



Using the GammaRAE II R

Personal Radiation Detector and Dosimeter in One
Firmware Version: V3.60 D



November 2010

- GammaRAE II R
- Features
- Getting Started
 - Replacing the batteries
 - Turn the unit on/off
- Operation Screens
- Programming Modes
 - Basic User Mode
 - Full Programming Mode



Features

Sensors	CsI(Tl) + Photodiode
	Photodiode
Dose Equivalent	1 μ R/h to 600 R/h
Accuracy of DER for ^{137}Cs	$\pm 20\%$
Dose Range	1 μ R to 999.9 R
Energy Range:	0.06 to 3.0 MeV
Certifications	Intrinsically Safe - Class I, Division I, Groups A, B, C, D, T4 ATEX II IG Eex is IIC T4
	IP67 Rated - Immersible

Features

- Detector and Dosimeter
- Continuous display of dose rate
- Adjustable audible, visible and vibration alarms
- LCD display flips (side) for belt or hand-held viewing
- Highly-visible LED lights
- Easy to use



GammaRAE II R Reliability

- Up to 600 hours on alkaline batteries
- Temperature range of -4° F to 122° F
- Passes drop test from 1.5 m (59")
- Non-slip rubber housing
- Rugged metal belt clip, wrist strap



Physical Description



- GammaRAE II R Features
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Replacing the Batteries

- Compartment opens with the included hex tool.
- Use only alkaline batteries. Carbon batteries may leak, causing damage.



Replacing the Batteries

- Insert new batteries according to diagram on back of the GammaRAE II R
- Replace cover and turn screw clockwise to tighten cover
- Datalog and settings are stored in nonvolatile memory and are NOT lost when the batteries die or are removed



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Turning On the GIIR

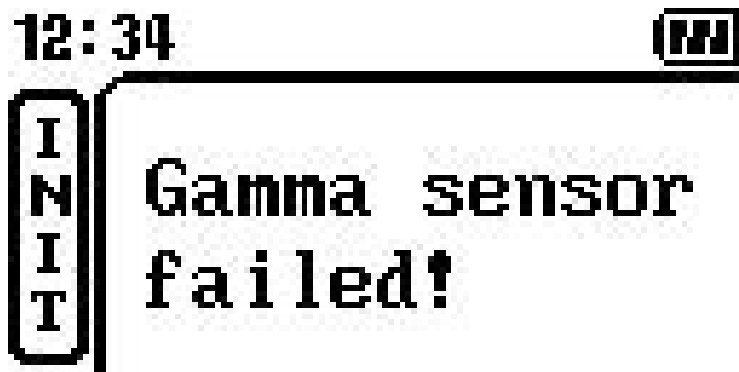
- Press and hold the MODE button for 3 seconds
- Buzzer sounds (if buzzer alert is set to ON)
- LCD displays firmware version
- LEDs and vibrator self-test (if set to ON)

Turning On the GIIR

- Instrument performs a self-check
 - Time and battery status display
- Current settings display
- 36-second background reference reading (if set to Search Mode)



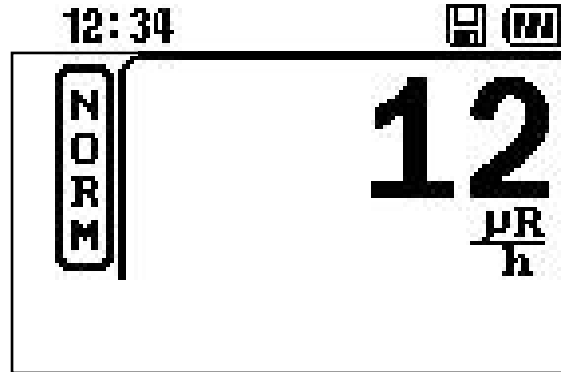
Start-Up Warnings



Important! If your GammaRAE II R displays “Gamma sensor failed” or “All sensors failed!” contact your distributor or RAE Systems service at **1-877-723-2878** **or 408-952-8200**. Do not attempt to use or repair the unit. There are no user-serviceable parts in the GammaRAE II R.



NORMal Display



- After warm up, the **NORM**al Operating screen displays
- As the dose rate increases, the units will autorange, displaying different units of R/h, or cps.
- Note: NORM does not mean “Naturally Occurring Radioactive Material”; It indicates that the unit is on the Normal Operating screen.

Turning GammaRAE II R Off

- Press and hold the MODE button for 5 seconds
- The detector counts down 5 seconds on the screen, flashes the orange LEDs (if set to ON), and beeps (if set to ON), and then shuts off
- Do not release the MODE button until the unit has counted down to zero or the unit will return to the Normal Operating screen.



