

# C30994E

## Solid State Gamma-Ray Detector

### Developmental Type

### Silicon Avalanche Photodiodes Coupled to Bismuth Germanium Oxide ( $\text{Bi}_4\text{Ge}_3\text{O}_{12}$ ) Scintillators



(Actual Size) L-1116

RCA Developmental type C30994E consists of two Bismuth Germanium Oxide (BGO) crystals, each coupled to separate silicon avalanche photodiodes in a lightproof hermetically sealed package. These detectors are useful for identifying  $\gamma$ -rays with energies above 250 keV. A key feature of this device is its spatial resolution due to the small detector size and high packing fraction.

These devices operate on principles similar to conventional BGO photomultiplier (PMT)  $\gamma$ -ray scintillation detectors. When a  $\gamma$ -ray is stopped by the BGO, the BGO emits light. In this

case, however, the light emitted is monitored by an avalanche photodiode (APD). Their small size, lower operating voltages, and simple biasing make these devices more attractive than photomultipliers in some applications; note however, that a low noise preamplifier is required.

The energy resolution at 22° C is typically 20% FWHM (Compton corrected) for the  $^{137}\text{Cs}$  662 keV  $\gamma$ -ray. Each detector is tested before shipment; energy resolution and bias voltage are supplied with each device. Typical timing resolution is less than 20 ns FWHM as measured with a  $^{22}\text{Na}$  source emitting two coincident 511 keV  $\gamma$ 's, one observed with a fast plastic scintillator.

- Solid State
- Small Size for Good Spatial Resolution
- Hermetically Sealed
- Low Operating Voltage

At 22° C the energy and time resolutions are influenced significantly by shot noise in the avalanche photodiode due to thermally generated dark current. Cooling to 0° C decreases the energy resolution to about 17%, and the timing resolution to below 15 ns (with a 30 keV energy window).

#### Characteristics at 22° C

	Min.	Typ.	Max.	Units
Operating Voltage $V_R$ .....	400	—	700	V
Temperature Coefficient of $V_R$ for Constant Gain .....	—	3.0	—	V/°C
Operating Temperature ....	-30	—	35	°C
Detector Capacitance .....	—	12	14	pF
Energy Resolution FWHM for $^{137}\text{Cs}$ 662 keV (with low noise amplifier and .5 $\mu\text{s}$ shaping).	—	20	25	%
(Compton Corrected) .....	—	20	25	%
Output Signal for $^{137}\text{Cs}$ 662 keV .....	60,000	75,000	—	electrons
Dark Current .....	—	200	—	nA

