Instruction Manual

Model 940

Model 940 SAM Eagle ™

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Table of Contents

1 Introduction

The SAM 940™ is a portable, radio-isotope identification (RIID) system that detects and identifies multiple nuclides, providing quantified results using real time and MCA analysis.

The instrument can be operated in a very simple mode requiring no previous experience (see the Quick Start section on page 2) or in other operating modes that take advantage of the comprehensive set of advanced features.

The SAM 940 offers two log-on modes: *User* and *Administrator*. The *User* functions allow first line responders to perform all the tasks needed in the line of duty. The *Administrator* functions allow an experienced operator to set up the device for specific applications, and to perform additional maintenance functions. This manual will cover aspects of both, but places an emphasis on *User* functions. These are discussed further in Sections 3 and 4

After turning power on and logging in, the device begins in an initial search mode. Several different views of this mode are available, but all are based on data collected in real time. In addition to the Search modes, functions such as setup, alarm review, calibration, and others can be accessed through the menu system. These are discussed in Section 3.1 starting on page 14.

The instrument has a simple user interface (described in Section 1.4 on page 3) and a wide range of setup functions and utilities (described in Section 5 on page 28).

The SAM 940 can be connected to a remote computer using Ethernet or RS-232, and accessed with Quantum™ software. Live acquisition with Quantum™ software allows:

Up to 8 MCAs to be viewed at one time, with full spectrum data in real time.

Spectral analysis in 256 QCC or linear, 512 QCC or linear, and 1024 linear modes.

Note that if you are using the SAM 940 as a stand-alone device, the resolution is limited to 256 and 512 QCC (depending on detector type), including the saving of spectra.

See Section 7 starting on page 49 for more information about available software, and Sections 2.4 and 2.5 starting on page 9 for instructions on connecting the SAM 940 to your computer.

1.1 About Your SAM 940

The basic SAM 940 unit consists of:

The spectrometer electronics

The gamma ray detector (normally attached underneath the instrument)

A rechargeable battery pack (installed in the rear compartment of the instrument)

An AC power adapter / battery charger

Optional devices and software include:

A neutron detector (external to, or incorporated into, the gamma detector)

Quantum NaI/D and/or SAM 940 Analysis Viewer software

A vehicle power adapter

A set of headphones and headphone adapter

Global Positioning System and accessories

1.2 How to Use This Manual

This manual uses the following typographic conventions:

Identify, User	Softkey names are shown in bold mixed case.
Calibrate Area Monitor	Menu choices and on-screen prompts are shown in italics.
ENTER, MENU, UP	Keypad key names are shown in small capital letters.
`E:\spectra`	File or path names will be shown in typewriter font. Your PC drive letter may be different; we will use `E:` by default.

1.3 Quick Start

Getting Started

Before turning on the SAM 940, make sure that the detector is connected to the SAM via a detector cable. Turn on the SAM 940 by holding down the BACK / ⏻ key for one full second until the BNC Eagle screen appears. Press ENTER (↵) to move to the login screen. Press ENTER again to log in as User, and advance to the Search screen (typically **Dial**). At the bottom of the screen there will be a message indicating that AutoCal (automatic calibration) is in progress. Wait for AutoCal to complete (typically1-3 minutes).

Basic Operation

At the bottom of the Search screen, three softkeys are displayed (**Identify**, **Background**, and **Finder**). These are highlighted by the LEFT (⬅) or RIGHT (➡) arrow keys, and will perform the labeled function by pressing ENTER. The far right softkey allows the user to select between the available Search screens. The **Dial** and **Finder** screens are simple modes of operation. The **Dial** screen displays count rate information in the form of an analog meter. Radioactive energy moves the needle into the green region, indicating proper source intensity for identification with gamma count rate (and with optional neutron count rate). The other colored regions indicate that the source is too weak (gray) or too strong (red). If the menu option is enabled, “Move Closer” or “Move Back” will actually display. The **Finder** screen aids in location of the source by displaying intensity vertically and time horizontally. The mid-scale region is the proper intensity region for identification. An audio signal can also aid in finding the source. Access to two other advanced search modes (**Bars** and **Spectrum**) must be enabled in the *Admin* (administrator) menu. All screen modes display isotope category and dose rate in real time.

Search and Identify

Always acquire and store a background reference before conducting Search and Identification. The default time for acquiring a background or an ID spectrum is one minute. Simply highlight the **Background** softkey and press ENTER. Make certain there are no known radioactive sources nearby and press ENTER again. When finished, the SAM automatically returns to the Search screen. Use the arrow keys to highlight the **Identify** softkey. Begin searching. When radioactive energy is detected, press ENTER. The SAM displays a report when finished. Isotopes identified are shown with a statistical confidence ranging from 70 to 100%. Confidence is based on source strength, length of acquisition, number of energy lines and other statistical factors. The time of acquisition can be increased or decreased by 30 second increments. Simply press ENTER when the softkey highlight is on **+30s** or -**30s**. If ENTER is held down, the length of time will change rapidly. After viewing the report, press the BACK key to return to the Search screen. Holding down the BACK / power key for the count down of 3 seconds turns the instrument off.

Menu

Coarse calibration, review of stored spectra, alarm thresholds, and many other features can be accessed with the MENU key. Logging in as Administrator (if not password protected) offers more advanced menu choices. Menus may be accessed from any of the search mode screens.

1.4 Description of Keypad and Softkeys

Figure 1 shows a rendering of the SAM 940 keypad. The keypad has been designed so that it may be operated with the thumb of the same hand holding the instrument, and is accessible to people wearing protective gear as well as to both left and right-handed users.

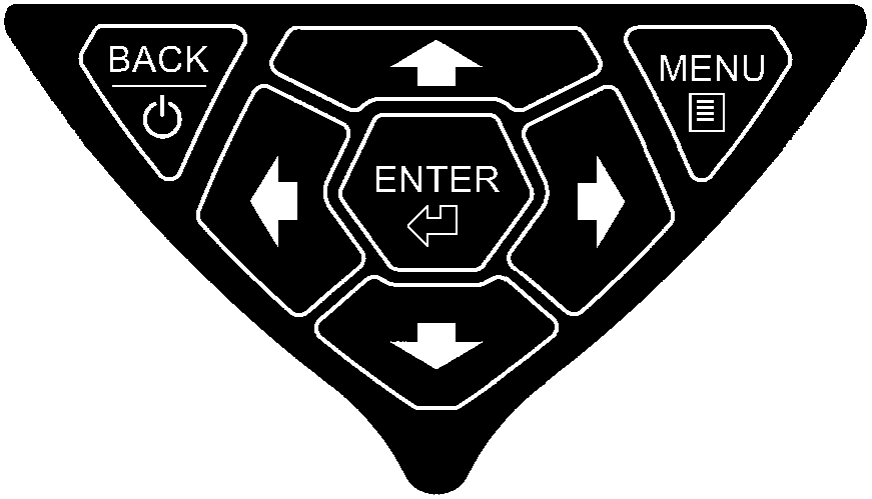


Figure 1 - SAM 940 Keypad

Following is a brief description of the seven keys, and their respective functions.

BACK/⏻	Returns to the previous screen, exits from menu or report. This key is also used to turn system power on and off.
MENU	Enters the menu system from any search screen.
ENTER	Selects the currently highlighted softkey or menu item. It is also used to continue to the next step of multi-step processes.
⬅ and ➡	These keys will be referred to throughout the text as LEFT and RIGHT. They are used to select among the softkey options or menu tabs; to move backward and forward in a string entry process; to select among items in a menu choice process; and for various other applications that will be described later in the manual.
⬆ and ⬇	These keys will be referred to as UP and DOWN. They are used to scroll among menu items; to scroll through reports; to change the current letter when entering a string such as a password; and for various other applications that will be described later in the manual.

Many of the common operations of the SAM 940 are performed using “Softkeys.” These are represented by a set of words in a dark green bar shown at the bottom of the screen. In Figure 2, the normal softkeys seen in the **Dial** search screen are shown. The **Identify** softkey is currently selected. By pressing the LEFT and RIGHT keys, you can highlight the other softkeys, **Background** and **Finder**. Pressing the ENTER key will perform the action specified by the currently highlighted softkey, for example, entering the Identification mode to collect, report, and store an analysis of a possible radioactive substance.

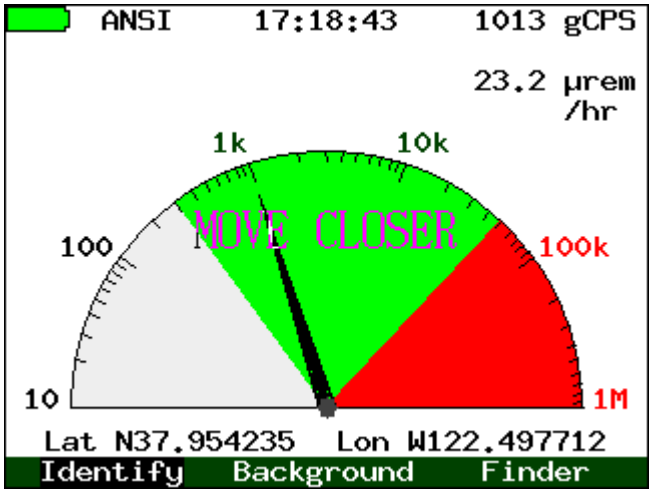
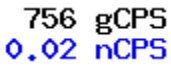


Figure 2 - Example of Softkeys

1.5 SAM 940 Display Conventions

In order to make the SAM 940 more friendly and easy-to-use, BNC has defined several color and layout conventions for the user interface.

Gamma and neutron radiation are distinguished by colored numbers, dials, and graphs. Gamma elements are black, and neutron elements are blue, as shown here:



Four different nuclide “classes” are defined by their colors, which appear as labels and as filled in areas in spectra. These are blue for industrial (IND), magenta for special nuclear materials (SNM), cyan for medical (MED), and green for naturally occurring radioactive materials (NORM or NRM). In addition, when there is insufficient data to be sure something is present, it will be marked in yellow, for uncertain (UNC); and when there is something definitely present but not matched to any currently enabled nuclide, it will be labeled in red, for unknown (UNK). Beginning with firmware version 3.8.2, Compton edges and Backscatter (C/B) of identified nuclides in the continuum are quickly identified and the regions of interest are labeled in gray.

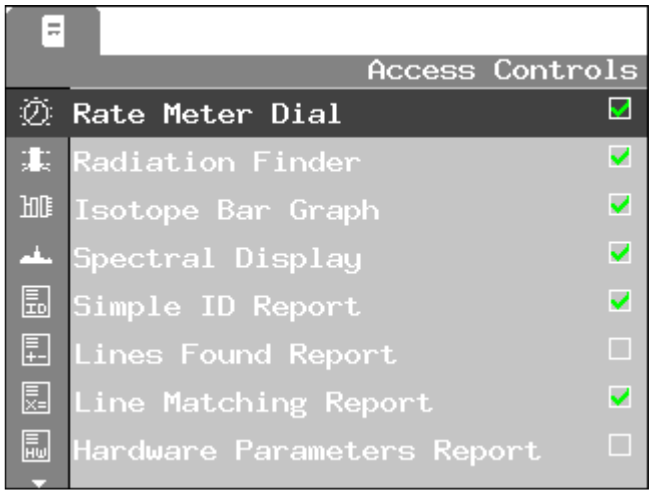
SAM 940 systems with firmware version 3.7.2 or older, do not include the (C/B) labeling.

In other contexts, red is used to signal bad conditions (dead battery, calibration failure, dangerous dose rate); yellow and orange indicate concern (battery nearing end of life, calibration incomplete); and green indicating everything is normal (battery good, calibration done, OK to ID). Two examples are shown here.

Softkeys are always displayed in the dark green bar at the very bottom of the screen, highlighted in shades of black and white.

In most cases, where possible, small arrows are shown on the currently selected item to indicate possible choices. For example, on a selected menu tab, you can go LEFT or RIGHT or DOWN into the menu. For some menu items, you may be able to use LEFT and RIGHT to change the value. Two examples are shown here.

Different colors are used to group the items in each of the main menus. All sub-menus (the menus that come up within an operation selected from the menu system) are displayed in shades of gray and white. This helps you remember that if you exit this menu with the BACK key, it will only take you back to the higher level menu.



2 Connections

The SAM 940 has two external connectors for power, communications, and other functions. Both are located on the part of the instrument facing away from the user, as show in Figure 3. In the lower right-hand corner is a watertight, multi-function connector for AC power, RS-232 connection, GPS connection, and headphone connection. There is a flexible, black, (or gray) rubber port cover at the top (shown as partly transparent here). And behind it are a CompactFlash slot on the left and an Ethernet connector on the right.

Figure 3 - Lower Front Face of SAM 940

2.1 Connecting AC Power or Car Adapter

A universal (110-240V, 50/60Hz) AC power supply is available for your SAM 940 unit. Depending on your SAM 940 model, there may be two different power supplies available. One supply is only used with SAM units that have an internal battery charger, and connects directly to the multi-port connector. The other supply requires an adapter cable that plugs into the multi-port connector. The AC power supply then plugs into a mating plug on the adapter cable. Always make certain that the SAM 940 is turned off before connecting the AC power adapter.

The car adapter plugs into a 12V accessory outlet or “cigarette lighter” outlet in your vehicle. It then connects to the same adapter cable described above, which in turn, plugs into the multi-port connector on the SAM 940.

A black, bayonet-style connector is used on the AC power supply and on the car adapter. The connector is released by turning the collar one-quarter turn counter-clockwise and gently pulling backward on the textured grip. Do not pull on the cable jacket, and do not twist this connector to remove it – it pulls straight out. Twisting or forcing the connector to turn may damage the cable or the power device.

2.2 CompactFlash Card

Your SAM 940 unit comes with a CompactFlash card that serves the following purposes:

Storage for an estimated 4090 spectra in ANSI standard (N42.42) format.

Storage of specific system configuration information.

Easily upgradeable system firmware.

Do not remove the CompactFlash card while the system is turned on. The system will not continue to operate without the card in place. Turn the unit off, remove the card, perform whatever activities are needed, and reinsert the card before turning the unit back on. Also, it is important to note that this card is ***specific to your unit and detector***. In fact, the serial number of the electronics and detector is printed right on your particular CF card. Because each unit is factory calibrated for optimal performance, and because this calibration is stored on the CompactFlash card, the cards should never be exchanged between different units. Also, the contents of the card should not be erased, except through the menus provided in the SAM 940 itself (see Section 5.2.1 beginning on page 30).

You may wish to read the saved spectral information on the CF by using your PC. If your PC includes a media reader bay, you should be able to insert the card and read it as simply as you would access a CD-ROM or floppy. If your PC does not have a media reader built in, a simple USB interface is available as an accessory. In either case, the device will be assigned a drive letter (often `D:`, `E:`, or `F:` – we will assume `E:` throughout this document). The spectra may then be read from the directory `E:\spectra`.

For more information on reading spectral files and the software you can use for these purposes, see Section 7 starting on page 49.

2.3 Batteries

A rechargeable Nickel-Metal Hydride (NiMH) battery pack is supplied with the SAM and is the recommended portable power source for the SAM 940. This battery pack has proprietary safety features, and should not be substituted with any other rechargeable battery pack. The battery pack may only be charged while installed in the SAM 940. The battery pack may only be charged using the external AC power adapter that is supplied with the SAM 940.

*** Operating the SAM 940 while charging the battery pack is not recommended. ***

The battery pack is in a compartment with a removable cover. The battery compartment is highlighted in Figure 4, and may be secured by ¼ -turn thumb-screws or threaded screws. It can be quickly replaced with another battery pack.

Off-the-shelf AA alkaline batteries (8) can be used in the provided battery holder to power the unit when the primary rechargeable battery pack is not available. Alkaline batteries are safe to use with the SAM 940 because the charging circuit will only allow charging of the NiMH battery pack.

Always make certain that the SAM 940 is turned off and disconnected from the external AC power adapter before replacing batteries or battery packs. Always make certain that the SAM 940 is turned off before connecting the AC power adapter.

An optional 12 VDC vehicle power adapter cable may also be used to power the SAM 940.
Note that if using the unit on 12 VDC vehicle power, the batteries will not be charged.

Figure 4 - SAM 940 Battery Compartment (Highlighted)

The NiMH batteries in new units will require a few charge / discharge cycles to reach full capacity. Follow the procedure below to charge the unit and then fully discharge the batteries. Repeat this cycle 2 to 3 times to condition the batteries. The unit can be fully discharged by operating the unit on battery power for a period of 8-9 hours.

The recommended charging procedure is:

1. Use only the supplied external power supply to charge the SAM 940.

2. Charge the internal battery pack for a period of
   Minimum: 5 hours
   Maximum: 16 hours

3. NiMH batteries do not require a constant trickle-charge and should not be kept under constant charge. If the instrument is not being used daily, refreshing the battery charge once a week should be sufficient to keep the instrument ready for use.

4. The charging circuit is designed to charge the battery pack quickly (the battery pack will reach 90% full charge within 1 hour). There is a thermal resistor in the battery pack to protect against overheating during the fast-current charge. If the SAM will not turn on after charging the battery pack, and if the battery pack feels warm to the touch, wait 15 to 30 minutes before turning on the SAM

Depending on usage, the SAM 940 will generally run 6 to 8 hours on a single charge when the recommended batteries are used. There are several things you can do to improve your battery life:

Reduce the display brightness as low as possible without affecting your ability to read the display. If operating out-of-doors, you may find that the reflected sunlight is sufficient to read the display even with the brightness at its minimum setting.

Turn off the Audible Count Rate and/or Mute the speaker.

Shorten the Backlight Timeout so that the display darkens when you are not using the system.

In many office or bench-top environments, you may disconnect the batteries and use only the external AC power adapter that is supplied with the SAM 940 power when connecting to a PC or doing other stationary operations.

For your safety:

If the SAM is not being used and if the batteries are fully charged, do not leave the SAM connected to the AC power adapter.

If you choose to use rechargeable batteries other than the factory supplied battery pack, do not attempt to recharge the batteries while installed within the SAM.

When charging the battery pack for the first time after long term storage, the batteries will have decreased capacity. The battery pack will be restored to original performance after several cycles of charging and discharging. If stored for periods of more than 1 year, charge the battery pack at least once per year to prevent deterioration in performance.

2.4 Ethernet Connection for Data Output

The Ethernet connector (also shown in Figure 3 above) can be used to connect your SAM 940 unit to a network or to your PC. By making this connection, you will be able to stream live gamma counts from the SAM 940 to Quantum™ software. NOTE: Data that is collected remotely with Quantum™ software is not stored in the CF memory of the SAM 940.

If you are connecting to an Ethernet switch or hub, use a standard CAT-5 Ethernet cable. If you wish to connect directly to your PC, you will need a special "crossover" cable that takes the place of the switch or hub.

1. Turn off the SAM 940. Connect the Ethernet cable to the LAN/Ethernet connector.

   A. If connecting to a hub or switch, use a standard or "straight through" Ethernet cable.
   B. If connecting directly to a PC, use a "crossover" Ethernet cable.

2. Connect the other end of the cable to the host computer, hub, or switch.

3. If you are connecting to a network, contact your IT Administrator to learn the IP address for your PC.

   If your are connecting peer-to-peer:

   A. Open the Control Panel on your PC and select Network Connections.

   B. Select Local Area Connections, click on Properties, and scroll to Internet Protocol (TCP/IP). Once again, click on Properties.

   C. Remove the dot that selects "Obtain an IP address automatically", then select the dot for "Use the following IP address".

   D. Enter an IP address for your PC, for example, enter 192.168.1.134

   E. Enter an IP Subnet Mask for your PC, typically 255.255.255.0

   F. Entering a Gateway is usually not needed for peer-to-peer communication.

   G. Click OK and then close Local Area Connections.

4. Turn on the SAM 940 power, and log in as the **Administrator**.

5. Press the MENU button key to display the menu tabs, then press the RIGHT (➡) arrow key to locate the *Admin* menu.

6. Use the UP and DOWN (⬆ and ⬇) arrow keys to select the *Network Setup* dialog.

7. Use the DOWN arrow key to highlight the first line.

8. Enter an IP address using an address that is in the approximate vicinity of the address that you received from your IT Administrator, or in the approximate vicinity of the address that you entered in Step 3. For instance if your Network/PC address is 192.168.1.134, enter an IP address of 192.168.1.23 for your SAM 940.

9. Use the DOWN arrow key to highlight the next line. Enter an IP Subnet Mask, typically 255.255.255.0

10. Use the DOWN arrow key to highlight the next line. Entering a Gateway is not usually necessary, but a typical IP Default Gateway in this instance would be 192.168.1.1

11. To save these SAM 940 IP values, turn off the power for the SAM 940, then turn on the power again. Once again log in as the **Administrator**.

12. Once again press the MENU button key to display the menu tabs, then press the RIGHT (➡) arrow key to locate the *Admin* menu.

13. Use the DOWN arrow key to highlight the second line *Serial Mode/Speed*. Press the LEFT and RIGHT (⬅ and ➡) arrow keys to select Strm 115k.

14. Use the UP arrow key to highlight the first line *Remote Mode.* Press the ENTER key to enable remote operation.

To check if your connection is successful, follow the instructions in Section 7.2.3 Live Acquisition of SAM 940 Spectra.

2.5 RS-232 Connection for Data Output

As an alternative to the Ethernet connector, the multi-port connector (also shown in Figure 3 above) can be used to connect your SAM 940 unit directly to the RS-232 port of your PC. By making this connection, you will be able to stream live gamma counts from the SAM 940 to Quantum™ software, or stream live spectra to Analysis Viewer.

A special RS-232 adapter (p/n 6993) is required and you will need a “crossover” or Null Modem RS-232 serial cable.

A black, bayonet-style connector is used on the RS-232 adapter. The connector is released by turning the collar one-quarter turn counter-clockwise and gently pulling backward on the textured grip. Do not pull on the cable jacket, and do not twist this connector to remove it – it pulls straight out. Twisting the connector or forcing it to turn may damage the RS-232 adapter or the SAM 940.

1. Connect the 8-pin circular connector of the RS-232 adapter to the multi-port connector.

2. Connect the 9-pin sub D connector of the RS-232 adapter to a crossover / Null Modem cable.

3. Connect the other end of the crossover / Null Modem cable to the serial port of the host PC.

4. Turn on the SAM 940 power, and log in as the **Administrator**.

5. Press the MENU button key to go to the menu, and move right to select the *Admin* menu.

6. Make note of the Serial Mode/Speed setting (either Comm 115K or Comm 19.2K).

7. Use the UP or DOWN buttons to select the first item, *Remote Mode*. Press the ENTER key to select remote operation.

To check if your connection is successful, follow the instructions in Section 7.2.3 Live Acquisition of SAM 940 Spectra.