- GammaRAE II R Features
- Getting Started
 - Replacing the batteries
 - Turn the unit on/off
- **Operation Screens**
- Programming Modes
 - Basic User Mode
 - Full Programming Mode



GammaRAE II R Operations

- The GammaRAE II R has two modes of operation: Normal Operating Mode and Programming Mode
- In Normal Operating Mode, the GammaRAE II R detects gamma radiation and accumulates radiation dosage data.
- In Programming Mode, operating parameters are specified.

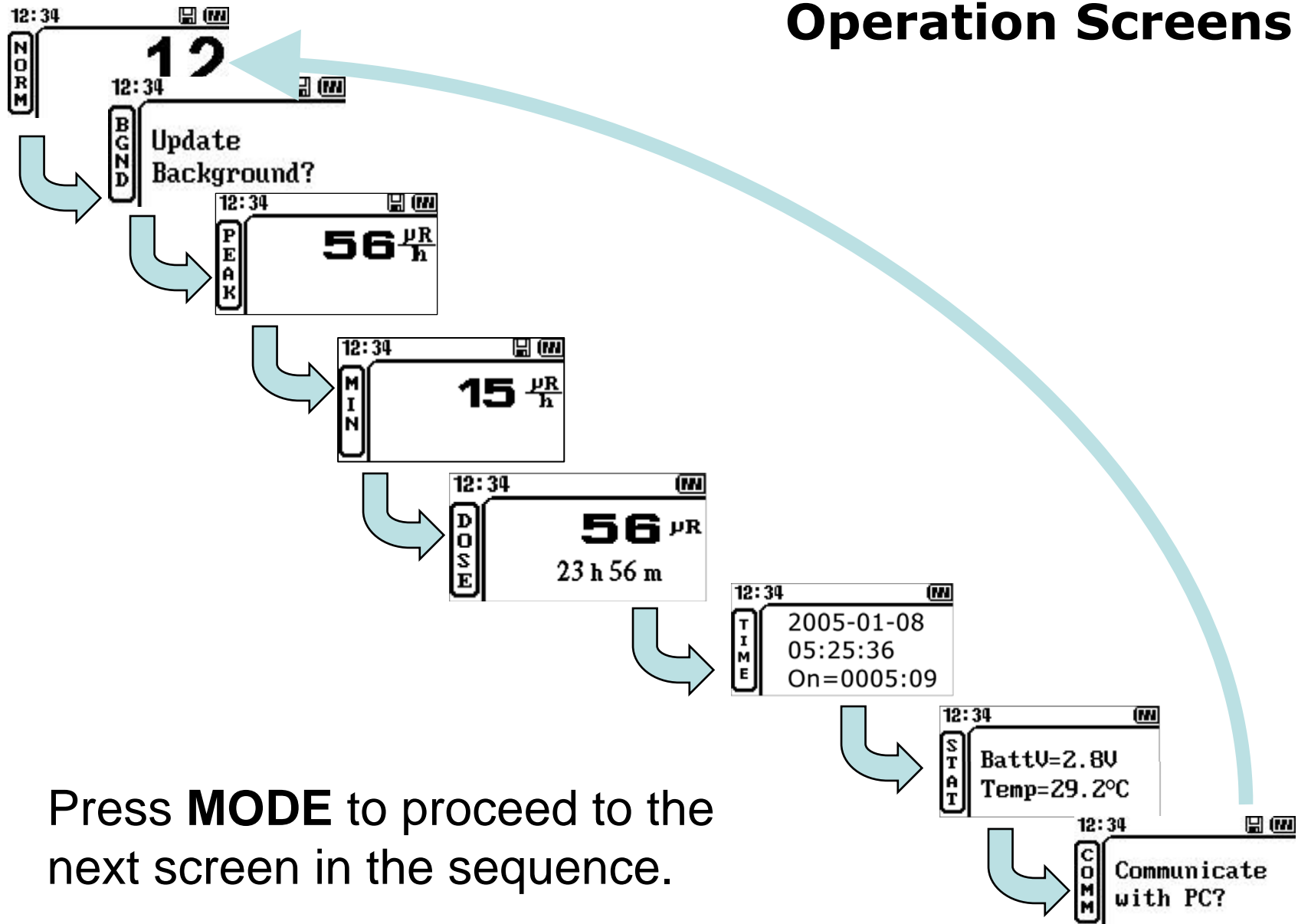


Operation Screens

NORM	Normal Operation screen
BGND	Background calibration (Search Mode only)
PEAK	Maximum radiation level detected since last cleared
MIN	Minimum radiation level detected since last cleared
DOSE	Accumulated radiation dosage since last cleared
TIME	Current time & date, time since start up
STAT	Battery voltage and internal temperature
COMM	Initiate Bluetooth® connection with computer

