ORTEC®

# Alpha Aria®

## Integrated Alpha Spectrometer
## Hardware User's Manual

Printed in U.S.A. | ORTEC Part No. 931057 | 0814
Manual Revision C

**Advanced Measurement Technology, Inc.**

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

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Before being approved for shipment, each ORTEC instrument must pass a stringent set of quality control tests designed to expose any flaws in materials or workmanship. Permanent records of these tests are maintained for use in warranty repair and as a source of statistical information for design improvements.

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## Damage in Transit

Shipments should be examined immediately upon receipt for evidence of external or concealed damage. The carrier making delivery should be notified immediately of any such damage, since the carrier is normally liable for damage in shipment. Packing materials, waybills, and other such documentation should be preserved in order to establish claims. After such notification to the carrier, please notify ORTEC of the circumstances so that assistance can be provided in making damage claims and in providing replacement equipment, if necessary.

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# Safety Instructions and Symbols

This manual contains up to three levels of safety instructions that must be observed in order to avoid personal injury and/or damage to equipment or other property. These are:

**DANGER** Indicates a hazard that could result in death or serious bodily harm if the safety instruction is not observed.

**WARNING** Indicates a hazard that could result in bodily harm if the safety instruction is not observed.

**CAUTION** Indicates a hazard that could result in property damage if the safety instruction is not observed.

In addition, the following symbols may appear on the product:

**DANGER – Hazardous Voltage**

**ATTENTION – Consult the manual in all cases where this symbol is marked in order to determine the nature of the potential hazards and any actions that must be taken to avoid them**

**Protective earth (ground) terminal**

Please read all safety instructions carefully and make sure you understand them fully before attempting to use this product.

# Cleaning Instructions

To clean the instrument exterior:

- Disconnect the instrument from the power source.
- Remove loose dust on the outside of the instrument with a lint-free cloth.
- Remove remaining dirt with a lint-free cloth dampened in a general-purpose detergent and water solution. Do not use abrasive cleaners.

| | |
|---|---|
| **CAUTION** | To prevent moisture inside of the instrument during external cleaning, use only enough liquid to dampen the cloth or applicator. |

- Allow the instrument to dry completely before reconnecting it to the power source.


ORTEC®
a division of AMETEK®
Alpha Aria™
HV / PULSER
ADC
VACUUM
PUMP
HOLD
VENT

# 1. INTRODUCTION

With the introduction of the ORTEC® Alpha Suite™ of integrated alpha spectrometers, we are able to address the needs of any counting laboratory, large or small, whether you are upgrading or just starting out. The ORTEC Alpha Aria® incorporates a vacuum chamber, variable detector bias supply (switchable positive or negative), preamplifier, test pulser generator, leakage current monitor, and digital signal processor-based multichannel analyzer (MCA) in a NIM-standard double-width module.

- **Easy System Expansion** — Any of the Alpha Suite spectrometers can be added to existing ORTEC systems simply by installing the latest CONNECTIONS Driver Update Kit (P/N 797230) supplied with the instrument.

- **Performance** — The Alpha Aria has a variable detector bias supply (positive or negative); preamplifier; test pulser generator with variable amplitude; and leakage current monitor. Its detector operates with a completely adjustable energy range from 0 MeV to 10 MeV. The pulse generator is adjustable over a range representing 0 MeV to 10 MeV. The bias supply is adjustable over the range from 0 V to ±100 V. All hardware controls, data acquisition settings, and detector bias voltage and leakage current are controlled and monitored with ORTEC CONNECTIONS applications such as the accompanying MAESTRO® MCA Emulator or our AlphaVision® Alpha Particle Spectrum Acquisition and Analysis for Microsoft Windows 7 and Windows XP SP3.

- **High-Speed USB or Ethernet Connectivity** — The Alpha Aria connects to your PC via a single, high-speed USB cable. Alternatively, you can use our USB-CONC CONNECTIONS Distance Extender (purchased separately) to make a wired or wireless Ethernet connection without the distance limitation of USB communication.

- **Vacuum Connections and Monitoring** — The front-panel PUMP/HOLD/VENT valve makes it easy to insert, count, and remove samples without disturbing the vacuum on other Alpha Aria chambers attached to the same vacuum pump. The ORTEC ALPHA-PPS-115 (or -230) pump station is available for this application. A standard Swagelok® fitting on the rear panel simplifies connection of the valve and chamber to an external vacuum pump.

- **Easy Maintenance and Decontamination** — In the event of a contamination problem, the affected Alpha Aria can be removed from its bin for decontamination while use of other alpha chambers continues uninterrupted.

- **Software Controlled Operation** — Except for chamber pressure monitoring and control, all hardware and data acquisition settings are computer controlled with MAESTRO, AlphaVision, or other ORTEC CONNECTIONS applications. The MCB Properties pages in MAESTRO display all bias, stabilizer, digital offset, ADC, and pulser controls for the selected spectrometer. AlphaVision has a specialized hardware panel that shows these readouts on one screen (see also Section 3.4.7).

- **Optional Recoil Protection** — We offer an optional recoil protection system that includes a biased sample holder and a Granville-Philips gauge with solenoid vacuum controller.

## 1.1. About this Manual

This manual tells you how to set up and install the Alpha Aria. Refer to the MAESTRO or AlphaVision *User's Manual* for instructions on installing the software.

We assume you are familiar with alpha spectroscopy and sample preparation techniques. A good starting reference and further reference materials can be found in "Measurement of Radio-nuclides in Food and the Environment, A Guidebook," *Technical Reports,* Series No. 295, ISBN 92-0-125189-0, Vienna IAEA.

- **Chapter 2** of this manual provides instructions on installing and configuring the Alpha Aria and its operating software, connecting the detector to it, and connecting it to a vacuum pump.

- **Chapter 3** tells how to control the sample chamber pressure, change samples, and operate the Alpha Aria with MAESTRO.

- **Chapter 4** discusses maintenance including detector and chamber decontamination, chamber replacement, and troubleshooting.

- **Chapter 5** contains the system specifications and feature mask bits.

- **Appendix A** lists the Alpha Aria firmware commands for users who wish to write custom software to control the unit with the ORTEC CONNECTIONS Programmer's Toolkit (A11).

- **Appendix B** tells how to switch to a detector of the opposite polarity.

# 2. INSTALLATION

Setting up your Alpha Aria is straightforward:

- Do not connect the Alpha Aria to your PC until the CONNECTIONS Driver Update Kit is installed.
- Install the accompanying CONNECTIONS Driver Update Kit on your PC *first*.
- Install the MAESTRO or AlphaVision software.
- Connect the Alpha Aria to a bin/power supply and to the host PC.
- Install the detector.
- Connect to the vacuum pump.

## 2.1. Install CONNECTIONS and Other Software Applications

First, install the copy of CONNECTIONS accompanying your new Aria, following the instructions in the driver update kit. Be sure to select the **USB-based instruments** family on the Instrument Setup page of the install wizard.

If you also purchased other ORTEC applications, install them next. If MAESTRO and/or Alpha-Vision is already installed on your PC, no further software installation steps are necessary.

## 2.2. Connect to the NIM Bin and PC

1) Turn the bin/power supply off. Install the Alpha Aria (requires two slots) and tighten its front-panel screws.

2) With the PC on, attach the USB cable between the Alpha Aria's rear-panel USB connector and a USB port on the PC.

3) Turn on the bin/power supply.

4) The PC will display a series of "found new hardware" messages. If Windows does not locate the driver, a wizard will open. Choose the option that does ***not*** search the internet for the appropriate driver, go to the next screen and select the "automatically find driver" option, then follow the remaining wizard prompts to complete installation.

5) On the PC, run the MCB Configuration program from the Windows Start menu by selecting **MAESTRO**, then **MCB Configuration**. MCB Configuration will automatically detect the new Alpha Aria and add it to the list of detectors available to this PC. (If the new instrument is not listed on the available detectors list, see the troubleshooting guide in Section 4.3).

6) When MAESTRO or AlphaVision is correctly communicating with the new Alpha Aria, you should be able to select it from the detector pick list within the software application (at this point, there will be no spectrum to view). See Chapter 3 for instructions on using the vacuum chamber and controlling data acquisition with MAESTRO and AlphaVision.

### 2.2.1. Multiple-Aria Systems

Adding more Alpha Arias to your system is fast and straightforward. Simply add new modules to the bin, and re-run the MCB Configuration program to establish communication with the new unit. See the MAESTRO *User's Manual* for instructions.

## 2.3. Install the Detector

The ULTRA-AS series detectors normally used in the Alpha Aria have a thin (500-Å) contact that is ion-implanted into the silicon surface. The contact is thus more rugged than that formed by an evaporated gold layer. If the silicon surface is scratched, however, the detector will be damaged. Therefore, take reasonable precautions when handling these detectors.

If other types of detectors are used, read the detector's instruction sheet before installing and using it. If changing from a positive-polarity detector to a negative-polarity detector (or vice versa), see Appendix B.

1) Turn the detector bias off for the chamber into which the detector is being installed.

2) Use clean plastic gloves and make sure the white protective cap for the detector is in place. Align the center pin in the top of the chamber with the center socket in the detector connector (threads are right-handed). Install the detector into the connector at the top of the chamber.

3) Remove the plastic cover, being careful not to touch the detector face (which will contaminate it).

## 2.4. Connect to the Vacuum Pump

Apply a clean, dry, oil-free vacuum from a roughing pump or vacuum manifold to the Alpha Aria through the 0.25 in. Swagelok fitting on the rear panel. This connector accepts 0.25 in. OD tubing and is accessible when the module has been installed in the NIM bin. For a single Alpha Aria, the pump should have a displacement of about 2 CFM (57 liter/min). If several Alpha Aria modules are connected together via a manifold, the pump should have a displacement of about 4 CFM (113 liter/min). For larger systems (more than four modules), a pump with a displacement of 6.7 CFM (190 liters/min) should be used. The ALPHA-PPS-115 (or -230) is well-suited for this application.

Set the front-panel PUMP/HOLD/VENT control at VENT to isolate the vacuum source from the chamber and to vent the chamber to atmospheric pressure. With the chamber door closed, the control can be set at PUMP to connect the chamber to the vacuum source.

**CAUTION** Do not set the control at PUMP unless the door is closed, or the vacuum source will be connected directly to atmospheric pressure through the open chamber.

The control can be placed in the HOLD position to isolate the chamber from the manifold without venting the sample.

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# 3. OPERATION

This chapter tells how to operate the Alpha Aria's vacuum chamber, and discusses the MAESTRO hardware and data acquisition controls.

## 3.1. Operating the Pump/Hold/Vent Valve

Chamber pressure is controlled by the 3-position, front-panel PUMP/HOLD/VENT valve (Fig. 1). The PUMP position connects the chamber to the manifold, the HOLD position isolates the chamber, and the VENT position connects the chamber to the atmosphere, allowing the door to be opened.

