

**ORTEC<sup>®</sup>**

***digiDART<sup>®</sup>***

**Portable HPGe MCA**

**Operator Manual**

# **Advanced Measurement Technology, Inc.**

a/k/a/ ORTEC®, a subsidiary of AMETEK®, Inc.

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# ADDITIONAL WARRANTY STATEMENT

Please note that the digiDART contains *no user-serviceable parts*. Breaking the seal on the case *voids your warranty*. The digiDART should be opened only by ORTEC-authorized service personnel.



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# 1. INTRODUCTION

The ORTEC digiDART<sup>®</sup> is a low-power, hand-held HPGe-grade MCA based on low-power digital signal processing (DSP) technology. It is ideal for:

- In-situ gamma spectroscopy
- Fissile material assay
- Chemical weapons assay — PINS
- Comprehensive nuclear test ban treaty activities (inspection systems)
- Non-fissile waste assay

Lighter in weight and more rugged than any previous portable MCA, the digiDART gives you a full suite of features for in-field data acquisition. The display shows the spectra you are collecting in the field in live time, without using a laptop. With the keypad you can view or change any of the data-acquisition settings and internal parameters whenever you need to, without a PC.

The digiDART can perform real-time identifications and activity calculations for up to 9 user-defined nuclides at a time. Everything is user-controlled: the library for analysis, displayed peak labels, unit labels, calibration parameters, regions of interest (ROIs), and data acquisition settings. These can all be downloaded from MAESTRO-32 to the digiDART or you can set them up from the instrument's keypad. You can also adjust parameters such as gain and pole zero whenever needed, without a PC.

Spectra can be saved and later uploaded to a PC and reanalyzed in more detail using a more sophisticated analysis package such as our GammaVision<sup>®</sup>-32 MCA Emulation and Analysis Software (A66-B32).

The digiDART also offers these features:

- Small enough to mount on a detector Dewar or attach easily to an ORTEC M-1 tripod.
- Rugged ABS plastic case with a shock-resistant elastomer covering.
- The cable between the MCA and detector does not carry high voltage, so the digiDART is protected from electrical damage.
- Connects to the host PC via the USB port.
- Long battery life — up to 12 hours on a single battery.
- Highly stable peak shape and peak position with temperature and count rate.
- Optimize detector performance for a given application from the digiDART or from the PC using the InSight<sup>™</sup> Virtual Oscilloscope.
- ORTEC's easy automatic pole-zero adjustment.<sup>1</sup>
- Administrator and user passwords entered from the digiDART keypad only (not PC)

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<sup>1</sup>Patent number 5,872,363.

software). provides added security for your data.

- Monitor the contents and capacity of the stored-spectrum memory.
- Highly accurate Gedcke-Hale extended live-time correction method.<sup>2</sup>
- In-the-field accessories for ease of use in all conditions.

The digiDART is the first MCB to support ORTEC's SMART-1® HPGe detector technology, which monitors and records the detector's "state of health" (SOH), including detector temperature. It supports HPGe, NaI, CZT, and other detector types. The digiDART can also use our DIM-POSNAI and DIM-296 detector interface modules (DIMs) to supply detector bias.

Attached to a PC or laptop (running any version of Microsoft® Windows® listed in Section ?), the digiDART operates just like any other ORTEC CONNECTIONS-32 MCB and is compatible with all CONNECTIONS-32 products and our CONNECTIONS-32 Programmer's Toolkit (A11-B32). It is backward compatible with existing CONNECTIONS-32 custom applications at the general operation/control level. And because the digiDART is part of our CONNECTIONS-32 architecture, its operations can be controlled remotely over a network, with the authentication performed at the data source, making the digiDART ideal for unattended monitoring applications.

## 1.1. How the digiDART Collects and Stores Spectra

The live or current spectrum and all the associated information are stored in high-speed spectrum memory. The spectrum can then be stored in the stored-spectrum memory. Both the live spectrum and the stored spectra are retained when power is turned off and when the battery is removed.

### 1.1.1. Live Spectrum

The currently acquiring or most recently acquired spectrum is stored here. This also holds the presets, ROIs, calibration, and the SOH status. This spectrum is lost when **CLEAR** is pressed or when a stored-spectrum is recalled or read by the PC.

### 1.1.2. Stored-Spectrum Memory

Stored-spectrum memory is the storage place for spectral data acquired in the field. At the end of a data acquisition, simply press the **Store** button to copy the spectrum and all the information associated with this acquisition, including the presets, ROIs, calibration, and SOH bit from the live memory to stored-spectrum memory. This entire set of data can be downloaded to the host PC using a program such as MAESTRO. The file can then be saved as an **.SPC** file.

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<sup>2</sup>Ron Jenkins, R. W. Gould, and Dale Gedcke, *Quantitative X-Ray Spectrometry* (New York: Marcel Dekker, Inc.), 1981, pp. 266–267.

The stored spectra are retained until you delete them, even when the digiDART is powered off and has been disconnected from all external and battery power.

The digiDART has 1.5 Mbytes of spectrum memory available for stored-spectra. Each stored spectrum consumes 4 bytes × the number of channels in the spectrum, plus 400 bytes of settings information. The spectrum storage required for different conversion gains is shown in Table 1. In addition, the table shows the total number of spectra that can be stored in spectrum memory if all of the spectra have the same conversion gain. You can collect and store spectra with any combination of conversion gain settings.

**Table 1. Capacity of Spectrum Memory According to Conversion Gain Setting Used.**

Conversion Gain	Memory Required (bytes)	Total Spectra
32k	131472	12
16k	65936	24
8k	33168	48
4k	16784	96
2k	8592	188
1k	4496	360
512	2448	662

The digiDART has a **Spectrum Memory** menu (see Section 2.2 for more details) that allows you to view the contents and remainder of the spectrum memory. The **Spectrum Directory** command allows you to view the spectrum identification for the spectra in spectrum memory. The display format is :

```
sequence# spectrum_id start_date start_time
```

The bottom of the screen displays a message saying **x# of y# bytes used** so you can keep track of the available storage. Use the up and down arrows to scroll through the spectra (if there are too many to view at once on the screen). Also, you can advance to a particular spectrum by entering its sequence number or spectrum ID so you don't have to scroll through the list.

If you try to store a spectrum when the spectrum memory is full, the digiDART displays a **Write Error: Spectrum Memory is Full** message.

## **1.2. Host PC and Software Requirements**

The digiDART can be operated with any suitable version of ORTEC software, including MAESTRO-32 MCA Emulation Software version 5.2 or higher. The digiDART is supported on any Microsoft® Windows® PC that supports the USB port. The current release of MAESTRO-32 runs under Windows 2000 Professional SP4, XP Professional SP2 or higher, and Vista Ultimate.

# 2. THE DIGIDART

## 2.1. Display and Keypad

Figure 1 shows the digiDART's display and keypad and highlights some of its features.

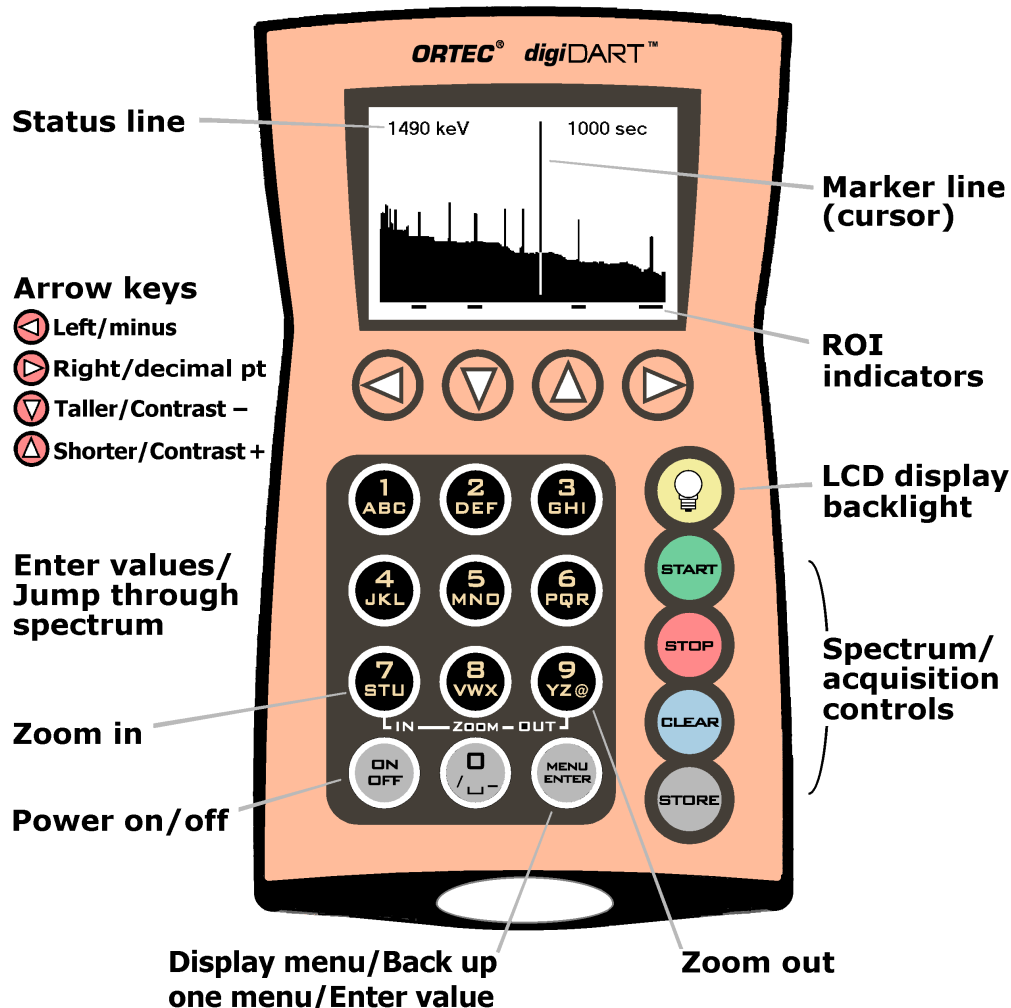


Figure 1. The digiDART.

### 2.1.1. The Display

The digiDART has a 240 × 160-pixel LCD display for viewing data acquisitions in the field as well as viewing and changing most of the MCA settings. In certain situations in which the spectrum should not be viewed by the operator, the spectrum display can be disabled. When the spectrum display is disabled, all keypad functions are operational except (5) **Peak Info**, however, the digiDART cannot communicate with a PC.

The left and right arrow buttons allow you to move the vertical **Marker Line** by one channel or one pixel. The **(0)** through **(6)** number keys move the marker quickly through the spectrum.

The marker channel is used in the following:








- The status line shows details of the marker channel on the display.
- **Peak Info** is displayed for the peak ROI containing the marker.
- The spectrum **Zoom in** and **Zoom out** functions expand or contract the spectrum's horizontal axis around the marker position.














The **Status Line** at the top of the display can 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 the current ROI (selected with the marker), and counts in the ROI. Selection of these parameters can only be done from the keypad.













The **ROI Indicator** line at the bottom of the display shows which channels in the spectrum have the ROI bit set. The ROIs can be set using the digiDART keypad and menus (Section 4.1.12) or from a program such as MAESTRO.

### 2.1.2. Keypad






The keypad allows you to use the digiDART without a host PC. The following table tells how to use the buttons in spectrum mode, menu mode, and parameter/text entry mode. The parameter/text entry mode allows you to enter alphanumeric ROI labels and ROI units for the Nuclide Report, and spectrum sample IDs. All keys are disabled when the digiDART is connected to a PC.

Button	Spectrum Mode 	Menu Mode 	Parameter/Text Entry Mode (in conjunction with  and  )
	Turns the digiDART on and off. See Section 3.5.		
	Switches to the Main Menu.	Returns you to the previous menu. From the Main Menu, returns you to spectrum mode.	Completes the entry of a parameter value.
	Turns on the display backlight. The backlight remains on for 10 seconds after the last button press then turns off.		

Button	Spectrum Mode 	Menu Mode 	Parameter/Text Entry Mode (in conjunction with  and  )
	Begins data acquisition.	No action. If in View Status menu, starts acquisition.	No action. If in Enter ID, retrieves current ID.
	Manually ends data acquisition.	No action. If in View Status menu, stops acquisition.	No action.
	Erases the currently displayed spectrum from the digiDART memory. If you press CLEAR before you have saved the current spectrum with the STORE button, the spectrum will be lost.	Jump to spectrum display.	Backspace/erase.
	Saves the currently displayed spectrum in the digiDART stored-spectrum memory. When a spectrum is stored, you can assign it an 8 character ID (see Section 2.2.2). If you try to store a spectrum when the stored spectrum memory is full, the digiDART displays a <b>Write Error: Spectrum Memory is Full</b> message.	No action.	Switches the most recently entered alphabetic character between lowercase and uppercase.
	Moves the marker to the left.	No action.	Minus sign.
	Moves the marker to the right.	No action.	Decimal point.
	Increase the vertical scale, making peaks look shorter. Use it in conjunction with the <b>Zoom In</b> and <b>Zoom Out</b> buttons (buttons <b>7</b> and <b>9</b> , respectively).	Increases display contrast.	Used in conjunction with the number buttons; cycles through the 3 alphanumeric characters assigned to a number button.
	Decreases the vertical scale, making peaks look taller. Use it in conjunction with the <b>Zoom In</b> and <b>Zoom Out</b> buttons (buttons <b>7</b> and <b>9</b> , respectively).	Decreases display contrast.	Used in conjunction with the number buttons; cycles through the 3 alphanumeric characters assigned to a number button.
	Jumps the marker to channel 0.	0	0, /, space, underscore Press the number button then the up or down arrow to move through

Button	Spectrum Mode 	Menu Mode 	Parameter/Text Entry Mode (in conjunction with  and  )
			the letter/symbol choices. Press STORE to switch between lowercase and uppercase letters.
	Jumps the marker to the channel at 1/6 of the display.	1	1, A, B, C
	Jumps the marker to the channel at 1/3 of the display.	2	2, D, E, F
	Jumps the marker to the channel at 1/2 of the display.	3	3, G, H, I
	Jumps the marker to the channel at 2/3 of the display.	4	4, J, K, L
	Jumps the marker to the channel at 5/6 of the display.	5	5, M, N, O
	Jumps the marker to the right-most channel on the display.	6	6, P, Q, R
	<b>Zoom In;</b> Each button press reduces the number of channels displayed by half, to a minimum of 240 channels. The zoom-in view is centered on the marker location.	7	7, S, T, U
	<p>This is used as a “shift” or “function” key when used in combination with other buttons. Press and hold the 8 button, press the second button in the combination, then release both.</p> <ul style="list-style-type: none"> <li>● <b>&lt;8+Left-arrow&gt;</b> moves the marker to the lowest-channel ROI.</li> <li>● <b>&lt;8+Right-arrow&gt;</b> moves the marker to the next ROI to the right.</li> <li>● <b>&lt;8+Up-arrow&gt;</b> Sets the display mode to linear autoscale.</li> <li>● <b>&lt;8+1&gt;</b> Sets the display mode to logarithmic.</li> <li>● <b>&lt;8+3&gt;</b> sets the first point of a new ROI at the current marker location.</li> </ul>	8	8, V, W, X



Button	Spectrum Mode 	Menu Mode 	Parameter/Text Entry Mode (in conjunction with  and  )
	<ul style="list-style-type: none"> <li>● <b>&lt;8+6&gt;</b> sets the endpoint for the new ROI and fills in the ROI. This endpoint can be at a lower channel number or energy than the start point, <i>but you must start marking with &lt;8+3&gt; and end with &lt;8+6&gt;</i>.</li> <li>● <b>&lt;8+4&gt;</b> removes the ROI if the marker is in an ROI region.</li> <li>● <b>&lt;8+7&gt;</b> zooms the horizontal axis to maximum expansion (240 channels).</li> <li>● <b>&lt;8+9&gt;</b> zooms to minimum expansion (maximum number of channels).</li> <li>● <b>&lt;8+CLEAR&gt;</b> jump back to menu</li> </ul>		
	<b>Zoom Out;</b> doubles the number of channels displayed, the marker is centered in the display.	9	9, Y, Z, @

## 2.2. Menu Commands

The digiDART keypad and display allow you to view or change most of the MCA settings in the field without a host PC. This section describes the digiDART menus, commands, and status screens. In addition, a quick reference menu tree is included on the last page of the manual (after the index). Chapter 4 tells how to use the unit in the field.

The digiDART keypad is simple to use:

- When you first turn the unit on, it starts in spectrum mode. Press **MENU/ENTER** to open the Main Menu.
- To select items from the menus, press the number buttons.
- To modify a setting, enter the new value, then press **MENU/ENTER**. To erase a digit, press **CLEAR**.
- To return to the preceding menu, press **MENU/ENTER**.

- There are two ways to return to spectrum mode from any menu: (1) press **MENU/ENTER** until the spectrum is displayed; or (2) press **CLEAR**. If you press **CLEAR** to jump from a menu to spectrum mode, you can jump back to that menu by pressing **<8+CLEAR>**.
- On any entry, if you just press **MENU/ENTER** without pressing any other keys, the current value will be used; that is, no change will be made. Therefore, if you enter a dialog by mistake, you can just press **MENU/ENTER** to go back without changing anything.

The **Main Menu** for the USB digiDART is shown in Fig. 2. For the digiDART-R's main menu, see the digiDART-R user's manual supplement.

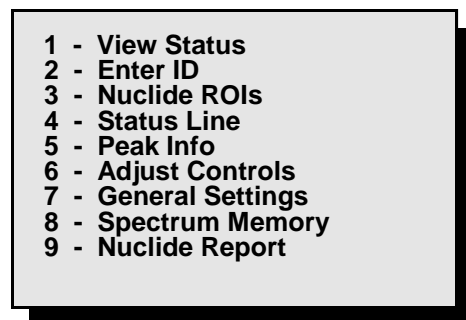


Figure 2. The Main Menu.

### 2.2.1. (1) View Status

The status screen (Fig. 3) displays all of the major MCA settings at one time. Press **MENU/ENTER** to return to the Main Menu.



Figure 3. View Status.

### 2.2.2. (2) Enter ID

Allows you to enter an 8-character alphanumeric identifier to describe the sample, as shown in Fig. 4.

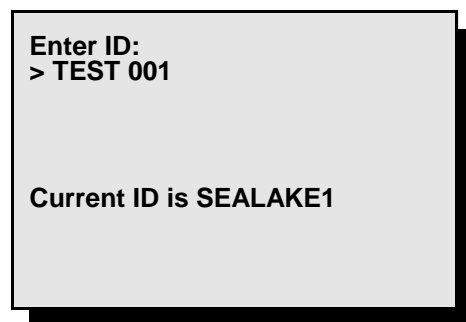
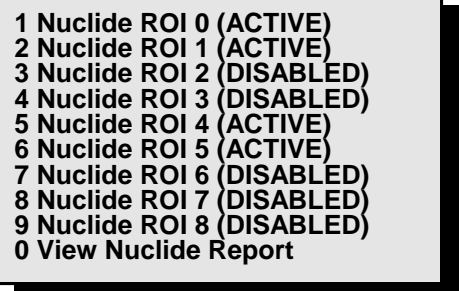


Figure 4. Enter Spectrum ID.

### 2.2.3. (3) Nuclide ROIs

Use this screen (Fig. 5) to set up the ROIs for the Nuclide Report, which is described in Section 6.1. Each ROI is labeled as ACTIVE (the ROI will be displayed on the Nuclide Report screen) or DISABLED (the ROI will not be displayed on the report screen). To view the real-time Nuclide Report for the currently active ROIs, press **(0) View Nuclide Report**.



```

1 Nuclide ROI 0 (ACTIVE)
2 Nuclide ROI 1 (ACTIVE)
3 Nuclide ROI 2 (DISABLED)
4 Nuclide ROI 3 (DISABLED)
5 Nuclide ROI 4 (ACTIVE)
6 Nuclide ROI 5 (ACTIVE)
7 Nuclide ROI 6 (DISABLED)
8 Nuclide ROI 7 (DISABLED)
9 Nuclide ROI 8 (DISABLED)
0 View Nuclide Report

```

Figure 5. Nuclide Report ROIs.

To set up a nuclide ROI, press its number to display the submenu shown in Fig. 6.

Press **(1) Change Label** to enter the nuclide name. The name can be 6 characters long (for example, AM-241). See Section 2.1.2. for instructions on entering the various characters.



```

1 - Change Label
2 - Change Units
3 - Change Start Channel
4 - Change ROI Length
5 - Change Constant
6 - Clear ROI
7 - Show ROI Setup

```

Figure 6. Set Up the ROIs.

Press **(2) Change Units** and enter the desired unit of measure (text, up to 6 characters). The same units label is used for all entries and is only entered once.

Next press **(3) Change Start Channel** and enter the start channel for the region. The start channel should be below (on the low-energy side of) the peak in the background. The first 3 channels are used for the low-energy background.

Press **(4) Change ROI Length** and enter the width of the region, which must be at least 7 channels. The width should stop above (on the high-energy side of) the peak in the background so that the region is approximately centered on the peak channel. The last 3 channels are used for the high-energy background.

Next, press **(5) Change Constant**. The constant is multiplied times the net peak count rate to give the value shown on the report. To report activities, you need to know the branching ratio (yield) for this gamma ray for this nuclide and the efficiency. The branching ratio can be found in any gamma-ray library (e.g., NuclideNavigator<sup>®</sup> III). The efficiency can be calculated by a program such as ScintiVision or determined by other methods.

To confirm that you have entered the desired values and labels, press **(7)** to show the current setup for this ROI. Press **MENU/ENTER** to return to the setup list.

When setup is complete, press **MENU/ENTER** to return to the Nuclide Report list of ROIs. The ROIs you have set up will now be marked **ACTIVE**.

To enter another region, press the number and repeat entry as described above.

To remove an ROI from the report, press the corresponding Nuclide ROI number to open the setup list, then press **(6) Clear ROI**. This will completely remove all the setup information for this one ROI, which will now be marked **DISABLED** on the Nuclide ROIs screen.

The Nuclide Report will display the active ROIs in the order entered on this setup screen. *Note that these ROIs are separate from the spectrum ROIs discussed in Section 4.1.12, and are not displayed or marked in any way on the spectrum screen.*

#### 2.2.4. (4) Status Line

The Status Line at the top of the spectrum display can show any two of the parameters shown in Fig. 7.

The numbers are select/deselect toggles (i.e., press a number once to select an item, and press again to de-select it). When you mark the first status item, a **1\*** appears beside your first selection. This parameter is displayed at the top left of the spectrum. The second status item is marked with **2\*** and is displayed at the top right. The order in which you select items allows you to determine which parameter is shown on the left and right sides of the display.

1*1 - Cursor Location (Energy)
2 - Cursor Location (Channel)
3 - Live Time
4 - Real Time
5 - Live Time Remaining
6 - Real Time Remaining
7 - Battery Time Remaining
8 - Count Rate
9 - Count Rate in ROI
2*0 - Counts

Figure 7. Set Up the Status Line.

#### 2.2.5. (5) Peak Info

When you place the marker in a defined ROI and issue this command, it reports the centroid, FWHM, and net and gross counts for the region (Fig. 8). Access is denied when the spectrum display is locked. If the marker is not in an ROI, all values are shown as **N/A**.

Peak Centroid	1332.5
FWHM	2.03
Net Counts	52971
Gross Counts	83497
ROI Start Channel	4320
ROI End Channel	4352

Figure 8. Peak Info.

## 2.2.6. (6) Adjust Controls

The list of controls is shown in Fig. 9.

- 
- 1 - HV Settings
  - 2 - Amplifier Settings
  - 3 - Presets Settings
  - 4 - ADC Settings
  - 5 - Stabilizer Settings

Figure 9. Adjust Controls.

### 2.2.6.1. HV Settings

This dialog (Fig. 10) includes the following functions:

#### 1 Enable HV

Turns on the high voltage. If no detector (SMART-1 or DIM) is attached or if HV is in shutdown status, the **Error: Cannot Enable HV** message is displayed. If **Disable HV** is displayed, the HV is on and pressing **(1)** will turn it off. When the voltage is enabled/disabled, a message is displayed until you press **MENU/ENTER**.

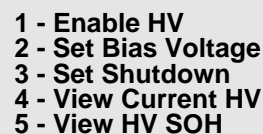
- 
- 1 - Enable HV
  - 2 - Set Bias Voltage
  - 3 - Set Shutdown
  - 4 - View Current HV
  - 5 - View HV SOH

Figure 10. HV Settings.

#### 2 Set Bias Voltage

This sets the HV to the desired voltage. The polarity is determined by the SMART-1 or DIM. The recommended voltage is shown for the SMART-1.

#### 3 Set Shutdown

When connecting to a SMART-1 HPGe Detector, select **(3)**. For using “non-SMART-1” detectors, choose **(1)** TTL or **(2)** ORTEC (Fig. 11).

- 1 TTL
- 2 ORTEC
- 3 SMART

- 
- 1 - TTL
  - 2 - ORTEC
  - 3 - SMART

Figure 11. Set Shutdown.

## 4 View Current HV

This displays the current HV parameters as shown in Fig. 12. The **Type** can be GE-POS, GE-NEG, or NaI.

HV Status	OFF
HV Target Bias	0
HV Actual Bias	0
HV Shutdown	ORTEC
Type	GE-POS
Overloaded Status	NO
HV Serial #	0
SMART-1 Detector	NO
Recommend HV	
Live Det. Temp	92

Figure 12. View Current HV Settings.

## 5 View HV SOH

This displays the HV and other state-of-health flags as shown in Fig. 13.

+24V	OK	+0.00
+12V	OK	+0.00
-12V	OK	+0.00
-24V	OK	+0.00
Temp	OK	+0.00
HV Volt	OK	
Shutdown	OK	
Overload	OK	
Security	ERR	
Power	OK	

Figure 13. Monitor the SOH Flags.

### 2.2.6.2. Amplifier Settings

These settings (Fig. 14) should be performed in this order: 9, 8, 6, 3, 4, 1, 2, 7. The **Device Busy** message means the unit is collecting data; to continue changing the amplifier settings, return to spectrum mode and press **STOP**.

#### 1 Coarse Gain

This sets the amplifier coarse gain to  $\times 1$ ,  $\times 2$ ,  $\times 4$ ,  $\times 8$ ,  $\times 16$  or  $\times 32$ .

#### 2 Fine Gain

This sets the amplifier fine gain to any value between 0.45 and 1.00.

#### 3 Rise Time

This sets the rise time to values between 0.8 and 23.0. Values less than 0.8 are automatically adjusted up to 0.8. Values greater than 23.0 are adjusted down to 23.0.

1 - Coarse Gain
2 - Fine Gain
3 - Rise Time
4 - Flattop
5 - Pole Zero
6 - Baseline Restore
7 - Optimize
8 - Preamp Type
9 - Input Polarity
0 - View Current Settings

Figure 14. Amplifier Settings.

#### 4 Flattop

This sets the filter flattop width to values between 0.3 and 2.4. Values less than 0.3 are automatically adjusted up to 0.3. Values greater than 2.4 are adjusted down to 2.4.