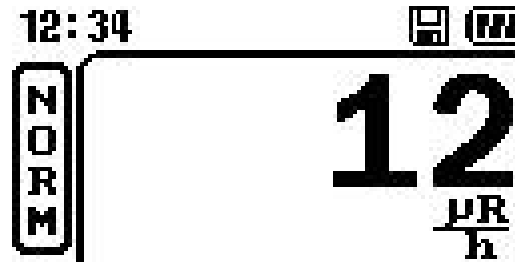
- Each screen remains active for 60 seconds before automatically returning to Normal Operating Mode.
- Press the **MODE** button to go to the next screen in the sequence.

Operation Screens



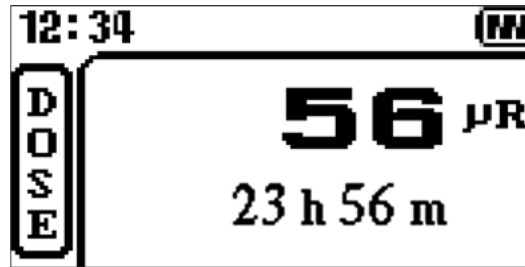
Press **MODE** to proceed to the next screen in the sequence.

Normal Operating Screen (NORM)



- Displays a measurement of the ambient radiation
- Can display dose rate in divisions of R/h or Sv/h (choose in Programming Mode), or radiation field measurement in cps (counts-per-second)
- Switch back and forth between dose rate units and cps units by pressing the **SET** button
- Flip the screen 180° by pressing and holding the **SET** button for 3 seconds
- Press the **MODE** button to step to the next function.

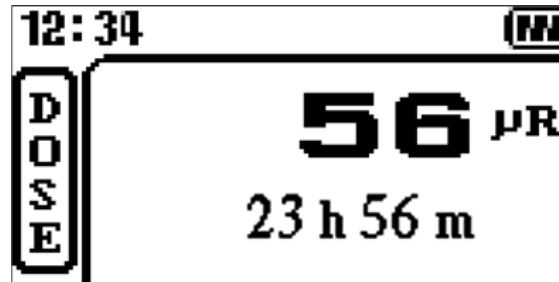
Stay Time



- The Stay Time feature provides alarms based on calculations that examine the dose threshold, current accumulated dose, and current dose rate.
- As Stay Time becomes 2 hours or less, alarms are activated at the intervals shown below:

Stay Time (T)	Alarm Status
$T > 2 \text{ hours}$	No alarm
$2 \text{ hours} > T > 3 \text{ minutes}$	Alarm once per minute
$T < 3 \text{ minutes}$	Alarm once every 5 seconds
$T < 0$	Same as Dose alarm

Stay Time



- The **Stay Time** is calculated in the following way:

$$\frac{(\text{Dose Alarm High}) - (\text{Current Accumulated Dose})}{\text{Current Dose Rate}}$$

Radiation Measurements

- GammaRAE II R gives readings in Rems-per-hour (R/h) or counts-per-second (cps)
- All units are auto-ranging.

Unit Equivalents					
1 μ R/h	1 cps				
1,000 μ R/h	1,000 cps	1 mR/h	1 kcps		
1,000,000 μ R/h	1,000,000 cps	1,000 mR/h	1,000 kcps	1 R/h	1 Mcps

Radiation Measurements

- All dose rate and dose measurements are auto-ranging

- NORM
- PEAK
- MIN

0 to 9,999 $\mu\text{R}/\text{h}$
10 to 9,999 mR/h
10 to 600 R/h (overrange)

