ORTEC®

Detective-SPM Series

HPGe Interchangeable Detector Module (IDM)

Intelligent, Modular Solutions to Portal Monitoring System Needs for Illicit Nuclear and Radiological Material Interdiction

High-Resolution Detector with Cooler, Electronics, MCA and USB

The ORTEC Interchangeable Detector Module or IDM is a gamma-ray detection "building block." The IDM is a completely self-contained subsystem, comprising a single, mechanically cooled high-purity germanium (HPGe) detector of standardized crystal dimensions and all necessary electronics in a RUGGED package. It is everything needed to detect gamma rays and send the energy histogram or digitized pulse stream to a PC for analysis. An IDM can be used in a variety of systems where nuclide identification/monitoring is needed. IDMs are designed for long, reliable service, and are interchangeable. An IDM can be swapped out for service quickly, resulting in high system availability and limiting down time to an absolute minimum. The IDM is light enough to be installed by one person. For OEM applications, ORTEC *CONNECTIONS*-32 programmers toolkits are available.

Figure 1. Interchangeable Detector Module (IDM).

IDM Feature Summary

HPGe Detector

- High low-energy efficiency
- Uniform detector size
- High cooling capacity with highly reliable Stirling cooler
- Integrated high voltage supply

Digital MCA

- 16k channels
- Histogram mode
- Streaming list mode

USB Connection

- High speed connection
- Mains powered
- Can operate without PC connection if required

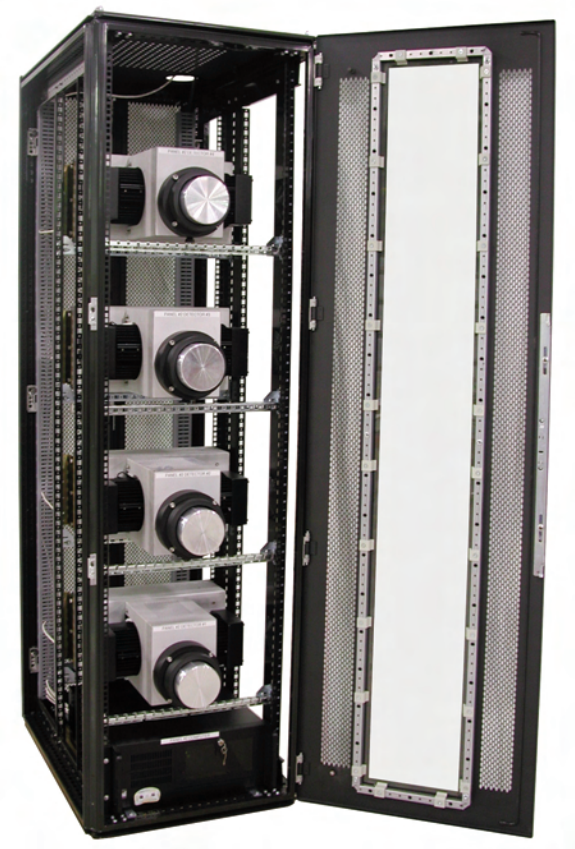

Figure 2. IDMs mounted in cabinet.

IDM Benefits

- Large area 85 mm x 30 mm HPGe crystal
- High-reliability Stirling cycle cooler cools rapidly to operating temperature
- Hardened cryostat designed for long operational life
- Can be temperature cycled at any time, even from partial warm up
- High performance, digitally stable signal processing
- "Hot swap" of IDM modules while in operational state – reduced downtime
- USB 2.0 data communications
- Continuous data collection, no dead spots, using list mode
- Low power consumption
- Low Frequency Rejector (LFR) improves spectrum resolution in noisy environments

Mechanical

The IDM has been designed specifically for use in HPGe portal monitors and other similar systems for nuclear materials interdiction. These hardware subsystems are designed for use in demanding applications. All the components are derived from ORTEC technology, proven in the field by hundreds of Detective portable identifiers.

The IDM is a compact detection instrument subsystem. Figure 1 shows the IDM with a protective cover. With or without the cover, the IDM can be mounted by slide rails or placed conveniently on a shelf within a cabinet. For portable applications, the slide rails can be replaced by handles. IDMs can be positioned in a vertical stack for portal applications. Most applications will use IDMs spaced further apart than the minimum spacing of ~30 cm. The IDM is narrow enough to fit in a standard 19" rack.

In order to maintain adequate cooling, air flows into the sides and out the top of the IDM. Low power consumption reduces heat dissipation requirements. An entire operating IDM consumes ~110 watts of power when cooled to operating temperature (~300 watts peak during cool down). Low power consumption means systems configured using the IDM do not need high levels of cabinet air conditioning.