T-41-67

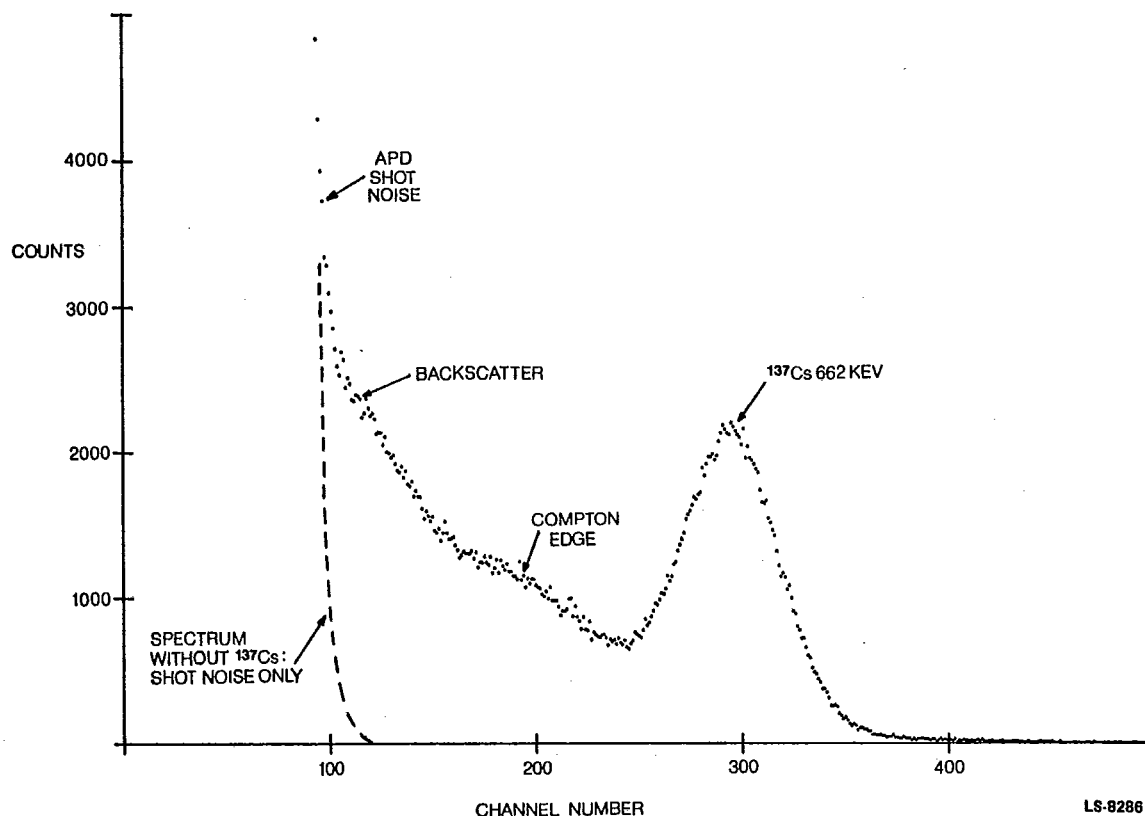
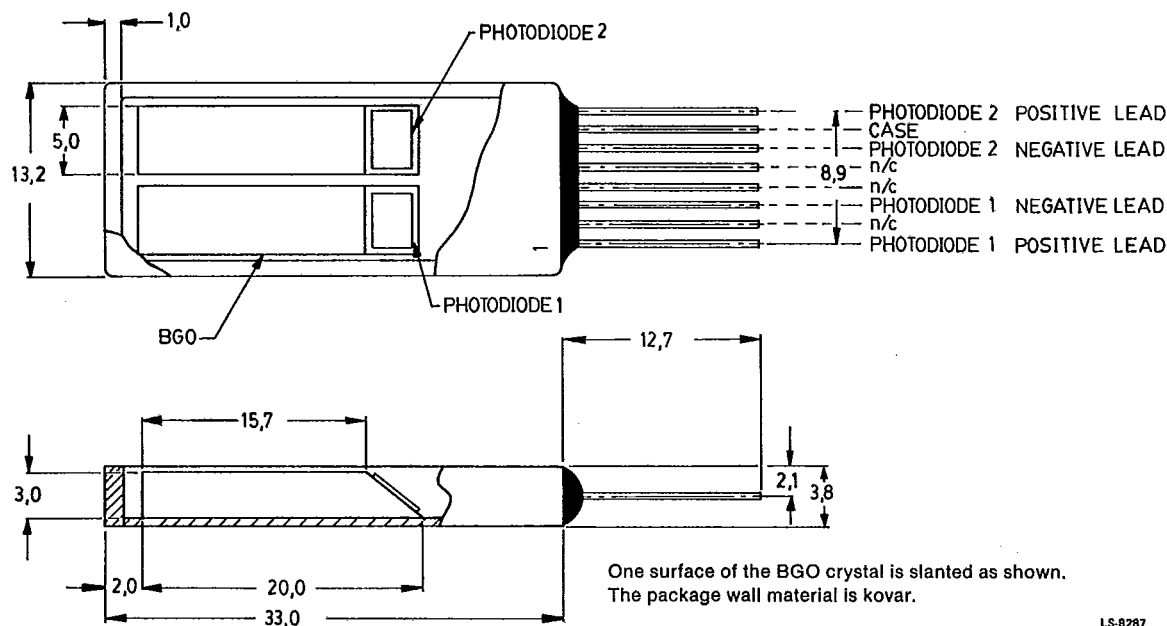


Figure 1 - Typical  $^{137}\text{Cs}$  Spectrum as Accumulated at  $22^\circ\text{C}$  with a Shaping Time of  $0.5\ \mu\text{s}$



Dimensions in millimeters.

Figure 2 - Dimensional Outline

For further information or application assistance on these devices, contact your RCA Sales Representative or Photodetector Marketing, RCA, Ste. Anne de Bellevue, Quebec, Canada H9X 3L3 (514) 457-9000.

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