GR-135G Plus
The Identifier

System Manual

Revision 1.0, December 15, 2006

Part Number: 87617-1

SAIC®
From Science to Solutions™

Exploranium
A Division of SAIC Canada

Revision History			
Revision	**Date**	**ECO**	**Description**
Rev 1.0	Dec 15, 06	-	Initial release

Disclaimers:

1. Every effort is made to provide accurate and complete information, however, due to our continual efforts to improve the product; specifications, dimensions, engineering drawings and operating procedures may change without notice. This may lead to discrepancies between the hardware design (engineering drawings) and the current version of the manual, the engineering drawings will always take precedence.
2. If a discrepancy appears between the electronic version of the product manual delivered on the Product Support CD and the hard copy of the manual included with the product, the electronic version will always take precedence.

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USERS ARE HEREBY NOTIFIED THAT THIS MANUAL CONTAINS TECHNICAL INFORMATION OF A PROPRIETARY NATURE. THIS INFORMATION IS NECESSARY FOR TECHNICALLY KNOWLEDGEABLE USERS TO UNDERSTAND SYSTEM OPERATION AND TO SATISFY THEMSELVES THAT THE SYSTEM IS PERFORMING CORRECTLY.

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Manufactured by SAIC Exploranium, 6108 Edwards Blvd, Mississauga, Ontario, Canada, L5T 2V7

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1.0 GENERAL SYSTEM DESCRIPTION

The **GR-135G Plus** - **THE IDENTIFIER** - represents a major breakthrough in the field of radiation monitoring, offering the user the ability to search for and locate specific radioactive material. The calibration coefficients for the ASSAY Mode have been established by SAIC Exploranium on calibration pads (concrete blocks with known concentrations of K, U, and Th), the stripping coefficients have been burned into the EEPROM and cannot be altered by the user. This makes the GR-135G Plus an excellent reconnaissance tool for geological applications, providing the user with a good idea of the concentration and trends of Potassium (K), Uranium (U) and Thorium (Th).

Additional features of the unit include:

- Semi- Automatic STABILIZATION
- Data Memory for both Survey and Spectral Data
- The DOSE RATE function is operational and calibrated
- SET-UP menus for the operating parameters of the different modes.

1.1 GR-135G PLUS HARDWARE VERSIONS

a) **GR-135G Plus** – the Geophysical GR-135G Plus model is similar to the GR-135B basic model with the exception that the EPROM has been modified to permit an ASSAY type mode evaluation of the measurement. The Analysis Mode from the Basic unit is replaced with the ASSAY Mode in the Geophysical model. This model replaces the older GR-130 model.

Note: Wherever the name **GR-135** is noted in this manual, it shall refer to the **GR-135G Plus** model, also wherever the word *isotope* is used in the manual it will also mean *nuclide*.

b) **DOCKING STATION** (OPTIONAL) – this model can be supplied with an Optional Docking Station (DS). For more information about the DS see **Appendix D**.

1.2 SOFTWARE RELEASES

This manual describes the current software release as defined in the title, all information regarding system software or hardware changes and improvements are detailed in **Appendix H**.

1.3 BASIC SYSTEM OPERATION

The GR-135 is normally delivered with the Mode switch set in the Automatic position but it can also be run in the Manual Mode. The Automatic/ Manual mode switch is located behind the battery door and can be set to either Manual or Automatic Mode (see Figure 2-1).

GR-135 Modes of Operation:

AUTOMATIC MODE (See Appendix J for Quick Start):

Restricted to **SEARCH** and **ASSAY** functions only, all other functions are disabled to simplify system use by non-technical personnel.

Note: Normally the GR-135 needs to be connected to the 12V power cable (or in the optional Docking Station (DS)) when not in use. System parameters normally require being

connected to the 12V power cable (or placed into the DS) at least once every 24 hours for stabilization to occur. The DS has a built in Cesium (Cs137) source to make stabilization simple, but the user must place a Cesium (Cs137) source face first into the hole provided in the yellow protective boot for stabilization to occur when connected to the 12V power cable.

- The GR-135 will stabilize itself while (placed in the optional DS) connected to a12V power cable with a cesium source in place (see Chapter 7.0), while the batteries are being recharged.
- The GR-135 will begin operating as soon as it is lifted from the docking station and operates within a restricted simplified mode of operation.
- The modes of operation are **SEARCH** and **ASSAY**, while all other options are not accessible by the operator. (This mode is good for operators who do not require a detailed analysis).
- The Screens SEARCH, and ASSAY in Automatic Mode have a navigation menu displayed (see Chapter 3.0) at the bottom of the screen to help the operator choose joystick control functions.
- When the operation is complete and the GR-135 is no longer required it is connected to the 12V power cable with a Cesium (Cs137) source in place for stabilization or it is placed back into the docking station (with a built in Cesium (Cs137) source). This allows the batteries to be recharged and the unit to remain stabilized.

MANUAL MODE – unrestricted system operation **(See Appendix K for Quick Start):**

Selection between modes is via a special switch in the battery compartment to restrict unauthorized adjustments (refer to Figure 2-1 for location).

- The user has access to all the screens available to the GR-135 in Manual Mode. The GR-135 in Manual Mode is used to perform the following functions:

  Note: Turn the GR-135 ON by clicking the joystick down (held for at least 2 seconds) and allowing the unit to initialize.

  - SEARCH + DOSE – (refer to Chapter 5.0)

    Stabilize the unit before starting (see Chapter 7.0), and from the MAIN Menu select SEARCH+DOSE, a (long) click down on the joystick will begin the SEARCH Mode.

  - ASSAY – (refer to Chapter 6.0)

    Stabilize the unit before starting (see Chapter 7.0), and from the MAIN Menu select ASSAY, a (long) click down on the joystick will begin the ASSAY Mode.

  - STABILIZE – (refer to Chapter 7.0)

    From the MAIN Menu select STABILIZE and connect the unit to a 12V power cable with a Cesium (Cs137) source in place or place the unit into the optional docking station (see Chapter 7.0). Press ENTER to begin.

  - DATA MEMORY – (refer to Chapter 8.0)

    From the MAIN Menu select DATA MEMORY, a (long) click down on the joystick will display the DATA MEMORY screen, which will allow the operator to transfer stored survey, dose or spectral data to an external PC.

  - SETUP – (refer to Chapter 9.0)

    From the MAIN Menu select SETUP, a (long) click down on the joystick will display the SETUP Menu, where the user can select operating parameters to change in accordance with their site design requirements (see Appendix E).

  - MAINTENANCE – (see Chapter 10.0)

From the MAIN Menu select MAINTENANCE, a (long) click down on the joystick will display the MAINTENANCE Menu, where the user can perform maintenance functions as well as load libraries and view system status.

- Placing the GR-135 unit back onto the 12V power cable or into the optional docking station will automatically start the battery charger (see Section 3.4).

First time operation of the GR-135 is as follows:

Note: Refer to **Appendix J** for a guide to the Automatic Mode Quick Start or to **Appendix K** for a guide to the Manual Mode Quick Start.

1. Plug the docking station (DS) into an electrical source using the supplied adapter cable (see Appendix B.1 for cable selection).
2. Remove the yellow GR-135 protective boot from the unit.
3. Remove the rear cover and load the batteries (see Figure 2-1 and Section 2-3), leave the cover off.

   Note: While rechargeable batteries are shipped fully charged, they will self-discharge with time when not in use. It is important to condition new batteries, whether received with the system or purchased separately. To get reliable performance and full capacity out of the batteries throughout their life, it is important to let them fully discharge and then fully re-charge for 12 hours at least once every two months. This will assure that the batteries provide 8 (12) hours of operation.
4. The GR-135 is delivered factory set to Automatic Mode.
5. Place the GR-135 onto the 12V power cable or into the optional DS, the GR-135 will turn ON automatically and begin to charge the batteries and start stabilization (an integrated 0.25µCi (9.25 kBq) Cesium-137 source is present in the DS).

   Note: The unit will only STABILIZE automatically in the docking station with the GR-135 set to Automatic Mode. When the GR-135 is set to Manual Mode it must be stabilized from the MAIN Menu using the STABILIZE option (refer to Chapter 7.0) before placing it onto the docking station.
6. Remove the GR-135 from the 12V power cable or the optional DS when the battery icon shows a full charge.
7. Setting up the system parameters requires the GR-135 to be set in the Manual Mode. While the rear cover is removed, move the switch to the Manual (M) position (see Figure 2-1).
8. From the MAIN Menu select SETUP, a (long) click down on the joystick will display the SETUP Menu where the user selects operating parameters to change in accordance with their site design requirements (see Appendix E for Default Parameters).
9. Turn the GR-135 OFF by clicking the joystick forward (for approximately 5 seconds) until the countdown is finished and the LCD goes blank.
10. Select the mode of operation; either **Automatic** (**A**) or **Manual** (**M**) (see Section 2.4) as desired to use for Normal Operation and replace the rear cover.

    a. In **Automatic** Mode the GR-135 will begin SEARCH Mode immediately after removal from the 12V power cable or the optional docking station. Refer to **Appendix J** for a guide to Automatic Mode Quick Start.

       Note: During normal operation the system will operate within 2 primary radiation monitoring functions; SEARCH Mode and ASSAY Mode (the results of which is displayed in ASSAY - Results). The user will not have access to any other system options.

    b. In **Manual** Mode the user must first turn the GR-135 **ON** by clicking the joystick down (held for at least 2 seconds) and allow the unit to initialize. From the MAIN Menu the

user selects SEARCH+DOSE, a (long) click down on the joystick to begin the SEARCH Mode. Refer to **Appendix K** for a guide to Manual Mode Quick Start.

Note: Access to all system options from the MAIN Menu is open to the user, but normally the user will operate the system using the SEARCH+DOSE and ASSAY MODE from the MAIN Menu (2 primary radiation monitoring functions). ASSAY - Results will be displayed as a result of the ASSAY Mode.

11. Continue with normal operation.

Note: To turn the GR-135 **OFF** click the joystick forward (for approximately 5 seconds) until the countdown is finished and the LCD goes blank.

When not in use, replace the GR-135 back onto the optional docking station or connected to the 12V power cable with the Cesium (Cs137) source in place. The GR-135 will begin to charge the battery and stabilize the unit as required.

1.4 NORMAL OPERATION (PRIMARY MONITORING FUNCTIONS)

The GR-135 may be operated in 2 **Primary** radiation monitoring functions.

a) **SEARCH + DOSE** Mode

In this mode, the GR-135 acts as a SEARCH Meter displaying the current COUNT RATE in counts/sec. A variable-tone AUDIO will indicate radiation intensity with an automatic audio-meter or user adjusted alarm level. A “chart-record” of the last 100 data points is displayed on the screen during the SEARCH. This mode is typically used to search for radioactive material or to carry out Total-Count grid Search.

This mode also displays the current DOSE RATE (in selectable units and quantities) as well as ACCUMULATED DOSE from the time the mode was enabled. The dose meter is used to determine the relative hazard level and to assess handling requirements of a radioactive material. Dose Search of an area can also be carried out in this mode.

Note: The DOSE RATE function is operational and calibrated.

b) **ASSAY** Mode – (GEO Identification)

In this mode, the GR-135 accumulates data concerning the concentration and trend of naturally occurring radioactive materials (Potassium (K), Uranium (U), and Thorium (Th). At the end of the user defined sample period, the display indicates the ground concentration of K in %K and cpm, eU and/or eTh in ppm and cpm (extending the measurement time (see Section 9-3 para a)) will improve the accuracy of the readings).

Note: The Calibration coefficients for the ASSAY Mode have been established by SAIC Exploranium for this GR-135 on calibration pads (concrete blocks with known concentrations of K, U, and Th), these have been burned into the EPROM and cannot be altered by the user. **DO NOT ALTER** the Regions of Interest (ROI 1-3) channel settings as they were derived during calibration. In the event they are changed the actual values are recorded on the calibration sheet as Windows #2, #3 and #4 respectively. These ROIs or windows are imbedded in the unit and in the event that the user resets “Default Values” the correct values will be inserted in to the unit.

The ASSAY cannot be calculated post mission from the spectral data as the accompanying software does not permit it. However, the spectrum can be saved and played back using the DATA MEMORY feature, note the spectrum will be ASSAYED again prior to playback.

Note: The ASSAY values are displayed and not stored!

1.5 SYSTEM FEATURES

a) **INSTRUMENT BODY** – The instrument body consists of 2 primary parts, the lower case and top panel. The lower case is deep-formed aluminum that provides a strong basic structure. The top panel is specially formed ABS plastic that minimizes weight while maintaining the ruggedness of the unit. The combination of the two parts provides a high degree of system strength, suitable for field operations where mechanical abuse may be unavoidable.

b) **DETECTOR** –

i. **NaI** – The 4.0 cu. in. (0.065L) Sodium-Iodide [NaI (Tl)] detector assembly is specially designed for rugged environments. The NaI crystal is enclosed in a specially molded rubber sleeve to give a high degree of mechanical protection against shock and is fully enclosed within the instrument body.

ii. **GM** – the rugged GM tube is mounted just behind the instrument front face and is used to extend the Dose Rate range to 1R+ (1mSv+) for special applications.

c) **HANDLE** – The handle is a custom designed molded rubber part with a carefully designed diameter and special indentations for fingers. The rubber type was selected to give a good balance between strength and comfort.

d) **JOYSTICK** – The GR-135 has only one operating control - the rubber-covered joystick on the handle. All system functions are controlled by the **JOYSTICK** that permits very easy instrument operation **EVEN WHEN WEARING GLOVES IN A BIOHAZARD SUIT.** The **JOYSTICK** is a specially designed switch with five actions – UP, DOWN, LEFT, and RIGHT. The **JOYSTICK** and use of menu driven functions makes the GR-135 very easy to operate and avoids the necessity of "memorizing" complex sequences of action.

e) **DISPLAY** – An LCD is used for the GR-135 to permit a full range of alphanumeric and graphic display capabilities. This LCD gives excellent contrast in high light conditions but is not easily visible in low light conditions.

To solve this problem, the system has a "BACKLITE" function, which provides excellent visibility in a low light environment. The display contrast may also be manually adjusted depending on ambient light conditions. The unit also incorporates automatic temperature compensation to maintain correct contrast even when the temperature substantially changes.

f) **BACK-DOOR** – The GR-135 has a back door that is removable by a 1/4 turn of the slotted fastener. The door may be removed to allow access to the battery compartment to change batteries and the I/O connectors as required. Use these connectors if the optional Docking-Station is not used. The door is sealed with a gasket to provide a high degree of water protection when in place (see Figure 1-1).

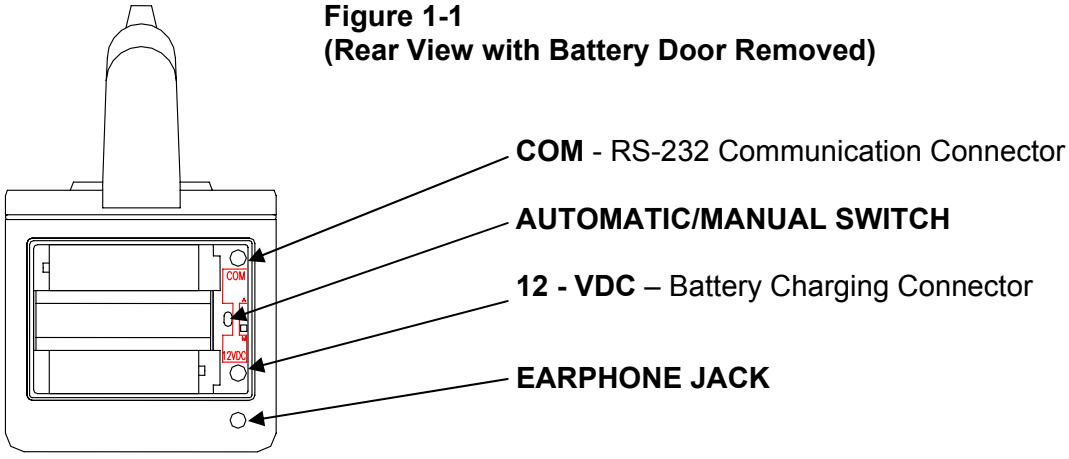


Figure 1-1
(Rear View with Battery Door Removed)

g) **BATTERIES** – The GR-135 requires two D-cell batteries. Three types of batteries can be used. Standard Nickel-Cadmium rechargeable batteries provide 8 hours of normal operation when fully charged. Nickel-Metal Hydride rechargeable batteries provide 12 hours of operation when fully charged. Alkaline batteries provide 12 hours of normal operation and are the preferred type when operating in cold field conditions.

WARNING: When using **Alkaline Batteries** with the Docking Station or connecting a power cable directly to the unit always make sure that the GR-135 Battery is set to **NO/CH *(refer to Section 9.7 – Miscellaneous)***. If this is not done, ***it will result in battery leakage and extensive system damage*.**

While rechargeable batteries are shipped fully charged, they will self-discharge with time when not in use. It is important to condition new batteries, whether received with the system or purchased separately. Conditioning is achieved by first totally discharging the batteries in the GR-135 unit and then fully charging them using the special cable (PN 87387-1) plugged into the cigarette lighter of the vehicle for at least 12 hours.

Note: To get reliable performance and full capacity out of the batteries throughout their life, it is important to let them fully discharge and then fully re-charge for 12 hours at least once every two months. This will assure that the batteries provide 8 (12) hours of operation.

CAUTION: To save battery life It is recommended to turn the backlight off if the unit is not expected to be used for a period of time. It is also recommended to set backlight to 5 sec, which will turn backlight on when the joystick is touched for a user selected time.

h) **BATTERY-CHARGER** – the GR-135 battery charger is INTERNAL. This feature has been added as this permits the battery charging system to be fully under software control. With the increased availability of specialty batteries, this feature means that a wide variety of battery types can be used in the instrument – the user simply selects battery type and the charger automatically selects the correct charging parameters for this battery type.

i) **NON-DS OPERATION** – a docking station is not recommended and may be unsuitable for use with the GR-135G Plus, as the unit is meant to be used in the field. The GR-135G Plus is provided with special cabling for charging/data I/O and a test source to permit NON DS **GR-135G Plus** operation.

DOCKING STATION (DS) Optional – Most GR-135 users find that the Docking Station internal source makes it easier to control sources, as small system test sources are easy to lose. This device is a cradle that the GR-135 unit sits in (**see Appendix D**). The cradle is connected to the **AC** connection, has an **internal radioactive source** (exempt quantity) and may be directly connected to a **PC**. 4 "fingers" on the base of the GR-135 connect to mating 4 fingers on the Docking Station to provide charging and data connections `without opening the rear access data door.

Please advise SAIC Exploranium, as a **DOCKING STATION KIT** is available as an option and the system comprises:

- the DS chassis - a special base that the GR-135 is seated in
- the system Test Source mechanically embedded in the DS
- an AC adaptor
- an RS-232 signal cable (PN 60-320-232) refer to Appendix B.1.

This unit includes a very low activity radioactive source. It is considered an EXCEPTED PACKAGE as specified in US NRC 49CFR 173.424 for radioactive material, excepted package-instruments or articles, UN2910. Refer to Appendix H for proper handling of Check Sources.

Note that a stick on label (see figure) is on the optional DS unit that specifies the fact that the internal test source requires no licensing and no transport restrictions apply. See the (Appendix H) in this manual for specific details of the applicable documents to source possession and transportation.

j) **SYSTEM SUPPORT SOFTWARE** – Support software named **IdentiView** is provided with the GR-135 on a CD-ROM. This is a Windows based program and operates under Windows 98, NT, 2000 and XP. The program is discussed in **Appendix A** and provides data downloading, data display, custom library uploading, spectrum display analysis and various other features - as well as ASCII downloading to produce the data in a format suitable for importing into various Spreadsheet programs.

k) **BOOT** – A yellow "boot" is provided with the unit. This boot is custom molded from a compressive material and, once installed, provides a high level of protection from accidental mechanical damage. With the boot in place, the unit's basic rugged design is further improved, enabling the unit to withstand accidental drops or "knocks" against hard material. The boot also provides an advantage when the unit is placed on wet or muddy ground by keeping the unit clean and free from dirt. Note that this boot adds slightly to the system weight and is easily removed if required, however SAIC Exploranium recommends using the unit with the boot in place whenever possible.

Note: A hole is provided in the yellow boot to support the test source.

l) **VINYL CARRYING CASE** – The system is supplied with a soft vinyl carrying case with shoulder strap for easy transportation of the GR-135. An easy-open zipper flap allows access to the instrument while providing additional weather protection. The carry-case also has an external pocket for carrying notebooks, etc.

m) **MANUAL** – The user manual is supplied with the instrument.

n) **SHIPPING/STORAGE CASE** – The GR-135 system is shipped to the customer in a rugged black polyurethane carrying case that is fully waterproof and highly shock resistant. This case is intended for shipping and/or storage purposes. It is equipped with a pressure purge valve and is capable of withstanding air-cargo shipping abuse while offering a high level of protection to the instrument. On site, most users carry the GR-135 in the vinyl carry-case leaving the storage case back at the office. However, if the unit is to be transported under conditions where it could be bumped or dropped, the shipping case is recommended and would prevent other luggage from damaging the instrument.

Note: Even if the user does not intend to use the polyurethane storage case, it should be kept in storage as SAIC Exploranium will only honor the full instrument warranty if the GR-135 is returned in this (or a similar) case.

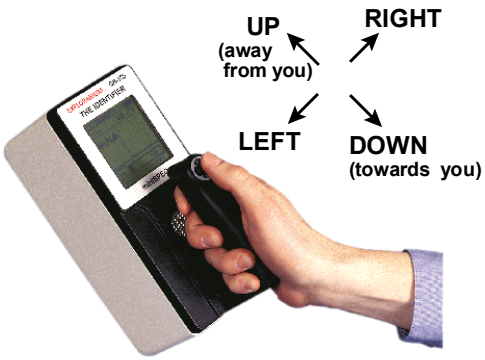
2.0 DETAILED OPERATION GUIDE

This section offers a detailed guide to the system operation. The "**AUTOMATIC**" (= simplified) mode of operation is described in **Chapter 3.0**.

The manual assumes that the unit is being operated in **MANUAL Mode** without the optional DOCKING-STATION (DS) (see **Appendix D** for information concerning the optional Docking Station).

2.1 JOYSTICK

The GR-135 is equipped with a rubber-covered JOYSTICK on the instrument handle, referred to in this manual as the **JOYSTICK** and this is the ONLY control on the instrument. The great advantage of this single button control is that besides being very easy to use it also permits full operation EVEN WHEN WEARING GLOVES – a definite advantage in many applications where protective clothing is required.



JOYSTICK ACTIONS

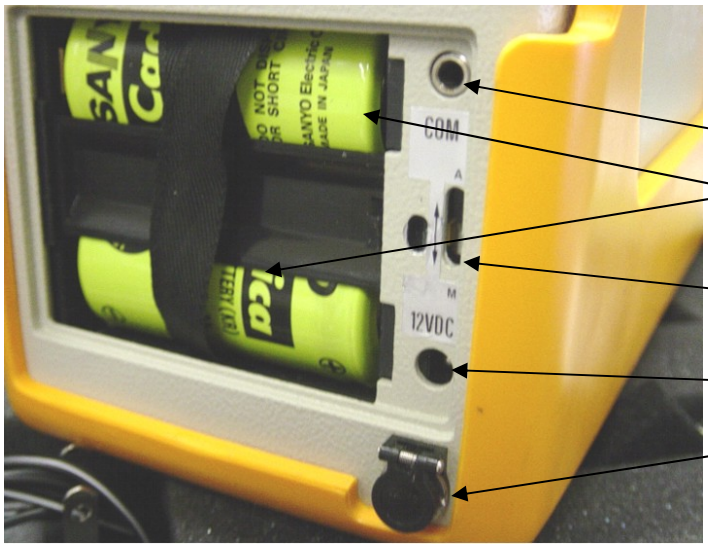
Various Joystick actions are permitted depending on the application:

CLICK UP/DOWN – a **SHORT** (up to 0.5 sec) push (CLICK) of the JOYSTICK **UP** (away from the user) or **DOWN** (towards the user) is used to scroll through the system menus

ENTER – holding the JOYSTICK **DOWN** (toward the ON position on the joystick label) for about **ONE SECOND** (in the manual referred to as **ENTER**) is used to activate the selection highlighted on the display.

CLICK LEFT/RIGHT – SHORT click used in some menus to change parameters and in the Main Menu to adjust display contrast.

2.2 CONNECTIONS – BATTERY COMPARTMENT



Rear View with Battery Door Removed

COM - RS-232 Communication Connector

BATTERIES

AUTOMATIC/ MANUAL SWITCH

12V DC – Battery Charging Connector

EARPHONE JACK

Figure 2-1

The Battery Compartment Figure 2-1 shows the following: (see Appendix B for cable selection)

a) **COM –** plug in the RS-232 Communication cable from the PC serial port to this location.

b) **Batteries –** install the two D-cell rechargeable NiCd batteries in this location. A plastic retainer bar holds the batteries in place. (see Section 2.3 for battery polarity)

c) **AUTOMATIC/ MANUAL Switch** –the switch allows the unit to be placed in either the Automatic Mode (switch in UP position) or Manual Mode (switch in DOWN position).

d) **12V DC** – plug in the Battery Charging or Power cable into this connector.

e) **EARPHONE JACK** – an earphone can be plugged into this location.

2.3 POWER AND STARTUP FUNCTIONS

a) BATTERIES (see Figure 2-1 for location)

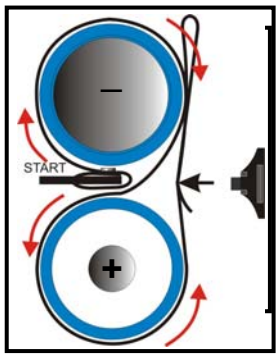
The GR-135 has an integrated Battery-Charging capability which operates with the supplied D-cell (qty 2) rechargeable NiCd batteries. The internal battery charger permits the battery charging system to be fully under software control. An internal temperature sensor in the unit will shut power down if an increased temperature is detected, providing a high level of system protection. With the increased availability of specialty rechargeable batteries, this feature means that a wide variety of battery types can be used in the instrument – the user simply selects battery type and the charger automatically selects the correct charging parameters for this battery type. Consult SAIC Exploranium if special battery usage is required.

