

# ORTEC<sup>®</sup>

## *digiDART*<sup>™</sup>

Portable HPGe MCA



“The EXTRA-ordinary portable HPGe MCA!”

**AMETEK<sup>®</sup>**  
ADVANCED MEASUREMENT TECHNOLOGY

- High-performance RUGGED HPGe grade spectrometer, 16k channels.
- DIGITALLY stable: consistent answers for long counts, changing count-rates and temperatures.
- Operates WITHOUT an attached PC.
- Built-in backlit LCD display and control keypad — Live display of acquiring data.
- Energy calibration using keypad.
- Nuclide ID and activity calculation for nine Regions of Interest (ROI).
- High throughput — over 100,000 processed pulses per second.
- Fits in the palm of your hand or hangs from your belt.
- Holds 23 16k spectra in internal memory (614 at 512 resolution).
- Battery life >9 hours.
- Only 860 grams, including batteries.
- Fast USB communications.
- Supports the latest generation "SMART-1" HPGe detectors and all other detectors using the DIM.
- Provides Authentication of spectral data.
- Optional 32k channel resolution model.

The ORTEC DigiDART is an extraordinary, portable, HPGe-grade Multichannel Analyzer. It has been carefully engineered to perform the most demanding real world, PORTABLE gamma-ray spectroscopy applications. The entire design, from the on-board display to the package ergonomics, answers the needs of people like you — leading practitioners of in-field spectroscopy.

As you expect from ORTEC, the DigiDART is an advanced, *all-digital design*, with three ORTEC-held patents<sup>1</sup> — clearly advancing the state of the art for portable MCAs.

## digiDART . . . Tough, yet light.

Weighing less than 1160 grams, the DigiDART is an attractive, light-weight instrument; easy to handle, and RUGGED. The case is molded ABS — the same strong plastic used extensively in automobiles. The outside is coated with a shock-absorbing, easy-grip, stay-clean coating — just like your other tools. The display and keypad are recessed to protect them when the instrument is dropped. The connectors are all on one side and recessed for protection. The battery is inside — again for added protection and covered with a splash-proof door. It can be charged in place, even when the DigiDART is operating. The battery is truly integrated into the rugged DigiDART and not simply clipped on the back panel; exposed and easy to break. Changing the battery is simple: just open the door and replace.

### DigiDART Display and Keypad

Naturally, the DigiDART is entirely computer controllable; but with the built-in display and numeric keypad, it is a DRAMATIC ADVANCE from the current generation of portable MCAs. This high-quality display and easy to use keypad mean it can perform a variety of tasks without an attached PC.

For in-field applications, a PC is difficult to carry and operate, but without a display you can't see the spectrum or results. The DigiDART's built-in, backlit LCD display panel and keypad provide the confidence you need that your data is good. A clear spectral display is provided and start/stop control is accomplished simply by a single keypad entry.

The spectral Display of the DigiDART is patterned after ORTEC's very successful MAESTRO MCA Emulator, in use on thousands of systems worldwide. A 240 x 160 pixel LCD display allows the user to monitor acquisitions and instrument settings status, with no attached PC. It features a live spectral display with region of interest, peak information and on line activity calculations. ROIs are shown as a bar below the spectrum.

<sup>1</sup>U.S. Patents No's. 5,821,533; 5,872,363 and 5,912,825

## Keypad and Display Features



- 1 - View Status
- 2 - Enter ID
- 3 - Nuclide ROIs
- 4 - Status Line
- 5 - Peak Info
- 6 - Adjust Controls
- 7 - General Settings
- 8 - Spectrum Memory

Live Time	72531
Real Time	72730
Dead Time (%)	0.274
Battery (% full)	100
Fine Gain	0.700
Coarse Gain	2
Rise Time	10.200
Flat Top	0.800
BLR Setting	3

Nuclide	keV	μCi	±%
241Am	59.5	1.72	5.2
109Cd	88	2.19	10.1
57Co	122	0.93	4.9
57Co	136	0.89	8.7
137Cs	661.6	2.6	2.5
60Co	1173	0.79	5.3
60Co	1332	0.81	5.1
40K	1460	0.02	11.4
208Tl	2614	0.01	21.7

## Real Time Activity Calculations . . . NO PC Required!

DigiDART can also perform nuclide ID and activity calculations using internally stored calibration information, at the touch of a button, and all without the use of an attached PC. Everything is user controlled: the library for analysis, displayed peak labels, unit labels and calibration parameters. They are all easily downloaded by MAESTRO to the DigiDART, but they can be changed in-field to adapt to your changing needs. Activity is calculated for the list of up to 9 nuclides. The spectral data can be saved and later re-analyzed in more detail using a more sophisticated PC-based analysis package such as GammaVision.