2.6 GPS Connection

If your SAM 940 unit is equipped with the GPS Option, the multi-port connector (also shown in Figure 3 above) can be used to connect your SAM 940 to an RS-232 compatible GPS receiver. By making this connection, you will be able to stream latitude and longitude coordinates to the SAM 940 directly from the GPS receiver.

A special RS-232 adapter (p/n 6993) is required to connect the GPS data cable to the multi-port connector.

A black, bayonet-style connector is used on the RS-232 adapter. The connector is released by turning the collar one-quarter turn counter-clockwise and gently pulling backward on the textured grip. Do not pull on the cable jacket, and do not twist this connector to remove it – it pulls straight out. Twisting or forcing the connector to turn may damage the cable or the GPS receiver.

1. Connect the 8-pin circular connector of the I/O adapter to the multi-port connector.

2. Connect the 9-pin sub D connector of the I/O adapter to the GPS data cable.

3. Connect the other end of the GPS data cable to the GPS and turn on the GPS.

4. Turn on the SAM 940 power, and log in as the **Administrator**.

5. Press the MENU button key to go to the menus, and move right to select the *Admin* menu.

6. Use the UP or DOWN buttons to move to the *Serial Mode/Speed* setting.

7. Use the LEFT or RIGHT buttons to select *GPS NMEA*. (If you do not have a GPS license key, the *GPS NMEA* selection is not available.)

8. Use the UP or DOWN buttons to move to the *Logging Interval* setting.

9. Use the LEFT or RIGHT buttons to select *OFF, 1 sec, 2 sec,* or *5 sec*.

10. Latitude and longitude will be displayed on the Search Mode Screen during normal operation, and they will be included in the Analysis Reports as well.

2.7 Headphone Connection

Additionally the multi-port connector (also shown in Figure 3 above) can be used to connect your SAM 940 unit to headphones. By making this connection, you will be able to hear count activity, alarms, messages, and warnings in sensitive environments. A special I/O adapter is required to connect headphones to the multi-port connector.

A black, bayonet-style connector is used on the special headphone adapter. The connector is released by turning the collar one-quarter turn counter-clockwise and gently pulling backward on the textured grip. Do not pull on the cable jacket, and do not twist this connector to remove it – it pulls straight out. Twisting or forcing the connector to turn may damage the cable or the headphones.

2.8 Detector Connection

The detector is mechanically attached to the SAM 940 with a single ¼ -turn thumbscrew located in the handle, as shown in Figure 5. Although this operation configuration makes one-handed use easy, for certain special applications the detector may be detached from the electronics unit (in older models this is necessary to access the battery compartment). To do this, flip up the metal ring in the middle of the handle, as shown in the Figure 5. Rotate it ¼ -turn counter-clockwise to detach. When re-attaching the detector, first be sure that the two handles are correctly seated by squeezing them together with your hand. Then, push down slightly on the connecting screw, rotate it ¼ -turn clockwise, and flip the ring back down into the recess on the SAM 940 handle.

To move the detector further from the electronics, an extension cable may be attached. A black, bayonet-style connector and a special water-tight LEMO connector are used on your detector cables. The black connector is released by turning the collar one-quarter turn counter-clockwise and gently pulling backward on the textured grip. The LEMO connector is released by gently pulling backward on the textured grip. Do not pull on the cable jacket, and do not twist these connectors to remove them – they pull straight out. Twisting or forcing the connectors to turn may damage the cables, the SAM controller, or the detector.

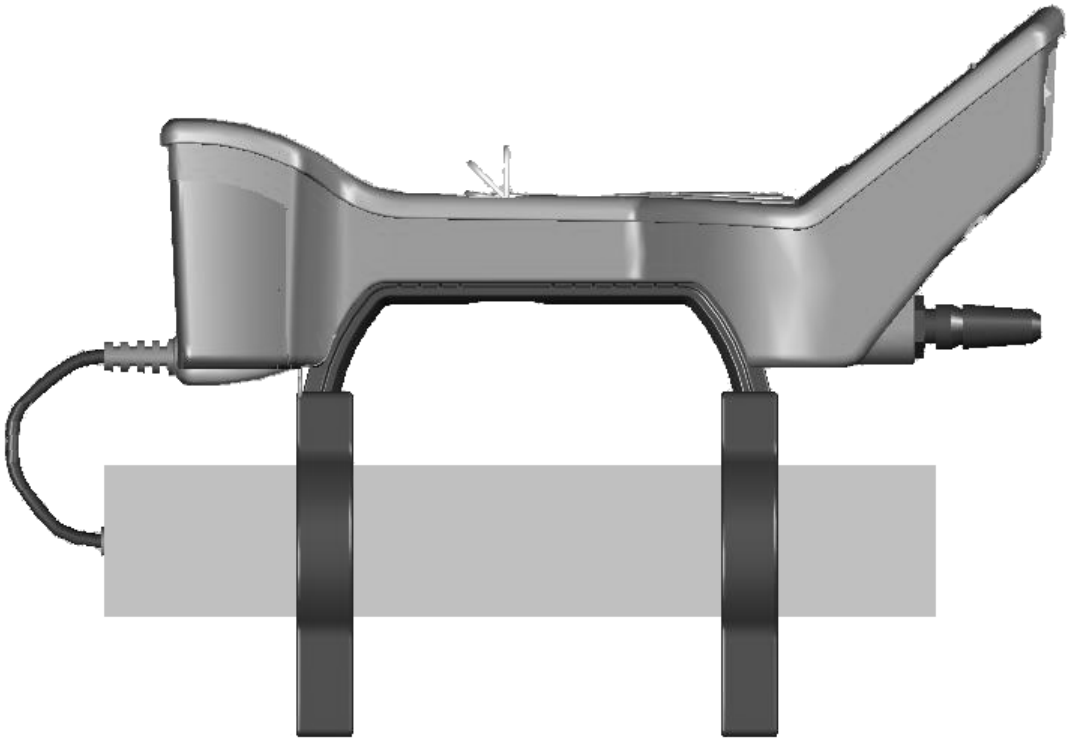


Figure 5 - Side View of SAM 940 with Detector

2.9 Neutron Detector Connection

If your SAM 940 includes an externally mounted He3 Neutron Detector Option, then your detector cable will be a bi-furcated cable with a single, black, water-tight connector attached to the handset that splits into two separate detector connectors. The standard water-tight LEMO connector will attach to the rear of your gamma detector as shown in Figure 5, and the mini water-tight LEMO connector will attach to rear of the He3 neutron detector that is mounted next to the gamma detector.

Both LEMO connectors are released by gently pulling backward on the textured grip. ***Do not* try to turn this connector to remove it** – it pulls straight out, and forcing the connector to turn may damage the cable or the detector.

3 General Operation

The following sections describe the standard operating procedures for the system including the different operating modes.

3.1 Turning the Power On and Off

Turn on the SAM 940 by holding down the BACK / ⏻ key for one full second until the BNC SAM Eagle screen appears.

To turn the SAM 940 off, press and hold the BACK / ⏻ key. A message will show a count down of three seconds before the system turns off. When turned off in this way, all information is saved on the CompactFlash card, allowing you to restart the instrument without losing calibrations or other information. The real-time clock has a separate internal lithium battery that keeps it running even when there is no other power source.

When the power of the SAM 940 is first turned on, you will see a screen that shows the results of an initial power-on self-test, or "POST." A properly functioning unit will have a display similar to that shown in Figure 6. The version of firmware is displayed in the upper-right corner. The internal case temperature may vary, and of course, your estimated battery life will change as batteries are charged and discharged.

The number of Stored Spectra may also vary. It is advised that when the Stored Spectra amount (as reported on the POST screen at power up) approaches 4000 or more, the SAM spectra files should be saved onto PC, and the operator should perform the *Erase All Spectra* procedure for the SAM as described on page 33 in Section 5.2.1.

Press ENTER to continue to the login screen.

Figure 6 - Successful POST Screen

If any of the self-tests are displayed as "FAIL", turn off your SAM 940. In the rare event of a system lock-up, it may be necessary to hold the key down for a longer period of time (10 to 20 seconds) in order to engage the fail-safe power-down mechanism. After powering down, wait 30 seconds, and turn on the SAM as described above.

If any of the self-tests are still displayed as "FAIL", call 800-234-7858 for Technical Support, or visit our website at http://www.berkeleynucleonics.com/ for the support and service center nearest you.

3.2 Choosing User or Administrator Operation

Immediately after the self-test screen, a login screen appears, as shown in Figure 7. On this screen, you have the option of logging in as the **User** or **Administrator**. The **User** functions allow first line responders to perform all the tasks needed in the line of duty. The **Administrator** functions allow a Health Physicist or other knowledgeable person to set up the device for specific applications, and to perform additional maintenance functions.[1] The **User** mode can generally be accessed without a password, while the **Administrator** mode requires a password to be entered.

Figure 7 - Login Screen with User Selected

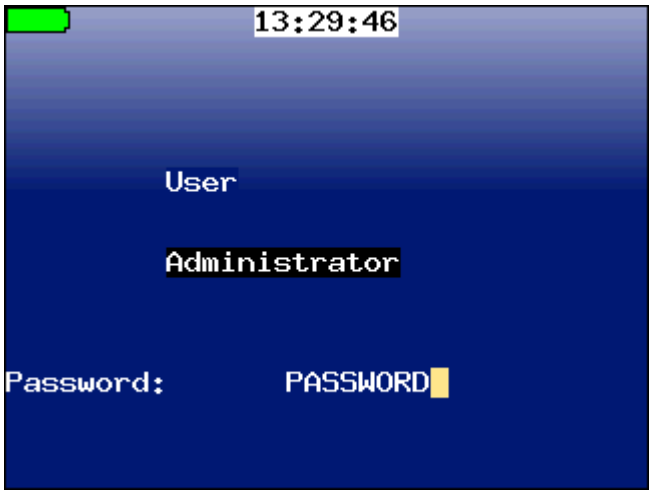


Figure 8 - Login Screen for Administrator, with Password

When entering a password, as shown for the **Administrator** in Figure 8, use the UP and DOWN arrows to change the letter, and the LEFT and RIGHT arrows to move within the word. Holding down the UP or DOWN arrows will rapidly scan through the alphabet. The word is displayed on the screen, because otherwise it would be impossible to determine what letter is being entered! To ensure secrecy, enter the password while no one else can see the screen.

[1] These modes are designed to comply with ANSI N42.34 *Routine* and *Restricted* modes and IAEA Pub 1240 *Easy* and *Expert* modes.

After navigating past the self-test and the login screens, the SAM will display the Search Mode Screen (see Figure 9 on the following page.)

Sodium iodide detectors normally stabilize about 10 minutes after the power is turned on, assuming a stable temperature environment. However, the SAM 940 has a built-in stabilization feature that will generally complete a recalibration within three minutes. During this time, it will display an informational message at the bottom of the screen indicating that AutoCalibration is in progress. Although, in an emergency, data can still be collected while the unit is stabilizing, the built-in analytical software may not make correct identifications during this time. Eventually a green banner stating "AutoCal is Complete" appears on the screen. The SAM is ready when the message goes away,

To start taking readings, see Section 3.3, "Search Modes" below, and Section 3.5, "Identifying sources of Radiation" on page 23.

3.3 Search Modes

The "Search" modes are the modes normally used to detect the presence of radioactivity and determine its location. They respond quickly and make it easy to tell if something has changed, but give less detailed analytical results. In these modes, the instrument continuously takes readings, searches for isotopes, and analyzes them for dose rate and other measurements.

There are four Search modes available, called *Dial*, *Finder*, *Bars*, and *Spectrum*. Only *Dial* and *Finder* are enabled by default when logged in as **User**. However, your **Administrator** may change which screens are enabled, so that it is easier to quickly access the most important information for your particular response plan. To learn more about enabling and disabling features, see Section 5.3.2 beginning on page 43.

There are common elements that appear on all of the Search screens. These are shown on the **Dial** screen in Figure 9.

In the upper left corner is a battery icon, which shows in green when the batteries have at least ten minutes of useful life remaining. It shows in yellow when the batteries have between 5 and 10 minutes left, and it shows in red when the batteries have less than 5 minutes left. When the time is short, the battery icon will indicate a remaining time in hours and minutes. Please note that these times assume the system is running on the factory-provided batteries, and are still somewhat approximate as the battery life can change with use and from one charge cycle to another.

Just to the right of the battery icon is a message indicating the currently selected Trigger List. The Trigger List is the list of all of the nuclides that are currently enabled for detection and analysis. Knowing the kind of nuclides you normally search for will help reduce false identifications. To learn more about this feature, see Section 5.2.2 beginning on page 35.

In the top center, the screen displays the clock time. It is important to have this time set correctly, including your time zone, so that the stored spectra will have the correct time recorded.

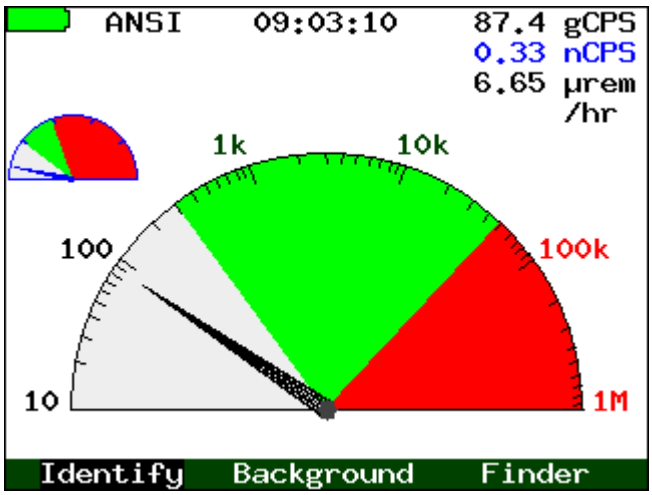


Figure 9 - *Dial* Search Mode Screen

The three numbers in the top right corner indicate the count rate for gamma rays (black) and neutrons (blue) and the current dose rate. These help associate specific numbers with the visual elements of the dial. If your system does not have a neutron detector, the blue neutron count rate and neutron dial will not appear – this version of the display is shown in Figure 10.

Finally, at the bottom of the screen you will see three softkeys: **Identify**, **Background**, and one additional choice that allow you to move to the next search display mode. (On systems where only one mode is enabled, only the first two keys will be shown.)

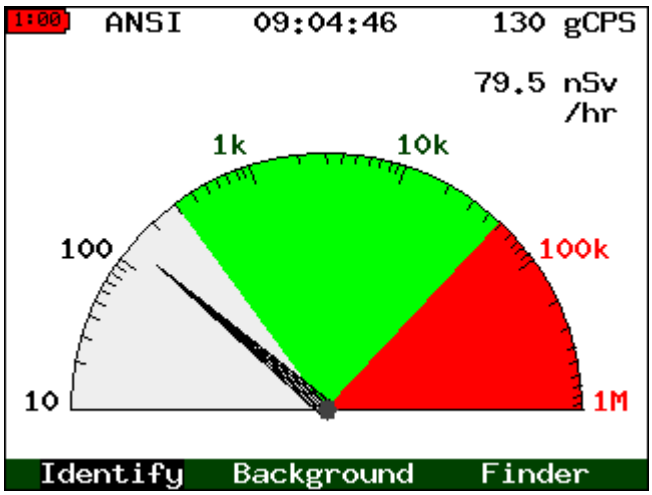


Figure 10 - Dial Screen without Neutrons

The main purpose of the **Dial** screen is to provide a quick visual indication, similar to that given by a handheld dose meter or Geiger counter, showing the amount of radioactivity being measured. When the dial pointer is in the gray area, there is little radioactivity present – most of the counts are coming from either cosmic rays or naturally occurring sources such as potassium-40.

Once the pointer moves up into the green area (on either the gamma dial or, if present, on the neutron dial), the SAM will display a Count Rate Alert to indicate the detection of unusual activity. You will be advised to "*Move Closer*" to the source of activity (shown in Figure 11), or "*Move Back*" from the source of activity (shown in Figure 12) to achieve an optimal distance for statistical sampling.

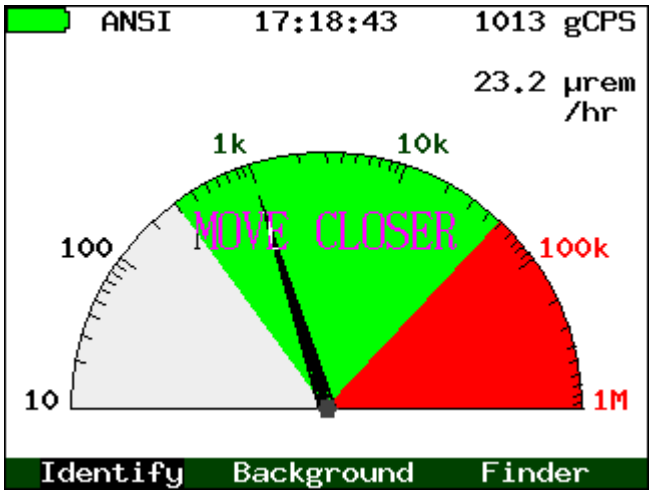


Figure 11 - Count Rate Alert - *Move Closer*

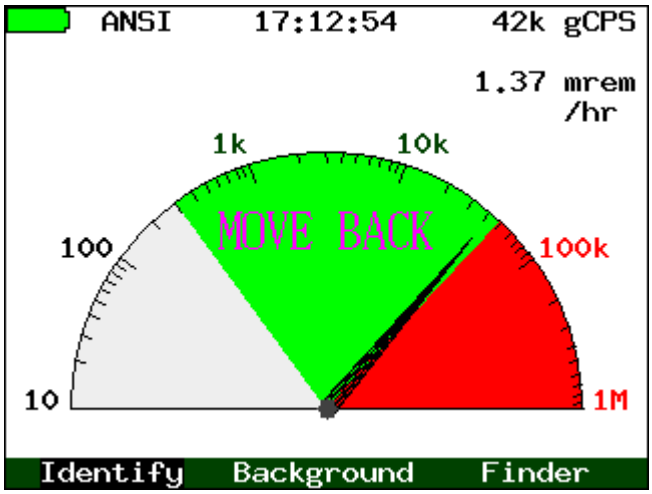


Figure 12 - Count Rate Alert - *Move Back*

When advised to "*Begin ID*" (shown in Figure 13), an **Identify** operation (described in Section 3.5 starting on page 23) should be started.

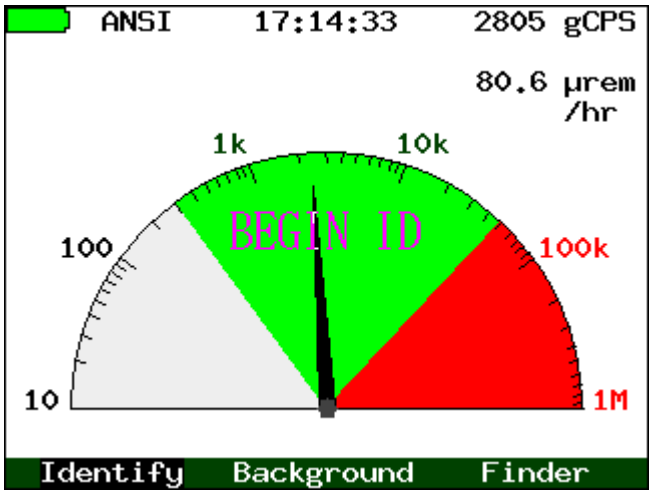


Figure 13 - Count Rate Alert - *Begin ID*

Beginning with firmware version 3.8.2 for SAM 940 systems employing 3x3 NaI detectors, BNC has modified the 3x3 Dial Search to range from 100 gCPS to 1,000,000 gCPS (shown in Figure 14).

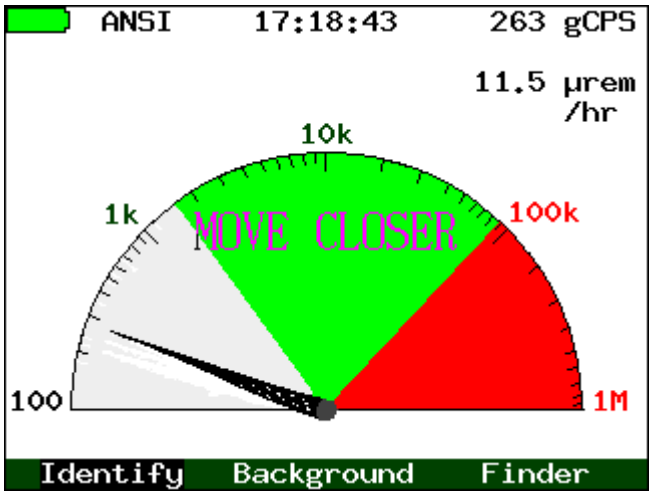


Figure 14 – 3x3 *Dial* Search Mode Screen

The Count Rate Alert has not changed. "*Move Closer*" displays when gCPS exceeds 250, "*Begin ID*" displays when gCPS exceeds 2000, and "*Move Back*" displays when gCPS exceeds 40,000. The optimum region for capturing spectra is still within 2000 gCPS to 40,000 gCPS range

Finally, if the pointer moves into the red area, the activity is too high for a correct identification. The SAM will display several audio and visual alerts. It is *strongly advised that you move back from the radioactive source*, if possible, before attempting to identify it.

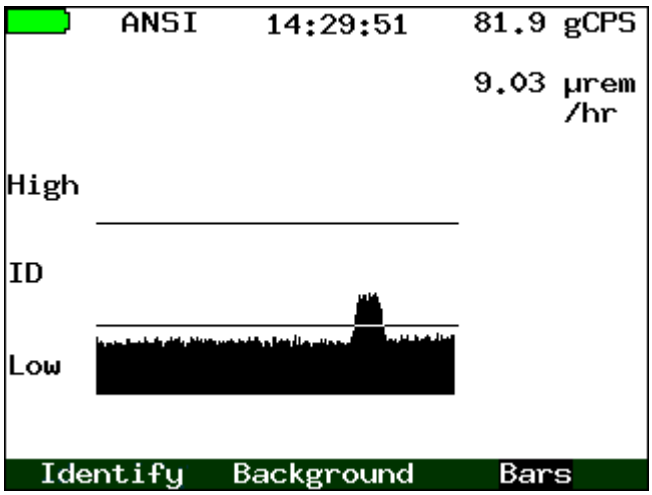


Figure 15 - Finder Screen

The **Finder** screen shows a similar type of count-rate-based information. However, it is displayed as part of a bar graph that continually moves to the left at 10 steps every second. The full histogram displayed on the screen represents approximately the last 20 seconds. This mode can be extremely helpful when you are walking through an area looking for a radioactive source. The system is giving you "cold/warmer/hot" feedback as you move, so that you can localize the source effectively. Once you have narrowed in on the source, you should do an **Identify** operation. The *Low* area shown on the screen corresponds to the gray area on the **Dial**; the *ID* area matches the green portion; and the *High* area matches the red portion. **Identify** will be most effective when the top of the rolling chart is falling within the *ID* area.

