GR-135

THE IDENTIFIER
SYSTEM MANUAL

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EXPLORANIUM
RADIATION DETECTION SYSTEMS

GR-135

THE IDENTIFIER

SYSTEM MANUAL
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GR-135 – THE IDENTIFIER

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THE IDENTIFIER

SYSTEM MANUAL

1.0   GENERAL SYSTEM DESCRIPTION:

The **GR-135** - **THE IDENTIFIER** - represents a major breakthrough in the field of radiation monitoring, offering the user not only the ability to search for and locate radioactive material but also to automatically identify the radioactive nuclides present. This capability in a fully portable hand-held unit will permit its use in a wide variety of applications including :

- Hazard identification and risk assessment
- Inspection of incoming and outgoing material for radioactive contamination
- Inspection of radioactive gauges for leaks
- SEARCH of waste sites for radioactive material
- Employee exposure rate and dose monitoring
- Radioactive source monitoring
- Government inspection for material compliance
- Identification of unknown radioactive material
- Regulatory control of radioactive material
- Classification of radioactive material for a wide variety of users

1.1   GR-135 HARDWARE VERSIONS

a)   **GR-135** – the basic GR-135 model is a 2-detector system **–** utilizing a **Sodium-Iodide** detector for high sensitivity and a **G-M** detector for extended Dose Rate range.   This model replaces the older GR-130 model

b)   **GR-135N** – a 3-detector system – in addition to the **Sodium-Iodide** detector and **G-M** detector there is an additional **NEUTRON** detector

c)   **GR-135CN** – a 4 detector system - in addition to the **Sodium-Iodide, G-M** and **NEUTRON** detectors this model incorporates an additional CZT detector for special applications.

d)   **DOCKING STATION** – all of these models can be supplied with a Docking Station, which permits operation in a special **AUTOMATIC** mode highly suitable for semi-technical users (Appendix A).

1.2   GR-135 OPERATIONAL MODES

The GR-135 can be operated in 2 different modes.

a)   **AUTOMATIC MODE** – restricted to SEARCH and IDENTIFY functions only. All other functions are disabled to simplify system use by non-technical personnel – **available only to DOCKING-STATION users**

b)   **MANUAL MODE** – unrestricted system operation
Selection between modes is via a special switch in the battery compartment to restrict unauthorized adjustments.

1.3   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 Y**.

2.0   SYSTEM DESCRIPTION & FEATURES

This manual fully describes the **MANUAL** mode so full system functionality is covered
See Appendix A for **AUTOMATIC** mode operation

2.1   OPERATIONAL FUNCTIONS

The GR-135 may be operated in 2 <u>**Primary**</u> radiation monitoring functions.

a)   SEARCH + DOSE mode
In this mode, the GR-135 acts as 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

b)   IDENTIFY mode – (Nuclide Identification)
In this mode, the GR-135 accumulates spectral data from a sample and analyses the spectrum in terms of emitted energy level and net count contribution. The nuclides responsible for producing the spectrum are identified by comparison to a nuclide library and presented in tabular form. This essential information can then be used to determine risk assessment. If the optional CZT detector is used the unit automatically decides on detector use as determined by the source signature, so this is fully automatic.

2.2   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 –
   1-   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.
   2 -   GM – the rugged GM tube is mounted just behind the instrument front face and is used to extend the Dose Rate range to 1R+ for special applications
   3 -   NEUTRON – this detector is a solid-state non-gaseous detector with high sensitivity and has no travel restrictions.
   4 -   CZT - this optional detector is used in special applications to improve the systems Nuclide ID capability. CZT is a specialized detector with a resolution approx twice that of Sodium-Iodide thus allowing discrimination of some peaks that are impossible to see on a NaI detector.

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 functions **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.

OPTIONAL: for AUTOMATIC mode users only – a handle with a single PUSH-BUTTON switch is available to make user actions as simple as absolutely possible.

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 ¼ turn of the integrated handle. The door may be removed to allow access to the battery compartment to change batteries and the I/O connectors as required. These connectors are for use when the supplied Docking-Station is inconvenient. The door is gasketed to provide a high degree of water protection when in place.

Rear View with Battery Door Removed

COM - RS-232 Communication Connector

AUTOMATIC/MANUAL SWITCH

12 - VDC – Battery Charging Connector

EARPHONE JACK
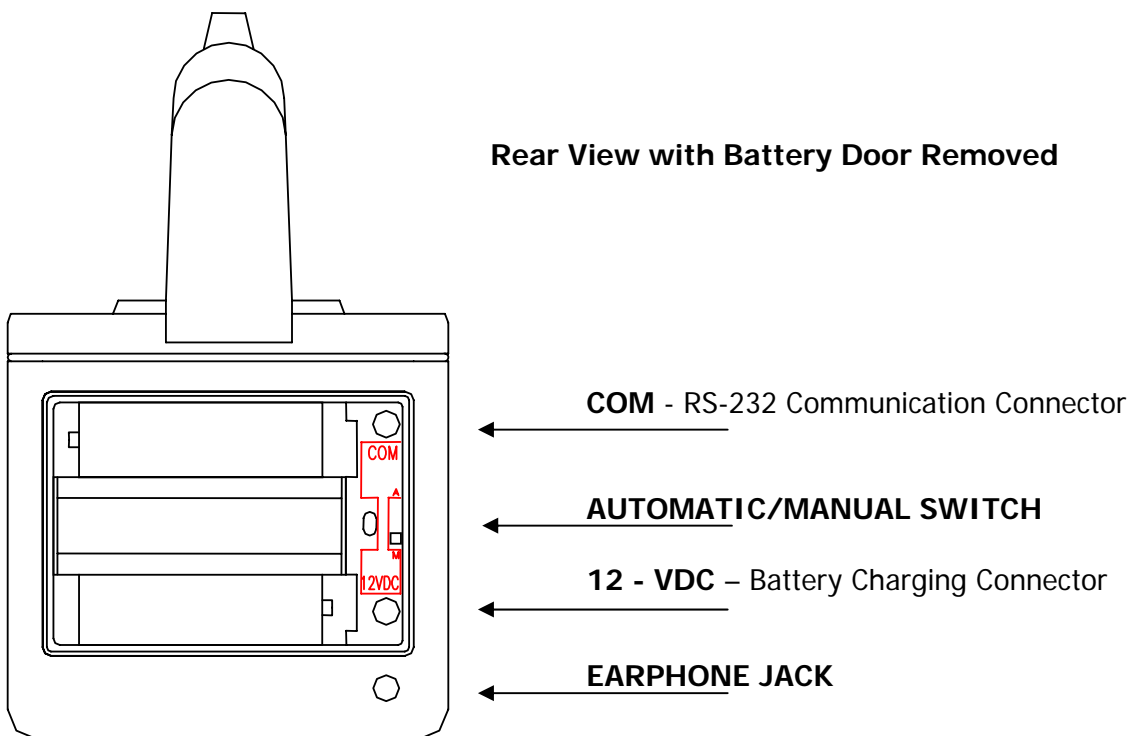
g)   **BATTERIES -** The GR-135 requires two D-cell batteries. Three types of batteries can be used. Standard Nickel-Cadmium rechargeable batteries provide 8 hours of normal operation when fully charged. Nickel-Metal Hydride rechargeable batteries provide 12 hours of operation when fully charged. Alkaline batteries may also be used. They provide 12 hours of normal operation.

WARNING: **Users are reminded not to place the GR-135 in the Docking Station, or connect any battery charger to the unit while alkaline batteries are being used, as this 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 outside the docking station and then fully charging them in the docking station 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.

WARNING: Leaving the GR-135 in the docking station with the backlight activated over a long period of inactivity may cause the batteries to be totally discharged. It is recommended to turn the backlight off if the unit is not expected to be used within 4 hours. Alternately, it is advisable to lift the GR-135 from the docking station and put it back at least once a day. This restores the charging cycle during the prolonged period of inactivity.

h)   **BATTERY-CHARGER** – in the GR-135 the 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)   **DOCKING STATION (DS)** – a Docking-Station is normally supplied with the GR-135. This device is a cradle that the GR-135 unit sits in. The cradle is connected to the **AC** connection, has an **internal radioactive source** (exempt quantity) and may be 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 <u>without opening the rear access data door</u>.

The **DOCKING STATION** 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

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

> **This unit includes a very low activity radioactive source. This source has NO license limitations and NO shipping limitations apply as it is considered an EXCEPTED PACKAGE as specified in US NRC 49CFR 173.424 for radioactive material, excepted package-instruments or articles, UN2910.**

NON-DS OPERATION - Most users find that the Docking Station internal source makes it easier to control sources, as small system test sources are easy to lose. For users who find the Docking-Station operation unsuitable to their application – please advise Exploranium as a special **NON-DS KIT** is available as an option that provides special cabling for charging/data I/O and a test source to permit NON DS operation (**see Appendix C**)

k)   **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 95, 98, NT and 2000. The program is described in **Appendix B** 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.

l)   **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 Exploranium recommends using the unit with the boot in place whenever possible.

m)   **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.

n)   **MANUAL -** This user manual is supplied with the instrument. A special manual titled **USER MANUAL (AUTOMATIC mode),** which covers only the limited AUTOMATIC mode operation fully described in **Appendix A,** is available as required.

o)   **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 Exploranium will only honor the full instrument warranty if the GR-135 is returned in this (or a similar) case.

3.0 JOYSTICK OPERATION

The unit is supplied with a single-button control device called **THE JOYSTICK**.
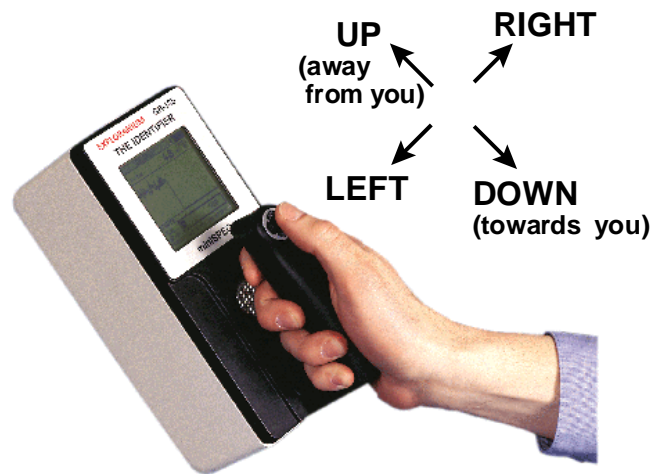
JOYSTICK ACTIONS

4.0   QUICK START – MANUAL MODE

This section offers a VERY simplified guide to system operation; a more complete description is available in Section **4+**.   The manual assumes that unit is being operated with the supplied **DOCKING-STATION (DS)** – non-DS users please refer to **Appendix C**

a)   **CONNECT DOCKING STATION –** connect the DS to an AC source using the cable supplied

b)   **REMOVE THE GR-135 BOOT –** remove the attached Yellow protection boot

b)   **LOAD BATTERIES** - remove rear door and insert 2 batteries – check polarity as marked - ONLY use the supplied rechargeable batteries. Replace battery clamp and door and ensure the door is correctly seated.

c)   **JOYSTICK OPERATION** - the JOYSTICK mounted on the handle (see picture above) 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) – see graphic in Section 3 above

d)   **POWER ON** - a **CLICK DOWN** for at least 2 seconds - the unit will power ON and after a few seconds the MAIN MENU is shown.

e)   **DOCKING-STATION** – place the unit in the DS to charge the batteries

f)   **STABILIZE** – while in the DOCKING-STATION (which has an embedded 0.25uCi Cs137 stabilization source) select **STABILIZE** then **ENTER** (**LONG DOWN**) and follow display prompts to automatically set the system gain

e)   **REMOVE** from the DS and attach the Yellow boot for unit mechanical protection

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

g)   **STOP** – to stop any function – press **ENTER** until you see STOP on the display. Then **ENTER** again to go back to the Main Menu

h)   **IDENTIFY** - Selecting **IDENTIFY** from the Main Menu begins a spectral reading for a pre-set duration. At the end of the sample period, a menu permits viewing the spectrum, peak analysis, Nuclide Identification, storing the spectrum for later analysis or output of the spectrum to a PC.

**i)**   For a detailed explanation of these functions and other system functions - see the following Sections

5.0 DETAILED OPERATION GUIDE

This section offers a detailed guide to system operation. The "**AUTOMATIC**" (= simplified) mode of operation is described in **Appendix A**, note there is a special Users manual for "**AUTOMATIC**" only operations.

The manual assumes that unit is being operated with the supplied DOCKING-STATION (DS) – non DS users please refer to Appendix C for differences

5.1 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. Various Joystick actions are permitted depending on the application:
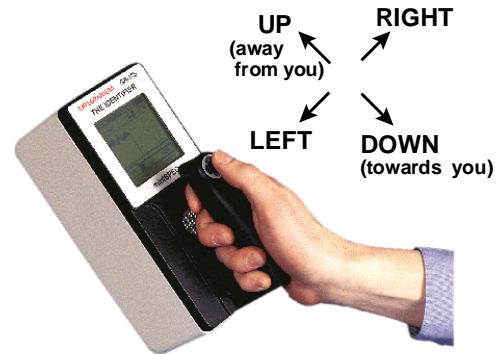
JOYSTICK ACTIONS

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.

5.2 POWER

a) **BATTERIES**

The GR-135 has an integrated Battery-Charging capability and operates with the supplied two D-cell rechargeable NiCd batteries for Docking-Station usage. The internal battery charger 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. Consult Exploranium if special battery usage is required.

Alkaline batteries can be used but in this case **DS operation is NOT permitted** or system damage and battery leakage may occur. An internal temperature sensor in the unit will shut power down if an increased temperature is detected, to provide a high level of system protection but system damage from battery leakage could still occur.   See Appendix C for NON-DS operation.

When not in use for an extended period of time (1 month or more) – either leave the unit charging in the DS – or remove the batteries to prevent leakage.

b)   LOADING BATTERIES

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 fig). 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)

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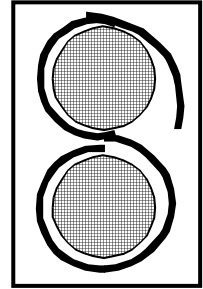
c)   POWER ON

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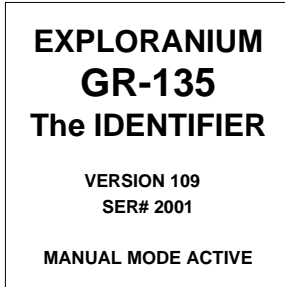
TESTING

Fig. 1A

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

If any errors are detected, they are displayed (see Appendix E). If no errors are found, the display will change to the start up screen (Fig. 4) shown below after a few seconds

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MANUAL MODE ACTIVE

Fig. 1B

MANUAL MODE ACTIVE – shows that the unit is in the **MANUAL** mode that permits full unit functionality

‐ ‐

d)   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 (Section 10) but users should be aware that enabling the BACKLITE feature reduces battery life by an estimated 50%.

‐ ‐

e)   POWER OFF - MANUAL

To power the unit OFF, CLICK **UP** (away from the user) and hold for approx. 5 seconds. The display (Fig. 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.

```
TURNING OFF

3 (2,1..)
```

Fig. 2

NOTE
LIKE ALL COMPUTER BASED SYSTEMS THERE IS A SLIGHT POSSIBILITY THAT AN UNEXPECTED COMBINATION OF USER ACTIONS COULD CAUSE THE SYSTEM TO HANG UP.
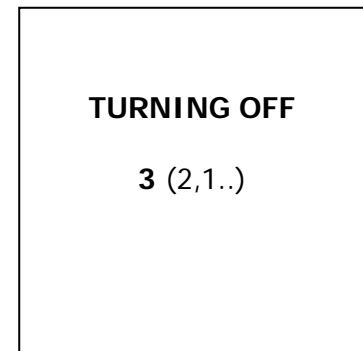**WHILE HIGHLY UNLIKELY, USERS ARE ADVISED THAT IF UNUSUAL ACTIONS OCCUR - SWITCH THE UNIT OFF AS DESCRIBED IN (e) ABOVE AND AT THE NEXT POWER ON THE SYSTEM SHOULD BE OK.**

- -

f)   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.

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.

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   ½ Charge   **LOW** Low Battery Warning

Fig. 3

5.3   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 on page 8).

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.

