Model 1300
InSpector 2000

Hardware Manual

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SYSTEM
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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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1. Introduction

The InSpector 2000 is a high performance, portable spectroscopy workstation based on Digital Signal Processing (DSP) technology. Applications for the InSpector 2000 include all HPGe, NaI and Cd(Zn)Te detector applications common in environmental characterization; nuclear safeguards; decommissioning and decontamination; and in-facility monitoring. The instrument provides unsurpassed count rate and resolution performance coupled with environmental stability previously seen only in high-end laboratory systems. Package size and battery life set a new standard for field portability and convenience. The host Genie-2000 software environment provides the user with the ultimate flexibility in field operation. A wide range of application specific software options, designed specifically for field spectroscopy, is available under the Genie-2000 family.

The unprecedented performance of the InSpector 2000 derives from the application of DSP technology. Previously limited to laboratory applications due to the high power requirements of the internal components, DSP now gives the field spectroscopist the capability to perform high precision, measurements in adverse environmental conditions with a portable instrument. Earlier analog spectroscopy systems were prone to count rate and environmental instabilities that required continual adjustment of the signal processing subsystem - and often compromised analysis results. With the InSpector 2000, these problems are dramatically reduced - while portability is significantly improved.

The heart of the InSpector-2000 is the Digital Signal Processor subsystem. Unlike conventional systems, which digitize the signals at the end of the signal processing chain, the InSpector 2000 digitizes the preamplifier signals at the front end of the signal processing chain. This approach minimizes the amount of analog circuitry at the front end of the instrument, resulting in increased stability, accuracy and reproducibility.

The use of DSP technology also improves the overall signal acquisition performance. Signal filtering functions previously implemented in traditional analog electronics are limited. DSP allows filtering functions and pulse shapes that are not realizable using conventional analog processing techniques. The result is a more efficient trapezoidal filter function, which exhibits less processing time, less sensitivity to ballistic deficit, and superior resolution. With trapezoidal filtering, the pulses can be processed more rapidly and accurately, so the spectrum resolution is enhanced while throughput is increased.

Performance Benefits for Field Applications

These improvements in signal processing performance provide several tangible benefits to the field spectroscopist. Most significant for field operation is the significantly improved temperature stability. Important even in temperature controlled laboratory environment - the improved stability becomes far more dramatic in field operations where ambient temperatures may vary as much as + 10 °C in the course of a work day. Without temperature stability, the operator is forced into frequent QA checks and gain adjustments in order to retain calibrated peak position and quality peak shape. The InSpector 2000 offers peak gain stability in some cases a factor of 2-3 better than past generation analog products.

Count rate performance is another potentially significant issue for the field user. In many nuclear safeguards or Decommissioning and Decontamination applications, measurements may be taken in areas ranging from natural background to highly contaminated. Count rate ranges of several orders of magnitude are not uncommon. The dynamic range of the DSP based system allows such a wide range of count rate to be encountered with minimal shift in peak positioning and minimal peak broadening.

Even when a system is used largely for low activity work, the count rate performance can be significant. Any dead time reduction achieved through faster signal processing can improve measurement sensitivity. One study (1) demonstrated that the use of DSP at a count rate as low as 3 kcps can reduce count time to achieve a desired MDA by as much as 20% compared to typical analog system. With the increased use of higher efficiency germanium detectors, more users are seeing higher count rates in natural background - particularly when counting open areas of soil. The presence of any contamination can further raise count rates raising the possibility of significant dead time.

Traditional analog portable instruments typically are equipped with only 2 shaping times - due to the physical space required by the components that would be needed to provide more. This limitation means that the user cannot always precisely optimize processing time to provide the best performance for a given detector or application requirement - the shaping time limitation requires a compromise. In the InSpector 2000, processing time is controlled digitally by altering the rise/fall and flat top times of the trapezoidal filter. There are 40 rise/fall times and 21 flat top times in the InSpector 2000 - for practical purposes giving the user an “infinite” range of processing time adjustability.

The InSpector 2000 supports both the traditional Pulse Height Analysis (PHA) mode as well as a multichannel scaling (MCS) mode for time varying applications. The MCS mode can display data from either an external TTL input, a full spectrum integral or a Region of Interest (ROI). The InSpector 2000 also supports two memory groups (8K per group maximum) with a “ping-pong” memory feature that allows the user to acquire a spectrum into one memory group while reading from a second. Both the ping-pong memory and the MCS mode make the InSpector 2000 ideal for applications involving characterization of a surface or area while the detector is moving.

The InSpector 2000 is designed for full 16K channel memory/conversion gain operation. This capability is particularly advantageous where a wide energy range is required. Many users involved in field characterization will benefit from this capability to evaluate natural radionuclides with energies >2.5 MeV while retaining very good spectral resolution in the complex 200-500 keV range.

Efficient, Convenient Operation

In addition to the unique characteristics of the InSpector 2000 in terms of spectroscopy performance, the unit offers a number of additional features that facilitate convenient, efficient operation in field applications. At 1.3 kg (2.8 lb) the instrument sets a new standard for full featured multichannel analyzers - less than half the weight of previous generation instruments. The 17.3 x 18.4 x 3.8 cm (6.8 x 7.3 x 1.5 in.) package reduces the footprint to less than half that of older generation instruments - making it perfectly compatible with the latest generation of mini-notebook computers.

The InSpector 2000 provides an extraordinary level of battery life from a standard Lithium-ion Sony Camcorder battery. The Li-ion technology provides long life, outstanding shelf charge hold time and virtually eliminates the memory effect associated with older battery technologies. With the standard full capacity battery, the user can expect a full 10 hours of operation with an HPGe detector and a standard RC type preamplifier. A typical NaI detector will run over 12 hours. An optional, low profile battery is available with 1/3 the life of the standard battery. The low profile battery reduces the unit weight and footprint still further and is suitable for applications where longer battery life is not needed.

In some cases, the power management features built in to the InSpector 2000 further extend battery life. With power management enabled, the InSpector 2000 will shut itself down in an orderly manner after a user selectable period of time with acquisition stopped and no communications activity.

Where desired, external power can be supplied via the DC input connector. This can be a standard ac adapter (included), a car battery adapter (optional) or a user supplied DC source. When the external DC source is connected, a mounted CAMcorder battery is always trickle charged. This feature facilitates the use of the InSpector 2000 in emergency response applications - it can be used in a facility as a lab device - then taken out in a portable mode with full confidence of a full battery charge. Additionally, the mounted battery can function as an uninterruptible power supply (UPS) in laboratory operations.

Two methods of host communications are supported. The preferred method is the Universal Serial Bus (USB) interface which provides ultra fast host communications at 12 Mbits/second. This provides data transfer and display update performance that previously had only been available in laboratory systems based on Ethernet media. USB provides the additional capability of having multiple units attached to a single host/port via a USB hub. This allows multiple InSpector 2000s to be deployed in a single fixed location monitoring application. USB requires the use of either Windows 98 or Windows 2000 operating environments.

The second method of host interface is a standard RS-232 serial connection. Due to the communications rate constraints of serial ports, the InSpector 2000 has been designed for highly compressed/optimized communications. Using the serial link, the user can expect screen updates in the range of an update per second on 8K spectra at moderate count rate.

Note that this rate varies due to count rates and spectrum sizes.

To facilitate optimal pole zero adjustment, the InSpector 2000 is equipped with a Pole Zero Assistant (PZA) feature. The PZA allows the user to adjust the pole zero cancellation circuit while logic in the InSpector 2000 analyzes and displays the degree of overshoot and undershoot exhibited by the filtered signal. The user simply moves the PZ control until the over/under indicator is centered - indicating optimal adjustment.

Purists who wish to view the actual signal while adjusting pole zero or other parameters will use the digital oscilloscope function implemented with the InSpector 2000 and host computer software. With the digital oscilloscope, the user views a graphical reconstruction of the digitized, filtered signal. Scaling and trigger functions are similar to those of an actual oscilloscope.

Upon initial power up, the InSpector 2000 performs a set of internal diagnostic analyses, checking the status of the microprocessor and its components as well as the signal processing logic. During this time, the fault LED is illuminated. If the Fault LED remains illuminated, a fault is indicated. While in this state another LED will blink to indicate the nature of the fault. A blinking ACQ LED indicates a problem with the microprocessor or related components is indicated. If the battery LED blinks, this indicates a possible problem with the power supply or signal processing logic and a blinking HV LED indicates HV Inhibit signal.

Genie-2000 Software Support

The InSpector 2000 is supported by Canberra's industry standard Genie-2000 spectroscopy software suite. Genie-2000 offers unsurpassed capability of the gamma spectroscopist - intuitive user interface, time proven data reduction algorithms, extensive quality assurance capabilities and flexible report generation. These facilities are documented extensively in Genie-2000 documentation.

Additionally, there are a number of Genie-2000 based layered application software products that are specifically designed for field portable applications. These provide dedicated user interface environments and analysis facilities for those applications - allowing operation by technicians with application specific procedural training rather than highly trained spectroscopists.

A brief description of these application packages follows:

In Situ Object Counting Software (ISOCS):

One of the larger challenges in many field applications is generating an accurate efficiency calibration for large objects - waste containers, large pieces of equipment, walls, floors, pipes, fume hoods, planes of soil, etc. Calibrating for such geometries with radioactive sources is generally impractical. The ISOCS software is designed to develop such calibrations using mathematical modeling instead of sources - resulting in accurate calibrations at minimal cost.

In Situ Soil Counting System:

Counting large areas of contaminated or potentially contaminated soil also has calibration complications. Specially developed, mathematically generated calibrations for this application are available for specially characterized Canberra germanium detectors.

IMCA Uranium Enrichment Software:

The IMCA software was specifically designed to duplicate IAEA inspection procedures with respect to uranium enrichment assay. It supports the standard

IAEA NAID (Am doped NaI) detector and GDET (Canberra LEGe) detector. A user interface specifically designed for safeguards inspectors, temperature stabilized NaI operation and automatic gain adjustment are standard features of the software. (Consult factory for upgrades required to support InSpector 2000).

Uranium/Plutonium (U-Pu) InSpector software:

U-Pu InSpector software uses the worldwide standard Multigroup Analysis (MGA) for plutonium and Multigroup Analysis for Uranium (MGAU) software codes. A technician/inspector oriented user interface makes the software simple to operate in a procedural sense without in-depth spectroscopy knowledge.

PROcount-2000:

PROcount-2000 provides both laboratory and field gamma spectroscopy users with a straightforward, technician oriented user interface. PROcount can be set up for the specific application - in terminology chosen by the user - and used by operators with minimal spectroscopy knowledge.

How to Use this Manual

This manual is a comprehensive reference, covering the capabilities and operation of the InSpector 2000.

1. Introduction

This chapter is an introduction to the manual's contents and an overview of the InSpector 2000's features.

2. Controls and Connectors

You'll find a brief description of the front and rear panels' indicators and connectors here.

3. Getting Started and Setup Configuration

Read this chapter for instructions on system setup and configuration.

4. User Interface and Controls

This chapter continues with more setup information. Most of the controls discussed here are programmable through the host computer's software.

5. Using the Digital Oscilloscope

This chapter discussed the InSpector 2000's digital scope function.

6. Setup and Operation

This is the heart of the manual, day-to-day basic spectroscopy operation.

7. PUR/LTC Operation

This chapter details how and why you use the InSpector 2000's Pulse Pileup Rejector and Live Time Corrector (PUR/LTC) feature.

The Appendices

The appendices offer useful information not usually needed in day-to-day operation.

2. Controls and Connectors

Front Panel

This is a brief description of the InSpector 2000's front panel LED indicators. For more detailed information, refer to Appendix A, Specifications.

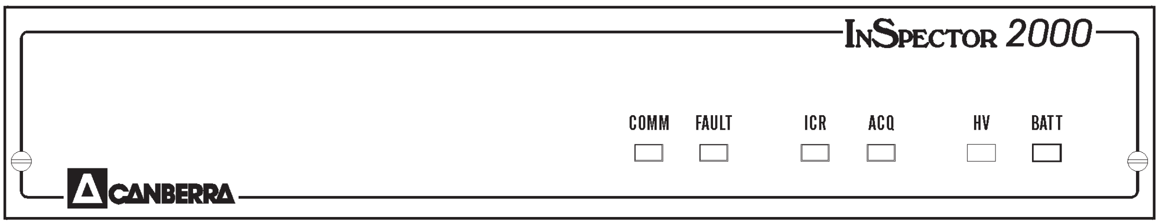

Figure 1 InSpector 2000 Front Panel

The Status Indicators

The InSpector 2000's front panel indicators show the status of: communication with host computer, system diagnostics, incoming count rate, acquisition, detector high voltage power supply, system power, and battery charge.

COMM	Green LED, indicates USB or RS-232 activity.
FAULT	Green LED, indicates a power ON diagnostic or high voltage fault has occurred.
ICR	Green LED, indicates incoming count rate; blink rate is proportional to count rate.
ACQ	Green LED, indicates when data acquisition is active.
HV	Green LED indicates high voltage power status. Constant ON indicates the detector high voltage power supply is on and high voltage could be present at the rear panel high voltage connector. Blinks for fault condition such as a high voltage overload or inhibit due to a detector warmup when connected.
BATT	Green LED indicates status of the battery and system power.

Steady On: Power switch is ON and the InSpector 2000 is powered by the ac adapter or charged battery.

Slow Blink: The battery is becoming discharged and less than 5% of capacity remains.

Fast Blink: The battery has become discharged, two minutes or less of operation remains and the InSpector 2000 is going through an orderly shut down; acquisition is halted, data is backed up in memory, the HVPS is ramped down to zero volts and the instrument is shut off.

Power Switch

The InSpector 2000's power switch (1/0), located on the left side of the unit, toward the rear; controls power to the instrument. Power is enabled when the switch is in the "1" position and disabled when the switch is in the "0" position. The Battery (BATT) LED continuously illuminates green when the power switch is ON and the instrument is powered from a power adapter or charged battery. See Figure 2.

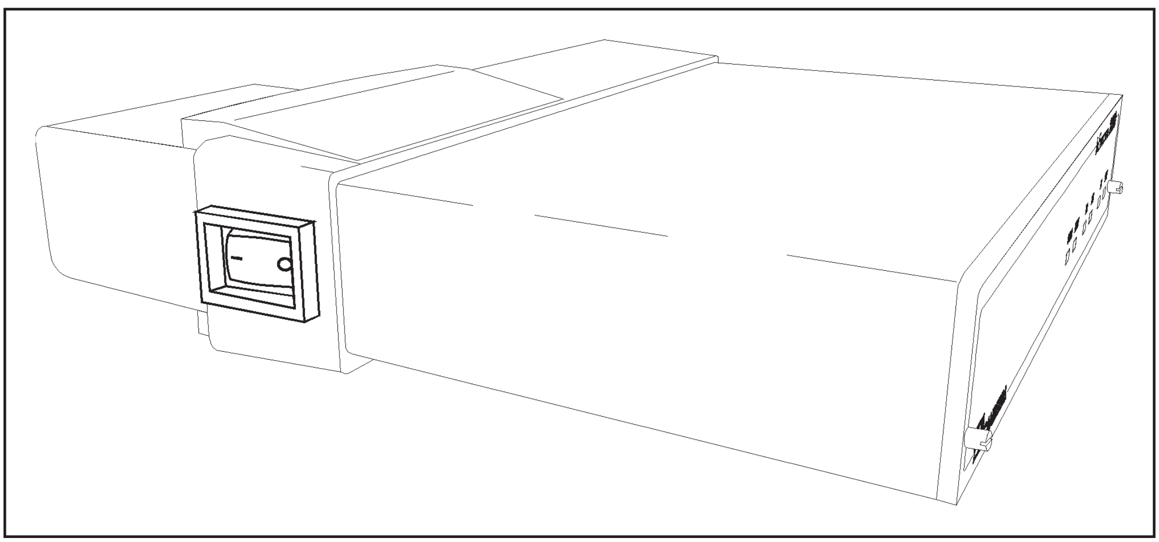

Figure 2 InSpector 2000 Power Switch

Rear Panel

This is a brief description of the InSpector 2000's rear panel connectors and power switch. For more detailed information, refer to Appendix A, Specifications.

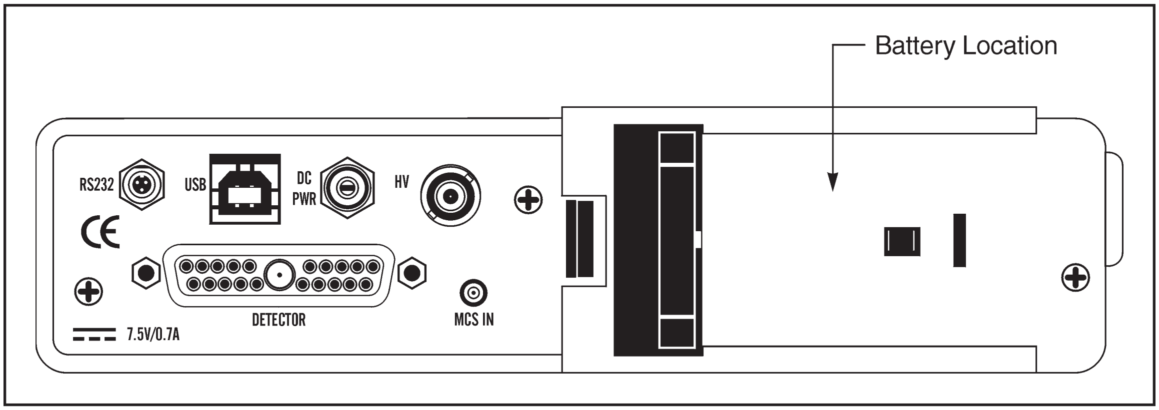

Figure 3 InSpector 2000 Rear Panel

Battery	Sony NP-F950/NP-F550 or equivalent Lithium-ion battery.
DC PWR	Auxiliary DC power input; 2.5/5.5 mm rear panel connector; Nominal 7.5 V dc at 0.70 amps.
DETECTOR	21-pin composite D-connector, rear panel, containing the following signals for connecting to the detector/preamplifier. For information on maximum preamp current and power, please refer to Appendix A, *Specifications*.

PREAMP	Preamp power connections; provides ± 24 volts and ± 12 volts for powering most detector preamps.
AMP IN	Input coax connection for receiving detector/preamplifier signal.
RESET	Reset inhibit input signal connection when using reset type preamp.
HV INH	Preamp high voltage inhibit input connection.
THERM IN	Thermistor monitor input; voltage range 0 to +5 V.

HV	High Voltage output connector, rear panel SHV.

MCS IN	MCS count input connector, rear panel MCX connector.
RS232	RS-232 computer interface for connecting to host personal computer; subminiature circular 3-pin connector; rear panel; auto sense selection of data rates (2.4, 4.8, 9.6, 14.4, 19.2, 28.8, 38.4, 57.6, and 115.2 kbaud).
USB	USB computer port for connecting to host personal computer, rear panel, Series B connector.

3. Getting Started - Basic Hardware Setup and Configuration

This chapter is a guide to unpacking and connecting the system. Software installation is covered in Appendix A, *Software Installation, of the Genie-2000 Operations Manual.*

Unpacking the InSpector 2000

When you receive your InSpector 2000 hardware, examine it carefully for evidence of damage caused in transit. If damage is found, notify Canberra and the carrier immediately.

Use the following checklist to verify that you have received all of the system components

Basic System

Your package should contain the following items:

- The InSpector 2000 portable Digital Spectroscopy Workstation.
- This manual.
- One high capacity Sony NP-F950 or equivalent Lithium-ion battery. Note: The InSpector 2000's Lithium-ion battery is shipped uncharged; you must charge the battery before using it. Refer to "Charging the Batteries" on page 13.
- One ac adapter.
- One ac adapter line cord.
- One battery charger.
- One 1 m (3 ft) RS-232 serial interface cable.
- One 1 m (3 ft) USB computer cable.
- One 1 m (3 ft) MCS cable.
- One standard 3 m (10 ft) detector cable for connecting to detectors with RC preamps.
- One soft travel case.
- S504 Genie-2000 InSpector Basic Spectroscopy Software.

System Options

Your package will include any optional InSpector 2000 items ordered. Examples of optional hardware items include the following:

- Model C1725-10; spare standard detector cable.
- Model C1726-10; detector cable for use with reset preamp.
- Model 1312; car battery power adaptor/charger.
- Model 1331; spare Sony NP-F950 or equivalent high capacity battery.
- Model 1332; Sony NP-F550 low profile (3 hr) battery.

Complete System

If you ordered a complete system it will consist of all of the items in the Basic System, plus a computer. All software will have been installed on the computer and the system will have been configured and tested at the factory.

Initial Setup

To properly install and apply power to the InSpector 2000 Digital Spectroscopy Workstation, please verify the following:

Operating Environment

Be sure you are in the operating environment specified for the instrument. The temperature and humidity specifications can be found in Appendix A, “Specifications”.

High Voltage Power Supply Configuration

Please consider and/or verify the high voltage range and polarity requirements for the intended detector application at this time.

Turning the high voltage power supply ON or OFF and setting the output voltage setting are programmable through the computer and Genie-2000 software environment. However, the polarity and range are manually configured using programming modules; the programming modules are conveniently located inside the InSpector 2000. The high voltage range and polarity are preset at the factory for the positive 5000 volt range, which is compatible with many Ge detector applications. If your detector requires negative polarity or the higher current 1300 volt range please reference Appendix E, *Configuring the High Voltage Power Supply*, for instructions on changing the InSpector 2000’s high voltage range and polarity. Please consult your detector’s manual for its specific high voltage bias requirements.

The high voltage range and polarity can be verified by physically viewing the high voltage module installation. Again, please reference Appendix E, *Configuring the High Voltage Power Supply* for instruction on verifying and changing the InSpector 2000's high voltage range and polarity. If the InSpector 2000 is already operational with the computer and Genie-2000 software the high voltage configuration and settings can be verified reviewing the MCA Front-End Hardware Status report in the Gamma Acquisition and Analysis application. The Status report can be opened by clicking on MCA and then **Status** in the drop down menu. If the MID definition and the high voltage power supply configuration do not match Genie-2000 will report a hardware verification error when attempting to open the data source. For complete information on the MID Files and the Gamma Acquisition Analysis application, please refer to the *Genie-2000 Operations* manual.

It is recommended that the high voltage setting be verified prior to turning the high voltage power supply to ON.

CAUTION Excessive voltage and/or incorrect polarity can permanently damage the detector system.

Power Connections

Power Sources

The InSpector 2000 can operate by using either a lithium-ion battery or an ac adapter. Refer to Appendix D, *Power System* for more information.

Charging the Battery

Before the Lithium-ion battery shipped with the InSpector 2000 can be used, it must be charged with the supplied battery charger.

To charge a battery, if installed remove it from the InSpector 2000 (see "Battery Removal" on page 15), attach it to the charger and plug the charger into a line power outlet. The charger's orange Charge lamp will stay on while the battery is being charged. When the lamp goes out, the battery is fully charged. Refer to the charger's user manual for complete instructions.

When using the ac or car battery adapters a trickle charger built into the InSpector 2000 will charge the installed battery. The trickle charging time is dependent on the preamp power loading. For more information please refer to Appendix D, *Power System*.

Note: The power switch must be in the ON ("1") position for the trickle charger to charge the battery.

Battery Charge Life

How long the fully-charged battery will provide power is typically dependent on the detector application. The NP-F950 or equivalent high capacity battery will typical provide ten plus hours for a Canberra Ge detector and 2002 RC preamp. For more information please refer to Appendix D, *Power System*.

Low Battery Monitor

The battery monitor, monitors the charge status of the battery connected to the InSpector 2000. The actions of the BATT LED indicator on the front panel serves as a prompt when the battery becomes low. As the battery is discharged, through normal operation, the BATT LED will blink at a slow rate when the battery has only 5% or less of capacity remaining.

When the battery becomes depleted an orderly shut down is initiated; acquisition is halted, data is saved, high voltage is ramped down to zero volts and the InSpector 2000 is shut off. During the shut down sequence the BATT LED will blink at a fast rate. For more information please refer to Appendix D, *Power System*.

Attaching the Battery

Referring to Figure 4, attach the fully charged battery to the InSpector 2000's battery port.

1. Looking at the back of the InSpector 2000, hold the battery such that the brand name and direction arrow is to your left. Position the battery near the battery port on the rear of the InSpector 2000.

2. Place the battery on the battery port so that it is pressed against the battery port back wall and against the battery connector to the left.

3. Press the battery to the left to engage the battery; the battery will lock into place.

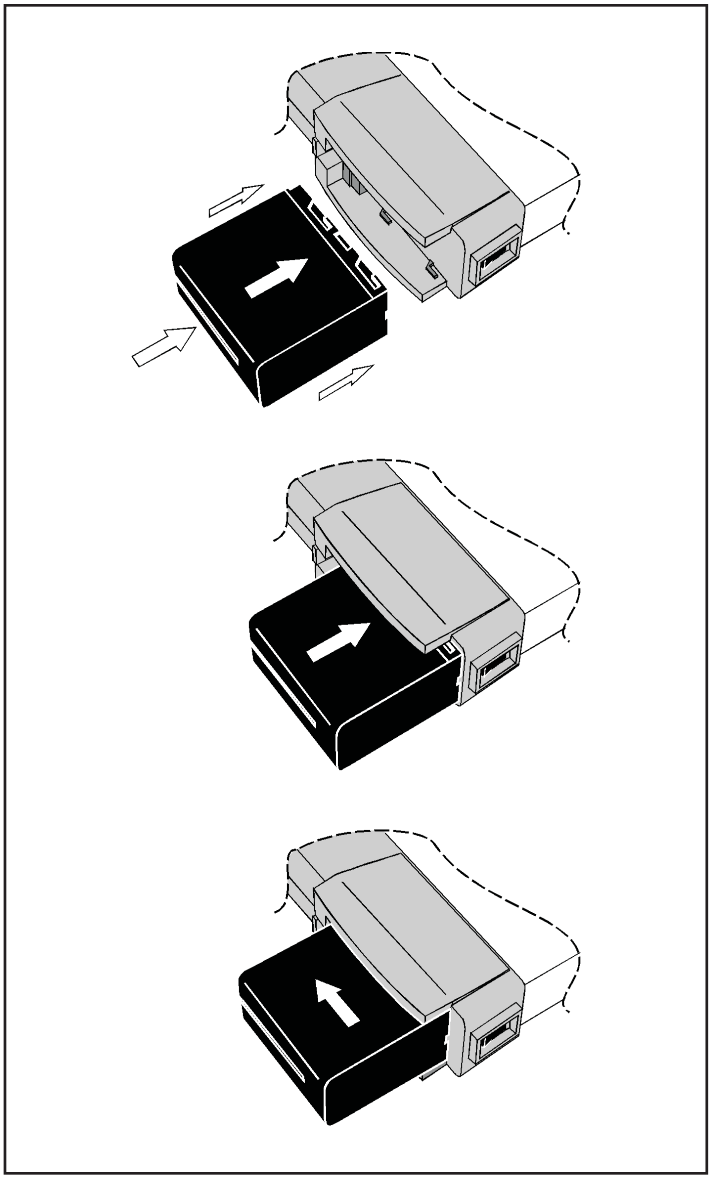

Figure 4 Attaching the Battery

Battery Removal

Referring to Figure 5, press the battery release tab to release and remove the battery as described in the steps below.

1. Position the InSpector 2000 so that the rear panel and battery areas are facing you.

2. Grasp the InSpector 2000 with your left hand; place fingers on the rear right side of the enclosure next to the power switch and thumb on the battery release tab. Grasp the battery with your right hand.