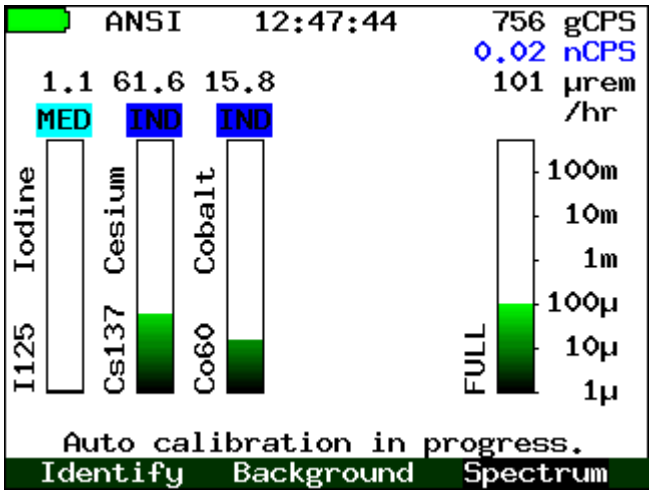


Figure 16 - Bars Screen

The **Bars** screen provides a very different sort of information, organized around *what* is present rather than on *how much* is present. The numbers at the top right still indicate the count and dose rates, but the individual bars indicate the different radioisotopes that are thought to be present. The symbol and name of the isotope are listed to its left. Above each bar is a "class" indication. Each bar shows an estimated dose rate attributable to that particular isotope. This screen is used by advanced users as the most sensitive indication of radioactive material. Bars that indicate a dose rate far below background may represent a false ID, but an advanced user

will promptly start an acquisition on an otherwise missed radioactive source with the end-result being a correct ID.

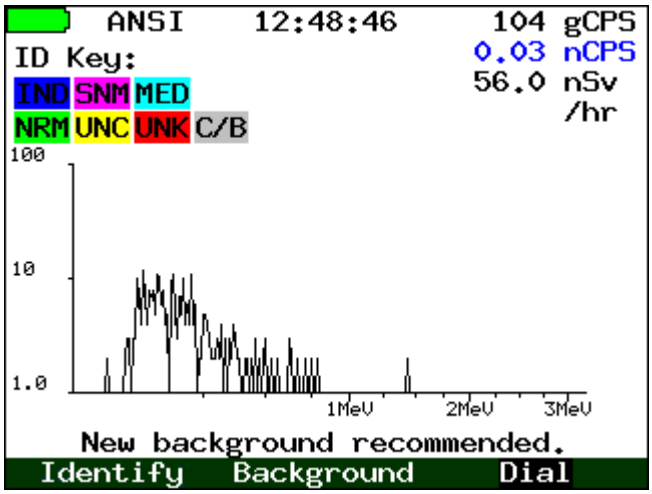


Figure 17 - Spectrum Screen

The **Spectrum** screen is designed for users with a Health Physics background to see the data collection and statistics in real time. Certain changes in the spectrum shape, such as that produced by beta particle interactions, can be interpreted by the trained eye, even when it cannot be identified by the automated algorithms. This screen provides a dynamic display for this particular set of users.

3.3.1 Audible Search Setting

The search modes described above are visually oriented. There may be instances when watching the display screen is inconvenient. The human ear is surprisingly sensitive to changes in rate, so you may find that you can better tell whether you are detecting radioactivity by enabling the audible search tool.

The *Audible Count Rate* setting in the *Field Settings* menu turns on a “click” sound that increases in frequency along with the input count rate. This sound continues as long as the instrument is monitoring data, so it also gives feedback when you are in menus and other screens that do not show count rate information. In the same menu, you can also mute the internal speaker if you want to use the optional headphone attachment. These menu items are shown in Section 5.2.2 starting on page 45.

Note: Enabling the *Audible Count Rate* may noticeably reduce your battery life.

3.4 Taking a Background

To ensure accurate results, it is very important to take frequent background reference spectra in the actual monitoring location. The background is the point of reference against which readings are measured, and corrects for ambient radioactivity or background from cosmic rays in the area of the detector. The ambient background spectrum is stored and then subtracted from all other collected spectra on a channel-by-channel basis during analysis.

It is easy to take a new background reference on the SAM 940. Use the LEFT or RIGHT buttons to simply select the **Background** softkey and press ENTER. First, the system will remind you to ensure that any known sources of radioactivity are properly stored or shielded, as shown in Figure 18. Whenever you are ready, you may **Continue**. If you need more time, you may **Wait** or even **Cancel** if necessary. If the countdown completes, the system will start taking a background.

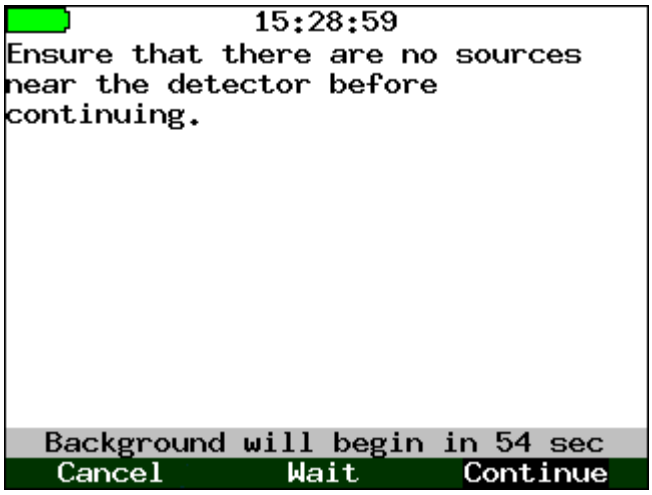


Figure 18 - Collecting Background - Instructions to Remove Sources

Once you continue, you will see a display like that shown in Figure 19. Initially, the graph will be fuzzy (lack of statistics), but it should smooth as time goes on. If you wish to collect a longer background, you can increase beyond the default time by selecting **+30 s**. Holding down the ENTER key will rapidly increase the collection time. You also have the option to shorten the collection time, to **Cancel** at any time, or to **Erase** (for example, if you believe that you have forgotten to shield all sources in the vicinity). When the reference background is completed, the system will return to the "Search" screen, and will be ready for operation.

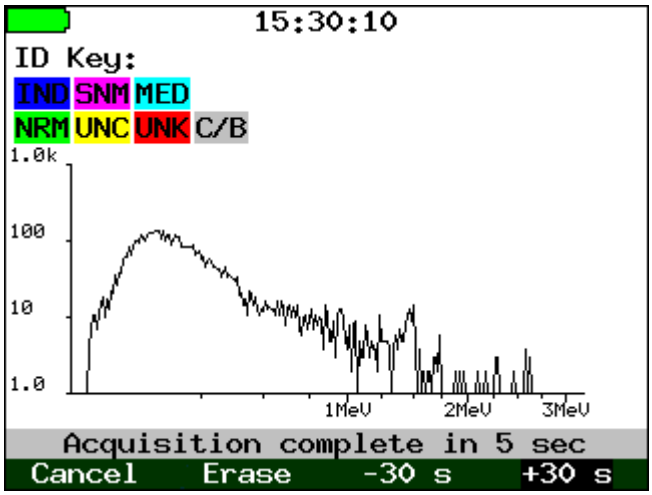


Figure 19 - Collecting Background - Typical Spectrum

Background spectra can be acquired at any point, and should be taken:

Whenever the ambient background changes (for example, if the instrument is moved to a new location).

Every week, as prompted by a message on the SAM 940 Search screen.

Because the counting statistics in the background spectrum directly affect the uncertainty in the analyzed spectra, the background should be counted for as long as or longer than the acquisition time.

Normal readings will have significant variations based on location and detector size. Only with experience can the user determine what "normal" CPM readings are. The most likely causes for high background readings are radioactive materials near the detector (i.e. calibration sources or radioactive waste), or high concentrations of natural radioactive material such as K40 in building materials.

Less likely causes include high cosmic radiation at high altitudes.

3.5 Identifying Sources of Radiation

Once the SAM 940 has helped you locate radioactive material, it can help you determine the specific material that is present. The system has an internal library of 39 nuclides. However, at any given time, only the subset defined by the current *Trigger List* is enabled. You can change between trigger lists by using the *Select Trigger List* item in the *Field Settings* menu. This is described in more detail in Section 5.2.2 starting on page 35.

To collect data for identification, simply select the **Identify** softkey on the Search screen. The system will immediately begin to collect data for identification. An example is shown in Figure 20, with the industrial nuclide Cs137 present. As soon as the system has identified the nuclide(s) present, it will color in the peaks with their appropriate class color: blue for industrial (IND), magenta for special nuclear materials (SNM), cyan for medical (MED), and green for naturally occurring radioactive materials (NORM or NRM).

Do not be concerned if some peaks of the spectrum are yellow – this indication is usually caused by unresolved daughter activity or poor statistics. Poor statistics can be improved by longer acquisition time. In this case, extend the collection time by using the **+30 s** softkey until the uncertainty has been resolved.

When there is a definite peak present but it does not match any nuclide on the current trigger list, it will be labeled in red, for unknown (UNK). In this event, it may be valuable to select the other trigger list to see if the relevant nuclide was simply not in the previously enabled library. If no analysis can be found, it may be time to consider sending the spectrum to a Reachback center, as described in Section 6.3 starting on page 48.

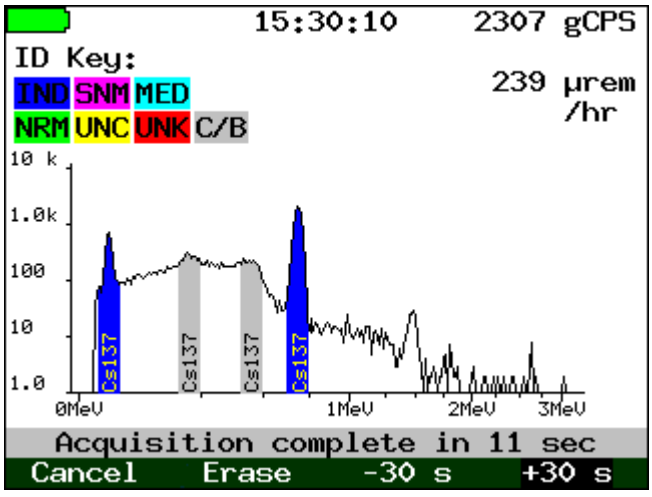


Figure 20 - Identify in Progress with Cs137

Once identification is completed, an Analysis Report will be presented, as described in the next section.

3.6 Analysis Report

The Analysis Report presents a detailed analysis of the collected data. An example of this is shown in Figure 21. Different details of this report may be enabled for different applications.

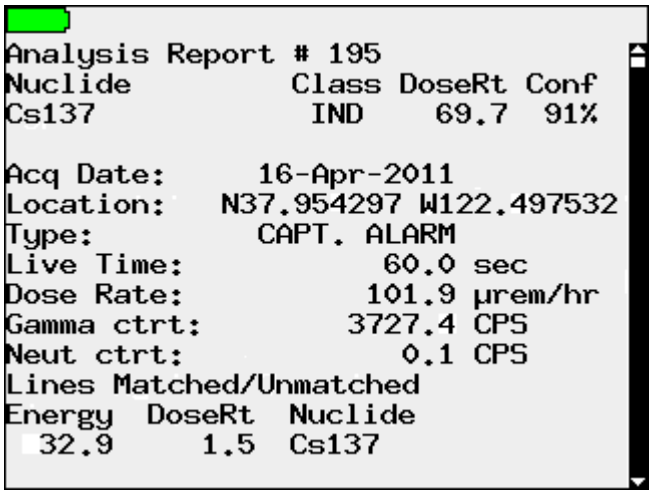


Figure 21 - Sample Analysis Report of Cs137

The initial part of the report lists "found nuclides", which is some of the most critical information. It shows the name of any suspected nuclides, the class identification, the nuclide-specific dose rate (in the same units as above), and the confidence in this particular identification.

Immediately below is the date the spectrum was acquired, the GPS location coordinates (if the GPS option is included), the type of spectrum (e.g. a Manually Captured Alarm), the collection time, the same dose rate and count rate information normally shown on the main screen, and the significant energy lines detected in the spectrum.

DoseRt near the top of the report refers to the amount of Dose Rate that is caused by all of the energy peaks of the particular nuclide. *Dose Rate* near the middle of the report refers to the total amount of Dose Rate including named nuclides and background NORM. *DoseRt* near the bottom of the report refers to the amount of Dose Rate within the particular energy peak of this particular nuclide. The total Dose Rate from the energy peaks of a particular nuclide will equal the Dose Rate amount of the particular nuclide(e) near the top of the report.

3.7 Storing, Reviewing, and Erasing Spectra

Spectra are automatically saved whenever an **Identify** process is completed. Spectra are also saved for each reference background, and for operations like fine energy calibration. The SAM 940 can store up to 4090 spectra in its "catalog." Each stored spectra file consists of a spectrum and all the information necessary to analyze it. They are stored in a standard format designed to comply with ANSI N42.42.

You can review and (when desired) erase these spectra using the *Spectral Data* menu, described in detail in Section 5.2.1 starting on page 30.

If the maximum limit of spectra files is reached, a message indicating "Out of memory" will be displayed at the end of the **Identify** or **Background** acquisition. Additionally, the "Out of memory" message will also display if you attempt to review or erase a spectrum when the maximum limit has been reached. It is advised that when the Stored Spectra amount (as reported on the POST screen at power up) approaches 4000 or more, the SAM spectra files should be saved to PC, and the operator should perform the *Erase All Spectra* procedure as described on page 33 in Section 5.2.1.

4 Manual Calibration

Occasionally, you may find it desirable to re-calibrate your instrument manually, rather than relying on the built in calibration mechanism. We recommend doing this calibration under the following circumstances:

Perform a Coarse Calibrate with Cs137, and acquire a background spectrum when you first install the instrument on site. Although the instrument is factory calibrated for fine energy, the on site calibration allows a check for accurate base-line reference.

Perform a Coarse Calibration whenever the unit has been subjected to a severe temperature change while it was turned off, such as transporting it from the trunk of your car to the inside of a building. This is particularly important if the unit was turned off at one temperature (e.g., indoors) and turned on again at another (e.g., right after spending a long time in your car).

The collection of a new reference background was already detailed in Section 3.4 starting on page 21. The manual calibration procedure is detailed below.

4.1 Coarse Calibration

The calibration procedure described in this section automatically adjusts hardware parameters (for example, high voltage and amplifier gain) to obtain an accurate system energy base-line. It requires one radioactive source, a license-exempt Cs137 source of approximately 0.5 to 5 µCi. If a source > 5 µCi must be used, place the source 4 to 5 inches from the detector window.

To begin the process, you must enter the menu system by pressing the MENU button. Press the RIGHT key and you should immediately see a *Field Settings* menu that looks similar to Figure 22. By pressing the UP or DOWN arrow keys, move the selection so that *Coarse Calibrate with Cs137* is highlighted. Press ENTER to begin the calibration.

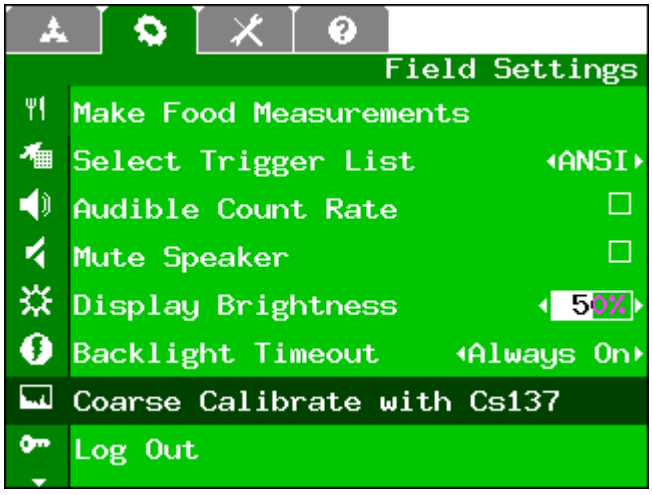


Figure 22 - *Field Settings* Menu with *Coarse Calibrate* Selected

You will now be prompted (as shown in Figure 23) to place the Cs137 source near the detector. If you do not have the source at hand, you can ask the system to **Wait** (give you an extra minute) or **Cancel** if you made a mistake.

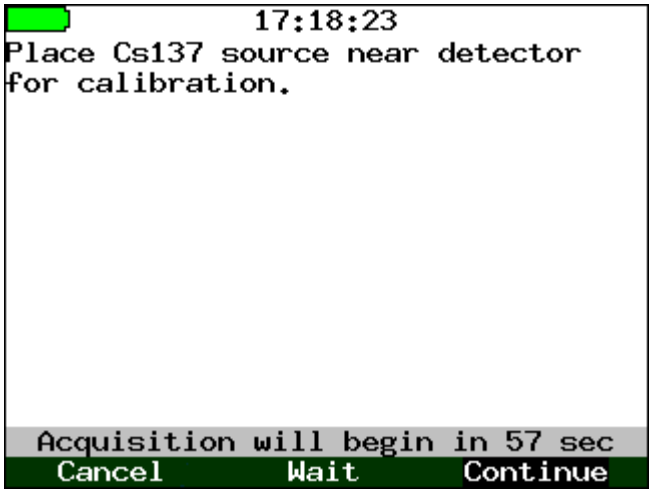


Figure 23 - *Coarse Calibrate* Source Placement Dialog

Once you **Continue** (or allow the countdown to complete) you will see a screen that looks similar to the one shown in Figure 24. This process may repeat several times as the system updates different parameters to ensure that your calibration is as close as possible to the target calibration. The target calibration is shown by the two blue/gray lines near the centers of the peaks. Do not be concerned if the parameters shown in the message area above the softkeys are different from those shown in Figure 24 – they are unique to each detector type and size.

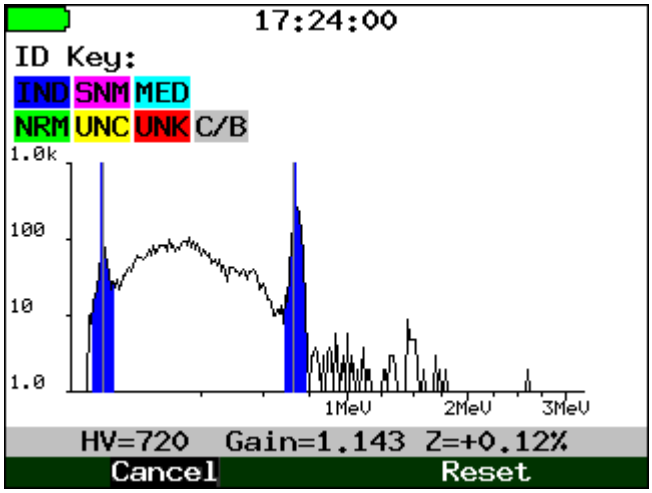


Figure 24 - *Coarse Calibrate* Collecting Data

When the process is complete, the system will beep three times (unless you have the speaker turned off) and return to the *Field Settings* menu.

If for some reason your system is having trouble seeing the peaks – for instance, if the peaks are already far to the right of where they should be – you can also select the **Reset** softkey to initialize all the parameters to defaults. Please be aware that resetting all the parameters will make the calibration take a much longer time than normal. If the calibration does not look right or is taking too long, you can always **Cancel** and go back to the previously stored calibration.

4.2 Dose Rate and Fine Energy Calibration

Your system has two additional calibrations that are performed at the factory. One corrects the dose rate for individual variations in the detector efficiency; the other ensures that the energies of measured radiation lines are correct across the entire spectrum.

If for some reason you believe these calibrations are no longer correct, or if your regulations require periodic recalibration of the instruments with NIST-traceable sources, please contact the factory for more information.

5 System Menus

The following sections describe how to use the menu system, and show the different settings that can be adjusted from each menu.

5.1 Using the Menus

Before describing each of the different menus in detail, this section shows and explains how to choose the menu, how to choose an item within the menu, and how each of several standard menu editing operations works.

First, to enter the menu system, you must press the MENU key while in any one of the search mode screens.

When you first enter the menu system, you will start with the *Spectral Data* menu (details for this menu will be discussed in Section 5.2.1 on page 30). Press the RIGHT key and you should immediately see the *Field Settings* menu. Figure 25 shows the menu "tabs" that appear if logged in as **User**. The second tab from the left corresponds to *Field Settings*, and so it is shown highlighted in color, while all the other (unselected) tabs are shown in gray. The name of the menu, "*Field Settings*," also appears just below the tabs as shown. To change to another menu when the tab is selected, you may use the RIGHT and LEFT (⬅ and ➡) arrow keys. (In this case, the RIGHT arrow key will take you to the *Spectral Data* menu, while the LEFT arrow key will also wrap around and bring you to the *Help* menu.) If you are somewhere in the middle of a menu, and want to quickly return to the tabs, you can press the MENU key to do so.

Figure 25 - Example of Menu Tabs

To select an item from the menu, press the UP or DOWN (⬆ and ⬇) arrow keys. Pressing the DOWN arrow when on the tab will take you to the first item on the menu. Alternatively, as a shortcut, pressing the UP arrow when on the tab will take you to the *last* menu item.

To return from the menu system to the Search mode, you can use the BACK key (unless you are running a procedure or editing a specific item) or you can select the *Exit* item at the bottom of each menu.

We will now elaborate on how to make changes for various types of menu items.

5.1.1 Run a Procedure/Display Information/Open Submenu

Perhaps the simplest type of menu item is one which either runs a procedure, displays information (such as a *Help* file), or opens a sub-menu. These all look the same on the screen, except for the name of the menu item. The *Coarse Calibrate with Cs137* item is shown here as an example.

To perform the listed task, simply move the highlighted area (darker background) onto this menu item, and press ENTER. In the case of a procedure like calibration, the first step of the procedure will then be displayed. For a *Help* menu item, the associated help text is displayed.