5.4   DISPLAY CONTRAST

When the unit is first turned **ON**, the user may use the joystick to adjust the Display Contrast to suit themselves. 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 60 seconds after power on. This is to prevent inadvertent contrast adjustment during other system operations. 60 seconds is usually long enough for adjusting contrast, however if further adjustment is required, switch the unit off then on again to obtain another 60-second adjustment

---

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

USER ADVISORY
Some users switch the unit ON
And see NO DISPLAY.

This is usually because they have set the CONTRAST completely wrong.

If a greenish-colored blank display is seen, switch the unit OFF (UP for 5 seconds ensures 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 blue, then repeat the above procedure but click the Joystick LEFT.

Contact Exploranium if the display is still blank.

5.5   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.

MAIN MENU
SEARCH + DOSE
IDENTIFY
STABILIZE
DATA MEMORY
SETUP
MAINTENANCE
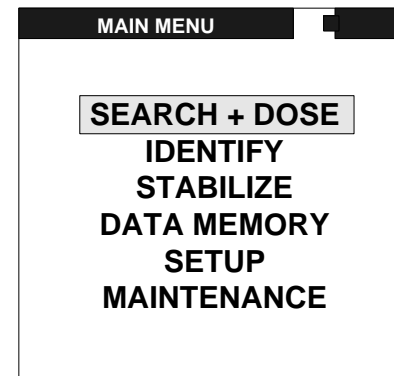
Fig. 4

5.6   STABILIZATION

The GR-135 is designed to automatically carry out system stabilization in the **AUTOMATIC** mode in the **DOCKING STATION**. 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 section 7.

If the unit decides that Stabilization is required then a STABILIZATION WARNING display will be shown – see Fig. 5.

If DEFAULT PARAMETERS are loaded then this warning will be seen as Stabilization is required before the SEARCH and IDENTIFY functions.

IT IS EXTREMELY IMPORTANT THAT STABILIZATION BE CARRIED OUT IF 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
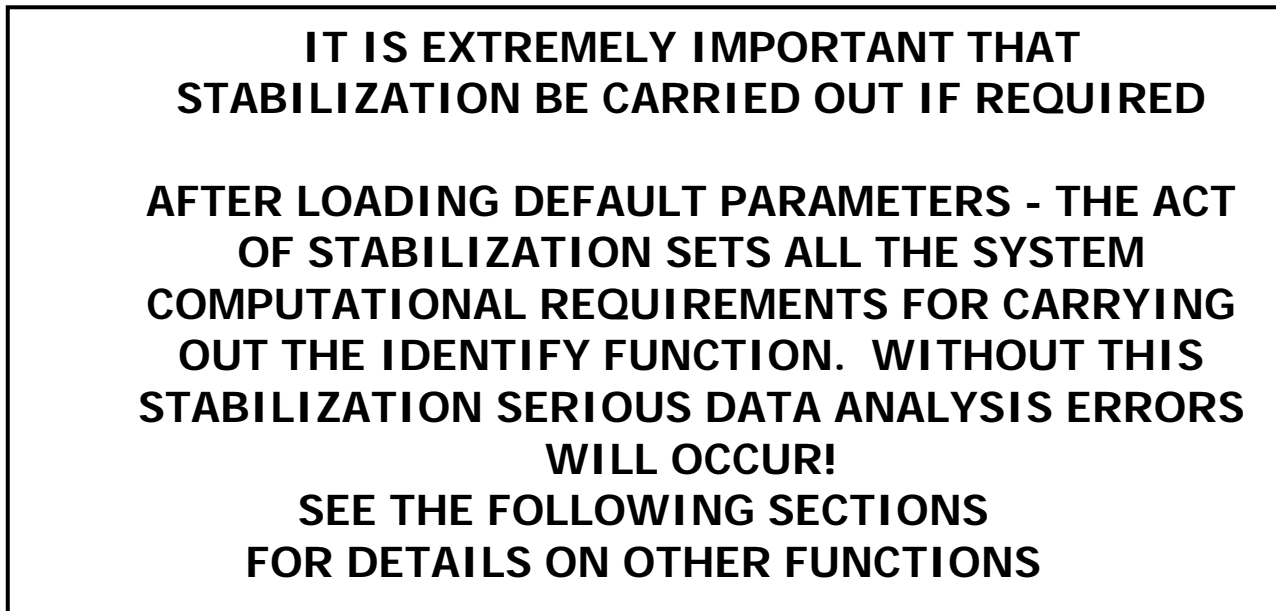
Fig. 5

5.7   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 sealing plug 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

EXTERNAL AUDIO
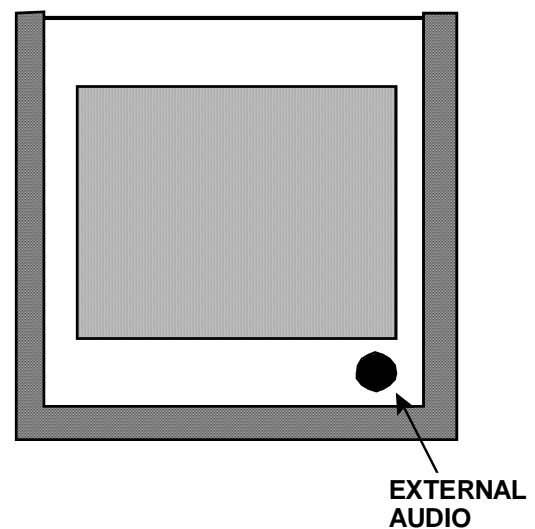
6.0 SEARCH+DOSE

6.1 SEARCH MODE

Select this menu item then **ENTER** to activate – fig. 6 is seen

SEARCH -	Shows that the system is in the SEARCH mode.

Fig. 6

SEARCH -   Shows that the system is in the SEARCH mode.

■■■■ -   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

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.
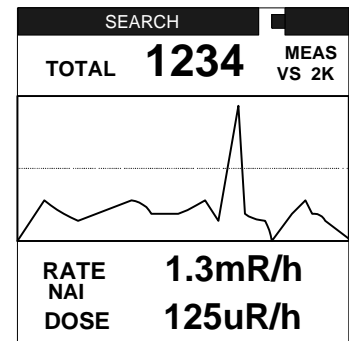
6.2 HIGH DOSE

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 **<u>distinctive</u>** audio warning tone occurs and the display changes (fig 7) :

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

WARNING!!

HI RADIATION DOSE RATE MOVE AWAY!!

Fig. 7

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
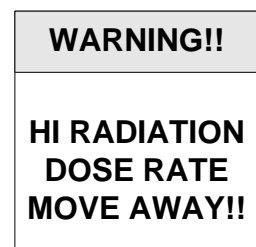
6.3   NEUTRON ALARM

The system has a selectable Neutron Alarm Threshold (for settings see Section 10.3). If this level is exceeded a distinctive audio warning tone occurs and the display changes (fig 8).

This display will stay on the screen as long as the Neutron data is above the threshold **and for 5 seconds after the data drops below the alarm threshold** to ensure that the user can inspect the data adequately.

WARNING
NEUTRONS DETECTED
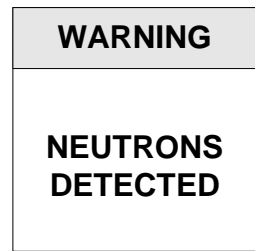
Fig. 8

6.4   SEARCH ALARM

If the **ALARM LEVEL** parameter (**section 10.1**) 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 in the figure. As the user moves away from the source the audio and pop-up display will go away.

WARNING!!
ALARM ABOVE LIMIT
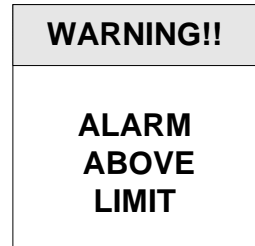
Fig. 9

6.5   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 which is the maximum radiation intensity.

6.6   SEARCH MODE - DATA RECORDING

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 each 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.

When the internal DATA MEMORY is full as described above, users should return to MAIN MENU (**ENTER**) and dump the data to an external PC as detailed in Appendix B

To log data directly to a PC refer to **Appendix B**

7.0   IDENTIFY

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

- Search and locate a source of radiation in the **SEARCH** mode as this has maximum sensitivity
- If a source of radiation is found then use the **SEARCH** mode to estimate its approx. geographic boundaries (by observing the count-rate or audio)
- Position the detector facing the approximate center of the area of radiation
- 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
- Highlight **IDENTIFY** in the Main Menu and press **ENTER** to select.
- The GR-135 immediately begins to acquire a spectrum with the display appearing as shown in Figure 10. Note the system **DEAD-TIME** – for best results this should be between **10-25%**
- At the termination of the sample the data will be analyzed for radioactive material and the display will show the results
- See below for full details

NOTE – Section 7.1 covers instrument behavior if **IDENTIFY** is started from the **MAIN MENU**. Section 7.2 – 7.8 cover a different mode of operation

7.1   IDENTIFY DISPLAY

As the sample progresses the display is updated at a 1/sec rate as shown in Fig. 10 until the preset sample time is reached. For full details of this display see section 7.4 below.
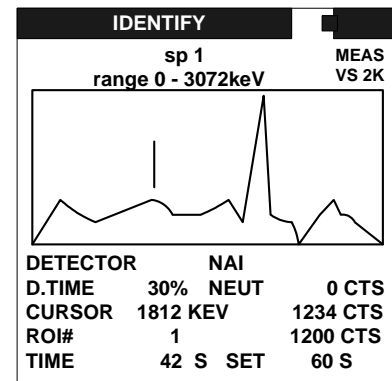
Fig. 10

ANALYSIS DISPLAY

When the sample terminates the Nuclide Identification function is automatically activated. The display shows "**COMPUTING – PLEASE WAIT**" for a few seconds then Fig. 11 is displayed.

This display shows any Nuclides that have been identified in 3 columns:

TYPE – the Nuclides in the library are divided into 4 categories **IND**ustrial, **SNM** (Special Nuclear Materials**)**, **MED**ical and **NOR(**M**)**. See Appendix D for a list of isotopes and types.

ISOTOPE – the full name of the isotope (see App. D)

Fig. 11

SIZE – the relative size of the peaks of the isotope in SD units.
(Standard Deviation units – this gives a good idea of the significance of the peak)
For isotopes with multiple peaks the individual peaks SDs are summed.

NOTE: This relatively simplified display is intended to offer quick user analysis capability. For more expert users see the further functions below.
ENTER – pressing ENTER goes to the ANALYSIS menu for further functions

7.2   ANALYSIS MENU

When Nuclide ID is complete, ENTER goes to the main ANALYSIS menu (Fig. 12) where further functions can be selected
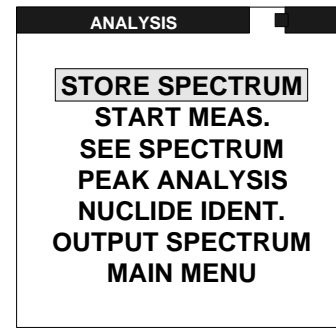
Fig. 12

7.3   STORE SPECTRUM

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 fig. 13 – in this case showing that this spectrum has been stored as Spectrum #12.
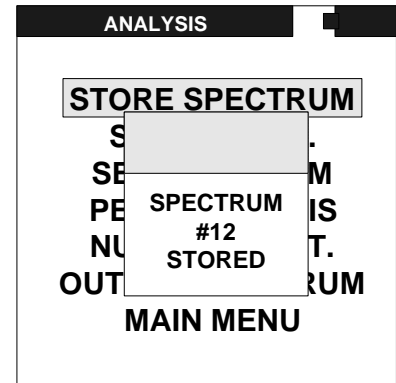
Fig. 13

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

7.4   START MEAS

This option allows the user to take another spectrum sample without having to go back to the Main Menu and selecting **IDENTIFY** again. If this option is selected then the IDENTIFY sampling display (shown in 7.1 above) is shown and data accumulation begins again. As the sample progresses the display is updated at a 1/sec rate as shown in Fig. 14 until the preset sample time is reached.

NOTE: If the IDENTIFY analysis capability is started from the START MEASUREMENT menu item then at the end of the sample the display goes to the ANALYSIS menu so the user can select subsequent actions. However if IDENTIFY is started from the MAIN MENU it automatically carries out NUCLIDE ID to try to somewhat simplify user actions.
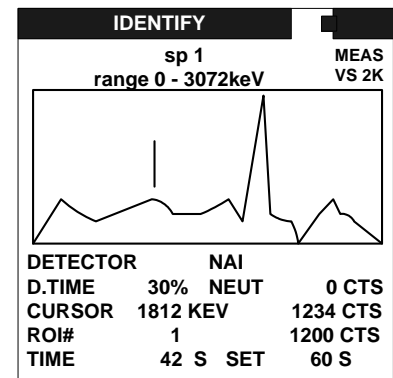
Fig. 14

Labels are:

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

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 %

NEUT – The count rate for the Neutron detector in cts/sec

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 (42 secs currently)

SET – shows the preset sample time of 60 seconds.

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 Nuclide ID mode and the display results as shown in Fig. 11 are seen.

7.4.1   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

7.5 SEE SPECTRUM

This display shows the spectrum of the last sample analyzed. The figure shows a typical display.   Data are 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 it's full count (in this case no premature termination due to overflow)
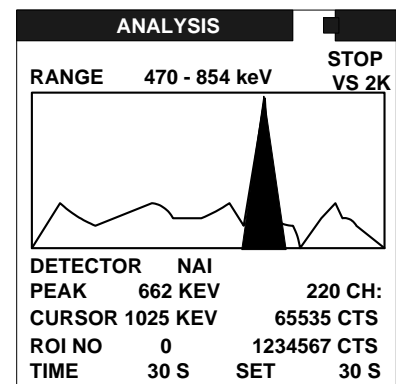
Fig. 15

7.5.1 SEE SPECTRUM

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 appears (Fig. 16):

The cursor goes immediately to the **ZOOM RETURN** selection and if **ENTER** is pressed again it goes back to the **ANALYSIS** menu
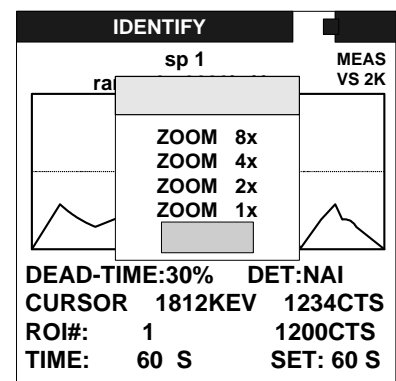
The other selections permit the zoom feature:

X8 – 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

X4 - this selection sets the display to show 1 pixel = 2 channels. This means that the full display now covers 128 channels = 768keV

X2 - this selection sets the display to show 1 pixel = 4 channels. This means that the full display now covers 128 channels = 1536keV
    Fig. 16

X1 - this selection sets the display to show 1 pixel = 8 channels. This means that the full display now covers 128 channels = 3072keV

RETURN – goes to the Analysis Menu

Correct operation of the ZOOM feature is to 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 x8 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.

- -
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 Fig. 17

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.
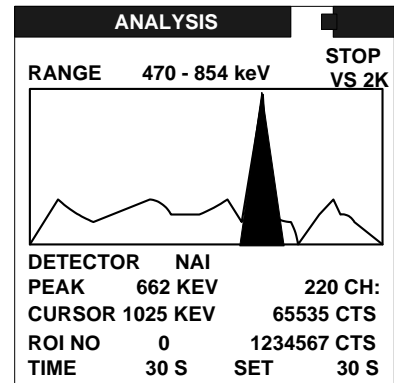
Fig. 17

7.6 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. Data labels:

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.

SIZE - The amplitude of the peak in SD units
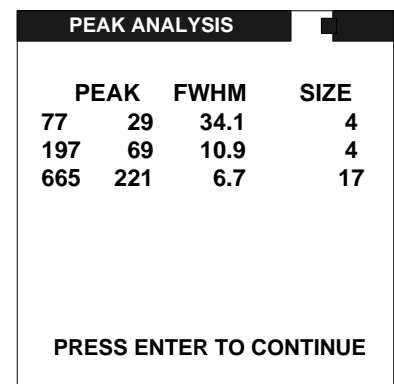
Fig. 18

"-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 **ANALYSIS** menu.