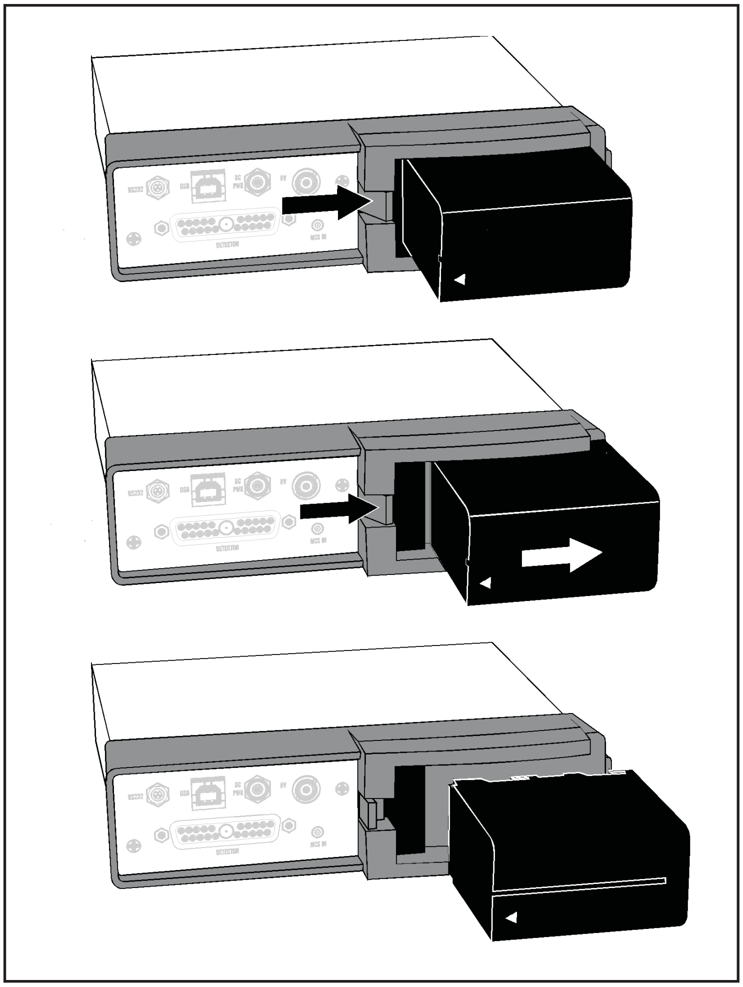

Figure 5 Removing the Battery

3. Using your thumb press the battery release tab toward the battery to unlock and disengage the battery. Slide the battery to the right and remove from the InSpector 2000.

The AC Power Adapter

If the AC Power Adapter is connected to the DC PWR in jack, located on the rear panel, it will supply power to the InSpector 2000, conserving the batteries for times when ac power is not available. In addition, an installed battery will be trickle charged. For more information on Trickling Charging please refer to “Battery Charging” on page 102.

Connecting the System Cables

This section provides a step-by-step instructions for connecting the system cables to the InSpector 2000's rear panel connectors. (Figure 6).

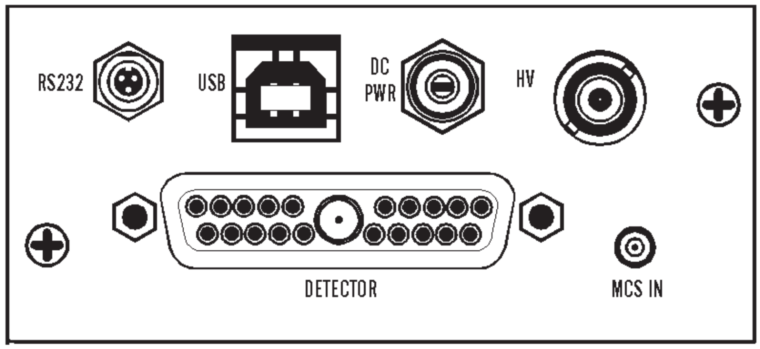

Figure 6 Rear Panel Connectors

The Composite Detector Cable

The Composite Detector Cable makes all the necessary signal and power connections between the InSpector 2000 and the intended detector. The composite cable connections include detector high voltage, preamplifier power, preamp signal input and any control signals such as the high voltage Inhibit and/or reset preamp Reset signals. Although the sensitive signals use individual shielded coax cables, Canberra recommends that it be routed away from interfering signals. If there is a nearby computer display with a CRT display, *do not* run the cables near it.

There are several possible types of Composite Cables, all similar to the cable shown in Figure 7. Each one is designed for use with a specific application and is described and differentiated in one of the following paragraphs.

Standard Cable

C1725 Cable: The C1725 cable, shipped with your InSpector can be used for most detector applications. This cable, which is designed for use with a slimline cryostat, includes the preamp Power, Energy, HV and HV Inhibit connectors.

Optional Cables

C1726 Cable: This cable, which is designed for TRP and Optical Reset preamps, includes the preamp Power, Energy, HV, HV Inhibit and Reset connectors.

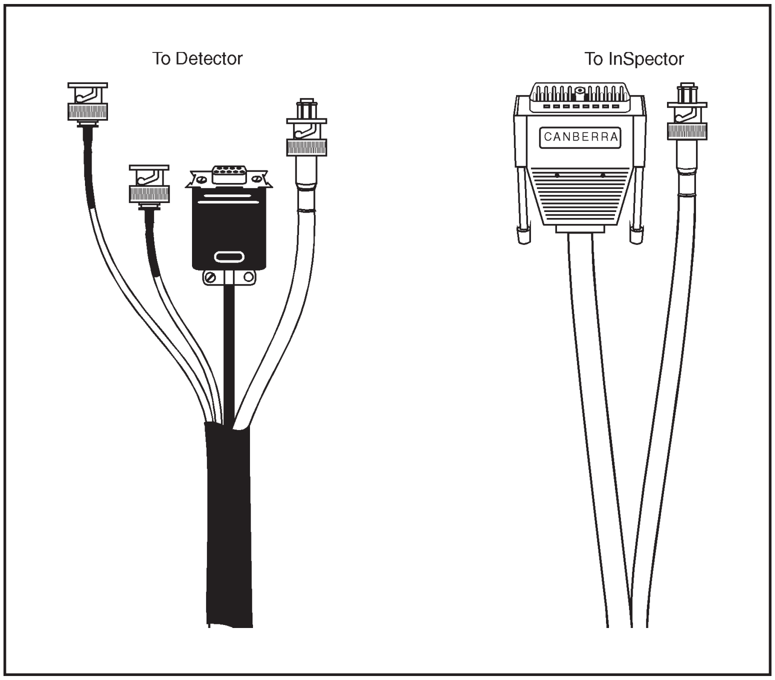

Figure 7 A Typical Composite Cable

Connecting the Composite Cable

One end of the Composite Cable has two connectors:

- A large rectangular or D-type connector on a thick cable. Connect this to the InSpector 2000's DETECTOR connector. Tighten the two thumb screw to secure the connector.
- A barrel shaped SHV connector on a thinner cable. Connect this to the InSpector 2000's HV connector.

The other end of the Composite Cable has several connectors:

- One small rectangular or D-type connector; this is the preamp power connector.
- Several barrel shaped connectors; each connector is color coded and labeled with its functional name.

Preamp Power Connector

Connect the preamp power connector to the preamp's 9-pin power connector. Secure the connector by snapping on the two associated springs clip latches.

Energy Connector

Connect the cable's red Energy connector to the preamp's energy output connector. Its signal must be either a voltage "tail" pulse, usually derived from an RC preamplifier, or a "step" input, usually derived from a Reset preamplifier. Properly matching the amplifier parameters to this input shape is essential to achieving optimum system performance. Refer to "Preamp Type" on page 35 for instructions on selecting the system's preamplifier type.

The High Voltage Connector

Connect the cable's SHV connector to the preamp's High Voltage Input connector.

HV Inhibit Connector

Connect the cable's green high voltage Inhibit connector to the preamp's HV INHIBIT connector, if provided. This signal shuts down the high voltage supply if the detector warms up. The High Voltage Inhibit input can be programmed for positive or negative polarity. Please refer to "Inh. polarity" on page 33 for instructions for matching the polarity selection to the intended detector preamplifier; all Canberra preamplifiers use positive polarity.

Reset Connector

If your system includes a Reset preamplifier, such as the Canberra 2101 or 2008, connect the cable's blue RESET connector (only on the C1726 cable) to the preamp's INHIBIT connector.

For instructions on using and optimizing performance when using Reset preamps, refer to "Operation with Reset Preamps" on page 92.

Connecting to the Host Computer

The InSpector supports two serial computer interface systems; RS-232 and high speed USB. Connect the InSpector 2000 to the host computer using the RS-232 or USB interface as described below. If your computer supports USB this would be the better choice since it is a high speed interface which significantly increases the InSpector to host computer response time and data transfer rate.

The communication interface must be defined and configured in the Genie-2000 MID definition. When using RS-232 a baud rate for the COM port must be selected. When using USB the InSpector 2000 serial number must be entered into the MCA Input Definition (MID) Configuration to allow the Genie-2000 software to identify the specific InSpector instrument. If this has not already been done please refer to "The MID Wizard" on page 23 for instruction on defining the InSpector 2000 MID input definition for RS-232 or USB operation.

For more information on using the RS-232 or USB interface or connecting multiple InSpector 2000's please refer to Appendix F, *Connecting the Host Computer*.

Serial RS-232 Computer Interface

The RS-232 cable is 1 m (3 ft) long, it allows transfer of computer commands and spectral data between the InSpector 2000 and the host computer. One end of the cable has a 9 pin D-type female connector; connect this end to your computer's communications COM port connector. The other end of the connector has a subminiature circular 3-pin connector; connect this end to the RS-232 connector located on the rear panel of the InSpector 2000.

Note: The power management on some Lap Top computers may power down the RS-232 port which will disrupt the serial data stream the InSpector 2000. If you experience random or periodic communication errors this may be due to the Lap Top computer power manager. For this case it is recommended to disable the Power Management Features on your Lap Top computer. Please consult the User Manual for your Lap Top computer for specific instructions to disable the Power Management Feature.

Connecting the USB Cable

The USB cable is 1 m (3 ft) long, it allows transfer of computer commands and spectral data between the InSpector 2000 and the host computer. Both ends have USB connectors which are defined by the USB standard; one end is rectangular, the other end is square. Connect the square end to the USB port located on the rear panel of the InSpector 2000, connect the rectangular end to the USB port on the host computer.

Grounding the System

It's not necessary to ground the InSpector 2000 system in most applications. However in extreme environmental conditions, the InSpector 2000 might be susceptible to oscillations or noise due to ground loops, radio frequency interference (RFI), or electromagnetic interference (EMI). When grounding the InSpector 2000 is required, a ground connector can be attached to bottom left screw on the rear panel. A ground connection at this point makes positive electrical contact with both circuit and chassis ground. Using a spade lug simplifies the operation since the screw does not require complete removal, it only needs to be loosened.

Power On

When the InSpector 2000 is first turned ON, it will go through an initialization and self-test process. During the initialization period, the InSpector 2000 will run internal diagnostics routines to verify correct operation of the hardware. The FAULT, BATT and ACQ LEDs report the status.

During power on diagnostics the FAULT LED is illuminated. If the diagnostics were successful the BATT LED will remain on and the FAULT LED will extinguish.

If during diagnostics a fault was detected the FAULT LED will remain on. In addition the actions of the BATT and ACQ LEDs will aid with identifying the potential problem area. A FAULT LED and blinking BATT LED indicates a problem with the power source (battery or ac adapter) or signal processing logic. A FAULT LED and blinking ACQ LED indicates a problem was detected with the microprocessor ram, data memory, loading the FPGA logic or FPGA communication.

After the self diagnostics completes or any time there after a FAULT LED in conjunction with a blinking HV LED indicates a HV Inhibit or high voltage power supply fault.

If the BATT LED remains on and no fault condition were detected and the InSpector instrument is configured in the MID Definition the InSpector 2000 is ready for operation. Please refer to Chapter 4, *User Interface and Controls* for configuring the Genie-2000 MID Editor.

4. User Interface and Controls

This chapter provides basic information on the installation of the Genie-2000 software, the user interface and operation of the setup controls for the Model InSpector 2000 Portable Spectroscopy Workstation. Additional details and discussion can be found in Chapter 6, *Basic Spectroscopy Operation,* Chapter 7, *PUR/LTC Operation*, and Appendix B, *Performance Adjustments*.

With exception to the High Voltage Power Supply range and polarity configuration, all controls are programmable through the host computer software. For specific details on using the host computer software, please refer to software documentation provided with the Genie-2000 (V1.4 and higher) installation CD. For information on configuring the High Voltage Power Supply refer to Appendix E, *Configuring the High Voltage Power Supply*.

Software and USB Driver Installation

If your system wasn't integrated by Canberra please follow the instructions on the Genie-2000 installation CD to install the Genie-2000 software and purchased options.

If you plan to interface the InSpector 2000 to the host computer using the USB port you need to first install the USB driver. If this has not already been done please follow the directions below for setting up the USB driver under Windows 98.

1. Connect the InSpector 2000 to the host computer using the USB ports and using the supplied USB cable. Please reference "Connecting the USB Cable" on page 20 and "Using the USB Port" on page 113 for additional information.

2. Turn the InSpector 2000 power to ON.

3. Windows 98 will automatically prompt you for the USB driver diskette as part of its plug and play device architecture. There is no need to re-boot your system.

4. Follow the steps in the "Add New Hardware" Wizard to add your new USB driver. Use the default steps by clicking "Next".

5. Choose "Search for the best driver for your device" by clicking the Next button (default).

6. Click on the check box for "specify a location", type your CDROM drive letter and specify the CIUSB directory on the CDROM.

7. Click Next and Finish to complete the steps to install the USB driver. It is not necessary to reboot.

Note: These steps are only required once, i.e. when Windows 98 detects that new hardware has been added to your system or if the drivers are missing or need to be re-installed.

Creating an MCA Input Definition

The first step in using your InSpector 2000 is to create an MCA Input Definition (MID).

For most Genie-2000 based systems, you'll want to use the MID Wizard to help you set up your InSpector 2000's Input Definition quickly and easily.

If your Input Definition is more complex than the MID Wizard was designed to handle, you'll have to use the MID Editor to create your definition. It is covered in detail starting on page 27.

The MID Wizard

To use the MID Wizard, open the Genie-2000 folder and select the MID Wizard icon to start the definition process.

Step 1

The first screen (Figure 8) lets you select the MCA you want to create a definition for. If you are connecting your InSpector 2000 to the host computer using the RS-232 interface choose "InSpector -2000 via I2k-232". If using the USB interface then choose "InSpector-2000 via I2k-USB. When done making your selection, then select the **Next** button.

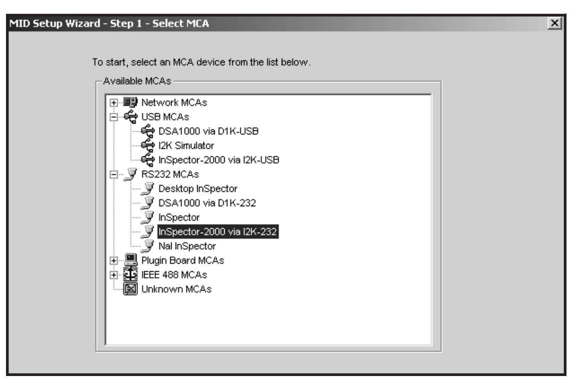

Figure 8 Selecting the MCA

Step 2

The step 2 screen will vary depending on your previous selection of the computer interface type.

USB Interface

For the USB Interface, the setup screen will ask you to define the MCA Full Memory, the Device Serial Number and Acquisition Mode as shown in Figure 9. The Device Serial Number is the 8-digit serial number located on the bottom of the InSpector 2000 instrument.

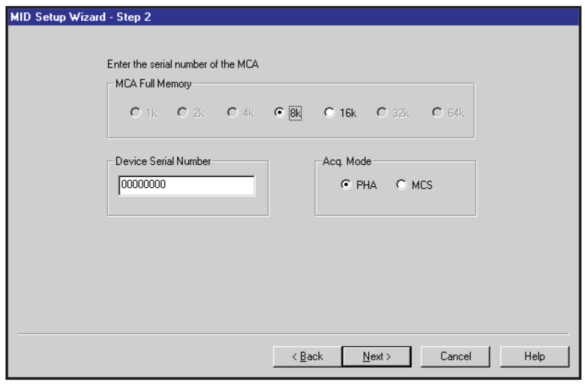

Figure 9 Defining the Full Memory and Device Serial Number for USB Operation

Note: Memory size of 8k and 16k are selectable for PHA acquisition mode and 8k only for the MCS acquisition mode.

RS-232 Interface

For the RS-232 Interface, the setup screen will ask you to define the MCA Full Memory, COM Port and Baud Rate as shown in Figure 10.

Note: Memory size of 8K and 16K are selectable for the PHA acquisition mode and 8K only for the MCS acquisition Mode.

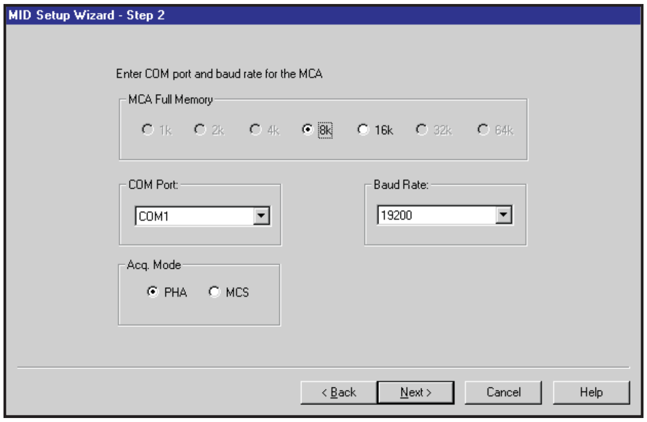

Figure 10 Defining the MCA Full Memory, COM Port and Baud Rate for RS-232

Click on the COM Port Box to select the desired COM port and Baud Rate box to select the baud rate. The InSpector 2000 supports baud rates of 2400, 4800, 9600, 19200, 38400, 57600 and 115200 as shown in Figure 11.

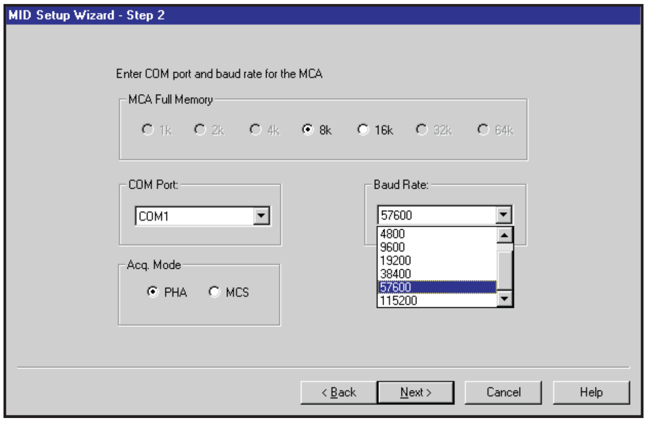

Figure 11 Setting the Baud Rate for RS-232 Operation

Note: Baud rates higher than 57 kbaud may require the use of special hardware and/or device drivers installed in your computer.

Steps 3 and 4

You won't see the screens for Steps 3 and 4; these steps are not used when setting up a InSpector 2000.

Step 5

The Step 5 screen in Figure 12 asks you to define the high voltage power supply's Range, Voltage Limit, and Voltage. Click on the Range Box to select the desired voltage range. The InSpector 2000 supports four voltages ranges: + 5000 V dc, +1300 V dc, –5000 V dc and –1300 V dc. Both the positive and negative 5000 volt ranges are adjustable from 1300 volts to 5000 volts and provides up to 20 µA of current suitable for most HPGe detector applications.

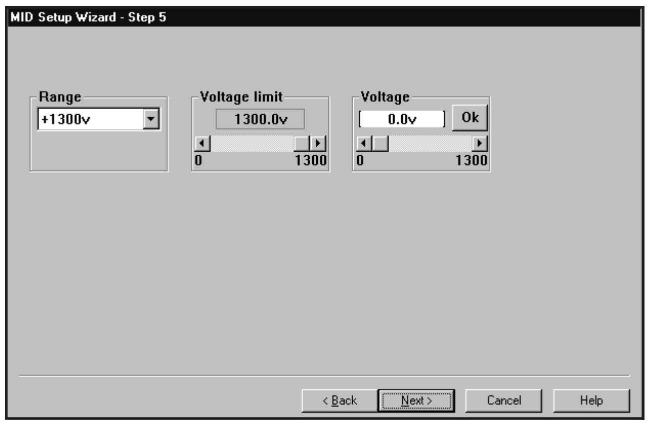

Figure 12 Defining the High Voltage Parameters

Both the 1300 volt ranges are adjustable from 10 volts 1300 volts and provides up to 300 µA of current for detectors requiring lower voltages and/or higher current such as NaI or Cd(Zn)Te.

The voltage range and polarity should be set to match the configuration of the high voltage power supply. If there is a mismatch the Genie-2000 environment will report a hardware verification error when attempting to open the Data Source in the Gamma Acquisition and Analysis Application. To configure the high voltage power supply please refer to Appendix E, *Configuring the High Voltage Power Supply*.

Step 6

The Step 6 screen in Figure 13 asks for a Detector Type and acquisition memory size in channels, and requires that an Input Name be entered.

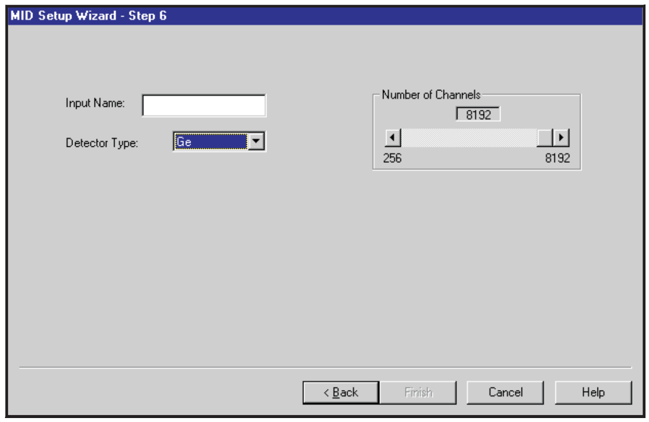

Figure 13 Assigning the Detector Type

Ending the Definition

To complete your Input Definition, select **Finish**. The input that you just defined will be stored as an MID file named inputname.MID and automatically loaded into the MCA Runtime Configuration Database. When you select **Finish**, you will be asked if you would like to define another input. Answering No will close the Wizard.

Note that if you didn't enter an Input Name, you won't be allowed to exit the Step 6 screen. If the name you entered is the same as the name of an existing MID file, the system will tell you so and go back to Step 6 to let you enter another name.

The MCA Input Definition Editor

The MCA Input Definition (MID) Editor allows you to create, edit and manage input definitions. However, for most users, the facilities provided in the MID Wizard are sufficient. You'll have to use the MID Editor only if you wish to change any of the following parameters from their default values.

Digital Stabilizer

Gain Rate Divider (Default = 1)
Correction Range (Default = Ge)

High Voltage Power Supply

Inhibit Signal Polarity (Default = Positive)

DSP Gain

Gain Attenuator (Default = OFF)
Reset Preamp Inhibit Polarity (Default = Positive)

DSP Filter

Preamp Type (Default = RC)
FDisc Shaping (Default = Normal)

Editing The MID Settings

This section discusses the specific settings for the InSpector 2000 in the MCA Definition. To change any of them, refer to the procedures described in “Editing an MCA Definition” in the MCA Input Definition chapter of the *Genie-2000 Operations Manual*. That chapter also has detailed information on using the MID Editor.

Note: MCS will be available only if the MCA Acq. Mode under **Devices** was previously configured for MCS, otherwise is grayed out. See Figure 14.

MCA Settings

This device has no adjustable controls.

Stabilizer Settings

The Stabilizer maintains the stability of high resolution spectroscopy in applications involving long count times or high count rates. It accomplishes this by using a reference peak in the spectrum and correcting the system gain to keep the peak from drifting. The count rates in the reference peak should be high enough to be significantly more than the background in the chosen stabilizer window.

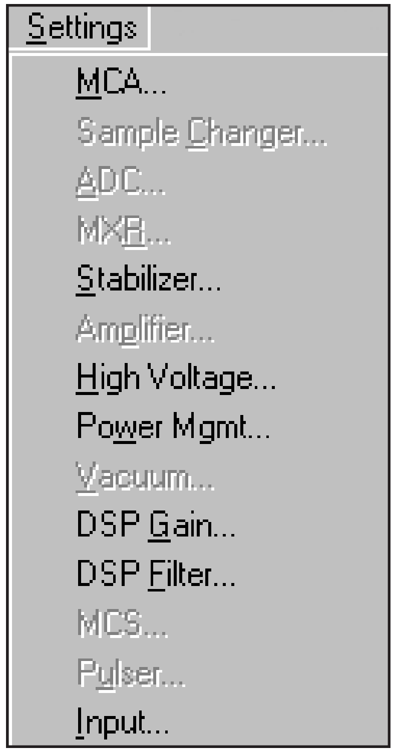

Figure 14 The Settings Menu

Selecting the **Stabilizer** command pops up the Dialog Box shown in Figure 15.

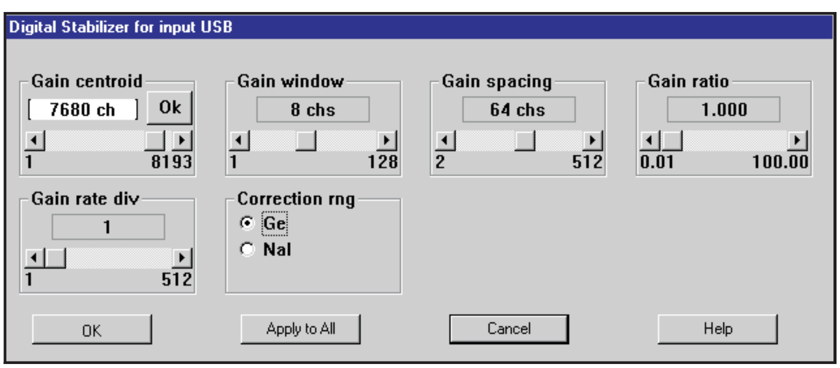

Figure 15 Stabilizer Settings Dialog

Note: This window's initial focus is on the **Cancel** button; pressing the keyboard's ENTER key after making changes in this dialog box will cancel the changes. Be sure to click on the OK key to accept the changes.

Gain Centroid

Sets the centroid (in channels) of the reference peak at the high end of the spectrum for gain stabilization.

Gain Window

Sets the width (in channels) of the upper and lower sampling windows on either side of the gain reference peak.

Gain Spacing

Sets the spacing (in channels) between the upper and lower sampling windows. The windows should be placed so that a shift in the reference peak reflects a significant change in count rate through the window. For broad peaks, the spacing should be set so that the windows' edges are not on the flat part of the peak.

Gain Rate Div

The Gain Rate Divisor sets the count rate dividers at the input to the correction register for Gain. For high count rate reference peaks, increasing the Divider value will smooth out the correction applied to the system and minimize any peak broadening. This control can only be set via the MID Editor.

Gain Ratio

The Gain ratio value is interpreted by the stabilizer as the ratio to maintain between the two gain windows (ratio = upper window / lower window). For instance, a value of 1 would be appropriate for a pure Gaussian peak.

Correction Rng

Correction range: (Ge) 1% or (NaI) 10%. This control selects the Gain Correction range that can be provided to correct for drift. Select Ge for a germanium detector or NaI for a sodium iodide detector. This control can only be set via the MID Editor.

High Voltage Settings

The **High Voltage** command, shown in Figure 16, adjusts the High Voltage Power Supply (HVPS).

Note: The voltage range and polarity should be set to match the hardware configuration of the HVPS. If there is a mismatch the Genie-2000 environment will report a hardware verification error when attempting to open the datasource in the Gamma Acquisition and Analysis Application. To configure the HVPS please refer to Appendix E, *Configuring the High Voltage Power Supply*.