#### 5 Pole Zero

This shows the PZ dialog, where you select either manual or automatic PZ. Note that if you use the Optimize function, it automatically PZs the digiDART

- |                           |  |
|---------------------------|--|
| 1 Enter Manual PZ Setting | This allows you to enter the PZ value to any number between 1 and 4095.  |
| 2 Perform Auto-PZ         | This performs the auto pole zero. The unit must be collecting data with a dead time less than 10% for best results. The PZ process does not start until you reply that the unit is ready to start by pressing 1 on the next dialog. You can press <b>MENU/ENTER</b> to return to the previous menu at this time. During the PZ process, the current PZ value is displayed. To abort the PZ process, press the <b>MENU/ENTER</b> key. |

#### 6 Baseline Restore

This opens a dialog listing three Baseline Restore settings. Select the desired setting by pressing 1, 2, or 3. After you select a setting, the display returns to the Amplifier Settings menu.

- |        |   |
|--------|---|
| 1 Auto | This sets the baseline restorer time constant to the automatic mode. This is the normal setting.    |
| 2 Fast | This sets the baseline restorer to operate in the fast restore mode for high-count-rate situations. |
| 3 Slow | This sets the baseline restorer to operate in the slow restore mode for low-count-rate situations.  |

#### 7 Optimize

This performs the optimize and pole-zero process. For best results, the digiDART must be collecting data with a dead time less than 10%. Optimization does not start until you press **1 on the next dialog** to indicate that the unit is ready to start. If you wish to return to the previous menu at this time, press **MENU/ ENTER**. During optimization, a row of dots is displayed to show progress. To abort the Optimize process, press **MENU/ENTER**.

## 8 Preamp Type

The preamplifier type must be set for the type of detector connected. This is true for both SMART-1 and DIMs. Press **MENU/ENTER** to leave the setting unchanged.

- |             |                                 |
|-------------|---------------------------------|
| 1 Resistive | Resistive-feedback preamplifier |
| 2 TRP       | Transistor-reset preamplifier   |

## 9 Input Polarity

This sets the polarity for the input signal from the detector. GEM detectors have positive output and GMX, LEPS, and LOAX detectors have negative output. This is true for both SMART-1 and for DIMs. Press **MENU/ ENTER** to leave the setting unchanged.

- 1 Positive
- 2 Negative

## 0 View Current Settings

This displays all the amplifier settings currently being used (Fig. 15).

Coarse Gain	2
Fine Gain	0.500
Rise Time	12.000
Flat Top	0.8000
Pole Zero	2220
Baseline Restore	SLOW
Preamp Type	RES
Input Polarity	POS

Figure 15. View Current Amplifier Settings.

### 2.2.6.3. Preset Settings

This dialog is shown in Fig. 16. The **Device Busy** message means the unit is collecting data and this parameter cannot be changed until the unit is stopped. To continue changing the presets, return to spectrum mode and press **STOP**.

#### 1 Live Time Preset

This dialog is used to enter the live time preset in seconds. This stops acquisition when the live time reaches this value. To clear the preset, enter 0 (zero) and press the **MENU/ENTER** key.

#### 2 Real Time Preset

This dialog is used to enter the real time preset in seconds. This stops acquisition when the real time reaches this value. To clear the preset, enter 0 (zero) and press the **MENU/ENTER** key.

1 - Live Time Preset
2 - Real Time Preset
3 - ROI Integral Preset
4 - ROI Peak Preset
5 - Uncertainty Preset
6 - MDA Presets
7 - View Current Settings

Figure 16. Presets.



### 3 ROI Integral Preset

This dialog is used to enter the ROI integral preset. This stops the acquisition when the sum of all counts in all ROIs in the spectrum reaches this value. To clear the preset, enter 0 (zero) and press the **MENU/ENTER** key.

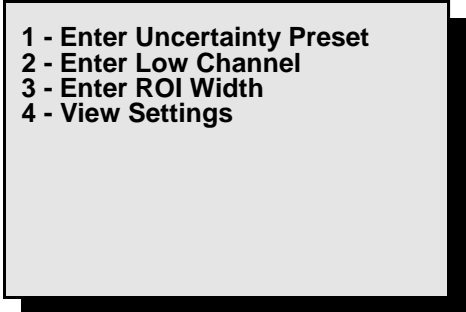
### 4 ROI Peak Preset

This dialog is used to enter the ROI peak preset. This stops the acquisition when any channel in any ROI reaches this value. To clear the preset, enter 0 (zero) and press the **MENU/ENTER** key.

### 5 Uncertainty Preset

This shows the dialog in Fig. 17 to enter the uncertainty preset and region to be used. This stops the acquisition when the uncertainty of the selected peak reaches this value. Enter the low channel and length first.

- |                            |  |
|----------------------------|--|
| 1 Enter Uncertainty Preset | This is the percent uncertainty for the peak that will stop the acquisition. The calculation is described in Section 6.1. To clear the preset, enter 0 (zero) and press the <b>MENU/ENTER</b> key.   |
| 2 Enter Low Channel        | This is the beginning of the peak region. The region should start in the background region below the peak. The three left-most channels should be background. The region should not be wider than necessary, as the unnecessary width increases the uncertainty value.                     |
| 3 Enter ROI Width          | This is the number of channels for the peak region. The region should be wide enough to end in the background above the peak. The three right most channels should be background. The region should not be wider than necessary, as the unnecessary width increases the uncertainty value. |
| 4 View Settings            | This shows the three values entered above as well as the current uncertainty in the peak region.   |



1 - Enter Uncertainty Preset  
2 - Enter Low Channel  
3 - Enter ROI Width  
4 - View Settings

Figure 17. Uncertainty Preset.

## 6 MDA Presets

This function lets you establish MDA presets for up to 20 nuclides. Data acquisition stops when the MDAs of all of the selected peaks reach their set value. The dialog (Fig. 18) shows the enable/disable status of the MDA presets. Use the down arrow to see the MDA preset for nuclides 11 to 20. Use the up arrow to return to the first 10. The presets must be set in numerical order beginning with MDA 0 (e.g., MDA 1 must be next).

To enter the values for a specific MDA, press its number to display the submenu shown in Fig. 19. The details of the calculations and the definitions of the coefficients are explained in Section 6.2.

- |   |                           |  |
|---|---------------------------|--|
| 1 | Enter MDA Preset (User)   | Enter the value for the preset as displayed by GammaVision. This value is the preset in activity units (Bq or $\mu\text{Ci}$ ). It is the MDA Preset (Actual) divided by the branching ratio and efficiency as described in Section 6.2. The branching ratio-efficiency product is entered below. GammaVision also stores this product in the digiDART memory. The MDA Preset (Actual) value is also changed when this is entered. To retain current value, press <b>MENU/ENTER</b> .            |
| 2 | Enter MDA Preset (Actual) | Enter the MDA preset in this dialog. The value entered here is the desired MDA value (MDA Preset [User]) multiplied by the branching ratio and efficiency as described in Section 6.2. The branching ratio is found in the gamma library, and the efficiency can be calculated in GammaVision or similar programs. Use (5) Clear MDA to turn off this MDA preset off. The MDA Preset (User) is also changed when this value is entered. To retain the current setting, press <b>MENU/ENTER</b> . |

1 - MDA 0	(ACTIVE)
2 - MDA 1	(ACTIVE)
3 - MDA 2	(ACTIVE)
4 - MDA 3	(ACTIVE)
5 - MDA 4	(DISABLED)
6 - MDA 5	(DISABLED)
7 - MDA 6	(DISABLED)
8 - MDA 7	(DISABLED)
9 - MDA 8	(DISABLED)
0 - MDA 9	(DISABLED)

Figure 18. MDA Presets.

1 - Enter MDA Preset (User)
2 - Enter MDA Preset (Actual)
3 - Enter MDA Coefficient
4 - Enter Low Channel
5 - Enter ROI Length
6 - Enter Efficiency Yield
7 - Enter Nuclide Name
8 - Clear MDA
9 - View Settings

Figure 19. Set Up an MDA Preset.

- 3 Enter MDA Coefficient These are the MDA coefficients used in the MDA calculation (see Section 6.2). These coefficients depend on the MDA formula used. You can enter any coefficients here, but to have the values correspond to the MDA value calculated in the software such as GammaVision, use the values shown in the GammaVision dialog for MDA preset.
- The three coefficients are entered as decimal numbers. These coefficients are used for all 20 MDA calculations. Changing them for one MDA changes them for all MDAs. It is only necessary to enter them once.
- 4 Enter Low Channel This is the beginning of the peak region. The region should start in the background region below the peak. The three left-most channels should be background. The region should not be wider than necessary, as the unnecessary width increases the background and the MDA value.
- 5 Enter ROI Length This is the number of channels for the peak region. The region should be wide enough to end in the background above the peak. The three right-most channels should be background. The region should not be wider than necessary, as the unnecessary width increases the background and the MDA value.
- 6 Enter Efficiency Yield Enter the product of the detector efficiency and the gamma-ray yield or branching ratio. This value is entered by GammaVision when you use it to setup the Preset. To retain the current value, press **MENU/ENTER**.  $\text{MDA Preset (Actual)} = \text{Efficiency Yield product} \times \text{MDA Preset (User)}$ .
- 7 Enter Nuclide Name Enter the nuclide name to be displayed in the MDA table and in the software display. This is loaded by the software when the preset is set to retain the current name, press **MENU/ENTER**.
- 8 Clear MDA This disables the current MDA and sets all of the settings to 0, except the coefficients.

## 9 View Settings

This shows the 6 values entered above as well as the current MDA calculation for the peak region.

## 7 View Current Settings

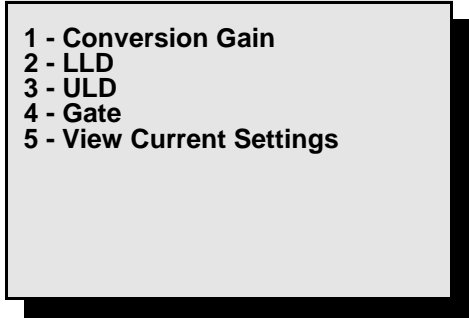
This displays the live time, real time, ROI integral, and ROI peak presets currently being used. The uncertainty and MDA presets have separate displays.

### 2.2.6.4. ADC Settings

The dialog is shown in Fig. 20.

#### 1 Conversion Gain

This is the ADC conversion gain. It is the number of channels in the spectrum. Select from 512, 1024, 2048, 4096, 8192, 16384, and (optional) 32768. Press **MENU/ENTER** to keep the current setting.



1 - Conversion Gain  
2 - LLD  
3 - ULD  
4 - Gate  
5 - View Current Settings

Figure 20. ADC Settings.

#### 2 LLD

This is the lower-level discriminator. It should be set to reject any low-level noise but not any useful peaks.

#### 3 ULD

This is the upper-level discriminator. It is normally set to the conversion gain value. It is automatically set to the last channel when the conversion gain is changed.

#### 4 Gate

##### 1 Off

This is the normal mode of the gate input.

##### 2 Coincidence

This sets the gate mode to coincidence mode. In this mode, only those counts that are in coincidence with the gate are counted in the spectrum. To inspect the relative timing for the two pulses, connect to a PC and use the InSight™ Virtual Oscilloscope mode in MAESTRO.

##### 3 Anticoincidence

This sets the gate mode to anticoincidence mode. In this mode, only those counts that are not in coincidence with the gate are counted in the spectrum. Use the InSight mode in MAESTRO to inspect the relative timing for the two pulses.

## 5 View Current Settings

This displays the ADC settings currently being used.

### 2.2.6.5. Stabilizer Settings

The dialog is shown in Fig. 21. Gain and zero stabilization are discussed in detail in Sections 6.3 and 6.4, respectively.

#### 1 Enable Gain Stabilization

This will enable the gain stabilizer to operate. The stabilizer must be set up before it can be enabled. An error message is displayed if the stabilization cannot be enabled. A confirmation message is shown if the stabilizer is enabled. Press **MENU/ENTER** to continue.

#### 2 Gain Stab Center Channel

This is the center channel of the region used for the stabilization. The peak will be centered in this region by the stabilizer operation. The peak should be in the upper half of the spectrum and isolated from other peaks.

#### 3 Gain Stab Width

This is the width (in channels) of the peak region to be used. It should be slightly wider than the peak, but not overly wide.

#### 4 Initialize Gain Stabilization

Resets the gain peak stabilization adjustment to unity (no adjustment).

#### 5 Enable Zero Stabilization

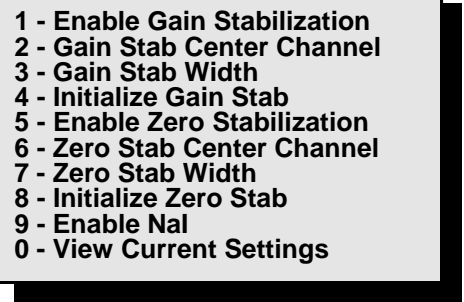
This enables the zero stabilizer to operate. The stabilizer must be set up before it can be enabled. A confirmation message is shown when the stabilizer is enabled; an error message is displayed if stabilization cannot be enabled. Press **MENU/ENTER** to continue.

#### 6 Zero Stab Center Channel

This is the center channel of the region used for the stabilization. The peak in this region will be centered by the stabilizer operation. The peak should be in the lower quarter of the spectrum.

#### 7 Zero Stab Width

This is the width (in channels) of the peak region to be used. It should be slightly wider than the peak, but not overly wide.



1 - Enable Gain Stabilization  
 2 - Gain Stab Center Channel  
 3 - Gain Stab Width  
 4 - Initialize Gain Stab  
 5 - Enable Zero Stabilization  
 6 - Zero Stab Center Channel  
 7 - Zero Stab Width  
 8 - Initialize Zero Stab  
 9 - Enable Nal  
 0 - View Current Settings

Figure 21. Stabilizer Settings.

## 8 Initialize Zero Stab

Resets the zero peak stabilization adjustment to unity (no adjustment).

## 9 Enable NaI

This is an enable/disable toggle. Enable switches the bias supply to the NaI (high-current, low-voltage) mode. Disable switches to the Ge (low-current, high-voltage) mode. The HV is turned off when this command is sent.

## 0 View Current Settings

This displays the stabilizer settings currently being used.

### 2.2.7. (7) General Settings

These commands (Fig. 22) control instrument access, calibration, and the LCD display.

#### 1 Change User Password

Use this to set a numeric password to prevent unauthorized use of the instrument. The password is limited to 9 digits. When the user password has been set, the digiDART prompts for it on power-up. To clear the password, enter 0 (zero) for the password, then press **MENU/ENTER**.

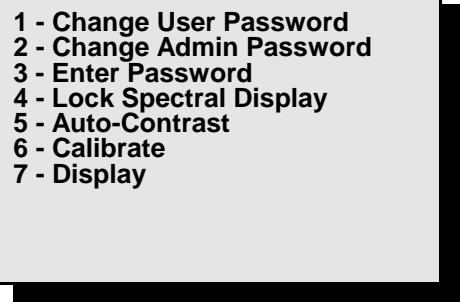
#### 2 Change Admin Password

Use this to set a numeric administrator password that prevents other users from changing the current digiDART settings. The password is limited to 9 digits. When the administrator password has been set, users (as distinguished from administrators) can view the current settings and the spectrum, unless the display is locked. They can also **START** and **STOP** data acquisition. However, if users try to change settings, an "Access denied" message will be displayed. Use **(3) Enter Password** to enter the administrator password and gain full access.

If the administrator password is not set, all users have full access to all functions. To clear the password, enter 0 (zero) for the password, then **MENU/ENTER**.

If the user and administrator passwords are identical, the digiDART will grant administrator (full) access when the user password is entered. See Section 4.1.15.

**NOTE** *There is no master administrator password.* If you lose this password, contact your ORTEC service representative or our Global Service Center.



1 - Change User Password  
2 - Change Admin Password  
3 - Enter Password  
4 - Lock Spectral Display  
5 - Auto-Contrast  
6 - Calibrate  
7 - Display

Figure 22. General Settings.

### 3 Enter Password

Allows you to enter the administrator password so you can switch to administrator mode and then change the digiDART settings. See Section 4.1.15.

To exit administrator mode, turn the power off and on, then enter user password if needed.

### 4 Lock Spectral Display

This locks (turns off) or unlocks (displays) the spectrum display and **Peak Info** command. The unit must be in administrator mode to lock or unlock the display. Select (4) to switch from lock to unlock or unlock to lock. The display is not turned off until you leave administrator mode by turning the digiDART off then back on.

**NOTE** When the display is locked *the unit will not respond to PC-based software commands.*

### 5 Auto-Contrast

Automatically adjusts display contrast as ambient temperature changes. Note that you can also adjust the contrast in menu mode by the up/down arrow buttons.

- 1 Enable Auto-Contrast
- 2 Disable Auto-Contrast

### 6 Calibrate

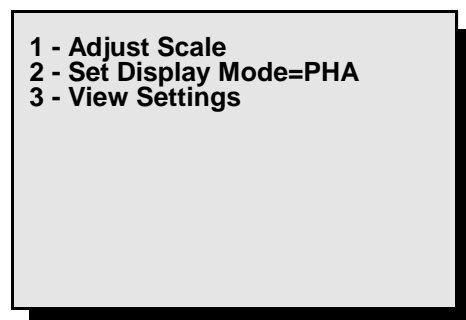
Allows you to enter slope and intercept (linear) calibration coefficients from the keypad. This replaces the previous calibration, including calibrations from the host PC. See Section 4.1.10 for more details. This calibration will be read by software when the digiDART is connected to the PC.

- |                            |  |
|----------------------------|--|
| 1 Enter Slope              | This can be any positive decimal number.             |
| 2 Enter Intercept          | This can be any positive or negative decimal number. |
| 3 View Current Calibration |  |

### 7 Display

Figure 23 shows the Display menu.

- |                |  |
|----------------|--|
| 1 Adjust Scale | Selects between linear and log and autoscale on or autoscale off. Autoscale Off applies only to linear displays. |
|----------------|--|



**Figure 23. Adjust Display Settings.**

1 *Auto* — Switches the linear vertical scale to autoscale mode, which continuously adjusts the vertical scale so the tallest peak on the display is shown at about 75% of the maximum height of the screen. Autoscaling continues until you select (3). You can also autoscale by pressing <8+Up-arrow>.

2 *Log* — Switches to logarithmic vertical scale. The log display is always in autoscale mode. You can also do this by pressing <8+1>.

3 *Normal* — Switches to linear scale, autoscale off.

2 Set Display Mode=PHA

The operation is set to PHA. This is only needed when you disconnected from the host PC with the digiDART in InSight mode (see Section 4.3.1).

3 View Settings

This shows the current display settings (Fig. 24).

Scale Factor	Log
Peak Displayed	120
Start Channel	0
End Channel	272
Display Mode	PHA
Auto-Contrast	ON

Figure 24. View the Current Display Settings.

## 2.2.8. (8) Spectrum Memory

Figure 25 shows the Spectrum Memory menu. These commands let you view and monitor the contents of the digiDART stored spectrum memory.

### 1 Retrieve Stored Spectrum

Copies the selected spectrum from stored spectrum memory to the live spectrum memory. To select the spectrum, enter the stored-spectrum sequence number or the spectrum ID. To see the list of stored spectrum sequence numbers and IDs, press (3) Spectrum Directory. The display for selecting a spectrum number or ID is shown.

1 - Retrieve Stored Spectrum
2 - Erase All Stored Spectra
3 - Spectrum Directory

Figure 25. Stored Spectrum Memory.



Figure 26 shows the spectrum number entry display. If you enter a spectrum number greater than the number of stored spectra, a message is displayed. When a spectrum is retrieved the current live spectral data are lost.

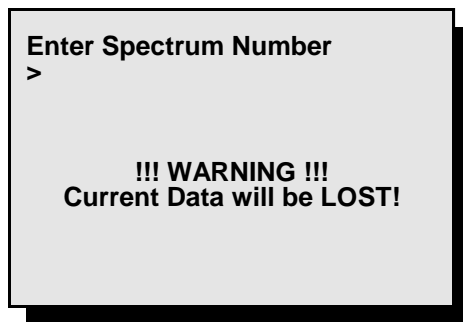


Figure 26. Retrieve Stored Spectra.

## 2 Erase All Stored Spectra

Deletes all stored spectra from stored spectrum memory. You must confirm the deletion of the spectra. The display is shown in Fig. 27.

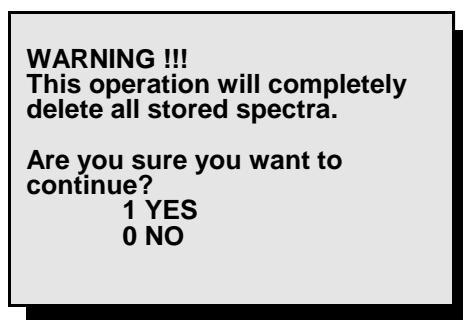


Figure 27. Erase All Stored Spectra (be careful!).

## 3 Spectrum Directory

Allows you to see the list of spectra in the stored spectrum memory (Fig. 28). The format is:

**sequence# spectrum id month/day hour:minute:second**

The bottom of the screen displays a message saying **x# of y# bytes used** so you can keep track of the storage remaining. Use the up and down arrows to go through the spectra, one page at a time. Also, you can advance to a particular spectrum by entering its sequence number or spectrum ID so you don't have to go through the list.

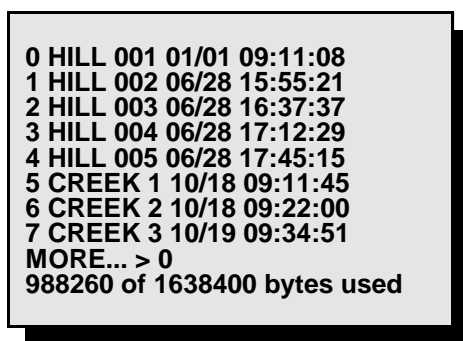
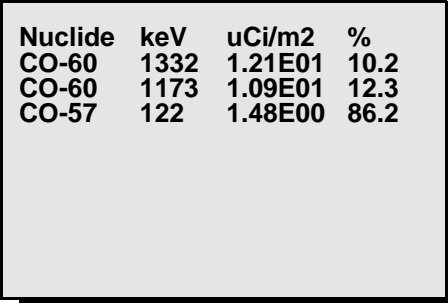


Figure 28. Monitor Stored Spectra.

## 2.2.9. (9) Nuclide Report

The Nuclide Report (Fig. 29) is a very useful tool for monitoring nuclide count rates and activities in the field. The report readouts update in real time, for as long as the report screen is displayed, so you can have a “live” reading of the selected nuclides. You can select up to 9 gamma-ray energies located anywhere in the spectrum. The display shows the nuclide name, the energy, and the calculated value. The calculated value is the net area times a factor divided by the live time. The factor is user entered. If you enter a **1**, the value calculated is the net peak count rate. By including the efficiency and branching ratio in the factor, the value calculated is the activity.



Nuclide	keV	uCi/m2	%
CO-60	1332	1.21E01	10.2
CO-60	1173	1.09E01	12.3
CO-57	122	1.48E00	86.2

**Figure 29. Real-Time Nuclide Report Display.**

See Section 2.2.3 for detailed instructions on setting up the ROIs to be monitored by this report.

# 3. INSTALLATION AND STARTUP

## 3.1. Software and Hardware Installation

Installing the digiDART and the MAESTRO-32 MCA Emulation Software takes just three easy steps. (Do not connect the digiDART to your PC until MAESTRO has been installed.)

### 3.1.1. Install MAESTRO-32 and the CONNECTIONS-32 Driver Update Kit

- Install the accompanying version of MAESTRO-32 (must be v6.04 or higher) according to the instructions in the *MAESTRO Software User's Manual*, selecting the **USB-based instruments** hardware option.
- If your MAESTRO CD is accompanied by a CONNECTIONS-32 Driver Update Kit (P/N 797230), follow the installation instructions for the update kit, which supersede the MAESTRO instructions.

### 3.1.2. Connect the digiDART to the USB Port on the PC

- With the PC powered on, connect the digiDART to the PC's USB port.
- Windows will indicate that the digiDART has been detected and will start up the new hardware installation wizard. Click on **Next**, indicate that you *do not* wish to connect to the internet or the Microsoft website to locate the driver, choose the "automatically locate driver" option, and follow the remaining prompts to completion. You will now be ready to run the MCB Configuration program so that MAESTRO and other CONNECTIONS-32 software can recognize the digiDART.

### 3.1.3. Run the MCB Configuration Program to Build a List of Available Detectors

- From the Windows Start menu, select **MAESTRO 32** and **MCB Configuration**. The MCB Configuration program will locate all of the (powered on) ORTEC CONNECTIONS-32 MCBs attached to the local PC and to any network PCs, display a master list of the instruments found, and allow you to enter customized instrument numbers and descriptions. For complete instructions on building and customizing this Master Instrument List, see the *MAESTRO-32 Software User's Manual*.

### 3.1.4. Attaching More Than One digiDART to the PC

Once the drivers have been installed for one digiDART, simply attach subsequent units to any available USB port on the PC or attached USB hub, and re-run the MCB Configuration program.

**REMINDER** Be sure to run MCB Configuration any time you add new digiDART (or any other ORTEC MCBs) to establish communication between the MCBs and the spectroscopy software.

### 3.1.5. Connecting to and Disconnecting from the PC

The USB connection allows you to connect digiDARTs to and disconnect them from a USB port without shutting down MAESTRO, the PC, or the USB hub. Note that if MAESTRO is running when you disconnect the digiDART, the software will display a “detector not responding” message on the status line at the bottom of the MAESTRO window. When you reconnect the digiDART to the PC, simply reselect it from the detector droplist on the MAESTRO Toolbar.

**NOTE** When the digiDART is connected to the PC, the keypad will be disabled and the display will read **LCD Display Disabled: Host USB Connected**. In this configuration, the digiDART will function as a standard ORTEC CONNECTIONS-32 MCB.

## 3.2. Cabling

Figure 30 shows the digiDART connectors at the top of the instrument.

Connect the power supply cable to the **12–15V DC** connector. When the digiDART is supplied with external 12-V power, the installed battery is charging. The external battery charger is only needed when you wish to charge batteries outside the digiDART.

Attach the SMART-1 HPGe detector or DIM cable to the **DETECTOR** connector.

Finally, connect the **USB** port to the PC. You can connect and disconnect the digiDART from the PC without restarting Windows or MAESTRO.

**NOTE** When the digiDART is connected to the PC, the keypad is disabled and the display reads only **USB connected**. The digiDART functions in this configuration just like other ORTEC CONNECTIONS-32 MCBs.

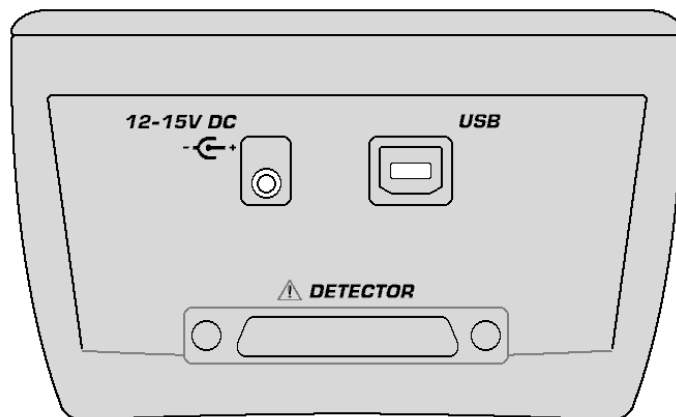


Figure 30. digiDART Connectors.

