UltraRadiac™-Plus Personal Radiation Monitor

7068914D   **User's Manual**

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UltraRadiac™-Plus
Personal Radiation
Monitor

User's Manual

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Preface

The UltraRadiac-Plus is a hand-held personal radiation monitor designed for the needs of first responders.

- Measures and displays radiation dose rate and total dose

- Presettable two level audio, visual and vibrating alarms for rate and dose.

- Designed to operate in extremes of temperature, shock, humidity, dust, immersion and radiation

- Large, easy-to-read backlit LCD display

- Intuitive six button user interface

- Operable/readable by personnel in fire fighting or HAZMAT protective gear

- Can be powered by NiMH rechargeable batteries (optional DC charger)

- Ultra-small size (12.8 in.^{3}) and weight (9.5 oz)

- Low life cycle costs due to calibration stability and automatic self calibration

- Mirion Technologies's unique time-to-count technology for wider dynamic range

- Data logging capability to 999 points

- "Stay time" display shows time remaining to dose alarm

- Source finder mode

- Derived from military qualified MRAD115 Radiac Set

1.   Introduction

The UltraRadiac™-Plus is a durable, portable, personal radiation monitor. Once set up, it is preconfigured to detect certain types of radiation, and then alert you using an audible and/or vibrating alarm and a visual data display. It can log (save a record of) radiation data for further evaluation by your Administrator.

READ THIS

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If you don't read anything else in this manual, read the chapters *Controls and Indicators* on page 5 and *Basic Operations* on page 9. These cover the basics of using the UltraRadiac-Plus Personal Radiation Monitor.

Note: Operational procedures are the responsibility of the UltraRadiac-Plus's users. Instructions provided in this manual are "how to's", not procedural recommendations.

Your UltraRadiac-Plus can measure and display both the instantaneous radiation dose rate (Rate), the amount of radiation being measured at this moment, and the total accumulated radiation dose received (Dose) since the dose memory was last cleared.

The Alarms

The UltraRadiac-Plus's presettable alarms for both instantaneous Rate and cumulative Dose can alert you to hazardous conditions. When an enabled alarm's threshold is exceeded, a visual indicator will begin flashing and, optionally, an LED will blink and/or an audible alarm will sound. All units also include a vibrator alarm that can be independently set.

The Radiation Units

Depending on the model, your UltraRadiac-Plus is factory-set to display the Rate and the Dose in one of these units of radiation measurement:

- R (roentgen) – a measure of radiation exposure.

- Sv (sievert) – a measure of absorbed dose equivalent.

Most illustrations in this manual show the radiation units as μR (microroentgens, one millionth of a roentgen). The units are defined in the appendix *Default Alarm Settings* on page 65.

Equipment Check

If your organization's procedures require periodic equipment checks, refer to the chapter *Operational Verification Tests* on page 16.

Setting Up the Unit

The UltraRadiac-Plus has five modes: Rate, Dose, Source Finder, Sleep, and Data Logging. The chapter *Setting Up the Unit* on page 28, describes them and tells you how to set and enable the Rate alarms and the Dose alarms.

Maintenance Procedures

The chapter *Maintenance* on page 48, lists the UltraRadiac-Plus's preventive maintenance checks and describes how to install, charge, or replace the batteries. The UltraRadiac-Plus uses four AAA batteries and can accept either alkaline or rechargeable NiMH .

Note: The battery recharging device should only be used with NiMH batteries. Connecting the charger with Alkaline batteries may result in severe damage to the batteries or the device.

2. Controls and Indicators

This is a brief overview of the UltraRadiac-Plus's controls and indicators and its protective case. Each of the controls and indicators is covered in detail in the remaining sections of the manual.
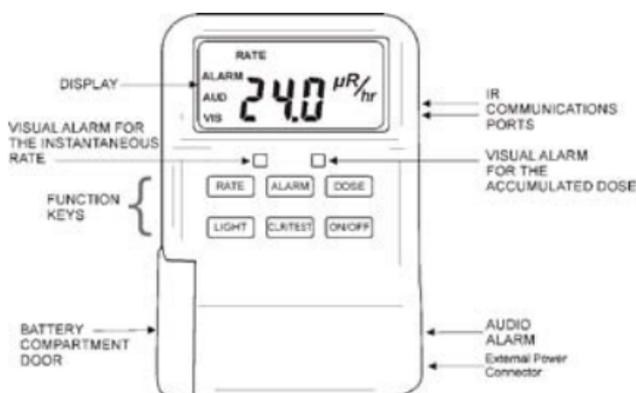
Figure 1 The UltraRadiac-Plus Front Panel

The Function Keys

The primary function of each of the function keys is briefly described below. The programming functions of these keys are covered in the chapter *Setting Up the Unit* on page 28.

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ON/OFF   Press and hold to turn the unit on or off.

RATE   Press to change to the Rate Mode.

DOSE   Press to change to the Dose Mode.

ALARM   Press to see the Stay Time, the number of minutes you can safely stay in the area at the current Dose Rate. Specific information on Stay Time is given in the *Glossary* on page 68.

WARNING: If the Dose Rate goes up, your remaining Stay Time will go down.

You should check your Stay Time frequently when you are in the presence of radiation.

LIGHT	In the dark, press to illuminate the display for about five seconds. Note that the backlight may not be visible in daylight or normal room lighting.
CLR/TEST	In the Rate Mode, press and hold to enable the Display Test Sequence

The Battery Life Indicator

The UltraRadiac-Plus has two battery life indicators. See *The Batteries* on page 49 for instructions on changing the batteries.

- If a blinking 8 is displayed, the unit has stopped functioning. Replace the batteries before the unit's next use.

- If a blinking BAT is seen in the top-left corner of the display, the unit's batteries have 10 hours or less of useful life. Replace the batteries as soon as possible.

- If the display is blank, the batteries are dead. Replace the batteries before the unit's next use.

Remaining Battery Life

In the Rate Mode with the BAT indicator blinking, press the **CLR/TEST** key. A three-digit number indicating the approximate remaining battery life, in minutes, will be displayed.

3.   Basic Operation

The first time you take your UltraRadiac-Plus out of its shipping carton, you'll have to install its batteries. For detailed instruction see *The Batteries* on page 49.

Powering the Unit

 ► To turn the unit on, press **ON/OFF** until 000 is displayed.

 ► Release **ON/OFF**.

