ORTEC®

HTDS Hi-Tech Detection Systems

DSPEC jr 2.0

High-Performance, Digital Signal Processing for Gamma-Ray Spectrometry

- Innovative ZDT™ "loss-free counting" correction[2] including the uncertainty associated with the ZDT spectrum
- Enhance your spectral quality with the NEW Low Frequency Rejector (LFR)[1] technology
- Automate – Improve your laboratory productivity with integrated Sample Changer connections and controls
- Fastest data transfer capability available with USB 2.0
- Maintains DSPEC® qualities including rock-solid stability
- Easy setup features including Automatic Pole Zero, Automatic Baseline Restorer, and "Optimize" features
- Front panel display of detector status and state-of-health information — SMART-1™ intelligent HPGe support
- Simple installation with true plug-and-play on USB
- Excellent temperature and count rate stability
- Full computer control of every function
- Support for HPGe and NaI detectors

DSPEC jr 2.0 Benefits

DSPEC jr 2.0 is the fifth-generation integrated gamma spectrometer from ORTEC based on digital signal processing. This unique product combines the latest in digital filter technology (Low Frequency Rejector) and the fastest, most up-to-date data transfer available (USB 2.0) with the proven performance of the ORTEC DSPEC line.

New Performance Enhancements

- Innovative ZDT™ "loss-free counting" correction[2] including the uncertainty associated with the ZDT spectrum
- Enhance your spectral quality with the NEW Low Frequency Rejector (LFR)[1] technology
- Automate – Improve your laboratory productivity with integrated Sample Changer connections and controls
- Fastest data transfer capability available with USB 2.0

Proven Performance Features

- Maintains DSPEC® qualities including rock-solid stability
- Easy setup features including Automatic Pole Zero, Automatic Baseline Restorer, and "Optimize" features
- Front panel display of detector status and state-of-health information — SMART-1™ intelligent HPGe support
- Simple installation with true plug-and-play on USB
- Excellent temperature and count rate stability
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- Support for HPGe and NaI detectors

DSPEC jr 2.0 New Feature Highlights

Zero Dead Time (ZDT) — Loss Free Counting Correction

Got rapidly changing count rate? Need to calculate the uncertainty? You need ZDT!

ZDT is an alternative to conventional live time extension to correct for dead time.[3] It is especially beneficial to applications where the count rate is significantly decaying during the acquisition, such as in Neutron Activation Analysis, or where there is a rapid spike of activity during a long acquisition, as in the case of hot particles in stack monitoring.

Live-Time Clocks expand the counting time of the electronics to compensate for dead time. Loss-free counting methods, like our ZDT, correct the actual number of counts in the spectrum for those counts "lost" while the system was processing other pulses. The ZDT method uses ORTEC's highly accurate Gedcke-Hale clock to determine how many events should be added for the time that the electronics were "dead."

In the ZDT Mode, the DSPEC jr 2.0 automatically stores the corrected spectrum and the variance spectrum. Both spectra are also stored in the ORTEC SPC format file structure to allow comparisons to be made at anytime in the future. The user can easily switch between the corrected and uncorrected spectra through simple menu commands in GammaVision® and MAESTRO®.

The ORTEC ZDT mode includes an uncertainty estimation algorithm to further enhance our ZDT method. Unlike other "loss-free counting" methods which cannot calculate the uncertainty associated with counts added to the spectrum, the ZDT mode in the DSPEC jr 2.0 simultaneously generates the corrected spectrum and the uncertainty as data is collected. See Application Note 56, "Loss-Free Counting with Uncertainty Analysis Using ORTEC's Innovative Zero Dead-Time Technique" for more information on ZDT.

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[1]Patent Pending
[2]Patent No. 6,327,549
[3]Ron Jenkins, R.W. Gould, and Dale Gedcke, *Quantitative X-Ray Spectrometry* (New York: Marcel Dekker, Inc.), 1981, pp 266–267.

Low Frequency Rejector. . .

LFR Results Are In!

New Digital Filter Improves Resolution for Mechanically-Cooled Systems!

