RC2^{PLUS} User Manual

HANDHELD PORTABLE

RADCOMM SYSTEMS CORP.

150-85-002 REVISION 8.0 – NOV. 28, 2019

Revision History			
Revision	**Date**	**ECO**	**Description**
Rev 1	Apr 12-13	-	Initial Release
Rev 2	May 8-13	703	Minor changes – Maggie Gao
Rev 3	Aug 14-13	739	Added Docking station info
Rev 4	Feb 19-14	777	Added Memory Storage, changed ROI to SD
Rev 5	May 28-14	799	Added Configuration screen mods
Rev 6	July 6-16	866,1004	Change the configuration page for Basic Mode
Rev 7	June 29-17	1079	Change High Dose Rate switching point Change Alarm Threshold algorithm for Basic Mode
Rev 8	Nov 28-19	1236	Remove nSv/h and nR/h unit for dose rate/exposure rate display

Product Manual - Disclaimers:

Due to our efforts to continuously improve this product; specifications, dimensions, operating features and procedures described in this manual are subject to frequent changes. The printed version of this manual reflects only the configuration current at the time of printing. The most current version of the manual is provided in electronic format on the Product Support CD supplied with the instrument. Please refer to the electronic version of the manual for the most accurate interpretation. Contact RadComm Radiation Detection Systems at www.radcommsystems.com

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RADCOMM
RADIATION DETECTION SYSTEMS

Manufactured by RadComm, 2931 Portland Dr, Oakville, Ontario, Canada, L6H 5S4

Contents

INTRODUCTION

The RC2PLUS portable radiation detector utilizes advanced spectral techniques to enhance sensitivity for reliable detection of isotopes with extremely low Dose Rates.

The RC2PLUS is available in two versions; the Total Count Basic version and the Advanced ROI Analyses version. The Basic version tracks the total count rate produced by all of the measured gamma energies during the scanning period and automatically sets an alarm threshold over the total background count rate average.

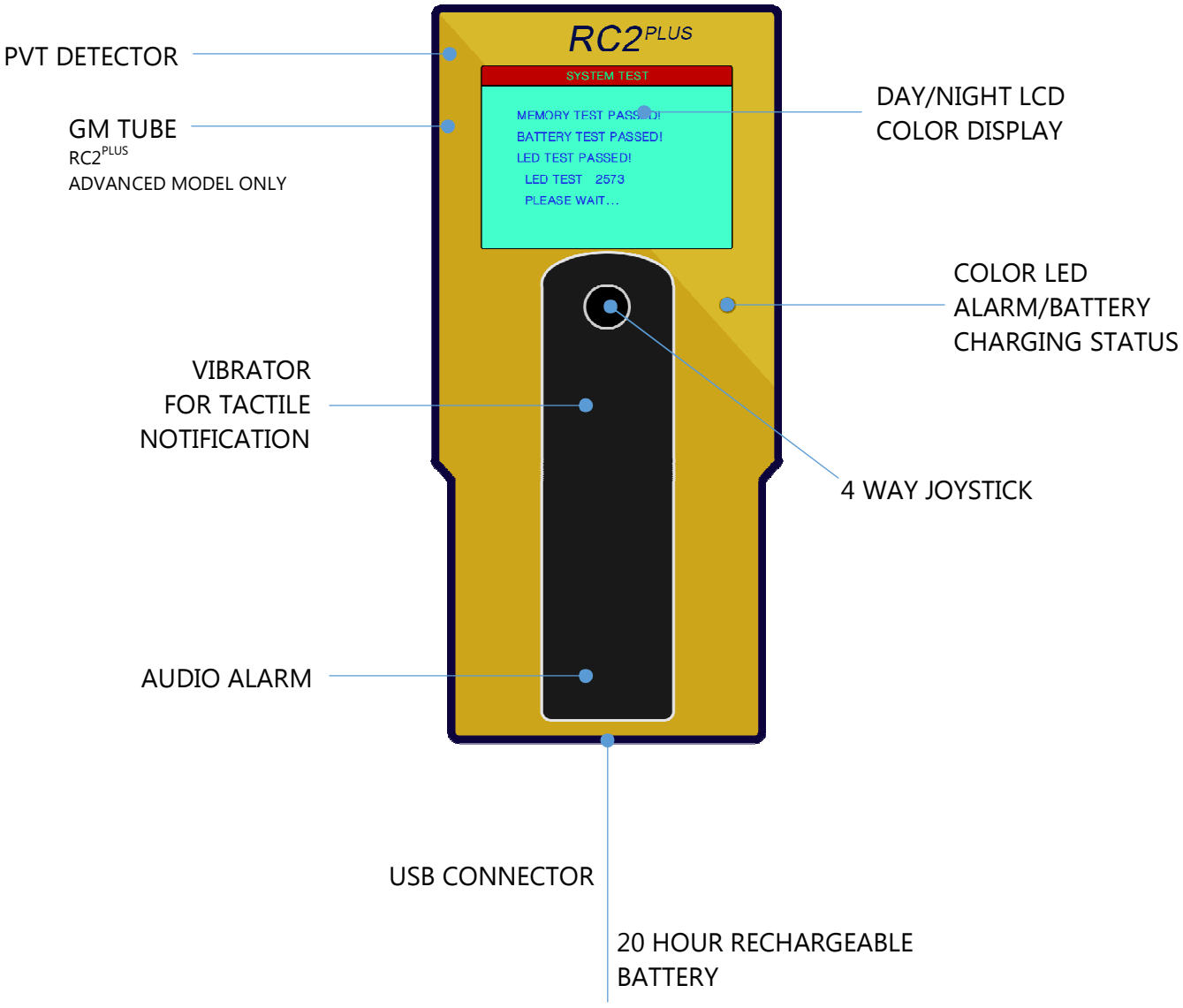
The Advanced ROI Analyses version allows the operator to see the distributed measured gamma energies in a histogram form which specific ROIs can be selected for the desired energy ranges applicable to the requirement. Once the ROI ranges are selected, a specific alarm threshold can be set for each ROI. This unique technology provides extremely high sensitivity while decreasing the interference from ambient background radiation including situations where high background levels are measured.

The RC2PLUS is supplied with default parameters which have been selected for the Metals Recycling industry. There are several commonly found isotopes in scrap metal cargos that have resulted in the vast majority of radiological detections. The RC2PLUS selected ROI energy ranges and alarm thresholds have been factory preset to enhance the detection of these isotopes. The RC2PLUS allows users the ability to change the factory defaults as required to enhance the detection capability for any selected isotopes. All parameter changes can then be saved in non-volatile memory to as not to lose them when the power has been turned off. The RC2PLUS will automatically return to normal operation with the previously stored parameters when the unit power has been restored.

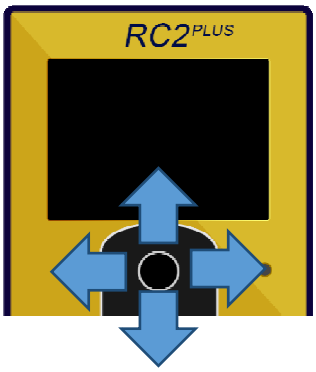
The RC2PLUS provides many additional features such as the display of gamma energy response in a histogram form, data storage, selected ROI count rate viewing and dose rates.

The RC2PLUS stores operator selected histograms which can be downloaded via USB to RadComm's PC software for further analysis and archiving purposes. Reports can also be saved in PDF format. Remote servicing/ diagnostics and software updates can be performed via a network connection with RadComm's PC software application.

