RADIATION ALERT®

The *Geiger*

Operation Manual

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1 Introduction

The Geiger is a radiation safety instrument that measures beta, gamma, and x-rays.

Precautions

To keep the Geiger in good condition, handle it with care, and observe the following precautions.

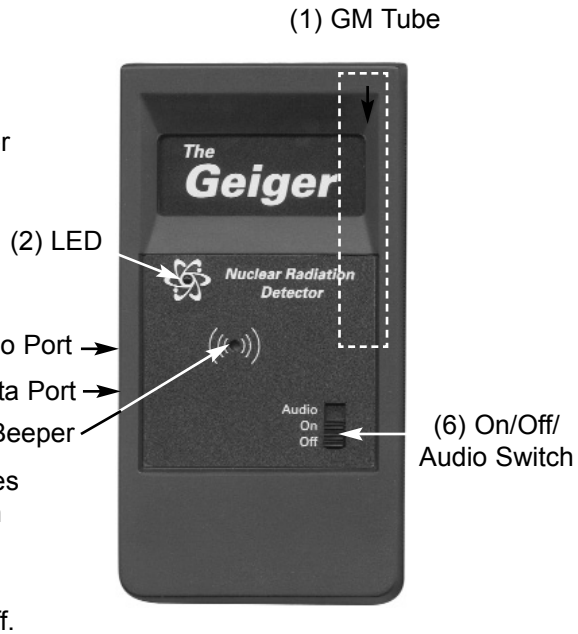
- Do not contaminate the Geiger by touching radioactive surfaces or materials.
- Do not leave the Geiger in temperatures over 100° F (38° C) or in direct sunlight for extended periods of time.
- Do not get the Geiger wet. Water can damage the circuitry.
- Do not put the Geiger in a microwave oven. It cannot measure microwaves, and you may damage it or the oven.
- Avoid using the Geiger in high-intensity radio frequency, microwave, electrostatic, and electromagnetic fields; it may be sensitive to these fields and may not operate properly.
- If you expect to not use the Geiger for longer than one month, remove the battery to avoid damage from battery corrosion.
- Change the battery promptly when the battery indicator appears on the display.

2 Features

This chapter briefly describes the Geiger's functions. For more information, see Chapter 3, "Operation."

The Switch

The Geiger has one switch on the front. The switch has three settings, which are described below.



On/Off/Audio (6)

Audio. The Geiger is on, and it makes a clicking sound for each radiation event detected.

On. The Geiger is operating, but audio is off.

Off. The Geiger is not operating.

The Detector (1)

The Geiger uses a glass Geiger Mueller tube to detect radiation. The tube is visible through the lexan window on the back of the instrument.

The Ports

There are two ports on the left side of the Geiger.

The **audio output (3)** is the top port on the side. It allows you to interface the Geiger to an external earpiece, amplifier, or tape recorder using a 2.5 mm plug.

The **data output port (4)** is below the audio output port. It allows you to interface the Geiger to a computer, data logger, using a 3.5 mm stereo plug. For more information, see “Interfacing to an External Device” in Chapter 3.

3 Operation

Starting the Geiger

Be sure that a standard 9-volt alkaline battery is installed in the battery compartment in the lower rear of the Geiger. Note: When installing the battery, place the battery wires along the side of the battery and not under it.

To start the Geiger, set the switch to **On** or **Audio**. The radiation level is displayed by a red LED and audible beep.

The Geiger indicates ionizing events. Whenever the Geiger is operating, the red count light (2) flashes and audible beep sounds (5) each time a count (an ionizing event) is detected.

Interfacing to an External Device

The upper output jack on the left side provides an audio output (a click for each count) through a 2.5 mm plug to an external audio amplifier, earpiece, or tape recorder.

The lower jack is a dual miniature jack that provides a data output . You can use it to record the counts on a computer or data logger. Use a 3.5 mm stereo plug to access this port. The output at the tip of the plug provides a positive (5 volt) pulse each time the Geiger tube detects a count. A cable with an RS-232 connector for an IBM PC-compatible computer serial port and accompanying software are available.

Using the Optional Geiger Program

To start the Geiger program, follow these steps:

1. Turn on the computer and change to the disk or directory where the Geiger program is located.
2. Type geiger and press Enter. Press any key to continue.
3. At the prompt, select the port.
4. At the alert level prompt, type the number of counts per minute (for example, 100) you want for the alert level and press Enter. The program will show the alert level on the graph, and will sound an audible alert whenever the count reaches the alert level.

5. At the prompt, type a two-character station ID number and press Enter.

The operating screen appears, with the station ID, the current, 24-hour average, minimum and maximum readings, and a graph.

The program waits for the start of a new minute before it starts counting.

After the first full minute, it starts displaying data. Watch the screen for a few minutes to make sure the readings are being updated.

While the program is operating, you can press Escape at any time to exit.

You can toggle the audible alert off and on by pressing F3.

The first time you use the program, a configuration file is created, and you don't have to answer the prompts on subsequent sessions. To change a configuration setting (for example, alert level), you can either delete the configuration file or press F1 while the program is running.