The LFR is designed to remove microphonic noise from the output signal of high purity germanium detectors. What kind of results can you expect? If you have mechanically-cooled systems with degraded resolution, the LFR can improve your resolution significantly. Here are some examples.

Test Case 1: X-COOLER				Test Case 2: Stirling Cooler				Test Case 3: X-COOLER			
Laboratory Based System		Resolution (FWHM, keV)		Portable "Detective" Type System		Resolution (FWHM, keV)		Laboratory Based System		Resolution (FWHM, keV)	
Detector	Energy (keV)	LFR ON	LFR OFF	Detector	Energy (keV)	LFR ON	LFR OFF	Detector	Energy (keV)	LFR ON	LFR OFF
GEM65	59.5	0.75	0.85	GEM15	59.5	1.2	1.6	GMX15	59.5	0.75	0.76
	662	1.30	1.34		662	1.5	2.0		662	1.28	1.25
	1173	1.65	1.73		1173	1.9	2.3		1173	1.59	1.63
	1332	1.74	1.79		1332	1.8	2.3		1332	1.69	1.74
Improved Resolution				Improved Resolution				No Microphonic Noise			

What Does the LFR Do?

The LFR is a new digital filter that can improve the resolution of your system. The innovative design was developed specifically to remove periodic low frequency electronic noise from the output of high purity germanium detectors. Sources of electronic noise that cause spectral degradation include mechanical coolers, ground loops, and other environmental sources.

LFR works with the digital filter to remove such periodic noise from the output signal of the detector. A typical digital filter integrates the height of the pulse (energy of the photon) from a detector preamplifier using a well-known trapezoidal filter (Fig. 1).[4] Typical digital filters assume the baseline is flat, but when there is low frequency noise present, the baseline has a slope due to cyclic noise (as in Fig. 2). The LFR filter uses the slope to estimate the cyclic noise and subtracts that from the trapezoid output.

Voila. . . Improved Resolution!

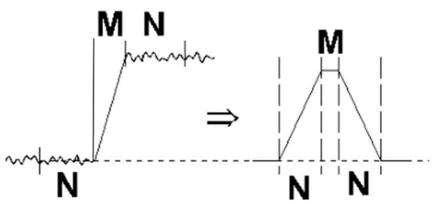


Figure 1.

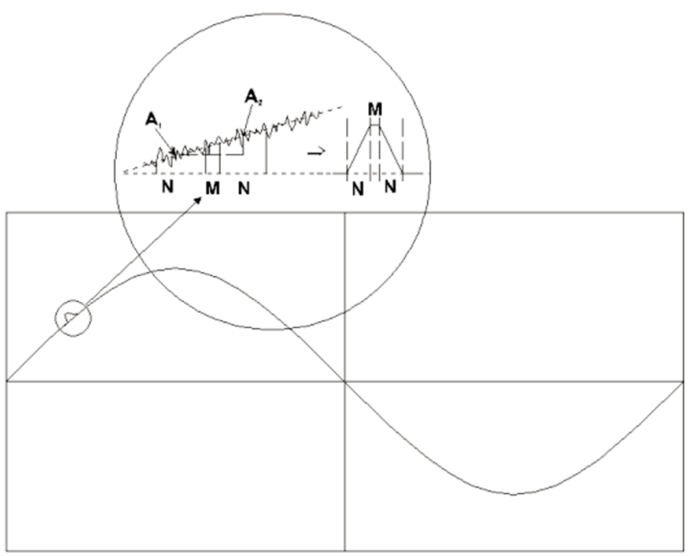


Figure 2.

[4]D.L. Upp, R.M. Keyser, T.R. Twomey, ORTEC, "New Cooling Methods for HPGe Detectors and Associated Electronics," Presented at MARC VI Conference, April 2003

FAST Communications with USB 2.0

Universal Serial Bus, or USB, is a computer standard designed to eliminate the guess work in connecting peripherals to your PC. With the DSPEC jr 2.0, ORTEC keeps your laboratory current with the fastest and easiest way to manage data transfer in the industry. With the introduction of USB 2.0, the standard boasts a 40 fold improvement in data transfer rate! Don’t waste a microsecond!

