

# Model iPA Intelligent Preamplifier for HPGe Detector

7080526C

User's Manual



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The information in this document describes the product as accurately as possible, but is subject to change without notice.

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# Important Safety Considerations

## Read Carefully



Indicates warning of mains or high voltage present at output labeled HV.  
Risk of electrical shock if covers are removed.



Caution – risk of danger. Refer to documentation for detailed explanation of caution symbol wherever marked.



Earth tree symbol: indicates the connection point for the primary earth (ground) supply.



Product complies with appropriate current EU directives (Low Voltage & EMC).



Product complies with appropriate current FCC /UL / CSA 61010-1 directives (Low Voltage & EMC).

### **Manufacturer's Address**

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# Notes

# 1. Introduction

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The Canberra Intelligent Preamplifier (iPA) for High-Purity Germanium (HPGe) Detectors is a low-noise, high-speed preamplifier designed for high resolution gamma spectroscopy and timing measurements. The iPA converts the ionization charge developed in the detector during each absorbed nuclear event to a step-function output pulse whose amplitude is proportional to the total charge accumulated in the event. The pulse decays exponentially with a time constant of 50  $\mu$ s (nominal) to segregate successive events in high count rate applications.

The preamplifier includes a low-noise FET input circuit optimized for the ultra-high source impedance of germanium detectors. To reduce noise, the iPA input circuits are cooled by mounting them inside the cryostat, creating an integral detector-preamplifier assembly. A protection network prevents damage to the amplifier input from high voltage transients. The charge amplifier and buffer stages have been designed for both the low noise and high speed performance needed for precise energy and timing spectroscopy. In addition, special circuits monitor both the temperature and activity of the detector, and warn when improper operating conditions exist. A high-voltage filter network insures a noise-free power source for the detector.

The iPA is equipped with a high-speed USB2.0 serial data interface. This interface facilitates extensive control and monitoring of many critical preamplifier and detector functions. The included *iPA Control Panel* software application provides the user with real-time monitoring of the detector current and temperature, along with pertinent internal preamplifier operating voltages. The integrated data logging feature continuously records several of these key operating parameters on a periodic basis, and stores them within the iPA mass storage memory. The stored data log files can be readily downloaded by the user and viewed with the *iPA Control Panel software*.

The block diagram in Figure 1 shows a functional breakdown of the preamplifier. The first stage serves as an **integrator** yielding an output voltage proportional to the accumulated charge from the detector. A **differentiator** follows the first stage and includes a digitally-calibrated pole/zero network to provide the unipolar signal with an accurate return to baseline. The second amplifier serves as an output buffer and allows preamplifier conversion factors of 50, 100, 250, or 500 mV/MeV, digitally programmable through the *iPA Control Panel software*. Separately terminated Energy and Timing outputs are available. A digitally-controlled offset adjustment insures a nominal quiescent DC output of zero volts.

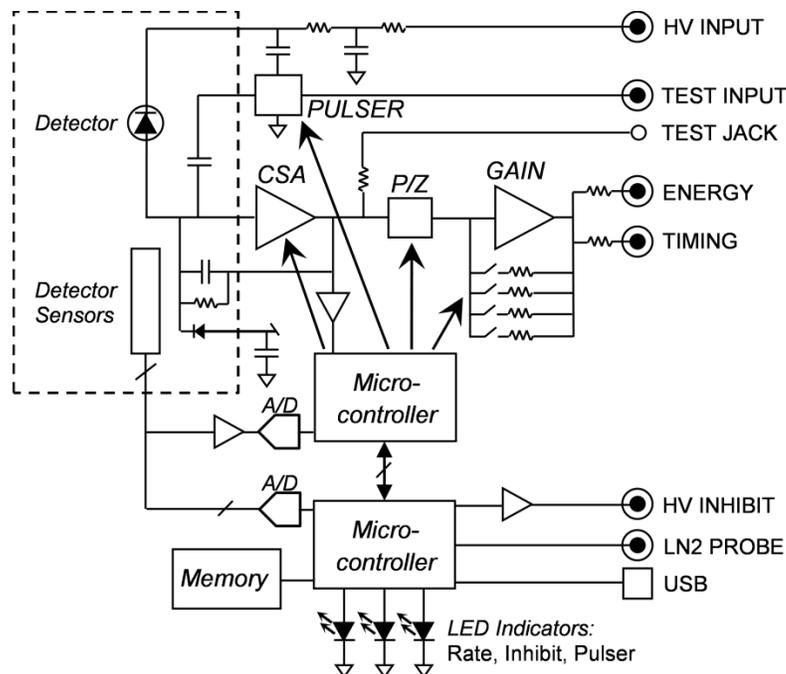


Figure 1 iPA Block Diagram

The fast rise time of the iPA is maintained over a wide range of detector capacitances, making the preamplifier an excellent choice for timing measurements. Timing analysis can be done using Canberra Timing-Filter Amplifiers. Constant Fraction Discriminators and Time to Amplitude Converters as required.

The count rate capability of the iPA has been demonstrated in excess of 200,000 counts per second using a  $^{60}\text{Co}$  gamma energy source (1.33 MeV peak). In order to take advantage of the high-count-rate capability of the iPA, a Canberra high-count-rate main shaping amplifier or MCA is recommended.

A source, which is too active, may lead to detector-preamplifier overload. As the maximum energy-rate product is approached, the preamplifier may operate intermittently, producing excessive peak shift and resolution degradation. When the maximum energy-rate product is reached, the preamplifier will shut down. The iPA includes a red High Rate warning LED that glows when the high rate condition is approached.

Germanium detectors operate properly only when cooled to liquid nitrogen temperatures. The iPA preamplifier includes a monitoring circuit, which operates in conjunction with a temperature probe thermally connected to the detector. If the detector temperature is correct, the High Voltage Inhibit LED will glow green. If the temperature of the detector rises beyond the normal operating range, the High Voltage Inhibit LED will glow red. The Inhibit signal available on the rear panel BNC connector is used to disable the high voltage supply under these conditions.

~~The iPA also includes an integrated LN<sub>2</sub> level monitoring circuit, for use with an optional Canberra LN<sub>2</sub> level sensing probe. The iPA and probe work together to continuously measure the LN<sub>2</sub> level within the Dewar. The measurement is displayed on the iPA Control Panel status screen, and warns the user when the LN<sub>2</sub> level becomes low and the Dewar requires refilling.~~

Both a standard test input and internal test pulser are provided to assist system setup and as a diagnostic aid. The internal test pulser is digitally-controlled through the *iPA Control Panel* software, and can be adjusted to produce pulses at a frequency of 20-2000Hz and 0-1.025V amplitude. The nominal voltage gain through the preamplifier test input is 1X for the output scale factor of 100 mV/MeV, 0.5X for 50 mV/MeV, 2.5X for 250 mV/MeV, and 5X for 500 mV/MeV.

The resistor-buffered output of the charge integrator is available at the rear panel Test jack for detector/preamplifier troubleshooting. The V-I characteristics of the detector can be readily checked by measuring the test-point voltage as a function of detector bias voltage.

Power for the iPA is usually supplied from the associated Canberra pulse shaping amplifier or MCA. The power lines are filtered within the iPA to provide high noise immunity. A 3 m (10 ft) power cable is provided with the preamplifier.

