

Complete Gamma Ray Spectrometer

GAMMA-RAD

Includes

- 76 x 76 mm NaI(Tl) scintillator with PMT
- Digital pulse processor with shaping amplifier and MCA
- All power supplies (low voltage and high voltage)
- Interface hardware and PC software

Features

- Ruggedized scintillator and PMT
- Gain stabilized in software
- Ethernet & USB interfaces for robust communications
- USB powers entire system
- Flexible architecture for tailoring interfaces
- For OEMs and custom users

Detector

- Standard detector size: 76 x 76 mm (3 x 3") NaI(Tl)
- Custom detectors available, including:
 - 76 x 152 mm (3 x 6") NaI(Tl)
 - 10 x 10 x 40 cm³ (4 x 4 x 16") NaI(Tl)
 - 2.5 x 2.5 cm (1 x 1") LaCl₃
 - 76 x 76 mm (3 x 3") BGO

Standard Performance

- Dynamic range: 10 to 3000 keV
- Resolution: <7% FWHM @ 662 keV, <5% @ 1.33 MeV
- Count rates: to 200,000 cps
- Power: 750 mW typical

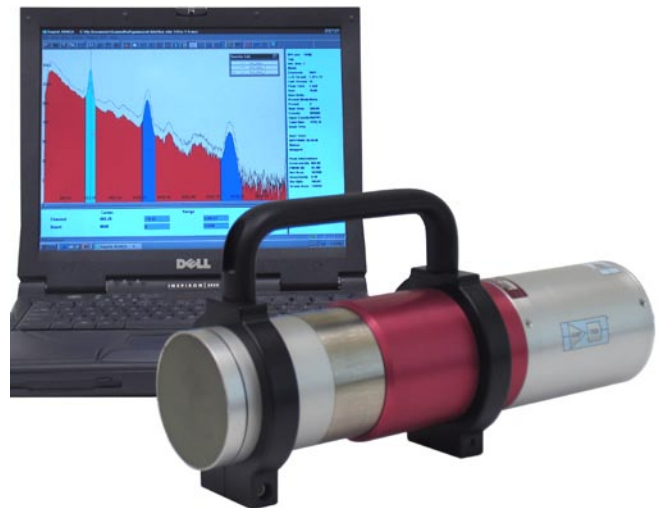
Applications

- **Homeland security:** portal monitors, shipping containers, handheld monitors
- First responders and emergency workers
- Nuclear safeguards verification
- Toxic dump site monitor
- In situ processing
- Environmental or industrial monitoring
- Teaching and research

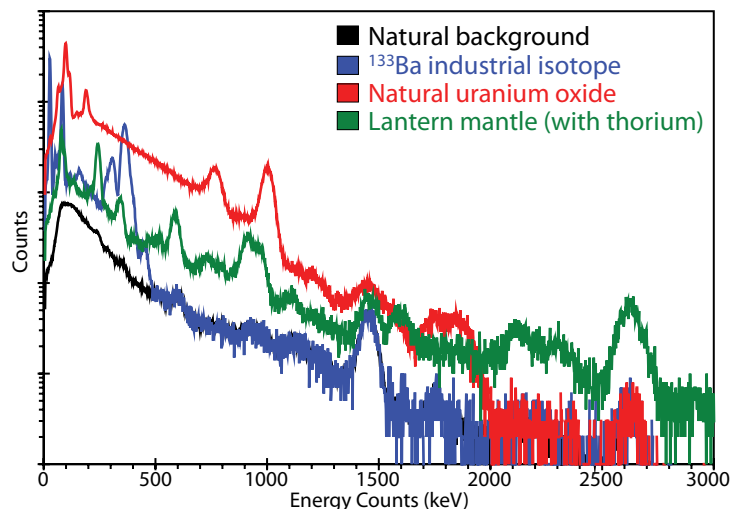
Overview

The GAMMA-RAD is a complete, integrated γ -ray spectrometer. It includes a scintillator and PMT, a digital pulse processor based on Amptek's DP4, all the hardware and software necessary to control and communicate to a PC, and all power supplies. It is a single, integrated, portable module.

Several key innovations make this system ideal for field use. First, the scintillator and PMT are ruggedized to protect against mechanical shock and vibration. Second, the Ethernet interface permits operation over long distances: 100 m via Ethernet or, with Internet software, globally while the USB interface permits a single connection (power and data) to virtually any computer. Third, it has a flexible digital architecture so it can be easily tailored for specific applications. The GAMMA-RAD is ideally suited for a wide range of γ -ray spectroscopy measurements, from lab applications to most harsh field homeland security applications.