ENTER to go back to the Identify menu

7.7 NUCLIDE IDENT

If this mode is activated then a new Nuclide Identification analysis of the selected spectrum is carried out. The display shows "**ANALYZING SPECTRUM PLEASE WAIT**" for a few seconds then the display shows the **NUCLIDE LIST** screen – Fig. 19. Note that this display is a more complex version of the previous Nuclide ID display shown in Fig. 11 as this secondary display is intended to show a higher level of details for further user analysis.

Cs-137 – is the isotope label of the identified isotope

21 - this is the relative amplitude of the isotope in Standard-Deviation units. In the case of an isotope with multiple peaks this is the sum of all the relevant peaks.

```
┌────────────────────────────┐
│ NUCLIDE LIST          ■    │
│                            │
│                            │
│                            │
│  Cs-137         21         │
│                            │
│  Non Identified    4       │
│                            │
│  RETURN                    │
│                            │
│                            │
└────────────────────────────┘
```

Fig. 19

Non Identified – this shows the sum of all the peaks that cannot be identified. Usually these peaks are very small so they are suppressed in the simplified analysis screen as for most users they are confusing, however for specialized users they may be of interest. Note in the AUTO display, any peaks that are statistically unimportant are suppressed

HIGHLIGHTING – when the display appears, the first isotope is highlighted. The joystick can be used to move up/down the displayed list to highlight a required item

RETURN – pressing **ENTER** goes to the main Identify menu

- -

7.7.1 NUCLIDE DETAILS

When the highlighted isotope is selected by cursor, then **ENTER** pressed, the details of that isotope selection are displayed – Fig. 20. This display shows all the peaks related to the isotope and various data about them:

Cs-137 – is the isotope identified then selected

1/1 – relates to the isotope identification requirements in this case a single peak is required for identification

662 – the peak in keV

6.6 – the FWHM of the peak, a useful measure of peak quality

15 – the amplitude of the peak in SD units

ENTER returns to the IDENTIFY screen

```
┌────────────────────────────┐
│ NUCLIDE DETAILS       ■    │
│                            │
│  Cs-137      1/1           │
│  662       6.6     15      │
│   30       30.0    11      │
│                            │
│                            │
│                            │
│      ENTER TO CONTINUE     │
│                            │
└────────────────────────────┘
```

Fig. 20

- -

7.7.2 NEUTRONS

If the integrated NEUTRON sensor detects the presence of Neutrons, this data is displayed as pseudo Dose data (calibrated for Cf-252) as shown in Fig. 21 and 22 (or as COUNTS depending on parameter settings in SETUP)

```
┌─────────────────────────────┐        ┌─────────────────────────────┐
│     NUCLIDE IDENT    ■ ▯     │        │     NUCLIDE LIST    ■ ▯      │
├─────────────────────────────┤        ├─────────────────────────────┤
│                             │        │                             │
│ TYPE    ISOTOPE      SIZE   │        │                             │
│  I ND   Cesium-137    11    │        │   Cs-137       21           │
│                             │        │                             │
│ NEUTRONS   0.452uSv/h       │        │                             │
│                             │        │  NEUTRONS 0.452uSv/h        │
│                             │        │                             │
│                             │        │      RETURN                 │
│                             │        │                             │
│                             │        │                             │
│     ENTER TO CONTINUE       │        │                             │
└─────────────────────────────┘        └─────────────────────────────┘
```
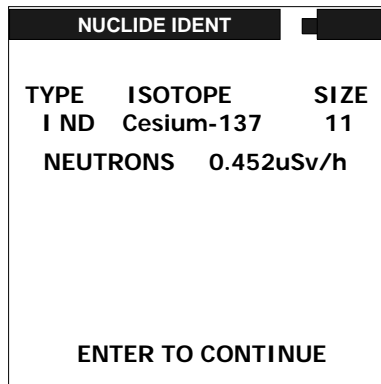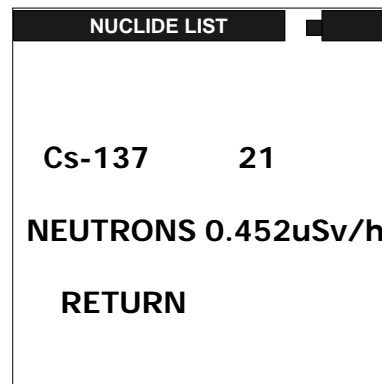
Fig. 21   **Fig. 22**

In SETUP (section 10) special parameters are used to optimize Neutron performance.

_ _

7.7.3 OTHER DISPLAY LABELS

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

_ _

CZT REQUIRED – this means that the analysis showed some uncertainty about the peaks so a CZT analysis is required. In the AUTOMATIC mode this is fully automatic, however in the **MANUAL** mode the user must use **SETUP/IDENTIFY/DETECTOR** and set **DETECTOR=CZT** then carry out data analysis

In this case the Sodium-Iodide spectral analysis and the CZT spectral analysis are totally separate

```
┌─────────────────────────────┐
│     NUCLIDE IDENT    ■ ▯     │
├─────────────────────────────┤
│                             │
│ TYPE     ISOTOPE            │
│  CZT     Required           │
│  I ND    Thorium-232        │
│                             │
│                             │
│                             │
│                             │
│                             │
│     ENTER TO CONTINUE       │
└─────────────────────────────┘
```

Fig. 23

NOTE: USERS ARE ADVISED THAT IN THE MANUAL MODE THE SODIUM-IODIDE DATA ANALYSIS RESULTS ARE SEPARATE FROM THE CZT ANALYSIS RESULTS. SO IT IS NECESSARY TO NOTE THE RESULTS FROM THE NaI BEFORE SWITCHING TO THE CZT (as long as the spectra are all stored – use STORE SPECTRUM – then the users can go back and look at all spectra when they want)

MAIN MENU Exits back to the Main Menu

8.0 STABILIZE

8.1 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.
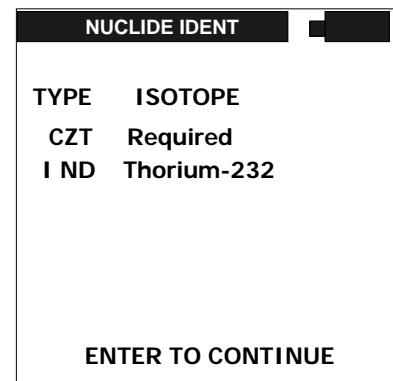
The GR-135 carries out Stabilization in various ways.

a)   **AUTO-STABILIZATION in the DOCKING STATION – <u>AUTOMATIC</u> MODE –** see section 8.2

b)   **MANUAL-STABILIZATION in the DOCKING STATION** – see section 8.3

c)   **AUTOMATIC CORRECTION when in USE** – see section 8.4

e)   **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

---

8.2 AUTO-STABILIZATION IN THE DOCKING STATION – AUTOMATIC MODE

If the GR-135 unit is set in the AUTOMATIC mode and placed in the DS, the system starts automatically stabilizing on the very small (0.25uCi) Cesium source embedded in the DS. The display shows system activity and advises the user when stabilization is complete. During the entire time the unit spends in the DS, the batteries are continually charged and the system is continually stabilized. See full details in Appendix A

8.3 MANUAL-STABILIZATION IN THE DOCKING STATION

For normal operation the Docking Station is used (refer to Appendix C for non-DS operation). From the MAIN MENU select "**STABILIZE**" and press **ENTER** the display shows Fig. 23

This function is usually used with an external source, hence the display wording. The user can assume that the source in the DS is positioned correctly - so press **ENTER** to continue. (Selecting **UP** returns to the Main Menu).

```
        STABILIZE        ▮

     PLACE CS SOURCE
       AT THE FACE
      OF THE GR-135



       PRESS ENTER
      TO CONTINUE
     OR UP TO EXIT
```
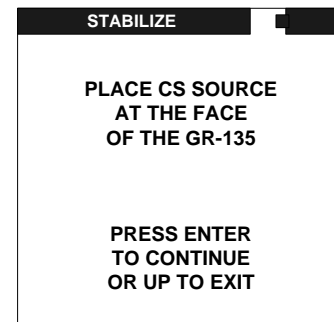
Fig. 23

Stabilization will now occur, the system is fully automatic, various displays will be seen (the word "**COMPUTING**" may appear as well as some data are being processed), then finally a beep shows that the process is complete with the display as shown as in Fig. 24

These data are:
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).

```
        STABILIZE        ▮

      STABILIZATION
        COMPLETED
    REMOVE CS SOURCE AND
    PUSH ENTER TO CONTINUE

        PEAK: 220.1
        FWHM: 6.8%
      OLD GAIN : 522
      NEW GAIN : 514
```
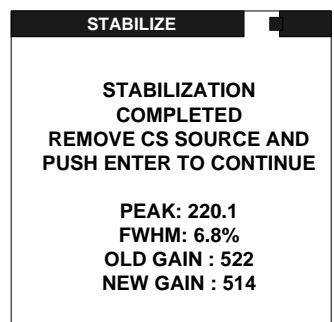
Fig. 24

FWHM -   the Full-Width-Half-Maximum is a measurement of the quality of the detector to resolve narrow peaks. The best detectors when new have a FWHM of 6 – 6.5% but good operation is possible up to 8.5%. Above 8.5% the 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.

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 unit may be removed from the Docking-Station and used. However if the user is not ready then the GR-135 may be left in the DS to keep the batteries charged. This process also keeps the unit "warmed-up" as well as continuously charging the batteries so when not in use it is recommended that the unit remains in the DS.

NOTE: In this software release – automatic stabilization in the DS in the MANUAL mode is NOT supported

8.4   AUTOMATIC CORRECTION WHEN IN USE

When the unit is removed from the Docking-Station, the GR-135 electronics detects this change. Stabilization on Cesium is automatically halted and the current detector temperature 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.

9.0   DATA MEMORY

If this is selected a new menu appears :

```
┌─────────────────────────────┐
│ ▐ DATA MEMORY         ▐■ ▌  │
│                             │
│          STATUS             │
│                             │
│          DUMP               │
│                             │
│          ERASE              │
│                             │
│        MEM SCAN             │
│                             │
│        MAIN MENU            │
│                             │
└─────────────────────────────┘
```
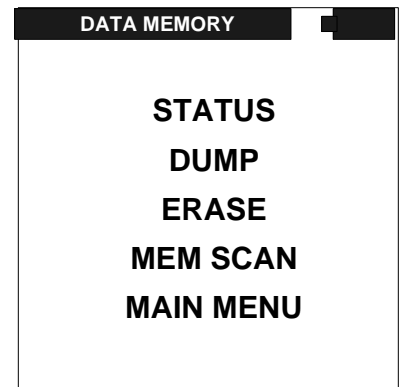
Fig. 25

9.1   STATUS

Selecting STATUS shows the current state of the data memory. The GR-135 can store data from the 2 operational modes (SEARCH+DOSE and IDENTIFY) 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 IDENTIFY data are classified as **SPECTRA**.

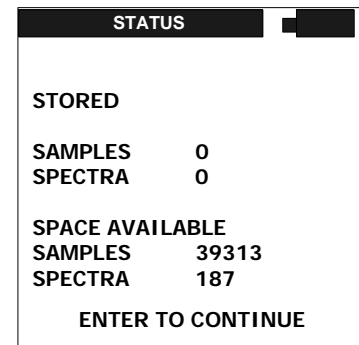**STORED** - This indicates the current status of data storage.

```
┌─────────────────────────────┐
│ ▐ STATUS             ▐■ ▌  │
│                             │
│  STORED                     │
│                             │
│  SAMPLES       0            │
│  SPECTRA       0            │
│                             │
│  SPACE AVAILABLE            │
│  SAMPLES       39313        │
│  SPECTRA       187          │
│     ENTER TO CONTINUE       │
└─────────────────────────────┘
```

Fig. 26

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

9.1.1 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 **IDENTIFY** 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

9.2 DUMP

DUMP is a utility for outputting data stored in the GR135 memory to an external utility program such as the Exploranium supplied PC utility program IdentiView (described in Appendix B). .

Selecting DUMP allows the user to transfer stored Survey, Dose and Spectral data to an external PC via the data transfer cable from the DS unit. It is critical that the GR-135 be turned OFF before connecting the unit to the data transfer cable. If the unit remains ON, any shock or power surge arising from the connection may corrupt data in memory.

User may use such utilities as HyperTerminal to output the stored data however the majority of the stored data is in a Binary format so the user must have special conversion utilities to convert the data in the format they require.

Note the RS232 port is configured as :
- Baud = 19200
- Data bits = 8
- Parity = none
- Stop bit = 1
- Flow control = none

Selecting **DUMP** will produce the display shown in fig. 27.   When the appropriate PC software is operating, data may be transferred by CLICK DOWN. Pushing the button up will cancel this function. When data transfer is complete
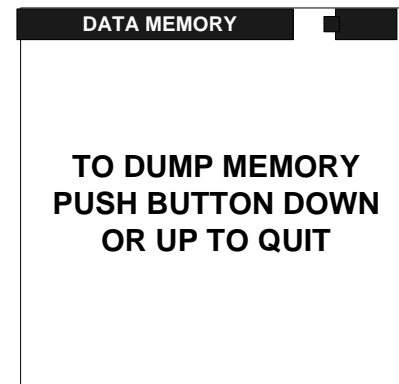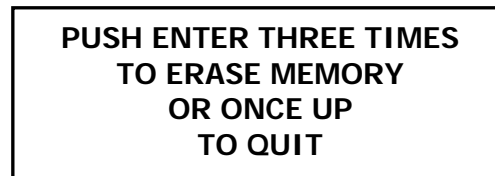
```
┌─────────────────────────┐
│ DATA MEMORY          ■   │
│                         │
│                         │
│                         │
│    TO DUMP MEMORY       │
│   PUSH BUTTON DOWN      │
│     OR UP TO QUIT       │
│                         │
│                         │
│                         │
│                         │
└─────────────────────────┘
```

Fig. 27

9.3 ERASE

Selecting this function produces a new display. The display shows:

```
┌─────────────────────────┐
│  PUSH ENTER THREE TIMES │
│    TO ERASE MEMORY      │
│       OR ONCE UP        │
│        TO QUIT          │
└─────────────────────────┘
```

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

Users Are Warned That Erased Data Cannot Be Recovered!

9.4 MEM SCAN

This selection 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:

```
┌─────────────────────────┐
│      SPECTRUM #1        │
│                         │
│   DATE 02  01  18       │
│   TIME 12  36  50       │
└─────────────────────────┘
```
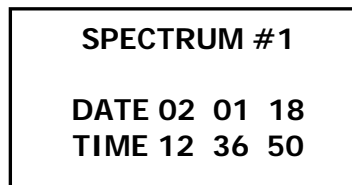
Note the DATE is in YY – MM – DD format
The user must **CLICK LEFT/RIGHT** to select the required spectrum. The spectrum number is the same one used as a label during the spectrum store. The Date/Time of the recorded spectra are also provided for reference.

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 PEAK ANALYSIS etc. as required

The features and displayed data are exactly the same as in the IDENTIFY features described in sections 6.4 etc.

```
┌─────────────────────────────┐
│  REANALYSIS          ■       │
│                             │
│   ┌───────────────────┐     │
│   │    MEM SCAN       │     │
│   └───────────────────┘     │
│      START MEAS.            │
│     SEE SPECTRUM            │
│     PEAK ANALYSIS           │
│     NUCLIDE IDENT.          │
│      MAIN MENU              │
│                             │
│                             │
└─────────────────────────────┘
```
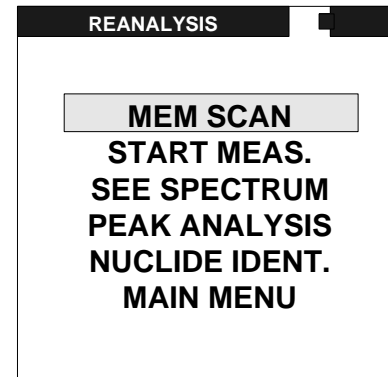
Fig. 28

10.0 SETUP

These menus permit the user to setup the required operating parameters. If this item is selected from the MAIN MENU this display is seen.

Use the cursor UP/DOWN to select (highlight) the required selection then **ENTER** to activate this selection.