## 2. Controls and Connectors

### Front and Rear Panels

This is a brief description of the iPA's controls and connectors. For more detailed information, refer to Appendix A, *Specifications*. Note that the iPA-SL preamplifier enclosure is different from that shown for the iPA.

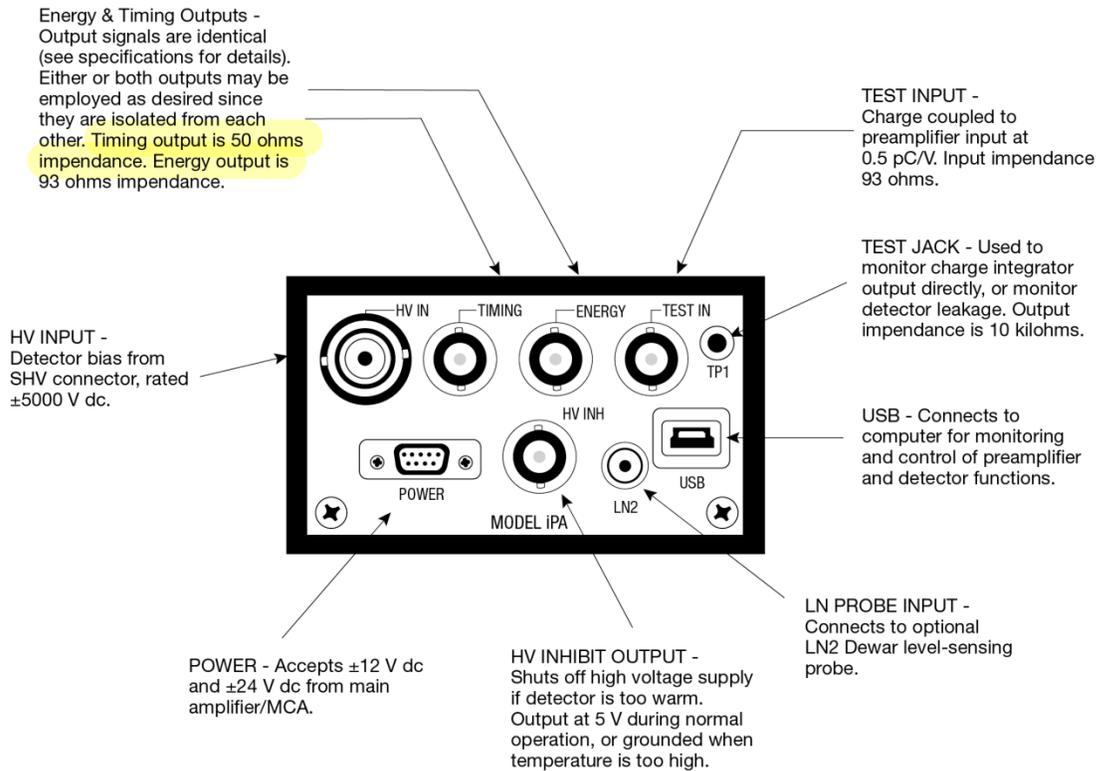


Figure 2 Front Panel Connectors

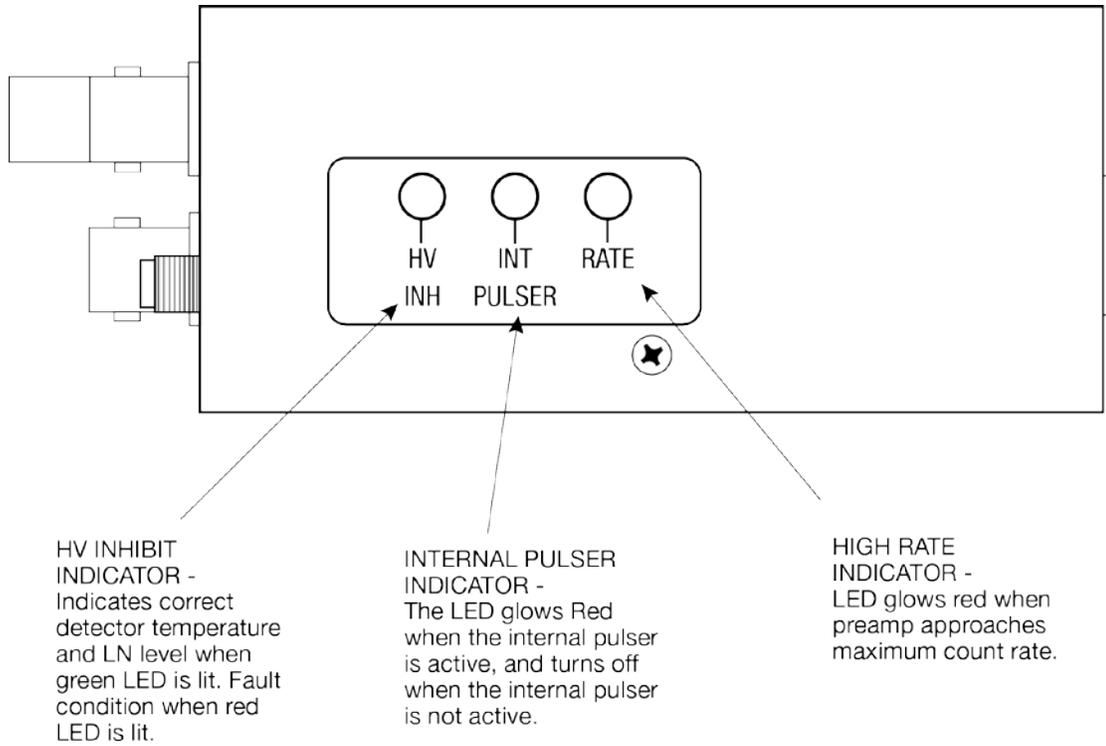


Figure 3 Side View of iPA showing Labels

## 3. Installation

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The iPA preamplifier connects to the body of a detector cryostat, which has an accessible anode or cathode lead along with the cooled FET assembly interface connector.

### Mounting the Model iPA

The front panel of the Canberra iPA is reversible to facilitate either end-mounting or side-mounting to the cryostat as desired. The panel provides a 25 by 35 mm opening for routing the input leads to the cryostat feed-through pins, and two number 4-40 tapped holes for mounting an adapter bracket for the particular cryostat body.

Mounting may be accomplished most readily and conveniently if the cover is removed from the preamplifier. However, the user must be very cautious not to touch the high voltage capacitors or high megohm resistors in the detector bias supply, otherwise fingerprints and residue will degrade noise performance. It is also suggested that the input leads be dressed away from each other and from the chassis to minimize the stray capacitances which aggravate noise.

### Precautions

Strict attention must be paid to these precautions in order to insure optimum performance and reliability. Since the iPA is a state of the art ultra-low noise preamplifier, field repairs are not recommended.

The user must be very cautious in inspecting or adjusting the Preamplifier, particularly in the area of the high voltage components as described above.



While the long filter time constant relieves restrictions on the rate of voltage applied to the HV INPUT, the user should never connect or disconnect the Preamplifier from a detector while the high voltage is ON. Always wait at least 5 minutes after the detector bias has been reduced to zero (allowing the filter to fully discharge back into the High Voltage Power supply), before disconnecting the preamplifier from the detector.