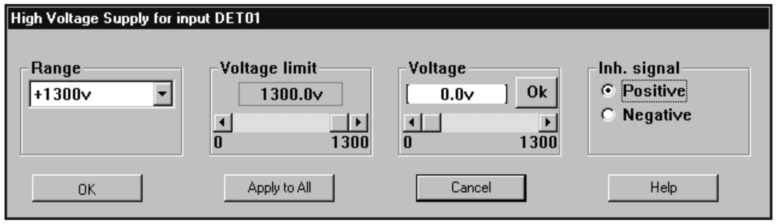

Figure 16 The High Voltage Settings

Note: This window's initial focus is on the **Cancel** button; pressing the keyboard's ENTER key after making changes in this dialog box will cancel the changes. Be sure to click on the **OK** button to accept the changes.

Range

Click on the **Range** Box to select the desired voltage range. The InSpector 2000 supports four voltages ranges: + 5000 V dc, +1300 V dc, –5000 V dc and –1300 V dc. Both the positive and negative 5000 volt ranges are adjustable from 1300 volts to 5000 volts and provides up to 20 µA of current suitable for most HPGe detector applications.

Both the 1300 volt ranges are adjustable from 10 volts 1300 volts and provides up to 300 µA of current for detectors requiring lower voltages and/or higher current such as NaI or Cd(Zn)Te.

The **Range** control, must be set *before* the Voltage Limit or Voltage Control is adjusted, this automatically changes the upper value for the Voltage Limit and Voltage controls. This control can be set only in this Dialog Box; it cannot be changed in the Acquisition and Analysis application.

Voltage Limit

The **Voltage limit** control establishes the HVPS's maximum output voltage within the selected range. It must be set *before* the Voltage control is adjusted. This control can be set only in this Dialog Box; it cannot be changed in the Acquisition and Analysis application.

Voltage

After setting the Voltage Limit, the **Voltage** scroll bar sets the output voltage of the HVPS between the Voltage Limit's minimum and maximum settings. The voltage can also be typed in from the keyboard, then accepted with the **Ok** button within the control. The MCA Adjust HVPS dialog in the Acquisition and Analysis application allows you to adjust the output voltage, as well as turn the HVPS on and off and reset it.

Inh. Signal

Sets the polarity of the H.V. Inhibit input. All Canberra detectors and preamps use the Positive setting. For additional information refer to Appendix A, *Specifications*.

Power Management Settings

The InSpector 2000 can be programmed to automatically shut down after a programmable delay when no acquisition and communication with the host computer is detected (Figure 17). For additional information on using the automatic shut down feature please refer to “Power Management” on page 100.

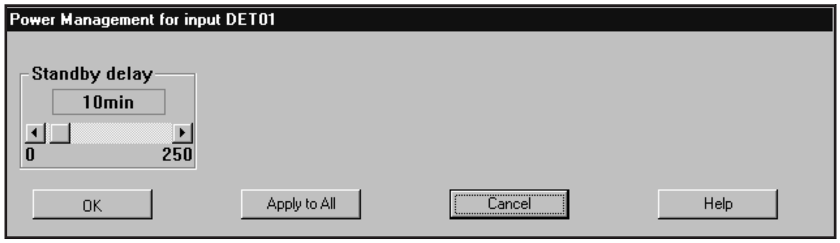

Figure 17 The Power Management Settings

Standby Delay

Allows adjustment of the shut down delay when the automatic mode is selected. The adjustment range is 1 minute to 250 minutes. Off or disabled for a setting value of 0. ON for an adjustment setting value of 1 to 250. The default setting is 10 minutes.

DSP Gain Settings

The DSP Gain settings screen (Figure 18) for the InSpector 2000 contains the following controls.

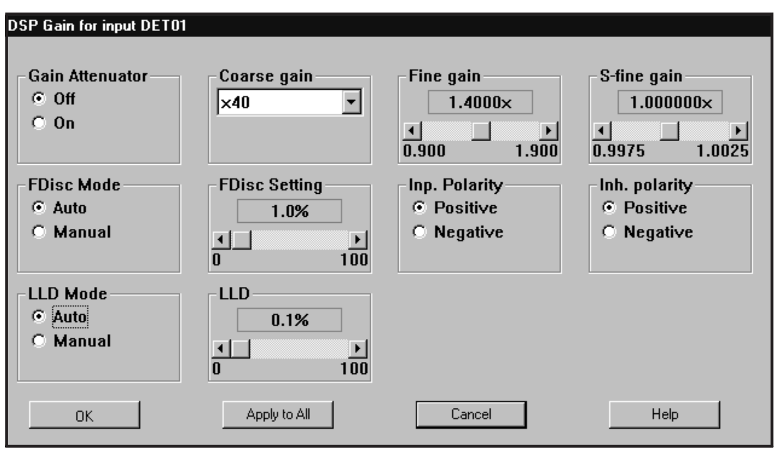

Figure 18 The DSP Gain Settings

The combination of Coarse, Fine and Super Fine Gain (SFG) sets the overall system gain to match the requirements of the detector and energy application; overall gain is continuously variable from x2.24 to x2438.

Gain Attenuator

ON enables a divide by four input attenuator to minimize overload due to preamp signals with large dc offsets and Reset preamps with large output dynamic range; overall gain settings reduce by a factor of four. When OFF is selected the signal attenuator is removed.

Coarse Gain

Sets the device's coarse gain. It's best to choose the highest Fine Gain which, combined with the Coarse and Super-Fine Gains, will produce the total desired gain. The Coarse gain allows selections of x2.5 through x1280.

Fine Gain

Sets the device's Fine Gain multiplier; the adjustment range is x0.900 to x1.900.

S-Fine Gain

Sets the device's Super-Fine Gain multiplier; the adjustment range is x0.9975 to x1.0025.

FDisc Mode

Sets the device's Fast Discriminator threshold mode. AUTO allows the threshold to be optimized automatically above the system noise level; MANUAL allows the threshold to be manually adjusted.

FDisc Setting

Sets the device's Fast Discriminator threshold level (when MANUAL Fdisc Mode is selected). The range is 0 to 100%.

Inp. Polarity

Sets the device's Input signal polarity to either Positive or Negative. The device's input polarity must match the preamplifier's output polarity. This control can only be set via the MID Editor.

Inh. Polarity

Sets the device's Reset Inhibit signal polarity to either Positive or Negative. If you are using a TRP preamplifier, set the Reset Inhibit polarity of the device to match the polarity of the preamp's Inhibit output. Canberra Reset preamps use a positive Inhibit polarity.

LLD Mode

Selects Automatic and Manual LLD modes; the digital Lower Level Discriminator selects minimum input acceptance level. With Auto select the LLD cutoff is automatically optimized just above the spectral noise threshold. Manual allows the LLD cutoff to be set manually using the LLD slider bar as a percentage of the full-scale spectral size or range. The LLD slider bar does not function when Auto is selected.

LLD

Active when the Manual LLD Mode is selected, sets the minimum input acceptance level, range is 0 to 100%.

DSP Filter Settings

The DSP Filter settings screen (Figure 19) for the InSpector 2000 contains the following controls.

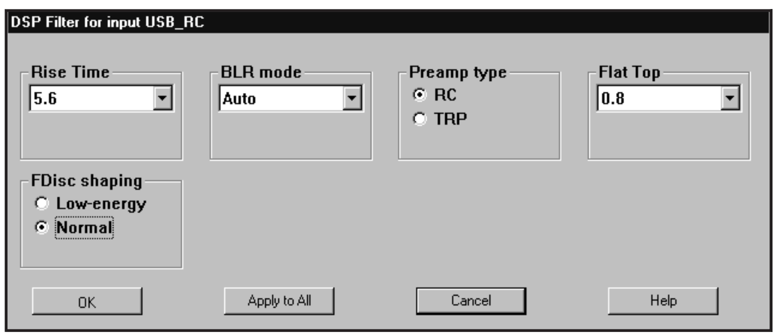

Figure 19 The DSP Filter Settings

Rise Time

Symmetrically sets the rise time and fall time of the digital filter time response. As with conventional Gaussian shaping, the degree of noise filtering is proportional to the rise time selection. There are 40 rise/fall times, ranging from 0.4 to 38 µs. The rise time can also be set in the Acquisition and Analysis application; for more information please refer to “Rise Time and Flat Top Adjustments” on page 82.

BLR Mode

Sets the baseline restorer mode. When set to AUTO, the baseline restorer is automatically optimized as a function of trapezoid shaping time and count rate. With settings, of SOFT, MEDIUM and HARD, the baseline restorer is set to fixed rates as selected.

Preamp Type

Selects the Preamplifier type as either TRP (Transistor Reset Preamp type) or RC (resistor capacitor feedback type). RC enables the Pole/Zero Assistant function and Pole/Zero setting slider bar in the **MCA | Adjust | Filter** Device screen. Selecting TRP disables the Pole/Zero Assistant function (the Adjust Screen becomes hidden) and enables the TRP Inhibit settings in the **MCA | Adjust | Filter** Device screen. This control can only be set via the MID Editor.

Flat Top

Sets the flat top portion of the digital filter time response. The flat top matches the filter to the detector charge collection characteristics to minimize the effects of ballistic deficit. There are 21 flat top time selections, ranging from 0 to 3 µs.

FDisc Shaping

Selects Normal or Low-energy to optimize the fast discriminator shaping for the detector type. Selecting NORMAL optimizes the fast discriminator shaping for use with Ge detectors and general gamma spectroscopy; the fast discriminator filter rise time is set to 0.04 µs. Selecting Low-energy the fast discriminator rise time is set proportional to the slow shaper rise time selection. For this selection the fast discriminator shaping time increases proportionally with the slow shaper which optimizes the signal to noise ratio for improved pile-up detection at low energies when using low noise, low energy detectors.

MCS Settings

If you choose the MCS mode in the **Device | MCA** setup, you'll also have to select the MCS Disc Mode and Dwell time as shown in Figure 20.

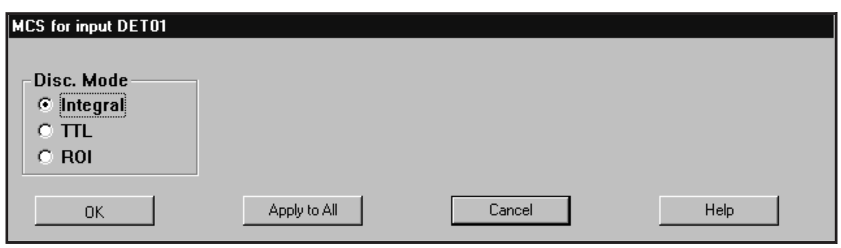

Figure 20 Choosing the MCS Disc Mode

Note: This window's initial focus is on the **Cancel** button; pressing the keyboard's ENTER key after making changes in this dialog box will cancel the changes. Be sure to click on **OK** to accept the changes.

Disc. Mode

The Disc Mode control establishes the MCS mode to be used. Selecting Integral enables the MCS's "Integral mode": all valid gamma events processed by the DSP that would otherwise be stored in PHA spectral memory are counted. Selecting TTL enables the MCS's "TTL mode" causes all TTL events (as seen at the MCS IN rear panel connector) to be counted. Selecting ROI enables the "ROI discrimination mode", meaning that all incoming events processed by the DSP that fall within the selected discrimination window are counted.

Input Settings

The **Input** command is used to change the name of the Input and set up the structure of its memory via the Dialog Box shown in Figure 21. These commands are not available in the Acquisition and Analysis application.

Note: This window's initial focus is on the **Cancel** button; pressing the keyboard's ENTER key after making changes in this dialog box will cancel the changes. Be sure to click on the **OK** key to accept the changes.

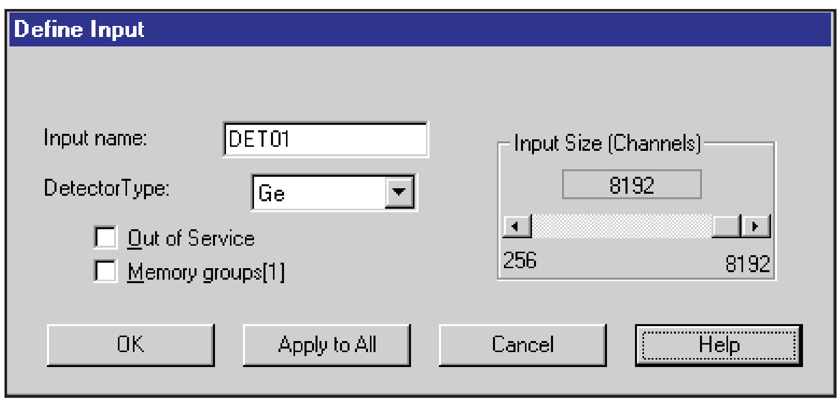

Figure 21 The Define Input Dialog

Input Name

The default DETnn name is the name displayed here, allowing you to easily change it to a more meaningful name, such as "H2OSampl", up to a total of eight characters.

Detector Type

Use this drop-down list to select the type of detector to be used with this MCA; this also assigns appropriate default values to the spectrum display and analysis parameters. Three choices are available: Ge, NaI or Alpha. For additional information please refer to *Genie-2000 documentation*.

Input Size

This parameter defaults to 8K, the number of channels assigned during Device setup for the MCA, on the assumption that you'll be using "Full Memory" for your data acquisition. To use less than the maximum available memory size, use this control to select the size you want to use. For instance, for NaI spectra, you wouldn't want to use more than 1024 channels.

Out of Service

This check box allows you to place this Input temporarily "out of service". That is, it will remain as an entry in your MCA Definition File but will not be available for data acquisition. It is meant to be used when the MCA or its front end electronics are temporarily disconnected.

Memory Groups

This check box allows you to define a multi-memory group input; this box is enabled if the input size is defined less than the physical MCA memory size.

Acquisition Window Adjust Dialogs

The Adjust dialogs are found under the MCA menu in the Acquisition and Analysis application. The datasource for the specific instrument must be opened. To open a datasource, select **File | Open Datasource,** then select "Detector" in the Type box. Next, select the datasource file and select open.

In the following Adjust Screen discussion, the MCS Adjust Screen and the associated selection button are available only if MCS was selected as the Acquisition Mode when setting up the MCA controls in the **Devices | MCA** screen of the MID Editor. If MCS was not selected the selection button and adjust screen are hidden form view.

Notes: If you get a "Required Hardware Unavailable" error, likely causes are you may have selected the wrong data source for the instrument, there is a problem with the RS-232 or USB communication interface (check the cables), the instrument power is off or the instrument serial number was incorrectly entered when configuring the **MCA | Devices** dialog box. For this case the problem must be corrected before the data source can be opened.

If you get a "Hardware Verification Error" there is a mismatch between the MID Definition setup and the hardware configuration. Likely causes are the High Voltage Power Supply configuration or the hardware settings have been changed.

You can choose to accept or not accept the verification error in the associated dialog box. If you select NO, a RED error box will appear in the top left corner of the Acquisition and Analysis window. You can determine the source of the verification error by looking at the Status Page, which you can access by clicking **MCA | Status**. The problematic item will be marked with an asterisk (*).

The following section describes those parameters for the InSpector 2000 that can be accessed from the acquisition windows' Adjust dialog screen; click on **MCA | Adjust**. Note that the Adjust screen for a given device may actually be composed of several screens, which are accessed by using the **Next/Prev** pushbuttons. More detail information about specific function can be found in Chapter 6, *Basic Spectroscopy Operation*; Chapter 7, *PUR/LTC Operation* and Appendix B, *Performance Adjustments*.

Stabilizer Parameters

The Stabilizer settings screen (Figure 22) for the InSpector 2000 contains the following controls.

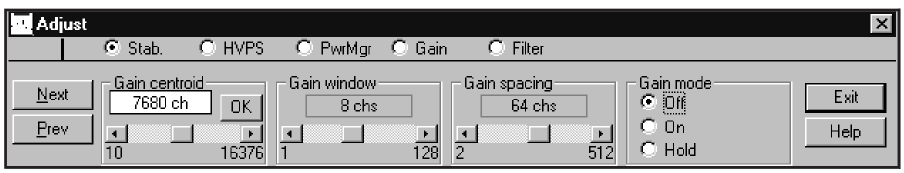

Figure 22 Adjust Screen's Stabilizer Settings

Figure 23 shows the relationship between the Stabilizer's Centroid, Window and window Spacing on a typical peak.

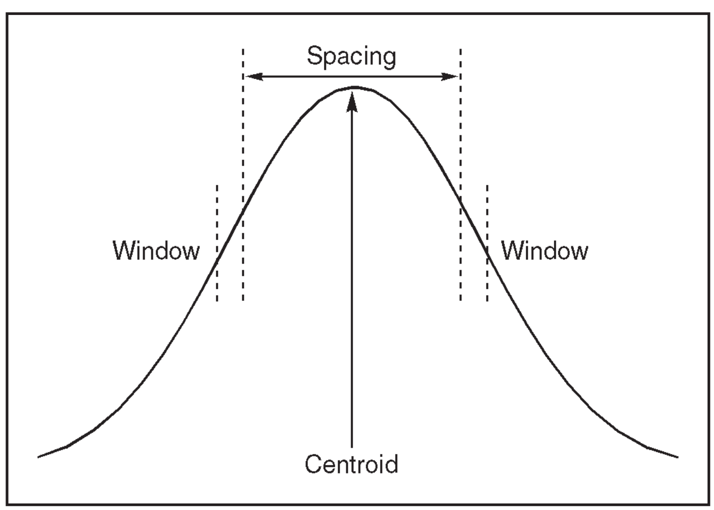

Figure 23 Relationship Between Stabilizer Functions

Gain Centroid

Sets the centroid (in channels) of the reference peak at the high end of the spectrum for gain stabilization.

Gain Window

Sets the width (in channels) of the upper and lower sampling windows on either side of the gain reference peak.

Gain Spacing

Sets the spacing (in channels) between the upper and lower sampling windows. The windows should be placed so that a shift in the reference peak reflects a significant change in count rate through the window. For broad peaks, the spacing should be set so that the windows' edges are not on the flat part of the peak.

Gain Mode

Sets the Gain Stabilization mode to Off, On or Hold.

Off disables gain stabilization and sets the correction adjustment to 0.

On enables gain stabilization, allowing the Stabilizer to compare the incoming data to the gain Centroid and Window settings, then compensate for data below (or above) the Centroid.

Hold disables gain stabilization, but maintains the current correction adjustment at the Stabilizer's output.

Gain Ratio

The Gain ratio value is interpreted by the stabilizer as the ratio to maintain between the two gain windows (ratio = upper window / lower window). For instance, a value of 1 would be appropriate for a pure Gaussian peak.

High Voltage

The **High Voltage** command, shown in Figure 24, adjusts the High Voltage Power Supply (HVPS).

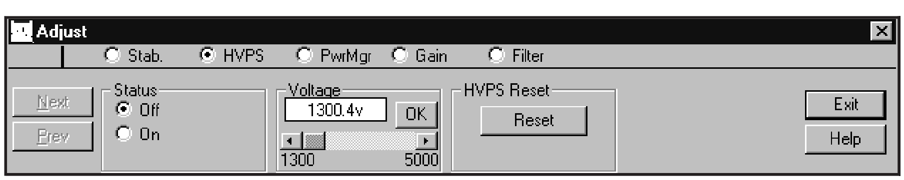

Figure 24 Adjust Screen's HVPS Settings

Status

This control allows you to turn the HVPS on/off.

Voltage

The **Voltage** scroll bar sets the output voltage of the HVPS between the Voltage Limit's minimum and maximum settings. The voltage setting can also be typed in from the keyboard, then accepted with the **OK** button within the control.

Note: The maximum setting may be limited by the Voltage Limit setting in the MID Editor.

HVPS Reset

This control resets any HVPS fault condition (for example, inhibit or overload).

MCS Parameters

The MCS settings screen (Figure 25) for the InSpector 2000 contains the following controls.

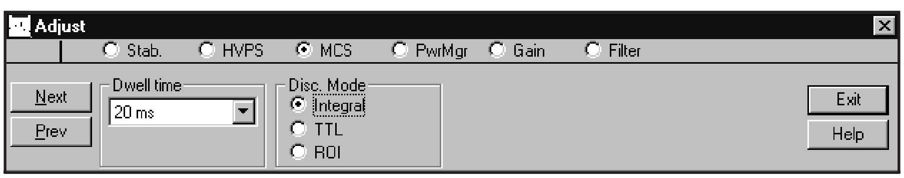

Figure 25 Adjust Screen's MCS Setting

Note: The MCS Adjust Screen and the associated selection button are available only if MCS was selected as the Acquisition Mode when setting up the MCA controls in the **Devices | MCA** screen of the MID Editor. If MCS was not selected the selection button and adjust screen are hidden form view.

Dwell Time

Sets the dwell time value. There are 14 selections ranging from 5 ms to 10 seconds.

Disc. Mode

The Disc Mode control establishes the MCS mode to be used. Selecting Integral enables the MCS's "Integral mode": all valid gamma events processed by the DSP that would otherwise be stored in PHA spectral memory are counted. Selecting TTL enables the MCS's "TTL mode" causes all TTL events (as seen at the MCS IN rear panel connector) to be counted. Selecting ROI enables the "ROI discrimination mode", meaning that all incoming events processed by the DSP that fall within the selected discrimination window are counted.

PwrMgr Parameters

The Power manager setting screen (Figure 26) for the InSpector 2000 contains the following control.

Figure 26 Adjust Screen's Power Management Settings

The InSpector 2000 can be programmed to automatically shut down after a programmable delay when no acquisition and communication with the host computer is detected. For additional information on using the automatic shut down feature please refer to "Power Management" on page 100.

Standby Delay

Allows adjustment of the shut down delay when the automatic mode is selected. The adjustment range is 1 minute to 250 minutes. Off or disabled for a setting value of 0. ON for an adjustment setting value of 1 to 250. The default setting is 10 minutes.

DSP Gain Parameters

The DSP Gain settings screen (Figure 27) for the InSpector 2000 contains the following controls.

The combination of Coarse, Fine Gain and Super Fine Gain (SFG) sets the overall system gain to match the requirements of the detector and energy application; overall gain is continuously variable from x2.24 to x2438.

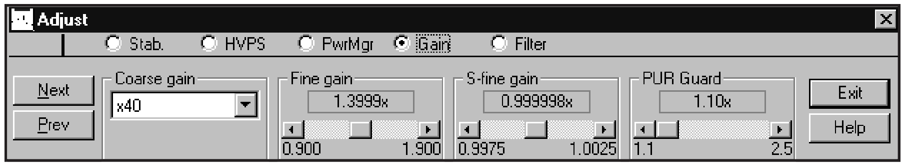

Figure 27 Adjust Screen's Gain Settings

Coarse Gain

Sets the device's coarse gain. It's best to choose the highest Fine Gain which, combined with the Coarse and Super-Fine Gains, will produce the total desired gain. The Coarse Gain allows selection of x2.5 through x1280.

Fine Gain

Sets the device's Fine Gain multiplier; the adjustment range is x0.900 to x1.900.

S-Fine Gain

Sets the device's Super-Fine Gain multiplier; the adjustment range is x0.9975 to x1.0025.

PUR Guard

Sets the device's Guard Time (GT) multiplier to reject trailing edge pileup in the event of detector/preamp anomalies. The PUR guard sets the pileup reject interval, which is defined by GT x $T_{Risetime}$ + $T_{flattop}$. For additional information on using the PUR Guard feature please refer to "PUR Guard" on page 69.

FDisc Mode

Sets the device's Fast Discriminator threshold mode. AUTO allows the threshold to be optimized automatically above the system noise level; MANUAL allows the threshold to be manually adjusted.

FDisc Setting

Sets the device's Fast Discriminator threshold level (when MANUAL Fdisc Mode is selected). The range is 0 to 100%.

LTC Mode

Sets the amplifier's Pulse Pileup Rejector and Live Time Corrector. When PUR is On, the pileup rejector and live time corrector (LTC) are enabled. Off disables the pileup rejector and LTC.

LT Trim

Allows adjustment of the trapezoid pulse evolution time or dead time to optimize LTC performance. The adjustment range is 0 to 1000; the default value of 500 provides good LTC performance for a wide range of applications. For additional information on using the LT Trim function please refer to “Live Time Correction with a Live Source” on page 67.

LLD Mode

Selects Automatic or Manual LLD modes. With Automatic selected the LLD cutoff is automatically set just above the spectral noise threshold. Manual allows the LLD cutoff to be set manually as a percentage of the full-scale spectral size.

LLD

Sets the minimum input acceptance level; active only when Manual LLD mode is selected; adjustment range is 0.0% to 100% of the spectrum full scale range.

Note: The Inhibit Adjust Screen and Inhibit controls described below are available only if TRP preamp type is selected in the **Settings | DSP Filter Devices** in the MID Editor. If RC Preamp type is selected the Inhibit Adjust Screen and controls are hidden from view.

Inhibit Mode

Selects the Auto or Manual Inhibit Mode. AUTO gates the system off for the greater of the Reset Preamp Inhibit Time “OR” the internal inhibit time. MANUAL gates the system off for the greater of the adjustable Inhibit Setting “OR” the Reset Preamp Inhibit time “OR” the internal inhibit time.

Inh Setting

Active when the Manual Reset Preamp Inhibit Mode is selected sets the Inhibit Time, range 0 to 160 µs.

DSP Filter Parameters

The DSP Filter settings screen (Figure 28) for the InSpector 2000 contains the following controls.

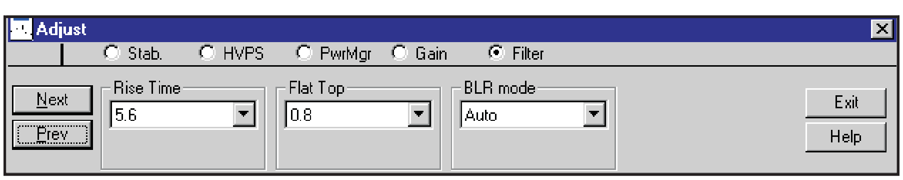

Figure 28 Adjust Screen's DSP Filter Settings

Rise Time

Symmetrically sets the rise time and fall time of the digital filter time response. As with conventional Gaussian shaping, the degree of noise filtering is proportional to the rise time selection. The rise time can be selected from 40 rise/fall times ranging from 0.4 to 38 µs.

Flat Top

Sets the flat top portion of the digital filter time response. The flat top matches the filter to the detector charge collection characteristics to minimize the effects of ballistic deficit. The flat top time can be selected from 21 flat top selections ranging from 0 to 3 µs.

BLR mode

Sets the baseline restorer mode. With a setting of AUTO, the baseline restorer is automatically optimized as a function of trapezoid shaping time and count rate. With settings, of SOFT, MEDIUM and HARD, the baseline restorer is set to fixed rates as selected.

Pole Zero Assistant

The Pole Zero Assistant Adjust screen (Figure 29) is on the second page of the DSP Filter parameters; select **Next** after opening the Adjust Screen to get to the second page.

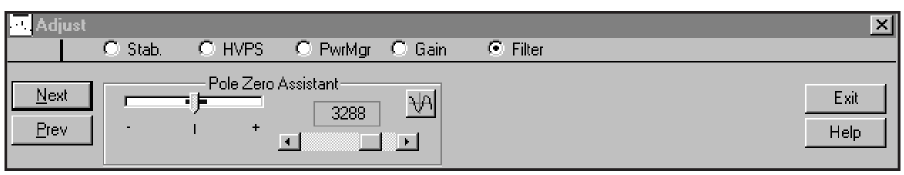

Figure 29 Pole Zero Assistant Adjust Screen

Note: The Pole Zero Assistant screen is available only if RC is selected as the Preamp Type in the **Settings | DSP Filter** Device of the MID Definition. If TRP Preamp type is selected the Pole/Zero setting is set to Infinity and the Pole Zero Assistant Adjust Screen is hidden from view.

The Pole/Zero is manually adjusted using the P/Z slider bar. The adjustment range is 45 µs to infinity. The Pole Zero Assistant and Digital Oscilloscope are provided as user aids when optimizing the pole/zero setting.

The Pole Zero Assistant provides visual feedback of the Pole/Zero convergence quality via the Quality Indicator. The Pole Zero Assistant measures and analyzes the tail of the trapezoid signal and provides visual feedback showing the quality of the pole zero adjustment via a simulated Null Meter or Pole/Zero Quality Indicator. For additional information on adjusting the pole/zero using the Pole Zero Assistant please refer to “Detector Matching” on page 58.

