ORTEC®

ORTEC MCB *CONNECTIONS-32*
Hardware Property Dialogs Manual

Software Version 6

Printed in U.S.A. ORTEC Part No. 931001 0209
Manual Revision A

Advanced Measurement Technology, Inc.
a/k/a/ ORTEC®, a subsidiary of AMETEK®, Inc.

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NOTE!

We assume that you are thoroughly familiar with 32-bit Microsoft® Windows® usage and terminology. If you are not fully acquainted with the Windows environment, including the use of the mouse, ***we strongly urge you to read the Microsoft documentation supplied with your Windows software and familiarize yourself with a few simple applications before proceeding.***

The convention used in this manual to represent actual keys pressed is to enclose the key label within angle brackets; for example, **<F1>**. For key combinations, the key labels are joined by a + within the angle brackets; for example, **<Alt + 2>**.

INSTALLATION

This manual describes the ***CONNECTIONS**-32* software to communicate with your ORTEC MCBs. The manual is supplied with our ***CONNECTIONS**-32* applications, such as MAESTRO®-32, GammaVision®-32, or ScintiVision™-32, and is used in conjunction with each application's software user manual. The installation for these applications automatically installs the communication software; no additional disks or setup wizards are necessary in this case.

The ***CONNECTIONS**-32* communication software can be updated without changing the application software. The most common reason for updating is to add communication support for new MCBs. This will keep your application software (ORTEC or other) up to date with the latest MCBs. In the case of an update, you must install the new ***CONNECTIONS*** communication software from the CD supplied with the new MCB. Before installing the update, connect and power on all local and network ORTEC instruments that you wish to use. Insert the CD-ROM and click on **Start**, then **Run...**. In the Run dialog, enter **D:\Setup.exe** (use your CD-ROM drive designator) and click on **OK**. The remainder of the installation is automatic — just answer the wizard questions, then restart the PC if directed to do so. You will then be ready to use the new MCB with MAESTRO or other applications.

For more detailed installation instructions, see Section 2.3.

1. INTRODUCTION

This reference manual contains the information you will need to set up all of your ORTEC multichannel buffers (MCBs) for data acquisition in ***CONNECTIONS-32*** programs such as MAESTRO®-32, GammaVision®-32, ScintiVision™-32, ISOTOPIC-32, and AlphaVision®-32.[1] Use this manual in conjunction with the user manuals for your particular ***CONNECTIONS*** application and hardware.

The individual application software manuals contain the MCB Property dialogs for the most common MCB used for that application. All applications can use any of the more than 25 MCBs supported, and this manual gives complete descriptions for all MCBs.

In addition to the MCB Properties setup information that comprises most of this manual, Chapter 2 contains general information on installing ***CONNECTIONS*** software, selecting the proper network protocol for using ***CONNECTIONS*** systems over a network, installing plug-and-play hardware drivers, and building the Master Instrument List. (You can then select the MCBs to be used from the master list in your application software.)

1.1. Setting the Data Acquisition Parameters

The MCB properties are generally set in a dialog with multiple tabs, as shown in Fig. 1. The number of tabs and the contents of the tabs are controlled by the capabilities of both the MCB and the application program. The MCBs have a feature status which the *CONNECTIONS* software reads. Only those features supported by the hard-ware (such as high-voltage polarity) are shown. The application software can suppress or add tabs. Support for the MDA preset depends on the application. Chapter 3 shows the basic Properties dialogs; the common variations are described.

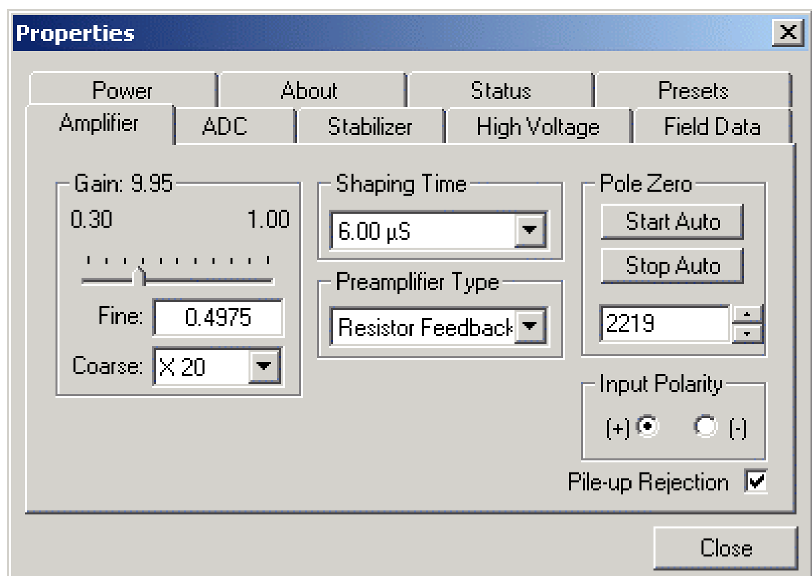


Figure 1. Example Properties Dialog.

To use this manual for setting your MCB properties, simply find your instrument’s setup section in the table of contents or index, click on **Acquire/MCB Properties...**, move from tab to tab and set your hardware parameters, then click on **Close** — it's that easy.

[1] For the purposes of this manual, when we refer to MAESTRO, we mean the MCA emulator/analysis application you are using (e.g., MAESTRO, GammaVision, ScintiVision, ISOTOPIC).

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

1.2. *CONNECTIONS* Programmer's Toolkit

Most users communicate with their MCBs through MAESTRO, so direct interaction with the ***CONNECTIONS*** software layer[2] is not necessary. However, we offer the ***CONNECTIONS*** Programmer's Toolkit with Microsoft ActiveX® Controls for Microsoft Windows 95, 98, 2000, and NT® (A11-B32) for those who wish to write customized applications in Microsoft Visual Basic®, Microsoft Visual C++®, and National Instruments LabVIEW® that directly control ORTEC MCBs.

[2]Also called the Universal Multichannel Buffer Interface or UMCBI.

2. SOFTWARE INSTALLATION AND CONFIGURATION

This chapter discusses the general workflow for installing ***CONNECTIONS-32*** software and hardware, including:

- Installing the drivers for new instruments.
- Choosing the correct protocol for communicating with ORTEC MCBs over a network.
- Installing MAESTRO or other ***CONNECTIONS*** applications.
- Building the Master Instrument List from which you will select the MCBs to be used by your application(s).

Appendix A contains additional setup and configuration notes for special cases including some laptops and older PCs.

2.1. Installing Add-In Drivers for USB Instruments

If you have a USB device, follow these instructions.

2.1.1. Enabling the USB Port on Your PC

Some PC manufacturers ship their computers with the USB port disabled. Before trying to use USB instruments such as the digiDART™, DSPEC jr™, or microBASE™, make sure the USB port is enabled. To check if the USB port is enabled, go to Windows **Settings, Control Panel**, **System**, and click on the Device Manager tab. At the bottom of the list it should show that the "Universal serial bus controller"(⊞ Universal serial bus controller) is present. If not, go to your PC BIOS setup and enable the USB port.

2.1.2. Installing Add-In Drivers

ORTEC USB instruments are supplied with plug-and-play drivers, which are located on the application software or Connections update CD that accompanies the instrument. The USB driver only works in Windows 98 SE and 2000.[3] If your computer does not have a CD drive, you can make floppy disks from the files on the CD. If the hardware manual for your MCB does not specify the necessary files, copy the root directory of the CD to the floppy disk. For further assistance, contact your ORTEC representative.

[3]Windows 95 does not support USB internally, but some USB drivers have been made as additions to Windows 95. These USB drivers do not have complete support for the USB port and do not work with ORTEC USB instruments.

When the unit is connected to the USB port for the first time, Windows will automatically detect that new hardware has been installed and will prompt you to **Select a location** or have **Windows locate the driver**. Click the **Select a location** radio button. On the next menu, select **CD drive** (or **Floppy Disk**). The remainder of the installation is automatic.

2.2. Setting Up the Network Protocol

This section describes how to select the right Windows 95/98, NT, 2000, and XP protocols for ***CONNECTIONS*** operation on a network. ORTEC ***CONNECTIONS*** software will use all of the network "languages" — called *protocols* — supported by 32-bit Windows. If multiple protocols are installed on the various PCs in the network, only those PCs with compatible protocols will be able to communicate with one another. No special settings are required in that case. However, ***CONNECTIONS*** products with built-in Ethernet adapters, such as the DSPEC Plus ™, DSPEC®, ORSIM™ II or III, OCTÊTE Plus™, 919E, 920E, 921E, MatchMaker™, and 92X-II, communicate directly with the PCs on the network; we refer to these as "direct-connect" devices. The PCs and these direct-connect units must "speak the same language" (i.e., use the same protocol) in order to understand each other. If you are connected to instruments via a network and one or more of the MCBs on the network has a built-in Ethernet adapter, the network default protocol must be set to the following protocols on all PCs that use ***CONNECTIONS*** hardware:

- Windows 95/98 — **IPX/SPX Compatible Transport with NetBIOS**
- Windows NT — **NWLink IPX/SPX Compatible Transport** or **NWLink IPX/SPX NetBIOS**
- Windows 2000/XP — **NWLink IPX/SPX/NetBIOS Compatible Transport Protocol**

In addition, in a network that has both 16-bit (e.g., Windows 3.x) and 32-bit Windows systems on it, the 32-bit systems must use the IPX/SPX protocol before they can communicate with any 16-bit system.

2.2.1. Windows 95/98 Network Setup

To use direct-connect MCBs, Windows 95 and 98 must use the **IPX/SPX Compatible Transport with NetBIOS** protocol. As noted above, systems without any direct-connect Ethernet devices can use any protocol.

To check to see if the IPX/SPX protocol is installed, add it, or set it as the default, click on **Start** from the Windows Taskbar. Next select **Settings**, then **Control Panel** as shown in Fig. 2.

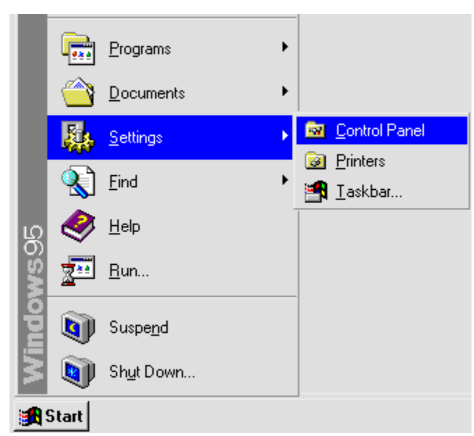
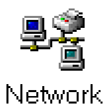


Figure 2. Starting Windows 95/98 Control Panel.



When the Control Panel opens, double-click on the **Network** icon to open the Network dialog (Fig. 3).

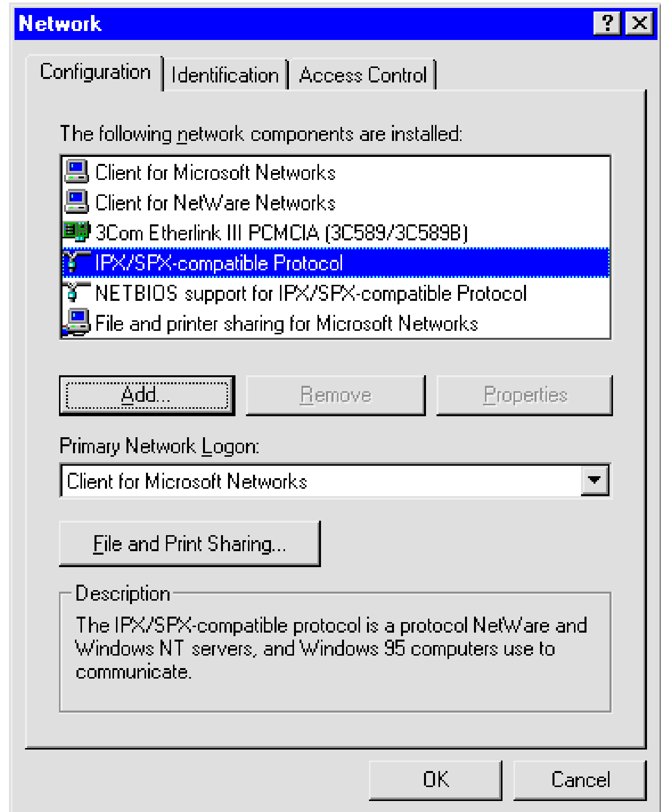


Figure 3. The Network Dialog.

2.2.1.1. Adapter

Make sure the Ethernet adapter is on the list of installed components. If not, it must be added.

To add the Ethernet adapter to the list, click on the **Add...** button. This will open the Select Network Component Type dialog (Fig. 4). Select **Adapter** and click on **Add...**. Add the adapter according to the hardware instructions. When adapter setup is complete, click on **OK** to return to the Network dialog.

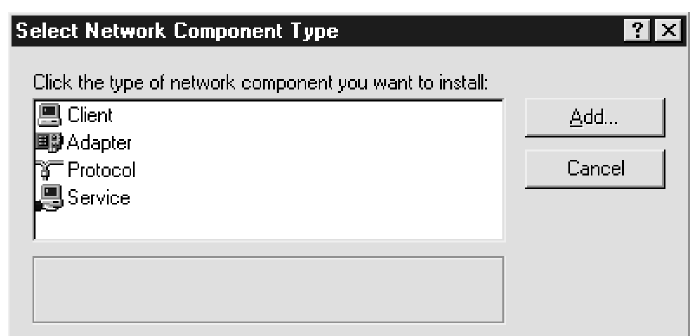


Figure 4. Select Network Component.

2.2.1.2. Protocol

If **IPX/SPX-compatible Protocol** is not listed, it needs to be added. To do so, click on **Add...**. This will again open the Select Network Component Type dialog. Click on **Protocol** and click on **Add...**. The Select Network Protocol dialog (Fig. 5) will open.

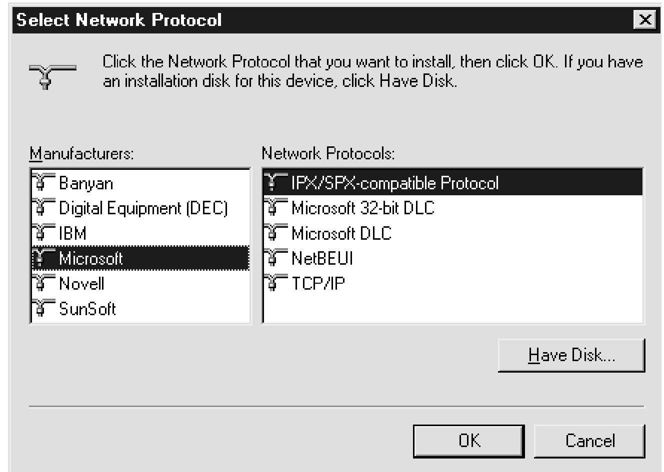


Figure 5. Select IPX/SPX-Compatible Protocol.

Under **Manufacturers**, click on **Microsoft**. Under **Network Protocols**, click on **IPX/SPX-compatible Protocol**. Click **OK** to add the protocol to the list and return to the Network dialog.

On the Network dialog, click once on **IPX/SPX-compatible Protocol** to highlight it, then click on **Properties**. This will open the IPX/SPX-compatible Protocol Properties dialog shown in Fig. 6. Click on the **NetBIOS** tab, then check the option **I want to enable NetBIOS over IPX/SPX**.

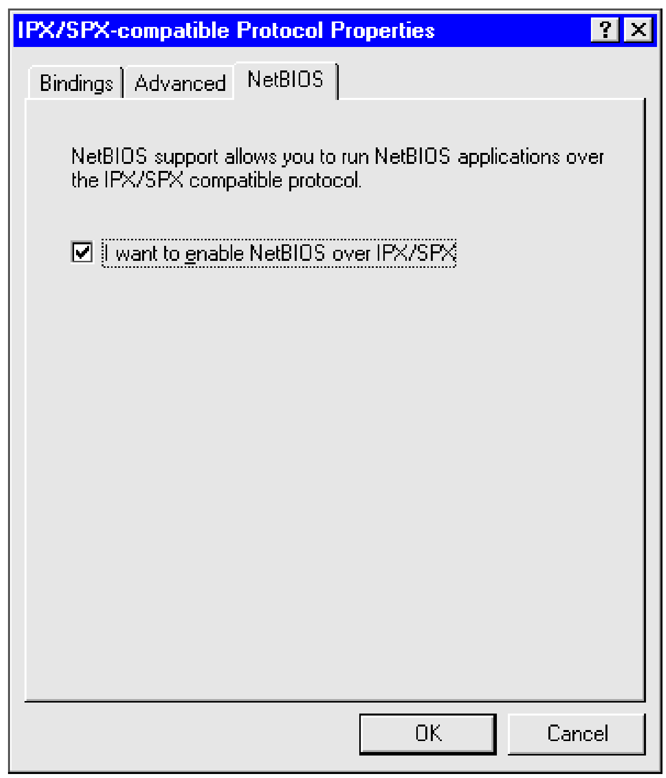


Figure 6. Enable NetBIOS over IPX/SPX.

Next, click on the Advanced tab as shown in Fig. 7. In the **Property:** box, click once to select **Frame Type**. Open the **Value:** field pull-down list (double-click on the field or click once on the down arrow) and select **Ethernet 802.3**. Check the option **Set this protocol to be the default protocol**. Click on **OK** to return to the Network dialog (Fig. 3).

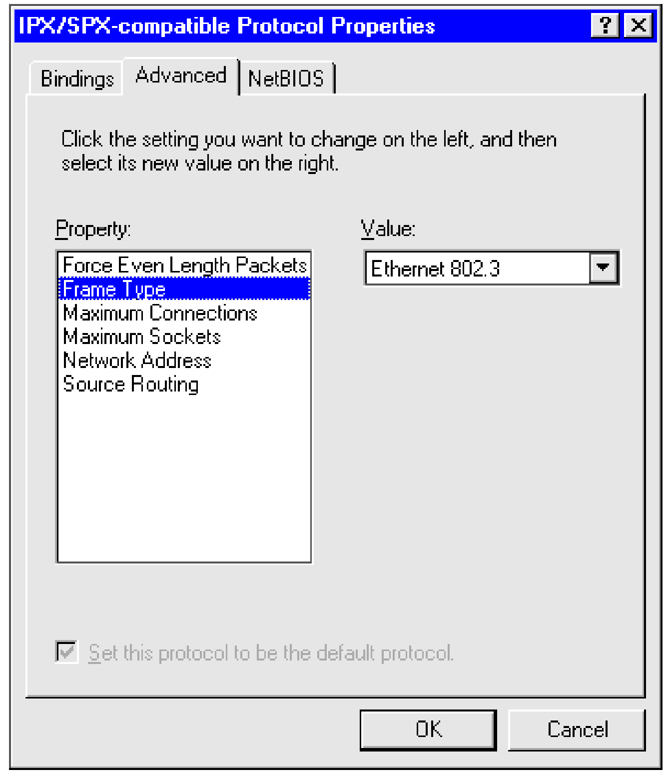


Figure 7. Advanced Protocol Setup.

2.2.1.3. Network Client

If **Client for Microsoft Networks** is not on the list of currently installed network components, click on **Add...** to open the Select Network Component Type dialog. Select **Client** and click on **Add...** to open the Select Network Client dialog (Fig. 8).

Click on **Microsoft** in the list of **Manufacturers**, and **Client for Microsoft Networks** under **Network Clients**. Next, click on **OK** to return to the Select Network Client dialog. Finally, click on **Add** to finish the operation and return to the Network dialog.