How Does USB Work With My Systems?

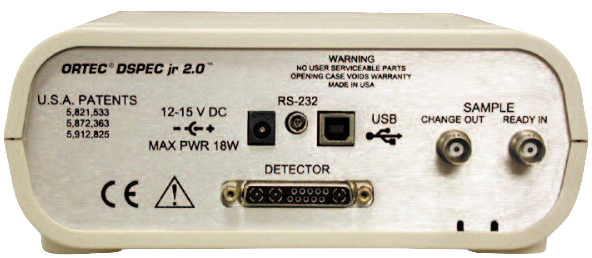
Currently, the USB Specification, Revision 2.0, covers three speeds: 480 Mbps, 12 Mbps, and 1.5 Mbps. This means that the DSPEC jr 2.0 is backward compatible with earlier versions of USB.

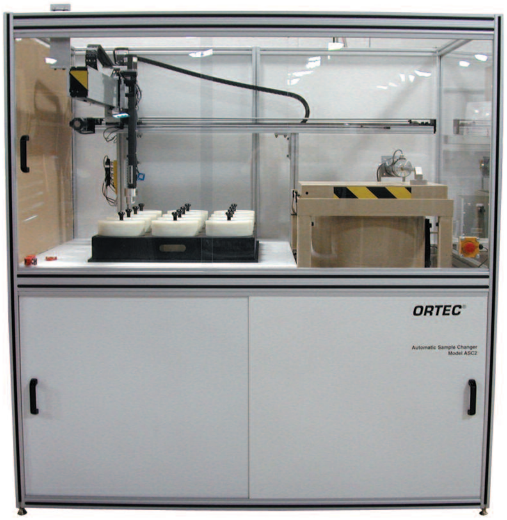
The plug-and-play feature makes installation simple. A nearly unlimited number of DSPEC jr 2.0s can be connected simultaneously using USB hubs. As an ORTEC *CONNECTIONS* compatible instrument, DSPEC jr 2.0 works in a networked and a stand-alone configuration. ORTEC *CONNECTIONS* means: any hardware, any software, anywhere in the laboratory with full seamless control and built-in security.

Need to Automate your Routine Counting?

Add a Sample Changer

When you are ready to automate your process with an integrated sample changer, DSPEC jr 2.0 is ready and able, with built-in Sample Changer connections and controls.





ASC2 Sample Changer

DSPEC jr 2.0 Proven Performance Features

Be Certain With the Time Tested Features of the DSPEC jr

DSPEC jr 2.0 includes all the benefits of it’s popular predecessor, DSPEC jr. Be certain your detectors are functioning properly with SMART-1 technology and monitor them easily with the front panel display. Set signal processing parameters easily, and it’s still as easy as ever to set up and go.

Simple to Set Shaping Parameters

DSPEC jr 2.0 helps you maintain control of your digital system. The rise time and flat top width adjustments empower you to "fine tune" spectrometer performance to the application. Optimizing your resolution and throughput has never been easier!

In DSPEC jr 2.0 there are 112 rise times (from 0.8 to 23 μs in 0.2 increments) and 22 flat top widths (from 0.3 to 2.4 μs in 0.1 increments), in addition to tilt parameters, giving you well over 2,000 combinations of parameters.

Don't worry . . . we still include the automated "Optimize" feature in the control panel to allow you to choose the best fit! This means that improvements for the resolution capability of your detector and better throughput are just a click of a mouse button away.

SMART-1™ Support for Quality Data — all the time, every time

ORTEC's unique SMART-1 detectors are indeed smart. They monitor and store the detector state-of-health (detector temperature, preamp power, bias overrange, bias on/off state). A single check by the DSPEC jr 2.0 will verify the detector is ready and remains ready to perform acquisition. During acquisition, the SMART-1 detector continually monitors the state-of-health (SOH) to ensure the integrity of the acquired data. At the end of acquisition a quick check of the SOH flag in the SMART-1 detector shows if any parameters deviated from specification during the measurement. This is vitally important for environmental samples that must be counted for long periods of time and regulatory-driven samples where data integrity is important.

