IMI ONYX®

Personal Radiation Monitor

Operating Manual

Contents

1. About ONYX

Thank you for purchasing this **ONYX** Personal Radiation Detector. **ONYX** is not a typical radiation detector—it is both experimental and revolutionary and has a compelling history. Please read about it in **Chapter 12: History and Credits**. The uniquely small size and sleek stealthy ergonomics of **ONYX** make it easy to carry and use discretely, making it a good solution for first responders, medical professionals, activists, travelers and other users who do not want to carry a traditional bulky radiation detector.

ONYX was designed to push the limits of traditional instruments. It is primarily an open source product, which allows for innovation and improvements by the community of users. It was designed with the intention to help communities with its ability to share collected data. No other geiger counter has ever been designed to interact with a mobile phone to tweet radiation data in emergency situations. Data collected with your **ONYX** can be shared with **Safecast** (safecast.org) and **RadResponder** (radresponder.net) Networks.

The USB data stick that came with your **ONYX** contains the I**MI Gateway App** with versions for OS X and Windows 10. When you connect your **ONYX** to the app it will automatically synch your time and also allow you to view and share data and calibrate your instrument at a qualified lab. More information on **ONYX** is available at www.medcom.com/onyx-resources.

Before operating your **ONYX**, please read **Chapter 2: Safety Information**, and also **Care and Precautions** in **Chapter 7**.

Please enjoy using your **ONYX**. We hope it makes your life safer and more interesting. Please contact us at customercare@medcom.com if you have any questions.

2. Safety Information

ONYX does not contain radioactive materials. **ONYX** does contain a Lithium Ion battery. Do not charge the instrument when temperatures are below 32 degrees F (0 degrees C) or above 113 degrees F (45 degrees C) or damage to the battery could occur. Charge your instrument using CE or UL approved USB chargers or computers and in a safe fireproof location. Be careful around radioactive materials and make sure your instrument is charged and working properly if you are working or living in proximity to radiation sources. If you are working in

proximity to radioactive materials we recommend you utilize redundant radiation detectors and safety systems. Do not drop or mishandle your instrument and it should provide you with many years of useful service. Contact us if you have any safety concerns. 1-707-823-0336 Ext 101 or customercare@medcom.com

3. Quick-Start Navigation Guide

ONYX is designed to always be on. If you choose to use the logging function, it will periodically record radiation data as long as the battery has a charge. The logging interval is set under the Settings/Geiger Menu.

The switch on the bottom of the instrument controls whether the instrument is either actively taking and displaying radiation levels in **Active Mode (UnLock)**, or it is in **Standby Mode (Lock)**, continuously and quietly monitoring background radiation without displaying information. You may switch Modes freely at any time.

If the switch is in the DOWN position(Unlock), and the display does not illuminate, please charge the instrument by plugging it into a computer USB port or charger.

The **Front Panel** keypad is touch-sensitive.

Use the keypad to access the following functions:

◯ – **Home Main Menu** is displayed

〉– **Select Function** (Select a menu item, or a setting)

〈– **Back** (return to previous menu screen)

^ – **Scroll Up** (to menu items)

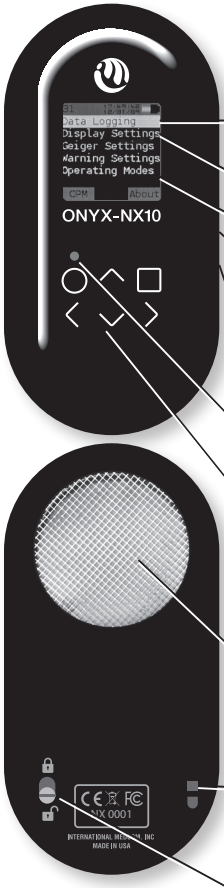
v – **Scroll Down** (to menu items)

☐ – **Help Function**, (context-sensitive information)

To immediately begin using the instrument as a Geiger Counter, with current data displayed, select the **Home ◯ Key, Current Readings,** then the **Select 〉Key.**

To **Lock the Keypad**, simultaneously touch and hold the left 〈 and right 〉 arrow keys. A Lock icon will indicate Locked status in the lower right screen after approximately 3 seconds. Repeat to UnLock the keypad.

