displayed Saved Spectrum

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The navigational controls on the right side of the spectrum can be used to zoom in and out and to change the display scale. Press the **Back** button to return to the Display Spectrum screen. Press the **Back** button a second time to return to the Spectra Settings screen.

> **NOTE**   Choosing to display a stored spectrum does not load it into (overwrite the current spectrum in) the detector's live-spectrum memory.

8.2.6.5   Deleting a Spectrum File

Press the **Delete** button to open the Delete Spectrum screen and permanently delete a selected file.
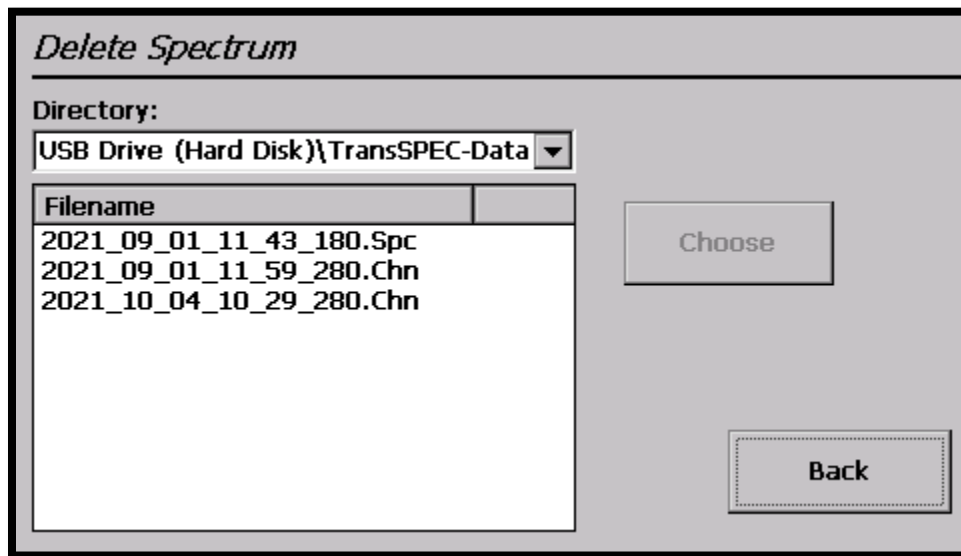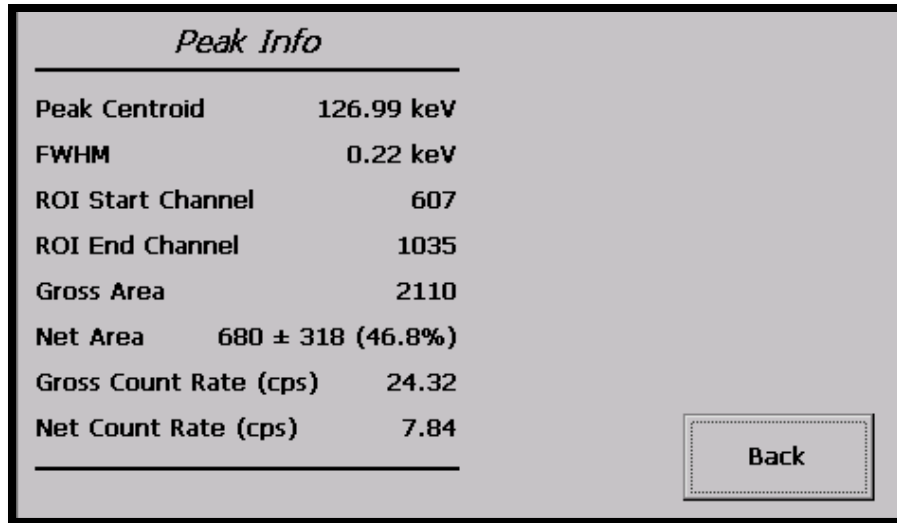
Figure 190. Delete Spectrum

To delete a file, select the desired file location from the drop-down menu (My Documents or USB Hard Disk). Tap the filename in the list to select it (it will be highlighted blue). Press **Choose** to open a yes/no confirmation message and select **Yes** to delete the file. Once all of the desired files have been deleted, press **Back** to return to the Spectra Settings screen.

> **WARNING**   There is no undo for this. Once a file has been deleted, it can never be restored.

8.2.7   Peak Info

Prior to being able to use the Peak Info feature, a ROI must be defined on the spectrum (see Section 8.1.3 for steps to define and ROI). Position the green channel marker within the ROI before pressing the **Peak Info** button. After pressing the **Peak Info** button, the following screen will be displayed.

Figure 191. Peak Info

This dialog reports the centroid, FWHM, and net and gross counts for the region identified by the marker position. Press the **Back** button to return to the Main Menu screen.

NOTE	If the green marker line is not positioned in an ROI prior to pressing the Peak Info button, all values will be displayed as N/A.

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9. 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** menu. 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 Detective X, 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** menu and the **Smooth** and **Strip** commands on the **Calculate** menu are disabled for this instrument.

NOTE	Refer to the introduction to Section 7 and to Section 7.4 for more information on the operation of the settings bank selection.

9.1   AMPLIFIER

Figure 192 shows the Amplifier tab, which displays the **Coarse** and **Fine Gain** and **Pole Zero** controls.

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

Figure 192. MCB Properties Amplifier Tab

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**,[4] **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 in the trans-SPEC 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.

9.2 AMPLIFIER 2

Figure 193 shows the Amplifier 2 tab, which accesses the advanced shaping controls including the InSight Virtual Oscilloscope mode.