### 3.3. Turning the Power On and Off

To power up the digiDART, press **ON/OFF**. It takes 3–5 seconds for the spectrum display to appear. If not connected to a PC, when you turn the unit on but do not press any other key, the digiDART will wait 10 minutes and shut itself off. This avoids battery drain from accidental start up.

To turn off the instrument, press **ON/OFF** again. The digiDART is set up to avoid accidental power-down so you don't stop a spectrum in mid-acquisition. The display will ask you to confirm shutdown. Press **1** to power down or **0** to ignore the shutdown command.

### 3.4. Changing the Battery

Swapping batteries is easy. Open the battery hatch at the base of the instrument, position the palm of your hand under the opening, and tap the digiDART's base gently against your palm. The battery will dislodge and slide into your hand. Press another battery into place and close the hatch.



# 4. USING THE DIGIDART IN FIELD MODE

This chapter tells how to configure and operate the digiDART by keypad in field/portable mode. You can also connect it to a PC and use software such as MAESTRO to set it up and operate it as a benchtop MCA (see Chapter 5 and the *MAESTRO Software User's Manual*). You can only store spectra in the digiDART memory with the STORE button on the keypad. Spectra acquired with the digiDART attached to a PC must be stored on the PC or its removable drives. The InSight Virtual Oscilloscope mode for viewing the pulses can only be accessed via MAESTRO or similar programs, with the digiDART connected to the PC.

## 4.1. Normal Operation

This section walks you through the normal steps needed for first-time use of the digiDART in the field and saving the spectra on the laboratory PC. Once set up, the digiDART saves all the settings and restores them on the next startup.

On any entry, if you just press **MENU/ENTER** without pressing any other keys, the current value will be used, that is, no change will be made. Therefore, if you open a dialog by mistake you can just press **MENU/ENTER** to go back without changing anything.

For complete details on the menus and dialogs, refer to Section 2.2. In addition, a quick reference menu tree is included on the last page of the manual (after the index).

**CAUTION** The digiDART is splashproof but not watertight. To avoid equipment failure, protect the unit from prolonged or heavy rainfall and from immersion.

### 4.1.1. Battery

The battery will last up to 12 hours in full operation with the detector. The battery is charged internally when external power is supplied. Before starting a series of measurements, you should check the battery. To check the battery, turn on the digiDART power, press **MENU/ENTER**, then **(1) View Status**. If the percent power is below 15% (1 hour remaining), you should install a new battery. To remove the battery, turn off the power, open the door at the base of the instrument, position the palm of your hand under the opening, and tap the digiDART's base gently against your palm. The battery will dislodge and slide into your hand. Note the battery contacts and install the new battery in the same orientation.

If you need to change the battery in the field, you should stop the acquisition and turn off the HV to the detector, then turn off the power. The acquisition will stop and the HV will turn off as soon as the battery is removed. However, to maintain the highest spectrum quality you should stop the acquisition and turn off the detector HV manually. Change the battery, then power up the digiDART and the detector HV. Wait approximately 2 minutes for the detector to stabilize,

then restart acquisition. To change the battery when external power is connected, it is not necessary to turn off the digiDART.

#### 4.1.2. Detector

Connect the digiDART to your cooled detector and power on the digiDART. Now set the HV shutdown mode to protect the detector. Set the shutdown mode by pressing **MENU/ENTER**, **(6) Adjust Controls**, **(1) HV Settings**, **(3) Set Shutdown**. For a SMART-1 HPGe Detector, press **(3) SMART**; for other types of detectors, select **(1) TTL** or **(2) ORTEC**. If the detector does not have a shutdown signal, use **(1) TTL**.

Now set the HV to the value for the detector by pressing **(2) Set Bias Voltage** and entering the correct value. The polarity is set in the SMART-1 or DIM. Now turn on the HV by pressing **(1) Enable HV**. Finally, check all of these operations by pressing **(4)** to view the HV settings. If no detector is connected, the readings have no meaning.

#### 4.1.3. Stored Spectrum Memory

Next check the amount of memory available for stored spectra. Press **MENU/ENTER**, then **(8) Spectrum Memory**, **(3) Spectrum Directory** to display the contents and remaining capacity of the stored-spectrum memory. The display format is:

**sequence#, Identifier, start month and day, start time**

The bottom of the screen displays a message saying **x# of y# bytes used**. If you expect to need more than the remaining storage space, you must clear out the existing spectra. If you want to save these spectra, you must download them to PC. After download, clear the digiDART memory by pressing **MENU/ENTER**, **(8) Spectrum Memory**, then **(2) Erase All**.

If no more stored-spectrum memory is available, you can, if you wish, collect a final spectrum and leave it stored in RAM. Once you've docked to the host PC, download that final spectrum first, then download the spectra from stored spectrum memory.

#### 4.1.4. Spectrum Status Parameters

The digiDART displays two data-acquisition parameters in real time at the top of the spectrum (see the top of Fig. 31, page 36). To set up this status line, press **MENU/ENTER** and press **(4) Status Line** to display the numbered list of parameters.

- 1 Cursor location (energy)
- 2 Cursor location (channel)



- 3 Live time
- 4 Real time
- 5 Live time remaining
- 6 Real time remaining
- 7 Battery time remaining
- 8 Count rate
- 9 Count rate in ROI
- 0 Counts

If any parameters are currently selected, they will be indicated by a 1\* or 2\* before the parameter number. If you like these settings, press **MENU/ENTER**. To remove a setting (with 1\* or 2\*), press the parameter number. To add a setting, press the parameter number. If no parameters are set, the first one selected becomes 1\*. If one parameter is selected, the next one selected becomes the other number. The 1\* parameter is shown on the left of the display and the 2\* is shown on the right. As an example for use in later steps, select **(2)** for 1\* and **(3)** for 2\*. Press **MENU/ENTER** to return to the Main Menu.

#### 4.1.5. ADC

For HPGe detectors the spectrum size is normally 8K or more channels, and for NaI the spectrum size is normally 512, 1024 or 2048 channels. To set the number of channels (or conversion gain), press **MENU/ENTER**, **(6)**, **(4)**, then **(1)**. Now press **(6)** for a conversion gain of 16384 channels. Press **(2)** and set the LLD to 50 (this is in channels). Press **(3)** and set the ULD to 16380. To turn off the gate, press **(4)** and **(1)**. Press **(5)** to view the settings you just made to verify they are correct. Press **MENU/ENTER** 4 times to return to the spectrum display.

#### 4.1.6. Amplifier

Now you need to set the amplifier to the proper settings. First, set the polarity for the input to match the output of the detector. GEM detectors have positive output and GMX, LEPS, and LOAX detectors have negative output. Press **MENU/ENTER**, **(6)**, then **(2)** to show the menu of amplifier settings. Press **(1)** and then **(2)**. Press **MENU/ENTER** 3 times to return to the spectrum display. Press **<8+9>** to show the complete spectrum. Put a known source (such as  $^{137}\text{Cs}$  or  $^{60}\text{Co}$ ) in front of the detector, and press **STOP**, **CLEAR**, then **START** to begin collecting a spectrum. You should see a spectrum in the display and see the live time on the upper right.

If the peaks are not where you want them in the spectrum, press **MENU/ENTER**, **(6)**, **(2)**, and then **(1)** or **(2)** depending on how far from ideal the peaks are. Then adjust the gain to a lower or higher value. Press **MENU/ENTER** 3 times to return to the spectrum display, then press **STOP**,

**CLEAR**, and **START** to collect another spectrum. Adjust again if needed or continue with the next step.

#### 4.1.7. Rise Time and Flattop

The rise time should be set for the count rate and resolution you expect. Of course, you can't improve the resolution beyond the capabilities of the detector, but you can adjust the digiDART setting for the best resolution at any count rate. For most field work, the rise time is set to 12 and the flattop is set to 1. This corresponds to the analog shaping time constant of 6 microseconds, which is the setting used for detector test and specification. If the count rate is expected to be high, then shorter rise times and flattops can be selected, which will increase the FWHM.

To set the rise time, press **MENU/ENTER**, **(6)**, **(2)**, **(3)**, then enter the rise time. The rise time is a decimal number. If you don't enter one of the exact values (say you enter 11.3), the digiDART selects the closest value (e.g., 11.4). Now set the flattop by pressing **(4)**, then the flattop. The flattop is a decimal number. If you don't enter one of the exact values (suppose you enter 1.1), the closest value is selected (e.g., 1.2). You can view the settings now by selecting **(0)**. Press **MENU/ENTER** 3 times to return to the spectrum display.

#### 4.1.8. Optimize

The next step is to optimize the detector (see Section for a detailed discussion of this operation). Optimization adjusts the pole zero and the flattop tilt for the best resolution for the detector. Use a source positioned so the detector count rate is approximately 5000 cps. To monitor the count rate, display it as one of the status line options as discussed in Section 4.1.4. When the count rate is satisfactory, press **MENU/ENTER**, **(6)**, **(2)**, **(7)**, then **(1)** to start the optimization. The display will show that the optimization is underway. The progress is shown by a series of dots. If you need to stop the process because of no counts or too high a count rate, press any key to abort. If you abort, you must fix the problem and redo the optimization before collecting any spectra. Press **MENU/ENTER** to return to the Amplifier dialog. It is not necessary to do the pole zero step, as this is done automatically during optimize. Press **MENU/ENTER** 3 times to return to the spectrum display.

#### 4.1.9. Detector State of Health

Press **STOP**. Now you can view the SMART-1 HPGc Detector state of health to check what has happened during the last acquisition. To check the detector SOH, press **MENU/ENTER**, **(6)**, **(1)**, **(5)** **View HV SOH**. This will display the status of the nine SOH bits as shown in Table 2. The Values are cleared on each **START** and set on each **STOP**. Press **MENU/ENTER** 4 times to return to the spectrum display.

**Table 2. State-of-Health Bit Definitions.**

Bit	Description	Comment
0	+24V	The first four bits monitor the voltages coming from the digiDART. If one of these values varies by $\pm 2$ V, the corresponding bit is set.
1	+12V	
2	-12 V	
3	-24V	
4	Temperature	Set if the detector temperature increases and shuts down the HV (therefore, the SHUT bit will also be set).
5	HV voltage	Set if the high voltage deviates $\pm 300$ V from the value you entered in <b>(6) Adjust Controls/(2) Set Bias Voltage</b> .
6	Overload	Set if the preamplifier overloads for more than about 4.0 seconds.
7	Shutdown	Set if the preamplifier shuts down for any reason.
8	Security	At the start of the acquisition, the digiDART queries the Smart-1 HPGe Detector for its serial number. The digiDART then writes a random number to the Smart-1 HPGe Detector. At the end of the acquisition, both numbers are read from the Smart-1 HPGe Detector and compared to the original values. If there is a mismatch, the Security SOH bit is set.
9	Power	Set if the power fails during an acquisition.

#### 4.1.10. Calibration

Now set up a two-point (linear fit) calibration. First, collect a spectrum or use the one collected above. Locate the peaks in the spectrum for the source. Use the left or right arrow to scroll the cursor to the first peak. Record the cursor channel as shown in the upper left corner of the display. Now put the marker on the second peak. Now find the slope by dividing the difference between the two energies by the difference between the two channel values. This is the slope. To enter the slope, press **MENU/ENTER**, select **(7) General Settings, (6) Calibrate, (1)**, now enter the slope. To calculate the intercept, multiply the slope by the low channel number. Subtract this value from the low energy. This is the intercept. Press **(2)** and enter the intercept. This linear calibration is used in the Peak calculation for the Nuclide Report (see Section 6.1.1).

For example, for a  $^{60}\text{Co}$  spectrum, the 1173 peak is in channel 7241 and the 1332 peak is in 8226. This gives  $(1173 - 1332)/(7241 - 8226)$  or 0.1614 for the slope and  $1173 - (0.1614 * 7241)$  or 4.148 for the zero intercept. The zero intercept is the energy of channel 0 in the spectrum.

Select **(3)** to show the current slope and intercept. Press **MENU/ENTER** 4 times to show the spectrum.

**NOTE** The most recently entered calibration (from either software or the digiDART) will be written into the stored spectrum memory when the spectrum is stored. The calibration will remain with the spectrum when it is downloaded to the PC and stored as an **.SPC** file.

#### 4.1.11. Display Energy

Now select **MENU/ENTER**, then **(4)** to show the current status line selections. Press **(2)** to remove the marker channel and press **(1)** to display the marker energy. Press **MENU/ENTER** 2 times to return to the spectrum display.

#### 4.1.12. Setting ROIs in the Spectrum Display

The digiDART lets you mark any number of ROIs on the spectrum display. They are shown as horizontal lines immediately beneath the spectrum (Fig. 31). Any ROIs saved with the spectrum are displayed when the spectrum is viewed in MAESTRO, ScintiVision, etc. *Note that these are not the same as the ROIs for the Nuclide Report discussed in Section 4.1.15.*

To set an ROI in the spectrum mode, put the marker on the starting channel and press **<8+3>**, then move the marker to the end channel and press **<8+6>**.

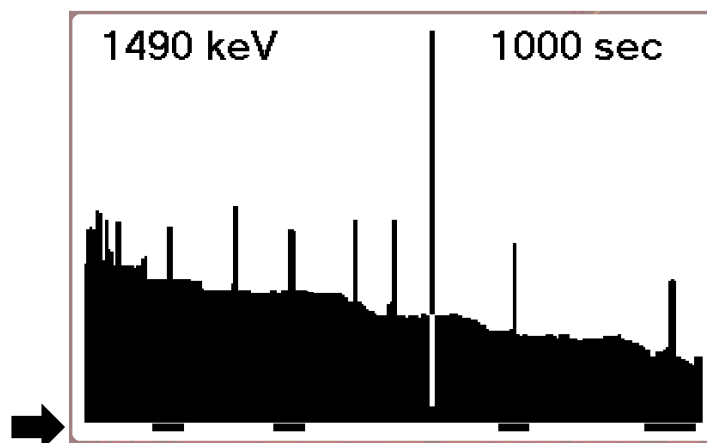


Figure 31. ROI Indicator Lines.

The ROI is shown by a bar below the spectrum. The bar will always be shown, even if it is a small region in a condensed display.

To delete an ROI, put the marker in the ROI and press **<8+4>**.

#### 4.1.13. Presets

To set a preset to stop the collection at a specific point, press **MENU/ENTER**, **(6)**, **(3)**, then the number of the preset type you want. For example, to set the Live time preset, press **(1)** now and enter the preset value in seconds. The value is a decimal number with resolution of 20 milliseconds. The entered value is truncated to the nearest valid value.

To turn off a preset, enter a 0 (not a blank), then **MENU/ENTER**. Entering a blank or nothing then pressing **MENU/ENTER** will keep the existing preset.

Press **(7)** to view the live, real, count and integral preset settings. The uncertainty and MDA settings are viewed on their own separate displays. Press **MENU/ENTER** 4 times to return to the spectrum display.

The MDA preset is used to stop the counting when all of the nuclide MDAs are met. The MDA setup process is discussed on page 18. The MDA preset requires the detector efficiency and nuclide branching ratio, both of these can easily be found or calculated with software such as GammaVision.

#### 4.1.14. Stabilizers

The digiDART is very stable, so unless you see peak drift the stabilizers can be turned off or disabled. To disable the stabilizers, press **MENU/ENTER**, **(6)**, **(5)**, then **(7)** to show the current state. If both show as **DISABLED**, press **MENU/ENTER** 4 times to return to the spectrum display. If either or both are enabled, press **MENU/ENTER**, then **(1)** for gain to disable it, or **(4)** to disable zero. Then press **MENU/ENTER** 3 times to return to the spectrum display.

#### 4.1.15. Nuclide Report

The Nuclide Report is a very useful tool for monitoring nuclide count rates and activities in the field. The report readouts update in real time, for as long as the report screen is displayed, so you can have a “live” reading of the selected nuclides. You can select up to 9 gamma-ray energies located anywhere in the spectrum. The display shows the nuclide name, the energy, and the calculated value. The calculated value is the net area times a factor divided by the live time. The factor is user entered. If you enter a **1**, the value calculated is the net peak count rate. By including the efficiency and branching ratio in the factor, the value calculated is the activity.

To set up the ROIs to be monitored on the Nuclide Report screen, see Section 2.2.3.

To view the Nuclide Report from the spectrum screen, press **MENU/ENTER**, **(9)**.

#### 4.1.16. Administrator and User Passwords

The digiDART offers two levels of password security: user and administrator. The user password prevents any unauthorized startup of the instrument. The administrator password prevents non-administrators from changing the current digiDART settings, but allows them to set and enable the detector high voltage, **START** and **STOP** data acquisition, monitor hardware

status, and view the Nuclide Report. *Note that spectrum locking (Section 4.1.16) only works when an administrator password is set.*

- The passwords are numerical, and are one or more characters in length (but cannot be a single zero).
- Assigning a single zero (0) as the password is the “remove password” command.
- After assigning the password(s), power the digiDART off/on to ensure they are in effect.
- If the user password is set, the digiDART will prompt for the password when the unit is started up.
- If both a user and administrator password have been activated, either the user password or the administrator password can be entered at startup. If you enter it correctly, the password screen closes and the digiDART goes to spectrum mode (unless the spectrum is locked and you have only user access). If not correct, an “Access denied” message is displayed. If the spectrum is locked, a text message will be shown at startup to indicate that the password was accepted.
- Once the administrator password is set, you must enter the administrator password to change passwords.
- To exit the administrator level, cycle the power off/on.

Table 3 summarizes how the two passwords work.

**Table 3. digiDART-LF Passwords.**

Password(s) set	Required on startup?	Required to adjust setup controls?
User pwd only	Yes	No (full access granted)
Admin pwd only	No	Yes
User and Admin pwds*	One of the two	If only User pwd entered, no access to setup controls If Admin pwd entered, full access granted

\* If the user and administrator passwords are identical, entering the password grants full administrator access.

To set or change the user password, press **MENU/ENTER**, **(7) General Settings**, **(1) Change User Password**. Now enter the number(s) you wish to assign as the password. If you make a

mistake, press **CLEAR** to erase the preceding character. When finished, press **MENU/ENTER** to return to the General Settings menu. To remove the password, enter a single 0, then **MENU/ENTER**.

To set or change the administrator password from spectrum display mode, press, **MENU/ENTER (7) General Settings, (2) Change Administrator Password**, then enter the number(s) you wish to assign as the password. If you make a mistake, press **CLEAR** to erase the preceding character.

When finished, press **MENU/ENTER** to return to the General Settings menu.

To enter the administrator password and go to the administrator level, from the spectrum display, press **MENU/ENTER, (7), (3) Enter Password**, enter the number string, and press **MENU/ENTER**. When you enter it correctly, the password display closes and returns to the Main Menu. If incorrect, an “Access denied” message is displayed.

If you do not know the password, press **MENU/ENTER** to clear the “Access denied” message and return to the Main Menu.

**NOTE** *There is no master administrator password.* If you lose this password, contact your ORTEC service representative or our Global Service Center.

#### 4.1.17. Locking the Spectrum Display

For use in sensitive areas, the spectrum display can be locked so that it can only be viewed by an administrator (e.g., an administrator password must be set for this feature to work). When the administrator locks the spectrum display, the spectrum screen shows a “locked” message and the **(5) Peak Info** function is not available. However, the operator can still view the Nuclide Report.

To lock the display, enter the administrator password, then go to the Main Menu, press **(7) General Settings, (4) Lock Spectral Display**, then **(1) LOCK**. The “Display Locked” message will be displayed. Press **MENU/ENTER** 2 times to return to the General Settings menu. Now power off the digiDART. On next startup, the display will be locked and can only be unlocked by an administrator.

To unlock the display, in administrator mode go to the Main Menu, press **(7) General Settings, (4) Lock Spectral Display**, then **(1) UNLOCK**. The “Display Unlocked” message will be displayed. Press **MENU/ENTER** 2 times to return to the General Settings menu.

Table 4 summarizes how passwording interacts with spectrum locking.

**Table 4. Passwords and Spectrum Locking.**

<b>Spectrum locked (effect is immediate if admin pwd set)</b>	<b>Spectrum displayed?</b>
No pwd set	Yes
Only User pwd set	Yes
Only Admin pwd set	No; must enter Admin pwd to display spectrum
Both User and Admin pwds set*	If only User pwd entered, spectrum not displayed If Admin pwd entered, spectrum displayed

\* If the user and administrator passwords are identical, entering the password grants full administrator access and spectrum is displayed.

**NOTE** When the display is locked, the digiDART will not communicate with PC-based spectroscopy applications. To restore communication with the PC software you must unplug the USB cable, enter the administrator password, unlock the display, then reconnect the USB cable.

#### 4.1.18. Collecting Spectra

You are now ready to collect spectra. When you have collected the first spectrum, it can be saved in the digiDART's internal, stored-spectrum memory. To save the spectrum, press **STORE**, enter the 8-character spectrum ID to be stored with the spectrum, then press **MENU/ENTER**. The current ID is displayed. To use this, just press **MENU/ENTER**. The same ID can be used in multiple spectra. On the ID entry dialog, you are also shown the amount of memory used and the amount used for this spectrum. When the memory is full, a warning is displayed. The next dialog asks you to confirm that you want to store this spectrum. Press **(1)** to store or **(2)** to skip the storage process. An individual spectrum cannot be erased from the stored spectrum memory.

The list of stored spectra is shown, from the spectrum display, by pressing **MENU/ENTER**, **(8)**, **(3)**. The list is shown by sequence number, ID, and date/time. To show any particular spectrum, enter the sequence number. For sequence numbers above 9, enter the first digit, then the second digit, then the other digits. Depending on how quickly you enter the two or more digits, the display may update with different lists. For example, to select spectrum 351:

- Press **(3)** and pause; the page with spectrum 3 at the top will be displayed.
- Next press **(5)** and pause; now the page with spectrum 35 at the top will be displayed.
- Now press **(1)** to show the page with spectrum 351 at the top.



To browse through all the spectra, use the down arrow key to display the next group of 8 spectra and the up arrow key to display the previous group of 8.

#### **4.1.19. Downloading Spectra to the PC**

After you have collected the spectra and stored them in the digiDART stored-spectrum memory, you can download them to a PC disk storage. The download of the spectra is controlled by PC-based software such as MAESTRO. Typically, the software allows you to download the spectra one at a time or all at one time automatically. See the software user's manual for details on downloading and saving the spectra.

When connected to the PC, the digiDART displays a "USB Connected" message. Otherwise, the display and keypad are disabled. Every function is available to the software dialogs except the ability to store spectra, enter or change the digiDART user and administrator passwords, and display locking. MAESTRO, GammaVision, and other ORTEC programs have detector-locking commands that prevent unauthorized users from changing detector settings, starting and stopping data acquisition, and clearing the detector memory. These commands function separately from the digiDART's user and administrator passwords. If the digiDART is locked by software, it can be used in the field without knowing the password, but cannot be reconnected to a PC and its memory erased unless the user knows the password.

## **4.2. Should You Take a Laptop Into the Field?**

The digiDART is designed so that you don't need a PC to operate it, especially in the field. But, there are a few situations where a laptop is of use in field operations. One use is for advanced analysis of the spectra where the Nuclide Report does not show enough detail. In this case, software such as GammaVision or M-1 can be used to process the spectra "on the spot." The second is to provide storage for more spectra than the digiDART stored-spectrum memory capacity (see Table 1, page 3). A laptop with MAESTRO will allow you to periodically transfer spectra from the digiDART and clear its spectrum memory so you can continue data collection.

### **4.2.1. Operation with a PC**

The details of the operation of the digiDART by the PC software depend on the software itself. ORTEC software, such as MAESTRO, is described in the manual for the software. In general, the digiDART operates very much like other ORTEC MCBs using CONNECTIONS-32. The digiDART is a modern digital signal processor with all the settings, controls, and adjustments controllable by software. To use it with your own software, we recommend using the CONNECTIONS-32 Programmer's Toolkit with Microsoft ActiveX<sup>®</sup> Controls (A11-B32). The commands are given in Chapter 8. For use with handheld computers without Windows, the low-level commands are given in Section 8.2.

## 4.3. Troubleshooting

### 4.3.1. If You Disconnected While In InSight Virtual Oscilloscope Mode

If digiDART was in InSight mode when you disconnected it from the PC, it will stay in InSight mode until it is changed. You must switch the digiDART out of InSight mode to collect data. If the spectrum display is unlocked, the digiDART will display the message, **Display enabled, not in PHA mode**. To return to PHA mode, click on **MENU/ENTER, (7) Display, (2) Set Display Mode=PHA**. If the spectrum display is locked, enter the administrator password, then **(2) Set Display Mode = PHA**.

### 4.3.2. The digiDART Will Not Turn on

Replace the battery or connect to external power. Check that the battery is properly installed.

### 4.3.3. If You Forgot the Password

If you have forgotten the user password, start the digiDART, enter the administrator password, and enter a new user password. If there is no administrator password or you have forgotten it, too, contact your ORTEC service representative.

### 4.3.4. MAESTRO Does Not Connect with the digiDART

If properly installed and functioning MAESTRO software (or other CONNECTIONS-32 programs) cannot find and communicate with the digiDART, check the following:

- The digiDART is not turned on.
- The USB cable is not properly connected.
- The digiDART display is locked.
- The Master Instrument List on the PC does not include the digiDART. Run the MCB Configuration program as discussed in Section 3.1.3 or the *MAESTRO Software User's Manual*.

If this does not resolve the communication issue, contact our Global Service Center.

# 5. USING THE DIGIDART WITH MAESTRO

The digiDART is intended for completely independent operation, with no PC required. However, when you connect it to a PC running ORTEC CONNECTIONS-32 spectroscopy applications, such MAESTRO or ScintiVision you can use it as a high-performance spectrometer/digital MCA. When you disconnect from the PC, any changes you have made to the hardware settings via PC will remain in effect until changed from the keypad.

Be sure to install the accompanying MAESTRO-32 MCA Emulator application and, if supplied, the CONNECTIONS-32 Driver Update Kit. These contain the most up-to-date drivers for the digiDART and other ORTEC hardware. If you have any questions about software/hardware compatibility, contact your ORTEC representative or our Global Service Center. The *MAESTRO Software User's Manual* contains complete instructions on software installation and configuration of the MCBs attached to your PC. When installing MAESTRO, choose the **USB-Based Instruments** selection to install the correct driver for the digiDART.

The rest of this chapter discusses the hardware setup dialog you will see within MAESTRO, ScintiVision, and all other ORTEC CONNECTIONS-32 software when you click on **Acquire/MCB Properties...** When the digiDART is connected to the PC, it is completely software controlled. The MCB Properties dialog contains all of the instrument controls including ADC setup parameters, acquisition presets, amplifier gain adjustments, pole-zero controls, and access to the InSight Virtual Oscilloscope. Just move from tab to tab and set your hardware parameters, then click on **Close** — it's that easy.