4. Features



- **32-bit ARM Processor** for rapid processing of data and power to communicate in multiple ways
- **128×128 color OLED** (Organic Light Emitting Diode) display
- **Real-time Clock Time and Date** in UTC Format
- Twitter Integration via **QR Code**
- **Micro-USB Port** for charging and data upload interface, featuring an FTDI-based serial chipset capable of loading firmware directly into the microcontroller
- **3.5mm jack** audio output for headset
- **Red count light** flashes each time a count (an ionizing event) is detected
- **6-button capacitive-touch-array** user interface (UI)
- **Stealth Logging Mode** allows data logging with display off to conserve energy
- **Pancake Detector:** 2-inch(7.1cm) diameter for broad sensitivity to alpha, beta, gamma and X- radiation
- **Lanyard attachment** for ease of handling
- **Audible Event Notification** via piezoelectric beeper
- **Lock/Unlock (On/Off) Switch**

5. How ONYX Works

The **ONYX** uses a 2-inch (7.1cm) Pancake Geiger-Mueller tube with a low-density mica window to detect ionizing radiation. The Geiger tube generates a pulse of electrical current each time radiation passes through and causes ionization. Each pulse is electronically detected and registers as a count. **ONYX** displays this collected data in the mode you choose: Counts Per Minute (CPM), microSieverts per Hour (µSv/hr) or microRoentgens per-hour (µR/hr).

The number of counts detected by **ONYX** varies from second to second, due to the random nature of radioactivity, but averaging protocols provide a fairly stable average of that random data.

6. Applications

If you work around radiation sources, **ONYX** is a good instrument for personal health protection. In normal environments the instrument can also provide peace of mind, by letting you know if there are any unexpected radiation sources in your environment. If you are documenting contamination or collecting data for the **Safecast Global Network, RadResponder** or other networks, you may share the data you collect.

Other Applications of ONYX

- Documenting the effectiveness of decontamination and safety programs.
- Sharing radiation measurements with a global mapping system developed by Safecast.
- Monitoring possible radiation exposure while working around radionuclides or in contaminated environments.
- Alerting the user with an audible indicator if radiation goes above a user preset Alert level.
- Detecting noble gases and low energy radionuclides.
- Continuous logging of radiation levels.

7. Care and Precautions

To keep the **ONYX** in good condition, handle it with care, and observe the following precautions:

- Avoid contamination of the **ONYX** by not touching it to radioactive surfaces or materials; instead, hold it just above the surface that is suspected of contamination to take readings. If contamination of your instrument is suspected, clean the surface of your instrument with mild detergent and a clean, damp cloth, using care to keep the Geiger Tube dry. You may call IMI for more information at +1 707.823.0336 (USA).
- Do not leave your **ONYX** in temperatures over 122° F (50° C) or in direct sunlight for extended periods of time.
- Do not submerse **ONYX** in liquid of any kind. Water can damage the circuitry and the coating of the mica surface of the Geiger tube.
- If the surface of the mica on your pancake detector becomes scratched or loses its coating, avoid making measurements with the detector window in direct sunlight; this could affect the readings.
- Do not put the **ONYX** in a microwave oven. It cannot measure microwaves, and you may damage it or the oven.
- Please remember to treat radiation sources with respect. Any exposure carries some risk, though it might be small. Educate and protect yourself.
- Please review the Lithium Battery Safety information in **Appendix 3**.

8. Operation

Units of Measurement **ONYX** will display detected radiation levels in CPM (Counts Per Minute), µSv/hr (microSieverts Per Hour), or mR/hr (milliRoentgens Per Hour).

