ORTEC®

DSPEC Pro

Advanced, Digital Gamma-Ray Spectrometer for HPGe Detector Systems

AMETEK®
ADVANCED MEASUREMENT TECHNOLOGY

DSPEC Pro: Advancing the Art of Digital Gamma-Ray Spectroscopy

The immense versatility of DSPEC Pro, brought about by the number of unique features and modes of operation, means that it is an ideal solution for a wide variety of applications. Its neat and compact packaging further enhance its applicability.

Digital spectrometers are inherently more stable than the analog variety of years gone by, and since the introduction of the original DSPEC, ORTEC has achieved the reputation as the supplier of instruments which represent the benchmark in stability, both relating to temperature and count rate.

DSPEC Pro Features at a Glance

For High-Rate Spectroscopy Applications

"Loss Free" or "Zero Dead Time" (ZDT)[1] The usual way to account for counting losses at high rates is through extending the acquisition time. The underlying assumption must be that the sample does not change during the extended period. This is far from true when short half lives are encountered or the sample is not stationary (e.g., flowing through a pipe). ORTEC has refined the loss-free counting technique in the digital domain. In this method, the spectrum itself is corrected pulse by pulse, and the ZDT method provides both an accurately corrected spectrum and correctly calculated statistical uncertainty.

"Enhanced Throughput" Mode Accuracy at high input count-rates can be limited by the speed at which the spectrometer stores data to memory. It is said to be "throughput-limited". Pulse pileup means that beyond a certain point, as input count-rate increases still further, the rate of data stored to memory DECREASES, reducing result quality. By developing a new kind of digital peak detector algorithm, ORTEC has increased the maximum throughput by up to 30% by removing some of the dead time associated with the process of pulse peak amplitude determination.

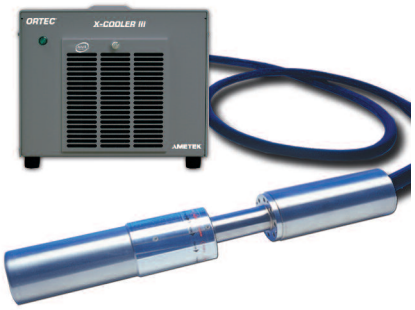
For Samples in Motion

List Mode For situations in which the sample is moving relative to the detector, it is often vitally important to be able to measure an activity profile as a function of time. Examples of such applications include aerial and land-based surveying and portal monitoring. It is usually a requirement that no "dead periods" occur, associated with the acquire-store-clear-restart cycle. In the list mode of operation, data are streamed directly to the computer, event by event. There is no associated "dead period". In the DSPEC Pro implementation, each event is time-stamped to an accuracy of 200 nanoseconds. Via the use of a programmers toolkit, data may be re-constituted into a spectrum for off-line analysis by one of ORTEC's wide range of analysis software products or user-developed codes.

For Hostile Environments and for Mechanical Coolers

Low-Frequency Rejector (LFR) HPGe detectors do not, as a rule, perform well in environments where there is mechanical vibration. Microphonic noise degrades energy resolution by adding low frequency periodic electrical noise to the primary signal. Electrical ground loops are also a source of low frequency electrical noise. There is increasing use of mechanical coolers for HPGe detectors (to eliminate the need for LN_2) and the increasing need to take HPGe detectors out of the laboratory environment.

DSPEC Pro incorporates a Low-Frequency Rejector (LFR)[2] Filter feature, which reduces the effects of such noise sources. Combined with high performance list mode, the DSPEC Pro is the instrument of choice for mobile vehicle survey systems.



X-COOLER III Mechanical Cooler for HPGe Detectors

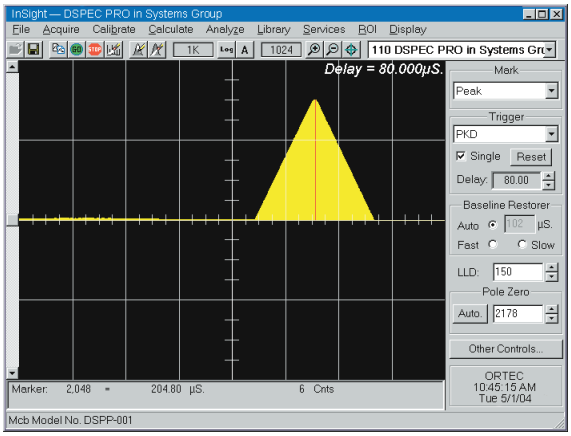
[1]Patent No. 6,327,549
[2]Patent Pending