WARNING: When using **Alkaline Batteries** with the Docking Station or connecting a power cable directly to the unit always make sure that the GR-135 Battery is set to **NO/CH** ***(refer to Section 9.7 – Miscellaneous)***. If this is not done, ***it will result in battery leakage and extensive system damage*****.**

Remove the batteries to prevent leakage when not in use for an extended period of time (1 month or more).

b) LOADING BATTERIES (see Figure 2-1 for location)

To load the batteries, remove the battery back door at the rear of the instrument by applying a ¼ turn to the door latch. Insert the two rechargeable D-cell batteries with the **"+"** to the small brass ring and the **"-"** to the spring. The fabric strip should be placed behind the batteries to aid in their removal (see figure). Ensure that both batteries are firmly seated, attach the plastic battery retainer clip properly then re-attach the door. (Be sure that the door is properly attached).



c) BATTERY CHARGING

The battery charger is integrated into the GR-135 electronics so the external "battery charging" is really supplying 12VDC to the unit to charge the two "D" cell NiCd batteries in the GR-135 without removing them from the instrument.

This 12V DC input may be supplied from an external AC/DC power source using cable (PN 92309-4) or via a special cable (PN 87387-1) that can be connected directly to the lighter socket of a vehicle. This 12V input is also used to power the unit for extended sampling when normal battery life may be insufficient. Approximately 8 to 10 hours of charging is required to charge a fully discharged set of batteries.

NOTE
APPLYING EXTERNAL POWER TO THE GR135G OPERATES THE UNIT BUT ALSO CHARGES THE BATTERIES. THE BATTERY CHARGER PROVIDED WITH THE GR-135 IS FOR USE WITH NICD "D" CELL BATTERIES ONLY. OPERATING THE CHARGER WHILE ALKALINE BATTERIES ARE IN THE UNIT MAY CAUSE BATTERY LEAKAGE AND MAY SERIOUSLY DAMAGE THE GR-135. SAIC EXPLORANIUM IS NOT RESPONSIBLE FOR ANY DAMAGE CAUSED BY IMPROPER BATTERY CHARGER OPERATION.

d) POWER ON

To switch the unit **ON**, **CLICK DOWN** (towards the user) **for at least 2 seconds**. The display will come on and show Figure 2-1A for a few seconds. The unit is carrying out internal testing to verify that the units' components are functioning correctly during this display.

Figure 2-1A

After approx. 3 seconds this display will be replaced by the normal startup display shown in Figure 2-1B and an audio beep will be heard.

Note: The Active Mode (Manual/ Automatic) will be displayed on the bottom of the screen (Figure 2-1B). See Section 2.2 to change the Mode using the Automatic/ Manual Switch.

If any errors are detected, they are displayed on the optional Docking Station (see **Appendix D**). If no errors are found, the display will change to the Main Menu screen (Figure 2-4) after a few seconds.

Figure 2-1B

e) MAIN MENU

After the initial start-up screen, the GR-135 Main Menu appears. The user may scroll through the menu items by a short click **UP** or click **DOWN**. Reverse "highlighting" shows the current menu item selected.

Menu items are selected by highlighting the desired item and using **ENTER** to activate the selection (see Figure 2-1C).

Figure 2-1C

f) BACKLITE ON

A BACKLITE option is built into the GR-135 such that the display may be viewed in low light conditions. BACKLITE can be enabled in the system setup for frequent use or activated manually for intermittent use. To enable the BACKLITE, be sure that the unit is OFF, then **CLICK DOWN** (towards the user) and **HOLD** the JOYSTICK in this position. After about 3 seconds the display will be illuminated (BACKLITE switches ON), after which the JOYSTICK

may be released. The BACKLITE will remain active until the unit is powered OFF. The GR-135 has a built-in battery saving feature such that the BACKLITE will not turn ON if the battery voltage is below 2.2 V. This low voltage indicates that there is little battery life left so disabling the BACKLITE feature allows the user to use the remaining battery life optimally.

Note that to turn off the BACKLITE, the unit must be switched OFF then switched ON again with the normal short click

The BACKLITE feature may be selected to be ON all the time for some applications or for set periods of time as described in the SETUP section (Chapter 9.0) but users should be aware that enabling the BACKLITE feature reduces battery life by an estimated 50%.

g) POWER OFF - MANUAL

To power the unit OFF, CLICK **UP** (away from the user) and hold for approx. 5 seconds. The display (Figure 2-2) shows the seconds counting down; **3, 2, 1**. After this countdown the unit powers OFF. At any time during the countdown, releasing the JOYSTICK will cancel the power OFF.

Figure 2-2

NOTE

IF THE UNIT FAILS TO RESPOND TO JOYSTICK MOVEMENT, IT MAY BE NECESSARY TO PERFORM A SYSTEM RESET. POWER THE UNIT OFF AS DESCRIBED IN THIS SECTION AND SHUT THE SYSTEM DOWN. THEN POWER ON AS USUAL (see d) above) AND THE UNIT SHALL RESPOND AS NORMAL.

h) LOW BATTERY WARNINGS

The Battery ICON at the top right of the display is used to provide the user with an idea of the current battery status. Unfortunately rechargeable NiCd batteries exhibit a very flat discharge curve. This means that for a very long period the battery voltage is almost constant and then it will suddenly discharge very rapidly at the end of battery charge. This battery characteristic means that it is not possible to display a **fully accurate** battery-life indication.

SAIC Exploranium recommends that it is a sensible precaution to carry a spare set of ALKALINE batteries in the system pouch if extensive field operations are required, to act as a backup (**but NOT for DS operation!).** This ensures that battery failure does not prevent data acquisition when required. ALKALINE batteries also show a longer life in cold weather conditions.

For convenience, most users tend to use the NiCd rechargeable batteries. To provide some level of warning of imminent battery life - if the batteries fall below a certain level then a 3-beep audio occurs and the Battery ICON changes to the message **LOW**. The user has between 2 and 10 minutes of measuring time left in the battery at this time. When there is no longer enough power to allow measuring, the GR-135 turns off.

Full Charge 1/2 Charge Low Battery Warning

Figure 2-3

2.4 SWITCHING FROM AUTOMATIC MODE TO MANUAL MODE

With the unit set up correctly and being operated by the user, it is important to ensure that no one changes the system settings in an unauthorized manner. For this reason there is a "hidden" slider switch in the battery compartment used to select modes. (On more recent models the slider switch is located behind the battery door on the right hand side – see Figure -2-1).

The slider switch has 2 modes labeled "**A**" for AUTOMATIC mode and "**M**" for MANUAL mode. With the unit switched OFF, the user should select the mode of operation then power the unit ON to activate the mode.

2.5 DISPLAY CONTRAST

When the unit is first turned **ON**, the user may use the joystick to adjust the Display Contrast to suit. Clicking **LEFT** changes contrast to lighter, clicking **RIGHT** changes contrast to darker. The control is limited to 10 steps in either direction, and when extremes are reached, an audio double-beep is heard to advise the user that they are at the limit of adjustment. Note that the user-set display contrast will be retained even when the unit is powered **OFF**.

NOTE

Manual contrast adjustment is only enabled during the first 15 seconds after power on. This is to prevent inadvertent contrast adjustment during other system operations. 15 seconds is usually long enough for adjusting contrast, however if further adjustment is required, switch the unit off then on again to obtain another 15-second adjustment period.

After the initial contrast setting by the user**, the contrast is automatically adjusted by temperature compensation** using an internal temperature sensor.

Advisory Notice: In some conditions the display appears blank, so that no fonts are visible. See Advisory #1 Appendix L.

2.6 STABILIZATION

The GR-135 is designed to automatically carry out system stabilization in the **AUTOMATIC** Mode when the appropriate power cable is connected (see Appendix B.1 for cable selection). Once this has been done correctly then internal temperature correction is used to maintain this level even if the unit has not been stabilized for many hours.

However in the **MANUAL** mode the system must be stabilized manually using the functions described in Chapter 7.0.

If **Stabilization** is required then the GR-135 will display a **STABILIZATION WARNING**.

If DEFAULT PARAMETERS are loaded then the following warning (see Figure 2-4) will be shown, as Stabilization is required before the SEARCH and ASSAY functions.

IT IS EXTREMELY IMPORTANT THAT STABILIZATION BE CARRIED OUT AS REQUIRED.

AFTER LOADING DEFAULT PARAMETERS - THE ACT OF STABILIZATION SETS ALL THE SYSTEM COMPUTATIONAL REQUIREMENTS FOR CARRYING OUT THE IDENTIFY FUNCTION. WITHOUT THIS STABILIZATION SERIOUS DATA ANALYSIS ERRORS WILL OCCUR!

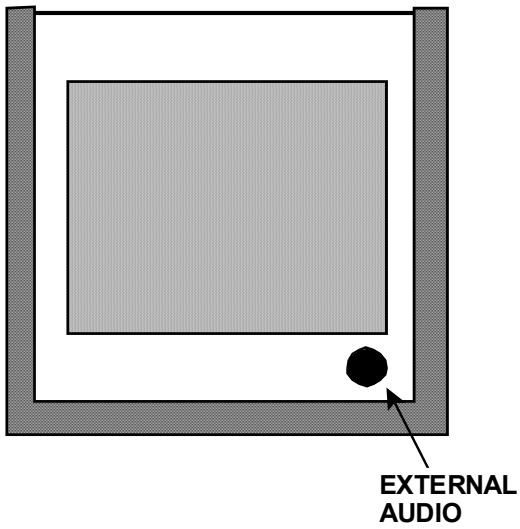
SEE THE FOLLOWING SECTIONS FOR DETAILS ON OTHER FUNCTIONS.

Figure 2-4

2.7 EXTERNAL AUDIO

On the rear of the unit is a special connector as shown in the rear view of the instrument shown in the figure (external audio). Normally this connecter is fitted with a dust cover for weather protection. However, users with the optional external earphone can plug it into this socket. When this occurs the internal audio is silenced and the audio tones are only audible through the external earphone.

This silencing of the units audio is especially useful in covert audio scanning or when the operator does not wish to alarm anyone with sudden audio tone increases.



3.0 AUTOMATIC MODE OF OPERATION

GENERAL:

The Automatic mode was developed for semi-technical users who only require a limited number of instrument functions (SEARCH and ASSAY) and do not want to select relatively complex system functions/options and parameters. The GR-135 is delivered to the customer in the Automatic Mode (see Appendix J – if the user has some experience with the unit and desires to start immediately).

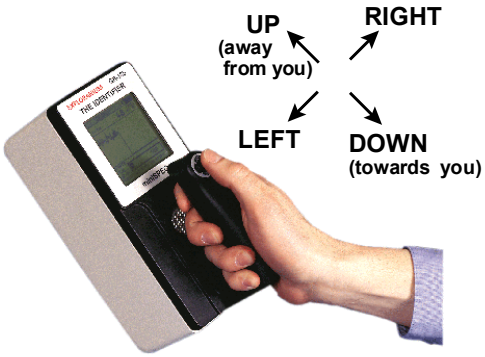
The operating parameters are selected and set by a local technical person (see Chapter 9.0) to suit the instruments' application and then the system can be switched into the **AUTOMATIC** Mode (see Figure 2-1 for the location of the AUTOMATIC/MANUAL switch).

Operating functions are described below.

3.1 JOYSTICK – NAVIGATION MENUS

Operation of the joystick, detailing all of its functions is discussed in Chapter 2.0 Section 2.1.

Navigation menus have been embedded into the system screens of the **Automatic Mode** (ONLY) for the following operations:



JOYSTICK ACTIONS

SEARCH MODE:	← BLON	→	↑ OFF	↓ ASSAY
ASSAY MODE:	← BLON	→	↑ OFF	↓ STOP
ASSAY (Results):	← BLON	→ 2MIN	↑ OFF	↓ SRCH

The Navigation Menus are located across the bottom of the screens in the Search Mode, Assay Mode and Assay Results with the joystick functions described below:

Note: In some screens the internal computer is busy so a few seconds may pass before the selected change occurs

SEARCH Mode:

← **BLON** - Backlight can be switched ON if required (if selected then the B/L stays ON for the period specified in the parameter setup – default = 60 secs)

→ **no action**

↑ **OFF** – approx. 4 secs then unit powers OFF

↓ **ASSAY** – switches to the ASSAY Mode

ASSAY Mode:

BLON - Backlight can be switched ON if required (if selected then the B/L stays ON for the period specified in the parameter setup – default = 60 secs)

no action

OFF – approx. 4 secs then unit powers OFF

STOP – stops the ASSAY sample

ASSAY – Results:

BLON - Backlight can be switched ON if required (if selected then the B/L stays ON for the period specified in the parameter setup – default = 60 secs)

2 min – initiates an additional 2 minute count that adds to the current spectrum and at the end of the period gives a combined analysis

OFF – approx. 4 secs then unit powers OFF

SRCH – switches to the SEARCH Mode

3.2 LOADING BATTERIES

The GR-135 version is designed to be used extensively in the field, and for this reason Alkaline batteries (two D-cell) are recommended. Alkaline batteries are not as susceptible to cold weather conditions and will last longer than the NiCd batteries provided. The user may start with NiCd batteries and switch to alkaline when needed, without concern over re-stabilizing the unit.

WARNING: When using **Alkaline Batteries** with the Docking Station or connecting a power cable directly to the unit always make sure that the GR-135 Battery is set to **NO/CH *(refer to Section 9.7 – Miscellaneous)***. If this is not done, ***it will result in battery leakage and extensive system damage*.**

Ensure that both batteries are firmly seated, attach the plastic battery retainer clip then re-attach the door. Refer to Figure 2-1 concerning battery location. Refer to Chapter 2.0, Section 2.3.

3.3 SETUP DOCKING STATION (DS) – (OPTIONAL)

If used place the DS in a convenient location, connect the supplied AC plug into an AC socket then plug it into the DS. If data retrieval is required, also attach the supplied 9 pin cable to your computers' RS232 port (see Appendix B.1 for cable selection).

Observe the lights on the front of the Docking-Station labeled – **ERROR, POWER, CHARGE**

Correct operation after power connection **WITH NO UNIT IN THE DS** is –

ERROR (RED) – flashing
POWER (GREEN) – **ON**
CHARGE (YELLOW) – **OFF**

Refer to **Appendix A** for software installation and description.

3.4 PLACE UNIT IN DOCKING STATION – (OPTIONAL)

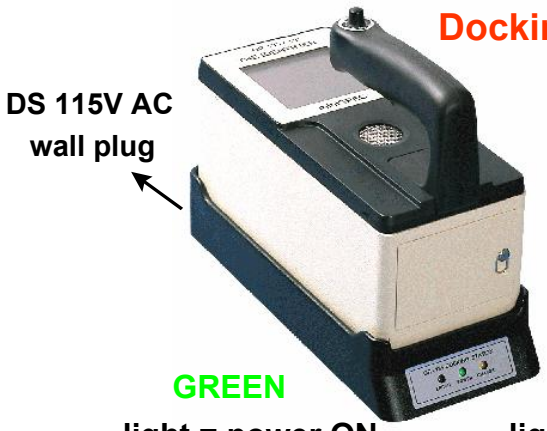
Remove the YELLOW protective "boot" from the instrument that exposes the 4 "**pads**" on the base of the unit. Note the 4 "**pins**" on the top of the DS.

Place the GR-135 unit in the DS so the pads match the pins (the rim around the DS ensures that correct positioning of the unit in the DS is very easy).

The audio should beep as the unit is automatically switched ON as it is seated in the DS

The front panel **CHARGE** (YELLOW) light on the DS should come ON to show that the batteries are charging

When not in active use the GR135 stays in the Docking Station



3.5 STARTUP DISPLAYS

The unit automatically switches on when the power cable is connected (or when it is placed in the optional DS) and the following screens are displayed:

Note: Install the Cs137 source face first into the hole provided in the yellow protective boot when the unit is connected to a power cable upon start-up (for automatic stabilization). If using the optional DS, the source is built into the station.

a) STARTUP – the display (TESTING and the Startup screen) appears briefly.

Data shown on the Start-up Screen is:

GR-135 – instrument name

VERSION 6V01.02 – the software version in the unit

SER# 9999 – the serial number of the unit

AUTOMATIC MODE ACTIVE – shows the unit is in the **AUTOMATIC** mode of operation (**MANUAL Mode** is the other Active Mode)

b) WARMING UP

The Startup screen is replaced by a new display, Warming Up screen as shown.

As specified by the display, the system is warming up so **WAIT.**

During this time the system is automatically adjusting its internal parameters as well as charging the batteries

This basic process should take approximately 2 minutes but users are recommended to leave it connected to the power cable for approximately 1 hour before starting any system operations to give the batteries time to take a charge.

Note: The "warm-up" mode only occurs when the unit is first put into service or when the batteries require charging.

NOTE:

LEAVE THE UNIT PLUGGED INTO THE POWER CABLE WHEN NOT IN USE

c) SYSTEM READY

Once the system has AUTOMATICALLY adjusted the basic system parameters correctly, this display shows:

SYSTEM READY – means that internal parameters are set correctly and the unit can be removed from the 12V power cable (or the DS). Remove the Cs137 source from the yellow protective boot and store in a safe location.

REMOVE WHEN REQUIRED – means the unit is ready for use. As commented above if this is a first time use, it is good practice to leave the unit plugged into the power cable (or left in the optional DS) for 1 hour to get some level of battery charge.

When the power cable is removed from the unit (or the unit from the optional DS), and system operation will automatically start in the SEARCH Mode.

d) POWERING ON WHEN <u>NOT</u> connected to the 12V power cable (or in the optional DS)

Normally the GR-135 needs to be connected to the 12V power cable (or in the optional DS) when not in use. System parameters normally require being connected to the 12V power cable (or in the DS) at least once every 24 hours for stabilization. If the time is exceeded a special message is displayed (see figure).

As noted on the display, users should connect the unit to the 12V power cable (or place the unit **IN** the DS) and then the system will automatically adjust itself (minimum period connected to the 12V power cable (or in the DS) = 2 minutes but longer is recommended for battery charging).

Note: Install the Cs137 source face first into the hole provided in the yellow protective boot when the unit is connected to a 12V power cable upon start-up (for automatic stabilization). If using the optional DS, the source is built into the station.

3.6 SYSTEM USE

The GR-135 set to **AUTOMATIC** only operates in 2 modes – **SEARCH** and **ASSAY**

The **SEARCH** mode is used to search and locate radioactive material (K, U and/or Th) in the field. The user can easily scan area and look for a significant increase in radiation using the tools described in the **SEARCH** section below.

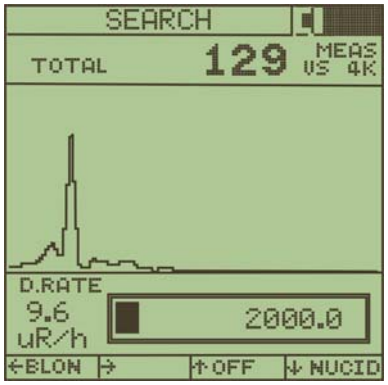
Once a source of radiation is found, the **SEARCH** mode is used to find its' maximum point and then the user selects the **ASSAY** mode.

As described in detail below, the **ASSAY** mode takes a sample (usually for 300 seconds) then automatically analyses it and advises the user of the details of the radioactive materials found.

3.6.1 SEARCH MODE

This special mode is used to search for radioactive material. When the unit is removed from the power cable (or the optional DS) this mode **is automatically selected** and the display shows the **SEARCH** display (see figure below).

Data displayed are:



SEARCH – the function currently activated (i.e. SEARCH)

 - a battery icon that shows battery status.

TOTAL – an operating mode set by the supervisor

45 – shows the radiation level in cps (counts per second). This level will always show some counts even if no apparent radioactive material is present as this is the local radiation background of an area. Typically in low background areas, 50-100cps is common.

MEAS – shows that measurement is in progress

VS 2K – shows that the vertical scale on the chart display below is 2K (2000cps). This scale will change automatically as radiation increases so the chart will always contain the peak radiation

CHART DISPLAY – this is a chart display of the radiation data. The bottom of the chart is ZERO cps and the top of the scale is automatically scaled. The display moves from left to right so the **LEFT** hand data is the current data. The chart shows the last 126 samples and is a very useful "view back" at the data making it very easy to see any significant radiation increases. Note that the numeric cps data is not energy dependent so very small changes of any type of radioactive material emitting gamma rays can be easily seen.

D.RATE – the bar display and the numeric data show the Dose Rate data. The numeric data shown above (45cps in the figure) is an essential tool to locate radioactive material but the **DOSE** data gives the user an idea of the potential hazard level of such material.

2.6µR/h – this is the numeric value of the Dose Rate in the selected units, in this case Roentgen/h usually referred to as **R/h**. Many users find the numeric display useful but some users find its' changing units gets confusing which is why the bar graph and the numeric data are both shown.

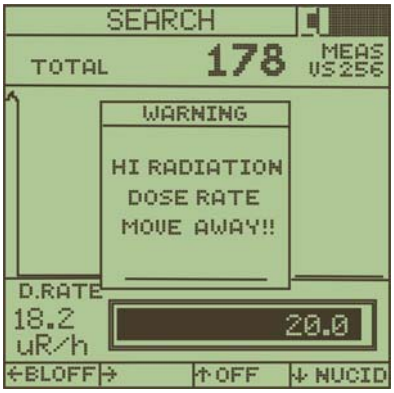
2000 - shows the defined limit selected by the system supervisor that is the maximum range on the bar graph. If this limit is exceeded a special alarm occurs (se below). Note that this user is in the units selected – in the display shown – since the D.RATE is in µR/h then the 2000 = 2000µR/h. At this setting, if the DOSE RATE exceeds 2000uR/h then the warning alarm will occur (see 3.10 below)

 - the bar graph gives the user an easy visual display of the Dose hazard level (Zero on the left and Maximum on the right). The Users' technical personnel determine at what Maximum Dose level their personnel are permitted to work in. This is then set in the system parameters and defines the upper level of the bar graph. When this limit is exceeded the user is warned – see the **HIGH DOSE** Section 3.10 below.

PRESS ENTER TO ASSAY - pressing the JOYSTICK is referred to as **ENTER**, so the user is advised that pressing **ENTER** will change the operating mode to the ASSAY mode described below. As noted above, when the center of the radiation is located in the SEARCH mode then the user presses **ENTER** to analyze the radiation as explained below.

3.6.1.1 HIGH DOSE

The system has a preset maximum Dose Rate level – normally set at **2000µ/R**. Below this level Dose Rates are considered acceptable for system operation. However above this level it is recommended that users move away from the source of radiation to reduce this Dose Rate level to an acceptable level. To make things simple, the GR-135 advises the users automatically if the Dose Rate level goes above the preset limit.



If the level is exceeded a **distinctive** audio warning tone occurs and the display changes (see figure).

As noted the user should back away until the Dose Rate level falls below this limit and the display warning goes away. Note that the lower Dose Rate bar graph also shows that the Dose rate is at or above the preset limit.

Users should be reminded that short-term operation close to the limit has a negligible hazard level but prolonged operation significantly above this level is not recommended

3.6.2 ASSAY MODE

When this mode is activated from SEARCH by pressing **ENTER**, a new display appears:

ASSAY – shows the mode of operation (ASSAY)

SAMPLE IN PROGRESS WAIT – advises the user that a sample is in progress for the time period set in the unit so the unit should be held in a fixed position to enable a proper sample to be taken.

OK – this flashing box advises users of a way to get the best sample. The system has internal parameters that assess detector functions. If OK is shown this means that the data accumulation is OK for good system analysis.

Alternative displays in this box are:

MOVE CLOSER – means that the signal is very weak so **<u>if possible</u>** the user should move the unit **<u>closer</u>** to the suspect source of radiation. In many cases this is impossible so no action need be taken, but if possible move the unit closer until the display shows **OK**.

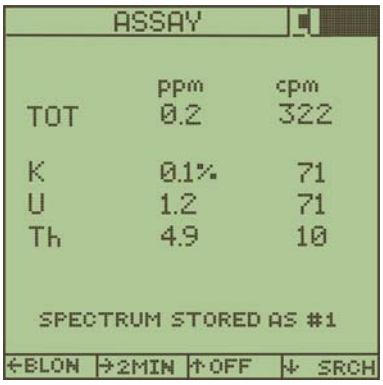
MOVE AWAY – means that the signal is stronger than is necessary to take a proper sample. Correct action is to back away until the display shows **OK**.

TIME TO GO – this shows the selected sample time as mm:ss (minutes:seconds) and is counted down from the sample time.

00.32

 – the progress bar shows the time progress to the end of the user defined sample period.

3.6.2.1 ASSAY RESULTS



After the sample time is complete the system <u>automatically</u> analyses the data to determine the concentration of the radioactive materials and displays the results as shown.

TOT – total count over the entire spectrum

Labels used are:

- **K** – Potassium (% and cpm)
- **U** – Uranium (ppm and cpm)
- **Th** – Thorium (ppm and cpm)

SPECTRUM STORED AS #1 - after ASSAY analysis takes place the user must click down to store spectrum # into memory where it can be accessed with special software for subsequent analysis by the users radiation experts as required. The display advises the user what the data set is with the label SPECTRUM #2. This number can be anywhere from 1 to 185 spectra and serves to uniquely identify the data in system memory for use during data retrieval and analysis.

An additional feature is that under special conditions the user may see various special nuclear items that are NOT included in the system library. In this case the manufacturer can analyses these data and if required the internal analysis library can be updated so in future this type of material would be identified.