**CAUTION** Be sure to turn off the detector bias before venting the chamber.

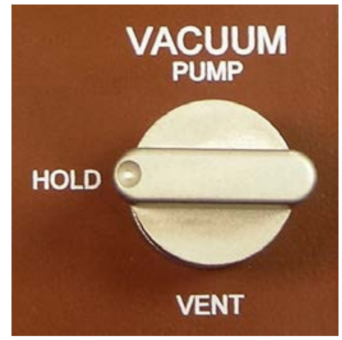


**Fig. 1.**

## 3.2. Inserting a Sample into the Vacuum Chamber

1) Once the desired vacuum chamber(s) has been vented, open the door. Figure 2 shows an open sample chamber with a detector, a sample holder, and the series of slots that allow you to adjust the sample-to-detector distance in 4 mm increments.

2) Slide the sample holder into the slot at the desired height. (Note that, for optimum resolution, the sample-to-detector spacing should be at least equal to the detector diameter. The maximum spacing is 44 mm. The sample trays shipped with the Alpha Aria are for 3/4 in. and 1 in. samples. Visit our website for a detailed description of the sample trays.

3) When the sample is in place, close the door, and use MAESTRO or AlphaVision to begin pumping. When the vacuum has reached a satisfactory value, you are ready to start data collection.

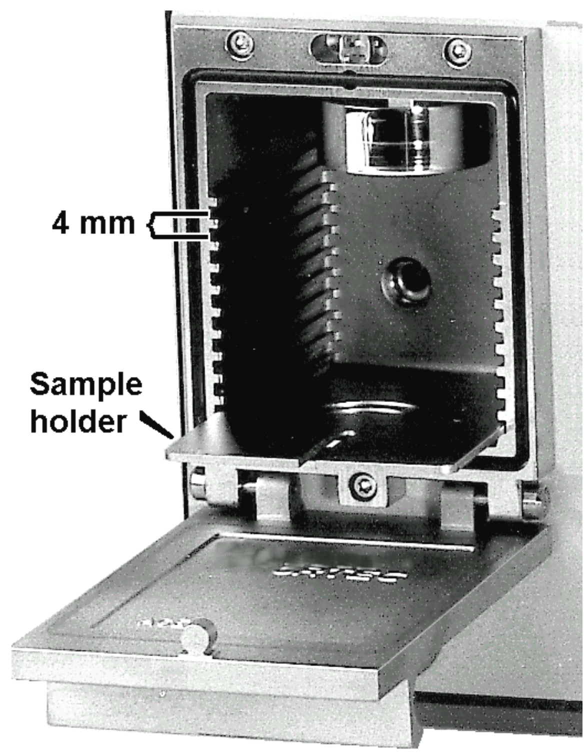


**Fig. 2. Open Sample Chamber.**

## 3.3. Resolution Measurement and Calibration

The measurement of alpha-particle resolution should be performed in a vacuum with a uniform, ultra-thin source located at a source-to-detector distance at least equal to the detector diameter. Using old or inferior sources may cause apparently poor resolution and can lead to detector contamination due to recoil sputtering. When using a source in an Alpha Aria chamber, either for resolution measurement or system calibration, the following steps should be used for best results.

1) Place the source on a sample tray and insert it into the Alpha Aria chamber. Placing the source as far as possible from the detector helps reduce any solid-angle-related and/or count-rate problems.

2) Evacuate the chamber.

3) Set the target bias and turn the bias on with the controls on the High Voltage property page in MAESTRO (see Section 3.4.5) or the Hardware panel in AlphaVision. Wait 2 minutes.

4) Accumulate a peak containing at least 1,000 counts in the peak channel.

5) Determining the resolution requires measurement of the full-width at half maximum (FWHM) of the peak. Use the **Peak Info** command in MAESTRO or the **Peak Search** and **Peak Fit** features in AlphaVision.

## 3.4. Alpha Aria MCB Properties in MAESTRO

This section discusses the hardware setup dialog you will see within MAESTRO, the AlphaVision advanced chamber properties feature, and all other ORTEC CONNECTIONS software when you click on **Acquire/MCB Properties...**. The MCB Properties dialog contains all of the computer-selectable hardware controls including ADC setup parameters, high voltage on/off, chamber pressure controls and readouts, and acquisition presets. 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.

### 3.4.1. Amplifier

Figure 3 shows the Amplifier tab. Set the amplifier **Fine** gain by adjusting the horizontal slider or entering the value, in the range of 0.25 to 1.00. The effective gain is shown at the top of the **Gain** section.

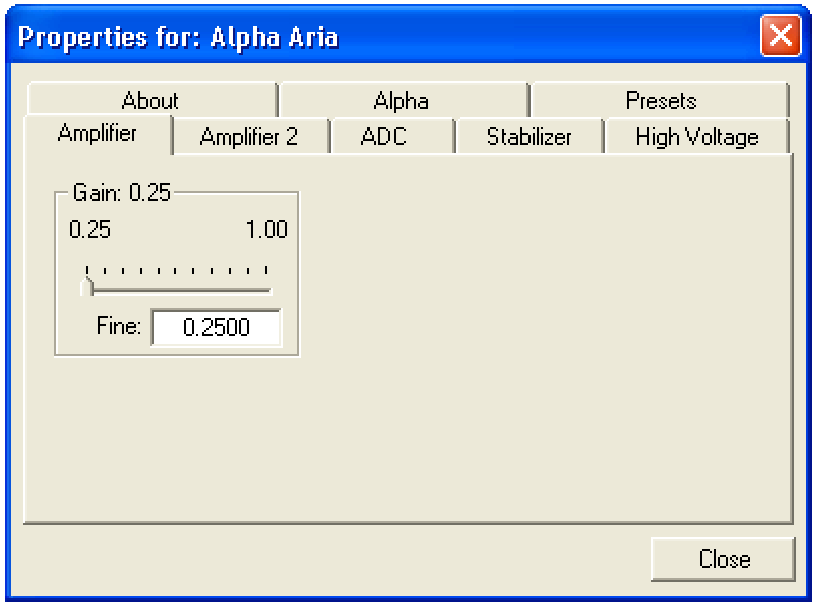


**Fig. 3. Alpha Aria Amplifier Tab.**

### 3.4.2. Amplifier 2

Figure 4 shows the Amplifier 2 tab, which accesses the advanced Alpha Aria shaping controls including the InSight™ Virtual Oscilloscope mode. This is typically not used in alpha spectroscopy. For more information on the InSight mode, see the MAESTRO *User's Manual*.

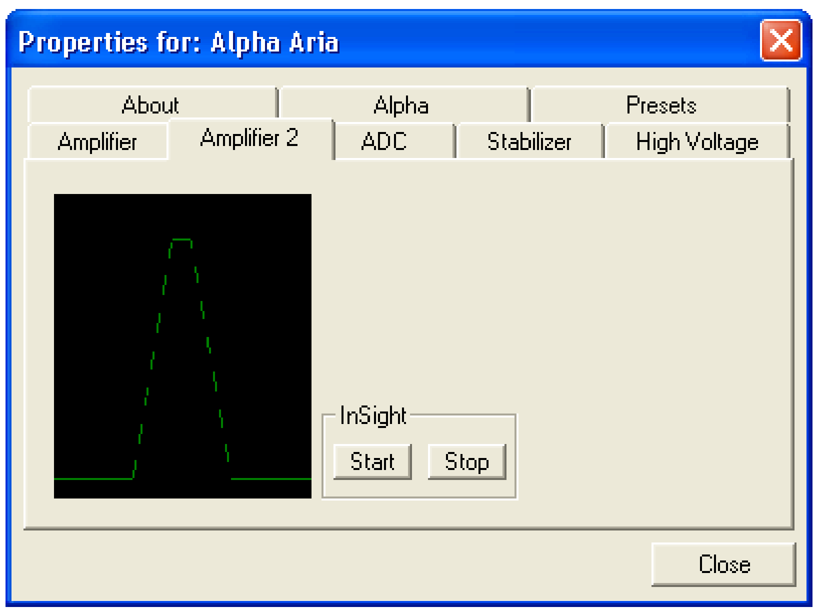


**Fig. 4. Alpha Aria Amplifier 2 Tab.**

### 3.4.3. ADC

This tab (Fig. 5) contains the **Conversion Gain**, and **Lower** and **Upper Level Disc**riminator controls. In addition, the current real time, live time, and input count rate are monitored at the bottom of the dialog.

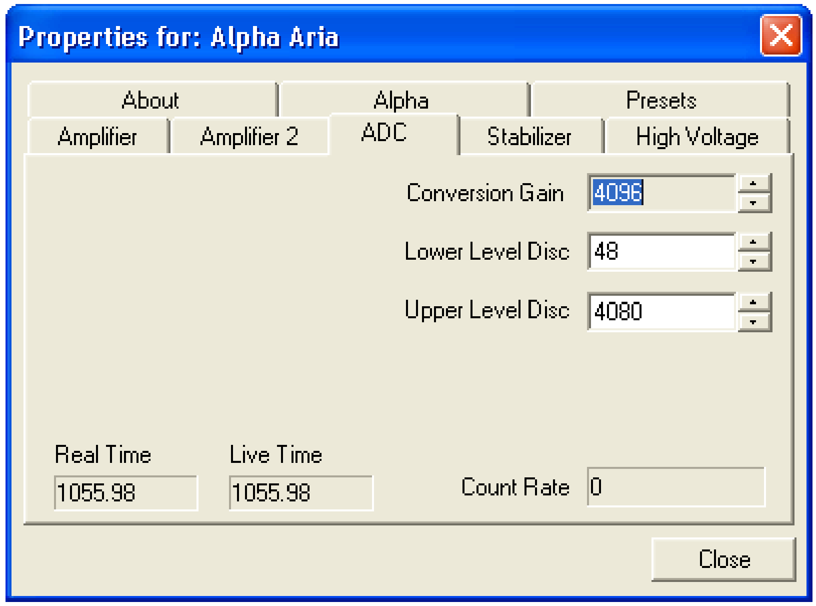


**Fig. 5. Alpha Aria ADC Tab.**

### 3.4.4. Stabilizer

The Stabilizer tab (Fig. 6) shows the current settings for the Alpha Aria's gain stabilizer (gain stabilization is discussed in the MAESTRO *User's Manual*).