The many choices of **Rise Time** allow users to precisely control the tradeoff 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.
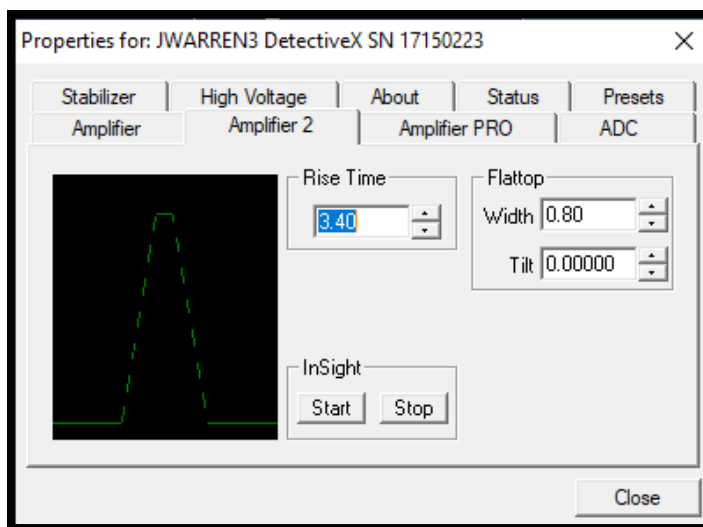
Figure 193. MCB Properties Amplifier 2 Tab

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

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.

9.3   AMPLIFIER PRO

Figure 194 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. We strongly recommend the LFR be enabled during all data acquisitions. Note, however, that users must turn the LFR *off* to pole-zero the Detective X. Subsequent measurements can then be taken with the LFR filter on.
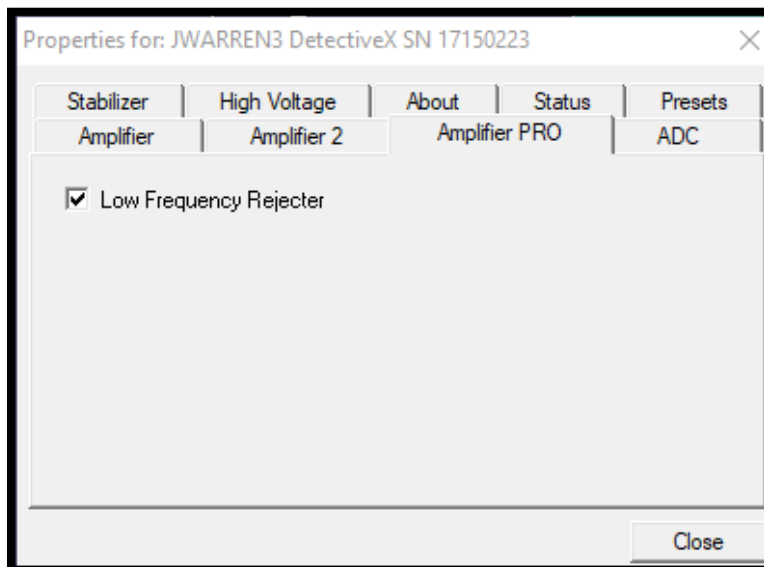
Figure 194. MCB Properties Amplifier PRO Tab

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9.4   ADC

The ADC tab (Figure 195) 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.
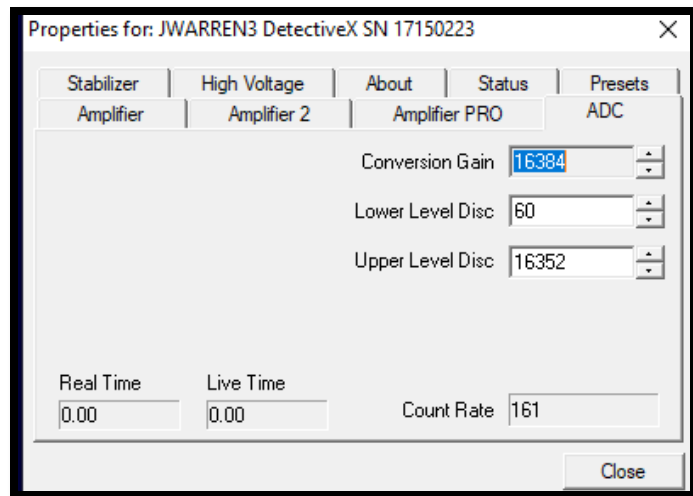
Figure 195. MCB Properties ADC Tab

9.5   STABILIZER

The Detective X 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 196) 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.
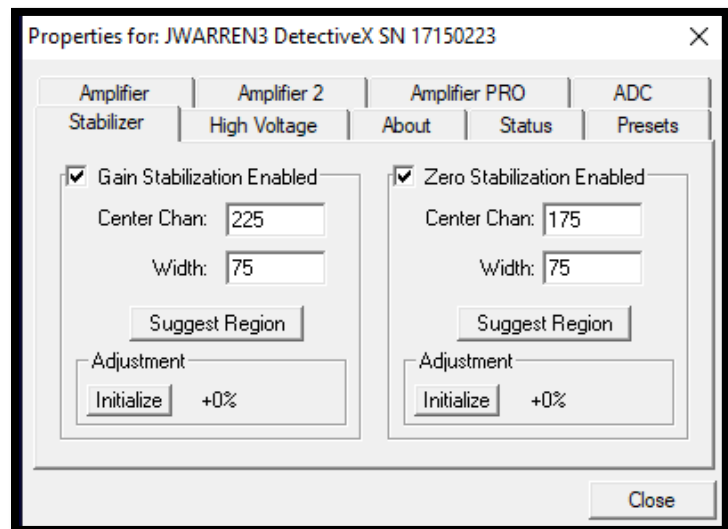
Figure 196. MCB Properties Stabilizer Tab

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

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the fields. If the marker is in an ROI, the limits of the ROI are used. If the marker is not in an 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.