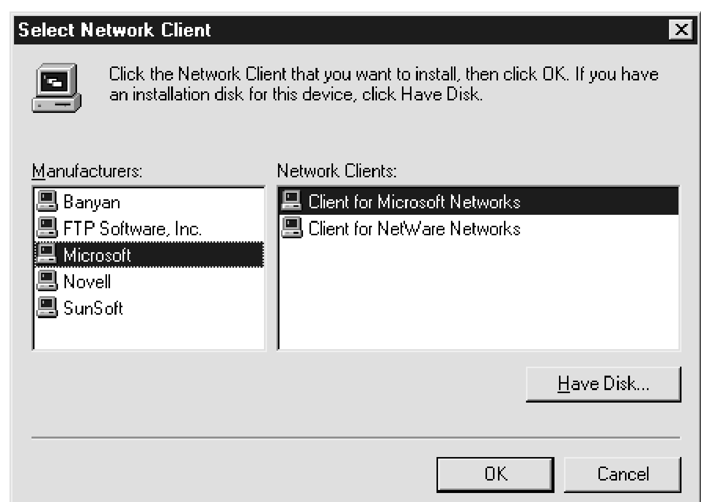


Figure 8. Select Client for Microsoft Networks.

Click **OK** again to close the Network dialog and finish the operation. If changes were made, you must restart the PC so the changes will be applied to Windows. This is necessary before direct-connect MCBs can be used.

2.2.2. Windows NT (V4.x) Network Setup

To use direct-connect MCBs, Windows NT V4.x must use the **NWLink IPX/SPX Compatible Transport** protocol. As noted above, systems without any direct-connect Ethernet devices can use any protocol.

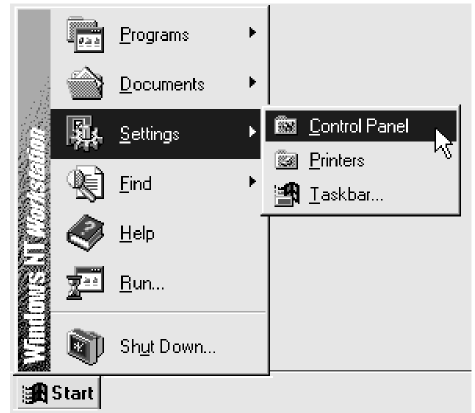
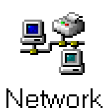


Figure 9. Start the Control Panel.

To check to see if the NWLink IPX/SPX Compatible Transport protocol is installed, to add it, or to select it as the default, click on **Start** from the Windows Taskbar. Next select **Settings**, then **Control Panel** as shown in Fig. 9.



When the Control Panel opens, double-click on the **Network** icon. This will open the Network dialog to the Identification tab.

2.2.2.1. Adapter

If no adapter is shown, it needs to be added. Click on the **Add...** button and follow the hardware instructions for adding the proper adapter. When adapter setup is complete, click on **OK** to return to the Network dialog.

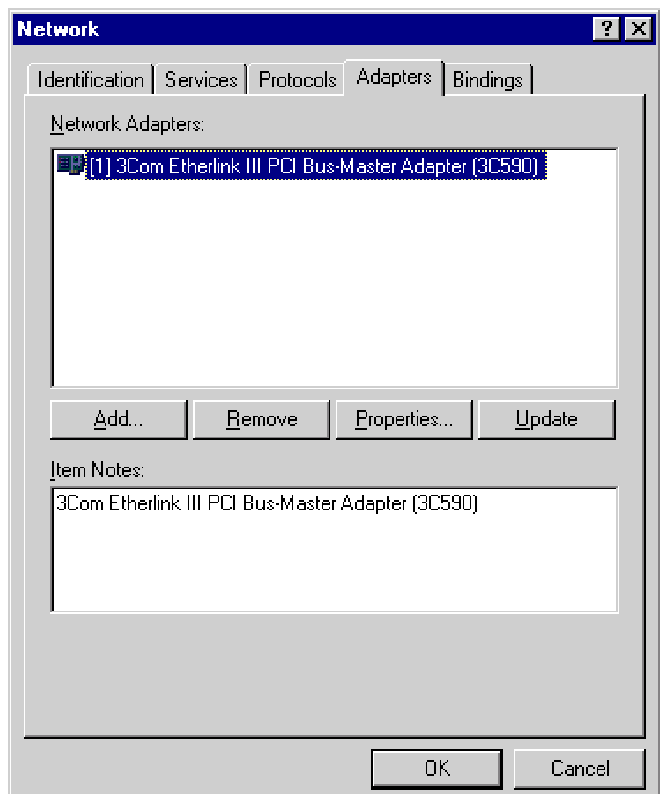


Figure 10. The Network Dialog, Adapter Tab.

2.2.2.2. Protocol

On the Network dialog, click on the Protocols tab to open the dialog shown in Fig. 11. If the **NWLink IPX/SPX Compatible Transport** or **NWLink NetBIOS** protocol is not listed, it needs to be added.

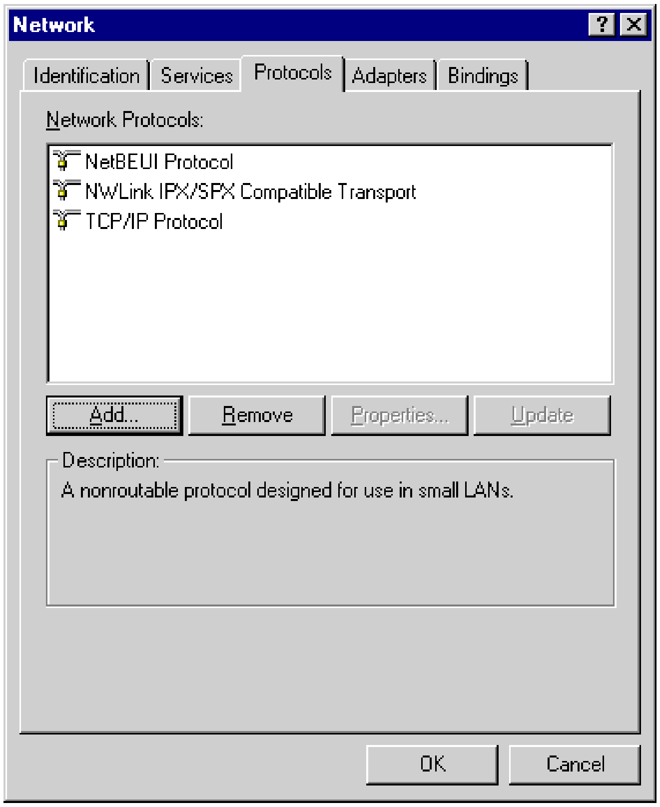


Figure 11. The Network Dialog, Protocols Tab.

To add the **NWLink IPX/SPX Compatible Transport** protocol to the list, click on **Add...** to display the Select Network Protocol dialog shown in Fig. 12. Click on **NWLink IPX/SPX Compatible Transport**, then click on **OK** to return to the Network dialog.

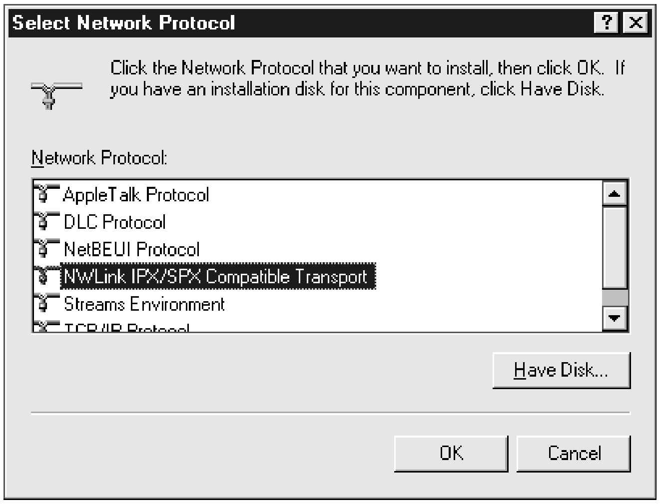


Figure 12. Select IPX/SPX Protocol.

On the Network dialog, click once on **NWLink IPX/SPX Compatible Transport,** then on **Configure...** to open a dialog similar to the one in Fig. 13.

Open the **Adapter** pull-down list (double-click in the field or click once on the down arrow) and select the adapter to be used. Normally there will only be one adapter on the system. Next select the **Frame Type** pull-down list and click on **Ethernet 802.3**. The **Internal Network Number** should be left at the default value. To complete this step and return to the Network dialog, click on **OK**.

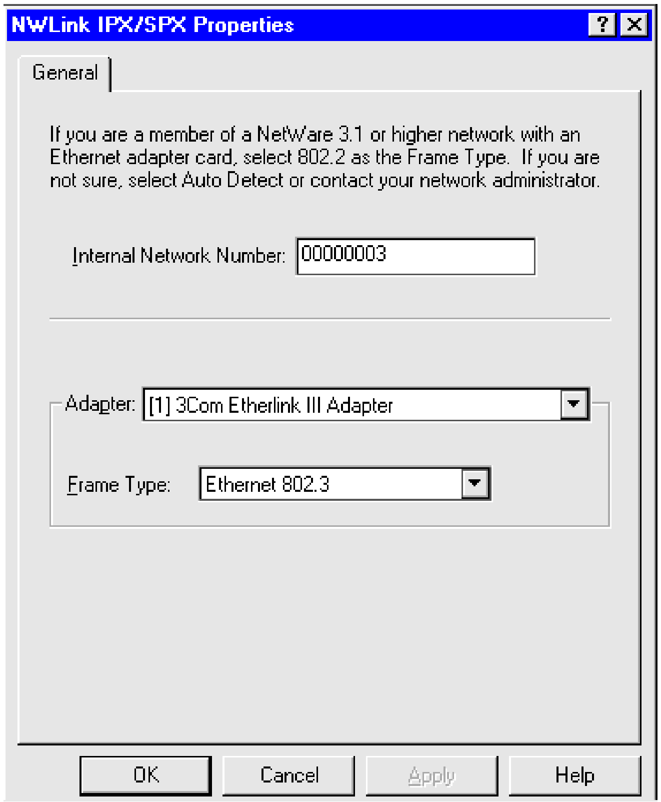


Figure 13. Select Ethernet 802.3 Frame Type.

2.2.2.3. Services

Click on the Services tab to display the dialog shown in Fig. 14.

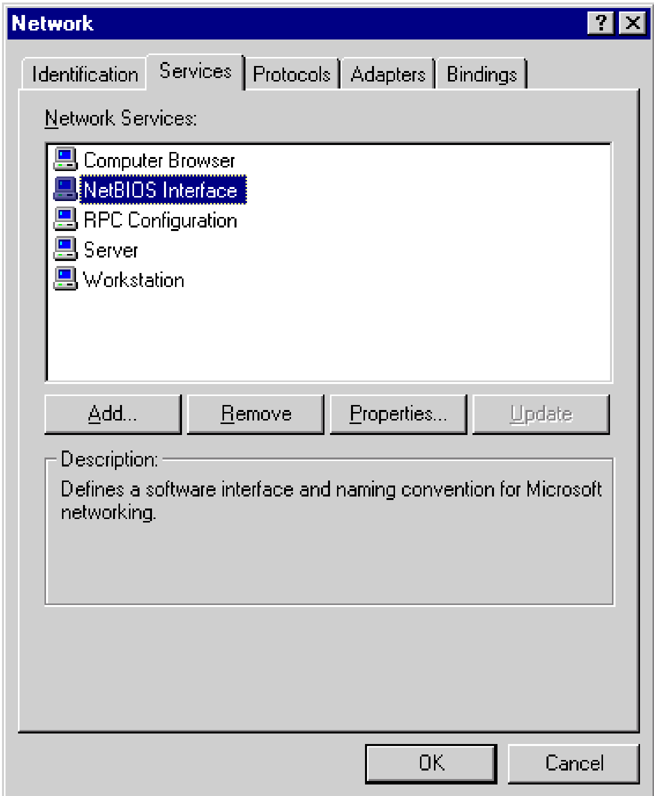


Figure 14. The Network Dialog, Services Tab.

If **NetBIOS Interface** is not shown, it should be added. To do this, click on **Add...** to display the Select Network Service dialog (see Fig. 15).

Click once on **NetBIOS Interface** to highlight it, then click on **OK** to add the service and return to the Network dialog.

Click **OK** again to close the Network dialog and finish the operation. If you changed any of the settings, you must restart the PC so the changes will be applied to Windows. This is necessary before direct-connect devices can be used.

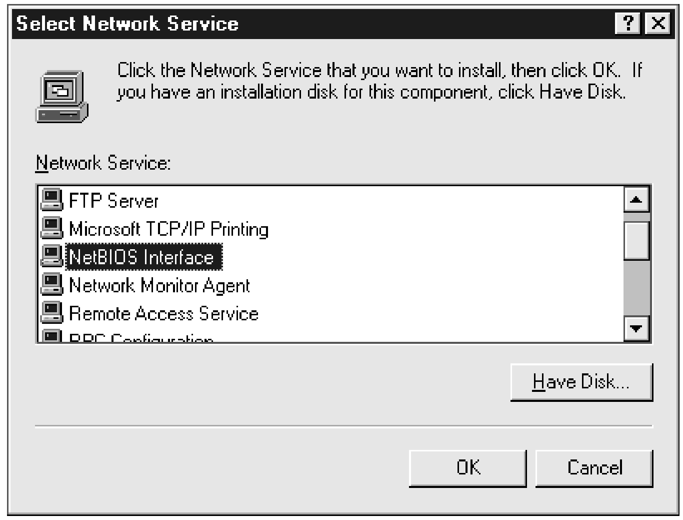


Figure 15. Select NetBIOS Interface.

2.2.3. Windows 2000 Setup

To determine whether the NWLink IPX/SPX/NetBIOS Compatible Transport Protocol is installed, to add it, or to select it as the default, go to the Taskbar and click on **Start/Settings/Network and Dial-up Connection** as shown in Fig. 16. This will open the Network and Dial-up Connections dialog shown in Fig. 17.

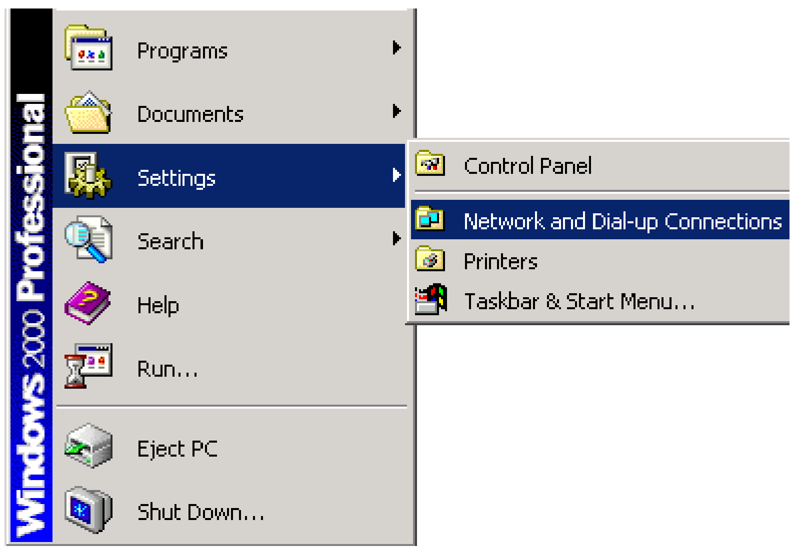


Figure 16. Start Network and Dial-up Connection..

This dialog displays the existing connections. If no network entry is shown, install the hardware and follow the instructions for new hardware, then return to this screen.

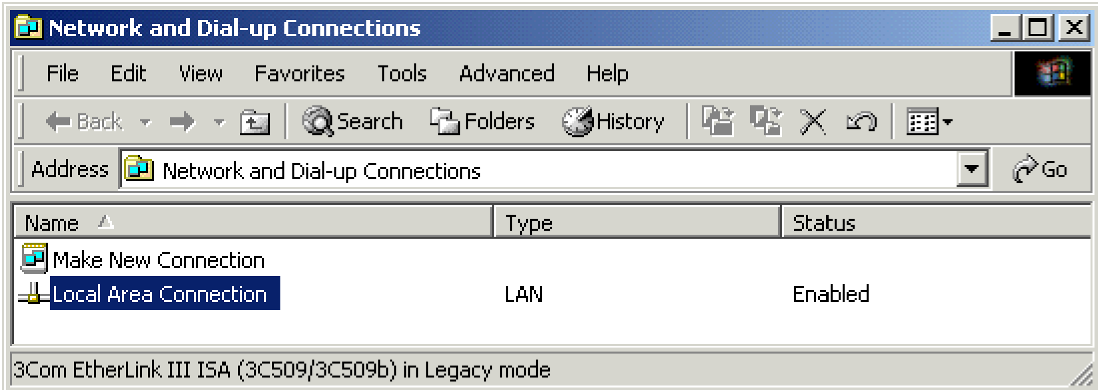


Figure 17. Network and Dial-up Connections.

Double-click on the **Local Area Connection** entry to display the status dialog as shown in Fig.18.

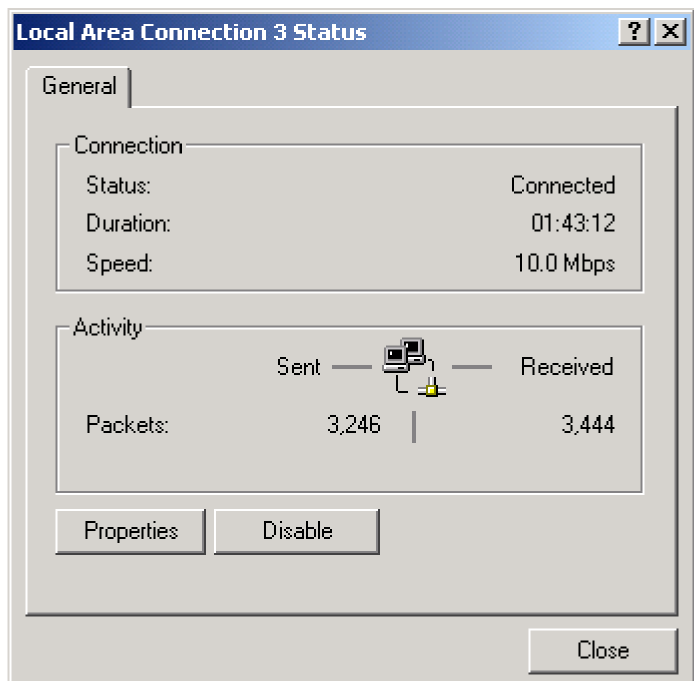


Figure 18. LAN Connection.

Click on the **Properties** button to open the Local Area Connection Properties dialog shown in Fig. 19.