The HPGe detector is shielded on the back of the cryostat. Other shielding can be easily placed on the sides of the detector endcap to limit the horizontal field of view. The vertical field of view can also be defined by shielding. (By designing shielding/collimation as free standing, it is possible to greatly simplify serviceability and interchangeability.)

Germanium Detector

The majority of the gamma-ray emissions from special nuclear material (SNM) are below 1 MeV. Extensive modeling has shown that a detector size of 85 mm diameter by 30 mm deep is an excellent geometry for detecting these gamma rays. The HPGe crystal geometry is nominally the same in all IDMs.

ORTEC leads the field in the development and deployment of mechanically cooled HPGe technology, introducing the first mechanically cooled HPGe detector more than 20 years ago. There are more HPGe spectrometers in the field world-wide cooled by ORTEC-supplied mechanical cooling systems than all other commercial and non-commercial systems combined. In particular, and most recently, ORTEC Detective HPGe Portable Hand Held Identifiers are operating in the field by the hundreds and the Stirling cooler technology used by the Detective, and now the IDM, is proven by experience.

The IDM cryostat design evolved from the Detective Hand Held Identifier, itself a non-traditional design, which does not use molecular sieve as a cryo-pump, but does use all metal seals and very clean construction methods. The all-metal construction results in a robust long-life cryostat which can be temperature cycled, either completely or partially, indefinitely. The cooler can be turned off then on at any time, greatly aiding service operations.

DSP Electronics

The digital signal processing (DSP) electronics subsystem used in the IDM is derived from the ORTEC DigiDART, DSPEC-Pro and Detective family systems. The low power design has extreme high stability with both count-rate and temperature variation, important in many different applications.

Field operation of any instrument is different than laboratory operation. One common feature of field operation that can lead to reduced system performance is mechanical vibration or acoustical noise. The normally very good energy resolution of HPGe detectors can be degraded by mechanical vibration or microphonic noise. ORTEC's LFR[1] technology solves the vibration problem common in aerial survey and portal monitoring systems. Another source of low frequency electrical noise is electrical ground loops – common in field systems. The LFR Filter feature reduces the effects of all such noise sources.

[1]Patent Pending.

The data can be collected in a histogram mode (the traditional mode for Pulse Height Analysis) and transferred to a PC for further analysis. There is a small dead time when the data are being transferred that new data are not collected. List mode data collection is essential in situations where no data can be missed. List mode has been used with great success in many real-world situations. For example, when the sample is moving relative to the detector and it is important to measure an activity profile as a function of time or position. Another application is aerial and land-based surveying. No "dead periods" occur in the data collection. When moving at 50 kph, a 100 millisecond gap in data collection means a gap of nearly 1.5 meters in the data collection profile. In the list mode of operation, data are stored directly to memory, event by event, with a time stamp (200 nanoseconds). This wealth of data can then be reconstructed into separate spectra by time, energy, or position within a portal. This feature of the IDM greatly enhances the detection sensitivity of the system in all applications.

Communications

High speed plug-and-play USB 2.0 communications makes module control and data collection fast and easy.

Service

The replacement of an IDM is particularly fast and straightforward. Only two connections are required, line power and USB.

IDM Specifications

Internal HPGe Detector Crystal

P-type high-purity germanium. Coaxial construction.

Nominal Dimensions: 85 mm diameter x 30 mm deep.

Cryostat: All metal sealed, long life cryostat, no Molecular Sieve.

Cooler: High reliability, low power Stirling Cooler. Cooler design life >5 years continuous running. Power consumption ~110 W at operating temperature.

Digital Noise Suppression: "LFR Filter" ORTEC Patent Pending.

Digital MCA and Data Processor

Digital MCA. Up to 16k Channel Conversion gain.

System Gain Settings
Coarse Gain: 1, 2, 4, 8, 16, or 32.
Fine Gain: 0.45 to 1.

System Conversion Gain
The system conversion gain is software controlled from 512 to 16k channels.

Digital Filter Shaping-Time Constants
Rise Times: 0.8 µs to 23 µs in steps of 0.2 µs.
Flat Tops: 0.3 to 2.4 in steps of 0.1 µs.
Dead-Time Correction: Extended live-time correction according to Gedcke-Hale method.
Accuracy: Area of reference peak changes <±3% from 0 to 50,000 counts per second.

Low-Frequency Rejector: When set to ON, removes low-frequency (<3 kHz) input noise from spectrum.

Linearity
Integral Nonlinearity: <±0.025% over top 99.5% of spectrum, measured with a mixed source (55Fe @ 5.9 keV to 88Y @ 1836 keV).
Differential Nonlinearity: <±1% (measured with a BNC pulser and ramp generator) over top 99% of range.

