

Compton Suppressors Detectors for Suppressing Unwanted Background

In gamma spectroscopy performed with Ge detectors, the detection of low intensity peaks is often complicated by the presence of Compton scattering of gamma radiation of higher energy. A Compton suppressor (also known as an anti-Compton shield or ACS) performs in conjunction with a central Ge detector. The Compton suppressor, which can be designed using NaI(Tl) or BGO, surrounds the Ge detector. The interaction of a scattered photon with the crystal in the Compton shield provides a signal that is used to veto the incomplete and unwanted signal in the Ge detector.

Standard Configurations -

Compton suppression spectrometers can be constructed in two ways, symmetrically (axial design) or asymmetrically (transverse design). See photos below.

- Axial design: This design serves as an economical and compact Compton suppression shield. It can be supplied as a right cylinder or it can be tapered at one end to allow close assembling of multiple units into an array. The simplicity of the design makes this the most economical unit.
- Transverse design: This design provides an efficient Compton suppression shield with scintillation material surrounding the Germanium detector at the front as well as the sides. It can either be supplied as a right cylinder or it can be tapered at one end to allow close assembling into an arc or sphere. This configuration is much simpler to operate since it only has one PMT.

Design Notes -

- Number and diameter of PMTs mounted on crystals are chosen to maximize light collection.
- Scintillation material used is dependent on application. NaI(Tl) gives superior resolution and timing performance but requires larger detectors. In contrast, BGO has 2 times more stopping power, so detectors can be smaller. BGO has a better signal/noise ratio and lower dead time (no slow component).
- Wells and through-side holes are tailor-made to the geometry of the Germanium detector.
- Units made of segments can be optically coupled or optically separated.

Increasing the material volume on the side of the Compton suppression spectrometer improves the suppression over the whole energy range of interest. The material behind the Ge detector affects mainly the suppression in the low energy part of the spectrum, up to 250 keV. Having scintillation material behind the Ge detector is necessary when one is interested in detecting low energy γ -rays in the presence of high energy γ -rays.

From the above discussion, it may be clear that the asymmetric type of Compton suppression spectrometer has a superior suppression compared to the symmetric one. On the other hand, the symmetric one is more suitable for multi-detector assemblies.

Advantages -

- Shape and finish matched to meet application
- Demountable PMTs
- Active shield material of NaI(Tl), or BGO
- Detector performance can be guaranteed for energy resolution

Typical Performance NaI(Tl) versus BGO		
Property	NaI(Tl)	BGO
Density (g/cm ³)	3.67	7.13
Efficiency (light output)	100	10-12
Decay Constant (μ sec)	.25	.30

Compton Suppressors

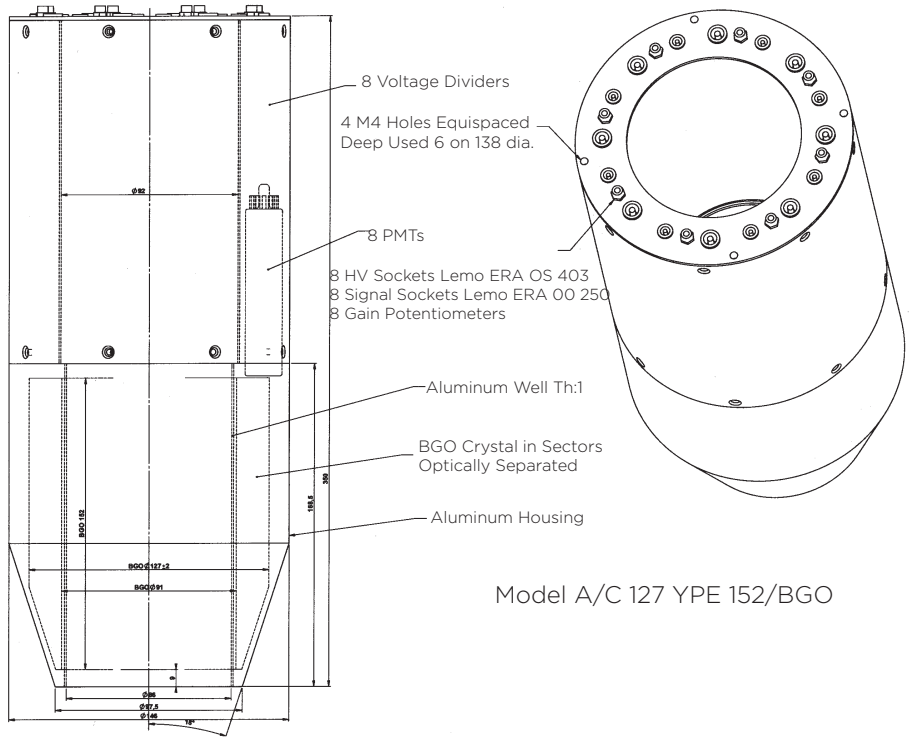
Detectors for Suppressing Unwanted Background