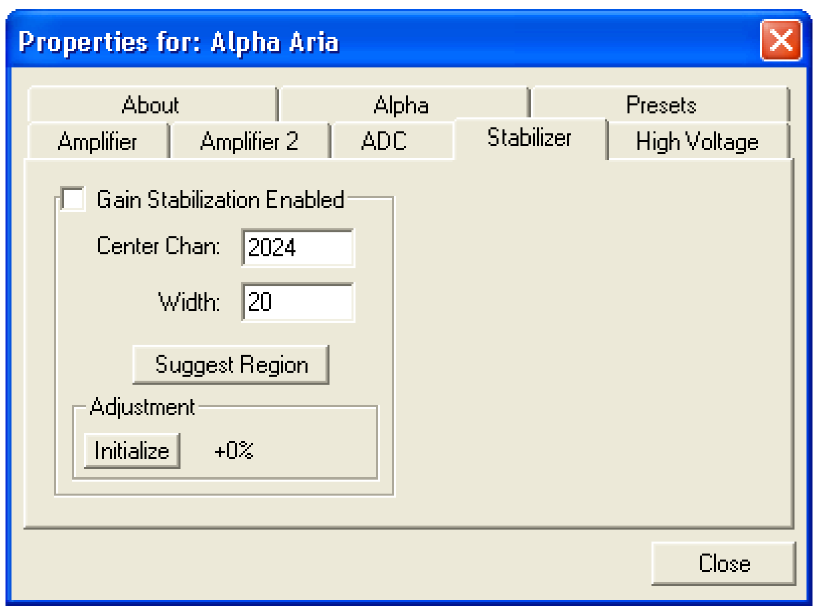


**Fig. 6. Alpha Aria Stabilizer Tab.**

The value in the **Adjustment** section shows how much adjustment is currently applied. The **Initialize** button sets 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 Chan**nel and **Width** fields show the peak currently used for stabilization.

To enable the stabilizer, enter the **Center Chan**nel 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 enabled even if the power is turned off. When the stabilizer is enabled, the **Center Chan**nel and **Width** cannot be changed.

### 3.4.5. High Voltage

Figure 7 shows the High Voltage tab, which allows you to set the bias voltage from 0 V to ±100 V, turn the detector bias on or off, and monitor the voltage (**Actual**) and leakage **Current**.

When the bias is on, the detector leakage current is shown in the **Current** field. The leakage current is detector dependent and will be near zero when the bias is turned off.

While the Properties dialog is open, the computer monitors the Alpha Aria in real time, updating the **Actual** voltage and leakage **Current**.

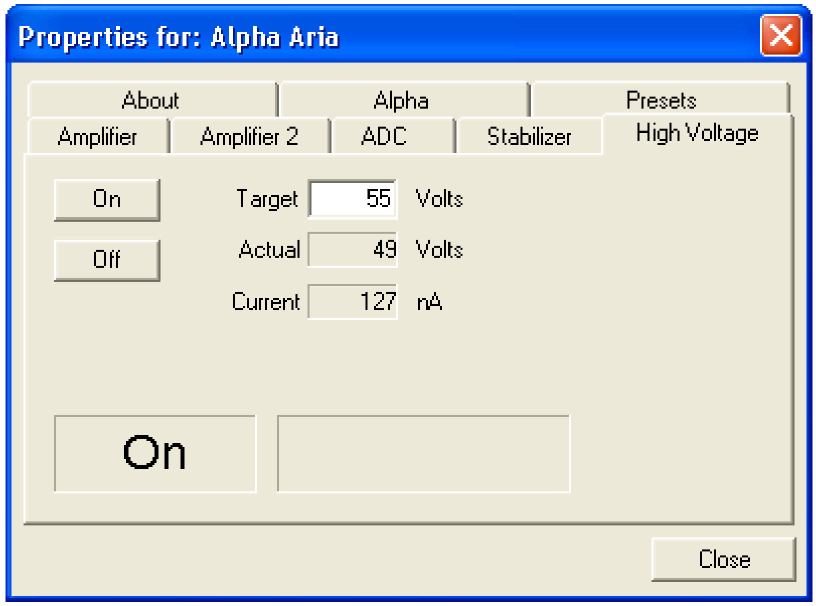


**Fig. 7. Alpha Aria High Voltage Tab.**

### 3.4.6. About

This tab (Fig. 8) displays hardware and firmware information about the currently selected Alpha Aria as well as the data **Acquisition Start Time** and **Sample** description. The **Access** field shows whether the MCA is currently locked with a password. **Read/Write** indicates that the MCA is unlocked; **Read Only** means it is locked.

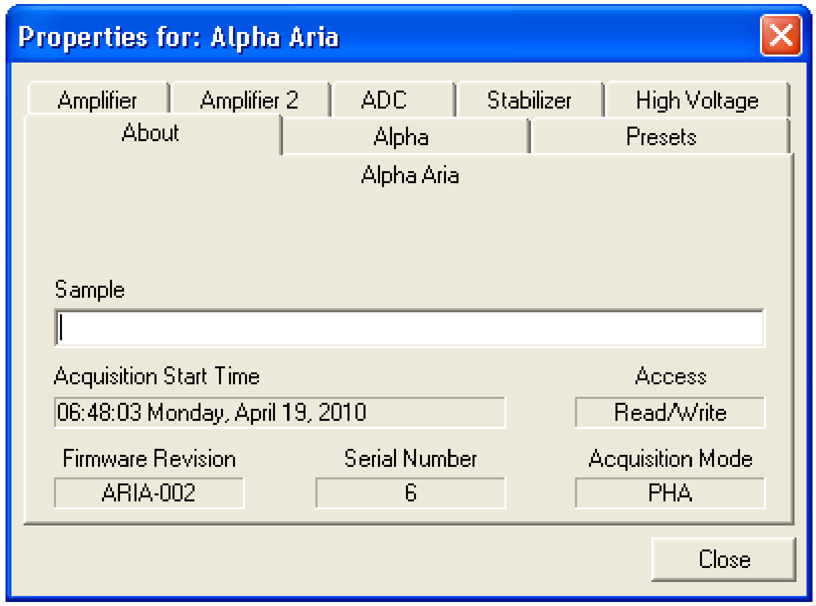

**Fig. 8. Alpha Aria About Tab.**

This screen displays the Alpha Aria's serial number (all Alpha Arias have a unique serial number which is read by the software and stored in the spectrum file for verification of the spectrum). The Alpha Aria input currently being monitored is shown at the top of the dialog. The name displayed here is the MCB **Description** entered when the MCB Configuration program is run.

### 3.4.7. Alpha

The Alpha tab (Fig. 9) contains the controls for the digital offset and pulser. The Alpha Aria's chamber pressure is manually controlled so the vacuum monitoring controls on this dialog are disabled.

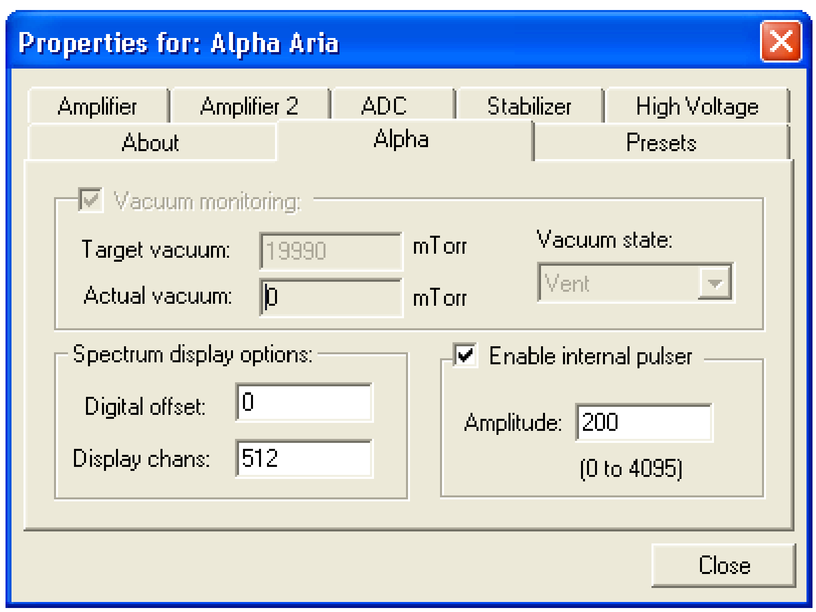

**Fig. 9. Alpha Aria Alpha Tab.**

#### 3.4.7.1. Data Collection Window

The **Digital offset** and **Display chans** settings are used to control the starting energy and energy range of the spectrum collected. In many cases, the low-energy portion of the spectrum contains no data of interest and can be discarded. Use the digital offset to exclude this region.

### 3.4.7.2. Internal Pulser

To use the pulser, enter the desired channel in the **Amplitude** field and click to mark the **Enable internal pulser** checkbox. When you start the next data acquisition, pulser data will begin accumulating in the spectrum window. The front-panel HV/PULSER indicator will flash quickly if the bias is on and slowly if the bias is off.

### 3.4.7.3. Alpha Chamber Data Display in AlphaVision

AlphaVision uses a Hardware panel (Fig. 10) to display most of the controls from the Alpha, Stabilizer, and HV tabs. (Note that when you view the AlphaVision **Chamber Properties** for an Alpha Aria chamber, the Properties dialog does not display the Alpha tab).

Note that some of the field names on the AlphaVision Hardware panel differ slightly from those on the MAESTRO Alpha tab.