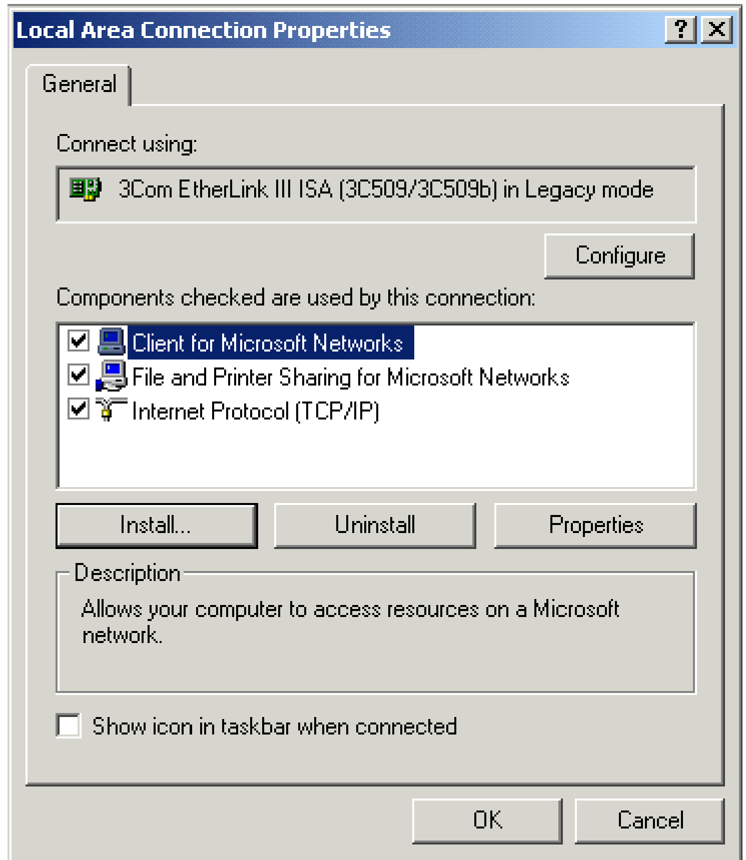


Figure 19. LAN Properties.

To add the **NWLink IPX/SPX/NetBIOS Compatible Transport Protocol**, click on the **Install...** button. This will open the Select Network Component Type dialog (Fig. 20). Click on **Protocol** to display the Select Network Protocol dialog shown in Fig. 21.

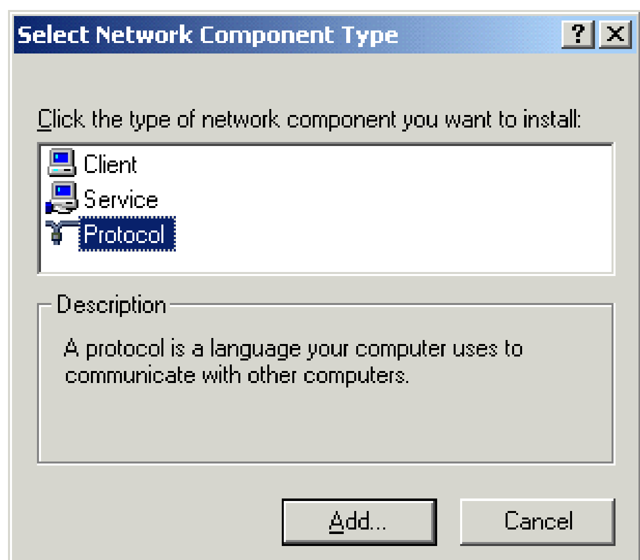


Figure 20. Add a New Protocol.

Click on **NWLink IPX/SPX/ NetBIOS Compatible Transport Protocol**, then click on **OK** to return to the Local Area Connection Properties dialog. (Fig. 22).

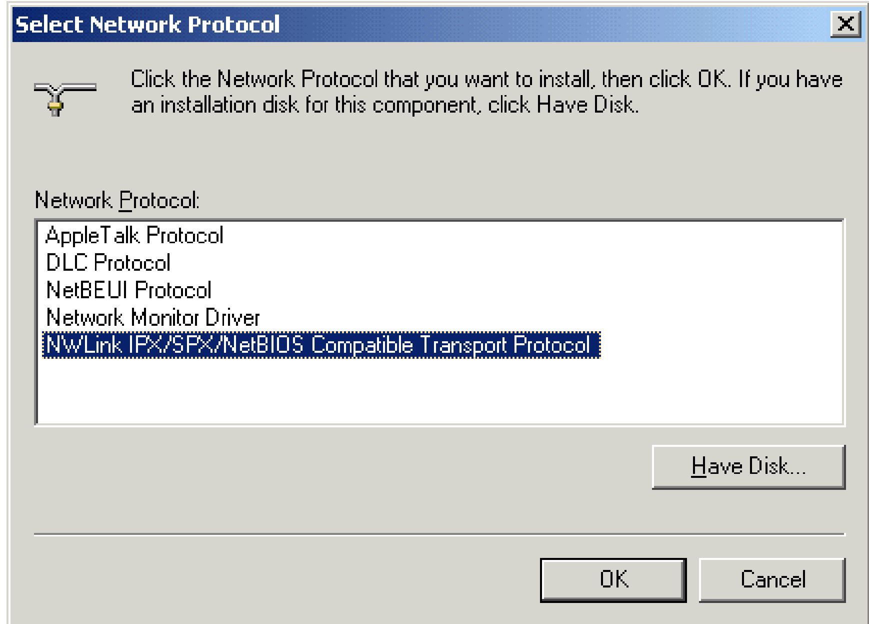


Figure 21. Choose the Protocol.

Select **NWLINK IPX...** as shown, then click on **Properties** to open the dialog shown in Fig. 23.

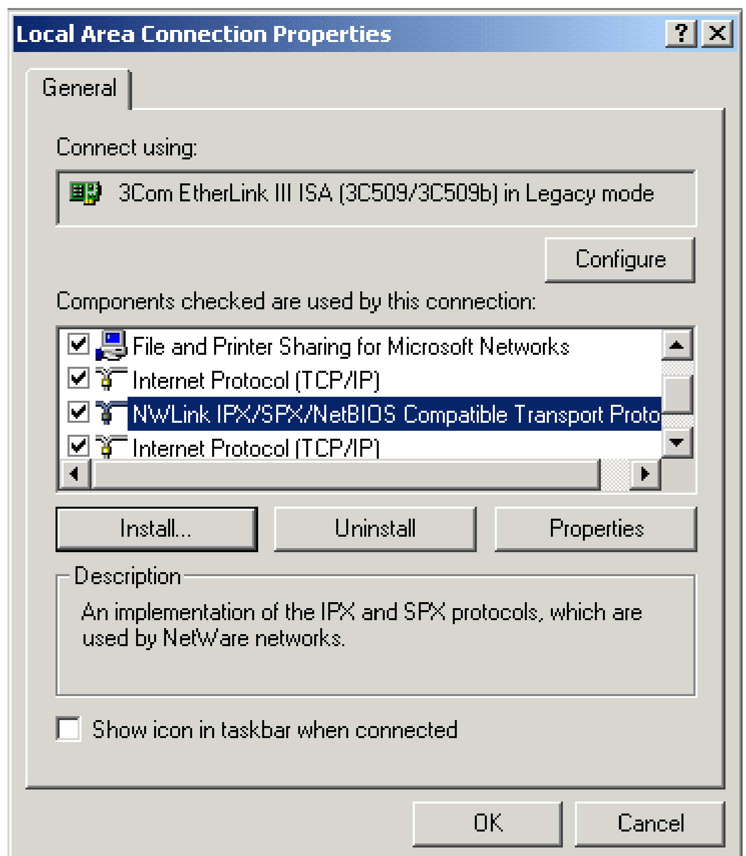


Figure 22. LAN Properties.

Set the **Frame type** to 802.3 as shown, then click on **OK** and return to the Windows desktop.

NOTE Should you experience difficulties communicating with network MCBs, return to this dialog and make sure the **Frame type** setting was saved.

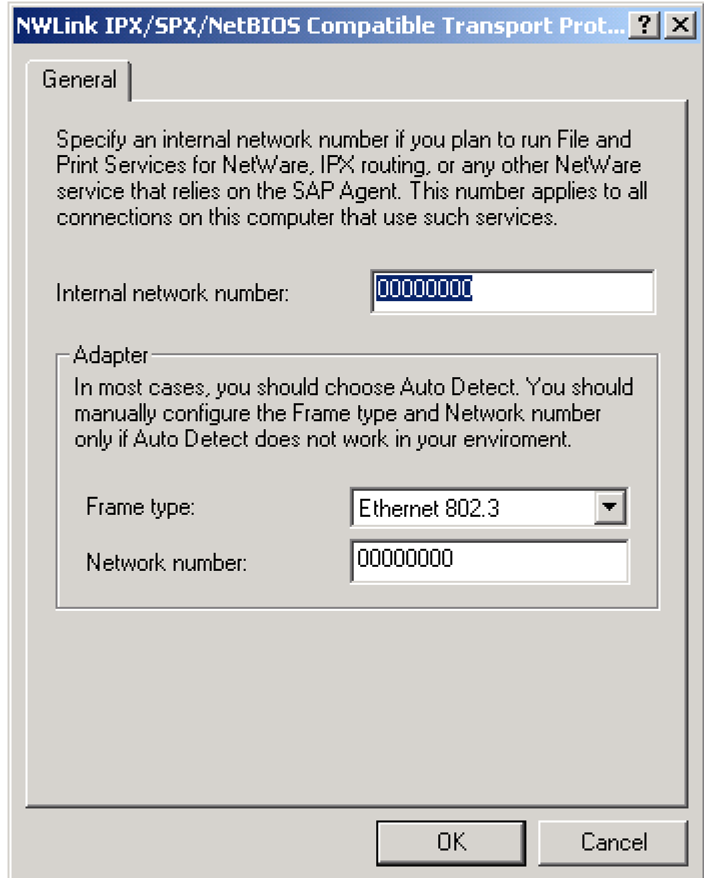


Figure 23. Choose the Correct Frame Type.

2.2.4. Windows XP Setup

To determine whether the NWLink IPX/SPX/NetBIOS Compatible Transport Protocol is installed, to add it, or to select it as the default, go to the Taskbar and click on **Start**, then **Control Panel**. In the Control Panel under "Pick a Category," choose **Network and Internet Connections** (Fig. 24).

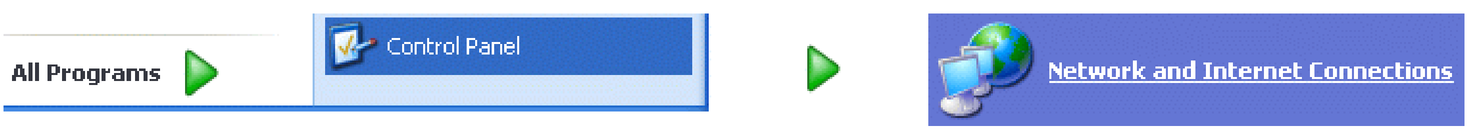


Figure 24. Open the Control Panel, then Network and Internet Connections.

Under "Pick a Control Panel Icon," click on **Network Connections** (Fig. 25). This will display the **LAN or High-Speed Internet** connections, as shown in Fig. 26.

Figure 25. Network Connections.

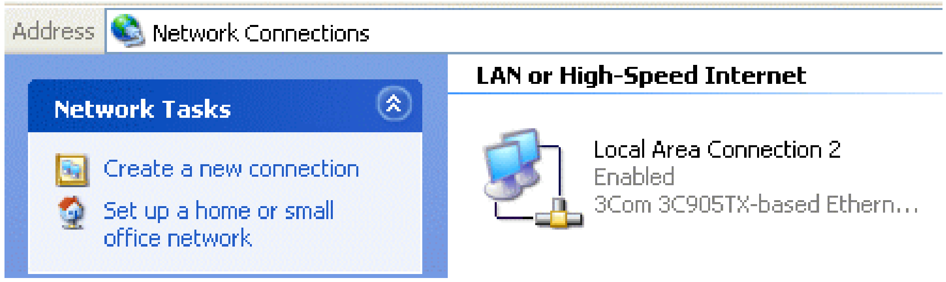


Figure 26. Existing Network Connections.

If no network entry is shown, install the hardware and follow the instructions for new hardware, then return to this screen.

Double-click on the existing LAN entry to display the status dialog shown in Fig. 27. Click on **Properties** to open the LAN properties dialog (Fig. 28).

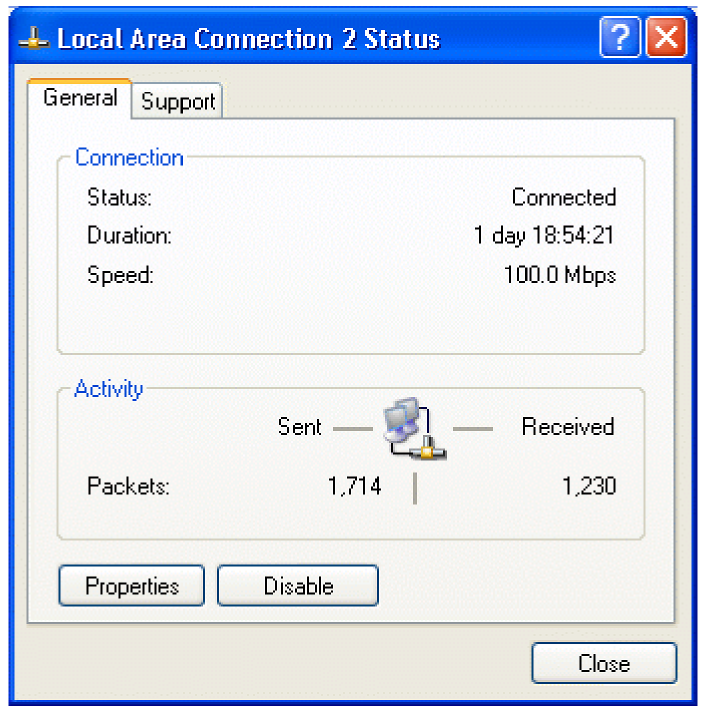


Figure 27. LAN Connection Status.

To add the **NWLink IPX/SPX/NetBIOS Compatible Transport Protocol**, click on the **Install...** button. This will open the Select Network Component Type dialog (Fig. 29).

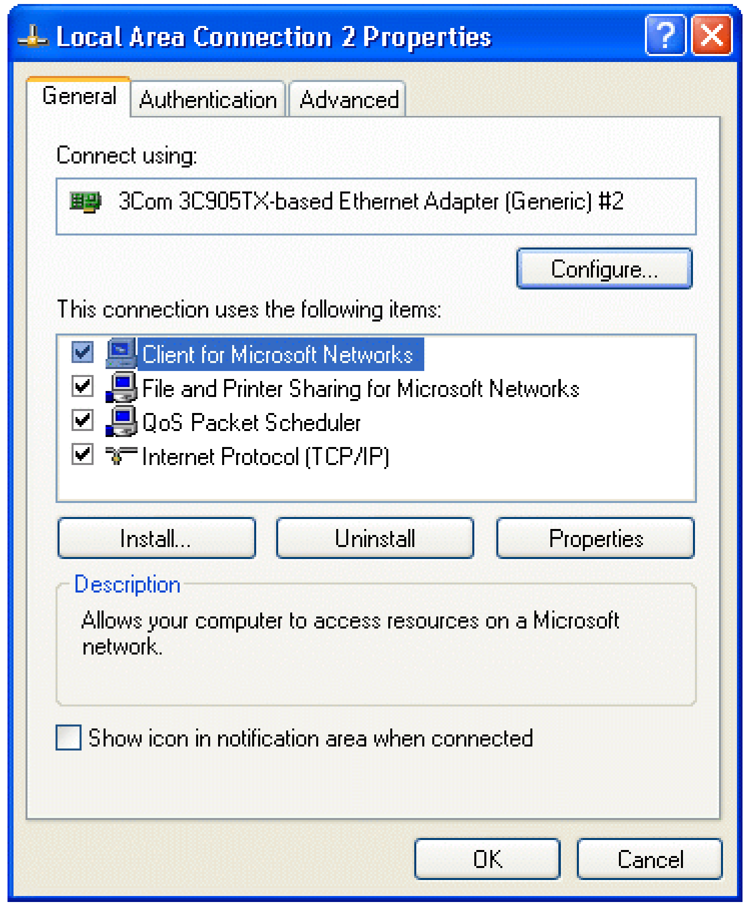


Figure 28. LAN Properties.

Click on **Protocol** to display the Select Network Protocol dialog shown in Fig. 30.

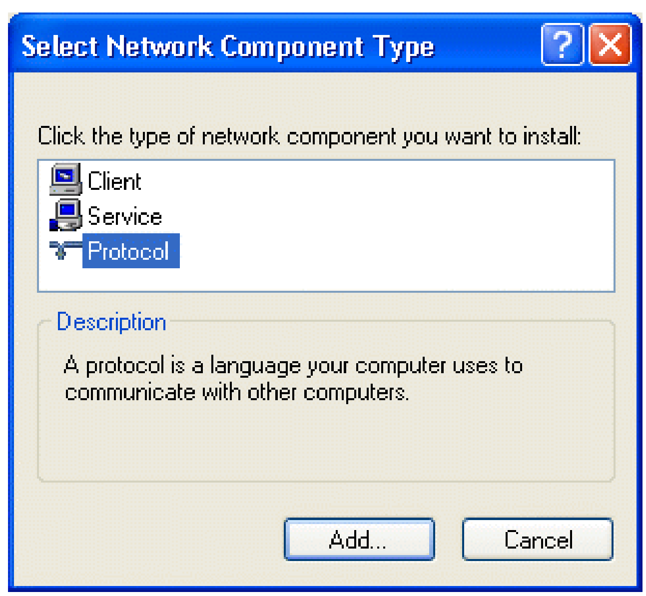


Figure 29. Add a New Protocol.

Click on **NWLink IPX/SPX/ NetBIOS Compatible Transport Protocol**, then click on **OK** to return to the Local Area Connection Properties dialog (Fig. 31).

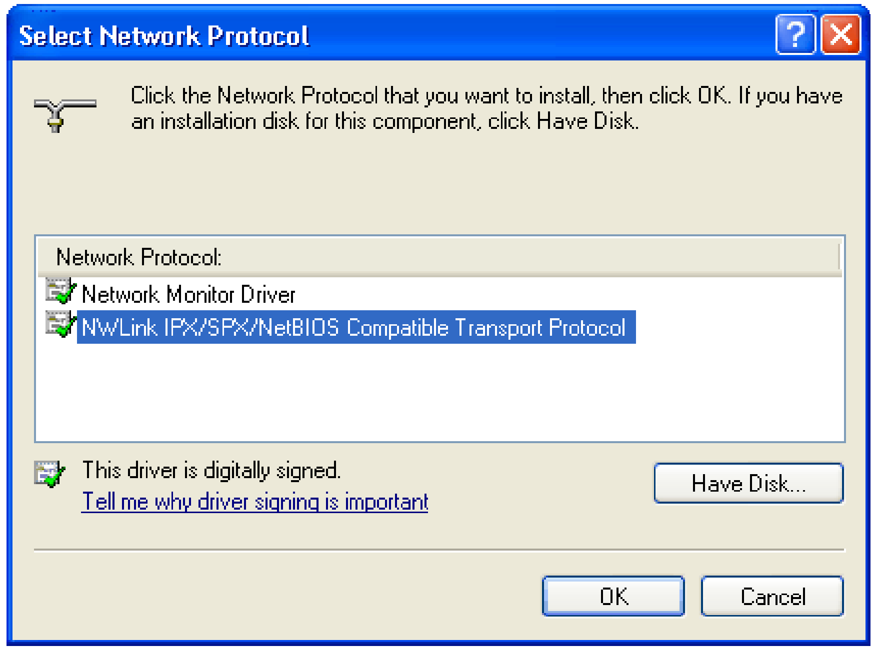


Figure 30. Choose the Correct Protocol.

Select **NWLINK IPX...** as shown, then click on **Properties** to open the dialog shown in Fig. 32.