GETTING STARTED



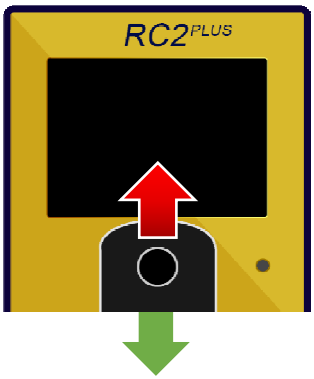
4 WAY JOYSTICK



The RC2Plus is operated with a four way joystick located on top of the handle.

- Up
- Down
- Right
- Left

ENTER AND EXIT FUNCTIONS



In some menu screens there will be an option to Enter or Cancel. The following explains how to Enter or Exit using the joystick.

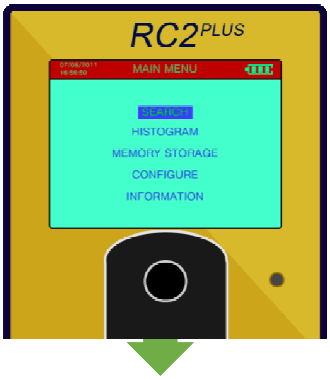
EXIT

The Exit/Cancel function is triggered when the joystick is held in the Up position for 1 second.

ENTER

The Enter function is triggered when the joystick is held in the Down position for 2 seconds. Enter also saves selections or settings on certain screens.

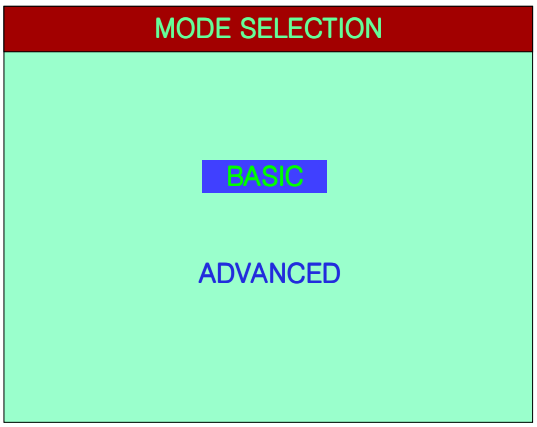
POWER ON



Starting with the unit OFF, to POWER ON, **Push** the joystick **Down**.

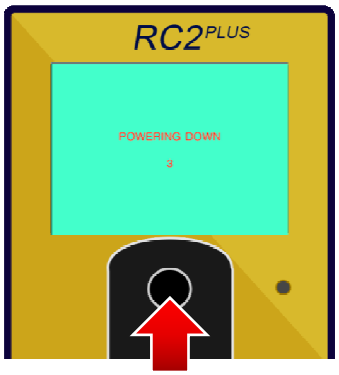
On power on the RC2PLUS initializes and does a self test. When complete it displays the main screen.

MODE SELECTION



The RC2PLUS is delivered fully powered and in BASIC Mode. To change the Mode setting, startup the unit and hold down the joystick when the cover page appears, the mode selection screen will then appear and the user can use the joystick to choose from BASIC or ADVANCED MODE. The RC2PLUS is ready to be used for the selected mode by the operator or technician.

POWER OFF



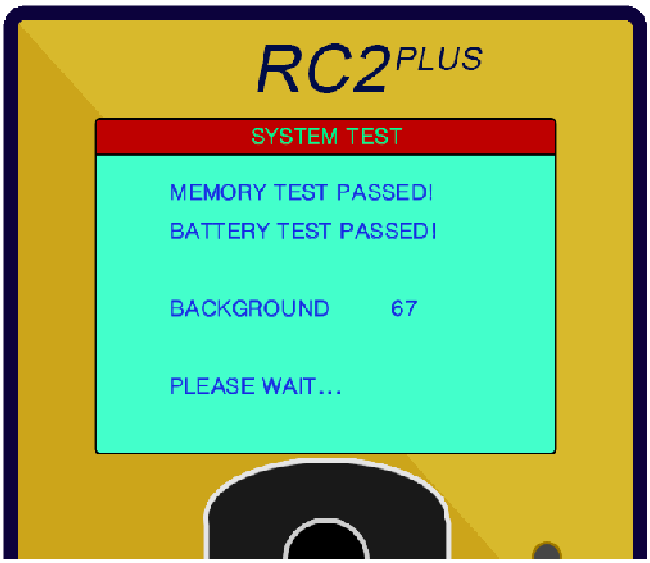
1. To power off **Push UP** and **Hold** the joystick for 3 seconds.
2. When the joystick is held in the Up position a 3 second countdown begins.
3. The RC2PLUS turns off

STARTING SELF-TEST

Every time when the RC2PLUS is power on it does a self-test and learns the background.

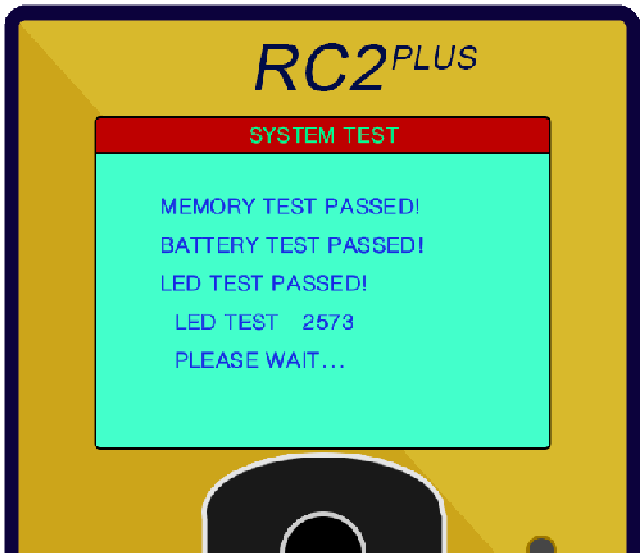
BACKGROUND LEARN

During startup the RC2PLUS learns its background. This background is displayed in the RC2PLUS System Test screen.



LED TEST CHECK

LED test checks the alarm algorithms to ensure the RC2PLUS is ready to search.



CALIBRATION REQUIRED

For the Basic Mode, if the system requires calibration, 'CALIBRATION REQUIRED' will be displayed on the bottom of the System Test screen. This message will appear after one year or LED test fails.

RC2PLUS OPERATION MODES

The RC2Plus offers two models: the **Basic** model and the **Advanced** model. Only in the Advanced Model allows toggling back to Basic mode and back to Advanced mode on every startup.

