SCINTILLATION DETECTOR & MCA

GAMMA-8000

Gamma Ray and X-Ray Spectroscopy System

Hand-Held, High Efficiency NaI(Tl) Detector

The GAMMA-8000 is a powerful, portable instrument combining a scintillation probe and MCA that provides the same high quality spectroscopic information both inside the laboratory and in the field.

HOMELAND SECURITY APPLICATIONS

FEATURES

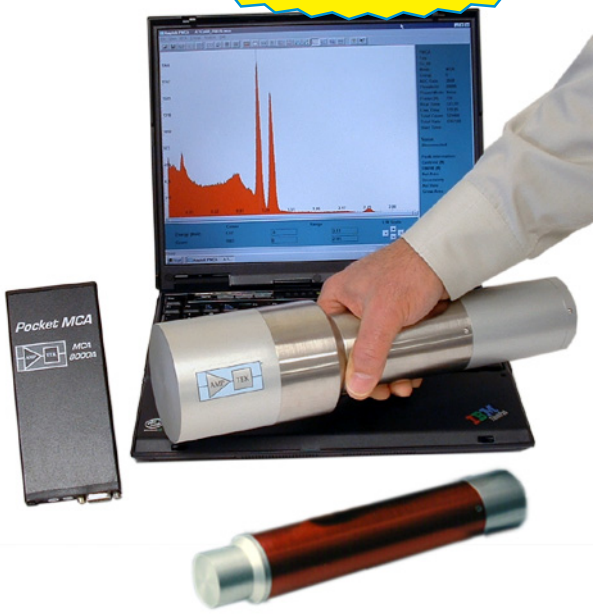
- **The Pocket MCA provides power to the Probe from two AA batteries**
- **Scintillator Probe includes:**
  - **PM Tube**
  - **Ultra stable High Voltage Supply**
  - **Preamplifier and Amplifier**
- **Crystal Sizes from 30 x 30 mm up to 152 x 76 mm**
- **Choice of crystals: NaI(Tl), CsI(Tl), BGO, etc.**
- **Rugged design, water and gas tight**
- **Low power consumption (200 mW)**

APPLICATIONS

- **High resolution X-ray and Gamma ray spectroscopy**
- **Homeland security**
- **Nuclear safeguards verification**
- **Cargo container inspection**
- **Toxic dump site monitor**
- ***In situ* processing**
- **Environmental monitoring**
- **Teaching and Research**

2005 Winner of Radiation Detection Excellence in Technology of the Year Award

2005 FROST & SULLIVAN Radiation Detection Excellence in Technology of the Year Award



Scintillation detectors 76 x 76 mm (top) and 30 x 30 mm (bottom) shown with Amptek 'Pocket MCA' and laptop computer showing sample spectrum.

The **GAMMA-8000** is a unique combination of a low power Scintillation Probe and the world's smallest MCA, the MCA8000A. The scintillation probe features a complete, ruggedized design of Scintillator, PM Tube, High Voltage Supply, Preamplifier and Amplifier.

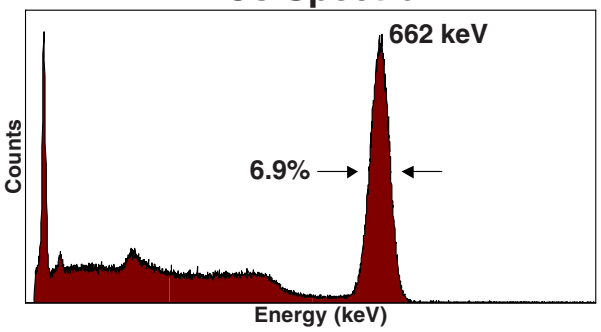
The standard scintillation crystal is NaI(Tl). The internal High Voltage supply ensures stable gain at high count rates and low power consumption. The housing is made of anodized aluminum with a thickness of 0.5 mm around the scintillation crystal.