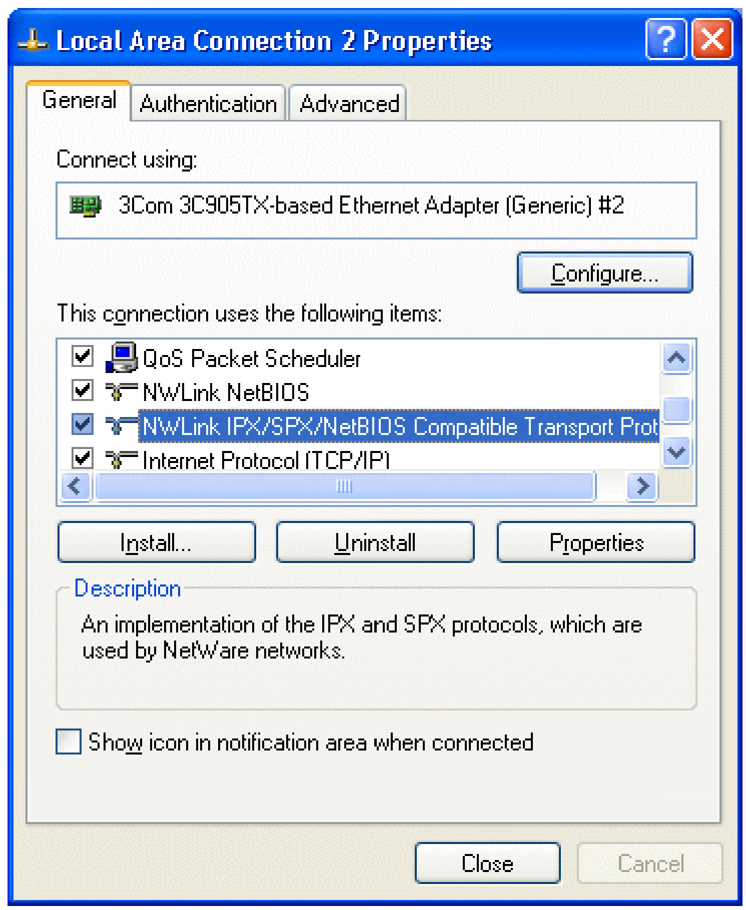


Figure 31. LAN Properties.

Set the **Frame type** to 802.3 as shown, then click on **OK**, **Close**, and **Close** to return to the Windows desktop.

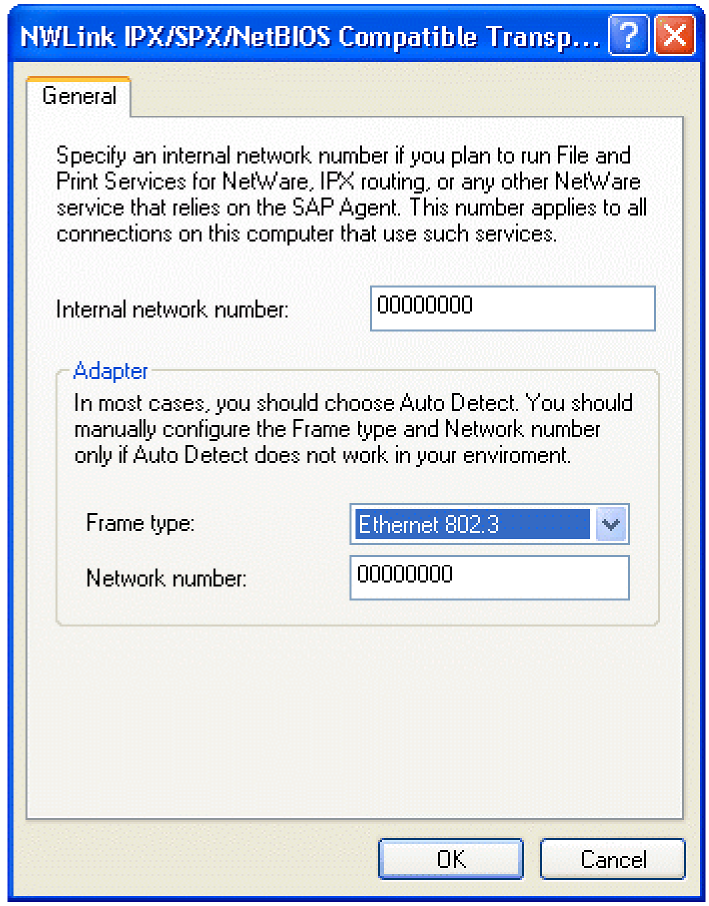


Figure 32. Choose the Correct Frame Type.

2.3. Installing *CONNECTIONS* Communication Software Updates

The installation wizard for a ***CONNECTIONS*** update performs two major tasks:

- It loads the hardware interfaces and add-in drivers to be used, based on your selections within the wizard.

- It searches the local PC and any networked PCs for ORTEC ***CONNECTIONS*** instruments and builds a *Master Instrument List* from which you can select the MCB(s) to be used by your application(s).

This section tells you how to install an update to your ***CONNECTIONS*** communication software. The procedure is similar to the installation of ORTEC MCA emulation/analysis programs, except that no application software is installed. For instructions on installing a specific application, such as MAESTRO, refer to the corresponding software user’s manual.

1) Before installing the update, connect and power on all local and network ORTEC instruments that you wish to use, then start all of the PCs to which the instruments are attached, otherwise, the software will not detect them during installation. Any instruments not detected can be configured manually at a later time (see Section 2.5).

2) If any of the components on the network is a DSPEC Plus, ORSIM II or III, MatchMaker, DSPEC, 92X-II, 919E, 920E, 921E, or other direct-connect module, the network default protocol must be set to the **IPX/SPX Compatible Transport with NetBIOS** selection on all PCs that use ***CONNECTIONS*** hardware. See Section 2.2 for instructions on making this the default.

3) Make sure that the MCB Server program, **MCBSER32**, is running on all network PCs with ORTEC MCBs attached. The MCBSER32 icon should be displayed in the system tray on the right side of the Windows Taskbar. If MCBSER32 is not running on a PC, open Windows Explorer on that machine, go to **`c:\Program Files\Common Files\ORTEC Shared\Umcbi`**, and double-click on **`McbSer32.Exe`**.

4) Insert the update CD. If the install program does not start automatically, go to the Taskbar and click on **Start**, then **Run...**. In the Run dialog, enter **`D:\ Setup.exe`** (use your CD-ROM drive designator) and click on **OK** to start the software installation wizard. Each software application contains

5) The second installation wizard screen (Fig. 33) will ask which instrument interfaces you wish to use. These choices are given to minimize the interferences with existing hardware on the PC or network. Select as many as needed, however, choose only the attachment options appropriate for this PC. For laptops, do not check the **Attach instruments to my PC interface card** box. Check the **Attach instruments to my printer port** box only if you are connecting MCBs via the printer port.

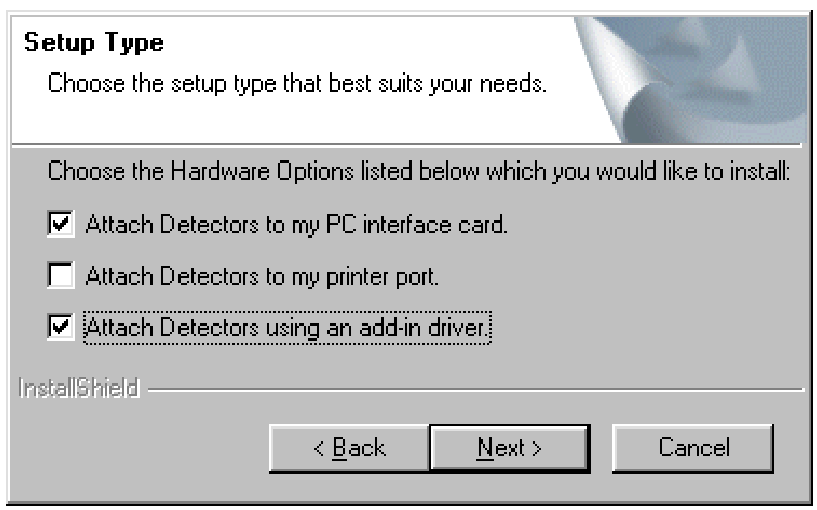


Figure 33. Select Hardware Interface Options.

- Use the PC interface card selection for ORTEC PCI cards and Dual-Port Memory Interface instruments including the 917, 918, 919, 920, 921, 92X, MicroACE®, NOMAD®, NOMAD Plus®, ACE®, TRUMP®, and OCTÊTE PC®.

- The printer port is used for MicroNOMAD, DART®, Model 926, and NOMAD Plus.

  NOTE In some cases, the test for an instrument on the printer port may inactivate a printer attached to that port. If this happens, just reset the printer.

- The add-in drivers are used for instruments such as the digiDART, DSPEC jr, microBASE, DSP-Scint™, M^3CA, and MiniMCA-166.

Note that direct-connect Ethernet devices are always enabled so no checkbox is provided for them. These include the DSPEC Plus, DSPEC, OCTÊTE Plus, MatchMaker, ORSIM II and III, 92X-II, 919E, 920E, 921E, and MCBs on other PCs.

If you have chosen to use an add-in driver, an additional wizard screen will prompt you to choose a **Driver Option** (Fig. 34). The options available on this screen may vary depending on the software being installed.

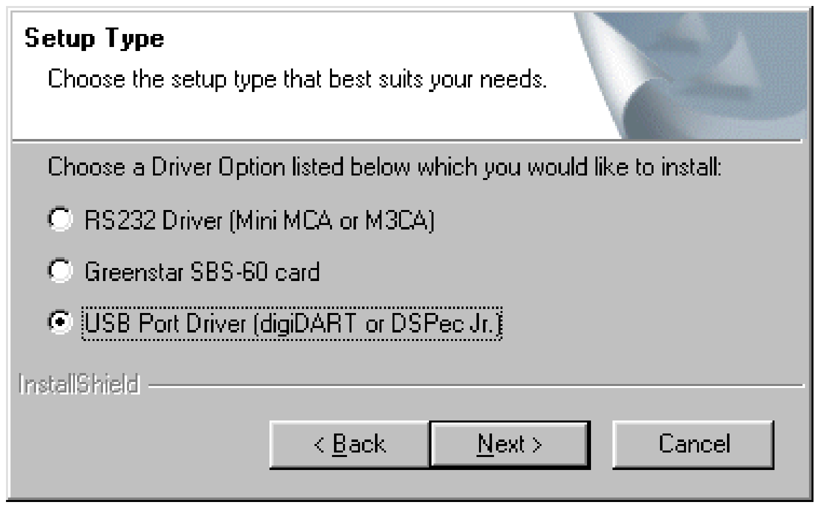


Figure 34. Select the Appropriate Add-in Driver.

6) When you complete the wizard screens and click on **Finish**, the instrument configuration program, MCB Configuration, will locate all of the (powered on) ORTEC MCBs attached to the local PC and any network PCs, display a list of the instruments found, allow you to enter customized instrument numbers and descriptions, and optionally write this configuration to all PCs in the network that are running MCBSER32, as described in the following section. If this is the first time you have installed ORTEC software on your system, be sure to refer there for more detailed information on initial system configuration.

7) At the end of the wizard, follow the instructions to complete installation (depending on the software installed, you may be asked to restart the PC). Your ***CONNECTIONS*** software is now ready for startup.

2.4. Initial Configuration of the Master MCB List

The initial MCB configuration is determined by the MCB Configuration program, which runs automatically during installation or can be run manually later from the Taskbar (see Section 2.5).

When MCB Configuration runs, it searches the PC and the network (if any) for MCBs, then displays a master list of the instruments found (Fig. 35).

Note that you can change the instrument numbers and descriptions at any time by double-clicking on an instrument entry in the Configure Instruments dialog. This will open the Change Description or ID dialog (Fig. 36). It shows the physical detector location (read-only) and allows you to change the **ID** and **Description**. Make the desired changes and click on **Close**.

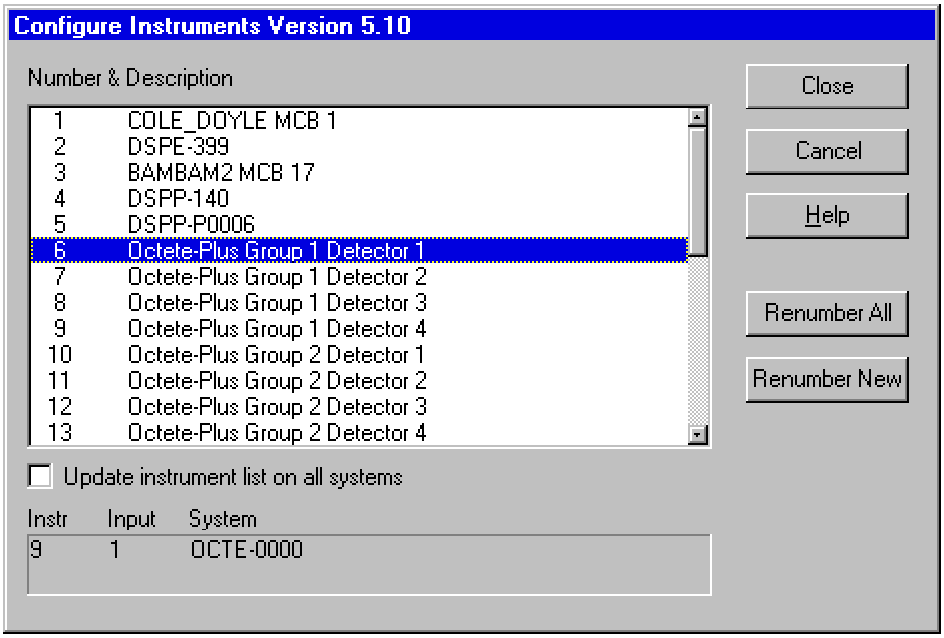


Figure 35. MCB Numbering.

If you or another user have already assigned a description to a particular instrument, you can restore the default description by deleting the entry in the **Description** field. Then, the next time you run MCB Configuration (see Section 2.5), the default description will be displayed.

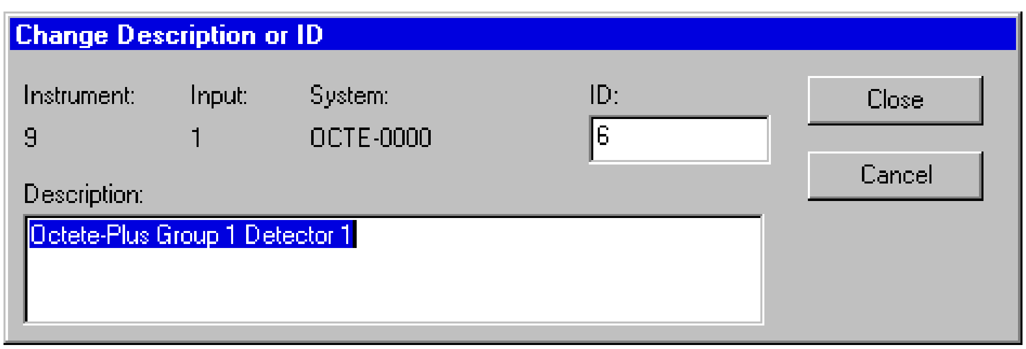


Figure 36. Change MCB Number or Description.

When MCB Configuration runs, the resulting MCB list configuration is normally broadcast to all PCs on the network. If you do not want to broadcast the results, unmark the **Update detector list**

on all systems checkbox under the instrument list (see Fig. 35) so the configuration will be saved only to the local PC.

The first time the system is configured, Fig. 37 will be displayed to remind you that all new instruments must be assigned a unique, *non-zero* ID number.

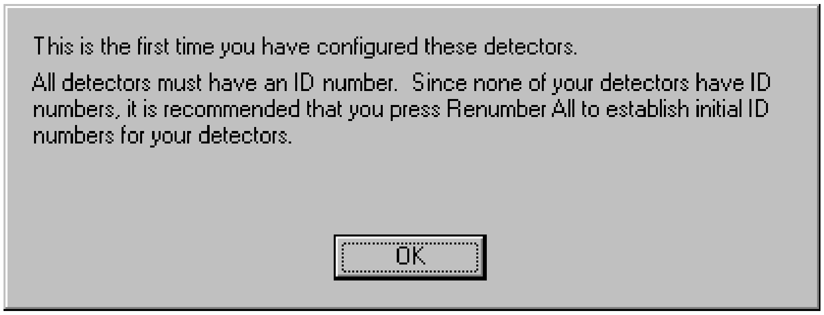


Figure 37. MCB Numbering First Time.

You can change all the instrument numbers by clicking on **Renumber All** to assign new numbers in sequence; or click on **Renumber New** to renumber just the new instruments. Figure 38 will be displayed if the list is a mixture of old and new numbers.

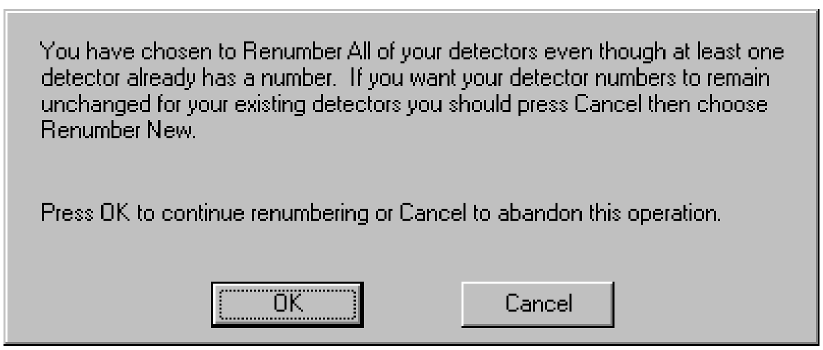


Figure 38. Renumbering Warning.

NOTE Remember that some applications use the instrument number to refer to a specific MCB or device (e.g., the .JOB file command SET_DETECTOR 5). Therefore, you may want to subsequently avoid changing its ***number*** so all defined processes will still operate.

Click on the **Help** button on the Configure Instruments dialog to display a detailed help screen.

2.5. Running MCB Configuration Manually

When an MCB is added to the system, you can't communicate with it until it has been added to the Master Instrument List by manually re-running MCB Configuration. To do this:

1) Start all of the PCs with which you want to communicate over the network.

2) On each PC, set up the network communication protocol as described in Section 2.2 as necessary.

3) Connect and power on all MCBs to be configured.

4) Make sure that the MCB Server program is running on all PCs on the network. The MCBSER32 icon should be displayed in the system tray on the right side of the Windows Taskbar. If MCBSER32 is not running on a PC, open Windows Explorer on that machine, go to **`\Program Files\Common Files\ORTEC Shared\Umcbi`**, and double-click on **`McbSer32.Exe`**.

5) Run the MCB Configuration program on any PC on the network. To do this from a PC on which an ORTEC ***CONNECTIONS*** is installed, go to the Windows Taskbar and click on **Start**, **Programs**, the program name (e.g., MAESTRO, GammaVision), and **Mcb Configuration**. The configuration program will poll all the MCB hardware on all PCs on the network, present the list of instruments found, allow you to enter descriptions and names for these instruments, and optionally write this configuration to all of the PCs in the network (see Section 2.4).

At this point, MAESTRO and other ***CONNECTIONS*** applications can be run on any PC, and the MCB pick list for each program on each PC can be tailored to a specific list of instruments.

2.6. Detector Security

Detectors can be protected from destructive access by password. If your application supports detector locking and unlocking, passwords can be set within the application. Once a password is set, no application can start, stop, clear, change presets, change ROIs, or perform any command that affects the data in the detector if the password is not known (however, in most cases, the current spectrum and settings for the locked device can be viewed read-only). The password is required for any access, even on a network. This includes changing instrument descriptions and IDs with the MCB Configuration program.