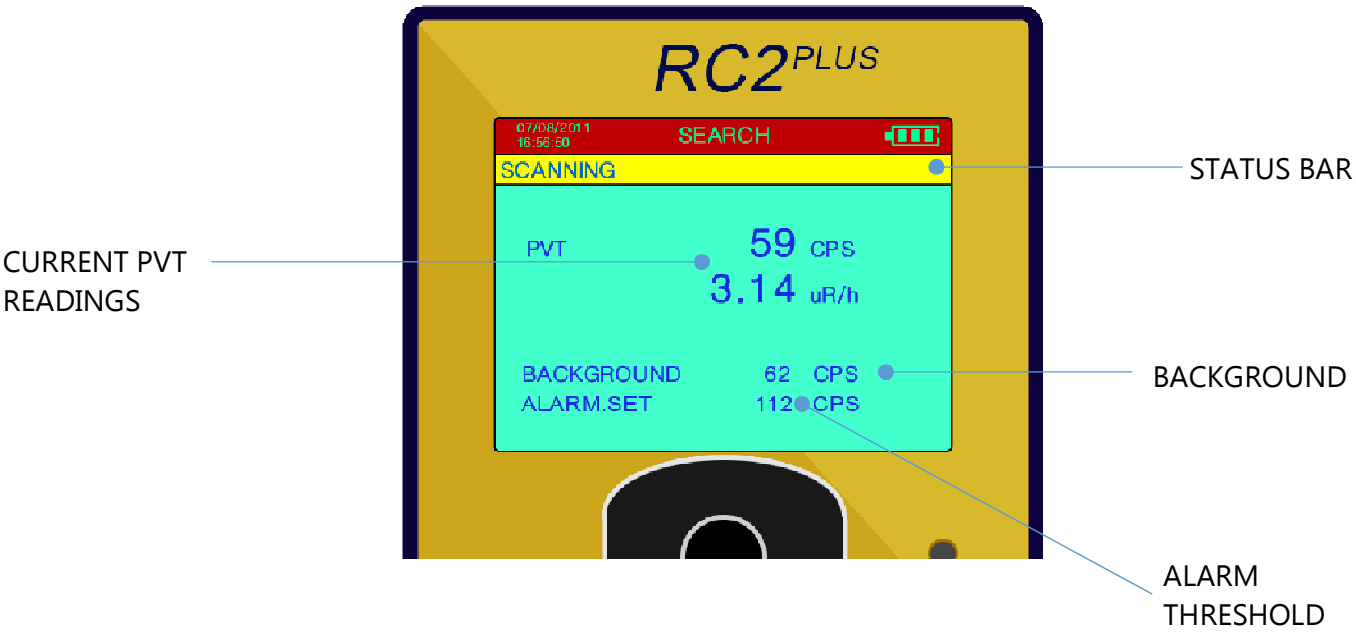
When you purchase the RC2Plus Basic model the Advanced option is NOT included.

This document explains both Basic and Advanced operation modes.

GM tube is only available in Advanced Model. When the dose rate reading is higher than 40μSv/h, the RC2Plus switches to GM for better accuracy.

There is no GPS for Basic Model. For Advanced Model, GPS is optional.

RC2PLUS BASIC MODE OPERATION



PVT	Displays the current readings.
BACKGROUND	Displays the background value learned during Power On.
ALARM THRESHOLD	Displays the alarm threshold. This threshold can be changed in the configuration screen. The RC2PLUS Basic has 3 Alarm Threshold settings.

RC2PLUS BASIC STATUS BAR

SCANNING

The RC2PLUS is in normal operation. Ready for search and find.

CPS EXCEEDS THRSH!

This message is displayed when the RC2PLUS is alarming. The RC2PLUS alarms when the current PVT readings are higher than the ALARM SET.

DOSE RATE EXCEEDS THRSH!

This is an alarm message displayed when the dose rate value exceeds its threshold setting. The unit warns the user with the audio, visual and tactile notifications. This setting is configurable through the Configuration screen for Basic Mode.

HIGH DOSE RATE. MOVE AWAY!

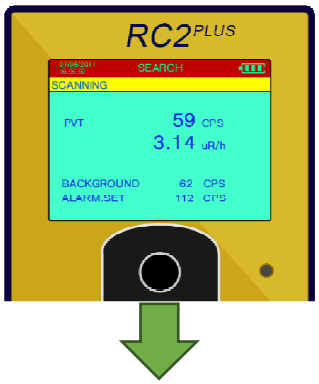
When the dose rate reading is higher than 10µSv/h this message is displayed.

SYSTEM IS OUT OF RANGE!

This message is displayed when the dose rate is higher than 50mSv/h the unit has overloaded its scanning capacity.

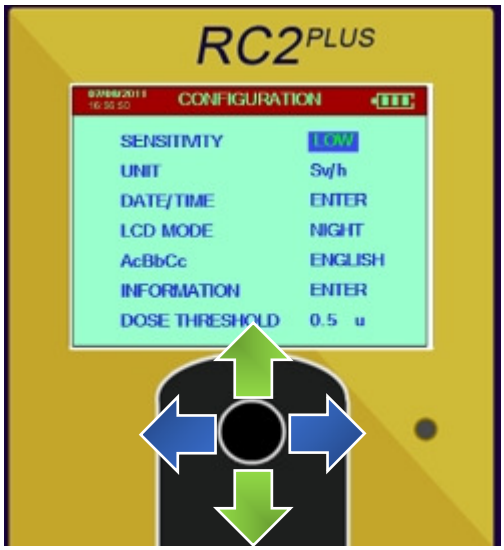
RC2PLUS BASIC CONFIGURATION

To enter into the configuration screen hold the joystick down for 2 seconds. After 2 seconds it displays the Configuration screen.

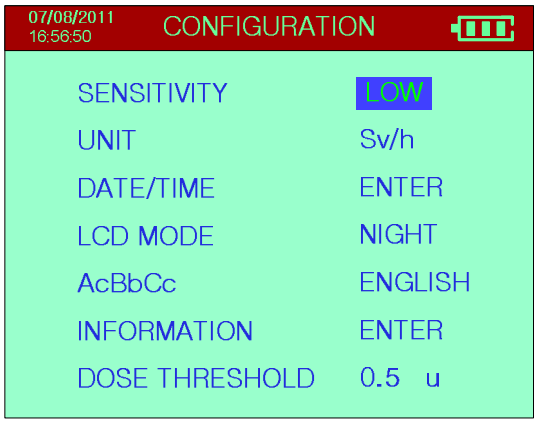


The configuration screen displays settable options. To navigate these options use the joysticks **UP/DOWN**. Moving the joystick **UP/DOWN** highlights the setting to change.

Using the joysticks **RIGHT/LEFT** on the selected options changes the setting.



Once the changes are made **HOLD DOWN** to save.



The configuration screen displays the following:

SENSITIVITY

There are 3 alarm thresholds, which correspond to the level of sensitivity, normally LOW, MED and HIGH. Low level threshold equals to 12 Standard Deviation of ambient background ($12\sqrt{BG}$)+ambient background.

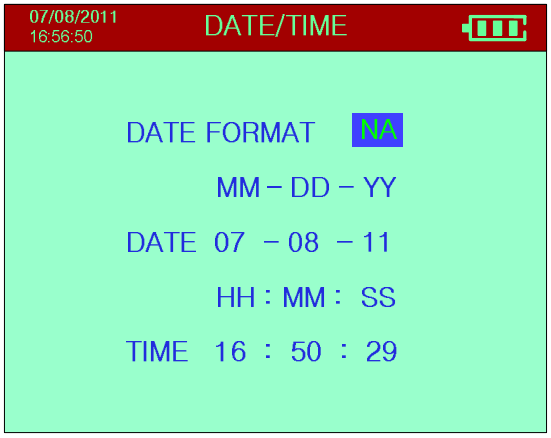
LOW	$BG + 12\sqrt{BG}$
MED	$BG + 8\sqrt{BG}$
HIGH	$BG + 4\sqrt{BG}$

UNIT

Unit toggles between R/h or Sv/h

DATE/TIME

Changes the Date and Time



LCD MODE

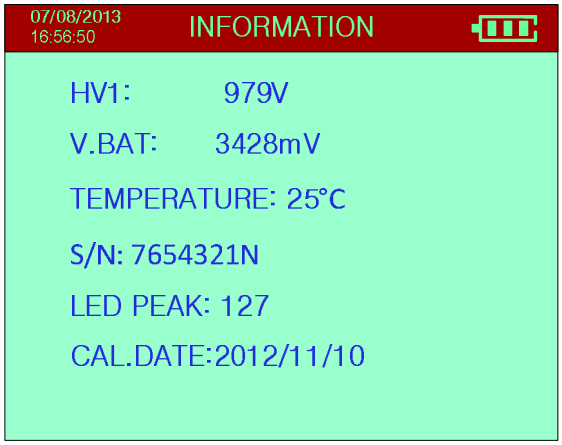
Toggles the display between NIGHT and DAY.