GAMMA-RAD with a laptop computer - a complete γ -ray measurement solution.



Measured γ -ray spectra of naturally occurring radioactive materials (NORM), an industrial ¹³³Ba isotope, compared to natural background with no sources present.

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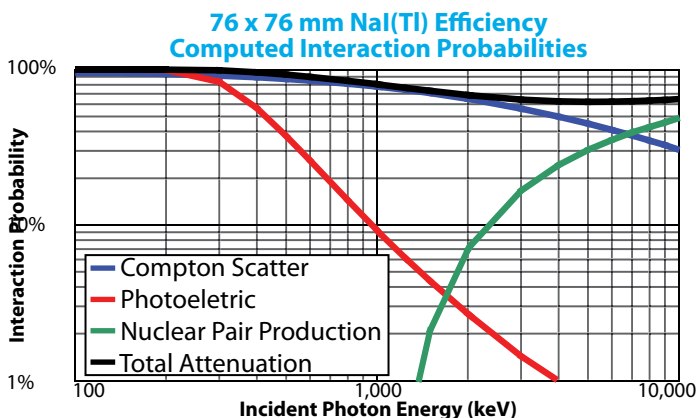
Tel: +1 (781) 275-2242 Fax: +1 (781) 275-3470 e-mail: sales@amptek.com www.amptek.com

GAMMA-RAD Specifications

Detector

The detector is a ruggedized scintillator and PMT. The 76 x 76 mm NaI(Tl) is considered standard, but many different configurations are possible. Contact Amptek for details.

The detector performance (resolution, stopping power, photo-fraction, etc) are determined by the scintillation crystal.



Pulse Processing Performance

Gain Settings: Two software selectable coarse gain settings are available: 3 MeV full scale and 750 keV full scale. Fine gain is adjustable between 0.75 and 1.25.

Pulse Shape: Trapezoidal, typically set to 2.4 μ s peaking time (equivalent to a 1 μ s shaping time). Software commandable from 0.8 to 102.4 μ s peaking time (0.3 to 40 μ s equivalent shaping time).

Gain Stabilization: The gain from the NaI(Tl) and PMT is well known to vary with temperature. A gain stabilization algorithm runs in software to compensate.

Maximum Count Rate, Dead Time, and Throughput: With the default configuration, the system operates to an input count rate of 150,000 CPS with a throughput >50% and good baseline stability and pile-up rejection. Configured for the shortest peaking time, 0.8 μ s, it will sustain an input count rate of >300,000 CPS with throughput >50%.

Events can be processed when separated by less than a full pulse width, specifically by 1.25 times the peaking time. Pulse processing electronics have a cycle time of 1 μ s so a 1 MHz periodic signal can be acquired. The fast channel (used for pile-up rejection and measuring the input count rate) has a 600 ns resolving time.

MCA Performance

Number of channels: Commandable to 8k, 4k, 2k, 1k, 0.5k, or 0.25k channels.

Minimum Acquisition Time: <10 ms.

Presets: Time, total counts, counts in an ROI, counts in a single channel.

External Connections

USB: USB 1.1 (2.0 compatible) at full-speed (12 mbps). Provides both serial data and power for the entire GAMMA-RAD.

Ethernet: 10Base-T/100Base-TX, TCP or UDP, DHCP or fixed IP.

DAC Output: Single pin LEMO connector.

Power

+5V USB: Average current 150 mA. Entire Gamma-Rad can be powered from USB. In order to achieve the stated USB power, the Ethernet port must be disabled. This can be done only at the factory. Please specify at time of order whether low power USB operation is needed.

+5V Ethernet: Average current 350 mA. Requires the use of the external DC supply.

High Voltage: A stabilized, high efficiency Cockroft-Walton power supply provides PMT bias. HV is software controlled; HV Monitor Test point on the back panel; 1 mV = 1 V, e.g., 0.800 mV = 800 V

Physical

Size: 35.5 cm X 8.3 cm (dia)