Before Using Your ONYX

Charge your **ONYX**. Depending on the charger used, this will take 1 to 2 hours if the battery is fully depleted. You may charge your **ONYX** from any standard computer USB port or from a USB Charger. When you connect a powered micro-USB connector to your **ONYX**, it will perform a soft reset and self-test. You will see the startup screen, showing your firmware version number, before settling-in to begin counting again.

You will also see a charge indicator on the battery icon while **ONYX** is being charged.

Using Your ONYX

On the back of the **ONYX**, slide the Mode Switch down to the "UnLock" position . Once the processor re-initializes, the OLED display will illuminate and **ONYX** will immediately begin to count and measure radiation while displaying the Current Readings on-screen. The **ONYX** is now monitoring radiation in your surrounding environment and recording your measurement data to memory (if Logging is enabled in Settings).

You can scroll up and down to select the mode you are operating in: **CPM**, **µSv/hr**, **mR/hr**, **Accumulated Count** or **Graph** mode. You can also use the menu to select which of these modes is displayed when you scroll. When measuring surface contamination, pay attention to CPM, rather than to µSv/hr or mR/hr because it is not accurate to report alpha or beta surface activity as gamma dose rate. Please note that gamma dose rate is only accurate in situations where there is no Beta or Alpha radiation present, or if shielded. The detector is not energy-compensated and is calibrated to Cs137. On the OLED display there is a colored Status Bar across the top. When the bar is Amber, the **ONYX** has not yet collected enough data to display statistically accurate readings. Once the Status Bar turns blue, it is then reading with maximum statistical relevancy.

Navigation Exercise

Navigation on the **ONYX** is intuitive. Here is a practical exercise. If you'd like to perform a manual set-up, please follow these instructions:

Setting the Time Manually

Begin by pressing the **Home** ◯ key to get to the Home screen.

Scroll down with the ﹀ key to Settings, then click once on the 〉key to select.

Scroll down with the ﹀ key to Time/Date and click the 〉key once to select.

Now select **Set Time (UTC)** with the 〉key.

• The screen will show the following, HH (Hours) :MM (Minutes) :SS (Seconds). The small diamonds indicate that each digit may be altered using the touch-pad arrow. The diamond color will change to maroon when that digit is selected for adjustment.

• Scroll up and down with the ﹀ and ﹀ keys to set each digit, then use the 〉key to move to the next digit. When complete, scroll fully right until **Save** is highlighted, then click the 〉key one more time to **Save** your changes. The time will be displayed in the upper right corner of the **Status Bar,** next to the battery symbol.

Menu Structure

Whenever you press the **Home** ◯ Key, the **Main Menu** appears with five menu items:

Data Logging
Display Settings
Geiger Settings
Warning Settings
Operating Modes

Use the ﹀ and ﹀ keys to navigate to the menu you wish to adjust, and use the 〉key to advance to the sub-menu. The submenus are:

Data Logging

- **Log Storage (% Full)** - Percentage usage of Flash Memory for data logging
- **Hours remaining** - Remaining data logging time based on the current Log Interval setting
- **# records** - Number of readings logged and total number of available data "slots"

Select the **Clear Log** function to immediately clear all readings. When finished, **ONYX** will display **Log Cleared**, **Press Any Key.**

Caution: Do not select Clear Log unless all stored data is to be removed.

Display Settings

- **Brightness** - Adjust the OLED display brightness. Use the ^ and v keys; number 9 for brightest and 1 for dimmest. The brightness will change during adjustment.
- **Language** - Choose between English and Japanese (more to come)
- **Time and Date** - Set Time, Date, and UTC Offset. Whether you set the time automatically, or manually, you will still need to adjust the UTC Offset for your time zone, to display the time for your part of the world. Always set the time for Universal Time (UTC) and then adjust the UTC offset for your location. This will be important if you are logging data to be displayed as part of a measurements network, so researchers can trust that your data points are valid. UTC time can be found easily with a Web search at www.time.is/UTC and offsets can be found at www.en.wikipedia.org/wiki/List_of_UTC_time_offsets. Setting the time is not critical for simply using the Geiger Counter to determine the **Current Reading**, but if you want to log data with an accurate time and date stamp, you need to perform proper set-up first.
- **Never Dim** - Toggle on or off. Disables the energy-saving screen-dimming function. We suggest enabling this function only when **ONYX** is connected to a power source via USB cable. Please note that prolonged long-term use without screen dimming will eventually cause deterioration of the display.
- **Turn screen off** - Toggle on or off.