UP TO REPEAT SAMPLE – sometimes if the radiation levels of the material being analyzed are very low, it is possible that, at the end of a 60 second sample period, the analysis of the sample may show Naturally Occurring Radioactive Material **(NORM)**. In some cases the user may wish to take a longer sample to improve the analysis.

If the button is pressed UP (away from the user) then a second sample takes place. If the system is set for a 1 minute sample time then pressing UP will take an additional 1 minute sample, add it to the original sample to produce a 2 minute sample, store this in a second spectrum in memory and carry out NUCLIDE IDENTIFICATION again. Perhaps this time the improved data quality from a longer count will permit an identification to be performed.

This UP (to repeat the sample) can be performed as often as the user requires to build up a larger and larger sample for analysis.

PRESS ENTER TO SEARCH – pressing ENTER moves the user to the SEARCH mode again

OTHER FEATURES:

3.7 POWER OFF - MANUAL

To power the unit OFF, IT MUST BE UNPLUGGED FROM THE 12V POWER CABLE (or IT MUST BE REMOVED FROM THE OPTIONAL DS UNIT). Then CLICK **UP** (away from the user) and hold for 4 seconds. The display will show a special display (see Figure) with the seconds counting down; **3, 2, 1**. After this countdown the unit powers OFF. At any time during the countdown, releasing the JOYSTICK will cancel the power OFF.

3.8 BACKLITE

A BACKLITE option is built into the GR-135 such that the display may be viewed in low light conditions. BACKLITE can be enabled in the system setup for frequent use or as shown below for intermittent use.

To switch the BACKLITE on it is first necessary to switch the unit OFF as described above in Section 3.11.

With the unit OFF, press **ENTER** and **HOLD** the JOYSTICK in this position. After about 4 seconds the display will be illuminated, after which the JOYSTICK may be released. The BACKLITE will remain active until the unit is powered OFF.

The GR-135 has a built-in battery saving feature such that the BACKLITE will not turn ON if the battery voltage is below 2.2 V. This low voltage indicates that there is little battery life left so disabling the BACKLITE feature allows the user to use the remaining battery life optimally. Note that to turn off the BACKLITE, the unit must be switched OFF then switched ON again with the normal short click action.

The BACKLITE feature may be selected to be ON all the time for some applications but users should be aware that enabling the BACKLITE feature reduces battery life by an estimated 50%.

3.9 LOW BATTERY WARNINGS

The Battery ICON at the top right of the display is intended to provide the user with an idea of the current battery status. For convenience, most users tend to use the NiCd rechargeable batteries. To provide some level of warning of imminent battery life - if the batteries fall below a certain level then a 3-beep audio occurs and the Battery ICON changes to the message **LOW**. The user has between 2 and 10 minutes of measuring time left in the battery at this time. When there is no longer enough power to allow measuring, the GR-135 turns off.

Full Charge 1/2 Charge Low Battery Warning

Battery Icons

3.10 PROBLEMS

NOTE

IF THE UNIT FAILS TO RESPOND TO JOYSTICK MOVEMENT, IT MAY BE NECESSARY TO PERFORM A SYSTEM RESET. POWER THE UNIT OFF AS DESCRIBED IN THIS SECTION AND SHUT THE SYSTEM DOWN. THEN POWER ON AS USUAL AND THE UNIT SHALL RESPOND AS NORMAL.

4.0 MANUAL MODE – NAVIGATING MENUS

This Manual is arranged in the same order as the Main Menu as follows (see Figure 3-1):

- Chapter 5.0 – Search + Dose.
- Chapter 6.0 – Assay
- Chapter 7.0 – Stabilize
- Chapter 8.0 – Data Memory
- Chapter 9.0 – Setup
- Chapter 10.0 – Maintenance

Note: These functions are not available when the unit is set to **Automatic Mode**! See **Chapter 3.0** for Operating the GR-135 in Automatic Mode or Appendix J for Quick Start in Automatic Mode.

Operation of the Joystick, detailing all of its functions is described in Chapter 2.0, Section 2.1.

Figure 4-1 illustrates all of the active modes (GR-135 set to Manual Mode), routines and sub-menus associated with the Main Menu. The operator navigates through the menus and sub-menus using short clicks down (joystick is pushed towards the operator) or up (joystick is pushed away from the operator) to scroll through the main menu or sub-menus, individual menu items will highlight as the joystick is pushed. When the desired menu item is highlighted the operator may select this by using a long click, which will open the menu item to an active screen, a selection screen (instructions) or a sub-menu (see Figure 4-1).

Note: A short click (S) is when the joystick is pushed and released (the joystick will automatically return to the center). A long click (L) is when the joystick is pushed and held in place until an action occurs on the screen and then released (the joystick will automatically center when released).

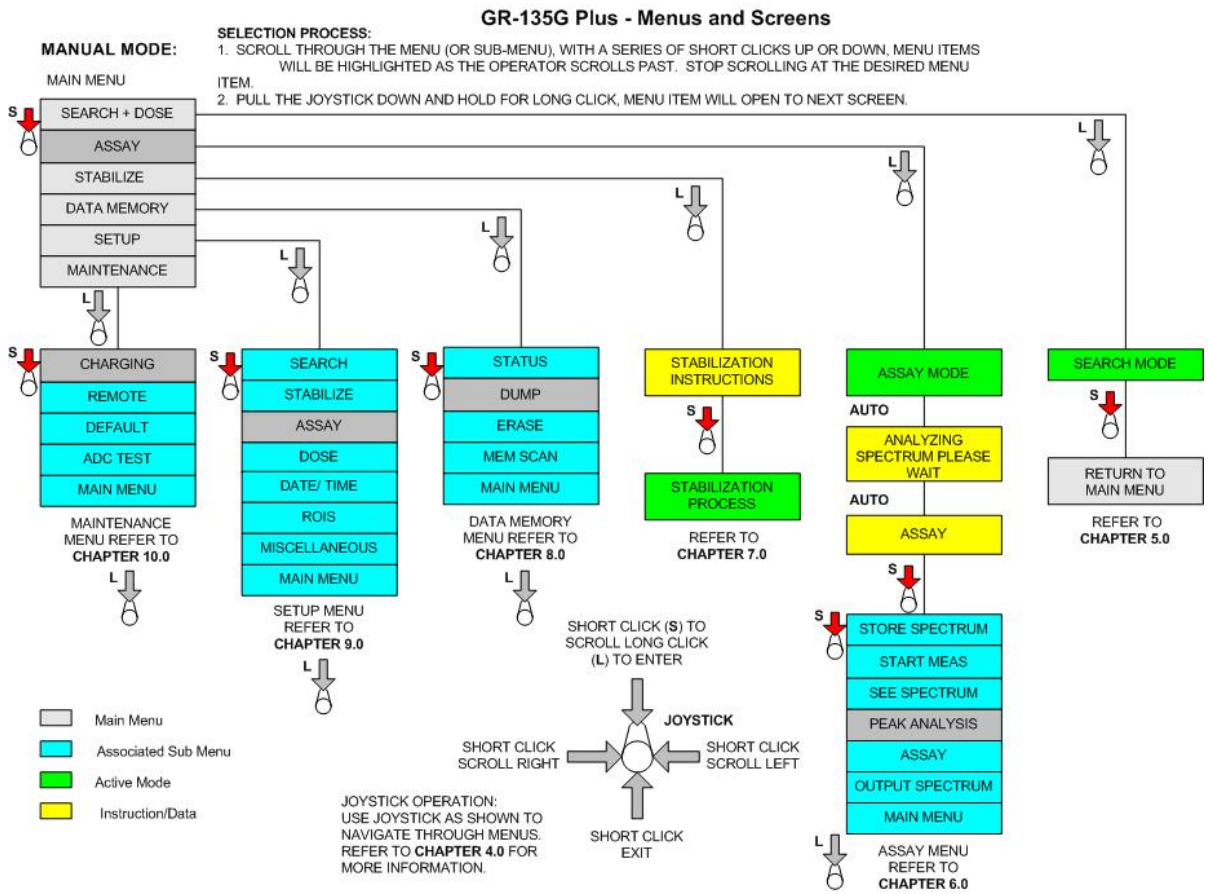


Figure 4-1

5.0 SEARCH+DOSE

5.1 SEARCH MODE

Select this menu item then **ENTER** to activate – Figure 5-1 displays:

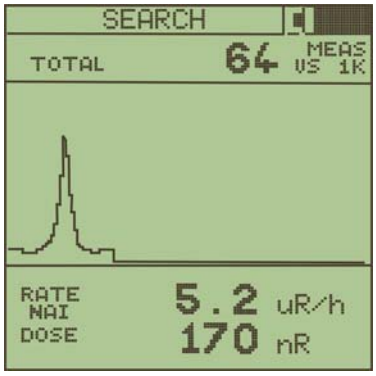


Figure 5-1

SEARCH – Shows that the system is in the SEARCH Mode.

[redacted] - The Battery Icon shows battery status.

TOTAL – Shows that the SEARCH Mode is using the full Total Count data. See Section 9.1 for use with special ROI data.

1234 – Is the current count rate in counts per second (cps) updated every sample period.

MEAS – means unit is measuring (STOP means it is not measuring)

VS 2K – This is the vertical scale of the "chart-recorder" (in this case 2000cps). Most users let the unit auto-scale but the user can manually set a fixed scale in SETUP – Section 9.1.

CHART RECORDER - The data in the data box shows the last 126 samples of data in a "chart-recorder" format (left to right with the most current data on the LEFT). Therefore, at a one second data rate, 126 seconds of data are displayed OR at a five second data rate, 630 seconds of data are displayed etc. The Chart Recorder display is updated at the end of every sample period.

D.RATE – is the current DOSE RATE in selected units – see Section 9.4 for more details

NAI – shows the active detector.

DOSE – is the TOTAL DOSE accumulated from the point in time SEARCH+DOSE mode was activated – see Section 9.4 for more details

STOP – to stop this function press **ENTER** and the display will go back to the Main Menu. If the user presses AND HOLDS the joystick in the **ENTER** position, the display will stop updating and permit the user to inspect the data. Releasing the joystick goes back to the menu.

5.2 HIGH DOSE

The system has a preset maximum Dose Rate level – normally set at 2000uR/h. Below this level Dose Rates are considered acceptable for system operation. However above this level it is recommended that users move away from the source of radiation to reduce this Dose Rate level to an acceptable level. To make things simple, the GR-135 advises the users automatically if the Dose Rate level goes above the preset limit.

If this level is exceeded a distinctive audio warning tone occurs and the pop-up menu message appears (Figure 5-2).

As noted, the user should back away until the Dose Rate level falls below this limit and the display warning goes away.

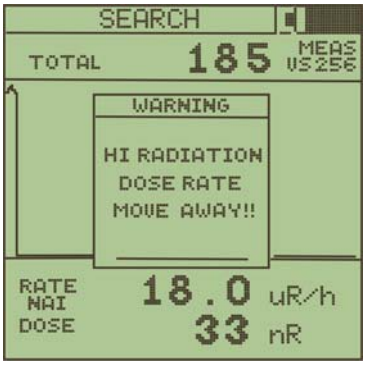


Figure 5-2

Users should be reminded that short-term operation close to the limit has a negligible hazard level but prolonged operation significantly above this level is not recommended.

5.3 SEARCH ALARM

If the **ALARM LEVEL** parameter (see Section 9.1) is set to a preset value and the radiation field exceeds this value, a distinct audio beep will be heard and a pop-up box will appear as shown by Figure 5-3. As the user moves away from the source the audio and pop-up display will go away.

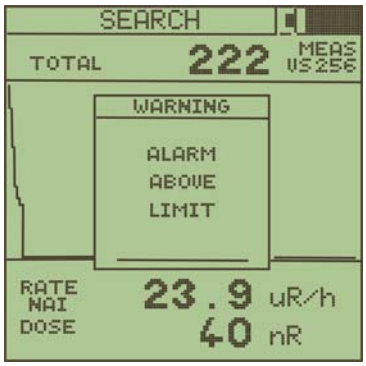


Figure 5-3

5.4 SEARCH - AUDIO

In the SEARCH mode the radiation data from the high-sensitivity Sodium-Iodide (NaI) detector is used to create an audio search capability thus permitting the user to have an "eyes-free" operational mode. It is very difficult to scan a vehicle and inspect the display continuously.

The GR-135 scans the incoming data at a **20 TIMES a SECOND RATE** – and converts the radiation field into a mode that changes the frequency of the audio tone to reflect the radiation field intensity. Various parameters are used (see section 10 for details) to adjust system performance to suit the user. In the majority of cases the audio gives occasional "beeps" of low intensity audio on normal background (this shows the user that the audio system is alive) but in the presence of a real radioactive field the audio frequency changes rapidly. With this feature it is very easy to scan back and forwards to readily locate the highest audio pitch that is the maximum radiation intensity.

5.5 SEARCH MODE - DATA RECORDING

The ASSAY cannot be calculated post mission from the spectral data as the accompanying software does not permit it. However, the spectrum can be saved and played back using the DATA MEMORY feature, note the spectrum will be ASSAYED again prior to playback.

Note: The **ASSAY** values are displayed and not stored!

The data displayed during the SEARCH mode can be recorded in memory. Recording to memory is implemented by menu selection in the SETUP - SEARCH menu (Section 9.1). When the "OUTPUT TO" parameter is set to "MEM" and the SEARCH mode is started, the data is logged into memory at the selected Sample Rate. The message **SEARCH>MEM** will be displayed at the top of the screen during the SEARCH to indicate that the data is being saved to memory.

Data recording is terminated when the memory is full or the mode is stopped (**ENTER**). Every time the SEARCH mode is stopped then started again, a new header is written so the data can be retrieved later with the appropriate time information. Remember that all SEARCH data will be loaded into memory until the data recording option is disabled in SETUP mode.

The data memory can record approximately 45,000 readings at the selected data rate. Thus, at a one sample per second data rate, the memory will hold almost 12.5 hours of SEARCH+DOSE data. Once the GR-135 memory is full the message **MF** (memory full) will be displayed at the top of the screen and the user gets a **3-beep** audio warning and the **SEARCH>MEM** label is removed.

The user should be aware that at the beginning of a new SEARCH mode activation, a header is stored in memory. This header uses memory space equivalent to 6 SEARCH samples. Therefore, if a large number of separate SEARCH samples are stored in memory, slightly less memory is available for samples than if the SEARCH was taken in one complete set.

6.0 ASSAY

This mode enables detailed spectral analysis and permits spectrum display, peak identification and Assay results. The user should observe some simple operating procedures to get best results from the instrument. SAIC Exploranium recommends the following procedure:

a) Search and locate a source of radiation in the **SEARCH** mode as this has maximum sensitivity.

b) If a source of radiation is found then use the **SEARCH** mode to estimate its approx. geographic boundaries (by observing the count-rate and/or listen to audio).

c) Position the detector facing the approximate center of the area of radiation.

d) Move the unit away (or toward) the source (in the SEARCH mode) until the count rate is between **2000 and 5000 counts/sec** for best results.

e) Highlight **ASSAY** in the Main Menu and press **ENTER** to select.

f) The GR-135 immediately begins to acquire a spectrum with the display appearing as shown in Figure 6-1.

g) At the termination of the sample the data will be analyzed for radioactive material and the display will show the results as shown in Figure 6-2.

h) See below for full details.

NOTE – Section 6.1 covers instrument behavior if **ASSAY** is started from the **MAIN MENU**. Section 6.2 – 6.8 cover a different mode of operation (selections made from the ASSAY sub-menu).

6.1 ASSAY DISPLAY

As the sample progresses the display is updated at a 1/sec rate as shown in Figure 6-1 until the preset sample time is reached. For full details of this display see Section 6.4 below.

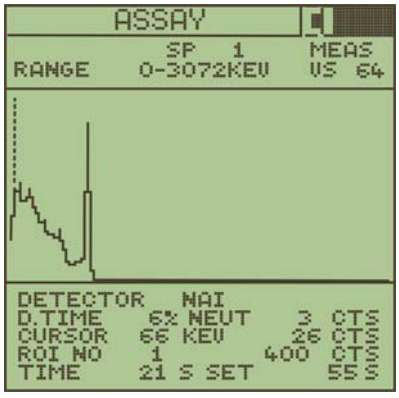


Figure 6-1

ASSAY IDENTIFICATION

When the sample terminates the Identification function is automatically activated. The display briefly shows "**ANALYZING SPECTRUM PLEASE WAIT**" for a few seconds then Figure 6-2 is displayed.

This display shows the concentration of **K**, **U** and **Th** that have been identified in 3 columns:

TOT – the totals for radioactive materials K, U and Th.

ppm (Parts per Million) and cpm (Counts per Minute).

ENTER – pressing ENTER switches to the ASSAY sub-menu for further functions.

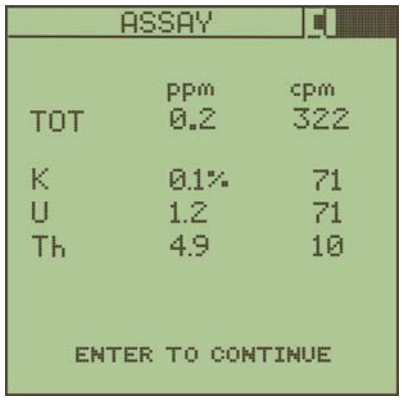


Figure 6-2

6.2 ASSAY MENU

When the sample is complete, press ENTER (click joystick down) to display the ASSAY sub-menu, where further functions can be selected. These functions are detailed below.

Figure 6-3

6.2.1 STORE SPECTRUM Mode

This option stores the current (most recently measured) spectrum in the memory of the GR-135, assigns it a unique Sample Number and tags it with the date and time of measurement for easy identification. All data recorded in memory can be downloaded to an external computer.

To store data in memory, highlight **STORE SPECTRUM** and **ENTER**. A new display appears for 10 seconds as shown in figure 6-4 – in this case showing that this spectrum has been stored as Spectrum #1.

Figure 6-4

Note: The GR-135 can store up to 187 complete 1024 channel spectra in memory.

6.2.2 START MEAS Mode

This option allows the user to take another spectrum sample without having to go back to the Main Menu and selecting **ASSAY** again. If this option is selected then the ASSAY sampling display (as shown in section 6.1 above) is shown and data accumulation begins again. As the sample progresses the display is updated at a 1/sec rate as shown in Figure 6-5 until the preset sample time (ie. 55 s) is reached.

Note: When the ASSAY analysis capability is started from the START MEASUREMENT screen (ASSAY Menu), then at the end of the sample the display returns to the ASSAY menu so the user can select subsequent actions.

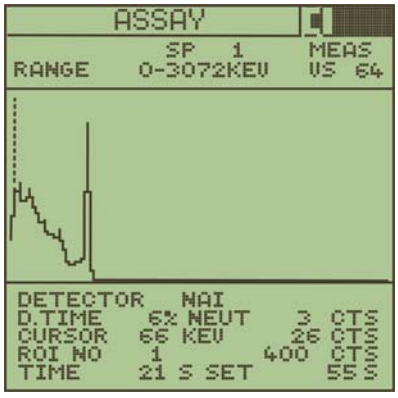


Figure 6-5

However if the ASSAY is started from the MAIN MENU, it automatically carries out ASSAY Identification which somewhat simplifies user actions.

Labels are:

Sp1 – the last spectrum # that was stored. So if the current sample (when complete) is stored – it would be Spectrum #2 etc.

RANGE 0-3072keV shows that the full 3MeV spectrum is displayed

MEAS – means that the system is in measurement mode

VS 2K – means that the vertical scale is currently 2K (2000cps). This is automatically changed if any channel exceeds this limit.

DETECTOR – NaI shows that the Sodium-Iodide detector is currently in use

D.TIME – shows the Sodium-Iodide dead time as a %

CURSOR – KEV - CTS – the cursor position data in Channels and Counts

ROI# - CTS – the ROI# and counts in the ROI in counts

TIME – shows sample progress (21 secs currently)

SET – shows the preset sample time of 55 seconds.

Note: A longer preset sample time will produce better results.

The sample accumulates until the preset sample time is reached but the user can stop the sample at any time by pressing **ENTER.** When the sample is complete it automatically activates the ASSAY ID mode and the display results as shown in Figure 6-2 are seen.

6.2.2.1 DATA OVERFLOW

The maximum count possible in any channel is 65535 during a sample. If any channel exceeds this level the channel data is flagged and "frozen" but the sample time continues until it is complete. This way the high count rates of lower energy nuclides do not inhibit the analysis of higher energy peaks

6.2.3 SEE SPECTRUM Mode

This display shows the spectrum of the last sample analyzed. Figure 6-6 shows a typical display. Data is defined as described in 6.4 above. The only difference is:

TIME/SET - show the sample preset time period – the fact they are the same means the sample terminated at its full count (in this case no premature termination due to overflow)

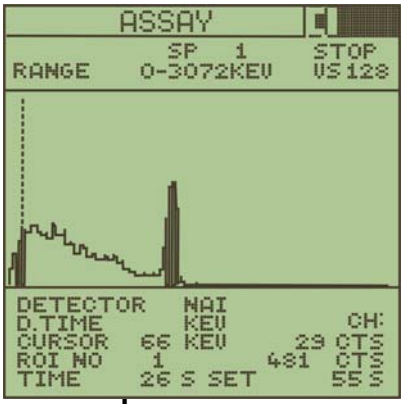


Figure 6-6

6.2.3.1 SEE SPECTRUM – ASSAY Menu

The display is only 128 pixels (dots) wide and the GR-135 utilizes a 1024 channel spectrometer. Thus if the full spectrum is displayed, each pixel shows the average of 8 actual data channels. In many cases the user wants to inspect the spectrum in greater detail so a zoom feature is available. To activate this feature press **ENTER** and a new display (ASSAY) appears (Figure 6-7):

The cursor goes immediately to the **ZOOM RETURN** selection and if **ENTER** is pressed again it will return to the **ASSAY** menu.

The other selections permit the zoom feature: (see Figure 6-6)

8x – this is the maximum zoom selection and sets the display to show 1 pixel = 1 channel. This means that the full display now covers 128 channels = 384keV

4x – this selection sets the display to show 1 pixel = 2 channels. This means that the full display now covers 128 channels = 768keV

2x – this selection sets the display to show 1 pixel = 4 channels. This means that the full display now covers 128 channels = 1536keV

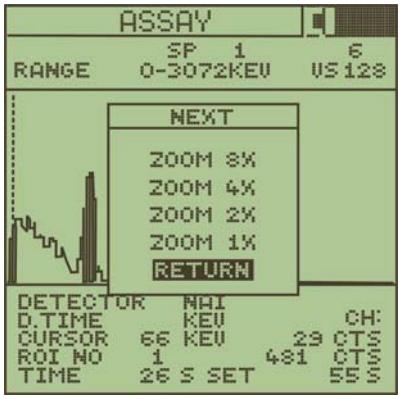


Figure 6-7

1x – this selection sets the display to show 1 pixel = 8 channels. This means that the full display now covers 128 channels = 3072keV

RETURN – returns to the Analysis Menu

Correct operation of the ZOOM feature is to move the cursor along the display and position the cursor on a peak of interest, then activate the zoom feature. Once the zoom selection is made the display is centralized on the peak. As an example:

- the user positions the cursor on the 662keV Cesium peak
- then they select the 8x zoom and press ENTER
- the display now displays only the selected peak at the center of the display and the display covers only a 384keV range.

Thus the limits of the display are shown as 470-854keV and this range is shown on the display

If the user moves the cursor the cursor stays at the center of the display and the spectrum scrolls past it until the limits of the display are reached.

6.2.3.2 PEAK DISPLAY -

In the SEE SPECTRUM mode as the cursor moves across the display, any peaks that have been identified in the analysis routine are highlighted and if the cursor enters this highlighting area the display shows the peak information on the display as **KEV** and **CH#** - as shown in Figure 6-8.

If the cursor is moved to the next peak, the first peak will continue to be displayed until the next peak is entered in which case the PEAK display shows the new peaks data.

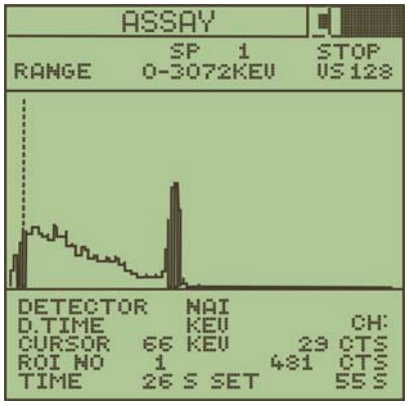


Figure 6-8

6.2.4 PEAK ANALYSIS

Selecting the PEAK ANALYSIS mode results in an automatic analysis of the last recorded spectrum to identify peaks. The results are displayed in ascending order, sorted by energy level – as shown in Figure 6-9.

Data Labels (see Figure 6-9):

Peak - two data are shown, the peak position in keV (**77**) and channels (**29**).

FWHM - Full Width Half Maximum - The computed FWHM of the located peaks in % gives an idea of the quality of the peak - resolution.

SIZE - The amplitude of the peak in SD units.

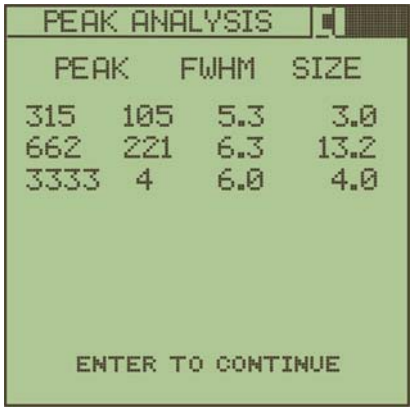


Figure 6-9

"-more-" - The word "-**more**-" is displayed at the bottom of the screen when more peaks have been identified than can be displayed on one screen. A short **CLICK DOWN** will show the next screen with a continued display of computed peaks. If "**more**" is not shown, then all identified peaks are displayed and **ENTER** returns you to the **ASSAY** menu.