 ► In a few seconds, the instantaneous rate will be displayed, with the word RATE at the top left of the screen.

 ► If a 8 or a blinking BAT indicator appears in the display or if the display is blank, refer to *The Battery Life Indicators* on page 7.

 ► To turn the unit off, press **ON/OFF** until – – – is displayed.

Turning Off an Alarm

The UltraRadiac-Plus has two alarms, Low Level and High Level for each of two modes, Rate and Dose.

If any alarm sounds, the next four sections tell you how you turn it off.

- **Clearing the Low Rate Alarm**

  ▶ Press the **CLR/TEST** key to turn off the vibrator and the audio alert.

  ▶ The visual alerts will continue until the rate falls below the Low Rate Alarm threshold.

- **Clearing the High Rate Alarm**

  ▶ Press the **CLR/TEST** key to turn off the vibrator.

  ▶ The audio (if enabled) and visual alerts will continue until the Rate falls below the High Rate Alarm threshold.

▶ At that time, the unit may pass into the Low Rate Alarm region depending on the set point. See above instructions for clearing this alarm.

- **Clearing the Low Dose Alarm**

  ▶ Press the **CLR/TEST** key to turn off the vibrator and the audio alert.

  ▶ The visual alerts will continue until the integrated Dose is reset to 0.

  ▶ To turn off the visual alerts, you'll have to clear the dose memory. See *Clearing the Accumulated Dose* on page 13.

- **Clearing the High Dose Alarm**

  ▶ Press the **CLR/TEST** key to turn off the vibrator.

  ▶ The visual alerts will continue until the integrated Dose is reset to 0.

  ▶ To turn off the alerts, you'll have to clear the dose memory. See *Clearing the Accumulated Dose* on page 13.

Checking Your Stay Times

Press **ALARM** to see the number of minutes you can safely stay in the area at the current Dose Rate. Specific information on Stay Time is given in the *Glossary* on page 68.

WARNING: If the Dose Rate goes up, your remaining Stay Time will go down.

You should check your Stay Time frequently when you are in the presence of radiation.

Checking the Accumulated Dose

► Press **DOSE** to see the accumulated dose (the word DOSE is at at the top right of the screen).

► To return to the Rate Mode, press the **RATE** key.

Clearing the Accumulated Dose

- ▶ Press and hold **DOSE** + **CLR/TEST**.

- ▶ The display will flash for a few seconds, then clear the accumulated dose.

- ▶ To return to the Rate Mode, press the **RATE** key.

Reading the Alarm Threshold

- ▶ Press **ALARM** + **RATE** or **ALARM** + **DOSE**.

- ▶ You'll see an H, for High Level Alarm, displayed.

- ▶ To read the Low Level Alarm setting, press the **RATE** (**DOSE**) key again; the display will show an L.

- ▶ Press the **CLR/TEST** key; the flashing display will show the selected (H or L) alarm threshold setting.

▶ If the Vibrator Alarm has been
   activated, the display will alternate
   between the threshold value and a
   vertically scrolling horizontal bar
   (– – –).

Changing the Alarm Indicators

▶ Press the **ALARM** + **RATE** keys or
   the **ALARM** + **DOSE** keys.

▶ You'll see an H, for High Level
   Alarm, displayed.

▶ To change the Low Level indicators,
   press the **RATE** (**DOSE**) key again;
   the display will show an L.

▶ Press the **CLR/TEST** key to access
   the selected (H or L) indicators.

▶ Repeatedly press the **ALARM** key
   until you see the desired combination
   of indicators: AUDio, VISual,
   vibrator, or no indicators.

Using the Backlight

In dim light, you can enable the unit's backlight to read the display.

- Press the **LIGHT** key.

- The display's backlight will turn on.

- To conserve battery power, the backlight will automatically turn off in about five seconds.

4. Operational Verification Tests

These Operational Verification Tests should be performed periodically, as required by your departmental procedures.

Installing the Batteries

The first time you take your UltraRadiac-Plus out of its shipping carton, you'll have to install its batteries. See *The Batteries* on page 49 for instructions.

CAUTION: Use of non-rechargeable batteries or rechargeable batteries other than those supplied or recommended by Mirion Technologies (Canberra) may cause an explosion or other fire hazard resulting in personal injury. Mirion Technologies (Canberra) is not liable for personal injury or damage resulting from the use of incompatible batteries.

Turning the Unit On

Press and hold the **ON/OFF** key until the display appears, then release the key.

- The unit will display the numbers 0, 1, 2, 3, 4, in sequence.

- The Rate Mode display should appear, with the word RATE shown at the top left of the screen (Figure 2).
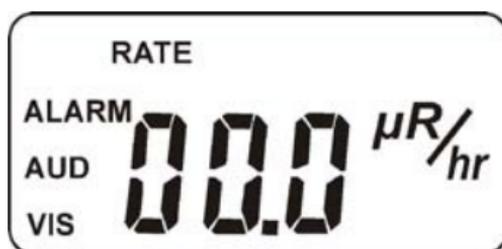
Figure 2 The Rate Display

- If 8 or a blinking BAT indicator appear in the display or if the display is blank, refer to *The Battery Life Indicators* on page 7.

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- AUD and VIS indicate that the Audio and Visual alarms are both enabled.

- The unit will start counting and displaying the instantaneous Rate. Naturally occurring background radiation will cause the unit to display a low reading[1].

- To switch to the Dose Mode, press the **DOSE** key.

- Press the **RATE** key to return to the Rate Mode.

- The rate units indicator $\mu R/hr$ will blink slowly to show that the Rate Mode is active.

Note: Because the UltraRadiac automatically adjusts its display to accommodate the amount of data, the units (R, for instance) may be displayed with a prefix. For instance, at natural background levels, you'll see μR, microroentgens.

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[1] Naturally occurring background radiation typically measures less than 20 mR/h or 0.20 mSv/h.

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At higher exposure rates, the display will change to mR (milliroentgens). With large exposure rates, it will show just R. It's important to understand these units because each one is 1000 times greater than the previous one.

Turning the Unit Off

To turn the unit off:

- Press and hold the **ON/OFF** key.

- OFF will be displayed.

- Then you'll see – – –.

- Release the **ON/OFF** key; the unit will turn its power off.

All data collected up to this time will be stored in memory.