If the preamplifier is to be used in an environment of high relative humidity, special precautions, and possible special treatment at the factory, may be necessary to minimize extraneous noise or possible destruction of the FET due to high voltage leakage and discharges.

## Connecting the Preamplifier

Rear panel connections are made as follows. The Energy output is used to connect to a spectroscopy amplifier or MCA. The Timing output, which has 50  $\Omega$  impedance, should be used for timing experiments. The High Voltage Bias connection should be made using a high voltage cable to the high voltage supply. If the High Voltage Inhibit feature is used, connection should be made to the bias supply's Inhibit input. Power should be taken from the associated amplifier or MCA with the supplied power cable.

To prevent ground loop noise from entering the system, the H.V. Input and H.V. Inhibit output grounds are isolated. To maintain this isolation on the iPA-SL preamps, slip the flexible sleeving included with the preamplifier over the BNC and SHV connector shells after connecting the cables.

## Mounting Models iPA-SL

The iPA-SL preamplifier is normally mounted and connected to the detector at the factory.

The USB cable was not connected, though.

## 4. Operating Instructions

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This chapter will acquaint you with the operating features of the iPA family of preamplifiers and discuss system considerations.

### Temperature Monitoring Circuit

Before applying power to the system, make sure that the High Voltage Inhibit connection has been made to the Inhibit input of the high voltage supply. When the preamplifier is turned on, the green LED will glow if the detector has already been cooled to LN temperatures.

If the HV INHIBIT feature is in use and the detector temperature is not correct, the HV Inhibit output will prevent high voltage from being applied and the red HV Inhibit LED will turn on. Remember that preamplifier power must be on for the High Voltage Inhibit output to function.

If the liquid nitrogen in the Dewar runs low, the red LED will light and the external high voltage power supply will be shut down. The Inhibit output is normally +5 V when detector temperature is correct and approximately +0.1 V during a fault condition. If you are using a high voltage supply not manufactured by Canberra, make sure the Inhibit input is compatible with the preamplifier output.

Some high voltage supplies may require a logical high voltage greater than +5V. In such cases, the HV Inhibit output of the iPA includes a diode coupling which may be pulled up externally to the required voltage, up to +50V.

The iPA also supports an alternative HV Inhibit mode, for use with HV supplies not manufactured by Canberra. When operated in “Other” mode, the iPA HV Inhibit circuit acts as a DC current source instead of a logic voltage output. Under normal operating conditions, when the detector temperature is correct, the HV Inhibit circuit generates a current of 0.5mA, which flows into the HV Inhibit output. This current is sensed by the connected HV supply and subsequently applies HV bias to the detector. When the detector temperature is not correct, the HV Inhibit output of the iPA becomes an open-circuit, and causes the HV supply to be shut down.

### LN<sub>2</sub> Level Monitoring

The Model iPA incorporates a special circuit, which is intended to be used in combination with an optional LN<sub>2</sub> Dewar level-sensing probe. When the optional probe is connected to the LN<sub>2</sub> Input connector on the iPA, the LN<sub>2</sub> level within the Dewar is continuously measured and displayed on the *iPA Control Panel* software status screen. The LN<sub>2</sub> level measurement is reported in terms of percentage of full-scale, and is highlighted in red when it reaches a Low state to alert the user to refill the Dewar.

## High Rate Indicator

The High Rate warning indicator LED will glow red when the preamplifier is being overdriven by too active of a source. Higher energy sources will cause preamplifier saturation at a lower count rate than lower energy sources. If the LED flickers red, the preamplifier is entering the overload region. If it glows red steadily, it may be necessary to reduce the exposure of the detector to source activity by separating the detector and the source. The LED will also glow red if excessive leakage develops in the detector. When first powered up, the LED may glow red for several seconds due to transient conditions. Under normal operating conditions, when the count rate is sufficiently low, the LED will glow green.

## Test Pulser Input

Besides being useful for troubleshooting system noise, the Test Input can be used to check system gains, pulse shapes, and rise times. To check the intrinsic preamplifier rise time, connect a square wave or pulse generator with a fast rise time leading edge, preferably 5 ns or less rise time, to the Test Pulser input. Connect the Timing Output to a fast rise time oscilloscope using 50  $\Omega$  cable and terminate the cable at the oscilloscope end with 50  $\Omega$ . The rise time will show the performance of the preamplifier and the effect of any added detector capacitance. Fastest rise time will be seen with the gain selected at the 50 mV/MeV setting.

## Internal Test Pulser

The internal test pulser is digitally-controlled through the *iPA Control Panel* software, and can be adjusted to produce pulses at a frequency of 20-2000Hz and 0-1.025V amplitude. The nominal voltage gain is the same as that of the preamplifier test input, with 1X for the output scale factor of 100 mV/MeV, 0.5X for 50 mV/MeV, 2.5X for 250 mV/MeV, and 5X for 500 mV/MeV. When the internal pulser is active, the Internal Pulser LED will glow red. When the internal pulser is not active, the LED is turned off.

Preamp output induced by the internal pulser is positive, different from  $\gamma$  ray signals

## Common Operating Problems

The modern HPGe gamma ray spectrometer is an extremely sensitive, state-of-the-art system. Inexact performance of other than the grossest type is generally due to subtle factors. It is the ability to determine and correct these factors constitutes the art in the science of gamma spectroscopy instrumentation.

All of the many possible contributors to less than optimum performance cannot be listed here. The purpose of this section is to note the usual causes of loss of resolution, and to suggest corrective steps.

Do not expect to diagnose problems with a detector, a preamplifier, a main amplifier, and a multichannel analyzer. To troubleshoot a spectroscopy system, a good modern, high-bandwidth oscilloscope will be needed. Also, a high quality tail pulse generator (Canberra 814FP or equivalent) will be extremely useful.

## Chapter 4 Operating Instructions

The simplest test is, of course, to connect your detector, apply bias, present a source, and accumulate a spectrum. Be sure a pulser is not feeding the preamplifier while the spectrum is accumulating or resolution loss may result. If the results obtained are far different from what is expected, it then becomes necessary to troubleshoot the system.

First, observe the amplifier/MCA output on an oscilloscope at various time base and amplitude settings. Is the amplifier/MCA properly pole/zero canceled? If it is not, you will probably see output pulses causing undershoots that persist for longer than two or more main pulse widths. Set the main amplifier/MCA pole/zero cancellation by the procedure given in the amplifier/MCA manual.

The next step is to remove all sources and, with the detector still connected and bias applied, to apply a test pulse to the preamplifier's TEST input. Make sure the pulser polarity is correct. Set the amplitude of the pulser so that its peak occurs near the region of the peak of the source previously used.

Observe the output of the amplifier/MCA. Note that the output is not properly pole/zero canceled for the pulser feeding the preamplifier (due to the extra time constant of the pulser). This is of no consequence for a pure pulser input. Are the baseline fluctuations of one or two times AC line frequency? A ground loop is indicated. Insert all system line plugs into the same outlet. Or, are the baseline fluctuations of random frequency between 10 Hz and 15 000 Hz? If so, clap your hands near the detector and look for increased noise of this type. The area may be too noisy, causing microphonic problems.