3. MCB PROPERTIES DIALOGS

3.1. Introduction

ORTEC ***CONNECTIONS-32*** applications now use a uniform data-acquisition setup dialog called Properties. The Properties dialog opens when you select the appropriate command in the application. This chapter covers the Properties dialog for all ***CONNECTIONS***-compliant MCBs. Depending on the currently selected MCB, the Properties dialog displays several tabs of hardware controls including ADC setup parameters, acquisition presets, high-voltage controls, amplifier gain adjustments, gain and zero stabilizers, pole-zero and other shaping controls, and access to the InSight™ Virtual Oscilloscope. In addition, the Status tab for certain MCBs monitors conditions such as alpha chamber pressure, detector status, charge remaining on batteries, and the number of spectra collected in remote mode.

The following MCBs are listed with the newest first. Use the table of contents or index to find the setup section for your MCB, move from tab to tab and set your hardware parameters, then click on **Close**. Note that as you enter characters in the data-entry fields, the characters will be underlined until you move to another field or until 5 seconds have lapsed since a character was last entered. During the time the entry is underlined, no other program or PC on the network can modify this value.

3.2. MCB Properties Dialogs

3.2.1. DSPEC jr

3.2.1.1. Amplifier

Figure 39 shows the Amplifier tab. This tab contains the controls for **Gain**, **Baseline Restore**, **Preamplifier Type**, **Input Polarity**, and **Optimize**. Be sure that all of the controls on the tabs have been set *before* clicking the **Start Auto** (optimize) button.

NOTE The changes you make on most property tabs *take place immediately*. There is no cancel or undo for these dialogs.

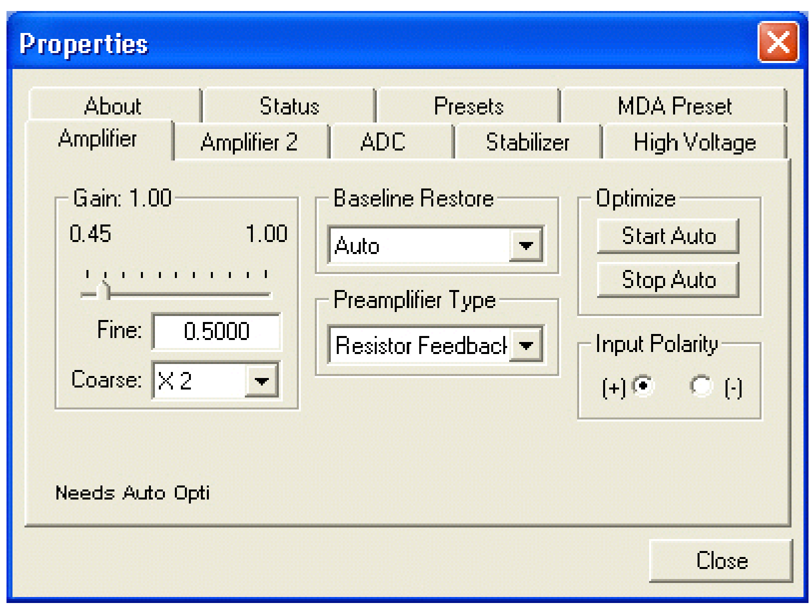


Figure 39 . DSPEC jr Amplifier Tab.

Gain

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

Input Polarity

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

Baseline Restore

The **Baseline Restore** is used to return the baseline of the pulses to the true zero between incoming pulses. This improves the resolution by removing low frequency noise such as dc shifts or mains power ac pickup. The baseline settings control the time constant of the circuit that returns the baseline to zero. There are three fixed choices (**Auto**,[4] **Fast**, and **Slow**). The fast setting is used for high count rates, the slow for low count rates. **Auto** adjusts the time constant as appropriate for the input count rate. The settings (**Auto**, **Fast**, or **Slow**) are saved in the DSPEC jr even when the power is off. The time constant can be manually set on the InSight display (see Section 3.3).

You can view the time when the baseline restorer is active on the InSight display as a **Mark** region (see the discussion on Marks, p. 142). In the automatic mode, the current value is shown on the InSight sidebar (Fig. 161). For a low-count-rate system, the value will remain at about 90.

Preamplifier Type

Use the **Preamplifier Type** section to choose **Transistor Reset** or **Resistive Feedback** preamplifier operation. Your choice will depend on the preamplifier supplied with the germanium detector being used.

[4]Patent number 5,912,825.

Optimize

The DSPEC jr is equipped with both automatic pole-zero logic[5] and automatic flattop logic.[6] The **Start Auto** optimization button uses these features to automatically choose the best pole zero and flattop tilt settings. Note that if you selected **Transistor Reset** as the **Preamplifier Type** for this DSPEC jr, the **Start Auto** button does not perform the pole zero.

As with any system, the DSPEC jr should be optimized any time the detector is replaced or if the flattop width is changed. For optimization to take place, the DSPEC jr must be processing pulses. The detector should be connected in its final configuration before optimizing is started. There should be a radioactive source near the detector so that the count rate causes a dead time of ~5%. Dead time is displayed on the DSPEC jr front panel and on the Status Sidebar during data acquisition.

Select either the **Resistive Feedback** or **Transistor Reset** option and click on **Start Auto**. The optimize command is sent to the DSPEC jr at this time and, if the DSPEC jr is able to start the operation, a series of short beeps sounds to indicate that optimization is in progress. When optimizing is complete, the beeping stops.

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

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

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

3.2.1.2. Amplifier 2

Figure 40 shows the Amplifier 2 tab, which accesses the advanced DSPEC jr shaping controls including the InSight Virtual Oscilloscope mode, which is discussed in Section 3.3.

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[5]Patent number 5,872,363.

[6]Patent number 5,821,533.

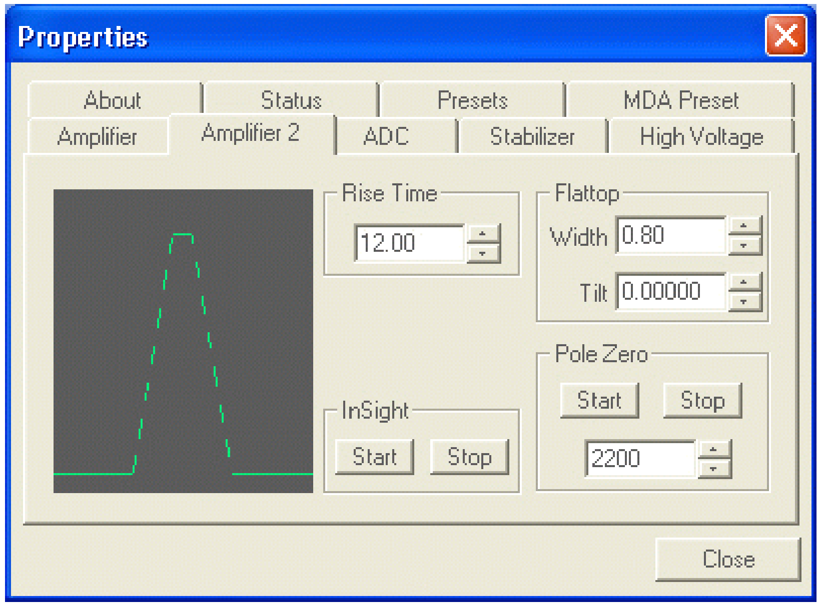

Figure 40. DSPEC jr Amplifier 2 Tab.

The many choices of **Rise Time** allow you to precisely control the tradeoff between resolution and throughput. Section 3.8 discusses this tradeoff and contains a guide to choosing rise time according to count rate. The value of the rise time parameter in the DSPEC jr is roughly equivalent to twice the integration time set on a conventional analog spectroscopy amplifier. Thus, a DSPEC jr value of 12 corresponds to 6 in a conventional amplifier. Starting with the nominal value of 12.0, you should increase values of the rise time for better resolution for expected lower count rates, or when unusually high count rates are anticipated, reduce the rise time for higher throughput with somewhat worse resolution.

Use the up/down arrows to adjust the rise time within the range of 0.2 to 23.0. After all the controls have been adjusted, return to the Amplifier tab and click on **Start Auto**. The most recent settings are saved in the DSPEC jr firmware even when the power is turned off.

For the more advanced user, the InSight mode allows you to directly view all the parameters and adjust them interactively while collecting live data. To access the InSight mode, go to the **InSight** section on the Amplifier 2 tab and click on **Start**.

Note that the Amplifier 2 tab graphically presents a *modeled shape*. This is *not* a sampled waveform of the actual pulse shape, only a model based on the current parameters. The modeled shape is nominally a quasi-trapezoid whose sides and top may be adjusted by the controls in this dialog. While a particular control is being adjusted, the model is updated to represent the changes made.

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

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

The dead time per pulse is three times the rise time plus two times the flattop width.

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

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

Once data acquisition is underway, the advanced user may wish to return to **MCB Properties...** and click on the **InSight** section's **Start** button to adjust the shaping parameters interactively with a "live" waveform showing the actual pulse shape, or just to verify that all is well. Section 3.3 provides detailed instructions on using the InSight mode.

3.2.1.3. ADC

This tab (Fig. 41) contains the **Gate**, **Conversion Gain**, **Lower Level Discriminator**, and **Upper Level Discriminator** controls. In addition, the current real time, live time, and count rate are monitored at the bottom of the dialog.

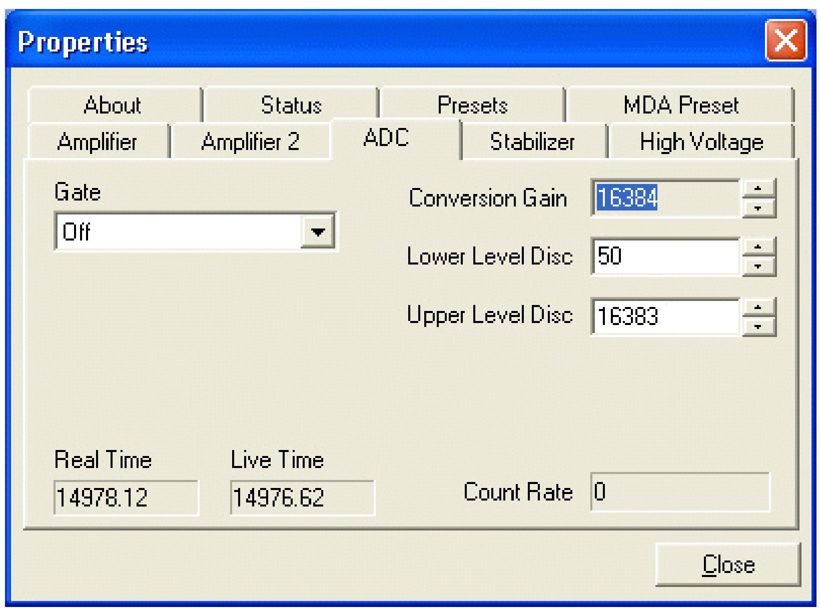

Figure 41. DSPEC jr ADC Tab.

Gate

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

Conversion Gain

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

Upper- and Lower-Level Discriminators

In the DSPEC jr, the lower- and upper-level discriminators are under computer control. The **Lower Level Disc**riminator sets the level of the lowest amplitude pulse that will be stored. This level establishes a lower-level cutoff by channel number for ADC conversions.

The **Upper Level Disc**riminator sets the level of the highest amplitude pulse that will be stored. This level establishes an upper-level cutoff, by channel number, for storage.

3.2.1.4. Stabilizer

The DSPEC jr has both a gain stabilizer and a zero stabilizer. These are discussed in detail in Sections 3.4 and 3.5, respectively.

The Stabilizer tab (Fig. 42) shows the current values for the stabilizers. The value in each **Adjustment** section shows how much adjustment is currently applied. The **Initialize** buttons set the adjustment to 0. If the value approaches 90% or above, the amplifier gain should be adjusted so the stabilizer can continue to function — when the adjustment value reaches 100%, the stabilizer cannot make further corrections in that direction. The **Center Chan**nel and **Width** fields show the peak currently used for stabilization.

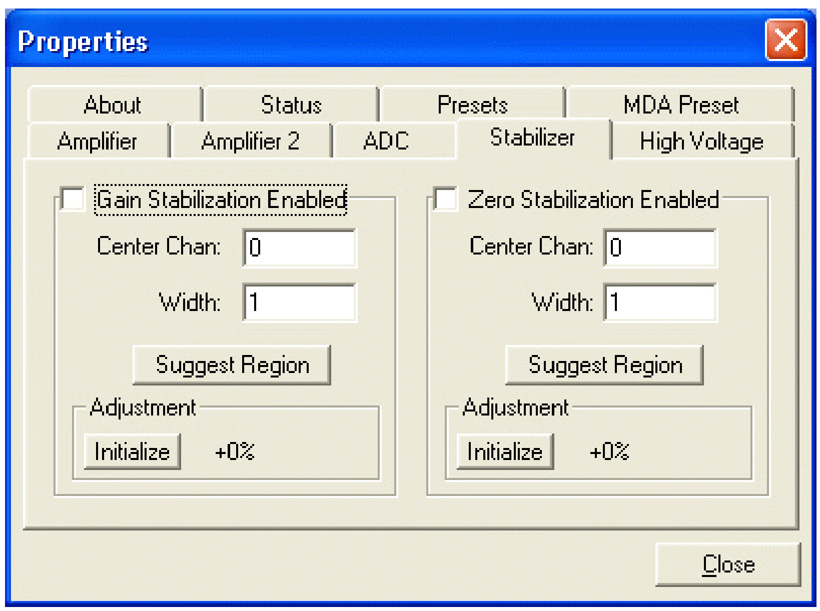

Figure 42. DSPEC jr Stabilizer Tab.

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

3.2.1.5. High Voltage

Figure 43 shows the High Voltage tab, which allows you to turn the high voltage on or off; set and monitor the voltage; and choose the **Shutdown** mode. The polarity is set in the DIM module.

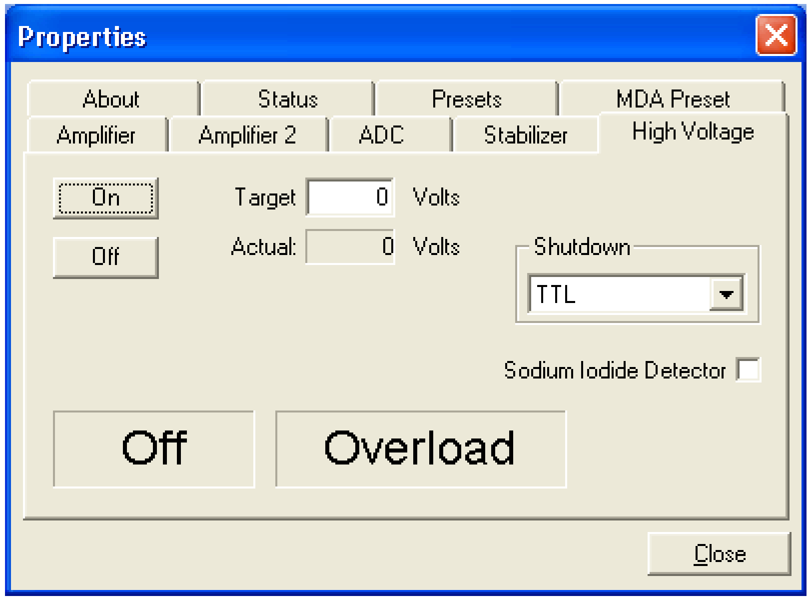

Figure 43. DSPEC jr High Voltage Tab.

The high voltage is overridden by the detector bias remote shutdown signal from the detector; high voltage cannot be enabled if the remote shutdown or overload signals prevent it. Enter the detector high voltage in the **Target** field, click **On**, and monitor the voltage in the **Actual** field. Click the **Off** button to turn off the high voltage.

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

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

To use a **Sodium Iodide Detector**, mark the checkbox. This changes the gain and zero stabilizers to operate in a faster mode. For the DIM-296, the HV is controlled by the adjustment in the Model 296 and not here.

3.2.1.6. About

This tab (Fig. 44) displays hardware and firmware information about the currently selected DSPEC jr as well as the data **Acquisition Start Time** and **Sample** description. In addition, the **Access** field shows whether the MCB is currently locked with a password; **Read/Write** indicates that the MCB is unlocked; **Read Only** means it is locked.

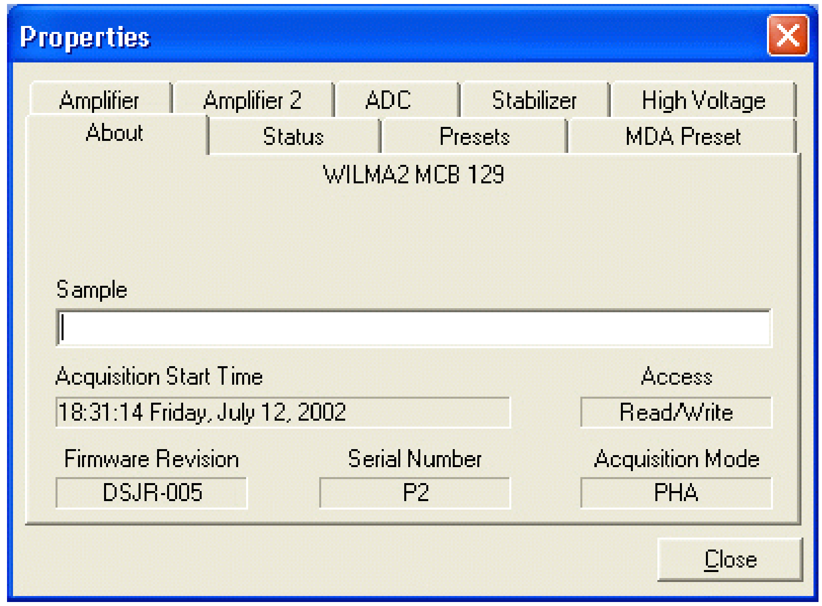

Figure 44. DSPEC jr: The About Tab.

3.2.1.7. Status

Figure 45 shows the Status tab. Twenty-one parameters are monitored at all times. You can select any six of these at a time to be displayed n the Status tab (normally, the six that are most important to you). You can choose to view other parameters at any time. Two types of status responses are displayed: **OK** or **ERR**, and a numeric value. The state-of-health (SOH) parameters all respond with **OK** or **ERR**. If the state is **OK**, the parameter stayed within the set limits during the spectrum acquisition. If the parameter varied from the nominal value by more than the allowed limit, the **ERR** is set until cleared by the program. The numeric values are displayed in the units reported by the DSPEC jr. **Security**, **Detector temperature**, and **Live detector temperature** are available only for SMART-1 detectors. For non-SMART-1 detectors, they respond with **N/A**.

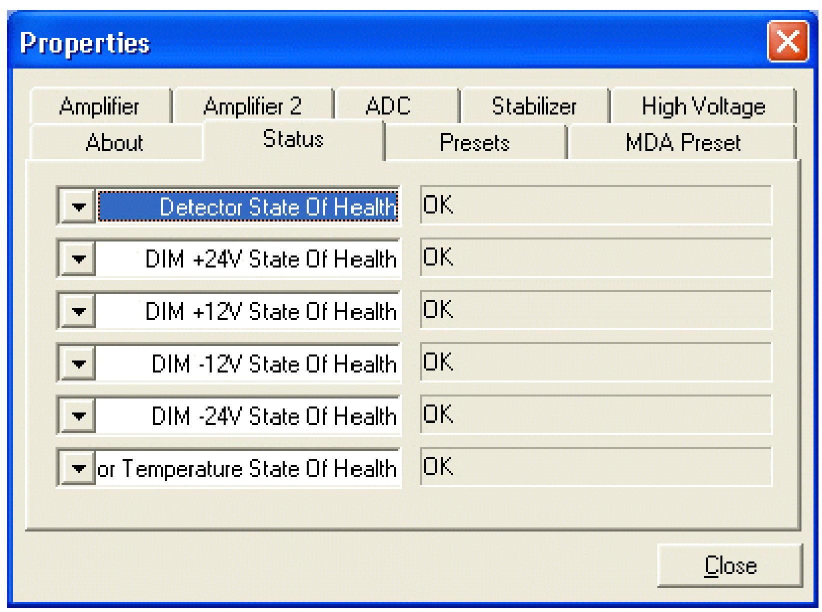

Figure 45. DSPEC jr: The Status Tab.