A low power preamplifier and spectroscopic amplifier process signals from the photomultiplier tube. The output pulses from the shaping amplifier are directly connected to the MCA8000A via a 4-wire cable. The cable also provides power to the probe from the two AA batteries located inside the MCA8000A. A high voltage monitor and control is provided at the back of the probe via a twenty-turn potentiometer. For laboratory use, the AC adaptor included with the MCA8000A can provide continuous power to the system.

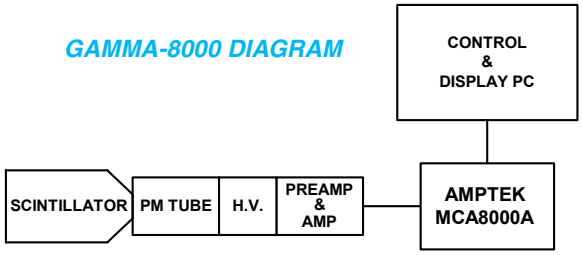
Energy resolution with the standard 30 x 30 mm NaI(Tl) crystal is <7.5% FWHM at 662 keV and <14% FWHM at 59.5 keV. Energy resolution for the optional 76 x 76 mm NaI(Tl) crystal is typically 6.9% at 662 keV and 4.7% at 1.33 MeV.

Control and display of the MCA8000A can be provided by a laptop or desktop computer. The MCA8000A features up to 16k channels successive approximation ADC with less than 5 µs conversion time and sliding scale linearization. Windows software is included (see MCA8000A specifications).

^{137}Cs Spectrum



GAMMA-8000 DIAGRAM



NaI(Tl) Probe Specifications*

Scintillation Crystal: Standard: 30 x 30 mm NaI(Tl)
Optional: 76 x 76 mm NaI(Tl)

Photomultiplier Tube: Standard: 30 mm diameter, fast linear focused
Optional: 78 mm diameter

Housing around Scintillation Crystal: Anodized aluminum: 1.0mm thick front surface
1.5 mm thick side surface

Energy Resolution (Typical)

30 x 30 mm Probe: <7.5% FWHM at 662 keV
<14% FWHM at 59.5 keV

76 x 76 mm Probe: 6.9% at 662 keV
4.7% at 1.33 MeV

High Voltage Generator: Cockroft Walton type

High Voltage Regulation: 0 - 1500 V (20 turn screw potentiometer)

Power Supply: +5 V to +6 V provided by the MCA8000A

High Voltage Monitor: 1 V = 1 kV (adjustable on back of assembly)

Power Requirements: 200 mW

Spectroscopy Amplifier

Output Impedance: 50 Ω

Pulse Shape: Bipolar , 3 µs rise time, 3 µs fall time.

Maximum Output: + 4.0 V

Electrical Connections:

Cable Type: Shielded cable for power supply and signal (2 m)