9.6   HIGH VOLTAGE

Figure 197 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**.[5]
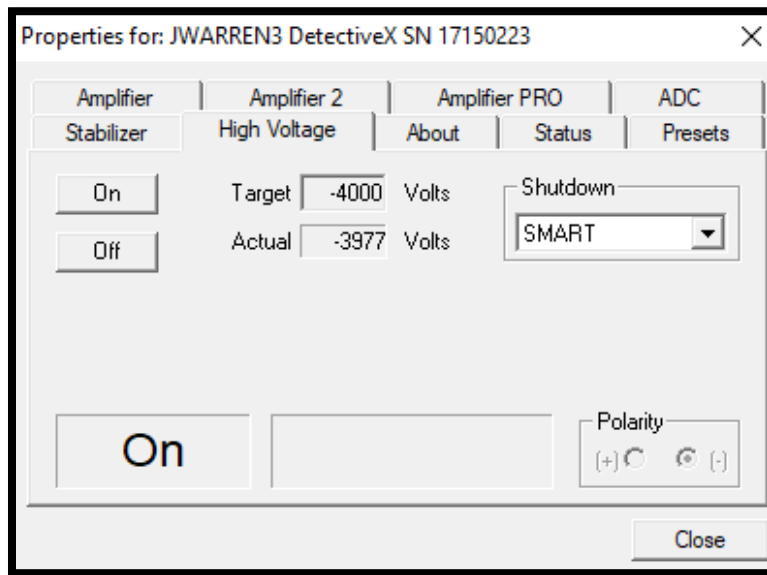
Figure 197. MCB Properties High Voltage Tab

9.7   ABOUT

This tab (Figure 198) displays hardware and firmware information about the Detective X 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 Detective X running firmware v5. Users can also use the About tab to view this information for **.SPC**-format spectra downloaded from the Detective X.

---

[5] 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

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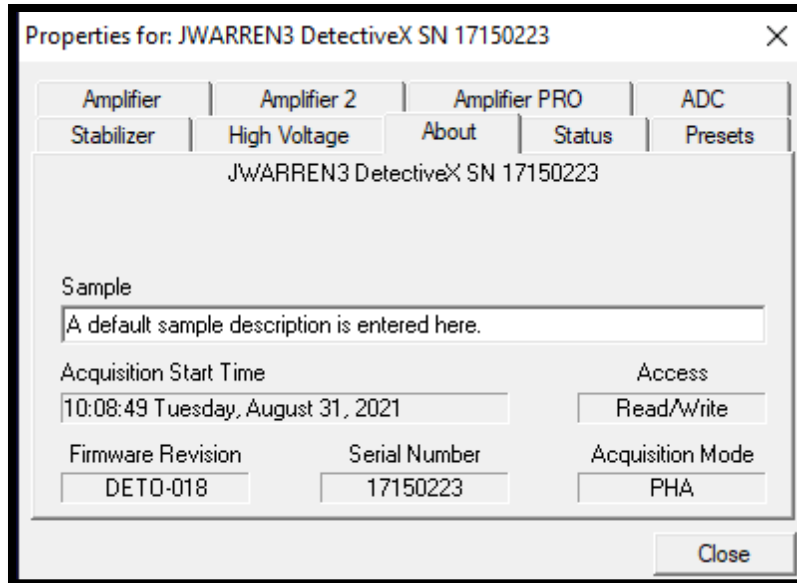
Figure 198. MCB Properties About Tab

9.8   STATUS

Figure 199 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.
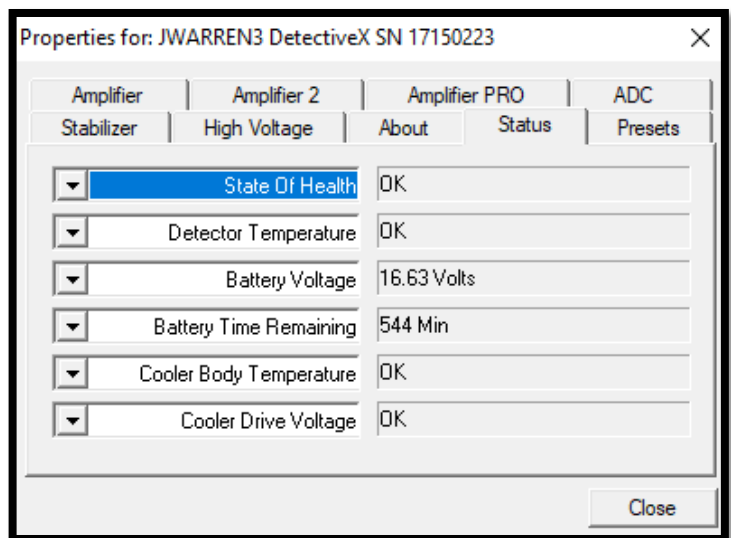
Figure 199. MCB Properties Status Tab

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.

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- **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.

9.9   PRESETS

Figure 200 shows the Presets tab. The presets can only be set when the Detective X 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 set 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."

Figure 200. MCB Properties Presets Tab

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).

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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.

APPENDIX A. MOBILE FIELD KIT API

Mobile Field Kit (MFK) is a product of Asynchrony, a division of World Wide Technology. The Detective X is ready to connect to MFK, as delivered. A network connection is a prerequisite for setup and use of MFK (see Section 4.9).

Beginning with Detective X Version 2.0 software, there are no MFK settings on the instrument. Instead, the Asynchrony application will connect to the Detective X unit as a client. The Asynchrony application will only need to know the IP Address of the Detective X unit.

The following sections provide detailed information on the communication protocol implemented on the Detective X 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 Detective X radioisotope identification devices (RIID).

Note that this interface is different than previous ORTEC implementations for the ICD API (such as Detective X v1.4, Detective-PRO and Detective-EX).