Geiger Settings - Adjusts how the **ONYX** functions and takes readings

- **µSv/uR** - Toggle between µSv and µR. (Select your preferred units of measurement. Japan and Europe are almost exclusively on the SI system, which is µSv/hr. Eventually we expect that most countries will convert to the SI system, however the adaptation process can take some time.) Use the ^ and v keys to select your desired units, and then click on the > key to place a ✓ confirming your selection.
- **Calibration** - This function allows **ONYX** to be calibrated at a qualified laboratory. If you are sure you wish to calibrate the **ONYX** yourself, please go to www.medcom.com/onyx/calibrate and follow the detailed instructions.
- **Timed Count Set** - Set max count
- **CPM/CPS Auto** - Toggle on or off. Enable to allow the **ONYX** to automatically display radiation measurements in Counts per Minute, or Counts per Second. To enable this function click on > the key until you see a ✓ to the right. To deactivate, simply click > key again.
- **Pulse output** - Choose between No Pulse, 10 µs, 1 ms, and Audio tone (via the 3.5 mm jack for use in data logging or for discrete monitoring on a headset).

Warning Settings

- **Mute alarm** - Toggle on or off
- **Warning level** - Set the alert level for the **ONYX**. Once activated, the instrument will alert with an audible tone when this level is reached. To mute the tone, press any key. To reactivate the alert warning mode after muting, slide the switch to **Stealth Mode (Lock)** , and then back to **Active Mode (Un-Lock)**. To disable Alerts altogether, set the Warning Levels to – 0 – , which is the Default Value.

If you are relying on this beeper for safety purposes, be sure it is loud enough for you to hear it in your measurement environment.

Operating Modes

- **CPM** - Toggle on or off
- **µSv/µR** - Toggle on or off
- **Graph** - Toggle on or off. Displays two rolling minutes of data in CPM. The Min. and Max. counts will be shown bracketing the Graph, above and below, and apply only to the rolling 2-minute period. The two-digit current count continues to appear in the upper left corner of the display. If you switch to **Lock Mode**, current graph data will be lost.
- **Timed Count** - Toggle on or off
- **Becquerel** - Toggle on or off. A **Becquerel** (Bq) is a measure of activity, and one Bq is defined as 1 disintegration per second. Units are displayed in Bq/m2 (Becquerel per square meter) **Note:** A Bq Efficiency Value must be set for this to display. For this to be used with accuracy, Unit efficiency needs to be known for the particular radionuclide mix on the surface being measured.
- **QR Code** - Toggle on or off. Displays a QR Code representing a current radiation count, which you may then scan with a Smart Phone camera, to share that measurement with your followers at www.Twitter.com. You will need a QR App on your smart phone to use this feature.

When you return to the main display screen, advance through the display of the modes toggled on by tapping the ❯ key. The last 2 rolling minutes of measurement data will be displayed graphically, in CPM. For more information on the current menu selection, press the **Help** ▢ key, the **ONYX** context-sensitive Help or Info screen.

Firmware Version and Update

From the Data Logging menu, tap the **Help** ▢ key to identify the Firmware Release version of your **ONYX.** If a firmware update is available, it may be upgraded using the IMI Gateway App provided with your instrument.