- DOSE

0 to 9,999 μR
10 to 9,999 mR
10 to 999.9 R

Radiation Measurements

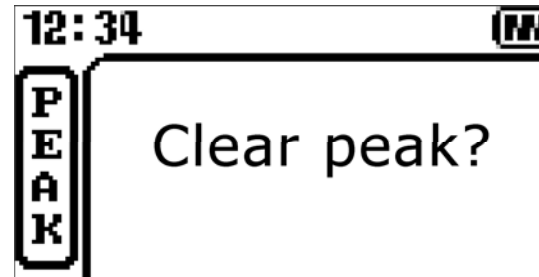
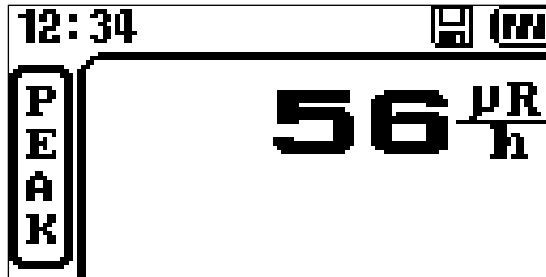
- What is “safe”?
 - Normal background levels are 1 to 50 $\mu\text{R}/\text{h}$
 - Know what the background in your area is
 - You should investigate if the radiation measurement is considerably higher than background (2x), or is above 50 $\mu\text{R}/\text{h}$
 - You are not in physical danger at these dose rates!

Background Reference Reading (BGND)



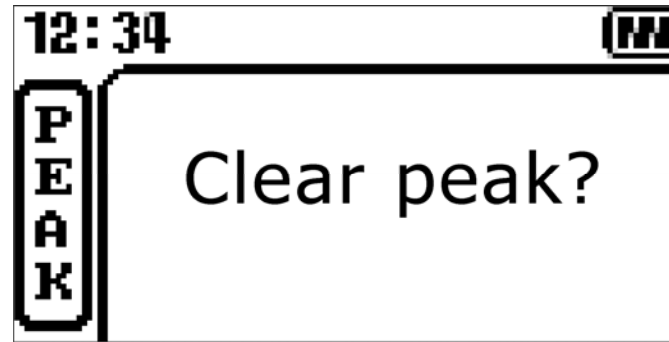
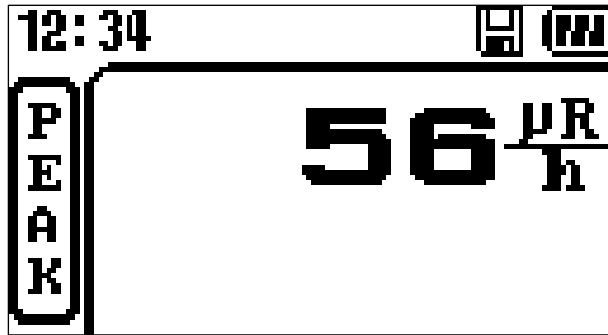
- Background reference reading (Search Mode only)
- Press the **SET** button to obtain a new background reference reading. This reading is used in determining the alarm threshold in Search Mode.
- Press the **MODE** button to step to the next function.

Peak Reading (PEAK)



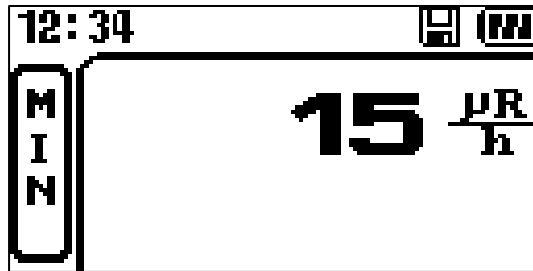
- The maximum radiation level detected since last cleared
- Press the **SET** button to clear the PEAK value: “Clear Peak?” will be displayed:
 - Press **SET** again to clear the PEAK
 - Press **MODE** to keep the current PEAK reading

Peak Reading (PEAK)



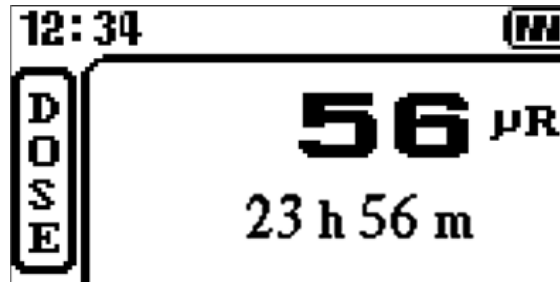
- The PEAK value is also cleared when the detector is turned off
- Press **MODE** to step to the next function

Minimum Reading (MIN)




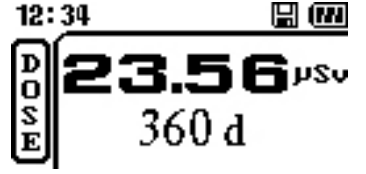
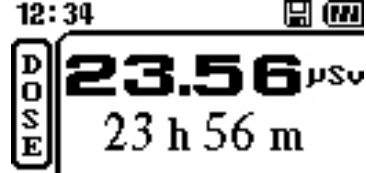
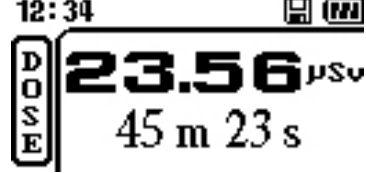