Note that as you enter characters in the data-entry fields, the characters will be underlined until you move to another field or until 5 seconds have lapsed since a character was last entered. During the time the entry is underlined, no other program or PC on the network can modify this value.

## 5.1. Amplifier Tab

Figure 32 shows the controls on the Amplifier tab. It the controls for **Gain**, **Baseline Restore**, **Preamplifier Type**, **Input Polarity**, and optimization. Be sure that all of the controls on the tabs have been set *before* clicking the **Start Auto** (optimize) button.

**NOTE** The changes you make on this tab *take place immediately*. There is no cancel or undo for this dialog.

**Gain** — Set the amplifier coarse gain by selecting from the **Coarse** droplist, then adjust the **Fine** gain with the horizontal slider bar or the edit box, in the range of 0.45 to 1.00. The resulting effective gain is shown at the top of the **Gain** section. The two controls used together cover the entire range of amplification from 0.45 to 100.

The **Input Polarity** radio buttons select the preamplifier input signal polarity for the signal from the detector. Normally, GEM (p-type) detectors have a positive signal and GMX (n-type) have a negative signal.

The **Baseline Restore** is used to return the baseline of the pulses to the true zero between incoming pulses. This improves the resolution by removing low frequency noise such as dc shifts or mains power ac pickup. The baseline settings control the time constant of the circuit that returns the baseline to zero. There are three fixed choices (**Auto**,<sup>3</sup> **Fast**, and **Slow**). The fast setting is used for high count rates, the slow for low count rates. **Auto** adjusts the time constant as appropriate for the input count rate. The settings (auto, fast, or slow) are saved in the digiDART even when the power is off. The time constant can be manually set on the InSight display (see the InSight discussion in the *MAESTRO Software User's Manual*).

You can view the time when the baseline restorer is active on the InSight display as a **Mark** region (see the discussion on Marks in the *Software User's Manual*). In the automatic mode, the current value is shown on the InSight sidebar. For a low-count-rate system, the value will remain at about 90.

**Preamplifier Type** — The digiDART uses **Resistive Feedback** preamplifiers.

**Optimize** — The digiDART is equipped with both automatic pole-zero logic<sup>7</sup> and automatic flattop logic.<sup>7</sup> The **Start Auto** optimization button uses these features to automatically choose the best pole zero and flattop tilt settings. Note that if you selected **Transistor Reset** as the **Preamplifier Type** for this digiDART, the **Start Auto** button does not perform the pole zero.

As with any system, the digiDART should be optimized any time the detector is replaced or if the flattop width is changed. For optimization to take place, the digiDART must be processing pulses. The detector should be connected in its final configuration before optimizing. Position a source such that the input count rate is approximately 5000 cps. Monitor the count rate with either the **Peak Info** or **Input Count Rate** command.

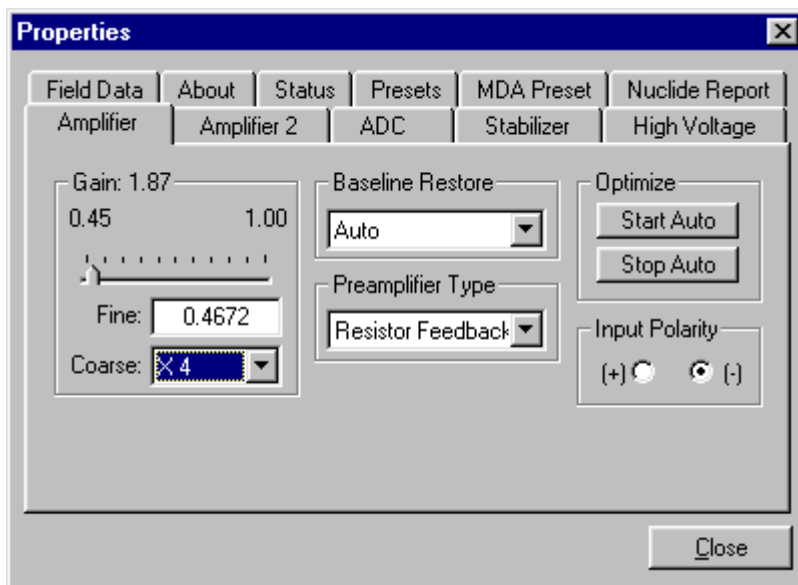


Figure 32. Amplifier Tab.

<sup>3</sup>U.S. Patent 5,912,825.

Click on **Start Auto**. The optimize command is sent to the digiDART at this time and, if the digiDART is able to start the operation, a series of short beeps sounds to indicate that optimization is in progress. When optimizing is complete, the beeping stops.

During optimization, pole zeroes are performed for several rise-time values and the digiDART is cycled through all the rise time values for the determination of the optimum tilt values. As all of the values for all the combinations are maintained in the digiDART, the optimize function does not need to be repeated for each possible rise time. The optimization can take from 1 to 10 minutes depending on count rate.

You should repeat the optimization if the flattop width is changed.

The effect of optimization on the pulse can be seen in the InSight mode, on the Amplifier 2 tab. Note, however, that if the settings were close to proper adjustment before starting optimization, the pulse shape might not change enough for you to see. (In this situation, you also might not notice a change in the shape of the spectrum peaks.) The most visible effect of incorrect settings is high- or low-side peak tailing or poor resolution.

## 5.2. Amplifier 2 Tab

Figure 33 shows the Amplifier 2 tab, which accesses the advanced digiDART shaping controls including the InSight Virtual Oscilloscope mode, which is discussed in the *MAESTRO Software User's Manual*.

The many choices of **Rise Time** allow you to precisely control the tradeoff between resolution and throughput. The MAESTRO manual discusses this tradeoff and contains a guide to choosing rise time according to count rate. The value of the rise time parameter in the digiDART is roughly equivalent to twice the integration time set on a conventional analog spectroscopy amplifier. Thus, a digiDART value of 12  $\mu\text{s}$  corresponds to 6  $\mu\text{s}$  in a conventional amplifier. Starting with the nominal value of 12.0, you should increase values of the rise time for better resolution for expected lower count rates, or when unusually high count rates are anticipated, reduce the rise time for higher throughput with somewhat worse resolution.

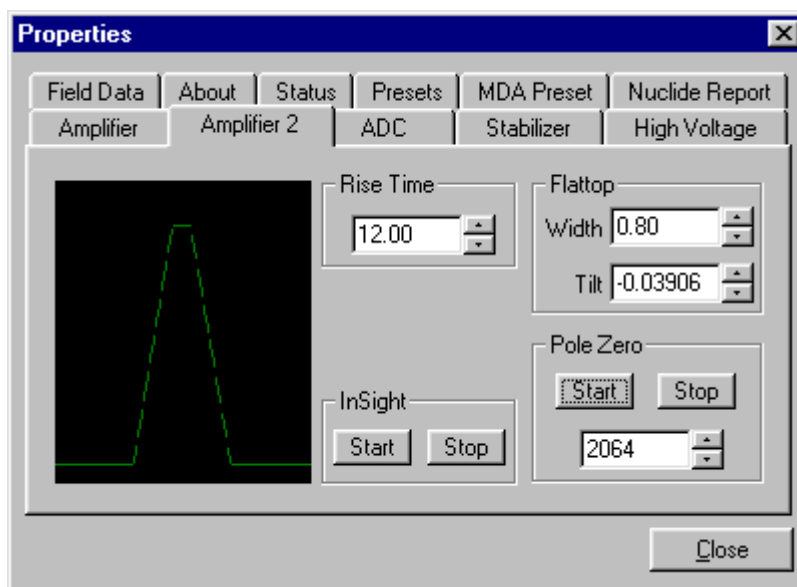


Figure 33. Amplifier 2 Tab.

Use the up/down buttons to adjust the rise time within the range of 0.2  $\mu$ s to 23.0  $\mu$ s. The most recent settings are saved in the digiDART firmware even when the power is turned off.

For the more advanced user, the InSight mode allows you to directly view all the parameters and adjust them interactively while collecting live data. To access the InSight mode, go to the **InSight** section and click on **Start**.

The **Rise Time** value is for both the rise and fall times; thus, changing the rise time has the effect of spreading or narrowing the quasi-trapezoid symmetrically.

The **Flattop** controls adjust the top of the quasi-trapezoid. The **Width** adjusts the extent of the flattop (from 0.3 to 2.4  $\mu$ s). The **Tilt** adjustment varies the “flatness” of this section slightly. The **Tilt** can be positive or negative. Choosing a positive value results in a flattop that slopes downward; choosing a negative value gives an upward slope. Alternatively, the optimize feature on the Amplifier tab can set the tilt value automatically. This automatic value is normally the best for resolution, but it can be changed on this dialog and in the InSight mode to accommodate particular throughput/resolution tradeoffs. The optimize feature also automatically adjusts the pole-zero setting.

The dead time per pulse is  $(3 \times \text{Rise Time}) + (2 \times \text{Flattop Width})$ .

In the **Pole Zero** section, the **Start** button performs a pole zero at the specified rise time and other shaping values. Unlike the optimize feature, it performs a pole zero for only the one rise time. The pole-zero **Stop** button aborts the pole zero, and is normally not used.

When you are satisfied with the settings, **Close** the Properties dialog and prepare to acquire data.

Once data acquisition is underway, the advanced user might wish to select **MCB Properties...** and click on the **InSight** section's **Start** button to adjust the shaping parameters interactively with a “live” waveform showing the actual pulse shape, or just to verify that all is well. Section ? provides detailed instructions on using the InSight mode.

### 5.3. ADC Tab

This tab (Fig. 34) contains the **Gate**, **Conversion Gain**, **Lower Level Discriminator**, and **Upper Level Discriminator** controls. In addition, the current real time, live time, and count rate are monitored at the bottom of the dialog.

**Gate** — This control allows you to select a logic gating function. With this function **Off**, no gating is performed (that is, all detector signals are processed); with the function in **Coincidence**, a gating input signal *must be* present at the proper time for the conversion of the event; in **Anticoincidence**, the gating input signal *must not be* present for the conversion of the detector signal. The gating signal must occur prior to and extend 500 nanoseconds beyond peak detect (peak maximum).

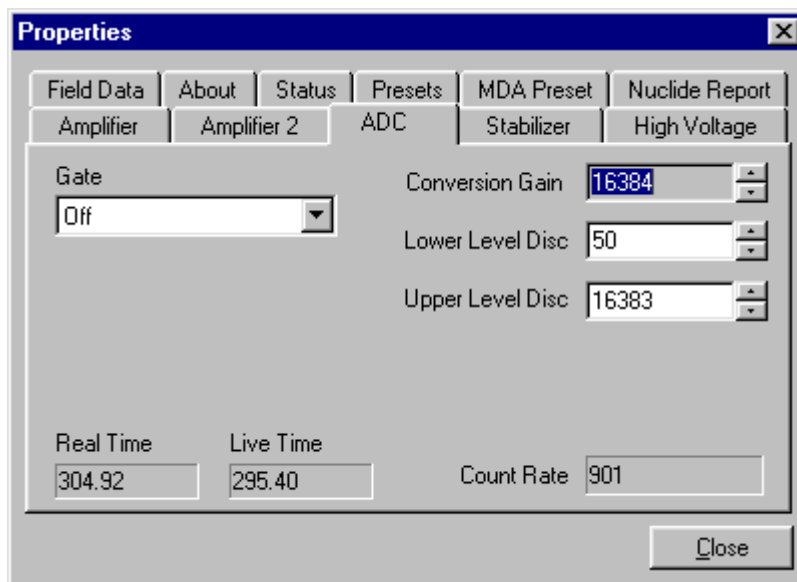


Figure 34. ADC Tab.

**Conversion Gain** — Sets the maximum channel number in the spectrum. If set to 16384, the energy scale will be divided into 16384 channels. The conversion gain is entered in powers of 2 (e.g., 8192, 4096, 2048, ...). The up/down arrow buttons step through the valid settings for the digiDART.

**Upper- and Lower-Level Discriminators** — The **Lower Level Discriminator** sets the level of the lowest amplitude pulse that will be stored. This level establishes a lower-level cutoff, by channel number, for ADC conversions. Setting that level above random noise increases useful throughput because the MCB is not unproductively occupied processing noise pulses. The **Upper Level Discriminator** sets the level of the highest amplitude pulse that will be stored. This level establishes an upper-level cutoff, by channel number, for ADC conversions.

## 5.4. Stabilizer Tab

The digiDART has both a gain stabilizer and a zero stabilizer. These are discussed in detail in Sections 6.3 and 6.4.

The Stabilizer tab (Fig. 35) shows the current values for the stabilizers. The value in each **Adjustment** section shows how much adjustment is currently applied. The **Initialize** buttons set the adjustment to 0. If the value approaches 90% or above, the amplifier gain should be adjusted so the stabilizer can continue to function — when the adjustment value reaches 100%, the stabilizer cannot make further corrections in that direction. The **Center Channel** and **Width** fields show the peak currently used for stabilization.

To enable the stabilizer, enter the **Center Channel** and **Width** values manually or click on the **Suggest Region** button. **Suggest Region** reads the position of the marker and inserts values into the fields. If the marker is in an ROI, the limits of the ROI are used. If the marker is not in an ROI, the center channel is the marker channel and the width is 3 times the FWHM at this energy. Now click on the appropriate **Enabled** checkbox to turn the stabilizer on. Until changed in this dialog, the stabilizer will stay active even if the power is turned off. When the stabilizer is enabled, the **Center Channel** and **Width** cannot be changed.

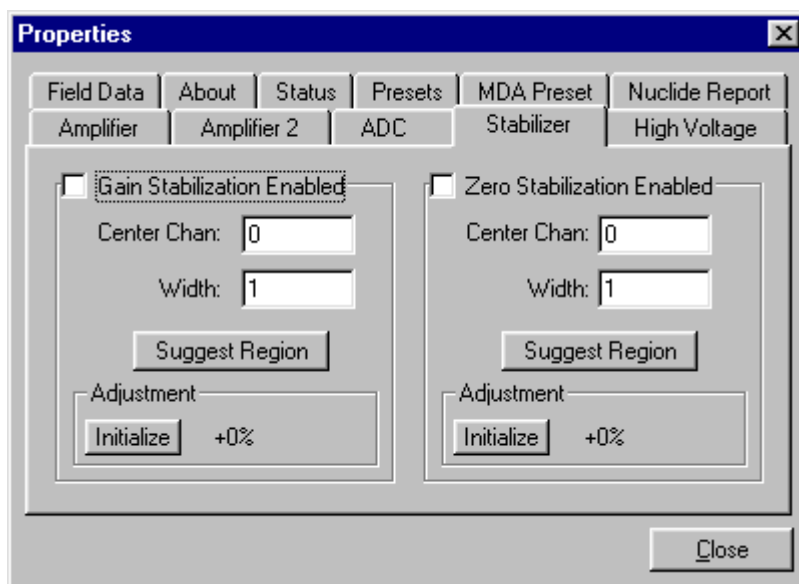


Figure 35. Stabilizer Tab.

## 5.5. High Voltage Tab

Figure 36 shows the High Voltage tab, which allows you to turn the high voltage on or off, set and monitor the voltage, and choose the **Shutdown** mode.

The high voltage is overridden by the detector bias remote shutdown signal from the detector; high voltage cannot be enabled if the remote shutdown or overload signals prevent it. If an **Overload** indicator is displayed, there is a bad connection in your system. If a **Shutdown** indicator is displayed, either the detector is warm or you have chosen the wrong shutdown mode.

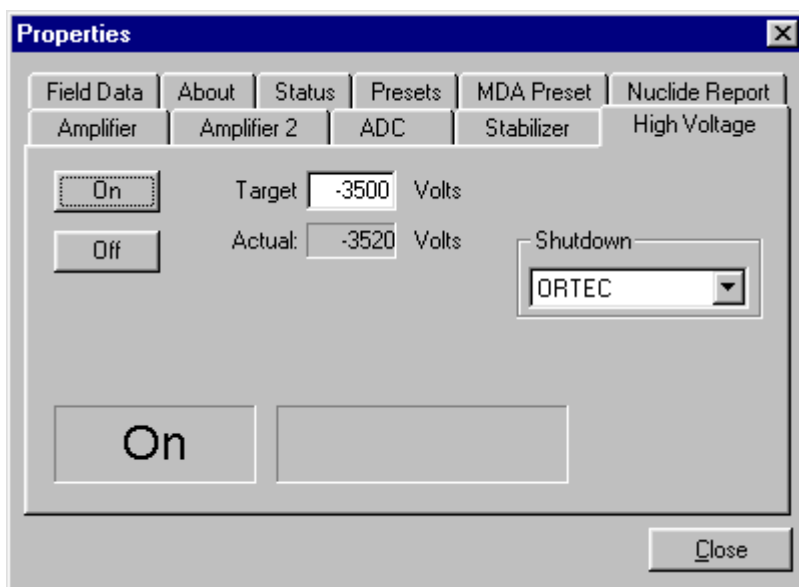


Figure 36. High Voltage Tab.

Enter the detector high voltage in the **Target** field, click **On**, and monitor the voltage in the **Actual** field. Click the **Off** button to turn off the high voltage.



The shutdown can be **ORTEC**, **TTL** or **SMART**. The **ORTEC** mode is used for all **ORTEC** detectors except SMART-1 detectors; use the SMART option for those detectors. Check with the detector manufacturer for other detectors. The **TTL** mode is used for most non-ORTEC detectors.

The high voltage in the digiDART is supplied by the SMART-1 module or in a separate DIM. The recommended HV for SMART-1 is displayed on the dialog. For other detectors, see the detector manual or data sheet for the correct voltage. The polarity is determined by the DIM or SMART-1 module.

## 5.6. Field Data Tab

This tab (Fig. 37) is used to view the digiDART spectra collected in Field Mode, that is, in remote mode, detached from a PC. The digiDART is always in Field Mode when disconnected from the PC. The spectrum can then be viewed as the “active” spectrum in the digiDART. The active spectrum is the spectrum where the new data are collected. The current active spectrum is lost.

The lower left of the tab shows the total number of spectra (not counting the active spectrum) stored in the digiDART memory. The spectrum ID of the active spectrum is shown in the lower right. The spectrum ID is the eight-character alphanumeric value stored with the spectrum. The stored spectra cannot be viewed or stored in the PC until they are moved to the active spectrum position.

To move a spectrum from the stored memory to the active memory, enter the spectrum number and click on **Move**. Use the up/down arrow buttons to scroll through the list of spectra. The label on the lower right does not update until a spectrum is moved. The numbers are the same as the numbers shown on the digiDART display in the stored spectrum list. Note that this only moves the spectrum inside the digiDART. To save the current active spectrum to the PC disk, use the **File/Save** commands in the PC-based application.

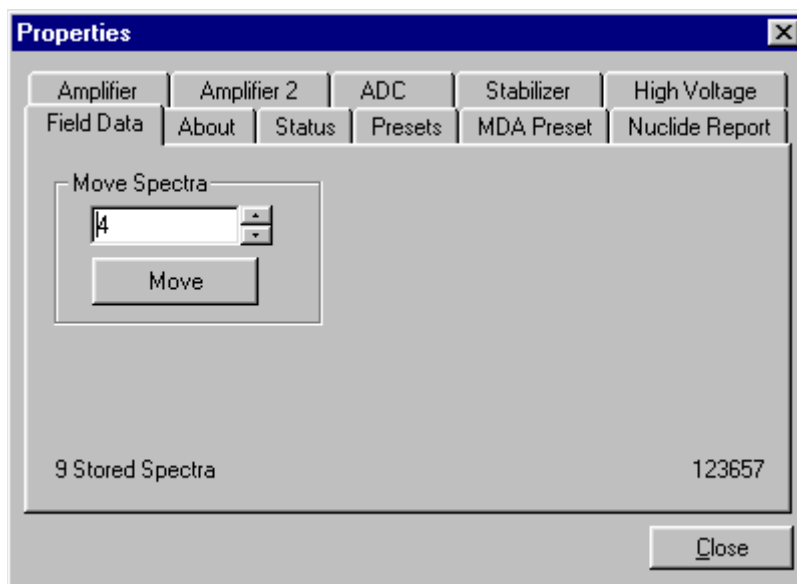


Figure 37. Field Data Tab.

The **Acquire/Download Spectra** command can also be used to download and save all the stored spectra to the host PC. (Be sure to read the *Software User's Manual* for details on selecting the proper conversion gain and spectrum file format before downloading.)

## 5.7. About Tab

This tab (Fig. 38) displays hardware and firmware information about the currently selected digiDART as well as the data **Acquisition Start Time** and **Sample** description. In addition, the **Access** field shows whether the MCB is currently locked with a password. **Read/Write** indicates that the MCB is unlocked; **Read Only** means it is locked.

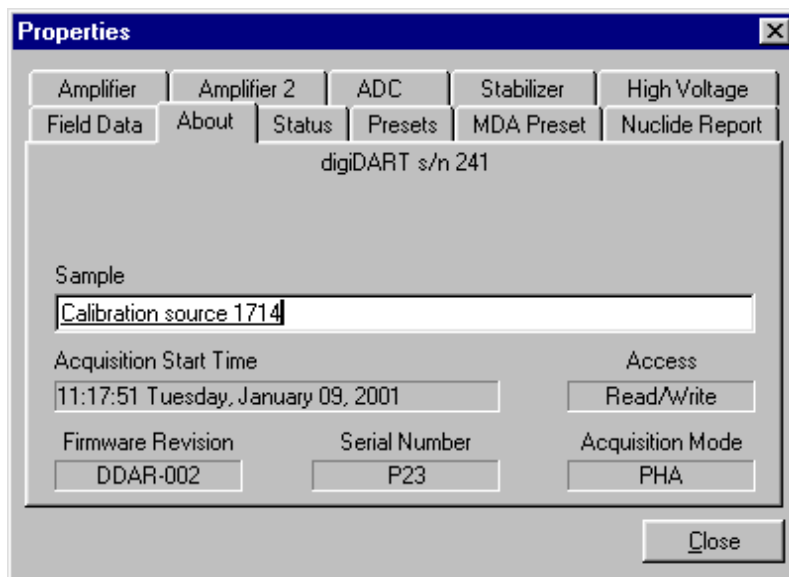


Figure 38. About Tab.

## 5.8. Status Tab

Figure 39 shows the hardware Status tab. Twenty-one parameters are monitored at all times. Use the droplists to select any six parameters to be displayed simultaneously on the this tab. You can change your selections at any time.

Two types of status responses are displayed: **OK** or **ERR**, and a numeric value. The state-of-health (SOH) parameters all respond with **OK** or **ERR**. If the state is **OK**, the parameter stayed within the set limits during the spectrum acquisition. If the parameter varied from the nominal value by more than the allowed limit, the **ERR** is set until cleared by the program. The numeric values are displayed in the units reported by the digiDART. The **Security**, **Temperature State of Health**, **Detector temperature**, and **Live detector temperature** readouts are not available for this unit and read **N/A**.

The parameters are:

### Detector State of Health

This is OK if all the SOH are OK and ERR if any one is ERR.

### DIM +24V State of Health

This is OK if the +24 volt supply in the DIM has stayed within 200 mV of +24 volts since the last time the SOH was cleared.

### DIM +12V State of Health

This is OK if the +12 volt supply in the DIM has stayed within 200 mV of +12 volts since the last time the SOH was cleared.

### DIM -12V State of Health

This is OK if the -12 volt supply in the DIM has stayed within 200 mV of -12 volts since the last time the SOH was cleared.

### DIM -24V State of Health

This is OK if the -24 volt supply in the DIM has stayed within 200 mV of -24 volts since the last time the SOH was cleared.

### Temperature State of Health

Not available for the digiDART.

### High Voltage State of Health

This is OK if the HV supply in the DIM has stayed within 200 V of specified bias voltage since the last time the SOH was cleared.

### Shutdown State of Health

This is OK if the detector shutdown has not activated since the last time the SOH was cleared.

### Preamplifier overload State of Health

This is OK if the preamplifier overload has not activated since the last time the SOH was cleared.

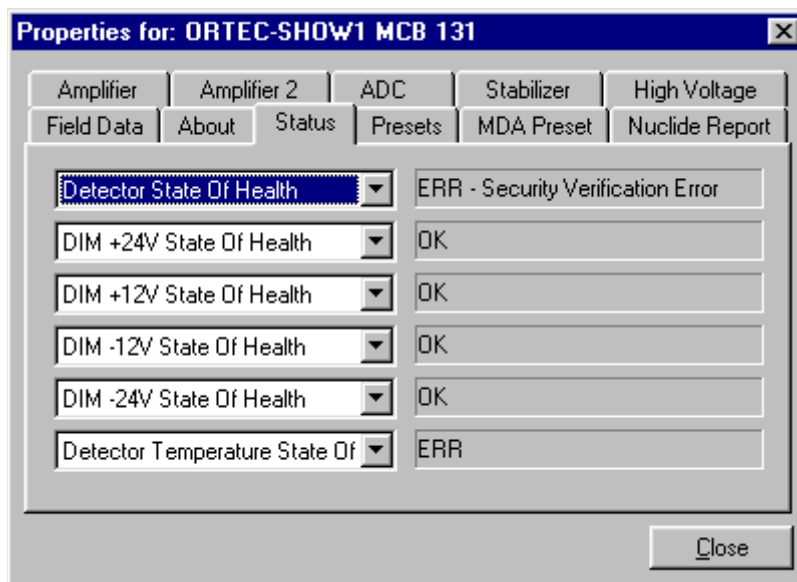


Figure 39. Status Tab.

### **Security State of Health**

Not available for the digiDART.

### **Power State of Health**

This is OK if the power to the DIM was constant during the last spectrum acquisition.

#### **+24 volts**

This is the current value of the +24 volt supply in the DIM as delivered to the detector.

#### **+12 volts**

This is the current value of the +12 volt supply in the DIM as delivered to the detector.

#### **-12 volts**

This is the current value of the -12 volt supply in the DIM as delivered to the detector.

#### **-24 volts**

This is the current value of the -24 volt supply in the DIM as delivered to the detector.

### **High Voltage**

This is the current value of the high-voltage bias supply in the DIM as delivered to the detector.

### **Detector temperature**

Not available for the digiDART.

### **Live detector temperature**

Not available for the digiDART.

### **Battery voltage**

This is the present voltage of the internal battery.

### **Battery % full**

This is an estimate of the amount of power remaining in the battery.

### **Battery time remaining**

This is an estimate of the time remaining when using the internal battery operating in the current mode.

## 5.9. Presets Tab

Figure 40 shows the Presets tab. MDA presets are shown on a separate tab.

The presets can only be set on an MCB that is *not* acquiring data (during acquisition the preset field backgrounds are gray indicating that they are inactive). You can use any or all of the presets at one time. To disable a preset, enter a value of zero. If you disable all of the presets, data acquisition will continue until manually stopped.