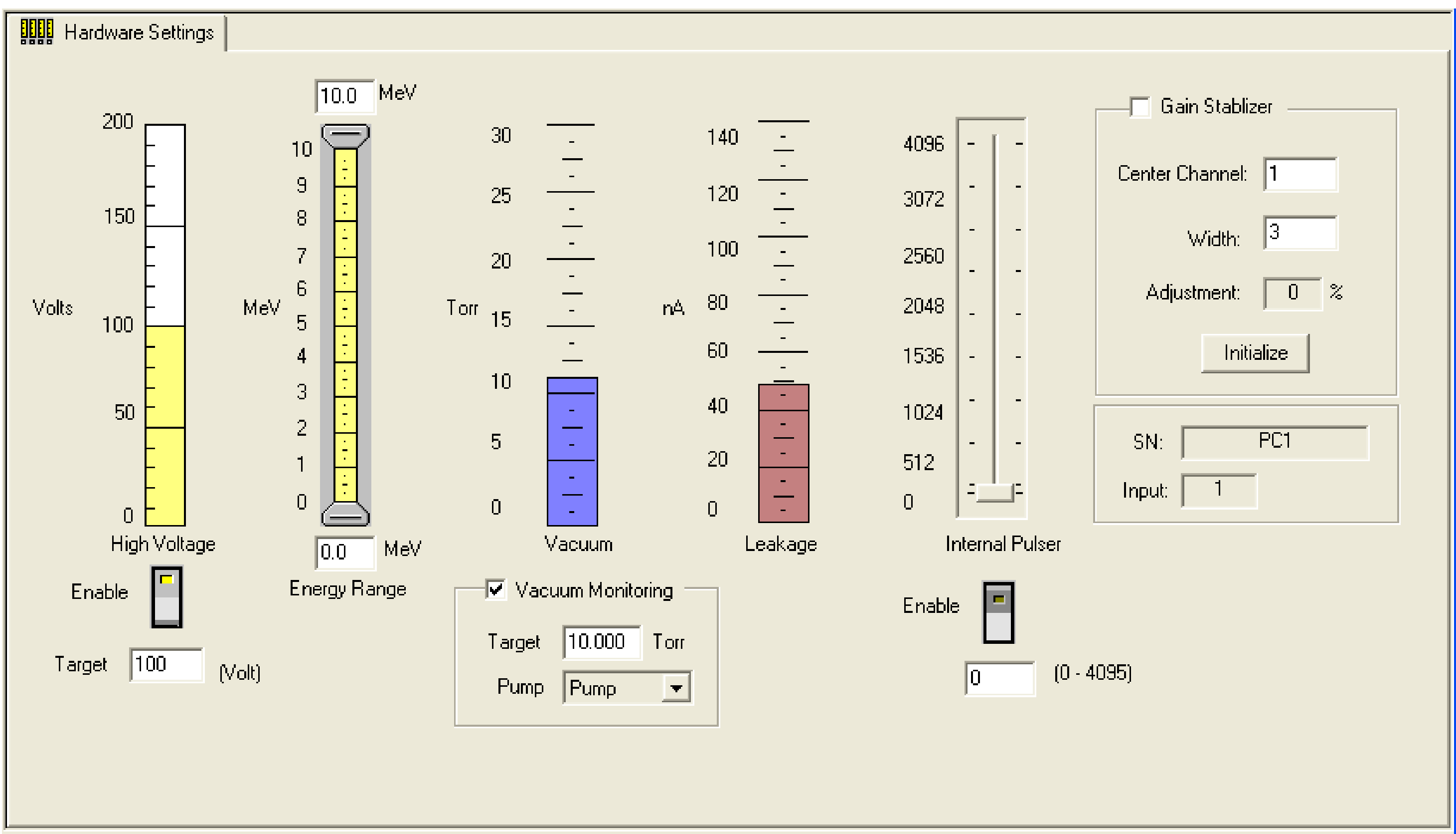


**Fig. 10. Alpha Aria Hardware Readouts in AlphaVision.**

### 3.4.8. Presets

Figure 11 shows the Presets tab. The presets can only be set on an MCA that is *not* acquiring data. 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.

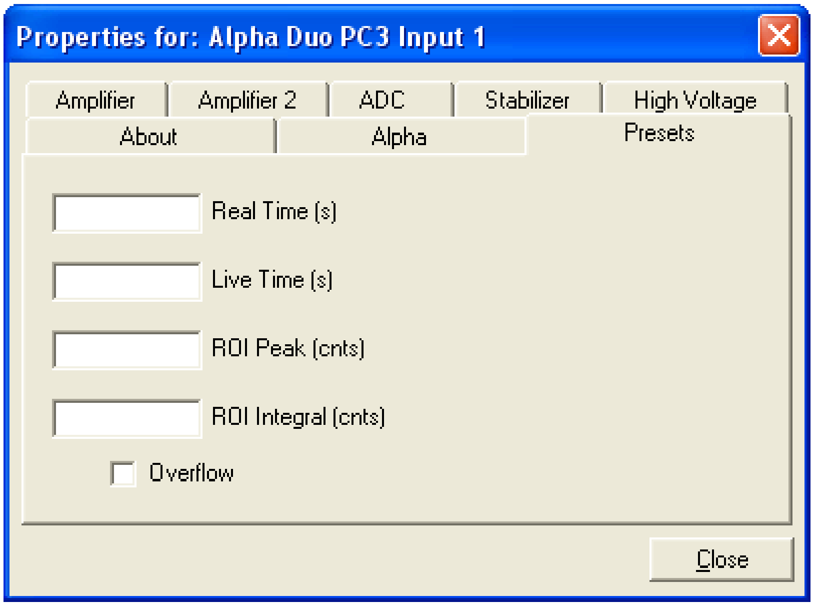


**Fig. 11. Alpha Aria Presets Tab.**

When more than one preset is enabled (set to a non-zero value), the first condition met during the acquisition causes the MCA 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 MCA 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 MCA clock increments by 20 ms. *Real time* means elapsed time or clock time. *Live time* refers to the amount of time that the MCA 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 MCA is not available).

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

Enter the **ROI Integral** preset value in counts. With this preset condition, the MCA stops counting when the sum of all counts in all ROI channels (regardless of the number of ROIs) reaches this value. This has no function if no ROIs are marked in the MCB.

Marking the **Overflow** checkbox terminates acquisition when data in any channel exceeds $2^{31}-1$ (over $2\times10^9$) counts.

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# 4. MAINTENANCE AND SERVICE

## 4.1. Decontamination

The normal background count above 3 MeV for the detector in the Aria should be <24 counts per day for the 300 $mm^2$ and 450 $mm^2$ ULTRA-AS detectors. If an increase of background is noted, this may be caused by contamination of the chamber and/or the detector by residual deposits of alpha-emitting materials. Decontamination of the chamber and of the detector (if ULTRA or Ruggedized) is indicated.

**CAUTION** ***Non-ULTRA or non-Ruggedized surface barrier detectors cannot be subjected to cleaning procedures; consult the instruction manual for the detector to determine how to clean it.***

### 4.1.1. Chamber Decontamination

To decontaminate an Alpha Aria chamber in place:

1) Turn off bias to the detector and vent the chamber.

2) Remove the detector from the chamber by rotating it counterclockwise.

   **CAUTION** To avoid damaging the detector, make sure its protective cover (supplied) is in place before the detector is removed. Wear plastic gloves to keep from contaminating your hands or the chamber.

3) Pour the cleaning agent into a clean beaker. Methanol, or water with a methanol rinse, can be used as the cleaning agent.

4) Dip a cotton swab or a cotton-covered stick into the agent and gently wipe the internal surfaces of the chamber to remove any contamination. Avoid contaminating vacuum or vacuum gauge ports. Plug holes if necessary.

5) When contamination from the surface is visible on the cotton swab, discard it and use a clean one to avoid returning the contaminant to other areas of the chamber.

6) When the chamber is clean, blow it dry with clean nitrogen gas.

### 4.1.2. ULTRA-AS Detector Decontamination

The front surface of an ULTRA-AS detector can be cleaned with a cotton swab moistened with acetone. Gently rub the detector surface with the swab. Repeat with fresh acetone and a fresh swab. Blow dry with dry nitrogen gas. Before applying bias, leave the detector under vacuum for 30 minutes to remove all surface moisture.

### 4.1.3. Ruggedized Detector Decontamination

To decontaminate the front (aluminum) surface of a Ruggedized detector:

1) Turn off bias to the detector, vent the Alpha Aria, and power off the bin.

2) Remove the Alpha Aria from the bin, disconnecting the vacuum line and USB cable.

3) Pour deionized water into a clean beaker.

4) Dip a cotton swab into the water and then carefully blot on a clean tissue to remove the excess.

5) ***GENTLY*** swab the aluminum surface of the detector. ***DO NOT "scrub" the detector.*** Gently wiping the detector's aluminum surface with the damp swab a few times should pick up most of the removable contamination. If cotton-covered sticks are used, loosen the cotton around the stick and be careful not to allow the end of the stick to contact the aluminum surface.

6) Clean the housing of the detector and the protective cover in the same way.

7) Blow dry with clean nitrogen gas.

## 4.2. Removing and Replacing Chambers

These instructions apply to the removal of a vacuum chamber assembly from the Alpha Aria for the purpose of cleaning or replacing the chamber.

In a multi-detector system, the Alpha Aria can be isolated and removed from the vacuum system so the other chambers can continue in use.

### 4.2.1. Chamber Removal

1) Turn off bias to the detector, vent the Alpha Aria, power off the bin, and disconnect it from ac mains power.

2) Place the white protective cap on the detector and remove the detector. ***Do not touch the detector front surface.***

3) Use a 3/32 in. hex-head wrench to unscrew the three socket head cap screws holding the chamber in place. Remove the two top screws first and the bottom screw last.

4) Pull the chamber out slightly (about 1 in.). Put the screws back in the holes and close the chamber door to trap the screws in place. This prevents losing them and keeps them handy for chamber reinstallation.

5) Pull the chamber out a little more until the glass feedthrough on the top of the chamber is exposed. See Fig. 12.

| | |
|---|---|
| **CAUTION** | ***If the cable is caught on the top of the panel, you may damage the feed-through pin by pulling hard on the chamber.*** |


**Fig. 12. Chamber Removed from Alpha Aria.**

6) Unsolder the center lead of the coaxial signal cable.

7) Unscrew the slotted screw holding the ground wire of the coaxial signal cable about one turn. Do not remove this screw. Remove the ground-wire connector. This frees the coaxial signal cable.

8) Pull the chamber out far enough to expose the vacuum connection on the back of the chamber. Slide the black rubber vacuum hose off the vacuum port.

### 4.2.2. Chamber Installation

Reinstall the chamber assembly in exactly the reverse order of disassembly.

1) Reconnect the vacuum hose.

2) Connect the ground wire, tighten the screw, and solder the center lead on the one-pin feedthrough.

3) Restore the chamber assembly to its position against the front panel. Be certain that the signal wire is not trapped under the chamber assembly flange.

4) Tighten the chamber screws lightly, bottom screw first. When the three screws are in place, tighten them securely, but ***do not overtighten.***

5) Reconnect the bin to the ac mains source and turn it on.

## 4.3. Troubleshooting

When installation is complete, you should be able to start up MAESTRO or AlphaVision, go to the detector pick list in the program, and select the spectrometer you configured during setup.

### 4.3.1. Can't Find the Alpha Aria on the Detector Pick List

- Make sure the Alpha unit is powered on.
- Check your USB cable and its connection to the PC and Alpha Aria. You should hear a USB connect/disconnect audio signal. If not, switch to a different USB port.
- If you're connected to a network, can you see other devices on the network?
- During MAESTRO (or AlphaVision) installation, did you select the **USB-based instruments** connection option? To check this, go to the Windows Control Panel, open

**Programs and Features** (Windows 7) or **Add/Remove Programs** (XP), select CONNECTIONS, and choose to modify it. This will reopen the CONNECTIONS wizard. On the Instrument Setup page, select the **USB-based instruments** add-in, then complete the wizard and restart the PC as instructed. Rerun MCB Configuration to locate the Alpha Aria.

- If necessary, use the Windows Control Panel hardware **Device Manager** utility to confirm the ORTEC USB driver is installed correctly.

For further assistance, contact your ORTEC representative or our Global Service Center.

### 4.3.2. Data or Settings Are Lost When Power Is Turned Off

The memory in the Alpha Aria has battery backup to maintain data when power is removed from the unit. The battery is located on the upper-rear quadrant of the PWB. Contact ORTEC for the appropriate replacement.