Instrument Test

While in the Rate Mode, press and hold the
CLR/TEST key until you see the test display
in Figure 3, then release the key[2].

Figure 3 The Test Display

Display Test Sequence

- A set of numbers in the following order
  will appear. Check that all of the
  numbers are exactly as shown below.

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[2] The 'GN' located in the upper right corner of the
display is used only by maintenance technicians.
It's shown here so you can verify that the entire
display is operating properly.

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```
        00.0 µR
       1 1 1 µR
        2.22 mR
        33.3 mR
         444 mR
        5.55 R
        66.6 R
         777 R
         888 R
         999 R
        00.0 µR
      9 (blinking)
```

- The blinking 9 indicates that the unit passed all tests. A blinking 0 indicates a failure; contact your local Mirion Technologies (Canberra) Service Center.

  - Press the **CLR/TEST** key to return to Rate Mode (or wait about 10 seconds).

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Checking the Alarm

At any time during the Clr/Test sequence of numbers:

- Press the **RATE** key – the audio alarm should sound and the Rate LED, the left and one below the display, should turn on.

- Press the **DOSE** key – the audio alarm should sound and the Dose LED, the right hand one below the display, should turn on.

- Press the **ALARM** key – the audio alarm should sound and both LEDs should turn on.

- If the optional vibrator alarm is installed, the unit will vibrate when any of these three keys is pressed.

Checking the Function Keys

When the 000 display appears during the "Testing the Display" sequence, press each function key in turn, except the **ON/OFF** key.

The unit will beep and display the indications shown in the following table. Any other numerical indication indicates a fault in that key's circuit.

Function	Indication
DOSE	002
ALARM	010
RATE	001
LIGHT	020
CLR/TEST	004

Ending the Display Test

At the end of the test sequence, the blinking 9 will appear, indicating that the Rate Mode is operational. A blinking 0 indicates a failure; contact your local Mirion Technologies (Canberra) Service Center.

The unit will return to the Rate Mode in about ten seconds.

Backlight Test

Press the **LIGHT** key; the display's backlight will turn on for about five seconds. This function is meant to be used in total darkness; the backlight may not be visible in daylight or normal room lighting.

Sleep Mode Test

Press and hold the **RATE** key, then press the **ON/OFF** key.

- The characters SLP will be displayed briefly.

- When you see – – – , release both keys.

- You'll see the SLEEP indicator at the top of the screen (Figure 4)
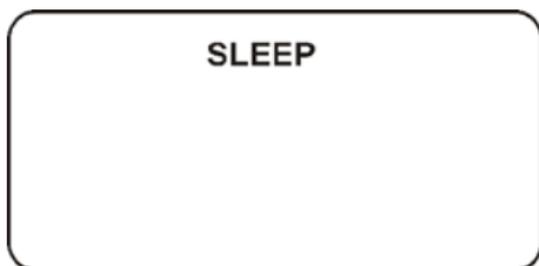
Figure 4 The Unit is Asleep

- To wake the unit, press and hold the
  ON/OFF key until the SLEEP indicator
  disappears.

- The unit will cycle through the 0–4
  startup sequence, then return to the Rate
  Mode.

Completing the Test

When the UltraRadiac has passed all tests, the
unit is ready for operation.

If the unit fails any of these Operational
Verification Tests, contact your local Mirion
Technologies (Canberra) Service Center.

GM Tube Failure Indication

If the unit's Geiger-Mueller tube should stop counting, the display will flash, showing three rows of three dashed lines each (Figure 5).
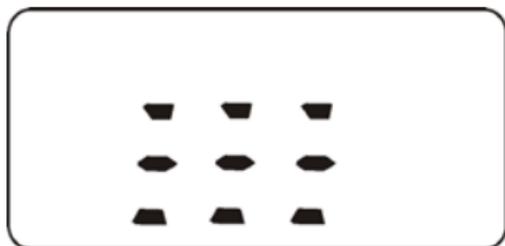
Figure 5 The GM Tube Has Failed

Contact your local Mirion Technologies (Canberra) Service Center for repairs.

Operation at Low Temperatures

At temperatures below –22 °F (–30 °C), it takes somewhat longer for characters to form on the display. The UltraRadiac-Plus automatically corrects for this by sensing the ambient temperature and increasing the display refresh time from two to five seconds. Operation of the UltraRadiac-Plus is otherwise unchanged.

Error Displays

Above 200 R/hr (2.0 Sv/h), and up to 600 R/h (6.0 Sv/h), the upper three-segment bar ($- - -$) on the display will begin flashing to indicate that:

- The dose rate exceeds the range of the UltraRadiac-Plus.

- The error might be greater than 20%.

- The value of the displayed dose rate (and consequently of the calculated dose) is not accurate.

- The "true rate" might be significantly higher than the displayed value.

Above 600 R/h (6.0 Sv/h) the unit will not increase dose-rate measurement and will keep displaying 600 R/h (6.0 Sv/h).

5. Setting Up the Unit

This chapter has been written for the System Administrator, the person responsible for your organization's UltraRadiac-Plus units. It describes each of the unit's functions and gives detailed instructions on how to set and enable the alarms. This is applicable only if the functions were not disabled by the optional Model S900 UltraRadiac Setup Software.

CAUTION: To make your changes permanent, you must go through the entire setup sequence outlined in this chapter.

Exiting the sequence before it is complete, such as by changing only one parameter then waiting 10 seconds for the display to return to the Rate Mode, will cause all changes to be lost when the unit is turned off.

The Rate Mode

To turn the UltraRadiac-Plus on, press and hold **ON/OFF** key until you see the Rate display in Figure 6.

Figure 6 The Rate Display

The Rate Alarm

There are two Rate Alarm Thresholds: Low Rate, for a minor hazard, and High Rate, for a severe hazard.

The alarm indicators will remain enabled as long as you remain in the radiation area that triggered the alarm.

High Threshold