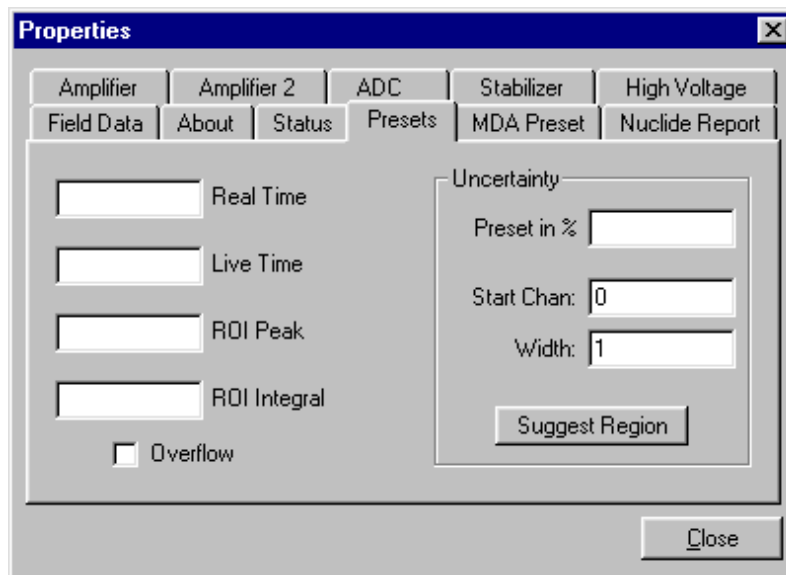


Figure 40. Presets Tab.

When more than one preset is enabled (set to a non-zero value), the first condition met during the acquisition causes the MCB to stop. This can be useful when you are analyzing samples of widely varying activity and do not know the general activity before counting. For example, the **Live Time** preset can be set so that sufficient counts can be obtained for proper calculation of the activity in the sample with the least activity. But if the sample contains a large amount of this or another nuclide, the dead time could be high, resulting in a long counting time for the sample. If you set the **ROI Peak** preset in addition to the **Live Time** preset, the low-level samples will be counted to the desired fixed live time while the very active samples will be counted for the ROI peak count. In this circumstance, the **ROI Peak** preset can be viewed as a “safety valve.”

The values of all presets for the currently selected MCB are shown on the Status Sidebar. These values do not change as new values are entered on the Presets tab; the changes take place only when you **Close** the Properties dialog.

Enter the **Real Time** and **Live Time** presets in units of seconds and fractions of a second. These values are stored internally with a resolution of 20 milliseconds (ms) since the MCB clock increments by 20 ms. *Real time* means elapsed time or clock time. *Live time* refers to the amount of time that the MCB is available to accept another pulse (i.e., is not busy), and is equal to the real time minus the *dead time* (the time the MCB is not available).

Enter the **ROI Peak** count preset value in counts. With this preset condition, the MCB stops counting when any ROI channel reaches this value unless there are no ROIs marked in the MCB, in which case that MCB continues counting until the count is manually stopped.

Enter the **ROI Integral** preset value in counts. With this preset condition, the MCB stops counting when the sum of all counts in all channels for this MCB marked with an ROI reaches this value, unless no ROIs are marked in the MCB.

The **Uncertainty** preset stops acquisition when the statistical or counting uncertainty of a user-selected net peak reaches the value you have entered. Enter the **Preset in %** value as percent uncertainty at 1 sigma of the net peak area. The range is from 99% to 0.1% in 0.1% steps. You have complete control over the selected peak region. The region must be at least 7 channels wide with 3 channels of background on each side of the peak. As the uncertainty is calculated approximately every 30 seconds, the uncertainty achieved for a high count-rate sample might be better than the preset value.

Use the **Start Channel** and **Width** fields to enter the channel limits directly, or click on **Suggest Region**. If the marker is positioned in an ROI around the peak of interest, **Suggest Region** reads the limits of the ROI with the marker and display those limits in the **Start Chan** and **Width** fields. The ROI can be cleared after the preset is entered without affecting the uncertainty calculation. If the marker is not positioned in an ROI, the start channel is 1.5 times the FWHM below the marker channel and the width is 3 times the FWHM. The net peak area and statistical uncertainty are calculated in the same manner as for the **MAESTRO Peak Info** command, which is discussed in the *Software User's Manual*. Note that the **Suggest Region** button is not displayed during data acquisition.

Marking the **Overflow** checkbox terminates acquisition when data in any channel exceeds  $2^{31}-1$  (over  $2 \times 10^9$ ) counts.

## 5.10. MDA Preset Tab

The MDA preset (Fig. 41) can monitor up to 20 nuclides at one time, and stops data collection when the minimum detectable activity for each of the user-specified MDA nuclides reaches the designated value. The MDA preset is implemented in the hardware. The formulas for the MDA are given in various textbooks and in the “Analysis Methods” chapter in the *GammaVision-32 Software User's Manual* and can be generally represented as follows:

$$MDA = \frac{a + \sqrt{b + c * Counts}}{Live\ time * Eff * Yield}$$

See also Section 6.2. The coefficients  $a$ ,  $b$ , and  $c$  are determined by the MDA formula to be used. The  $Eff$  (detector efficiency) is determined from the calibration. The  $Yield$  (branching ratio) is read from the working library using the nuclide and energy specified. The **MDA** value is the one you have entered in the dialog.  $Counts$  is the gross counts in the specified region and  $Live\ time$  is

the live time. The *MDA* value is calculated in the MCB given the values *a*, *b*, *c*, *Live time*, *Eff*, and *Yield*. The calculated value is compared with the **MDA** value on the dialog and when it is lower, acquisition is stopped.

**Coefficients A, B, and C** can be entered as numbers. If the application, such as ScintiVision, supports MDA calculations, you can click on the **Suggest** button to enter (from an internal table) the values for the MDA type selected. The MDA type should be chosen before the preset is selected here.

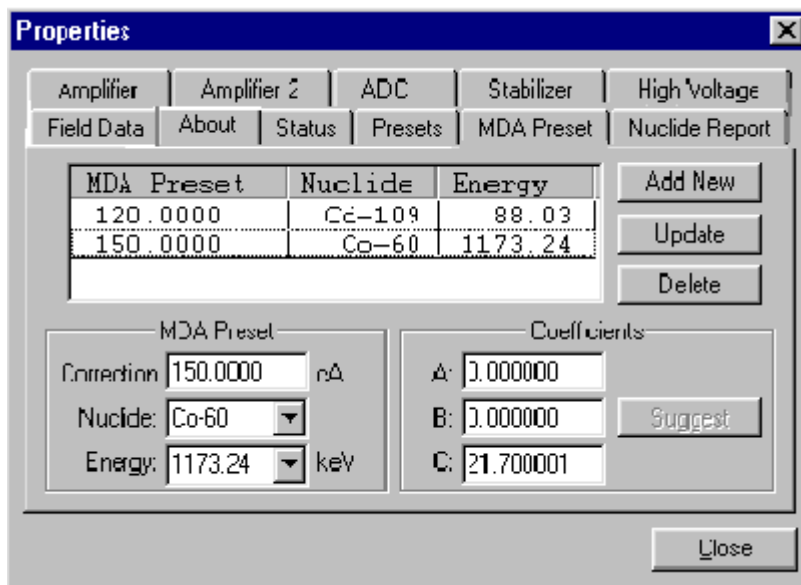


Figure 41. MDA Preset Tab.

Select the **Nuclide** and **Energy** from the droplists. The **Nuclide** list contains all the nuclides in the working library. The **Energy** list shows all the gamma-ray energies for the selected nuclide in the library.

If the application supports efficiency calibration and the digiDART is efficiency calibrated, the **MDA** is entered in the units selected in the application. If the unit is not efficiency calibrated (e.g., in MAESTRO, which does not support efficiency calibration), the **MDA** field is labeled **Correction**, the efficiency (*Eff*) is set to 1.0 and the preset operates as before. If the **Correction** factor is the actual MDA times the efficiency (known from other sources), the MDA preset will function normally.

## 5.11. Nuclide Report Tab

Figure 42 shows the Nuclide Report tab. The Nuclide Report displays the activity of up to 9 user-selected peaks. Once the report is set up you can view the Nuclide Report at any time on the digiDART display. The peak area calculations in the hardware use the same methods as the MAESTRO **Peak Info** calculation (see the *Software User's Manual*), so the Nuclide Report display is the same as the **Peak Info** display on the selected peak in the spectra stored in the PC. The calculated value is computed by multiplying the net peak count rate by a user-defined constant. If the constant includes the efficiency and branching ratio, the displayed value is the activity. You enter the nuclide label and the activity units.

The report format and calculations are discussed in detail in Chapter 6.

### 5.11.1. Add New

#### 5.11.1.1. Manual Add

Nuclides can be added to the list using the library to assist in the region definition or manually. To add a nuclide manually, enter the nuclide name, ROI start and end channels, multiplicative factor and units in the Report section. Now press **Add New** to add this nuclide to the list. The units need only be entered once, since they are the same for all nuclides in the table.

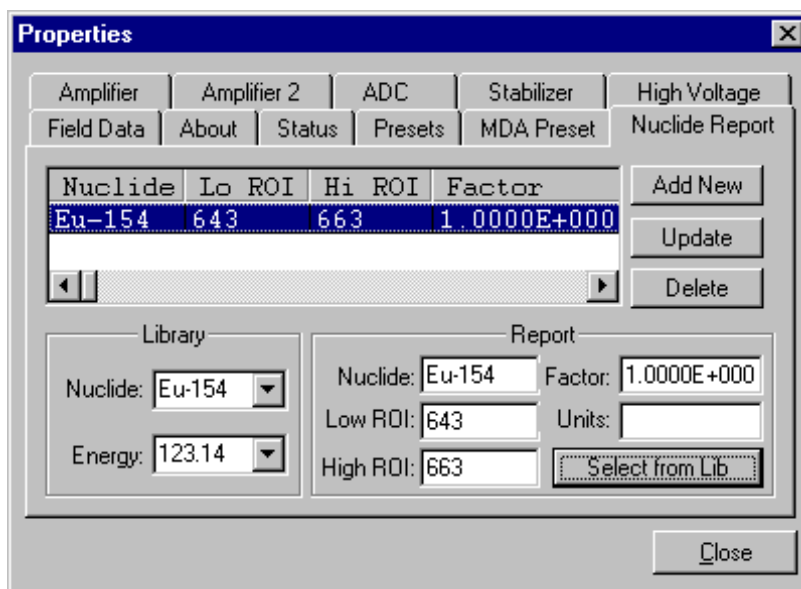


Figure 42. Nuclide Report Tab.

#### 5.11.1.2. Library Add

To use the library to aid in the definition, select the nuclide from the library nuclide drop down list. Now select the gamma-ray energy from the Energy drop down list. This defines what gamma ray to use. Now Press the **Select from Lib** button in the Report section. This will update all the entries in this section and show (as a yellow band) the region to be used in both the expanded spectrum and the full window. Now press **Add New** to add this nuclide to the list.

#### 5.11.2. Edit

To change any of the current nuclides, select the nuclide in the list (use the scroll bars if needed). This will show the current settings for this nuclide. Make any changes needed. Any or all of the entries can be changed. When finished with the changes, click on **Update**.

#### 5.11.3. Delete

To remove an entry, select the entry and press **Delete**.

When you close the Properties dialog, all the values entered are written to the digiDART and are used when you view the Nuclide Report on the digiDART display.



# 6. CALCULATIONS

## 6.1. The Nuclide Report

The Nuclide Report displays the activity of up to 9 user-selected peaks. Once the report is set up you can view the Nuclide Report at any time. The peak area calculations are the same as the calculations in MAESTRO and other ORTEC software, so the Report contents can be duplicated using the spectra stored in the PC. The calculated value is computed by multiplying the net peak count rate by a user-defined constant. If the constant includes the efficiency and branching ratio, the displayed value will be activity. The nuclide label and the activity units are entered by the user.

The report has this format:

Nuclide	keV	uCi/m2	±%
CO-60	1332.5	1.21E+01	10.2
CO-60	1173.2	1.09E+01	12.3
CO-57	122.1	1.48E+00	86.2

### 6.1.1. Calculations

These are the calculations used to generate the Nuclide Report's **Activity**, **Uncertainty**, and **Peak** values.

**Activity** is calculated as follows:

$$Activity = \frac{NetCounts \cdot NucCoef}{LiveTime}$$

*NucCoef* is normally the inverse of efficiency times the branching ratio. Note that the efficiency is the ABSOLUTE counting efficiency for the source-detector geometry being used. Thus, in order to get meaningful activity results, as in any counting situation, you need to have efficiency factors which are appropriate to the actual counting geometry. If *NucCoef* is set to 1, you will get peak count rate on the display.

*LiveTime* is the current live time.

*NetCounts* is computed with the following equation:

$$\mathit{NetCounts} = \mathit{GrossCounts} - \mathit{Background}$$

*GrossCounts* is the sum of the counts in the ROI, excluding the first and last 3 channels of the ROI.

*Background* is:

$$\mathit{Background} = \frac{\mathit{AvgCount\ first\ 3\ chan} + \mathit{AvgCount\ last\ 3\ chan}}{2} \cdot \mathit{ROIWidth}$$

*ROIWidth* is:

$$\mathit{ROIWidth} = \mathit{EndChannel} - \mathit{StartChannel} + 1 - 6$$

**Uncertainty** (in percent) is calculated as follows:

$$\mathit{Uncertainty} = \frac{\sqrt{\mathit{GrossCounts} + \mathit{Background} \cdot \frac{\mathit{ROIWidth}}{6}}}{\mathit{NetCounts}} * 100$$

**Peak** is the position of the maximum count and is computed with the following equation:

$$\mathit{Peak} = \mathit{MaximumROIChan} * \mathit{EnergySlope} + \mathit{EnergyIntercept}$$

*MaximumROIChan* is the channel in the ROI with the most counts. If there are no data, the center channel of the ROI is used.

*EnergySlope* and *EnergyIntercept* are the energy calibration values as entered on the digiDART keypad or by software. If the values are not present, the result is given in channels.

## 6.2. MDA Preset Calculation

The formula for the MDA can be represented as follows:

$$Eff_i * Yield * MDA_i = \frac{a + \sqrt{b + c * Counts\ in\ ROI_i}}{Live\ time}$$

The MDA values in the MCB are calculated given the constants  $a$ ,  $b$ , and  $c$ .  $i$  is a index from 0 to 19 that represents the 20 unique nuclides.  $Counts\ in\ ROI_i$  is the gross counts in the specified region for the  $i^{th}$  nuclide, and  $LiveTime$  is the live time. The constants  $a$ ,  $b$ , and  $c$  and the total left-hand factor (expected value) are loaded into the MCB by the user. The calculated value (right-hand side) is compared with the expected value and when all are lower, acquisition is stopped. Note that  $a$ ,  $b$ , and  $c$  are common for all nuclides while the ROI and the preset (left-hand value) are unique for each of the nuclides.

## 6.3. Gain Stabilization

The gain stabilizer (Section 2.2.6.5) requires a peak in the spectrum to monitor the changes in the gain of the system amplifier. The gain stabilizer controls the amplification factor of a separate amplifier so that the peak will be maintained in its original position. The input pulse-height-to-channel-number relationship is:

$$Channel\ number = Intercept + Gain * pulse\ height$$

where:

*Intercept* = The channel number of the zero-height input pulse

*Gain* = The relation between pulse height and channel number (slope of the curve)

Changes in either the intercept or gain can affect the positions of all the peaks in the spectrum. When used with the zero stabilizer, both the zero intercept and the gain (slope) will be monitored to keep all the peaks in the spectrum stabilized. The zero stabilization and gain stabilization are separate functions in the digiDART but both will affect the position of the peaks in the spectrum.

The stabilization operates by keeping a peak centered in an ROI you have defined. The ROI should be made symmetrically about the center of a peak with reasonably good count rate in the higher channels of the spectrum. The ROI should be about twice the FWHM of the peak. If the region is too large, counts not in the peak will have an effect on the stabilization.

Before setting either stabilization peak, the coarse and fine gains should be set to the desired values, and the pole zero performed.

## 6.4. Zero Stabilization

The zero stabilizer (Section 2.2.6.5) enables you to control the zero-level (or offset) stabilizer. The zero-level stabilizer uses a peak in the spectrum to monitor the changes in the zero level of the system amplifier. The zero stabilizer controls the offset bias level so the peak will be maintained in its original position. The input pulse-height-to-channel-number relationship is:

$$\text{Channel number} = \text{Intercept} + \text{Gain} * \text{pulse height}$$

where:

*Intercept* = The channel number of the zero-height input pulse

*Gain* = The relation between pulse height and channel number (slope of the curve)

Changes in either the zero intercept or gain can affect the positions of all the peaks in the spectrum. When used with the gain stabilizer, both the zero intercept and the gain (slope) are monitored to keep all the peaks in the spectrum stabilized. The zero stabilization and gain stabilization are separate functions in the digiDART but both will affect the position of the peaks in the spectrum.

The stabilization operates by keeping a peak centered in an ROI you have defined. The ROI should be set symmetrically about the center of a peak with reasonably good count rate in the lower channels of the spectrum. The ROI should be about twice the FWHM of the peak. If the region is too large, counts not in the peak will have an effect on the stabilization.

## 6.5. Optimization

The digiDART is equipped with both automatic pole-zero logic<sup>4</sup> and automatic flattop logic.<sup>5</sup> These features automatically choose the best pole-zero and flattop tilt settings. Note that if you selected **(2)** TRP (transistor reset) the preamplifier type for this digiDART, the optimize function does not perform the pole zero.

As with any system, the digiDART should be optimized any time the detector is replaced or if the coarse gain is changed. For optimization to take place, the digiDART must be processing

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<sup>4</sup>Patent number 5,872,363.

<sup>5</sup>Patent number 5,821,533.

pulses. The detector should be connected in its final configuration before optimizing. Position a radioactive source near the detector so the count rate is approximately 5000 cps. To monitor dead time, go to the Main Menu and press **(1) View Status**.

During optimization, pole zeroes are performed for several rise-time values and the digiDART is cycled through all the rise time values for determination of the optimum tilt values. As all of the values for all the combinations are maintained in the digiDART, the optimize function does not need to be repeated for each possible rise time. The optimization can take from 1 to 10 minutes depending on count rate.

The effect of optimization on the pulse can be seen in InSight mode in MAESTRO. Note, however, that if the settings were close to proper adjustment before starting optimization, the pulse shape may not change enough for you to see. (In this situation, you also may not notice a change in the shape of the spectrum peaks.) The most visible effect of incorrect settings is high- or low-side peak tailing or poor resolution.

See Section 4.1.8 for instructions on optimizing the digiDART.



# 7. SPECIFICATIONS

## 7.1. digiDART

**Maximum system throughput** >100,000 cps.

**Coarse Gain Settings** 1 to 32 in binary steps (1,2,4,8,16,32).

**Fine Gain** 0.45 to 1.

**Input Polarity** Selectable from digiDART keypad or in MAESTRO.

**System Conversion Gain** Computer selectable as 16384, 8192, 4096, 2048, 1024, or 512 channels, with optional 32768.

**Preamplifier Support** Supports both resistive and TRP preamplifiers.

### Shaping-Time Constants

- Rise time: 0.8  $\mu\text{s}$  to 23  $\mu\text{s}$  in steps of 0.2  $\mu\text{s}$ .
- Flattop: 0.3  $\mu\text{s}$  to 2.4  $\mu\text{s}$  in steps of 0.1  $\mu\text{s}$ .

**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 cps.

### Linearity

- Integral Nonlinearity:  $<\pm 0.025\%$  over top 99.5% of spectrum, measured with a mixed source ( $^{55}\text{Fe}$  at 5.9 keV to  $^{88}\text{Y}$  at 1836 keV).
- Differential Nonlinearity:  $<\pm 1\%$  (measured with a BNC pulser and ramp generator).

### System Temperature Coefficient

- Gain:  $<50$  ppm/ $^{\circ}\text{C}$  [typically 30 ppm/ $^{\circ}\text{C}$ ]
- Offset:  $<10$  ppm/ $^{\circ}\text{C}$ , with rise and fall times of 12  $\mu\text{s}$  and flattop of 1  $\mu\text{s}$  (similar to analog 6- $\mu\text{s}$  shaping).

**Overload Recovery** At maximum gain, recovers to within 2% of rated output from  $\times 1000$  overload in 2.5 non-overloaded pulse widths (measured using the InSight Virtual Oscilloscope).

**Pulse Pileup Rejector** Automatically set threshold. Pulse-pair resolution typically 500 ns.

**Automatic Digital Pole-Zero Adjustment** Performed from the digiDART keypad or software.<sup>4</sup> Can be set automatically or manually. Remote diagnostics via InSight Virtual Oscilloscope mode in MAESTRO.

**Digital Gated Baseline Restorer** Adjustment of the restorer rate (High, Low, and Auto<sup>6</sup>) controlled from the digiDART keypad or software.

**ADC Gate** (Not available for -PLUS [transistor-reset preamplifier] or SMART-1 detectors.) Accepts a positive TTL input via the DIM's "Inhibit" BNC. Signal must occur prior to and extend 0.5  $\mu$ s beyond peak detect. Software-selectable as off, coincidence, and anticoincidence.

**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.

**Software Ratemeter** Monitor the input count rate from the digiDART display or software.

**Stored Spectrum Memory** 1.5 MB of memory available for storage of spectra and collection parameters. Any combination of spectrum sizes can be stored.

**Presets** Multiple presets can be set (by software or keypad) on any or all of the following:

- **Real Time** Stops data collection when the real time reaches this value (in increments of 1 s).
- **Live Time** Stops data collection when the live time reaches this value (in increments of 1 s).
- **ROI Integral** Integral count stops data collection when the sum of all ROI channels reaches this value.
- **ROI Peak** Peak count stops data acquisition when any ROI channel reaches this value (maximum value of  $2^{32}-1$  counts [4 billion]).
- **Uncertainty** Sets the required statistical accuracy on a key peak (for example: stop counting when the activity of  $^{60}\text{Co}$  is known to be better than 5%).

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<sup>6</sup>Patent number 5,912,825.



- **Multi-Nuclide MDA** Stops data collection when the value of the minimum detectable activity (MDA) for up to 20 user-specified MDA nuclides reaches the needed value. The presets are implemented in hardware so do not require the computer to be polling the digiDART for the preset to operate. See Section 6.2 for details on the MDA preset calculation.
- **Data Overflow** Terminates acquisition when data in any channel exceeds  $2^{31} - 1$  (2 billion) counts.

### Digital Spectrum Stabilizer (controlled from the digiDART or software)

- **Stabilization** Peak centroid (zero and gain) channel 2 to 16384; stabilization window width (zero and gain)  $\pm 1$  to  $\pm 256$  channels.
- **Zero Correction Resolution**  $\pm 64$  channels with a minimum adjustment of 0.1 channel out of 16384 total channels.
- **Gain Correction Resolution** 0.00025% (from 99.5% to 100.5% in 4096 steps).

### 7.1.1. Electrical and Mechanical

#### Dimensions

- **digiDART:** The digiDART is shaped to fit your hand; the maximum dimensions are: 20 cm  $\times$  10 cm  $\times$  7.5 cm (8 in.  $\times$  5 in.  $\times$  3 in.).
- **DIM:** The DIM is shaped for easy mounting; the maximum dimensions (including handles) are: 12 cm  $\times$  8.2 cm  $\times$  3.3 cm (4.7 in.  $\times$  3.2 in.  $\times$  1.3 in.).

#### Weight

- **digiDART:** <900 gm (1.9 lb)
- **DIM:** <240 gm (0.5 lb)

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

**Battery** 7.2 V lithium-ion camcorder battery. Charging circuitry and battery management circuitry internal to digiDART. Battery inserted through door in case. The compartment is semi-sealed and protects against penetration of dirt and moisture. Battery can be changed without loss of data in spectrum memory. Battery life with ORTEC low-power preamplifier and HPGe detector is up to 12 hours.

## 7.1.2. Connectors

### DETECTOR:

- Preamp Power: 1 W only (+12V, -12V, +24V, -24V, 2 GND)
- Amp In: Normal amplifier input
- Inhibit: For TRP or gate
- Battery Power (5 V–8.5 V) for DIM
- Control for HV
- SMART-1 HPGe detector control

**USB** Universal serial bus for PC communications.

**12-15V DC** External power input, 12 V dc, <1.25 A, center contact positive.

## 7.2. PC Prerequisites

The digiDART support software (MAESTRO-32 MCA Emulation Software is included) operates on any Windows PC that supports the USB interface. MAESTRO-32 runs under Windows 2000 Professional SP4, XP Professional SP2 or higher, or Vista Ultimate.

## 7.3. Feature Mask Bits

The following table describes the feature bits from the SHOW\_FEATURES command discussed on page 95. If the feature is supported in the digiDART the bit is set to 1; if the feature is not supported, the bit is 0.