Another big advantage is the SMART-1 detectors have the recommended bias value preset at the factory. You no longer have to look through paperwork or for tags on the detector to find the right bias setting. Simply turn on the DSPEC jr 2.0 and the SMART-1 detector automatically senses the detector temperature, determines the right high voltage bias, and turns it on.

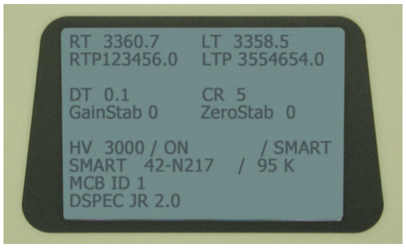
SMART-1 Detector with Detector Interface Module (DIM).

Simple, Single-Cable Connection to Detectors

DSPEC jr 2.0 uses the unique ORTEC DIM (Detector Interface Module) to connect the DSPEC jr 2.0 and the detector with only a single cable. The DIM provides for bias close to the detectors so that only signal and low voltage power are carried in the cable. Potential hazards due to high voltage being carried on long cables is now eliminated.

Display of Vital Parameters

The DSPEC jr 2.0 shows vital system parameters on the front panel LCD display. The DSPEC jr 2.0 displays the instrument ID, name, serial number, preset count conditions, current live and real time, dead time percentage, input count rate, HV status and value, and the serial number for SMART-1 detectors.



DSPEC jr 2.0 Display.

Small Size

With a footprint the size of a desk diary, DSPEC jr 2.0 can sit right on the desktop. Lightweight and rugged, multiple DSPEC jr 2.0 can be stacked on top of one another, their cases interlocked, without fear of sliding or tipping.

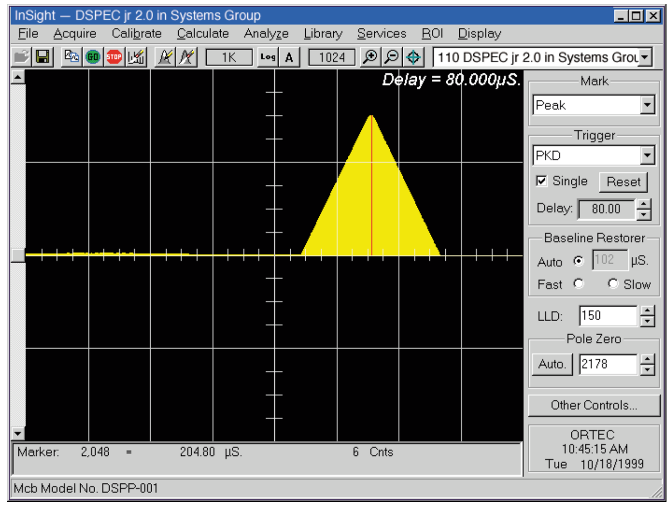
Mix-and-Match with Your Existing MCBs

ORTEC *CONNECTIONS* software supports any combination and number of USB devices connected to any computer. For example, two digiDARTs may be combined with two DSPEC jr 2.0s to the same PC using a USB hub. And any number of other ORTEC MCBs can be connected to the same system by network, printer port, RS-232, or Dual Port Memory.

Ballistic Deficit Correction

No need to worry about ballistic deficit with the patented digital signal processing of the DSPEC product line from ORTEC. In larger HPGe detectors, a characteristic known as ballistic deficit is sometimes exhibited. This typically results in poor resolution especially for high energy peaks. In analog systems, the ballistic deficit is corrected with either a gated integrator amplifier or through a resolution enhancer module. In digital systems, however, a simple adjustment to the flat top width of the digital filter is all that is necessary.

Using the InSight mode in the DSPEC jr 2.0 allows the operator to make adjustments to the flat top width (and tilt) and immediately see the effects of the signal processing. In most cases with extremely large detectors (such as the 207% efficient one used in this example!), a flat top setting of 0.8 μs is more than sufficient to recover excellent resolution.