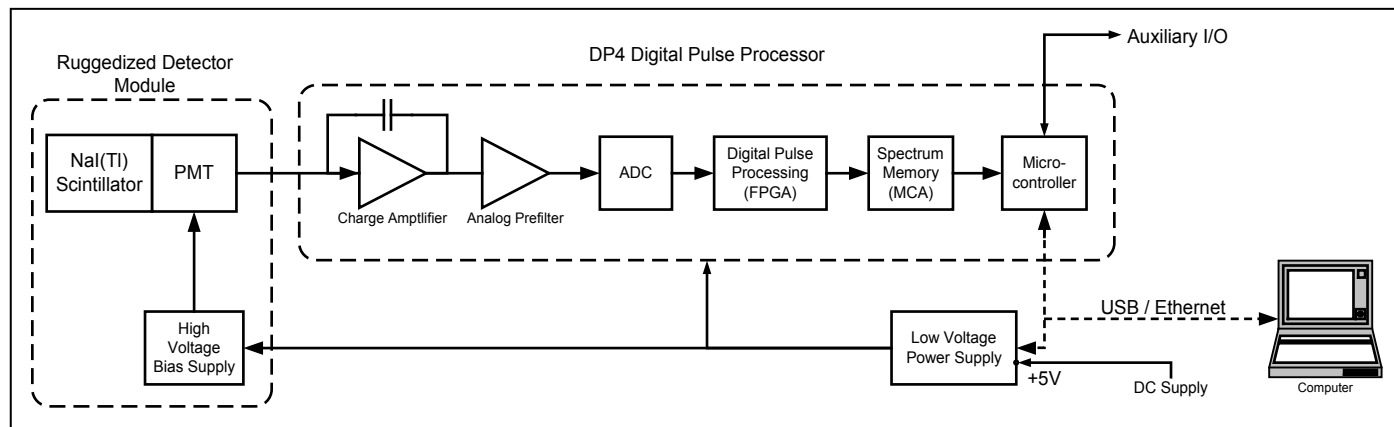
Mass: 3.6 kg (76 x 76 mm NaI(Tl))

Interface Software

ADMCA is a standard data acquisition and control package, for use with all of Amptek's digital processors and MCAs, including the GAMMA-RAD. This package provides the capability to configure the GAMMA-RAD and acquire and save data. It is described in detail on Amptek's website, where a demo version may be downloaded.

Amptek provides a DLL library (API) of routines so that users can write their own interface software. Also included are example routines, written in Visual Basic and Visual C++, which can be used to control data acquisition. These can be tailored for specific uses. This includes an example code which implements the gain stabilization algorithm, using the ⁴⁰K peak in the background spectrum.

GAMMA-RAD Architecture

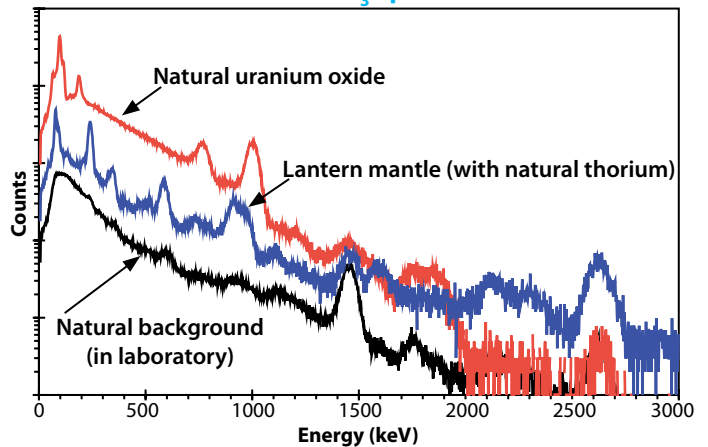


GAMMA-RAD Applications

Nuclear Safeguard or Environmental Monitor

An example program is provided with the GAMMA-RAD to aid in long term monitoring where weak sources are present. This program automatically saves a spectrum at user defined intervals, it provides gain stabilization using the ^{40}K background peak, and it provides a simple ROI analysis capability to verify if suspect counts are present above preset thresholds. This software can run on a laptop, connected to the GAMMA-RAD by a USB cable. It can also run over an Ethernet link and the Internet, and be monitored on the other side of the world. The plot on the right shows a background spectrum and measurements from natural UO_3 and a lantern mantle containing natural thorium.