## Operator Menus

All of the DigiDART screens and operations are set using the keypad and the display. The operation is simple — select what you want from the displayed list by number and the Enter key. The main groups are: View Status, Enter ID, Nuclide ROI contents, Peak Info, Select ROIs, Select Status contents, Adjust controls, general settings and View memory contents. The complete list of all functions is given in the specification section.

Using the keypad and the display, the MCA settings can be verified or changed in the field without a host computer.

## Protection

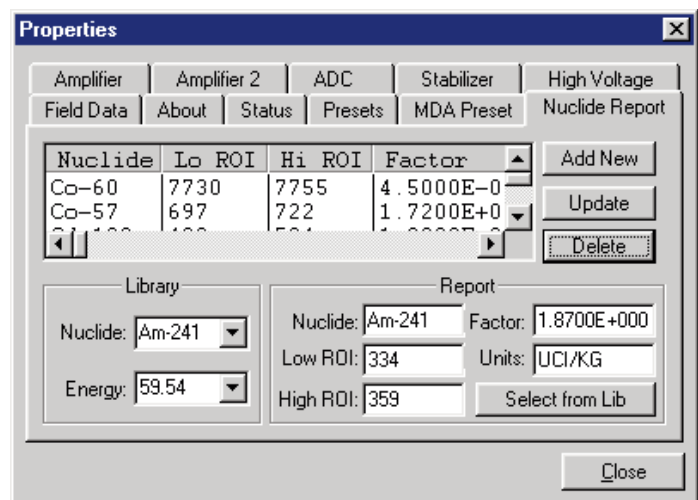
Protection of the data is important, so the MENUS have password protection. The operations are separated into two groups: USER and ADMINISTRATOR. The USER password protects the instrument from unauthorized use. That is, you can protect your data stored in the internal memory. The ADMIN or Setup functions are protected by a different administrator password. The ADMIN functions can only be changed by the Administrator ensuring that your results are based on the correct parameters.

## SMART-1 HPGe Detector Support

ORTEC's SMART-1 detector technology is a great advance in HPGe detectors and their operation. SMART-1 technology is a major enhancement to data and chain of custody integrity. It is a dramatic 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." 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.

DigiDART uses the special SMART-1 "state of health" (SOH) function to verify that the detector was operating properly for the entire data collection time. When the acquisition is started, DigiDART clears the SOH register in the SMART-1 controller. 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 DigiDART reads the SOH and displays a warning message if a problem was detected. No Message — no problem. The SOH status is saved with the spectral data in the SPC file as part of the QA process. Any CONNECTIONS program, even user-developed packages, may read the SOH register through the DigiDART for maintaining the spectrum QA.



DigiDART is fully integrated with ORTEC software applications such as MAESTRO which can easily download setup parameters.

## Authentication using the SMART-1 Detector

The DigiDART/SMART-1 combination also guarantees spectrum authenticity. At the start of the acquisition, the DigiDART reads the SMART-1 detector serial number. The DigiDART generates a random number and writes it to the SMART-1 detector. At the end of the acquisition, the DigiDART reads both numbers from the SMART-1 detector and compares the "stop" values to the "start" values. An exact match assures data integrity. Because DigiDART, like all ORTEC MCA products, forms part of the *CONNECTIONS* architecture, these operations may be carried out remotely over a network, making DigiDART **IDEAL** for unattended monitoring applications. The combination of the DigiDART and a SMART-1 detector is all that is required to provide full functionality and traceability. The SMART-1 detector includes the module shown in the figure which houses the HV and the detector controller. The cables are captive, strain-relieved and sealed against water penetration, eliminating the high voltage connectors and all the problems of HV connectors.



**SMART-1 Detector Interface Module.**

## Detector Interface Modules for non-SMART-1 HPGe Detectors

For older, non-SMART-1 detectors a DigiDART system is completed with a Detector Interface Module (DIM). The DIM includes the HV, controlled from the DigiDART, and connects to the "usual" detector connections for preamplifier and high voltage. DIMs are available for all types of detectors used with the DigiDART. The DIM connects to the DigiDART with a single cable.

## System Specifications

**Display:** 240 x 160 pixel backlit LCD provides LIVE spectral display, status information and analysis results.

**Full Display and Zoom Modes:** Display of multiple ROIs.

**Status Line:** User-configurable parameter display. Choice of two from: cursor energy, location, live time, live time remaining, real time remaining, battery life remaining, Count rate, Count rate in ROI, counts.

The spectral display may be disabled from an attached computer using an administrator function.

