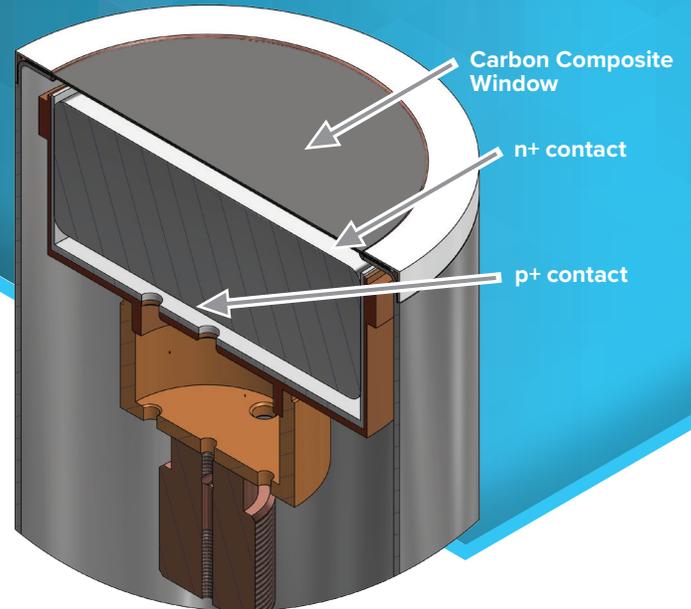




## DETECTORS

# BEGe™

Broad Energy Germanium  
Detectors



## FEATURES

- Energy range from 3 keV to 3 MeV combines the spectral advantages of Low Energy and Coaxial HPGe detectors
- Detection efficiencies and energy resolutions are optimized in the 3 keV to 662 keV energy region where most tightly-grouped gamma lines of interest are located
- Flat, non-bulletized crystals offer optimum efficiencies for samples counted close to the detector
- Thin, stable entrance window allows the detector to be stored warm with no fear of low energy efficiency loss over time
- Equipped with Intelligent Preamplifier
- USB 2.0 Serial Interface

## DESCRIPTION

The Mirion BEGe Broad Energy Ge Detector covers the energy range of 3 keV to 3 MeV like no other. The resolution at low energies is equivalent to that of our Low Energy Ge (LEGe™) Detector and the resolution at high energy is comparable to that of good quality coaxial (SEGe™) detectors.

Most importantly the BEGe detector has a short, fat shape which greatly enhances the efficiency below 1 MeV for typical sample geometries. This shape is chosen for optimum efficiency for real samples in the energy range that is most important for routine gamma analysis. This is in stark contrast to the traditional relative efficiency measurement – a <sup>60</sup>Co point source at 25 cm which is hardly a relevant test condition for real samples. See the figures below comparing absolute detector efficiencies of a 5000 mm<sup>2</sup> and 6500 mm<sup>2</sup> BEGe Detector to coaxial detectors with approximately 60% relative efficiency.

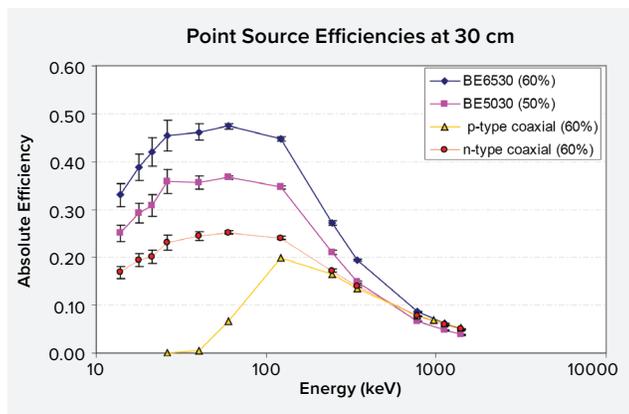
In addition to higher efficiency for typical samples, the BEGe detector exhibits lower background than typical coaxial detectors because it is more transparent to high energy cosmogenic background radiation that permeates above ground laboratories and to high energy gammas from naturally occurring radioisotopes such as <sup>40</sup>K and <sup>208</sup>Tl (thorium). This aspect of thin detector performance has long been recognized in applications such as actinide lung burden analysis.

Most Low Energy Detectors are aptly named because they do not give good resolution at higher energies. In fact resolution is not usually specified above 122 keV. The BEGe detector represents a breakthrough in this respect. The BEGe unit is designed with an electrode structure that enhances low energy resolution and is fabricated from select germanium having an impurity profile that improves charge collection (thus resolution and peak shape) at high energies. Indeed, this ensures good resolution and peak shape over the entire mid-range which is particularly important in analysis of the complex spectra from uranium and plutonium.

## BEGe | BROAD ENERGY GERMANIUM DETECTORS

In addition to routine sample counting, there are many applications in which the BEGe Detector really excels. In internal dosimetry the BEGe unit gives the high resolution and low background need for actinide lung burden analysis and the efficiency and resolution at high energy for whole body counting. The same is true of certain waste assay systems particularly those involving special nuclear materials.