Isolate the detector as much as possible by setting it on a foam rubber base and place a foam rubber collar between the bottom of the cryostat head and the Dewar neck. The bubbling of the liquid nitrogen in the Dewar is a frequent, hard-to-cure cause of microphonics.

If high frequency noise is observed, is it random or periodic? Periodic noise may be a sign of electronics failure: isolate the cause by observing the preamplifier output. Is the same pattern observed, or is the problem in the main amplifier? Does the noise amplitude change if the connecting cables are moved? If so, locate the source of the interference and separate it from the cabling. Random high frequency noise may be detector load resistor or input capacitor breakdown.

Low level periodic system noise may be difficult to detect using an oscilloscope, but still produce significant resolution degradation. The offending periodic noise may be masked by the normal composite of detector signals and system noise making it almost impossible for the scope to synchronize with it. The cause may again be cable pickup since cable loops are capable of picking up magnetically transmitted noise (EMI) from equipment capable of producing strong fields.

To test for the presence of low level EMI, connect the preamplifier power cable, then connect a BNC cable from the shaping amplifier input to the preamplifier test input (see Figure 4). No detector signals will be transferred, but the cable will continue to pick up the magnetically transmitted noise. Observe the output of the shaping amp with an oscilloscope. If periodic noise is observed, move the signal and preamplifier power lines away from the interfering equipment.

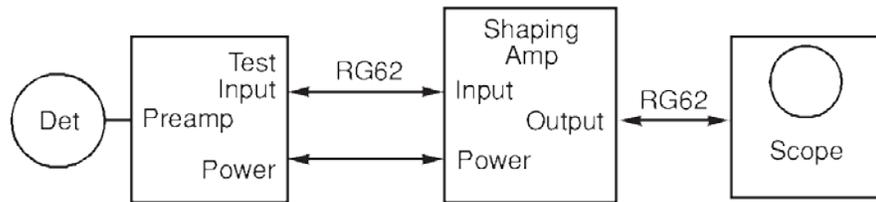


Figure 4 Test Setup for Magnetically Induced Noise

If the lines cannot be moved far enough from the interfering source to remove the noise, install a cable transformer (Canberra Model LB1500) at the preamplifier output, before reconnecting it to the shaping amp, and a ground-loop-eliminator preamplifier power cable (Canberra Model LB1501).

In order to reduce the effect of ground-loop induced noise, the grounds of the HV Input and HV Inhibit connectors are isolated from the analog signal ground. Some preamps are equipped with an external wiring harness, which creates a potential for the connector shells to touch, negating the ground isolation. If an iPA-SL Preamplifier is being used which includes insulating sleeves for the HV and HV Inhibit connectors, the sleeves should be slipped over the BNC and SHV connectors after they have been attached to the HV power supply wiring.

If low frequency noise still is a serious problem, the user should experiment with different baseline restorer settings to minimize the noise.

For further information refer to the “System Considerations with High Resolution Detectors” application note, included in the Germanium Detectors User’s Manual, and available separately from the factory

## 5. iPA Control Panel Application

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*iPA Control Panel* is a desktop application dedicated to the setup and monitoring of the Intelligent Preamplifier (iPA) device parameters through the USB interface. The application is Java-based and is compatible with modern operating systems, which have Java installed. The application supports the following operating system:

- Microsoft Windows 7 (32 /64 Bit) (English, French, German)

### Installation

Prior to installation, ensure that Java 6 or higher is installed on the target computer. Then proceed to follow the installation steps described below.

#### USB Drivers Installation for Windows 7

1. Connect the iPA to the USB port. Windows 7 will display a message stating that the driver was not found.
2. Open device manager and find the device labeled “iPA”. Right Click on the “iPA” device and select “Update driver software”.
3. Select “Browse my computer for driver software”.
4. Browse to the USB Drivers folder on the distribution CD.
5. Click **Next**.
6. Windows 7 will install the driver software and indicate that the driver has been successfully installed.

#### Installing the Application [Download and install Jave first.](#)

Unzip the iPAControlPanel.zip file provided on the installation CD to a folder on your local disk.

Browse to the folder and run iPAControlPanel.jar. Double-clicking the .jar file executes the application.

## Menu Options

The iPA Control Panel menu commands are briefly explained here.

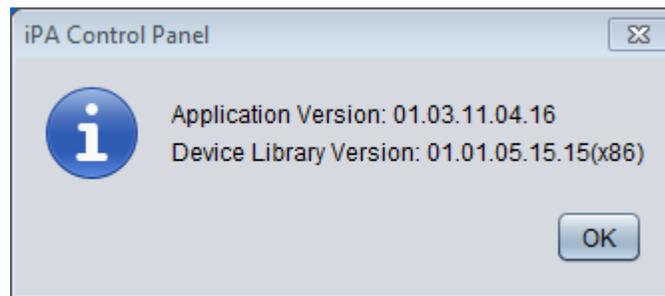
### File

The File menu allows you to enable the LN2 level-sensing probe settings, change the factory settings, or exit the application.

Note: You must enter a password to access the Factory Settings. Contact Canberra for the password.

### Help

The Help menu displays the About... dialog.



## Using the Application

When the application is first launched, the iPA Control Panel is displayed as shown in Figure 5.

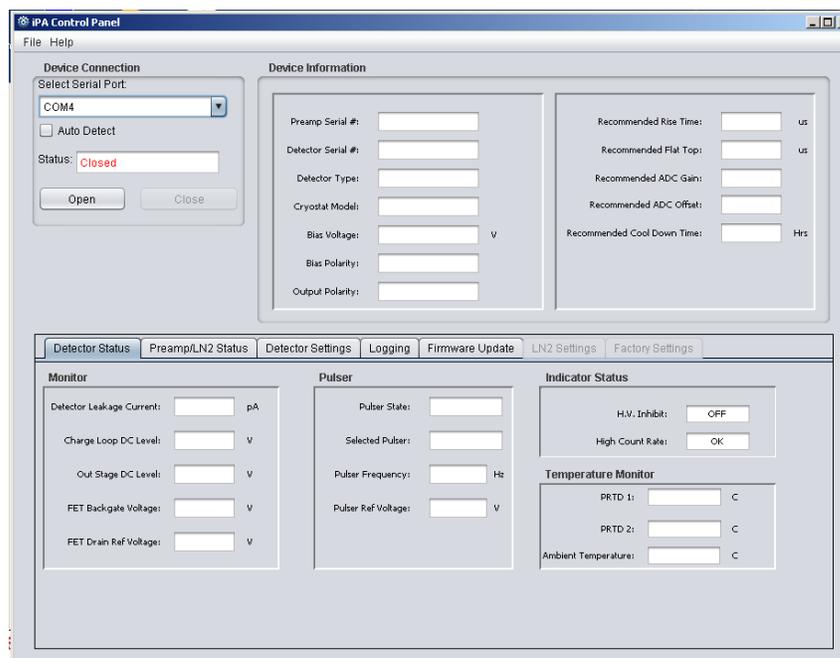


Figure 5 iPA Control Panel Application

## Connecting to the Device

Before any operation can be performed, connection to the device needs to be established. To connect to the device, select the correct serial port from the “Select Serial Port” drop-down list. If the serial port is not known, select the “Auto Detect” check box.