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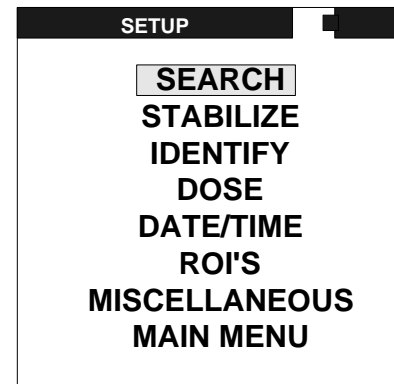
ENTER to exit and accept the changes

```
┌─────────────────────────┐
│ ▐ SETUP          ▗▖      │
│                         │
│      SEARCH             │
│     STABILIZE           │
│     IDENTIFY            │
│       DOSE              │
│     DATE/TIME           │
│      ROI'S              │
│   MISCELLANEOUS         │
│    MAIN MENU            │
│                         │
└─────────────────────────┘
```

Fig. 29

For all the selections below, the normal default selection is shown in large bold print

---

10.1 SEARCH

Selections are:

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.

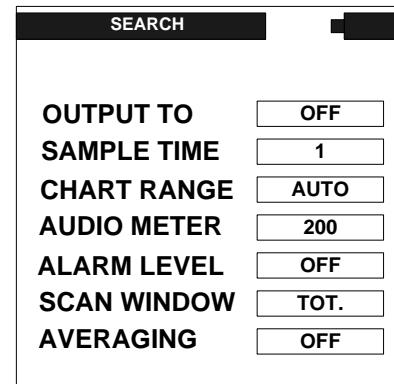   **MEM** - the SEARCH data is to be stored in the GR-135 internal memory

```
┌─────────────────────────┐
│ ▐ SEARCH         ▗▖      │
│                         │
│  OUTPUT TO     ┌─────┐   │
│                │ OFF │   │
│  SAMPLE TIME   │  1  │   │
│  CHART RANGE   │AUTO │   │
│  AUDIO METER   │ 200 │   │
│  ALARM LEVEL   │ OFF │   │
│  SCAN WINDOW   │TOT. │   │
│  AVERAGING     │ OFF │   │
│                └─────┘   │
└─────────────────────────┘
```

Fig. 30

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 Fig. 31.
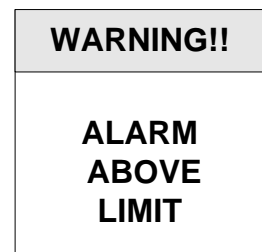
WARNING!!
ALARM ABOVE LIMIT

Fig. 31

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 9.6. 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

10.2 STABILIZE
Selections are **CZT FINE GAIN** and **RE-STAB MODE**

10.2.1 CZT FINE GAIN
Set by Exploranium, see system **CALIBRATION SHEET** for the correct setting. The calibrated value for this parameter is stored in system memory. When defaults are loaded the calibrated value is automatically loaded

– –

10.2.2 RE-STAB MODE
Selection currently are only **S.VALIDITY**

10.2.2.1 S. VALIDITY
Selections are OFF, 12H, **24H**

This parameter is used to advise users when system re-stabilization is required in the AUTO mode

OFF - with this selection (in the AUTO mode) - when the unit is removed from the DS unit then the correct Gain is maintained using the reference temperature correction. The OFF parameter means that NO WARNINGS are given to the user of when a recommended stabilization in the DS is required. This setting is often used by users who have no realistic capability of using the DS prior to instrument deployment so would find the requirement to stabilize in the DS 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 an "**UNIDENTIFIED ISOTOPE**" message 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 and then repeating the measurement. If the same "**UNIDENTIFIED ISOTOPE**" message is received again then this truly is an isotope whose characteristics are not in the system library.

12H, 24H – if either of these parameters are selected it means that 12 hours (12H) or 24 hours (24H) after removing the system from the DS – a message will appear on the GR135 display requiring the system to be returned to the DS for system stabilization. The standard setting is 24 hours as this is a reasonable time for system operation without the super accurate requirement of DS stabilization. Most AUTO mode users keep the unit in the DS when not in use so in most cases this parameters effects are not seen

10.3 IDENTIFY
There are 4 sub-sections – **DETECTOR, NaI, CZT, NEUTRON**

10.3.1 DETECTOR

a)   **DETECTOR –** this selects the detector used in the **IDENTIFY** mode, choices are **AUTO**, **NaI**, **CZT**

AUTO – normal selection. In this mode the system starts off with the NaI detector and if required the CZT detector is automatically enabled

NOTE: ALWAYS SET THIS MODE TO <u>AUTO</u> UNLESS SPECIAL CZT EXPERIMENTS ARE BEING CARRIED OUT. IT IS ESSENTIAL THAT FOR NORMAL OPERATION THAT THIS IS SET TO <u>AUTO</u> OR CORRECT SYSTEM OPERATION IS IMPAIRED IN THE AUTO MODE

NaI – selects <u>**only**</u> the Sodium-Iodide (NaI) detector (CZT is disabled if present)

CZT – this selects <u>**only**</u> the optional CZT detector (NaI is disabled)

b)   **PILEUP** – this sets the Pile-up rejector **ON** or **OFF**
The Pile-up rejector only applies to the NaI detector, as the relative inefficiency of the CZT detector does not require this function. So this parameter controls only the NaI data collection, CZT analysis automatically disables the Pile-Up detector regardless of how this parameter is set. 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 rejector 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 10, 15, 20, 25, **30**, 35, 40, 45, 50
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)   **AUTO NI LIM.** – selections are 10, 15, 20, **25**, 30, 35, 40, 45, 50%

The libraries have been optimized for various applications to suit the majority of normal cases. It is possible that occasionally the user will come across an unusual isotope that has not been included in the library. However during routine analysis, spurious peaks are quite often detected (caused by pile-up events, back scatter or various other scattering phenomena). In the MANUAL mode, peaks that are not accounted for in the Nuclide Identification process are summed and shown as **N.I.** (Non Identified peaks).   This is an acceptable procedure for skilled uses as their experience allows them to asses the relevance of such "extra" peaks. However in the AUTO mode where semi-skilled users involved these N.I. peaks cause confusion as in most cases they are relatively insignificant.

In software version 1V22 this problem is solved by computing the percentage of NI peaks in the analysis. After peak analysis when all the low amplitude peaks have been removed via the PEAK LIMIT parameter, all remaining peak amplitudes (in SD units) are summed.   The Nuclide Identification takes place. Any NI peaks left over from this analysis also have their amplitude summed. The NI ratio is then computed being (NI amplitude/All peak amplitude). If this amplitude exceeds the NON-ID THRESHOLD parameter then the display shows **UNKNOWN ISOTOPE**.

The default setting of 25% is a reasonable compromise for normal operation and prevents semi-skilled users from having unnecessary concern when operating in the AUTO mode as unimportant peaks are just suppressed.

10.3.2 NaI

Selections here are :

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

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

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. [As an example, see DT in Figure 10]. 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 Cs-137 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 by 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 B 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 <u>LIVE</u> MODE – ACTUAL SAMPLE TIMES WILL BE MUCH SLOWER IN HIGH COUNT RATE AREAS. IF ONLY NUCLIDE-ID IS REQUIRED THEN USE OF <u>CLOCK</u> WILL ENSURE THAT THE PRESET SAMPLE TIME IS THE ACTUAL SAMPLE TIME.

c)   **ADC –** denotes the number of channels in the spectrum – system is currently hard wired at **1024** channels = 3keV/channel

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

10.3.3 CZT

This sets system parameters for the optional CZT detector. Parameters are the same as the NaI detector selections. See section 9.3.2 for a detailed explanation of each selection

a)   **MEAS TIME** – sets the detector sample rate – selections are 60, 120, **300**, 500, 1000, 2000secs. The CZT detector is very small and relatively inefficient so much longer sample times are required for correct operation

b)   **MEAS MODE** – usually set at **CLOCK**

c)   **ADC** – fixed at **1024** channels

d)   **AUDIO** – usually set **ON**

e)   **CZT OFFSET** – set by the factory – see system **CALIBRATION SHEET** for the correct value

10.3.4 NEUTRON

This sets the parameters for the Neutron detector -

a)   **N SUMMING** – Selects the data averaging. Selections are OFF, 3P, **5P**, 10P - this parameter only applies to the SEARCH mode data analysis. The default selection "**5P**" sets a 5 sample moving SUM for the data. Users should note that this is NOT a moving average but a moving SUM. The reason for this is to improve effective sensitivity. Since the Neutron detector is quite small in area, during operation occasionally for statistical reasons the sample counts may be zero. If an average is used then this "pulls" the average down. Since we are using Integer math here it is impossible to use non-whole numbers as a threshold to compensate. So using the SUM method means that integer values can readily be used without limiting system performance.   The only disadvantage to this method is the N SUMMING/ ALARM LEVEL and SAMPLE TIME are interactive so users should consider all these parameters before selecting the final set of parameters. It is recommended that the DEFAULT values be used for best performance in the SEARCH mode.

b)   **ALARM LEVEL** – Sets the detector alarm level in COUNTS. Selections are OFF, 1, 2, **3**, 4, 5, 6, 7, 8, 9, 10, 20, 50, 100 counts - this parameter only applies to the SEARCH mode data analysis.   Since the detector has a very low Gamma interference the 3 level is recommended for good sensitivity.

c)   **SAMPLE TIME** – sets the SEARCH analysis sample time – selections are **1**, 2, 3, 4**,** 5, 6, 7, 8, 9, 10, 15, 20, 50, 100 secs - this parameter only applies to SEARCH mode data analysis. In the SEARCH mode it is usually essential to operate at a 1sec rate or it is too easy to miss a source as the user moves the instrument past the container/vehicle of interest.

d)   **NE IDENT THR –** sets the alarm threshold level in the IDENTIFY mode – selections are OFF, 1, 2, 3, 4, **5**, 6, 7, 8, 9, 10, 15, 20, 50, 100 counts. When the user enters the IDENTIFY mode, the normal Neutron alarm system is disabled. Instead the system accumulates the sum of all Neutron counts detected in the IDENTIFY sample period. Thus for the default IDENTIFY sample time of 30 seconds – once IDENTIFY is started, an internal counter counts all Neutron pulses detected in the 30 second sample time. At the end of this period the TOTAL COUNTS are then compared to the **NE IDENT THR** which is also set in counts. If the TOTAL COUNTS exceed the threshold set then the word NEUTRONS appears on the NUCLIDE ID display followed by a number either in counts or uSv/h depending on the setting of the next parameter. If the TOTAL COUNTS is below this threshold then only the normal Nuclide ID data is displayed.

e)   **NE UNIT** – sets the Neutron UNITS used for display – selections are **cps** or **uSv/h**. The IAEA has decided that most users are best suited to see the Neutron data in estimated Dose Rate in uSv/h. However some users prefer to see the raw Neutron counts. So this parameter permits the user to select what they require.

10.4 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, **2000u**, 4000, 5000, 9000   **uR/h**
-    **Sv**   -   OFF, 0.1, 0.2, 0.5, 1.0, 2.0, 5.0, 10.0, 20.0, 40.0, 50.0, 90.0   **uSv/h**
-    **Gy**   -   OFF, 0.1, 0.2, 0.5, 1.0, 2.0, 5.0, 10.0, 20.0, 40.0, 50.0, 90.0   **uGy/h**

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

10.5   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

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

Ensure you follow the displayed conventions for Year, Month etc. to set the data correctly.

10.6   ROIS

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

Default settings are :
ROI#1 – 15-30 – centered on Americium-241

ROI#2 – 210-230 – centered on Cesium-137

ROI#3 – 320-470 – centered on Cobalt-60

ROI#0 – fixed at **20keV - 3000keV** = 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

10.7   MISCELLANEOUS

a)   **LANGUAGE** – selects the language for the displays. In this release, selections are **ENG** (English), **DEU** (German), **FRA** (French), **POL** (Polish), **ESP** (Spanish), **SVE** (Swedish), **NOR** (Norwegian, or **CZ** (Czech). Future releases will support **RUS** (Russian) and **JAP** (Japanese).

b)   **BATTERY** – sets the battery type. Current selections are **NICD** (Nickel Cadmium) and ALK (Alkaline).

c)   **BACKLITE** – sets the display Backlite operating mode. Selections are **OFF**, ON, 5S, 10S, 30S, 60S.
        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—60S) – 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 is only recommended when essential.

d)   **ACTIVE LIBR** – this sets the Library used for analysis – selections are **STAND** (Standard),
        MEDIC (Medical), **INDUST** (Industrial), **WASTE** (Waste sites) 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
        Exploranium (send request to hovgaardJ@SAIC.com or komarI@SAIC.com) as required. These new
        libraries are then loaded into the USER location using the Exploranium supplied PC support program
        IdentiView (see Appendix B for more details).   A new release of PC support software currently
        scheduled for Jan 2003 will provide a "**LIBRARY BUILD**" program so users can construct their own
        libraries.

        Note that once selected in this parameter setting, the actual isotopes in the library can be viewed in
        MAINTENANCE/LIBRARY as described below.

11.0 MAINTENANCE

This section has a selection of special utility programs for special functions

11.1 MAINTENANCE MENU
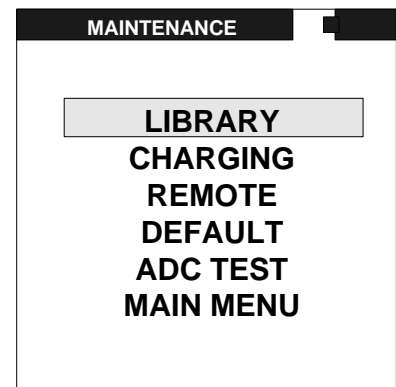
This is the main Maintenance menu – see fig. 36

```
 ┌──────────────────────────┐
 │    MAINTENANCE      ▮     │
 │                          │
 │  ┌────────────────────┐  │
 │  │      LIBRARY       │  │
 │  └────────────────────┘  │
 │       CHARGING           │
 │        REMOTE            │
 │        DEFAULT           │
 │       ADC TEST           │
 │      MAIN MENU           │
 │                          │
 └──────────────────────────┘
```

Fig. 36

11.2 LIBRARY

Selection of this option displays the nuclides in the system library – see Fig. 37. For the current library list refer to Appendix D

```
 ┌──────────────────────────┐
 │      LIBRARY        ▮     │
 │  STANDARD LIBRARY        │
 │  U-238          RA-226   │
 │  TH-232         K-40     │
 │  CE-139         I-131    │
 │  CS-137         CO-60    │
 │  BA-133         TC99M    │
 │  CO-57          AM-241   │
 │  XE-133         NP-237   │
 │  PD-103         IR-192   │
 │                          │
 │  ENTER TO GET MORE       │
 └──────────────────────────┘
```
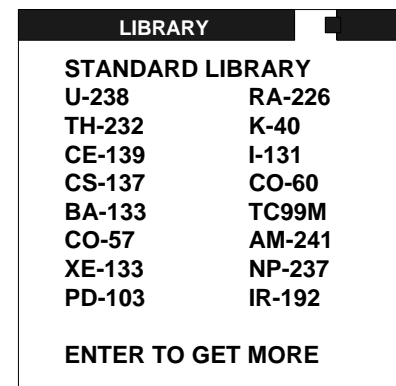
Fig. 37

11.3 CHARGING

This special feature is used during system setup

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

```
 ┌──────────────────────────┐
 │      CHARGING       ▮     │
 │                          │
 │  BAT VOLTAGE    243      │
 │  EL.METER       01273    │
 │  EXT.POWER      OFF      │
 │  CHARGING       OFF      │
 │  CH.TIME        00000    │
 │  REFRESH        OFF      │
 │  ERR.STATUS     02       │
 │                          │
 └──────────────────────────┘
```
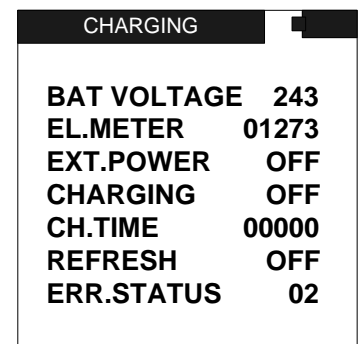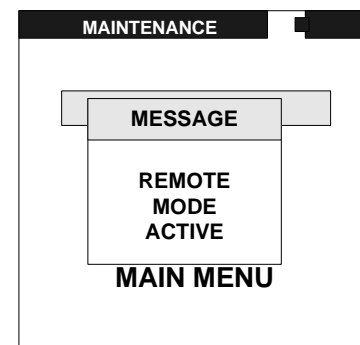
Fig. 38

11.4 REMOTE

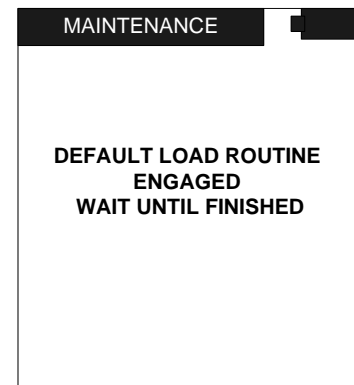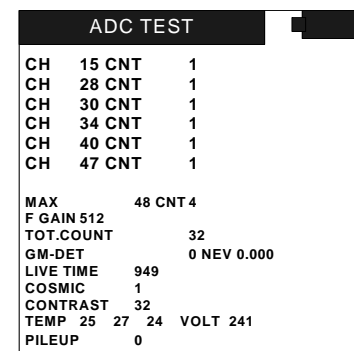This sets the RS232 port to the active state to permit data transfer using the Exploranium IdentiView software described in Appendix B. This setting works as a latch – the first activation sets the port **ACTIVE** and the next activation sets it **INACTIVE**. Normally the port should be **INACTIVE** for normal system functions.

