FREQUENTLY ASKED QUESTIONS (FAQ) FOR AMPTEK GAMMA-RAD5

Is the Gamma-Rad5 comparable to a turn-key radioisotope identifier?

The Gamma-Rad5 contains all of the hardware required to do gamma-ray spectroscopy and identify isotopes. It includes software to control the hardware, readout the data, display it, and do simple data processing. But the Gamma-Rad5 is not a turn-key radioisotope identifier. The customer must supply software to process the spectrum, identify isotopes, and quantify the radiation intensity and must also address calibration.

The Gamma-Rad5 is unique in providing a high performance, integrated, rugged, and yet highly configurable sensor assembly. Configurability is key: the customer can select among many scintillator materials and geometries, has access to a wide range of signal processing parameters, and can tailor the interfaces. The Gamma-Rad5 has many auxiliary I/O signals, simplifying integration with external hardware. It is supplied with a library of subroutines and example code so can be used with a customer's spectrum processing and display software. The same hardware and software interfaces are used with Amptek's other digital processors, which can be used with HPGe, CdTe, SDD, Si-PIN, and other detectors.

The Gamma-Rad5 is ideally suited to users integrating a high performance, rugged gamma-ray sensor into their complete system. For example, the Gamma-Rad5 is well suited to expert laboratory users and customers needing a tailored solution for specific applications not easily addressed by the general purpose turn-key systems. It is also well suited for OEM making turn-key isotope identifiers or gamma-ray spectrometers.

How can the Gamma-Rad5 be tailored for my application?

Scintillator

The standard Gamma-Rad5 includes either a NaI(Tl) scintillator, 7.6 cm (dia) x 7.6 cm or 7.6 cm (dia) x 15.2 cm and gives <7% FWHM at 662 keV. But many other options are possible! For example:

- A large volume 10 x 10 x 40 cm^3 NaI(Tl) scintillator, common in portal applications or vehicle mounted monitors, provides very high efficiency for weak sources.
- A well geometry provides high efficiency for small samples.
- $LaCl_3$ provides better energy resolution than NaI(Tl) (but is limited to 2.5 cm x 2.5 cm and is much more expensive).
- A NaI(Tl)/LiI(Eu) Phoswich detector provides gamma-ray spectroscopy with neutron counting using a single PMT and signal processor (using pulse shape discrimination to separate them).
- A low background sensor in in which a Compton veto shield (made from a plastic scintillator) surrounds the primary NaI(Tl) detector.

Signal processor configuration

There are many software adjustable parameters in the Gamma-Rad5, including the gain, the HV bias to the PMT, the peaking time, and number of MCA channels. It includes pulse shape discrimination with several adjustable parameters. These parameters permit one to tailor the configuration for a particular scintillator or measurement application.

Auxiliary I/O

The primary data from the Gamma-Rad5 is the energy spectrum, sent over USB, Ethernet, or RS232 interfaces to a computer running the analysis software. It is typically updated once per second.

As secondary data, the Gamma-Rad5 has several hardware I/O channels (software configurable). It includes several single channel analyzers, which produce output logic pulses (in real-time). This can be used for a fast trigger of radiation intensity. It includes a counter input, which can be used for

example with an external neutron counter, allowing one to combine the neutron count information into a single data packet. It includes a gate input, allowing one to synchronize acquisition with external hardware. There are other auxiliary signals available, discussed in the documentation.

I want to use my own scintillator and PMT. Do you sell a digital tube base?

Amptek, Inc. does not currently sell an integrated digital tube base, i.e. a single component which includes the tube base with dynode divider, HV supply, and digital processor which can be mated to PMTs.

However, we can provide the components in a conventional tube base. This permits us to support many different PMT bases rather than one single option. We can also provide just the digital processor used in the Gamma-Rad5 if you want to provide the other components.

Do you have a solution for HPGe, CdTe, and other detectors?