Click the **Open** button. If the device connection is successful, the Status will display “Connected” indicating that the connection to the device has been established. The title bar displays the name of the detector to which the application is connected. The Device Information fields and the Status page fields are populated with their corresponding values as shown in Figure 6.

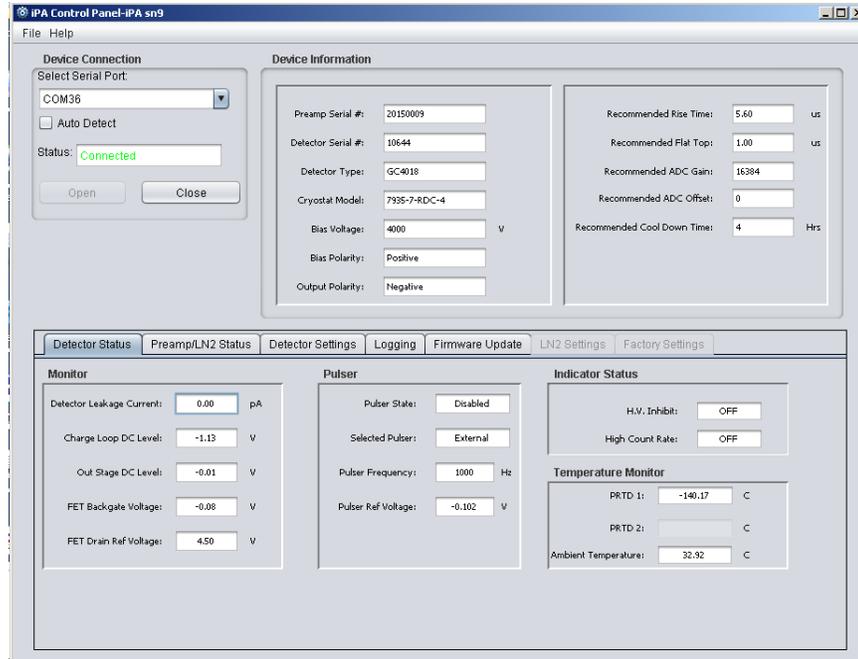


Figure 6 Connecting to a Device

## Device Information

The fields in this group box display static information about the detector and preamplifier.

### Preamplifier Serial #

The factory-programmed serial number of the Intelligent Preamplifier (iPA).

### Detector Serial #

The factory-programmed serial number of the detector matched with the iPA.

### Detector Type

The type of the detector matched with the iPA

### Cryostat Model

The model name/number of the cryostat used with the matched detector.

### Bias Voltage

The recommended bias voltage of the detector matched with the iPA.

### Bias Polarity

The HV bias polarity of the detector. ‘Negative’ indicates negative polarity and ‘Positive’ indicates positive polarity.

### Output Polarity

The output signal polarity of the preamplifier. ‘Negative’ indicates negative polarity and ‘Positive’ indicates positive polarity.

### Recommended Rise Time

The factory recommended Rise time in  $\mu\text{sec}$ .

### Recommended Flat Top

The factory recommended Flat Top time in  $\mu\text{sec}$ .

### Recommended ADC Gain

The factory recommended ADC Gain settings.

### Recommended ADC Offset

The factory recommended ADC offset settings.

### Recommended Cool Down Time

The factory recommended cool down time for the detector in hours.

## Detector Status

The Detector Status tab (Figure 7) displays the various detector parameters monitored by the iPA. These values are updated every 5 seconds. A red field indicates that the value is out of range. A log record is created each time a parameter value goes out of range.

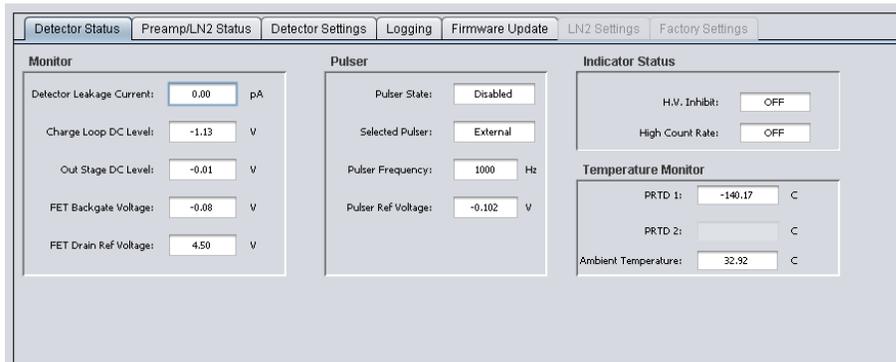


Figure 7 Monitoring the Detector Status

### Monitor

#### Detector Leakage Current

The measured operating current of the detector in picoAmps.

#### Charge Loop DC Level

The measured CSA DC voltage (similar to the Test jack) in Volts.

#### Out Stage DC Offset

The measured DC voltage of the preamplifier output in Volts.

#### FET Backgate Voltage

The measured FET Backgate reference voltage in Volts.

### **FET Drain Ref Voltage**

The measured FET Drain reference voltage in Volts.

### **Pulser**

#### **Pulser State**

The selected internal pulser operating mode: Enabled or Disabled.

#### **Selected Pulser**

The selected pulser source: Internal or External.

#### **Pulser Frequency**

The present setting of the internal pulser signal frequency in Hz.

#### **Pulser Ref Voltage**

The present setting of the internal pulser signal reference voltage in Volts.

### **Indicator Status**

#### **H.V. Inhibit**

OFF indicates that H.V. Inhibit is not active.

ON indicates that H.V Inhibit is active.

#### **High Count Rate**

OFF indicates that the preamplifier is operating within its linear range.

ON indicates that a High Count Rate condition is present in the preamplifier.

### **Temperature Monitor**

#### **PRTD 1**

The measured temperature for PRTD1 in degrees Celsius.

Note: If there is a failure reading the measured temperature, the value "+999.90" will be displayed and the HV Inhibit will be automatically set active.

#### **PRTD 2**

The measured temperature for PRTD2 in degrees Celsius.

Note: If there is a failure reading the measured temperature, the value "+999.90" will be displayed and the HV Inhibit will be automatically set active.

(If PRTD2 is not present, this value is grayed-out)

#### **Ambient Temperature**

The measured ambient temperature within the iPA in degrees Celsius.

## Preamp/LN<sub>2</sub> Status

The Preamp/LN<sub>2</sub> Status tab (Figure 8) displays the various internal preamplifier and LN<sub>2</sub>- related parameters monitored by the iPA. The values are updated every 5 seconds. A red field indicates that the value is out of range. A log record is created each time a parameter value goes out of range.

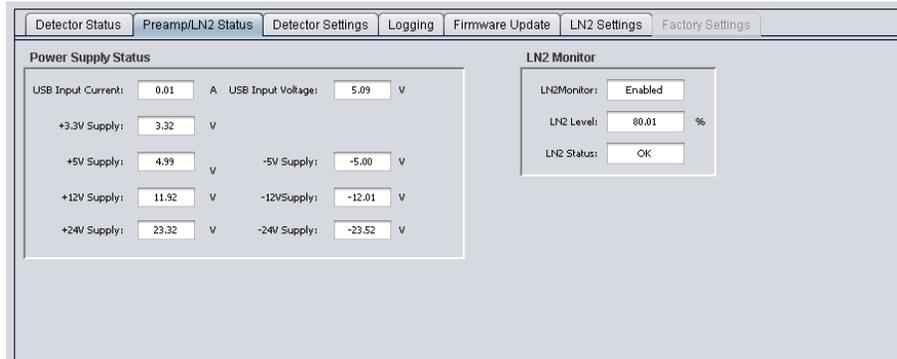


Figure 8 Monitoring the Preamplifier & LN<sub>2</sub> Status

### Power Supply Status

#### USB Input Current

The measured USB input current in Amps.