Connectors on Probe and MCA: 4-Pin LEMO, ERA 0 S 304 CLL

Connectors on Cable: 4-Pin LEMO, FFA 0 S 304 CLAC42

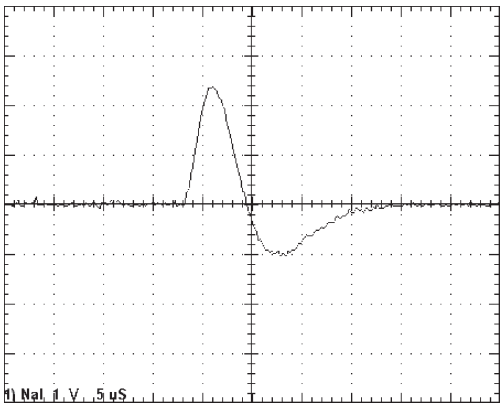
Pin 1 = Signal — Pin 3 = +5 V to +6 V

Pin 2 = Signal Ground — Pin 4 = Power Ground

Operating Range: -25 °C to +55 °C

Weight: MCA8000A: 300 g
30 x 30 Probe: 450 g
76 x 76 Probe: 2 kg

Output Pulse of the GAMMA-8000 NaI Probe



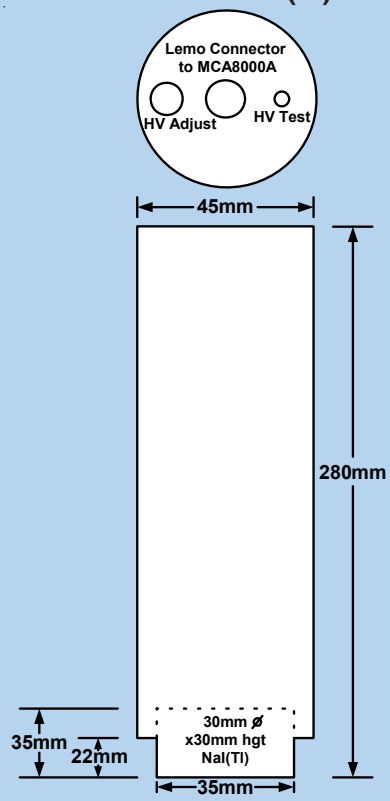
Use of the MCA8000A With Other Detectors

In applications other than the Amptek GAMMA-8000, the signal from the PM tube or other detector must be first connected to a preamplifier and shaping amplifier and then to the MCA8000A. The input to the MCA8000A from other detectors must be a positive going unipolar or bipolar pulse from the output of a shaping amplifier with peaking time greater than 250 ns.

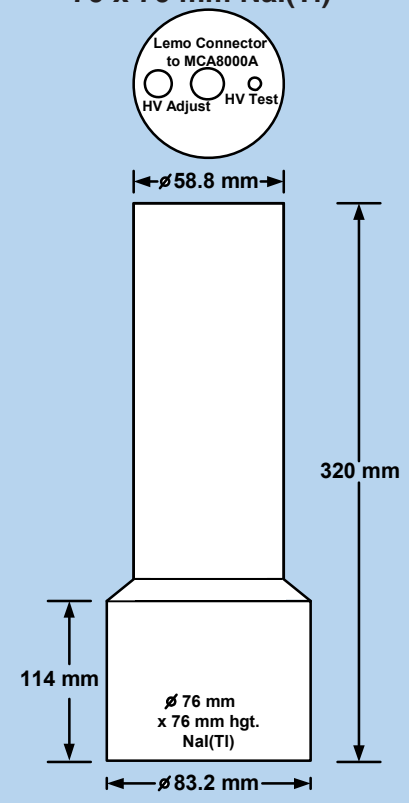
Mechanical Dimensions

Note: Drawings are not to scale

30 x 30 mm NaI(Tl)



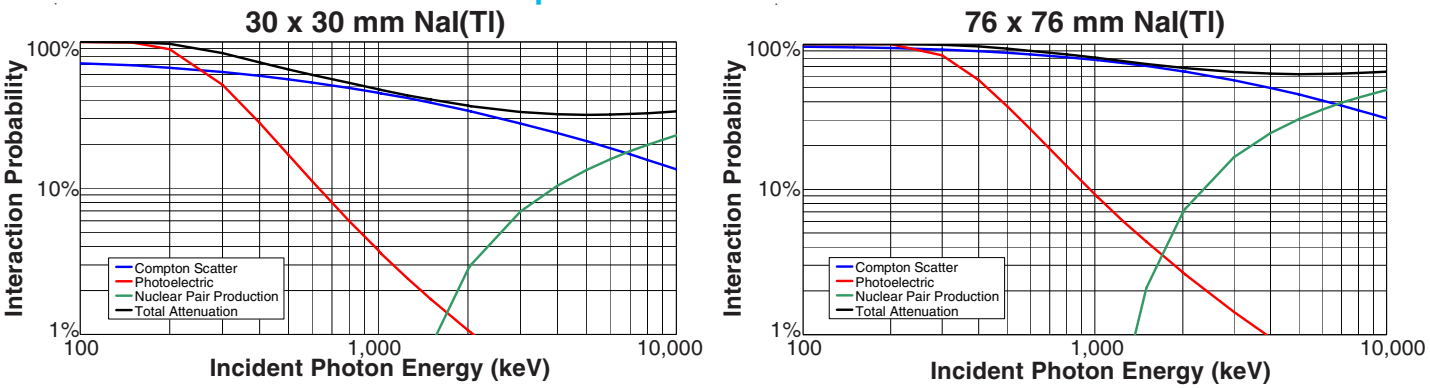
76 x 76 mm NaI(Tl)