Please check our web page for updates: www.medcom.com/onyx-resources

9. Using ONYX with IMI Gateway App

The **Gateway** app is provided on a USB data stick in the package with your instrument. Versions are provided for both OS X and Windows 10. When installed you can pair your instrument with the app and share data, display readings on your computer, set time and date and calibrate your instrument. You can also install software upgrades as they are available. Please see the **read-me** file on the enclosed USB data stick.

Upload Your Data to SafeCast

You can learn more about submitting reports using Safecast's web-based data submission site at: www.api.safecast.org

You will need to become a registered user to contribute data to Safecast. View data others have contributed to the growing network at map.safecast.org.

Upload Your Data to RadResponder Network

The **RadResponder Network** (radresponder.net) is a product of collaboration between FEMA, DOE/NNSA and the EPA as a solution for management of radiological data. It is provided free of charge to all federal, state, local, tribal, and territorial response organizations. You need to register with RadResponder to participate. The **IMI Gateway App** will allow you to link to the network after you register.

10. Maintenance and Calibration

The **ONYX** should be handled with care. Do not drop or handle the instrument roughly and it should serve you well for many years. To clean the instrument use a damp cloth. Do not get the mica window wet or poke anything through the copper berrylium screen that protects the GM mica window. The instrument can be calibrated as necessary to comply with any applicable regulations. Use the following guidelines to maintain the **ONYX** properly.

Calibration

The **ONYX**'s readings typically remain stable for many years of use. Specific industries, such as diagnostic laboratories, radiography, and public safety, operate under standards or regulations that require routine calibrations. In

most regulated environments, an annual calibration meets these standards. Some standards require more frequent calibrations, and some also require the occasional use of a check source to make sure the instrument is working properly. For a list of recommended laboratories for instrument calibration, please contact International Medcom, Inc. Check sources are available from various licensed companies. Any radioactive source should be handled with caution and shielded properly during storage.

The standard radionuclide for calibration is Cesium-137. To calibrate to another radionuclide, use a calibrated source for that radionuclide or deter-mine the appropriate conversion factor referenced to Cs-137. A certified test range should be used. Depending on the facility, calibrations are typically done at about two-thirds of the maximum reading, or 660 µSv/hr (66 mR/hr). Some labs can do a three-point calibration check at, for example, 250, 500, and 660 µSv/hr (25, 50, and 66 mR/hr). Calibration should not be done at levels below 10 µSv/hr (1mR/hr) or above 900 µSv/hr (90 mR/hr).

Calibrating Using a Source

Most certified calibration laboratories utilize robotics to minimize or eliminate radiation exposure to the calibration personnel. The **ONYX**'s calibration procedure is designed to further minimize exposure. Calibrations can be done with a computer using **IMI Gateway App** or manually using the menu. Most certified labs are familiar with Medcom instruments. Contact IMI with any questions.

Before you calibrate the **ONYX**, make sure the distance between the **ONYX** and the source is correct to produce the appropriate dose rate.

11. Troubleshooting and Service

The **ONYX** 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
Display is blank	Battery is dead	Charge battery. Contact IMI.
	Damaged display	If count light and audio work, the OLED may need to be replaced
Display works, but no counts are registered	Damaged Geiger tube	If the mica surface of the tube has visible breaks or wrinkles, it needs to be replaced
Reading is high, but another instrument has a normal reading in the same location	Contamination	Scan the ONYX with another instrument; clean the instrument with a damp cloth and mild detergent
	Moisture	The circuit board may be wet; dry the instrument in a warm dry place; if it still has a problem, it requires factory service
	Photosensitivity	Remove from direct sunlight and ultraviolet sources; if the high count drops, the mica coating on the Geiger tube may be damaged and the tube needs to be replaced
	Continuous discharge	The Geiger tube needs to be replaced
	Electromagnetic interference	Move the instrument away from sources of extremely high-energy non-ionizing radiation, e.g., electromagnetic or microwave

If the **ONYX** requires servicing, please contact your distributor or International Medcom, Inc. for instructions on where to ship the instrument. You can contact International Medcom, Inc. at 707-823-0336 or at customercare@medcom.com.