The digital oscilloscope can be opened by clicking on the Oscilloscope icon in the right top corner of the Pole Zero Assistant box. When using the Oscilloscope function stop any MCA acquisitions in process to maximize the scope update rate. For additional information on using the digital Oscilloscope please reference Chapter 5, *Using the Digital Oscilloscope Function* and “Pole/Zero Matching Using the Digital Oscilloscope” on page 85.

5. Using the Digital Oscilloscope Function

The digital oscilloscope is provided as a visual aid to assist with parameter setup and to verify operation of the InSpector 2000. The digital oscilloscope reconstructs the digital filter output signal (which is filtered using a trapezoidal weighting function) for viewing. The waveform provided by the digital oscilloscope is similar to the waveform produced by a traditional spectroscopy amplifier when viewed on an analog or digital oscilloscope. However, the InSpector 2000 digital oscilloscope contains built in averaging and rejection functions to reduce noise and pileup to improve waveform fidelity. This makes it easier to perform necessary adjustments quickly and accurately.

The Digital Oscilloscope can be launched from the Pole Zero Assistant screen or the Gamma Acquisition and Analysis application's main toolbar. The Pole Zero Assistant screen is active only if **RC** is selected as the Preamp Type in the MID Definition. The Pole Zero Assistant screen is located on the second page of the **MCA | Adjust | Filter** screen as shown in Figure 30.

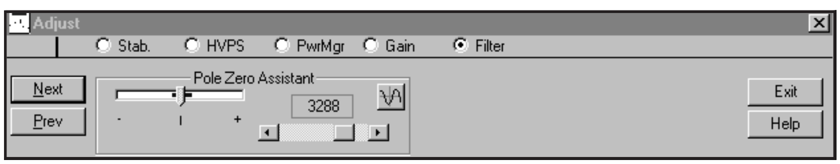

Figure 30 Pole Zero Assistant Adjust Screen

Click on the oscilloscope icon, in the right top corner of the Pole Zero Assistant box, to launch the oscilloscope function. If **Reset** is selected as the **Preamp Type** in the MID Definition the pole/zero compensation is automatically set to a value of zero representing the matching required for a fall time of infinite duration which requires no compensation. As a result it's not necessary to adjust the pole/zero setting; the Pole Zero Assistant screen is not required and is not displayed. For this case the digital oscilloscope icon can be added to the main toolbar by choosing the Commands tab on the **Display | Preferences | Toolbar Setup** screen. Choose the MCA Category icon group and drag the oscilloscope icon to the toolbar. This pushbutton will now be available for starting the digital oscilloscope. To remove the colored title bar just above the icon, click in the colored area with the left mouse button and drag it down. The toolbar can now be saved by pressing the Save button on the Display Preferences screen. For more information on adding command buttons to the toolbar, see Toolbar Setup in the Genie-2000 Spectroscopy System Operations Manual in the Display Preference section of the Gamma Acquisition and Analysis section.

Note: The Digital Oscilloscope update rate may be impacted by having MCA Acquire set ON. For best speed performance it is recommended the MCA Acquire be set off when using the Digital Oscilloscope utility.

Minimizing or Hiding the Scope From View

Each time the Digital Oscilloscope is opened its controls are set to the default settings. This may be inconvenient if you are using a specific scope setup and you need to switch between various Adjust screen and the scope during the system setup. For this case the scope can be minimized or hidden from view, for either case the scope window is temporally removed from the Gamma Acquisition and Analysis (GAA) window to allow viewing of the spectral data and adjust screens. When the scope window is maximized or restored to view it retains the setting that were last used.

If the scope application is open it can be hidden from view by clicking on the scope icon in the PZA adjust screen or the tool bar in the GAA window. Clicking on the scope icon a second time will restore the scope window to view. The scope window can also be minimized by clicking on the minimize button in the top right corner of the scope window. When performed, the scope window minimizes to a task bar; the default location is at the lower left corner of the Windows Desktop. To restore or close the scope window click on the appropriate button.

Note: Clicking the scope icon will hide the scope application from view, if the scope window was minimized the scope task bar will also be hidden from view. Click on the icon again to restore the scope window or task bar.

Digital Oscilloscope Controls and Indicators

The digital oscilloscope is adjusted using the following controls. Refer to Figure 31 for the location of the controls. Adjusting the vertical and horizontal sliding controls is accomplished by either clicking on and dragging the button or clicking in the button's travel area.

Vertical Scale

Sets the vertical sensitivity of the digital oscilloscope in volts/div. This may be adjusted from 0.005 to 2 volts/div. The full scale reference is 10 V, representing the height of a pulse which collects in the highest MCA channel.

Vertical Offset

Adjusts the vertical position for viewing different portions of the waveform without changing the vertical scale.

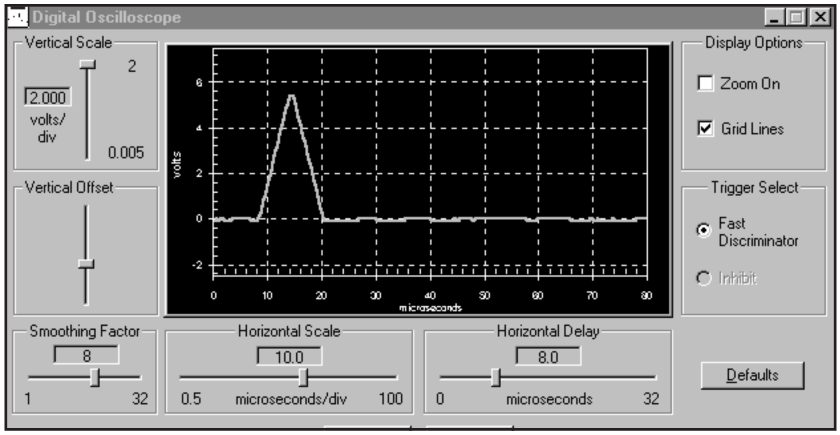

Figure 31 Digital Oscilloscope Screen Showing Detector Trapezoid Waveform

Smoothing Factor

Allows averaging up to 32 pulse waveforms to reduce noise. Selection of “1” turns averaging off.

Horizontal Scale

Sets the horizontal time scale in microsecond/div and the duration of the viewable portion of the waveform. Adjustable from 0.5 to 100 microsecond/div.

Horizontal Delay

Positions the waveform horizontally without changing the horizontal scale. Delay is adjustable from 0 to 32 microseconds.

Display Options

Zoom On

Allows magnification of a small portion of the waveform. To use the Zoom mode, first check the Zoom On box. Then press the left mouse button and drag the magnifying glass icon over the portion of the waveform of interest. To leave the zoom mode, clear the Zoom On box.

Grid Lines

Adds a reference grid to aid in waveform measurement. The default setting is ON. To remove the grid lines, clear the Grid Lines box.

Trigger Select

Sets the oscilloscope's trigger source. When set to "Fast Discriminator", the digital oscilloscope will display trapezoid pulses that are detected by the fast discriminator. When set to "Inhibit", the digital oscilloscope will display the trapezoid filter signal during and immediately after the filter overload caused by a preamplifier reset. This allows you to view the filter baseline during the reset recovery period. The "Inhibit" setting is used with reset preamplifiers only.

Note: The Inhibit Trigger select button is active only if **TRP** is selected as the **Preamp Type** in the **Setting | DSP Filter Device** of the MID definition. If RC Preamp Type is selected the Inhibit button will be grayed out.

Note: Scope does not trigger. With the Trigger Select set to **Inhibit** the Digital oscilloscope will not get triggered and the wrong error message may be displayed unless the Reset Preamplifier's Inhibit Signal is connected to the **Reset** input on the InSpector 2000 and the **Inhibit Polarity** is set correctly. For additional information on connecting and using the Reset Inhibit function please reference "Using the Reset Inhibit Function" on page 93.

Digital Oscilloscope Error messages

If for some reason the scope is not triggered one of the error messages below will appear to help diagnose the problem.

Count Rate Too Low

This message may appear if the Input Count Rate (ICR) is too low or the InSpector 2000 is not connected to the detector or test pulser. The Digital oscilloscope requires a minimum ICR of 40 cps to operate correctly.

Count Rate Too High

This message may appear for the following conditions:

- The ICR is above 20 kcps
- The Fast Discriminator Mode is set to Manual and the Fast Discriminator Threshold is set too low into the noise. For this condition the fast discriminator function is responding to noise producing an ICR rate above 20 kcps.

The corrective action is to lower the count rate and/or set the FDIC Mode to Auto or raise the FDIC Setting if using the Manual Fdisc Mode. For information on setting up the Fast Discriminator please refer to the DSP Gain Parameters on page 41.

Invalid Data

This message may appear for the following conditions:

- ICR is between 40 CAPS and 20 kcps

- Digital oscilloscope Horizontal Scale (us/div) is set too long resulting in a high rejection rate due to excessive pileup. For additional information on the scope pileup rejector please reference “Scope Triggering and Pileup Rejector” on page 51 for additional information.

The corrective action would be to reduce the ICR, reduce the Scope Horizontal Scale setting or close the scope utility.

Viewing the Trapezoidally Filtered Detector Pulses

Figure 31 shows a display of the waveform produced by a ^{60}Co source at an input count rate of 1.5k counts/second. For this example the InSpector 2000 FILTER settings of 5.6 µs Rise Time and 0.8 µs Flat Top were used. System gain was set so the ^{60}Co 1332 keV energy peak collected at approximately 90% of full scale. The scope is set to the default settings.

Using the Digital Oscilloscope to Verify System Setup

The digital oscilloscope can be used in setting up and verifying the Filter Shaping selections (Rise Time and Flat Top), Pole/Zero, Gain, and Input Polarity. For information on performing Pole Zero adjustment using the digital oscilloscope see “Pole /Zero Matching Using the Digital Oscilloscope” on page 85 and also Appendix B, *Performance Adjustment*. For information on optimizing the InSpector 2000 adjustments when a Reset Preamplifier is connected, refer to “Operation with Reset Preamps” on page 92.

Note that unlike traditional laboratory oscilloscopes, the InSpector 2000 always presents one trace at a time for viewing. When the Smoothing Factor is set to 2 or greater, the waveform may represent the average of several pulses of varying amplitudes. When high smoothing factors are selected, the waveforms will fluctuate less, and the pulse height will be roughly proportional to the center of mass of the MCA spectrum, which depends on system gain. This differs from traditional analog oscilloscopes, which display many traces at once, typically grouped around the energy peaks.

Note: If your detector is neutron damaged or exhibits excessively long charge collection time it is recommended the scope averaging be set off. Otherwise the long tails associated with the long collection times will be averaged into the smoothed trapezoid signal and give the wrong impression regarding the pole/zero setting.

Scope Triggering and Pileup Rejector

In order to prevent piled up pulses from distorting the waveform viewed on the digital oscilloscope and to prevent extraneous pulses from disturbing the baseline before and after the pulse, the digital oscilloscope incorporates a pulse rejector. The rejector allows pulses to be displayed only if there is a clear period before and after each pulse. The pile up reject window is dependent on the horizontal display size. The probability of pulse pileup and the rejection rate is dependent on the Horizontal Scale setting and the Incoming Count Rate (ICR). As the count rate increases, the digital oscilloscope will reject a larger percentage of the pulses processed by the instrument. If the rejection rate becomes too high the scope may stop updating and the alarm message “Invalid Data” will be posted just below the Trigger Select box. If the ICR is increased, the Invalid Data alarm message may flash on and off as a warning that the high rejection rate threshold is being approached. If the ICR exceeds 20 kcps the “Count Rate Too High” message will be posted.

The corrective action is to reduce the Horizontal Scale setting and/or the ICR.

The trigger for the rejector is the fast discriminator. In order to avoid rejecting reset events accompanied by fast discriminator pulses, the rejector is turned off when the Inhibit trigger is selected. The unit will also reject any pulses which exceed its dynamic range, which is somewhat larger than the full scale equivalent of 10 volts.

Note also that the normal trigger source for the Digital Oscilloscope is the Fast Discriminator. If the Fast Discriminator is set in Manual mode, then the trigger level can be controlled manually, and the digital oscilloscope will display only energy pulses associated with fast discriminator pulses above the manual threshold setting.

6. Basic Spectroscopy Operation

This chapter is a quick setup guide, and outlines the operation of the InSpector 2000. More detailed information about specific functions can be found in Chapters 2 through 5, Chapter 7, and the Appendices. Following the procedures below will make you familiar enough with the instrument to be able to use it effectively.

Initialization and Self Diagnostics at Power On

When the InSpector 2000 is first turned ON, it will go through an initialization and self-test process. During the initialization period, the InSpector 2000 will run internal diagnostics routines to verify correct operation of the hardware. The FAULT, BATT, and ACQ LEDs report the status.

During power on diagnostics the FAULT LED is illuminated. If the diagnostics were successful the BATT LED will remain on and the FAULT LED will extinguish.

If during diagnostics a fault was detected the FAULT LED will remain on. In addition the actions of the BATT and ACQ LEDs will aid with identifying the potential problem area. A FAULT LED and blinking BATT LED indicates a problem with the power source (battery or ac adapter) or signal processing logic. A FAULT LED and blinking ACQ LED indicates a problem was detected with the microprocessor ram, data memory, loading the FPGA logic or FPGA communication.

After the self diagnostics completes or any time there after a FAULT LED in conjunction with a blinking HV LED indicates a HV Inhibit or high voltage power supply fault.

Spectroscopy System Setup

Figure 32 shows a typical gamma spectroscopy system.

Perform the following steps to set up your spectroscopy system:

1. If you are using a detector with a reset preamp, please refer to “Operation with Reset Preamps” on page 92 for specific instructions.

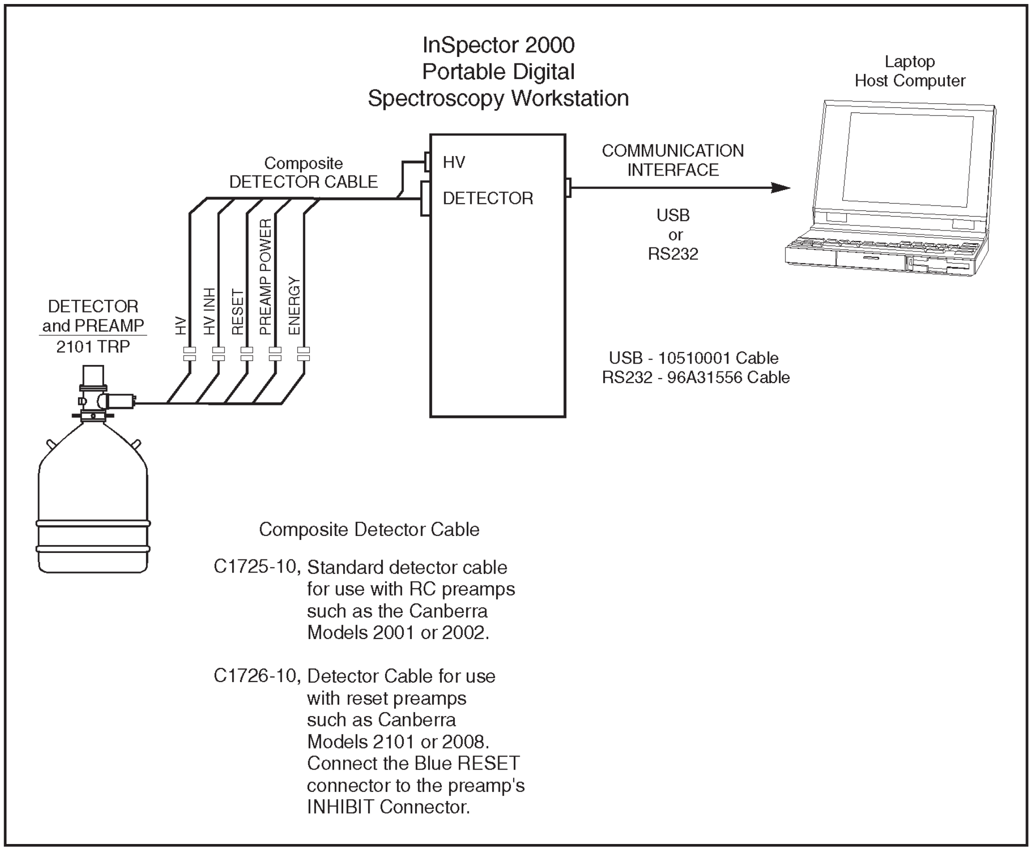

Figure 32 Typical Gamma Spectroscopy

2. Connect the intended Detector/Preamp to the InSpector 2000. Preamp power is provided by means of a 9-pin Am phenol connector, part of the InSpector 2000's DETECTOR composite cable. Connect the InSpector 2000's Energy (red cable) connector to the Preamp's Output signal connector. If the detector preamp is a reset type, connect the composite cable's blue Reset connector (only on the C1726 Cable) to the preamp's Inhibit connector.

Note: Multiple ground connections to the detector preamp (preamp power, signal B.C. cable, HV power supply cable, etc.) can setup ground loops which may be sensitive to EMI noise pickup. These effects can cause resolution degradation, excessive dead time and erratic count rate (ICR) measurement.

If you experience any of these problems, make sure the preamp cables are tightly bundled together and routed away from EMI noise sources such as motors, AC switching equipment, computers, monitors, etc.

3. Connect the high voltage SHV connectors of the composite cable; connect one end to the InSpector 2000, connect the other end to the HV In connector on the preamp.

4. If using the High Voltage Inhibit Function connect the composite cable's green Inhibit connector to the preamp's HV INHIBIT connector. This signal shuts down the high voltage power supply if the detector warms up. The High Voltage Inhibit input can be programmed for Positive or Negative polarity. Please refer to Inh. signal on page 31 or Appendix A, *Specifications*, for instructions for matching the polarity selection to the intended detector preamplifier. All Canberra detector/preamps use the Positive polarity setting.

5. Turn on the InSpector 2000. At power up, the InSpector 2000 will go through an initialization and self-diagnostic process as described in "Initialization and Self-Diagnostics" on page 52.

6. The setup instructions that follow will allow you to get the InSpector 2000 set up and running with a typical detector and to become acquainted with its operation. For the following setup, a detector with preamp gain of 500 mV/MeV and a ^{60}Co radioactive source will acquire in channel 6500 to 7200 on the MCA when setup for a 8192 memory or spectrum size.

   The parameters are grouped into six Adjust Screen types: Stab., HVPS, MCS, PwrMgr, Gain, and Filter.

Note: The MCS Adjust Screen is only available if the MCS acquisition mode is selected in the MID Definition, otherwise the MCS select button and Adjust Screen are hidden from view. For information on setting the acquisition Mode in the MID Definition please reference "MCS Settings" on page 35.

   For this quick setup and check of the InSpector 2000, many of the parameters may not require adjustment; leave them set to the default values. Parameters marked with an asterisk (*) indicate initial factory default settings.

   If the setup parameters were previously changed and saved using the MID File Save command, the host computer will down load the last value's saved.

7. MID Definition Settings. Please verify or set the following setup parameters in your Genie Spectroscopy System's MCA Input Definition (MID). For complete information on editing MID files, refer to the MID Editor chapter in your Genie manual set.

   7a. DSP Filter/Gain Settings

   *Preamp Type: RC

Inp Polarity:	Set Positive or Negative to match the preamp signal polarity of the intended detector. This parameter can be set only in the MID Definition.
Inh Polarity:	If the detector has an RC type preamp, this function is not applicable and it is not necessary to make selections or changes. If the detector has a reset preamp, set Positive or Negative to match the polarity of the inhibit signal generated by the preamp. The Canberra 2101 TRP and 2008 preamps require a positive Inhibit setting. This parameter can be set only in the MID Definition.

7b. HVPS Configuration

Please consider and/or verify the high voltage range and polarity requirements for the intended detector application at this time.

Turning the high voltage power supply ON or OFF and setting the operating voltage are programmable through the computer and Genie-2000 software environment. However, the polarity and range are manually configured using programming modules; the programming modules are conveniently located inside the InSpector 2000. The high voltage range and polarity are preset at the factory for the positive 5000 volt range, which is compatible with many Ge detector applications. If your detector requires negative polarity or the higher current 1300 volt range please reference Appendix E, *Configuring the High Voltage Power Supply,* for instructions on changing the InSpector 2000's high voltage range and polarity. Please consult your detector's manual for its specific high voltage bias requirements.

The high voltage range and polarity can be verified by physically viewing the high voltage module installation. Again, please reference Appendix E, *Configuring the High Voltage Power Supply*, for instruction on verifying and changing the InSpector 2000's high voltage range and polarity. If the InSpector 2000 is already operational with the computer and Genie-2000 software the high voltage configuration and settings can be verified using the Status Page associated with the Gamma Acquisition and Analysis (GAA) window. The Status Page can be opened by clicking on MCA and then Status in the drop down menu. If the MID Definition for the high voltage power supply configuration do not match Genie-2000 will report a hardware verification error when attempting to open the data source in the GAA window. For complete information on the MID Files and the Gamma Acquisition and Analysis window please reference the *Genie-2000 Operations* manual.

It is recommended that the high voltage setting be verified prior to turning the high voltage power supply to ON.

CAUTION: Excessive voltage and/or incorrect polarity can permanently damage the detector system.

7c. HV Settings

Range	Sets the HV Range to match the configuration of the high voltage power supply and requirements of the intended detector. The choices are +5000, +1300, –1300, and –5000.
Voltage Limit:	This control limits the maximum voltage for the selected HV range, preventing accidental application of excessive voltage to the detector. Set the slider to the desired limit or maximum for the selected voltage range.
Voltage:	Sets the target high voltage value; it is adjustable from 0 to the maximum voltage selected by the Range control. Set the slider to the voltage setting required for the intended detector. The voltage settings can also be typed in from the keyboard, then accepted with the OK button within the control.
Inh Signal:	Sets the polarity of the HV Inhibit input. All Canberra detectors and preamps use the Positive setting. For additional information please refer to High Voltage Settings in the MID Definition and Appendix A, *Specifications*.

There are many other parameters that can be adjusted in the MID Definition, but it isn't necessary to adjust them now. They will be adjusted using the MCA | Adjust Screens in the following step. When you make adjustments, be sure to save the MID File.

8. **MCA | Adjust Screens**. The following parameters can be accessed and set using the Gain and Filter Device Adjust screens. The adjustments can be saved to the datasource's CAM file by using the **File | Save** command.

8a. Gain Device Adjust Screen

Coarse Gain:	x10
Fine Gain:	x1.0001
S-Fine Gain:	x1.000002

*Fdisc Mode:	Auto
*LT TRIM:	500
*LTC Mode:	On
*PUR Guard:	1.1x
Inp Polarity	Set Positive or Negative to match the signal polarity from the detector /preamp.
*LLD Mode:	Auto

8b. Filter Device Adjust Screen

*Rise Time:	5.6 µs
*Flat Top:	0.8 µs
*BLR Mode:	Auto
Pole/Zero:	3200

Note: Please see "Rise Time and Flat Top Adjustments" on page 82 for additional information on setting the Rise Time and Flat Top settings and their relationship to traditional Gaussian shaping times.

8c. High Voltage Device Adjust Screen

Set the **Voltage** setting to the operating bias voltage required for the intended detector. The **Voltage** scroll bar sets the output voltage of the HVPS between the voltage limit's minimum and maximum setting. The voltage can also be typed in from the keyboard, then accepted with the OK button within the control.

Note: The voltage range, polarity and maximum setting are selected in the MID Definition. For additional information please reference "High Voltage Settings" on page 30 for configuring the MID Definition and Appendix E, *Configuring the High Voltage Power Supply*, for configuring the HVPS range and polarity.

Set the HVPS to **ON**, the ON/OFF control is located in the **Status** Box. The High voltage output will increase to the set voltage at a controlled ramp up rate.

8d. Stabilizer Device Adjust Screen

*Gain Mode: OFF

8e. PwrMgr Device Adjust Screen

Standby delay 10 minutes

Note: For additional information on this control, please refer to “Power Management” on page 100.

Detector Matching

Pole/zero compensation is extremely critical for achieving good performance at high count rates when using detectors with RC preamps. It is equally important for good overload recovery due to high energy and cosmic events. The Pole/Zero adjustment range accommodates RC preamp fall times of 45 µs to 1.7 ms. When a reset preamp is used, Pole/Zero compensation is not required and the Pole/Zero value must be set to zero (0). If the InSpector 2000 is connected to a detector with a reset preamp such as the Canberra 2101 or 2008, use the MID Editor to change the preamp type in the MID Definition from RC to TRP.

With TRP selected, the pole/zero compensation is automatically set to a value of zero, representing the matching required for a fall time of infinite duration, which requires no compensation. In this case the Pole Zero Assistant is not needed and will not be displayed. If the preamplifier type selected in the MID Definition is RC and the InSpector 2000 is connected to a reset preamp, the P/Z setting must be manually set to a value of zero (0). Please refer to the section "Operation with Reset Preamps" on page 92 for additional information.

Note Once the Pole/Zero is optimized for the intended detector, the digital filter shaping parameters (Rise Time and Flat Top) can be changed as required without the need to make further Pole/Zero adjustments. However the Pole/Zero compensation *must* be readjusted if the detector is changed.

Pole/Zero Matching using the Pole/Zero Assistant

Pole/zero matching is adjusted manually using a slider bar located on the Pole Zero Assistant screen (Figure 33). The Pole Zero Assistant and Digital Oscilloscope are provided as user aids for optimizing the pole/zero setting. For more information on pole/zero adjustment using the Digital Oscilloscope function please refer to “Pole/Zero Matching Using the Digital Oscilloscope” on page 85.

The Pole Zero Assistant measures and analyzes the tail of the trapezoid signal and provides visual feedback showing the quality of the pole zero adjustment via a simulated null meter or Pole/Zero Quality Indicator.

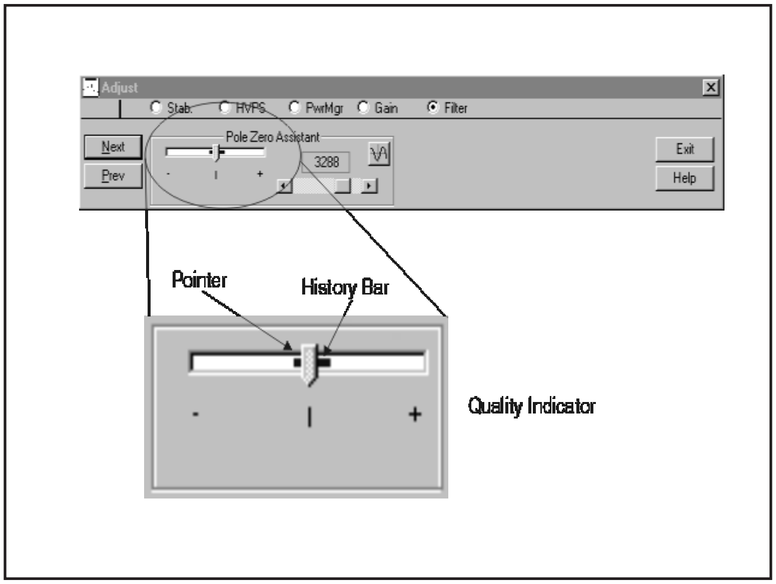

Figure 33 Pole Zero Assistant Screen

The center of the indicator, marked with a vertical centerline, serves as the target when adjusting the pole/zero. The pole/zero is optimally set when the pointer and the target centerline (null point) are aligned. The Quality Indicator pointer indicates the quality of the current pole/zero setting. The area to left of the target null point and centerline indicates the trapezoid waveform is exhibiting undershoot and the pole/zero setting is low. Similarly, the area to the right of the target null point and centerline indicates the pole/zero setting is too high; there is too much compensation and the trapezoid waveform is exhibiting overshoot.