- The minimum radiation level detected since last cleared
- Press the **SET** button to clear the MIN value: “Clear Min?” will be displayed:
 - Press **SET** again to clear the MIN
 - Press **MODE** to keep the current MIN reading
- The MIN value is also cleared when the detector is turned off
- Press **MODE** to step to the next function

Accumulated Dose (DOSE)



- The accumulated radiation dose since last cleared, and the Stay Time
- The Stay Time display changes as the time interval decreases and the accumulated dosage increases
- Press **MODE** to step to the next function

Stay Time in Dose View (DOSE)

Display Format	Conditions	Display
> 1 year	Stay time > 1 year	 <p>12:34 [Battery Icon] [RAE Icon] DOSE 23.56 µSv > one year</p>
Days	365 days > Stay Time > 1 day	 <p>12:34 [Battery Icon] [RAE Icon] DOSE 23.56 µSv 360 d</p>
xxhxxm	24 hours > Stay Time > 1 hour	 <p>12:34 [Battery Icon] [RAE Icon] DOSE 23.56 µSv 23 h 56 m</p>
xxmxxs	1 hour > Stay Time > 0 minute	 <p>12:34 [Battery Icon] [RAE Icon] DOSE 23.56 µSv 45 m 23 s</p>
Dose Alarm !	Dose alarm has been triggered	 <p>12:34 [Battery Icon] [RAE Icon] DOSE 23.56 µSv Dose Alarm!</p>

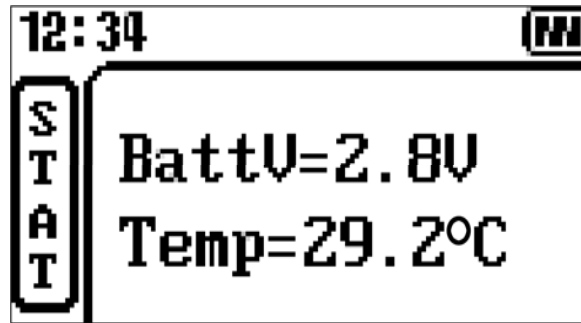
Time (TIME)

12:34  

T	2005-07-20
I	10:35:30
M	
E	On=0001:30

- Time, date, and time since start up
- **On**: Run time from when the detector was turned on (shown in hours and minutes, hhhh:mm)
- Press the **MODE** button to step to the next function

Detector Status (STAT)



- Detector battery and temperature status
- **BattV**: Battery voltage
- **Temp**: Internal temperature (can be displayed in °C or °F – set in Programming Mode)
- Press the **MODE** button to step to the next function

Communicate with Computer (COMM)

12:34 [Battery] [Signal]
COMM
Communicate
with PC?

12:34 [Bluetooth] [Battery]
COMM
Communicate
ready...
BT:149-001011

- Press **SET** to open a Bluetooth® connection with a computer, and download datalogs and change configuration settings using ProRAE Studio Radiation software
- Press the **MODE** button to step to the next function

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- **Basic User Mode**
 - No password required
 - Change alarm type and alerts, datalog type, backlight and basic settings
 - Cannot change alarm thresholds
- **Full Programming Mode**
 - Password protected
 - Access to ALL settings

Programming Modes



- Press and hold the **MODE** and **SET** buttons for 3 seconds
- Datalog is paused
- Password entry screen is displayed

Programming Modes

- To enter **Basic User Mode**
 - Press **MODE** until Skip is highlighted, then press **SET**
- To enter **Full Programming Mode**
 - Use **SET** to increment the password digits, and **MODE** to move between digits to enter the password
 - Use **MODE** to highlight Ok and press **SET**

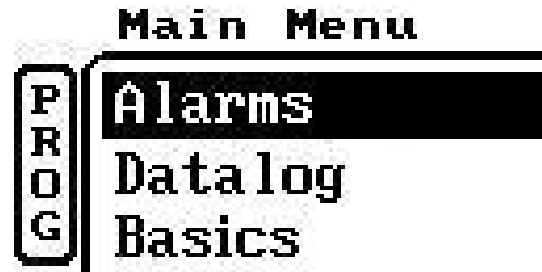


Basic User Mode

- Use MODE to step through the menu items, and SET to select one
- Highlighting and Selecting Quit exits Basic User Mode, restarts the datalog, and returns the unit to the NORM screen