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

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

12. History and Credits

ONYX was conceived on a swaying rooftop In Tokyo Japan in April 2011. The swaying was due to aftershocks of the massive Tohoku Earthquake that struck Japan on March 11. The radiation readings were elevated on the rooftop due to radionuclides released by the three reactor meltdowns that occurred because of the earthquakes and resulting tidal waves in Fukushima Prefecture to the North.

On the rooftop were a large contingent of distinguished scientists, tech innovators, futurists, hackers, activists, and mothers and fathers who were concerned about the lack of data on contamination from the reactor meltdowns. The gathering was arranged by Joi Ito, soon to become Director of MIT Media Lab, along with Sean Bonner, soon to become a Director of Safecast, a nonprofit that also grew out of this rooftop gathering of minds. Dr. Bunnie Wang, an American scientist and "hacker" of open source hardware and software innovations, based in Singapore, volunteered to work with Medcom and the gathered participants to develop an instrument to contribute to Japan's safety and well being. Bunnie is responsible for the elegant physical and overall electronic design of the instrument , which was probably influenced by the tastes of the fashion and design conscious Shibuya District where we were meeting. **ONYX** was designed to interact with the emerging Safecast monitoring network, which has won the coveted Good Design Award for the project.

Medcom contributed core technology to the project including hardware, algorithms and software developed over 30 years of radiation detection innovation. The first prototype was sent to an independent lab and came back with a report of 2 percent accuracy. Funding to launch the tooling and further software development was crowd-sourced in a Kickstarter project developed by Sean Bonner. The project became a "Best of Kickstarter" launch that was covered by the Wall Street Journal, NY Times and many other news outlets.

Major contributions to the project were also made by Edouard LaFargue, Nav Whiteford, XBob, Steve Weiss, Ross Randrup, Orapin Sythe, Rob Oudenjik, Peter Franken, Joe "Jam" Moross , Deng Keophilaphan, Kiki Tanaka, Noy Keophllaphanh, Yuka Hayashi, Kelly Wu Branesky, and numerous Safecast volunteers including Ray Ozzie, a major backer of the Kickstarter project. Ray was just leaving his post as CTO of Microsoft when we all met on the rooftop. Apologies for any names not mentioned here who have contributed.

Appendix 1:
Radiation and Its Measurement

The following information is provided for users who are not already familiar with the basics of what radiation is and how it is measured. It is helpful in understanding how the ONYX works and in interpreting its readings.

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 detected by the **ONYX** can be categorized into four types:

X-rays are usually man-made 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.

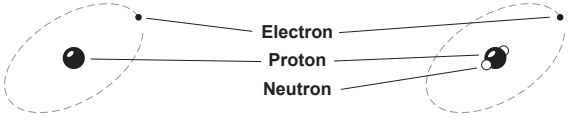
Gamma rays occur in nature and are almost identical to X-rays, but generally have a shorter wavelength than X-rays. Gamma rays can be very penetrating; thick lead shielding is generally required to stop energetic gamma radiation.

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.



Hydrogen

A hydrogen atom has one electron and one proton. The most common isotope has no neutrons and is stable.

Tritium

Tritium is a radioactive isotope of hydrogen. It has two neutrons in its nucleus.

The chart below shows the complete decay chain for Uranium 238, which ends with a stable isotope of lead. Notice that the half-life of the radionuclides in the chain range from 164 microseconds to 4.5 billion years.