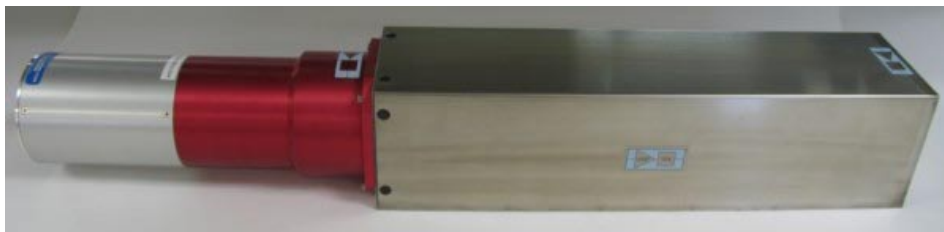
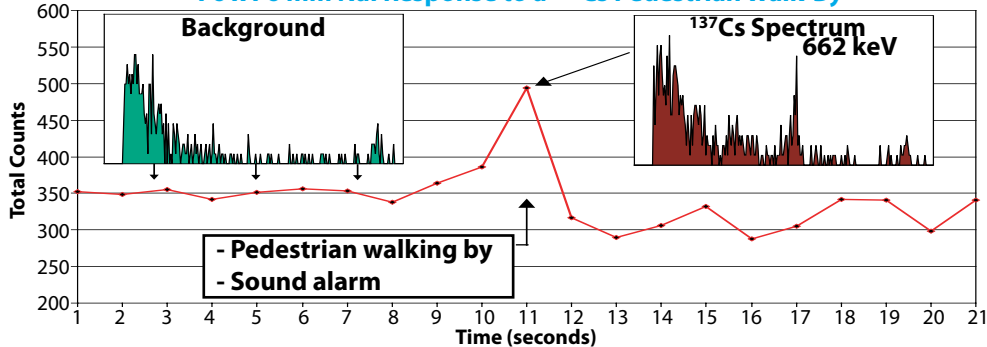
Natural UO_3 Spectrum



Pedestrian Portal Monitor

The same software used for the environmental monitoring application can be used in a pedestrian or vehicle portal monitor using much shorter data acquisition intervals. The plot below shows the count rate, both total (red line) and in the 662 keV peak (small graph on right), when a pedestrian walked by the 76 X 76 mm detector at a distance of 10 feet with a 100 μCi ^{137}Cs . A standard Geiger counter was unable to detect the source, since it registered a natural background of 0.02 mR/hr before and during the pedestrian incident, but the GAMMA-RAD clearly detected it and identified the energy.

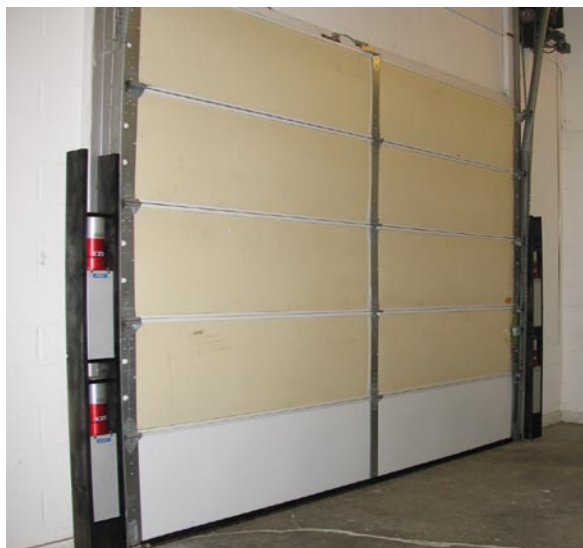
76 x 76 mm NaI Response to a ^{137}Cs Pedestrian Walk-By



The photo above shows a high sensitivity detector, a 10 x 10 x 40 cm³ (4 x 4 x 16") NaI(Tl) "bar."

The photo near right shows four "bars" mounted on a loading dock door.

The photo far right shows four "bars" mounted in a hallway.



GAMMA-RAD Applications (con't)

Shipping Container Monitor

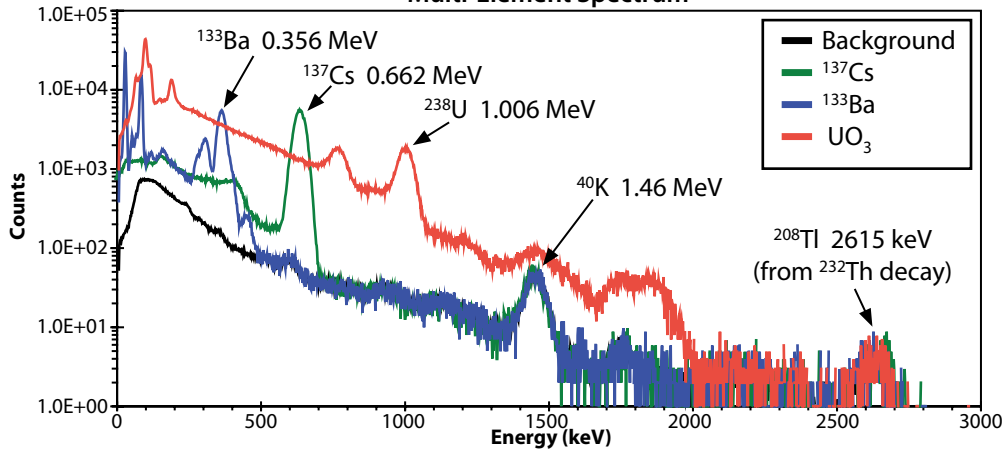
The photograph on the right shows an application that takes full advantage of the ruggedization of the GAMMA-RAD. The GAMMA-RAD modules are mounted on the VeriSpreader™ bar of the crane that lifts shipping containers. Radiation detection is carried out during routine handling so there is no delay in processing. The spectroscopy performance keeps the false positive rate at a very low level, which is a vital concern.