### 4.3.3. Resolution Problems

Severe degradation in peak resolution can destroy an alpha spectrometer's ability to make meaningful measurements. Apparent degradation of resolution may be due to one or more causes:

- **Poor vacuum** — Check the chamber pressure reading.

- **Excessive electronic noise** — Examine the pulser peak resolution and detector leakage current compared to that specified on the original detector quality-control sheet. Sometimes a noisy detector can be restored by the simple act of removal and replacement, which reseats the connector pin. If detector substitution demonstrates the problem to be in the electronics, contact the Global Service Center.

- **Pulser OK But No Source Peaks** — Wrong amplifier polarity. See Section B.

- **Spectrum Very Noisy** — Wrong bias polarity. See Appendix B.

### 4.3.4. Troubleshooting Vacuum Problems

The vacuum valve is connected to each vacuum chamber with a neoprene vacuum line. When the vacuum valve is in either the HOLD or VENT position, the chamber is isolated from the vacuum manifold. Most vacuum problems can be easily isolated using a systematic approach starting at the chamber valve.

If the total system pressure read at the vacuum pump is too high in a system with multiple chambers connected to a vacuum line or manifold, begin at the chamber farthest from the pump and turn the vacuum valve to the HOLD position. If the system pressure improves significantly, the problem is isolated to that chamber. The most common problem affecting the vacuum will be dirt or nicks on the O-ring. A broken feedthrough can also cause a leak. If the problem is not in the last chamber, continue isolating chambers until the vacuum improves or until all valves have been operated. If all valves are on HOLD and the vacuum does not improve, the problem is in the manifold or something common to all the chambers such as the vacuum pump.

If the vacuum pump is very low on oil, it will not pump well. If any of the fittings from the back of the SOLOIST to the vacuum pump have been recently disconnected, they are suspect. When looking for vacuum problems, check things that have been recently changed.

Outgassing of contaminants in the vacuum chamber will also cause the pressure to be high in the individual chamber, but will have only a slight effect on adjoining chambers. A "good" chamber should pump down in 5 minutes.

If it becomes necessary to replace an O-ring, a *small* amount of silicone vacuum grease should be smeared onto the O-ring with the fingers (use plastic gloves). All excess should be wiped off. Excess vacuum grease traps dust, which degrades the vacuum seal. A kit of 10 spare O-rings is supplied with each Alpha Aria. Additional kits can be ordered from ORTEC.

For further assistance with troubleshooting, contact your ORTEC representative or our Global Service Center.

# 5. SPECIFICATIONS

## 5.1. Performance

Unless otherwise specified, performance is based on use with a BU-017-450-100 ULTRA™ Series detector with a good-quality $^{241}$Am point source.

**Maximum Sample Size** 51 mm (2.030 in.).

**Sample-to-Detector Spacing** Adjustable from nominally 1 mm to 41 mm in increments of 4 mm using slide-in sample trays. Maximum distance from detector to bottom of chamber is approximately 44 mm.

**Maximum Detector Size** 1200 mm$^2$.

**Energy Range** 0 to 10 MeV.

**Energy Resolution** ≤ 20 keV (FWHM) with a detector-to-source spacing equal to the detector diameter.

**Detector Efficiency** ≥25% is achievable with close detector-to-source spacing.

**Background** Above 3 MeV, ≤1 count/hour based on a BU-020-450-AS detector.

## 5.2. Bias Supply

**Range** 0 ± 100 V, 10 µA; selected and monitored in software.

**Bias** Computer controlled adjustable in 1 V increments.

**Bias Enable/disable** Software controlled.

## 5.3. Calibration Pulser

**Range** 0 to 10 MeV.

**Pulser** Computer controls the internal pulser. amplitude with 12 bit (2.5 keV) level settings; set to a nominal 7-MeV pulse when shipped.

**Frequency** 100 Hz.

**Frequency Stability** ≤ ±50 ppm/°C.

**Amplitude Drift** Typically ≤ ±150 ppm/°C.

**Long Term Drift** Typically ≤ ±0.005% of full scale / 24 hours at constant temperature.

**On/Off** Computer controlled.

## 5.4. Detector Current Monitor

**Range** 0 to 10,000 nA; read by computer.

**Display Resolution** 3 nA.

## 5.5. Preamplifier

**Charge Sensitive** Nominally 10mV/Mev.

**Polarity** Positive/negative selectable with 3 PWB-mounted slide switches per chamber (typically factory set for positive bias voltage).

## 5.6. ADC

**Digital Filter** 1 µs unipolar equivalent.

**Conversion Gain** Software-selectable as 256, 512, 1024, 2048, or 4096.

**Fine Gain** Software-selectable range from 0.25 to 1.

**Digital Offset** Software-selectable range from 0 to conversion gain setting (4096 maximum) in 1-channel increments.

**Display Channels** Software-selectable range from 0 to (conversion gain − digital offset).

**Conversion Time per Event** <2 µs dead time.

**Gain Instability** ≤ ±100 ppm/°C measured with external pulser and charge terminator.

**Digital Spectrum Stabilizer** Controlled via computer, stabilizes gain errors.

**Dead-Time Correction** Extended live-time correction according to the Gedcke-Hale method.[1]

**Lower-Level Discriminator** Computer controlled from 0 to 100% full scale.

**Upper-Level Discriminator** Computer controlled from 0 to 100% full scale.

## 5.7. Presets

**Real Time/Live Time** Multiples of 20 ms.

**Region of Interest** Peak count/Integral count.

**Data Overflow** Terminates acquisition when any channel exceeds $2^{31} - 1$.

## 5.8. Vacuum Chamber

**Construction** Cast brass, with nickel plating for ease of decontamination. High-performance O-ring seal. Front-panel 3-position PUMP/HOLD/ VENT valve.

**Detector Connector Type** Rear microdot (ORTEC B-Mount).

**Sample Trays** Slide-in, nickel-plated brass sample trays are available to accommodate sample diameters from 13 mm (0.5 in.) to 51 mm (2 in.). One sample tray is included.

**Vacuum Manifold Connector** 0.25 in. Swagelok tube fitting.

**Vacuum Pump Requirements** Rotary vacuum pump, 6.7 CFM (190 L/min) displacement, with oil mist trap. The ORTEC ALPHA-PPS-115 (or -230) is available for this application.

## 5.9. Indicators

**ADC** Red front-panel LED flashes once for each pulse digitized by ADC.

**HV/PULSER** Red front-panel LED. Continuous on = bias on; slow flash = bias off, pulser on; fast flash = bias on, pulser on.

[1]Ron Jenkins, R. W. Gould, and Dale Gedcke, *Quantitative X-Ray Spectrometry* (New York: Marcel Dekker, Inc.), 1981, pp. 266–267.

## 5.10. Controls

**Vacuum PUMP/HOLD/VENT** Front-panel, three- position valve controls the pumping or venting of the vacuum chamber. The HOLD position can be used to isolate the chamber from the vacuum pump when evacuating other chambers.

**Polarity Switches (+/-)** Three switches on the PWB select the polarity of the amplifier gain and the detector bias voltage to match the polarity of voltage required by the detector. Typically shipped in the positive (+) position.

All data acquisition, ADC, amplifier, and bias controls and readouts are software controlled with MAESTRO, AlphaVision, or other ORTEC CONNECTIONS applications. See Section 3.4.

## 5.11. Connectors

**Vacuum Connector** Rear-panel Swagelok connector for 0.25 in. OD tubing for attachment to vacuum pump.

**High-Speed USB Port** Rear-panel standard "B"-type USB connector.

## 5.12. Electrical and Mechanical

**Dimensions** NIM-standard, double-width module 6.90 cm W × 22.13 cm H (2.70 in. × 8.71 in.) front panel.

**Weight**

- Net Weight: 1.9 kg (4.2 lb).
- Shipping Weight: 2.3 kg (7.3 lb).

**Power Required** +6 V at 315 mA, +12 V at 50 mA, −12 V at 75 mA, +24 V at 50 mA.

**Power Consumption** 5 W input power.

**Operating Environment** 0° to 50°C, maximum 95% relative humidity, non-condensing.

**CE** Conforms to CE standards for radiated and conducted emissions, susceptibility, and low-voltage power directives.

## 5.13. Battery Backup

The memory in the Alpha Aria has battery backup to maintain settings data when power to the module is off. The coin battery is mounted on the PWB; contact ORTEC for the appropriate replacement.

## 5.14. Feature Mask Bits

The following table describes the feature bits for the SHOW_FEATURES command discussed on page 42. If the feature is supported in the Alpha Aria, the bit will be set to 1; if the feature is not supported, the bit will be 0.

| Bit | Meaning |
|---|---|
| 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 | 918-style list mode functions available |
| 8 | Sample mode functions available |
| 9 | Digital Offset (e.g., 920) |
| 10 | Software-selectable analog offset |
| 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 (SHOW_SNUM) |
| 22 | Power management commands |
| 23 | Battery status support (SHOW_STAT_BATT) |
| 24 | Software-selectable AMP polarity (SET/SHOW_GAIN_POLAR) |

| Bit | Meaning |
|---|---|
| 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®) |
| 29 | Software-selectable DPM address (SET_DPM_ADDR) |
| 30 | Multiple devices (e.g., 919) |
| 31 | Software-selectable ADC gate mode (SET_GATE...) |
| | *Start of second word* |
| 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 |
| 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) |

| Bit | Meaning |
|---|---|
| 60 | Hardware acquisition trigger (ENA/DIS/SHO_TRIG) |
| 61 | Ordinal numbers for shaping times (SET_SHAP 0, SET_SHAP 1, ...) |
| 62 | Explorable gain ranges (LIST/VERI_GAIN_FINE, ..._COAR, ..._CONV) |
| 63 | Routable inputs (SET/SHOW_INPUT_ROUTE) |
| | *Start of third word* |
| 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 | Zero Dead Time functions available (DSPEC-series, ASPEC-927) |
| 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 | Multiple ZDT modes (SET/SHOW/LIST_MODE_ZDT) |
| 76 | Multi-nuclide MDA preset |
| 77 | MCS Replace then Sum Mode (SET_RPLSUM) |
| 78 | Programmable external dwell voltage capability |
| 79 | NO Peak Preset feature ($M^3$CA and OASIS) |
| 80 | Programmable pulser (OASIS) |
| 81 | Programmable Vacuum/HV interlock (OASIS) |
| 82 | Programmable Current/HV interlock (OASIS) |
| 83 | Explorable Stabilizer (LIST_GAIN_ADJU, LIST_ZERO_ADJU) |
| 84 | Programmable input impedance (MCS) |
| 85 | Advanced shaping-time feature has no CUSP (digiDART, DSPEC jr 2.0, DSPEC Pro) |
| 86 | Selectable HV rise-time (SET/SHOW/LIST_HV_RISE) (SBS-60) |
| 87 | Explorable ADC GATE settings (LIST_GATE, SET_GATE n) |
| 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) |
| 93 | SET/SHOW_VIEW in MCBs with Dual-Port Memory or printer port interfaces, LIST_VIEW in all MCBs |