In the system architecture the RS232 port and the AUDIO sound share a common data point. This is normally not an issue as the Audio is not normally active during RS232 functions.

```
 ┌──────────────────────────┐
 │    MAINTENANCE      ▮     │
 │                          │
 │   ┌──────────────────┐   │
 │   │     MESSAGE      │   │
 │   │                  │   │
 │   │     REMOTE       │   │
 │   │      MODE        │   │
 │   │     ACTIVE       │   │
 │   └──────────────────┘   │
 │      MAIN MENU           │
 │                          │
 └──────────────────────────┘
```

<u>**Users are advised that when the REMOTE mode is active, the AUDIO is disabled.**</u>

11.5 DEFAULTS

This selection permits the user to LOAD DEFAULT PARAMETERS. 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.

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

```
┌─────────────────────────────┐
│ MAINTENANCE            ▉▉    │
├─────────────────────────────┤
│                             │
│                             │
│   PUSH ENTER THREE TIMES    │
│      TO LOAD DEFAULT        │
│        OR UP ONCE           │
│         TO EXIT             │
│                             │
│                             │
└─────────────────────────────┘
```
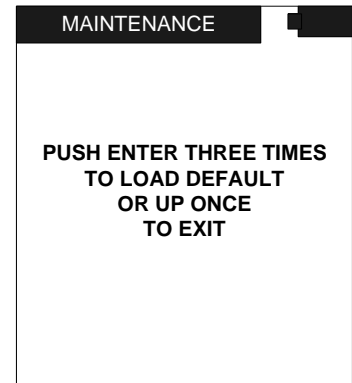
Fig. 39

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, 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.

```
┌─────────────────────────────┐
│ MAINTENANCE            ▉▉    │
├─────────────────────────────┤
│                             │
│                             │
│   DEFAULT LOAD ROUTINE      │
│        ENGAGED              │
│    WAIT UNTIL FINISHED      │
│                             │
│                             │
│                             │
│                             │
└─────────────────────────────┘
```

Fig. 40

11.5 ADC TEST

This special feature is used during system setup

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

```
┌─────────────────────────────┐
│ ADC TEST               ▉▉   │
├─────────────────────────────┤
│ CH   15 CNT      1          │
│ CH   28 CNT      1          │
│ CH   30 CNT      1          │
│ CH   34 CNT      1          │
│ CH   40 CNT      1          │
│ CH   47 CNT      1          │
│                             │
│ MAX          48 CNT 4       │
│ F GAIN 512                  │
│ TOT.COUNT        32         │
│ GM-DET        0 NEV 0.000   │
│ LIVE TIME     949           │
│ COSMIC        1             │
│ CONTRAST      32            │
│ TEMP 25  27  24  VOLT 241   │
│ PILEUP        0             │
└─────────────────────────────┘
```

Fig. 41

12.0 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

c)   NEUTRON detector (optional):   solid state N detector coupled with a miniature PMT 0.86″ long by 0.7″ diam.

Sensitivity :   ITRAP spec – will alarm on a 20KN/s source at 25cms in 5 seconds

d)   CZT detector (optional) :   10x10x5mm CZT Capture detector

Resolution: Better than 11.0% FWHM for Barium-133 at 81 keV.

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 Cs-137.

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 (IDENTIFY 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 - see Appendix I.

- -

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 <u>OPTIONS</u>

A<u>.</u>   <u>Internal Rechargeable Battery</u>
Type:	2 "D" cells, 1.25 V NiCd.
Operation time:	Typically 8 hours of operation at 25 ^{o}C, no backlight, 4 AH NiCd.
Charging:	External, constant current float charger, overnight charging, full charge indication by LED.

B.   <u>Internal Battery</u>
Type:	2 "D" cells, alkaline.
Battery Life:	Typically 15 hours of operation at 25 ^{o}C, no backlight, with Alkaline EVEREADY #1250.

C.   <u>External:</u>
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 RS232

- -

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 ^{o}C

Storage Temperature Range: - 20 to + 60 ^{o}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

Standard: - GR-135 Unit.
                       - 110VAC 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 - AUTOMATIC MODE OPERATION

GENERAL: this mode was developed for semi-technical users who only require a limited number of instrument functions and do not want to select relatively complex system functions and parameters.

The operating parameters are selected by a local technical person to suit the application and then the system is set into the **AUTOMATIC** operating mode. Operating functions are described below.

A.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 WEARING GLOVES – a definite advantage in many applications where protection clothing is required.

As the figure shows **LEFT, RIGHT, UP** (away from you) and **DOWN** (towards you) are the 4 normal actions of the joystick. For mechanical reasons the user can also press the button **IN** (into the handle) **BUT THIS HAS NO EFFECT AT ALL**.
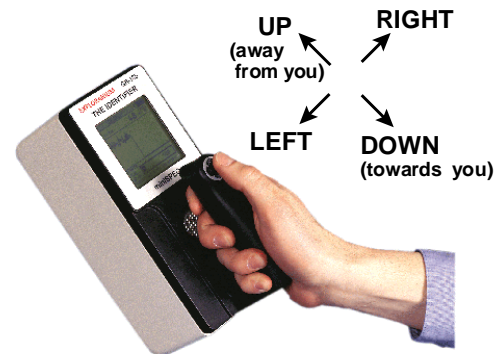
JOYSTICK ACTIONS

For ease of use the system is arranged so ANY ACTION EXCEPT UP – is considered an action and is referred to in this manual as **ENTER**. This means that **LEFT/RIGHT** and **DOWN** (towards you) any of these actions act as an **ENTER** command to the system. (Most users find that pressing the button **DOWN** is the easiest)

Once again - **IN** has **NO FUNCTION**

A.2   LOADING BATTERIES

To load batteries, remove the battery backdoor at the rear of the instrument by applying a ¼ turn to the door lock. 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 in an "S" fashion to be able to remove each battery separately (see fig).

Ensure that both batteries are firmly seated, attach the plastic battery retainer clip then re-attach the door.
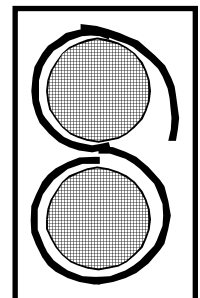
A.3   SETUP DOCKING STATION (DS)

Place the DS at 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 computer RS232 port (see **Appendix B** for computer software installation and description)

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 –

<div align="center">

ERROR (RED) – flashing

POWER (GREEN) – on

CHARGE (YELLOW) – off

</div>

A.4   PLACE UNIT IN DOCKING STATION

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 base of the DS.

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

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).

DS 115V AC wall plug

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

YELLOW light = charging

GREEN light = power ON

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

---
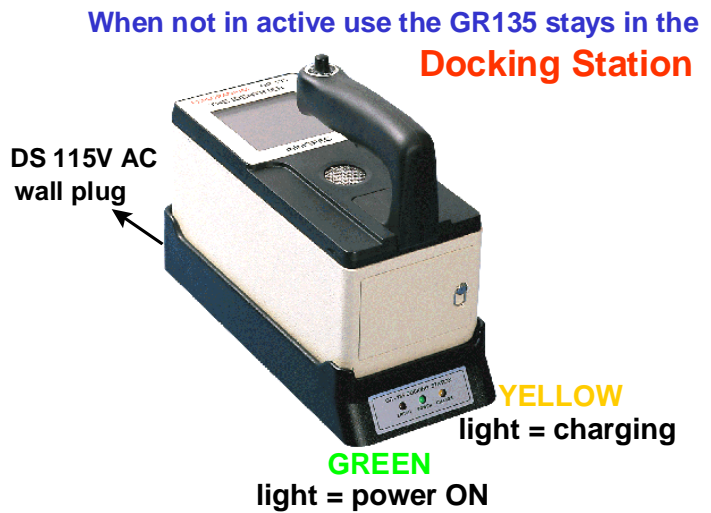
A.5   STARTUP DISPLAYS

The unit automatically switches on when it is placed in the DS and various displays are seen:

a)   **STARTUP** – this display appears for only a few seconds. Data shown are:

GR-135 – instrument name

VERSION 104 – the software version in the unit

SER# 2001 – the serial number of the unit

AUTOMATIC MODE ACTIVE – shows the unit is in the __AUTOMATIC__ mode of operation

<div style="border:1px solid black; text-align:center">

EXPLORANIUM
GR-135
The IDENTIFIER

VERSION 104
SER# 2001

AUTOMATIC MODE ACTIVE

</div>

b)   WARMING UP

After the Startup screen is seen a new display appears as shown.
As specified in 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 in the DS for approximately 1 hour before starting any system operations to give the batteries time to take a charge
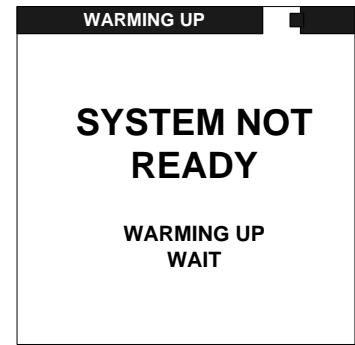
Note that this "warm-up" mode only occurs when the unit is first put in use or if the unit has been left out of the DS for an extended period of time (see section 10.2)

NOTE:

LEAVE THE UNIT IN THE DS WHEN NOT IN USE

---

c)   SYSTEM READY

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

SYSTEM READY – means that internal parameters are set correctly
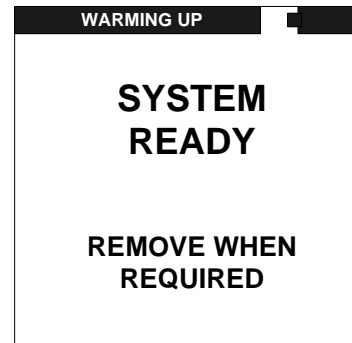
> **REMOVE WHEN REQUIRED** – means the unit is ready for use. As commented above if this is a first time use, it is good practice to leave the unit in the DS for 1 hour to get some level of battery charge.

When the unit is removed from the DS, system operation is automatically started in the SEARCH mode.

d)   POWERING ON WHEN <u>NOT</u> in DS – normally the GR135 needs to be in the DS when not in use. System parameters normally require being in the DS at least once every 24 hours.   If this time is exceeded a special message is seen (see figure).

As noted on the display, users should place the unit **IN** the DS and then the system will automatically adjust itself (minimum period ion the DS = 2 minutes but longer is recommended for battery charging).
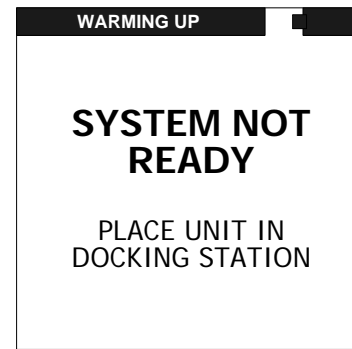
A.6   SYSTEM USE

The GR-135 in the **AUTOMATIC** mode only operates in 2 modes – **SEARCH** and **IDENTIFY**

The **SEARCH** mode is used to search and locate radioactive material in vehicles, packages or on people etc. The user can easily scan the suspect item 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 it's maximum point and then the user selects the **IDENTIFY** mode.

As described in detail below, the **IDENTIFY** mode takes a sample (usually for 60 seconds) then automatically analyses it and advises the user of the details of any radioactive material found.

A.7   SEARCH MODE

This special mode is used for searching for radioactive material. When the unit is removed from the DS this mode **is automatically selected** and the display shows the **SEARCH** display (see fig).

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

1234 – this is 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 are 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 120 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.
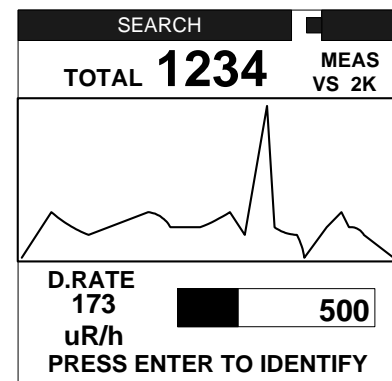
D.RATE – the bar display and the numeric data show the Dose Rate data. The numeric data shown above (1234cps in the figure) is an essential tool to locate radioactive material but the **DOSE** data gives the user an idea of the potential hazard level of such material.

173uR/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 it's changing units gets confusing which is why the bar graph and the numeric data are both shown

500 - this 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 uR/h then the 500 = 500uR/h. At this setting, if the DOSE RATE exceeds 500uR/h then the warning alarm will occur (see A.10 below)

- this 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 this bar graph. Once the is limit is exceeded the user is warned – see the HIGH DOSE section A.10 below

PRESS ENTER TO IDENTIFY - pressing the JOYSTICK is referred to as **ENTER**, so the user is advised that pressing **ENTER** will change the operating mode to the IDENTIFY 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.

A.8   IDENTIFY MODE

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

IDENTIFY – shows the mode of operation (IDENTIFY)

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 **if possible** the user should move the unit **closer** 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**.
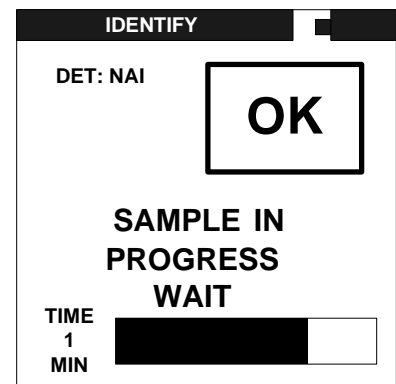
TIME	this shows the selected sample time, in this case 1 minute. Thus the progress bar
1	shows the progress of the 1-minute count time
MIN	

■■□   the progress box shows the time progress to the end of the sample period (1 minute in the example)

A.9   RESULTS

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

```
┌─────────────────────────────┐
│   NUCLIDE IDENT     ■ ■      │
├─────────────────────────────┤
│  TYPE      ISOTOPE          │
│  I ND   Cesium-137          │
│                             │
│                             │
│   SPECTRUM STORED AS #6     │
│    UP TO REPEAT SAMPLE      │
│   PRESS ENTER TO SEARCH     │
└─────────────────────────────┘
```

TYPE – shows the category of the isotope identified.
           Labels used are :
-          **IND** – Industrial isotope
-          **MED** – Medical isotope
-          **SNM** – Special Nuclear Material

ISOTOPE – is the actual name of the isotope

SPECTRUM STORED AS #6 - every time an IDENTIFY analysis takes place the radiation data (spectrum) from this analysis is stored in 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 #6. This number can be anywhere from 1 to 999 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 **NO NUCLIDES FOUND**. 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

UNKNOWN ISOTOPE

The GR-135 has a wide selection of radioactive isotopes in its internal library. However it is possible that a very rare isotope can be encountered. In this case the system cannot identify the isotope so the message **UNKNOWN ISOTOPE** is displayed. If this message is seen we recommend that you retrieve this stored spectrum and send it to hovgaardJ@SAIC.com at Exploranium for further analysis.
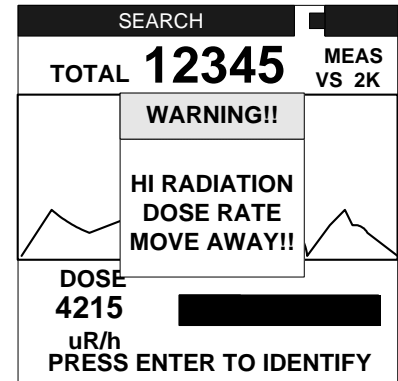
OTHER FEATURES:

A.10 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 fig)

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


```
        SEARCH        ▪ ▪
TOTAL 12345      MEAS
                 VS 2K
      ┌─ WARNING!! ─┐
      │             │
      │ HI RADIATION│
      │  DOSE RATE  │
      │ MOVE AWAY!! │
  DOSE│             │
  4215 ───────────────
   uR/h
  PRESS ENTER TO IDENTIFY
```

A.11 NEUTRON ALARM

If the integrated Neutron detector computes an alarm above it's preset alarm threshold then a Neutron Alarm is declared. A distinctive audio warning tone occurs and the display changes (see fig).


```
        SEARCH        ▪ ▪
TOTAL 12345      MEAS
                 VS 2K
      ┌─ WARNING ─┐
      │           │
      │ NEUTRONS  │
      │ DETECTED  │
  DOSE│           │
  173  ───────────────
   uR/h
  PRESS ENTER TO IDENTIFY
```
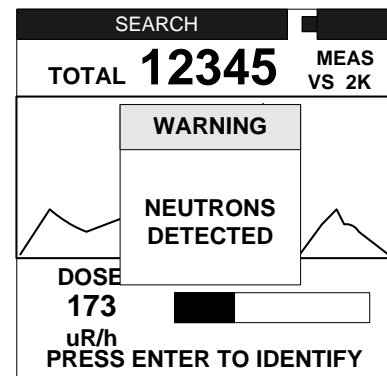
A.12 NEUTRONS DETECTED DURING IDENTIFY

If any Neutron activity is detected during IDENTIFY this data is shown on the display – see Fig.