There are several indicators for the High Rate Alarm Threshold (Figure 6).

- **Visual Enabled** – The entire display and the left LED will flash quickly.

- **Audio Enabled** – The audio will beep quickly.

- **Optional Vibrator Enabled** – The unit will vibrate.

Low Threshold

There are several indicators for the Low Rate Alarm Threshold (Figure 6).

- **Visual Enabled** – The **RATE** and **ALARM** indicators and the left LED will flash slowly.

- **Audio Enabled** – The audio will beep slowly.

- **Optional Vibrator Enabled** – The unit will vibrate.

The optional Vibrator Alarm can be used in addition to the audio and visual alarms when background noise makes the audio alarm hard to hear.

Reading the Rate Alarm Threshold

To display the High level (H) or Low level (L) rate alarm thresholds:

- Press the **ALARM** and **RATE** keys.

- You'll see an H, for High Level Alarm, displayed.

- To read the Low Level Alarm setting, press the **RATE** key again; the display will show an L.

- Press the **CLR/TEST** key; the flashing display will show the selected (H or L) alarm threshold setting.

- If the optional Vibrator Alarm has been activated, the display will alternate between the threshold value and a vertically scrolling horizontal bar (− − −).

Changing the Rate Alarm Indicators

To change the High level (H) or Low level (L) alarm indicator settings:

- Press the **ALARM** and **RATE** keys.

- You'll see an H, for High Level Alarm, displayed.

- To change the Low Level indicators, press the **RATE** key again; the display will show an L.

- Press the **CLR/TEST** key to access the selected (H or L) indicators.

- Repeatedly press the **ALARM** key until you see the desired combination of indicators, AUDio, VISual, vibrator (– – –), or no indicators.

- The unit will automatically return to the Rate Mode display about 10 seconds after the last keypress.

Changing the Rate Alarm Thresholds

To change the High level (H) or Low level (L) rate alarm settings:

- Press the **ALARM** and **RATE** keys.

- You'll see an H, for High Level Alarm, displayed.

- To access the Low Level Alarm settings, press the **RATE** key again; the display will show an L.

- Press the **CLR/TEST** key; the flashing display will show the selected alarm level (H or L) settings.

- If the optional Vibrator Alarm has been activated, the display will alternate between the threshold value and a vertically scrolling horizontal bar (– – –).

Changing the Alarm Indicators

- To choose one or more of the alarm indicators for the selected alarm level:

- Repeatedly press the **ALARM** key until you see the desired combination of indicators, AUDio, VISual, vibrator, or no indicators.

Setting the Alarm Threshold

To set the threshold for the selected alarm level (Figure 7):
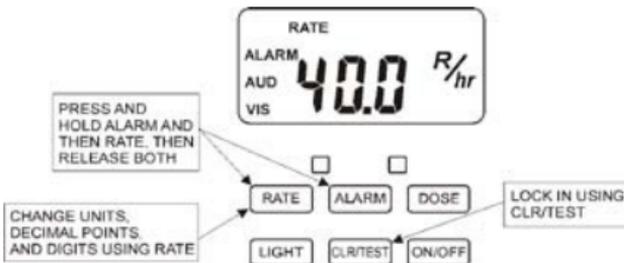
Figure 7 Changing the Rate Alarm Threshold

- Press the **CLR/TEST** key; the decimal point and the threshold unit indicator will begin to flash.

- Repeatedly press the **RATE** key until the desired decimal point location and threshold unit indication are displayed.

- Press the **CLR/TEST** key. This action will lock in the selected decimal point location and threshold unit indication.

- The left-most digit will begin to flash.

- Repeatedly press the **RATE** key until the desired value of the digit is displayed.

- Press the **CLR/TEST** key to lock in the digit's value. The next digit will begin to flash.

- Repeat the above two steps to select and lock in each of the two remaining digits.

- When the last digit has been set, the entire threshold value and unit will flash.

- Press the **CLR/TEST** key to return to the Rate Mode or wait about 10 seconds.

The Dose Mode

When the unit is on, dose data is continuously accumulated and updated every two seconds.

- To enter the Dose Mode, press the **DOSE** key.

- The Dose Mode display (Figure 8) will show you the dose that has accumulated since the unit's memory was last reset to zero.
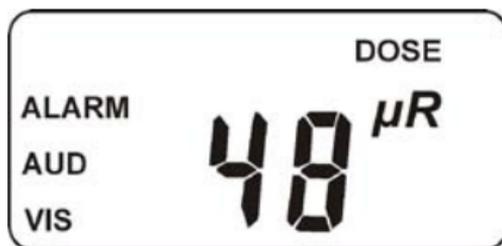
Figure 8 The Dose Display

The AUD and VIS display indicators will be seen only if the corresponding Dose Alarm mode and its indicator have been enabled. See *Changing the Dose Alarm Indicator* on page 38.

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The Dose Alarms

There are two Dose Alarm thresholds: Low Dose, for a minor hazard, and High Dose, for a severe hazard.

The optional Vibrator Alarm can be used in addition to the audio and visual alarms when background noise makes the audio alarm hard to hear.

High Threshold

There are several indicators for the High Dose Alarm Threshold (Figure 8).

- **Visual Enabled** – The DOSE and ALARM indicators and the right LED will flash quickly.

- **Audio Enabled** – The audio will beep quickly.

- **Optional Vibrator Enabled** – The unit will vibrate.

Low Threshold

There are several indicators for the Low Dose Alarm Threshold (Figure 8).

- **Visual Enabled** – The **ALARM** indicators and the right LED will flash slowly.

- **Audio Enabled** – The audio will beep slowly.

- **Optional Vibrator Enabled** – The unit will vibrate.

Reading the Dose Alarm Threshold

To display the High level (H) or Low level (L) dose alarm thresholds:

- Press the **ALARM** and **DOSE** keys.

- You'll see an H, for High Level Alarm, displayed.

- To read the Low Level Alarm setting, press the **DOSE** key again; the display will show an L.

- Press the **CLR/TEST** key; the flashing display will show the selected (H or L) alarm threshold setting.

