ITECH IGC SERIES

P-TYPE HIGH-PURITY GERMANIUM COAXIAL DETECTORS

ITECH INSTRUMENTS P-type HPGe detectors have proven themselves worldwide over many years of unfailing service because they are manufactured in the past by PGT company. They exhibit excellent resolution and peak symmetry, with a useful energy range of 40 keV to 10 MeV. Efficiencies of 10 - 100% are available.

The coaxial HPGe crystal has an N+ lithium diffusion layer on the outside and a P+ gold metallization layer as the center core contact. ITECH's leadership in mounting technology assures low-noise operation.

Features:

- P-type high-purity germanium
- Vertical slimline dipstick cryostat
- Standard 30-liter Dewar
- Aluminum endcap
- RG-11 B/C low noise resistive feedback preamplifier
- 12-ft. bias, signal and power cables
- Unlimited temperature cycling without loss of resolution

Options:

- Cryostat configurations to meet your needs
- Portable and mechanically cooled systems
- Ultra-low microphonic QUIET-ONE^{TM} crystal mounting
- Low-background materials
- Transistor reset preamplifiers for high count rates
- Low-power preamplifiers

These rugged detectors come in a variety of cryostat configurations for laboratory or portable applications. They can also be used with a mechanical cooler, such as ITECH's RICOR Cool, for freedom from cumbersome LN_2 Dewars and supplies.

Resolution is uncompromised, no matter how often or for how long the detector is warmed to room temperature.
IGC-series detectors are the true mainstay of the spectroscopy laboratory.

IGC Series Detectors

Model Number	Relative Efficiency	Resolution* (FWHM)		Peak/ Compton	Peak shape FWTM/FWHM
		@ 122 keV (ev)	@ 1.33 MeV (kev)		
IGC10175	10%	800	1.75	42:1	1.90
IGC10185	10%	850	1.85	39:1	1.95
IGC10200	10%	900	2.00	37:1	2.00
IGC15180	15%	800	1.80	47:1	1.90
IGC15190	15%	900	1.90	45:1	1.95
IGC15200	15%	950	2.00	42:1	2.00
IGC20180	20%	825	1.80	52:1	1.90
IGC20190	20%	900	1.90	49:1	1.95
IGC20200	20%	975	2.00	46:1	2.00
IGC25185	25%	850	1.85	55:1	1.90
IGC25195	25%	950	1.95	53:1	1.95
IGC25200	25%	1000	2.00	50:1	2.00
IGC30185	30%	860	1.85	58:1	1.90
IGC30195	30%	950	1.95	56:1	1.95
IGC30200	30%	1000	2.00	54:1	2.00
IGC35190	35%	875	1.90	60:1	1.90
IGC35200	35%	1000	2.00	58:1	1.95
IGC35210	35%	1100	2.10	54:1	2.00
IGC40190	40%	875	1.90	62:1	1.90
IGC40200	40%	1000	2.00	58:1	1.95
IGC40210	40%	1100	2.10	54:1	2.00
IGC45195	45%	900	1.95	64:1	1.90
IGC45200	45%	1000	2.00	60:1	1.95
IGC45210	45%	1100	2.10	56:1	2.00
IGC50195	50%	950	1.95	65:1	1.90
IGC50200	50%	1000	2.00	63:1	1.95
IGC50210	50%	1100	2.10	60:1	2.00
IGC55200	55%	1000	2.00	66:1	2.00
IGC55220	55%	1200	2.20	62:1	2.00
IGC60200	60%	1000	2.00	68:1	2.00
IGC60220	60%	1200	2.20	66:1	2.00
IGC70210	70%	1000	2.10	70:1	2.00
IGC70230	70%	1200	2.30	68:1	2.00
IGC80210	80%	1000	2.10	72:1	2.00
IGC80230	80%	1200	2.30	68:1	2.00
IGC90220	90%	1200	2.20	76:1	2.00
IGC90230	90%	1400	2.30	64:1	2.00
IGC100230	100%	1200	2.30	80:1	2.00
IGC100240	100%	1400	2.40	68:1	2.00
*Quoted resolutions are typical. Other sizes/resolutions available on request.					

ITECH will be happy to work with you to design the detector system best suited to your needs. Please call for details and exact quotes.

ITECH NIGC SERIES

N-TYPE EXTENDED RANGE HIGH-PURITY GERMANIUM COAXIAL DETECTORS

ITECH INSTRUMENTS N-type germanium coaxial detectors are useful down to ~3 keV, since they have a standard beryllium entrance window and a thin (0.3 µm) P+ face. The NIGC extended range detectors are therefore the best choice for applications involving both X-ray and high-energy gamma-ray spectroscopy in the same sample.

These detectors exhibit excellent timing characteristics and are appropriate with anti-Compton shielding. They are thus especially suitable for suppression of Compton scattering to reduce background.