ENTER - to go back to the ASSAY menu.

6.2.5 ASSAY Results

If this mode is activated then a new Assay analysis of the selected spectrum is carried out. The display shows "**ANALYZING SPECTRUM PLEASE WAIT**" briefly before the display shows the **ASSAY** screen – Figure 6-10. This is a result of the matrix computation using the sampling time data from the ROIs and applying the 14 calibration constants. Each GR-135 unit has been calibrated on SAIC Exploranium Test Pads so the data results are presented in the computed Assay form.

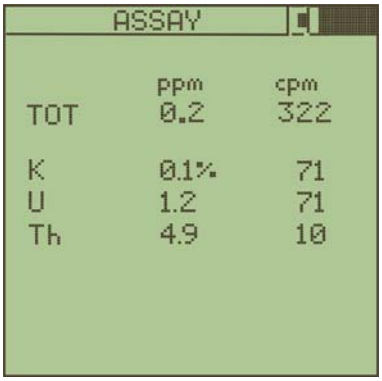


Figure 6-10

The data is displayed as:

TOT – total count – the totals for radioactive materials K, U and Th.

Note: TOT is not necessarily significant to-day and may be ignored.

K, U and Th – the data results are shown in ppm and cpm for Uranium (U) and Thorium (Th), the data results are shown in % and cpm for Potassium (K).

6.2.5.1 OTHER DISPLAY LABELS

NO NUCLIDES FOUND – this means that the analysis routines found no identifiable nuclides

6.2.6 OUTPUT SPECTRUM

The spectrum is stored automatically, and this menu option is no longer supported. The error message "PC DOES NOT RESPOND" will be displayed after selecting this option.

6.2.7 MAIN MENU

Returns to the Main Menu (see Section 2.3 and Figure 2-1C).

7.0 STABILIZE

7.1 STABILIZATION - GENERAL

When any spectrometer is turned ON, the internal electronic components exhibit some level of warm-up drift with time, which may be exacerbated by changes in the ambient temperature. Sodium-Iodide crystals typically exhibit a +/-15% change over the -10 to +50° C temperature range. If uncorrected, this drift could seriously affect data analysis. For this reason, the GR-135 incorporates a procedure called STABILIZATION to remove these effects. Stabilization automatically "fine-tunes" the system to adjust the internal system gain and align the spectrometer correctly.

Note: This parameter is used to advise users when system re-stabilization is required, but we recommend that the unit be stabilized each time prior to use for consistent and accurate readings.

The GR-135 carries out Stabilization in various ways;

- **AUTOMATIC CORRECTION when in USE** – see Section 7.2.
- **MANUAL-STABILIZATION with no DOCKING STATION** – at any time the user can activate STABILIZE from the Main menu and then use an external Cesium source to carry out the Stabilization function.

Stabilizing the GR-135 outside the DS depends on the MODE of operation.

a) MANUAL MODE

From the MAIN MENU select "**STABILIZE**" and press **ENTER,** the Stabilization Mode will display as shown by Figure 7-1.

This function is usually used with an external source, hence the display wording. The user places the Cs137 source face first into a hole provided in the yellow protective boot on the unit – and presses **ENTER** to continue. The user can push the joystick **UP,** to return to the Main Menu.

Figure 7-1

Stabilization will now occur, the system is fully automatic, various displays will be seen (the word "**COMPUTING**" may appear as well as data being processed), then finally a beep shows that the process is complete with the display as shown in Figure 7-2.

The data is described as follows:

PEAK – this is the peak channel of the centroid of the accumulated spectrum. The correct final channel for CESIUM stabilization is **channel 220** (+/- 0.5ch).

FWHM – the Full-Width-Half-Maximum is a measurement of the quality of the detector to resolve narrow peaks. Good operation is possible with units measuring FWHM up to 8.5%. FWHM measurements above 8.5%; spectral peaks are widening, making accurate peak analysis very difficult, and above 9.5%; spectral analysis, especially in the lower energy area, is almost impossible.

Figure 7-2

NEW GAIN – the Gain computed based on the error of the peak centroid calculation.

OLD GAIN – the gain setting before the gain is corrected.

System stabilization is now complete so the source can be removed from the face of the unit and the unit can be used.

b) AUTOMATIC MODE

If the user does not place the GR-135 into a Docking Station (DS) (with an embedded Cs137 source) and a power source, the user should follow the procedure below:

In this case it is necessary to let the unit think it is in a DS as the Automatic Mode functions are optimized for this mode of operation.

This is easily done as follows:

- Place the Cs137 source face first into a hole provided in the yellow protective boot on the unit.
- Plug in one of the sources of external power (see Appendix B.1 para b))
- As long as external power is supplied the unit will continue to automatically stabilize as described in Chapter 3.0.

  Note: If the Test Source is removed an error message will appear on the display.
- Allow the unit time to finish stabilizing, a Warming Up message will appear to advise the user the "**SYSTEM READY**" and "**Remove When Required"**.

Note: *This unit can only stabilize in 1024G Channel Mode (to set the parameter see Section 9.3.2 – Assay paragraph c).*

7.2 AUTOMATIC CORRECTION WHEN IN USE

When the source is removed from the face of the unit, the GR-135 electronics detects this change. Stabilization on Cesium is automatically halted and the current detector temperature is noted. As the detector temperature changes, the system automatically corrects for any gain drifts using a built in gain-correction Vs temperature curve so the Gain is maintained correctly.

8.0 DATA MEMORY

If Data Memory is selected a new menu appears: (see Figure 8-1)

Figure 8-1

8.1 STATUS

Selecting STATUS (see Figure 8-2) shows the current state of the data memory. The GR-135 can store data from the 2 operational modes (SEARCH+DOSE and ASSAY) in different formats. Each set of data is tagged with a special header that identifies the type of data.

The SEARCH+DOSE data are classified as **SAMPLES** and ASSAY data are classified as **SPECTRA**.

STORED - This indicates the current status of data storage.

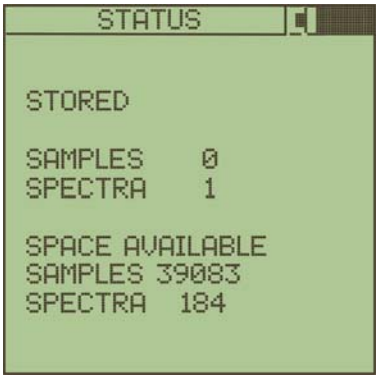


Figure 8-2

SPACE AVAILABLE - This indicates available space for additional sample or spectral data.

8.1.1 MEMORY SPACE

The **SEARCH+DOSE** data are stored in a fixed data forma. For all data storage, the header is written to memory first and then each data sample is recorded separately.

The header is 47 bytes in size and each sample is 8 bytes. Thus, a 10 sample record contains,

Header	47 bytes
10xSample (8)	80 bytes
Checksum	1 byte
TOTAL	128 bytes

Therefore, the amount of memory space occupied by data is a function of how many samples are recorded. The system automatically computes available space based on this information but considers the presence of only one set of header information and the rest being data. If the user takes separate sets of readings (i.e. more than one header) the number of samples required to fill the data memory will be less than that calculated by the GR-135 due to the memory requirement for the extra headers. Therefore, the available memory display data should be used only as a guide.

The **ASSAY** mode records data in a much larger format as each reading is a 1024 channel spectrum with 2 bytes/channel stored as follows:

Header	47 bytes
1 spectrum	2048 bytes
Checksum	1 byte
TOTAL	2096 bytes

8.2 DUMP

DUMP is a legacy utility for outputting data stored in the GR135 memory to an external utility program such as the SAIC Exploranium supplied PC utility program IdentiView (described in Appendix A). DUMP is no longer supported by this version of the firmware program. The error message “PC DOES NOT RESPOND” will be displayed after entering the screen.

8.3 ERASE

Selecting this function produces a new display. The display shows (see Figure 8-3):

Pressing the button down three times erases the data memory completely. The first two times the button is pressed, the word ERASE should appear at the bottom of the display.

Users Are Warned That Erased Data Cannot Be Recovered!

Figure 8-3

8.4 MEM SCAN

This selection (see Figure 8-1) lets the user inspect and re-analyze spectra previously stored in memory.

If this option is selected, the first spectrum in memory summary is displayed. For example (see Figure 8-4):

Note the DATE is in YY – MM – DD format

The user must **CLICK LEFT/RIGHT** to select the required spectrum. The spectrum number is the same one used as a label during the spectrum store. The Date/Time of the recorded spectra are also provided for reference.

Figure 8-4

Once a spectrum is selected then **ENTER** activates this feature and the selected spectrum is selected and the **MEM SCAN** menu is shown. The user may select one of the sub-menu items from the **REASSAY** Menu as required.

The features and displayed data are exactly the same as in the ASSAY features described in Chapter 6.0 for the items listed in the REASSAY sub-menu (see Figure 8-5).

Figure 8-5

9.0 SETUP

The Setup menu (see Figure 9-1) permits the user to setup the required operating parameters. If this item is selected from the MAIN MENU this display is seen.

Move the cursor UP or DOWN to make a selection (highlight) then press **ENTER** to activate the chosen selection.

Inside each menu use UP/DOWN cursor action to select a parameter then LEFT/RIGHT cursor action to change the item.

ENTER - to exit and accept the changes

Figure 9-1

Note: For all the selections below, the normal default selection is shown in large **bold** print.

9.1 SEARCH

Selections are (see Figure 9-2):

a) **OUTPUT TO -** Options - **OFF**, MEM or PC

OFF - the data is shown on the display but is not recorded into data memory - this is the default operating mode.

MEM - the SEARCH data is to be stored in the GR-135 internal memory.

PC - data is recorded to the PC.

Figure 9-2

b) **SAMPLE TIME –** this indicates the interval at which SEARCH samples are taken.

Selections are: **1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 30, 40, 50 or 60** seconds.

Under most conditions, a 5 second sample gives reasonable accuracy however, a 1 second selection is advisable if the unit is being used in a continuous search mode and numeric data is required.

NOTE: The Audio response is NOT affected by this time selection as it is updated at a fixed 20 times/second rate.

c) **CHART RANGE**

This sets the maximum vertical chart scale in counts for the “chart recorder” display.

Selections are **64cps, 128, 256, 512**, **1K, 2K, 4K, 8K, 16K, 32K, 64Kcps and AUTO.**

Some users prefer to have a fixed display so they can judge relative changes in the data while “chart recording”. They can select the desired range from the above selections.

NOTE: If a fixed full scale value is set and exceeded the display will saturate at the top. Thus if you set 1K (1000cps) then the chart display will have 0 at the bottom and 1000cps at the top. As long as the radiation field stays BELOW 1000cps then the display is normal.

If the radiation field goes above 1000cps then it will reach the upper limit and stay there until

the radiation comes below 1000cps. The numeric data on the display are unaffected by these limits.

The **AUTO** mode automatically changes the vertical scaling to optimize the "chart recorder" screen display. For example, if the current chart scale is 500 counts and the radiation level is exceeded by 60% of the current scale, the vertical scale changes to the next highest value (in this case to 1K or 1000 counts). If the number of counts exceeds 65535, the chart record scale will remain at 64K.

If the radiation level decreases, the vertical scale will remain its current level (say 2K) until the "peak" that caused the scale change disappears from the "chart record" (60 samples of data are displayed at one time).

The vertical scale changes back according to the 30% rule - that is, the scale decreases such that the highest value appearing in the chart record is 30% of the maximum vertical scale. In the above example, the radiation level may drop to 105 counts, at which time the vertical scale returns to 500.

d) **AUDIO METER** - determines the mode of operation of the Audio meter system

Options are **OFF**, **AUTO, 50, 100, 150, 200, 250cps**

AUTO: In this mode, the variable radiation level digital data displayed on the screen will also give a variable tone audio which directly follows the radiation level. Thus a sudden increase in radiation level will give a corresponding increase in audio pitch. This is a very important feature of the **SEARCH** mode as it permits a very sensitive "eyes free" search tool. The data is sampled at a 20Hz (50mSec) rate with an optimized filter to give a quick audio response as radiation increases.

If this mode is selected, then when the SEARCH mode is started - the first 3 samples are averaged and a 2 Standard Deviations Audio Alarm Threshold set above this average value. This stays as the permanent Audio Threshold until the mode is de-selected and re-started. This method is suitable for most applications as it automatically averages Background levels to define a reasonable threshold above background.

50..250: These selections permit a fixed count rate audio threshold to be selected rather than the automatic selection as above. Once this threshold is exceeded then the audio gives a variable tone following the variable radiation level

OFF: This selection switches the audio meter OFF to disable the audio search mode

e) **ALARM LEVEL**: selections are **OFF, 100, 200, 250, 300, 350, 400, 450, 500, 600, 700, 1000, 2000, 5000, 9000cps**

This selects a specified ALARM THRESHOLD LEVEL. When this threshold is exceeded a special audio warning tone is heard and the display shows a pop-up window – see Figure 9-3.

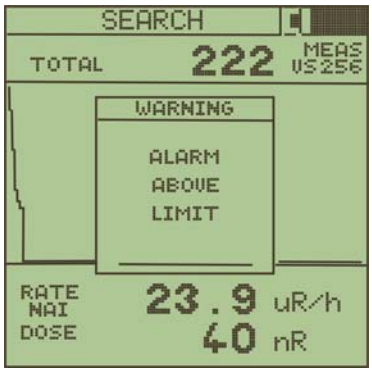


Figure 9-3

f) **SCAN WINDOW :** selections are **TOT, ROI1, ROI2, ROI3**

This selects the data used in the **SEARCH** mode. If **TOT** is selected then the display will show TOTAL and the full spectrum data is used – everything above the lower threshold of 20keV.

Any of the ROI selections utilize data ONLY FROM THIS ROI for the SEARCH mode. Settings for the ROIs are explained in ***Section 9.7***. Thus with ROI1 at its default setting for

Americium-241 – then if ROI1 is selected then only the Americium data will be used for the SEARCH scan.

NOTE: users are advised that, in most cases, using the **TOT** selection is recommended as this selection gives you the highest count-rate and therefore the highest sensitivity.

g) **AVERAGING:** selections are **OFF, 3P, 5P, 10P**

This selection permits data filtering. 3P = 3 point filtering – really a 3 point moving average. So at a 1 second base sample rate the data will be displayed at a 3 second average updated at a 1/sec rate. This makes the data chart display smoother and easier to read but users are cautioned that averaging also reduces small peaks amplitudes so if the instrument is rapidly moved then small peaks may be missed.

OFF – raw data only, no data averaging

3P = 3 point averaging

5P = 5 point averaging

10P = 10 point averaging

9.2 STABILIZE

Selection is **RE-STAB MODE**

Note: This parameter is used to advise users when system re-stabilization is required, but we recommend that the unit be stabilized each time prior to use for consistent and accurate readings. Also refer to Section 9.2.1.1.

9.2.1 RE-STAB MODE

Selection currently is only **S.VALIDITY**

9.2.1.1 S. VALIDITY

Selections are OFF, 12H, **24H**

OFF - With this selection (in the AUTO mode) - when the unit is removed from the DS or power cable the correct Gain will be maintained using the reference temperature correction. The OFF parameter means that NO WARNINGS are given to the user of when a recommended stabilization is required. This setting is often used by users who have no realistic capability of using the DS or the power cable prior to instrument deployment so would find the requirement to stabilize in the DS or on the power cable as impractical. Users are advised that although the temperature correction is quite accurate under some special conditions the accuracy of the correction may be inadequate. The rule of thumb is that if during operation you get a "**SHIELDED SOURCE**" message and the dose rate is **ABOVE** the NI Dose Limit setting or "**NORM SOURCE**" and the dose rate is **BELOW** the NI Dose Limit setting then this is possibly because the gain correction is a little off.

In this case users are advised to stabilize the system in the DS or by using the power cable and then repeat the measurement. If the same "**SHIELDED SOURCE**" or "**NORM SOURCE**" message is received again then this truly is an isotope whose characteristics are not listed in the system library.

12H, 24H – if either of the parameters is selected, it means that either 12 hours (12H) or 24 hours (24H) after removing the system from the DS or the power cable – a message will appear on the GR-135 display requiring the system to be returned to the

DS or placed on the power cable with the Cesium source installed, for system stabilization. The standard setting is 24 hours as this is a reasonable time for system operation without the super accurate requirement of stabilization. Most **AUTO** mode users keep the unit in the DS or connected to the power cable when not in use, so in most cases the parameter effects are unnoticed.

9.3 ASSAY

There are 3 sub-sections – **DETECTOR, NAI, NEUTRON**

Note: NEUTRON is **NOT AVAILABLE** for this version of firmware.

9.3.1 DETECTOR

a) **DETECTOR –** this selects the detector type used in the **ASSAY** mode, the current selection is **NaI –** and selects **only** the Sodium-Iodide (NaI) detector.

b) **PILEUP** – This sets the Pile-up rejecter **ON** or **OFF**

The Pile-up rejecter only applies to the NaI detector, so this parameter controls only the NaI data collection. For the NaI detector this item automatically detects if 2 pulses are impacting the detector simultaneously. Normally such pulses would combine to produce an incorrect energy pulse. The Pile-up rejecter automatically rejects BOTH pulses and changes the Dead-Time counter to compensate. The OFF selection permits system testing for special applications.

c) **PEAK LIMIT** – Selections are 20, 25, **30**, 35, 40, 45, 50 (SD units)
This parameter is essentially a "sensitivity" setting for Nuclide Identification.

During Nuclide Identification, a spectrum is taken then a Peak Analysis engine is used to select significant peaks. This engine suppresses backscatter peaks etc and other spurious peaks during its action and then defines a list of all peaks found. For each peak the error on that peak is computed and the amplitude of the peak is determined in Standard-Deviation (SD) units.

The **PEAK LIMIT** setting is then used to remove low amplitude peaks. So if 30 is selected (the default value) then any peak 2.9 SDs or below is eliminated before the peak list is used for Nuclide Identification.

This parameter is useful in some applications where low amplitude peaks need to be excluded for special application. However if this value is set too low then some spurious peaks may occur so the default setting of 30 usually gives the best results.

d) **NI DOSE LIMIT** – Selections are 10, 15, **20**, 30, 40, 50 (µR/h units)
This "NI Dose Limit" normally set at 20µR/h (200nSv/h) is used to show that the radiation level is clearly above the background level indicating some source is present and is used as explained below.

After Nuclide ID, if NO PEAKS are found or a peak is found that is not in the library and the Dose Rate is **BELOW** the NI DOSE LIMIT setting the following messages displays:

NORM (Naturally Occurring Radioactive Material) SOURCE - If the analysis results are such that the **Dose Rate ≈ BG** radiation, then the GR-135 shall display "**NORM SOURCE**" as the system is seeing the local NORM background.

After Nuclide ID, if NO PEAKS are found or a peak is found that is not in the library and the Dose Rate is **ABOVE** the NI DOSE LIMIT setting the following messages displays:

SHIELDED SOURCE – If the analysis results show the **Dose Rate » BG** radiation, then the GR-135 shall display "**SHIELDED SOURCE**". Furthermore the results may show these conditions; Peaks, with no Isotope Identification, No Peaks, but scattered

radiation, with no Isotope Identification or a combination of an identified isotope and strong peaks with no Isotope Identification, these all indicate the presence of a shielded source.

Note: If users are testing Nuclide ID with NO SOURCES PRESENT then the results should normally be "NORM SOURCE" as the system is seeing the local NORM background.

e) **NUCL LIMIT** – Selections are 3, 5, 7, 8, **9**, 10, 11, 12, 15 (SD units)

The "NUCL LIMIT" = **9SD**s as default. In Nuclide ID the **PEAK LIMIT** parameter is normally set at 30=3.0SDs to determine whether a peak is used in Nuclide ID. The Peak Analysis engine produces a list of all peaks found and any peak below this setting (3SDs) are NOT used for Nuclide ID. This works very well for multi-peak isotopes but many complex spectra can easily produce aberrant peaks because of Pile-Up etc. and these can easily be misconstrued as being present whereas in fact they are scattering effects etc.. The parameter **NUCL LIMIT** requires the SUM of all the peaks in an ID to exceed the default setting (9SDs).

For example, if you have an analysis producing 3 peaks A=5SDs, B=6SDs and C=3SDs and Isotope X requires A+B. Then in this case A+B = 11SDs which is above the 9SD default setting, so identification of isotope X is displayed. In the case where isotope Y requires only 1 peak and this is B, then since B=6SDs and this value is below the 9SDs limit, isotope Y is NOT identified. The net effect of this is that single peak identification is very significantly improved with very little down side.

9.3.2 NAI

Selections are:

a) **MEAS TIME –** sets the sample time in seconds for acquiring a Sodium-Iodide spectrum in the ASSAY mode– selections are 10, 20, 30, 40, 50, 55, 60 .. 100, 200, **300** .. 600, 1200, 1800, 3600, 5400 secs

b) **MEAS MODE** - Selections are: LIVE, **CLOCK,** REP.

GENERAL COMMENTS regarding LIVE-TIME and DEAD-TIME **.** When the spectrometer is acquiring data, each incoming signal pulse from the detector takes a finite time to process (convert from an analog amplitude indicative of energy level to the corresponding channel number in the spectrum).

The time taken to process each pulse is referred to as DEAD-TIME and is usually expressed as a % of the available time. If the incoming count rate is very high then the Dead-Time will be very high. As an example, if Dead-Time = 50% then for every second of sample time, the system is only "available" for 50% of the time = 0.5 seconds - to process new pulses, so any incoming pulses encountered during signal processing will be lost. Thus when accumulating data the system is "LIVE" only for a fraction of the time.

At very low count rates, the Dead-Time is relatively insignificant. However at higher rates Dead-Time correction is important. The standard way of dealing with Dead-Time is to normalize the data to compensate for this sampling Dead-Time by using the actual system LIVE-TIME, where:

LT (Live-Time) = ST (Sample-Time) - DT (Dead-Time)

The system LIVE-TIME is automatically accumulated by the GR-135 and stored as a data variable that is output on the data stream to permit data correction on external processing systems. The displayed DEAD-TIME is computed at a 1/sec rate for display purposes only by the simple formula:

DT%= [(ST - LT)/ST]*100

For example, if a 100 second sample had a Live-Time of 91.373 secs then:

ST - SAMPLE -TIME = 100.000 sec

LT - LIVE-TIME = 91.373 sec

Therefore DT = 8.6% from the above formula.

The DEAD-TIME is only computed for display purposes to advise the user in the ANALYSIS mode of the approximate intensity. As mentioned previously for best data analysis Dead-Time below 20% are advised as above this level the local radiation field is so intense that scattering may cause data analysis problems. Since the radiation falls off as the inverse square - moving a few feet away from a "hot" source will reduce the DT thus giving better data analysis and reducing the users' exposure.

To give an idea of Dead-Time:

10% Dead-Time

= a DOSE Rate for Cs137 of approx. 0.5mR/h

= a count rate of approx. 5000cps in the SURVEY mode

The **LIVE-TIME** data is what is important and it is used to correct the data for the "lost" sampling time as shown in the following example:

ST = 100.000 secs

LT = 91.373 secs

Channel 128 = 1850 counts after the 100 secs sample = **18.5** counts/sec

The **REAL** value for Channel 128 = 1850/91.373 = **20.25** counts/sec

As can be clearly seen – LIVE-TIME correction is essential for proper data analysis.

To make data analysis simpler, the user has 2 options on how to correct this effect as follows:

LIVE - This setting enables an **automatic correction method** and this correction essentially increases the sample-time by the Dead-Time to account for all the pulses that would have been lost because the electronics were "too busy" to process the incoming pulse.

If **LIVE** mode is selected, the preset sample period is AUTOMATICALLY extended by the Dead-Time so the final data is automatically Dead-Time corrected. Thus if you set a 100 second sample period and there is a 10% Dead-Time, then the actual sample period will be approximately 110 seconds thus all the "lost" time has been compensated for and the data represents a true 100 second sample. The selection of LIVE mode is an advantage to users who want "automatic" operation to minimize data processing. In low count areas extending the sample period also gives slightly more accurate data. The main drawback to this mode of operation is that the actual duration of the sample is **variable**.

CLOCK - In this mode, the preset sample time is the actual sample time and any Dead-Time occurring must be corrected manually. The data output includes the system Live-Time so that correction is quite simple especially if using a spreadsheet program.

(As an example the Exploranium **IdentiView** program described in Appendix A provides the option to output the spectra to a spreadsheet. In the process the data is automatically Live-Time corrected and normalized to counts/minute.) The CLOCK mode is used primarily when several analyses are being compared without time normalization and it is necessary to have the same sample time.

NOTE

USERS ARE REMINDED THAT IN THE LIVE MODE – ACTUAL SAMPLE TIMES WILL BE MUCH SLOWER IN HIGH COUNT RATE AREAS. IF ONLY NUCLIDE-ID IS REQUIRED THEN USE OF CLOCK WILL ENSURE THAT THE PRESET SAMPLE TIME IS THE ACTUAL SAMPLE TIME.

REP. - This setting enables the unit to do multiple spectrum sampling and analysis. Each spectrum measurement is sampled over the user defined sample time (MEAS TIME) and stored as a unique spectrum #. The routine is stopped by pulling the joystick down (ENTER), which will then display the ASSAY sub-menu.

c) **ADC –** denotes the number of channels in the spectrum – system is currently hard wired at **1024G** channels = 3keV/channel – selections are 256N, **1024G**.

Note: *ADC must be set to 1024G channels for stabilization to occur (this unit can only stabilize in 1024G Channel Mode).*

d) **AUDIO** – selections are **ON**, OFF

This sets a mode so that at the end of the data sample the audio will beep to remind users that the sample is complete. The OFF selection sets no beep.

e) **GAIN CORR** – selections are **ON**, OFF

This enables the automatic correction of detector drift as a function of temperature. Normally this is **ON** as this feature is mandatory for proper system operation. However under special conditions the user may wish to disable this correction so an OFF capability is permitted.

