

# Phoswich Detectors For High Energy Backgrounds

A phoswich (“phosphor sandwich”) is a combination of scintillators with dissimilar pulse shape characteristics optically coupled to each other and to a common PMT (or PMTs). Pulse shape analysis distinguishes the signals from the two scintillators, identifying in which scintillator the event occurred.

Phoswich detectors were developed to detect low-intensity, low-energy gamma rays, X-rays, as well as alpha and beta particles efficiently in a higher-energy ambient background. Some detector designs can measure and separately identify all energies simultaneously.

## Operating Principle -

The two scintillation crystals viewed by the same photomultiplier tube operate as an efficient low background detector for the radiation of interest. The thin primary crystal has sufficient thickness to absorb the radiation of interest, whereas the thick secondary crystal acts as anti-coincidence shielding. With this configuration, radiation will either be totally absorbed in the primary crystal, pass through the primary crystal or encounter Compton scattering in the primary crystal. If the Compton scattering occurs, the larger secondary crystals absorb the forward scattered photon and supplies a signal to allow electronic rejection of the event.

When the detector is used in an anti-coincidence mode, event signals from the primary detector are accepted only when there is no coincidence (veto) signal from the guard detector. This active shielding configuration results in substantially lower background than that of conventional designs.

## Applications -

Phoswiches for whole body counting and X-ray astronomy applications use thin NaI(Tl) as the primary detector. Behind this is a much thicker “guard crystal” of CsI(Na) or CsI(Tl) (see example 2 on reverse side).

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CaF<sub>2</sub>(Eu) is frequently coupled to NaI(Tl) and viewed by a single photomultiplier tube. Signals from this phoswich configuration are processed through a pulse shape discrimination (PSD) circuit and separated into fast decay (0.25 msec) and slow decay (0.94 msec) components. This configuration allows simultaneous alpha, beta, and gamma counting.

We also produce phoswich designs which combine a thick, slow-decay plastic scintillator (our BC-444) with a thin, fast scintillator (typically our BC-412). This configuration is useful in charged particle investigations where the fast scintillator provides dE/dx information while the slow scintillator gives the total energy .



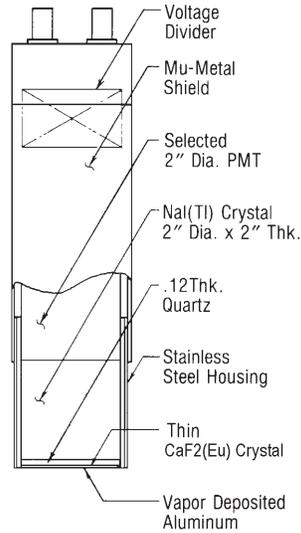
An 8" (20.3cm) diameter, CsI(Tl) phoswich detector for low-background, whole body counting

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## Popular Configurations -

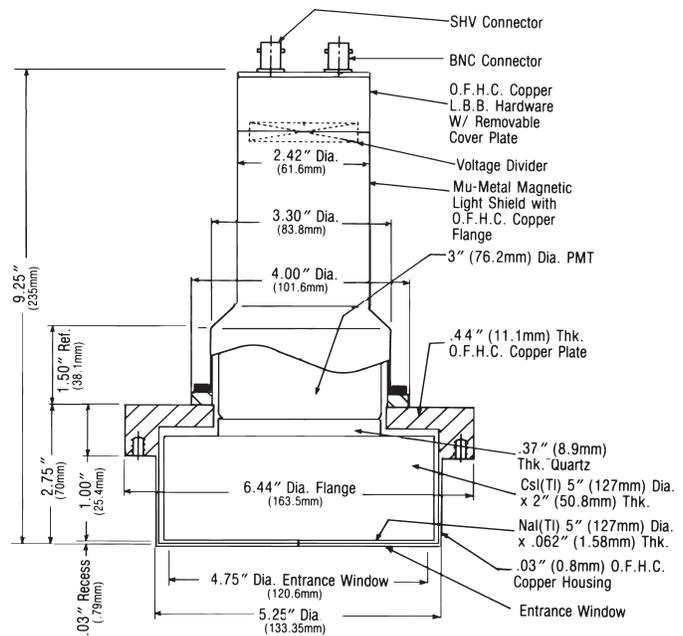
Example 1:

This configuration is composed of  $\text{CaF}_2(\text{Eu})$  to detect alpha and beta particles and  $\text{NaI}(\text{Tl})$  to detect gamma rays. All three types of radiation can be measured at once from the same source.



Example 2:

Phoswiches used for whole body counting and X-ray astronomy typically use thin  $\text{NaI}(\text{Tl})$  as the primary detector. Behind the  $\text{NaI}(\text{Tl})$  is a much thicker "guard crystal" of  $\text{CsI}(\text{Na})$  or  $\text{CsI}(\text{Tl})$ .



Model 5XH.063CsI(Tl)/NaI(Tl)Q/3BOKLC-X

*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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