<b><u>Bit</u></b>	<b><u>Meaning</u></b>
0	Software-selectable conversion gain
1	Software-selectable coarse gain
2	Software-selectable fine gain
3	Gain stabilizer
4	Zero stabilizer
5	PHA mode functions available
6	MCS mode functions available
7	List mode functions available
8	Sample mode functions available
9	Digital Offset (e.g., 920)
10	Software-selectable analog offset

<b>Bit</b>	<b>Meaning</b>
11	HV power supply
12	Enhanced HV (SET_HV, SET/SHOW_HV_POL, SHOW_HV_ACT)
13	Software-selectable HV range (ENA_NAI, DIS_NAI)
14	Auto PZ (START_PZ_AUTO)
15	Software-selectable manual PZ (SET/SHOW_PZ)
16	Battery-backed, real-time clock (SHOW_DATE/TIME, SHOW_DATE/TIME_START)
17	Sample changer support (SET/SHOW_OUTPUT, SHOW_INPUT)
18	One-button acquisition (ENA/DIS/SHOW_TRIG_SPEC, MOVE)
19	Nomadic (likely to move between opens)
20	Local app data (SET_DATA_APP, SHOW_DATA_APP)
21	Software-retrievable serial number
22	Power management commands
23	Battery status support (SHOW_STAT_BATT)
24	Software-selectable AMP polarity (SET/SHOW_GAIN_POLAR)
25	Support for flattop optimization (ENA/DIS_OPTI)
26	Stoppable AutoPZ (STOP_PZ_AUTO)
27	Network support (e.g., DSPEC)
28	Multi-drop serial support (e.g., MicroNOMAD <sup>®2</sup> )
29	Software-selectable DPM address (SET_DPM_ADDR)
30	Multiple devices (e.g., 919)
31	Software-selectable ADC gate mode (SET_GATE...)
32	Software-downloadable firmware
33	Time histogramming functions available (e.g., 9308)
34	Software-selectable lower level discriminator
35	Software-selectable upper level discriminator
36	MCS-mode SCA input available
37	MCS-mode positive TTL input available
38	MCS-mode fast-negative NIM input available
39	MCS-mode discriminator input available
40	Software-switchable MCS-mode discriminator edge
41	Software-programmable MCS-mode discriminator level

<b><u>Bit</u></b>	<b><u>Meaning</u></b>
42	Software-programmable SCA upper and lower thresholds
43	Software-selectable MCS-mode input sources
44	Uncertainty/statistical preset (SET_UNCERT_PRES)
45	Features vary by input (SHOW_FEATURES depends on device/segment; multi-input MCBs only)
46	Software-selectable HV shutdown mode (SET/SHOW/VERI_SHUT)
47	Software-selectable shaping time constants (SET_SHAP)
48	Explorable shaping time constants (SHOW_CONFIG_SHAP)
49	Advanced shaping time (SET_SHAP_RISE, SET_SHAPE_FLAT, etc.)
50	Software-selectable BLR (ENA/DIS/SHO_BLR_AUTO SET/SHO/VERI_BLR)
51	SHOW_STATUS command supported (returns \$M record)
52	Overflow preset (ENA/DIS/SHO_OVER_PRES)
53	Software-enabled, MicroNOMAD-style audio clicker (ENA/DIS_CLICK)
54	Software-readable thermistor (SHOW_THERM)
55	Floating-point fine gain (SET/SHO/VERI/LIST_GAIN_FINE)
56	Software-enabled pileup rejector. (ENA/DIS/SHO_PUR, SET/VERI_WIDT_REJ)
57	Alpha-style HV power (SHOW_HV_CURRENT)
58	Software-readable vacuum (SHOW_VACUUM)
59	Acquisition alarms (ENA/DIS/SHO_ALARM)
60	Hardware acquisition trigger (ENA/DIS/SHO_TRIG)
61	Ordinal numbers for shaping times (SET_SHAP 0, SET_SHAP 1, ...)
62	Query gain ranges (LIST/VERI_GAIN_FINE, ..._COAR, ..._CONV)
63	Routable inputs (SET/SHOW_INPUT_ROUTE)
64	External dwell support (ENA/DIS_DWELL_EXT)
65	Selectable SUM or REPLACE MCS modes (ENA/DIS_SUM)
66	External start of pass support (ENA/DIS/SHO_START_EXT)
67	Explorable with MCS list commands (LIST_SOURCE, LIST_LLSCA & LIST_ULSCA)
68	Device supports the MDA preset
69	Software-selectable ADC type (Matchmaker™)
70	Has ability to daisy-chain MCBs (DART)
71	ZDT functions available (DSPEC Plus™)

<b>Bit</b>	<b>Meaning</b>
72	DSPEC Plus-style InSight triggering (LIST/SET_TRIG_SAMP)
73	Multiple inputs per connection (for example, OCTÊTE® Plus)
74	Hardware count-rate meter (SH_CRM)
75	Has multiple ZDT modes (SET/SHOW/LIST_MODE_ZDT)
76	Has multi-nuclide MDA preset
77	Has MCS Replace then Sum Mode (SET_RPLSUM)
78	Has programmable external dwell voltage capability 1
79	No Peak Preset feature (M <sup>3</sup> CA and OASIS)
80	Programmable pulser (OASIS)
81	Programmable Vacuum/HV interlock (OASIS)
82	Programmable Current/HV interlock (OASIS) 0
83	Explorable Stabilizer (LIST_GAIN_ADJU,LIST_ZERO_ADJU)
84	Has programmable input impedance (MCS)
85	Advanced shaping-time feature has no CUSP (digiDART)
86	Selectable HV rise-time (SET/SHOW/LIST_HV_RISE) (SBS-60)
87	—
88	Monitor command support (SHOW_MONI_MAX/LABEL/VALUE)
89	SMART-1 Detector support (SHOW_SMART_DET, SHOW_SNUM_DET, SHOW_HV_RECO)
90	Nuclide report (SET/SHOW_NUCL_COEF, SET/SHOW_ROI_NUCL, ...)
91	Interactive Display Features Such as Nuclide Report
92	Advanced Stored Spectra (SH_SPEC_COUNT, SET/SHOW_SPEC_ID, MOVE)



# 8. FIRMWARE COMMANDS AND RESPONSES

Most software communication with the digiDART will be through the CONNECTIONS-32 software layer. CONNECTIONS-32 is used by all ORTEC software and is available for other software development. Direct communication with the digiDART is not as simple and straight forward as the ASCII syntax. However, there are some situations where it is necessary to use direct communication. The direct syntax is explained in Section 8.2.

## 8.1. CONNECTIONS-32

In CONNECTIONS-32, the communication consists of sending command records to the MCB API and receiving response records from the MCB API. Both command and response records consist of a sequence of printable ASCII characters followed by an ASCII carriage return. The single exception to this rule is the “#B” response record for the WRITE command, which contains binary integer numbers. All commands eventually respond with a percent response record (so named because the response begins with an ASCII percent sign “%”) which signifies the completion of the command. SHOW and STEP commands respond with a dollar response record (which begins with an ASCII dollar sign “\$”) followed by a percent response record. The WRITE command can respond with multiple pound sign records (which begin with an ASCII pound sign “#”) but eventually completes by sending a percent response record. All other commands result in a single percent response record upon completion.

### 8.1.1. Command Records

Commands consist of a command header that may be followed by numeric parameter values. The header consists of a verb or a verb and noun separated by an underscore; or a verb, noun, and modifier, each separated by underscores. The verbs, nouns, and modifiers in the command header are mnemonic words such as the verb ENABLE or the noun OVERFLOW that relate to the function performed by the MCB API when it executes the command. The first four letters of any word will always be enough to uniquely identify the word when composing commands for an MCB API. For example, the command **ENABLE\_OVERFLOW\_PRESET** can be abbreviated to **ENAB\_OVER\_PRES**.

Numeric parameters follow the command header separated by one or more spaces. Specific commands require up to three parameters, separated by commas, which specify numeric quantities related to the operation of the MCB, such as live time or conversion gain. The command **SET\_WINDOW 0,16384** has two parameters, 0 and 16384, which set the window of interest to start at channel 0 and continue for 16384 channels.

Some parameters listed in the command dictionary are considered optional and are distinguished from mandatory parameters by being surrounded by brackets in the command prototype line

(e.g., **SET\_WINDOW [start,length]**). Commands that have optional parameters may be sent to the MCB API without the optional parameters, in which case the behavior will be changed as explained in the command description.

An optional checksum may be added to the end of any command sent to MCB API. The checksum is a 1-byte unsigned integer sum of all of the characters in a command, treated as unsigned integers, up to and including the comma or space(s) that separates the checksum from the command. The checksum simply appears as an extra parameter added to the end of the command parameter list. For commands that do not normally have parameters, the checksum appears as the only parameter separated from the header by one or more spaces. All optional parameters must be included in a command if a checksum is to be provided so that the checksum is not mistaken by the MCB API as a parameter. For example, the **SET\_WINDOW** command must include the two optional parameters, start and length, if the checksum is provided (e.g., **SET\_WINDOW 0,16384,209**).

### 8.1.2. Percent Response Records

The MCB API responds to all commands with a percent response record that signifies the completion of the command. Percent response records contain two error code numbers and a 1-byte checksum as follows:

**%aaabbbccc<CR>**

where % represents the ASCII % character, **aaa** represents the macro error code, **bbb** represents the micro error code, **ccc** represents the checksum and **<CR>** represents the ASCII carriage return character signifying the end of the record. The macro error code represents the general class of error with 0 meaning no error, and the micro error code represents the sub-class of error with 0 meaning no error. Following is a list of all percent responses for the digiDART.

Unconditional Success:

<b>%000000069&lt;CR&gt;</b>	No errors detected. Command executed as specified.
<b>%000005074&lt;CR&gt;</b>	Device already started or stopped. The <b>START</b> or <b>STOP</b> command was ignored.
<b>%000006075&lt;CR&gt;</b>	Device preset already exceeded. The <b>START</b> command was ignored.
<b>%000016076&lt;CR&gt;</b>	<b>START</b> requested but amplifier not pole-zeroed since last power-up. <b>START</b> was attempted anyway.
<b>%000032074&lt;CR&gt;</b>	<b>START</b> requested but high voltage not enabled <b>START</b> was attempted anyway.
<b>%000064079&lt;CR&gt;</b>	Specified parameter was rounded to the closest legal value.



Note that the above responses can be combined to indicate a combination of warnings such as:

<b>%000048081&lt;CR&gt;</b>	Amplifier was not pole-zeroed nor was high voltage enabled. The START was attempted anyway.
<b>%000037079&lt;CR&gt;</b>	Device already started and high voltage not enabled. The command was ignored.
<b>%000053077&lt;CR&gt;</b>	Device already started, high voltage not enabled and amplifier was not pole-zeroed. The command was ignored.
<b>%000038080&lt;CR&gt;</b>	Device preset already exceeded and high voltage not enabled. The command was ignored.
<b>%000054078&lt;CR&gt;</b>	Device preset already exceeded, high voltage not enabled and amplifier was not pole-zeroed. The command was ignored.

Power-Up Alert:

<b>%001000070&lt;CR&gt;</b>	Power-up just occurred and the selftest results are: All power-up selftest passed.
<b>%003000072&lt;CR&gt;</b>	Battery backed-up data lost.

Command Syntax Errors:

<b>%129001082&lt;CR&gt;</b>	Invalid command verb.
<b>%129002083&lt;CR&gt;</b>	Invalid command noun.
<b>%129003084&lt;CR&gt;</b>	Invalid command verb and noun.
<b>%129004085&lt;CR&gt;</b>	Invalid command modifier.
<b>%129005086&lt;CR&gt;</b>	Invalid command verb and modifier.
<b>%129006087&lt;CR&gt;</b>	Invalid command noun and modifier.
<b>%129007088&lt;CR&gt;</b>	Invalid command verb, noun, and modifier.
<b>%129132087&lt;CR&gt;</b>	Invalid command (verb, noun, and modifier valid but not together).

Communication Errors:

<b>%130001074&lt;CR&gt;</b>	Serial line buffer overrun.
<b>%130002075&lt;CR&gt;</b>	Serial line parity error.
<b>%130003076&lt;CR&gt;</b>	Serial line buffer overrun and parity error.
<b>%130004077&lt;CR&gt;</b>	Serial line framing error.
<b>%130005078&lt;CR&gt;</b>	Serial line buffer overrun and framing error.
<b>%130006079&lt;CR&gt;</b>	Serial line parity error and framing error.
<b>%130007080&lt;CR&gt;</b>	Serial line buffer overrun, parity error, and framing error.
<b>%130008081&lt;CR&gt;</b>	Serial line break detected.
<b>%130128084&lt;CR&gt;</b>	Command checksum incorrect (only when optional checksum provided).
<b>%130129085&lt;CR&gt;</b>	Command (or WRITE handshake) record too long.
<b>%130131078&lt;CR&gt;</b>	WRITE command aborted by "HA" handshake.

**%130132079<CR>** WRITE command aborted by timeout.  
**%130133080<CR>** WRITE command aborted by invalid handshake.

#### Execution Errors:

**%131128085<CR>** Invalid 1st command parameter.  
**%131129086<CR>** Invalid 2nd command parameter.  
**%131130078<CR>** Invalid 3rd command parameter.  
**%131132080<CR>** Invalid number of command parameters.  
**%131134082<CR>** Invalid device or segment selected.  
**%131135083<CR>** Command not allowed while acquisition in progress.  
**%131136084<CR>** Command not allowed in current mode of operation.  
**%131137085<CR>** Hardware failure detected while processing command.

### 8.1.3. Dollar Response Records

SHOW and STEP commands respond with a single dollar response record followed immediately by a percent response record. All valid dollar response records for each command are listed in the command dictionary.

The following list provides the general form of each dollar response record for the MCB API. In this list, lower case letters represent numeric values. The letters “ccc” always represent an 8-bit unsigned checksum of all characters on the record up to but not including the checksum characters, and <CR> represents the ASCII carriage return character.

**\$Axxxccc<CR>** xxx is a single 8-bit unsigned number.  
**\$Cxxxxxccc<CR>** xxxxx is a single 16-bit unsigned number.  
**\$Dxxxxxyyyyyccc<CR>** xxxxx and yyyyy are 16-bit unsigned numbers.  
**\$Exxxxxccc<CR>** xxxxx is a single 16-bit alarm mask.  
**\$Fssss...<CR>** ssss... is a variable length ASCII character sequence (no checksum is sent with this record).  
**\$Gxxxxxxxxxxxccc<CR>** xxxxxxxxxxx is a single 32-bit unsigned number.  
**\$IT<CR>** True response to a SHOW command (no checksum).  
**\$IF<CR>** False response to a SHOW command (no checksum).  
**\$Jxxxxxyyyyy...ccc<CR>** Response to SHOW\_CONFIGURATION command.  
**\$Mxxxxxxxxxxx...ccc<CR>** Response to SHOW\_STATUS command.  
**\$Nxxxyyyzzzccc<CR>** xxx, yyy, and zzz are 8-bit unsigned numbers.

### 8.1.4. Command Catalog

This section lists each command with a description of its operation. The descriptions include a list of any unusual responses that may result. As described in previous sections, the usual

response from a command is a **%000000069<CR>** response, which represents a macro error code of 0 and a micro error code of 0 (no errors).

All execution error responses, if any, are listed for each command. Though syntax and communication error responses may result from any command, in practice, these error responses rarely occur on systems with reliable communication hardware running debugged software. Refer to Section 8.1.2 for information about error responses.

In the following catalog, the commands are listed in alphabetical order, each starting with a command prototype line. Upper-case letters, numeric digits, blank spaces, and special symbols such as the underscore ( `_` ) and comma ( `,` ) in the prototype line are *literal text to be sent to the MCB exactly as they appear*. Lower-case letters in the prototype line represent numeric values as described in the accompanying text and should not be sent literally to the MCB but should be *replaced by an appropriate numeric value*. Lower-case letters enclosed in quotes represent *alphanumeric character strings* rather than numerical values. Items in the command prototype that are surrounded by square brackets “[...]” are optional items and are not always required.

In this section the term `<CR>` represents the ASCII carriage return character, decimal value 13, and the character “`_`” represents the ASCII underscore character, decimal value 95.

## **CLEAR**

The channels of spectral data in the window of interest (see `SET_WINDOW` command) are set to zero. The live time and true time counters are also set to zero. This command is equivalent to the combination of `CLEAR_COUNTERS` and `CLEAR_DATA` commands.

## **CLEAR\_ALL**

This command is equivalent to the combination of `CLEAR_COUNTERS`, `CLEAR_DATA`, `CLEAR_PRESETS`, and `CLEAR_ROI` commands.

### Execution Errors:

**%131135083<CR>**

The command was attempted while spectrum acquisition was in progress. No action was taken.

## **CLEAR\_COUNTERS**

The live time and true time counters are set to zero.

## **CLEAR\_DATA**

The channels of spectral data in the window of interest (see `SET_WINDOW` command) are set to zero. The ROI flags are not changed, nor are the presets changed.

## **CLEAR\_HV\_HEALTH**

Clears (resets) the state-of-health bits.

### **CLEAR\_MDA\_PRESET**

Clears all MCA preset values. This command is used to quickly clear the list of MDA preset values.

### **CLEAR\_NUCLIDE** [PeakNumber]

Clears all parameters for a specific nuclide peak number. This command is used to quickly clear the list of nuclide values.

### **CLEAR\_NUCLIDE\_ALL**

Clears all nuclide values. This command is used to quickly clear the list of nuclide values.

### **CLEAR\_PRESETS**

The live time, true time, ROI integral, ROI peak, and overflow presets are all set to zero (disabled).

#### Execution Errors:

**%131135083<CR>**

The command was attempted while spectrum acquisition was in progress. No action was taken.

### **CLEAR\_ROI**

The region-of-interest flags for the channels in the window of interest (see SET\_WINDOW command) in the currently selected device (see SET\_DEVICE command) are cleared.

#### Execution Errors:

**%131135083<CR>**

The command was attempted while spectrum acquisition was in progress. No action was taken.

### **CLEAR\_SPECTRUM** num

Clears out the single spectrum (num) stored in stored spectrum memory. (num) is a number between 0 and the value returned by SHOW\_SPECTRUM\_COUNT.

### **CLEAR\_SOH**

Clear the state of health byte.

### **CLEAR\_SPECTRUM\_ALL**

Clears all stored spectra from stored spectrum memory.

### **CLOSE\_FILE** "filename"

Completes download of file to RAM Disk in the MCB. See OPEN\_FILE and WRITE\_FILE. This command may also be used to terminate a download to the FLASH without reprogramming the FLASH.

**CLOSE\_FILE\_FLASH** *crc*

Completes download of FLASH data. *Crc* is the CRC checksum of the data which was downloaded. See OPEN\_FILE\_FLASH and WRITE\_FILE\_FLASH.

**COMP**

Selects the computer mode for the communication replies.

**DISABLE\_BLRE\_AUTOMATIC**

Disables the automatic determination of baseline restorer time constant. See also ENABLE\_BLRE\_AUTOMATIC, SET\_BLRE, and SHOW\_BLRE.

**DISABLE\_DISPLAY**

Disables the spectrum display when the digiDART is disconnected from the PC.

**DISABLE\_GAIN\_STABILIZATION**

Stops stabilization of the gain peak while data is being acquired. The gain stabilization adjustment is held at its current value until either gain stabilization is reenabled with the ENABLE\_GAIN\_STABILIZATION command or reinitialized with the INITIALIZE\_GAIN\_STABILIZATION, SET\_GAIN\_PEAK or SET\_GAIN\_WIDTH command. See also SHOW\_GAIN\_STABILIZATION.

**DISABLE\_GATE\_ROUTE**

Disables the use of the gate input for routing spectra. this command is included for backward compatibility.

**DISABLE\_HV**

Turns off the high-voltage enable signal of the digiDART. See the section on the bias supply for more information about the high-voltage output. See also ENABLE\_HV and SHOW\_HV.

**DISABLE\_NAI**

Switches the stabilizers to Ge mode. See ENABLE\_NAI.

**DISABLE\_OPTI\_NEED**

Disables the reporting of an error when the digiDART has not been optimized.

**DISABLE\_OVERFLOW\_PRESET**

Disables the overflow preset. Channels that receive a count when they contain 2147483647 counts, the maximum number of counts, will roll over to zero counts if the overflow preset is disabled. See also ENABLE\_OVERFLOW\_PRESET and SHOW\_OVERFLOW\_PRESET.

### **DISABLE\_PZ\_AUTOMATIC**

Disables the automatic pole zero mode. See also ENABLE\_PZ\_AUTOMATIC.

### **DISABLE\_PZ\_NEED**

Disables the reporting of an error when the digiDART has not been pole zeroed.

### **DISABLE\_REMOTE**

Disables the recognition of commands on the alternate communication path. See also ENABLE\_REMOTE and SHOW\_REMOTE.

### **DISABLE\_THRESHOLD\_AUTOMATIC**

### **DISABLE\_THRESHOLD\_SAMPLE**

### **DISABLE\_TRIGGER\_SPECIAL**

No function in the digiDART. These commands have been included for backward compatibility.

### **DISABLE\_ZERO\_STABILIZATION**

Stops stabilization of the zero peak while data is being acquired. The zero stabilization adjustment is held at its current value until either zero stabilization is reenabled with the ENABLE\_ZERO\_STABILIZATION command or reinitialized with the INITIALIZE\_ZERO\_STABILIZATION, SET\_ZERO\_CHANNEL or SET\_ZERO\_WIDTH commands. See also SHOW\_ZERO\_STABILIZATION.

### **ENABLE\_BLRE\_AUTOMATIC**

Enables the automatic determination of baseline restorer time constant. See also DISABLE\_BLRE\_AUTO, SHOW\_BLRE, and SET\_BLRE.

### **ENABLE\_DISPLAY**

Enables the spectrum display when the digiDART is disconnected from the PC.

### **ENABLE\_GAIN\_STABILIZATION**

Enables the stabilization of the gain peak by the previously selected method, either Gauss mode or point mode (see SET\_MODE\_GAUSS and SET\_MODE\_POINT). See also DISABLE\_GAIN\_STABILIZATION, SHOW\_GAIN\_STABILIZATION, and INITIALIZE\_GAIN\_STABILIZATION.

### **ENABLE\_GATE\_ROUTE**

Included for backward compatibility.

**ENABLE\_HV**

Turns on the high-voltage enable output of the digiDART. See also `DISABLE_HV` and `SHOW_HV`.

Execution Errors:

`%131137085<CR>`

The high voltage could not be enabled due to a high voltage shutdown condition.

**ENABLE\_NAI**

Switches the stabilizers to NaI mode. The stabilizers use the “fine” adjustment in NaI mode and the “very fine” adjustment in Ge mode. See `DISABLE_NAI`.

**ENABLE\_OPTI\_NEED**

Enables the reporting of an error when the digiDART needs optimizing.

**ENABLE\_OVERFLOW\_PRESET**

Enables the overflow preset. Channels that receive a count when they contain 2147483647 counts, the maximum number of counts, will stop the acquisition if the overflow preset is enabled. The channel that caused the preset to complete will contain 2147483647 counts. See also `DISABLE_OVERFLOW_PRESET` and `SHOW_OVERFLOW_PRESET` commands.

**ENABLE\_PZ\_AUTOMATIC**

Enables the automatic pole zero mode. See also `DISABLE_PZ_AUTO` and `SHOW_PZ_AUTO`.

**ENABLE\_PZ\_NEED**

Enables the reporting of an error when the digiDART needs pole zeroing.

**ENABLE\_REMOTE**

Enables the recognition of commands on the alternate communication path. If this command is sent to the digiDART via Ethernet, it enables command recognition on the serial line.

**ENABLE\_THRESHOLD\_AUTOMATIC**

Enables automatic determination of the positive and negative thresholds. See also `DISABLE_THRESHOLD_AUTO`, `SHOW_THRESHOLD_AUTO`, `SET_THRESHOLD_NEGATIVE`, and `SET_THRESHOLD_POSITIVE`.

**ENABLE\_THRESHOLD\_SAMPLE****ENABLE\_TRIGGER\_SPECIAL**

No function; included for backward compatibility.

## **ENABLE\_ZERO\_STABILIZATION**

Enables the stabilization of the zero peak by the previously selected method, either Gauss mode or point mode (see SET\_MODE\_GAUSS and SET\_MODE\_POINT). See also DISABLE\_ZERO\_STABILIZATION, SHOW\_ZERO\_STABILIZATION, and INITIALIZE\_ZERO\_STABILIZATION.

## **INITIALIZE**

Returns the digiDART to the factory default settings.

### Execution Errors:

The INITIALIZE command simulates a power-down/power-up cycle for the MCB after a simulated loss of battery-backed-up memory.

### Response:

**%003000072<CR>** MCB Power-up occurred/Memory lost/No selftest errors  
(Normal Response for INITIALIZE command).

## **INITIALIZE\_GAIN\_STABILIZATION**

Resets the gain peak stabilization adjustment to unity (no adjustment). This value is reported as 2048 by the SHOW\_GAIN\_ADJUSTMENT command. See also SET\_GAIN\_ADJUSTMENT, ENABLE\_GAIN\_STABILIZATION, and DISABLE\_GAIN\_STABILIZATION.

## **INITIALIZE\_ZERO\_STABILIZATION**

Resets the zero peak stabilization adjustment to unity (no adjustment). This value is reported as 2048 by the SHOW\_ZERO\_ADJUSTMENT command. See also SET\_ZERO\_ADJUSTMENT, ENABLE\_ZERO\_STABILIZATION, and DISABLE\_ZERO\_STABILIZATION.

## **LIST\_BLRE**

Lists the valid settings of the baseline restore function.

## **LIST\_CORR\_FLAT**

Lists the valid settings of the flattop width.

## **LIST\_GAIN\_COARSE**

Lists the valid coarse-gain settings.

## **LIST\_GAIN\_FINE**

Lists the valid fine-gain settings.

## **LIST\_HV**

Lists the valid high-voltage settings.



**LIST\_ROI\_SAMPLE**

Lists the valid ROI sample settings.

**LIST\_SHAP\_CUSP**

Lists the valid cusp shape settings.

**LIST\_SHAP\_FLAT**

Lists the valid flattop width settings.

**LIST\_SHAPE\_RISE**

Lists the valid rise-time settings.

**LIST\_SHUT**

Lists the valid shutdown settings.

**LIST\_TRIG\_SAMPLE**

Lists the valid sample trigger settings.

**MOVE** <spectrum number>

This command copies the specified stored spectrum, calibration, and all parameters to the live memory along with the live time, real time, start time and date, live-time preset, real-time preset, ROI-integral preset, ROI-peak preset, and data ID string, if any (see SET\_ID). Spectrum number can be any value from 1 to the number of spectra stored.

Execution Errors:

**%131128085<CR>**

An invalid spectrum number was specified. No action was taken.

**%131135083<CR>**

Command was attempted while spectrum acquisition was in progress. No action was taken.

**OFF**

Turns the digiDART off.

**OPEN\_FILE** “filename.ext”

A filename is needed to open a file. Begins the download of a file to the RAM Disk by opening **filename.ext** on the RAM Disk. See WRITE\_FILE and CLOSE\_FILE.

**OPEN\_FILE\_FLASH**

Begins the download of a new FLASH (ROM DISK). This command removes all files on the RAM Disk except **autoexec.bat** and **ini83905.exe** to make room for **ROMDISK.ABS**. It also stops all acquisitions which are in progress. See WRITE\_FILE\_FLASH and CLOSE\_FILE\_FLASH. Not normally used.

## RESET

Resets the digiDART to the state just after power is applied. This command responds with a % response that indicates power-up just occurred.

## RESET\_REMOTE

Resets any UART error conditions when sent to the digiDART via the Ethernet.

## SAMPLE

Sending this command causes another waveform to be captured in InSight mode. This command is invalid when not in InSight mode.

### Execution Errors:

**%131136084<CR>** Command not allowed in current mode of operation.

## SET\_BLRE baseline

This sets the baseline restorer time constant to the value baseline. Baseline is in microseconds with a range from 10 to 100. The specified value is only used if automatic baseline restorer mode is disabled. See also ENABLE\_BLRE, DISABLE\_BLRE, and SHOW\_BLRE.

### Execution Warnings:

**%000064079<CR>** Value was rounded to the closest legal value.

## SET\_CONFIGURATION\_UART “bbbbbps”

Sets the baud rate, parity, number of data bits and the number of stop bits for serial port communication. The parameter is an ASCII string which specifies the settings where bbbbb is the baud rate with leading zeros if necessary, p is replaced with O, E, or N to indicate odd, even, or no parity, d is replaced with the number of data bits (5–8), and s is replaced with the number of stop bits (1–2). For example SET\_CONFIG\_UART “09600N81” sets the baud rate to 9600, disables parity checking, sets the number of bits to 8 and the number of stop bits to 1.

## SET\_CORRECTION\_FLAT value

This sets the flattop correction to value. The flattop correction is normally determined with the OPTIMIZE command. See also SHOW\_CORRECTION\_FLAT.

## SET\_DATA [start, chans],value

If the optional start and chans parameters are included in this command, the range of channels specified by start and chans is loaded with value. If start and chans are not specified, sets all channels of spectral data in the window of interest (see SET\_WINDOW command) to the specified value. ROI flags are not affected.

**SET\_DATA\_APPLICATION** “string1”,”string2”

This is used to store information in the digiDART internal memory that can be used by other programs, such as sample descriptions and energy calibrations. CONNECTIONS-32 makes use of this feature. String1 = the data identifier, 32 bytes maximum; string2 = the data, 128 bytes maximum.