9.4 DOSE

These selections set the DOSE parameters.

a) **MEAS UNIT** – sets the Dose measurement units – selections are **R**, Sv, Gy

Gy (GRAYS): the system is calibrated to the AIR KERMA RATE for Dose in GRAYS

R (Roentgen): a conversion factor is used **GRAYS -> R = x 114** (NUREC #ICRU-47)

Sv (Sievert): Unit is directly calibrated in **Ambient Dose Equivalent** (**H*10),** (H*10 is the International cal standard for Dose)

b) **SAMPLE TIME** – sets the Dose update sample time – selectable **1**, 2..10, 20 ..60 seconds

This sets the actual update time in seconds of the DOSE measurement. If a 5 second sample time is selected when the DOSE mode is started, the display shows “0” for 5 seconds and then displays the current reading. This display will then stay constant for another 5 seconds and then the new value will be seen.

c) **AVERAGING** – selects data averaging. Settings are **3P**, 5P, 10P, OFF. This uses a selectable running mean updated at the sample rate. So a sample rate of 1 second and a Averaging of 3P means that the data is a 3 point average updated every second.

d) **CORRECTION** - Selections are: 80, 85, 90, 95, **100**, 105, 110, 115, 120%.

This feature permits users to change the Dose Calibration to suit local standards. The system should correctly be set for **100%**. However if a local calibration shows that the system is reading **+10%** high, then adjusting this parameter to **-10%** will correct the data to achieve local calibration.

Note: Users should leave this setting at 100% if at all possible as careful calibration has shown that this is the correct value and many calibration facilities may be inaccurate at the lower Dose levels used in the GR-135.

e) **ALARM LEVEL** -

This sets the DOSE Alarm Level in micro units. Once set, if the Dose exceeds this level the audio will alarm to warn the user. Note that this setting changes depending on the units selected, as follows:

- **R** - OFF, 10, 20, 50, 100, 200, 500, 1000, **2000µ**, 4000, 5000, 9000 **µR/h**
- **Sv** - OFF, 0.1, 0.2, 0.5, 1.0, 2.0, 5.0, 10.0, **20.0µ**, 40.0, 50.0, 90.0 **µSv/h**
- **Gy** - OFF, 0.1, 0.2, 0.5, 1.0, 2.0, 5.0, 10.0, **20.0µ**, 40.0, 50.0, 90.0 **µGy/h**

Note: A factor of 100 is maintained between R and Gy/Sv that approximates the relationship. Thus if you set 2000µ in the R setting this means a threshold of 2000µR/h – if the units are changed from R to Sv – this value will automatically change to 20.0 µSv/h. Thus the parameter setting is always in **micro (µ) units** whether R, Gy or Sv.

In AUTOMATIC mode this parameter sets the upper (right hand) limit of the bar graph.

In both modes, if this level is exceeded, a pop-up data box warns of **HIGH DOSE** and warns users to **MOVE AWAY**.

9.5 DATE/TIME

This selection permits the user to set up the local Date and Time. Since all stored data is date stamped it is important to set this up correctly as an aid in locating data for data analysis. The selection for (**DAT. FORMAT**) is either **U** or E.

U – Date will be presented in the following format MM – DD – YY.
E – Date will be presented in the following format YY – MM – DD.

Use LEFT/RIGHT cursor to select the digit to change then UP/DOWN to change it

Ensure you follow the display conventions for **DATE**; MM – DD – YY and **TIME**; HH: MM: SS, to set the data correctly.

9.6 ROI S

This selection permits the user to select 3 ROIs to whatever channel range in the spectrum is required.

Default for GR-135 settings are imbedded into the EPROM:

ROI#1 – 431-489 – **Factory Set -** Potassium Source (from 1350.4 to 1548.9)

ROI#2 – 510-582 – **Factory Set -** Uranium Source (from 1621.7 to 1875.3)

ROI#3 – 761-815 – **Factory Set -** Thorium Source (from 2532.3 to 2738.0)

ROI#0 – Factory Set - TOTAL COUNT

ROIs are used in various ways:

a) SEARCH DATA – some users need the ability to search only for a specific isotope so setting the appropriate ROI in this menu then selecting the appropriate ROI in the SEARCH menu permits this.

b) In the SEE SPECTRUM mode (see later) the ROI contents can be displayed for special applications

9.7 MISCELLANEOUS

a) **LANGUAGE** – selects the language for the displays. In this release, selection is **ENG** (English) only.

b) **BATTERY** – sets the battery type. Current selections are **NO/CH** (No Charge – Alkaline) and **CD/MH** (Nickel Cadmium/Nickel Metal Hydride).

WARNING: When using **Alkaline Batteries** with the Docking Station or connecting a power cable directly to the unit always make sure that the GR-135 Battery is set to **NO/CH**. If this is not done, ***it will result in battery leakage and extensive system damage*.**

c) **BACKLITE** – sets the display Backlite operating mode. Selections are **OFF**, ON, 5S, 10S, 30S, 60S, 255S.

OFF – means that the Backlite will only be switched ON when the user powers on the unit by holding the joystick down for 4 seconds. If this is done the Backlite will come on and stay on until the unit is powered off.

ON - means that the Backlite is switched ON permanently until the selection is changed. With this setting when the unit is power on the Backlite will come on and stay on

5S(10-255S) – means that the Backlite will come on and stay on for 5 seconds then go off. However every time the joystick is activated it will come on again for 5 seconds

Backlite use reduces battery life by 50% so Backlite is only recommended when essential.

d) **ACTIVE LIBR** – this sets the Library used for analysis – selections are **CUST** (Customs), **STAND** (Standard), **MEDIC** (Medical), **INDUST** (Industrial) or **USER**. These libraries have been selected as optimum for the different applications. However some users have special requirements and require a special library. In this release of software, all special libraries must be constructed by SAIC Exploranium (contact the Help Desk see Appendix Z) as required. These new libraries are then loaded into the USER location using the SAIC Exploranium supplied PC support program IdentiView.

Note that once selected in this parameter setting, the actual isotopes in the library can be viewed in MAINTENANCE/LIBRARY as described (see Section 10.2).

Note: If the batteries are totally discharged, have been removed from the unit or if the Default Parameters have been loaded (see Section 10.5), the uploaded Special Libraries in the USER location will be lost, and need to be restored with IdentiView (see Appendix A for more details).

10.0 MAINTENANCE

The Maintenance section has a selection of special utility programs for special functions

10.1 MAINTENANCE MENU

This is the main Maintenance menu – see Figure 10-1.

Figure 10-1

10.2 LIBRARY

Selection of this option displays the nuclides in the system library – see Figure 10-2. For the current library list refer to Appendix C.

Figure 10-2

10.3 CHARGING

This special feature is used during system setup (see Figure 10-3)

IT IS NOT RECOMMENDED FOR GENERAL USE AS IT CONTAINS NO USEFUL INFORMATION FOR THE AVERAGE USER.

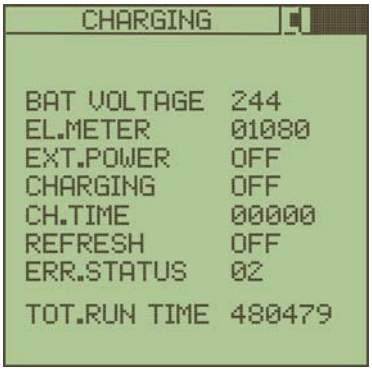


Figure 10-3

10.4 REMOTE

This sets the RS 232 port to the active state to permit data transfer using the SAIC Exploranium IdentiView software described in Appendix A. This setting works as a latch – the first activation sets the port **ACTIVE** and the next activation sets it **INACTIVE** (see Figure 10-4). Normally the port should be **INACTIVE** for normal system functions.

In the system architecture the RS 232 port and the AUDIO sound share a common data point. This is normally not an issue as the Audio is not normally active during RS 232 functions.

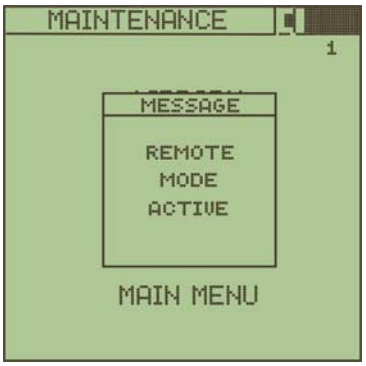


Figure 10-4

Users are advised that when the REMOTE mode is active, the AUDIO is disabled.

10.5 DEFAULTS

This selection permits the user to LOAD DEFAULT PARAMETERS (see Figure 10-5). This is sometimes useful when the instrument has not been used for a long period or when "strange" system performance occurs.

Like all computer-based systems, sometimes the data memory gets corrupted. The system software checks all functions continuously to try to trap any problems that could cause memory corruption but not all features can be protected against.

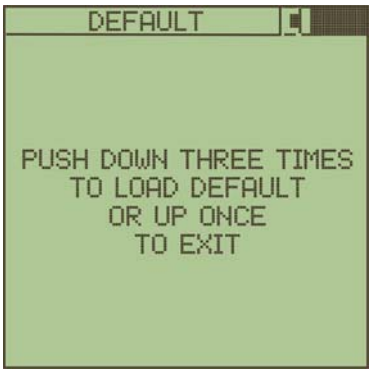


Figure 10-5

For these reasons sometimes it is necessary to clean the entire system memory and load the basic Default parameters.

This is done by selecting this function and a new figure appears.

NOTE – LOADING DEFAULT PARAMETERS ERASES ALL DATA MEMORY SO IF NECESSARY THE USER SHOULD SAVE THE DATA USING IdentiView BEFORE LOADING DEFAULTS.

As the display shows (see Figure 10-5), press ENTER 3 times to activate this feature. The screen then shows the figure on the right. The unit will return to the Maintenance screen when defaults have been loaded (see Figure 10-6).

Figure 10-6

10.6 ADC TEST

This special feature is used during system setup (see Figure 10-7)

IT IS NOT RECOMMENDED FOR GENERAL USE AS IT CONTAINS NO USEFUL INFORMATION FOR THE AVERAGE USER.

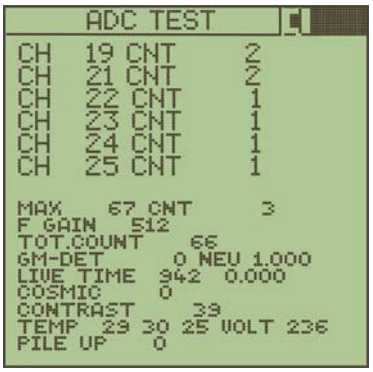


Figure 10-7

10.7 MAIN MENU

Selecting **MAIN MENU** and pressing **ENTER** returns to the Main Menu (see Section 2.3 and Figure 2-1C).

11.0 SPECIFICATIONS

DETECTORS

a) SODIUM-IODIDE
Detector: Sodium Iodide (Thallium) [NaI(Tl)] 4.0 cu ins (65 cm^3) volume detector
1.5" diam * 2.2" long (38 mm dia x 57mm long) with an integral bi-alkali PMT.

Resolution: Better than 9.0 % FWHM for Cesium 137 at 662 keV.

b) G-M tube: 0.5" diam x 2" long – energy compensated GM tube

Range – 1mR/h to 10R/h for Cesium-137

ANALOG TO DIGITAL CONVERTER

Type: Buffered, high speed, high linearity, 8 ΦS - Successive Approximation ADC.

# of channels: 1024

Lower threshold: Internally adjustable – set at 15keV

Upper threshold: Fixed to Ch 1023, all pulses above this level are Cosmic and are accumulated and displayed in Channel 1024.

ADC Offset: Internally adjustable.

Maximum Count per Channel: 65,535

Dead Time Correction: Automatic, 0.1% precision.

DOSEMETER

Sample time: 1, 2, 3, ... , 10, 20, 30, ... , 60 s

Energy range: 50 keV - 3.0 MeV set by the spectrometer

Meas. units: Selectable R, Sv, Gy.

Meas. range: Sodium-Iodide only: 1 µR/h - 5 mR/h
System may overload at the higher level at a different rate depending on the isotope. Approximate maximum levels are 2mR/h for Am-241 and 5 mR/h for Cs137.

Meas. Range: G-M tube: 1 µR/h - 1 R/h (10nSv/h – 10mSv/h)

Precision (NaI): ±10% in range 100 keV - 3.0 MeV
±20% in range 60 keV - 100 keV

Output: Memory or PC.

MISCELLANEOUS

CLOCK - CALENDAR

Type: Built in 24-hour clock, 4-year calendar (including leap year).
Full battery backup,10 year retention time.

Precision: +/- 3 s/day at 25 deg. C.
+/- 30 s/day over full operating temperature range.

DATA STORAGE

Type: 2MB CMOS SRAM memory, with Li-battery back-up.

Capacity: 40,000 samples, including time/date (SEARCH+DOSE mode)
or
187 spectra (ASSAY mode - 1024 channels), including time/date

Data Retention Time: Typically 10 years, limited by Li-battery life.

Stored Data Retrieval: Via serial channel to a computer.

DATA OUTPUT

Type: Serial channel RS-232C, 1 start bit, 8 data bits, no parity, 1 stop bit.

Baud Rate: 19200 Bd.

Format: Binary data in packets.

GENERAL DATA

DISPLAY

Type: WTSTN (Wide Temperature Super Twist Nematic) graphics LCD, 128 x 128 pixels, LED backlight. Viewing area: 67 x 67 mm.

Contrast: Digitally adjustable in 20 steps, by joystick in selection menu.

POWER REQUIREMENTS

Battery voltage = 3 V

Power usage	OPERATION	NORMAL
Measurement:	0.65 W	1.2 W
Main menu and all setting menus:	0.35 W	0.7 W

POWER SUPPLY OPTIONS

A. Internal Rechargeable Battery

Type:	2 "D" cells, 1.25 V NiCd.
Operation time:	Typically 8 hours of operation at 25 °C, no backlight, 4 AH NiCd.
Charging:	External, constant current float charger, overnight charging, full charge indication by LED.

B. Internal Battery

Type:	2 "D" cells, alkaline.
Battery Life:	Typically 15 hours of operation at 25 °C, no backlight, with Alkaline EVEREADY #1250.

C. External:

Type:	12 VDC, 1.0A external power supply
Voltage Range:	From 9-24VDC.

CONNECTORS

Charger (Ext. Power Supply): 2.5 mm power circular jack, "+" on the center pin.
Mating connector: 2.5 mm power circular plug.

Serial Channel: 3.5 mm stereo jack.
Mating connector: 3.5 mm stereo plug.

Docking Station: 4 spring loaded pins for power and RS 232

PHYSICAL

Dimensions: L = 9.25" (235 mm)
W = 4.5" (110 mm)
H = 3.9" (100 mm), 6.75" (170 mm) including handle

Weight: 1.9 kg (4.4 lbs) without battery.
2.4 kg (5.5 lbs) including battery.

ENVIRONMENTAL

Operating Temperature Range: - 10 to + 50 °C

Storage Temperature Range: - 20 to + 60 °C

Protection: Weather proof, dust and water sealed (no immersing).

Non-condensing Relative Humidity: Less than 90% at 40°C.

Vibration: 0.5G max. (10 - 300 Hz, XYZ directions, 1 h)

Shock: 3G (10 mS, XYZ directions, 1 time each).

RFI/EMI Emission: Complies with FCC rules (47 CFR Part 15) for class A.

Full CE Certification

ACCESSORIES

Geophysical:

- GR-135 Unit.
- 110V AC Charger Adapter for battery charging.
- Vinyl carrying case.
- CD-ROM with **IdentiView** Windows software.
- RS-232 cable for PC connection.
- Reference Source Cesium 137 (0.25 µCi).
- Operating Manual.
- Padded, compartmentalized carrying case.

Optional:

- 220 VAC Charger Adapter for battery charging.
- DOCKING STATION for automatic charging and PC connection
- External earphone system
- 2uCi Cs source if permitted by local regulations

APPENDIX A – IDENTIVIEW SOFTWARE

A.1 GENERAL

IdentiView is a specially designed software program supplied by SAIC Exploranium that is used to download data from the GR135G instrument and view/analyze/format the data. In this version of software documentation it is assumed that the user is ALWAYS in the AUTOMATIC MODE and only spectra will be downloaded. For MANUAL mode operation, the procedure for downloading data from the GR-135 is identical except that the GR-135 must first be set to the **MAIN MENU → MAINTENANCE → REMOTE** data access mode.

A.2 INSTALLING THE SOFTWARE

1. Load the Exploranium "**Program/Document Support**" CD into the PC.
2. Select RUN and BROWSE, then navigate to the **GR135\Software\Identiview release version xxx\disks** directory, where xxx is the version number. Select the file **setup.exe** and click **OK**.
3. Select desired install location (default = **C:\IdentiView**).
4. Click **FINISH**. After some screen activity, the screen should show "**Successful Installation**".
5. Once the **IdentiView** Application program appears right-click and use "**Send-to**" to setup an icon on the Desktop.
6. Close this window.
7. Follow screen prompts to install the **LabView** engine software.
8. Exit all screens.

> **Note:** The GR135G is hard-wired to operate at 19200 Baud to suit most computers.

A.3 USING THE SOFTWARE IN AUTOMATIC MODE

A.3.1 SETTING UP THE SYSTEM

Set up the system as follows:

1. Connect the GR135G unit to the PC com port via the supplied RS-232 communication cable. (If using the DS, connect the DS to the PC with the standard DB9 data cable – M/F and place the GR135 into the DS). Refer to Appendix B.
2. Connect the 12V power cable to the GR135G unit (or the DS). Refer to Appendix B.
3. Click the GR135G joystick button down for at least 2 seconds. The unit will power ON and after a few seconds the SYSTEM READY message appears.
4. Start the program by clicking the **IdentiView** icon. The following screen appears.

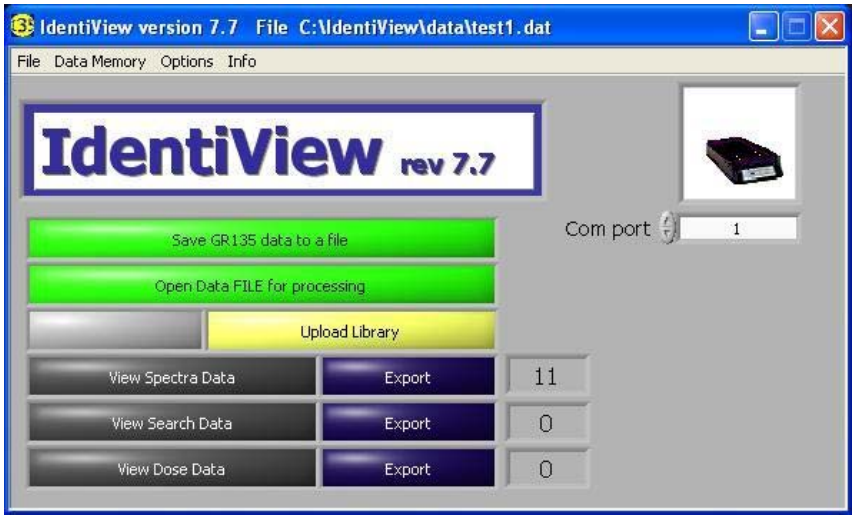


Figure A-1

The icon in the top right-hand corner of the display (see Figure A-1) indicates when the GR135G **IS NOT** connected to the 12V power cable (or placed in the DS), or if it is not communicating with the PC through the communication (data) cable. If the unit **IS** connected to the 12V power cable (or placed in the DS) then this graphic is replaced with an icon depicting the unit in the DS as shown in Figure A-2:

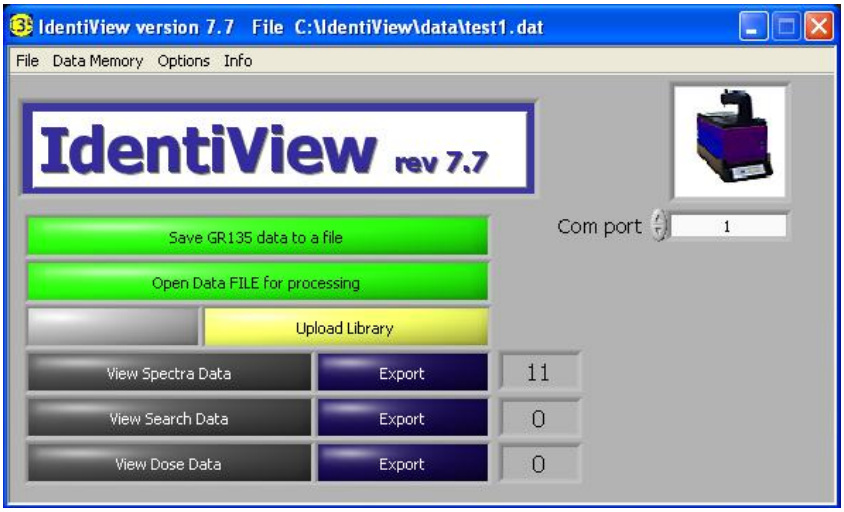


Figure A-2

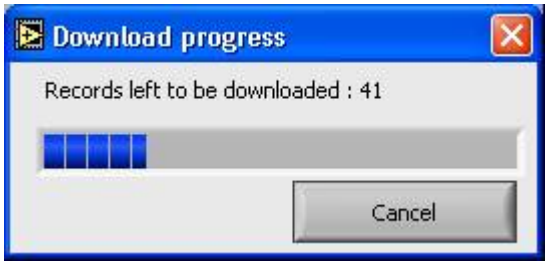
If the correct icon as in Figure A-2 is **NOT** seen, check:

- That the GR135G is connected to the 12V power cable.
- Or that the GR135G is correctly placed in the optional DS if used
- the GR135G/or the optional DS is cabled to the correct COM port (to check this change the COM port settings on the IdentiView screen)
- that the GR135G/ or the optional DS are powered on.

If the icon is still not visible, remove the 12V power cable from the GR135G (or remove the GR135 from the DS) and power off. Exit the software (File/Exit), restart the software, then place the 12V power cable onto the GR135G (or place the GR135 into the DS). If the icon is still incorrect, contact SAIC Exploranium.

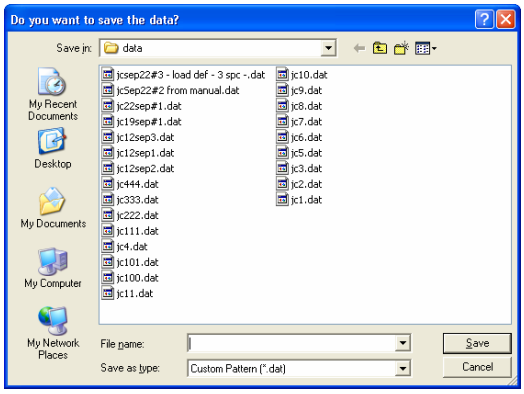
A.3.2 DOWNLOADING DATA

- As soon as the IdentiView software recognizes that the GR135G is connected to the 12V power cable (or in the optional Docking Station) it automatically starts to download the data and the following display appears:



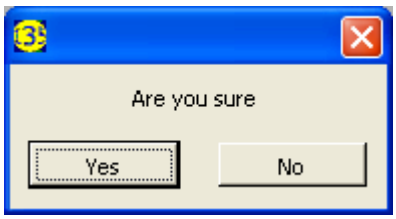
- The program is downloading the data at approx 1 spectra/second.

AT THE END OF DATA TRANSFER THE FOLLOWING SCREEN ON THE RIGHT APPEARS.
ENTER AN APPROPRIATE LOCATION AND FILENAME AND CLICK "SAVE".
THE DEFAULT FILE LOCATION IS C:\INDENTIVIEW\DATA.
ENTER AN APPROPRIATE LOCATION AND FILENAME AND CLICK "SAVE".



- Once the data is saved a new message appears. This permits the user to erase all the spectra in the data memory of the GR135G. This is usually a good idea as once the data is transferred then it is not really necessary to keep it in the 135. In addition if the memory is not cleared then next time data is transferred the same spectra will be downloaded again (plus any new spectra recorded since the last download). Eventually data transfer will be very time consuming as the system memory can accommodate 187 spectra (187 secs to download!).

- IF YES IS SELECTED A SECOND MESSAGE APPEARS TO ENSURE THAT THIS IS THE PREFERRED ACTION



- Click "**NO"** to NOT erase the memory

INSPECT THE DATA.

> **NOTE**: Normally, erasing the data is the correct action. However, these spectra are important evidence of an event, so the following procedure is recommended.

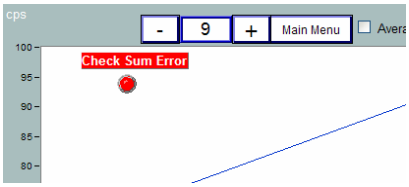
ONCE YOU ARE CONFIDENT ALL IS OK, SELECT "DATA MEMORY ERASE" FROM THE MAIN MENU AND ERASE THE DATA.

Checksum

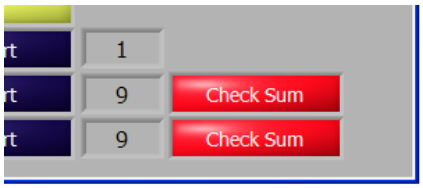
Checksum is a simple error-detection scheme in which each transmitted message is accompanied by a numerical value based on the number of set bits in the message. The receiving station then applies the same formula to the message and checks to make sure the accompanying numerical value is the same. If not, the receiver can assume that the message has been garbled.

IdentiView has two checksum processes:

- Transfer — occurs during RS232 download only. A transfer error can occur due to improper packet transfer action. If this happens, you can recover from the error: don't erase or download the data again.



- Data record — occurs when opening a data file or while viewing a data record after downloading it. A data checksum error can occur if the data inside the GR-135 memory already has this error. This rarely happens and it would usually be isolated to one record. In this case, the data is not recoverable. If this error occurs frequently, reload the default configuration.