**Energy Calibration:** Two point energy calibration of channel and FWHM.

**On Line Activity Calculation:** Activity and uncertainty are calculated and reported on-screen, on-line for up to 9 user-defined regions. Activity is calculated as net count-rate divided by user supplied efficiency factor.

**Presets:** Live time, real time, integral peak count, peak count, uncertainty and Multi-Nuclide MDA. Up to 20 nuclide ROIs may be specified. Acquisition halts when all MDA requirements have been satisfied. Real/Live Time in multiples of 1 sec.

**Keypad:** 20 numeric and function keys. Many of the DigiDART function keys are multi-function. The precise function depends on the context at the time the key is pushed.

When the unit is connected to a computer via the USB, the keypad is locked out.

## Menu Functions

Pressing the Menu button while a spectrum is displayed brings up the Main Menu.

## Main Menu Options

**View Status:** Displays all of the major MCA settings, including: Live time, Real time, Dead time, Battery voltage, Bias voltage, Fine gain, Coarse gain, Rise time, Flat top, Baseline restore [BLR] setting.

**Enter ID:** Entry dialog for a numerical ID included with the spectrum.

**Nuclide ROIs:** View the nuclide report and the setup menu for the Nuclide Report. The following are entered for each of the 9 ROIs: ACTIVE/DISABLED, Label (text), Units (text), Start Channel, number of channels, area multiplier, Clear this ROI, Show these settings.

**Status Line:** Setup the Status Line at the top of the spectrum display to show any two of the following parameters: Cursor location (energy), Cursor location (channel), Live time, Real time, Live time remaining, Real time remaining, Battery time remaining, Count rate, Count rate in ROI, Counts in marker channel.

**Peak Info:** Displays the centroid, FWHM, net counts and gross counts for the region identified by the marker position. Access is denied when spectrum display is locked.

**Adjust Controls:** Displays dialog for the following:

HV Settings: View and set the following: enable HV, Set Bias Voltage, Set Shutdown mode, View Current HV value, View SOH.

Amplifier Settings: View and set the following: Coarse Gain, Fine Gain, Rise Time, Flat Top, Pole Zero, Baseline Restore, Optimize, Preamp Type, Input Polarity.

Preset Settings: View and set the following: Live Time Preset, Real Time Preset, ROI Integral Preset, ROI Peak Preset, Uncertainty Preset, MDA Presets.

ADC Settings: Set the Conversion Gain, LLD, ULD, and gate.

Stabilization Settings: Enable, view and setup the Gain and Zero stabilizers.

## General Settings

Change User Password

Change Admin Password

Enter Password

Lock Spectral Display

Auto-Contrast: Enable or Disable

Calibrate: Enter or view the Calibration

Display

Adjust vertical scale to Auto, Log, or Normal

Set Mode to PHA

View Settings

**Spectrum Memory:** Retrieve, list or erase stored spectra.

## MCA Specifications

Maximum system throughput >100,000 cps

### System Gain Settings:

Coarse Gain: 1, 2, 4, 8, 16, or 32

Fine Gain: 0.45 to 1

With the available range of gain settings, the system is suitable for all types of HPGe detectors. Specifically the following FULL SCALE energy ranges are achievable (assuming standard ORTEC preamplifier):

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:** Select either resistive or TRP preamplifier.

**System Conversion Gain:** The system conversion gain is software controlled from 512 to 16k channels in the standard model and 512 to 32k channels in the optional -32 model.

### Digital Filter Shaping-Time Constants

Rise times: 0.8  $\mu$ s to 20  $\mu$ s in steps of 0.2  $\mu$ s.

Flat tops: 0.5 to 2.0 in steps of 0.1  $\mu$ s

**Dead-Time Correction:** Extended live-time correction according to Gedcke-Hale method. Accuracy: Area of reference peak changes  $\pm 3\%$  from 0 to 50,000 counts per second.

## Linearity

Integral Nonlinearity:  $< \pm 0.025\%$  over top 99.5% of spectrum, measured with a mixed source (55Fe @ 5.9 keV to 88Y @ 1836 keV).

Differential Nonlinearity:  $< \pm 1\%$  (measured with a BNC pulser and ramp generator).

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

## System Temperature Coefficient

Gain:  $< 35$  ppm/ $^{\circ}\text{C}$ . [Typically 30 ppm/ $^{\circ}\text{C}$ .]

Offset:  $< 3$  ppm/ $^{\circ}\text{C}$ , with Rise and Fall times of 12  $\mu\text{s}$ , and Flat Top of 1  $\mu\text{s}$ . (Similar to analog 6  $\mu\text{s}$  shaping.)