- If the optional Vibrator Alarm has been activated, the display will alternate between the threshold value and a vertically scrolling horizontal bar (– – –).

Changing the Dose Alarm Indicators

To change the High level (H) or Low level (L) alarm indicator settings:

- Press the **ALARM** and **DOSE** keys.

- You'll see an H, for High Level Alarm, displayed.

- To change the Low Level indicators, press the **DOSE** key again; the display will show an L.

- Press the **CLR/TEST** key to access the selected (H or L) indicators.

- Repeatedly press the **ALARM** key until you see the desired combination of indicators, AUDio, VISual, vibrator (– – –), or no indicators.

- The unit will automatically return to the Dose Mode display about 10 seconds after the last keypress.

Changing the Dose Alarm Thresholds

To change the High level (H) or Low level (L) rate alarm settings:

- Press the **ALARM** and **DOSE** keys.

- You'll see an H, for High Level Alarm, displayed.

- To access the Low Level Alarm settings, press the **DOSE** key again; the display will show an L.

- Press the **CLR/TEST** key; the flashing display will show the selected alarm level (H or L) settings.

- If the optional Vibrator Alarm has been activated, the display will alternate between the threshold value and a vertically scrolling horizontal bar (– – –).

Setting the Alarm Threshold

To set the threshold for the selected alarm level:

- Press the **CLR/TEST** key; the decimal point and the threshold unit indicator will begin to flash.

- Repeatedly press the **DOSE** key until the desired decimal point location and threshold unit indication are displayed.

- Press the **CLR/TEST** key. This action will lock in the selected decimal point location and threshold unit indication.

- The left-most digit will begin to flash.

- Repeatedly press the **DOSE** key until the desired value of the digit is displayed.

- Press the **CLR/TEST** key to lock in the digit's value. The next digit will begin to flash.

- Repeat the above two steps to select and lock in each of the two remaining digits.

- When the last digit has been set, the entire threshold value and unit will flash.

- Press the **CLR/TEST** key to return to the Rate Mode or wait about 10 seconds.

The Source Finder Mode

The Source Finder Mode allows the unit to locate an isolated source. In this mode, the unit will start clicking if the unit is near radioactive material. As you move closer to the radioactivity (or further away), the unit will click faster (or slower).

For best results, aim the top of the unit at the suspected source of the radiation.

The Rate and Dose modes are active when the Source Finder Mode is enabled. This means that you can read the higher Rate or Dose without exiting the Source Finder Mode.

Enabling the Source Finder Mode

To enable the Source Finder Mode:

- Press and hold the **RATE** key until the display changes to a flashing 1.

- Release the **RATE** key.

Exiting the Source Finder Mode

To exit the Source Finder Mode:

- Press and hold the **RATE** key until the display changes to a flashing 0.

- Release the **RATE** key.

The Sleep Mode

When the Sleep Mode is enabled, most of the unit's circuits will be turned off to conserve battery power. Every 5 minutes, the unit will wake up for 4–6 seconds and check the current Rate.

The battery life time for the UltraRadiac-Plus in this mode is approximately 2000 hours.

WARNING: Do not place the unit in Sleep Mode before responding!

Doing so can expose you to radiation for as long as five minutes before you are alerted.

Enabling the Sleep Mode

To enable the Sleep Mode:

- Press and hold the **RATE** key, then press the **ON/OFF** key.

- The characters SLP will be displayed briefly.

- When you see – – – , release both keys.

- You'll see the SLEEP indicator at the top of the screen (Figure 9)
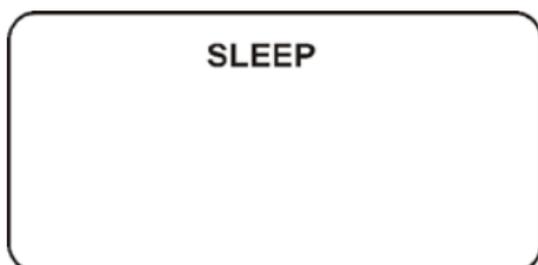
Figure 9 The Unit is Asleep

When the Unit Wakes Up

- It compares the current Rate with the Rate Alarm thresholds.

- If a Rate Alarm is triggered, the unit will stay awake.

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- If no Rate Alarm thresholds have been exceeded, the unit will go back to sleep for five minutes.

- This wake-sleep cycle will repeat continuously until the Sleep Mode is cancelled.

Note: The unit does not accumulate Dose data while asleep.

Exiting the Sleep Mode

To exit the Sleep Mode:

- Press and hold the **ON/OFF** key until the unit starts cycling through the 0–4 startup sequence.

- The unit will then exit the Sleep mode and enter Rate Mode.

The Data Logging Mode

The Data Log lets you record up to 999 individual dose/rate data pairs, each with an index number, for later retrieval. This is useful for performing a survey or for cataloging readings.

Capturing Data Pairs

To capture data pairs, the unit must be ON and in the Rate Mode.

- Press the **RATE** and **DOSE** keys together.

- Hold both buttons down until the displayed number stops blinking (in about three seconds),

- The next sequential rate/dose pair index number will appear.

- Release both buttons. The unit will save the data pair and its index, then return to the Rate Mode. This process takes about 10 seconds.

- To record another reading, point the unit at the location to be recorded and repeat the process.

Viewing the Data Log

To view the stored data, the unit must be OFF.

- Press the **RATE** and **OFF/ON** keys together.

- When the unit turns on, the last sequence number recorded will be displayed.

- Press the **RATE** button to scroll down, or the **DOSE** button to scroll up, through the memory.