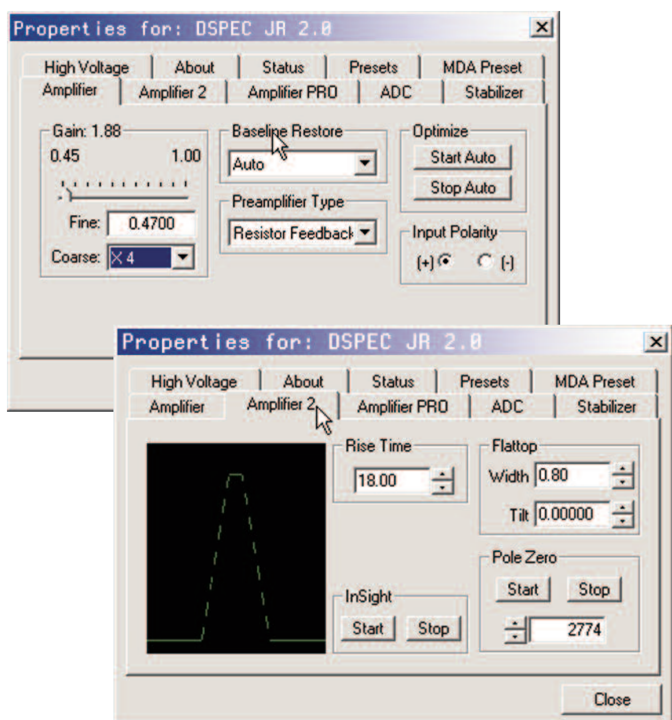
InSight Oscilloscope Mode.

. . . And Still as Easy to Set Up as Ever!

The DSPEC instruments are easy to set up and use. With the intelligent MCA control, no manual configurations or even so-called Wizards are needed. Simply install the software (such as GammaVision or MAESTRO) and the software "just knows" what control panels to show. The tabular design of the panels uses logical groupings of the controls and features available on the DSPEC jr 2.0.

The DSPEC jr 2.0 includes the ORTEC patented Digital Automatic Pole Zero[5] circuit, Digital Automatic Baseline Restorer[6], and the Optimize feature[7] which chooses the optimum flat top/tilt settings for the detector currently connected to the DSPEC jr 2.0, making setup and enhancement of your spectroscopy system as easy as possible.

Of course, one of the most innovative features provided in our products is InSight™, the built-in virtual digital oscilloscope. With the InSight feature, you can easily see the effects of changing the flat top width, baseline restore setting, or check the effects of Ballistic Deficit Correction (see side bar). No longer is it necessary to have a heavy, cumbersome, external oscilloscope around. No special software is necessary. Simply open the control panel and turn InSight mode on.



[5]U.S. Patent No. 5,872,363
[6]U.S. Patent No. 5,912,825
[7]U.S. Patent No. 5,821,533

Specifications

Display: 240 x 160 pixel backlit LCD provides status information, instrument ID, bias information, live and real time.

Concurrent Connections: Limited by the computer and supporting USB hubs. ORTEC *CONNECTIONS* software supports up to 127 USB-connected devices per computer.

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

The available range of gain settings supports all types of HPGe detectors. Specifically the following maximum energy values are achievable using the standard ORTEC preamplifier (max gain to min gain):

COAX	187 keV to 12 MeV
LO-AX	94 keV to 6 MeV
GLP/SLP	16.5 keV to 1 MeV
IGLET-X	8 keV to 500 keV

Preamplifiers: Computer selectable as either resistive or TRP preamplifier.

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 (^{55}Fe @ 5.9 keV to ^{88}Y @ 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.)

Maximum System Throughput: >100,000 cps 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.)

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 MCA and/or PC screen.

Battery: Internal battery-backed up memory to maintain settings in the event of a power interruption.

Inputs and Outputs

Detector: Multipin connector (13W3) with the following:
Preamp Power: 1 W maximum (+12 V, –12 V, +24 V, –24 V, 2 GND).
Amp In: Normal amplifier input.
TRP Inhibit.
Power for SMART-1 or DIM.
Control of HV and SMART-1 Detector (2 wires).