AABBCC

Changes the language displayed.

INFORMATION

Displays system information i.e. Calibration Date, Operating temperature and Serial number.



Dose Threshold

If the Dose Rate exceeds this value, the audio will alarm to warn the user.

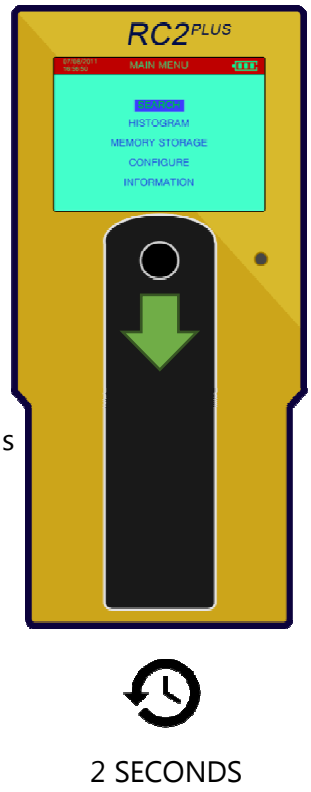
RC2PLUS ADVANCED MODE OPERATION

The RC2PLUS Advanced Mode offers a Total and ROIs search and find functions.

MAIN MENU

The Main Menu displays the following:

- SEARCH
- HISTOGRAM
- MEMORY STORAGE
- CONFIGURE
- INFORMATION



To navigate the menu use the Joystick's UP/DOWN

To make a selection **HOLD DOWN** the joystick for 2 seconds

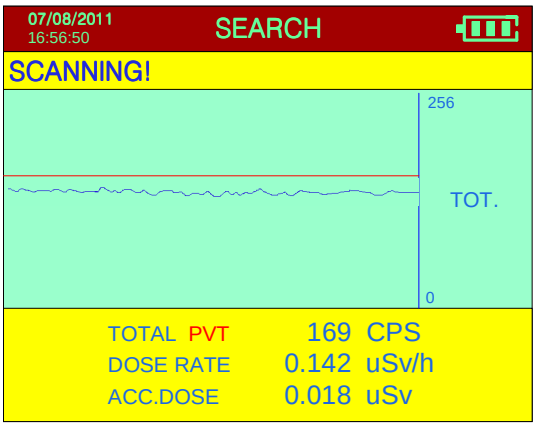
2 SECONDS

SEARCH

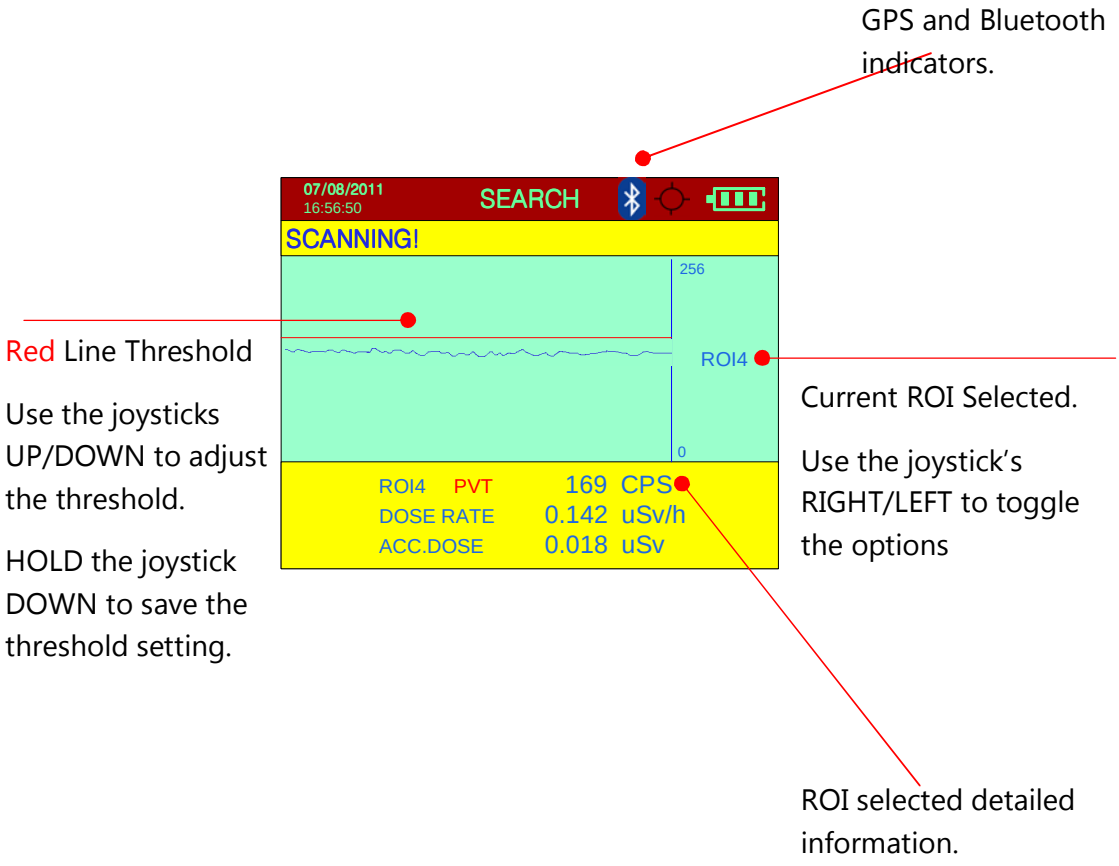
In Search mode the RC2PLUS Advanced gives the user 5 selectable options.

1. Total Counts
2. ROI 1
3. ROI 2
4. ROI 3
5. ROI 4

The 5 options can be toggled by switching the joystick RIGHT/LEFT.



Each option is presented with a Red Line Threshold. This threshold can be adjusted using the joysticks UP and DOWN. When the ROI Alarm Threshold for a certain ROI is set to OFF, the red line doesn't appear.