#### USB Input Voltage

The measured USB input in Volts.

#### +3.3V Supply

The measured 3.3V power supply voltage in Volts

#### +5V Supply

The measured +5V power supply voltage in Volts

#### -5V Supply

The measured -5V power supply voltage in Volts

#### +12V Supply

The measured +12V power supply voltage in Volts

#### -12V Supply

The measured -12V power supply voltage in Volts

#### +24V Supply

The measured +24V power supply voltage in Volts

#### -24V Supply

The measured -24V power supply voltage in Volts

## LN2 Monitor

### LN2 Monitor

The selected LN2 monitor operating mode: Enabled or Disabled.

### LN2 Level

The measured LN2 level as a percentage of full-scale, when the LN2 monitor function is enabled.

### LN2 Status

The present status of the LN2 level: HIGH, LOW, or OK.

## Detector Settings

The Detector Settings tab (Figure 9) displays the various detector-related settings within the iPA. When this tab is first selected, it displays the currently-selected (set) values. All settings are stored in non-volatile memory to insure that they are not lost when power is cycled. The iPA applies the stored parameter settings at each power-up.

The screenshot shows the 'Detector Settings' tab selected in a software interface. The tabs at the top are: Detector Status, Preamp/LN2 Status, Detector Settings (active), Logging, Firmware Update, LN2 Settings, and Factory Settings. The main content area is divided into several sections:

- Device Name:** A text box containing 'IPA sn8' and an 'Apply' button.
- Pulsar Setup:** A section with a 'Select Pulser' dropdown menu set to 'External', a 'Frequency (20-2000Hz)' text box set to '500' Hz with an 'Apply' button, and a 'Pulsar REF Voltage (0-1.025)' text box set to '0.000' V with an 'Apply' button.
- Pulsar Enable / Disable:** Two radio buttons, 'Enabled' and 'Disabled', with 'Disabled' selected.
- HV Inhibit Mode Select:** Two radio buttons, 'Canberra' (selected) and 'Other'.
- Output Stage Gain:** A 'Select Gain' dropdown menu set to 'x10'.
- Output Stage DC Offset (-1 to +1 V):** A text box set to '0.005' V with an 'Apply' button.

Figure 9 The Detector Settings

### Device Name

Sets a user-configurable name for the iPA, which is displayed on the title block when the application is connected to the corresponding iPA. Enter the Device Name and then click the **Apply** button.

### HV Mode Select

Selects the High Voltage Inhibit mode, either “Canberra” or “Other.”

### Output Stage Gain

Sets the output stage gain by selecting the desired gain (x1, x2, x5, or x10) from the drop-down list. The gain setting is applied immediately upon selection.

### Output Stage DC Offset

Sets the DC offset for the output stage. The DC offset can be set from (-1 to +1 V), with respect to the x1 gain setting. Enter the desired offset value in the textbox and then click the **Apply** button.

## Pulser Setup

### Select Pulser

Selects the test pulser source of the iPA, either “Internal” for the iPA internal pulser or “External” for a pulser connected to the Test In connector of the iPA.

### Frequency

Sets the frequency in Hertz for the iPA internal pulser. The frequency can be set between 20 and 2000 Hz. To change the setting, enter the desired frequency in the textbox and then click the **Apply** button.

### Pulser Reference Voltage

Sets the iPA internal pulser signal reference voltage between 0 and 1.025 V. To change the setting, enter the desired voltage in the textbox and then click the **Apply** button.

### Pulser Enable / Disable

Selects the operating mode of the iPA internal pulser, either “Enabled” to start or “Disabled” to stop the pulser signal. Note that this setting is not permanently stored, and defaults to “Disabled” upon power-up of the iPA.

## LN<sub>2</sub> Settings

The LN<sub>2</sub> Settings tab (Figure 10) displays the parameter settings related to the LN<sub>2</sub> level monitoring function of the iPA. It includes an Enable/Disable section to control the LN<sub>2</sub> Monitor operation, an LN<sub>2</sub> Alarms section to control the alarm setpoints and HV Inhibit functionality, and a Calibrate section to perform the LN<sub>2</sub> Low-Level and High-Level calibrations.

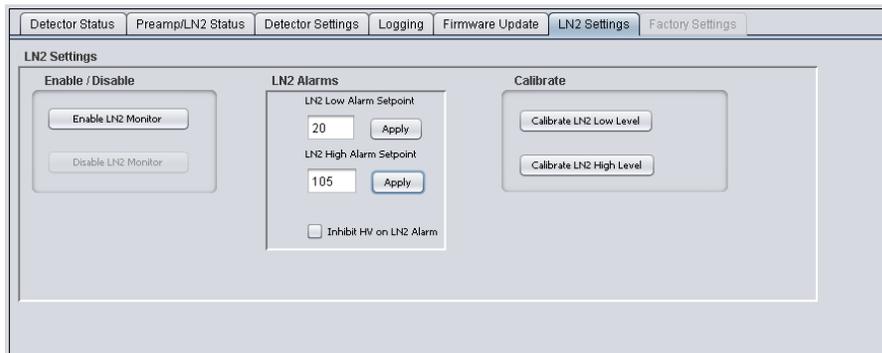


Figure 10 The LN<sub>2</sub> Settings

Note that to access the LN<sub>2</sub> Settings tab, it is necessary to first go to the **File** menu, and select **Enable LN<sub>2</sub> Settings**.

### Enable / Disable

Selects the operating mode of the LN<sub>2</sub> Monitor function, either “Enable LN<sub>2</sub> Monitor” to start or “Disable LN<sub>2</sub> Monitor” to stop the monitor.

## LN2 Alarms

### LN2 Low Alarm Setpoint

Sets the maximum LN2 dewar level reading (in %) that will be classified as a “Low” level by the LN2 Monitor. Enter the desired value and then click the **Apply** button.

### LN2 High Alarm Setpoint

Sets the minimum LN2 dewar level reading (in %) that will be classified as a “High” level by the LN2 Monitor. Enter the desired value and then click the **Apply** button.

### Inhibit HV on LN2 Alarm

Selecting the “Inhibit HV on LN2 Alarm” checkbox will cause the HV Inhibit function of the iPA to activate when the LN2 dewar level reading falls below the LN2 Low Alarm Setpoint or rises above the LN2 High Alarm Setpoint.

## Calibrate

If the LN2 monitor needs to be recalibrated, the steps to perform the calibration are as follows:

### Low Level Calibration

1. Insert the LN<sub>2</sub> Probe into the Dewar with the lowest fill level.
2. Press the **Calibrate LN2 Low Level** button.
3. Wait approximately 30 seconds. When the calibration is complete, the corresponding button will be displayed for the LN<sub>2</sub> Low Level.