Reading the Data

Each day, the data is saved in a file, named with the station number and date. For example, the data file for station 02 for June 4, 1997 is named 02060497.TXT. A new file is started every day at midnight. If you restart the program on a day when it has already been operating, the data is appended at the end of the existing file for that day.

The file is in ASCII (plain text) format. It has one line for each minute's reading, which shows time and radiation level, separated by commas. For example, a line might read: 02:21,45

The file can be imported into a spreadsheet program such as Excel or Lotus as a comma delimited ASCII file.

4 Common Procedures

The following sections give guidelines for several commonly-used procedures. With any procedure, the user must determine the suitability of the instrument or procedure for that application.

Establishing the Background Count

Normal background radiation levels vary at different locations, according to altitude and other factors, such as types of minerals in the ground. Levels differ at different distances from the ground, and may differ even in different areas of the same room. To accurately interpret the readings you get on the Geiger, it is a good idea to establish the normal background radiation level for each area you plan to monitor. You can count the number of counts during a one minute period. Repeat this several times and then average them together.

A ten-minute average is moderately accurate. If you need to determine whether there is prior contamination, take averages in several locations and compare the averages.

To measure as much as possible of the radioactivity of an object, place the Geiger as close as you can without touching the object. The radiation level for gamma radiation from a localized source decreases according to the inverse square law. If you move to twice the distance from the object, the radiation drops by a factor of four.

CAUTION: Never touch the Geiger to an object that may be contaminated. You may contaminate the instrument. A contaminated instrument will not be accepted for repair or servicing.

5 Maintenance

Troubleshooting

The Geiger is a highly reliable instrument. If it does not seem to be working properly, look through the following chart to see if you can identify the problem.

Problem	**Possible Cause**	**What to Check**
Reading is high, but another instrument has a normal reading in the location	contamination	check the Geiger with another instrument; clean the instrument with same a damp cloth with mild detergent
moisture wet	the circuit board may be warm dry place; if it still	dry the instrument in a has a problem, it requires factory service
continuous discharge	the Geiger tube needs to be replaced	
electromagnetic field	move the instrument away from possible sources of electromagnetic or radio frequency radiation	

If the Geiger requires servicing, please contact your distributor or the manufacturer at the following address:

CAUTION: Do not send a contaminated instrument for repair under any circumstances.

S.E. International, Inc.
P.O. Box 39, 436 Farm Rd.
Summertown, TN 38483-0039
Tel: 931-964-3561 Fax: 931-964-3564 E-mail: seiinc@usit.net

Do not attempt to repair the Geiger; it contains no user-serviceable parts and you could void your warranty.

6 Basics of Radiation and Its Measurement

This chapter briefly tells what radiation is and how it is measured. This information is provided for users who are not already familiar with the subject. It is helpful in understanding how the Geiger works.

Ionizing Radiation

Ionizing radiation is radiation that changes the structure of individual atoms by ionizing them. The ions produced in turn ionize more atoms. Substances that produce ionizing radiation are called radioactive.

Radioactivity is a natural phenomenon. Nuclear reactions take place continuously on the sun and all other stars. The emitted radiation travels through space, and a small fraction reaches the Earth. Natural sources of ionizing radiation also exist in the ground. The most common of these are uranium and its decay products.

Ionizing radiation is categorized into four types:

X-rays are usually manmade radiation produced by bombarding a metallic target with electrons at a high speed in a vacuum. X-rays are electromagnetic radiation of the same nature as light waves and radio waves, but at extremely short wavelength, less than 0.1 billionth of a centimeter. They are also called photons. The energy of X-rays is millions of times greater than that of light and radio waves. Because of this high energy level, X-rays penetrate a variety of materials, including body tissue.

Gamma rays occur in nature and are almost identical to X-rays. Gamma rays generally have a shorter wavelength than X-rays. Gamma rays are very penetrating; thick lead shielding is generally required to stop them.

Beta radiation. A beta particle consists of an electron emitted from an atom. It has more mass and less energy than a gamma ray, so it doesn't penetrate matter as deeply as gamma and X-rays.

Alpha radiation. An alpha particle consists of two protons and two neutrons, the same as the nucleus of a helium atom. It generally can travel no more than 1 to 3 inches in air before stopping, and can be stopped by a piece of paper.

When an atom emits an alpha or beta particle or a gamma ray, it becomes a different type of atom. Radioactive substances may go through several stages of decay before they change into a stable, or non-radioactive, form.

An element may have several forms, or isotopes. A radioactive form of an element is called a radioisotope or radionuclide. Each radionuclide has a half-life, which is the time required for half of a quantity of the material to decay.

Measuring Radiation

Alpha, beta, gamma, and x-rays ionize material they strike or pass through. The amount of radiation is generally measured by measuring the resulting ionization.

The Geiger tube used in the Geiger consists of an anode and a cathode (positive and negative electrodes) separated with a mixture of argon, neon, and either chlorine or bromine gases. The cathode is a glass cylinder sealed to contain the gas. The anode is a wire that extends into the cylinder. A high voltage is applied to the electrodes to create an electrical field within the chamber. When radiation passes through the chamber and ionizes the gas, it generates a pulse of current. The Geiger electronically processes these pulses to display the radiation level.