Since the IDENTIFY period is for typically 55 seconds as opposed to the SEARCH analysis which is only for a few seconds, a weak Neutron source may be detected in the IDENTIFY mode of analysis where it may be missed in the SEARCH mode.

The display shows the Neutron activity in DOSE units to give an idea of the relative intensity of the Neutron activity. However many users set the system for counts/second (**cps**)


```
      NUCLIDE IDENT    ▪ ▪

 TYPE     ISOTOPE
  I ND    Cesium-137
 NEUTRONS      0.452uSv/h




      ENTER TO CONTINUE
```
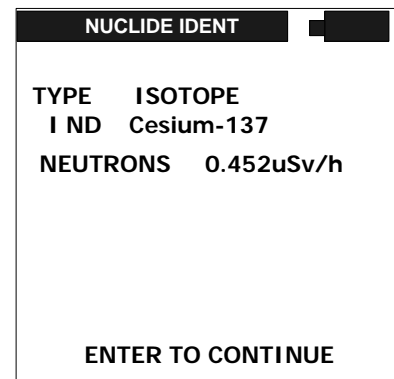
A.13 AUTOMATIC CZT DETECTOR ACTIVATION

The system has a special high sensitivity detector located inside. Special analysis determines the special case where using such a detector will improve system analysis. If this occurs the actual operation will be as follows:

- Unit takes the normal 55 second analysis and computes the results
- Normally the Nuclide ID results are displayed
- However if the analysis determines that CZT is required the unit will:
    - beep 3 times as a warning
    - automatically change detectors
    - the display will show **DET=CZT** and a pop-up menu (see fig) will appear to **warn** the user that CZT data analysis will now take place.

MESSAGE
CZT DETECTOR ACTIVATED ENTER TO START CZT

NOTE
CZT ANALYSIS IS REQUIRED UNDER SPECIAL CONDITIONS WHERE IT IS <u>POSSIBLE</u> THAT SNM MATERIAL IS PRESENT. THE CZT DETECTOR IS A RELATIVELY HIGH RESOLUTION DETECTOR AND THUS USING ITS DATA CAN ENHANCE DATA ANALYSIS. HOWEVER IT IS VERY INSENSITIVE SO A LONG COUNT TIME IS REQUIRED SO THE SYSTEM IS USUALLY SET FOR A 5 MINUTE CZT COUNT TIME. <u>5 MINUTES IS A LONG TIME TO HOLD THE INSTRUMENT</u> AGAINST SOMETHING SO MOST USERS PREFER TO PROP THE UNIT IN PLACE DURING THIS LONG ANALYSIS PERIOD. ALSO THE CZT DETECTOR IS LOCATED AT THE BOTTOM OF THE INSTRUMENT SO THE INSTRUMENT SHOULD BE POSITIONED ACCORDINGLY

- position the detector as required (see figure)
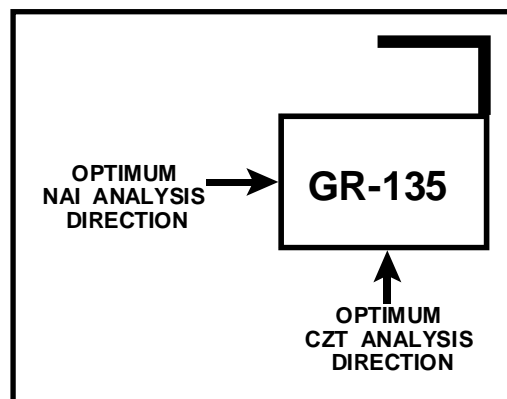
- press **ENTER** to start the automatic CZT analysis
- at the end of the CZT count period, the CZT spectra is stored and this spectrum # is shown on the display as usual. Note that the original NaI spectrum was also stored so at the end of the CZT spectrum period, the displayed stored spectrum # is for the CZT and the one before is the NaI spectra. Thus if after CZT analysis the spectra is stored as SPECTRUM #9 then SPECTRUM #8 is the related NaI spectrum
- after data storage the spectra from the NaI and CZT are automatically analyzed and the combined result shown to the user on the display

A.14   POWER OFF - MANUAL

To power the unit OFF, IT MUST BE REMOVED FROM THE DS UNIT. Then CLICK **UP** (away from the user) and hold for 4 seconds. The display will show a special display (see Fig.) 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.

TURNING OFF

3 (2,1..)

A.15   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 A13.

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%.

A.16   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.
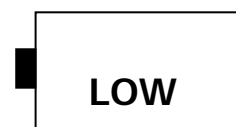
Full Charge   ½ Charge   **LOW**
                                                            Low Battery Warning

Battery Icons

A17.   PROBLEMS

NOTE

LIKE ANY COMPUTER BASED SYSTEM IT IS POSSIBLE THAT A SPECIAL COMBINATION OF EVENTS CAUSES THE SYSTEM TO "HANG-UP". IF THIS OCCURS – POWER THE UNIT OFF AS DESCRIBED IN THIS SECTION AND THIS WILL OVERRIDE ANY INTERNAL PROBLEMS AND SHUT THE SYSTEM DOWN. THEN POWER ON AS USUAL AND ALL SHOULD BE OK.

APPENDIX B - IDENTIVIEW SOFTWARE

1.   GENERAL

IdentiView is a specially designed software program supplied by Exploranium that is used to download data from the GR135 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 REMOTE data access mode.

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 GR135 is hard-wired to operate at 19200 Baud to suit most computers.

3.   USING THE SOFTWARE IN AUTOMATIC MODE

3.1   SETTING UP THE SYSTEM

Set up the system as follows:

1. Connect the DS to the PC com port via the supplied 9 pin cable.
2. Apply power to the DS with the power cord. The green light should be on.
3. Click the GR135 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.
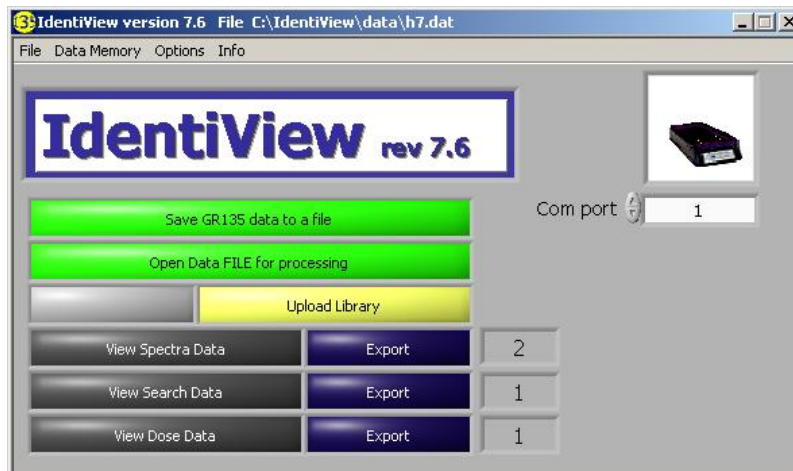
Fig. B1

The icon in the top right-hand corner of the display indicates when the GR135 **IS NOT** in the DS, or if it is not communicating with the PC. If the unit **IS** in the DS then this graphic is replaced with an icon depicting the unit in the DS as shown below:
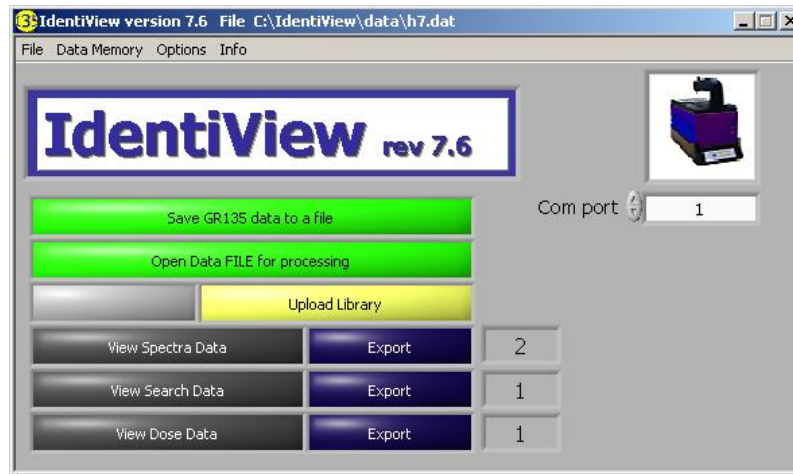
Fig. B2

If the correct icon as in Fig. B2 is **NOT** seen, check:
- that the GR135 is correctly placed in the DS
- the DS is cabled to the correct COM port (to check this change the COM port settings on the IdentiView screen)
- that the DS and the GR135 are both powered on.

If the icon is still not visible, remove the GR135 from the DS and power off. Exit the software (File/Exit), restart the software, then place the GR135 in the DS. If the icon is still incorrect, contact Exploranium.

3.2   DOWNLOADING DATA

- As soon as the IdentiView software recognizes that the GR135 is in the Docking Station it automatically starts to download the data and the following display appears:
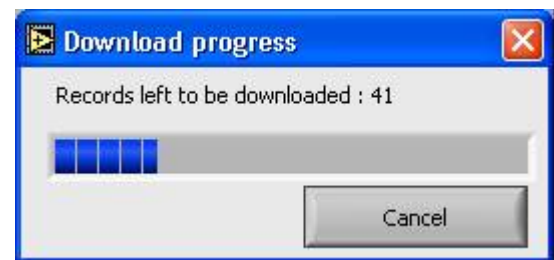
- The program is downloading the data at approx 1 spectra/second.
- At the end of data transfer the following screen on the right appears.
- Enter an appropriate location and filename and click "Save".
- The default file location is C:\Indentiview\Data.
- Enter an appropriate location and filename and click "Save".
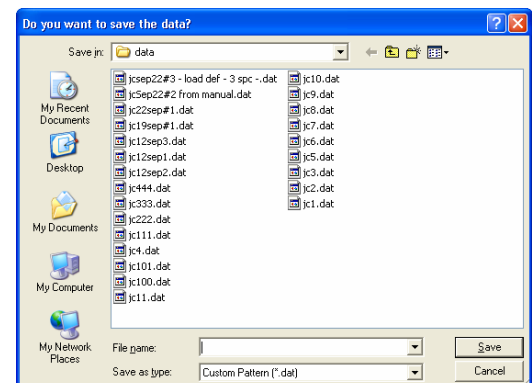
- Once the data is saved a new message appears. This permits the user to erase all the spectra in the data memory of the GR135. This is usually a good idea as once the data is transferred then it is not really necessary to keep it in the 135. In addition if the memory is not cleared then next time data 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!).
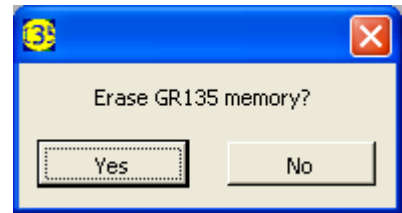
- If YES is selected a second message appears to ensure that this is the preferred action
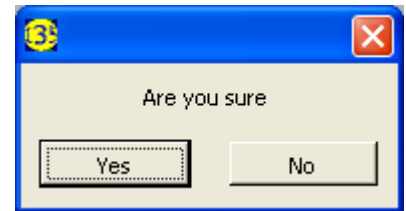
- Click "**NO"** to NOT erase the memory

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

- Inspect the data
- 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 GR135 anytime by selecting Download from the Data Memory menu on the main IdentiView screen. If the GR135 is removed from the DS, you can still save the data (since it was downloaded to a .temp file) by clicking the "Save GR135 data to file" button on the main IdentiView screen. Once the data is saved you can erase all the spectra in the data memory of the GR135 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

The installed LabView software comes with a standard isotope library. You can load this library or other isotope libraries into your 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.
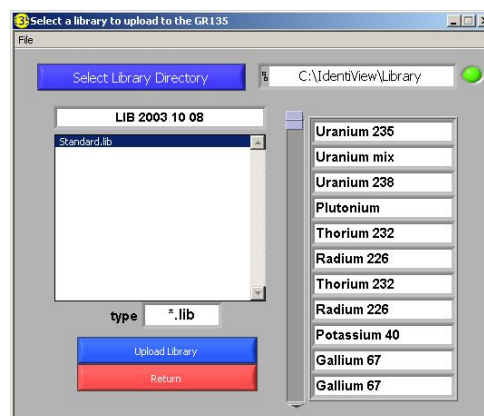
5. Click the Upload Library button to have IdentiView accept and apply the library information.

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

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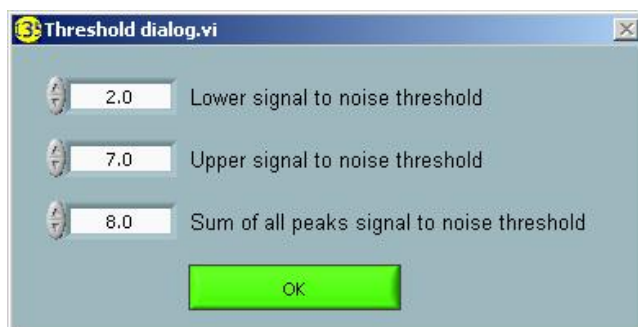
Set values for the following thresholds using the up or down arrows:

- 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

3.4   VIEWING SPECTRA DATA

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

Identifies the GR-135 unit, firmware version, sample time, and date and time of the spectrum. Each specific has its own date/time stamp.

Select spectrum # using up/down arrows. This box goes RED when the last spectrum is reached.

Optional user text box where custom comments can be entered (for printing purposes only)

Current library in use.

Graph pallete with cursor and search functions.

Active indication (double click to force All peaks)

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 and CZT data

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.

CZT data is shown in the same manner. In the event that CZT spectra have been collected the software recognizes this and changes the labels at the middle-right to define which detector the spectrum represents.

As explained earlier in the manual, if the system triggers an automatic analysis using the CZT detector, then the previous recorded spectrum is the NaI spectrum. If, for example, there are 4 spectra in memory then a new NaI spectrum would be #5. However, if the CZT is triggered then the final display will show "Recorded as spectrum #6". This means that the CZT spectrum is #6 and therefore its corresponding NaI spectrum is #5.

On the graphic display shown it is very easy to see the differences in these data as the NaI spectra is very large in amplitude compared to the CZT spectra.
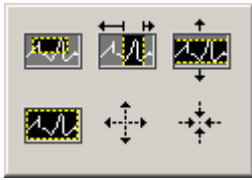
Focusing on portions of the spectra

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

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 Pallette, right-click anywhere on the graph, select Visible Items, and select Graph Pallette from the sub menu. The toolbar appears.