5.1.2 Check Option On or Off

Another simple procedure is to turn an option on or off. For these items, a check-box is shown, as in the example of the *Audible Count Rate*.

To change whether the option is enabled or not, highlight the menu item and press ENTER to toggle the check mark. Alternatively, the LEFT and RIGHT arrows toggle the check mark as well.

5.1.3 Adjust Slider

A few features are set with sliding adjustments like the ones you might find on your PC monitor. The *Display Brightness* is shown as an example here.

To change the value, highlight the item and press the LEFT arrow key to reduce the value, or the RIGHT arrow key to increase it. The value is shown both in percent and as a bar that goes from empty (0%) to full (100%). The small arrows shown on the screen are a reminder that LEFT and RIGHT are the keys you use to make a change.

5.1.4 Select Among Options

Some items give you a choice among different static options. *Dose Rate Scale*, shown here, gives you several standard options from which to choose.

Pressing the LEFT or RIGHT arrow will change to the previous/next item in the list. The small arrows shown on the screen are a reminder that LEFT and RIGHT are the keys you use to make a change. In cases where there is no particular order to the list, you can continue flipping through items until you come back around to where you started. For other items, like time intervals, there may be a minimum and maximum value. When the minimum is reached, the left arrow disappears from the screen and LEFT will no longer make a change; the same is true for RIGHT when the maximum is reached.

5.1.5 Edit Numeric Value

A few options, particularly those available to the **Administrator**, are numeric values that may need to be changed. The *Dose Rate Alarm Level* setting is shown here.

There are two mechanisms for changing these values. When the menu item is first highlighted, pressing the LEFT key will reduce the value to a smaller value – sometimes half, sometimes another convenient interval – until it reaches a minimum setting. Pressing the RIGHT key will increase the value up to a maximum.

If the existing steps are not satisfactory, you may change the value one digit at a time by entering the "free edit" mode. This is done by pressing ENTER while the menu item is highlighted; you will see the display change to appear like the display here:

Once in this mode, LEFT and RIGHT move to a different digit, and UP and DOWN change the currently highlighted digit. In order to accept your changes, or in order to use UP and DOWN to

move to the next menu item, you must press ENTER. This will save the current value and put you back in the normal menu-browsing mode.

5.1.6 Edit Date for Filter

When choosing a date for *Spectrum Search Criteria* menu, the menu item works in a way similar to the Edit Numeric Value function. Initially, *Any* date is allowed.

If you wish to make a restriction, so that fewer dates match, you must edit the value. Pressing a LEFT or RIGHT arrow key will change the date to today's date; pressing an arrow key again will change it back to *Any*. To edit the date, you must press ENTER.

While in this mode, you may change each portion of the date by using the UP and DOWN arrow keys. (Note that the actual format of the date may vary depending on your *Language* choice.) Pressing UP or DOWN a US date format (as shown above) will change the month to April or February. Pressing the LEFT and RIGHT keys will move the highlight to another field. When you have the date you would like, press ENTER to return to the normal mode.

Note that, if you press the LEFT and RIGHT arrow keys again, the date will change back to *Any*. However, the system will remember the date you entered and if you press the arrow key again, you will get back your edited date.

5.2 User Menus

Four menus are available to the **User**: *Spectral Data, Field Settings, Config,* and *Help.* These items are the ones most often needed in general operation. The same menus appear for the **Administrator**, but may display additional options. All the common options are described in this section, and only the new ones for the **Administrator** are described in Section 5.3 Administrator Menus.

5.2.1 Spectral Data

Figure 26 shows the *Spectral Data* menu. The items on this menu allow you to navigate through the stored spectra, search for particular spectra, review, and delete those spectra. This menu is the same for both **User** and **Administrator**.

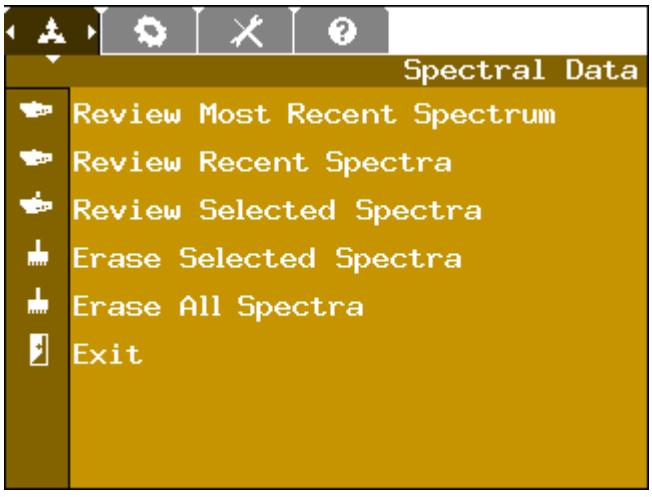


Figure 26 - *Spectral Data* Menu

By highlighting and selecting the *Review Most Recent Spectrum* operation, you are able to do exactly that. The screen will display the most recently captured spectrum whether it is the result of a "*Captured Alarm*", a "*Background*", or a "*Calibration*" operation. The **Report** softkey will by highlighted. By pressing the ENTER key again, you are able to view the most recent Analysis Report associated with that spectrum. If you highlight the **Erase** softkey and press the ENTER key, you will erase the file from the SAM 940 memory. ***Do this only if you are certain that you wish to erase the file.***

By highlighting and selecting the *Review Recent Spectra* operation, you are able to once again display the most recently captured spectrum, but you will also be able to review the ten most recent spectra as well. The **Previous** softkey will by highlighted. By pressing the ENTER key again and again, you may sequentially review the nine prior spectra in descending numeric order.

When either the *Review Selected Spectra* or the *Erase Selected Spectra* operation is chosen, the next screen displayed is a sub-menu that is used for searching the catalog of stored spectra, as shown in Figure 27. As you can see, this menu is shown in gray rather than color, indicating that it is a sub-menu of another menu operation.

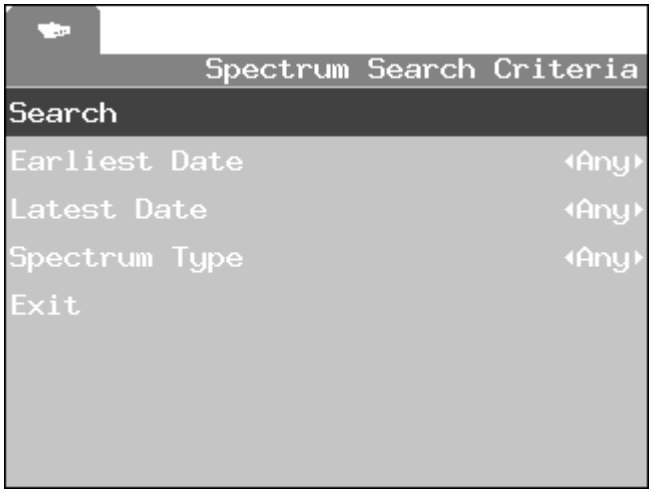


Figure 27 - *Spectrum Search Criteria* Submenu

In this menu, you can set the *Earliest Date* and *Latest Date* for the search, so that only a specific set of spectra are considered. (See Section 5.1.6 for details about entering a date.)

If you highlight *Earliest Date <Any>*, and press ENTER, the current date is displayed. If you then highlight *Search*, and press ENTER, the SAM 940 gathers all spectra acquired on the current date. If instead, you select a specific date, and press ENTER, the SAM 940 gathers all acquired spectra beginning with the selected date and continuing through the current date.

If you highlight *Latest Date <Any>*, and press ENTER, the current date is displayed. If you then highlight *Search*, and press ENTER, the SAM 940 gathers all spectra acquired prior to the current date. If instead, you select a specific date, and press ENTER, the SAM 940 gathers all acquired spectra prior to the selected date.

You may also restrict the search to a particular *Spectrum Type*. You may select "*Background*", "*Energy Calibration*", or "*Captured Alarm*". If you select *<Any>*, the SAM gathers all the spectra types. The default settings shown in Figure 27 would include every spectrum in the catalog.

Remember that you must highlight *Search* and press ENTER to continue to the next sub-menu shown in Figure 28. This menu gives you the opportunity to accept or reject individual spectra by placing or removing check marks. *Note: When erasing spectra, you will not be allowed to check or uncheck the current reference background spectrum.*

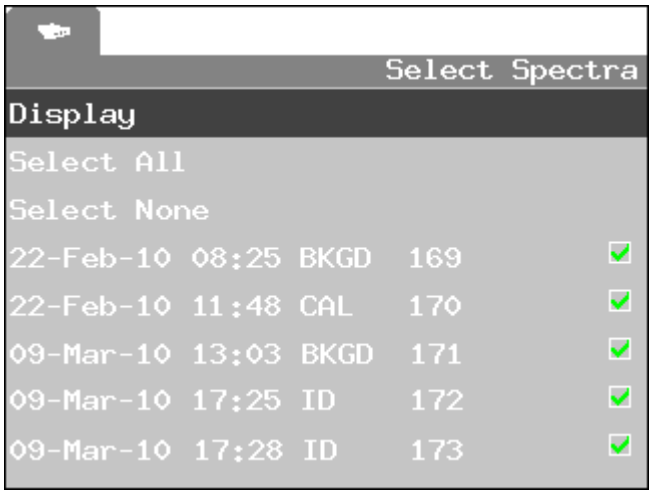


Figure 28 - *Select Spectra* Submenu

Once you have checked the relevant spectra, you must highlight the *Display* or *Erase* item at the very top of the menu.

If you are erasing spectra, the SAM 940 will return to the *Spectral Data* menu when the process is complete. However, if you are reviewing spectra, the SAM will display a screen similar to the one shown in Figure 29.

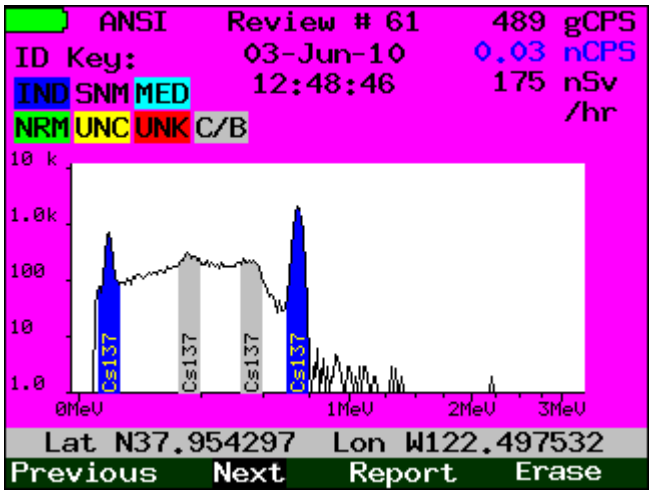


Figure 29 - Review Mode Screen

This display allows you to review a particular spectrum. The softkeys **Previous** and **Next** will take you through the list of spectra that you have selected. The **Report** softkey will let you see the detailed analysis of the data for each spectrum, and **Erase** will allow you to delete the spectrum and the analysis report.

When reviewing a spectrum, pressing the UP arrow key allows you to place a vertical cursor on the spectrum graph. The LEFT and RIGHT arrow keys then allow lateral placement of the cursor.

The information area just below the graph will display channel, energy, and count data pertaining to the cursor position. When the vertical cursor is within an identified region of interest, the nuclide name and the count integral for the ROI are also included in the information area. Pressing the DOWN arrow key removes the cursor and the information area.

As mentioned in Section 3.5, Identifying Sources of Radiation, the identification of nuclides is affected by the currently selected *Trigger List*. If the found nuclides and energy lines conflict with expected results, it may be valuable to select one of the other trigger lists, and review the selected spectra once again to see if the relevant nuclide was simply not included in the previously enabled list.

Erase All Spectra is used for deleting all stored spectra files from the SAM memory. This procedure may be used if for any reason you choose to make space available in the file memory.

Press the DOWN key to highlight *Erase All Spectra*.

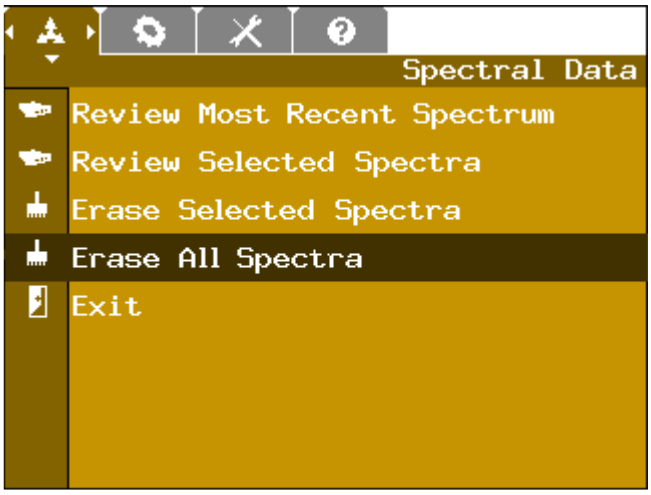


Figure 30 – *Erase All Spectra*

Press the ENTER key. The SAM will ask if you are certain that you want to erase all spectra.

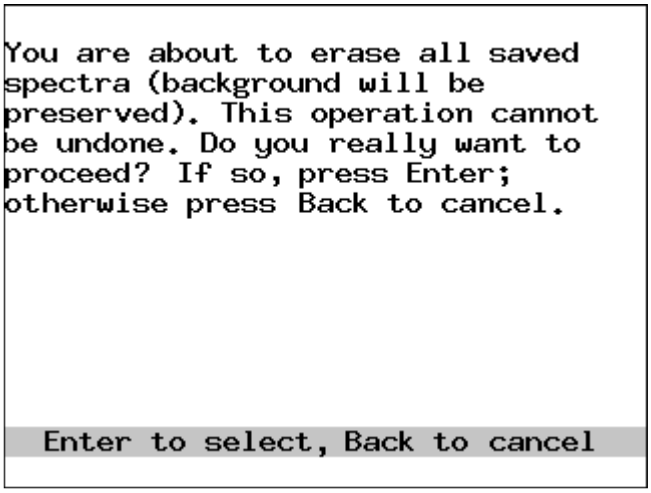


Figure 31 – Ask for Permission

Press the ENTER key to begin erasing.

In the bottom margin of the screen, the SAM will display its progress while it is S*earching* for all of the spectra files. If there are many spectra files, this process can take a significant amount of time. Please wait until searching has completed.

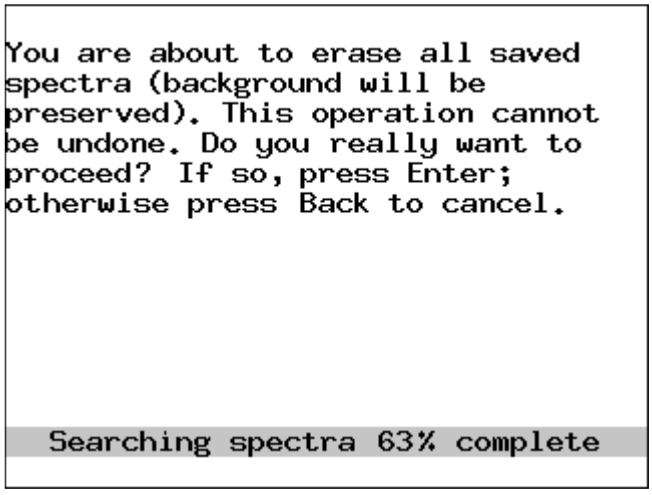


Figure 32 – Searching for Spectra Files

In the bottom margin of the screen, the SAM will display its progress while it is E*rasing* all of the spectra files that it found. If there are many spectra files, this process can take a significant amount of time. For instance, if you have filled your spectra memory with 4090 files, it may take 11 to 12 hours to erase all of the files. Please wait until searching has completed

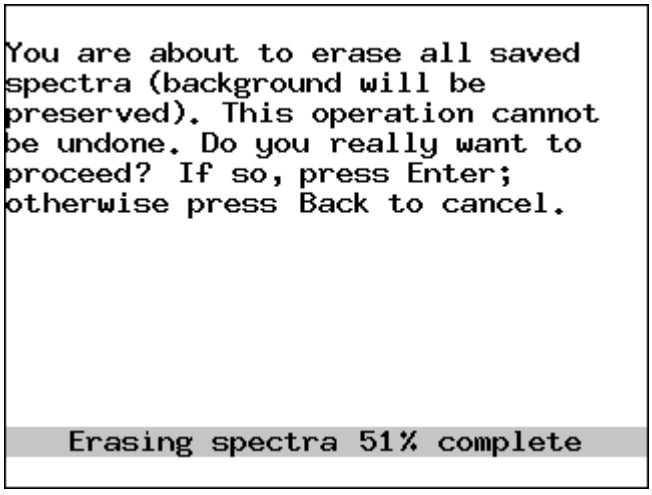


Figure 33 – Erasing Spectra Files

When the SAM has completed the *Erase All Spectra* task, the display will return to *Spectral Data* menu.

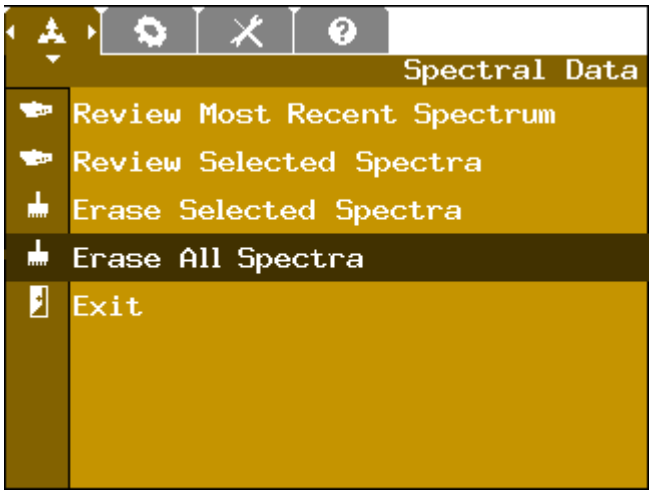


Figure 34 – Spectra Files Erased

To confirm that the Spectra files have been erased, press the ENTER key again. The SAM should indicate that there are no files to erase.

Press the BACK key to return to the main Search screen.

5.2.2 Field Settings

Figure 35 shows the **User** *Field Settings* menu. This menu is intended to put all the most frequently used items at the user's fingertips.

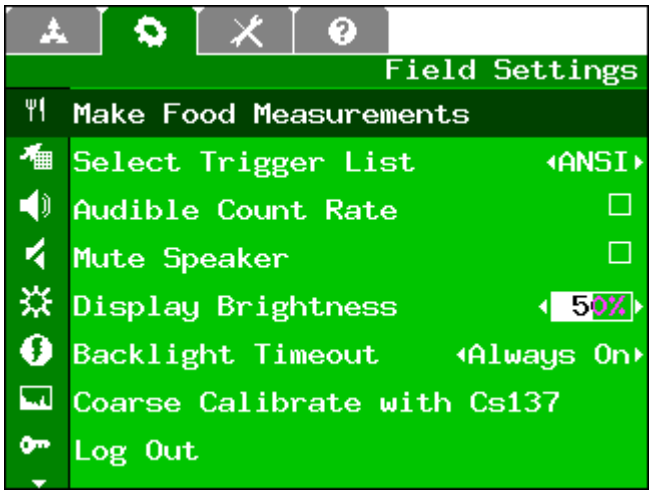


Figure 35 - User's *Field Settings* Menu

Make Food Measurements

This selection opens a series of sub-menus specifically for food inspection (the procedure can also be used for water or soil inspection as well). Instructions for this feature can be found in Appendix B of this Instruction Manual.

Select Trigger List

The "Trigger List" is the list of all of the nuclides that are currently enabled for real-time detection and analysis when you are in Search Mode. Although your **Administrator** may choose to limit the selection for operators that are logged in as **User**, there are two lists from which to choose:

ANSI – standard nuclides from ANSI N42.34.

F18	In111	Ir192	Np237
K40	I123	Tl201	U238
Co57	I125	Ra226	Pu239
Co60	I131	Th232	Am241
Ga67	Ba133	U233	
Tc99m	Cs137	U235	

.

USER – modifiable list of user-selectable nuclides

Normally identical to the ANSI list, the default USER list can be edited to include or omit other isotopes from the SAM's internal Isotope Library. Knowing the kind of nuclides for which you normally search will help reduce false identifications.

Select between the trigger lists with the LEFT and RIGHT arrow keys. Pressing ENTER will display the contents of the currently selected list. You can press ENTER again to return to the *Field Settings* menu.

Audible Count Rate

This option simply turns on and off the audible clicks that indicate the count rate. It is important to note that if the speaker is muted (see next item), you will not hear these clicks unless you are using headphones. Generally, you should hear the clicks as soon as you check the check-box.

Mute Speaker

This option turns on and off the internal SAM 940 speaker – when the box is *checked*, the speaker is *off*. No matter how this option is set, the headphone will continue to operate, allowing inconspicuous audio monitoring.

Display Brightness

This setting increases or decreases the brightness of the display "backlight." Because the display backlight is one of the largest consumers of battery power, changes to this setting can significantly impact your battery life. It is recommended that this be set to the lowest setting that still gives a comfortably readable display.

Backlight Timeout

You can set the timeout for the display backlight. The backlight will turn off if there is no activity for this amount of time. To turn the backlight on again, press any key. Again, because backlight use increases the battery discharge rate, using small timeout settings will give longer useful battery life.

Coarse Calibrate with Cs137

This operation performs a manual calibration, as described in Section 4.1 starting on page 25.

Log Out

This operation takes you back to the *Login* screen. You can then log in as **User** or **Administrator**, as described in Section. 3.1 on page 14.

Exit

This selection takes you back to the Search Mode screen.

Firmware version 3.8.2 for SAM 940 systems with Sodium Iodide detectors, does not include *Select Trigger List* in the *Field Settings* menu. The default nuclide trigger list for this version includes:

Na22	Tc99m	Cs137	U233
K40	In111	Eu152	U235
Mn54	I125	Ir192	U238
Co57	I131	Tl201	Np237
Co60	Ba133	Ra226	Pu239
Ga67	Cs134	Th232	Am241

SAM 940 systems with firmware version 3.7.2 and earlier, contain a *Select Trigger List* menu with the following selections:

ANSI – standard nuclides from ANSI N42.34.