Features:

- N-type high-purity germanium, with ion-implanted exterior surface and lithium diffusion center contact
- Vertical dipstick cryostat
- Standard 30-liter Dewar
- Aluminum endcap with beryllium or carbon epoxy window
- RG-11 B/C resistive feedback preamplifier
- 12-ft. bias, signal and power cables
- Unlimited temperature cycling without loss of resolution

Options:

- Portable and mechanically cooled systems
- A large variety of cryostat configurations
- Low-background materials, such as OFHC copper endcaps
- Ultra-low background beryllium windows
- Transistor reset preamplifier for high count rates (Energy count-rate product limit of >800,000 MeV/sec)
- Low-power preamplifier
- Ultra-low microphonic QUIET-ONE™ crystal mounting
- Neutron Radiation Damage Repair Kit

Fast neutrons can generate hole trapping centers, whose presence is manifested by poor resolution at 1.33 MeV or higher. Because the main charge carriers in NIGC

detectors are electrons, which are not as easily trapped as holes, these detectors are more resistant to neutron damage than are P-type detectors. This makes them ideal under conditions of high neutron flux. ITECH NIGC detectors have even proven themselves in space and high-altitude applications.

An optional neutron damage repair kit allows you to repair these detectors in your own lab if damage does occur.

NIGC Series Detectors

Model Number	Relative Efficiency	Resolution* (FWHM)		Peak / Compton	Peak shape FWTM/FWHM
		@ 122 keV (eV)	@ 1.33 MeV (keV)		
NIGC10180	10%	665	1.80	40:1	1.90
NIGC10190	10%	715	1.90	39:1	1.95
NIGC10200	10%	735	2.00	38:1	2.00
NIGC15185	15%	675	1.85	44:1	1.90
NIGC15190	15%	715	1.90	42:1	1.95
NIGC15200	15%	735	2.00	40:1	2.00
NIGC20190	20%	690	1.90	48:1	1.90
NIGC20195	20%	750	1.95	46:1	1.95
NIGC20200	20%	790	2.00	44:1	2.00
NIGC25190	25%	690	1.90	50:1	1.90
NIGC25200	25%	750	2.00	46:1	2.00
NIGC25210	25%	840	2.10	44:1	2.00
NIGC30190	30%	715	1.90	54:1	1.90
NIGC30200	30%	825	2.00	52:1	2.00
NIGC30210	30%	850	2.10	58:1	2.00
NIGC35200	35%	775	2.00	55:1	2.00
NIGC35210	35%	830	2.10	52:1	2.00
NIGC35220	35%	900	2.20	50:1	2.00
NIGC40200	40%	800	2.00	57:1	2.00
NIGC40210	40%	850	2.10	54:1	2.00
NIGC40220	40%	925	2.20	52:1	2.00
NIGC45210	45%	850	2.10	58:1	2.00
NIGC45220	45%	900	2.20	56:1	2.00
NIGC45230	45%	950	2.30	52:1	2.00
NIGC50220	50%	900	2.20	58:1	2.00
NIGC50230	50%	950	2.30	56:1	2.00
NIGC55220	55%	1000	2.20	60:1	2.00
NIGC55230	55%	1100	2.30	58:1	2.00
NIGC60220	60%	1100	2.20	60:1	2.00
NIGC60230	60%	1200	2.30	58:1	2.00
NIGC70230	70%	1100	2.30	62:1	2.00
NIGC70240	70%	1200	2.40	60:1	2.00
NIGC75230	75%	1100	2.30	64:1	2.00
NIGC75240	75%	1200	2.40	62:1	2.00

*Quoted resolutions are typical. Please call ITECH for quotes on other sizes/resolutions.

Other Options

The standard endcap has a 2.5-inch diameter beryllium (0.02 inch thick) or carbone epoxy window with excellent transmission for energies above 5 keV, unless otherwise specified. An all aluminum endcap can be furnished for use in rugged environments for measurements over the energy range 20 keV to 10 MeV.

For ultra-low background applications, ITECH offers oxygen-free high conductivity (OFHC) copper endcaps, ultra-low background aluminum or carbone epoxy, IF-1 beryllium entrance windows and plastic entrance windows. The NPR cryostat, with or without lead shielding, maintains the lowest level of background interference available.

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ITECH HPGe

ITECH INSTRUMENTS HIGH-PURITY GERMANIUM DETECTORS

ITECH INSTRUMENTS has been a leader in the field of semiconductor gamma- and X-ray detectors for over 30 years with PGT production. In the early days, this meant lithium-compensated germanium. Then, when General Electric first produced high-purity (intrinsic) germanium crystals in 1972-73, PGT detector service now owned by ITECH INSTRUMENTS manufactured the first commercial HPGe planar detectors, soon followed by the first HPGe coaxial. Since that time, ITECH HPGe detectors have explored outer space, gone to the depths of mines in search of β-β decay in enriched germanium, and found uses throughout the world in nuclear power plants, environmental measurements, and aerospace studies.

HPGe has an impurity level of ~10^{10} impurities per cubic centimeter and is designated either P-type or N-type, based on the type of impurity. One surface of the crystal has a lithium-diffusion N^+ layer, ~0.5 mm thick; the other surface has a thinner P^+ layer formed by boron ion implantation or gold metallization.