A data checksum error, transfer checksum error, or both can occur during the checksum process.

NOTE: When viewing dose/scan data from earlier versions of IdentiView, a checksum error will be displayed due to a problem with calculating checksum values inside the GR-135 version 1.24 or earlier.

Data Memory

You can download data directly from the GR135G anytime by selecting Download from the Data Memory menu on the main IdentiView screen. If the GR135G is removed from the 12V power cable (or from the DS) data can still be saved by clicking the "Save GR135 data to file" button on the main IdentiView screen (since it was downloaded to a .temp file). Once the data is saved you can erase all the spectra in the data memory of the GR135G by selecting Erase from the Data Memory menu.

Opening Data Files

You can open a previously saved data file by clicking the "Open data file for processing" button on the main screen and selecting a data file from the Open box.

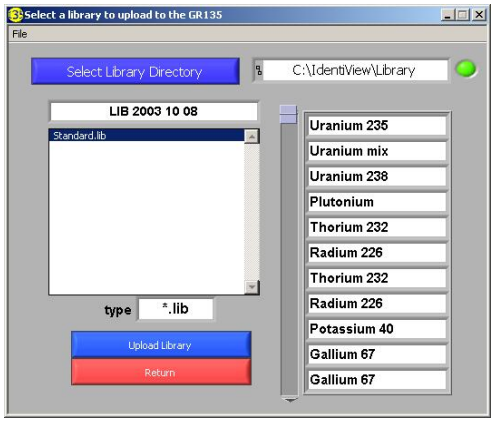
Uploading Isotope Libraries – Not Applicable

The calibration coefficients for the ASSAY Mode have been established by SAIC Exploranium for each GR135G on calibration pads (concrete blocks with known concentrations of potassium (K), Uranium (U) and Thorium (Th)), these coefficients have been burned into the EEPROM and can not be altered by the user.

The installed LabView software comes with a standard isotope library (this library should be sufficient for GEO purposes). Users can load this library or other isotope libraries into their IdentiView software:

1. Click the Upload Library button on the main screen. The Library dialog box appears.

2. Click the Select Library Directory button. The Select a Library Directory dialog appears.
3. Find a library folder and click the Select Cur Dir button.
4. Select the desired library file. The library name, type, directory path, and associated isotopes now appear in the Library dialog box.



5. Click the Upload Library button to have IdentiView accept and apply the library information.

The isotopes will now appear in the display when you view the search data.

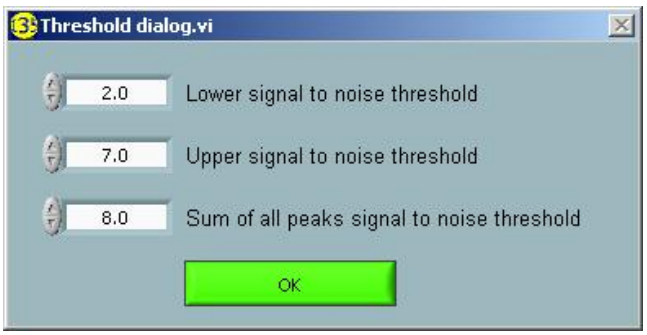
A.3.3 SETTING IDENTIVIEW OPTIONS

IdentiView lets you do the following tasks through the Options menu on the main IdentiView screen:

- Set the signal to noise thresholds
- Retrieve data from a previous IdentiView version
- Select the time and date format

Setting Signal to Noise Thresholds

You can set the signal to noise thresholds by selecting Threshold Settings from the Options menu. The following dialog box appears:



Set values for the following thresholds using the up or down arrows:

- Lower signal to noise threshold - This is the level at which peaks are considered to be “real” or significant and can be used to identify isotopes. Unidentified peaks above this level but below the upper threshold are shown as a blue line. The default value is 3.0.
- Upper signal to noise threshold - This is the level at which peaks are considered to be significant and can be used to identify isotopes. Unidentified peaks above this level are shown as a red line. The default value is 6.0.
- Sum of all peaks signal to noise threshold - This is a threshold that will reduce the number of false positives by requiring that for each isotope identified the total sum of all peaks’ signal to noise ratio is greater than this number. To disable this feature for maximum sensitivity, change this threshold to 3.0 (the same as the lower threshold). The typical range would be 4.0 to 9.0.

Retrieving Data from a Previous IdentiView Version

If you have a data file that was created and saved using a previous version of the IdentiView software, you can retrieve it using the latest version as follows:

1. Select Advanced from the Options menu.
2. From the submenu, select Open 1V16 file. A dialog box appears.
3. Select the file to be opened.

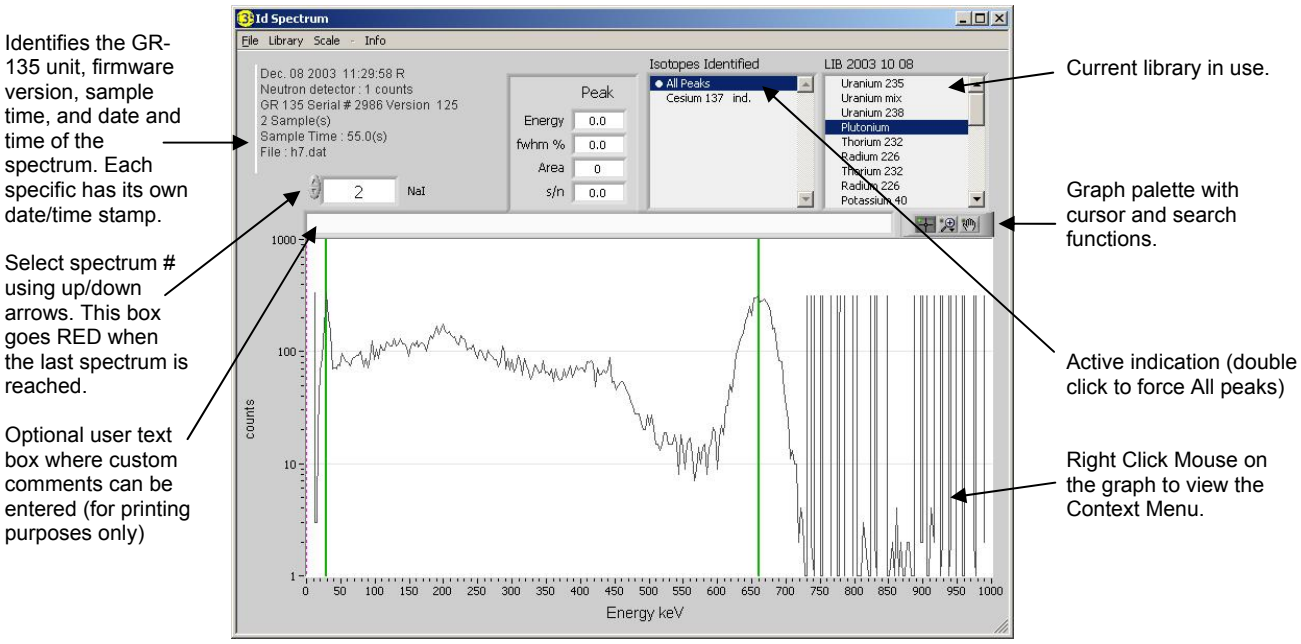
Selecting the Time and Date Format

IdentiView gives you several time and date formats from which to choose. From the Options menu, select Time and Date, and choose one of the following:

- Show local time - Displays the local time of day in the View Spectra Data, View Search Data, and View Dose Data charts. For display purposes only, data and unit still contain GMT time.
- Show GMT (UTC) time - Displays Greenwich Mean Time of day in the View Spectra Data, View Search Data, and View Dose Data charts. No time zone conversion is done.
- Synchronize on - Synchronize the time of day to Greenwich Mean Time (UTC). The default is automatically set every time the unit is placed in the docking station.
- Synchronize off - Allows you to set the time manually.
- Date format - Lets you choose one of the following options for displaying the date:
    - MMM DD YYYY
    - MM DD YYYY
    - DD MM YYYY
    - YYYY MM DD

A.3.4 VIEWING SPECTRA DATA

Once the spectra have been down loaded and stored on the PC, it can be inspected. Click the "**View Spectra Data**" button to see the spectra graphically.



The main display shows the selected spectrum in **LINEAR** mode. You can use the "**Scale**" button to select **LOG** if required. The following information is shown:

- The GREEN lines show the peaks that have been identified by the spectral analysis engine and the "Isotopes Identified" data box names these isotopes.

THE BLUE LINES SHOW PEAKS FOUND BUT TOO SMALL TO USE FOR ACCURATE ANALYSIS.

- The RED lines show peaks that are over the signal to noise threshold but relate to isotopes that could not be found.

THE DOTTED VERTICAL PURPLE IS THE CURSOR. THE MOUSE CAN BE USED TO DRAG THIS CURSOR (POSITION, LEFT-CLICK AND HOLD THEN DRAG)

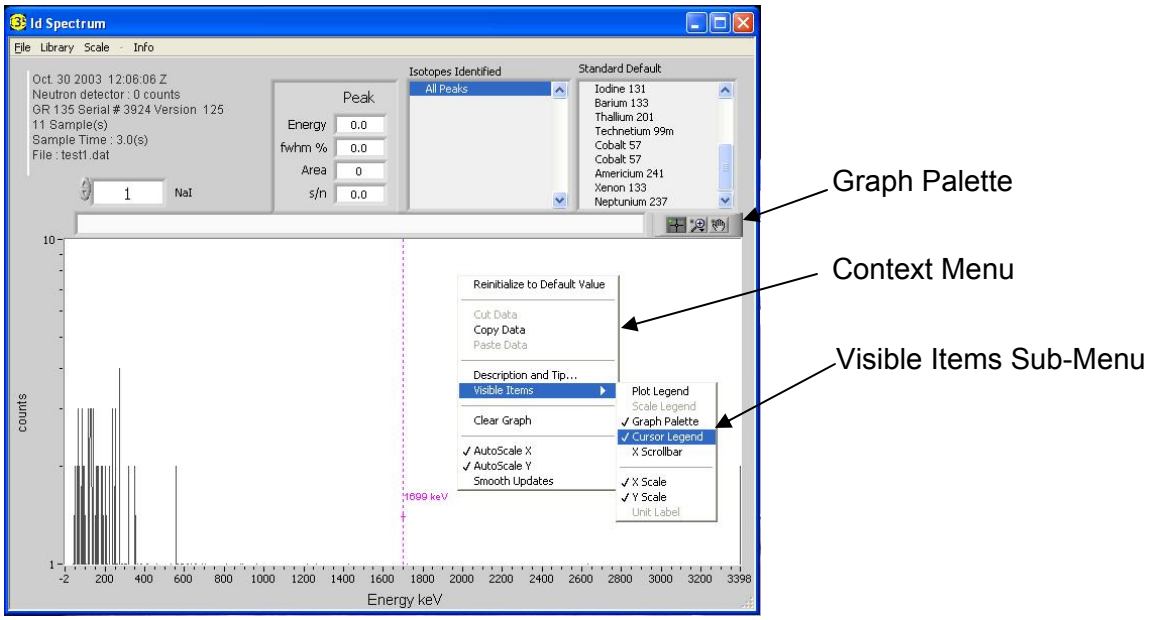
- From the current library (in the upper right corner) you can click on any line and the required lines for that isotope will appear on the spectral display. This allows you to quickly scan through the library and compare selected isotopes to the displayed peaks for a more in depth analysis.
- Any lines that find peaks that match the selection show as GREEN. If there is no match then they show as RED.

Using Isotope Libraries

The isotope library file that is used to upload to the GR-135 is the same as the one that can be loaded for analysis. The data will be re-analyzed with the new isotope library. The registry will remember the last library selected and will always use that library.

Context Menu

The Context Menu will be displayed, by right clicking the mouse anywhere within the graph as shown below:



The Context Menu contains the following options:

- Reinitialize to Default Value
- Cut Data - (Ghosted)
- Copy Data
- Paste Data - (Ghosted)
- Description and Tip
- Visible Items → see sub menu below
- Clear Graph
- AutoScale X
- AutoScale Y
- Smooth Updates

The Graph Palette and Cursor Legend as described below are located on the Context Menu → Visible Items Sub menu. The Visible Items Sub menu contains the following options:

- Plot Legend – allows the user to control the color and pattern of the spectrum and each plot line.
- Scale Legend - (Ghosted)
- **Graph Palette** – is turned on by default, and can be turned off here. (described below)
- **Cursor Legend** – is described below, the legend is hidden below the graph when first turned on and the user must resize the window by stretching the corner to view the legend.
- X Scrollbar – is used to scroll back and forth through the graph when it has been magnified.
- X Scale
- Y Scale
- Unit Label - (Ghosted)

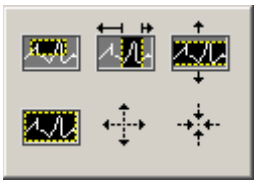
Focusing on Portions of the Spectra

You can focus on certain portions of the spectra by using the Graph Palette:

1. Turn off Auto-scaling by clicking the Scale menu and deselecting X Auto Scale and Y Auto Scale.

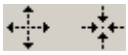
2. If you don't see the Graph Palette, right-click anywhere on the graph, select Visible Items, and select Graph Palette from the sub menu. The toolbar  appears.

3. Click the Search  icon. The Graph Palette appears.



4. Select one of the options to let you block off a certain vertical, horizontal, or square portion of the graph.

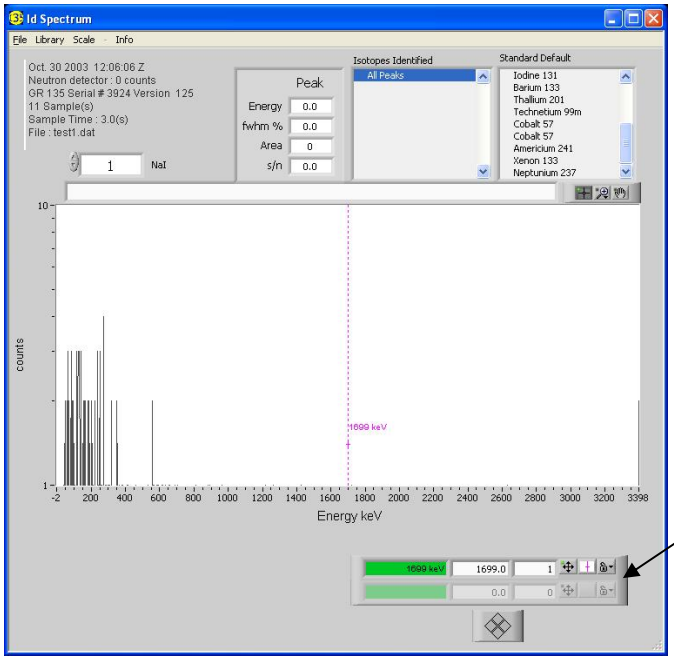
5. Drag the cursor across the area of the graph that you want to examine. That area now becomes the focus. The Counts and Energy scales re-adjust accordingly.

6. Use the zoom tools  to magnify or reduce the area you are examining.

You can move the graph in any direction with the cursor by first clicking the  icon. Clicking the  icon returns the cursor to its normal state.

Examining the Spectra in Detail

Note: The Graph window must be re-sized to view the Cursor Legend as shown below.

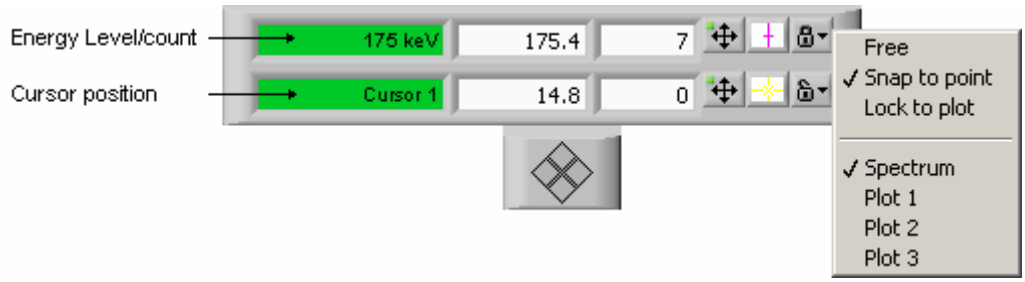


Cursor Legend – Resize window to view.

Use the cursor to drag the window down.

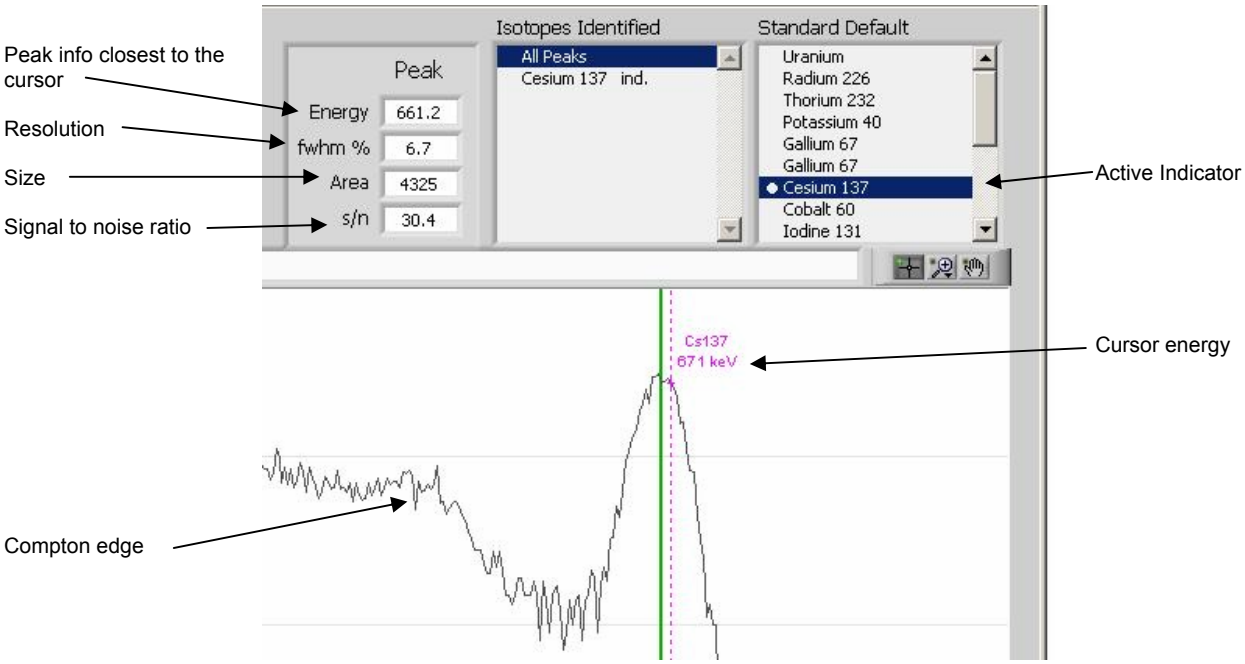
You can examine certain portions of the spectra in more detail by using the Cursor Legend:

1. Turn off Auto-scaling by clicking the Scale menu and deselecting X Auto Scale and Y Auto Scale.
2. If you don't see the Cursor Legend, right-click anywhere on the graph, select Visible Items, and select Cursor Legend from the sub menu. The Cursor Legend appears.



3. Click the icon, then select Snap to point.
4. Drag the cursor by the purple line or click the left and right arrows on the pad.

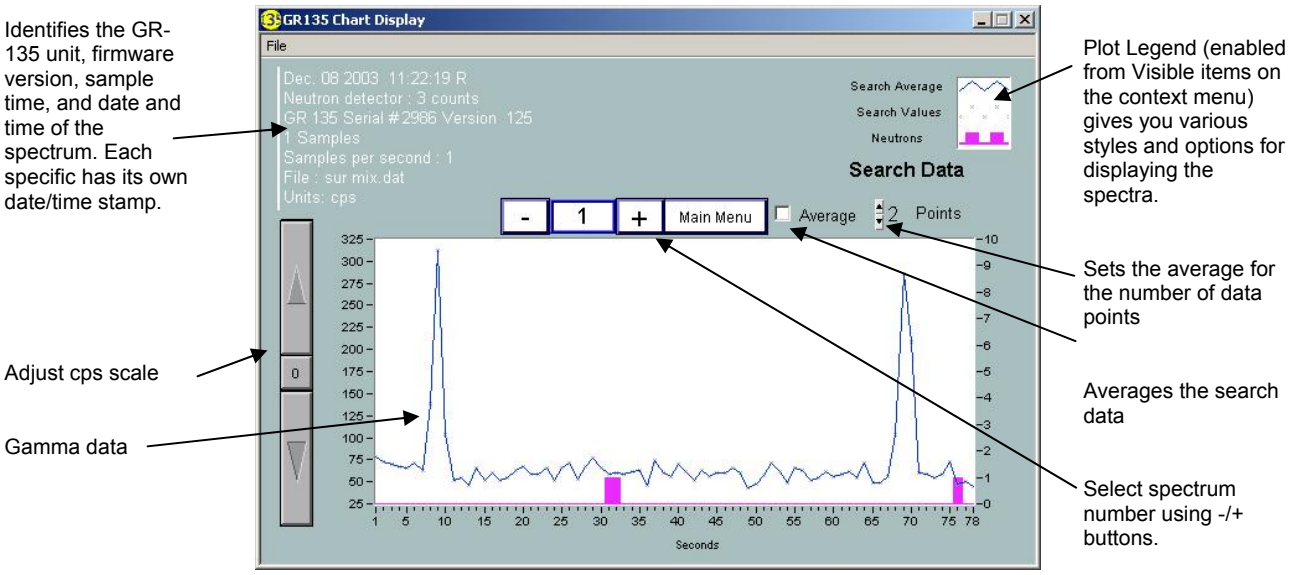
The cursor will now follow the spectra activity lines, displaying the energy level at each point along the scale. When the cursor moves close to any peak, the details are displayed in the Peak section.



A negative signal to noise ratio indicates that a peak has been found but is likely the result of backscatter or a Compton edge. Even if the peak is not highlighted with a red, green, or blue indicator, the peak info will be displayed.

A.3.5 VIEWING SEARCH DATA

You can views counts per second as a function of time. Click the View Search Data button on the IdentiView main screen. The Chart display appears.

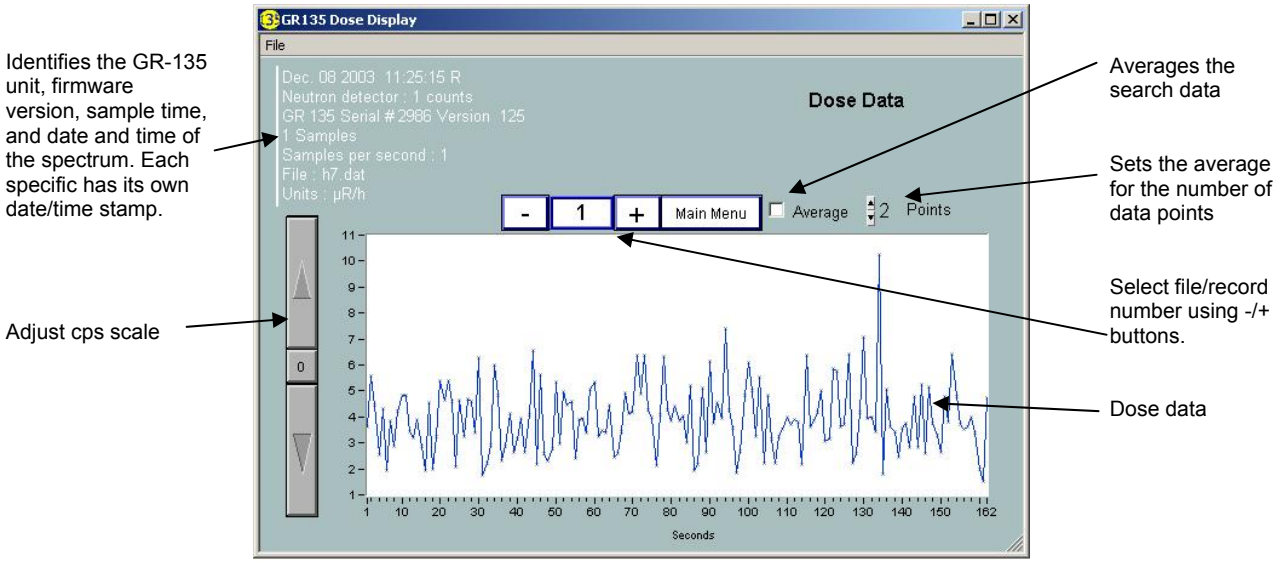


You can use the Average and Points controls  to reduce statistical noise in order to see a more accurate view of counts.

By default, search data is not stored; you have to choose to save search data as part of the setup.

A.3.6 VIEWING DOSE DATA

Dose data lets you see a replay of how high the actual radiation dose level was for each spectrum. You can review the dose data history for each spectrum by looking at the chart.



Dose data is calculated based on the full counts for the spectrum (spectra-weighted dose calculation).

You can use the Average and Points controls 

to reduce statistical noise in order to see a more accurate view of dose data.

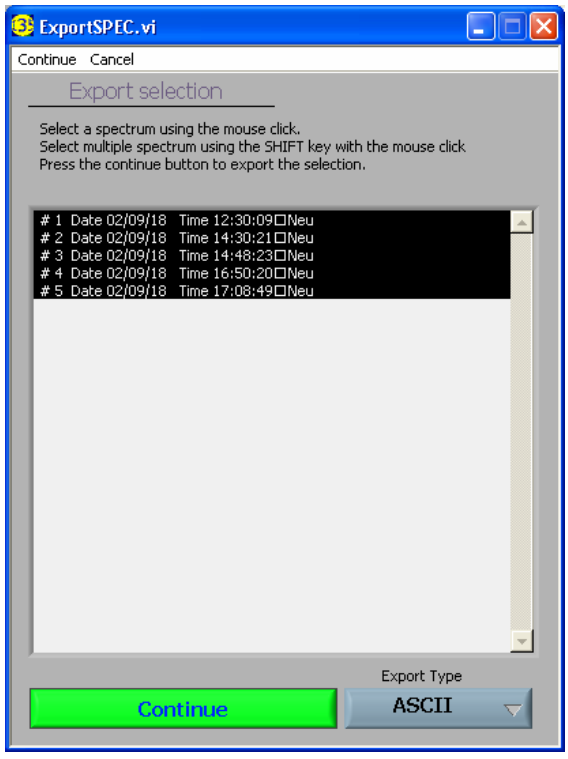
By default, dose data is not stored; you have to choose to save search data as part of the setup.