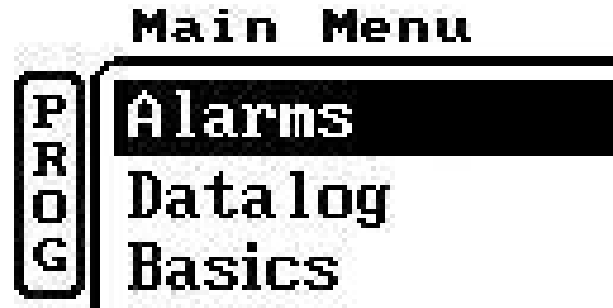


Basic User Mode



Menus	Sub-menu	Description
Alarms	Alarm Type	Select Search or Safety Mode
	Alarm Alerts	Select Buzzer, Vibrate, LEDs
Datalog	Datalog Type	Select Continuous or Event-Driven
Basics	Backlight	Select Manual, Off or Automatic
	Temp Unit	Select Fahrenheit or Celsius
	Gamma Unit	Select uR/h or uSv/h

Full Programming Mode



- Use MODE to step through the menu items, and SET to select one
- Highlighting and Selecting Quit exits Full Programming Mode, restarts the datalog, and returns the unit to the NORM screen

Alarms Menu

- Changing the Alarm settings

Sub-menus	Description
Alarm Type	Select Search or Safety Mode
Alarm Alerts	Select Buzzer, Vibrate, LEDs
Search Alarm	Select n = 1.0 to 9.9
Safety High	Select 1 uR/h to 600 R/h (0.01 uSv/h to 6 Sv/h). Choose units of uR/h, mR/h, R/h, uSv/h, mSv/h, Sv/h, cps, kcps, or Mcps
Safety Low	Select 1 uR/h to 600 R/h (0.01 uSv/h to 6 Sv/h). Choose units of uR/h, mR/h, R/h, uSv/h, mSv/h, Sv/h, cps, kcps, or Mcps
Dose Alarm High	Select 1 uR to 999 R (0.01 uSv to 9.9 Sv) Choose units of uR, mR, R, uSv, mSv, or Sv
Dose Alarm Low	Select 1 uR to 999 R (0.01 uSv to 9.9 Sv) Choose units of uR, mR, R, uSv, mSv, or Sv

Alarms Menu - Alarm Type – Search Mode

- Search Mode sets a single alarm threshold based on variations in the background radiation levels

$$\text{Search Mode Alarm} = (\text{Search Alarm}) * \sigma_{bk}$$

Where σ_{bk} is the standard deviation of the stored background reading.

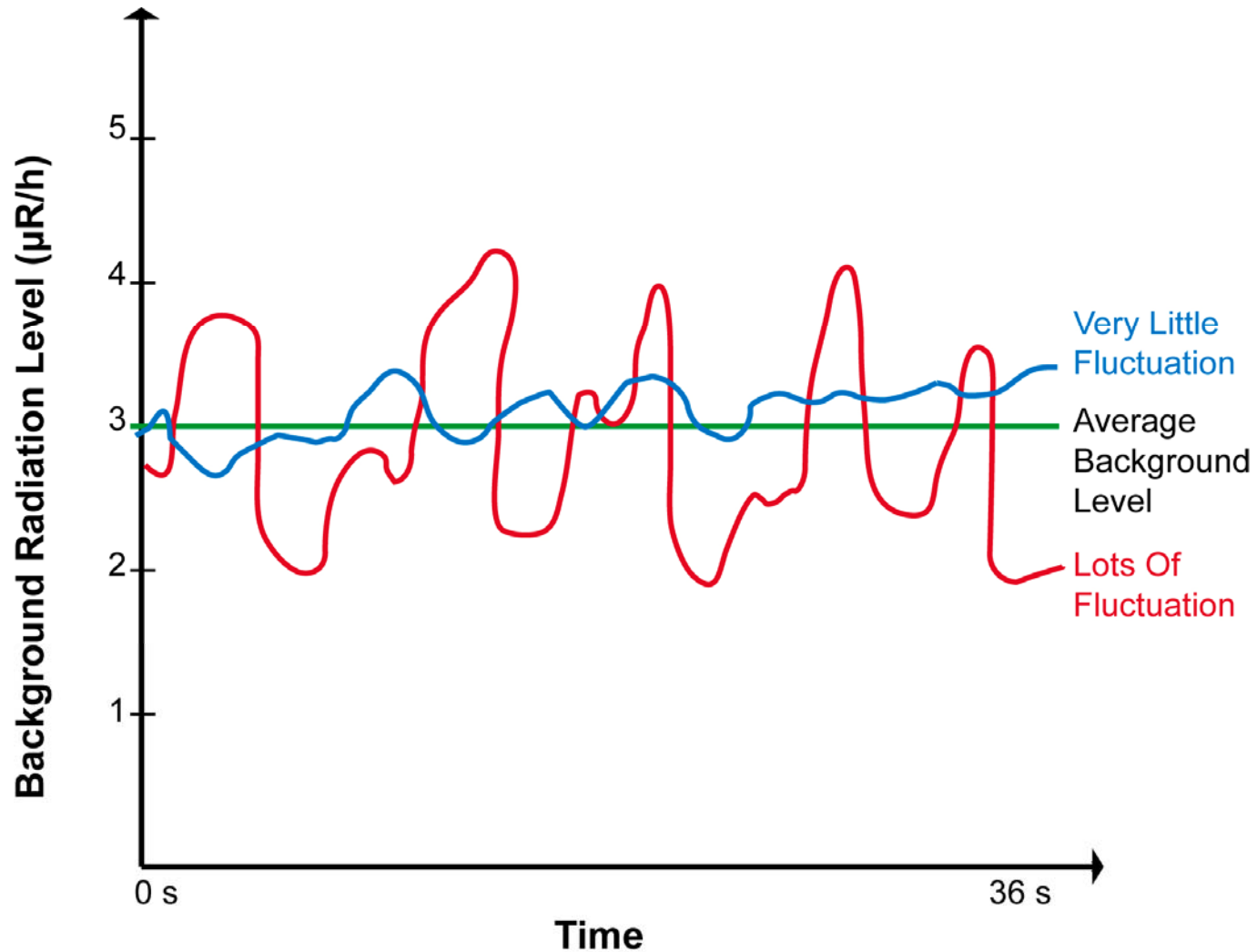
- Use to search for hidden radioactive sources