The parameters presented are:

Detector State of Health

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

DIM +24V State of Health

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

DIM +12V State of Health

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

DIM -12V State of Health

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

DIM -24V State of Health

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

Temperature State of Health

This is OK if the detector temperature has stayed below the high temperature limit set in the detector since the last time the SOH was cleared. This is available only for SMART-1 detectors.

High Voltage State of Health

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

Shutdown State of Health

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

Preamplifier overload State of Health

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

Security State of Health

This is OK if the security test was passed at the end of the last spectrum acquisition. This is available only for SMART-1 detectors.

Power State of Health

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

+24 volts

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

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

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

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

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

Detector temperature
This is the detector temperature at the time the current spectrum acquisition stopped. This is available only for SMART-1 detectors.

Live detector temperature
This is the detector temperature at the current time. This is available only for SMART-1 detectors.

Battery voltage
This is not used in the DSPEC jr.

Battery % full
This is not used in the DSPEC jr.

Battery time remaining
This is not used in the DSPEC jr.

Select the values to be displayed using the drop down list for each of the six positions.

3.2.1.8. Presets

Figure 46 shows the Presets tab. MDA presets are shown on a separate tab.

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

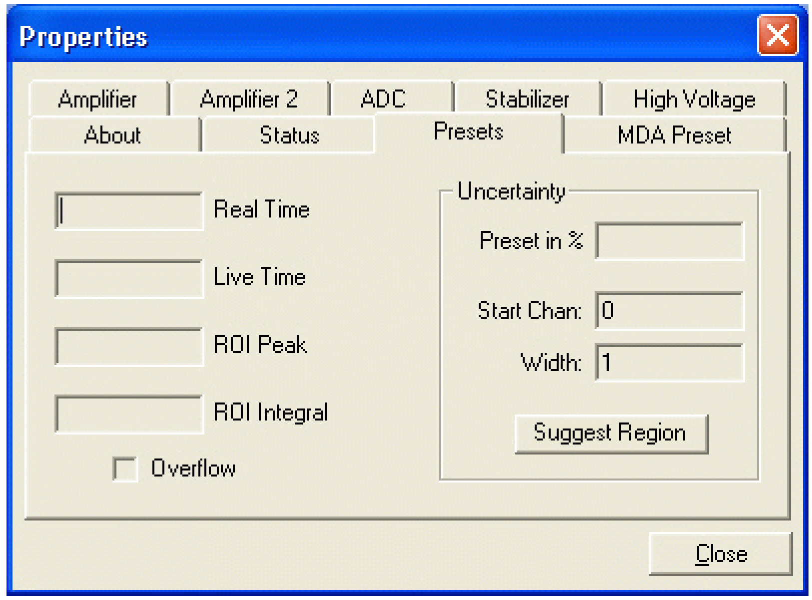

Figure 46. DSPEC jr: The Presets Tab.

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

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

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

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

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

The **Uncertainty** preset stops acquisition when the statistical or counting uncertainty of a user-selected net peak reaches the value you have entered. Enter the **Preset in %** value as percent uncertainty at 1 sigma of the net peak area. The range is from 99% to 0.1% in 0.1% steps. You

have complete control over the selected peak region. The region must be at least 7 channels wide with 3 channels of background on each side of the peak. As the uncertainty is calculated approximately every 30 seconds, the uncertainty achieved for a high count-rate sample may be lower than the preset value.

Use the **Start Chan**nel and **Width** fields to enter the channel limits directly, or click on **Suggest Region**. If the marker is positioned in an ROI around the peak of interest, **Suggest Region** reads the limits of the ROI with the marker and display those limits in the **Start Chan** and **Width** fields. The ROI can be cleared after the preset is entered without affecting the uncertainty calculation. If the marker is not positioned in an ROI, the start channel is 1.5 times the FWHM below the marker channel and the width is 3 times the FWHM. The net peak area and statistical uncertainty are calculated in the same manner as for the MAESTRO **Peak Info** command, which is discussed in Section 3.7. Note that the **Suggest Region** button is not displayed during data acquisition.

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

3.2.1.9. MDA Preset

The MDA preset (Fig. 47) can monitor up to 20 nuclides at one time, and stops data collection when the minimum detectable activity for each of the user-specified MDA nuclides reaches the designated value. The MDA preset is implemented in the hardware. The formulas for the MDA are given in various textbooks and in the "Analysis Methods" chapter in the GammaVision user manual and can be generally represented as follows:

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

The coefficients *a*, *b*, and *c* are determined by the MDA formula to be used. The *Eff* (detector efficiency) is determined from the calibration. The *Yield* (branching ratio) is read from the working library using the nuclide and energy specified. The **MDA** value is the one you have entered in the dialog. *Counts* is the gross counts in the specified region and *Live time* is the live time. The *MDA* value is calculated in the MCB given the values *a*, *b*, *c*, *Live time*, *Eff*, and *Yield*. The calculated value is compared with the **MDA** value on the dialog and when it is lower, acquisition is stopped.

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

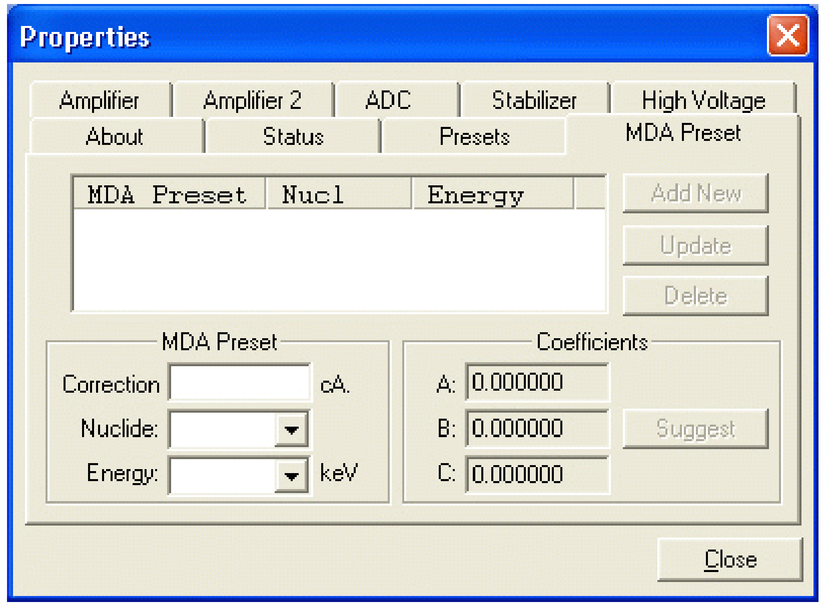

Figure 47. DSPEC jr: The MDA Preset Tab.

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

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

3.2.2. digiDART

3.2.2.1. Amplifier

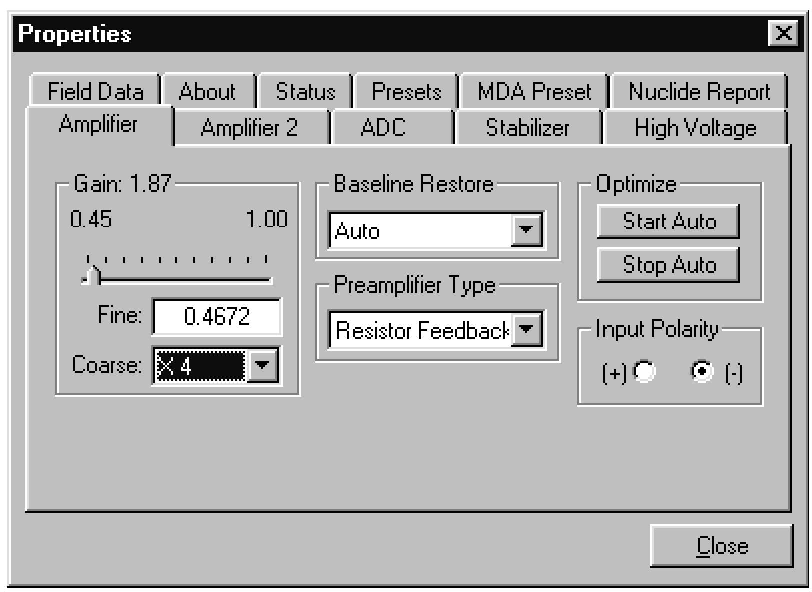

Figure 48. digiDART: The Amplifier Tab.

Figure 48 shows the Amplifier tab. This tab contains the controls for **Gain**, **Baseline Restore**, **Preamplifier Type**, **Input Polarity**, and optimization. Be sure that all of the controls on the tabs have been set *before* clicking the **Start Auto** (optimize) button.

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

Gain

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

Input Polarity

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

Baseline Restore

The **Baseline Restore** is used to return the baseline of the pulses to the true zero between incoming pulses. This improves the resolution by removing low frequency noise such as dc shifts or mains power ac pickup. The baseline settings control the time constant of the circuit that returns the baseline to zero. There are three fixed choices (**Auto**,[4] **Fast**, and **Slow**). The fast setting is used for high count rates, the slow for low count rates. **Auto** adjusts the time constant as appropriate for the input count rate. The settings (auto, fast, or slow) are saved in the digiDART even when the power is off. The time constant can be manually set on the InSight display (see Section 3.3).

You can view the time when the baseline restorer is active on the InSight display as a **Mark** region (see the discussion on Marks, p. 142). In the automatic mode, the current value is shown on the InSight sidebar (Fig. 161). For a low-count-rate system, the value will remain at about 90.

Preamplifier Type

Use the **Preamplifier Type** section to choose **Transistor Reset** or **Resistive Feedback** preamplifier operation. Your choice will depend on the preamplifier supplied with the type of germanium detector being used.

Optimize

The digiDART is equipped with both automatic pole-zero logic[5] and automatic flattop logic.[6] The **Start Auto** optimization button uses these features to automatically choose the best pole zero and flattop tilt settings. Note that if you selected **Transistor Reset** as the **Preamplifier Type** for this digiDART, the **Start Auto** button does not perform the pole zero.

As with any system, the digiDART should be optimized any time the detector is replaced or if the flattop width is changed. For optimization to take place, the digiDART must be processing pulses. The detector should be connected in its final configuration before optimizing is started. There should be a radioactive source near the detector so that the count rate causes a dead time of ~5%. Dead time is displayed on the digiDART front panel and on the Status Sidebar during data acquisition.

Select either the **Resistive Feedback** or **Transistor Reset** option and click on **Start Auto**. The optimize command is sent to the digiDART at this time and, if the digiDART is able to start the operation, a series of short beeps sounds to indicate that optimization is in progress. When optimizing is complete, the beeping stops.

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

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

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

3.2.2.2. Amplifier 2

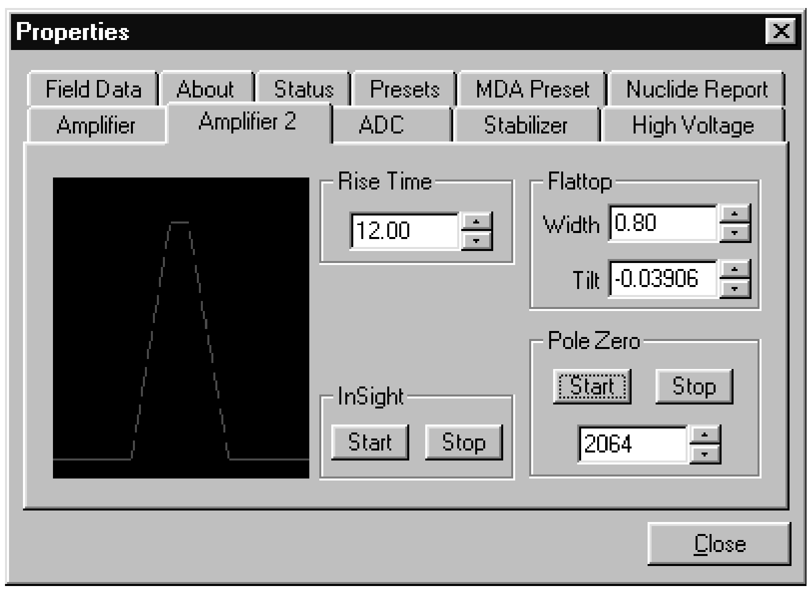

Figure 49. digiDART: The Amplifier 2 Tab.

Figure 49 shows the Amplifier 2 tab, which accesses the advanced digiDART shaping controls including the InSight Virtual Oscilloscope mode, which is discussed in Section 3.3.

The many choices of **Rise Time** allow you to precisely control the tradeoff between resolution and throughput. Section 3.8 discusses this tradeoff and contains a guide to choosing rise time according to count rate. The value of the rise time parameter in the digiDART is roughly equivalent to twice the integration time set on a conventional analog spectroscopy amplifier. Thus, a digiDART value of 12 corresponds to 6 in a conventional amplifier. Starting with the nominal value of 12.0, you should increase values of the rise time for better resolution for expected lower count rates, or when unusually high count rates are anticipated, reduce the rise time for higher throughput with somewhat worse resolution.

Use the up/down arrows to adjust the rise time within the range of 0.2 to 23.0. After all the controls have been adjusted, return to the Amplifier tab and click on **Start Auto**. The most recent settings are saved in the digiDART firmware even when the power is turned off.

For the more advanced user, the InSight mode allows you to directly view all the parameters and adjust them interactively while collecting live data. To access the InSight mode, go to the **InSight** section on the Amplifier 2 tab and click on **Start**.

Note that the Amplifier 2 tab graphically presents a *modeled shape*. This is *not* a sampled waveform of the actual pulse shape, only a model based on the current parameters. The modeled shape is nominally a quasi-trapezoid whose sides and top may be adjusted by the controls in this dialog. While a particular control is being adjusted, the model is updated to represent the changes made.

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

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

The dead time per pulse is three times the rise time plus two times the flattop width.

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

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

Once data acquisition is underway, the advanced user may wish to return to **MCB Properties...** and click on the **InSight** section's **Start** button to adjust the shaping parameters interactively with a "live" waveform showing the actual pulse shape, or just to verify that all is well. Section 3.3 provides detailed instructions on using the InSight mode.

3.2.2.3. ADC

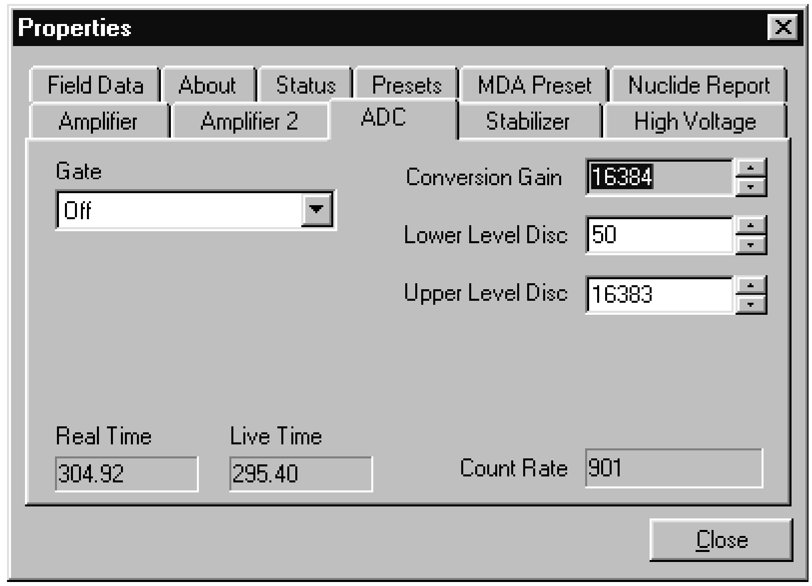

Figure 50. digiDART: The ADC Tab.

This tab (Fig. 50) contains the **Gate**, **Conversion Gain**, **Lower Level Disc**riminator, and **Upper Level Disc**riminator controls. In addition, the current real time, live time, and count rate are monitored at the bottom of the dialog.

Gate

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

Conversion Gain

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

Upper- and Lower-Level Discriminators

In the digiDART, the lower- and upper-level discriminators are under computer control. The **Lower Level Disc**riminator sets the level of the lowest amplitude pulse that will be stored. This level establishes a lower-level cutoff, by channel number, for ADC conversions. Setting that level above random noise increases useful throughput because the MCB is not unproductively occupied processing noise pulses.

The **Upper Level Disc**riminator sets the level of the highest amplitude pulse that will be stored. This level establishes an upper-level cutoff, by channel number, for ADC conversions.

3.2.2.4. Stabilizer

The digiDART has both a gain stabilizer and a zero stabilizer. These are discussed in detail in Sections 3.4 and 3.5, respectively.

The Stabilizer tab (Fig. 51) shows the current values for the stabilizers. The value in each **Adjustment** section shows how much adjustment is currently applied. The **Initialize** buttons set the adjustment to 0. If the value approaches 90% or above, the amplifier gain should be adjusted so the stabilizer can continue to function — when the adjustment value reaches 100%, the stabilizer cannot make further corrections in that direction. The **Center Chan**nel and **Width** fields show the peak currently used for stabilization.

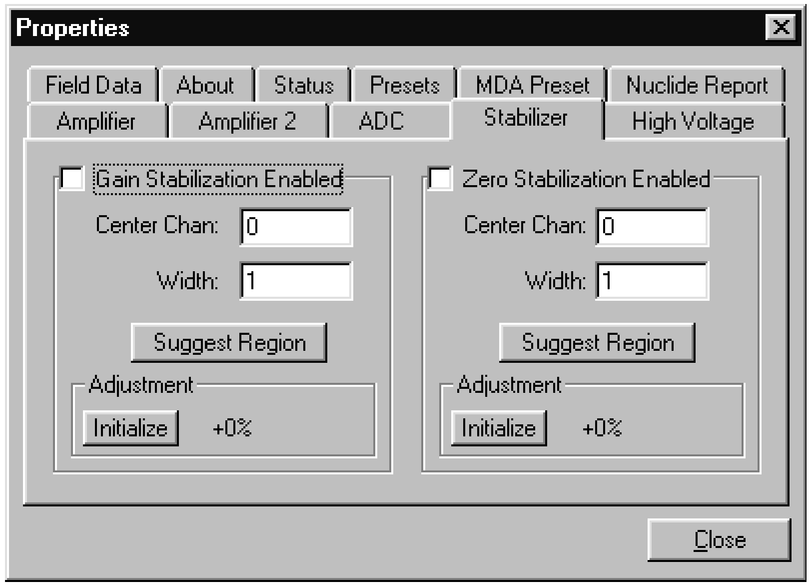

Figure 51. digiDART: The Stabilizer Tab.

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

3.2.2.5. High Voltage

Figure 52 shows the High Voltage tab, which allows you to turn the high voltage on or off, set and monitor the voltage, and choose the **ShutDown** mode.

The high voltage is overridden by the detector bias remote shutdown signal from the detector; high voltage cannot be enabled if the remote shutdown or overload signals prevent it. Enter the detector high voltage in the **Target** field, click **On**, and monitor the voltage in the **Actual** field. Click the **Off** button to turn off the high voltage.