Digital Spectrum Stabilizer: Controlled via computer, stabilizes gain and zero errors.

System Temperature Coefficient
Gain: <50 ppm/°C. [Typically <30 ppm/°C.]
Offset: <3 ppm/°C of full scale, with Rise and Fall times of 12 µs, and Flat Top of 1 µs. (Similar to analog 6 µs shaping.)
Overload Recovery: At maximum gain, recovers to within 2% of rated output from X1000 overload in 2.5 non-overloaded pulse widths. (Measured using the InSight Oscilloscope.)

Maximum System Throughtput: >100,000 cps, but may be restricted in software with LFR off. >34,000 cps with LFR on. Depends on shaping parameters.

Pulse Pile-Up Rejector: Automatically set threshold.

Pulse-Pair Resolution: Typically <500 ns.

Automatic Digital Pole-Zero Adjustment: Computer controlled. Can be set automatically or manually. Remote diagnostics via InSight Oscilloscope mode. (Patented.)

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Digital Gated Baseline Restorer: Computer controlled adjustment of the restorer rate (High, Low, and Auto). (Patented.)

LLD: Digital lower level discriminator set in channels. Hard cutoff of data in channels below the LLD setting.

ULD: Digital upper level discriminator set in channels. Hard cutoff of data in channels above the ULD setting.

Ratemeter: Count-rate display on PC screen.

Overall Dimensions:
47.3 cm L from detector nose to back panel (48.6 cm from detector nose to mounting bracket) x 45.6 cm W (48.3 cm including mounting brackets) x 22.9 cm H.

18-5/8" L from detector nose to back panel (19-1/8" from detector nose to mounting bracket) x 16-3/4" W (19" including mounting brackets) x 9" H.

Weight: 50 lb. (22.7 kg) without detector backshield.
60 lb. (27.2 kg) with detector backshield.

Input Power: 110/220 V ac 50/60 Hz. 110 W in steady state with cold detector.

Temperature Operation (without external enclosure)**:**
Range: –10°C to +50°C
Relative Humidity[2]: 100%, noncondensing.
The unit is expected to be kept running once cold.

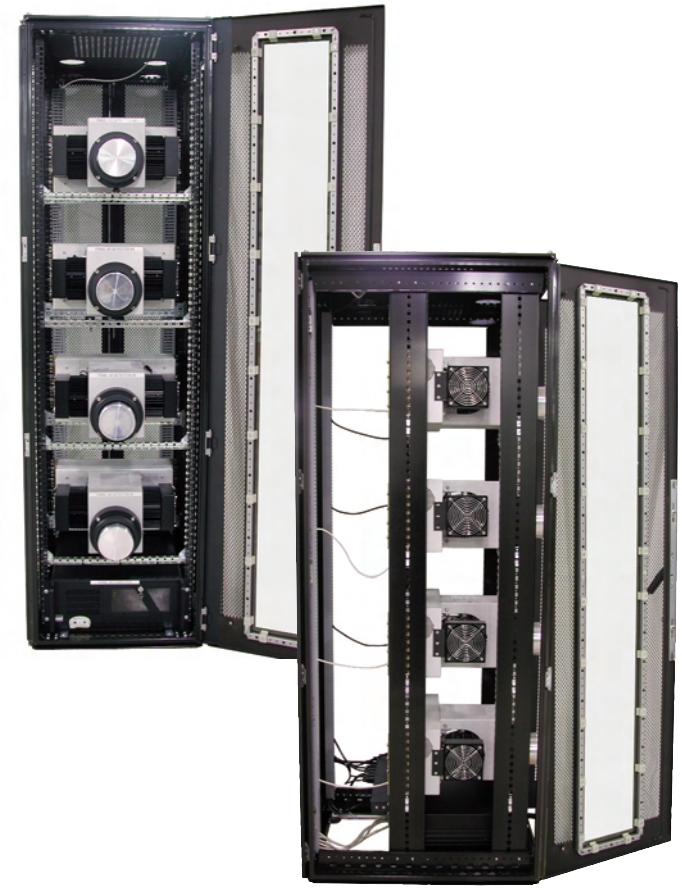
Cool Down Time: Initial cool down time depends on ambient temperature, but is typically 5 hours from ambient.

Communications Ports: USB 2.0 connection provided at the rear panel.

[2]This is an "in cabinet" specification. More severe environmental specifications can be met through the use of the appropriate cabinet and climate conditioning.

Ordering Information

Model	Description
IDM-A65	IDM with MAESTRO-32 (A65-B32) Software
IDM	IDM hardware only
A11-B32	CONNECTIONS Programmer's Toolkit with ActiveX Controls



Specifications subject to change
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