Isotope	Emits	Half-life	Product	
U-238	alpha	4.5 billion years	Th-234	Thorium
Th-234	beta	24.1 days	Pa-234	Proactinium
Pa-234	beta	1.17 minutes	U-234	Uranium
U-234	alpha	250,000 years	Th-230	Thorium
Th-230	alpha	80,000 years	Ra-226	Radium
Ra-226	alpha	1,602 years	Rn-222	Radon
Rn-222	alpha	3.8 days	Po-218	Polonium
Po-218	alpha	3 minutes	Pb-214	Lead
Pb-214	beta	26.8 minutes	Bi-214	Bismuth
Bi-214	beta	19.7 minutes	Po-214	Polonium
Po-214	alpha	164 microseconds	Pb-210	Lead
Pb-210	beta	21 years	Bi-210	Bismuth
Bi-210	beta	5 days	Po-210	Polonium
Po-210	alpha	138 days	Pb-206	Lead

Measuring Radiation

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

The Geiger tube used in the **ONYX** consists of an anode (positive electrode) positioned in the center of a stainless steel chamber which forms a cathode (negative electrode). The chamber is filled with a mixture of argon, neon, and either chlorine or bromine gases under a vacuum. 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 **ONYX** 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. The **ONYX** displays readings in milliroentgens per hour (mR/hr). 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 **becquerel** (Bq) is equivalent to one disintegration per second.

Higher Than Normal Readings

Due to the random nature of radioactivity, the **ONYX** reading varies from minute to minute. In one location with only background radiation, the reading in µSv/hr might vary from .007 to .180 in ten minutes and from .004 to .210 in an hour. Averages for both periods would be very close.

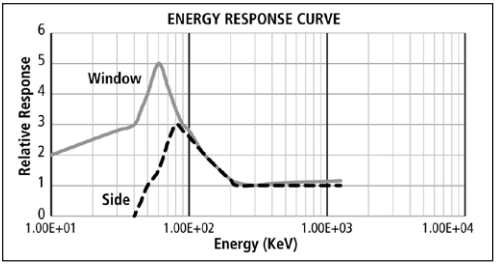
Normal radiation levels in different locations can vary greatly due to soil composition, altitude, and other factors. For example, normal background at 10,000 feet might be double that at sea level. On an airplane, the radiation at 35,000 to 40,000 feet may be as much as 30 to 50 times the normal level on the ground.

When monitoring radiation levels in one location, it is useful to determine the highest reading you can normally expect to see in that location. If you use Alert mode, you want to set the alert level to one that rarely gives a false alarm, yet sounds the alert when the radiation is higher than normal.

A single alert may occur occasionally and is not significant unless there is also an elevation in the average count. If you suspect an elevation and you have previously taken an average background count in the same location, you can take a total count to get the current average count for 30 minutes or another time period. You can then compare the current average to the previous average to see whether there is an elevation.

Appendix 2: Technical Specifications

Detector	LND 7317 "Pancake" Halogen-Quenched Geiger-Mueller tube; Effective diameter 1.75" (45 mm); Mica window density 1.5-2.0 mg/cm2; Detects Alpha, Beta, Gamma and X-radiation	
Display	128×128 color OLED (Organic Light Emitting Diode)	
Operating Range	µSv/hr: .000 to 1,000 mR/hr: .000 to 100 CPM: 0 to 350,000	
Calibration	Cesium-137 (gamma from daughter metastable Barium)	
Gamma Sensitivity	334 CPM per µSv/hr (3340 CPM per mR/hr) referenced to Cs-137	
Efficiencies	For 2 pi Geometry (typical Efficiencies, primary emissions noted)	
Isotopes	**Energy**	**Efficiency**
Pu-239	5.245 MeV (alpha primarily)	20 to 36%
Th-230	4.621 MeV (alpha)	20 to 36%
SrY-90	546 keV avg 2.3 MeV max (beta)	48%
Cs-137	Betas (-); 5.6% - 1,176 keV max (416.3 keV average) 94.4% - 514 keV max (174 keV average) Gamma 661 keV (released by Ba-137)	48%
Tc-99	294 keV beta	48 to 56%
Accuracy	+/- 10% typical, +/- 15% maximum	
Alert Range	0 to 99,999 CPM; Beeper sounds alert when warning level feature is activated	
Average	Accumulate/Average feature builds average over time when activated	
Count Light	Red LED flashes with each count	
Audio	Beeper chirps for each count when Geiger Beep function is activated	
Ports	Output: 3.5 mm jack sends pulses to Safecast iPhone application	
Anti-Saturation	Readout holds at full scale in fields up to 100 times the max. reading	
Temperature Range	-20 to +50 C, -4 to +122 F	
Power	One 3.7 V Lithium Ion battery	
Size	30 X 660 X 230 mm (5.1 X 2.6 X 0.9 inches)	
Weight	200 grams (7 oz) including battery	
Options	USB cable, charger and carrying case available	
Certifications	CE Certified: Emissions: EN 55011:2009+A1:2010 (Class B emissions limits); EN: 61000-4-2:1995 (ESD); EN 61000-4-3:1997. RoHs Compliant; Meets WEEE Standards	