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

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

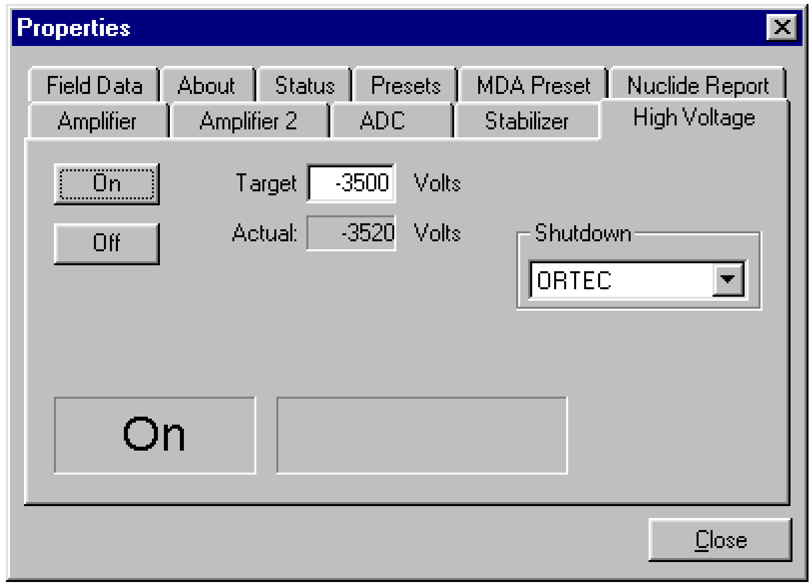

Figure 52. digiDART: The High Voltage Tab.

3.2.2.6. Field Data

This tab (Fig. 53) is used to view the digiDART spectra collected in Field Mode, that is, in remote mode, detached from a PC. The digiDART is always in Field Mode when disconnected from the PC. The spectrum can then be viewed as the "active" spectrum in the digiDART. The active spectrum is the spectrum where the new data are collected. The current active spectrum is lost.

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

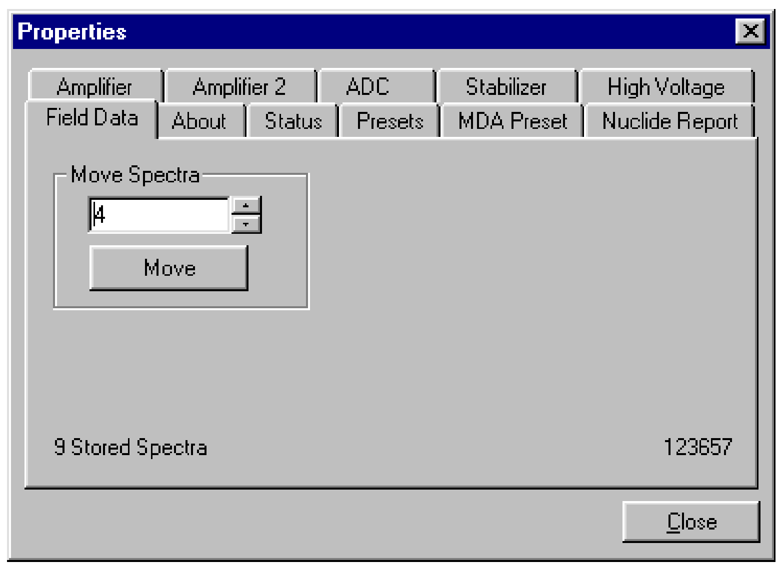

Figure 53. The digiDART Field Mode Spectrum Tab.

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

The **Acquire/Download Spectra** command can also be used to download all the stored spectra and save them to disk automatically. They can then be viewed in a buffer window.

3.2.2.7. About

This tab (Fig. 54) displays hardware and firmware information about the currently selected digiDART as well as the data **Acquisition Start Time** and **Sample** description. In addition, the **Access** field shows whether the MCB is currently locked with a password; **Read/Write** indicates that the MCB is unlocked; **Read Only** means it is locked.

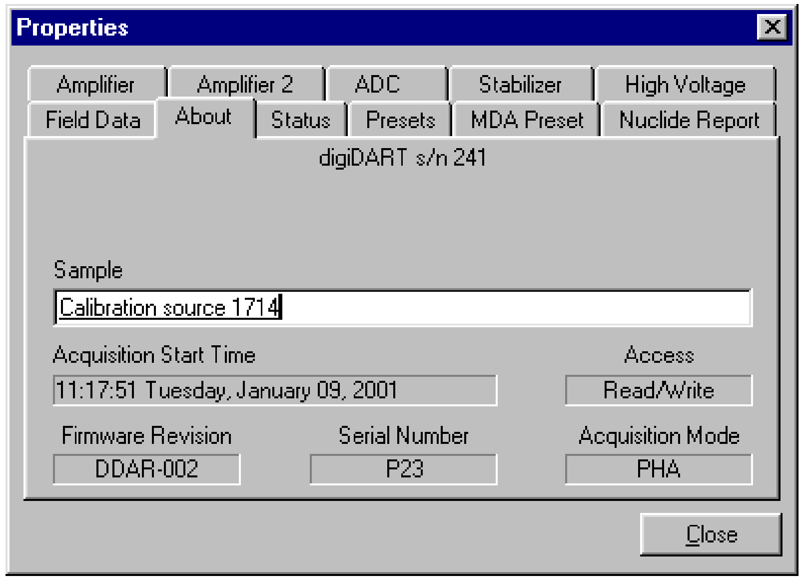

Figure 54. digiDART: The About Tab.

3.2.2.8. Status

Figure 55 shows the Status tab. Twenty-one parameters are monitored at all times. You can select any six of these at a time to be displayed on the Status tab (normally, the six that are most important to you). You can choose to view other parameters at any time. Two types of status responses are displayed: **OK** or **ERR**, and a numeric value. The state-of-health (SOH) parameters all respond with **OK** or **ERR**. If the state is **OK**, the parameter stayed within the set limits during the spectrum acquisition. If the parameter varied from the nominal value by more than the allowed limit, the **ERR** is set until cleared by the program. The numeric values are displayed in the units reported by the digiDART. **Security**, **Detector temperature**, and **Live detector temperature** are available only for SMART-1 detectors. For non-SMART-1 detectors, they respond with **N/A**.

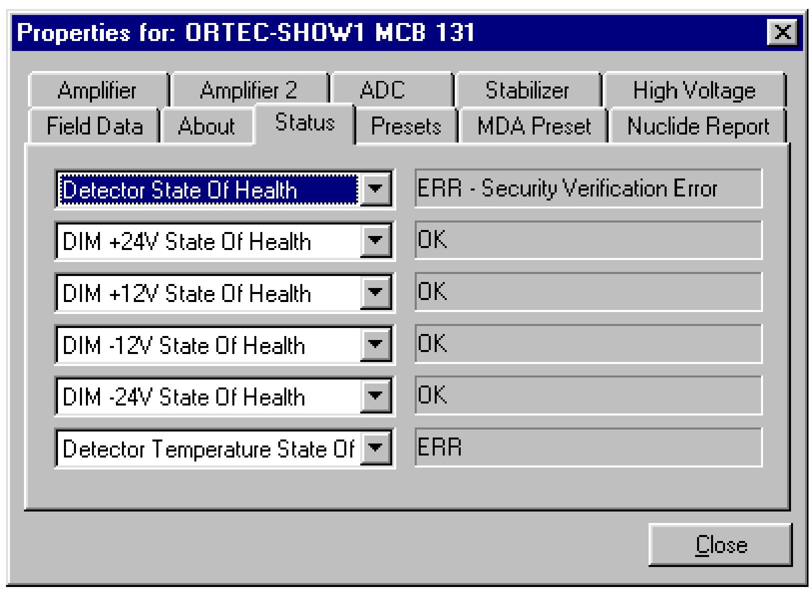

Figure 55. digiDART: The Status Tab.

The available parameters are:

Detector State of Health

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

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

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

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

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

Temperature State of Health
This is OK if the detector temperature has stayed below the high temperature limit set in the detector since the last time the SOH was cleared. This is available only for SMART-1 detectors.

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

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

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

Security State of Health
This is OK if the security test was passed at the end of the last spectrum acquisition. This is available only for SMART-1 detectors.

Power State of Health
This is OK if the power to the DIM was constant during the last spectrum acquisition.

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

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

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

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

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

Detector temperature
This is the detector temperature at the time the current spectrum acquisition stopped. This is available only for SMART-1 detectors.

Live detector temperature
This is the detector temperature at the current time. This is available only for SMART-1 detectors.

Battery voltage
This is the present voltage of the internal battery.

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

Battery time remaining
This is an estimate of the time remaining when using the internal battery and the digiDART operating in the present mode.

3.2.2.9. Presets

Figure 56 shows the Presets tab. MDA presets are shown on a separate tab.

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

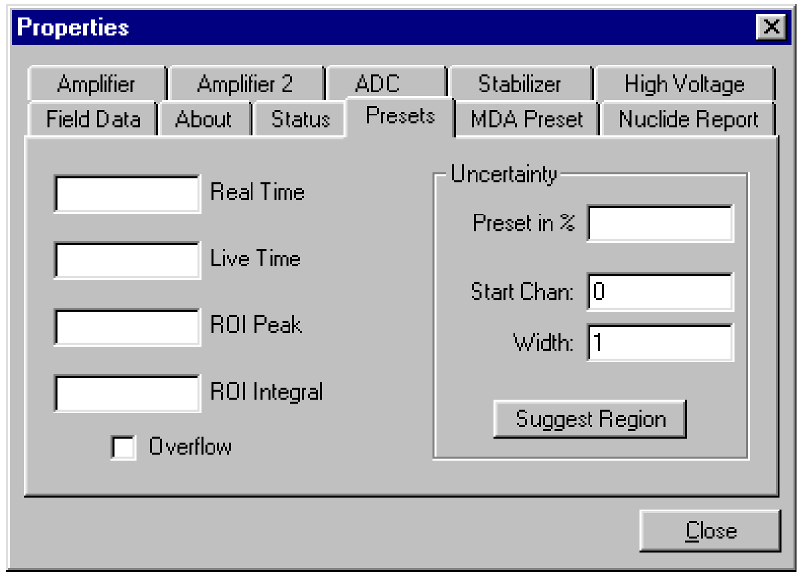

Figure 56. digiDART: The Presets Tab.

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

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

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

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

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

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

Use the **Start Chan**nel and **Width** fields to enter the channel limits directly, or click on **Suggest Region**. If the marker is positioned in an ROI around the peak of interest, **Suggest Region** reads the limits of the ROI with the marker and display those limits in the **Start Chan** and **Width** fields. The ROI can be cleared after the preset is entered without affecting the uncertainty calculation. If the marker is not positioned in an ROI, the start channel is 1.5 times the FWHM below the marker channel and the width is 3 times the FWHM. The net peak area and statistical uncertainty are calculated in the same manner as for the MAESTRO **Peak Info** command, which is discussed in Section 3.7. Note that the **Suggest Region** button is not displayed during data acquisition.

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

3.2.2.10. MDA Preset

The MDA preset (Fig. 57) can monitor up to 20 nuclides at one time, and stops data collection when the minimum detectable activity for each of the user-specified MDA nuclides reaches the designated value. The MDA preset is implemented in the hardware. The formulas for the MDA are given in various textbooks and in the “Analysis Methods” chapter in the GammaVision user manual and can be generally represented as follows:

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

The coefficients *a*, *b*, and *c* are determined by the MDA formula to be used. The *Eff* (detector efficiency) is determined from the calibration. The *Yield* (branching ratio) is read from the working library using the nuclide and energy specified. The **MDA** value is the one you have entered in the dialog. *Counts* is the gross counts in the specified region and *Live time* is the live time. The *MDA* value is calculated in the MCB given the values *a*, *b*, *c*, *Live time*, *Eff*, and *Yield*. The calculated value is compared with the **MDA** value on the dialog and when it is lower, acquisition is stopped.

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

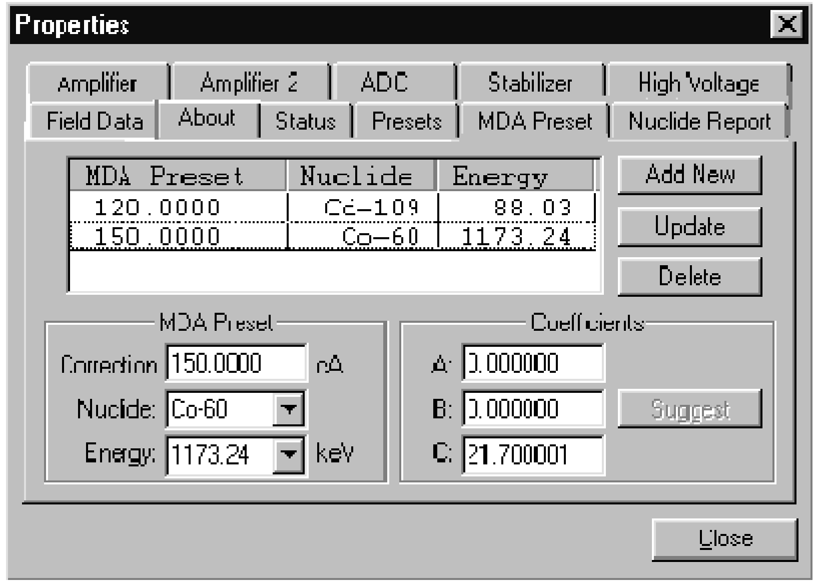

Figure 57. digiDART: The MDA Preset Tab.

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

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

3.2.2.11. Nuclide Report

Figure 58 shows the Nuclide Report tab. The Nuclide Report displays the activity of up to 9 user-selected peaks. Once the report is set up you can view the Nuclide Report at any time on the digiDART display. The peak area calculations in the hardware use the same methods as the MAESTRO **Peak Info** calculation described in Section 3.7, so the Nuclide Report display is the same as the **Peak Info** display on the selected peak in the spectra stored in the PC. The calculated value is computed by multiplying the net peak count rate by a user-defined constant. If the constant includes the efficiency and branching ratio, the displayed value is the activity. You enter the nuclide label and the activity units.

The report has this format:

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

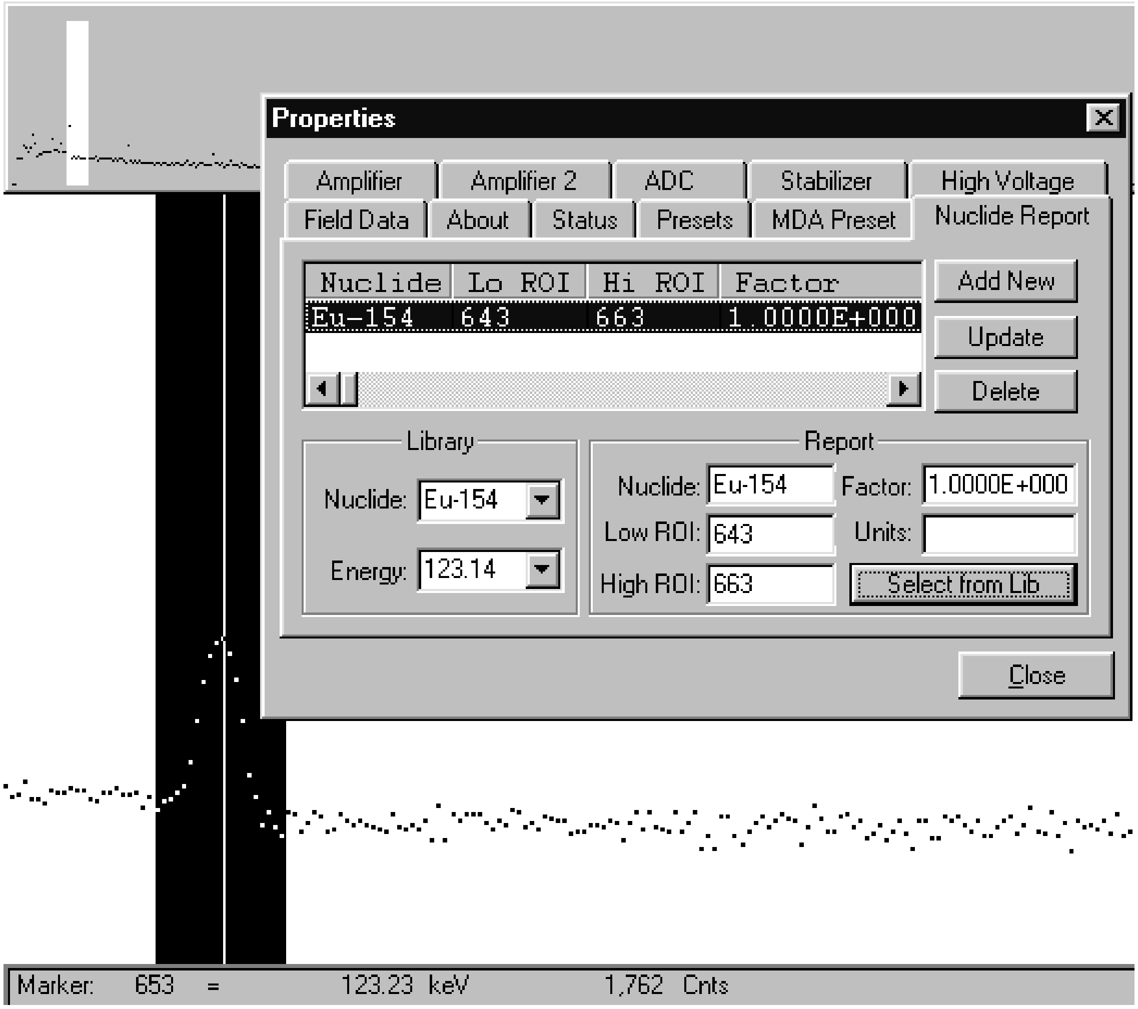

Figure 58. Nuclide Report Setup Tab.

Calculations

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

Activity is calculated as follows:

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

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

LiveTime is the current live time.

NetCounts is computed with the following equation:

$$NetCounts = GrossCounts - Background$$

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

Background is:

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

ROIWidth is:

$$ROIWidth = EndChannel - StartChannel + 1 - 6$$

Uncertainty (in percent) is calculated as follows:

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

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

$$Peak = MaximumROIChan * EnergySlope + EnergyIntercept$$

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

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

Add New

Manual Add

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

Library Add

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

Edit

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

Delete

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

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

3.2.3. DSPEC Plus

3.2.3.1. Amplifier

Figure 59 shows the Amplifier tab. This tab contains the controls for **Gain**, **Baseline Restore**, **Preamplifier Type**, **Input Polarity**, and optimization. Be sure that all of the controls on the tabs have been set *before* clicking the **Start Auto** (optimize) button.

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

Gain

Set the amplifier coarse gain by selecting from the **Coarse** droplist, then adjust the **Fine** gain with the horizontal slider bar or the edit box, in the range of 0.33 to 1.00. The resulting effective gain is shown at the top of the **Gain** section. The two controls used together cover the entire range of amplification from 0.33 to 100.