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 Detective X is available on the network). Simply start the browser and enter the URL (without 'GET' or 'PUT' prefixes) as shown in the following examples:

http://<IP Address>/remote/v1/InstrumentStatus
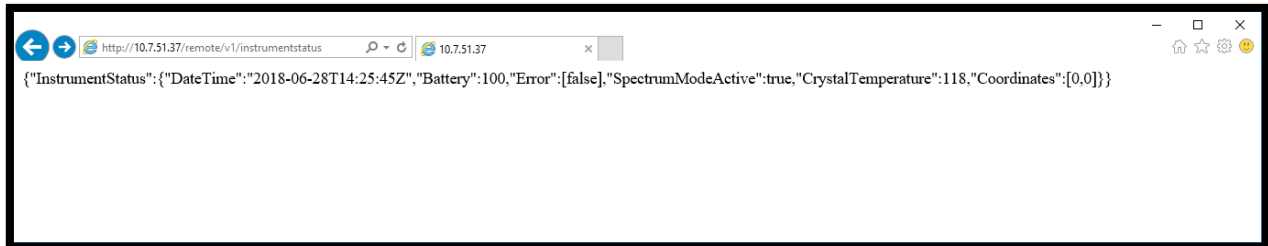
Figure 201. Example Instrument Status via Internet Browser Interface

http://<IP Address>/remote/v1/remote/Start
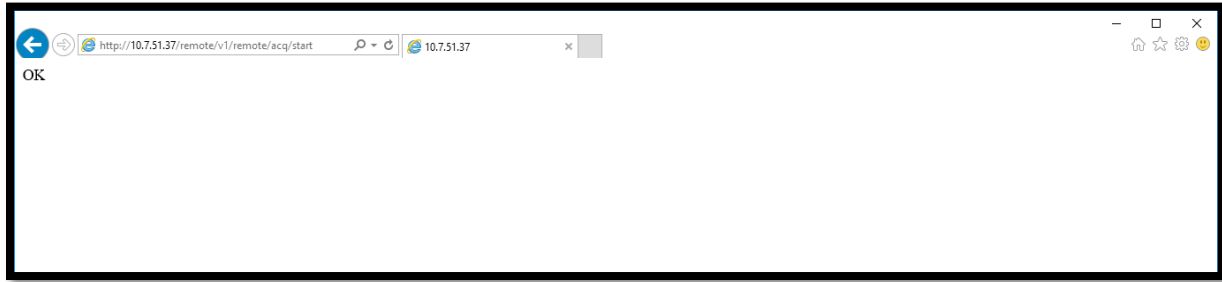
Figure 202. Example Start Acquisition via Internet Browser Interface

A.4   REQUEST

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

http://<ip-address>/remote/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 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 http://<ip-address>/remote/v1/instrumentInformation

Returns instrument information record.

Available response representations:

- Record example:
    ```
    {
      "InstrumentInformation": {
        "Manufacturer": "ORTEC",
    ```

```
    "ModelName": "DetectiveX",
    "ModelDescription": "ID Table Version: 9.3.5, OS Version 3.5.1.5020, Cooler Version 1.3.1",
    "SerialNumber": "17181862",
    "SoftwareVersion": "3.0.0.9",
    "HardwareVersion": "DETO-018",
    "ProbeTypes": [
      "HpGe 67mm x 52 mm",
      "With Neutron Detector",
      "GM"
    ]
  }
}
```

Table 4. System Information

Name	Type	Example	Comments
Manufacturer	String	ORTEC	
ModelName	String	DetectiveX	
ModelDescription	String	ID Table Version: 9.3.5, OS Version 3.5.1.5020, Cooler Version 1.3.1	Contains relevant software descriptions
SerialNumber	String	17181862	
SoftwareVersion	String	3.0.0.9	
HardwareVersion	String	DETO-018	Contains hardware Firmware revision
ProbeTypes	Array	HpGe 67mm x 52 mm, With Neutron Detector, GM	Contains all sensor in the device

A.8   STATUS

GET http://<ip-address>/remote/v1/instrumentStatus

Returns instrument status record.

Available response representations:

- Record example:

```
{
        "InstrumentStatus": {
                "DateTime": "2018-06-26T12:11:33",
                "Battery": 100,
                "Error": [false],
                "SpectrumModeActive": true,
                "CrystalTemperature": 117.9899978,
                "AckAlarms":false,
                "BackgroundAcqTime": 30,
                "CountPreset": 0,
                "StabilizeOnK40": true,
                "IntegrationTime": 8,
                "LCXMode": false,
                "MonitorK40Peak": true,
                "Coordinates": [
                 36.4321289,
                 84.2391927]
        }
}
```

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Table 5. Status Information

Name	Type	Example	Comments
InstrumentStatus	Object		
DateTime	String	2018-06-26T12:11:33	YYYY-MM-DDThh:mm:ss
Battery	Integer	100 = 100%	If the time remaining is over 8 hours, it's set to 100%. 100% is the maximum returned value
Error	[Boolean, String]	[true, "Description of problem"]	If false, array length is 1. If true, the error message is in the second element of the array
SpectrumModeActive	Boolean		If true, a spectrum is currently taken and is the Detective ID mode.
CrystalTemperature	Float	117.9899978	Unit is °K (degree Kelvin)
AckAlarms	Boolean	false	This indicates if the system is configured to require alarm acknowledgements (see 4.5.1).
BackgroundAcqTime	Integer	30	This is the System Background Preset Count Time in terms of minutes.
CountPreset	Integer	300	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 setup to stabilize on K-40 (see 4.15)
IntegrationTime	Integer	8	This is the rolling histogram integration time in seconds (see 4.6.4).
LCXMode	Boolean	false	This indicates if the instrument is setup in Low Confidence Expert mode (see 4.6.5).
MonitorK40Peak	Boolean	true	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 http://<ip-address>/remote/v1/measurement/doseCountRate

Returns Dose Rate and Count rate.

Available response representations:

- Example record:

```
{
    "Measurement": {
        "CountDoseData": [{
            "DetectorType": "",
            "Detector": "HpGe 67mm x 52mm",
            "Alarm": false,
            "AlarmDescription": "",
            "StartTime": "2018-06-28T15:42:52Z",
            "Remark": "",
            "DoseRate": [{
                "value": 0.400672256,
                "unit": "µSv/h"
            }, {
                "value": 0.0400672256,
```

```
                        "unit": "mrem/h"
                }],
                "CountRate": {
                        "value": 716,
                        "unit": ""
                }
        }, {
                "DetectorType": "",
                "Detector": "HpGe 67mm x 52mm",
                "Alarm": false,
                "AlarmDescription": "",
                "StartTime": "2018-06-28T15:42:52Z",
                "Remark": "",
                "DoseRate": [{
                        "value": 0.3590899705,
                        "unit": "μSv/h"
                }, {
                        "value": 0.035908997,
                        "unit": "mrem/h"
                }],
                "CountRate": {
                        "value": 560,
                        "unit": ""
                }
        }, {
                "DetectorType": "",
                "Detector": "HpGe 67mm x 52mm",
                "Alarm": false,
                "AlarmDescription": "",
                "StartTime": "2018-06-28T15:42:52Z",
                "Remark": "",
                "DoseRate": [{
                        "value": 0.3895567655,
                        "unit": "μSv/h"
                }, {
                        "value": 0.0389556773,
                        "unit": "mrem/h"
                }],
                "CountRate": {
                        "value": 596,
                        "unit": ""
                }
        }, {
                "DetectorType": "",
                "Detector": "",
                "Alarm": false,
                "AlarmDescription": "",
                "StartTime": "",
                "Remark": "",
                "CountRate": {
                        "value": 0.3740648031,
                        "unit": ""
                }
        }, {
                "DetectorType": "",
                "Detector": "",
                "Alarm": false,
                "AlarmDescription": "",
                "StartTime": "",
                "Remark": "",
                "CountRate": {
```

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```
                                    "value": 0.1243781074,
                                    "unit": ""
                            }
                    }, {
                            "DetectorType": "Li6F/ZnS",
                            "Detector": "Neutron",
                            "Alarm": false,
                            "AlarmDescription": "",
                            "StartTime": "",
                            "Remark": "Current",
                            "CountRate": {
                                    "value": 0.125,
                                    "unit": "cps"
                            }
                    }],
                    "MeasurementLocation": {
                            "Coordinates": [0, 0]
                    }
            }
    }
```

Table 6. 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	Detector used	
Alarm	Boolean	True, false	If false, no alarm description 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	Time	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	1.0	
unit	String	μSv/h, mrem/h	
CountRate	Object		Count Rate contains the value and the unit cps
value	Float		
unit	String	Cps	
MeasurementLocation	Object		
Coordinates	Array	[latitude, longitude]	The same as returned from Instrument Status

A.10 SPECTRUM

GET http://<ip-address>/remote/v1/measurement/spectrum

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

Available response representations:

- Example record:

```
{
        "Detective-X Analysis": {
                "Spectrum": {
                        "DetectorType": "Gamma",
                        "LiveTime": "PT16.8200s",
                        "RealTime": "PT17.1600s",
                        "Type": "PHA",
                        "SourceType": "Item",
                        "Detector": "HpGe 67mm x 52mm",
                        "StartTime": "2018-06-28T15:54:32Z",
                        "ChannelData": [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
                                        0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 5, 7, 12, 12, 7, …]
                },
                "AnalysisResults": {
                        "NuclideAnalysis": {
                                "AlgorithmDescription": "Detective-X ID algorithm",
                                "Nuclides": [{
                                        "Nuclide": {
                                                "NuclideName": "Cs-137",
                                                "NuclideType": "Innocent",
                                                "NuclideIDConfidenceIndication": "1.0000"
                                        }
                                }, {
                                        "Nuclide": {
                                                "NuclideName": "Ra-226",
                                                "NuclideType": "Innocent",
                                                "NuclideIDConfidenceIndication": "1.0000"
                                        }
                                }, {
                                        "Nuclide": {
                                                "NuclideName": "U-235",
                                                "NuclideType": "Threat",
                                                "NuclideIDConfidenceIndication": "0.5298"
                                        }
                                }],
                                "AlgorithmVersion": "9.3.2"
                        },
                        "ThreatDescription": "Threat"
                },
                "MeasurementLocation": {
                        "Coordinates": [0, 0]
                }
        }
}
```

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Table 7. Spectrum Information

Name	Type	Example	Comments
Measurement	Object		
Spectrum	Object		
DetectorType	String	Gamma	
LiveTime	PT7.000000s		
RealTime	PT8.000000s		
Type	String		
SourceType	String		
Detector	String	NaI_3x1	
StartTime	String		
ChannelData	Array	[int, int ,…]	Length is 16k fixed.
AnalysisResults	Object		
NuclideAnalysis	Object		
AlgorithmDescription	String		
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 Detective X ID Q value is over 10.0, then the value reported here is 1,0 (for 100%)
AlgorithmVersion	String		ID table version
ThreatDescription	String	Innocent, Threat or Suspect	The "highest" threat classification is reported.
MeasurementLocation	Object		
Coordinates	Array	[latitude, longitude]	As in the Status

A.11 CALIBRATION

GET http://<ip-address>/remote/v1/calibration

Returns Calibration information.

Available response representations:

- Example record:
```
{
        "CalibrationType": {
                "EquationModel": {
                        "Coefficients": [-0.1434900015, 0.4884499907, -0.0000000243],
                        "Model": "Polynomial"
                },
                "Unit": "keV",
                "Type": "Energy"
        }
}
```

Table 8. Calibration Information

Name	Type	Example	Comments
CalibrationType	Object		
EquationModel	Object		
Coefficients	Array		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:

$$f(channel) = a_0 + a_1 * channel + a_2 * channel^2$$

The coefficients [-0.1434900015, 0.4884499907, -0.0000000243] 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 http://<ip-address>/remote/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 Detective X File Formats for a detailed description of the Detective X N42 file format.

Available response representations:
- Example record:
  {"n42XML":"<?xml   version=\"1.0\"   encoding=\"UTF-8\"?>\r\n<?xml-model
  href=\"http://physics.nist.gov/N42/2011/schematron/n42.sch\"\r\ntype=\"application/xml\"
  schematypens=\"http://purl.oclc.org/dsdl/schematron\"?>\r\n<RadInstrumentData\r\nxmlns=\"http://phys
  ics.nist.gov/N42/2011/N42\"\r\nxmlns:xsi=\"http://www.w3.org/2001/XMLSchema-
  instance\"\r\nxsi:schemaLocation=\"http://physics.nist.gov/N42/2011/N42
  http://physics.nist.gov/N42/2011/n42.xsd\"\r\nn42DocUUID=\"64a170f5-4c39-4bd8-af16-
  f9e927b31ce6\">\r\n<RadInstrumentDataCreatorName>ORTEC</RadInstrumentDataCreatorName>\r\n<R
  adInstrumentInformation   id=\"RadInstrumentInformation-
  1\">\r\n<RadInstrumentManufacturerName>ORTEC</RadInstrumentManufacturerName>\r\n<RadInstrum
  entIdentifier>17181862</RadInstrumentIdentifier>\r\n<RadInstrumentModelName>Detective
  X</RadInstrumentModelName>\r\n<RadInstrumentClassCode>Radionuclide
  Identifier</RadInstrumentClassCode>\r\n<RadInstrumentVersion>\r\n<RadInstrumentComponentName>
  Firmware</RadInstrumentComponentName>\r\n<RadInstrumentComponentVersion>DETO-
  013</RadInstrumentComponentVersion>\r\n</RadInstrumentVersion>\r\n<RadInstrumentVersion>\r\n<R
  adInstrumentComponentName>Software</RadInstrumentComponentName>\r\n<RadInstrumentCompon
  entVersion>2.0.0.0</RadInstrumentComponentVersion>\r\n</RadInstrumentVersion>\r\n<RadInstrument

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Version>\r\n<RadInstrumentComponentName>AnalysisEngine</RadInstrumentComponentName>\r\n<RadInstrumentComponentVersion>9.3.2</RadInstrumentComponentVersion>\r\n</RadInstrumentVersion>\r\n</RadInstrumentInformation>\r\n<RadDetectorInformation 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0 4 1 0 2 1 1 2 1 2 0 1 1 0 1 2 0 1 1 2 1 0 1 2 1 0 1 1 0 3 2 0 3 1 3 1 0 3 1 0 1 1 0 5 1 1 2 0 1 1 0 1 1 0 1 1 0 3 2 1
0 1 1 0 1 1 0 2 1 1 0 1 1 1 0 2 1 0 1 1 1 0 1 2 0 1 2 2 3 0 4 3 0 1 2 1 0 2 1 0 4 1 0 4 3 0 1 1 0 6 1 0 2 1 0 4 2 0 1
2 2 0 7 1 1 0 1 2 0 1 1 1 0 1 1 0 1 1 2 3 2 0 3 1 1 0 8 1 2 0 1 2 1 0 3 1 0 3 2 0 1 1 2 0 1 1 0 1 1 0 2 1 0 1 1 0 1 1 0
3 1 0 3 1 1 0 6 1 0 2 2 0 2 1 0 1 1 1 0 4 1 0 2 3 1 0 6 1 1 0 3 1 0 2 2 0 4 1 0 2 3 0 3 1 0 1 3 2 1 5 2 0 6 2 0 1 1 1 0
3 1 1 0 6 2 1 2 2 8 6 5 5 0 2 1 0 1 2 1 2 0 1 1 1 0 3 1 0 9 1 0 1 1 0 1 1 0 1 1 1 0 1 2 1 1 0 3 1 0 1 0 2 0 5 1 1 0 1 1 1
0 4 1 0 2 1 1 1 1 1 0 1 2 1 0 1 1 0 4 1 0 3 1 1 1 0 1 1 0 8 1 0 2 1 0 1 1 0 6 2 0 1 1 0 8 1 0 1 1 0 1 1 0 1 1 0 7 1 1 0
5 1 1 1 0 1 1 1 2 2 2 13 17 27 22 29 18 10 4 2 0 1 1 0 5 1 0 5 1 0 2 1 0 1 1 0 4 1 0 2 1 0 1 1 1 0 2 1 2 1 0 3 1 0 15
1 0 9 1 0 1 1 0 1 1 0 8 1 0 8 1 0 2 2 0 3 2 0 2 1 1 0 5 1 0 2 1 0 3 1 0 5 1 1 2 0 2 1 0 1 3 1 0 1 1 0 3 1 0 1 1 0 5 1 0
5 1 0 4 1 0 2 1 0 1 1 2 1 0 1 1 0 1 1 0 1 1 1 0 1 2 2 1 1 5 1 0 7 1 0 2 1 0 16 1 0 4 1 0 4 2 0 2 1 0 3 1 0 6 1 0 1 1 1 0 2 1
1 0 2 1 1 0 2 1 0 2 1 1 0 10 1 0 2 2 1 1 0 1 1 0 22 1 0 7 1 1 0 1 1 0 2 1 0 7 1 2 0 2 1 0 5 1 0 13 1 0 1 0 1 0 3 1 0 5