| Bit | Meaning |
|---|---|
| 94 | Connected to MCB via RS-232 (slow) port |
| 95 | No SET_HV_POSI, SET_HV_NEGA, ENA_NAI and DIS_N |
| | *Start of fourth word* |
| 96 | Low Frequency Rejecter (ENA/DIS/SHOW_LFR) |
| 97 | Resolution Enhancer (ENA/DIS/SH_RENHANCER, SET/SHOW_RETABLE idx,val) |
| 98 | SET_MODE_RELIST for Resolution Enhancer List Mode |
| 99 | Readable Sample mode time per channel (SH_TIME_SAMPLE) |
| 100 | Adjustable Sample mode time per channel (SET/LIST_TIME_SAMPLE) |
| 101 | List Mode data streamed and formatted as in digiBASE |
| 102 | Supports ETP mode (ENA/DIS/SHOW_ETP) |
| 103 | List Mode data streamed and formatted as in DSPEC Pro |
| 104 | SET/SHOW/LIST_PZ using floating point microseconds |
| 105 | Rise time, flattop width and cusp not changeable from property page |
| 106 | HV not user changeable from property page (requires Bit 12) |
| 107 | Coarse and fine gain not user changeable from property page |
| 108 | PZ and flattop tilt not user changeable from property page |
| 109 | LFR not user changeable from property page (requires Bit 96) |
| 110 | Portal Monitor style List Mode Synch is available |
| 111 | DSPEC-Pro Auxiliary BNC input available |
| 112 | SET_DISPLAY is NOT used to select ZDT data view (requires Bit 93) |
| 113 | ID Reports (DO_ID, SHOW_REPORT, SHOW_REPO_LINES) |
| 114 | Has neutron detector (SHOW_CRM 2 returns valid number) |
| 115 | — |
| 116 | Has the ORTEC new Alpha feature set |
| 117 | — |
| 118 | — |
| 119 | — |
| 120 | — |
| 121 | — |
| 122 | — |
| 123 | — |
| 124 | — |

| **Bit** | **Meaning** |
|---|---|
| 125 | — |
| 126 | — |
| 127 | Extended feature mask available (SH_FEAT_EXT) |

[Intentionally blank]

# APPENDIX A. FIRMWARE COMMANDS AND RESPONSES

Most software communication with the Alpha Aria will be through the CONNECTIONS software layer. CONNECTIONS is used by all ORTEC software and can be accessed for other software development with our CONNECTIONS Programmer's Toolkit with Microsoft ActiveX® Controls (A11). Use the DLL interface call MIOComm or the ActiveX control UCONN's Comm method to send commands to instruments and receive responses.

## A.1. Command Format

The commands consist of a command header that may be followed by numeric parameter values. The header consists of a verb; a verb and noun; or a verb, noun, and modifier; each separated by underscores. The first four letters of a word in a command will always be enough to uniquely identify that word when composing commands for the instrument. For example, the command **ENABLE_GAIN_STABILIZATION** can be abbreviated to **ENAB_GAIN_STAB**.

Numeric parameters are unsigned integer numbers that follow the command header separated by one or more spaces. Specific commands require multiple parameters, separated by commas, that specify numeric quantities related to the operation of the MCB, such as live time or conversion gain. The command **SET_WINDOW 0,8192** has two parameters, 0 and 8192, which set the window of interest to start at channel 0 and continue for 8192 channels.

Some parameters are optional and are delimited by square brackets in the command prototype line to distinguish them from mandatory parameters (e.g., SET_WINDOW [start,length]). Commands with optional parameters can be sent to the MCB without the optional parameters, in which case the instrument behavior will be explained in the command description.

## A.2. Error Codes

On each completion of the command, the MCB returns a macro error code and micro error code. 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. In case of error condition, you can use the MIOGetLastError (DLL interface) or GetErrMajor, GetErrMinor (ActiveX control interface).

Macro error codes:

| | |
|---|---|
| 0 | Success |
| 1 | Power-up just occurred |
| 2 | Battery-backed data lost |

| | |
|---|---|
| 129 | Command syntax error |
| 131 | Command execution error |
| 132 | Invalid Command |

For macro code 129 (syntax error) or 131 (execution error), the following apply:

| | |
|---|---|
| 1 | Invalid Verb |
| 2 | Invalid Noun |
| 4 | Invalid Modifier |
| 128 | Invalid first parameter |
| 129 | Invalid second parameter |
| 130 | Invalid third parameter |
| 131 | Invalid fourth parameter |
| 132 | Invalid number of parameters |
| 133 | Invalid command |
| 134 | Response buffer too small |
| 135 | Not applicable while active |
| 136 | Invalid command in this mode |
| 137 | Hardware error |
| 138 | Requested data not found |

Micro error codes:

| | |
|---|---|
| 0 | Success |
| 1 | Input already started/stopped |
| 2 | Preset already exceeded |
| 4 | Input not started/stopped |
| 64 | Parameter was rounded (for decimal numbers) |
| 128 | No sample data available |

### A.2.1. 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. |
| **$Fssss...<CR>** | ssss... is a variable length ASCII character sequence (no checksum is sent with this record). |
| **$Gxxxxxxxxxxccc<CR>** | xxxxxxxxxx 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). |
| **$Jxxxxxyyyyy...ccc<CR>** | Response to SHOW_CONFIGURATION command. |
| **$Mxxxxxxxxxx...ccc<CR>** | Response to SHOW_STATUS command. |
| **$Nxxxyyyzzzccc<CR>** | xxx, yyy, and zzz are 8-bit unsigned numbers. |

### A.2.2. MCB Commands

This section lists each command with a description of its operation. The descriptions include a list of any error codes that may result. As described in the two preceding sections, the usual response is a macro error code of 0 and a micro error code of 0 (no errors). 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.

The commands are listed in alphabetical order, each starting with a command prototype line. Uppercase letters, numeric digits, blank space, and special symbols such as the underscore “**_**” and comma 13 “**,**” in the prototype line are *literal text to be sent to the MCB exactly as they appear*. Lowercase letters in the prototype line represent numeric values as described in the accompanying text; they should not be sent literally to the MCB but should be replaced by an appropriate numeric value. 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.

**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 and presets are not changed.

**CLEAR_PRESETS**

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

**CLEAR_ROI**

If start and length are not specified, the region-of-interest flags for the channels in the window of interest (see SET_WINDOW) are cleared. If start and length are specified, region-of-interest flags for the channels specified by start and length are cleared.

**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_HV**

Turns off the high-voltage enable signal. See also ENABLE_HV and SHOW_HV.

**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_PULSER**

Turns off the internal pulser.

**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_HV**

Turns on the high voltage.

**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 for that channel's device if the overflow preset is disabled. The channel that caused the preset to complete will contain 2147483647 counts. An alarm response record will be sent to the host if alarms are enabled for the device whose acquisition is stopped (see ENABLE_ALARM command). See also DISABLE_OVERFLOW_PRESET and SHOW_OVERFLOW_PRESET commands.

**ENABLE_PULSER**

Turns on the internal pulser.

**INITIALIZE**

Returns the Alpha Aria to the factory default settings.

**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.

**LIST_GAIN_ADJUST**

Lists the range of valid gain stabilizer adjustments.

Response:

| | |
|---|---|
| **GAIN_ADJU -100 100 -100 100** | Gain stabilizer adjustment ranges from −100% to +100%. |

**LIST_GAIN_CONVERSION**

Returns a string that enumerates each legal conversion gain setting separated by a space.

Response:

**GAIN_CONV 256 512 1024 2048 4096**

**LIST_GAIN_FINE**

Lists the valid fine-gain settings.

Response:

| | |
|---|---|
| **GAIN_FINE 0.250 1.0 1032192 4128768** | Valid fine gain settings range from 0.25 to 1.0. |

**LIST_HV**

Lists the valid bias settings. The Alpha Aria accepts bias values between 0 and +1200 V in 960 steps (1.25 V/step).

**RESET**

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

**SET_DATA** start channel,width,count

If the optional start and channels parameters are included in this command, the range of channels specified by start and channels is loaded with value. If start and channels 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_APP** "entry","data"

Stores information such as sample descriptions and energy calibrations in the MCB internal memory that can be used by other programs. Entry (32 characters maximum) specifies the type of information to store with data (128 characters maximum).

**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.

**SET_GAIN_CONVERSION** chans

Sets the conversion gain. The conversion gain defines the number of channels within the device that will used for spectral data. See also LIST_GAIN_CONVERSION and SHOW_ GAIN_CONVERSION.

Legal Commands:

| | |
|---|---|
| **SET_GAIN_CONVERSION 0<CR>** | Conversion gain set to default (4096). |
| **SET_GAIN_CONVERSION 4096<CR>** | Conversion gain set to 4096 channels (full ADC resolution). |
| **SET_GAIN_CONVERSION 2048<CR>** | Conversion gain set to 2048 channels. |
| **SET_GAIN_CONVERSION 1024<CR>** | Conversion gain set to 1024 channels. |
| **SET_GAIN_CONVERSION 512<CR>** | Conversion gain set to 512 channels. |
| **SET_GAIN_CONVERSION 256<CR>** | Conversion gain set to 256 channels. |

**SET_GAIN_FINE** value

This sets the fine gain to value. Value is a floating point value from 0.25 to 1.0. See also LIST_GAIN_FINE and SHOW_GAIN_FINE.

**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. See also SHOW_GAIN_WIDTH, SET_GAIN_CHANNEL and SHOW_GAIN_CHANNEL.

**SET_HV** value

This sets the bias to value, in volts, and stores value as the target HV.

**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 Alpha Aria. Setting an integral preset to 0 counts disables the preset. The integral preset can be set to from 0 (disabled) to 4294967295 counts. See also CLEAR_PRESETS and SHOW_INTEGRAL_PRESET.

**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 per second). Normally this value is set by the Alpha Aria during data acquisition. See also CLEAR_COUNTERS and SHOW_LIVE.

**SET_LIVE_PRESET** ticks

Sets the live-time preset to the specified number of ticks. During data acquisition when the live-time counter reaches the preset number of ticks, the preset is complete and the acquisition is stopped. Setting a live-time preset to 0 ticks disables the preset. See also CLEAR_PRESETS and SHOW_LIVE_PRESET.

**SET_LLD** chan

Sets the lower level discriminator to chan, which must be between 0 and 4095. See also SHOW_LLD.

**SET_MODE_PHA**

Sets the MCB to pulse height analysis mode for collection of histogram data.