- The first number shown in the display will be the index number, scrolling up (**DOSE** button) will next display the Rate data and scrolling up once again will display the Dose data.

- Scrolling down (**RATE** button) will reverse the order of sequence numbers but will still display first Rate data then Dose data.

- Scrolling will wrap around the memory, from first index entry to last, or last to first.

- To return to normal operation, the unit must be turned off and then on again (normal turn on sequence).

When the 999th sequence number has been recorded, the unit will cycle back to the first sequence number and any new data records will overwrite the previously recorded data in that location.

Clearing the Data Log

To clear all stored data, you must be in the Viewing the Data Log mode. (See the previous section.)

- While pressing both the **RATE** and **ALARM** keys, press and hold the **CLR/TEST** key for two seconds.

- The first index number (0) will appear

- This indicates that all data has been cleared.

- To return to the Rate/Dose mode of operation, turn the unit OFF, then back ON.

6.   Maintenance

Preventive maintenance consists of routine checks of the equipment before and after each mission, or as required by procedure.

Routine Checks Include:

- Cleaning the unit.

- Inspecting the battery compartment's door gasket.

- Inspecting the battery contacts for corrosion.

Cleaning the Unit

Remove dust, moisture and loose dirt from the outside surfaces of the UltraRadiac-Plus with a clean soft cloth. If necessary, the unit may be cleaned with a mild solution of ordinary detergent and water, rinsed, and thoroughly dried.

The Batteries

If you're installing batteries for the first time, the following caution can be disregarded. If you're replacing the batteries, *be sure to turn the unit off first*.

Installing or Replacing the Batteries

- To open the battery compartment door, turn its fastener a quarter-turn counterclockwise, swing the door open and slide out all four batteries.

- Install fresh batteries in the order shown in Figure 10.

CAUTION: Be sure to observe the polarity next to each of the four battery slots. The end of the battery facing out should match the slot's marked polarity, as shown in Figure 10 and Figure 11.

- With the batteries correctly installed, close and latch the door. See *Latching the Compartment Door* on page 54.
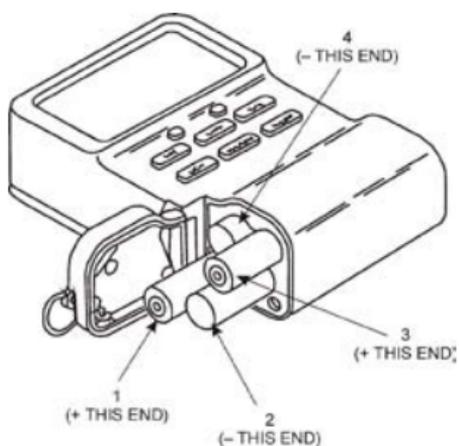
Figure 10 Location of the Batteries
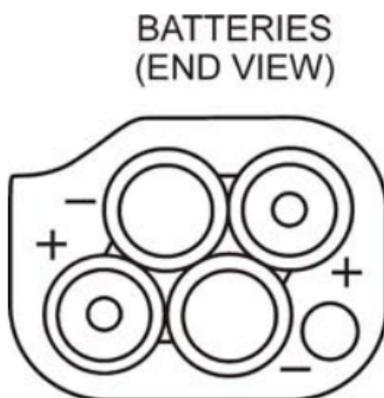
Figure 11 The Battery Polarity Indicators

Charging the Batteries

The UltraRadiac-Plus is equipped with the capability to use rechargeable AAA batteries as well as standard alkaline batteries. Nickel Metal Hydride (NiMH) batteries can be inserted in to the unit and used directly. To recharge the NiMH batteries insert them into the UltraRadiac-Plus and set the battery charger switch to ON position. In this setting, the charger will continuously charge the batteries while they are in the unit. In the POWER position, the UltraRadiac-Plus can be powered directly off of the charger without the batteries present. It can run in this mode indefinitely, although it can not recharge batteries in this mode. See Figure 12 and Figure 13.
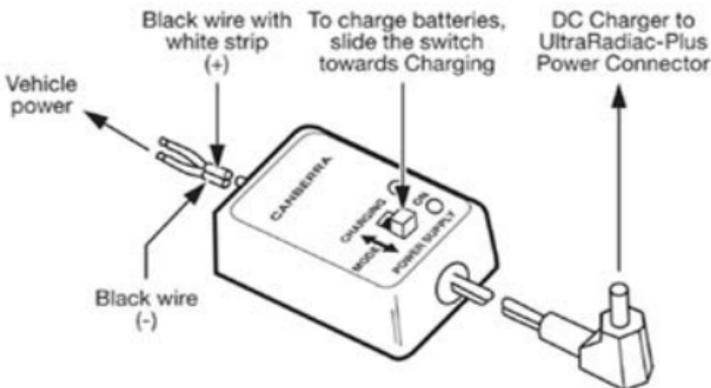
Figure 12 UltraRadiac-Plus Battery Charger

Figure 13 Right Side View of UltraRadiac-
Plus

Note: Do not attempt to charge standard
alkaline batteries. Damage can occur.

The Battery Compartment

To open the battery compartment door, turn its latch a quarter-turn counterclockwise and swing the door open.

- Inspect the four battery contacts on the inside of the door (Figure 14). If any corrosion is seen, clean it off with a pencil eraser.

- Inspect the seal on the inside of the door (Figure 14); it should be whole and entire. If the seal is cracked or broken, the unit may no longer be watertight.

- Inspect the O-ring seal around the door latch's post (Figure 14). If the seal is cracked or broken, the unit may no longer be watertight.

- For repair, contact your local Mirion Technologies (Canberra) Service Center.

- When the inspection is complete, close and latch the door. See the following section *Latching the Compartment Door*.

BATTERY CONTACTS

DOOR LATCH
O-RING

DOOR SEAL

BATTERY COMPARTMENT
DOOR – INSIDE VIEW
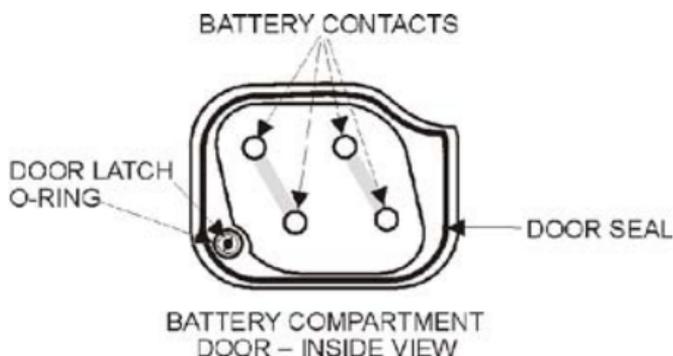
Figure 14 The Inside of the Battery Door

Latching the Compartment Door

Swing the battery cover closed, press it firmly against the unit and turn the fastener a quarter-turn clockwise.

Note: It may be necessary to turn the fastener slightly to line it up with the latch post before latch will engage.

When the door is properly closed, it will be possible to lay the fastener's D-ring down in the cover's fastener recess.

Note: When the door is latched, the unit may turn itself on in the Sleep Mode. To return to normal operation:

- Press and hold the ON/OFF key for about 2 seconds.

    – The unit will cycle through the display startup sequence, then enter the Rate Mode.

Attaching the Belt Clip

To attach the supplied belt clip, screw the clip's two captive retaining screws into the threaded inserts at the top of the unit's rear panel.

Note: To prevent cross-threading damage, insert each screw loosely, then tighten them alternately a few turns at a time. Do not over-tighten.

The Carrying Case

If the belt clip is installed, remove it from the back of the UltraRadiac-Plus by unscrewing its two captive retaining screws and lifting the clip off the unit.