K40	I125	Tl201	U238
Co57	I131	Ra226	Pu239
Co60	Ba133	Th232	Am241
Ga67	Cs137	U233	
Tc99m	Ir192	U235	

SNM – special nuclear materials, normally a subset of ANSI list

U233	Np237	Pu239
U235	Pu238	

IND – industrial isotopes, normally a subset of ANSI list

Co57	Ba133s	Tl204
Co60	Cs137	Am241
Ba133	Ir192	Th232

MED – medical isotopes, normally a subset of ANSI list

F18	Sr89	In111	Xe133
Cr51	Mo99	I123	Sm153
Ga67	Tc99m	I125	Tl201
Se75	Pd103	I131	

BNC – common check sources and "laboratory" isotopes

Na22	Co60	Eu152
K40	Cd109	Pu238
Mn54	Ba133	Am241
Co57	Cs137	

5.2.3 Configuration

The **User** configuration menu is very short, and contains only a few of the items shown on the **Administrator** version of the same menu (see Section 5.3.1). The **User** version of the menu is shown in Figure 36.

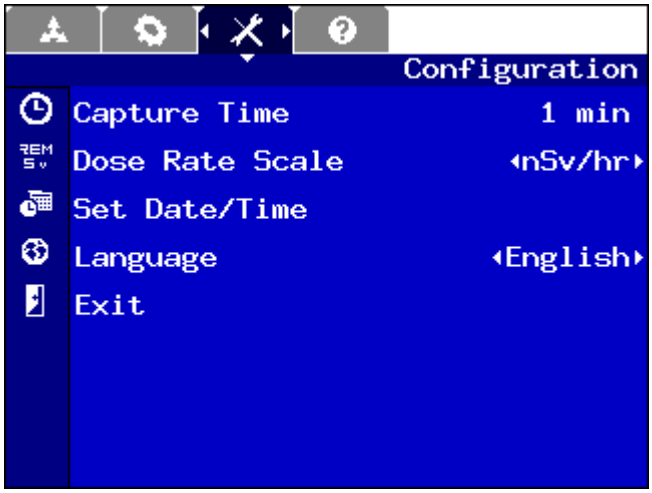


Figure 36 – User's *Configuration* Menu

Capture Time

The Capture Time setting determines the default acquisition time for the **Identify** operation. You can change the default time here, or increase or decrease the time from the **Identify** screen itself.

Dose Rate Scale

This setting changes the preference for the display units of dose rate. There are four options: µrem/hour, mrem/hour, nSieverts/hour, and µSieverts/hour; these are abbreviated on-screen. Dose rate values are stored internally in the same selected unit, so this has no effect on stored data, only on the way it appears on the display. When viewing the full **Administrator** menu, you will see that the dose level settings also change to match the currently selected unit value.

Set Date/Time

Beginning with firmware version 3.8.2, Set Date/Time is in the Configuration menu rather than the Admin menu. Because the SAM 940 records the date and time of every spectrum collected in Coordinated Universal Time (UTC), it must not only know the date and time, but also the current time zone. All of these are set from this menu item, which opens the dialog shown in Figure 37.

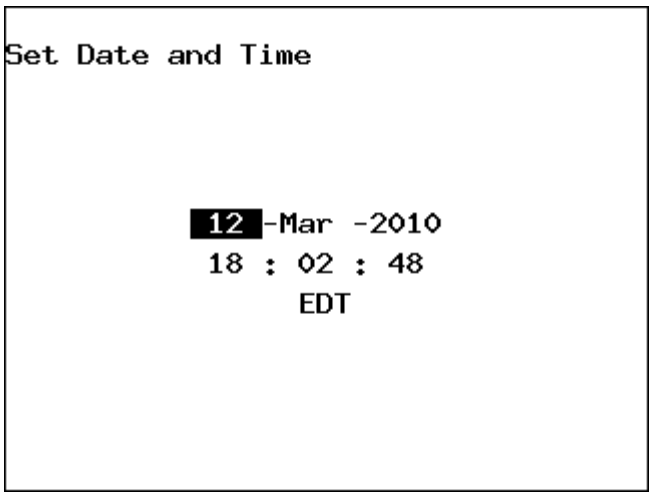


Figure 37 - Setting Date and Time

Use the LEFT and RIGHT keys to change from one field to the next. To increase or decrease the value of a particular field, use the UP or DOWN keys, respectively. If you need to change the time zone, it is recommended that you do this first, because the hour (and possibly minute) will be automatically updated when you make this change. Finally, press ENTER to accept the currently shown date and time.

For SAM 940 systems at firmware version 3.7.2 and lower, *Set Date/Time* is in the *Admin* menu.

Language

This allows you to select among different user interface languages. Full support for languages other than English may require an upgrade package – consult factory for details.

Exit

This selection takes you back to the Search Mode screen.

5.2.4 Help Menu

The *Help* menu provides in-system explanation of the features described in this manual. Each item in the menu is a separate help topic that can be read using a scrolling help viewer. The first page of the *Help* menu is shown in Figure 38.

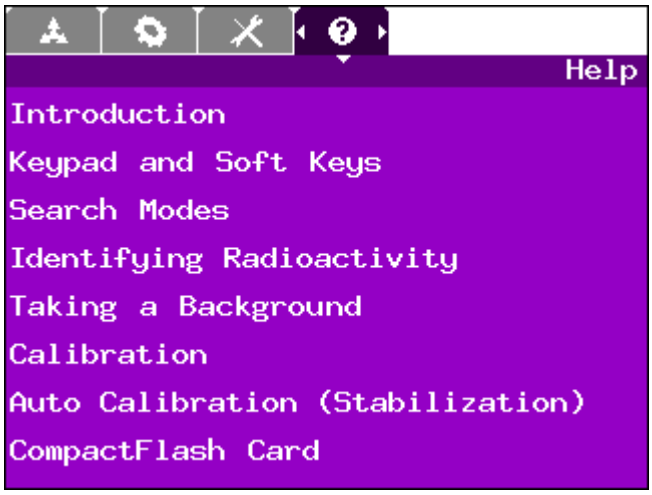


Figure 38 - *Help* Menu

To access any help item, highlight that item and press ENTER. If a scroll-bar is shown on the right, you may wish to scroll through the text using the UP and DOWN arrow keys. When you are done reading the help item, press ENTER again to return to the menu.

5.3 Administrator Menus

When logged in as an **Administrator**, additional menus and additional menu items are accessible. The additional menu items in the *Configuration* menu allow the system to be customized for a particular application, while still providing only the most frequently used items to the **User**.

5.3.1 Configuration (Extra Items)

The **Administrator** *Configuration* menu is shown in Figure 39. The last four items are identical in function to those found for the **User**, as documented in Section 5.2.3. The additional items are described below.

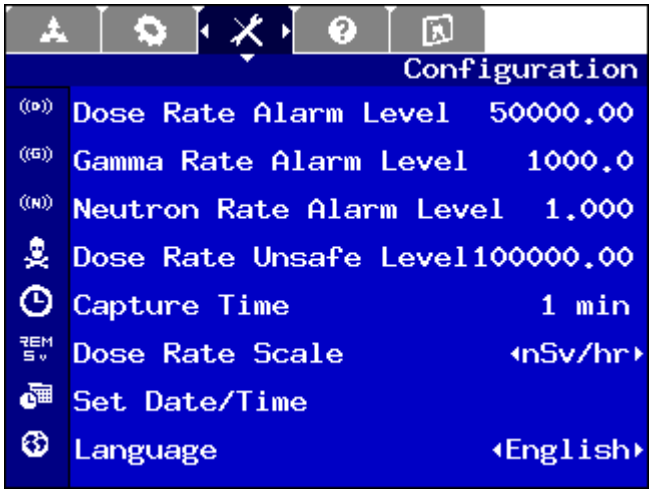


Figure 39 - Administrator's *Configuration* Menu

Dose Rate Alarm Level

This setting determines the dose rate required to set off the dose rate warning alarm. This is specified in the units given by the *Dose Rate Scale* further down in the menu. The display background will become orange, the message *"High dose rate, identify?"* will be displayed, and an audible beep will sound when this level is reached.

Gamma Rate Alarm Level

This setting determines the gamma count rate (in CPS) that will set off the gamma warning alarm. Although this has some functional overlap with the dose rate alarm, there may be cases where a low energy source with a high count rate would set off this alarm but not the dose rate alarm. The display background will become orange, *"High gamma, identify?"* will be displayed, and an audible beep will sound.

Neutron Rate Alarm Level

This setting determines the neutron count rate (in CPS) that will set off the neutron warning alarm. This is generally set much lower than the *Gamma Rate Alarm Level* because true background neutron events are quite rare. The display background will become orange, *"High neutron, identify?"* will be displayed, and an audible beep will sound.

Dose Rate Unsafe Level

This setting determines the dose rate that will set off the personnel protection alarm. This is specified in the units given by the *Dose Rate Scale* further down in the menu. The display background will change from white to red, *"TURNBACK, DANGEROUS RAD LEVEL!"* will be displayed, and the word, "Warning" will audibly sound.

5.3.2 Admin

The *Admin* menu is shown in Figure 40 and Figure 41. This menu contains utilities for setting up the instrument and changing the protection of the various modes. (Beginning with firmware version 3.7.2, *Log Isotopes* was changed to *Logging Mode*)

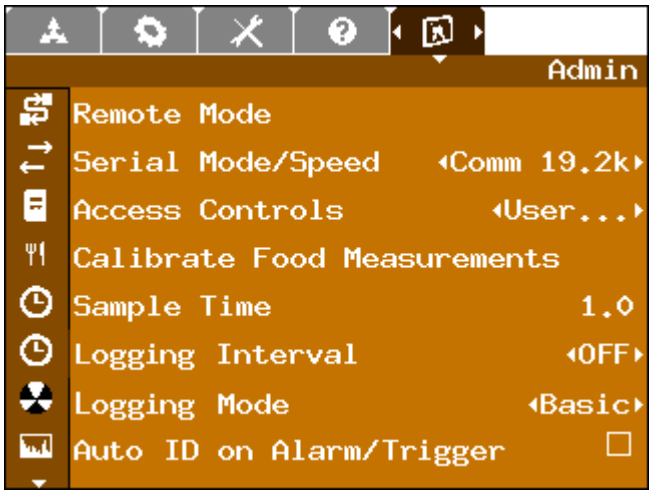


Figure 40 - *Admin* Menu, Part 1

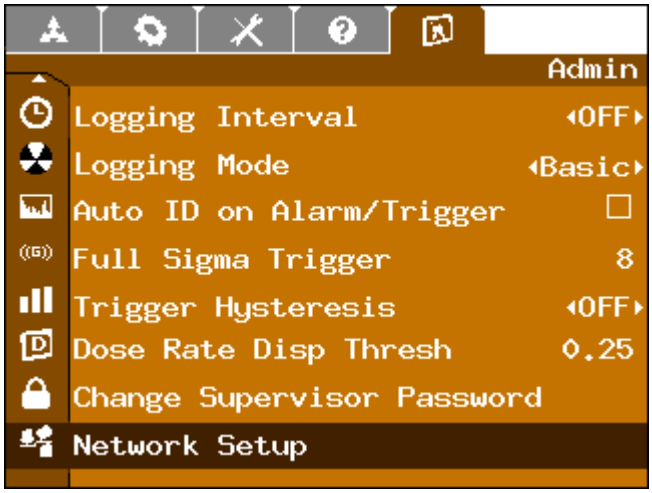


Figure 41 - *Admin* Menu, Part 2

Remote Mode

This operation puts the unit into a remote communications mode, as described in Sections 2.4 and 2.5 starting on page 9.

Serial Mode/Speed

This operation selects the serial transfer rate for *Remote Mode*. The choices are *Comm 115k* and *Comm 19.2k* for live spectrum acquisitions via RS-232 and Ethernet with Quantum™ software; *Strm 115k* for live data streaming with SAM 940 Analysis Viewer version 1.4; and *GPS NMEA* for live GPS data streaming (this choice is only available if your SAM 940 has the GPS option installed).

Access Controls

This item opens a sub-menu that allows enabling or disabling access to certain *User* (as shown in Figure 41), or *Admin* menu options. *User* or *Admin* can be selected using the LEFT or RIGHT arrow keys. The submenu is shown in Figure 42, Figure 43, and Figure 44.

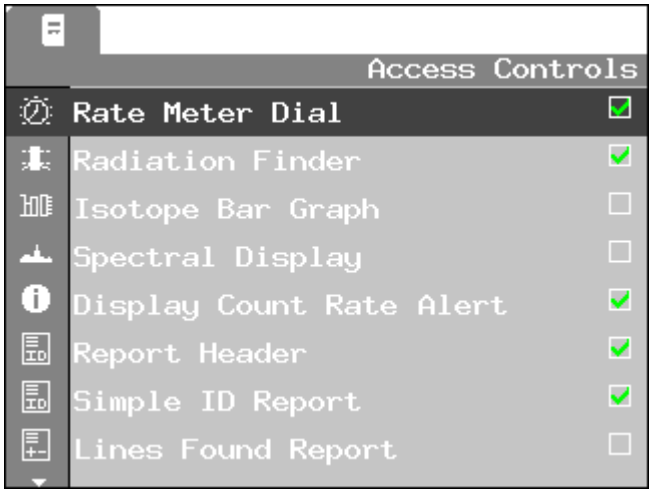


Figure 42 - *Access Controls* Submenu, Part 1

Each of the sub-menu items corresponds to a different feature that may be either enabled or disabled for the selected login. *Rate Meter Dial, Radiation Finder, Isotope Bar Graphs,* and *Spectral Display* determine which Search Modes are enabled. *Display Count Rate Alert* will advise the user to *"Move Closer", "Move Back",* or *"Begin ID"* to achieve optimal statistical sampling during data acquisition.

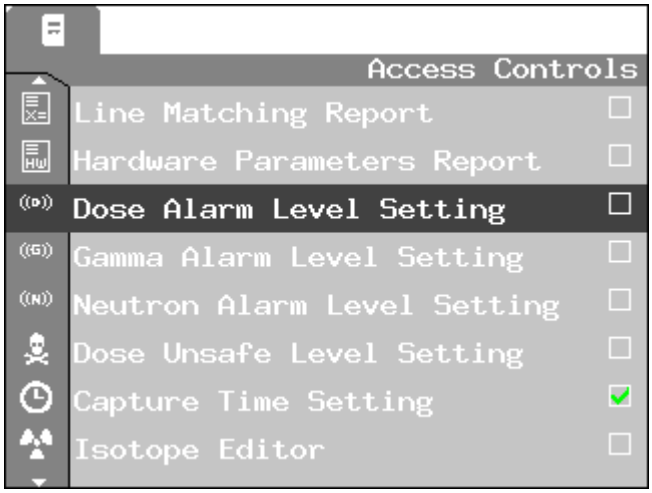


Figure 43 - *Access Controls* Submenu, Part 2

The five *Report* items enable and disable separate sections of the on-screen Analysis Report described in Section 3.6. The *Level Setting* items, *Capture Time Setting*, and *Dose Rate Scale Setting* items are features that appear in the *Configuration* menu, so that additional items may be added or removed for **User** access. As of the current firmware version, the *Isotope Editor* function is not yet supported in the SAM 940 product, and presently has no effect.

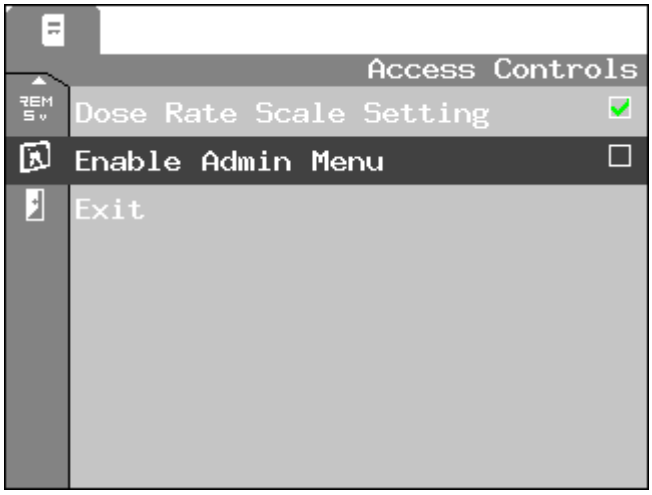


Figure 44 - *Access Controls* Submenu, Part 3

Enable Admin Menu allows the **Administrator** to make the *Admin* menu accessible to any operator that is logged in as **User.**

Calibrate Food Measurements

This selection opens a series of sub-menus that allow the operator to perform an Efficiency Calibration of the SAM detector specifically for food inspection (the procedure can also be used for water or soil inspection as well). Instructions for this feature can be found in Appendix B of this Instruction Manual.

Sample Time

The SAM 940 collects and analyzes spectra in real time. The *Sample Time* (sometimes called the time slice) is the continuously repeating update rate that occurs during collection and analysis. The recommended minimum sample time is one second; however, a 3 to 5 second setting is recommended for dose rate monitoring. Select a short sample time if a quick response is required. Select a longer time if more averaging is desired, or to minimize the occurrence of false positives in the *Bars* mode (although this generally defeats the purpose of the *Bars* mode – see page 20).

Logging Interval

If your SAM 940 unit is equipped with the GPS Option, this operation enables and initializes the logging of GPS coordinates into data files on the CF card. It also allows the user to select the rate at which GPS coordinates are logged. The choices are *OFF, 1 sec, 2 sec,* and *5 sec*. Additional information can be found in the GPS Log Files section of Appendix A.

Logging Mode

If your SAM 940 unit is equipped with the GPS Option, this operation enables you to select how gamma counts are displayed for each GPS coordinate in the GPS Log Files. The choices are *Basic, Isotopes,* and *Spectrum*. It is advised that you enable this operation before enabling the *Logging Interval*. Additional information can be found in the GPS Log Files of the Appendix

.

Auto ID on Alarm/Trigger

This selection allows a behind-the-scenes acquisition to automatically start based on spectrum peaks that have a certain sigma (standard deviations) above background. The sigma default setting is 5. Therefore, when any nuclide photo peak meets or exceeds a sigma of 5 standard deviations above background, acquisition will start automatically and continue to run behind-the-scenes until sigma falls below 5. Below 5 sigma, the acquisition stops and an Alarm report is stored in the SAM's CF.

Full Sigma Trigger

Full Sigma refers to the standard deviation across the full energy range rather than individual photo peaks. This default setting is 8 and purposely set high so that continuously fluctuating background will have little effect on triggering an acquisition. Its prime purpose is to allow a beta source (which has no gamma peaks, but will broadly affect the background) to trigger an acquisition.

Trigger Hysteresis

When starting an Auto ID automatically it is important to ensure that background fluctuations and cosmic interactions do not falsely trigger the system. This safeguard is accomplished by sampling statistics in one second intervals to insure a uniform distribution before accepting a trigger. The choices are *OFF, 2/1, 3/2,* and *5/3*. The number before the slash indicates how many consecutive samples above threshold are needed to trigger Auto ID, and the number after the slash indicates how many consecutive samples below threshold will end the Auto ID. A setting of 2/1 will statistically give better than a 97% confidence level of photo peaks at, or above background levels in the spectrum.

Dose Rate Display Threshold

This setting applies to all modes of operation. It determines the minimum dose rate across the entire spectrum that is required before photo peaks are recognized and highlighted during data acquisition. It also determines the minimum dose rate at which a bar graph will be displayed when searching in *Bars* mode. When the dose rate reaches this level for one *Sample Time* period, the bar will appear. It will then remain on the screen for up to 30 seconds, even if the level falls below the threshold again (to make the display easier to follow visually.)

Change Supervisor Password

The password used for the **Administrator** login (Section 3.2) may be changed by the **Administrator**. To do this, you must enter the old password first, and then enter the new password, as shown in Figure 45.

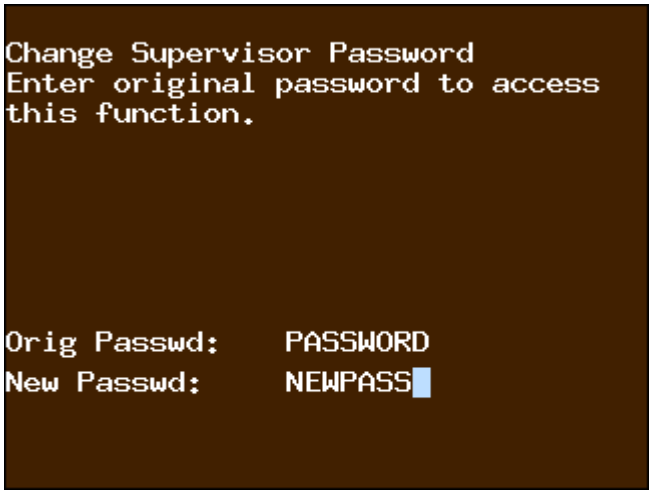


Figure 45 - Changing Password

Network Setup

The SAM 940 supports Ethernet connection to a network or to your PC in order to stream live gamma counts from the SAM 940 to Quantum™ software for remote data collection. In order to establish communications between the PC and the SAM 940, the network information for the SAM 940 must be configured in the *Network Setup*, and then entered into the "Hardware Search" utility of the Quantum™ Software. Figure 46 shows the *Network Setup* dialog, with sample values entered. You will need to get the correct values for your own network from your network administrator.

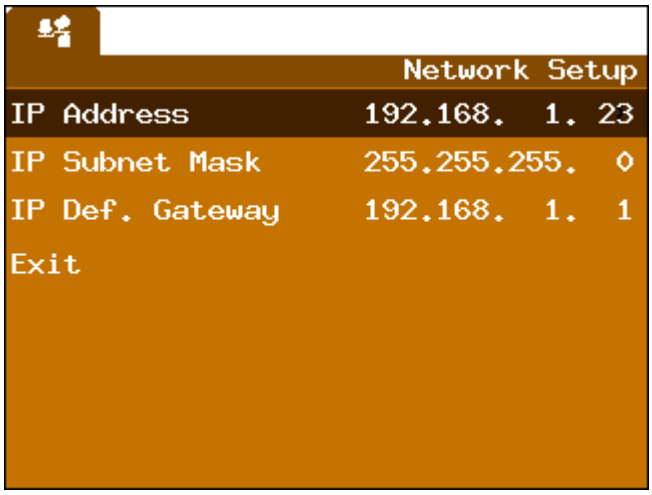


Figure 46 - Network Setup Dialog

Each of the three items (*IP Address, IP Subnet Mask,* and *IP Default Gateway*) must be highlighted in turn. By pressing ENTER, you can then edit each digit with the UP and DOWN arrows, and move between digits with the LEFT and RIGHT arrows. Additional information is discussed in Section 2.4 Ethernet Connection for Data Output.