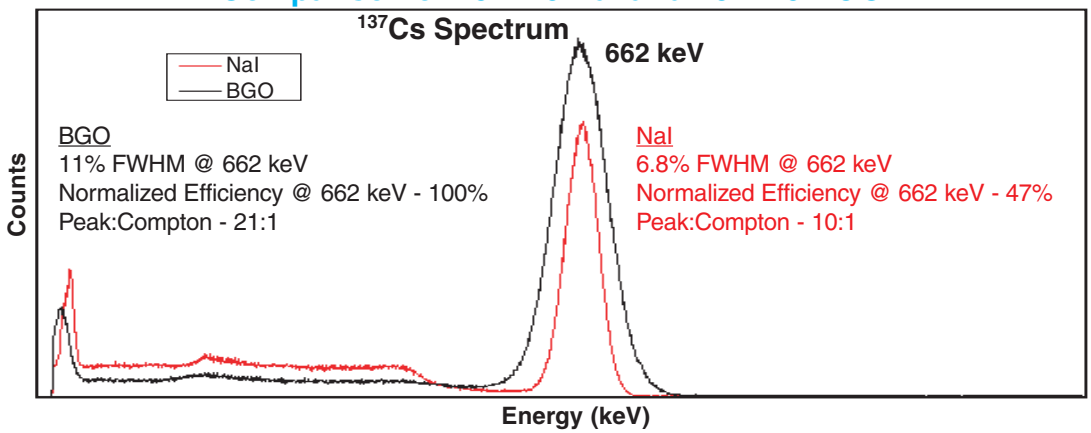
***See Also MCA8000A Specifications**

NaI(Tl) Efficiency

Computed Interaction Probabilities



Comparison of 76 x 76 NaI and 76 x 76 BGO



Application Notes

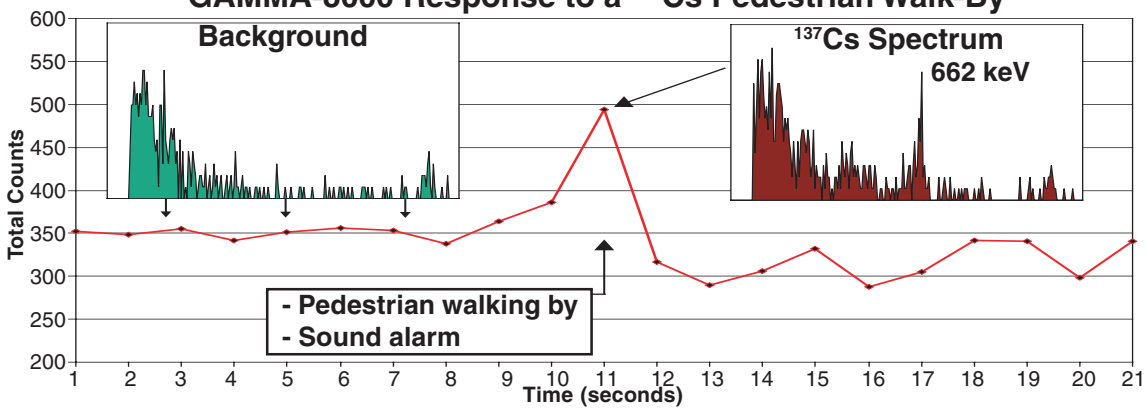
Long-Term Radiation Monitoring of the Environment

An example program written in Visual Basic and using the MCA8000A communication libraries has been provided to aid in the long-term radiation monitoring of the environment. This routine automatically saves a complete spectrum at user defined intervals. In addition, it produces an ASCII file consisting of the Total Counts in each spectrum. This Total Counts file can then be plotted to show the variation in counts over time. An example is given below.