When a bias voltage is applied to the crystal, incident ionizing radiation creates charge carriers that are swept toward oppositely charged contacts. In P-type coaxial (IGC series) and well detectors (IGW series), the applied voltage is positive, and holes are the primary charge carriers. In N-type coaxial (NIGC series) and planar crystals (IGP or NIGP

detectors), the outer face is the thin P^+ layer and the applied bias is negative. Electrons are the main carriers. These detectors have lower trapping levels and are less sensitive to neutron damage.

ITECH INSTRUMENTS also manufactures lithium-drifted silicon, Si(Li), detectors for X-ray spectroscopy.

Selecting a Detector

All ITECH HPGe and Si(Li) detectors can be temperature cycled and stored indefinitely at room temperature. Several parameters are useful in the selection of a detector for a particular application.

Energy Range

In general, IGC detectors are suitable for energies of 40 keV to 10 MeV. N-type coaxials extend the range down to 4 keV. For lower-energy gammas, planar detectors are recommended for the 3 keV-1 MeV range, since they have better energy resolution and less sensitivity to high energy background than do NIGC detectors. For X rays from 109 eV to 60 keV, Si(Li) detectors are preferred.

Efficiency

The IEEE Standards describe efficiency as **absolute**, the ratio of photons detected to all photons emitted by the source, or **relative**, which compares the number of photons detected to the number detected by a 7.62 mm x 7.62 mm (3" x 3") NaI(Tl) scintillation detector. Efficiency is also related to crystal size. Thus, coaxial detectors are frequently "sized" by percent relative efficiency. ITECH IGC detectors, for example, are available in 10-100% relative efficiency.

It is important to select the appropriate size. An overly large detector wastes money and may create high count rate problems. A small detector will be less expensive, but can cost more in time required for an analysis.

Energy Resolution

Energy resolution is a measure of how well neighboring or overlapping peaks can be distinguished from one another. The usual standard for energy resolution is the full width at half maximum (FWHM) for the full energy peak of the ^{60}Co 1.33 MeV line. Usually, a second value, at one-tenth the maximum (FWTM), is also determined. The ratio of these, FWTM/FWHM, is called peak shape, and is used in computer analysis of complex spectra. For lower-energy regions, the FWHM of the 5.9 keV line of ^{55}Fe or the 122 keV line of ^{57}Co is reported.

Resolution may be limited by the multichannel analyzer (MCA) used. For example, if the MCA has only 4000 channels available for a 2 MeV energy range (i.e., only 2 channels per keV), then the difference between a 2.2keV FWHM detector and a more expensive 1.7 keV FWHM detector will hardly be noticed.

Other Factors

The peak-to-Compton ratio is sometimes more important than resolution or efficiency. At the lowest energy ranges, the peak-to-background is the significant factor because the Compton Effect is small compared to scattering and window and edge effects. For planar detectors, the

active area, depletion depth, and window thickness need to be considered.

All these measures of detector performance are dependent also on the other system components. ITECH offers three types of preamplifier: resistive feedback, optical reset, and transistor reset.

A variety of liquid-nitrogen cooled cryostats, including dipstick, unitary, and portable styles, along with the RICOR Cool cryocooler, can be selected. The ITECH QUIET ONE™ ultra-low microphonics mounting system assures the best possible resolution even in the noisiest field deployment situations. Beryllium and low-Z organic windows and well inserts are needed for lower energy ranges. Low-background materials, as well as lead shields, can be specified if needed.

ITECH INTRUMENTS will be happy to design a system best suited to your nuclear spectroscopy needs.

Detector Performance Parameters

Detector Type/ Series	Crystal	Energy Range	Resolution			Standard Sizes	Standard Peak/ Compton	Peak Shape FWTM/ FWHM
			5.9 keV	122 keV	1.33 MeV			
Coaxial (NIGC)	N-type HPGe	3 kev - 10 MeV	665 - 1200 eV		1.8 - 2.4 keV	10 - 75%	38:1 - 64:1	1.9 - 2.0
Coaxial (IGC)	P-type HPGe	40 keV - 10 MeV		800 - 1200 eV	1.75 - 2.3 keV	10 - 100%	39:1 - 80:1	1.9 - 2.0
Well (IGW)	P-type HPGe	5 keV - 10 MeV		1200 - 1400 eV	2.1 - 2.3 kev	50 - 170 cm^3		1.9 - 2.0
Planar (NIGP)	N-type HPGe	3 keV* - 1 MeV	370 - 470 eV	620 - 950 eV		1500 - 3800 mm^2		<1.9
Planar (IGP)	P-type HPGe	3 keV - 1 MeV	145 - 400 eV	480 - 610 eV		25 - 1000 mm^2		<1.9
Planar (iGX)	P-type HPGe	180 eV* - 1 MeV	125 - 138 eV			10, 30 mm^2		<1.9
Planar (SL)	si(Li)	109 eV* - 60 kev	138 - 163 eV			10, 30, 60 mm^2		
* with optional low-energy windows or well insert								

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