6 Support Programs

Several levels of technical support are available for users of the SAM 940.

6.1 Factory Technical Support

Berkeley Nucleonics offers fast and efficient support from our headquarters in California, as well as several satellite offices domestically and abroad. Visit our website at http://www.berkeleynucleonics.com/ for the support and service center nearest you, or call 800-234-7858. Technical support programs range from First Responder end user support to advanced Health Physics technical assistance.

6.2 Protocol Development

Radiation Detection is a growing field, and many organizations are developing new protocols to address applications for interdiction of illegal transportation to confirmation of medical treatments. Conventional applications such as environmental remediation are also faced with new challenges. To assist in the development of protocols around your application, Berkeley Nucleonics can offer seasoned Health Physicists to work closely with your team. Contact our factory to discuss the details of your application. Domestic or International, Classified or Non-Classified, we have an on-site support team available to assist.

6.3 Vendor Enhanced Reachback Program

For applications when expedited support and spectroscopic analysis is required, Berkeley Nucleonics has established an around-the-clock support program available to customers of the Model 940 Series Isotope Identifiers. Access to spectroscopists can give your decision making management team, and your mitigation activities added credibility. Whether you are considering the event itself, or the documentation requirements that follow, enlist our team of spectroscopists with an Enhanced Reachback Program.

6.4 State or Federal Agency Support

Several State and Federal agencies are available to support your application. Our knowledgeable team will assist you in setting up your instruments to automatically condition the data in formats required by these agencies. Data can be exported automatically, or via electronic mail, to allow remote experts to analyze the information. A current list of email addresses, phone numbers, and contact names can be obtained from the factory, at 800-234-7858.

7 Software Support

The SAM 940 RIID utilizes standard ANSI N42.42 files. A number of PC software programs are available for viewing spectra, running remote applications and performing quantitative analysis.

- SAM 940 Analysis Viewer -- Included with SAM 940
- Quantum NaI/D -- Included with SAM 940
- Peak Easy – Available through US DOE (contact BNC for details)
- Cambio – Available through US DOE (contact BNC for details)

7.1 SAM 940 Analysis Viewer

Ideal for first line responders, and included with each SAM 940 unit, SAM 940 Analysis Viewer offers simple installation and an easy user interface. Spectra with all associated data including nuclide identification and graphs are easily viewed in linear or log format (total counts as a function of nuclide energy).

Compatible for viewing sodium iodide or lanthanum bromide detector spectra, the SAM 940 Analysis Viewer also displays useful information such as detector type, instrument serial numbers, instrument settings and photon data.

7.1.1 Installing SAM 940 Analysis Viewer

1. Insert the SAM 940 Resource Disc into your PC or laptop.
2. Access the CD drive in your PC / laptop.
3. Run the program SAM940 Viewer 1.3.1.0 Setup and follow the directions.

7.1.2 Installing the SAM 940 CompactFlash

1. Remove the CompactFlash (CF) card from behind the rubber port cover on the front of your SAM 940 (refer to Figure 6 in Chapter 2).

2. Insert the CF card in the media bay or the CF/USB Interface device for your PC / laptop. In either case, the device will be assigned a drive letter (often `D:`, `E:`, or `F:` – we will assume `E:` throughout this document). The spectra may then be read from the directory `E:\spectra`.

7.1.3 Using SAM 940 Analysis Viewer

1. Launch SAM 940 Analysis Viewer.

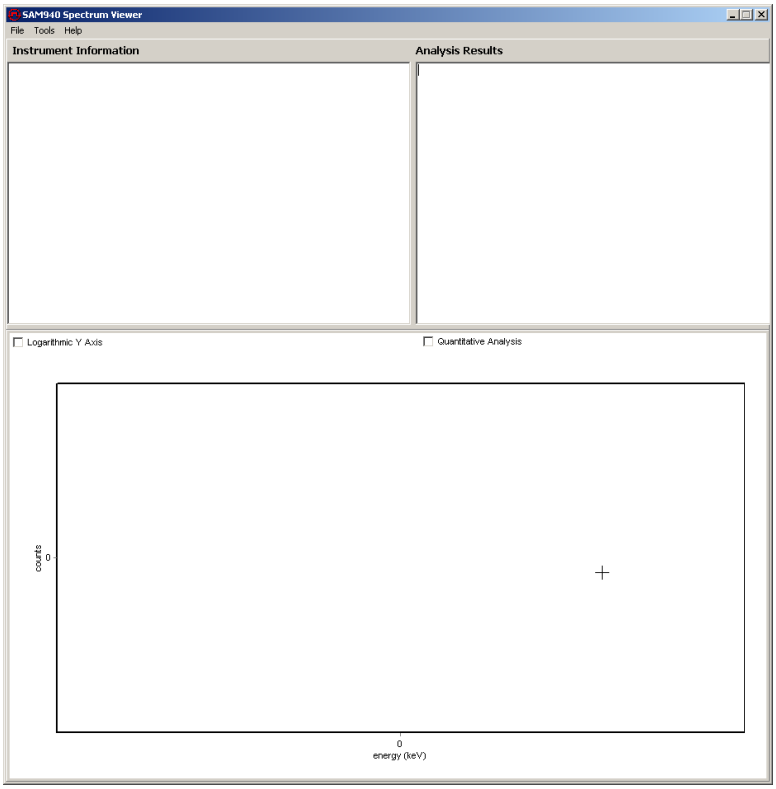


Figure 47 – Open Spectrum File

2. From the "File" menu, select Open File, then browse to the `E:\spectra` folder.

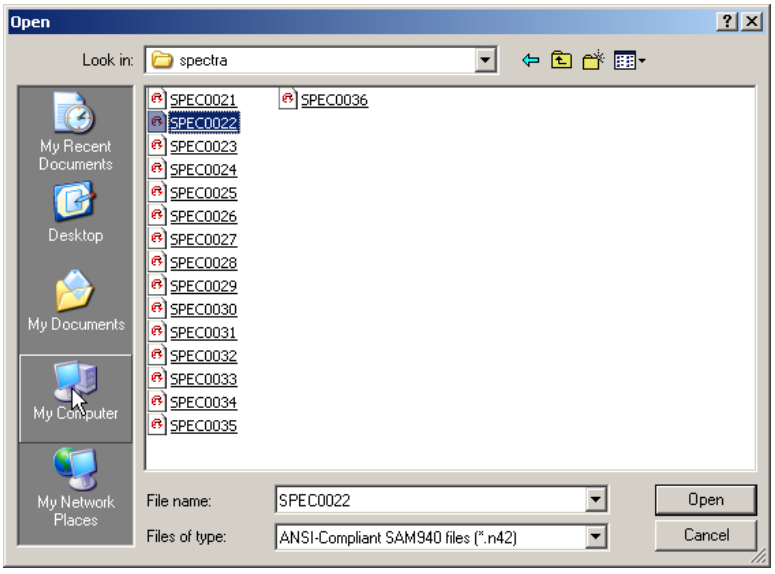


Figure 48 – Select Spectrum File

3. Click on any of the SPECnnnn.N42 files.

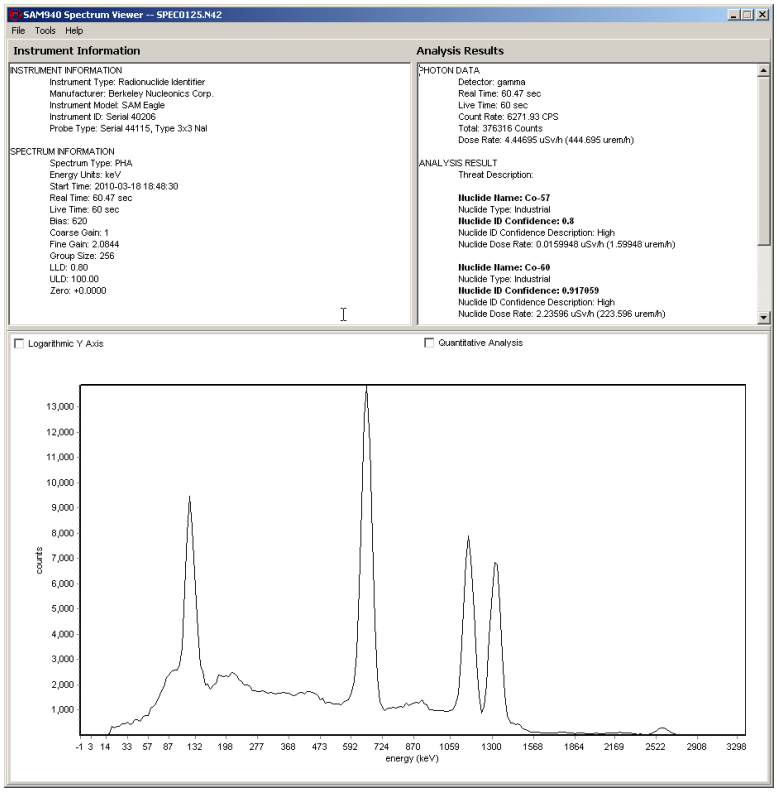


Figure 49 – SAM 940 Spectrum File

The spectrum file displays Instrument Information (including GPS coordinates if your SAM is so equipped), Analysis Results, and a Spectrum Graph. Placing the mouse cursor within the Spectrum Graph will automatically display the channel number, corresponding energy line, and corresponding gamma count specific to the cursor location on the graph.

The File menu in SAM 940 Analysis Viewer also allows you to save the spectrum file as a printable document in Rich Text Format (.rtf).

More complete instructions including how to achieve low-level Bequerel measurements are available in the Analysis Viewer 1.3 Instruction Manual. The manual is available in .pdf format at our web site http://www.berkeleynucleonics.com/

Support Center » Downloads » Isotope Identification » Model 940 » SAM 940 Analysis Viewer Instruction Manual

7.2 Quantum NaI/D

The Quantum™ software is a useful tool for advanced users seeking additional analytical capabilities for their SAM 940 spectra.

Quantum NaI/D software is an expanded package that allows quantitative analysis and remote monitoring. The SAM 940 data can be transmitted to a PC running Quantum for acquiring real time spectra. Using an Ethernet or RS-232 connection and placing the SAM 940 in remote, acquisitions can be controlled from the Quantum screen. Spectra may also be loaded on Quantum from the SAM 940 flash card. Quantum can provide spectrum peak searches, peak integrals, deconvolution, various spectrum manipulations, special automated acquisitions, energy resolution measurements, and multi point efficiency modeling of the detector. Efficiency modeling always requires standard (calibrated) sources to give a multi-point efficiency plot. Once the detector efficiency is determined, Quantum can calculate the activity of another source. Activity can be expressed in Curies, Becquerel or disintegrations per minute (dpm).

Note that Quantum software is optimized for use with NaI detectors utilizing 256 channel resolution. Quantum software is not compatible with LaBr or CeBr detectors utilizing 512 channel resolution.

7.2.1 Installing Quantum NaI/D

1. Insert the Quantum NaI/D Disc into your PC or laptop.
2. Access the CD drive in your PC / laptop.
3. Run the program SetupQtmNaID40400.exe and follow the directions.

7.2.2 Installing Quantum Patch for .N42 Files

In order for Quantum ™ NaI/D software to utilize standard ANSI N42.42 files, a software patch must be installed. Visit the BNC website at http://www.berkeleynucleonics.com/ or call 800-234-7858 for BNC Technical Support to obtain the necessary files. Once obtained, follow the instructions below.

1. Go to your C:\Windows\System32 (or C:\Winnt\System32) folder.
2. Rename (do not delete) pgtimp32.dll to pgtimp32_orig.dll. This allows you to go back to the released version if you run into any problems.
3. Place the new pgtimp32.dll into the same (System32) folder.
4. You should now be able to run Quantum ™ NaI/D and choose "ANSI N42.42" as the file type.

7.2.3 Live Acquisition of SAM 940 Spectra

If you are using Ethernet with the SAM 940, refer to the instructions in Section 2.4 Ethernet Connection for Data Output on page 9 to establish connection.

To check if your connection is successful

1. Click on the Quantum™ hardware search icon  to open the *MCA Devices Auto Configuration* program.
2. Select Ethernet, ANS Ethernet, and Quantum Ethernet. Enter the IP address given to you by your system administrator or entered in step 3 on page 9.
3. Click the *Update* button. If the connection is successful, the SAM version number and serial number will display on the *MCA Devices Auto Configuration* screen.
4. In addition to the reference information found in the Quantum software manual, detailed startup and calibration procedures can be found in the supplemental application notes in the "DOC" folder on the Quantum CD. Both PDF versions (for quick, on-screen reading) and Word documents (for better printing) are included. Start with the application note "QtmInitialCalibration," which includes software installation notes and hardware connection information. If you have an earlier version of Quantum without this document, contact BNC to have a PDF version e-mailed to you.

If you are using RS-232 with the SAM 940, refer to the instructions in Section 2.5 RS-232 Connection for Data Output on page 10 to establish connection.

To check if you connection is successful:

1. Click on the Quantum™ hardware search icon  to open the *MCA Devices Auto Configuration* program.
2. Under *General Categories of Devices*, enter a check mark in the *Serial Port* box.
3. Under *Specific Device Types*, enter a check mark in the *PGT/ANS COM* box.
4. Under *Include in Search*, enter a check mark in the *Quantum COM or Prospector* box that corresponds with the available serial port to which you attached your RS-232 cable. Typically *COM 1* or *COM 2*

5. Set the *Baud Rate* value to match the *Serial Mode/Speed* setting from your SAM 940 (either *115200* or *19200* as noted in your connection procedure).
6. Click the *Update* button. If the connection is successful, the SAM version number and serial number will display on the *MCA Devices Auto Configuration* screen.
7. In addition to the reference information found in the Quantum software manual, detailed startup and calibration procedures can be found in the supplemental application notes in the "DOC" folder on the Quantum CD. Both PDF versions (for quick, on-screen reading) and Word documents (for better printing) are included. Start with the application note "QtmInitialCalibration," which includes software installation notes and hardware connection information. If you have an earlier version of Quantum without this document, contact BNC to have a PDF version e-mailed to you

If the connection is successful, the SAM version number and serial number will display on the MCA Devices Auto Configuration window. Close the MCA Devices Auto Configuration window, and proceed as follows:

1. Open the Quantum program on your PC or laptop.
2. Click on the Erase Spectrum icon (Pencil Eraser) to clear the graph display of all previous spectra.
3. Click on the Library icon (7th icon from the top-left) and Select NaIlib.mdb.
4. Select Log for spectrum display.
5. Check the box labeled Auto.
6. From the Setup menu, select Clear Calibrations.
7. From the Edit menu, open System Parameters.
8. Enter “keV” as units for x-axis energy.
9. Accept all other default settings.

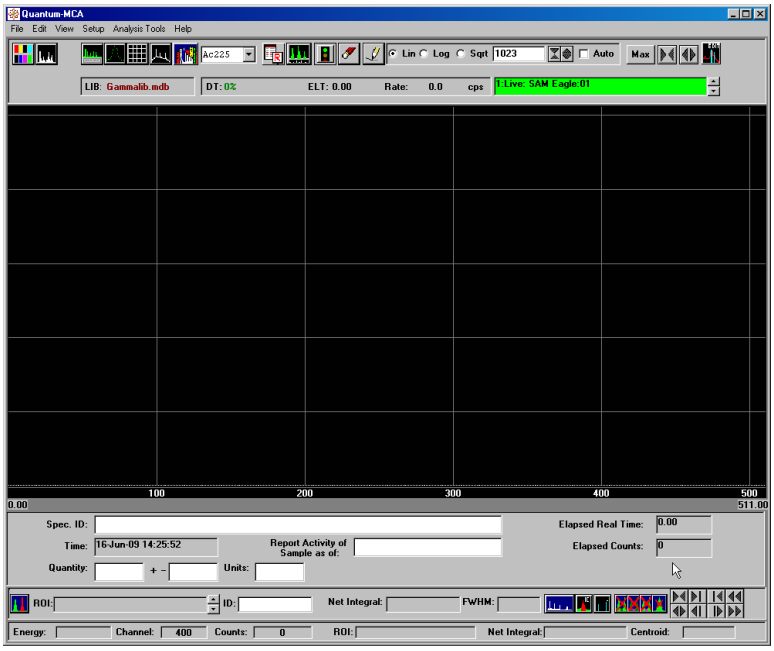


Figure 50 – Quantum Operator Window

10. Click on the Start/Stop Acquisition icon (Traffic Light) in the top row.
11. If a message, “Voltage is higher than optimal for detector. Continue acquisition?” appears, Press OK.

12. You should begin to notice small white dots near the bottom of the graph beginning to form peaks and other evidence of count activity. You are now acquiring Live. To stop, click on the Start/Stop Acquisition icon (Stop Sign) in the top row.

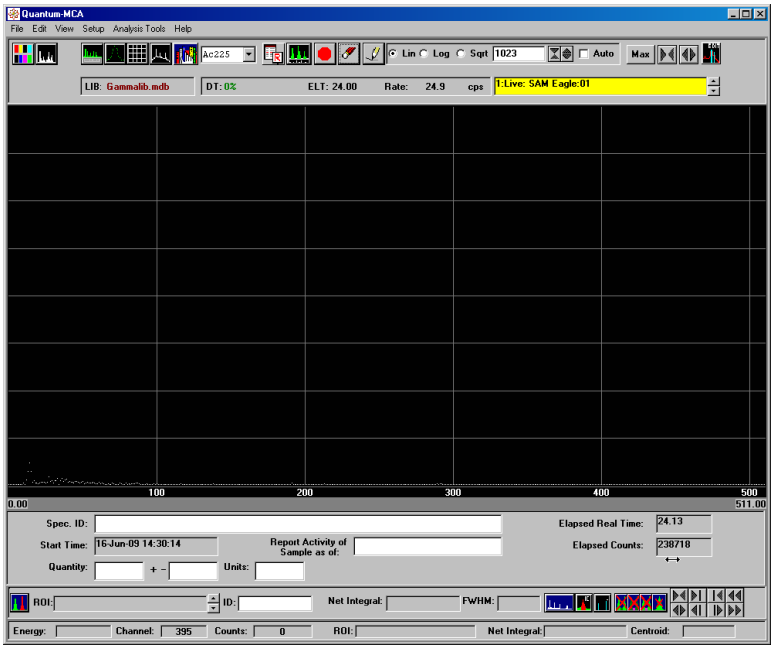


Figure 51 – Live Acquisition

If you wish to perform a Timed Live Acquisition, make certain that the acquisition has stopped (the Stop Sign icon is once again a Traffic Light icon), and proceed as follows:

13. Click on the Erase Spectrum icon (Pencil Eraser) to clear the graph display.
14. Select Draw Lines instead of dots (4th icon from the top-left).
15. Put a check in the box labeled Auto.

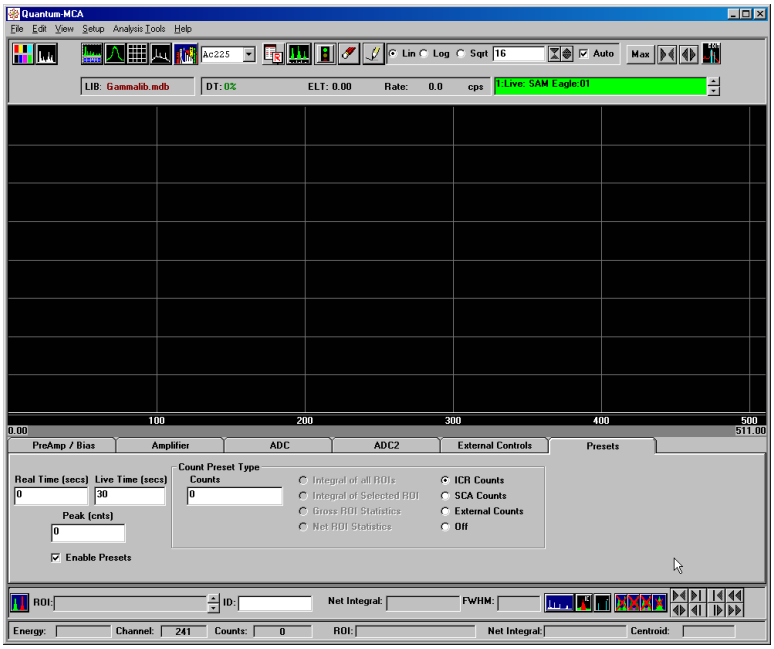


Figure 52 – Hardware Controls

16. Click on the Hardware Controls icon (3rd icon from top-left), and toggle the icon until there are tabs labeled PreAmp/Bias, Amplifier, ADC, ADC2, External Controls, and Presets displayed below the graph.
17. Select the Presets tab.
18. Enter a value for the length of the desired acquisition (in seconds) into the Live Time field.
19. Put a check in the box labeled Enable Presets.
20. Click on the Start/Stop Acquisition icon (Traffic Light) in the top row.
21. You may receive a message indicating, “Voltage is higher than optimal for detector. Continue acquisition?” Press OK.

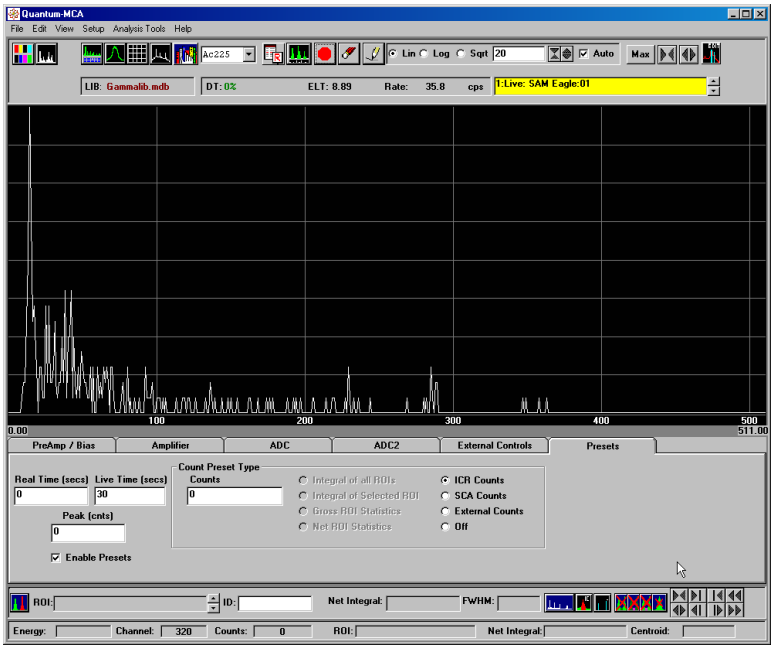


Figure 53 – Timed Live Acquisition

22. The Traffic Signal should once again become a Stop Sign, the field labeled 1:Live: SAM Eagle:01 should turn from green to yellow, and the spectrum lines should begin to appear on the graph.
23. When the elapsed time reaches the selected Live Time value, the Stop Sign should once again become a Traffic Signal, the field labeled 1:Live: SAM Eagle:01 should turn from yellow to violet, and the spectrum lines should remain fixed.
24. You may click on the Erase Spectrum icon (Pencil Eraser) to clear the graph display, and then click on the Start/Stop Acquisition icon (Traffic Light) to begin a new timed acquisition.