A.3.7 EXPORTING DATA

From the main display you can choose to export spectra, search, and/or dose data to a separate file. (The box to the right of each export function shows the number of spectra). The exported data is reformatted and stored under a similar filename with at .txt extension. These data are Live Time corrected and stored in an ASCII text format that permits direct loading into programs such as Excel as 1 spectra/column. The spectrum data files can be sent as email attachments for viewing on other computers that are running the IdentiView program. This is the preferred way to send data for further evaluation. However, data can also be exported to other programs as a text file.

This process is carried out as follows:

- Press the "**Export**" button and a new display appears:



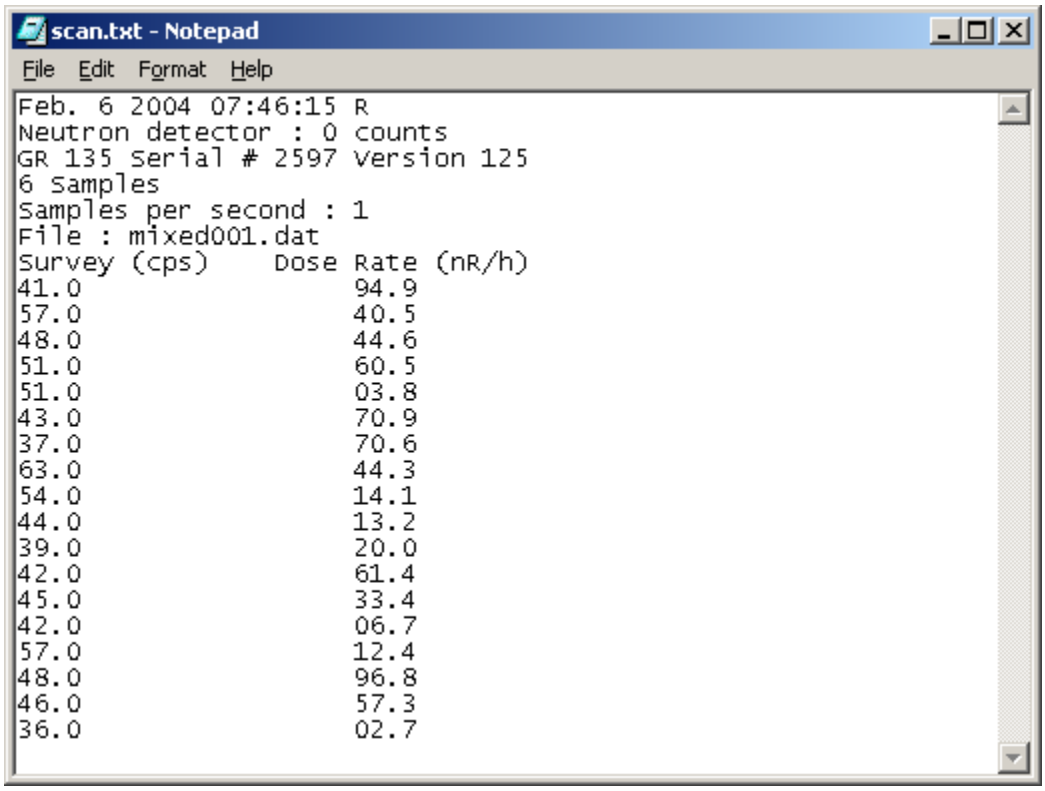
- As the display above shows, the mouse is used to select a single spectrum or SHIFT-click to select multiple spectra. Note that the date and time of when the spectra was stored is also displayed, which helps in data selection.

- The button labeled "**ASCII**" permits **ASCII** or **GBS.** GBS data is a standard used by the IAEA for data analysis. ASCII is text data that can be easily imported into any spreadsheet.

- Click "**Continue**" to save the data to any required location. We recommend a ***.txt** file extension if ASCII format is selected to make it easier to import into Excel as required. However, since this will be an ASCII file then the user can use it as required.

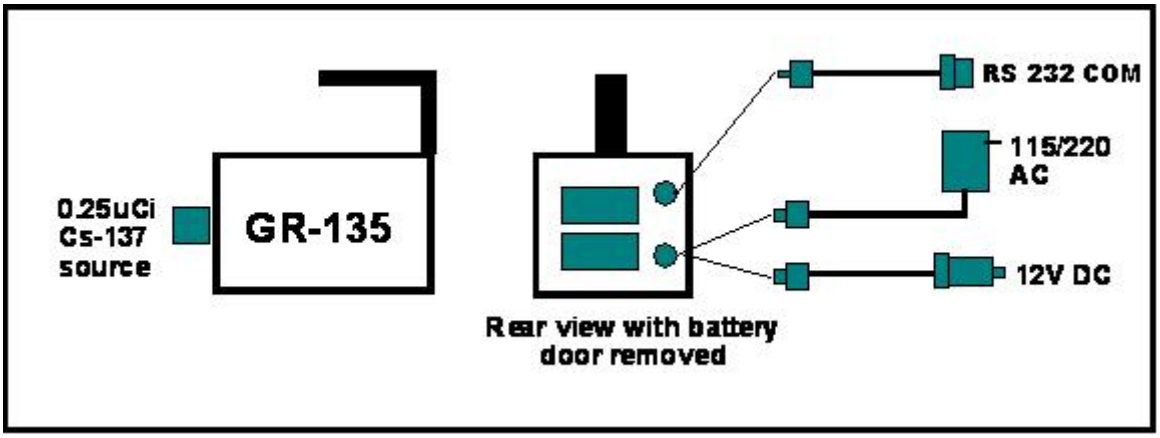
- The saved file can then be attached to an email as required and sent to experts for further analysis.

- Exported dose and scan data are the same (see the following illustration of exported dose data).



APPENDIX B – TEST SOURCE, POWER AND COMM CABLES

B.1 DESCRIPTION



The figure above shows the necessary hardware requirements for non-DS operation. For the **GR-135** the user needs a **TEST SOURCE**, a **POWER CABLE** and a **COMM CABLE**, these items are:

a) TEST SOURCE

- PN 87046-1 – 0.25µCi (9.25kBq) Cs137 Test Source

b) POWER CABLES

- PN 92309-1 – 220VAC (Europe) – 12V DC assembly
- PN 92309-2 – 220VAC (UK) – 12V DC assembly
- PN 92309-3 – 115VAC (Australia) – 12V DC assembly
- PN 92309-4 – Universal 115/220VAC (North America) – 12V DC assembly
- PN 87387-1 – Cigarette lighter plug - 12V DC assembly

c) PC CABLE

- PN 97945-1 – PC Communication cable – RS 232 (used to connect PC directly to GR-135 unit)
- PN 60-320-232 – (Optional) PC Communication cable – RS 232 (used to connect the optional DS to the PC.

B.2 STABILIZATION

Stabilizing the GR-135 outside the DS depends on the MODE of operation.

Note: This parameter is used to advise users when system re-stabilization is required, but we recommend that the unit be stabilized each time prior to use for consistent and accurate readings.

a) MANUAL MODE

From the **MAIN MENU** select **STABILIZE** then proceed as described in Section 7.1 except

in this case the source is held against the face of the unit rather than sitting the unit in the optional DS.

Note: A hole is provided in the yellow boot to hold the test source.

b) AUTOMATIC MODE

In this case it is necessary to let the unit think it is in the DS as the Automatic Mode functions are optimized for this mode of operation. This is easily done as follows:

- Place the Test Source against the face of the instrument

  Note: A hole is provided in the yellow boot to hold the test source.

- Plug in one of the sources of external power as shown (Appendix B.1)
- As long as external power is supplied, the unit will continue to automatically stabilize as described in Section 2.6.

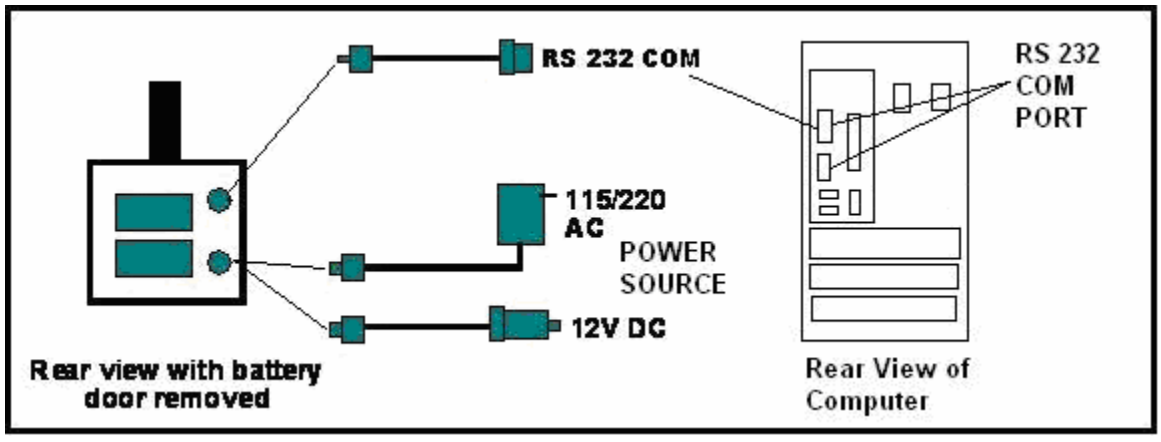
Note: – If the Test Source is removed an error message will appear on the display

B.3 BATTERY CHARGING

The battery charger is integrated into the GR-135 electronics so the external "battery charging" is really supplying 12VDC to the unit to charge the two "D" cell NiCd batteries in the GR-135 without removing them from the instrument.

This 12VDC input can be supplied from an external AC to DC power source or via a special cable that can be connected directly to the lighter socket of a vehicle as shown above. This 12V input is also used to power the unit for extended sampling when normal battery life may be insufficient. Approximately 8 to 10 hours of charging is required to charge a fully discharged set of batteries.

B.4 SYSTEM INTERCONNECT



Communication:

Plug the RS 232 COM cable into the GR-135 connector and the other end into one of the PC COM ports.

Notes: Use cable PN 97945-1 when connecting the GR-135 directly to a PC with serial COM ports.

If the Docking Station (DS) is used, connect the COM (use cable PN 60-320-232)

cable to the proper connection on the back of the DS. Connect the serial port on the PC to the RS232 connector on the DS.

Power:

The power cable is plugged into either a 115/220 AC or 12V DC power source depending on the location (use the appropriate cable see Appendix B.1 for reference).

Note: If the Docking Station (DS) is used, connect the correct power cable to the back of the DS (use the appropriate cable see Appendix B.1 for reference).

APPENDIX C – NUCLIDE LIBRARIES

There are 2 levels of nuclide library data in the GR-135 – **SNM nuclides** and **other nuclides**.

SNM NUCLIDES - Since SNM materials require extremely complex analysis, this capability is HARD CODED into the system and the user has no access to remove or change these items. Discuss this with SAIC Exploranium if this is an issue. The items coded are **Pu-239, Np-237, U-233, U-235 and U-mix**.

OTHER NUCLIDES – these items are stored in a special memory location and the user has access to add, change, delete or modify these items using the new IdentiView software (Appendix A). However the GR-135 has a very complex analysis capability so any library changes should be discussed with Exploranium. If required a special library can be developed and emailed to the user who can then use **IdentiView** to upload this library into the system.

Currently Exploranium has no plans to permit users to modify their own libraries as library development is so complex that modifications can easily unbalance the analysis capability of the system and significantly degrade performance. However we will readily work with users at no charge to develop an appropriate library to fulfill their special requirements

Note that a future software release will permit 5 libraries to be stored in memory and the user can select the appropriate library required for special functions as required.

The current list of nuclides in the library are:		STANDARD	MEDICAL	INDUSTRIAL	CUSTOMS	USER
Name	**Label**					
Am-241	Americium-241	I		I	I	
Ba-133	Barium-133	I			I	
Co-57	Cobalt-57	I	I	I	I	
Co-60	Cobalt-60	I		I	I	
Cr-51	Chromium-51		M			
Cs-137	Cesium-137	I	I	I	I	
DEP-U	Depleted Uranium				I	
Ga-67	Gallium-67	M	M	M	M	
I-123	Iodine-123		M	M		
I-131	Iodine-131	M	M	M	M	
In-111	Indium-111	M	M	M		
Ir-192	Iridium-192	I	I	I	I	
K-40	Potassium-40	N		N	N	
Np-237	Neptunium-237	S			S	
Pd-103	Palladium-103		M	M		
Pu-239	Plutonium-239				S	
Ra-226	Radium-226	N		N	N	
Sn-113	Tin-113		M	M		
Sr-85	Strontium-85		M	M		
Tc-99m	Technet-99m	M	M	M	M	
Th-232	Thorium-232	I	I	I	I	
Tl-201	Thallium-201	M	M	M	M	
U-233	Uranium-233				S	
U-235	Uranium-235				S	
U-238	Uranium-238	I		I		
U-mix	Uranium - mix				S	
Xe-133	Xenon-133	M			M	

Library names

Standard (STAND), Medical (MEDIC), Industrial (INDUST), CUSTOMS (CUST), User

Labels in columns

I= Industrial, M=Medical, S=SNM, N=NORM

APPENDIX D – DOCKING STATION (OPTIONAL) DETAILS

D.1 GENERAL

The optional Docking Station (DS) is especially designed for ease-of-use.

Note: The optional docking station may not be suitable for the GR-135. The GEO version of the GR-135 has been designed for extensive use in the field and as such may not benefit from the advantages of the DS. The operator can use the 12V power cable to charge directly from an automobile battery, see Appendix B (if chargeable batteries are used), and the external Cs137 source for stabilization. **DO NOT PLUG THE POWER CABLE** into the GR-135 if Alkaline batteries are being used.

The following information is provided for users who own a DS and wish to use it. The features are:

- 4 spring-loaded electrical contacts for connection to the base of the GR135
- Integrated 0.25µCi Cesium-137 source – BELOW CONTROL LIMITS WORLD WIDE
- 3 LEDs on the front panel showing system status
- 2 connectors on the rear for external DC and RS232 connection

D.2 LEDs

The 3 LEDs operation is as follows:

ERROR RED	POWER GREEN	CHARGE YELLOW	DS STATUS
OFF	ON	ON	CHARGING
OFF	ON	FLASH	END OF CHARGING
OFF	ON	OFF	ALKALINE batteries in 135 or Battery fully charged
FLASH	ON	OFF	DOCK EMPTY
OFF	FLASH	OFF	ERROR #1
ON	ON	ON	ERROR #2
FLASH	ON	FLASH	ERROR #3
OFF	OFF	OFF	NO INPUT POWER

Error #1 – Low Input Voltage – check AC adapter or input AC line

Error #2 – High current load – Bad GR135, Maintenance required

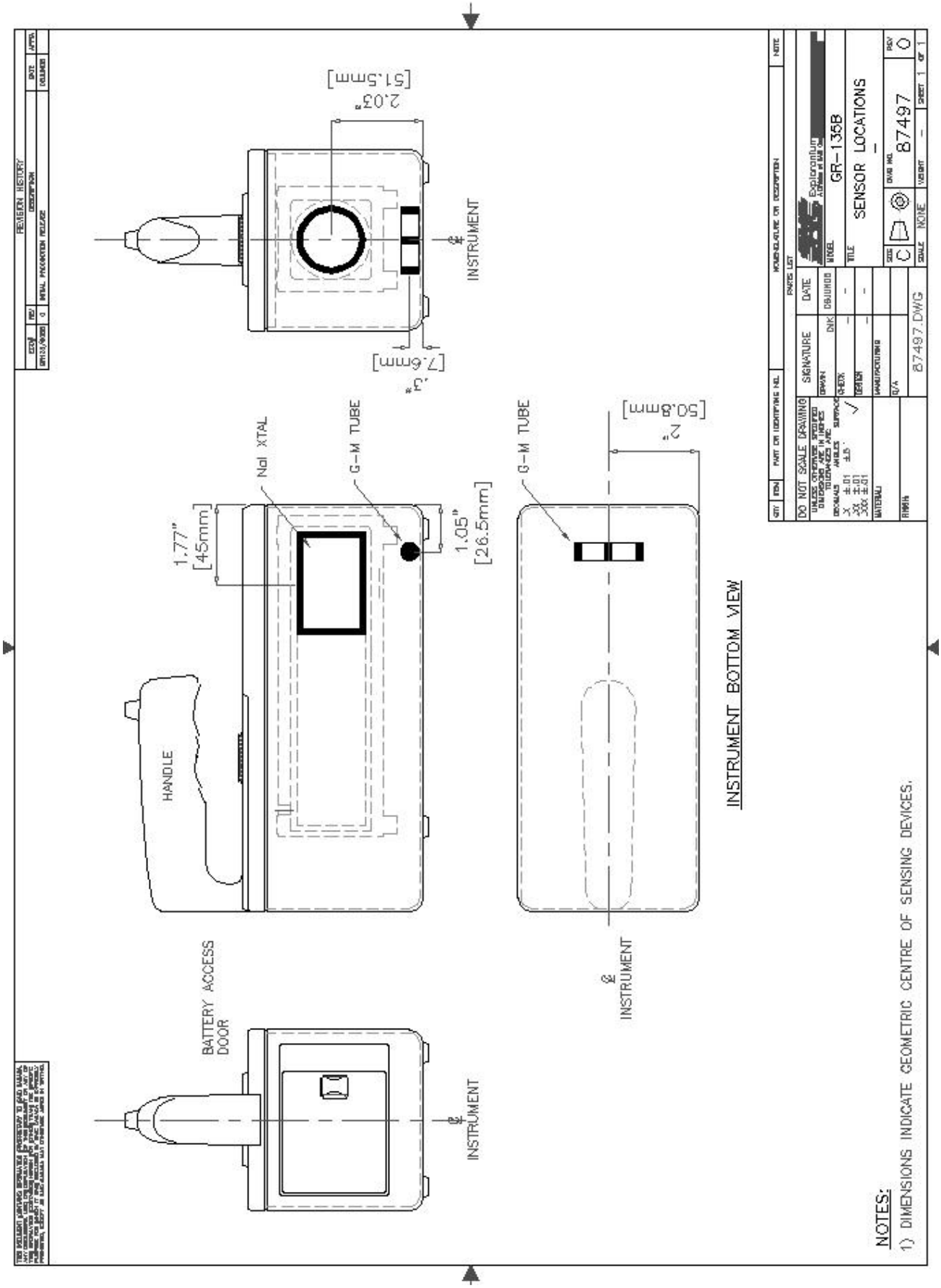
Error #3 – Power disconnected – short circuit inside GR135, Maintenance required

APPENDIX E – RECOMMENDED PARAMETERS
Firmware Version – 601.02 (6V01.02)

SETUP MENU	PARAMETER	DEFAULT	SELECTION
SEARCH	OUTPUT TO	**OFF**	OFF, MEM, PC
	SAMPLE TIME	**1**	1-10, 20-60 secs
	CHART RANGE	**AUTO**	AUTO, 64, 128, 256, 512, 1K, 2K, 4K, 8K, 16K, 32K, 64Kcps
	AUDIO METER	**AUTO**	AUTO, OFF, 50, 100, 150, 200, 250cps
	ALARM LEVEL	**OFF**	OFF, 100, 200, 250, 300, 350, 400, 450, 500, 600, 700, 1K, 2K, 5K, 9Kcps
	SCAN WINDOW	**TOT.**	TOT., ROI1, ROI2, ROI3
	AVERAGING	**3P**	OFF, 3P, 5P, 10P
STABILIZE	**RE-STAB MODE** **S. VALIDITY**	**24H**	OFF, 12H, 24H
ASSAY			
DETECTOR	DETECTOR	**NAI**	NAI
	PILEUP	**ON**	ON, OFF
	PEAK LIMIT	**30**	20, 25, 30, 35, 40, 45, 50 (SD units)
	NI DOSE LIM.	**20µ**	10, 15, 20, 30, 40, 50 (µR/h units)
	NUCL LIMIT	**9**	3, 5, 7, 8, 9, 10, 11, 12, 15 (SD units)
NAI	MEAS TIME	**55**	10 – 50, 55, 60 – 100, 200 – 600, 1200, 1800, 3600, 5400
	MEAS MODE	**CLOCK**	LIVE, REP., CLOCK
	ADC	**1024G**	256N, 1024G
	AUDIO	**ON**	ON, OFF
	GAIN	**ON**	ON, OFF
NEUTRON	FUNCTION IS NOT ACTIVE IN THIS VERSION.		
DOSE	MEAS UNIT	**R**	R, SV, GY
	SAMPLE TIME	**1**	1-10, 20-60secs
	AVERAGING	**3P**	OFF, 3P, 5P, 10P
	CORRECTION	**100**	80, 85, 90 . . . 120%
	ALARM LEVEL	**2000µ**	OFF, 10, 20, 50, 100, 200, 500, 1000, 2000, 4000, 5000, 9000µ (LINKED TO Unit R) OFF, 0.1, 0.2, 0.5, 1.0, 2.0, 5.0, 10.0, 20.0, 40.0, 50.0, 90.0µ (LINKED TO Unit SV) OFF, 0.1, 0.2, 0.5, 1.0, 2.0, 5.0, 10.0, 20.0, 40.0, 50.0, 90.0µ (LINKED TO Unit GY)
ROI S	ROI#1	**0431-0489**	Factory Calibrated (K)
	ROI#2	**0510-0582**	Factory Calibrated (U)
	ROI#3	**0761-0815**	Factory Calibrated (Th)
MISC	LANGUAGE	**ENG**	ENG, DEU, FRA, CZ, POL, RUS, ESP, SVE, JAP, NOR, DUT
	BATTERY	**CD/MH**	CD/MH, NO/CH
	BACK LITE	**OFF**	OFF, ON, 5S, 10S, 30S, 60S, 255S
	ACTIVE LIBR.	**CUST**	STAND, MEDIC, INDUST, CUST, USER

Note: This unit can only stabilize in 1024G Channel Mode (to set the parameter see *Section 9.3.2* – Assay paragraph c).

APPENDIX F – SENSOR LOCATIONS



APPENDIX G – SAFE HANDLING FOR CHECK SOURCES

Docking Station:

- **Licensing Requirements**: Radioactive material contained in this device is exempt from USNRC or US Agreement State licensing requirements.

- **Safe Handling**: Although quantities of radioactive material contained in these products are extremely small, the basic radiation protection principles of time, distance and shielding should be practiced as effective methods for minimizing exposure.

- **Use**: These devices should only be used as a method for verifying response of radiation measuring devices, and are to be used in accordance with manufacture's instructions.

- **Storage**: All devices containing radioactive material should be securely stored when not in use.

- **Disposal**: Different countries may have other regulations with respect to source disposal. The customer is advised to check local regulations and dispose the source accordingly.

External Check Sources

- **Licensing Requirements**: Radioactive material contained in these sources is exempt from USNRC or US Agreement State licensing requirements.

- **Safe Handling**: Although quantities of radioactive material contained in these products are extremely small, the basic radiation protection principles of time, distance and shielding should be practiced as effective methods for minimizing exposure.

- **Use**: These devices should only be used as a method for verifying response of radiation measuring devices, and are to be used in accordance with manufacture's instructions. These sources are not for human use, introduction into foods, beverages, cosmetics, drugs or medicines, or into products manufactured for commercial distribution. Exempt quantities should not be combined to increase the source activity.

- **Storage**: All radioactive material should be securely stored when not in use.

- **Disposal**: Different countries may have other regulations with respect to source disposal. The customer is advised to check local regulations and dispose the source accordingly.

APPENDIX H – SOFTWARE CHANGES

Updated for IdentiView software version 7.6 – Feb 2004

Updated for IdentiView software version 7.7 – Jan 2006

APPENDIX J – QUICK START – AUTOMATIC MODE

The GR-135 automatically turns on when the 12V power cable is attached to the power connector. Refer to Figure 4-1 for the location of the connector on the rear of the unit. This is necessary when the unit is used for the first time or the battery requires charging (allow approx. one hour prior to use). Placing the Cesium source (face first) into the hole provided on the yellow protective boot will stabilize the unit while it is charging the battery, saving a little time.

Note: The GR-135 is limited to two active modes when it is set to the AUTOMATIC MODE of Operation; - SEARCH and ASSAY. The MANUAL Mode is normally used to SETUP and MAINTAIN the system but can also be used for SEARCH and ASSAY, the difference being the Automatic Mode simplifies the operation when searching for concentrations of (K, U and Th) in the field, while the Manual Mode offers more options and greater sample detail. Refer to Figure 2-1 for the location of the Automatic/Manual Mode switch.

The steps below illustrate the process involved:

At startup these screens only appear briefly before a System Warm Up screen appears. The Active Mode (MANUAL OR AUTOMATIC) is displayed across the bottom of the Introduction screen (ie. AUTOMATIC MODE ACTIVE). The switch is located on the rear of the unit (see Figure 2-1).