**SET_MODE_SAMPLE**
Starts InSight Virtual Oscilloscope mode.

**SET_OFFSET** chans
Sets the digital offset to the specified number of channels. The digital offset represents the number of channels that the spectrum is shifted to the lower energy side of the segment. Note that if the digital offset is set to a value greater than the current conversion gain setting, no counts can be processed since the entire spectrum is shifted out of the segment. See also SHOW_OFFSET.

Legal Commands:

| | |
|---|---|
| **SET_OFFSET 0** | Digital offset set to 0 channels (no offset). |
| **SET_OFFSET 1** | Digital offset set to 1 channel. |
| **SET_OFFSET 2** | Digital offset set to 2 channels. |
| ... | ... |
| **SET_OFFSET 4095** | Digital offset set to 4095 (maximum offset). |

**SET_PEAK_PRESET** count
Sets the ROI peak preset the specified count. During data acquisition when the contents of any channel 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 Alpha Aria. Setting a peak preset to 0 counts disables the preset. The peak preset can be set to from 0 (disabled) to 2147483647 counts. See also CLEAR_PRESETS and SHOW_PEAK_PRESET.

**SET_PULAMP** pulseramplitude
Sets the pulser amplitude (from 0 to 4095).

**SET_RCAP**
Turns on automatic vacuum monitoring and regulation (same as marking the **Vacuum monitoring** checkbox on the Alpha tab under **Acquire/MCB Properties** in MAESTRO). See also SHOW_RCAP.

**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 that are considered for ROI integral and ROI peak presets.

**SET_SEGMENT** number
The segment number is used to represent the default input (chamber) for commands such as START and STOP. Normally, our interface software transparently manages the segment

number, and application programs should not attempt to change it. Always 1 for the Alpha Aria.

**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 per second). Normally this value is set by the Alpha Aria during data acquisition. See also CLEAR_COUNTERS and SHOW_TRUE.

**SET_TRUE_PRESET** ticks

Sets the true-time preset to the specified number of ticks. 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. See also CLEAR_PRESETS and SHOW_TRUE_PRESET.

**SET_ULD** value

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

**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 and SET_DATA. If neither start nor length is provided, the window is set to the maximum size allowed by the conversion gain specified.

**SHOW_ACTIVE**

Reports which segments are currently acquiring data. Always 1 for the Alpha Aria.

Responses:

| | |
|---|---|
| **$C00000087<CR>** | No segments are acquiring data. |
| **$C00001088<CR>** | Only segment 1 is acquiring data. |

**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, and the current conversion gain. The record is organized as follows:

**$J0819200001aaaaa00000**[65 zeros here for total of 75 zeros]**00000ccc**

where **aaaaa** represents the conversion gain for segment 1, and **ccc** represents the record checksum. See Section ? 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_CRM**

Returns the current reading of the count-rate meter.
Response:

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

**SHOW_DATA_APPLICATION** "entry"

If entry matches entry from a previous SET_DATA_APPLICATION command, the data from the SET_DATA_APPLICATION command is returned in a $F record.
Execution Errors:

| | |
|---|---|
| **%131138085** | Entry could not be matched. |

**SHOW_DEVICE**

Included for compatibility with other MCBs. Always returns one for the number of the currently selected device.
Responses:

| | |
|---|---|
| **$A001246<CR>** | Device number 1 is currently selected device. |

**SHOW_FEATURES**

Responds with four 32-bit masks that indicate which features are present in the MCB. See Section 5.14 for a complete description of each bit in the mask.
Example Response:
**FEATURES 00003152173 01116798988 02684945664 00001114120**

**SHOW_GAIN_ADJUST**

Returns the gain-stabilizer setting.

**SHOW_GAIN_CONVERSION**

This command returns the conversion gain.
Responses:

| | |
|---|---|
| **$C00256100<CR>** | Conversion gain reported as 256 channels. |
| **$C00512095<CR>** | Conversion gain reported as 512 channels. |
| **$C01024094<CR>** | Conversion gain reported as 1024 channels. |
| **$C02048101<CR>** | Conversion gain reported as 2048 channels. |
| **$C04096106<CR>** | Conversion gain reported as 4096 channels. |

**SHOW_GAIN_FINE**

Returns the current fine gain setting. See SET_GAIN_FINE.

Sample Response:

| | |
|---|---|
| **GAIN_FINE 0000000000000.5** | Parameter is set to 0.5. |

**SHOW_GAIN_STABILIZATION**

Reports the state of gain peak stabilization. See also ENABLE_GAIN_STABILIZATION and DISABLE_GAIN_STABILIZATION.

Responses:

| | |
|---|---|
| **$IT<CR>** | Gain stabilization is currently enabled. |
| **$IF<CR>** | 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:

| | |
|---|---|
| **$C00001088<CR>** | Gain width has not been set. |
| **$C00003089<CR>** | Gain width is 3 channels (lowest possible width). |
| ... | ... |
| **$C00256100<CR>** | Gain width is 256 channels. |

**SHOW_HV**

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

**$Dvvvvvssssscc**

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. **sssss** represents the status of the high voltage 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:** | High voltage 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_ACTUAL**

Returns the value of HV actually on the detector.

**SHOW_HV_CURRENT**

Returns the bias supply current for the default input Alpha Aria as follows:

**$Crrrrrccc<CR>**

where **rrrrr** represents the output current in nanoamps.

**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:

**$Dvvvvvssssscсс<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**

Returns the high voltage reading and bias supply status as follows:

**$Dvvvvvssssscсс<CR>**

where **vvvvv** represents the output voltage for the default input in units of 0.1 V (i.e., 100 represents 10 V). **sssss** represents the status of the high-voltage supply as a 16-bit decimal number with the following bit definitions:

| | |
|---|---|
| **Bit 0 (LSB):** | Supply polarity (0 = positive,1 = negative) |
| **Bit 1:** | Unused |
| **Bit 2:** | Supply enabled (0 = disabled,1 = enabled) |
| **Bit 3:** | Supply shutdown (0 = normal,1 = shutdown) |

**SHOW_HV_CURRENT**

Returns the bias supply current for the default input Alpha Aria as follows:

**$Crrrrrccc<CR>**

where rrrrr represents the output current in nanoamps.

**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 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. See SET_INTEGRAL_PRESET for more information about the ROI integral preset. See also SHOW_INTEGRAL.

Responses:

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

**SHOW_LIVE**

Reports the contents of the live-time counter in units of 20 ms (50 ticks per second). 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 23,000 days). |

**SHOW_LIVE_PRESET**

Reports the current live-time preset in units of 20 ms (50 ticks per second). 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_LLD**

Shows the lower level discriminator setting. See also SET_LLD.

Responses:

| | |
|---|---|
| **$C00050092** | The LLD is 50. |

**SHOW_MODE**

Reports mode of operation (PHA, or Sample [InSight]). Response: $FPHA<CR> PHA mode. $FLIS<CR> List mode. $FSAM<CR> Sample (InSight) mode.

Responses:

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

**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:

**$Dsssssnnnnnccc<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:

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

**SHOW_OFFSET**

This command returns the digital offset for the input routed to the currently selected segment. If more than one input is routed to the currently selected segment this command returns the offset for the lowest numbered input routed to the currently selected segment. See also SET_OFFSET and SET_INPUT_ROUTE.

Responses:

| | |
|---|---|
| **$C00000087<CR>** | Digital offset reported as 0 channels. |
| **$C00001088<CR>** | Digital offset reported as 1 channel. |
| ... | ... |
| **$C01000088<CR>** | Digital offset reported as 1000 channels. |

**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:

| | |
|---|---|
| **$G0000000000075<CR>** | Maximum count in an ROI channel is zero or no ROI channels were found. |
| **$G0000000001076<CR>** | Maximum count in an ROI channel is 1. |
| ... | ... |
| **$G2147483646120<CR>** | Maximum count in an ROI channel is 2147483646. |
| **$G2147483647121<CR>** | 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 that one channel contains the largest number of counts. Channel 4096 is the highest numbered channel.

Responses:

| | |
|---|---|
| **$C00000087<CR>** | Maximum count was found in channel 0 or no ROI channels were found. |
| **$C00001088<CR>** | Maximum count was found in channel 1. |
| ... | ... |
| **$C00412094<CR>** | Maximum count was found in channel 412. |

**SHOW_PEAK_PRESET**

Reports the value of the ROI peak preset. See SET_PEAK_PRESET for information about the ROI peak preset.

Responses:

| | |
|---|---|
| **$G0000000000075<CR>** | Peak preset disabled. |
| **$G0000000001076<CR>** | Peak preset set to 1 count. |
| ... | ... |
| **$G2147483646120<CR>** | Peak preset set to 2147483646 counts. |
| **$G2147483647121<CR>** | Peak preset set to 2147483647 counts. |

**SHOW_PULAMP**

Reports the pulser amplitude (from 0 to 4095).

Response:

| | |
|---|---|
| **PULAMP 000000000002000** | Pulser amplitude set to 2000. |

**SHOW_PULSER**

Reports whether pulser is on (true) or off (false).

Response:

| | |
|---|---|
| **$IT<CR>** | Pulser is on. |
| **$IF<CR>** | Pulser is off. |

**SHOW_RCAP**

Reports whether automatic vacuum monitoring and regulation is turned on (true) or off (false). See also SET_RCAP.

Response:

| | |
|---|---|
| **$IT<CR>** | Automatic vacuum monitoring is on. |
| **$IF<CR>** | Automatic vacuum monitoring is off. |

**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:

**$Dsssssnnnnnccc<CR>**

where sssss 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:

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

**SHOW_SEGMENT**

Returns the current segment number. Always 1 for the Alpha Aria.

**SHOW_SNUM**

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

Response:

| | |
|---|---|
| **$F100** | Serial Number = 100. |

**SHOW_STATUS**

Returns system status information in the following format:

**$Mllllllllllttttttttttaaaaahhhhhccc<CR>**

where **llllllllll** represents the live time as returned by the SHOW_LIVE command, **tttttttttt** represents the true time for the current segment 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:

| | |
|---|---|
| **Bit 0 (LSB):** | Bias Supply Polarity (0 = positive, 1 = negative). |
| **Bit 1:** | Bias Supply Overload (0 = overload, 1 = normal). |
| **Bit 2:** | High Voltage Enabled (0 = disabled, 1 = enabled). |
| **Bit 3:** | Unused. |
| **Bit 4:** | Amplifier pole-zeroed since initialization (0 = normal, 1 = needs pole zeroing). |
| **Bits 5–7:** | Unused. |
| **Bit 8:** | Amplifier Automatic Pole Zero (1 = Auto Pole Zero in progress, 0 = normal). |
| **Bits 9–14:** | Unused. |
| **Bit 15 (MSB):** | Reserved. |

**SHOW_TRUE**

Reports the contents of the true-time counter in units of 20 ms (50 ticks per second). 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 23,000 days). |

**SHOW_TRUE_PRESET**

Reports the current true-time preset in units of 20 ms (50 ticks per second). 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_ULD**

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

Example Response:

| | |
|---|---|
| **$C01023093** | The ULD is 1023. |

**SHOW_VERSION**

Reports the Alpha Aria firmware version number in the form:

**Fmmmm-vvv<CR>**

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

Example Responses:

| | |
|---|---|
| **$FARIA-002<CR>** | Alpha Aria firmware version 2 reported. |

**SHOW_WINDOW**

Reports the start channel and number of channels that are in the window of interest in the form:

**$Dxxxxxyyyyyccc<CR>**

where **xxxxx** is the start channel (0 through 4095) and **yyyyy** is the number of channels (1–4096). See SET_WINDOW for more information about the window of interest.