Radiation Measurement Units

Several different units are used to measure radiation, exposure to radiation, and dosage.

A **roentgen** is the amount of x-radiation or gamma radiation that produces one electrostatic unit of charge in one cc of dry air at 0°C and 760 mm of mercury atmospheric pressure. A milliroentgen is one one-thousandth of a roentgen.

A **rad** is the unit of exposure to ionizing radiation equal to an energy of 100 ergs per gram of irradiated material. This is approximately equal to 1.07 roentgen.

A **rem** is the dosage received from exposure to a rad. It is the number of rads multiplied by the quality factor of the particular source of radiation. The rem and millirem (one one-thousandth of a rem) are the most commonly-used measurement units of radiation dose in the U.S. One rem is generally considered to equal one rad.

A **sievert** is the standard international measurement of dose. One sievert is equivalent to one hundred rems. A microsievert (μSv) is one millionth of a sievert.

A **curie** is the amount of radioactive material that decays at the rate of 37 billion disintegrations per second, approximately the decay rate of one gram of radium. Microcuries (millionths of a curie) and picocuries (trillionths of a curie) are also often used as units of measurement.

A **bequerel (Bq)** is equivalent to one disintegration per second.

Appendix A Technical Specifications

Detector: Glass Geiger-Mueller detector detects Beta, Gamma, and X-rays. Sidewall density 50 mg/cm2 plus 15 mil Lexan window.

Operating Range: 0-420,000 CPM

Count light: Red LED flashes with each count

Beeper: Chirps for each count (can be muted)

Outputs: Dual miniature jack provides counts to a computer or data logger

Submini jack provides audio output to an external earpiece, amplifier, or tape recorder

Power: One 9-volt alkaline battery

Size: 150 x 80 x 30 mm (5.9” x 3.2” x 1.2”)

Weight: 200 grams (7 oz) including battery

Optional Software: IBM PC compatible on 3.5-inch floppy disk. Displays current CPM and average, maximum, and minimum since 12:01 AM. Graphs counts per minute over 8 hours. Provides an audible alert at a user-adjustable level. Saves data for each day in a comma-delimited file compatible with spreadsheet and database software.

Optional Cable: 6 ft., connects to 9-pin PC serial port (25-pin adapter available)

Warranty

LIMITED WARRANTY

WARRANTOR: S.E. International, Inc., P.O. Box 39, 436 Farm Road, Summertown, TN 38483-0039, USA, (931) 964-3561.

ELEMENTS OF WARRANTY: S.E. International, Inc., warrants for one year all materials and craftsmanship in this product to be free from all defects with only the limitations set out below.

WARRANTY DURATION: The warranty shall terminate and be of no further effect one year after the original date of purchase of the product or at the time the product is: a) damaged or not maintained as is reasonable or necessary, b) modified, c) repaired by someone other than the warrantor for a defect or malfunction covered by this Warranty, d) contaminated with radioactive materials, or e) used in a manner or purpose for which the instrument was not intended or contrary to S.E. International, Inc.'s written instructions. This warranty does not apply to any product subjected to corrosive elements, misuse, abuse, or neglect.

STATEMENT OF REMEDY: In the event that the product does not conform to the warranty at any time while this warranty is effective, the Warrantor will repair the defect and return the instrument to you prepaid, without charge for parts or labor.

NOTE: While the product will be remedied under this warranty without charge, this warranty does not cover or provide for the reimbursement or payment of incidental or consequential damages arising from the use of or the inability to use this product. The liability of the company arising out of the supplying of this instrument, or its use, whether on warranties or otherwise, shall not in any case exceed the cost of correcting defects in the instrument, and after the said one year (90 days on the tube) period all such liability shall terminate. Any implied warranty is limited to the duration of the written warranty.

PROCEDURE FOR OBTAINING PERFORMANCE OF WARRANTY: In the event that the product does not conform to this warranty, please write or call to the address above. S.E. International, Inc. will not accept contaminated instruments for calibration or repair under warranty or otherwise. **NOTE:** Before using this instrument, the user must determine the suitability of the product for his or her intended use. The user assumes all risk and liability connected with such use.

Calibration Database Service
For U.S. and Canada Only

For your convenience, we offer a calibration service. To be included in our Calibration Database, fill out the application included in this manual. Send it to the address listed on the application and we will enter you in the database free of charge.

Once your instrument is entered into our Calibration Database, at specified intervals, you will be sent a notice reminding you of the upcoming calibration date.

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CALIBRATION DATABASE APPLICATION

name

model name

company

serial no.
(Inside battery compartment or rear label)

address

City, state, zip code +4

calibrations per year
(circle) 1 2 3 4

phone number

Mail to Attn: Steve Skinner or Robbin Cramer

S.E. International, Inc., P.O. Box 39, Summertown, TN 38483-0039 or fax to (931) 964-3564