Now put the UltraRadiac-Plus into the carrying case with the display toward the bottom (closed) end of the case. To close the case, refer to Figure 15 and...

❶   Fold the top flap down over the front of the case.

❷   Pull the narrow strap across the top flap.

❸   Secure the narrow strap to both the top flap and the side of the case.

❹   Thread your belt through the slots in the belt loop.
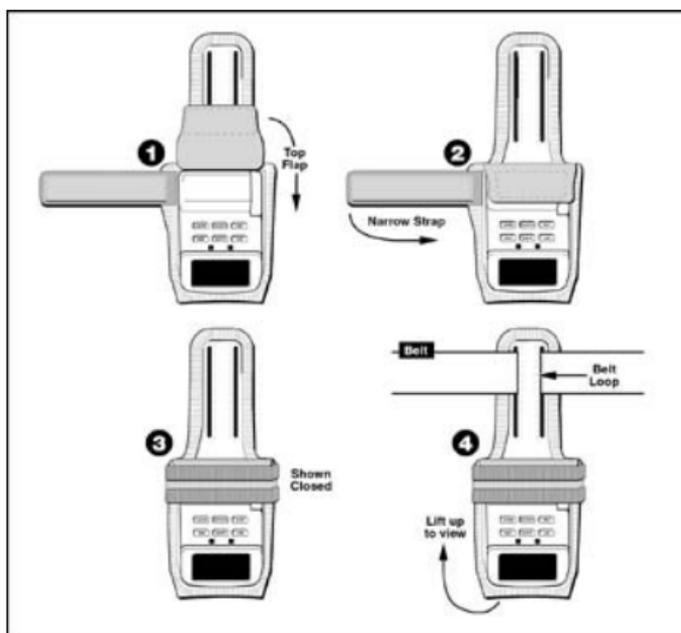
Figure 15 Using the Carrying Case

A. Specifications

Features

DOSE RATE – URAD-PLUS-S: 0.01 µSv/h to 2 Sv/h; URAD-PLUS-R: 1.0 µR/h to 200 R/h. Meets ANSI-N42.33-2006 standard above 1 µSv/h (100 µR/h). Dose rate alarm will function to 5.0Sv/h (500 R/h).

DOSE – URAD-PLUS-S: 0.001 µSv to 999 Sv; URAD-PLUS-R: 0.1 µR to 999 R.

PRESETTABLE AUDIBLE AND VISUAL ALARMS – User-defined and -set dose and dose rate alarms.

INITIALIZATION TIME – Operational in less than five seconds.

SETUP TIME – Less than one minute for all checks and alarms.

ACCURACY – Within ±30%. from 1 µSv/h (100 µR/h) to 2.0 Sv/h (200 R/h).

DATA RECORDING – Local data logging to
999 data points; data downloadable via optical
(IR) communications port.

SELF MONITORING – Continual self-
monitoring for the instrument's state of health.

CASE – Die-cast aluminum; available in
black or yellow.

EMI SUSCEPTIBILITY – Will not be
affected, or cause other equipment to be
affected, by its use.

OPERABLE AND READABLE – By persons
wearing protective clothing.

Detector

DETECTOR – Energy compensated GM
tube.

GAMMA ENERGY DEPENDENCE – ±40%,
60 keV to 1.5 MeV.

TOTAL (ACCUMULATED) DOSE
READOUT – Will not be erased when read;
resettable to zero as desired.

RESPONSE TIME – Achieves 90% of final reading in one second; subject to a step change from 1mR/h (10 µSv/h) to 55mR/h (550 µSv/h); updates display every second.

Display

LCD – Readable at 3 ft (1 m), updated every two seconds; can be backlit for night use.

UNITS – URAD-PLUS-S provides data in units of µSv, mSv, Sv, µSv/h, mSv/h and Sv/h; URAD-PLUS-R provides data in units of µR, mR, R, µR/h, mR/h and R/h.

Alarms

SELECTABLE ALARMS – Has selectable Visual and Audible indicators for day or night use. Alarm levels are settable over entire dynamic range.

ALARM TYPES – Alarm on dose rate and total cumulative dose.

ALARM LEVELS – Two alarm levels available for each type to indicate minor or severe hazard.

AUDIBLE ALARM – >85 dBA at 30 cm.

VIBRATION ALARM – Included.

Power

BATTERIES – Four AAA 1.5 V alkaline batteries.

MINIMUM BATTERY LIFE – 10 hours of battery life remaining allows display of remaining time.

LOW BATTERY INDICATION – Triggered when the remaining battery life is approximately 10 hours; allows display of remaining time in minutes.

Accept standard off the shelf rechargeable NiMH batteries with DC charger to URAD-PLUS power connector.

Environmental

OPERATING TEMPERATURE: –22°F to 141°F (–30°C to +61°C). Vibrating and audible alarms functional to -50°C.

At operating temperatures below -22°F (-30°C), it takes somewhat longer for characters to form on the display. The UltraRadiac-Plus automatically corrects for this by sensing the ambient temperature and increasing display refresh time from two to five seconds. Operation of the UltraRadiac-Plus is otherwise unchanged. Measurement is still accurate and audible and vibrating alarms are still functional even with the slower display refresh rate at low temperatures.

STORAGE/TRANSPORT TEMPERATURE: –40°F to 158°F (–40°C to +70°C).

HUMIDITY – Functions correctly over RH 40% to 93% at 95°F (35°C).

WATER IMMERSION (including salt water) – 3 ft (1 m) for at least 2 hr.

SAND/DUST – Operates in winds with exposure to fine dust and sand particles.

FUNGUS – Built from fungus resistant materials.

VIBRATION AND SHOCK – Withstands vibration associated with transport and shocks of dropping while in use.

ALTITUDE – 40 000 ft (12 000 m).

Physical

DIMENSIONS – 3.94 x 2.62 x 1.24 in. (100 x 66 x 31 mm) (HWD).

WEIGHT – 8.8 oz (249 g) including batteries. Pouch weight is 2.4 oz (68 g).

VOLUME – 12.8 in.^{3} (210 cc).

Qualification Testing

UltraRadiac-Plus has been type-tested to meet ANSI-N42.33-2006 with minor exceptions: Sec. 6.4, Sec. 5.12 and Sec. 5.7 (optional).

Ordering Information

URAD-PLUS-S/Y – UltraRadiac-Plus, Yellow, Sv unit, alkaline batteries.

URAD-PLUS-S/B – UltraRadiac-Plus, Black, Sv unit, alkaline batteries.

URAD-PLUS-R/Y – UltraRadiac-Plus, Yellow, R unit, alkaline batteries.

URAD-PLUS-R/B – UltraRadiac-Plus, Black, R unit, alkaline batteries.

URAD-PLUS-DCCHARG – DC charger with cigarette lighter connector (needs NiMH rechargeable batteries to operate).

URAD-PLUS-MOUNT – Vehicle mount for URAD-PLUS (allows the use of DC charger).

B. Default Alarm Settings

The Dose and Rate alarm settings (thresholds) for the UltraRadiac-Plus are factory set to the values in the following tables.

R	Low Setting	High Setting
Rate	500 µR/hr	2 R/hr
Dose	100 mR	10 R

Sv	Low Setting	High Setting
Rate	1 mSv/hr	100 mSv/hr
Dose	1 mSv	100 mSv

The factory settings can be changed manually (refer to the chapter *Setting Up the Unit* on page 28), or via the optional Model S900 UltraRadiac Setup Software.

CAUTION: The System Administrator is responsible for determining and setting the proper operational alarm thresholds for each UltraRadiac-Plus.

C. Display Units

Your unit's display will show R or Sv*[3]. Any unit can have larger and smaller subunits, which are indicated by prefixes. As the Rate and Dose change, the UltraRadiac-Plus will automatically adjust its displayed units.