### High Level Calibration

1. Insert the LN<sub>2</sub> Probe to the Dewar with the highest fill level.
2. Press the **Calibrate LN2 High Level** button.
3. Wait approximately 30 seconds. When the calibration is complete, the corresponding button will be displayed for the LN2 High Level.

## Logging and Log Files

The iPA maintains a data logging function to record both out-of-range parameters and periodic values (Figure 11).

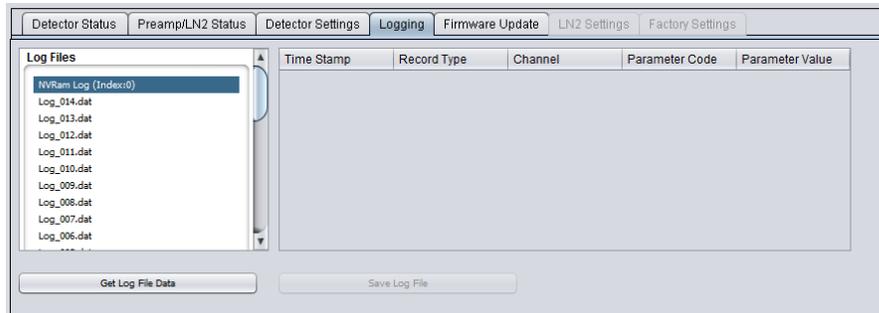


Figure 11 List of Log Records

For “Out-of-Range” parameters, a log record is created each time the parameter falls outside of its normal operating range. A record is also created if the parameter returns back within its permissible range.

The logging system also creates a record for certain parameters periodically, at the rate of once every hour, regardless of whether or not they are within their normal operating range. The following parameters are recorded periodically:

- PRTD1 Temperature
- PRTD2 Temperature
- Ambient Temperature
- LN<sub>2</sub> Level
- Detector Leakage Current
- Charge Loop (CSA) Average DC Level

### Log Files

As seen in Figure 11, the right-hand column of the window lists all of the log files present on the device. The files are sorted from newest to oldest. The NVRAM Log is the latest log maintained in the nonvolatile RAM within the iPA.

To download a particular log file, select the desired file and click on the **Get Log File Data** button. The log data is downloaded, and displayed in the window as shown in Figure 12.

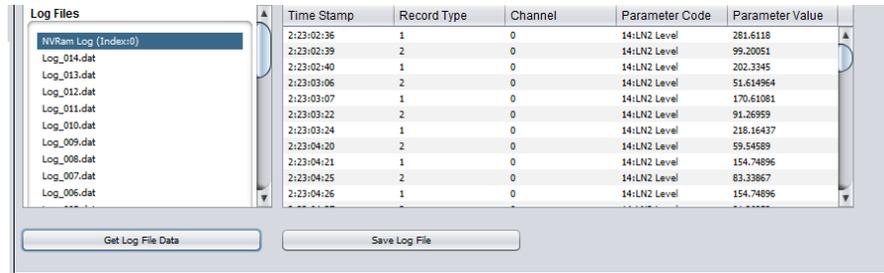


Figure 12 Selecting a Log File to Display

### Time Stamp

The time stamp when the log record was created. The time stamp represents the time relative to when the iPA was last powered on. The time stamp is of the format *Day:Hour:Minute:Second*.

### The Record Type

The type of record, as follows:

- 01: Parameter Out of Range
- 02: Parameter Back in Range
- 03: Periodic Log Data

### Parameter Code

The code and name of the parameter being logged.

### Parameter Value

The value of the parameter at the time the record was created.

### Save Log File

After the log file is downloaded from the iPA, it can be saved in .csv format on the local computer. Simply click the **Save Log File** button, select the desired name and folder, and save the file.

## Firmware Update

The Firmware Update tab (Figure 13) enables the user to update the DEM and the AEM firmware of the iPA through the USB interface. The firmware files are distributed as a .txt file. The tab displays the current firmware versions installed on the iPA hardware.

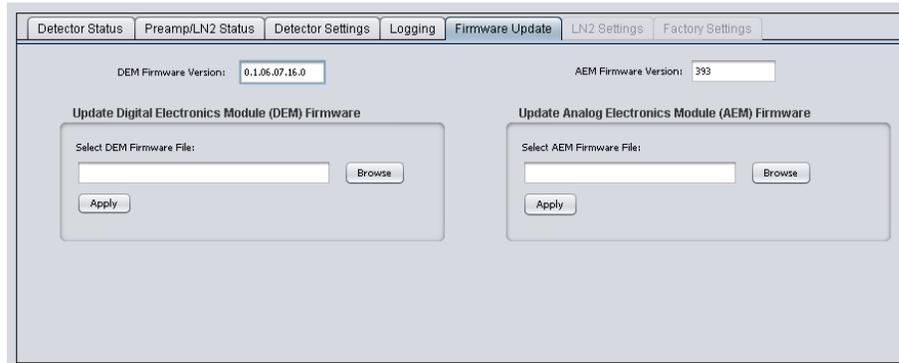


Figure 13 Updating the iPA Firmware

### Update Digital Electronics Module (DEM) Firmware

To update the DEM firmware, click on the **Browse** button and select the DEM firmware file. Click **Apply**. The device will update the new firmware and perform a reset. The update process takes approximately 30 seconds.

### Update Analog Electronics Module (AEM) Firmware

To update the AEM firmware, click on the **Browse** button and select the AEM firmware file. Click **Apply**. The device will update the new firmware and perform a reset. The update process takes approximately 30-45 seconds.

# A. Specifications

---

## Inputs

TEST INPUT – Charge coupled to preamplifier input at 0.5 pC/V nominal; voltage gain to outputs 0.5X, 1X, 2.5X, or 5X (as selected),  $\pm 30\%$ . Input impedance is 93  $\Omega$ .

HV INPUT – Detector bias voltage, 0 to  $\pm 5$  kV dc; no limit to the rate at which bias may be applied; series resistance to detector bias point is 2000 M $\Omega$  nominal; filter time constant is 6 seconds, nominal. High voltage ground is isolated from signal ground by 470  $\Omega$ .

LN<sub>2</sub> INPUT – Low-capacitance SMA coaxial connection for optional Canberra LN<sub>2</sub> Dewar level-sensing probe. Input impedance is 100 k $\Omega$ .

USB – High-speed USB2.0 mini-B serial data interface; supports data transfer rates up to 480 Mbps.

POWER – Accepts  $\pm 12$ VDC and  $\pm 24$ VDC from main shaping amplifier or MCA.

## Outputs and Indicators

ENERGY OUTPUT – Provides unipolar pulses with peak amplitude linearly proportional to the charge input, non-inverting. Decay time constant is 50  $\mu$ s ( $\pm 10\%$ ). Output swing range is  $\pm 10$  V open circuit. Output impedance is 93  $\Omega$ , series connected, dc coupled. Output dc offset is 0  $\pm 75$  mV dc (at gain of 100 mV/MeV), or 0  $\pm 100$  mV dc (at gain of 500 mV/MeV).

TIMING OUTPUT – Unipolar pulse for each input event; signal parameters same as above, except 50  $\Omega$  output.