The pointer presents the current pole/zero quality as you would interpret the pole/zero setting when viewing the trapezoid signal return to the baseline using the oscilloscope. As with all electronic processes noise generally accompanies the signal of interest. The noise component causes the instantaneous baseline value and pole/zero measurement to statistically vary from the average value. Smoothing or averaging is applied to the pole/zero measurement algorithm, however, low frequency noise components statistically influences the measurement which cause the Quality Indicator pointer to exhibit a small variation or dither. To minimize the effect of the Quality Indicator variation, the history of the pointer position is painted behind the pointer. The history bar provides the effect of additional averaging to assist with making the pole/zero adjustment. The objective of the pole/zero adjustment is to center the Quality Indicator pointer and associated history bar around the null point or center vertical line. When accomplished the pole/zero adjustment is properly optimized and further adjustment is not required.

The Pole Zero Assistant will give good results for most detector applications and count rates. However, there may be some applications or circumstances where it may be necessary to use the Digital Oscilloscope when optimizing the pole/zero compensation. Examples include detector applications which produce excessive baseline noise, high count rate operation or applications where the digitally filtered trapezoid signal is prevented from returning monotonically to the baseline. The feedback resistor on some RC preamps may exhibit non-ideal characteristics which produce multiple time constants, making the tail pulse fall time non-monotonic. This behavior may become problematic at high count rates causing significant baseline perturbations and resolution degradation. NaI detectors may have multiple time constants due to AC coupled preamps and scintillator interactions. In these situations it may also be possible to optimize performance further by fine tuning the pole/zero using the Digital Oscilloscope. Refer to “Pole/Zero Matching Using the Digital Oscilloscope” on page 85.

The Pole Zero Assistant automatically operates and shows the Pole Zero adjustment quality whenever RC is selected for the preamp type and the Pole Zero Assistant screen is open. The Pole Zero Assistant Screen is accessed by first selecting the **Adjust | MCA | Filter** screen, and then pressing the **Next** button. The screen consists of a simulated Null Meter or Quality Indicator, a slider bar to adjust the pole/zero setting, a four digit readout indicating the current pole zero setting, and a Digital Oscilloscope icon for launching the Digital Oscilloscope function. If the input count rate is either too low or too high for the Pole Zero Assistant to function correctly a text message indicating the condition will appear beneath the Quality Indicator. Refer to Figure 33.

Note: The speed of the Pole Zero Assistant (PZA) measurement may be reduced when MCA Acquire is set ON. For optimal speed performance it is recommended that MCA Acquire be set OFF. The PZA measurement speed may also be somewhat slower when the Digital Oscilloscope is open. The scope and PZA operate properly when both are open, however, the PZA measurement may be slower when the scope is open. Minimizing or closing the scope application will optimize the PZA measurement speed.

Pole/Zero Adjustment

Setup

Adjust the ^{60}Co radioactive source for an incoming count rate (ICR) between 40 counts/second and 20 k counts/second. The Pole Zero Assistant may fail to operate properly if the incoming count rate is not within this range. The incoming count rate can be verified by reading the ICR value on the **MCA | Status Page** of the Gamma Acquisition and Analysis window. Select “Update” to obtain a new ICR reading whenever the radioactive source is adjusted.

Note: Although any radioactive source may be used, the most accurate adjustment is obtained using sources with a small number of peaks such as ^{57}Co, ^{137}Cs or ^{60}Co. The Pole Zero Assistant operates properly with spectral peaks located within 25% to 100% of the MCA spectral range. However best performance is obtained with the system gain adjusted to place the primary peaks within the top 75% to 95% of the MCA spectral range. These recommendations also apply when adjusting the pole/zero manually on systems when not using the Pole Zero Assistant. Once completed, replace the calibration source with the sample to be analyzed and adjust the system gain as required.

Adjustment

Begin the adjustment by noting the Pole/Zero Quality Indicator pointer position. As previously mentioned the pointer position for proper pole/zero is the meter null point or vertical line at the center of the meter range. Using the indicator pointer and painted pointer history bar, adjust the pole zero setting slider bar in the direction that brings the Quality Indicator pointer toward the target vertical center line. The slider bar provides three levels of adjustment granularity. Grabbing the thumb tab with the mouse allows you to drag the tab to the desired setting. Clicking on the scroll box region between the slider box and the left/right arrow buttons changes the pole/zero setting by approximately 30 adjustment steps at a time. Clicking on the left/right arrow buttons increments the Pole/Zero setting one adjustment step at a time. Continue the adjustment until the Quality Indicator pointer variation and history bar are approximately centered around the target vertical centerline. When this is attained the Pole/Zero is properly adjusted and further adjustment is not necessary.

Adjustment Tips

1. Start the adjustment by grabbing the pole/zero slider bar tab (button) with the mouse pointer. Without releasing, slide the tab in the direction that moves the Quality Indicator pointer in the desired direction. Do not release the slider bar tab yet, move the slider bar tab until the Quality Indicator pointer moves back and forth around the target null point or centerline. When this is accomplished release the pole/zero setting slider bar tab. Finish the adjustment by clicking in the adjustment area of the slider bar (30 adjustment steps) or the left/right arrows for fine adjustments. In general, the adjustment is complete if the pointer remains near the centerline null point. The pointer on the PZA Quality Indicator will vary slightly as a function of time. This is normal and results due to the influence of noise as described above.

2. The PZA Quality Indicator incorporates averaging, it may respond slower and lag behind quick changes made to Pole Zero Setting. Don’t make changes to the pole/zero setting too quickly; allow sufficient time for the Quality Indicator to catch up for an accurate pole/zero measurement and indication.

3. Having the MCA in Acquire or the Digital Oscilloscope open competes for computer resources which may slow down the PZA Quality Indicator update rate. For optimal PZA performance temporarily set the MCA Acquire to OFF and minimize or close the scope window.

Pole Zero Assistant Error Messages

If the Pole Zero Assistant (PZA) is unable to accurately measure the pole/zero value one of the messages below will appear below the Quality Indicator display. The error message will extinguish when the error condition is corrected.

Count Rate Too Low

If this message appears the Input Count Rate (ICR) is too low or the InSpector 2000 is not connected to the detector or test pulser. The PZA requires a minimum ICR of 40 cps to operate correctly.

The corrective action would be to verify the detector is properly connected and/or adjust the source count rate.

Count Rate Too High

This message appears for the following conditions:

- The ICR is above 20 kcps
- The Fast Discriminator Mode is set to Manual and the Fast Discriminator Threshold is set too low into the noise. For this condition the fast discriminator function is responding to noise producing an ICR rate above 20 kcps.

The corrective action is to lower the count rate and/or set the FDisc Mode to Auto or raise the FDisc Setting if the FDisc Mode must remain set to Manual. For information on setting up the Fast Discriminator please refer to the DSP Gain Parameters on page 41.

Invalid Data

This message may appear if the Digital oscilloscope is open and/or minimized and the following conditions occur.

- ICR is between 40 cps and 20 kcps
- Digital oscilloscope Horizontal Scale (µs/div) is set too long resulting in a high rejection rate due to excessive pileup. For additional information on the scope pileup rejector please reference “Scope Triggering and Pileup Rejector” on page 51 for additional information.

The corrective action would be to reduce the ICR, reduce the Scope Horizontal Scale setting or close the scope utility.

Pole/Zero Value

The four digit value located under the pole/zero slider bar is a reference number which varies from 0 to 4095 representing the pole/zero adjustment range. The values 1 to 4095 cover a time constant range of 1.7 ms to 45 µs. When the value “0" is set, no compensation is applied. This is the proper setting for reset preamps and may be used if RC is selected as the preamp type instead of RESET in the MID Definition.

There are several ways to change the Pole/Zero setting. You can click on the scroll arrow buttons at each end of the slider bar, click on the scroll bar between the slider box and the left/right arrow buttons or click on the slider box (button) and drag to the desired value. Clicking on the left/right arrow buttons increments the Pole/Zero setting one adjustment step at a time. Clicking on the scroll box region between the slider box and the left/right arrow buttons changes the Pole/Zero setting by approximately 30 adjustment steps at a time.

The value arrived at by the Pole/Zero Assistant may vary slightly when successive adjustments are made. this is normal and results from statistical variation associated with the algorithm and system baseline noise.

Verifying Pole/Zero Accuracy

The precision of the Pole/Zero Assistant operation can be verified by observing the Trapezoid waveform using the digital oscilloscope (see “Viewing the Trapezoidally Filtered Detector Pulses” on page 50). Observe the trailing edge of the Trapezoid waveform as it returns to the baseline. It should return with no over or undershoot. Set the digital oscilloscope vertical range to an appropriate sensitivity. For additional discussion on pole/zero verification and manual adjustment, refer to “Pole/Zero Matching Using the Digital Oscilloscope” on page 85.

Matching Rise Time and Flat Top Settings to the Detector

The InSpector 2000 allows optimization of the trapezoid filter shape for a variety of detectors and applications. Proper matching will depend on detector characteristics, energy range and count rate. The digital filter in the InSpector 2000 features independent adjustment of the rise time setting and flat top. Therefore the rise time setting, which determines the noise filtering properties of the digital filter, can be optimized independently of the flat top, which is set to allow for full collection of detector charge and to reduce the effects of ballistic deficit in germanium detectors. The rise time and flat top settings are generally a compromise between optimizing for throughput or resolution. For a full discussion these settings, refer to “Pole/Zero Matching Using the Digital Oscilloscope” on page 85.

Acquiring a Spectrum

Please refer to the *Genie-2000 Operations Manual* for specific operating instructions.

Place a low activity ^{60}Co source on the detector. Set the MCA to COLLECT or ACQUIRE. For the InSpector 2000 setup performed in “Spectroscopy System Setup” on page 52, the 1332 keV ^{60}Co peak should collect in channel 6500 to 7200 for a detector preamp gain of 500 mV/MeV and 8192 memory or spectrum size.

Adjust the InSpector 2000’s gain to position the ^{60}Co peaks to the desired MCA spectral location. The Super Fine Gain (SFG) control provides 100 times more resolution than the Fine Gain. Use the SFG when matching the gains of several detectors or when establishing a specific gain calibration (energy per channel).

Auto LLD

If you have selected the Auto LLD Mode, the LLD cutoff is automatically adjusted just above the spectral noise threshold. However, if the trapezoid signal has excessive undershoot resulting from incorrect Pole/Zero adjustment the low-end spectral cutoff may be affected when using the Auto LLD Mode. If the low end spectral cutoff is higher than expected with Auto LLD selected verify and/or adjust the Pole/Zero as described in “Detector Matching” on page 58 or “Pole/Zero Matching Using the Digital Oscilloscope” on page 85.

7. PUR/LTC Operation

The Model InSpector 2000 Digital Spectrum Analyzer includes a pileup rejector and live time corrector. The pile up rejector inspects for pulse pileup and allows only non-piled up events to be processed and stored into the spectrum. The result is a reduced number of counts in the pileup region and reduced spectral interference for improved quantitative measurement and analysis.

To compensate for dead times associated with rejected pulses and amplifier processing times, the InSpector 2000 generates a dead time (DT) signal which extends the collection time by the appropriate amount.

Pileup Rejection With a Live Source

The pileup rejector monitors the signal processing activities of the fast discriminator (fast channel) and digital filtered signal (slow channel) and allows only signals resulting from a single detector event to be processed and stored in the spectrum. The fast discriminator detects the arrival of input events and is capable of discriminating between multiple events separated by less than 500 ns. If the fast discriminator detects two or more events within the processing time of the slow channel, the event is contaminated by pileup and is discarded.

The fast discriminator threshold is automatically adjusted just above the system noise level for accurate operation. However, for the discriminating researcher or special circumstances the threshold can be optimized manually. For instructions on adjusting the threshold manually, see “Manual Fast Discriminator Threshold” on page 91.

The following steps will demonstrate the operation of the Pileup Rejector and its ability to reduce spectral interference.

1. Connect the InSpector 2000 and set it up as described in “Spectroscopy System Setup” on page 52.

2. For the following demonstration of the Pileup Rejector, a ^{57}Co source will be used. Due to the lower energy of this source, the system gain will need to be increased; set the gain as follows:

   Coarse Gain: x40
   Fine Gain: x1.6001
   SF Gain: 1.00

   Leave the remaining functions as previously set up. Verify that the LTC mode is set on; the function is located on the Gain Device Adjust screen.

Note: The pile up rejector (PUR) and Live time corrector (LTC) operate as an integral system. The LTC On/Off function controls both the PUR and the LTC.

3. Pole/Zero Compensation

   The Pole/Zero was previously adjusted and it is not necessary to do it again. If for some reason readjustment is necessary, please refer to "Detector Matching" on page 58.

4. Adjust the InSpector 2000 Gain to locate the 122 keV ^{57}Co peak in channel 3500. This is to allow the Pileup region and sum peaks to be viewed in the upper half of the spectrum.

5. Readjust the ^{57}Co incoming count rate (ICR) for 50 kcps.

6. Set the MCA preset to 60 seconds Live Time.

7. Set the MCA acquire to OFF, clear the memory and set acquire to ON. Accumulate a spectrum with the LTC ON.

8. Save the spectral file or print the spectrum or make note of the background counts and sum peaks for comparison with the LTC set OFF.

9. Set the LTC to OFF, clear the memory and set acquire to ON. Accumulate a spectrum with the LTC OFF.

10. Compare the two spectra, LTC On and LTC Off, overlapping them with the compare function, as seen in Figure 34.

The spectra shown in the comparison are for an ICR of 50 and 4 µs Gaussian Equivalent Processing Time (Rise Time: 5.6 µs and Flat Top: 0.8 µs). Note the reduction in magnitude of both the sum peaks and background counts. Also note the improved resolution of the sum peaks. The background reduction and improved resolution are directly indicative of the Pileup Rejector's capabilities, since only sum peak pulses which are indeed 100% in coincidence are processed.

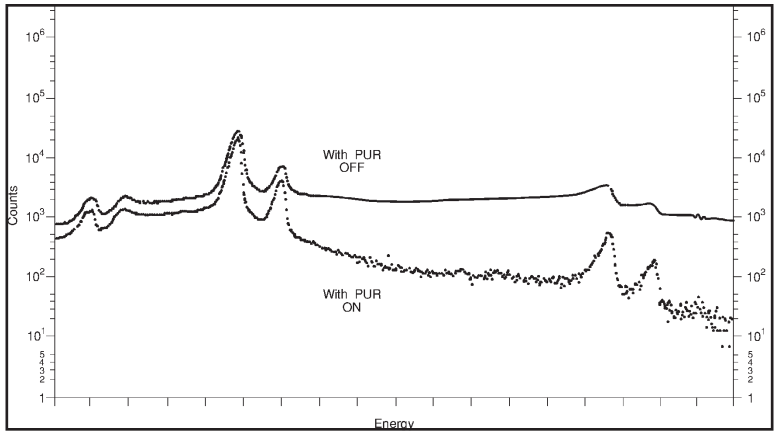

Figure 34 Comparing ^{57}Co Spectra w/ PUR On and Off

Live Time Correction With a Live Source

To compensate for events rejected due to pile-up and processing time, a system dead time is derived by the live-time correction function. The dead time signal controls the MCA “Live-Time” clock which extends the acquisition time by the appropriate amount.

The accuracy of the Live Time Correction (LTC) deployed on both traditional analog electronic and the InSpector 2000 Digital Spectrum Analyzer is dependent on the operation of the Fast Discriminator (fast channel) and the pulse evolution time or dead time of the shaped signal (slow channel). In the case of the InSpector 2000, the slow channel is the digital filtered trapezoid signal. Accurate Live Time Correction is obtained when the energy threshold and dynamic range of the fast channel and slow channel are the same. In practice however, the energy threshold of the fast channel is forced to be much higher compared to the slow channel. In order to obtain good pulse pair or timing resolution, the fast channel employs little or no noise filtering. As a result, the signal to noise ratio is much worse, requiring a higher energy/noise threshold.

To optimize the LTC accuracy on traditional systems, the ADC LLD is adjusted or optimized to normalize the energy threshold of the slow and fast channels. However, this has the undesirable effect of affecting the spectral low energy cutoff.

On the InSpector 2000, the "LT Trim" function allows minor adjustment of the pulse evolution time or dead time of the digital trapezoid signal to normalize the fast and slow channel energy thresholds without affecting the spectral low energy cutoff threshold. The LT Trim has an adjustment value of 0 to 1000 and the default value is 500, which gives good Live Time correction performance for most applications. In the steps that follow, Live Time Correction accuracy is measured using the "two source method" which monitors the area of a reference spectral peak when subjected to varying rates of background counts. Typical LTC performance (reference peak area variation) using the default LT Trim setting is typically less than 3% for dead times of 50%. The discriminating user can improve performance further, for the intended application, by calibrating the system using the "Two Source Method" and optimizing performance using the LT Trim.

The following steps are designed to demonstrate and verify the effectiveness of the Live Time Correction function. The verification/optimization process uses the "Two Source Method" which assumes that source "A" is ^{60}Co and source "B" is ^{137}Cs. The 1173.2 keV peak of ^{60}Co will be used as a reference. The upper peak, at 1332.5 keV, is not a good choice because the sum peak of ^{137}Cs at 2 x 661.6 = 1323.2 keV would interfere with the measurement.

1. Connect and set up the Model InSpector 2000 as described in "Spectroscopy System Setup" on page 52.

2. Verify LTC is set ON.

3. Pole/Zero Compensation

   The Pole/Zero was previously adjusted and it is not necessary to do it again. If for some reason readjustment is necessary, refer to "Detector Matching" on page 58.

4. Set the MCA's preset to 500 Live seconds.

5. Position the ^{60}Co source near the Ge detector and adjust for an incoming count rate of 2 to 5 kcps. The 1173.2 keV ^{60}Co reference peak should be at approximately 80% of the spectral full scale range. If necessary, adjust the InSpector 2000 gain to properly locate the peak.

Note: Once in place, the source should not be moved or altered in any way for the remainder of the experiment!

6. Clear the MCA and acquire a spectrum for 500 live seconds. Record the net area of the 1173.2 keV ^{60}Co peak (source "A").

7. To the ^{60}Co source, add approximately 25 kcps of ^{137}Cs to make the total incoming rate 30 kcps.

8. Clear the MCA, Collect a new spectrum for 500 live seconds, and record the net area of source “A”.

9. Compare the net area of the 1173.2 keV ^{60}Co peak acquired in step 6 and compute the percentage change.

10. If improvement is needed, try adjusting the LT TRIM slightly and repeat steps 6 through 9 until an optimum setting is achieved. The LT Trim function is located on the Gain Device Adjust screen. The value can be decremented/incremented over a range of 0 to 1000 using the adjust slide bar (the default setting is 500).

Since the detector-source geometry was maintained and the preset Live Collection time was held constant, the ^{60}Co (1173.2 keV) net area can be used as a standard when comparing the effect of adding background counts Cs^{137} (661 keV).

Note: Lowering the LT Trim value will decrease the system dead time and counts in the reference peak area at high count rates. Likewise, increasing the LT Trim will increase the system dead time and counts in the reference peak area.

11. Set the LTC ON/OFF switch to Off. Repeat steps 4 through 9. Compare the deviation of source “A’s” spectrum when the LTC is ON and the LTC is OFF.

With the LTC OFF, large changes will be observed in the reference net peak are as a function of count rate. With the LTC set ON, changes in the reference peak net area will be significantly reduced. The Live Time corrector extends the collection time compensating for signal processing time and events rejected due to pileup.

Note Performance may vary and is dependent on factors such as spectrum energy distribution, detector characteristics such as geometry, size, and detector ballistic deficit.

PUR Guard

The PUR Guard Time (GT) function is provided to optimize the performance of the Pileup Rejector. The pile up reject interval is defined as GT x T_R+$T_{Flat\ Top}$ where:

GT = PUR Guard Time selection; 8 selections ranging from 1.1 to 2.5 are provided

T_R = Filter Rise Time selection

$T_{Flat\ Top}$ = Filter Flat Top selection

With the default (minimum) PUR GT setting (1.1x) the pile up reject interval and the Peaking Time are the same; see Figure 35.

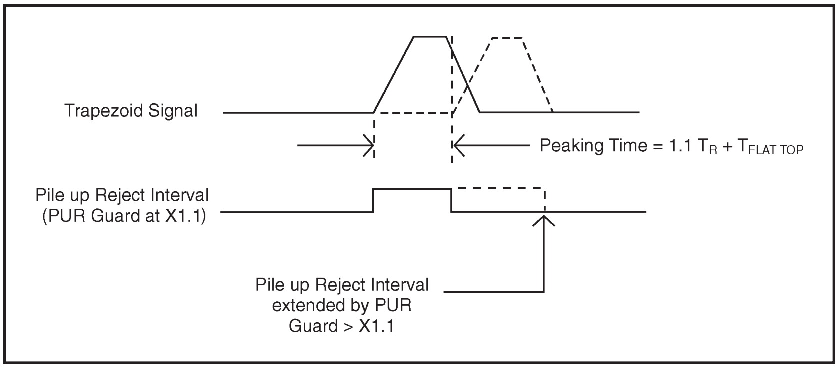

Figure 35 PUR Reject Interval

Subsequent events arriving within the PUR reject interval are rejected, events occurring afterwards are accepted. Increasing the Guard Time extends the pile up rejection interval to protect subsequent events from being corrupted by anomalies associated with the tail of the previous event. As expected, throughput is reduced as the Guard time and pile up rejection interval are increased. The maximum Guard Time setting (2.5x) requires the previous event to fully return to the baseline before subsequent events are accepted. The default Guard Time (1.1x) is minimum and provides optimum performance and maximum throughput for most detector applications.

For the example shown above, the second event begins before the first returns to the baseline. This is not normally a problem and the second event should be accepted for maximum throughput. However, if the tail of the first event exhibited detector-induced anomalies, the second event would be corrupted and should not be accepted. To prevent acceptance of this corrupted event, the PUR Guard should be increased as shown.

Some detectors with RC preamps may exhibit secondary time constants which is evident by a short lived undershoot or ring on the trailing edge of the shaped signal (see Figure 36).

This behavior is usually due to non-ideal characteristics of the preamp feedback resistor. Events that fall on the tail of an event which exhibits this behavior will become corrupted or distorted when minimal guard time is selected. In this case, the spectral peaks will be distorted with excessive high or low side tailing at high count rates. Events that arrive too close and are corrupted by the tail of the previous pulse can be rejected by increasing the Guard Time. For problematic detectors this will reduce spectral distortion at high count rates, but at the expense of reduced throughput.

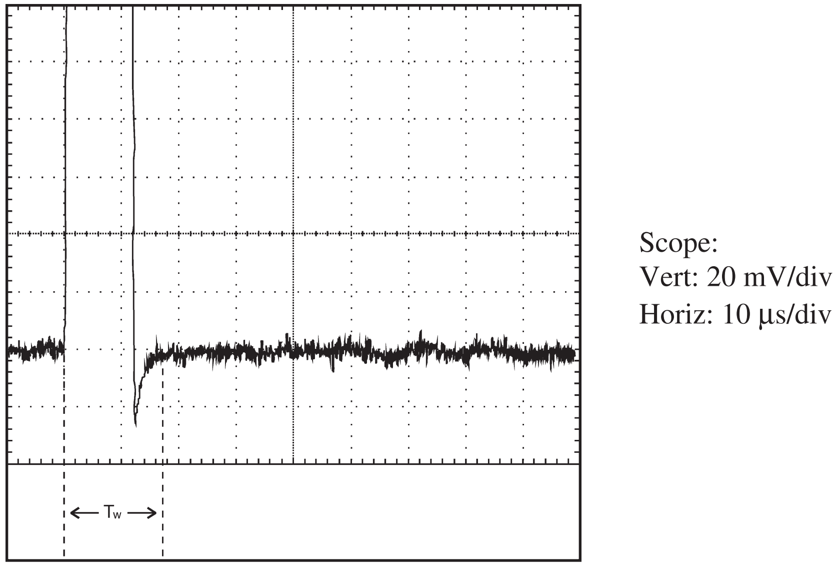

Figure 36 Preamplifier Secondary Time Constant

PUR Guard Setup

The default PUR Guard Time is 1.1x. This Guard Time is minimum and does not extend the pile up rejection interval beyond the peaking time. For events that exhibit secondary time constants or other anomalies, measure the pulse width from the leading edge to where it returns to the baseline and becomes stable. This is shown as time T_W in Figure 36. The required guard time is determined by dividing T_W by the Peaking Time ($1.1T_R$ + $T_{Flat\ Top}$).

For example:

- The filter rise time is set to 5.6 µs and the flat top is set to 0.8 µs.
- The Peaking Time is: 1.1 x 5.6 µs + 0.8 µs = 7.0 µs. T_W for a stable baseline is 15.0 µs.
- The desired guard time setting is: T_W/Peaking Time = 15.0/7.0 = 2.1

If the calculated guard time falls in between available selections, set the PUR Guard for the next higher setting. The pileup rejection interval will now be extended beyond the peaking time. Subsequent events that occur within the pileup reject interval of 15 µs will be rejected. After this instance, the anomaly associated with the tail of the previous pulse is over and subsequent events can be accepted. As noted earlier, extending the PUR interval by adding Guard Time will degrade throughput. Highest throughput is obtained with the PUR Guard set for minimum; x=1.1.

The PUR Guard adjust function is located on the Gain Device Adjust screen. The value can be decremented/incremented using the adjust slide bar. The adjust range is 1.1x to 2.5x (the default setting is 1.1x).

PUR Guard Adjustment Using a Live Spectrum

As mentioned earlier, detector/preamplifier induced effects on the trailing edge of the shaped signal will cause spectral distortion; low or high side tailing.

At moderate to high count rates, observe the shape of the spectral peaks. They should appear symmetrical. Low or high side tailing may indicate the presence of preamplifier-induced effects corrupting the trailing edge of the shaped signal. This could also be due to a misadjusted pole/zero. Verify the Pole/Zero is correctly optimized (refer to “Detector Matching” on page 58 or Appendix B, “Performance Adjustments”.

If the Pole/Zero is not the problem, set the PUR Guard to 2.5x and acquire a new spectrum. If the symmetry of spectral peaks improves, this affirms that trailing edge pileup effects associated with the shaped signal are responsible. Reduce the PUR Guard time to the next lower setting of 2.3x and re-acquire a spectrum. If the symmetry and FWHM of the spectral peaks remain good, reduce the PUR Guard time again to the next lower setting. Repeat this procedure until spectral distortion begins to reappears, then set the PUR Guard time to the next higher setting.

A. Specifications

Inputs/Outputs

Note: Signals indicated with asterisks are provided on the Detector Composite Connector and accessed by the associated Composite Cable.

AMP IN* – Accepts positive or negative signals from an associated detector preamplifier; amplitude for full scale conversion ±10 volts divided by selected gain; maximum input (signal +dc) for Linear operation is dependent on the Input Attenuator setting; Attenuator OFF (x1): ±4 V, Attenuator ON (x 0.25): ±12 volts, dc coupled and protected to ±24 volts maximum; rise time: less than the selected Rise Time + Flat Top settings; decay time constant: 45 µs to infinity; Zin is 1.3 kΩ.

RESET* – Accepts a standard TTL Logic signal; functionality is dependent on the Reset Preamp Inhibit mode selected; disables pulse processing, extends the system dead time, resets the pileup rejector and gates off the baseline restorer. Auto: system is gated off for the greater of the Reset Preamp Inhibit Time "OR" the Internal Inhibit time; Manual: functionality same as Auto mode except the signal processor is inhibited for the greater of the user selected Inhibit Setting "OR" the Internal Inhibit Time "OR" the Reset Preamp Inhibit Time. Positive true or negative true signal polarities, user selectable; minimum pulse width is 100 ns; logic high ≥+2 V, logic low ≤+0.8 V; maximum input voltage +5.5 V.

HV INH* – Accepts input from the detector preamplifier to shut down the HVPS in the event of a detector warm-up; polarity is user selectable to match the preamplifier. Positive polarity: for all Canberra preamplifiers; Enable condition (cold detector) is an open circuit or active high ≥+1.4 V to +24 V; Inhibit condition (warm detector) is –24 V to <+1.4 V or ground. Negative polarity: all preamplifiers and LN monitors where enable condition (cold detector) is – 24 V to <+1.4 V; Inhibit condition (warm detector) is open circuit or active high ≥+1.4 V to + 24 V. With Negative selected an open input will disable the high voltage.