USB: Universal serial bus for PC communications.

Power: Connection to supply power from a wall mounted dc supply. (+12 V dc <1.25 A).

Electrical and Mechanical

Change Sample Out: Rear panel BNC connector, TTL compatible.
Sample Ready In: Rear-panel BNC connector, accepts TTL level signal from Sample Changer. Software selectable polarity.

Dimensions:
DSPEC jr 2.0: 8.1 H x 20.3 W x 24.9 D cm
(3.2 H x 8 W x 9.8 D in.)
DIM: 11.2 x 3.13 x 6.5 W cm
(4.4 x 1.25 x 2.6 W in.)

Weight:
DSPEC jr 2.0: 1.0 kg (2.2 lb)
DIM: <240 g (0.5 lb)

Operating Temperature Range: 0 to 50°C, including LCD display.

U.S. Patents No.s: 5,872,363, 5,912,825, 5,821,533.

Operating Systems: Windows® 2000/XP.

DSPEC jr 2.0

Detector High Voltage Supplies

Detector Interface Module (DIM): DSPEC jr 2.0 offers high voltage supply flexibility in the form of a microprocessor controlled module, which connects the specific detector to the MCA. On a SMART-1 HPGe detector, the HV module is integral with the detector itself. For "legacy" or "non-SMART-1" detectors, the HV supply is in the form of a Detector Interface Module or "DIM" with 2 m cables. The DIM has a mating connector for the traditional detector cable set: 9-pin D preamp power cable, Analog In, Shutdown In, Bias Out, and Inhibit In.

DIMS for non-SMART-1 detectors are available with the following high voltage options:

DIM-POSGE: Detector Interface Module for ANY Non-SMART-1 positive bias HPGe detector.

DIM-NEGGE: Detector Interface Module for ANY Non-SMART-1 negative bias HPGe detector.

DIM-POSNAI: Detector Interface Module for ANY positive bias NaI detector.

DIM-296: Detector Interface Module with Model 296 ScintiPack tube base/preamplifier/bias supply for NaI detectors with 14-pin, 10 stage photomultiplier tubes.

Front Panel Display: In all cases, Bias Voltage Setting and Shutdown polarity are set from the computer. The DSPEC jr 2.0 can monitor the output voltage and shutdown state; Detector high voltage value (read only); and Detector high voltage state (on/off) (read/write) which are displayed on the front panel LCD. In addition, the SMART-1 detector provides additional state-of-health information by monitoring the following functions: Detector element temperature (read only); Detector overload state; Detector authentication code (read/write); and Detector serial number (read only).

Ordering Information

Model	Description
DSPEC jr 2.0	DSPEC jr 2.0 with MAESTRO Software, No DIM, for use with SMART-1 equipped detector.
DSPEC jr 2.0-POSGE	DSPEC jr 2.0 with MAESTRO Software and DIM-POSGE for use with Non-SMART-1 detector.
DSPEC jr 2.0-NEGGE	DSPEC jr 2.0 with MAESTRO Software and DIM-NEGGE for use with Non-SMART-1 detector.
DSPEC jr 2.0-POSNA	DSPEC jr 2.0 with MAESTRO Software and DIM-POSNAI for use with NaI detector.
DSPEC jr 2.0-296	DSPEC jr 2.0 with MAESTRO Software and DIM-296 for use with NaI detector.

Additional DIMS

DIM-POSGE	Detector Interface Module for ANY Non-SMART positive bias HPGe detector
DIM-NEGGE	Detector Interface Module for ANY Non-SMART negative bias HPGe detector
DIM-POSNAI	Detector Interface Module for ANY positive bias NaI detector
DIM-296	Detector Interface Module with Model 296 ScintiPack tube base/preamplifier/bias supply for NaI detectors with 14-pin, 10 stage photomultiplier tubes.

Example System Order:
DSPEC jr 2.0
GEM80P4-SMP
CFG-X-COOL-III-115

Specifies a DSPEC jr 2.0; 80% GEM PopTop detector with SMART-1 technology; and an X-COOLER III.

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