7.2.4 Using Stored SAM 940 Spectra Files

If you wish to open a stored spectrum file from the SAM 940, proceed as follows.

1. Open the Quantum program on your PC or laptop.
2. Click on the Erase Spectrum icon (Pencil Eraser) to clear the graph display of all previous spectra.
3. Click on the Library icon (7th icon from the top-left) and Select NaIlib.mdb.
4. Select Log for spectrum display.
5. Check the box labeled Auto.
6. From the Setup menu, select Clear Calibrations.
7. From the Edit menu, open System Parameters.
8. Enter “keV” as units for x-axis energy.

9. Accept all other default setting.
10. Remove the CompactFlash (CF) card from the CompactFlash slot behind the rubber port cover on the front of your SAM 940 (refer to Figure 6 in Chapter 2).
11. Insert the CF card in the media bay or the CF/USB Interface device for your PC / laptop. In either case, the device will be assigned a drive letter (often `D:`, `E:`, or `F:` – we will assume `E:` throughout this document). The spectra may then be read from the directory `E:\spectra`.
12. From the File menu, select Load Spectrum Data Only.
13. Ignore the Warning message and press Yes.
14. Browse to the location `E:\spectra`, open the `E:\spectra` folder, select File Type: .N42, and Click on any of the SPEC*nnnn*.N42 files.
15. Ignore the "…does not support…" message and press OK. The saved spectrum should appear on the graph.

7.2.5 Calibrating Quantum for SAM 940 Spectra Files

Calibration must be performed before an acquired SAM 940 spectrum file, or a stored SAM 940 spectrum file can be properly analyzed with the Quantum program. There is likely to be some non-linearity at the extreme low end (below 60 keV) or at the extreme high end (above 2500 keV) of the spectrum due to the Quantum calibration polynomial being a three order fit whereas the SAM 940 is a 4th order fit. In order to calibrate Quantum for the non-linearity, it is essential to use a SAM 940 spectrum that contains Am241, Cs137 & Co60 or Co57, Cs137 & Co60 to cover the breadth of the SAM 940's effective energy range.

The Quantum manual will suggest several means of calibration. Ignore some of the dialog boxes having to do with high voltage and calibration since the SAM 940 is already in calibration. The following will outline the best procedure:

1. From the Setup menu, select Tool Setup.
2. Select ROI Width of 11 channels and Background Parameters Width of 2 channels.
3. Press Apply, and then press Exit.
4. From the Analysis Tools menu, select Peak Search. A warning box may appear indicating "…not resolution calibrated". There is no need for Resolution Calibration. Simply click Yes to continue.
5. Click the "Show/Hide ROI Labels" icon (lower right – next to FWHM field) to turn "labels" on. Each ROI peak will receive a yellow vertical line (centroid) on the graph.

The calibration should be rather close, but the linearization coefficients of the SAM 940 do not match Quantum. Therefore, the next steps will correct this error.

6. Close the "Peak Finder Report" window.
7. From the Setup menu, select| Manual Calibrate, then select Energy by ROI Centroid.
8. Insert a dot at "Quadratic".
9. The first peak at the left of the graph will be colored green rather than yellow. Click on "Next" until the primary peak of Am241 (or Co57) is colored green.
10. Highlight the "Energy" field in the Multi-point Calibration window and type in the keV value for Am241 (or Co57).
    Use (Am241 @ 59.5, Cs137 @ 662, Co60 @ 1173, 1332 & 2505),
    or use (Co57@ 122, Cs137 @ 662, Co60 @ 1173, 1332, & 2505).
11. Move the green highlight to the next peak energy by clicking on "Next".
12. Observe the movement of the cursor each time you select "Next" to be sure you are on the correct peak, and again type in the keV value for that isotope.
13. When the final peak energy has been entered, click Execute and then close the Multi-point Calibration window.
14. The scale of the horizontal axis should have automatically adjusted to 3 MeV. If not, do it manually by clicking on the ►◄ icon (near the "Show/Hide ROI Labels" icon).

The spectrum is now calibrated. Ignore unknowns with energy labels that were loaded before calibration (step 1 above) since energy is now read in the bottom left corner of the Quantum window relative to the position of the cursor.

Calibration will remain in force as long as the Quantum window remains open, and as long as you are transferring data from the same SAM 940. Now you can calculate resolution and do peak integration.
Note: Accuracy should be within one channel (1 %) which is excellent for NaI spectroscopy. For example, an error of 6 keV at Co60 is only 0.45 %. At 1332 keV, one channel is about 15 keV and the accuracy is expected to be plus or minus one channel or less (+/- 1 % or less).

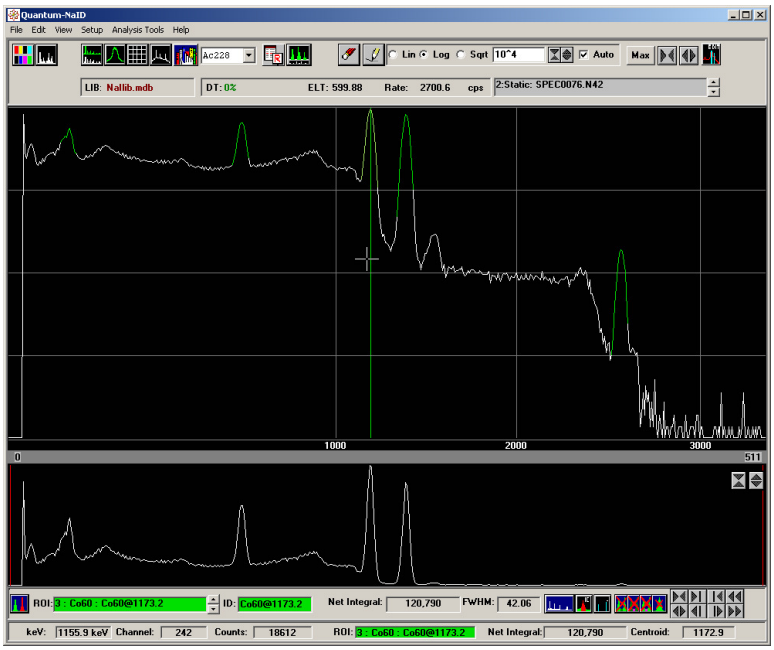


Figure 54 – Calibrated Quantum NaI/D File

7.3 Other Software for Advanced Users

SAM 940 users with similar utilities including Peak Easy and Cambio will find that they can continue using their favorite software also. These utilities provide date, time, length of acquisition, count rate, dose rate and analysis results with nuclide identification. Spectra are shown with energy calibration and a means of archiving all spectral information.

8 Specifications

Preamplifier

Type:	Charge Sensitive
Input:	Negative Current (anode)

ADC

Type:	14-bit pipelined
Speed:	50 MHz

Pulse Processing

Type:	Digital, Trapezoidal Shaping
Peaking times:	40 ns to 5.1 µs, factory set to 1.28 µs
Gain:	Digital, 0.25x to 16x.
LLD:	0 to 100 % of full scale digitally adjustable in .006 % intervals
ULD:	0 to 100 % of full scale digitally adjustable in .006 % intervals
Zero:	-5 % to + 5 % of full scale, digitally adjustable

Spectrum Conversion

Collection Mode:	Linear – 16384 Channels
Conversion Modes:	Linear – 256, 512, 1024 Channels
	QCC – 256, 512, 1024 Channels (U.S. Patent 5,608,222)

System Controller

Processor:	PPC405 CPU at 50 MHz
Display:	320 x 240 high contrast 32000 color display with LED backlight
Controls:	7-key custom keypad
I/O:	RJ-45 Ethernet port for computer connection
	ENP3 series watertight connector for power and other functions
Clock:	Battery-backed-up clock/calendar

Power

Batteries:	Internal, 8 x 2900 mAh NiMH AA batteries
AC:	35 W, 12 V or 15 V universal AC adapter
	(depending on system revision)
Auto:	9 V fused accessory adapter

Gamma Detector

Crystal:	2” x 2" or 3” x 3” NaI; 1” x 1” or 1.5” x 1.5” LaBr; 1.5” x 1.5” CeBr
Bias:	Integral HV supply from 0 – 1200 V
	Actual operating voltage calibrated to each detector
Dose Rate:*	10 pSv/hr to 100 uSv/hr (1 nR/hr to 10 mR/hr)
Connection:	IP67 watertight LEMO

Neutron Detector (if present)

Type:	^{6}LiI or ^{3}He
Moderator:	1 cm polypropylene
Discriminator:	Digital pulse shape and energy discrimination

* The operable Dose Rate range is the range within the SAM's statistical reliability. The upper range is somewhat dependent on energy and whether or not there is high background. The high end is 5-10 mrem/hr dependent upon the count rate distribution within a particular energy.

Appendix A – GPS Option

Specialized applications like topographical map developments, land reclamation, accident mitigation, and perimeter monitoring typically require time stamping and latitude/longitude information recorded with radiological measurements. The SAM 940 will accept NMEA-0183 version 2 input from commercial, professional, or military grade GPS units that utilize RS-232 serial communication. Upon enabling the GPS Option with a license key, the SAM Eagle firmware will provide ANSI N42.42 compliant spectral reports supported by general purpose systems with typical position accuracy of 3 meters, or by high resolution systems with sub-meter accuracy.

Convenient GPS packages are available for the SAM 940. The GPS packages include commercially available, WAAS-enabled GPS devices like the Garmin eTrex H (typical accuracy is 15 feet if there are sufficient satellites in view), and the Trimble ProXT (typical accuracy up to 1 foot with external antenna). If ordered from BNC for the SAM 940, these GPS receivers ship fully configured for plug-and-play readiness.

Enabling GPS

Berkeley Nucleonics Corp. advises that you read and familiarize yourself with the Operator Manuals that accompany the GPS receivers. Please observe all safety and usage advisements contained therein.

Instructions for connecting and enabling SAM 940 GPS Option are discussed in Section 2.6 GPS Connections beginning on page 11. Additional instructions for managing GPS logging functions are discussed in Section 5.3.2 Admin Menu beginning on page 43.

Be sure that the GPS has locked onto a satellite before operation. The SAM will display latitude and longitude indicating that it has a fix on a satellite. A fix is also indicated when the Garmin screen says, “Ready to Navigate”. If the Trimble is being used, its quickly blinking green light will begin to blink slowly as it acquires a fix.

Spectral GPS Data

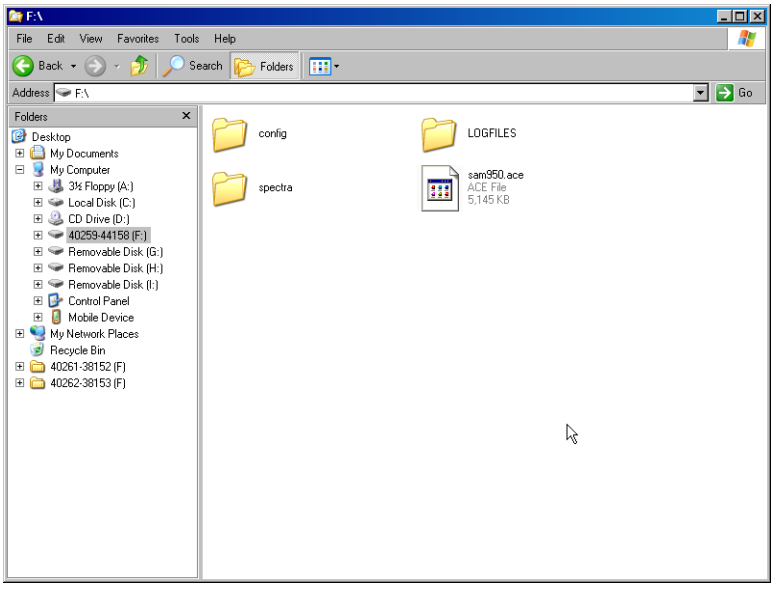
The software provides latitude and longitude as soon as sufficient satellite signals are acquired and during spectrum acquisition. This mode of operation is enabled as soon as the GPS unit is turned on. Latitude and longitude will appear at the bottom of any of the four viewing screens. GPS data are also given in the report that appears on the screen at the end of the spectrum acquisition. All GPS and spectral data are also stored on the CF card and can be viewed by ANSI N42.42 software programs such as SAM 940 Viewer (see Section 7.1)

GPS Logging Data

A unique feature of the SAM is its ability to provide spectral data and GPS logging data simultaneously. The logging feature sends date, time, count rate (gCPS) and GPS data to the CF card. This log can be printed or used with other software running on a PC for mapping (mapping software is specialized and not available from BNC).

GPS Log Files

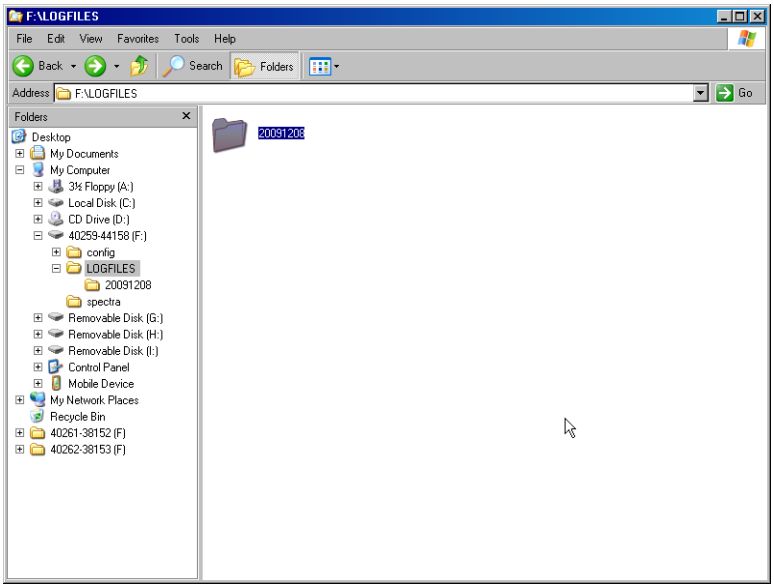
Remove the CompactFlash (CF) card from the CompactFlash slot behind the rubber port cover on the front of your SAM 940 (refer to Figure 6 in Chapter 2). Insert the CF card in the media bay or the CF/USB Interface device for your PC / laptop. In either case, the device will be assigned a drive letter (often D:, E:, or F: – we will assume E: throughout this document).



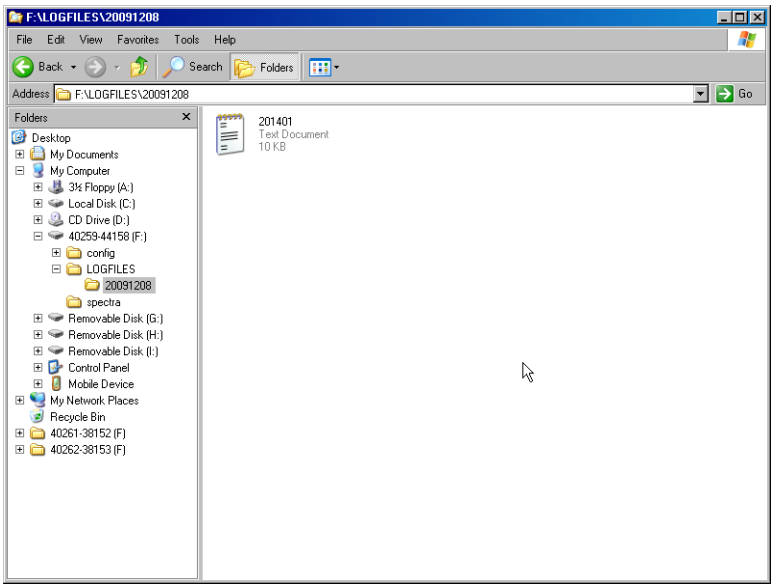
The directory includes the 4 items as shown above:

- SAM950.ACE – Compressed Firmware driver files.
- Config folder – Configuration settings, includes libraries and user info.
- Spectra folder – Stored spectra (.N42 files are spectra located inside spectra folder.)
- LOGFILES folder – GPS Log Files

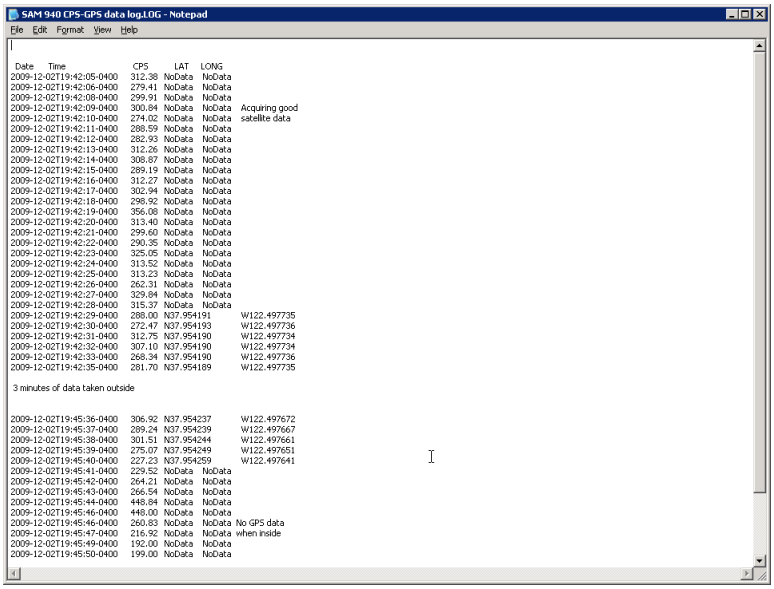
For SAM 940 firmware version 3.8.2 and greater, the directory will also include a Library folder.



Open the LOGFILES folder as shown on the previous page, and there will be another folder labeled with a date. Inside this dated folder is the file containing the logging data and labeled with a time corresponding to the time GPS logging was started. If the *Logging Interval* (Section 5.3.2 *Admin* Menu) is active when the SAM powers up, a new folder will be created in the LOGFILES folder with today's date.



Subsequently, a new Log File will be created in the dated folder. The new file will be titled with the time that the SAM begins receiving data from the GPS receiver. A full day of logging can be kept in this file. To create another file simply turn the SAM off and back on. Alternately, a new file can be created by navigating to the Admin menu and changing the *Logging Interval*. If a new *Logging Interval* is not selected but is instead changed back to the original interval, there will be an empty file noted by "0 K" bytes. On following days, a new dated folder will appear in the LOGFILES folder containing new logging files. This sequence will keep all logging files organized.



The Log File will capture Date, Time, CPS, Lat., and Long. data. An annotated example is shown on the previous page . To restart a new log file, either (a) turn the SAM power off and back on, or (b) select a different *Logging Interval* in the *Admin* menu and then change it back. For example if you change the *Logging Interval* from 2 seconds to 1 second and then back to 2 seconds, you might get a (brief) new log file at the 1 second rate, but a new log file at the 2 second interval will be created and titled with the time that the new file begins.

In the *Admin* menu, you may also choose a *Logging Mode*.

The default for displaying gamma counts is *Basic*. In the *Basic* mode, you will display total counts across the entire spectrum for each Log Interval entry. In the *Isotopes* mode, you will create a column for each isotope in the currently active trigger list, and record the gamma counts associated with a particular isotope for each GPS coordinate in the GPS Log Files. In the *Spectrum* mode, you will create a column for each channel in the SAM spectrum display, and record the gamma counts associated within an energy range for each GPS coordinate in the GPS Log Files. Once the *Logging Mode* is selected, you may begin a new log file by briefly changing the *Logging Interval* to OFF and then re-enabling the *Logging Interval*. The log file will begin recording gamma counts according to the selected mode. This comma separated value (.csv) data can be exported into spreadsheet software such as Excel as shown.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Date/Time	CPS	Latitude	Longitude	K40	Co57	Co60	Ga67	Tc99m	I125	I131	Ba133	Cs137
2643	2010-03-18T18:35:03-0400	2337.95	N37.954536	W122.497329	0	0	0	0	0	0	0	0	0
2644	2010-03-18T18:35:04-0400	2388.35	N37.954534	W122.497327	0	0	0	0	0	0	0	0	0
2645	2010-03-18T18:35:05-0400	2487.68	N37.954528	W122.497324	0	0	0	0	0	0	0	0	0
2646	2010-03-18T18:35:06-0400	2352.71	N37.954528	W122.497324	0	0	0	0	0	0	0	0	0
2647	2010-03-18T18:35:07-0400	2490.37	N37.954525	W122.497322	0	0	0	0	0	0	0	0	0
2648	2010-03-18T18:35:08-0400	2514.89	N37.954523	W122.497321	0	0	0	0	0	0	0	0	59.93
2649	2010-03-18T18:35:09-0400	2595.89	N37.954521	W122.497320	0	0	0	0	0	0	0	0	56.41
2650	2010-03-18T18:35:10-0400	2605.13	N37.954519	W122.497319	0	0	0	0	0	0	0	0	124.76
2651	2010-03-18T18:35:11-0400	3328.42	N37.954516	W122.497318	0	0	89.67	0	0	0	0	0	409.36
2652	2010-03-18T18:35:12-0400	4366.47	N37.954516	W122.497315	0	0	133.98	0	0	0	0	0	547.57
2653	2010-03-18T18:35:13-0400	4603.88	N37.954511	W122.497314	0	0	102.87	0	0	0	0	0	431.7
2654	2010-03-18T18:35:15-0400	4232.71	N37.954509	W122.497313	0	0	0	0	0	0	0	0	86.64
2655	2010-03-18T18:35:16-0400	2908.96	N37.954503	W122.497310	0	0	0	0	0	0	0	0	64.57
2656	2010-03-18T18:35:17-0400	2670.16	N37.954503	W122.497310	0	0	0	0	0	0	0	0	0
2657	2010-03-18T18:35:18-0400	2515.52	N37.954501	W122.497308	0						0	0	0
2658	2010-03-18T18:35:19-0400	2337.73	N37.954499	W122.497306	0						0	0	0
2659	2010-03-18T18:35:20-0400	2419.06	N37.954497	W122.497305	0						0	0	0
2660	2010-03-18T18:35:21-0400	2265.27	N37.954524	W122.497296	0						0	0	0
2661	2010-03-18T18:35:22-0400	2352.71	N37.954513	W122.497294	0						0	0	0
2662	2010-03-18T18:35:23-0400	2337.84	N37.954513	W122.497294	0						0	0	0
2663	2010-03-18T18:35:24-0400	2373.31	N37.954509	W122.497293	0						0	0	0
2664	2010-03-18T18:35:25-0400	2392.46	N37.954483	W122.497296	0						0	0	0
2665	2010-03-18T18:35:26-0400	2395.47	N37.954483	W122.497296	0						0	0	0
2666	2010-03-18T18:35:27-0400	2393.56	N37.954483	W122.497296	0	0	0	0	0	0	0	0	0
2667	2010-03-18T18:35:28-0400	2381.86	N37.954482	W122.497296	0	0	0	0	0	0	0	0	0

THE Co60 WAS OFFSET FROM THE Cs137 SO THE COUNT RATES ARE LESS FOR THE Co60, BOTH IN ABSOLUTE COUNTS AND IN DURATION OF LOGS GENERATED.