3. Click the Search icon. The Graph Pallette 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 options 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

You can examine on certain portions of the spectra in more detail by using the Cursor Legend:
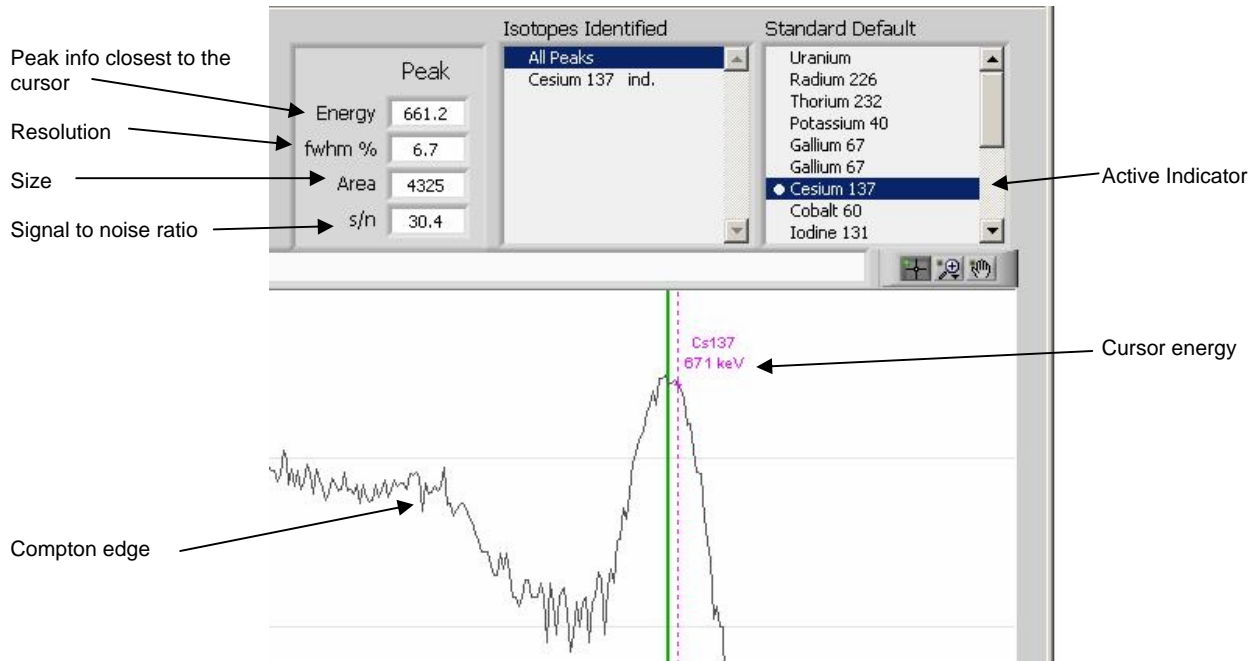
1. Turn off Auto-scaling by clicking the Scale menu and deselecting X Auto Scale and Y Auto Scale.
2. If you don't see the Cursor Legend, right-click anywhere on the graph, select Visible Items, and select Cursor Legend from the sub menu. The Cursor Legend appears.
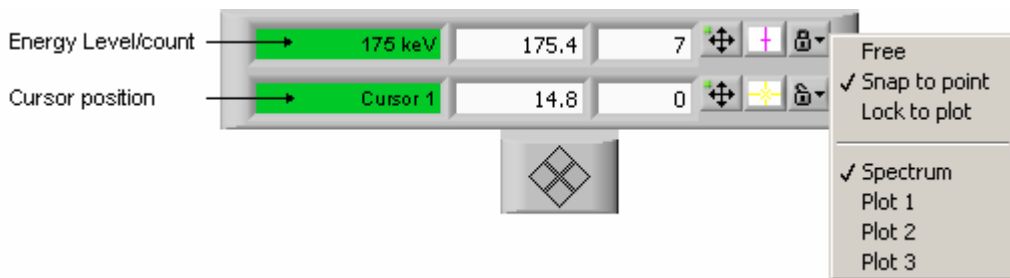
3. Click the icon, then select Snap to point.

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.

Peak info closest to the cursor

Resolution

Size

Signal to noise ratio

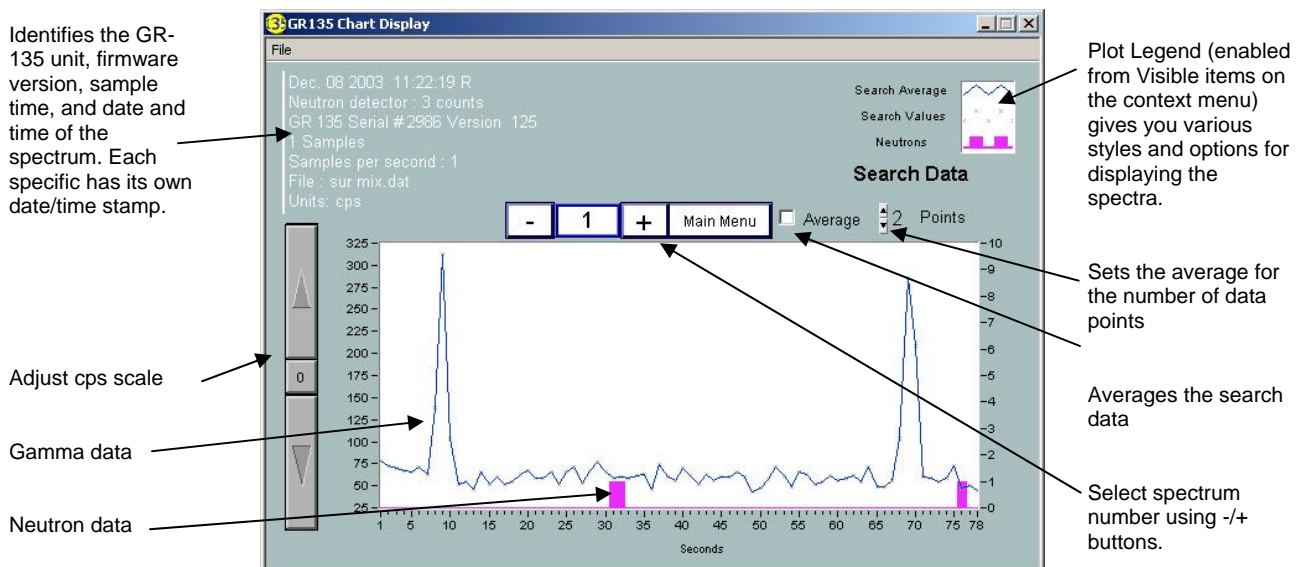Active Indicator

Cursor energy

Compton edge

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.

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.

Identifies the GR-135 unit, firmware version, sample time, and date and time of the spectrum. Each specific has its own date/time stamp.

Plot Legend (enabled from Visible items on the context menu) gives you various styles and options for displaying the spectra.

Sets the average for the number of data points

Averages the search data

Adjust cps scale

Gamma data

Neutron data

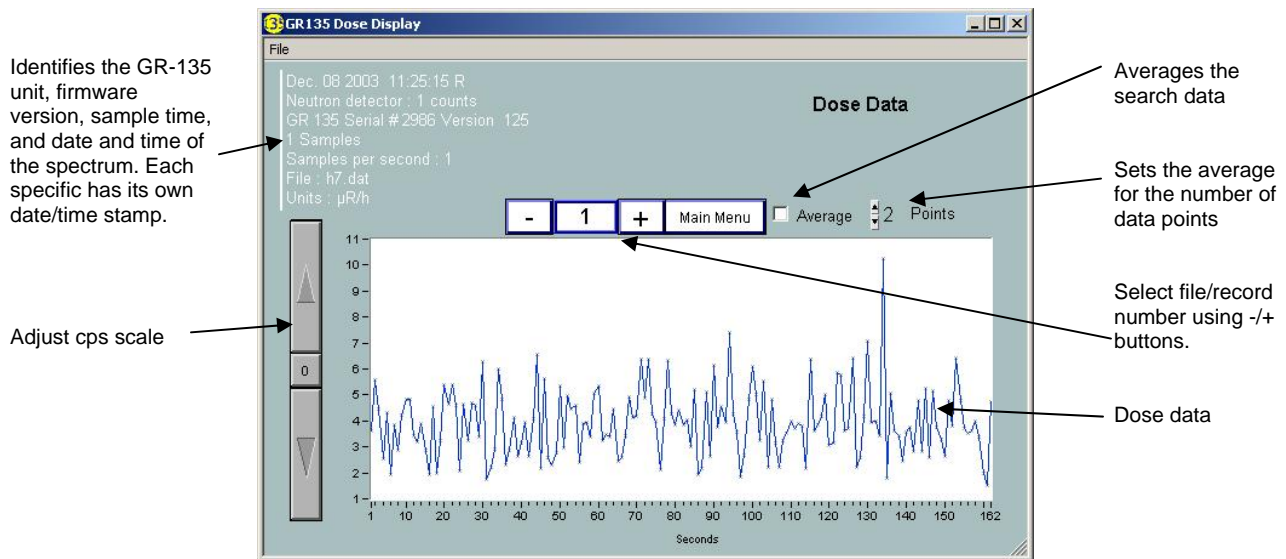Select spectrum number using -/+ buttons.

You can use the Average and Points controls ☑ Average ⬆2 Points to reduce statistical noise in order to see a more accurate view of counts and neutron data.

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

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.

Identifies the GR-135 unit, firmware version, sample time, and date and time of the spectrum. Each specific has its own date/time stamp.

Adjust cps scale

Averages the search data

Sets the average for the number of data points

Select file/record number using -/+ buttons.

Dose data

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

You can use the Average and Points controls ☑ Average ⬆2 Points 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.
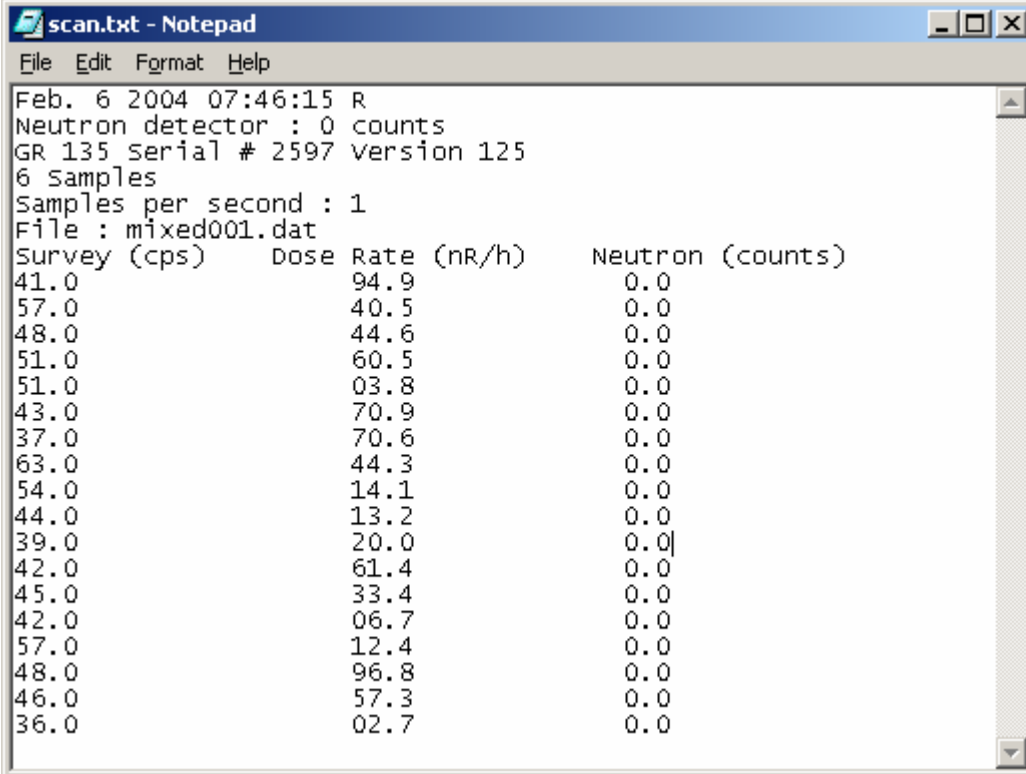
3.7   EXPORTING DATA

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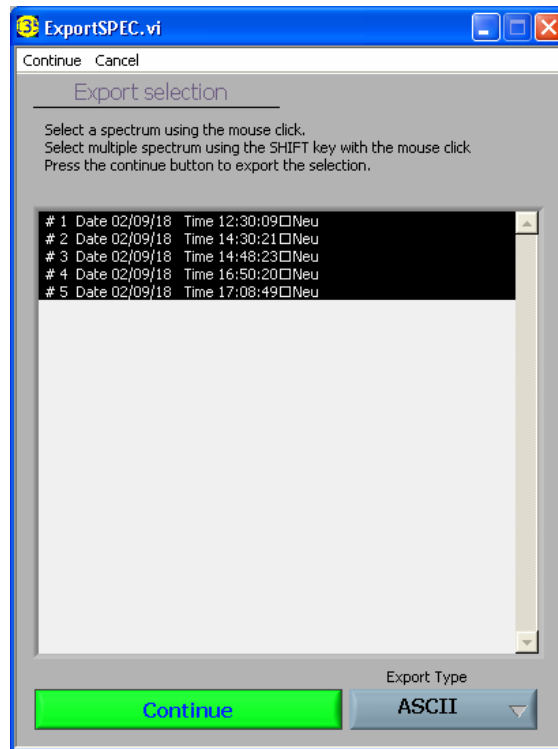
- As the display above shows, the mouse is used to select a single spectrum or SHIFT-click to select multiple spectra. Note that the date and time of when the spectra was stored is also displayed, which helps in data selection.

- 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).

```
scan.txt - Notepad                                                    _ □ ×
 File  Edit  Format  Help
Feb. 6 2004 07:46:15 R                                                    ▲
Neutron detector : 0 counts
GR 135 Serial # 2597 Version 125
6 Samples
Samples per second : 1
File : mixed001.dat
Survey (cps)     Dose Rate (nR/h)      Neutron (counts)
41.0              94.9                   0.0
57.0              40.5                   0.0
48.0              44.6                   0.0
51.0              60.5                   0.0
51.0              03.8                   0.0
43.0              70.9                   0.0
37.0              70.6                   0.0
63.0              44.3                   0.0
54.0              14.1                   0.0
44.0              13.2                   0.0
39.0              20.0                   0.0
42.0              61.4                   0.0
45.0              33.4                   0.0
42.0              06.7                   0.0
57.0              12.4                   0.0
48.0              96.8                   0.0
46.0              57.3                   0.0
36.0              02.7                   0.0
                                                                          ▼
```

APPENDIX C - OPERATION <u>WITHOUT</u> THE DOCKING-STATION

1.   DESCRIPTION
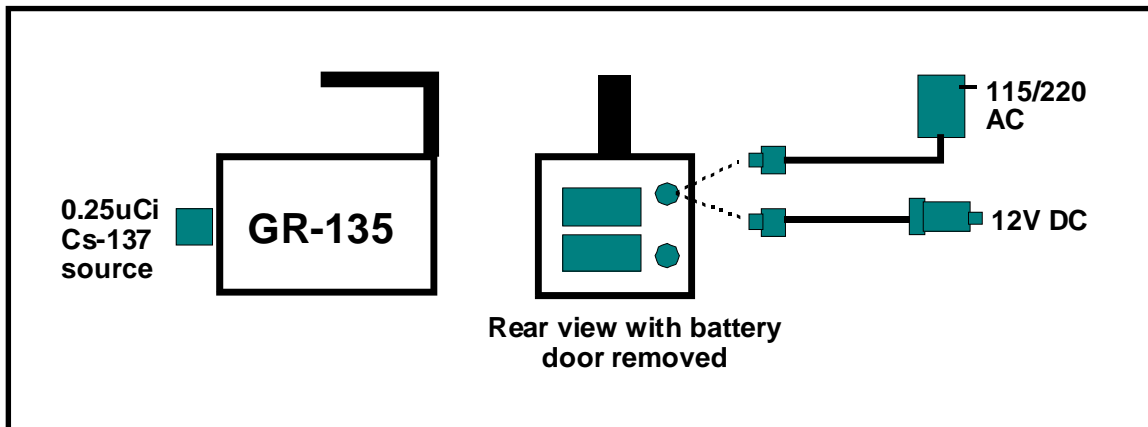
The figure shows the necessary hardware requirements for non-DS operation. Normally the GR-135 is supplied with a DOCKING-STATION (DS) but additional accessories are available. For non-DS use, the user needs a **TEST SOURCE** and a **POWER CABLE**, these optional items are:

a)   TEST SOURCE
            - PN 87046-1 – 0.25uCi Cs-137 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

2.   STABILIZATION
Stabilizing the GR135 outside the DS depends on the MODE of operation.

a)   MANUAL MODE
From the **MAIN MENU** select **STABILIZE** then proceed as described in **Section 7.3** except in this case the source is held against the face of the unit rather than sitting the unit in the DS.