Alarms Menu - Alarm Type – Search Mode

Alarm Threshold = (Background radiation level) + (Search Alarm) X (standard deviation of background radiation level)

- Background radiation level obtained at start up, or by selecting Update Background
- Standard deviation of background radiation level is a measure of how much the background levels are fluctuating
 - If they are fluctuating a lot, the Search Alarm threshold should be set higher
 - If there is only a little fluctuation, the Search Alarm threshold should be set lower

Alarms Menu - Alarm Type – Search Mode



Alarms Menu - Alarm Type – Safety Mode

- **Safety Mode** sets low and high absolute alarm thresholds based on dose rate
- **Dose Alarm L** and **Dose Alarm H** set low and high absolute alarm thresholds based on accumulated dose
- Use for personal protection

Alarms Menu – Alarm Alerts

- Three alarm alerts – buzzer, vibrator, and visible LEDs – can be enabled or disabled by the user
- Press **MODE** to highlight a choice, and **SET** to save the highlighted option

Alarm Alert Choices
All on
Buzzer + Light
Vib + Buzzer
Buzzer only
Vib + Light
Light only
Vib only

Alarms Menu – Search Alarm

- The higher the Search Alarm setting, the higher the alarm threshold
- Set the Search Alarm to a value between 1.0 and 9.9
- To change the setting:
 - Use MODE to highlight a digit, and SET to increment the digit
- To save changes:
 - Use MODE to highlight Save, and press SET to save
- To cancel:
 - Use MODE to highlight Quit, and press SET to exit to the Alarms Menu



Alarms Menu – Safety High

- High, absolute alarm level on dose rate
- Set the Safety High alarm threshold to a value between 1 μ R/h and 600 R/h
- To change the setting:
 - Use MODE to highlight a digit, and SET to increment the digit
 - Use MODE to highlight the units, and SET to scroll through the units choices
- To save changes:
 - Use MODE to highlight Save, and press SET to save
- To cancel:
 - Use MODE to highlight Quit, and press SET to exit to the Alarms Menu



Alarms Menu – Safety Low

- Low, absolute alarm level on dose rate
- Set the Safety Low alarm threshold to a value between 1 μ R/h and 600 R/h
- To change the setting:
 - Use MODE to highlight a digit, and SET to increment the digit
 - Use MODE to highlight the units, and SET to scroll through the units choices
- To save changes:
 - Use MODE to highlight Save, and press SET to save
- To cancel:
 - Use MODE to highlight Quit, and press SET to exit to the Alarms Menu