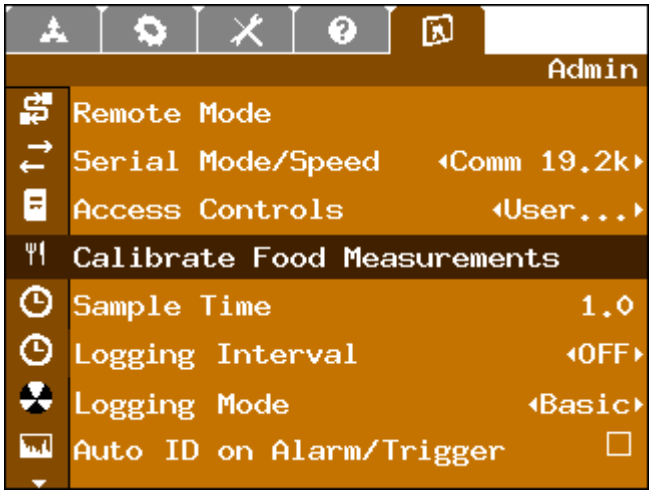
Appendix B – Food Measurements

Specialized applications like food, soil, and water inspection typically require Quantitative Analysis in order to provide measurements of radioactivity in relation to volume or mass.

Calibrate Food Measurements

Before performing analysis, the detector efficiency must be calculated for the energy associated with each isotope to be analyzed. The efficiency of the detector can be expressed as the ratio of the rate of gamma counts per amount of activity for a specific isotope. Efficiency Calibration is the means by which this data is known.

If the calibration activity is small then there will be quite a bit of statistical error built into the efficiency determination. Therefore, use a known calibration source large enough to gather good quality statistics within a 15 minute acquisition. For example, a 25 nCi calibration source may be used for reliable accuracy of samples at 375 pCi. For the best accuracy, the background acquisition should be performed with a matrix similar to the sample being analyzed. For example if the sample being analyzed is milk, then use a non-radioactive fluid similar to the density of milk.

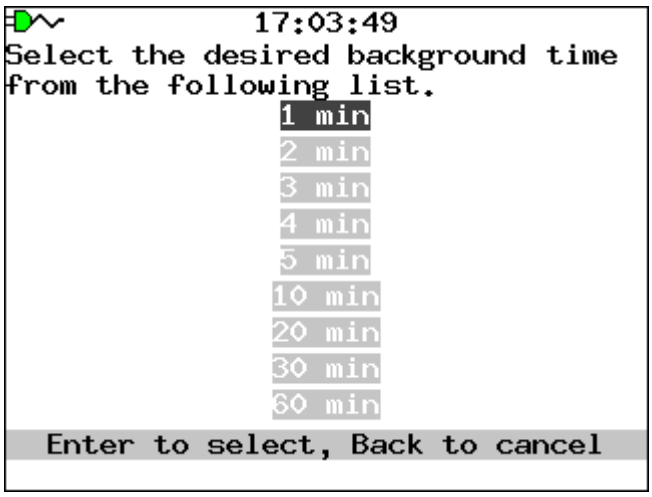


From the *Admin* menu, use the UP and DOWN arrow keys, to select *Calibrate Food Measurements*, then press ENTER.

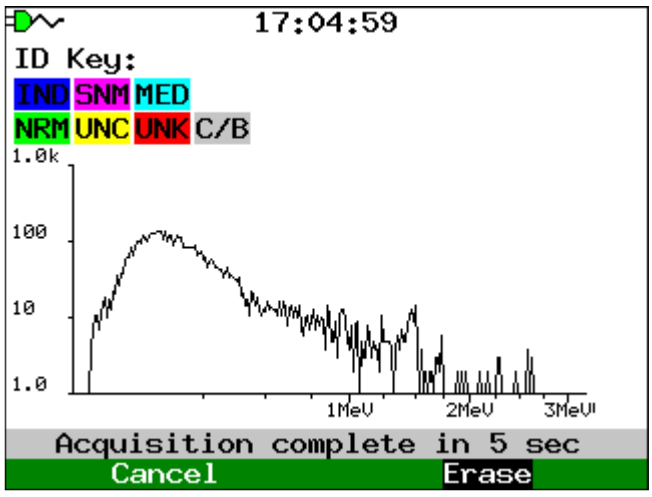
Background

The first process is to observe and store a reference background spectrum with the SAM 940 before continuing through the calibration process.

You will be asked to select the amount of time for your reference background acquisition. Use the UP and DOWN arrow keys to scroll to the appropriate amount of time for your acquisition. If the food samples to be tested are expected to have little or no radiation activity, then it is recommended that 15 minutes is the minimum amount of time for the reference background.



When the background time has been selected, press ENTER

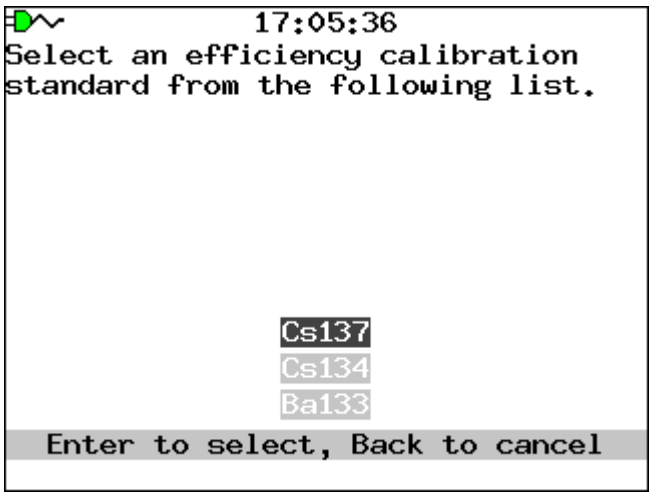


The SAM 940 will count down the remaining time until the completion of the reference background spectrum.

Calibration

Most food inspection is directed toward identifying isotopes that are likely to be in the soil and water as the aftermath of a fission event. The most common isotopes to be present after such an event are Cs137, Cs134, and I131. You will be asked to calibrate each isotope using a certified check source of each isotope. Ba133 is substituted for I131 because the very short half-life (8 days) of I131 makes it very difficult to obtain and store a certified amount for a practical amount of time.

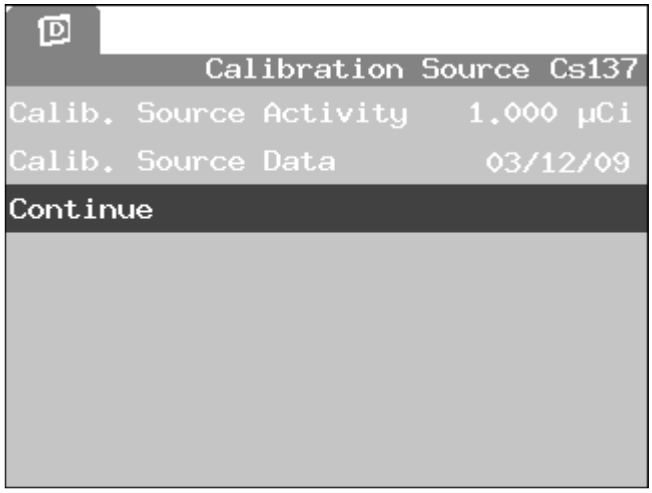
The industrial isotope Ba133 is chosen because it is very common, easily obtainable, and it also possesses a primary energy line that is characteristic of I131.



You will be asked to select one of the three isotopes. Using the UP and DOWN arrow keys, scroll to the appropriate selection. Press ENTER.

Efficiency Calibration of Cs137

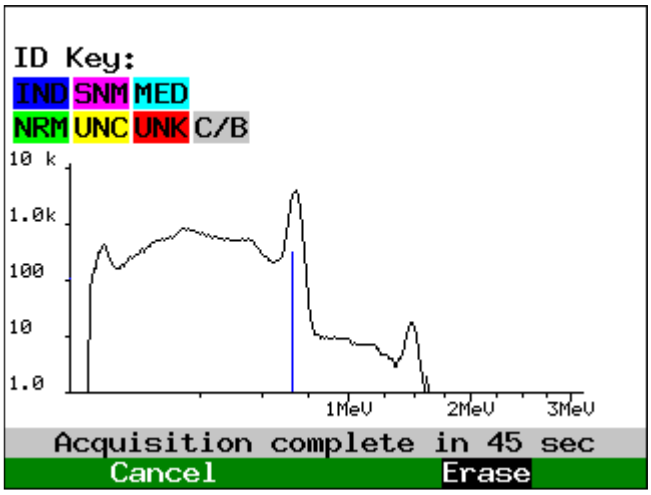
You will be asked to confirm the activity and certification date of your calibration source. If the activity and date are correct, press ENTER. If you wish to edit the activity or certification date, press BACK. Edit the necessary changes, then highlight *Continue* and press ENTER.



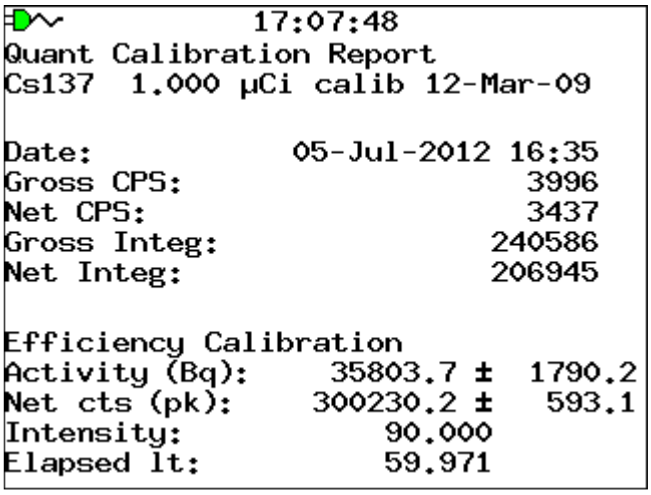
You will again be asked to confirm that the activity and date are correct. If they are, press ENTER If they need to be corrected, press BACK.

Just as with the background reference, you will be asked to select the amount of time for your calibration acquisition. It is best that you use the same amount of time as was used for the background. Use the UP and DOWN arrow keys to scroll onto the appropriate amount of time for your acquisition. Press ENTER.

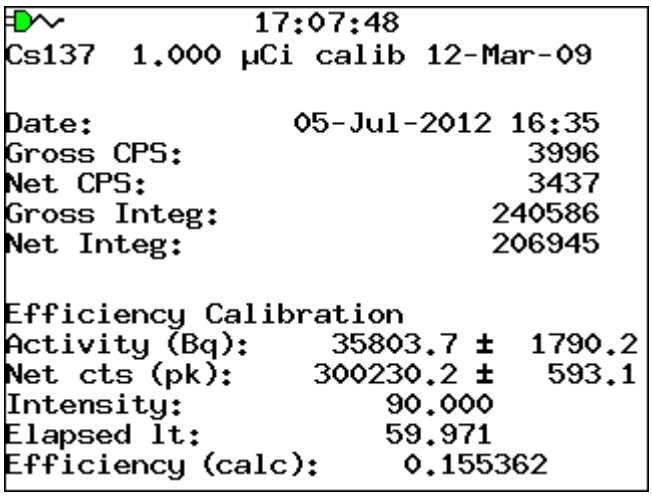
You will be prompted to place the certified isotope standard appropriately for calibration. After proper placement, press ENTER.



You will observe a spectrum that is dedicated to the primary energy line of the particular isotope.



When the calibration acquisition is complete, the SAM will display the *Quant(itative) Calibration Report*.



A copy of the *Quant Calibration Report* will also be stored as a text file (SPEC*nnnn*.txt) in the Spectra folder on the SAM 940 CF card for later reference.

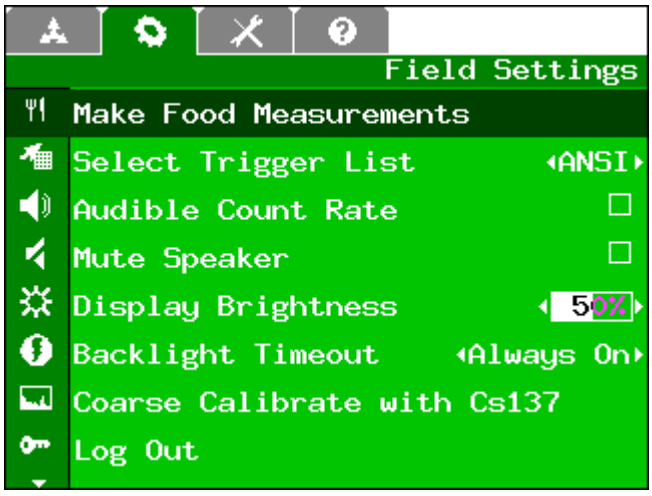
It is important to note that the Calibration Reports cannot be recalled when reviewing spectra files from the SAM 940's *Spectral Data* menu.

Press BACK to close the report. Repeat the process of Efficiency Calibration for Cs134 and Ba133.

When the Efficiency Calibration is complete for all three isotopes, the values are saved in the CF and need not be re-calibrated as long as all subsequent Food Measurements are performed with that particular detector.

Make Food Measurements

From the *Field Settings* menu, use the UP and DOWN arrow keys, to select *Make Food Measurements*, then press ENTER.

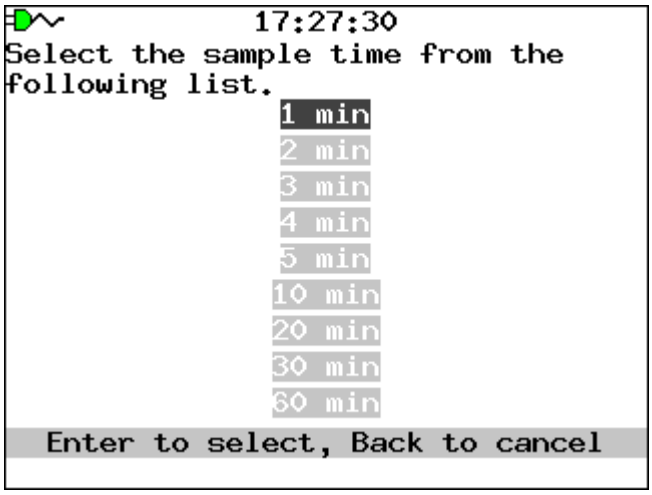


Background

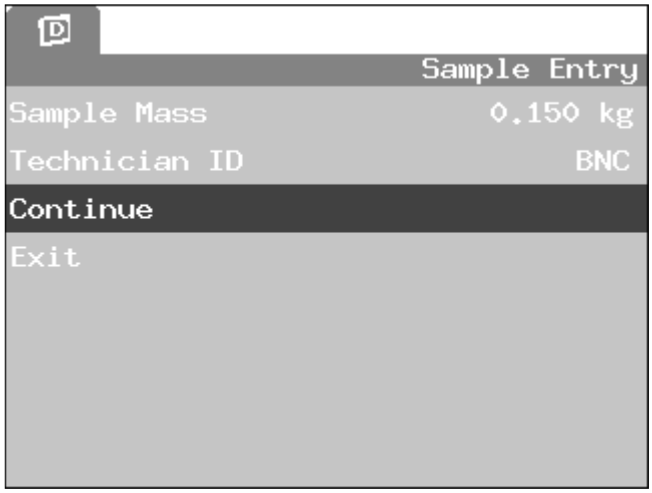
You will again be asked to select the amount of time for your background acquisition. It is best that you use the same amount of time as was used for the calibration acquisitions.

Sample

You will be asked to select the amount of time for your Sample acquisition.



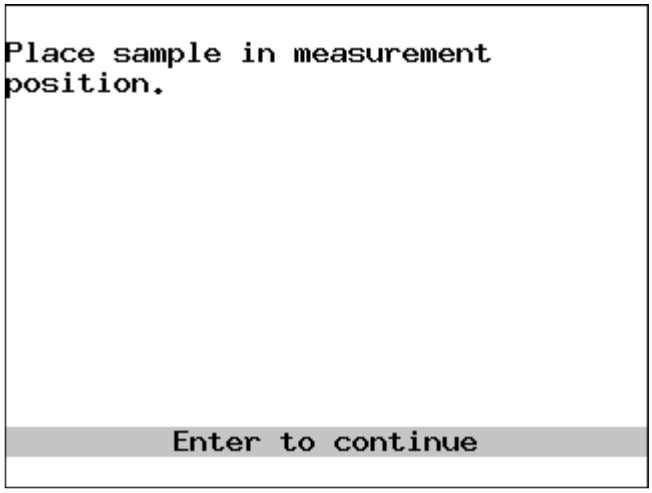
As a rule of thumb, it is best to select a Sample time that is equal to stored Background and Calibration time. Use the UP and DOWN arrow keys to scroll onto the appropriate amount of time for your acquisition. Press ENTER.



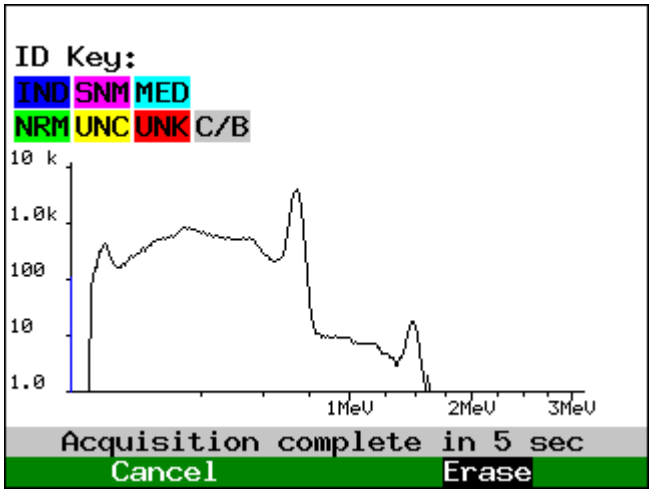
You will be prompted to provide the mass of the Sample to be inspected. Scroll to the *Sample Mass* selection and enter the mass in kilograms (kg).

You may also scroll to the *Technician ID* selection to enter an additional identifier to the sample acquisition for easier reference when reviewing your data.

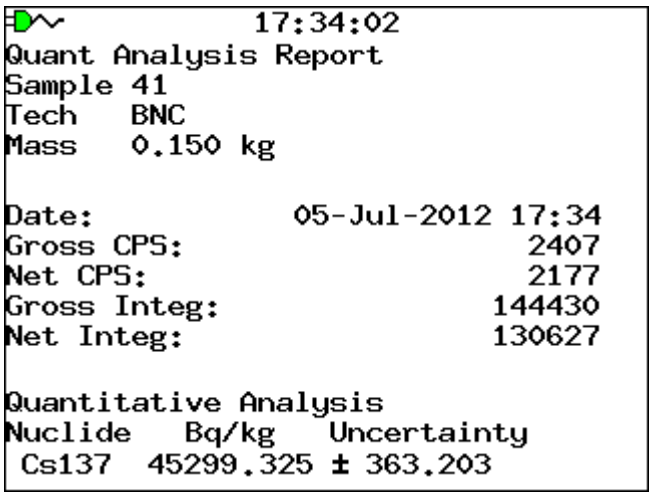
Select and press *Continue* , for further directions, or press *Exit* to begin again.



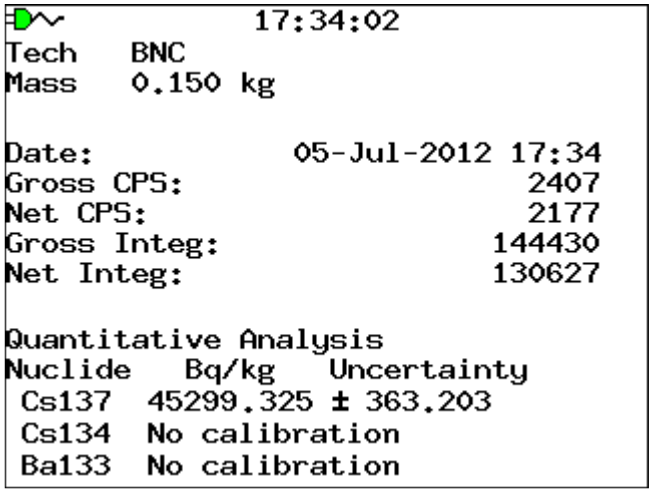
You will be prompted to place the sample appropriately for measurement. After proper placement, press ENTER.



You will observe the spectrum as the data is acquired. Note that the spectrum peaks are not colored and named, as in a typical *ID* spectrum. Food Measurement is dedicated to only the three isotopes Cs137, Cs134, and Ba133.



When the sample acquisition is complete, the SAM 940will display the *Quant(itative) Analysis Report*.



A copy of the *Quant Analysis Report* will also be stored as a text file (SAMP*nnnn*.txt) in the Spectra folder on the SAM 940 CF card for later reference.

It is important to note that the Quant Calibration Reports cannot be recalled when reviewing spectra files from the SAM 940's *Spectral Data* menu.

Press BACK to exit. You will return to the *Sample Entry* screen. You may enter a new mass value for the next sample, then proceed again.

When sample measurements are complete, scroll to *Exit* and press ENTER to return to the *Field Settings* menu.