Pedestrian Monitoring System for Radioactive Materials

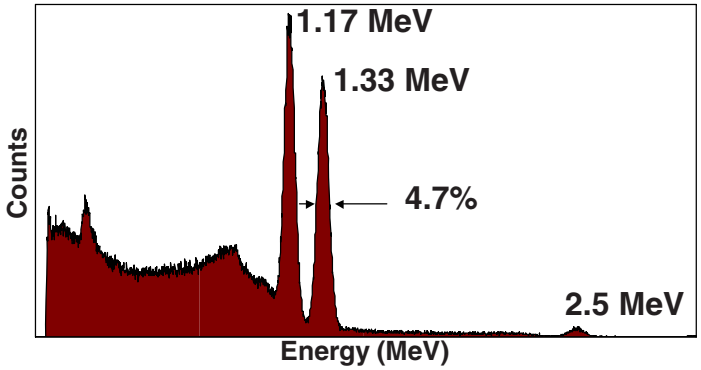
GAMMA-8000 (76 mm x 76 mm NaI)

Example of a pedestrian walking 10 ft away from a monitoring station and carrying a 100 µC ^{137}Cs radioactive source. This event was not detected with a standard Geiger counter, which registered a natural background of 0.02 mR/hr before and during the pedestrian incident. However, as shown in the figure below, the GAMMA-8000 quickly detected a rise in the Total Counts in order to sound the alarm, and unlike the Geiger counter, recorded the spectral information separately for every second. Hence, positive identification of the ^{137}Cs isotope was made by identifying the 662 keV peak.