SEARCH ALARM

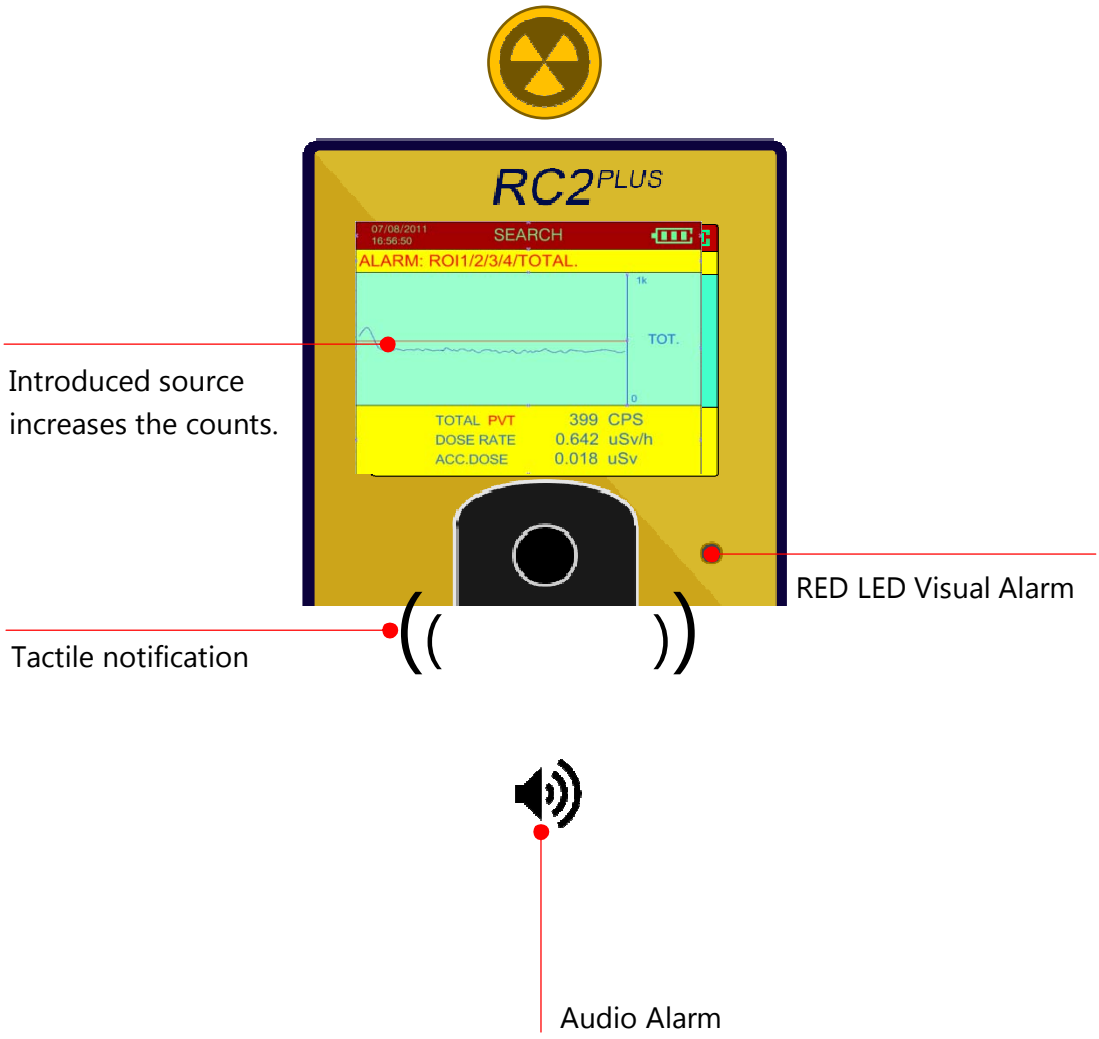
The Total and ROIs have % above background thresholds. Each can be set through the configuration screen.

The Red Line displays the alarm threshold for this total window.

When a radioactive source is in close proximity, its counts and graph will increase.

The alarm triggers when the increased counts cross the Red line. In this event the user is notify with:

- Audio Alarm
- Visual Alarm (RED LED)
- Tactile Alarm (Handle Vibrates)



RC2PLUS ADVANCED STATUS BAR

SCANNING

The RC2PLUS is in normal operation. Ready for search and find.

CALIBRATION REQUIRED

This message is displayed when the RC2PLUS needs to be recalibrated. This message will appear after one year or LED test fails.

ALARM: ROI1 OR 2/3/4 OR TOTAL!

This message is displayed when the RC2PLUS is alarming. The unit warns the user with the audio, visual and tactile notifications. The RC2PLUS will display the ROI# or Total window where the current reading value is above its alarm threshold.

HIGH DOSE RATE. MOVE AWAY!

When the dose rate reading is higher than 10µSv/h this message is displayed.

SYSTEM IS OUT OF RANGE!

This message is displayed when the dose rate is higher than 50mSv/h. The unit has overloaded its scanning capacity.

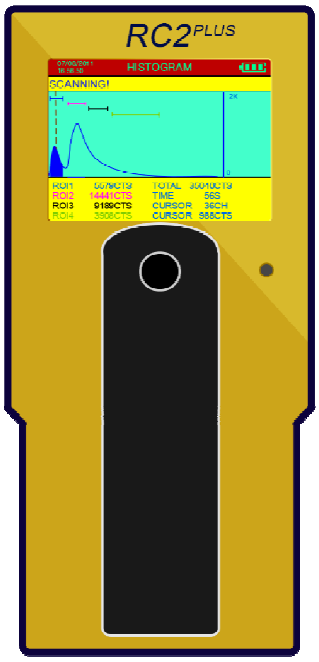
DOSE RATE EXCEEDS THRSH!

This is an alarm message displayed when the dose rate value exceeds its threshold setting. The unit warns the user with the audio, visual and tactile notifications. This setting is configurable through the Dose Setup in the Configuration screen.

DOSE MEMORY IS FULL!

This message is displayed when the memory for Dose data is full.