1 1 0 20 1 0 7 1 1 0 7 1 0 11 1 0 6 1 0 14 1 0 4 1 0 8 1 1 0 2 1 0 21 1 0 13 2 1 1 1 0 2 1 1 6 3 4 6 2 1 0 3 1 0 34 1
0 9 1 0 10 1 0 5 2 1 0 9 1 0 9 1 0 4 1 0 9 1 0 1 1 0 4 1 0 18 1 0 38 1 0 34 1 1 0 13 1 0 2 1 0 28 1 0 14 1 1 0 39 1
0 5 1 0 10 1 0 7 1 0 3 1 1 0 9 9 5 9 4 6 4 2 0 144 1 0 62 1 0 12 1 0 53 1 0 39 1 0 171 1 0 23 1 0 20 1 0 4 1 0 1 1 0
194 1 0 30 1 0 104 1 0 28 1 0 55 1 0 35 1 0 65 1 0 15 1 0 84 1 0 77 1 0 7 1 0 129 1 0 61 1 0 74 1 0 244 1 1 0 80
1 0 14 1 0 54 1 0 66 1 0 85 1 0 44 1 0 205 1 0 49 1 0 286 1 0 236 1 0 126 1 0 6 1 0 80 1 0 89 1 0 176 1 0 167 1
0 6 1 0 351 1 0 143 1 0 38 1 0 14 1 0 18 1 0 169 1 0 45 1 0 92 1 0 35 1 0 257 1 0 15 1 0 62 1 0 214 1 0 76 2 0 33
1 0 150 1 0 155 1 0 249 1 0 144 1 0 232 1 0 29 1 0 144 1 0 113 1 0 52 1 0 123 1 0 294 1 0 6 1 0 108 1 0 26 1 0
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>\r\n<AnalysisAlgorithmComponentVersion>1.0</AnalysisAlgorithmComponentVersion>\r\n</AnalysisA

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lgorithmVersion>\r\n<NuclideAnalysisResults>\r\n<Nuclide>\r\n<NuclideIdentifiedIndicator>true</Nuclid
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yDescription>Industrial</NuclideCategoryDescription>\r\n</Nuclide>\r\n</NuclideAnalysisResults>\r\n</
AnalysisResults>\r\n</RadInstrumentData>\r\n"}

A.13 REMOTE CONTROL

A.13.1 Start Spectrum Acquisition

PUT http://<ip-address>/remote/v1/remote/acq/start

A.13.2 Stop Spectrum Acquisition

PUT http://<ip-address>/remote/v1/remote/acq/stop

A.13.3 Clear Spectrum

PUT http://<ip-address>/remote/v1/remote/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 http://<ip-address>/remote/v1/instrumentInformation

GET http://<ip-address>/remote/v1/instrumentStatus

GET http://<ip-address>/remote/v1/calibration

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A.14.2 Dose and Count Rate Mode

Example calling sequence:

GET http://<ip-address>/remote/v1/instrumentStatus

GEThttp://<ip-address>/remote/v1/measurement/doseCountRate
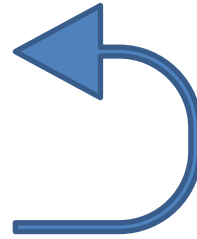
PAUSE   X

A.14.3 Start the Detective X ID Mode

Example calling sequence:

GET http://<ip-address>/remote/v1/instrumentstatus

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

GET http://<ip-address>/remote/v1/instrumentStatus

GET http://<ip-address>/remote/v1/measurement/doseCountRate

PAUSE   X
SECONDS

GET http://<ip-address>/remote/v1/measurement/spectrum

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APPENDIX B. SPECIFICATIONS AND CARE

See also Section 2.13 for additional information on the Detective X'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 Detective X 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 determine the gamma dose rate over a wide range from <0.05 mR/h to >100 R/h, a dose-rate range of over 6 decades. 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 2015 compliant.

B.2 HARDWARE

Digital MCA and Data Processor

- **Display** 4.3-in. WQVGA (480 × 272 pixels), sunlight-readable, touch-sensitive; operate with finger or stylus
- **Data Processor** FREESCALE I.MX535 operating at 1 GHz

Data Storage

- **Media** To 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 — 10/100Mbps, autosensing). Ready for use with MFK (Mobile Field Kit for DoD users), ORTEC GammaVision, iOS devices, and Android devices. WiFi (802.11) communication software. Wireless Mobile MCB Server software.

Wireless Connectivity IEEE 802.11b wireless and Bluetooth

GPS The instrument is equipped with an internal GPS. The location information associated with a measurement is optionally stored in the N42 files.

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Digital MCA with Internal Storage of Multiple Spectral Data

- **Digital Noise Suppression**   "LFR Filter"

- **Conversion Gain**   16K channel

- **Maximum Number of Stored Spectra**   Unlimited on removable media

B.3   PHYSICAL SPECIFICATIONS

Maximum Overall Dimensions
- Detective-X and Detective-X-8 configured without strap – 15.5in L X 5.6in W X 8.3 in H (39.5cm L x 14.3cm W x 21.0cm H)
- Detective-X and Detective-X-8 configured with strap – 15.5in L X 6.4in W X 8.3in H (39.5cm L x 14.3cm W x 21.0cm H)
- Detective-X and Detective-X-8 configured with neutron detector – 15.5in L X 6.4in W X 8.3in H (39.5cm L x 14.3cm W x 21.0cm H)

Weight   15.4 lb. (6.98 kg), gamma only; 16.8 lb. (7.2 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. <4-h time to charge. 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: <100 W. Cold with fully charged battery <35 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   COMMUNICATION SOFTWARE

The Detective X 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 Detective X 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.

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

B.5   MOBILE MCB SERVER

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

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

B.6   CLEANING INSTRUCTIONS

B.6.1   Cleaning the Exterior

- Disconnect the instrument from external power, turn off the cooler, and power off the computer interface.
- 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.6.2   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 Detective X 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 computer interface.
- 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 computer and cooler, then reconnect it to the external power supply.

B.7   REPLACING THE LI-ION BATTERIES

The typical service life of the Detective X'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 DETECTIVE-X-ACC-BAT. *It is strongly recommended to replace the batteries in pairs.*

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After replacing the batteries (unless they have been pre-charged), the Detective X 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.

APPENDIX C. NUCLIDE ID TABLE

The following table lists the default Detective X 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 4.17.

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

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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

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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
Neutrons on Fe	Threat	1	Other

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ID String	Classification	Priority	Sub-Classification
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
Th-232	Innocent	4	Thorium

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ID String	Classification	Priority	Sub-Classification
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 DETECTIVE X APPLICATION STOPS

The Detective X incorporates a computer running the Windows mobile operating system. Occasionally, the operating system will stop responding to external commands. Press and hold the power button until the computer shuts down and restarts; this may take 10–20 seconds (the mechanical cooler will continue running). This will reset the operating system and automatically relaunch the Launcher application (or the default application declared in Launcher, if applicable).