**SET\_DATE** day,month,year

Sets the date stored in the battery backed-up system clock to the specified values. Day can be any value from 1–31; month any value from 1–12; and year any value from 0–99. The current date and time are stored for a device when an acquisition is started. See also SHOW\_DATE, SET\_TIME, and SHOW\_TIME.

**SET\_DATE\_START** day,month,year

Sets the start date to the specified values. Normally the start date and time are set automatically whenever a device is started with the START command. See also SHOW\_DATE\_START, SET\_TIME\_START, and SHOW\_TIME\_START.

**SET\_DELAY\_COLLECTION** value

Controls the pileup rejector by setting a width threshold such that if a fast channel discriminator pulse is wider than value, the pulse is rejected. This portion of the pileup rejector rejects pulses that are too close together to be detected separately by the fast channel. Value is in microseconds with a range from 0.250 to 6 in steps of 0.05. See also SHOW\_DELAY\_COLLECTION.

**SET\_DELAY\_SAMPLE** num

Delays the waveform collected in InSight mode by num points. Num must be between 0 and 65535. See also SHOW\_DELAY\_SAMPLE.

**SET\_DEVICE****SET\_DISPLAY****SET\_FRONT\_BYPASS**

Not used; included for backward compatibility.

**SET\_GAIN\_ADJUSTMENT** value

Sets the gain stabilization adjustment to an arbitrary value from –65535 to 65535. This adjustment is usually made only by the gain stabilizer, and reset to 0 with the INITIALIZE\_GAIN\_STABILIZATION command. See also SHOW\_GAIN\_ADJUSTMENT.

Execution Errors:

**%131134082<CR>**

The command was attempted when the currently selected device was other than device 1.

**SET\_GAIN\_CHANNEL chan**

Sets the center channel for the stabilizer gain peak. If a gain channel is chosen such that the beginning channel or ending channel would be below channel 0 or above the maximum channel as determined by the conversion gain, the gain peak width is reduced until the peak fits the device boundaries. A gain channel and width must be set before gain stabilization can be enabled.

Execution Errors:**%131128085<CR>**

The specified channel number would create a peak that was less than the minimum width (3 channels) or would be outside the device's range.

**%131136084<CR>**

The command was attempted while gain stabilization was enabled.

**SET\_GAIN\_COARSE num**

This sets the coarse gain to num, which must be 1, 2, 4, 8, 16, or 32. See also SHOW\_GAIN\_COARSE.

**SET\_GAIN\_CONVERSION chans**

Sets the conversion gain. The conversion gain defines the number of channels within the device that will be used for spectral data. This has the effect of altering the resolution of the ADC from 14 bits (conversion gain = 16384) to 9 bits (conversion gain = 512) for the device. See also SHOW\_GAIN\_CONVERSION.

Legal Commands:**SET\_GAIN\_CONVERSION 0<CR>**

Conversion gain set to default (16384).

**SET\_GAIN\_CONVERSION 512<CR>**

Conversion gain set to 512 channels.

**SET\_GAIN\_CONVERSION 1024<CR>**

Conversion gain set to 1024 channels.

**SET\_GAIN\_CONVERSION 2048<CR>**

Conversion gain set to 2048 channels.

**SET\_GAIN\_CONVERSION 4096<CR>**

Conversion gain set to 4096 channels.

**SET\_GAIN\_CONVERSION 8192<CR>**

Conversion gain set to 8192 channels.

**SET\_GAIN\_CONVERSION 16384<CR>**

Conversion gain set to 16384 channels.

**SET\_GAIN\_FINE value**

This sets the fine gain to value. Value is a floating point value from 0.45 to 1.0. See also SHOW\_GAIN\_FINE.

**SET\_GAIN\_NEGATIVE**

This sets the amplifier input polarity to negative.

**SET\_GAIN\_POSITIVE**

This sets the amplifier input polarity to positive.

**SET\_GAIN\_WIDTH** chans

Sets the width in channels for the stabilizer gain peak. The gain width must be chosen such that the beginning channel is no lower than channel 0 and the ending channel is no higher than the maximum channel as determined by the conversion gain. The gain channel and width must be set before gain stabilization can be enabled. The absolute minimum width for the gain peak is 3 channels, and the absolute maximum width for the gain peak is 256 channels in Gauss mode. In point mode there is no maximum peak width, though the chosen width must allow the peak to fit within the device's channel limits as stated above. See also `SHOW_GAIN_WIDTH`, `SET_GAIN_CHANNEL` and `SHOW_GAIN_CHANNEL`.

Execution Errors:

**%131128085<CR>** The specified number of channels would create a peak that was less than the minimum (3 channel) width or would be outside the device's range.

**%131136084<CR>** The command was attempted while gain stabilization was enabled.

**SET\_GATE\_ANTICOINCIDENT**

Causes the digiDART to use the ADC gate input signal in anticoincident mode. See also `SET_GATE_OFF`, `SET_GATE_COINCIDENT`, and `SHOW_GATE`.

**SET\_GATE\_COINCIDENT**

Causes the digiDART to use the ADC gate input signal in coincident mode. See also `SET_GATE_OFF`, `SET_GATE_ANTICOINCIDENT`, and `SHOW_GATE`.

**SET\_GATE\_OFF**

Causes the digiDART to ignore the state of the ADC gate input signal. See also `SET_GATE_COINCIDENT`, `SET_GATE_ANTICOINCIDENT`, and `SHOW_GATE`.

**SET\_HV** value

This sets the HV bias to value, in volts.

**SET\_ID** “<id string>”

Sets the sample id string. This string can be up to 16 characters long and can be set to any arbitrary value. The id string is intended to uniquely identify the sample being analyzed. The id string is also set by the `BARCODE` command and is stored with each spectrum acquired in field mode. See also `SHOW_ID`.

Execution Errors:

**%131132080<CR>** No ID string was specified. No action was taken.

Examples:

**SET\_ID “Site 123”**

**SET\_ID “Sample 123456789”**

### **SET\_INTEGRAL\_PRESET** count

Sets the ROI integral preset to the specified count. During data acquisition when the sum of the counts contained in the channels that have the ROI flag set reaches the integral preset count, the preset is complete and the acquisition is stopped. The actual number of counts in the ROI integral may exceed the preset value by up to 512 counts due to the pipelined architecture of the digiDART. Setting an integral preset to 0 counts disables the preset. The integral preset may be set to from 0 (disabled) to 4294967295 counts. See also **CLEAR\_PRESETS** and **SHOW\_INTEGRAL\_PRESET**.

#### Execution Errors:

**%131135083<CR>** The command was attempted while spectrum acquisition was in progress. No action was taken.

### **SET\_LENGTH\_SAMPLE** length

Sets the number of points in the InSight mode display to the specified value. Normally this setting would remain at 1000.

### **SET\_LIVE** ticks

Sets the live-time counter to the specified number of ticks. The number represents live time in units of 20 ms (50 ticks/s). Normally this value is set by the digiDART during data acquisition. See also **CLEAR\_COUNTERS** and **SHOW\_LIVE**.

#### Execution Errors:

**%131135083<CR>** The command was attempted while spectrum acquisition was in progress. No action was taken.

### **SET\_LIVE\_PRESET** ticks

Sets the live-time preset to the specified number of ticks (20 ms/tick). During data acquisition when the live-time counter reaches the preset number of ticks, the preset is complete and the acquisition is stopped. The preset should always be set to a multiple of 1 second. Setting a live-time preset to 0 ticks disables the preset. See also **CLEAR\_PRESETS** and **SHOW\_LIVE\_PRESET**.

#### Execution Errors:

**%131135083<CR>** The command was attempted while spectrum acquisition was in progress. No action was taken.

### **SET\_LLD** chan

Sets the lower level discriminator to chan, which must be between 0 and 16383. See also **SHOW\_LLD**.

### **SET\_MDA\_COEF** a,b,c

Sets the coefficients in the MDA preset calculation to the specified values. A, b, and c are floating-point values. The MDA preset checks for the following condition to be met:

$$MDA\ Preset_i > \frac{a + \sqrt{b + c * Counts_{inROI_i}}}{Live\ Time}$$

The calculation is performed once every 30 seconds with  $i$  starting at 0 and advancing through each of up to 20 unique MDA presets.  $i$  only advances once the preset has been met. Note that  $a$ ,  $b$ , and  $c$  are the same for each of the unique presets. Only the ROI range and the MDA preset change when  $i$  advances. Once  $i$  reaches 20 or  $MDAPreset_i$  equals 0, the acquisition terminates.

#### **SET\_MDA\_PRESET** MDAPreset,[PeakNumber]

Sets or reports the MDAPreset PeakNumber value as shown in the equation in the SET\_MDA\_COEF description above. MDAPreset is usually the product of the desired MDA, the yield and the efficiency. PeakNumber is a parameter that specifies which of up to 20 (0–19) MDA presets to change. If PeakNumber is omitted in the set command, all MDA preset values will be set to 0 (disabled), and the supplied value will be applied to MDA Preset 0. This provides compatibility with old GammaVision products.

#### **SET\_MODE\_PHA**

The mode is set to PHA.

#### **SET\_MODE\_SAMPLE**

Starts InSight Virtual Oscilloscope mode.

#### **SET\_NUCLIDE\_COEF** NucCoef, [PeakNumber]

Sets or reports the NucCoef PeakNumber value as shown in the equation above. NucCoef is usually the product of the yield and the efficiency. PeakNumber is a parameter that specifies which of up to 9 (0–8) peaks to change. The coefficient can be any value from 0 to 65535.996 in steps of 1/256. (The add-in will convert the value to an unsigned long with a binary point between the left of the least significant byte.)

#### **SET\_NUCLIDE\_DESC** PeakNumber,"NucLabel"

Sets the nuclide label for the specified peak to the specified value. The label must be 6 characters or less.

#### **SET\_NUCLIDE\_UNITS** "units"

Sets the activity units to the specified string. The string may be no more than 6 characters.

**SET\_PEAK\_PRESET** count

Sets the ROI peak preset to the specified count. During data acquisition when the contents of any channel of a device that has the ROI flag set reaches the peak preset count, the preset is complete and the acquisition is stopped. The actual number of counts in the ROI peak may exceed the preset value by a small number of counts due to the pipelined architecture of the digiDART. Setting a peak preset to 0 counts disables the preset. The peak preset may be set to from 0 (disabled) to 2147483647 counts. See also CLEAR\_PRESETS and SHOW\_PEAK\_PRESET.

Execution Errors:**%131135083<CR>**

The command was attempted while spectrum acquisition was in progress. No action was taken.

**SET\_PZ** num

This sets the pole zero to num, which must be between 0 and 4095. See also ENABLE\_PZ\_AUTO, SHOW\_PZ, and DISABLE\_PZ\_AUTO.

**SET\_RADIX\_BINARY**

Not used; included for backward compatibility.

**SET\_ROI** start\_chan,number\_of\_chans

Sets the ROI flags for the specified channels. This command can be used multiple times to set ROI flags without affecting previously set flags. ROI flags specify channels within a device that are considered for ROI integral and ROI peak presets.

**SET\_ROI\_MDA** start,numchans, [PeakNumber]

Sets the region to use to compute the gross counts in the MDA calculation. PeakNumber is an optional parameter (assumed 0 if not present) that specifies which of up to 20 (0–19) MDA Presets to change.

**SET\_ROI\_NUCLIDE** start,numchans, [PeakNumber]

Sets the region to use to compute the net counts in the activity calculation. PeakNumber is an optional parameter (assumed 0 if not present) that specifies which of up to 9 (0–8) peaks to change.

**SET\_ROI\_SAMPLE** num

Selects which controls signals are displayed as an ROI on the captured waveform. Only a single bit can be turned on at a time. The following signals can be selected with the associated bit.

- Bit 0:** Pileup reject.
- Bit 1:** Negative baseline threshold.
- Bit 2:** Baseline restorer gate.



<b>Bit 3:</b>	Positive baseline threshold.
<b>Bit 4:</b>	Busy.
<b>Bit 5:</b>	Gate.
<b>Bit 6:</b>	Reserved.
<b>Bit 7:</b>	Peak detect.
<b>Bit 8:</b>	Reserved.

**SET\_ROI\_UNCERTAINTY** start, chans

Sets the region to be used for the uncertainty preset calculation. See also SHOW\_ROI\_UNCERTAINTY.

**SET\_SEGMENT****SET\_SHAPE\_CUSP**

Not used; included for backward compatibility.

**SET\_SHAP\_FLAT** value

Sets the width of the flattop to value. Value is in microseconds, ranging from 0.3 to 2.4 in steps of 0.1. See also SHOW\_SHAP\_FLAT.

**SET\_SHAP\_RISE** value

Sets the rise time to value. Value is in microseconds, ranging from 0.2 to 23 in steps of 0.2. See also SHOW\_SHAP\_RISE.

**SET\_SHUTDOWN** index

Used in conjunction with the LIST\_SHUTDOWN command to set the high voltage shutdown setting. Index specifies a position in the list of legal shutdown settings which were displayed with the LIST\_SHUTDOWN command.

Example:

<b>SET_SHUT 0</b>	Sets the SHUTDOWN to TTL.
<b>SET_SHUT 1</b>	Sets the SHUTDOWN to ORTEC.
<b>SET_SHUT 2</b>	Sets the SHUTDOWN to SMART1

**SET\_SHUTDOWN\_ORTEC**

This sets the bias shutdown mode to ORTEC. See page 13.

**SET\_SHUTDOWN\_SMART1**

Sets the bias shutdown mode to SMART-1. See page 13.

**SET\_SHUTDOWN\_TTL**

This sets the bias shutdown mode to TTL. See page 13.

**SET\_THRESHOLD\_NEGATIVE** value

Sets the negative threshold to value. The negative threshold is normally set automatically by the digiDART. See also **ENABLE\_THRESHOLD\_AUTOMATIC** and **SHOW\_THRESHOLD\_NEGATIVE**.

**SET\_THRESHOLD\_POSITIVE** value

Sets the positive threshold to value. The positive threshold is normally set automatically by the digiDART. See also **ENABLE\_THRESHOLD\_AUTOMATIC** and **SHOW\_THRESHOLD\_POSITIVE**.

**SET\_TIME** hour,min,sec

Sets the time stored in the battery backed-up system clock to the specified values. hour can be any value from 0–23; min and sec can be any value from 0–59. The current date and time are stored for a device when an acquisition is started. See also **SHOW\_TIME**, **SET\_DATE**, **SHOW\_DATE**, **SET\_TIME\_START**, and **SHOW\_TIME\_START**.

Execution Errors:

**%131137085<CR>** The time could not be set due to a hardware malfunction.  
Hardware service may be required.

**SET\_TIME\_START** hour,min,sec

Sets the start time to the specified values. Normally the start date and time are set automatically whenever a device is started with the **START** command. See also **SHOW\_TIME\_START**, **SET\_DATE\_START**, **SHOW\_DATE\_START**, **SET\_DATE**, and **SET\_TIME**.

**SET\_TRIG\_SAMPLE** setting

Selects the triggering source in InSight Mode. See **LIST\_TRIG\_SAMP** for legal trigger sources.

**SET\_TRUE** ticks

Sets the true-time counter to the specified number of ticks. The number represents true time in units of 20 ms (50 ticks/sec). Normally this value is set by the digiDART during data acquisition. See also **CLEAR\_COUNTERS** and **SHOW\_TRUE**.

Execution Errors:

**%131135083<CR>** The command was attempted while spectrum acquisition was in progress. No action was taken.

**SET\_TRUE\_PRESET** ticks

Sets the true-time preset to the specified number of ticks (20 ms/tick). During data acquisition when the true-time counter reaches the preset number of ticks, the preset is complete and the acquisition is stopped. Setting a true-time preset to 0 ticks disables the

preset. The preset should always be set to a multiple of one second. See also `CLEAR_PRESETS` and `SHOW_TRUE_PRESET`.

Execution Errors:

**%131135083<CR>**

The command was attempted while spectrum acquisition was in progress. No action was taken.

**SET\_ULD** value

This sets the upper level discriminator to value, in channels.

**SET\_UNCERTAINTY\_PRESET** percent

Sets the uncertainty preset to the specified value in percent. percent is a floating point value from 0–99.9999. See also `SHOW_UNCERTAINTY_PRESET`.

**SET\_WINDOW** [start, length]

Sets the window of interest to the specified start channel and number of channels. The channels of spectral data in the window of interest are affected by commands such as `CLEAR`, `SET_DATA`, and `WRITE`. If neither start nor length is provided, the window is set to the maximum size allowed by the conversion gain specified. The window of interest is always set to the maximum size after a `SET_DEVICE` command or a `SET_SEGMENT` command.

Execution Errors:

**%131128085<CR>**

The start channel was higher than the conversion gain.

**%131129086<CR>**

The length specified one or more channels that were too high conversion gain.

**%131132080<CR>**

The start channel was specified without a length. If one value is given, the other must also be given.

**SET\_ZERO\_ADJUSTMENT** value

Sets the zero stabilization adjustment to an arbitrary value from –65535 to 65535. The total range of the adjustment value represents  $\pm 256$  channels. This adjustment is usually only made by the gain stabilizer, and reset to 0 with the `INITIALIZE_ZERO_STABILIZATION` command. See also `SHOW_ZERO_ADJUSTMENT`.

**SET\_ZERO\_CHANNEL** chan

Sets the center channel for the stabilizer zero peak. If a zero channel is chosen such that the beginning channel or ending channel would be below channel 0 or above the maximum channel, as determined by the conversion gain, the zero peak width is reduced until the peak fits the device boundaries. A zero channel and width must be set before zero stabilization can be enabled. See also `ENABLE_ZERO_STABILIZATION`.

Execution Errors:

**%131128085<CR>**

The specified channel number would create a peak that was less than the minimum width (3 channels) or would be outside the device's range.

**%131136084<CR>**

The command was attempted while zero stabilization was enabled.

**SET\_ZERO\_WIDTH** chans

Sets the width in channels for the stabilizer zero peak. The zero width must be chosen such that the beginning channel is no lower than channel 0 and the ending channel is no higher than the maximum channel as determined by the conversion gain. The zero channel and width must be set before zero stabilization can be enabled. The absolute minimum width for the zero peak is 3 channels, and the absolute maximum width for the zero peak is 256 channels in Gauss mode. In point mode there is no maximum peak width, though the chosen width must allow the peak to fit within the device's channel limits as stated above.

Execution Errors:

**%131128085<CR>**

The specified number of channels would create a peak that was less than the minimum width (3 channels) or would be outside the devices range.

**%131136084<CR>**

The command was attempted while zero stabilization was enabled.

**SHOW\_ACTIVE**

Returns a 1 if the digiDART is active (i.e., acquiring spectral data) or 0 if it is not active.

Responses:

**\$C00000087<CR>**

Not active.

**\$C00001088<CR>**

Active.

**SHOW\_ADC\_CONV**

Returns the ADC conversion gain.

**SHOW\_BLRE**

Shows the baseline restorer time constant in microseconds. See also SET\_BLRE.

Responses:

**BLUE 000000000000091**

Time constant is 91  $\mu$ s.

**SHOW\_BLRE\_AUTOMATIC**

Shows whether automatic selection of the baseline restorer constant is off or on.

Responses:

**\$IT<CR>**

Automatic baseline is enabled.

**\$IF<CR>**

Automatic baseline is disabled.

**SHOW\_CONFIGURATION**

Returns a record that indicates the hardware configuration of the MCB. The record contains information about the number of segments in an MCB device (always 1 for the digiDART), and the current conversion gain for each segment. The record is organized as follows:

**\$J1638400001aaaaa00000[65 zeros here for total of 75 zeros]00000ccc**

where **aaaaa** represents the conversion gain for the one and only segment in the currently selected device, and **ccc** represents the record checksum. See the section on response records in this chapter for more information about response records and checksums.

**SHOW\_CONFIGURATION\_MASK**

Returns two masks, the first of which can be “anded” with data from the MCB to clear the ROI bit from the data. When the second mask value is “anded” with data from the MCB, the data bits are removed and only the ROI bit remains.

Response:

**CONF\_MASK 02147483647 02147483648**

**SHOW\_CONFIGURATION\_UART**

Reports the baud rate, parity option, number of data bits, and number of stop bits for the serial interface.

Responses:

<b>\$F09600N81</b>	9600 baud, no parity, 8 data bits, 1 stop bit.
<b>\$F19200E82</b>	19200 baud, even parity, 8 data bits, 2 stop bits.
<b>\$F02400O71</b>	2400 baud, odd parity, 7 data bits, 1 stop bits.

**SHOW\_CORRECTION\_FLAT**

Shows the flattop correction value. See also SET\_CORR\_FLAT.

Responses:

**CORR\_FLAT 0000000000000000**

**SHOW\_CRM**

Returns the current reading of the count-rate meter.

Response:

**\$G0000050781096** Current input count rate is 50781 counts/s.

**SHOW\_DATA\_APPLICATION “string”**

If string matches “string1” in a previous SET\_DATA\_APPLICATION command, then string2 from that command is returned. The response is a \$F record.

Execution Errors:

**%131138085<CR>** The specified string could not be matched.

## SHOW\_DATE

Returns the day, month, and year of the current date as maintained in the battery-backed-up real time clock, in the form dddmmmyyy. The day is returned as a 3-digit integer number from 001–031, month as a 3-digit integer number from 001–012, and year as a 3-digit integer number from 000–099. See also SET\_DATE\_START.

### Responses:

\$N001001088052<CR>	Date reported as Jan 1, 1988.
...	...
\$N031012099059<CR>	Date reported as Dec 31, 1999.
\$N001001000036<CR>	Date reported as Jan 1, 2000.
...	...
\$N031012087056<CR>	Date reported as Dec 31, 2087.

## SHOW\_DATE\_START

Returns the day, month and year of the acquisition start date in the form dddmmmyyy. The day is returned as a 3-digit integer number from 001–031, month as a 3-digit integer number from 001–012, and year as a 3-digit integer number from 000–099. See also SET\_DATE\_START.

### Responses:

\$N001001088052<CR>	Date reported as Jan 1, 1988
...	...
\$N031012099059<CR>	Date reported as Dec 31, 1999
\$N001001000036<CR>	Date reported as Jan 1, 2000
...	...
\$N031012087056<CR>	Date reported as Dec 31, 2087

## SHOW\_DEBUG

Shows the debug level of the software.

## SHOW\_DELAY\_COLLECTION

Shows the width of the PUR signal setting. See also SET\_DELAY\_COLLECTION.

### Responses:

DEL_COLL 0000000000001.6	Delay collection 1.6 seconds.
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## SHOW\_DELAY\_SAMPLE

Shows the Delay Sample setting. See also SET\_DELAY\_SAMPLE.

### Responses:

\$C00003090	The sample number is 00003, and 090 is the checksum.
-------------	--

**SHOW\_DET\_SMART**

Indicates whether the detector is SMART-1 and the shutdown mode is set for a SMART-1 HPGe Detector. Responses are true and false.

Responses:

**\$IT<CR>** SMART-1 shutdown set.  
**\$IF<CR>** TTL or ORTEC shutdown set.

**SHOW\_DET\_SNUM**

This command responds with the detector serial number stored in the DIM.

Response:

**\$FP40175** Serial number P40175.

**SHOW\_DET\_VERSION**

Returns the DIM firmware version.

Examples:

**\$FNAID000** NaI DIM firmware version.  
**\$FSMDT000** SMART-1 firmware version.

**SHOW\_DEV**

Shows the currently selected device. Always 1 for digiDART.

**SHOW\_FEATURES**

Responds with four 32-bit masks indicating which features are present in the MCB. See Appendix 7.3 for a complete description of each bit in the mask.

Example Response:

**FEATURES 02285062207 02014941185 00000000000 00000000000**

**SHOW\_GAIN\_ADJUST**

Returns the gain-stabilize amplifier setting.

**SHOW\_GAIN\_CHANNEL**

Reports the current center channel for the stabilizer gain peak. See also SET\_GAIN\_CHANNEL.

Responses:

**\$C00000087<CR>** Gain channel has not been set.  
**\$C00002089<CR>** Gain channel is channel 2 (lowest possible channel).  
 ...  
**\$C16382107<CR>** Gain channel is channel 16382 (highest possible channel).

## SHOW\_GAIN\_COARSE

Returns the coarse gain for the digiDART internal amplifier. In operation, the resulting signal gain is the product of the coarse gain, the fine gain, and the super-fine gain (used by stabilizer). The coarse gain is returned in terms of an integer gain multiplier.

### Responses:

<b>\$C00001088&lt;CR&gt;</b>	Coarse gain reported as 1.
<b>\$C00002089&lt;CR&gt;</b>	Coarse gain reported as 2.
<b>\$C00004091&lt;CR&gt;</b>	Coarse gain reported as 4.
<b>\$C00008095&lt;CR&gt;</b>	Coarse gain reported as 8.
<b>\$C00016094&lt;CR&gt;</b>	Coarse gain reported as 16.
<b>\$C00032092&lt;CR&gt;</b>	Coarse gain reported as 32.

## SHOW\_GAIN\_CONVERSION

This command returns the conversion gain.

### Responses:

<b>\$C00512095&lt;CR&gt;</b>	Conversion gain reported as 512 channels.
<b>\$C01024094&lt;CR&gt;</b>	Conversion gain reported as 1024 channels.
<b>\$C02048101&lt;CR&gt;</b>	Conversion gain reported as 2048 channels.
<b>\$C04096106&lt;CR&gt;</b>	Conversion gain reported as 4096 channels.
<b>\$C08192107&lt;CR&gt;</b>	Conversion gain reported as 8192 channels.
<b>\$C16384109&lt;CR&gt;</b>	Conversion gain reported as 16384 channels.

## SHOW\_GAIN\_FINE

Returns the current fine gain setting. See SET\_GAIN\_FINE.

### Sample Response:

<b>GAIN_FINE 000000000000.5</b>	Parameter is set to 0.5.
---------------------------------	--------------------------

## SHOW\_GAIN\_POLARITY

Returns the polarity of the amplifier input as \$F records.

### Responses:

<b>\$INEG&lt;CR&gt;</b>	The amplifier input is set to negative.
<b>\$IPOS&lt;CR&gt;</b>	The amplifier input is set to positive.

## SHOW\_GAIN\_STABILIZATION

Reports the state of gain peak stabilization. See also ENABLE\_GAIN\_STABILIZATION and DISABLE\_GAIN\_STABILIZATION.

### Responses:

<b>\$IT&lt;CR&gt;</b>	Gain stabilization is currently enabled.
<b>\$IF&lt;CR&gt;</b>	Gain stabilization is currently disabled.



**SHOW\_GAIN\_WIDTH**

Reports the current width for the stabilizer gain peak. See also SET\_GAIN\_WIDTH, SET\_GAIN\_CHANNEL, and SHOW\_GAIN\_CHANNEL.

Responses:

<b>\$C00001088&lt;CR&gt;</b>	Gain width has not been set.
<b>\$C00003089&lt;CR&gt;</b>	Gain width is 3 channels (lowest possible width).
...	...
<b>\$C00256100&lt;CR&gt;</b>	Gain width is 256 channels (highest possible width in Gauss mode).
...	...
<b>\$C16383108&lt;CR&gt;</b>	Gain width is 16383 channels (highest possible width in point mode with gain channel set to 8192).