Appendix 3: Lithium Battery Safety & Disposal

ONYX uses a Lithium-Ion Secondary Battery. Lithium-Ion batteries can be hazardous if mishandled. The user accepts liability for the use of a Lithium-Ion Battery. As the manufacturer and distributor cannot ensure the battery is used correctly (charging, discharging, storage), they cannot be held liable for damages caused to persons or property.

Take care to prevent puncture of the Lithium-Ion Cell. In the event of battery leakage, avoid any liquid coming into contact with the skin and eyes. In case of contact with skin, wash with copious amounts of cold water and consult a doctor immediately. If you notice a suspicious smell or noise, or observe smoke around the charger or instrument, disconnect immediately.

Charging should only be done with a certified USB power source, approved by the appropriate agency for the country of use. Charge in a safe fireproof location.

Make sure your **ONYX** has the latest firmware.
www.medcom.com/onyx-resources

Maximize active-use time and battery life by following these simple tips:

- Minimize time in **UnLock** mode (active display)
- Disable the **Never Dim** feature
- Use a longer **Log Interval** setting, or disable logging. (Logging is disabled by default when you receive your **ONYX**.)

If your Lithium-Ion Battery ever needs replacement, please contact IMI to arrange for replacement service. The battery is not a user-serviceable component and users should not attempt battery replacement.

We recycle Lithium-Ion batteries via Call2Recycle, a free web-based service, with their drop-off site locator on the Web at www.call2recycle.org.

Limited Warranty

We offer the following one-year limited warranty on this **ONYX Personal Radiation Detector**:

The instrument is warranted to the original owner to be free from defects in materials and workmanship for one year from the date of purchase. IMI-International Medcom, Inc. will, at its own discretion, repair or replace this instrument if it fails to operate properly within this warranty period unless the warranty has been voided by any of the following circumstances: misuse, abuse, or neglect of this instrument voids this warranty; modification or repair of this instrument by anyone other than IMI or their approved repair facility voids this warranty; dropping the instrument or subjecting it to shock or vibration voids the waranty; contamination of the instrument with radioactive materials voids this warranty. Contaminated instruments will not be accepted for servicing at our repair facility.

This warranty applies solely to the original owner and is valid only on instruments sold by IMI and its authorized representatives.

The user is responsible for determining the suitability of this product for his or her intended application. The user assumes all risk and liability connected with such use.

IMI is not responsible for incidental or consequential damages arising from the use of this instrument.

Should the battery ever need replacing, it should be done only by IMI or an authorized agent of IMI.

How to Request Warranty Service:

If your instrument fails to operate properly within the warranty period, contact IMI to receive a return authorization number (RMA).

PLEASE DO NOT SEND WITHOUT AN RMA NUMBER ON THE PACKAGE!

*For warranty services, the customer is responsible for the cost of shipping the instrument.

The terms of warranty and specifications are subject to change without notice.

The contents of this Manual and instrument specifications are subject to change without notice.

Please stay in touch with IMI at the following link for the latest ONYX information.

www.medcom.com/onyx-resources

For Support Contact International Medcom
Email: customercare@medcom.com
Phone: (USA) 707 823-0336

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Since 1986