Yes, Amptek has a family of signal processors, the DP5 family, which can be tailored to support a wide range of spectroscopy detectors.

- The DP5G is the signal processor used in the Gamma-Rad5. It is optimized for use with scintillators and includes a charge amplifier.
- The DP5 is designed for semiconductor detectors. A tailored DP5 provides excellent performance with HPGe detectors, as discussed in in the HPGe application note AN-DPP-003 (http://www.amptek.com/pdf/andpp003.pdf).
- The DP5 was originally designed for Amptek's high resolution detectors, including CdTe detectors and high resolution Si diodes for X-ray spectroscopy.
- A variant of the DP5, with a custom preamp, is used with proportional counters.

All of these digital processors have an identical software interface, supported by the DPPMCA software package and the software developer's kit. A user can readily develop a family of radiation detectors using the same core signal processing and interface technology.

These digital processors all include Ethernet, USB, and RS232 interfaces. With Ethernet, one can easily assembly a network of radiation detectors which can readily include scintillators, CdTe, HPGe, etc. With RS232, one can easily connect the processor to PDAs or small computers to make a family of handheld systems, sharing the core software and processor technology.

What software is provided by Amptek?

Amptek provides a compiled software package, DPPMCA, along with a software developer's toolkit (SDK) which has subroutines and example code. The compiled software has the following capabilities:

Hardware Control: DPPMCA provides full access to all hardware configuration parameters: gain, peaking time, HV bias on the PMT, preset times and counts for the MCA, thresholds for eight hardware SCAs, and many more. DPPMCA permits the user to start and stop acquisition and to readout the spectra and the counts. DPPMCA supports USB, Ethernet, and RS232 interfaces.

Basic data processing and display: DPPMCA has basic capabilities for data processing and display. It permits the user to define regions of interest (ROIs, usually set around photopeaks), it performs a simple background subtraction, and it computes the net counts and count rate in the ROIs. The user can also perform an energy calibration. It shows the histogram as it is acquired and permits one to adjust scaling.

Advanced data processing and display: For more sophisticated processing and formatted display, e.g. improved background removal, automatically identifying which peaks are present and setting ROIs, performing efficiency calibrations, deconvolving spectra, and estimating the activity present, the data from DPPMCA can be input to user supplied software. Windows Clipboard can be used to transfer data, or the ASCII files saved by DPPMCA can be read by the user software, or the user can use the SDK to control the Gamma-Rad5 from within his/her custom software.

Software Developer's Kit (SDK): The SDK consists of example subroutines and example code, written in C++ and in VB. These examples have been used by customers with LabView and with their own custom

software. This permits the DP5 data acquisition and control to be tightly integrated with the user's interface and analysis software.

Is the Gamma-Rad5 gain stabilized?

The gain of a scintillator and PMT is well known to vary significantly with temperature and with operating life. Any spectroscopy system using a scintillator and PMT must compensate for the gain changes. There are several different approaches to gain stabilization, with the "best" depending on the details of the application. Most approaches are software based, detecting and correcting for gain shifts as part of the data analysis software.

Since the Gamma-Rad5 was not designed for a single application but to support a wide range of applications, it is not built into the Gamma-Rad5. We regard it as part of the complete data processing software which a customer must provide.

Amptek does have sample code which provides gain stabilization based upon the ubiquitous, naturally occurring ^{40}K peak. ^{40}K emits gamma-rays at 1460.83 keV. The intensity is low, a few counts per second in the photopeak for a 7.6 x 7.6 cm NaI(Tl) in a typical environment, but is sufficient to detect gain shifts over a period of tens of minutes. When the software detects a shift, it can command a gain change in the Gamma-Rad5. Alternately, the software can re-bin the histogram while retaining the original data. Other approaches are quite feasible. For example, in spectrum processing software packages, once photopeaks are identified, the gain can be adjusted to provide the best match between photopeak centroids and the known gamma-ray energies.