MCS IN – MCS counts input; TTL compatible; maximum rate ≤1 MHz.; minimum pulse width ≥20 ns; logic low ≤+0.8 V, logic high ≥+2 V.

THERM IN* – Thermistor monitor input; voltage range 0 to +5 V.

BATTERY IN – Sony NP-F950/NP-F550 or equivalent Lithium-ion battery; Nominal 7.2 V dc at 0.70 amps.

DC POWER – Auxiliary dc power input; 2.5/5.5 mm rear panel connector; Nominal 7.5 V dc at 0.70 amps.

HV OUT – Dual range and polarity high voltage power supply; Voltage range and polarity selected by programming modules: ±10 to ±1300 V dc or ±1300 to ±5000 V dc; high voltage output provided on rear panel SHV connector. Low end of the 5000 volt range is limited to 1300 volts by software.

RS-232 – RS-232 interfaces to host personal computer; software selectable baud rate, 2.4K to 115K supported; rear panel 3-pin miniature connector.

USB – High Speed USB Interface for host communication; USB Series B connector.

- The InSpector 2000 is compatible with the Universal Serial Bus specification Rev 1.1.
- All Canberra USB devices are configured as a vendor specific Interface class. The InSpector 2000 belongs to the MCA subclass.
- The maximum cable length supported by USB is 5 meters.

PREAMP* – Provides ±24V (±5%), ±12V (±5%) and ground for standard preamplifiers; Overload protected: +24V at 40 mA max., –24V at 20 mA max., +12V at 80 mA max., –12V at 30 mA max.

Indicators

HV – Green LED, indicates HVPS is ON or HV fault condition, constant on indicates HVPS is on and high voltage may be present at the rear panel SHV connector. Blinks for a fault condition such as a high voltage overload or inhibit due to a detector warm up if connected.

FAULT – Green LED, indicates a power on diagnostic failure or high voltage fault.

ACQ – Green LED, indicates MCA is acquiring.

COMM – Green LED, indicates USB or RS-232 activity.

BATT – Green LED indicates power status.

Steady On – Power switch is ON and the InSpector 2000 is powered by the ac adapter or charged battery.

Slow Blink – The battery is becoming discharged with less than 5% of capacity remaining.

Fast Blink – The battery has become discharged (two minutes or less of operation remaining) and the InSpector 2000 is going through an orderly shut down; acquisition is halted, data is backed up in memory, the HVPS is ramped down to zero volts and the instrument is shut off.

ICR – Green LED, indicates incoming count rate; blink rate proportional to count rate.

Programmable Controls

Gain

The combination of Coarse Gain, Fine Gain and Super Fine Gain (SFG) set the overall system gain to match the requirements of the detector and energy application; overall gain is continuously adjustable from x2.24 to x2438.

COARSE GAIN – x2.5, x5, x10, x20, x40, x80, x160, x320, x640, x1280 (referenced to 10 V full-scale output).

FINE GAIN – Range is x0.9 to x1.9.

SUPER FINE GAIN – Range is x0.9975 to x1.0025.

GAIN ATTENUATOR – ON/OFF; When ON (selected) enables a divide by four input attenuator to minimize overload due to preamp signals with large dc offsets and Reset Preamps with large output ramp dynamic range; Coarse Gain settings displayed include the effects of the attenuator, the Coarse Gain selections reduce from 10 to 8 covering a range of x2.5 to x320. When OFF is selected the signal attenuation is removed.

MCA/INPUT SIZE – PHA Mode: Selections of 256, 512, 1024, 2048, 4096, 8192 or 16384 channels. Support for 2 memory groups of 8192 or less channels; MCS Mode: selections of 256, 512, 1024, 2048, 4096, or 8192 channels, support for two memory groups of 8192 or less channels.

LLD MODE – Selects Automatic or Manual LLD mode; AUTOMATIC: the LLD cutoff is automatically set just above the spectral noise threshold; MANUAL: allows the LLD cutoff to be set manually as a percentage of the full scale spectral size or range.

LLD SETTING – Active when the Manual LLD mode is selected, sets the minimum input acceptance level, range is 0 to 100%.

INP POLARITY – Selects either POSITIVE or NEGATIVE input polarity.

INH POLARITY – Selects either Active High or Active Low Reset Preamp Inhibit polarity.

PUR GUARD – Selects Guard Time (GT) multiplier in increments of 1.1, 1.3, 1.5, 1.7, 1.9, 2.1, 2.3 and 2.5 to reject trailing edge pile-up in the event of detector preamp anomalies.

FDISC SHAPING – Selects NORMAL or LOW ENERGY to optimize the fast discriminator shaping for the selected detector type; NORMAL: The Fast Discriminator shaping is optimized for Ge detectors and general gamma spectroscopy, the fast discriminator filter rise time is set to 0.040 µs; LOW ENERGY: the Fast Discriminator filter rise time is set proportional to the slow shaping rise time selection.

FDISC MODE – Sets the Fast Discriminator Threshold mode. AUTO: the threshold is optimized automatically above the system noise level; MANUAL: allows threshold to be adjusted manually.

FDISC SETTING – Active when manual FDISC mode is selected; sets the Fast Discriminator threshold level, range is 0 to 100%; the front panel ICR LED serves as a user aid when manually setting the Fast Discriminator threshold.

INHIBIT MODE – Selects AUTO or MANUAL Reset Preamp Inhibit Modes; disables pulse processing, extends the system dead time, re-initializes the pileup rejector and gates off the baseline restorer. AUTO: system is gated off for the greater of the Reset Preamp Inhibit Time “OR” the Internal Inhibit time functionality same as Auto mode except the signal processor is inhibited for the greater of the user selected Inhibit Setting “OR” the Reset Preamp Inhibit Time “OR” the Internal Inhibit Time.

INHIBIT SETTING – Active when the MANUAL Reset Preamp Inhibit Mode is selected, sets the Inhibit Time, range 0 to 160 µs in increments of 1 µs.

LTC MODE – ON/OFF; ON: Enables pile-up rejector and live time corrector (LTC). LTC generates dead time to extend the acquisition time to compensate for events that are piled-up and rejected. OFF: Pile-up rejector and LTC disabled.

LT TRIM – Allows adjustment of the trapezoid pulse evolution time or dead time to optimize Live Time Correction (LTC) performance. The adjustment range is 0 to 1000; the default value of 500 provides good LTC performance for a wide range of applications.

Filter

Note: Filter output (Trapezoid Signal) may be displayed on the Host computer using the digital oscilloscope feature.

RISE TIME – 40 rise and fall times ranging from 0.4 µs to 38 µs.

FLAT TOP – 21 flat top time selections ranging from 0 to 3 µs.

BLR MODE – AUTO, HARD, MEDIUM, SOFT; AUTO: The baseline restorer is automatically optimized as a function of trapezoid shaping time and count rate; HARD, MEDIUM, or SOFT: Sets the baseline restorer to fixed rates as selected.

POLE/ZERO – Pole/zero is adjusted by computer control; range: 45 µs to infinity; a digital oscilloscope and Pole/Zero Assistant is provided as a user aid when optimizing the pole/zero setting.

The Pole Zero Assistant measures and analyzes the tail of the trapezoid signal and provides visual feedback showing the quality of the pole zero adjustment via a simulated null meter or Pole/Zero Quality Indicator.

PREAMP TYPE – RC, RESET; selects the pole/zero mode; RC: pole/zero can be adjusted manually by computer command; range: 45 µs to infinity; RESET: Sets pole/zero at infinity for use with pulsed charged restoration (RESET) preamplifiers.

Power Management

POWER MANAGEMENT – ON/OFF; the InSpector 2000 can be programmed to automatically shut down when no acquisition and communication with the host computer is detected. ON: With no acquisition and no communication detected the InSpector 2000 automatically shuts down after a programmable delay; OFF: Automatic shutdown feature is disabled.

SHUT DOWN DELAY – Allows adjustment of the shut down delay when the automatic shutdown power management mode is selected; the adjustment range is 1 minute to 250 minutes.

Digital Oscilloscope

Allows examination of the digital trapezoid signal reconstructed in time to assist and verify instrument setup, pole/zero optimization and manual Reset Preamp INHIBIT adjustments.

HVPS

VOLTAGE RANGE – (Programmable Modules) Output voltage range and polarity selected by plug-in programming modules: +10 to +1300 V dc, +1300 to +5000 V dc, –10 to –1300 Vdc and –1300 to –5000 V dc, module type is read by firmware and displayed on host application; Low end of the 5000 V range is limited to 1300 V by software.

VOLTAGE LIMIT – Sets maximum voltage limit of voltage range selected; +10 to +1300 V dc, +1300 to +5000 V dc, –10 to –1300 V dc or –1300 to –5000 V dc. Voltage range and polarity selected by plug-in programming modules.

STATUS – ON, OFF; sets the HVPS ON or OFF.

VOLTAGE – Allows adjustment of the HVPS output over the voltage range selected by the HV module type and voltage limit selections.

HVPS RESET – Resets a power supply fault, after a fault condition has occurred (requires cycling HV off and on).

INH SIGNAL: – Sets the polarity sense of the High Voltage Inhibit input. Positive setting: for all Canberra preamplifiers; Enable condition (cold detector) is an open circuit or active high ≥+1.4 V to +24 V; Inhibit condition (warm detector) is –24 V to <+1.4 V or ground. Negative setting: all preamplifiers and LN monitors where enable condition (cold detector) is –24 V to <+1.4 V; Inhibit condition (warm detector) is open circuit or active high ≥+1.4 V to +24 V. With Negative selected an open input will disable the high voltage.

Stabilizer

GAIN MODE – ON, OFF, HOLD; ON/OFF: enables or disables the Gain Mode; HOLD: disables the stabilizer Gain Mode, but maintains the current Gain correction factor; Centroid (0 to 16 376 channels), Window (1 to 128 channels), Spacing (2 to 512 channels), Ratio (0.01 to 100), Rate Div (1 to 16); Correction Range of 1% for Ge and 10% for NaI detectors.

MCS

MODES – TTL, Integral, ROI Discrimination; Events are counted for the duration of a programmed number of sweeps. Each SWEEP incorporates a programmed number of channels. Each channel represents a DWELL duration. TTL: TTL pulses counted from MCS IN connector. Integral: Total gamma events counted from DSP spectrum. ROI Discrimination Gamma events counted if they occur within the programmed ROI window.

Programmable Settings

DWELL TIME SETTING – 5.00 ms to 10.0 s in 14 steps: 5.00 ms, 10.0 ms, 20.0 ms, 40.0 ms, 80.0 ms, 100.0 ms, 200.0 ms, 400.0 ms, 800 ms, 1.0 s, 2.0 s, 4.0 s, 8.0 s and 10.0 s.

DWELL TIME RESOLUTION – Less than 10 µs.

SWEEP COUNTER – 65 535 sweeps.

ROI DISC WINDOW– 1 to 8192 channels.

SWEEP MODE – Sweep Counter or Sweep Forever.

MCS CHANNEL RANGE – 256 to 8192.

START/STOP CONTROL – Software.

Performance

Signal Processing

SPECTRUM BROADENING –The FWHM of ^{60}Co 1.33 MeV gamma peak for an incoming count rate of 2 kcps to 100 kcps will typically change less than 6% for 2.8 µs rise/fall time, 0.8µs flat top and proper P/Z matching. These results may not be reproducible if the associated detector exhibits an inordinate amount of long rise time signals.

INTEGRAL NON-LINEARITY– ≤ ±0.025% of full scale over the top 99% of selected range.

DIFFERENTIAL NON-LINEARITY– ≤±1% over the top 99% of the range including the effects from integral non-linearity.

GAIN DRIFT – ≤35 ppm/°C after 15 minutes of operation.

ZERO DRIFT – 3 ppm/°C after 15 minutes of operation. Typically, less than 1 channel over full temperature range (8K Spectrum).

OVERLOAD RECOVERY– Recovers to within 1% of full scale output from x1000 overload in 2.5 non-overlapped pulse widths at full gain, at any shaping (processing time), and with pole/zero properly set.

Pileup Rejection/Live Time Correction

PULSE PAIR RESOLUTION – Better than 500 ns with NORM Detector Type selected.

DEAD TIME CORRECTION – Extended Live-Time correction, accuracy of reference peak area changes 5% (3% typical) at up to 50% system dead time with a setting of 5.6 µs rise time and 0.8 µs flat top.

Acquisition

DATA MEMORY GROUPS – 1–16K (PHA) Channels or 2–8K (PHA) channels (single mode only); 28 bits per channel, 10 year data retention (power loss). Divisible into halves, quarters, eighths, and sixteenths. 2–8K (MCS) channels; 28 bits per channel, 10 year data retention (power loss). Note: No simultaneous operation of PHA/MCS.

STORAGE MODE – PHA or MCS.

PRESET MODE

PHA Mode: Live or True Time, Counts in single channel or Counts in ROI.

MCS Mode: Sweeps, Count greater or equal to preset Counts, Count greater or equal to preset ROI Counts.

TIME RESOLUTION – 0.01 s live and true time.

PRESET TIME – 1 to > 4 x10^7 s.

PRESET SWEEPS –1 to 65 535.

HVPS

Plug-in programming modules select the maximum voltage range and polarity. Identification of installed module is reported by the software; 1300 Volt Range: +10 to +1300 V dc or –10 to –1300 V dc at 300 µA, 5000 Volt Range: +1300 to +5000 V dc or –1300 to –5000 V dc at 20 µA.

ADJUSTMENT RESOLUTION – 1 part in 4096, all modules.

RIPPLE – ±1300 V dc range ≤25 mVpp in 50 MHz bandwidth at maximum voltage and full load; 5000 VDC range ≤50 mVpp in 50 MHz bandwidth at maximum voltage and full load.

TEMP. COEFFICIENT – ≤±50 ppm/°C after 15 minute warm-up.

OUTPUT STABILITY – Long term drift of output voltage is ≤0.01%/h and ≤0.02%/8 h at constant load and ambient temperature after 15 minute warm-up.

VOLTAGE ACCURACY – ±5% of setting.

REGULATION – ≤5% variation in output voltage over the load range at constant ambient temperature.

OVERLOAD PROTECTION – The high voltage power supply will withstand any overload, including a short circuit for an indefinite period.

Cables

Composite Detector Cables

Standard – Detector composite cable, 3 m (10 ft); provides preamp power (9-Pin D), Energy, HV Inhibit, (BNCs) and High voltage (SHV).

Optional – 3 m (10 ft); same as standard cable except includes TRP RESET cable (B.C.).

Computer Cables

RS-232 (Standard) – Used for connecting the instrument to an IBM PC compatible serial port; 1 m (3 ft); 9-pin D connector for connection to the PC com port and a 3-pin miniature circular connector for connecting to the InSpector 2000 RS-232 port; baud rates supported are 2400, 4800, 9600, 14.4 k, 19.2 k, 28.8 k, 38.4 k, 57.6 k, and 115.2 k.

USB (Standard) – Used to connect the host IBM compatable computer USB port to the InSpector 2000 rear panel USB port; 1 m (3 ft.); shielded cable.

MCS Cable

Standard – Used for connecting the instrument to a TTL compatible logic signal. The cable is a one meter long RG-134 coaxial cable. The cable has a B.C. Female connector for connecting to an MCS signal source and a MCX connector for connecting to the InSpector 2000 rear panel MCS input.

Environmental

OPERATING TEMPERATURE – 0 to 50° C.

OPERATING HUMIDITY: Up to 80% non-condensing.

Physical

Metal and Plastic enclosure.

SIZE – 8 x 18.5 x 17.3 cm (1.5 x 7.3 x 6.8 in)

WEIGHT – 1.3 kg (2.8 lb) Includes NP-F950 Sony Lithium-ion high capacity battery.

B. Performance Adjustments

This appendix describes how to make several performance adjustments: adjusting the rise time and the flat top, optimizing the pole/zero manually, setting the baseline restorer, setting the fast discriminator threshold, operating the InSpector 2000 with reset preamps, and selecting and optimizing the Genie-2000 Display Preferences.

Rise Time and Flat Top Adjustments

The digital filter employed in the InSpector 2000 has a Triangular/Trapezoidal weighting or shaping function. The processing time (Shaping) is set by the Rise Time and Flat Top selections and is generally a compromise between optimizing throughput and resolution. Having the ability to independently set the Rise Time and Flat Top allows greater flexibility when optimizing the processing time or shaping for a wide variety of detector applications. The Rise Time sets the noise filtering characteristics of the Digital Filter while the Flat Top allows for the charge collection time of the particular detector. Independent adjustment of the flat top allows the shaping function to be optimized for detectors with long charge collection time, without a large increase in the overall processing time. For small detectors with minimal charge collection time variation or ballistic deficit, the trapezoidal shape reduces to triangular shaping when the Flat Top is set to minimum or zero. The triangular/trapezoidal shaping function is symmetrical. The fall time cannot be set independently, it always equals the Rise Time selection.

Shaping is adjusted by selecting the Rise Time and Flat Top, which determine the trapezoid pulse shape and optimizes performance for the specific detector, spectral energy range and count rate. As in any signal processing application, a performance tradeoff exists between high resolution and high throughput. For example when using a small Ge detector, 5.6 µs rise time and 0.8 µs flat top settings provide optimum resolution over a wide range of count rates. Shorter shaping times such as 2.8 µs rise time and 0.6 µs flat top may degrade low count rate resolution performance slightly, but results in less resolution broadening and peak shift over a much wider count rate range.

For ultra high counting and throughput rates, rise time and flat top settings of less than 1 µs may be used. For this case, optimum resolution is traded off for increased count rate performance. For high resolution detectors, longer rise time settings offer a better signal to noise (S/N) ratio and longer flat top settings reduce the effects of ballistic deficit. However, as the system count rate increases, resolution may degrade more rapidly due to increased processing time and the effects of pulse pile-up.

For most Ge detector applications, digital trapezoidal shaping provides Gaussian equivalent resolution with half the processing time. Faster processing time means the InSpector 2000 provides significantly greater throughput than a traditional analog system with its processing or shaping times set for equivalent resolution. When using small Ge detectors which are optimized for high count rate performance, throughputs of 100 kcps can be achieved. To achieve 100 kcps and higher throughput, the highest spectral peak must not exceed 80% of full scale.

However, the settings which realize reduced processing time, high throughput and equivalent resolution for Ge detectors may be a bit aggressive for some low energy applications. For these applications, which include LEGe, Si(Li) and X-ray detectors, resolution will be equal to or better than that obtained with traditional analog systems when the Rise Time and Flat Top filter parameters are optimized for resolution. For this case, the trapezoidal rise time parameter is increased so that the processing time and throughput are equivalent to Gaussian shaping.

Table 1 lists the InSpector 2000 Rise Time and Flat Top settings which optimize performance for high throughput/good resolution and optional setting for best resolution/lower throughput when using Germanium Coaxial detectors.

Table 1 Gaussian Shaping vs. Throughput and Resolution

Gaussian Shaping (µs)	Highest Throughput[1] Rise Time/Flat Top	Highest Resolution[2] Rise Time/Flat Top
0.5 µs	0.8 µs/0.2 µs	1.2 µs/0.2 µs
1.0 µs	1.2 µs/0.6 µs	2.8 µs/0.6 µs
2 µs	2.8 µs/0.6 µs	5.6 µs/0.6 µs
4 µs	5.6 µs/0.8 µs	12 µs/0.8 µs
6 µs	8.8 µs/1.2 µs	18.4 µs/1.2 µs
12 µs	16.8 µs/2.4µs	36 µs/2.4 µs

Note 1: Optimized for high throughput, good or equivalent Gaussian shaping resolution.
Note 2: Optimized for highest resolution, equivalent Gaussian shaping processing time/throughput.

Table 1 lists settings for optimizing throughput or resolution. Of course a setting in between can be chosen to optimize performance for a specific application. The Gaussian Equivalent Shaping Times are suggested as starting values. You may change these values to enhance throughput or resolution as required by your application.

As previously mentioned, the shaping times recommended for highest throughput produce a trapezoidal pulse response which has approximately one-half the processing time when compared with traditional analog Gaussian shaping amplifiers. These settings result in almost twice the throughput compared to traditional analog pulse processing, with little or no resolution degradation in most high energy Ge detector applications.

The shaping times recommended for highest Resolution produce a trapezoidal pulse response with a processing time that is equivalent to traditional analog signal processing. Longer rise time and flat top settings provide better noise filtering and reduced ballistic deficit. However, as the system count rate increases, resolution and throughput may degrade as a result of increased processing time and the effects of pulse pile-up.

The optimum shaping-time constant depends on the detector characteristics (such as size, noise characteristics and collection characteristics), preamplifier and incoming count rate. Settings for typical germanium coaxial detectors have been discussed above. Below is a list of InSpector 2000 rise time and flat top settings for other common detectors.

Detector	Rise Time / Flat Top (µs)
Scintillation [NaI(TI)]	0.8/0.2 or 1.2/0.6
Silicon Charged Particle (PIPS)	0.8/0.2, 1.2/0.6 or 2.8/0.6
Proportional Counter	0.8/0.2, 1.2/0.6 or 2.8/0.6
Lithium Drifted Silicon [Si(Li)]	18.4/1.2 or 36/2.4
Coaxial Germanium	2.8/0.6 or 5.6/0.8
Low Energy Germanium	5.6/0.8, 18.4/1.2 or 36/2.4

Refer to the specific Detector Operator's Manual for the recommended shaping time. A good starting point is the Gaussian equivalent processing time selections listed in the Table 1 on page 83. The Rise Time and Flat Top setting can be optimized further through experimentation. Collect spectra using rise time and flat top settings above and below the recommended settings, to optimize resolution performance for your particular detector and application.

Flat Top Setting

The InSpector 2000 allows independent selection of rise time and flat top. A detector with long charge collection times will require a flat top long enough to process all the charge from the detector. If the flat top is too short, it may result in low side spectral tailing and degraded resolution. However, if these symptoms occur at high rates only, the P/Z setting may be misadjusted. In this case, first verify the correct P/Z setting and readjust if necessary. To set the flat top, start with a long value, then collect a spectrum and verify good resolution and peak symmetry. Reduce the flat top and repeat the process. Continue until resolution and peak symmetry begin to degrade, then set the flat top to the next higher value. The optimal (shortest) flat top will allow the best throughput.

The rise time setting can be optimized separately to achieve the best count rate/resolution compromise. However, the optimum flat top for a detector depends somewhat on the rise time selection. Therefore, the best correction for ballistic deficit will be achieved manually checking the flat top setting if the rise time is increased or decreased by a factor of two or more.

Triangular shaping may give enhanced resolution performance for small detectors having little variability in charge collection time. To set the unit for triangular shaping, adjust the rise time to the desired value and set the flat top to zero.

Pole/Zero Matching Using the Digital Oscilloscope

At high count rates, Pole/Zero (P/Z) matching adjustment is extremely critical for maintaining good resolution and low peak shift. For precise and optimum setting of the P/Z matching, the digital oscilloscope can be used. Please review “Digital Oscilloscope Controls and Indicators” on page 47 for information on setting up and adjusting the digital oscilloscope. Because the oscilloscope uses digital data, overload does not occur and a high vertical sensitivity can be used to view and correct small overshoots and undershoots in the trapezoid waveform. For the pole/zero adjustment steps below an oscilloscope vertical sensitivity of 25 mV/division is used.

With correct P/Z adjustment, spectral peaks will appear symmetrical, while undercompensated P/Z adjustment will produce low energy tailing. Overcompensated P/Z adjustment will produce high energy tailing. An example of each condition is shown in Figure 37.

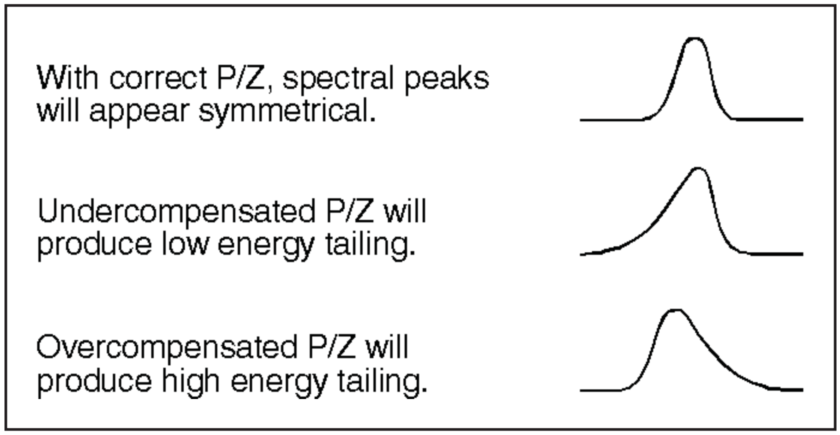

Figure 37 Pole/Zero Compensation - Examples

Using a Ge Detector, ^{60}Co Source, and Digital Oscilloscope

Follow the steps below to optimize the Pole/Zero using the Digital Oscilloscope.

1. Adjust the radiation source count rate to be between 500 counts/second and 4k counts/second. Observe the trapezoidal waveform on the digital oscilloscope.

2. Verify that the preamp type in the MID Definition **Settings | DSP Filter** screen is set to “RC”. Adjust the Pole/Zero slider bar, located on the **MCA | Adjust | Filter** dialog (second page), so that the trailing edge of the trapezoid pulse returns to the baseline with no overshoots or undershoots. The Digital Oscilloscope Smoothing Factor can be increased if necessary to remove noise which may obscure the shape of the undershoot or overshoot.

Notes: If the Pole/Zero was previously set using the Pole Zero Assistant, this setting can be modified or optimized further using the Pole/Zero slider bar and the Digital Oscilloscope function. If this result differs from that obtained using the Pole Zero Assistant, the LED adjustment indicators should be ignored.

Some systems may exhibit undershoots or other secondary time constant anomalies as the trapezoid signal returns to the baseline. Short, fast secondary time constants sometimes result from parasitic effects (stray inductance, capacitance) associated with the feedback resistor. The waveforms shown in Figures 38 through 39 exhibit a short time constant which is typical of this effect. If the fast decay time constant is less than 20 mV (refer to the digital scope vertical scale) its impact on performance is insignificant.

Undershoots with longer time constants may also occur due to excessive dielectric absorption associated with the preamp feedback capacitor or preamp differentiator circuit. NaI detectors also produce short secondary time constants due to the scintillation material and light decay time constant. These short time constants are not associated with the preamp decay time and cannot be corrected using the pole/zero compensation. However, if present they should not be confused with undershoots caused by the preamp decay time which can be compensated using the Pole/Zero adjustment.

Figure 38 below shows the correct setting of the P/Z adjustment, while Figures 40 and 39 show under and over compensation of the preamplifier decay time constant. As illustrated for correct P/Z compensation, the digital oscilloscope waveform should have a clean return to the baseline with no overshoots or undershoots.

For the examples in Figures 38 through 39, the InSpector 2000 Filter settings of 5.6 µs Rise Time and 0.8 µs Flat Top were used. System Gain was set so the ^{60}Co 1332 keV energy peak collected in approximately 90% of full scale.