For example: The Rate may start with µR/h (natural background radiation is less than 20 µR/h). If the Rate increases beyond 999 µR/h, the display will change to mR/h.

micro (µ)	µR – one millionth of a roentgen
milli (m)	mR – one thousandth of a roentgen (or µR times 1000)
centi (c)**	cR – one hundredth of a roentgen (or mR times 10)
the base unit	R – one roentgen (cR times 100)

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[3] The display units are set at the factory; they are not user changeable.

** The 'centi' prefix will be seen only on
UltraRadiac's displaying sievert units.

D. Glossary

These brief explanations are included to define terms used in this manual.

Dose

The total amount of radiation received. Also called Accumulated Dose.

Dose Rate

The average rate (in time) of radiation; e.g., Roentgen per hour. Also called Rate.

Rate

The amount of radiation measured by the UltraRadiac-Plus every 2 seconds, then extrapolated to and displayed as units per hour.

Roentgen (R)

Unit of measure of radiation exposure; monitors the amount of radiation received.

Sievert (Sv)

Unit of measure of absorbed radiation; monitors the biological danger of radiation.

Stay Time

The Stay Time is how much time remains, at the current Dose Rate, before the High Dose Alarm is triggered. Stay Time is calculated by dividing (the High Dose Alarm Setpoint minus the already accumulated Dose) by the current Dose Rate, then converting the result to minutes. If the display reads 999, the maximum, your Stay Time is at least 16.5 hours.

WARNING: If the Dose Rate goes up, your remaining Stay Time will go down.

You should check your Stay Time frequently when you are in the presence of radiation.

E. Disposing of This Equipment

Electrical and electronic equipment contain hazardous substances that, if disposed of improperly, can have a negative effect on the environment and on human health.

Users / owners of this equipment have the responsibility to ensure that this equipment does not pose a threat to the environment or to humans when it becomes obsolete and requires disposal.

The symbol below, also found on your equipment, indicates that this equipment should not be disposed of in unsorted municipal waste.

Therefore, following the provisions of COUNCIL DIRECTIVE 2002/96/EC on waste electrical and electronic equipment (WEEE), we ask that you contact your nearest Mirion Technologies office for instructions on the proper disposal of this equipment.

Warranty

Mirion Technologies (Canberra), Inc., (we, us, our) warrants to the customer (you, your) that for a period of ninety (90) days from the date of shipment, software provided by us in connection with equipment manufactured by us shall operate in accordance with applicable specifications when used with equipment manufactured by us and that the media on which the software is provided shall be free from defects. We also warrant that (A) equipment manufactured by us shall be free from defects in materials and workmanship for a period of one (1) year from the date of shipment of such equipment, and (B) services performed by us in connection with such equipment, such as site supervision and installation services relating to the equipment, shall be free from defects for a period of one (1) year from the date of performance of such services.

If defects in materials or workmanship are discovered within the applicable warranty period as set forth above, we shall, at our option and cost (A) in the case of defective software or equipment, either repair on a return to factory basis or replace the software or equipment, or (B) in the case of defective services, re-perform such services.

LIMITATIONS

EXCEPT AS SET FORTH HEREIN, NO OTHER WARRANTIES OR REMEDIES, WHETHER STATUTORY, WRITTEN, ORAL, EXPRESSED, IMPLIED (INCLUDING WITHOUT LIMITATION, THE WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE) OR OTHERWISE, SHALL APPLY. IN NO EVENT SHALL WE HAVE ANY LIABILITY FOR ANY SPECIAL, EXEMPLARY, PUNITIVE, INDIRECT OR CONSEQUENTIAL LOSSES OR DAMAGES OF ANY NATURE WHATSOEVER, WHETHER AS A RESULT OF BREACH OF CONTRACT, TORT LIABILITY (INCLUDING NEGLIGENCE), STRICT LIABILITY OR OTHERWISE. REPAIR OR REPLACEMENT OF THE SOFTWARE OR EQUIPMENT DURING THE APPLICABLE WARRANTY PERIOD AT OUR COST, OR, IN THE CASE OF DEFECTIVE SERVICES, REPERFORMANCE AT OUR COST, IS YOUR SOLE AND EXCLUSIVE REMEDY UNDER THIS WARRANTY.

EXCLUSIONS

Our warranty does not cover damage to equipment which has been altered or modified without our written permission or damage which has been caused by abuse, misuse, accident, neglect or unusual physical or electrical stress, as determined by our Service Personnel.

We are under no obligation to provide warranty service if adjustment or repair is required because of damage caused by other than ordinary use or if the equipment is serviced or repaired, or if an attempt is made to service or repair the equipment, by other than our Service Personnel without our prior approval.

Our warranty does not cover detector damage due to neutrons or heavy charged particles. Failure of beryllium, carbon composite, or polymer windows or of windowless detectors caused by physical or chemical damage from the environment is not covered by warranty.

We are not responsible for damage sustained in transit. You should examine shipments upon receipt for evidence of damage caused in transit. If damage is found, notify us and the carrier immediately. Keep all packages, materials and documents, including the freight bill, invoice and packing list.

Revised 04 Nov 16

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