HISTOGRAM

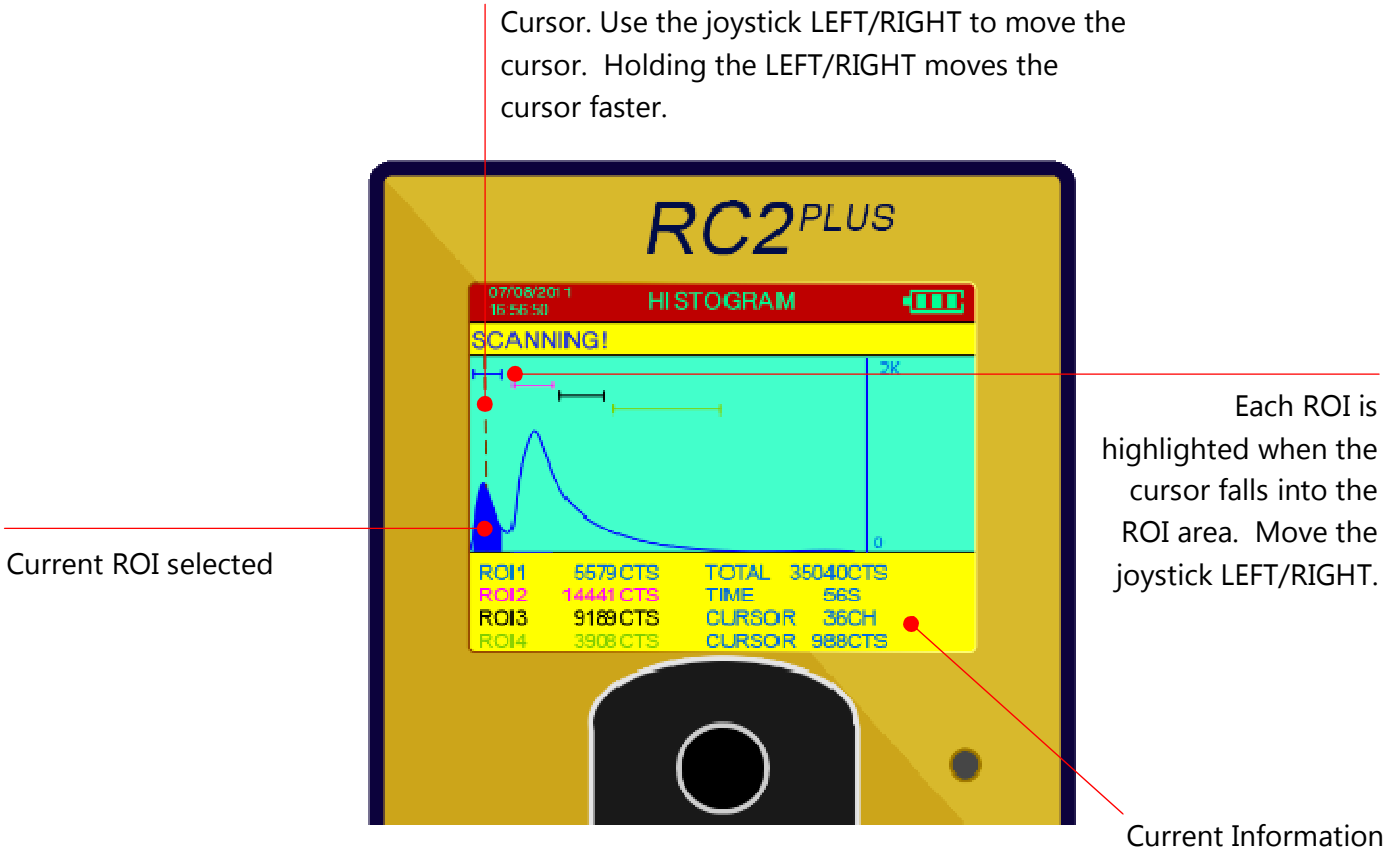


The Histogram function in the RC2PLUS allows the user to accumulate the histogram of a radioactive source.

The accumulation begins the moment the user enters the Histogram mode.

The Histogram also includes 4 ROI windows highlighted in different colors.

HISTOGRAM SCREEN OVERVIEW



ROI1	ROI counts for ROI1 Blue region
ROI2	ROI counts for ROI2 Magenta region
ROI3	ROI counts for ROI3 Black region
ROI4	ROI counts for ROI4 Khaki region
TOTAL	Total counts for the full histogram
TIME	Accumulation time in seconds since the histogram started
CURSOR CHANNEL	Channel Number where the cursor is currently positioned
CURSOR COUNTS	Counts where the current cursor is positioned

HISTOGRAM SCALING

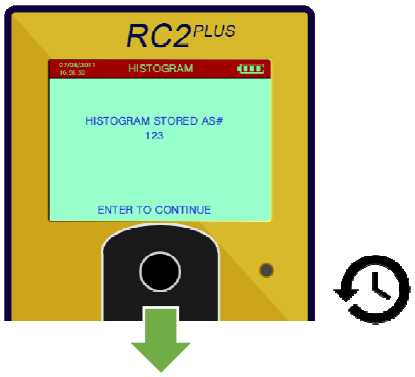
Auto scaling is enabled by default.

Scaling the graph is achieved by momentarily moving the joystick **UP/DOWN**.

Note: Once the joystick is moved UP/DOWN the auto

scaling is disabled for this histogram accumulation.

HISTOGRAM SAVING

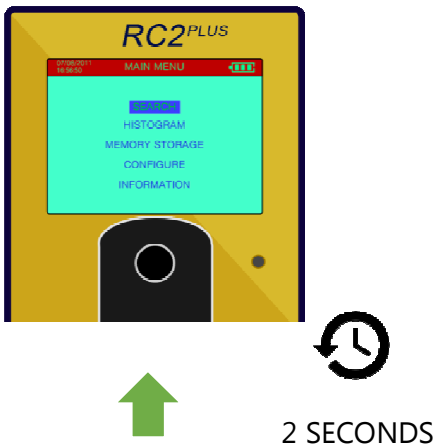


When you are ready to stop and store the accumulated histogram, HOLD the joystick DOWN for 2 seconds.

The RC2PLUS can store 300 histograms.

2 SECONDS

HISTOGRAM CANCEL



When you want to exit without saving the Histogram, **HOLD** the joystick **UP** for 2 seconds and release.

2 SECONDS

RC2PLUS ADVANCED HISTOGRAM STATUS BAR

SCANNING

The RC2PLUS is in normal operation and accumulating a histogram.

CALIBRATION REQUIRED

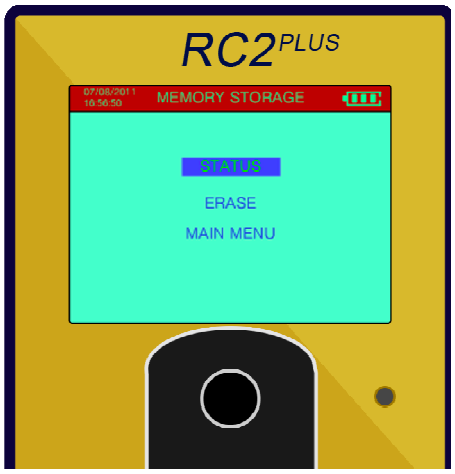
This message is displayed when the RC2PLUS needs to be recalibrated. This message will appear after one year or LED test fails.

HISTOGRAM MEMORY IS FULL

The RC2PLUS can store up to 300 histograms. Use the RadView PC software to download and save the histograms in memory. An erase function is available with the RadView software to erase the memory and clear the message.

MEMORY STORAGE

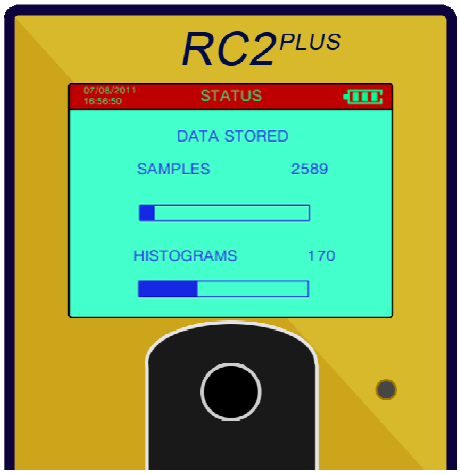
This section allows the user to view memory storage information.



STATUS

Selecting STATUS shows the current state of the data memory. The RC2PLUS can store data from the 2 operational modes (SEARCH and HISTOGRAM) in different formats. Each set of data is tagged with a special header that identifies the type of data.

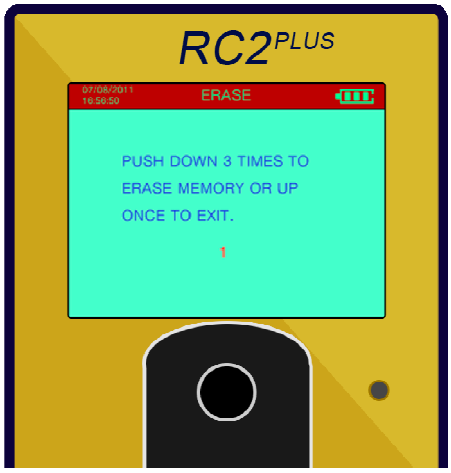
The SEARCH data is classified as SAMPLES (there is room for up to 28k samples) and in HISTOGRAM mode there is room for 300 histograms.



ERASE

Selecting Erase displays the erase data screen.

Pushing DOWN on the joystick 3 times will erase the memory.



CONFIGURATION

The configuration screen displays the following options

SEARCH

Search Setup allows the user to configure the Total and ROIs averaging.

DOSE SETUP

Configures and sets the Dose Measurement and Units.

ROI SETUP

The detection capability of system can be optimized by selecting specific energy ranges for given isotopes. The system is supplied with default energies ranges that are must applicable to the steel making industry.

ROI ALARM THRESHOLD

Each selected ROI can have a dedicated alarm threshold depending on the requirements.