For Enhancement of Resolution in Large or Neutron Damaged Detectors

Ballistic Deficit and Charge Trapping Correction The trapezoidal digital filter in the DSPEC Pro is held in common with all other ORTEC DSPEC family members. It allows adjustment of the filter to optimize the resolution performance of large HPGe detectors which can often suffer low-side peak tailing if ballistic deficit is present. These large detectors are finding increasing use in low level counting applications.

The adjustment is largely automated by the use of the "OPTIMIZE" feature and may be monitored by the InSIGHT digital oscilloscope mode.

The DSPEC Pro offers even further capability in the form of a charge trapping corrector which can be used to mitigate the peak degradation in the case of a neutron damaged detector. The neutron damage to the crystal lattice causes "trapping" centers which "hold onto" some of the charge created by the gamma-ray interaction. This results in low-side tailing similar to ballistic deficit although the cause is different. The charge trapping corrector is calibrated or "trained" such that it adds back the pulse height deficit, event by event.



InSight Oscilloscope Mode.

Other Important DSPEC Pro Benefits

While in many respects DSPEC Pro is breaking new ground, ORTEC did not forget to carry over the benefits already proven in other ORTEC MCA products:

Single-Cable Connection to your HPGe Detector

DSPEC Pro uses the unique ORTEC Detector Interface Module (DIM) for a single-cable connection to the detector. The DIM is designed to supply bias close to the detector so the cable carries only signal and low-voltage power — no longer is high-voltage bias, and the dangers associated with it, carried over long distances.

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

SMART-1 Support

DSPEC Pro has built in support for HPGe detectors which employ ORTEC SMART-1 technology. SMART-1 HPGe detector technology is a great advance in HPGe detectors and their operation. It is an enhancement to data and chain of custody integrity and an improvement in detector management practice and data control. A SMART-1 HPGe detector is "intelligent". The built-in controller monitors and reports on all vital system functions. Individual vital signs are available as well as the overall "state-of-health" (SOH). The detector controller "knows" who it is: each unit has its own identification serial number. To further increase data integrity, the controller can even store authentication codes and later return the code to ensure traceability of the data.

During data acquisition, the SMART-1 detector monitors all of its own "vital functions". Should any of the monitored functions fall outside a specified range of values (even if they subsequently return to normal), the condition is registered and at the end of the acquisition the DSPEC Pro reads the SOH and displays a warning message if a problem was detected. No Message — no problem.