Popular Configurations -

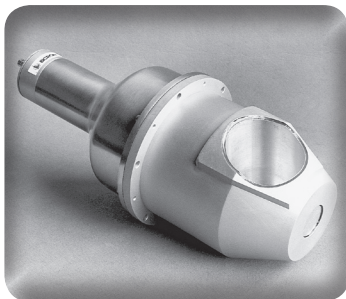
Axial or symmetric detectors are more suitable for multi-detector assemblies. Advantages include better timing, higher data rates and better signal-to-noise ratio. The design shown is optimized for value.



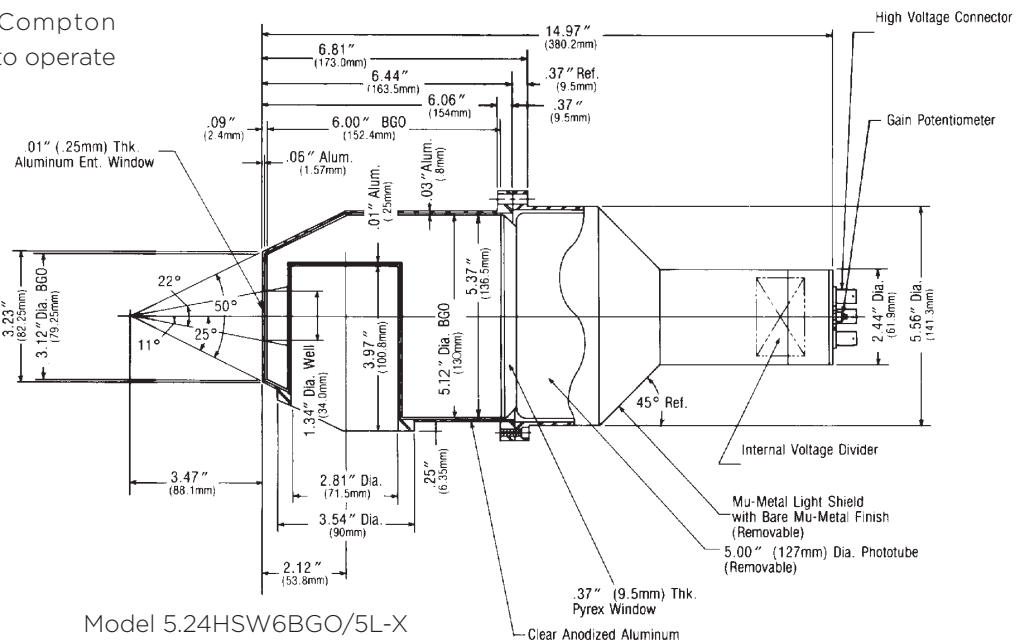
Example of axial (symmetric) design



The transverse or asymmetric configuration is the best design for superior Compton suppression. It is also much simpler to operate since it only has one PMT.



Example of transverse (asymmetric) design



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The drawing dimensions are nominal and subject to change. Call the factory for current values.

Manufacturer reserves the right to alter specifications.

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