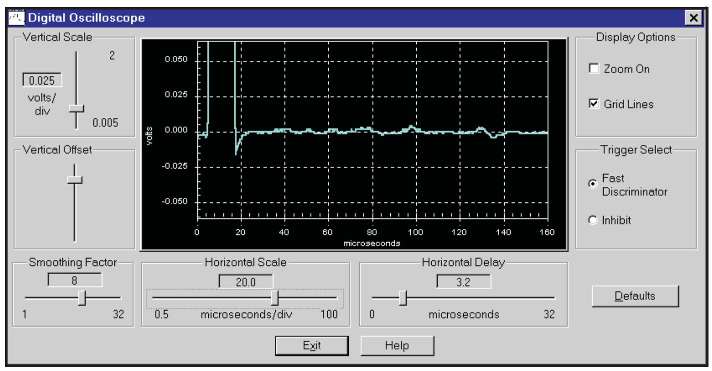

Figure 38 Correct Pole/Zero Compensation

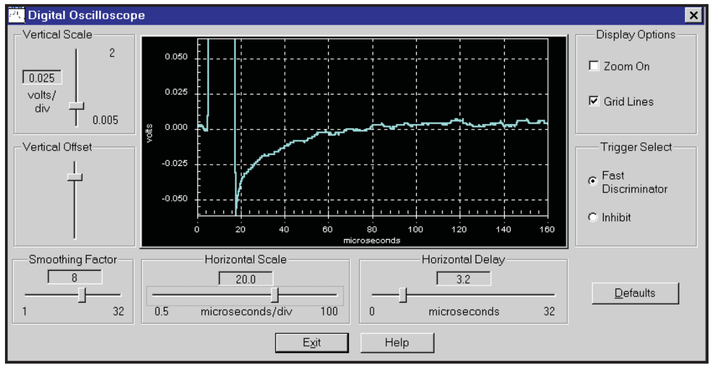

Figure 40 Undercompensation Pole/Zero

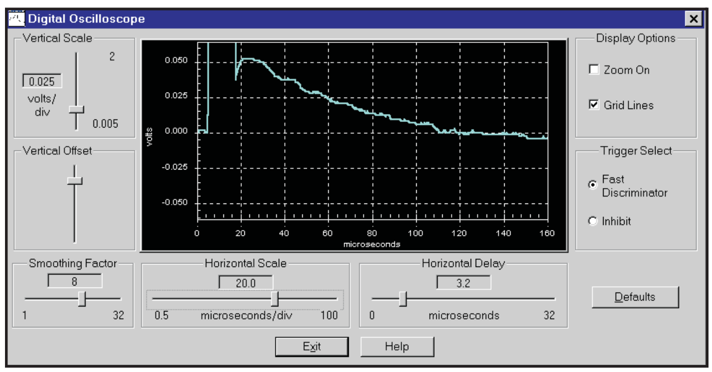

Figure 39 Overcompensated Pole/Zero

Adjustment Tips

1. When beginning the pole/zero adjustment its best to start off with a high Vertical Scale setting such as 0.250 volts/div. Increase the vertical sensitivity (lower Vertical Scale setting) as you approach and get close to the desire optimal pole/zero adjustment.

2. Try setting the Smoothing Factor to a lower value when using Rise Time settings longer than 20 µs.

Using a NaI(Tl) Detector, ^{60}Co Source, and Digital Oscilloscope

When adjusting the pole/zero matching using an NaI(Tl) detector, follow the steps 1 and 2 from “Using a Ge Detector, ^{60}Co Source, and the Digital Oscilloscope” on page 86. Due to AC coupling between the photomultiplier tube and the detector preamplifier, signals from NaI(Tl) detectors often contain a second time constant which causes undershoot and a delay in the return to baseline after each pulse. This coupling time constant cannot be removed using the pole/zero compensation, but with proper adjustment the main preamplifier time constant can be removed and the overall return to the baseline can be adjusted for minimal overshoot and undershoot.

Figure 41 shows the correct setting of the P/Z adjustment for a typical NaI(Tl) detector with some undershoot, while Figures 42 and 43 show under and over compensation of the preamplifier decay time constant.

For the examples in Figures 41 through 43, the InSpector 2000 Filter settings of 1.2 µs Rise Time and 0.6 µs Flat Top were used. System Gain was set so the ^{60}Co 1332 keV energy peak collected in approximately 70% of full scale.

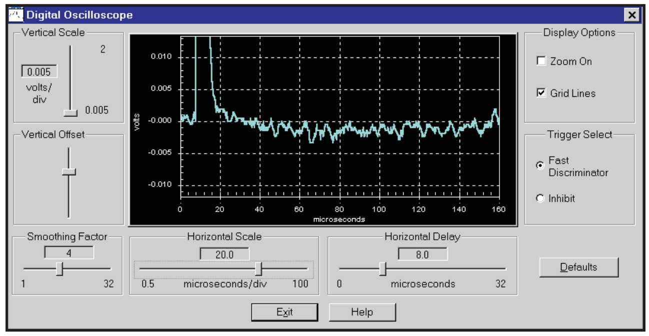

Figure 41 Correct Pole/Zero Using a NaI(Tl) Detector

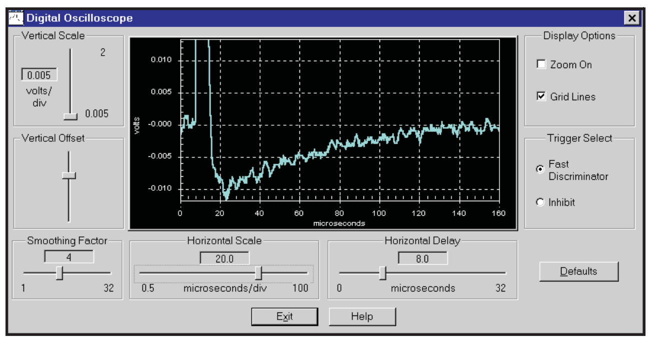

Figure 42 Undercompensated Pole/Zero Using a NaI(Tl) Detector

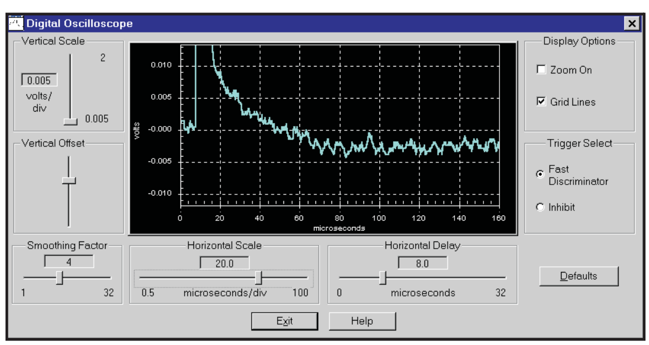

Figure 43 Overcompensated Pole/Zero Using a NaI(Tl) Detector

Baseline Restorer

The digital baseline restorer in the InSpector 2000 is flexible and allows adjustment for varying baseline conditions affected by detector type, noise and count rate. The baseline restorer rate is selected using the BLR mode drop down menu in the Filter Device Adjust screen.

With the Baseline set to AUTO, the digital baseline restorer is automatically set for optimum performance throughout the usable input count rate range.

The restorer can also be set to three manual settings: SOFT MEDIUM and HARD. These setting can be used to manually optimize the BLR response for a specific detector and count rate application or system noise condition. The SOFT selection significantly reduces the baseline restorer's restoration rate. This may prove to be advantageous in some low count rate/low energy applications. With the SOFT selected, the restorer's low frequency noise suppression effectiveness is reduced. The ambient low frequency noise and the implementation of noise reduction techniques regarding setup can easily be assessed and tested.

For situations where a higher than normal restoration rate is required, the restorer rate may be set to MEDIUM or HARD, which increases restoration rate proportionately. This can improve performance at extremely high input counting rates or where more control is required to maintain the baseline, such as with some NaI(Tl) scintillation detector systems or detectors which exhibit excessive microphonics.

Manual Fast Discriminator Threshold

In some cases, you may want to set the Fast Discriminator threshold manually. For best performance, set the threshold just above the system noise level.

1. Set the Amplifier Gain and shaping as required.

2. Set the FDisc Mode in the Gain Device Adjust screen to "Manual".

3. Remove all excitation sources from the vicinity of the detector.

4. Use the FDisc setting slider bar in the Gain Device Adjust screen to set the fast discriminator threshold just above the system noise as indicated in step 5.

5. The following steps optimize the discriminator sensitivity to insure the threshold is at its lowest setting, just above the noise level:

   Adjust the FDisc Setting to 0%. The ICR LED indicator continuously glows green.

Next, increase the FDisc Setting level until the ICR LED indicator is no longer on continuously, but shows low activity by blinking green occasionally. The fast discriminator threshold is properly set.

Note With the Fast Discriminator in the manual mode, the threshold must be re-checked and adjusted if the Detector/Preamplifier is changed or the InSpector 2000's GAIN is changed.

Operation with Reset Preamps

The InSpector 2000 is fully compatible with most pulsed reset preamplifiers. Reset preamps use an electronic circuit, as opposed to a feedback resistor, to restore the preamp back to a reference level. As a result, the preamp output is a succession of step functions that staircase or ramp up to an upper limit or threshold that initiates a preamp reset.

Configuring the Preamp Reset Mode

When using a Transistor Reset Preamp (TRP) it may be necessary to disable the Reset Delay feature, if present, on the associated preamplifier. If the Reset Delay feature is left enabled, small phantom peaks may result slightly before or after each of the main spectral peaks.

If you are using a Canberra Model 2101 preamplifier, disable the Reset Delay using these three steps:

1. Remove all signal and power connections from the preamp.

2. Remove the preamp cover and change jumper plug W1 from position A to position B. Jumper plug W1 is located on the main PC board next to RV1.

3. When done, reinstall the preamp cover and reconnect the preamp to the InSpector 2000 as before or as indicated in "Spectroscopy System Setup" on page 52 and in Figure 32.

For additional information on the Reset Delay feature and jumper plug W1 please refer to the Model 2101 User's Manual.

Pole/Zero Setting for Reset Preamps

Since the Reset Preamp output signal is a step function instead of the classical tail pulse, with exponential decay, Pole/Zero compensation is not required. For this application, the Pole/Zero compensation should be turned off or set to zero. On the InSpector 2000, this is accomplished by setting the preamp type to RESET. The preamp type is selected in the **Settings | DSP Filter** device of the MID Definition. If RESET is selected, the Pole/Zero is automatically set to a value of zero, corresponding to a fall time of infinity, and no further adjustment is required. If the RC Preamp Type is selected, the pole/zero value on the second page of the **MCA | Adjust | Filter dialog must be manually set to zero.**

Using the Reset Input and Inhibit Function

During the preamp reset interval, the preamp reset event produces a large signal, driving the InSpector 2000 into severe overload. The InSpector 2000 automatically senses reset events and gates off pulse processing during the associated overload event. However, to obtain optimum performance, especially at high count rates, it is recommended that the preamplifier's Inhibit signal be connected to the Reset Inhibit input on the InSpector 2000 and the Inhibit Polarity be set appropriately. Figure 44 shows a representation of the Trapezoid signal at the output of the digital filter, as well as the Preamp Output and Inhibit signals.

The InSpector 2000 system inhibit is initiated or derived from the Inhibit signal generated by the Reset Preamp. The optimum system inhibit time can be set automatically by the InSpector 2000, or adjusted manually using the adjustments located on the fourth page of the **MCA | Adjust | Gain** screen in the Acquisition and Analysis window.

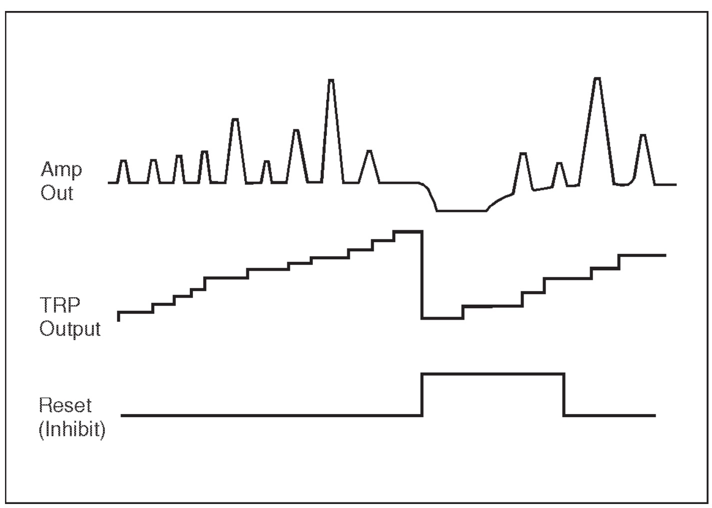

Figure 44 Monitor Output, TRP Output, TRP Inhibit

Automatic Inhibit Mode

For automatic inhibit, set the Inhibit Mode to Auto; this is the default setting. When using the Auto mode, the correct system inhibit time is automatically set. It is not necessary to make critical adjustments of the inhibit signal at the preamp. However, if the reset preamp is equipped with an adjustable inhibit signal pulse width, it should be set to its minimum value. Please consult the Detector/Preamp Operator's manual for this adjustment.

Note: When using the Automatic Reset inhibit mode, the total system inhibit duration is the time interval automatically generated by the InSpector 2000 "OR" the external (preamp) inhibit duration, whichever lasts longer. For proper automatic operation set the preamp inhibit time to minimum, or it can override the optimum inhibit time generated by the InSpector 2000.

Manual Inhibit Mode

The Inhibit time can also be set manually, by changing either the InSpector 2000 Inhibit Setting adjustment or the inhibit pulse width adjustment on the preamp. For certain detector characteristics and applications it may be necessary to set the Inhibit time interval longer then provided by the Automatic mode. Manual adjustment may be necessary if the preamp signal contains extra time constants resulting in abnormal behavior which extends the overload recovery time beyond the norm. The effect often becomes more noticeable at high gains.

To use the InSpector 2000 manual inhibit adjustment, set the Inhibit Mode to Manual. This setting can be changed on the third page of the **MCA | Adjust | Gain** screen. Before adjusting the Inhibit Setting, the Preamp Type must have been previously set to TRP using the **Settings | DSP Filter** device in the MID Definition. If this is not first done, the inhibit controls are not available in the **MCA | Adjust | Filter** dialog. The Inhibit Setting slider bar can adjust the inhibit duration between 0 and 160 µs, and becomes active in the Manual Inhibit Mode.

The optimum Inhibit time is determined using the InSpector 2000 Digital Oscilloscope, first launch the oscilloscope application. See Chapter 5, *Using the Oscilloscope Function*, for further information on the Digital Oscilloscope. With the MID Definition configured for Reset type preamps, the Digital Oscilloscope is launched by pressing the Digital Oscilloscope icon button on the toolbar. If the Digital Oscilloscope icon is not already available on the main toolbar, it can be added by following these steps:

1. Choose the Commands tab on the Gamma Acquisition and Analysis window's **Display | Preferences | Toolbar Setup** screen.

2. Choose the MCA Category icon group and drag the oscilloscope icon to the toolbar. This pushbutton will now be available for launching the digital oscilloscope.

3. To remove the colored title bar just above the icon, click in the colored area with the left mouse button and drag it down.

4. The toolbar can now be saved by pressing the **Save** button on the Display Preferences screen. For more information on adding command buttons to the toolbar, see Toolbar Setup in the Genie-2000 Spectroscopy System Operations Manual in the Display Preferences section of the Gamma Acquisition and Analysis.

Once the Digital Oscilloscope is activated, set the Trigger Select to Inhibit. When using this trigger source, make sure that the Inhibit output of the reset preamp has been connected to the InSpector 2000 Reset input. Otherwise the oscilloscope will not get triggered and the wrong error message may be displayed.

Note: The Inhibit Trigger select button is active only if **TRP** is selected as the **Preamp Type** in the **Settings | DSP Filter** device of the Mid Definition. If **RC** is selected as the **Preamp Type** the Inhibit button will be grayed out.

The overload recovery time of the trapezoid signal is measured to set the required inhibit time. The overload period is marked by the duration of the large negative overload excursion in the oscilloscope waveform. Measure the duration of the overload signal in microseconds; the overload signal begins with the large negative excursion and ends upon return to the baseline (see Figure 45). Set the Inhibit Setting equal to the measured overload time period.

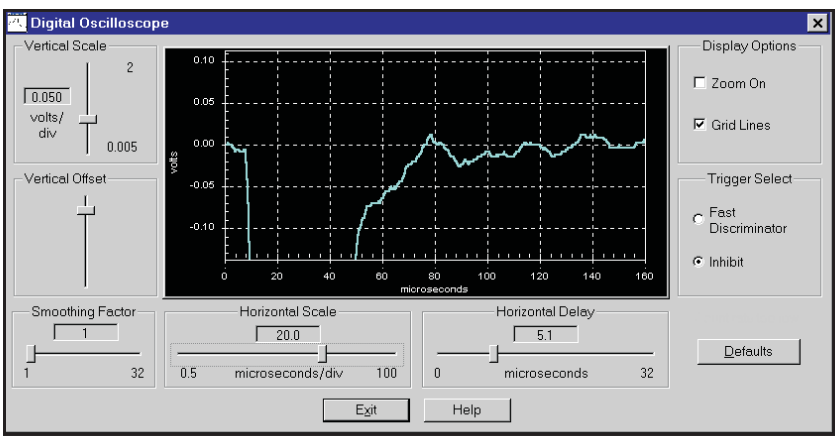

Figure 45 Digital Oscilloscope Waveform Showing Trapezoid Filter Reset Period

Adjustment Tips

As mentioned in chapter 5 the oscilloscope pile up rejector is turned off when the Trigger select is set to **inhibit.** When viewing and measuring the overload recovery characteristics its best to set the ICR to a low rate; between 1 and 5 kcps. Otherwise pile up will make it difficult to view the recovery characteristic.

On some reset preamps the Inhibit signal pulse width is adjustable. For preamps with this provision the preamp inhibit time can also be set to inhibit pulse processing during the reset period. Consult the Detector/Preamp Operator's manual for this adjustment. Note that when the InSpector 2000 Inhibit Mode is set to Manual, the system inhibit duration will be the time interval set by the InSpector 2000 Inhibit Setting slider bar "OR" the external (preamp) inhibit duration, whichever lasts longer.

As shown in Figure 45, the overload recovery time is approximately 70 µs, with the InSpector 2000 Rise Time set to 5.6 µs, Flat Top set to 0.8 µs, Coarse Gain of x320 and using a Canberra Model 2101 preamp and ^{60}Co source. For this example the Inhibit Time should be set to approximately 70 µs.

Selecting and Optimizing the Genie-2000 Display Preferences

The InSpector 2000's performance is most affected by the communications burden being placed on the system. The more communications you demand of your system, the slower the response will be. For instance, the software is at its busiest when the InSpector 2000 is acquiring data and scaling it for display.

To get the best absolute best performance, set your system up as follows.

- Under **Display | Preferences**, set the plot mode to "**Normal Plot**", which is meant to be used during data acquisition. Using the "**Full Plot**" mode, which is meant for close interaction with an acquired spectrum, may reduce the spectral update rate performance.

- You should normally turn off the Marker Info status page during acquisition. When this page is displayed, the system has to calculate centroids, area, integral, etc., at each update. This adds a processing burden that slows the update rate. If you do not need the Marker Info page, to monitor an ROI for instance, make sure the markers are set around the ROI. If you leave the markers set to full spectrum, there is more data to analyze, which will make your screen update noticeably slower.

- The spectral update rate depends on the selection of RS-232 or USB computer interface, spectral size and incoming count rate (ICR). Table 2 below illustrates typical spectral transfer rates for the RS-232 and USB verses spectral size and incoming count rate. For the measurements in Table 2, the Genie-2000 was running on a PentiumPro 200 MHz computer, the RS-232 baud rate was set to 57.6 kbaud, the Acquire mode was PHA and a NaI detector and ^{60}Co source was used as the input source.

Table 2 Performance Comparison of RS-232 and USB

InSpector 2000 Configuration	ICR = 0 cps	ICR = 6300 cps
RS-232 at 16K channels	1.11 sec.	2.55 sec.
RS-232 at 8k channels	0.62 sec.	1.39 sec.
USB at 16K channels	0.95 sec.	1.19 sec.
USB at 8k channels	0.56 sec.	0.70 sec.

Though the InSpector is capable of serial communications at up to 115 kbaud, most notebook computers don't work well at such fast data transfer rates. In addition, most notebooks have a smaller communication buffer, which means that even if capable of a high baud rate, they will slow down dramatically if asked to communicate with another device, such as a printer, while the InSpector is acquiring data.

Interestingly, trying to run at a rate that is too fast actually slows the system down. This is because the communications circuitry is not keeping up, drops characters, errors are generated and the system retries. The repeated retries consume considerable CPU resources. Under these circumstances a system that may update the screen in 2-1/2 seconds at 19.2 kbaud, may slow down to 10-20 seconds at 57 kbaud (or, in extreme cases, may lose communications entirely).

You can optimize your InSpector's communications by making several trials to look for the best performance. Start at a high baud rate and, if you don't get performance as good as, or better than that shown in Table 2, try a lower baud rate. Repeat this until you see an improvement. Be sure the tests are made under your standard operating conditions.

For example, if you are going to print while acquiring data, you will probably need to lower the baud rate. The same is true if you are using the S500 Genie-2000 Basic Spectroscopy software with its copy protection key instead of the S504 InSpector Basic Spectroscopy software.

C. Accessory and Cable Part Numbers

This section includes part numbers for all accessories, cables, and HVPS modules included with the InSpector 2000.

Item	Canberra Part Number
Standard Accessories	
AC Adapter	95200437
AC Adapter Line Cord	10150007
Battery Charger	95200442
High Capacity Sony NP-F950 or equivalent Lithium-ion Battery	Model 1331
Soft Travel Case	9531596_
Detector Cable, Composite cable for connecting to RC preamps	C1725-10
RS232 Serial Interface cable	96_31556
USB Computer Cable	10510001
MCS Cable	96_31547
Optional Accessories	
Sony NP-F550 Low profile (3) hr Battery	Model 1332
Car Battery Power Adapter/Charger	Model 1312
Detector Cable, Composite cable for connecting to Reset preamps	C1726-10
HV Power Supply Plug In Modules	
HV Interlock Board	96_31632
HV Polarity Module	96_31433
HV Range Module	96_31434

Note: An underscore (_) is included in some part numbers as a place holder for the latest revision letter

D. Power System

Instrument Power

Power can be provided by commercially available Sony or compatible Lithium-ion Camcorder battery packs, ac adapter or optional car battery adapter. For installation of the battery pack please reference “Attaching the Battery” on page 14. If using external power from an ac power adapter or car battery adapter connect the power connector to the dc Power jack located on the InSpector 2000 rear panel.

A high capacity battery Sony NP-F950 is provided with the InSpector 2000 which typically provides greater than 10 hr of acquisition time when using a Canberra detector and associated 2002 RC preamp. An optional low profile, low capacity battery Sony NP-F550 typically provides greater than 3 hr of acquisition time for the same detector configuration.

Input Power Requirements

The input voltage range is + 5.5 to + 8.5V; + 7.2 volts nominal as supplied by Sony NP-F950 or NP-F550 Lithium-ion battery pack. Rear Panel DC PWR jack - Nominal 7.5 V dc at 0.70 A using ac adaptor and nominal 8.4 V dc at 0.70 A using Model 1312 Car Battery Power Adapter/Charger.

Input current is dependent on input voltage and preamp type and load: 0.33 A to 0.70 A.

On/Off Control

The ON/OFF rocker switch is conveniently located on the rear left side of the Instrument. The switch is recessed to minimize inadvertent operation. Power to the InSpector 2000 is enabled when the switch is set to the ON (“1”) position. When OFF (“0”), the InSpector 2000 is turned off, however, there is a small amount of power draw required by the standby circuitry on the Low voltage power supply. The OFF state battery discharge current is less than 25 µA. Additionally, the InSpector 2000 may be powered down from the host application, by a programmed time-out; see “Power Management” on page 100 information.

Power Management

To conserve battery life the InSpector 2000 can be programmed to automatically shut down after a programmable delay when there is no data acquisition or communication detected by the host computer; the adjustment delay is 1 minute to 250 minutes. This feature is useful if you start an acquisition and disconnect InSpector from the host computer. The automatic power down function is turned OFF if the Standby Delay is set to a value of zero (0). When acquisition completes, the InSpector 2000 will shut off after the programmed delay period to conserve the remaining battery life. As a result the battery will not be run down and the InSpector can be reactivated at a later time to perform additional acquisitions or operations.

The automatic delayed shut down function is controlled in the Power Manager Device in the MID Definition or the Acquisition and Analysis window's Power Manager Adjust dialog. The automatic power down function is enabled when set ON (Standby delay of 1 through 250) and battery power is detected. The shut down delay period begins when no data acquisition or communication with the host computer is detected. Communication with the host computer is suspended only if the data source is closed or the InSpector to host communication link is interrupted. If the InSpector 2000 is acquiring the power down timer does not commence until acquisition completes.

Note: The automatic delayed shut down function is not enabled if the InSpector 2000 is powered from an ac adapter or car battery adapter.

If the automatic shut down delay is enabled, and the above conditions are met, the InSpector 2000 will go through an orderly shut down when the delay period expires. Prior to full shut down all data is backed up in memory, the HVPS is ramped down to zero volts and the instrument is shut off.

To reactivate the InSpector 2000, the Power Switch must be cycled OFF/ON and the data source opened. The data source is opened in the Gamma Analysis and Acquisition application.

Battery Status/Automatic Low Battery Shut Down

Battery status is reported visually by the actions of the front panel BATT LED. Also, the current operating battery voltage or external power source voltage is reported in the Status Page in the Gamma Analysis and Acquisition window. To access the status page, select **MCA | Status**, scroll down to the PwrMgr group to read the Power Mode and voltage.

When the BATT LED in on solid, the InSpector 2000 is powered by a charged battery, ac adapter or car battery adapter. The BATT LED blinks at a slow rate when the battery is becoming discharged and there is less than 5% of capacity remaining. When the battery voltage becomes depleted and drops below + 5.5 V dc the InSpector 2000 BATT LED blinks at a fast rate and the InSpector 2000 automatically initiates an orderly shut down sequence; all data and setup parameters are preserved. During the shut down sequence acquisition is halted, data is saved, high voltage is ramped down to zero volts and the InSpector 2000 is shut off.

To recover and resume operation replace the discharged battery with a fresh charged battery or connect the ac adapter or optional car battery adapter power sources. Cycle the InSpector 2000's power switch from ON to Off and then back ON again, the InSpector 2000 will power back up. Open and close the data source to reestablish communications between the InSpector 2000 and the host computer. The data source is opened in the Gamma Analysis and Acquisition application. Turn the High Voltage back on; the InSpector 2000 should now be ready to resume operation. Spectral data, time data and all setup parameters were saved prior to the discharged battery shutdown sequence. If the acquisition did not complete prior to being halted all you should need to do is restart acquire.

As mentioned earlier, the Power Mode and voltage is reported on the Status Page. If powering the InSpector 2000 from the ac adapter "A/C" will be reported for the Power Mode and a value of 9 to 10 will be reported for the Bat A Voltage on the next line below. If using a battery, "Good" will be reported for the Power Mode if the battery voltage is between 5.8 and 8.9 V dc. The current operating (loaded) battery voltage is reported on the next line below Power Mode. "Low" will be reported if the battery voltage is in the range of 5.5 to 5.79 V dc. If the battery voltage is less than 5.5 V dc the InSpector 2000 will not turn on.

Battery Life

The InSpector 2000 uses the latest in battery technology. The standard Sony Lithium-ion battery packs are readily available world wide, offering high power capacity, long life, outstanding shelf life and virtually eliminates the memory effect associated with older battery technologies. The high capacity NP-F950 provides 32.4 Watt/hr or 4.5 Amp/hr of capacity which typically provides in excess of 10 hours of acquisition when using a Canberra detector and associated 2002 RC preamp. When long battery life is not required the optional Sony NP-F550 low profile battery is available with 1/3 the life of the standard high capacity battery. The NP-F550 battery provides 10.8 Watt/hr or 1.5 amp/hr of capacity. The low profile battery reduces the instrument weight and footprint profile.

Expected Battery Life with Different Detector/Preamp Configurations

Battery life is dependent on the battery type, its condition, charge status, temperature and detector/preamp load. The battery life estimates listed in Table 3 are typical and assume the battery is in good condition, fully charged and ambient operating temperature of 25 °C. The preamps listed in Table 3 are full power preamps, battery life will be extended even further if using a low power preamp.

Table 3 Battery Life

Battery Pack	Ge Detector 2002 RC preamp	Ge Detector 2101 TRP Preamp	NaI Detector 2007P Preamp
High Capacity NP-F950	10 hr	8 hr	12.5 hr
Low Profile NP-F550	3 hr	2.5 hr	4 hr

Battery Charging

To charge the battery on the external charger attach it to the charger, connect the charger to the appropriate power source; ac outlet for ac charger or car cigarette lighter for the car battery adapter/charger. The charger's orange lamp will stay on while the battery is charging. When charging is finished, the charge lamp will extinguish and the battery is fully charged. Refer to the charger's user manual for complete instructions. The charging time for a discharged or empty battery can be up to 600 minutes for the NP-F950 battery pack and 240 minutes for the NP-F550 battery pack.