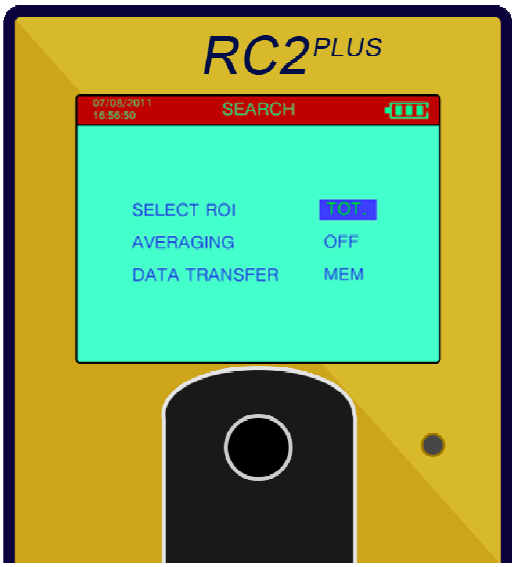
DATE/TIME

Date and time can be set as required.

MISCELLANEOUS

Languages can be selected; Loading manufacturers defaults can be selected.

SEARCH SETUP



In the Search Setup screen, it allows the user to select between Total, ROI1, ROI2, ROI3 and ROI4.

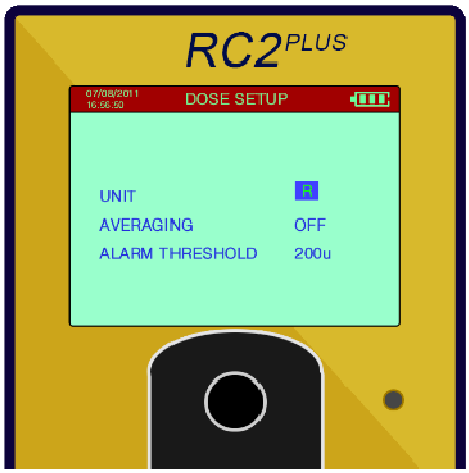
The user can also configure the averaging for the ROIs and Total. This selection permits data filtering. 3P = 3 point filtering – really a 3 point moving average updated at a 1/sec rate. This makes the data chart display smoother and easier to read but users are cautioned that averaging also reduces small peak 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

Data Transfer - This option configures the data transfer settings.

- **MEM** - Data will be stored in internal memory
- **OFF** - No data will be stored.

DOSE SETUP



UNIT

Unit sets the measurement units –selections are **R** for radiation exposure and Sv for radiation dose.

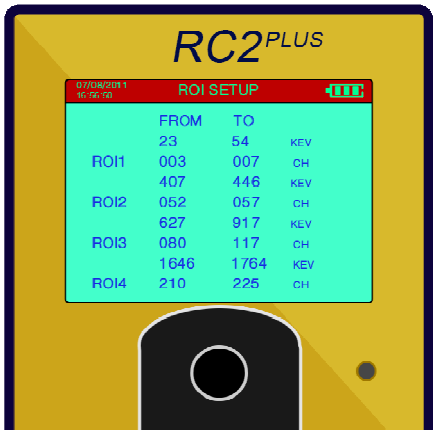
AVERAGING:

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

ALARM THRESHOLD:

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.

ROI SETUP



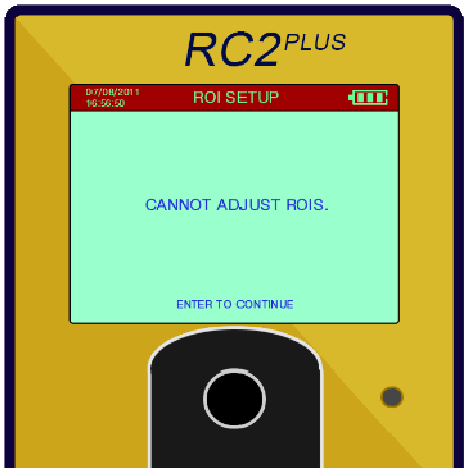
- ROI SETUP is for Users that are familiar with Gamma Energy Spectroscopy. The system can be optimized with ROIs energy ranges that enhance the detection capability for specific isotopes. The system is supplied with default ROIs ranges for ^{241}Am, ^{192}Ir, ^{137}Cs and ^{60}Co. Also, the system includes a default Total Count Range that cannot be adjusted to ensure the maximum range of Gamma energies can be measured.

		From	To
Am-241	ROI1	3	7
Ir-192	ROI2	16	40
Cs-137	ROI3	27	65
Co-60	ROI4	67	126

- There are four selectable ROIs that can be User configured to optimize the detection capability of a given ROI Window. FROM is the lower energy range

whereas TO is the upper range of energy. Above the ch settings are the associated energy levels in KeV.

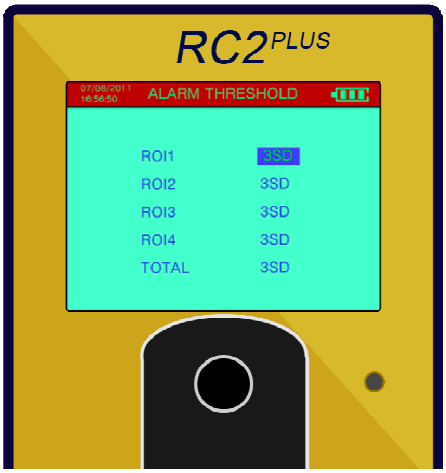
- **Cannot Adjust ROIs**: This message is telling the User that the FROM and TO settings are in conflict. The FROM must always be lower than the TO setting and vise-versa. The maximum channel number is 256.



ROI ALARM THRESHOLD SETUP

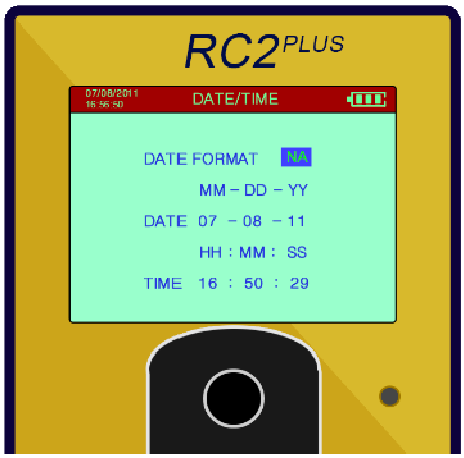
Each ROI (set by the User or RadComm's defaults) and the Total Count (Total) are listed on the left side.

The RC2PLUS applies a configurable threshold setting. The thresholds are given in terms of standard deviations of instrument background fluctuation for the selected window. The default setting is 3 standard deviations. The user can change it from 1 to 10 or OFF. Setting the ROI Alarm threshold to OFF turns off the Alarm algorithm for the selected ROI.



DATE AND TIME SETUP

The date and Time can be configured as required using the Joystick.



MISCELLANEOUS SETUP

The MISCELLANEOUS selection allows the user to select the following:

- Change Language.

  English, Chinese, Japanese, Spanish, Portuguese

- Toggle LCD Night/Day Modes.
- Load Default settings.

OPTIONAL

These options will display NA if not present

- GPS - Enable/Disable GPS
- Bluetooth - Enable/Disable Bluetooth

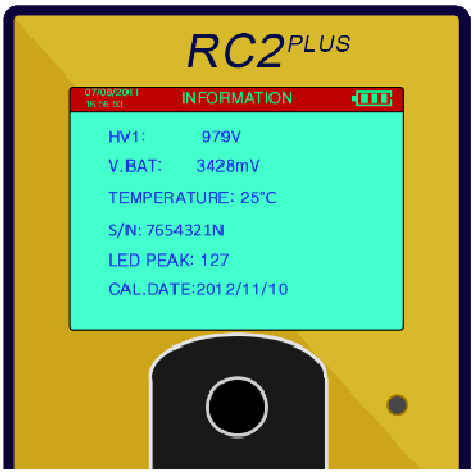
When activated, the GPS and Bluetooth icons will appear in the top red status bar on the Main Menu, Search and Histogram screens.