Example Responses:

| | |
|---|---|
| **$D0000004096091<CR>** | Window of interest reported as starting at channel 0 and continuing for 4096 channels. |
| **$D0000002048086<CR>** | Window of interest reported as starting at channel 0 and continuing for 2048 channels (first 1/2). |
| **$D0204802048100<CR>** | Window of interest reported as starting at channel 2048 and continuing for 2048 channels (last 1/2). |

**START** [seg-mask]

Starts data acquisition. 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 Alpha Aria.

**STOP** [seg-mask]

Stops the acquisition of spectral data. The optional segment mask is provided for compatibility with other MCBs and can be any value from 0 to 65535, but is ignored by the Alpha Aria.

# APPENDIX B. CHANGING TO AN OPPOSITE-POLARITY DETECTOR

Switching to an opposite-polarity detector[2] requires changing three slide switches on the printed wiring board (PWB) and recalibrating the pulser. After making these hardware changes, you must use MAESTRO or AlphaVision to recalibrate the detector.

Procedure:

1) Turn off the bin, disconnect the vacuum line and USB cable, and remove the Alpha Aria from its slot.

2) Remove the right side panel (as viewed from the front) with a Phillips-head screwdriver. Figure 13 shows the interior of the Alpha Aria, including the vacuum chamber, 3-way valve, and PWB.

3) The polarity switches are located on the half of the board closest to the top of the unit. They are highlighted in Fig. 14. Switch SW 101 is located at the top edge of the PWB. SW 102 is nearest the center line of the board, just outside the silver amplifier shield. SW 100 is located under its respective amplifier shield. Use your fingernail to *gently* pop the shield off. Slide all three switches toward the rear panel to change them to negative.

4) Move the three sliders toward the rear panel to switch them to negative polarity.

5) Replace the amplifier shield; it should click into place.

6) Install the new detector according to Section 2.3.

You are now ready to recalibrate the unit. The following instructions require a good-quality $^{241}$Am source, and peak location is based on its 5.945 MeV alpha peak.

7) Leaving the side panel off, return the Alpha Aria to the bin, tighten its front-panel screws, reconnect the vacuum line and USB cable, and power up the bin.

8) Place the source in the vacuum chamber and close the door.

---

[2]All ORTEC charged-particle detectors are shipped in a plastic container, accompanied by a quality-control sheet. Both bear the model number. The first letter gives the mount type (for Alpha Suite modules, this is always B rear Microdot). The second letter is the detector type: R = Ruggedized (negative bias), U = ULTRA (positive bias), and A = A Series (positive bias).

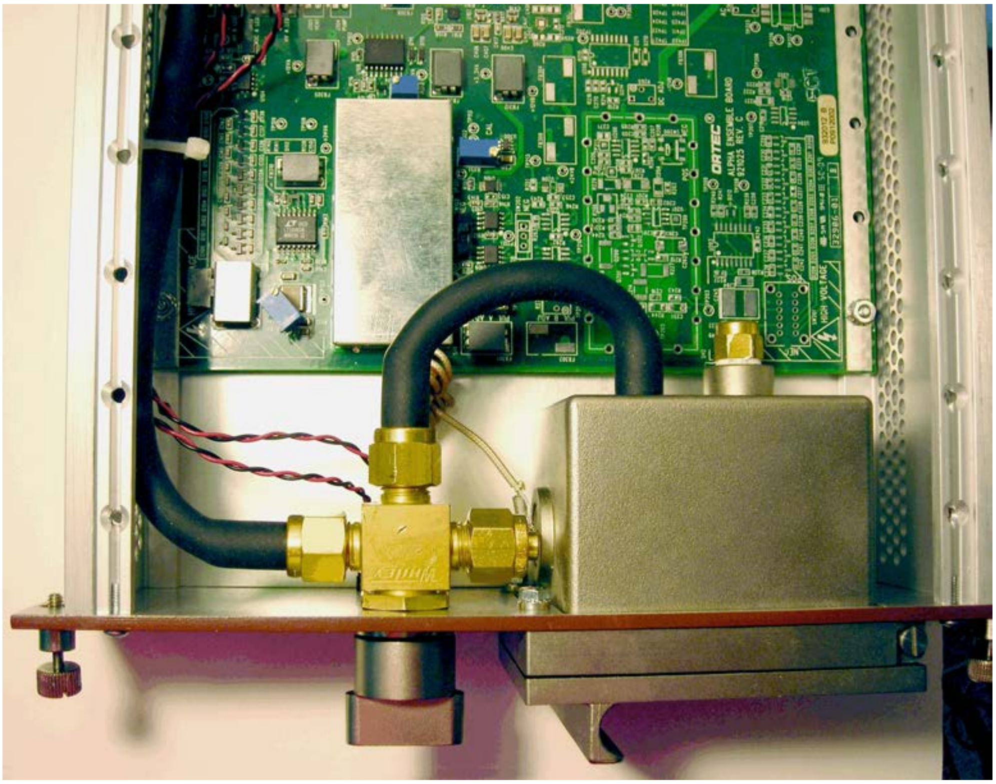

**Fig. 13. Inside the Alpha Aria.**

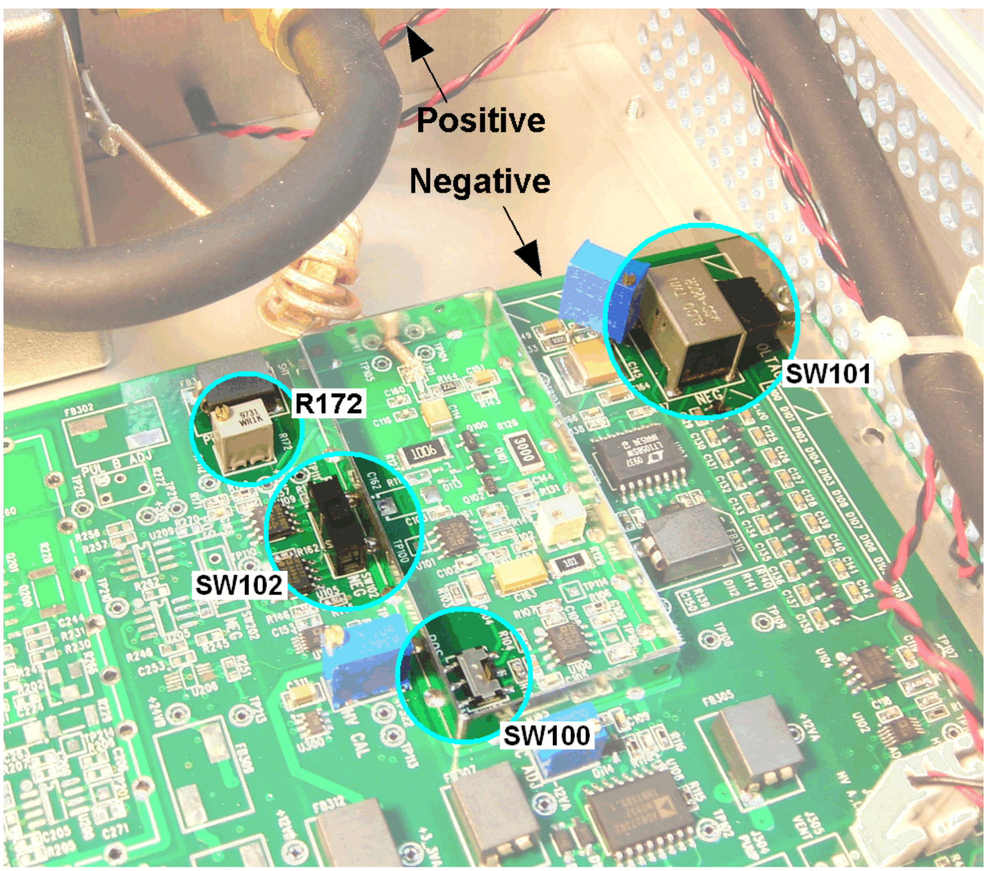


**Fig. 14. Polarity Slide Switches and Pulser Adjustment.**

9) Start MAESTRO, select the Alpha Aria from the detector pick list, then click on **Acquire/ MCB Properties** to open the Properties dialog. (Refer as needed to the MCB Properties instructions in Section 3.4).

10) On the ADC tab, set the following:

- Conversion Gain = 4096
- Lower Level Disc = 40
- Upper Level Disc = 4095

11) On the Stabilizer, make sure the **Gain Stabilization Enabled** checkbox is *unmarked*.

12) On the Alpha tab, set the following:

- Digital offset = 0
- Display chans = 4096
- Enable internal pulser = off (unmarked)

13) Turn the front-panel valve to **Pump** and evacuate the chamber.

14) On the High Voltage tab, enter the **Target** bias and turn the HV **On**.

15) Select **Calculate/Calibration...** from the menu bar, and click on the **Destroy Calibration** button. The status line below the spectrum will now read only in channels, not energy.

16) Press **<Alt + F7>** to ensure the Expanded Spectrum Window is fully zoomed out. Start data acquisition by clicking on **Acquire/Start**. A peak will begin accumulating in the spectrum window.

17) On the Amplifier tab, adjust the fine gain until the peak is in channel 2247.

18) Stop acquisition and clear the MCA memory by clicking on **Acquire/Stop** then **Acquire/ Clear**.

19) In the Properties dialog, go to the High Voltage tab and turn the HV **Off**.

20) Vent the chamber, remove the source, evacuate the chamber again, and turn the HV **On**.

21) On the Alpha tab, set the pulser **Amplitude** to 2246, then click to mark the **Enable internal pulser** checkbox. The front-panel HV/Pulser indicator should begin blinking and a peak should begin accumulating in the spectrum window.

22) Referring to Fig. 14, adjust screw-potentiometer R172 until the pulser peak is in channel 2246.

23) Turn off the HV and pulser, and vent the chamber.

24) You are now ready to turn off the bin power, replace the Alpha Aria's side panel, then return to MAESTRO to set your desired MCA settings and calibrate for the data window of interest.

For more information, contact your ORTEC representative or our Global Service Center.

# INDEX

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