The InSpector 2000 includes a battery trickle charger. When InSpector 2000 is turned ON and powered from an ac or car battery adapter the InSpector's internal trickle charger will charge the installed battery. The trickle charging time is dependent on the preamp power loading; 24 hours when the preamp power (+12 V) is loaded and approximately 72 hours with no preamp load connected.

Note: The internal trickle charger will not charge the battery if the InSpector 2000's power is turned OFF.

Uninterruptible Power Supply Operation

When the InSpector is powered using the ac power or car battery adapters, attaching a battery will provide uninterrupted operation in the event of power failure. If there is an interruption of power from the ac adapter or car battery adapter, the InSpector 2000 will automatically switch over to the attached battery source for uninterrupted operation.

E. Configuring the High Voltage Power Supply

The high voltage range and polarity should be verified and/or setup prior to connecting the InSpector 2000 to detector and turning power on.

Turning the high voltage power supply ON or OFF and setting the output voltage setting are programmable through the computer and Genie-2000 software environment. However, the polarity and range are manually configured using programming modules; the programming modules are conveniently located inside the InSpector 2000. The high voltage range and polarity are preset at the factory for the positive 5000 volt range, which is compatible with many Ge detector applications. If your detector requires negative polarity or the higher current 1300 volt range please reference “HVPS Polarity and Range Configuration” on page 104 for instructions on changing the InSpector 2000’s high voltage range and polarity. Please consult your detector’s manual for its specific high voltage bias requirements.

The high voltage range and polarity can be verified by physically viewing the high voltage module installation. If the InSpector 2000 is already operational with the computer and Genie-2000 software the high voltage configuration and settings can be verified using the Status Page associated with the Gamma Acquisition and Analysis (GAA) application. The Status Page can be opened by clicking on MCA, then Status in the drop down menu. If the MID Definition and high voltage power supply configuration do not match, Genie-2000 will report a hardware verification error when attempting to open the data source in the GAA window. For additional information on configuring the High Voltage Settings in the MID Definition please reference page 30. For complete information on the MID Files and the Gamma Acquisition and Analysis window, please reference the *Genie-2000 Operations* manual.

WARNING: The InSpector 2000 High Voltage Power Supply produces hazardous and lethal voltages. Turn the InSpector 2000 High Voltage Power Supply to OFF and main power to OFF before attempting to change the high voltage programming modules.

CAUTION: Excessive voltage and/or incorrect polarity can permanently damage the detector system.

It is recommended that the high voltage setting be verified prior to turning the high voltage power supply to ON.

HVPS Polarity and Range Configuration

Accessing the High Voltage Programming Modules

To access the High Voltage Programming Module the following steps are performed.

1. Remove the InSpector 2000 front panel assembly, turn the front panel thumb screws counter clockwise to remove the front panel, see Figures 46 and 47. The screws are installed finger tight and should turn easily without the requirement for tools. Its best to remove both screws simultaneously, set the front panel aside.

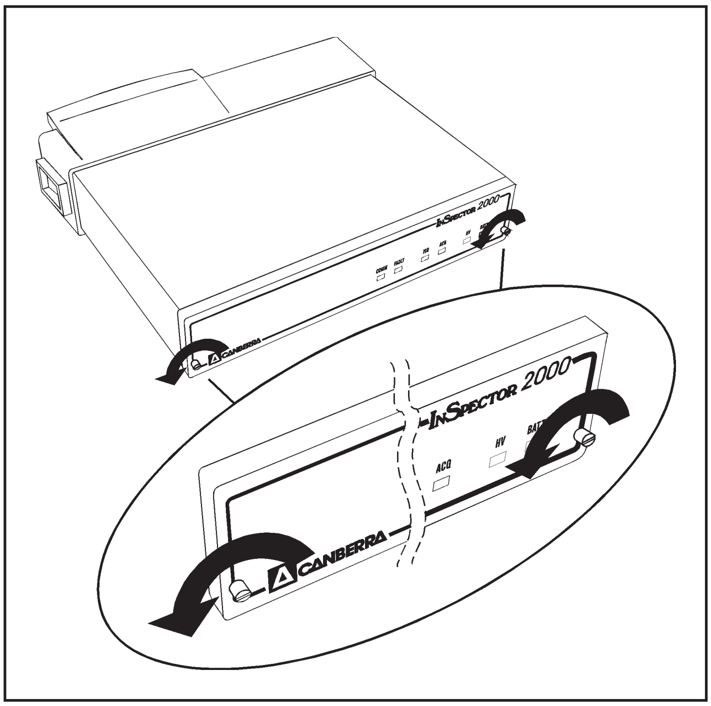

Figure 46 Removal of the Front Panel

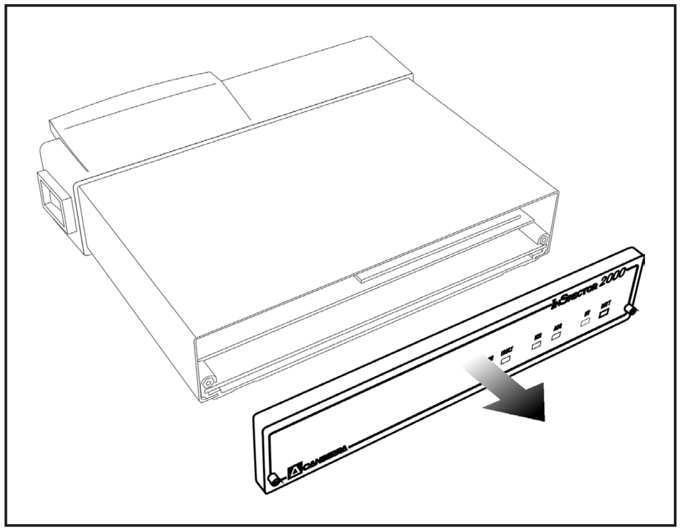

Figure 47 Front Panel Removed

2. Slide the top cover forward to expose the high voltage Interlock board as shown in Figure 48. The top cover slides in channels provided on each side of the aluminum base. Its not necessary to fully remove the cover, but if it inadvertently comes off make certain it engages the channels on each side of the base when reinstalling it.

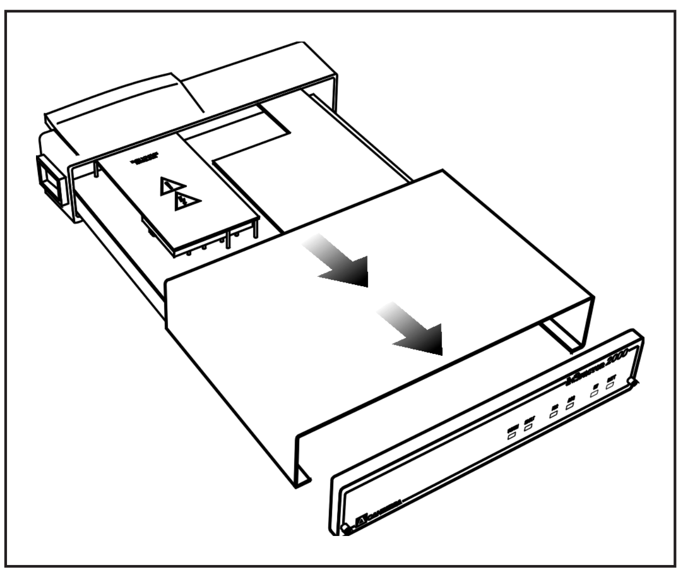

Figure 48 High Voltage Interlock Board Exposed

3. Carefully grasp the High Voltage (HV) Interlock Board with both hands, lift to disengage from the High Voltage Power Supply area as shown in Figure 49.

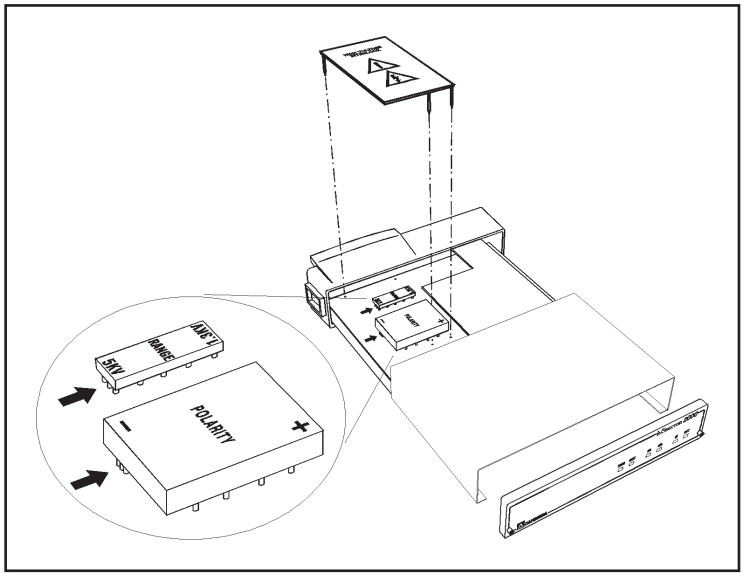

Figure 49 High Voltage Interlock Board Removed

For safety, the HV Interlock Board removes power from the high voltage power supply if the InSpector Power is inadvertently left on. Later versions of the high voltage interlock board may be equipped with a high voltage wedge/bleeder system and removal of the interlock board rapidly bleeds off any residual high voltage remaining on the high voltage power supply circuitry; the time constant is approximately 2 seconds.

Set the HV interlock board aside. For high voltage interlock boards without the wedge/bleeder system approximately 20 seconds are required for the high voltage to bleed down to safe value after the high voltage is shut off.

Changing the High Voltage Polarity

To change the High Voltage Polarity the following steps are performed.

1. Polarity markings (+) for positive and (–) for negative are located on each corner of the high voltage (HV) Polarity Module. The Polarity identifier arrow is located on the high voltage printed circuit board. The identifier arrow pointing to the polarity marking on the HV Polarity Module determines the polarity configuration. In Figure 49, the identifier arrow is pointing to the (–)

marking on the HV Polarity Module; the power supply is configured for negative high voltage.

2. To change the HV Polarity, carefully grasp the HV Polarity Module and remove by lifting up and away from the Main HV board. Rotate 180 degrees so that the (+) polarity marking is positioned toward the polarity identifier arrow on the printed circuit board, see Figure 50. Carefully reinstall the high voltage Polarity Module into the printed circuit board. Make certain the Polarity Module is aligned and fully engaged with the associated connector pin sockets on the high voltage board.

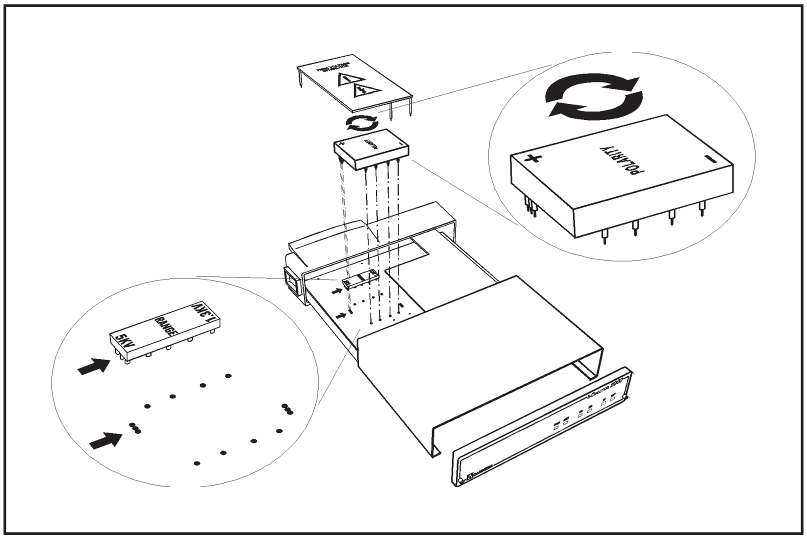

Figure 50 Changing the High Voltage Polarity

Verify the module is installed correctly. Check that the polarity identifier arrow on the printed circuit board is pointing to the intended polarity on the HV Polarity Module.

Changing the High Voltage Range

To change the High Voltage Range the following steps are performed.

1. Range markings (1.3 KV) for 1300 volts and (5 KV) for 5000 volts are located on each end of the High Voltage (HV) Range Module. The Polarity identifier arrow is located on the high voltage printed circuit board. The identifier arrow pointing to the range marking on the HV Range Module determines the range configuration. In Figure 49, the identifier arrow is pointing to the 5 KV marking

on the HV Range Module; the power supply is configured for the 5 kV full-scale range.

2. To change the HV Range, carefully grasp the HV Polarity Module and remove by lifting up and away from the Main HV board. Rotate 180 degrees so that the 1.3 KV polarity marking is positioned toward the polarity identifier arrow on the printed circuit board, see Figure 51. Carefully reinstall the high voltage Range Module into the printed circuit board. Make certain the Range Module is aligned and fully engaged with the associated connector pin sockets on the high voltage board.

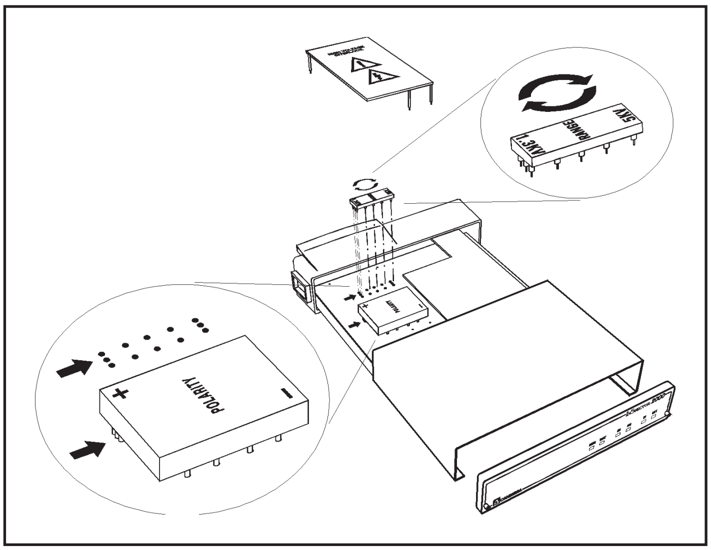

Figure 51 Changing the High Voltage Range

Verify the module is installed correctly. Check that the range identifier arrow on the printed circuit board is pointing to the intended range on the HV Range Module.

Reinstalling the High Voltage Interlock Board

To reinstall the High Voltage Interlock board the following steps are performed.

1. The High Voltage Interlock Board has four connector pins and a nylon high voltage wedge, if equipped, which must be aligned and engaged with the associated receptacle on the High Voltage Board. Orient the Interlock Board so that the caution arrows point toward the rear panel, see Figure 52.

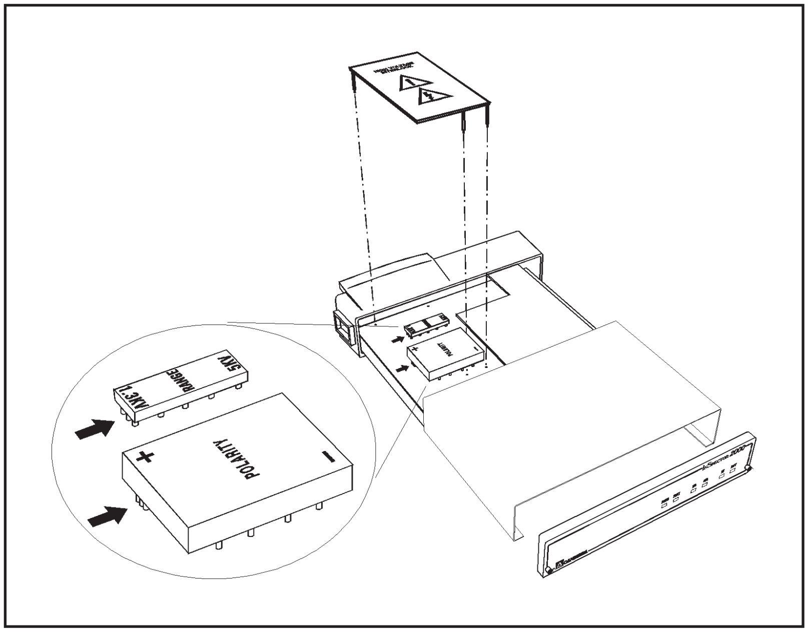

Figure 52 Reinstalling the High Voltage Interlock Board

2. Grasp the HV Interlock board with two hands, align the high voltage wedge, if equipped, and connector pins with the associated connector sockets on the HV board. Gently begin engaging the high voltage wedge, if equipped, into its associated connector sockets. While monitoring the alignment of the connector pins continue with the installation of the Interlock Board until the connector pins and nylon wedge, if equipped, are fully engaged. Check to make certain the four pins are aligned and engaged in the connector sockets on the HV board.

Note: When installing the HV Interlock board do not allow the board to rotate or twist as this might damage the wedge, if equipped, contact pins.

Reinstalling the Top Cover and Front Panel

To reinstall the top cover and front panel the following steps are performed.

1. Carefully slide the top cover back on toward the rear until it engages with the rear bezel.

2. Carefully align the front panel and attach using the two thumbscrews. Do not over tighten the front panel thumbscrews, do not use a screwdriver; they only need to be finger tight.

Genie-2000 Software Configuration

The MID Definition may need to be configured to match the high voltage hardware setting. If the MID definition and hardware configuration for the high voltage power supply do not match Genie-2000 will report a hardware verification error when attempting to open the data source in the Acquisition and Analysis window. For additional information on configuring the High Voltage Settings in the MID Definition please refer to page 30.

High Voltage Plug in Module Part Numbers

For part number information please refer to Appendix C, *Accessory and Cable Part Numbers*.

F. Connecting to the Host Computer

The InSpector 2000 can be connected to the host computer using the RS232 serial communication interface or the high-speed USB (Universal Serial Bus) communication interface. The following discussion will guide you in connecting the InSpector 2000 to your host computer. Information is provided below to:

- Help you select which communication interface to use.
- Connect the appropriate cable.
- Identify and select the appropriate communication port and baud rate when using the RS232 Port.
- Identify the Mulitport II serial number which serves as the unique device number when using the USB Port.

On IBM compatible computers, the RS232 interface is also known as a COM Port. It is a bi-directional serial interface for low to medium speed data transfer with peripheral devices. The maximum transfer rate is depended on the capabilities of the specific computer and cable length being used, but is limited to less than 115 200 bits per second. Also, most computers have only two COM ports which limits the number of devices that can be attached ant any given time.

The USB (Universal Serial Interface) is a high performance, high-speed serial interface that is available on most new computers. It can accommodate a data transfer rate up to 12 megabits per second as opposed to 100+ Kbits per second of the RS232 serial interface.

Most computers provide a minimum of two USB ports. Each USB port can accommodate up to seven devices with the addition of a USB Hub. The number of total USB devices can be expanded up to 128 with additional USB hub devices. However, in practice the actual number of InSpector 2000 instruments will be limited by host computer performance and available USB bandwidth.

The USB port is “plug and play” which makes adding peripheral devices easy, there is no need to set DIP switches or IRQ’s. The only requirement is that Genie-2000 software be configured with the unique InSpector device serial number.

“Hot-swapping” is another advantage of USB, you can plug and unplug USB peripheral devices while the computer is on. The USB also distributes and powers USB compatible peripheral devices. The computer automatically senses the device power requirement and delivers it to the device. The InSpector 2000 uses only a small amount of power from the USB buss; total power consumption from the USB buss is less than 1 USB unit load which is less than 100 µA.

Note: Canberra's USB driver is a Microsoft Win32 Driver Model (WDM) compatible with Windows 98 and future versions of Windows, i.e. Windows 2000. However, Windows 95 is not supported since not all the driver functions are supported under WDM for Windows 95.

Using the RS232 Port

Connecting to the Host Computer

The RS232 cable is 1 m (3 ft) long, it allows transfer of computer commands and spectral data between the InSpector 2000 and the host computer. One end of the cable has a 9 pin D-type connector; connect this end to your computer's communications COM port connector. The other end of the connector has a subminiature circular 3-pin connector; con-nect this end to the RS232 connector located on the rear panel of the InSpector 2000.

The communication interface must be defined and configured in the Genie-2000 MID Definition. Please refer to "The MID Wizard" on page 23 for instruction on assigning COM ports and baud rates. Baud rates of 2.4, 4.8, 9.6, 14.4, 19.2, 28.8, 38.4, 57.6 and 115.2 kbaud can be selected; the InSpector 2000 automatically senses the baud rate setup at the host computer.

Note: Baud rates higher than 57 kbaud may require the use of special hardware and/or device drivers installed in your computer.

Low baud rate selections may degrade performance such as Genie-2000 command response time, spectral and digital scope display update rates. For best performance select the highest baud rate supported by the host computer. For slower computers that cannot keep up with a selected baud rate communication retries may begin to occur which will also degrade performance. If this is suspected try using a lower baud rate and check for an improvement in performance.

Note: The power management on some Lap Top computers may power down the RS-232 port which will disrupt the serial data stream the InSpector 2000. If you experience random or periodic communication errors this may be due to the Lap Top computer power manager. For this case it is recommended to disable the Power Management Features on your Lap Top computer. Please consult the User Manual for your Lap Top computer for specific instructions to disable the Power Management Feature.

Connecting Multiple InSpector 2000's

If you have more than one InSpector 2000, each one will have to be connected to a different COM port, such as COM1 and COM2. Each InSpector 2000 must be assigned to the COM port that you are connected to. This is done in the MID Definition, please refer to "The MID Wizard" on page 23 for instruction on assigning COM ports and baud rates.

Using the USB Port

Connecting to the Host Computer

The USB cable is 1 m (3 ft) long, it allows transfer of computer commands and spectral data between the InSpector 2000 and the host computer. Both ends have USB connectors which are defined by the USB standard; one end is rectangular, the other end is square. Connect the square end of the USB cable to the USB port located on the rear panel of the InSpector 2000, connect the rectangular USB connector of the cable to the USB port on the host computer.

When connecting to the computer using the USB port a hardware configuration must be created in the MID Definition. The InSpector 2000 device is uniquely identified using it's serial number. The serial number is an 8 digit number that is affixed to the bottom of the instrument. Please refer to "The MID Wizard" on page 23 for instruction on configuring the hardware for USB operation.

Connecting Multiple InSpector 2000's

Most USB computers provide two host USB ports, the ports are usually designated A and B. Up to two InSpector 2000's can be supported with no additional hardware.

If more that two InSpector 2000's are to be connected to the same computer, then a USB hub will be required. Hubs are available that allow up to seven InSpector 2000's to be attached. For additional information on USB hubs please refer to the specific USB hub user manual.

As with connecting a single InSpector 2000 using the USB port a hardware configuration must be created in the MID Definition. The InSpector 2000 devices are uniquely identified using the hardware serial numbers. The serial number is an 8 digit number that is affixed to the bottom of each InSpector 2000. Please refer "The MID Wizard" on page 23 for instruction on configuring the hardware for USB operation.

USB Standard, Class, and Cable Information

- The InSpector 2000 is compatible with the Universal Serial Bus Specification Rev 1.1. The USB specifications are available from the USB Web Site at: USB.ORG
- All Canberra USB devices are configured as a "Vendor Specific Interface Class", the InSpector 2000 belongs to the MCA subclass.
- The InSpector 2000 conforms to the "Low-Power Function" defined by the USB spec.
- The InSpector 2000 is a high speed USB function which operates at 12 MB/s rate in accordance with the USB standard.
- The maximum cable length supported by USB is 5 meters.

G. Configuring and Stowing the InSpector in the Soft Travel Case

A soft travel case is provided for transporting and storing the InSpector 2000. The travel case includes adjustable dividers that are held in place with Velcro. The travel case and dividers are configured as shown in Figure 53.

The InSpector and cable accessories are stowed in the travel case as shown in Figure 54.

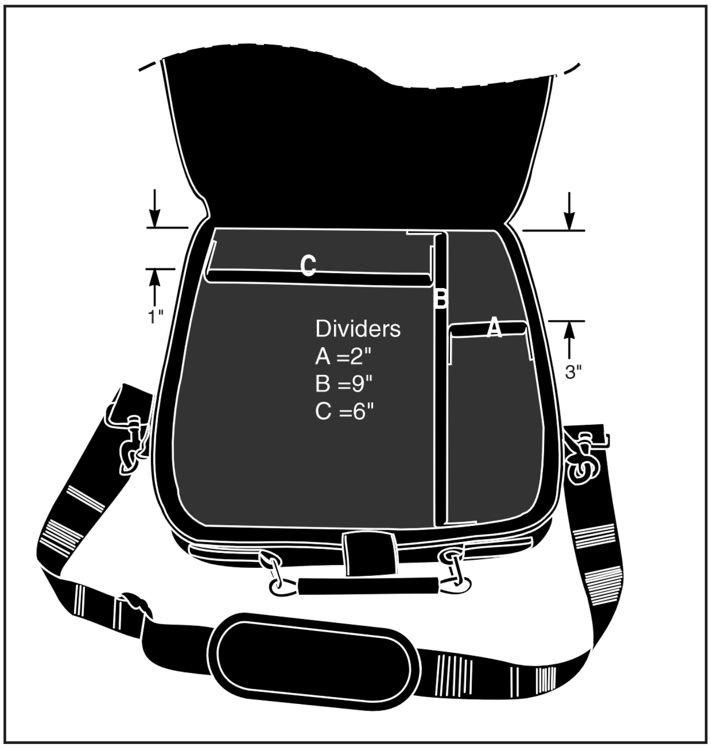

Figure 53 Soft Travel Case Configuration

The InSpector 2000 is held in the large compartment, a Velcro strap secures it in place. The battery pack is placed in the top right compartment, accessory cables are stored in the longer compartment below the battery compartment.

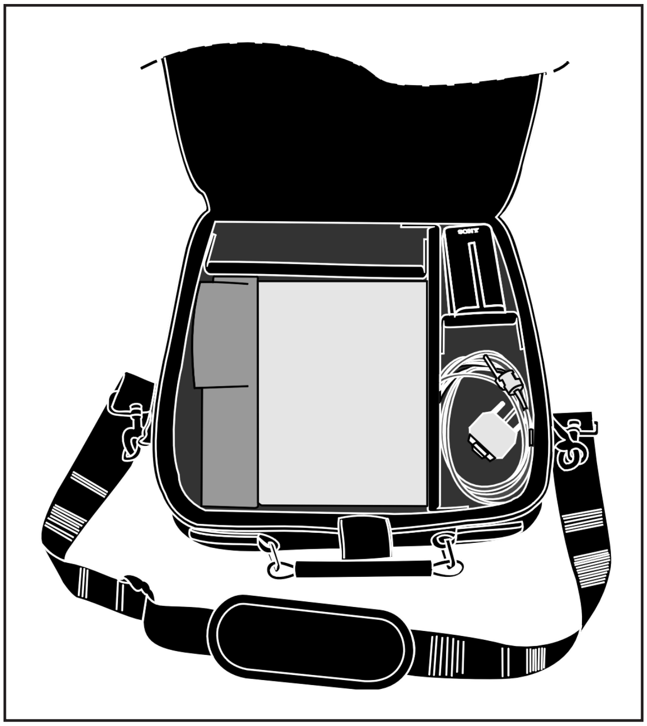

Figure 54 InSpector 2000 and Accessory Storage

Accessories such as the AC Adapter and Battery Charger can also be stored in compartment A. However, these items are not typically used in the field and will add unnecessary weight and clutter. When transporting the InSpector 2000 and associated detector, it is recommended you leave the detector cable connected to the detector.

H. Installation Considerations

This unit complies with all applicable European Union requirements.

Preventive Maintenance

Preventive maintenance is not required for this unit.

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 unit is fully dry before restoring power.

With exception to the High Voltage programming modules as discussed in Appendix E, *Configuring the High Voltage Power Supply*, there are no internal adjustments or maintenance required.

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.

Notes

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Warranty

Canberra (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 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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