D.2 DETECTIVE X WAS DROPPED

Although it is a precision scientific instrument, the Detective X 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 5 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 5 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 4.16.

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 Detective X and opening the case will void the warranty.

D.3 SUDDEN COOLER FAILURE

If the Detective X 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 Detective X, RAPiD, or Sleuth 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 Detective X will automatically

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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. Stop any counting functions and exit the software package back to the launcher screen. The button at the bottom of the launcher screen designated to start or stop the cooler will now be red and state "Reset Cooler." Click on the red button and the cooler should restart. The user can now resume normal operation of the instrument.
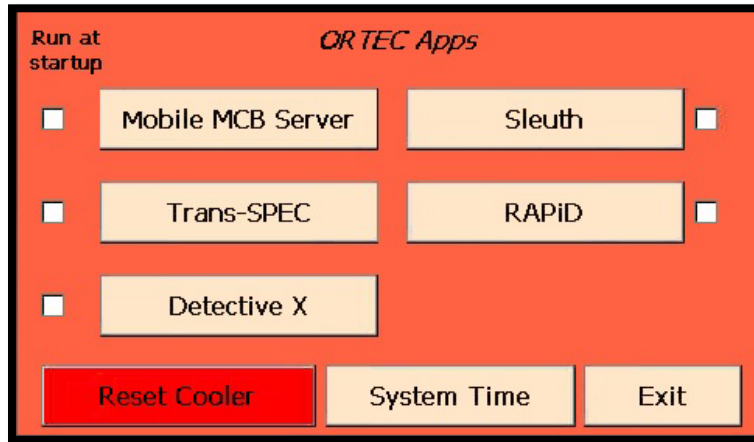
Figure 203. Reset Cooler Error

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   DETECTIVE X WILL NOT TURN ON

Connect the Detective X 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 PASSWORD

There is no master password. 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 Detective X 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 of 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.

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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 Detective X 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 Detective X will not reliably collect location information indoors.

D.8   COIN BATTERY DEAD ALARM

In case of power loss, the Detective X 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 factor as soon as possible to have the battery replaced.
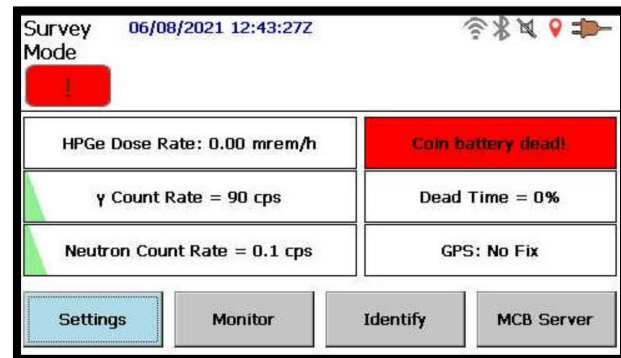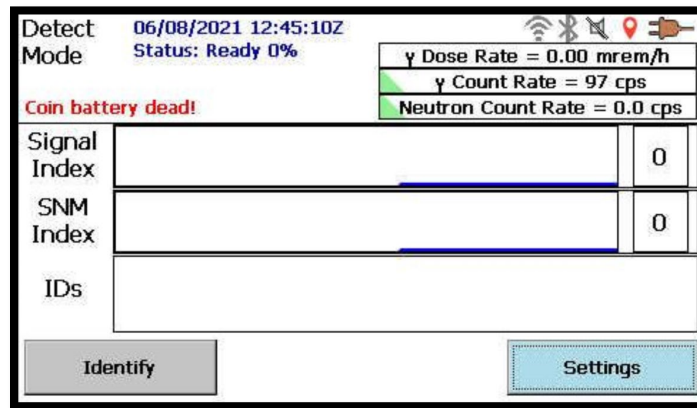
Figure 204. Coin Battery Dead Warning in Detective X, Sleuth, and RAPiD

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

Thoriated tungsten welding electrodes are a safe, convenient, and reliable very low activity source of gamma rays for use in calibrating a Detective-X. 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 **Cal Settings** button to open the Calibration settings screen (see Figure 97).
2. Click the Setup button to open the Calibration sources list (see Figure 98). Add Th-232 with an energy of 2614.5 keV by tapping in an empty cell. Once complete, click the **Back** button.
3. Select the Calibration sources dropdown (see Figure 97) and select the Th-232 source that was added. Select **Back** to return to the Settings screen.

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

1. Place the Thorium Electrodes, P/N DETECTIVE-X-ACC-TH-CAL, in front of the instrument as 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 96).
3. Tap **Start Calibration Now**. The acquisition will begin, and the spectrum will be displayed on the lower left of the screen.
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 **Use Improved Calibration** to complete the process.

> **NOTE**   If the **Back** button is tapped before tapping **Use Improved 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

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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 DSPEC 50.

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.

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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.

<u>Execution Errors:</u>

%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. 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.

<u>Execution Errors:</u>

The INITIALIZE command simulates a power-down/power-up cycle for the MCB after a simulated loss of battery-backed-up memory.

<u>Response:</u>

%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 2048 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 2048 by the SHOW_ZERO_ADJUSTMENT command. See also SET_ZERO_ ADJUSTMENT, ENABLE_ZERO_STABILIZATION, and DISABLE_ZERO_STABILIZATION.

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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. 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:

Command	Description
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.

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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. See also SHOW_TIME, SET_DATE, SHOW_DATE, SET_TIME_START, and SHOW_TIME_START.

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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.

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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.

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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).

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SHOW_HV

Reports the current high voltage and the status of the high voltage power supply in the form:
$$\text{\$Dvvvvvsssssccc<CR>}$$
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:
$$\text{\$Dvvvvvsssssccc<CR>}$$
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:
$INEG<CR>   The HV is set to negative.
$IPOS<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.

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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:

$$\text{\$Dsssssnnnnnccc}$$

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.

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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
$$\textbf{\$Dssssssnnnnnccc}$$
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:
$FSM1   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.

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SHOW_STATUS

Returns system status information in the following format:

$$\text{\$Mlllllllllllttttttttttaaaaahhhhhcccc}$$

where **lllllllll** represents the live time as returned by the SHOW_LIVE command, **tttttttttt** 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

$$\text{\$Nhhhmmmssscccc}$$

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

$$\text{\$Nhhhmmmssscccc}$$

where hhh represents a 3-digit integer hour (0 through 23), mmm represents a 3-digit integer minute (0 through 59) and sss represents a 3-digit integer second (0 through 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.

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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:

<div align="center">

Fmmmm-vvv

</div>

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).

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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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