Alarms Menu – Dose Alarm

- Absolute alarm level on total accumulated dose
- Set the Dose Alarm H and L thresholds to a value between 1 μ R and 999 R
- To change the setting:
 - Use MODE to highlight a digit, and SET to increment the digit
 - Use MODE to highlight the units, and SET to scroll through the units choices
- To save changes:
 - Use MODE to highlight Save, and press SET to save
- To cancel:
 - Use MODE to highlight Quit, and press SET to exit to the Alarms Menu

Datalog Menu

- Change datalog settings and clear datalog

Item	Description
Clear Data	Press SET to confirm clear
Datalog Type	Continuous or Event-Driven
Log Interval	1 sec to 3600 sec

- Disk icon () in upper-right corner of the display flashes when datalog is recording
- Datalog is wrap-around. When the memory is full:
 - Oldest data is recorded over
 - Disk icon becomes solid

Datalog Menu – Clear Data

- Press **SET** to select Clear Data
- Clear data? is displayed
 - Press **SET** to confirm
 - Press **MODE** to cancel



Datalog Menu – Datalog Type

- Select the datalogging mode
- **Continuous**
 - Always logs data at the set datalog interval
- **Event-Driven**
 - Begins recording data on alarm
 - Stop recording data 5 minutes after alarm condition is exited



Datalog Menu – Log Interval

- Set the desired datalog interval between 1 and 3600 seconds
- To change the interval:
 - Use **MODE** to highlight a digit, and **SET** to increment the digit
- To save changes:
 - Use **MODE** to highlight Save, and press **SET** to save
- To cancel:
 - Use **MODE** to highlight Quit, and press **SET** to exit to the Datalog Menu



- Change basic unit settings

Item	Description
Backlight	Manual, Off, or Automatic
Temp Unit	Fahrenheit or Celcius
Gamma Unit	uR/h (divisions of R) or uSv/h (divisions of Sv)
Change Date	Select Save to change date, or Quit to cancel
Change Time	Select Save to change time, or Quit to cancel

Basics Menu – Backlight

- Sets the behavior of the screen backlight
 - Automatic: Photosensor in left LED housing senses dim lighting and turns backlight on automatically
 - Manual: Pressing MODE or SET turns backlight on
 - Off: Backlight is always off
- Note that using the backlight frequently will drain the batteries faster

Photosensor in
LED housing



Basics Menu – Temp Unit

- Choose the preferred temperature unit for the internal temperature reading on the STAT screen
 - Celsius (°C)
 - Fahrenheit (°F)
- Press **MODE** to highlight the desired unit
- Press **SET** to save your choice and exit to the Basics Menu



Basics Menu – Gamma Unit

- Choose the preferred radiation measurement unit for the dose and dose rate readings on the NORM, PEAK, MIN and DOSE screens
 - Divisions of Rems ($\mu\text{R}/\text{h}$, mR/h , R/h , μR , mR , R)
 - Divisions of Sieverts ($\mu\text{Sv}/\text{h}$, mSv/h , Sv/h , μSv , mSv , Sv)

Basics Menu – Gamma Unit

- Press MODE to highlight the desired unit
- Press SET to save your choice and exit to the Basics Menu



Basics Menu – Change Date

- Set the date for the datalog date-stamp and TIME screen
- To change the date:
 - Press MODE to select the month, day or year, and SET to increment the selected item
- To save changes:
 - Use MODE to highlight Save, and press SET to save
- To cancel:
 - Use MODE to highlight Quit, and press SET to exit to the Basics Menu
- NOTE: Dates are in MM/DD/YYYY format



Basics Menu – Change Time

- Set the time for the datalog time-stamp and TIME screen
- To change the time:
 - Press MODE to select the hour, minute and seconds, and SET to increment the selected item
- To save changes:
 - Use MODE to highlight Save, and press SET to save
- To cancel:
 - Use MODE to highlight Quit, and press SET to exit to the Basics Menu
- NOTE: Time is in HH:MM:SS format



Defaults Menu

- Restores factory default settings
- Press **SET** to select Defaults
- Restore Defaults? is displayed
 - Press **SET** to confirm
 - Press **MODE** to cancel
- All alarm, basics and datalog settings are restored to the factory defaults. Recorded data is not lost.



Clear Dose Menu

- Clear the accumulated dose
- Press the **SET** button to clear the DOSE value: “Clear Dose?” will be displayed
 - Press **SET** again to clear the dose
 - Press **MODE** to cancel and keep the current dose reading

RAE Systems

3775 North First Street

San Jose, CA 5134

Voice: 408-952-8200

Fax: 408-952-8480

www.raesystems.com