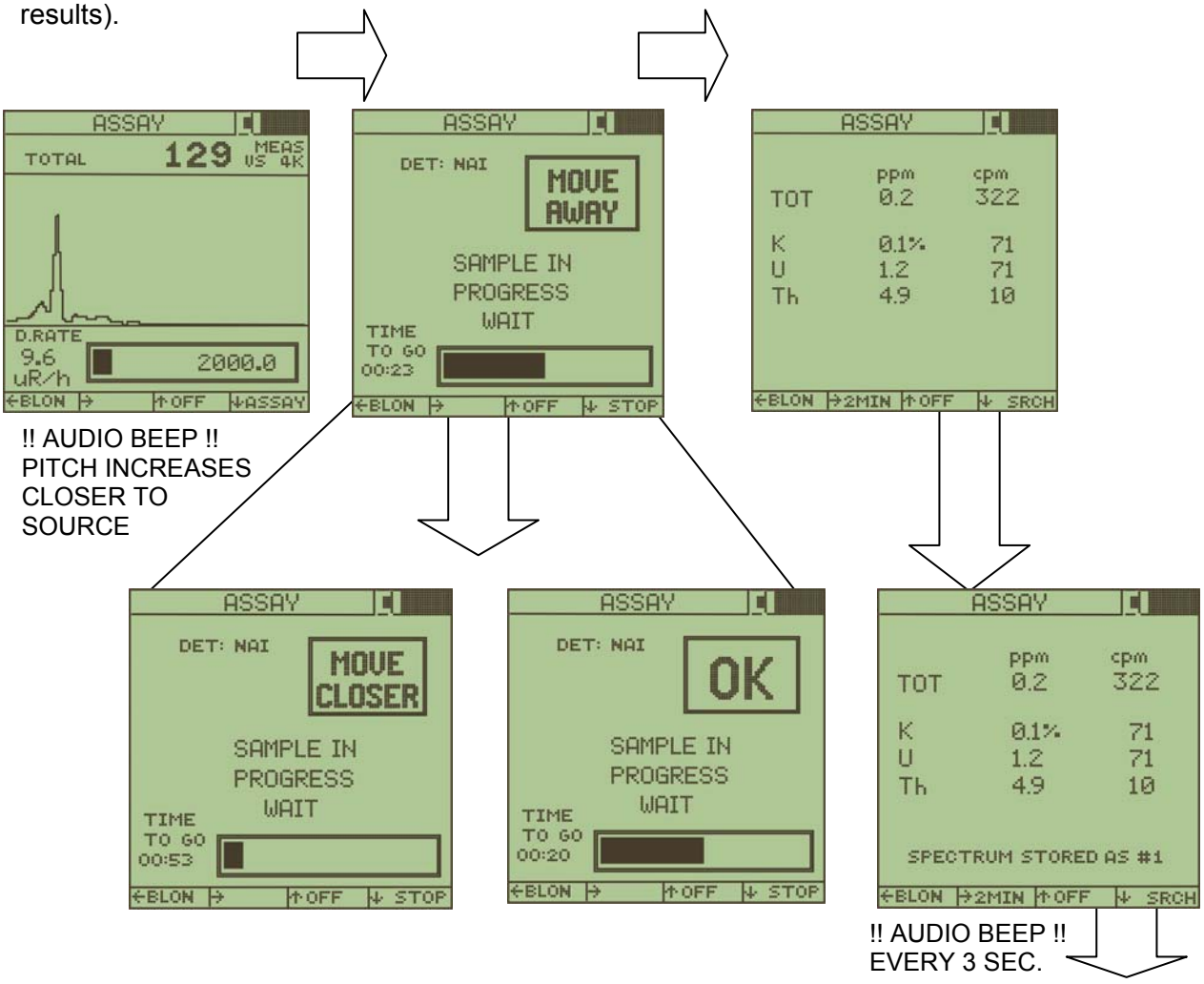
After the Startup screen disappears the Warm Up screen is displayed. Wait for the system to warm up, the system is automatically adjusting its' internal parameters to the cesium source (place the Cs137 source face first into the hole provided on the yellow protective boot) as well as charging the batteries. The process should take approximately 2 minutes but users are recommended to leave the unit connected for at least 1 hour prior starting any system operation (allowing the battery time to charge).

Note: This warm up mode is only required when the unit is first put into use or when the unit has been disconnected for a long period of time. Otherwise the user can immediately begin the Search Mode after a brief startup and initialization.

Once the system has automatically adjusted the basic system parameters the display changes to indicate the system is prepared for operation. Remove the Cs137 source from the hole provided on the yellow protective boot.

"REMOVE WHEN REQUIRED" means the unit is ready for use, remove the unit from the 12V power cable and the SEARCH Mode is activated immediately.

The unit will begin to seek and measure for concentrations of the radioactive materials (K, U and Th) in the field. The user will carry the GR-135 and scour the area on foot scanning for possible sources. Once a source is discovered, the Search Mode is used to find its' maximum point and the user selects the ASSAY Mode by short click down with the joystick. The ASSAY Mode takes a sample for a User defined sample period (selecting a longer sample period will provide better results).



After the sample time is complete the system automatically analyzes the data to determine the concentrations in ppm and cpm for (eU and eTh), in % and cpm for K. Once the Assay Results are complete, the user will use the joystick with a short click down to begin another Search Mode, but prior to beginning the next search the Spectrum will be stored as a # in chronological order. (The spectrum can be recalled from data memory and re-assayed at a later time).

NAVIGATION MENUS

Navigation Menus have been embedded in the system screens (Automatic Mode only).

SEARCH MODE: ← BLON | → | ↑ OFF | ↓ ASSAY

ASSAY MODE: ← BLON | → | ↑ OFF | ↓ STOP

ASSAY (Results): ← BLON | → 2MIN | ↑ OFF | ↓ SRCH

The Navigation Menus are located across the bottom of the screens in the Search Mode, Assay Mode and Assay Results with the joystick functions described below:

Note: In some screens the internal computer is busy so a few seconds may pass before the selected change occurs

SEARCH Mode:

BLON - Backlight can be switched ON if required (if selected then the B/L stays ON for the period specified in the parameter setup – default = 60 secs)

no action

OFF – approx. 4 secs then unit powers OFF

ASSAY – switches to the ASSAY Mode

ASSAY Mode:

BLON - Backlight can be switched ON if required (if selected then the B/L stays ON for the period specified in the parameter setup – default = 60 secs)

no action

OFF – approx. 4 secs then unit powers OFF

STOP – stops the ASSAY sample

ASSAY – Results:

BLON - Backlight can be switched ON if required (if selected then the B/L stays ON for the period specified in the parameter setup – default = 60 secs)

2 min – initiates an additional 2 minute count that adds to the current spectrum and at the end of the period gives a combined analysis

OFF – approx. 4 secs then unit powers OFF

SRCH – switches to the SEARCH Mode

Refer to Chapter 3.0 for a detailed explanation of all the screens and menus.

APPENDIX K – QUICK START – MANUAL MODE

For operators that have had some experience with the GR-135 and want to use the equipment quickly, this Appendix offers a Quick Start Guide to operating the equipment in Manual Mode without going into too much detail. For operators who wish to fully understand the equipment refer to Chapters 4.0 and above.

This manual assumes that the unit is being operated without the optional **DOCKING-STATION (DS)**.

Proceed as follows:

a) **LOAD BATTERIES** – remove rear door and insert 2 batteries (see Figure 2-1) – check polarity as marked (see Chapter 4.0). Replace plastic battery clamp and ensure the door is correctly seated before turning the fastener.

WARNING: When using **Alkaline Batteries** with the Docking Station or connecting a power cable directly to the unit always make sure that the GR-135 Battery is set to **NO/CH *(refer to Section 9.7 – Miscellaneous)***. If this is not done, ***it will result in battery leakage and extensive system damage*.**

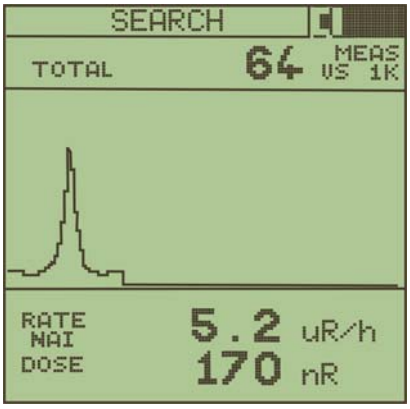
b) **JOYSTICK OPERATION** – the JOYSTICK mounted on the handle is the only control on the instrument. Basic JOYSTICK actions are **UP, DOWN, LEFT, RIGHT**. Some operations require a short activation **SHORT = less than 0.5secs** – or **LONG = more then 1 second**. **ENTER** in the manual means **LONG DOWN** (more than 1 second). Refer to Chapter 4.0 for detailed instructions.

c) **POWER ON** – a **CLICK DOWN** for at least 2 seconds - the unit will power **ON** and after TESTING the MAIN MENU will be displayed.

d) **Place Cs137 Source -** place the (0.25µCi (9.25kBq)) Cs137 stabilization source face first into the hole provided on the yellow protective boot of the unit.

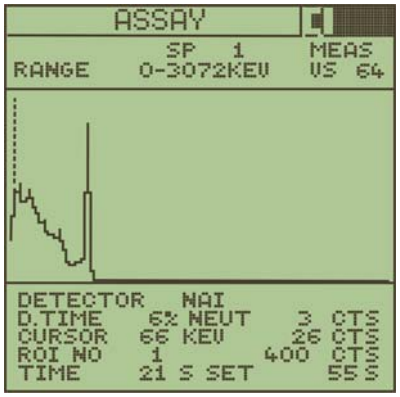
e) **STABILIZE** – select **STABILIZE** from the Main Menu, then **ENTER** (**LONG DOWN**) and follow the display prompts to automatically set the system gain.

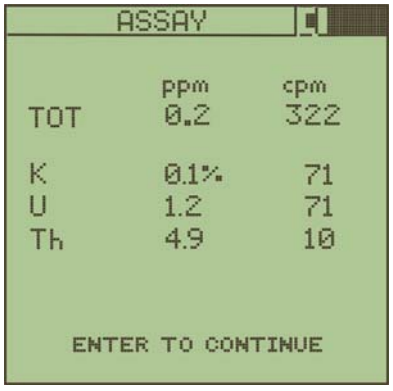
f) **SEARCH + DOSE** – from the Main Menu, activate the **SEARCH+DOSE** Mode by highlighting the item in the Main Menu and using **ENTER** (**LONG DOWN**) to select. The system display will show the current count rate in counts/sec while the internal "audio meter" will give an audio response with the tone related to radiation intensity. **DOSE RATE** data is also displayed. Refer to Chapter 5.0 for more information.



g) **STOP SEARCH** – to stop the Search mode – pressing **ENTER** will return to the Main Menu.

h) **ASSAY** – Selecting **ASSAY** from the Main Menu begins a spectral reading for a user defined duration. A message is displayed "**SAMPLE IN PROGRESS WAIT**". After the sample time is complete the system automatically analyzes the data to determine the concentrations in ppm and cpm for (eU and eTh), in % and cpm for K. Once the Assay Results are displayed, the user will use the joystick with a short click down to display the ASSAY Menu, but prior to opening the menu the Spectrum will be stored as a spectrum # in chronological order. The spectrum can be recalled from data memory and re-assayed at a later time from the ASSAY Menu.





i) **STOP ASSAY** – to stop the Assay mode – pressing **ENTER** will display the Assay Menu.

j) **ASSAY MENU** - The ASSAY Menu allows the operator to use menu functions that are not available in the Automatic Mode. Refer to Chapter 6.0 for detailed description concerning these functions.

Note: Select and press Main Menu to return to the Main Menu.

Note: For a detailed description for these and other system functions – refer to Chapters 4.0 to 10.0 of this manual.

APPENDIX L – ADVISORY NOTICES

1. If a condition arises that the LCD screen appears BLANK, such that the fonts are not visible, follow this advisory:

USER ADVISORY #1
Some users switch the unit ON and will see NO DISPLAY.

If a blank display is seen, switch the unit OFF (push joystick UP for 5 seconds to ensure the unit is switched OFF). Now power ON, wait 5 seconds, then RIGHT click the Joystick repeatedly (5-6 clicks is usually enough to restore the display CONTRAST) – the display should now be visible. If the display is dark, then repeat the above procedure but click the Joystick to the LEFT.

Contact Help Desk (see Appendix Z) if the display is still blank.

APPENDIX M – SCREEN NUMBERING

Note: Screen numbering is used only in the Manual Mode on the GR-135 and does not display in the Automatic Mode.

Screen numbers have been added to the upper right hand corner of certain screens, to aid in screen identification, and menu navigation in Manual Mode should the Language Parameter be altered to a foreign language and the user has difficulty finding the parameter screen to change it back.

The following procedure(s) should help the user navigate the GR-135 menus in order to change the Language Parameter back to the native language.

The GR-135 may start either with the MAIN MENU or the ANALYSIS screen, depending upon how the GR-135 was left before turning it OFF. The procedure below will illustrate both conditions.

When the GR-135 is turned on and the MAIN MENU (Screen #0) appears the user is asked to follow the procedure below (refer to Figure M-1):

Note: All the pertinent Menus have been translated and shown in the associated Figures, please refer to the Figures for this information.

1. With Screen number **0** – MAIN MENU showing (see Figure M-1), use the GR-135 joystick to toggle through the menu listings and select SET UP, pull the joystick towards you once to open this menu item.
2. Screen number **2** – SET UP will be displayed (see Figure M-2), use the GR-135 joystick to toggle through the menu listings and select MISCELLANEOUS, pull the joystick towards you once to open this menu item.
3. Screen number **5** – MISCELLANEOUS will be displayed (see Figure M-3), use the joystick to select the Language Parameter, then press the joystick to the left to toggle through the language listing, select your native language and pull the joystick towards you to make your language selection active. The Main Menu will automatically be displayed.

When the GR-135 is turned on and the ANALYSIS (Screen #4) appears the user may do the following:

1. With Screen number **4** – ANALYSIS showing (see Figure M-4), use the GR-135 joystick to toggle through the menu listings and select MAIN MENU, pull the joystick towards you once to open this menu item.
2. Follow steps 1 to 3 from the previous procedure when the Screen number 0 – MAIN MENU appears.

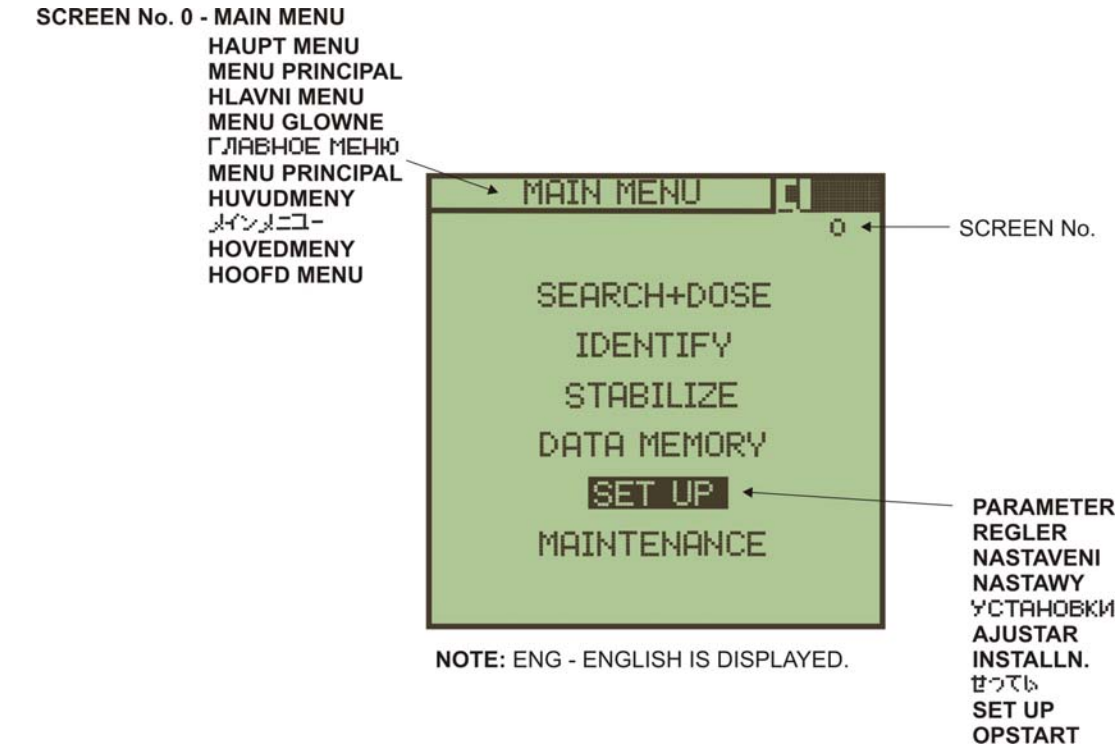


Figure M-1

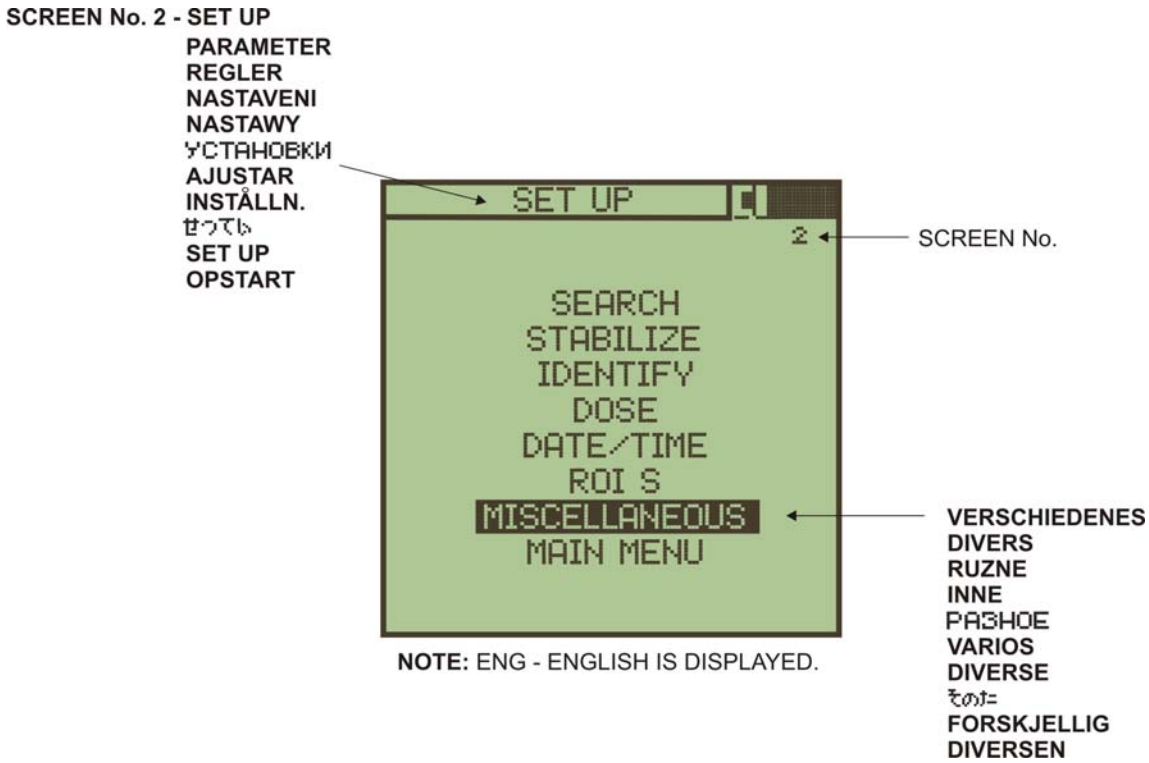


Figure M-2

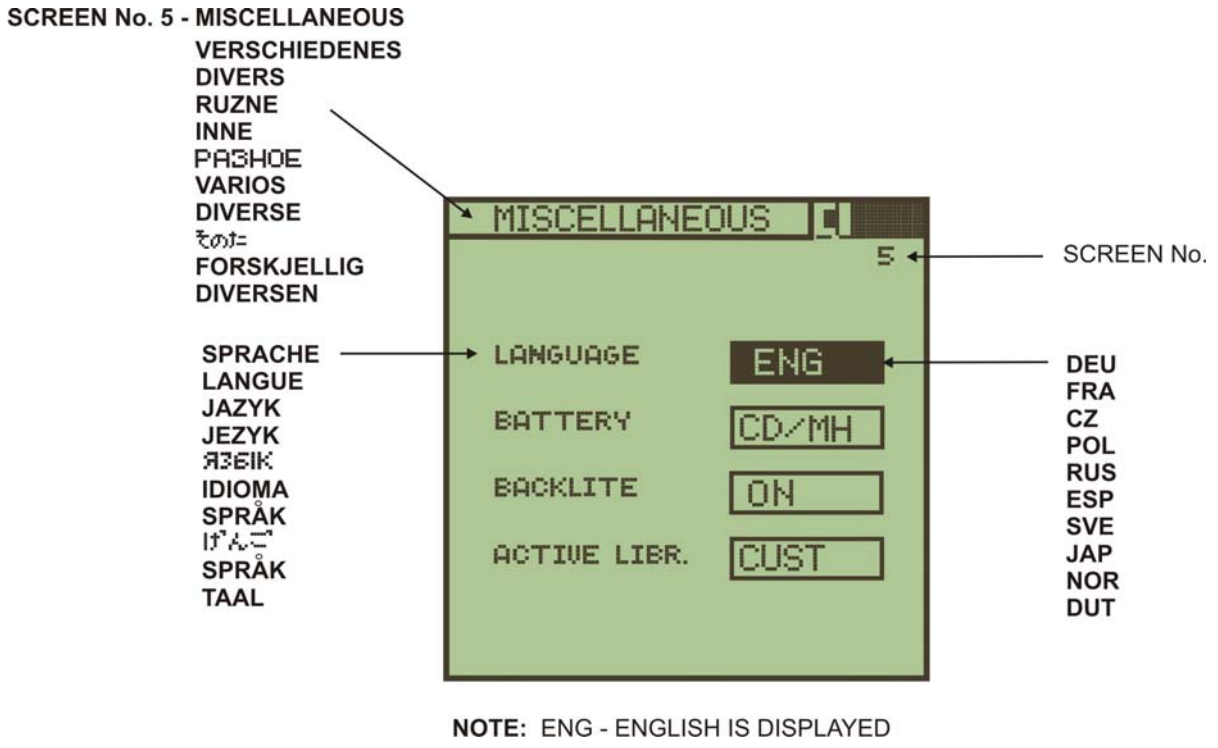


Figure M-3

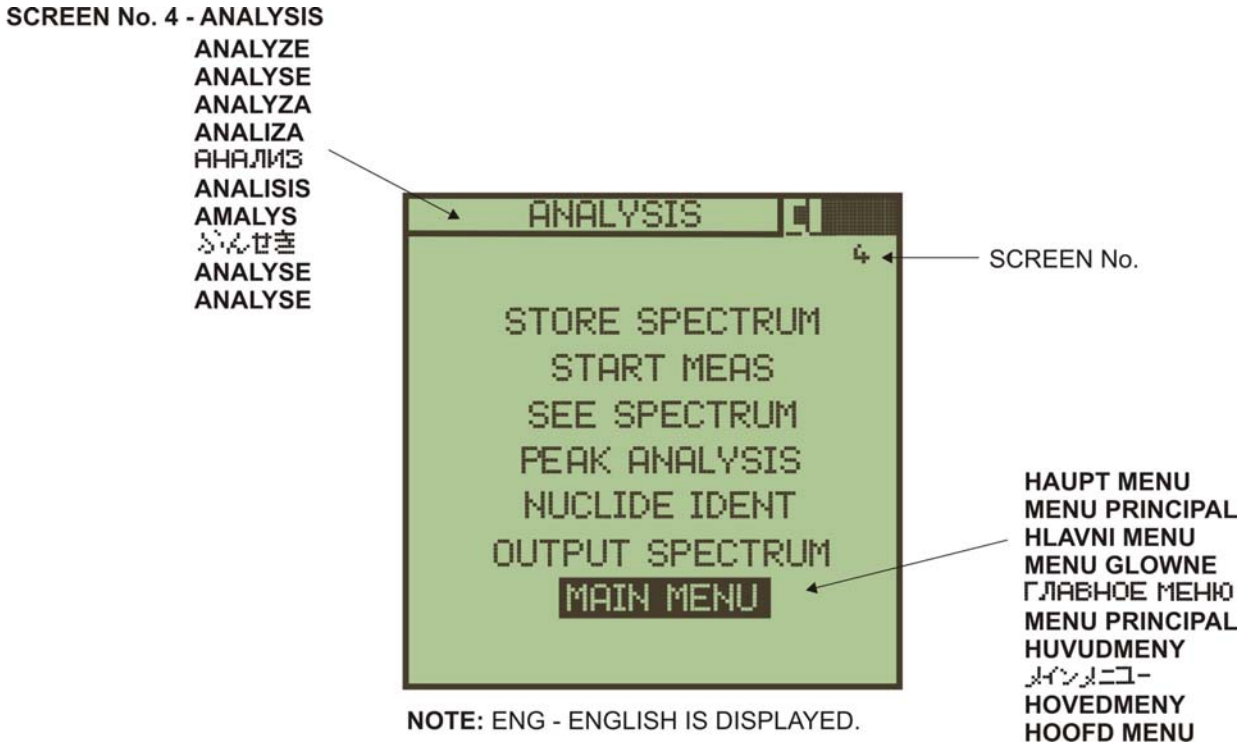


Figure M-4

APPENDIX Z – WARRANTY

SAIC EXPLORANIUM WARRANTY

SAIC Exploranium warrants the product to be free of defects in material and workmanship for a period of one year from the date of purchase. The warranty does not cover consumables or damage caused by improper use or unauthorized repairs. For details concerning warranty terms refer to the "*Standard Terms and Conditions*" as referenced in your purchasing agreement.

To make a warranty claim, contact the SAIC Help Desk at:

Contact:	**Help Desk** **24 Hour Product Support**
Phone:	**Toll Free: 877 482 2474 or 858 826 9400**
Fax:	**858 826 1500**
Email:	**ssioproductsupport@saic.com**