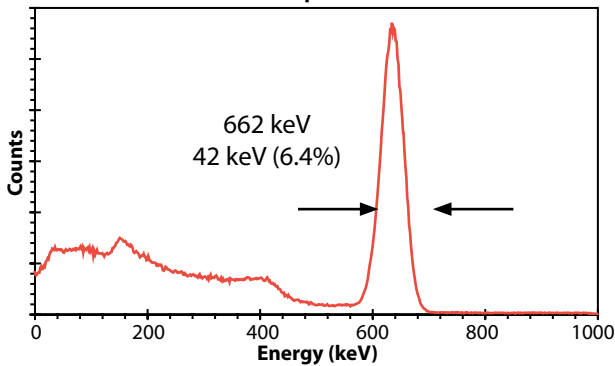
* VeriSpreader™ is a trademark of VeriTainer Corporation U.S. Patent 6,768,421.

GAMMA-RAD Spectra

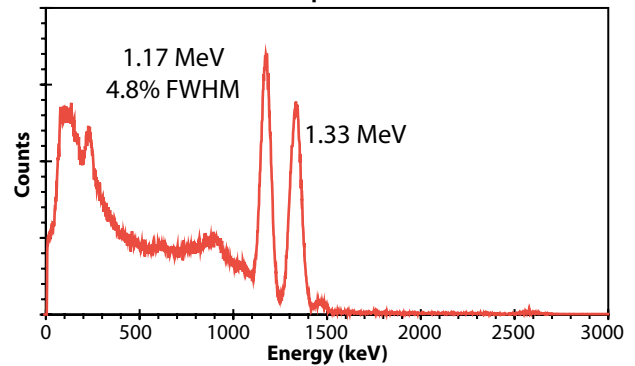
Multi-Element Spectrum



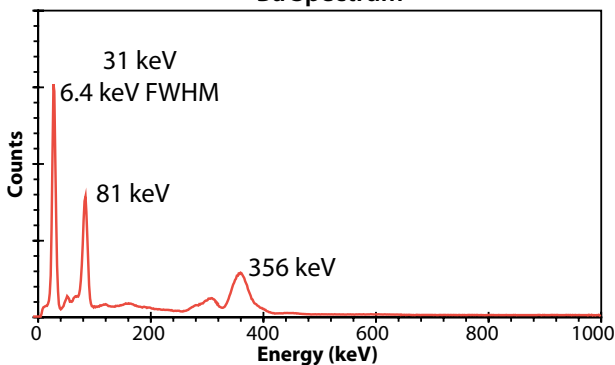
¹³⁷Cs Spectrum



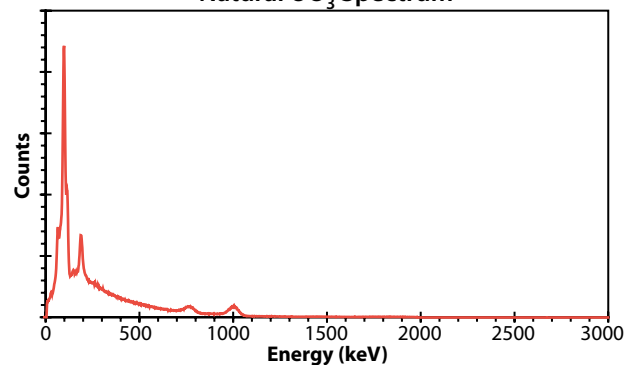
⁶⁰Co Spectrum



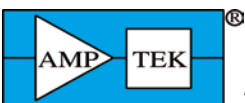
¹³³Ba Spectrum



Natural UO₃ Spectrum



For further technical specifications, please see our web site: www.amptek.com



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