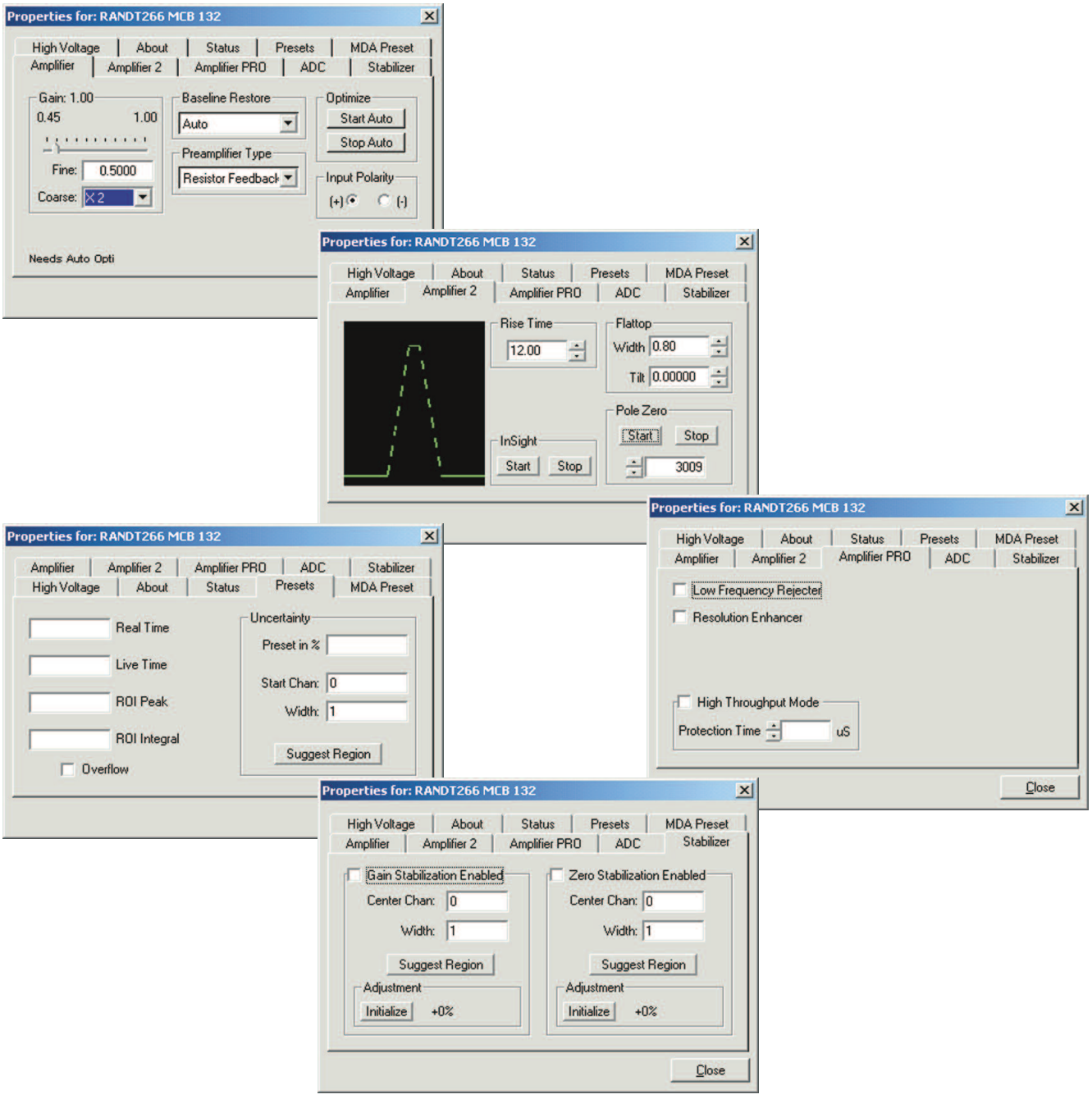
ASC2 Sample Changer

Support for Sample Changers

A simple to use hardware TTL port is provided for support of sample changer systems.

Connections to the DSPEC Pro

The DSPEC Pro provides high speed control via standard USB 2.0 to any Windows 2000/XP system. The plug-and-play feature makes installation simple. A nearly unlimited number of DSPEC Pro or other ORTEC USB instruments can be connected simultaneously using USB hubs. As an ORTEC CONNECTIONS compatible instrument, DSPEC Pro 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.



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: Multi pin 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 Pro: 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 Pro: 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: 64-bit Windows 8.1 and 7.
32-bit Windows 7 and XP.

Detector High Voltage Supplies

Detector Interface Module (DIM): DSPEC Pro 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 Pro 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 PRO	DSPEC Pro with MAESTRO Software, No DIM, for use with SMART-1 equipped detector.
DSPEC PRO-POSGE	DSPEC Pro with MAESTRO Software and DIM-POSGE for use with Non-SMART-1 detector.
DSPEC PRO-NEGGE	DSPEC Pro with MAESTRO Software and DIM-NEGGE for use with Non-SMART-1 detector.
DSPEC PRO-POSNA	DSPEC Pro with MAESTRO Software and DIM-POSNAI for use with NaI detector.
DSPEC PRO-296	DSPEC Pro with MAESTRO Software and DIM-296 for use with NaI detector.
DSPEC PRO-PKG-1	DSPEC Pro with MAESTRO and GammaVision Software, No DIM, for use with SMART-1 equipped detector.
DSPEC PRO-PTK	DSPEC Pro with MAESTRO and A11 Software, No DIM, for use with SMART-1 equipped 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 Pro
GEM80P4-SMP
CFG-X-COOL-III-115

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

Specifications subject to change
033115

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