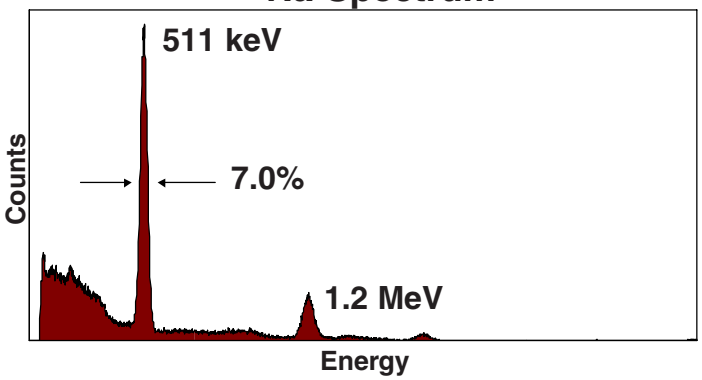


Typical Spectra with 76 x 76 mm NaI(Tl) Detector

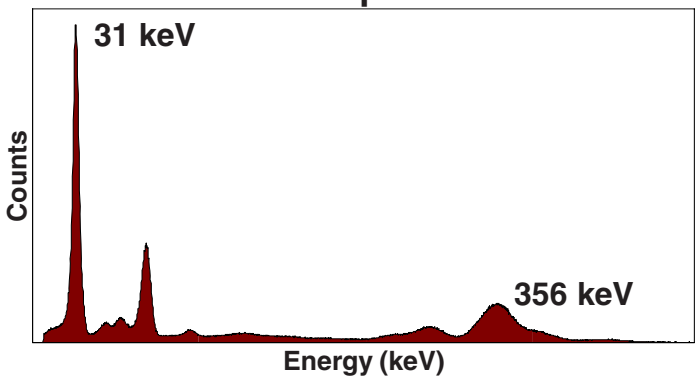
^{60}Co Spectrum



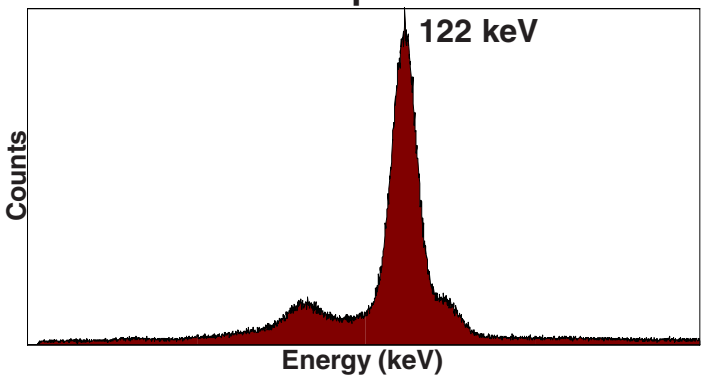
^{22}Na Spectrum



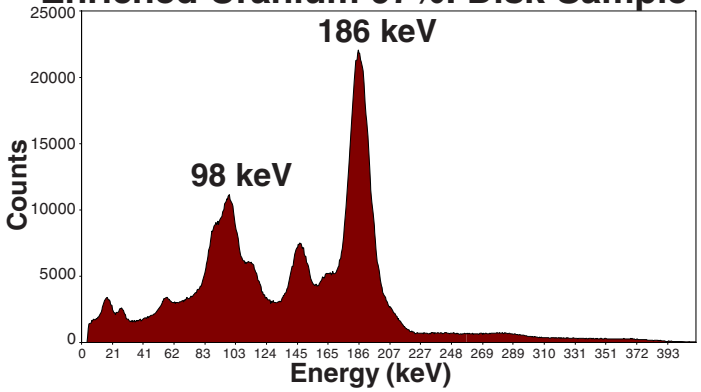
^{133}Ba Spectrum



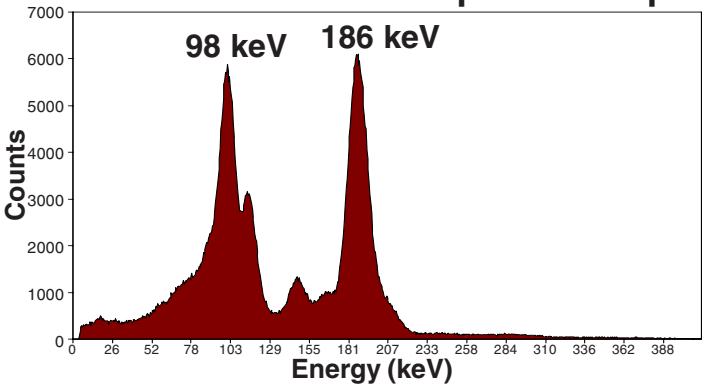
^{57}Co Spectrum



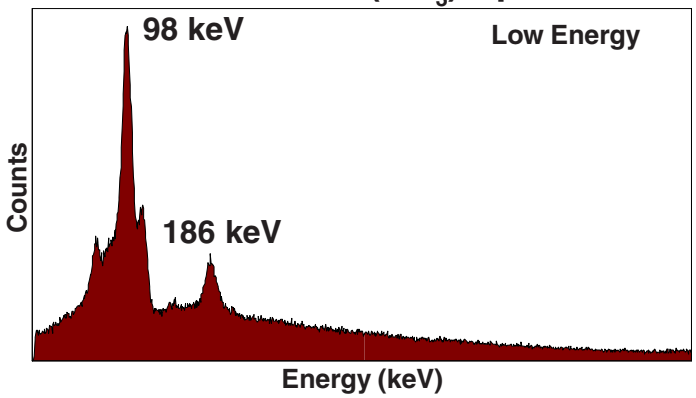
Enriched Uranium 97%: Disk Sample



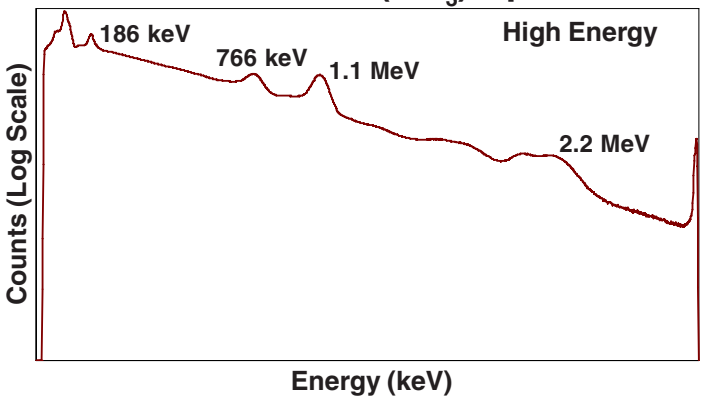
Enriched Uranium 97%: Sphere Sample



Natural Uranium (UO_3) Spectrum



Natural Uranium (UO_3) Spectrum



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