When the GPS option is ON, this symbol will display:

When the GPS is OFF, the icon will change to this:

INFORMATION SCREEN

INFORMATION provides the User with detailed information about the systems Operational parameters.



RADIATION SAFETY PROCEDURE

A qualified radiation safety professional should be consulted and a formal response to radioactive sources should be developed. The following section, Reacting to High Counts, is provided as a guideline only in helping develop this procedure. RadComm is not responsible for any use or misuse of the RC2PLUS Portable.

REACTING TO HIGH COUNTS

Table one shows the action to take relative to the counts displayed on the RC2 screen. When approaching a suspected source the RC2 PLUS Portable must always be held between the operator and the suspected source. When sources are to be isolated, an appropriate container for radioactive sources must be used.

Low indicates that the source may be safely approached and removed from the area. Under no circumstances should an enclosed source be further exposed or opened. Caution indicates that the source may be hot and should only be handled by a qualified radiation professional.

Isolate indicates that the entire load should be isolated with no attempt to remove the source. Only qualified radiation professionals should attempt to isolate and remove the actual source.

Readings in CPS Approximately 20,000CPS=10microSv/hr	**Distance From Contact Of The Source Of Radiation Measured In Meters**				
	On Contact	< 1m	< 2m	< 5m	> 5m
1 to 5,000	LOW	LOW	CAUTION	UNUSUAL	ISOLATE
5,001 TO 10,000	LOW	CAUTION	UNUSUAL	ISOLATE	ISOLATE
10,001 TO 30,000	CAUTION	CAUTION	ISOLATE	ACTION	ACTION
30,001 TO 80,000	ISOLATE	ISOLATE	ACTION	ACTION	ACTION
>120,000	ACTION	ACTION	ACTION	ACTION	ACTION

Table 1: CPS and Action to Take

OPTIONAL DOCKING STATION

The Docking station system consists of 2 main components - the RC2PLUS/DS docking Station Console and the RC2PLUS/DS Portable detector (mounted inside the RC2PLUS/DS). Its primary functions are to charge the internal RC2PLUS Portable batteries and to provide monitoring in the immediate area around the console. The unit incorporates circuitry that includes smart battery charger, AC to DC power supply, monitoring indicator, audio/visual alarms and alarm reset.

The RC2PLUS scans the ambient background radiation levels on a continuous basis while mounted inside the console. The portable establishes a continuous running average and automatically sets tracking alarm threshold levels. There are 3 alarm thresholds, which correspond to the level of sensitivity, normally LOW, MED and HIGH. The RC2PLUS/DS is capable of detecting a SEALED radioactive source of Cesium 137 with an on-contact exposure rate of 10 micro Sv/hr (1 mR/hr) from a distance of up to 3m (10 feet) in air.

The detection capability of the unit has been designed to alert personnel to a potential radiation hazard if a radioactive source were to be of significant quantity. These alarms can be reset via the front panel alarm reset pushbutton.

The RC2PLUS/DS serves 2 basic functions; 1) operates as a radiation detection unit when the RC2PLUS portable is installed, and 2) acts as a battery charger for the RC2PLUS portable.

INTERNAL RC2PLUS PORTABLE:

The RC2PLUS/DS is equipped with an internal portable RC2PLUS radiation detector. The RC2PLUS is located behind the locked front panel door on a built-in shelf. Quick release straps are used for holding the instrument in place. These can be easily and quickly undone when the portable is required for remote applications. There is an 10 pin DIN connector that must be plugged into the side of the portable when mounted in the RC2PLUS/DS. The connector serves 2 functions; it will charge the internal RC2PLUS batteries and transfer the logic control signals to the RC2PLUS/DS control circuitry. The RC2PLUS must be turned on at all times while mounted in the RC2PLUS/DS control unit.

Figure 1 – RC2PLUS Docking station

Door Latch

There are two key-lock door latches on the right side of the unit. They are spring loaded press fit latches that snap into place. The latches can remain closed without using the key-lock. To open the latch simply depress the black button.

Alarm Indicator

The indicator is controlled by the internal logic circuits and is used for alarm conditions. It will illuminate steady ON when there is a detection of radiation. The lamp is a maintenance free LED cluster and is powered by low voltage DC.

Monitoring Indicator

The indicator is controlled by the internal logic control circuits and indicates the systems operational status. Normal operation is steady ON which means the system is fully operational. Steady OFF means the unit is NOT operational.

The system will not be scanning during this period. The lamp is a maintenance free LED cluster and is powered by low voltage DC.

Alarm Reset

The audio reset is an illuminated pushbutton located on the front panel. This reset will reset both the audio and visual alarms. Once the alarms have been reset the system automatically reactivates the alarm for the next radiation detection.

RC2PLUS I/O Connector

The RC2PLUS I/O connector is located inside at the end of the communication cable. The connector is a standard DIN 10 pin connector. It must be firmly plugged into the bottom right hand side of the RC2PLUS portable. All communication signals and battery charging voltage (12 volts DC) is through this I/O connector.

Latch

There are two latches located on the right of the unit. A padlock can be added to the bottom latch for security.

Front Door

The front door is weather sealed with an outer hinge on the left side. There is also a RC2PLUS display viewing window to allow viewing of the RC2PLUS display without opening the door.

Audio Alarm

The Audio Alarm is located on the bottom of the Console. The audio will sound if the RC2PLUS Portable detects radiation that exceeds the alarm level settings. The audio is powered by low voltage DC. The output audio signal level is a continuous 2200 Hz tone with an output of 90 db at approximately 3 ft. The Audio will stay steady ON until it is reset.

AC Input

There is a 21mm (3/4") conduit hole at the bottom right corner of the cabinet available for the AC power input. The unit requires 100 230 volts AC /50/60 Hz.

SPECIFICATIONS

Mechanical

Detector Case: 7" H(18cm) x 9" L(23cm) x 4" W(10cm)

System weight:

Micro USB Connector for Internal Battery Charging and data transfer

Thru-hole for Audio Alarm

Electronics

Integral PMT with EM Shielding

Audio Alarm with Vibration

Stable Low Noise, High Voltage Power Supply

Internal Rechargeable Li Ion Battery with Charging LED indicator

Battery Life: 20 hours continuous

Battery Recharge Time:

Fast Charge: 2.5 hrs

via PC USB: 6 hrs min.

Software

Menu Driven User Interface

Configurable Data Storage with Backup

Emailing capability (with network connection)
Configurable Data Storage with Backup

Emailing capability (with network connection)

Detector Specifications

PVT: Size 4"(101.6mm) x 3"(76.2mm) x 2"(50.8mm)

Optional Geiger-Mueller tube, size 0.59"(12mm) x 1.9"(45mm)

Response/Sensitivity

Energy Range: 15 KeV – 2.0 MeV

Sensitivity: 8 cps/uCi at 1M with CS137

Gamma histogram: 256 Channels, channel capacity 16 bits

Accumulate dose up to 5.5mSv, custom increase

RC2PLUS BASIC vs ADVANCED

Feature	Basic Option	Advanced Option
Search+Find	✓	✓
Total Counts	✓	✓
Dose Rate	✓	✓
Dose Rate Alarm	✓	✓
Histogram		✓
Graph Plotting		✓
ROI Analysis		✓
ROI Alarm Threshold Settings		✓
Data storage		✓
Accumulated Dose		✓