The BEGe detector and associated preamplifier are normally optimized for energy rates of less than 60 000 MeV/sec. Charge collection times prohibit the use of short amplifier shaping time constants. Resolution is specified with an optimum shaping time constant and Lynx® digital peaking time equivalent.



Absolute Efficiency vs. Energy comparison for BE6530, BE5030, GC6020 (p-type coaxial) and GR6022 (n-type coaxial) detectors

Another big advantage of the BEGe unit is that the detector dimensions are virtually the same on a model by model basis. This means that like units can be substituted in an application without complete recalibration and that computer modeling can be done once for each detector size and used for all detectors of that model.

With cross-sectional areas of 20 to 65 cm<sup>2</sup> and thickness' of 20 to 30 mm, the nominal relative efficiency is given below along with the specifications for the entire range of models. BEGe detectors are normally equipped with our composite carbon windows which are robust and provide excellent transmission to below 10 keV. Aluminum windows are also available and are preferred when there is no interest in energies below 30 keV and improved ruggedness is desired. If full advantage of the low energy capability (down to 3 keV) needs to be taken, non-ULB Beryllium windows may be chosen on special request after consulting the factory.

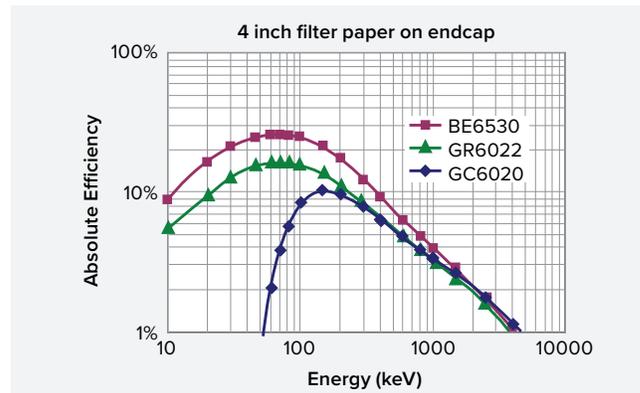
The iPA™ Intelligent Preamplifier included with this style of HPGe detector has an improved, low power analog front stage providing excellent resolution and count rate performance.

An integrated digital back-end makes use of the detector sensors to continuously monitor and store all relevant parameters and status information. This data, which may be trended over time, allows the user to take preventative measures if a key parameter starts to shift and ultimately improves equipment availability and productivity. As digital access to these State-of-Health (SoH) data are essential to enable a product-wide Mirion Lab-Pulse™ Monitoring Service leveraging modern Internet of Things (IoT) technology, the iPA preamplifier is called “Lab-Pulse Ready”.

It also enables setup and tuning of the preamplifier through digital controls rather than potentiometers.

The preamplifier status information, on board log file and digital controls are accessible through a USB 2.0 serial connection and software application which is provided with the iPA preamplifier.

See the “Intelligent Preamplifier” specification sheet for more details.



Absolute Efficiency vs. Energy Comparison for BE6530, GR6022 (n-type coaxial) and GC6020 (p-type coaxial) detectors – all with 60% Relative Efficiency @ 1332 keV

**SPECIFICATIONS**

**BEGe DETECTOR**

General Specifications and Information

**Standard configuration includes:**

- Vertical Slimline™ dipstick cryostat with 0.6 mm Carbon Composite window and 30 liter Dewar.
- Model iPA Intelligent Preamplifier with 3 meter bias, high voltage inhibit, signal and power cables.

Other cryostat options consult web site.

Relative efficiency is a **typical value**, not a spec limit.

Model Number	Area (cm <sup>2</sup> )	Thickness (mm)	Typical Rel. Eff. (%) ≥	Full Width Half Max (FWHM) Resolution (keV)			Endcap diameter mm (in.)
				At 5.9 keV energy	At 122 keV energy	At 1332 keV energy	
BE2020	20	20	9	0.35	0.65	1.80	76 (3.0)
BE2820	28	20	13	0.40	0.70	1.90	82 (3.25)
BE2825	28	25	18	0.40	0.70	1.90	82 (3.25)
BE2825P	28	25	18	0.35	0.65	1.80	82 (3.25)
BE3820	38	20	20	0.45	0.75	1.90	89 (3.50)
BE3825	38	25	26	0.45	0.72	1.90	89 (3.50)
BE3825P	38	25	26	0.40	0.65	1.80	89 (3.50)
BE3830	38	30	34	0.45	0.72	1.90	89 (3.50)
BE3830P	38	30	34	0.40	0.65	1.80	89 (3.50)
BE5025	50	25	37	0.50	0.75	2.00	102 (4.0)
BE5030	50	30	48	0.475	0.72	2.00	102 (4.0)
BE5030P	50	30	48	0.425	0.675	1.80	102 (4.0)
BE6530	65	30	60	0.50	0.75	2.00	114 (4.5)

Above specifications are in accordance with IEEE Std 325-1996.

Resolution performance is tested with Lynx digital MCA. For resolution performance guarantee using other Mirion digital MCAs consult factory.