**SHOW\_GATE**

Reports the current mode of operation of the ADC gate input. See also SET\_GATE\_OFF, SET\_GATE\_COINCIDENT, and SET\_GATE\_ANTICOINCIDENT.

Responses:

<b>\$FOFF&lt;CR&gt;</b>	Reports the ADC gate is off or ignored.
<b>\$FCOI&lt;CR&gt;</b>	Reports the ADC gate is in coincident mode.
<b>\$FANT&lt;CR&gt;</b>	Reports the ADC gate is in anticoincident mode.

**SHOW\_HV**

Reports the current high voltage and the status of the high voltage power supply in the form

**\$Dvvvvvsssssccc.**

Where vvvvv represents the current output voltage if the high voltage is enabled, or the rear-panel high voltage setting if the high voltage is disabled. ssss represents the status of the high voltage bias supply as a 16-bit decimal number with the following bit definitions:

<b>Bit 0 (LSB):</b>	Bias supply polarity (0=positive, 1=negative).
<b>Bit 1:</b>	Bias supply overload (0=overload, 1=normal).
<b>Bit 2:</b>	High voltage enabled (0=disabled, 1=enabled).

Example Responses:

<b>\$D0200000003077&lt;CR&gt;</b>	2000 V, negative, not overloaded, disabled.
<b>\$D0200000002076&lt;CR&gt;</b>	2000 V, positive, not overloaded, disabled.
<b>\$D0200000007082&lt;CR&gt;</b>	2000 V, negative, not overloaded, enabled.

**SHOW\_HV\_ACTUAL**

Returns the value of HV actually on the detector.

**SHOW\_HV\_HEALTH**

Returns the status of the state of health for the detector as reported by the DIM or SMART-1.

**SHOW\_HV\_RECOMMEND**

Returns HV, in ASCII, from SMART-1 detectors.

**SHOW\_HV\_TARGET**

Under normal operation, the HV will go to this value when the HV is enabled. Reports the current HV setting (see SET\_HV) and the status of the HV power supply in the form:

**\$Dvvvvvsssssccc<CR>**

where **vvvvv** represents the HV setting, and **sssss** represents the status of the HV bias supply as a 16-bit decimal number with the following bit definitions:

**Bit 0 (LSB):** Bias supply polarity (0=positive, 1=negative).

**Bit 1:** Bias supply overload (0=overload, 1=normal).

**Bit 2:** HV enabled (0=disabled, 1=enabled).

Example Responses:

**\$D0200000003077<CR>** 2000 V, negative, not overloaded, disabled.

**\$D0200000002076<CR>** 2000 V, positive, not overloaded, disabled.

**\$D0200000007082<CR>** 2000 V, negative, not overloaded, enabled.

**SHOW\_HV\_POLARITY**

This returns the HV polarity setting in the digiDART as a \$F record.

Responses:

**\$INEG<CR>** The HV is set to negative.

**\$IPOS<CR>** The HV is set to positive.

**SHOW\_ID**

Reports the sample ID string as was previously set by the SET\_ID command. The sample ID string is stored with each spectrum acquired in field mode and is restored with the field mode spectral data by the MOVE command.

Example Responses:

**\$Fsite 123<CR>** ID set to "Site 123".

**\$FSample 123456789<CR>** ID set to "Sample 123456789".

**SHOW\_INTEGRAL [start\_chan,number\_of\_chans]**

Reports the sum of the specified group of spectral data channels. If start\_chan and number\_of\_chans is not provided, SHOW\_INTEGRAL reports the sum of all channels in the currently selected segment that have their ROI flag set.

Responses:

**\$G0000000000075<CR>** Integral reported as 0.  
 ...  
**\$G4294967294131<CR>** Integral reported as 4294967294.  
**\$G4294967295132<CR>** Integral reported as greater than or equal to 4294967295  
 (maximum reportable value).

**SHOW\_INTEGRAL\_PRESET**

Reports the current ROI integral preset value. For more information about the ROI integral preset, see SET\_INTEGRAL\_PRESET. See also SHOW\_INTEGRAL.

Responses:

**\$G0000000000075<CR>** Integral preset reported as 0.  
 ...  
**\$G4294967295132<CR>** Integral reported as 4294967295.

**SHOW\_INTEGRAL\_REMAINING**

Reports the current ROI integral remaining value. For more information about the ROI integral remaining, see SET\_INTEGRAL\_REMAINING. See also SHOW\_INTEGRAL.

Responses:

**\$G0000000000075<CR>** Integral remaining reported as 0.  
 ...  
**\$G4294967295132<CR>** Integral reported as 4294967295.

**SHOW\_LENGTH\_SAMPLE**

Reports the number of points in the InSight Mode Waveform.

Response:

**\$C010000088** 1000 points in the waveform.

**SHOW\_LIVE**

Reports the contents of the live-time counter in units of 20 ms (50 ticks/s). See also CLEAR\_COUNTERS and SET\_LIVE.

Responses:

**\$G0000000000075<CR>** Live time reported as 0 ticks.  
**\$G0000000001076<CR>** Live time reported as 1 tick (20 ms).  
 ...  
**\$G4294967295132<CR>** Live time reported as 4294967295 ticks (over 23000 days).

**SHOW\_LIVE\_PRESET**

Reports the current live-time preset in units of 20 ms (50 ticks/s). See also CLEAR\_PRESETS and SET\_LIVE\_PRESET.

Responses:

**\$G0000000000075<CR>** Live-time preset reported as disabled.  
**\$G0000000001076<CR>** Live-time preset reported as 1 tick.  
...  
**\$G4294967295132<CR>** Live-time preset reported as 4294967295 ticks.

**SHOW\_LIVE\_REMAINING**

Reports the current live-time remaining in units of 20 ms (50 ticks/s). See also SET\_LIVE\_REMAINING.

Responses:

**\$G0000000000075<CR>** Live-time remaining reported as disabled.  
**\$G0000000001076<CR>** Live-time remaining reported as 1 tick.  
...  
**\$G4294967295132<CR>** Live-time remaining reported as 4294967295 ticks.

**SHOW\_LLD**

Shows the lower level discriminator setting. See also SET\_LLD.

Responses:

**\$C00050092** The LLD is 50.

**SHOW\_MARKER**

Returns the channel number of the marker.

**SHOW\_MDA [PeakNumber]**

Reports current MDA for the MDA Preset selected by PeakNumber. PeakNumber is assumed to be 0 if not supplied.

Example response:

**MDA 000000000010.7**

**SHOW\_MDA\_COEF**

Reports the current settings for coefficients a, b, and c used for the MDA calculation. See SET\_MDA\_COEF.

Example Responses:

**MDA\_COEF 00000000002.71 00000000000000 00000021.700001**  
Coefficient a = 2.71, b = 0, and c = 21.7.

**SHOW\_MDA\_PRESET [PeakNumber]**

Reports MDA preset PeakNumber. If PeakNumber is omitted, 0 is assumed.

Example Response:

**MDA\_PRES 0000000000025.7**

**SHOW\_MODE**

Reports the current mode of operation (PHA or Sample [InSight Virtual Oscilloscope]). See also SET\_MODE\_PHA and SET\_MODE\_SAMPLE.

Responses:

**\$FPHA<CR>**                      PHA mode.  
**\$FSAM<CR>**                      Sample mode (InSight).

**SHOW\_MODE\_STABILIZATION**

Reports the current stabilization mode of operation. See also SET\_MODE\_POINT and SET\_MODE\_GAUSS.

Responses:

**\$FPOINT<CR>**  
**\$FGAUSS<CR>**

**SHOW\_MODE\_TEST**

Reports whether the digiDART is in test mode and, if in test mode, which test mode is it in. This command is normally only used for testing at the factory.

Responses:

**\$A000ccc**                      Not in test mode.  
**\$A001ccc**                      ADC test mode.

**SHOW\_MONI\_LABEL num**

Returns with an ASCII string label designation for the monitor num.

**SHOW\_MONI\_MAX**

Returns with the number of monitors available for viewing.

**SHOW\_MONI\_VALUE num**

Returns with an ASCII representation of the value for the monitor.

**SHOW\_NAI**

Indicates whether ENABLE\_NAI has been sent. Responses are true and false.

Responses:

**\$IT<CR>**                      NaI mode enabled.  
**\$IF<CR>**                      NaI mode disabled.

**SHOW\_NEXT**

Used in conjunction with the SHOW\_ROI command, SHOW\_NEXT reports the next continuous group of channels that have the ROI flag set. The response is of the form

**\$Dssssnnnnccc<CR>**

where sssss represents an integer number that is the number of the first channel of the “next” group of channels that all have their ROI bit set, and nnnnn represents an integer number that is the number of channels in the group. If no more channels have their ROI bit set, SHOW\_NEXT returns a first channel of 0 and a number of channels of 0. The SHOW\_ROI command is used to report the “first” group of channels that all have their ROI bit set.

Example Responses:

**\$D0100000050078<CR>**      Next ROI group starts at channel 1000 and is 50 channels long.  
**\$D0215000150086<CR>**      Next ROI group starts at channel 2150 and is 150 channels long.  
**\$D0000000000072<CR>**      No other ROI groups to report.

**SHOW\_NUCLIDE** [PeakNumber]

Reports current activity and uncertainty for the nuclide selected by PeakNumber. PeakNumber is assumed to be 0 if not supplied.

Example:

**NUCLIDE 0000000000010.7 000000000001.2**      Activity is 10.7 and uncertainty is 1.2%.

**SHOW\_NUCLIDE\_COEFFICIENT** [PeakNumber]

Reports the coefficient for a specific peak as a floating-point number that corresponds to the number set with SET\_NUCLIDE\_COEF.

Example:

**NUCLIDE\_COEF 0000000000010.7**

**SHOW\_NUCLIDE\_DESC** PeakNumber

Reports the nuclide label for the specified peak in a \$F record.

**SHOW\_NUCLIDE\_UNITS**

Reports the nuclide activity units in a \$F record.

**SHOW\_OVERFLOW\_PRESET**

Reports the state of the overflow preset.

Responses:

**\$IT<CR>**      Overflow preset enabled.  
**\$IF<CR>**      Overflow preset disabled.

**SHOW\_PEAK**

This command returns the contents of the ROI channel with the largest number of counts. An ROI channel is a channel that has the ROI flag set. The maximum possible value is 2147483647, which is the maximum number of counts that can be stored in a 31-bit channel.

Responses:

<b>\$G0000000000075&lt;CR&gt;</b>	Maximum count in an ROI channel is zero or no ROI channels were found.
<b>\$G0000000001076&lt;CR&gt;</b>	Maximum count in an ROI channel is 1.
...	...
<b>\$G2147483646120&lt;CR&gt;</b>	Maximum count in an ROI channel is 2147483646.
<b>\$G2147483647121&lt;CR&gt;</b>	Maximum count in an ROI channel is 2147483647.

**SHOW\_PEAK\_CHANNEL**

This command returns the number of the ROI channel with the largest number of counts. An ROI channel is a channel that has the ROI flag set. The lowest number ROI channel with the largest count is reported if more than one channel contains the largest number of counts. Channel 16383 is the highest numbered channel in any device.

Responses:

<b>\$C00000087&lt;CR&gt;</b>	Maximum count was found in channel 0 or no ROI channels were found (see errors below).
<b>\$C00001088&lt;CR&gt;</b>	Maximum count was found in channel 1.
...	...
<b>\$C16382107&lt;CR&gt;</b>	Maximum count was found in channel 16382.
<b>\$C16383108&lt;CR&gt;</b>	Maximum count was found in channel 16383.

**SHOW\_PEAK\_PRESET**

Reports the value of the ROI peak preset. See SET\_PEAK\_PRESET for information about the ROI peak preset.

Responses:

<b>\$G0000000000075&lt;CR&gt;</b>	Peak preset disabled.
<b>\$G0000000001076&lt;CR&gt;</b>	Peak preset set to 1 count.
...	...
<b>\$G2147483646120&lt;CR&gt;</b>	Peak preset set to 2147483646 counts.
<b>\$G2147483647121&lt;CR&gt;</b>	Peak preset set to 2147483647 counts.

**SHOW\_PZ**

Displays the PZ setting. See also SET\_PZ.

Responses:

<b>PZ_ENA 002200</b>	Pole zero enabled and set to 2200.
<b>PZ_DIS 001000</b>	Pole zero disabled and set to 1000.

**SHOW\_PZ\_AUTOMATIC**

Shows the state of the automatic PZ. See also SET\_PZ\_AUTOMATIC.

Responses:

**\$IT<CR>** Pole zero enabled.  
**\$IF<CR>** Pole zero disabled (TRP).

**SHOW\_RADIX****SHOW\_RATE\_ZDT****SHOW\_REMOTE**

Not used; included for backward compatibility.

**SHOW\_ROI**

Used in conjunction with the SHOW\_NEXT command, SHOW\_ROI reports the first continuous group of channels that have the ROI flag set. The response is of the form

**\$Dssssnnnnnccc<CR>**

where ssss represents an integer number that is the number of the first channel of the “first” group of channels that all have their ROI bit set, and nnnnn represents an integer number that is the number of channels in the group. The SHOW\_NEXT command is used to report the “next” group of channels that all have their ROI bit set.

Responses:

**\$D0100000050078<CR>** First ROI group starts at channel 1000 and is 50 channels long.  
**\$D0215000150086<CR>** First ROI group starts at channel 2150 and is 150 channels long.  
**\$D0000000000072<CR>** No ROI groups to report.

**SHOW\_ROI\_MDA**

Reports the start channel and number of channels used in the MDA preset calculation.

Example Response:

**\$D0700000050ccc** Calculation is performed on channels 7000–7049.

**SHOW\_ROI\_NUCLIDE [PeakNumber]**

Reports the region to use to compute the counts in the activity calculation. PeakNumber (assumed 0 if not present) specifies which of up to 9 (0–8) peaks to report.

Example Response:

**\$D0083200052092** Region starts at channel 832 and is 52 channels wide.

**SHOW\_ROI\_SAMPLE**

Displays the ROI Sample setting. See also SET\_ROI\_SAMPLE.

Responses:

**\$C00001088**



**SHOW\_ROI\_UNCERTAINTY**

Reports the start channel and number of channels used in the uncertainty preset calculation. See also SET\_ROI\_UNCERTAINTY.

Response:

**\$D0700000050ccc** Calculation is performed on channels 7000–7049.

**SHOW\_SEGMENT**

Returns the current segment number. Always 1 for the digiDART.

**SHOW\_SHAPE\_CUSP**

Returns the current cusp shape factor. Always 1 for the digiDART.

**SHOW\_SHAP\_FLAT**

Reports the width of the flattop in  $\mu\text{s}$ . See also SET\_SHAP\_FLAT.

Responses:

**SHAP\_FLAT 0000000000001.2**

**SHOW\_SHAP\_RISE**

Displays the rise-time setting in  $\mu\text{s}$ . See also SET\_SHAP\_RISE.

Responses:

**SHAP\_RISE 0000000000003.2**

**SHOW\_SHUTDOWN**

Shows the type of HV shutdown selected.

Responses:

<b>\$FORT</b>	ORTEC mode selected.
<b>\$FTTL</b>	TTL mode selected.
<b>\$FSM1</b>	SMART-1 mode selected

**SHOW\_SHUT\_ACTUAL**

Returns the current status of the bias remote shutdown input signal. This command is valid whether the bias supply is turned on or off.

Responses:

<b>\$IT</b>	Shutdown is active (supply is shut down or can't be turned on).
<b>\$IF</b>	Shutdown is inactive (supply is on or can be turned on).

**SHOW\_SNUM**

Responds with a \$F record indicating the serial number of the digiDART.

Response:

**\$F100** Serial Number = 100.

**SHOW\_SOH**

Returns the state-of-health word for the detector.

**SHOW\_SPECTRUM num**

Copies the desired spectrum (num) from the stored spectrum memory to the active spectrum memory. (num) is a number between 0 and the value returned by SHOW\_SPECTRUM\_COUNT.

**SHOW\_SPECTRUM\_COUNT**

Returns with a response, where the number indicates the number of spectra in the stored spectrum memory.

**SHOW\_STATUS**

Returns system status information in the following format:

**\$Mlllllllllttttttttaaaaahhhhccc<CR>**

where **llllllll** represents the live time as returned by the SHOW\_LIVE command, **tttttttt** represents the true time for the current device as returned by the SHOW\_TRUE command, **aaaaa** represents the active device mask as returned by the SHOW\_ACTIVE\_DEVICES command, and **hhhhh** represents the hardware status, which is an ASCII representation of a 16 bit decimal number with the following bit definitions:

<b>Bit 0 (LSB):</b>	Bias supply polarity (0=positive, 1=negative)
<b>Bit 1:</b>	Bias supply overload (0=overload, 1=normal)
<b>Bit 2:</b>	High voltage enabled (0=disabled, 1=enabled)
<b>Bit 3:</b>	Unused
<b>Bit 4:</b>	Amplifier PZ'd since initialization (0=normal, 1=needs PZ'ing)
<b>Bit 5</b>	Optimization since initialization (0=normal, 1=needed)
<b>Bits 6–7:</b>	Unused
<b>Bit 8:</b>	Amplifier automatic PZ (1=Auto PZ in progress, 0=normal)
<b>Bit 9:</b>	Optimization (0=normal, 1=in progress)
<b>Bits 10–14:</b>	Unused
<b>Bit 15 (MSB):</b>	Reserved

**SHOW\_THRESHOLD\_AUTOMATIC**

See also SET\_THRESHOLD\_AUTOMATIC.

Responses:

<b>\$IT&lt;CR&gt;</b>	Automatic threshold is enabled.
<b>\$IF&lt;CR&gt;</b>	Automatic threshold is disabled.

**SHOW\_THRESHOLD\_NEGATIVE**

See also SET\_THRESHOLD\_NEGATIVE.

Responses:

**THR\_NEG 0000379791**      Negative threshold is 379791.

**SHOW\_THRESHOLD\_POSITIVE**

See also SET\_THRESHOLD\_POSITIVE.

Responses:

**THR\_POS 00000126811**      Positive threshold is 126811.

**SHOW\_TIME**

Reports the time from the battery backed-up system clock in the form

**\$Nhhmmssccc<CR>**

where hhh represents a 3-digit integer hour (0–23), mmm represents a 3-digit integer minute (0–59), and sss represents a 3-digit integer second (0–59). See also SET\_TIME, SET\_DATE, and SHOW\_DATE.

Example Responses:

**\$N010054017052<CR>**      Time returned 10:54:17 (10 h, 54 min, 17 s).

**\$N020013037050<CR>**      Time returned 20:13:37 (20 h, 13 min, 37 s).

**SHOW\_TIME\_START**

Reports the time of the last START command in the form

**\$Nhhmmssccc<CR>**

where hhh represents a 3-digit integer hour (0 through 23), mmm represents a 3-digit integer minute (0 through 59) and sss represents a 3-digit integer second (0 through 59). See also SET\_TIME\_START, SET\_DATE\_START, and SHOW\_DATE\_START.

Example Responses:

**\$N010054017052<CR>**      Time returned 10:54:17 (10 h, 54 min, 17 s).

**\$N020013037050<CR>**      Time returned 20:13:37 (20 h, 13 min, 37 s).

**SHOW\_TRIG\_SAMPLE**

Reports the trigger source in InSight Mode.

Responses:

**\$F0LLD**      LLD is source.

**\$F1PKD**      Peak-detect is source.

**\$F2RANDOM**      Trigger happens randomly.

**\$F3Gate**      Gate Input triggers the waveform.

**SHOW\_TRIGGER\_SPECIAL**

Not used; included for backward compatibility.

**SHOW\_TRUE**

Reports the contents of the true-time counter in units of 20 ms (50 ticks/s). See also CLEAR\_COUNTERS and SET\_TRUE.

Responses:

**\$G0000000000075<CR>**

True time reported as 0 ticks.

**\$G0000000001076<CR>**

True time reported as 1 tick (20 ms).

...

...

**\$G4294967295132<CR>**

True time reported as 4294967295 ticks (over 23000 days).

**SHOW\_TRUE\_PRESET**

Reports the current true-time preset in units of 20 ms (50 ticks/s). See also CLEAR\_PRESETS and SET\_TRUE\_PRESET.

Responses:

**\$G0000000000075<CR>**

True time preset reported as disabled.

**\$G0000000001076<CR>**

True time preset reported as 1 tick.

...

...

**\$G4294967295132<CR>**

True time preset reported as 4294967295 ticks.

**SHOW\_TRUE\_REMAINING**

Reports the current true time remaining in units of 20 milliseconds (50 ticks per second). See also SET\_TRUE\_REMAINING.

Responses:

**\$G0000000000075<CR>**

True time remaining reported as disabled.

**\$G0000000001076<CR>**

True time remaining reported as 1 tick.

...

...

**\$G4294967295132<CR>**

True time remaining reported as 4294967295 ticks.

**SHOW\_ULD**

Returns the value of the ULD in channels, as a \$C record.

**SHOW\_UNCERTAINTY**

Returns the current value of the uncertainty for the peak in the uncertainty preset. See also SET\_UNCERTAINTY.

Responses:

**UNCE 000000000008.5**

Uncertainty of the peak is 8.5%.

**SHOW\_UNCERTAINTY\_PRESET**

Returns the current uncertainty preset setting. See also SET\_UNCERTAINTY\_PRESET.

Responses:

**UNCE\_PRES 0000000000000000** No preset.  
**UNCE\_PRES 00000000000008.5** Preset set to 8.5%.

**SHOW\_VERSION**

Reports the digiDART firmware version number in the form

**Fmmm-vvv<CR>**

where mmmm is a 4-character model designator and vvv is a 3-character version designator.

Example Responses:

**\$FDDRT-002<CR>** Model digiDART firmware Version 2 reported.

**SHOW\_WINDOW**

Reports the start channel and number of channels in the window of interest, in the form

**\$Dxxxxxyyyyyccc<CR>**

where xxxxx is the start channel (0–16383) and yyyyy is the number of channels (1–16384). See SET\_WINDOW for more information about the window of interest.

Example Responses:

**\$D0000016384094<CR>** Window of interest reported as starting at channel 0 and continuing for 16384 channels.  
**\$D0000008192092<CR>** Window of interest reported as starting at channel 0 and continuing for 8192 channels (first 1/2).  
**\$D0819208192112<CR>** Window of interest reported as starting at channel 8192 and continuing for 8192 channels (last 1/2).

**SHOW\_ZDT**

Not used; included for backward compatibility.

**SHOW\_ZERO\_ADJ**

Returns the value of the zero offset for the zero stabilizer.

**SHOW\_ZERO\_CHANNEL**

Reports the center channel for the stabilizer zero peak. See also SET\_ZERO\_CHANNEL, SET\_ZERO\_WIDTH, and SHOW\_ZERO\_WIDTH.

Responses:

**\$C00000087<CR>** Zero channel has not been set.  
**\$C00002089<CR>** Zero channel is channel 2 (lowest possible channel).  
**\$C16382107<CR>** Zero channel is channel 16382 (highest possible channel).

## SHOW\_ZERO\_STABILIZATION

Reports the state of zero peak stabilization. See also ENABLE\_ZERO\_STABILIZATION and DISABLE\_ZERO\_STABILIZATION.

### Responses:

**\$IT<CR>** Zero stabilization is currently enabled.  
**\$IF<CR>** Zero stabilization is currently disabled.

## SHOW\_ZERO\_WIDTH

Reports the current width for the stabilizer zero peak. See also SET\_ZERO\_WIDTH, SET\_ZERO\_CHANNEL, and SHOW\_ZERO\_CHANNEL.

### Responses:

**\$C00001088<CR>** Zero width has not been set.  
**\$C00003089<CR>** Zero width is 3 channels (lowest possible width).  
...  
**\$C00256100<CR>** Zero width is 256 channels (highest possible width in Gauss mode).  
...  
**\$C16383108<CR>** Zero width is 16383 channels (highest possible width in point mode with zero channel set to 8192).

## SPECTRUM

Returns the complete spectrum, channel by channel with no pauses and no other characters.

## START [seg-mask]

Starts the acquisition of spectral data. The optional segment mask is provided for compatibility with other MCBs and may be any value from 0 to 65535 but is ignored by the digiDART.

### Execution Warnings:

**%000004073<CR>** No segment selected (occurs with other warnings).  
**%000005074<CR>** The acquisition is already started (no changes made).  
**%000006075<CR>** A preset was exceeded (acquisition was not started).  
**%000008073<CR>** Unit not optimized since initialization.  
**%000016076<CR>** Amplifier not PZ'd since initialization.  
**%000032074<CR>** High voltage is disabled.

The actual response record may be a combination of any of the above records depending on the warning conditions. For example:

**%000048081<CR>** Amplifier not PZ'd and high voltage disabled.

## START\_FLAT\_AUTO

Performs Optimization (START\_OPTI) for a single rise time instead of all rise times.

**START\_OPTIMIZE**

Starts optimization of PZ and flattop correction for all rise times.

**START\_PZADJUST\_AUTO**

Starts the automatic PZ process. The automatic PZ is not complete until indicated by the auto PZ status bit. This bit is returned by the SHOW\_STATUS command. Spectral data can be corrupted if automatic PZ is initiated while a device is collecting data.

Execution Errors:

**%131136084<CR>**

The command was attempted while the amplifier was set for a transistor reset preamplifier. No action was taken.

**STOP [seg-mask]**

Stops the acquisition of spectral data. The optional segment mask is provided for compatibility with other MCBs and may be any value from 0 to 65535 but is ignored.

Execution Warnings:

**%000005074**

Acquisition already stopped (no changes made).

**STOP\_OPTIMIZE**

Stops the optimization in progress. The digiDART may be in an indeterminate mode. See also START\_OPTIMIZE.

**STOP\_PZ\_AUTOMATIC**

Stops the optimization in progress. The digiDART may be in an indeterminate mode. See also START\_PZ\_AUTOMATIC.

**TERM**

Sets the digiDART to terminal mode; included for backward compatibility.

**TEST mask**

Performs any combination of the digiDART internal selftests where mask represents a 16-bit integer with each bit set specifying a test as follows:

**Bit 1:** Spectral data memory test (destroys spectral data).

**Bit 3:** Serial line test (serial loop-back connector required).

**Bit 6:** Front-panel LED test.

Execution Errors:

**%004016080<CR>**

Spectral data memory or mailbox memory failed test.

**%004064083<CR>**

Serial line failed test.

**VERIFY\_CORR\_FLAT**  
**VERIFY\_SHAPE\_FLAT**  
**VERIFY\_SHAPE\_RISE**

These test the argument against the list of valid settings and return true if valid.

**WRITE\_SPECTRUM**

Directs the digiDART to write the current active spectrum into stored spectrum memory. Same function as the STORE button.

## **8.2. Direct Communication**

The direct communication is a compact, direct method of control. It is used through the USB or optional RS232 port. This method is simpler for small, hand-held controllers and easier to implement in operating systems such as DOS. Not all commands available in CONNECTIONS-32 are available in the direct method.

This method of communication is only appropriate in very specialized applications where you wish to connect the digiDART to a computer that does not use the Windows operating system or does not support the USB interface.

Contact ORTEC for details on the commands.



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