**Pulse Pile-Up Rejector:** Automatically set threshold. Pulse-pair resolution typically 500 ns.

**Automatic Digital Pole-Zero Adjustment:** Computer controlled (U.S. Patent No. 5,872,363). Can be set automatically or manually. Remote Diagnostics via Insight Oscilloscope mode.

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

**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:** A single battery is inserted through door in case. The compartment is semi-sealed and designed to resist dirt and moisture. The battery may be changed without loss of data or charged in the field with no tools.

Battery Life: Up to 14 hours with fully charged Sony NP-F970 and standard ORTEC resistive feedback preamplifier.

Battery Type: Lithium-ion Camcorder Battery. Sony NP-F970 (7.2 V 47.5 W hr).

## Inputs and Outputs

**Detector:** Multipin connector with the following:

Preamp Power: 1 W max. (+12 V, -12 V, +24 V, -24 V, 2 GND)

Amp In: Normal amplifier input.

TRP Inhibit

Battery Power: (5-12 V) for HV module.

Control for 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) (Charging circuitry and battery management circuitry internal to DigiDART).

## Electrical and Mechanical

**Dimensions:** DigiDART 8" x 5" x 3" (20.32 x 12.7 x 7.62 cm)  
DIM 4.4" x 1.25" x 2.6 (W) [3" with handle]

**Weights:** DigiDART 1150 gm with battery (2.5 lb)  
850 gm without battery (1.9 lb)  
DIM  $< 240$  gm (0.5 lb)

**Operating Temperature Range:**  $-10$  to  $60^{\circ}\text{C}$ , including LCD Display.

## Detector High Voltage Supplies

DigiDART 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" detectors, the HV supply is in the form of a Detector Interface Module or "DIM" with 6" cables, each with a mating connector for the traditional detector cable set:

- 9-pin D preamp power cable
- Analog In
- Shutdown In
- Bias Out
- Inhibit In

DIMs 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.

In all cases, Bias Voltage Setting and Shutdown polarity are set from the computer using the DigiDART. The DigiDART can monitor the output voltage and shutdown state.

In addition, the SMART-1 detector provides additional state of health information by monitoring the following functions:

- Preamplifier  $\pm 12$ ,  $\pm 24$  Volt values (read only)
- Detector element temperature (read only)
- Detector high voltage value (read only)
- Detector high voltage state (on/off) (read/write)
- Detector overload state
- Detector HV shutdown state
- Detector serial number (read only)
- Detector authentication code (read/write)

## Ordering Information

Model	Description
DigiDART	DigiDART with MAESTRO software, 2 cables, battery and charger, operator manual, instruction card and USB Driver instruction sheet. NO DIM, for use with SMART-1 equipped detector.
DigiDART-POSGE	DigiDART with DIM-POSGE detector interface module for non-SMART positive bias HPGe detector
DigiDART-NEGGE	DigiDART with DIM-NEGGE detector interface module for non-SMART negative bias HPGe detector
DigiDART-POSNAI	DigiDART with DIM-POSNAI detector interface module for positive bias NaI detector
DigiDART-R-POSNAI	DigiDART with DIM-POSNAI detector interface module for positive bias NaI detector with RS-232-C communications
DigiDART-296	DigiDART with DIM-296 detector interface module for NaI detector
DigiDART-32	32k channel DigiDART with MAESTRO Software, NO DIM, for use with SMART-1 equipped detector.
DigiDART-32-POSGE	DigiDART-32 with DIM-POSGE detector interface module for non-SMART positive bias HPGe detector
DigiDART-32-296	DigiDART-32 with DIM-296 detector interface module for NaI detector
DigiDART-OPT1	Spare high capacity battery
DigiDART-OPT2	Battery charger 110–240 V 50/60 Hz
DigiDART-OPT2-E	Battery charger 110–240 V 50/60 Hz, CE approved for Europe
DigiDART-OPT3	Field Kit: carry strap/belt strap, auto adapter, universal mains adapter; spare battery
DigiDART-OPT4	RS-232 communication option (contact factory)

### Additional DIMS:

DIM-POSGE	Detector Interface Module for non-SMART positive bias HPGe detector
DIM-NEGGE	Detector Interface Module for non-SMART negative bias HPGe detector
DIM-POSNAI	Detector Interface Module for positive bias NaI detector

### Example System Order:

DigiDART  
GEM10P4-70-SMP  
CFG-PG4-3

Specifies a DigiDART; 10% GEM PopTop detector with SMART-1 technology; and a 3-liter Gamma Gage portable cryostat/dewar.

### Software Prerequisites

Setup and spectrum recovery requires a suitable version of MAESTRO (supplied with DigiDART) or other ORTEC CONNECTIONS applications.