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
-          plug in one of the sources of external power shown above in the figure
-          as long as external power is supplied the unit will continue to automatically stabilize as described in Appendix A

NOTE – if the Test Source is removed an error message will appear on the display

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 12V DC input can be supplied from an external AC: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.

NOTE
APPLYING EXTERNAL POWER TO THE GR135 OPERATES THE UNIT BUT ALSO CHARGES THE BATTERIES. THE BATTERY CHARGERS PROVIDED WITH THE GR-135 IS FOR USE WITH NICD "D" CELL BATTERIES ONLY. OPERATING THE CHARGER WHILE <u>ALKALINE</u> BATTERIES ARE IN THE UNIT MAY CAUSE BATTERY LEAKAGE AND MAY SERIOUSLY DAMAGE THE GR-135. EXPLORANIUM IS NOT RESPONSIBLE FOR ANY DAMAGE CAUSED BY IMPROPER BATTERY CHARGER OPERATION.

APPENDIX D - NUCLIDE LIBRARIES

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

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

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 B).
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 :

Library names
S=Standard, M=Medical, I=Industrial, W=Waste, U=User

Labels in columns
I=labeled as Industrial. M=Medical, S=SNM, N=NORM

Name	Label	S	M	I	W	U
	Americium-241	I		I	I	
Ba-133	Barium-133	I				
Bi-207	Bismuth-207					
Cf-252	Californium-252					
Cd-109	Cadmium-109					
Ce-139	Cerium-139					
Co-57	Cobalt-57	I	M	I	M	
Co-58	Cobalt-58					
Co-60	Cobalt-60	I		I	I	
Cr-51	Chromium-51		M			
Cs-137	Cesium-137	I	I	I	I	
DEP-U	Depleted-U					
Eu-152	Europium-152					
Eu-154	Europium-154					
F-18	Fluorine-18					
Fe-59	Iron-59					
Ga-67	Gallium-67	M	M		M	
I-123	Iodine-123		M		M	
I-125	Iodine-125					
I-129	Iodine-129					
I-131	Iodine-131	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	
Kr-85	Krypton-85					
Mn-54	Manganese-54					
Mo-99	Moly-99					
Na-22	Sodium-22					
Na-24	Sodium-24					
Np-237	Neptunium-237	S				
Pd-103	Palladium-103		M		M	
Pu-239	Plutonium-239	S				
Ra-226	Radium-226	N		N	N	
Se-75	Selinium-75					
Sm-153	Samarium-153					
Sn-113	Tin-113		M		M	
Sr-85	Strontium-85		M		M	
Tc-99m	Technet-99m	M	M		M	
Th-232	Thorium-232	N	N		N	
Tl-201	Thallium-201	M	M		M	
U-233	Uranium-233	S				
U-235	Uranium-235	S				
U238/5	Uranium-235/8	N			N	
Xe-133	Xenon-133	M				
Y-88	Yttrium-88					
Y-90m	Yttrium-90m					

APPENDIX F - DOCKING STATION DETAILS

1.   GENERAL
The Docking Station (DS) is specially designed for ease-of-use. The DS features are :
- 4 spring-loaded electrical contacts for connection to the base of the GR135
- Integrated 0.25uCi 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

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 G – RECOMMENDED PARAMETERS

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**	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	**CZT FINE GAIN**	**read**	Set as required 0-1024 (Gain steps)
	STAB VALID	**24H**	OFF, 12H, 24H
IDENTIFY			
DETECTOR	DETECTOR	**AUTO**	NaI, CZT, AUTO
	PILEUP	**ON**	ON, OFF
	PEAK LIMIT	**30**	20, 25, 30, 35, 40, 45, 50 (SD units)
	AUTO NI LIM.	**25**	10, 15, 20, 25, 30, 35, 40, 45, 50 (%)
NaI	MEAS TIME	**55**	10-50, 55, 60-100, 200-600, 1200, 1800, 3600, 5400secs
	MEAS MODE	**CLOCK**	LIVE, CLOCK, REP.
	ADC	**1024**	1024
	AUDIO	**ON**	ON, OFF
	GAIN CORR	**ON**	ON, OFF
CZT	MEAS TIME	**300**	10-100, 200-600, 1200, 1800, 3600, 5400secs
	MEAS MODE	**CLOCK**	LIVE, CLOCK
	ADC	**1024**	1024
	AUDIO	**ON**	ON, OFF
	CZT OFFSET	**read**	-10 ..... +10
NEUTRON	**N SUMMING**	**3P**	OFF, 3P, 5P, 10P
	ALARM LEVEL	**3**	OFF, 1,2,3, 4, 5, 6, 7, 8, 9, 10, 20, 50, 100
	SAMPLE TIME	**1**	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 50, 100
	N IDENT THR.	**5**	OFF, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 50, 100
	N UNITS	**cps**	cps, uSv/h
DOSE	MEAS UNIT	**R**	R, SV, GY
	SAMPLE TIME	**1**	1-10, 20-60secs
	AVERAGING	**3P**	OFF, 3P, 5P, 10P
	CORRECTION	**100**	85, 90, 95.....120%
	ALARM LEVEL	**2000u**	OFF, 10, 20, 50, 100, 200, 500, 1000, 2000, 4000, 5000, 9000 (LINKED TO Units)
ROIs	ROI#1	**15-30**	1–1024 to 1-1024 (Am241)
	ROI#2	**210-230**	1–1024 to 1-1024 (Cs137)
	ROI#3	**320-470**	1–1024 to 1-1024 (Co60)
MISC	**LANGUAGE**	**ENG**	ENG, DEU, FRA, SPA, NEW
	BATTERY	**NICD**	NICD, ALK
	BACK LIGHT	**OFF**	OFF, ON, 5S, 10, 30S, 60S
	ACTIVE LIBR.	**STAND**	STAND, MEDIC, INDUST, WASTE, USER

APPENDIX H – WIPE TEST (OPTIONAL)

If requested by the user, before the GR135 is shipped, a special capability is enabled that permits a **WIPE TEST** function. This function permits the GR135 to provide an semi-automatic measure of removable contamination. This function only operates in the **AUTO** mode.

In **SETUP/IDENTIFY/DETECTOR** a new parameter **WIPE TH** may be set – the parameter is set **1-10** in SD units with a default of **3**.

IDENTIFY	◼
DETECTOR	AUTO
PILEUP	ON
PEAK LIMIT	30
NON ID THR	25
WIPE TH	3

Function is as follows:

1. If the portal system alarms then the GR135 is used to find the location of the maximum radiation on the side of the vehicle

2. The user normally then carries out IDENTIFY to determine the isotopic content of the radiation as described earlier in the manual

3. Once located and identified, then the vehicle must be tested for REMOVABLE CONTAMINATION. The user takes a standard WIPE TEST sample cloth and carefully wipes a 10cm^2 area around the area of the vehicle side where the maximum radiation has been detected. This sample material is then placed in a plastic bag.

4. Press ENTER until the display shows the SEARCH mode. The bottom of the display shows "**UP=WIPE ENTER=IDENTIFY**"

5. Click **UP** (for WIPE). The display shows the message "**BACKGROUND NEEDED – MOVE AWAY FROM VEHICLE THEN PRESS ENTER**"

6. Move the GR135 at least 10ft away from any vehicle <u>in the SEARCH mode</u>, keep the test sample bag at least 3 ft away from the GR135 and check that the local Dose Rate where the test will be carried out is below **10uR/h** –- then press **ENTER**. Higher background will negatively affect sensitivity of the measurement.

    a. If the local Background is above 20uR/h the display will show the message "**DOSE RATE TOO HIGH – MOVE TO LOWER BACKGROUND**". The user must find an area where the background is lower, or use a shielded compartment to facilitate the measurement.

7. The display will start the **IDENTIFY** screen for the preset sample period to get a background sample

8. The display then shows "**PLACE WIPE SAMPLE AT DETECTOR FACE THEN PRESS ENTER**"

9. Place the plastic bag contain the sample as indicated and press **ENTER**

10. The display will start the **IDENTIFY** screen for the preset sample period

11. At the end of this time period the system computes the Contamination Level and compares it to a preset threshold.

12. If **NO CONTAMINATION** is detected - at the end of sample the display will show "**WIPE TEST CONTAMINATION IS BELOW ALARM LEVEL**"

13.   User can now press ENTER and return to the normal SEARCH mode

14.   If **CONTAMINATION** is detected - at the end of sample the display will show "**WIPE TEST CONTAMINATION ABOVE ALARM LEVEL – LEVEL = 55**".

   In this case removable contamination has been detected so the GR135 must be thoroughly cleaned to remove any potential contamination before further use.
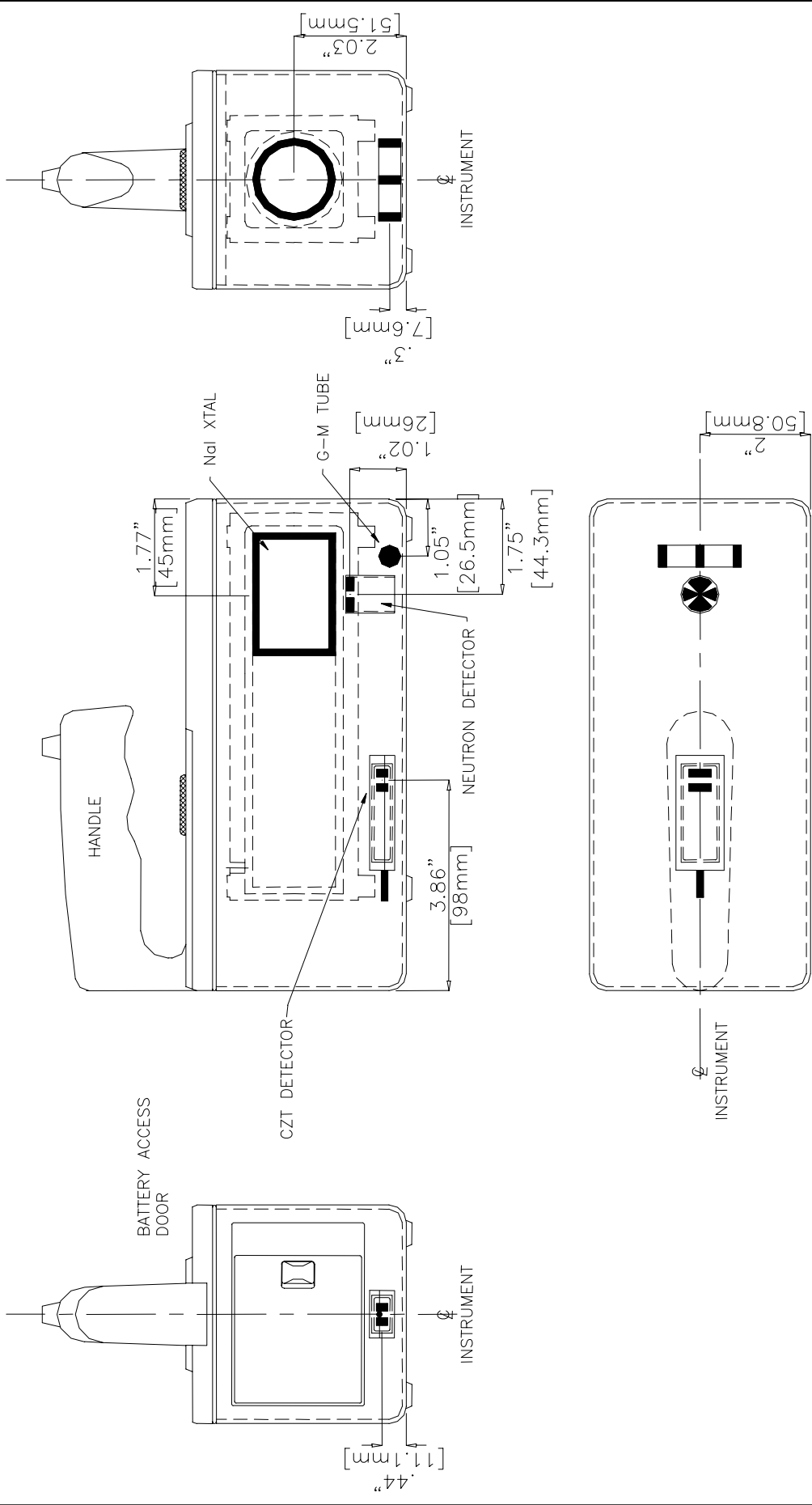
15.   **HIGH DOSE RATE**
   The above process works correctly as long as the local Radiation background Dose Rate is below 20uR/h. To prevent this being an issue the system will give a special warning as follows:

   The process is:
   1.   Press ENTER until the display shows the SEARCH mode. The bottom of the display shows "**UP=WIPE ENTER=IDENTIFY**"

   2.   Click **UP** (for WIPE). The display shows the message "**BACKGROUND NEEDED – MOVE AWAY FROM VEHICLE THEN PRESS ENTER**"

   3.   Move the GR135 at least 10ft away from any vehicle then press **ENTER**

   4.   At this time if the local Background is above 20uR/h the display will show the message "**DOSE RATE TOO HIGH – MOVE TO LOWER BACKGROUND**". The user must move to an area where the background is lower.

   5.   Recommended method is to press ENTER a few times to move back to the SEARCH mode and move until the GR135 shows that the Dose Rate is below 10uR/h – then start the test again with **UP** from the SEARCH menu

APPENDIX J – SENSOR LOCATIONS

NOTES:
1) DIMENSIONS INDICATE GEOMETRIC CENTRE OF SENSING DEVICES.

APPENDIX X – WARRANTY

EXPLORANIUM
RADIATION DETECTION SYSTEMS

EXPLORANIUM WARRANTY

Exploranium warrants the GR-135 Identifier 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. To make a warranty claim, the product must be returned, freight prepaid, to SAIC Exploranium's factory in Mississauga, Canada. Exploranium will repair or replace the product, at its discretion, and return the product, freight prepaid.

Ship to: SAIC EXPLORANIUM
6108 Edwards Blvd.
Mississauga, Ontario L5T 2V7 Canada

Attn: Service Department

Phone: 905 670 7071

Fax: 905 670 7072

APPENDIX Y – MANUAL CHANGES

Updated for Identiview software version 7.6 – Feb 2004

APPENDIX Z - DOCKING-STATION TEST SOURCE SPECS

49 CFR Ch.1 (10-1-01 Edition)
(extraction)

§173.422   Additional requirements for excepted packages containing Class 7 (radioactive) materials.

(a) Except for materials subject to the shipping paper requirements of subpart C of part 172 of this subchapter, excepted packages prepared for shipment under the provisions of §173.421, §173.424, §173.426, or §173.428 must be certified as being acceptable for transportation by having a notice enclosed in or on the package, included with the packing list, or otherwise forwarded with the package. This notice must include the name of the consignor or consignee and one of the following statements, as appropriate:

§173.424   Excepted packages for radioactive instruments and articles.

  A radioactive instrument or article and its packaging is excepted from the specification packaging, shipping paper and certification, marking and labeling requirements of this subchapter and requirements of this subpart, if:
  (a) Each package meets the general design requirements of §173.410;
  (b) The activity of the instrument or article does not exceed the relevant limit listed in table 7 in §173.425;
  (c) The total activity per package does not exceed the relevant limit listed in table 7 in §173.425;
  (d) The radiation level at 10 cm (4 in) from any point on the external surface of any unpackaged instrument or article does not exceed 0.1 mSv/hour (10mrem/hour);
  (e) The radiation level at any point on the external surface of a package bearing the article or instrument does not exceed 0.005 mSv./hour (0.5 mrem/hour), or, for exclusive use domestic shipments, 0.02 mSv (2 mrem/hour);
  (f) The nonfixed (removable) radioactive surface contamination on the external surface of the package does not exceed the limits specified in §173.443(a);
  (g) Except as provided in §173.426, the package does not contain more than 15 grams of uranium-235; and
  (h) The package is otherwise prepared for shipment as specified in §173.422.

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.