HV INHIBIT OUTPUT (Requires cryostat with temperature sensor) – Provides a logic signal to turn off High Voltage Power Supply when detector temperature exceeds level which causes detector leakage. Output is +5 V when temperature is correct and  $< +0.5$ V under fault condition; capable of sinking 10 mA. High voltage inhibit ground is isolated from signal ground by 47  $\Omega$  to prevent introduction of ground loop noise.

HV INHIBIT INDICATOR (Requires cryostat with temperature sensor) – Green LED glows when detector is at normal operating temperature. Red LED glows if temperature exceeds level, which causes detector leakage.

HIGH RATE INDICATOR – Provides a visual indication of count rate overload. LED begins to glow Red at nominal 75% of max count rate. LED glows Green when the count rate is below nominal 75% of max count rate.

INTERNAL PULSER INDICATOR – Provides a visual indication of the internal pulser status. The LED glows Red when the internal pulser is active, and turns off when the internal pulser is not active.

## Performance

INTEGRAL NONLINEARITY –  $< \pm 0.05\%$  for an output swing of  $\pm 8$  V (unterminated).

GAIN STABILITY –  $\leq \pm 0.005\%/^{\circ}\text{C}$  ( $\pm 50$  ppm/ $^{\circ}\text{C}$ ) over a range of 0 to  $+50$   $^{\circ}\text{C}$ ;

$\leq \pm 0.01\%$  over 24 hours at constant temperature after 1 hour stabilization.

CHARGE SENSITIVITY – 1, 2, 5, or 10 V/pC, corresponding to 50, 100, 250, or 500 mV/MeV (Ge) equivalent, as selected digitally. Shipped in the 500 mV/MeV position. Gain tolerance is  $\pm 25\%$ .

COUNT RATE – Count rate performance has been demonstrated at beyond 200 000 counts per second for  $^{60}\text{Co}$  source (1.33 MeV).

## Connector Types

HV INPUT – SHV

TEST INPUT – BNC UG-1094/U

ENERGY OUTPUT – BNC UG-1094/U

TIMING OUTPUT – BNC UG-1094/U

HV INHIBIT OUTPUT – BNC UG-1094/U (iPA-SL), Amphenol 31-10 (iPA)

LN2 INPUT – SMA (Emerson 142-0701-501)

USB – USB2.0-Mini-B (Tyco 1734035-2)

POWER – Molex 83611-9006 (iPA); Amphenol 17-20090 (iPA-SL)

## Accessories

CABLE ADAPTER – One 0.9 m (3 ft) power cable adapter is supplied with iPA.

CABLE – One 3 m (10 ft) power cable is supplied with iPA & iPA-SL.

## Power Requirements

+24 V dc – 12 mA      +12 V dc – 70 mA

-24 V dc – 10 mA      -12 V dc – 18 mA

## Physical

SIZE – iPA: 7.6 x 10.2 x 4.4 cm (3 x 4 x 1.75 in.);

iPA-SL: cylindrical, 12.7 x 7.9 cm (5 x 3.1 in.) (l x d)

NET WEIGHT – 0.40 kg (0.88 lb)

SHIPPING WEIGHT – 0.86 kg (1.9 lb)

## Environmental

OPERATING TEMPERATURE – 0 to 50 °C.

OPERATING HUMIDITY – 0-80% relative, non-condensing.

Tested to the environmental conditions specified by EN 61010, Installation Category I, Pollution Degree 2.



# Notes

# B. Installation Considerations

---

This unit complies with all applicable European Union requirements.

Compliance testing was performed with application configurations commonly used for this module; i.e. a CE compliant NIM Bin and Power Supply with additional CE compliant application-specific NIM were racked in a floor cabinet to support the module under test.

During the design and assembly of the module, reasonable precautions were taken by the manufacturer to minimize the effects of RFI and EMC on the system. However, care should be taken to maintain full compliance. These considerations include:

- A rack or tabletop enclosure fully closed on all sides with rear door access
- Single point external cable access
- Blank panels to cover open front panel Bin area
- Compliant grounding and safety precautions for any internal power distribution
- The use of CE compliant accessories such as fans, UPS, etc.

Any repairs or maintenance should be performed by a qualified Canberra service representative. Failure to use exact replacement components, or failure to reassemble the unit as delivered, may affect the unit's compliance with the specified EU requirements.

## Preventive Maintenance

This unit does not require any periodic cleaning maintenance.

Any maintenance should be performed by a qualified Canberra service representative.

## Operating Protection Impairment

Canberra is not liable for any operational malfunctions or personal injuries due to mishandling or unauthorized repair and maintenance not detailed in this manual.

## Cleaning/Decontamination



When needed, the front panel of the unit may be cleaned. Remove power from the unit before cleaning. Use only a soft cloth dampened with warm water and make sure the unit is fully dry before restoring power. *Do not* use any liquids directly on the preamplifier housing, front, or rear panels.

## C. FCC Notice

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The following paragraphs are notices required by Federal Communications Commission (FCC) rules, Part 15, Subpart A.

“The user is cautioned that any changes or modifications not expressly approved by the party responsible for compliance could void the user’s authority to operate the equipment.”

This equipment has been tested and found to comply with the limits for a class A digital Device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

# Request for Circuit Information

The Schematics, Block Diagrams, and/or Circuit Description may be available for this unit directly from Mirion Technologies (Canberra). Request can be made by calling, faxing, or emailing:

Training and Technical Services Department  
Mirion Technologies (Canberra), Inc  
800 Research Parkway, Meriden, CT 06450  
Telephone: (800) 255-6370 FAX: (203) 639-2067  
Email: [techsupport@canberra.com](mailto:techsupport@canberra.com)

If you would like schematics and/or a circuit description, if available, for this unit, please provide us with the following information.

Your Name \_\_\_\_\_

Your Address \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Unit's model number \_\_\_\_\_

Unit's serial number \_\_\_\_\_

Note: Schematics, block diagrams, and circuit descriptions are provided for information only; if you service or repair or try to service or repair this unit without Mirion Technologies (Canberra), Inc 's written permission you may void your warranty

# Notes



## Warranty

Mirion Technologies (Canberra) Inc. (we, us, our) warrants to the customer (you, your) that for a period of ninety (90) days from the date of shipment, software provided by us in connection with equipment manufactured by us shall operate in accordance with applicable specifications when used with equipment manufactured by us and that the media on which the software is provided shall be free from defects. We also warrant that (A) equipment manufactured by us shall be free from defects in materials and workmanship for a period of one (1) year from the date of shipment of such equipment, and (B) services performed by us in connection with such equipment, such as site supervision and installation services relating to the equipment, shall be free from defects for a period of one (1) year from the date of performance of such services.

If defects in materials or workmanship are discovered within the applicable warranty period as set forth above, we shall, at our option and cost (A) in the case of defective software or equipment, either repair on a return to factory basis or replace the software or equipment, or (B) in the case of defective services, reperform such services.

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We are under no obligation to provide warranty service if adjustment or repair is required because of damage caused by other than ordinary use or if the equipment is serviced or repaired, or if an attempt is made to service or repair the equipment, by other than our Service Personnel without our prior approval.

Our warranty does not cover detector damage due to neutrons or heavy charged particles. Failure of beryllium, carbon composite, or polymer windows or of windowless detectors caused by physical or chemical damage from the environment is not covered by warranty.

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