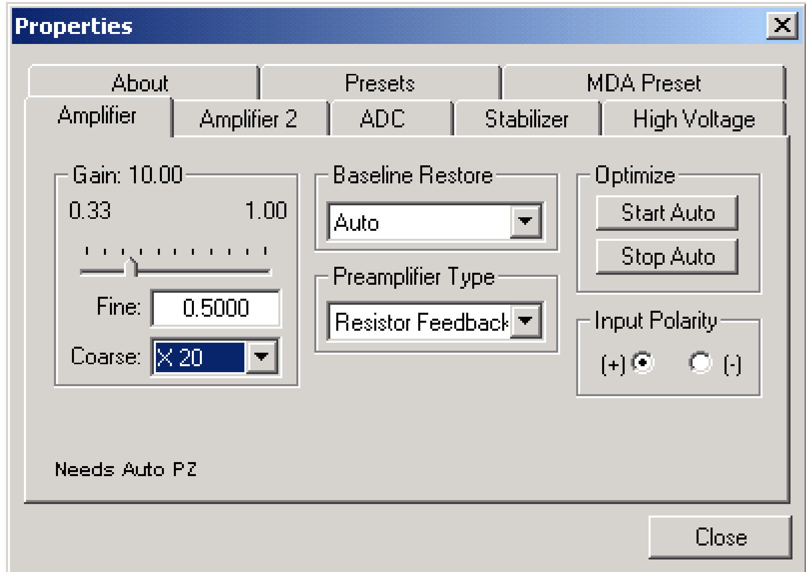

Figure 59. DSPEC Plus: The Amplifier Tab.

Input Polarity

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

Baseline Restore

The **Baseline Restore** is used to return the baseline of the pulses to the true zero between incoming pulses. This improves the resolution by removing low frequency noise such as dc shifts or mains power ac pickup. The baseline settings control the time constant of the circuit that returns the baseline to zero. There are three fixed choices (**Auto**,[4] **Fast**, and **Slow**). The fast setting is used for high count rates, the slow for low count rates. **Auto** adjusts the time constant as appropriate for the input count rate. The settings (**Auto**, **Fast**, or **Slow**) are saved in the DSPEC Plus even when the power is off. The time constant can be manually set on the InSight display (see Section 3.3).

You can view the time when the baseline restorer is active on the InSight display as a **Mark** region (see the discussion on Marks, p. 142). In the automatic mode, the current value is shown on the InSight sidebar (Fig. 161). For a low-count-rate system, the value will remain at about 90.

Preamplifier Type

Use the **Preamplifier Type** section to choose **Transistor Reset** or **Resistive Feedback** preamplifier operation. Your choice will depend on the preamplifier supplied with the type of germanium detector being used.

Optimize

The DSPEC Plus is equipped with both automatic pole-zero logic[5] and automatic flattop logic.[6] The **Start Auto** optimization button uses these features to automatically choose the best pole zero and flattop tilt settings. Note that if you selected **Transistor Reset** as the **Preamplifier Type** for this DSPEC Plus, the **Start Auto** button does not perform the pole zero.

As with any system, the DSPEC Plus should be optimized any time the detector is replaced or if the flattop width or cusp parameter is changed. For optimization to take place, the DSPEC Plus must be processing pulses. The detector should be connected in its final configuration before optimizing is started. There should be a radioactive source near the detector so that the count rate causes a dead time of ~5%. Dead time is displayed on the DSPEC Plus front panel and on the Status Sidebar during data acquisition.

Select either the **Resistive Feedback** or **Transistor Reset** option and click on **Start Auto**. The optimize command is sent to the DSPEC Plus at this time and, if the DSPEC Plus is able to start the operation, a series of short beeps sounds to indicate that optimization is in progress. When optimizing is complete, the beeping stops.

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

You should repeat the optimization if the flattop width or the cusp settings are changed.

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

3.2.3.2. Amplifier 2

Figure 60 shows the Amplifier 2 tab, which accesses the advanced DSPEC Plus shaping controls including the InSight Virtual Oscilloscope mode (see Section 3.3).

The many choices of **Rise Time** allow you to precisely control the tradeoff between resolution and throughput. Section 3.8 discusses this tradeoff and contains a guide to choosing rise time according to count rate. The value of the rise time parameter in the DSPEC Plus is roughly equivalent to twice the integration time set on a conventional analog spectroscopy amplifier. Thus, a DSPEC Plus value of 12 corresponds to 6 in a conventional amplifier. Starting with the nominal value of 12.0, you should increase values of the rise time for better resolution for expected lower count rates, or when unusually high count rates are anticipated, reduce the rise time for higher throughput with somewhat worse resolution.

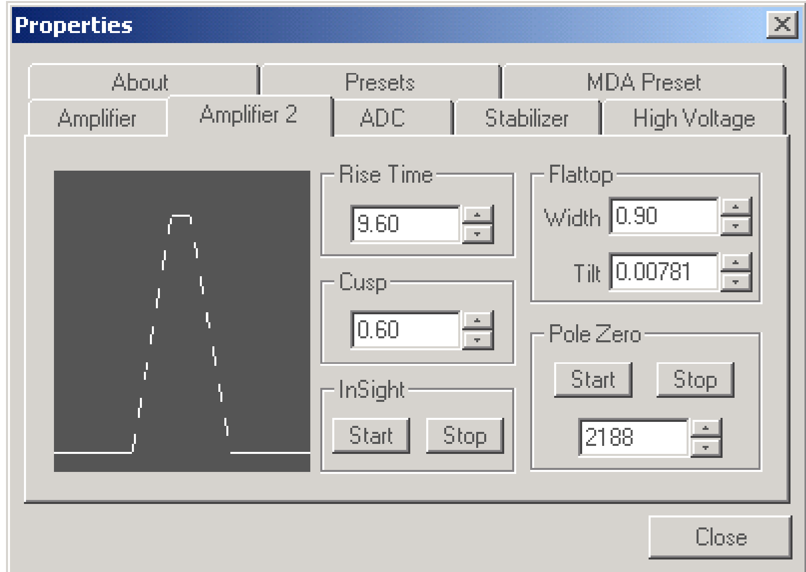

Figure 60. DSPEC Plus: The Amplifier 2 Tab.

Use the up/down arrows to adjust the rise time within the range of 0.2 to 23.0. After all the controls have been adjusted, return to the Amplifier tab and click on **Start Auto**. The most recent settings are saved in the DSPEC Plus firmware even when the power is turned off.

For the more advanced user, the InSight mode allows you to directly view all the parameters and adjust them interactively while collecting live data. To access the InSight mode, go to the **InSight** section on the Amplifier 2 tab and click on **Start**.

Note that the Amplifier 2 tab graphically presents a *modeled shape*. This is *not* a sampled waveform of the actual pulse shape, only a model based on the current parameters. The modeled shape is nominally a quasi-trapezoid whose sides and top may be adjusted by the controls in this dialog. While a particular control is being adjusted, the model is updated to represent the changes made.

The **Rise Time** and **Cusp** values are for both the rise and fall times; thus, changing the rise time has the effect of spreading or narrowing the quasi-trapezoid symmetrically. The **Cusp** value controls the curvature of the “sides” with larger values (approaching 1.00) giving a nearly straight-line shape for the rise and fall. The cusp value can range from 0.99 to 0.5. Under normal conditions, the cusp value will be in the upper part of the range.

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

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

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

Once data acquisition is underway, the advanced user may wish to return to **MCB Properties...** and click on the **InSight** section's **Start** button to adjust the shaping parameters interactively with a "live" waveform showing the actual pulse shape, or just to verify that all is well. Section 3.3 provides detailed instructions on using the InSight mode.

3.2.3.3. ADC

This tab (Fig. 61) contains the **Gate**, **ZDT Mode**, **Conversion Gain**, **Lower Level Disc**riminator, and **Upper Level Disc**riminator controls. In addition, the current real time, live time, and count rate are monitored at the bottom of the dialog.

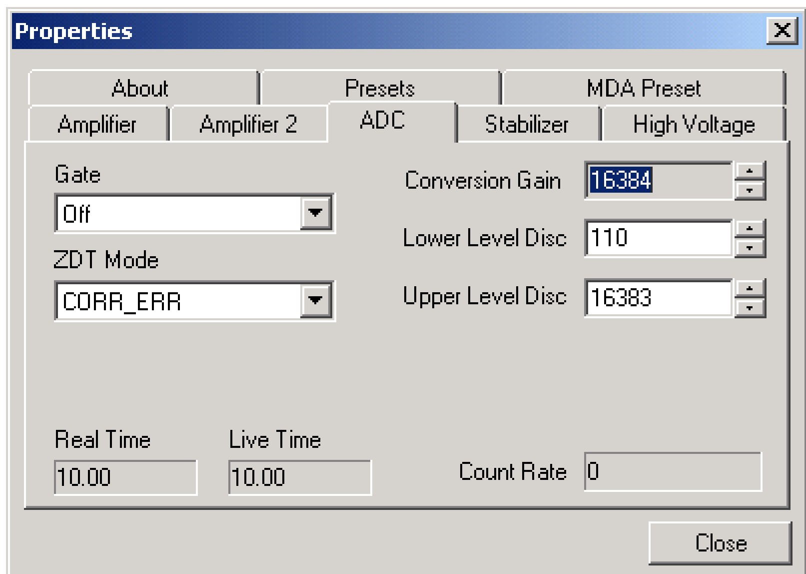

Figure 61. DSPEC Plus: The ADC Tab.

Gate

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

ZDT Mode

Use this droplist to choose the **ZDT Mode** to be used for collecting the zero dead time (corrected) spectrum (see Section 3.6). The three modes are **Off** (LTC only), **NORM_CORR** (LTC and ZDT), and **CORR_ERR** (ERR and ZDT). If one of the ZDT modes is selected, both spectra are stored in the same spectrum (.SPC) file. If you do not need the ZDT spectrum, you should select **Off**.

In MAESTRO, the display can show either of the two spectra. Use **<F3>** or **Acquire/ ZDT Display Select** to toggle the display between the two spectra. In the Compare mode, **<F3>** switches both spectra to the other type and **<Shift+F3>** switches only the compare spectrum. This allows you to make all types of comparisons.

Conversion Gain

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

Upper- and Lower-Level Discriminators

In the DSPEC Plus the lower- and upper-level discriminators are under computer control. The **Lower Level Disc**riminator sets the level of the lowest amplitude pulse that will be stored. This level establishes a lower-level cutoff, by channel number, for ADC conversions. Setting that level above random noise increases useful throughput because the MCB is not unproductively occupied processing noise pulses.

The **Upper Level Disc**riminator sets the level of the highest amplitude pulse that will be stored. This level establishes an upper-level cutoff, by channel number, for ADC conversions.

Stabilizer

The DSPEC Plus has both a gain stabilizer and a zero stabilizer. These are discussed in detail in Sections 3.4 and 3.5, respectively.

The Stabilizer tab (Fig. 62) shows the current values for the stabilizers. The value in each **Adjustment** section shows how much adjustment is currently applied. The **Initialize** buttons set the adjustment to 0. If the value approaches 90% or above, the amplifier gain should be adjusted so the stabilizer can continue to function — when the adjustment value reaches 100%, the stabilizer cannot make further corrections in that direction. The **Center Chan**nel and **Width** fields show the peak currently used for stabilization.

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

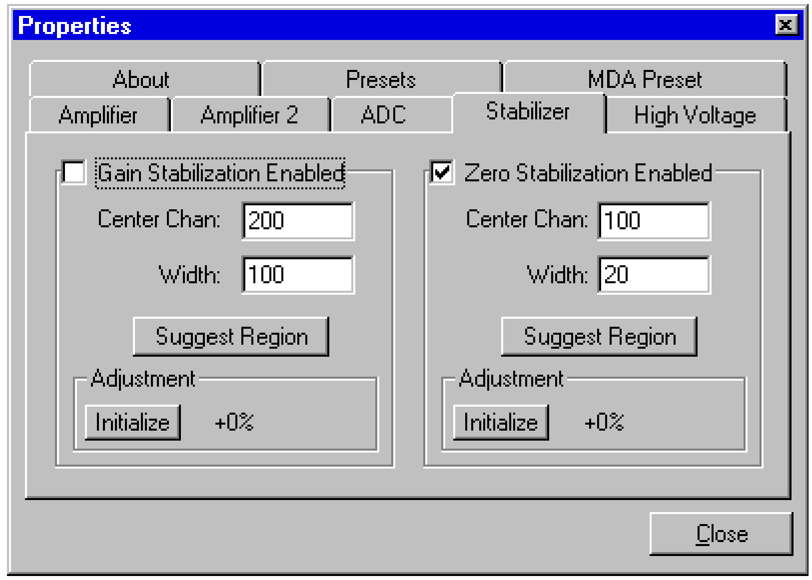

Figure 62. DSPEC Plus: The Stabilizer Tab.

High Voltage

Figure 63 shows the High Voltage tab, which allows you to turn the high voltage on or off; set and monitor the voltage; select the **Polarity**; and choose the **ShutDown** mode.

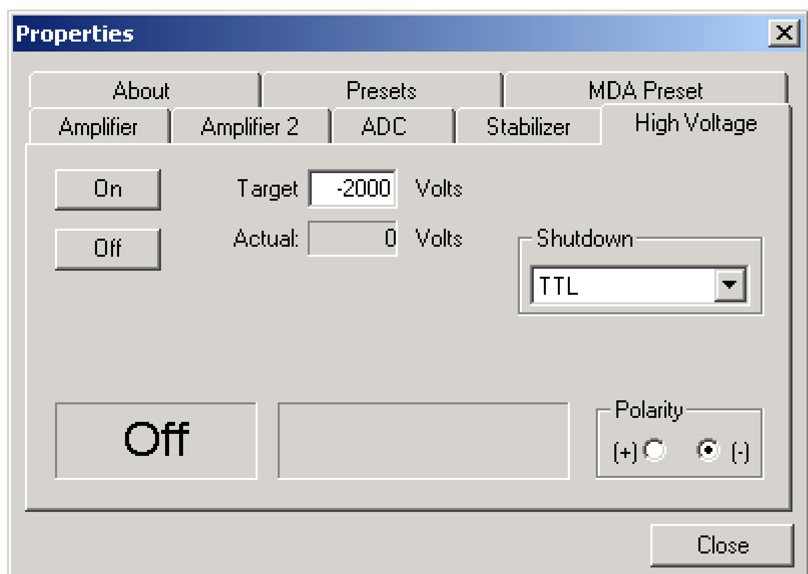

Figure 63. DSPEC Plus: The High Voltage Tab.

The high voltage is overridden by the detector bias remote shutdown signal from the detector; high voltage cannot be enabled if the remote shutdown or overload signals prevent it. Enter the detector high voltage in the **Target** field, click **On**, and monitor the voltage in the **Actual** field. Click the **Off** button to turn off the high voltage.

The **Polarity** selection determines which of the two rear-panel HV connectors have power. The blue or negative connector only has high voltage when **(−)** is selected, and the red or positive connector only has high voltage when **(+)** is selected. Choose the **Polarity** with the **(+)** and **(−)** radio buttons (the high voltage is disabled when the polarity is being changed).

3.2.3.4. About

This tab (Fig. 64) displays hardware and firmware information about the currently selected DSPEC Plus as well as the data **Acquisition Start Time** and **Sample** description. In addition, the **Access** field shows whether the MCB is currently locked with a password; **Read/Write** indicates that the MCB is unlocked; **Read Only** means it is locked.

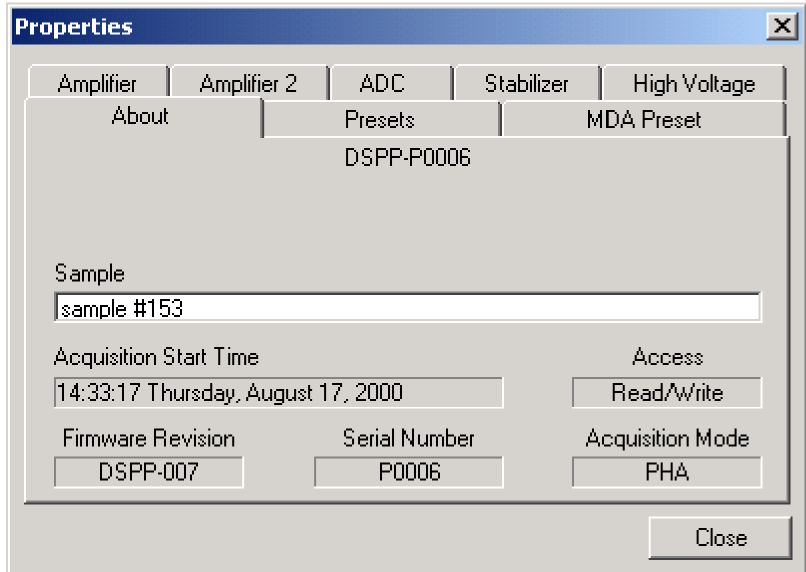

Figure 64. DSPEC Plus: The About Tab.

3.2.3.5. Presets

Figure 65 shows the Presets tab. MDA presets are shown on a separate tab.

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

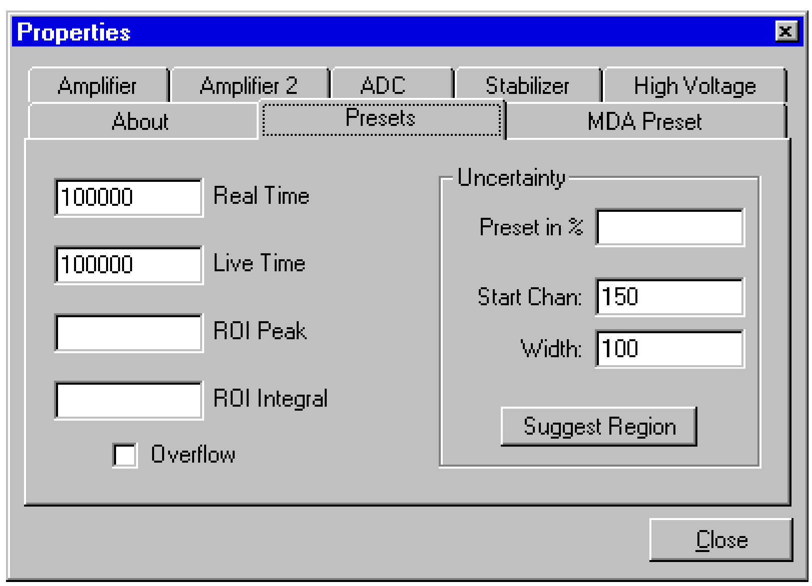

Figure 65. DSPEC Plus: The Presets Tab.

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

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

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

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

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

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

Use the **Start Chan**nel and **Width** fields to enter the channel limits directly, or click on **Suggest Region**. If the marker is positioned in an ROI around the peak of interest, **Suggest Region** reads the limits of the ROI with the marker and display those limits in the **Start Chan** and **Width** fields. The ROI can be cleared after the preset is entered without affecting the uncertainty calculation. If the marker is not positioned in an ROI, the start channel is 1.5 times the FWHM below the marker channel and the width is 3 times the FWHM. The net peak area and statistical uncertainty are calculated in the same manner as for the MAESTRO **Peak Info** command, which is discussed in Section 3.7. Note that the **Suggest Region** button is not displayed during data acquisition.

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

3.2.3.6. MDA Preset

The MDA preset (Fig. 66) can monitor up to 20 nuclides at one time, and stops data collection when the minimum detectable activity for each of the user-specified MDA nuclides reaches the designated value. The MDA preset is implemented in the hardware. The formulas for the MDA are given in various textbooks and in the "Analysis Methods" chapter in the GammaVision user manual and can be generally represented as follows:

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

The coefficients *a*, *b*, and *c* are determined by the MDA formula to be used. The *Eff* (detector efficiency) is determined from the calibration. The *Yield* (branching ratio) is read from the working library using the nuclide and energy specified. The **MDA** value is the one you have entered in the dialog. *Counts* is the gross counts in the specified region and *Live time* is the live time. The *MDA* value is calculated in the MCB given the values *a*, *b*, *c*, *Live time*, *Eff*, and *Yield*. The calculated value is compared with the **MDA** value on the dialog and when it is lower, acquisition is stopped.

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

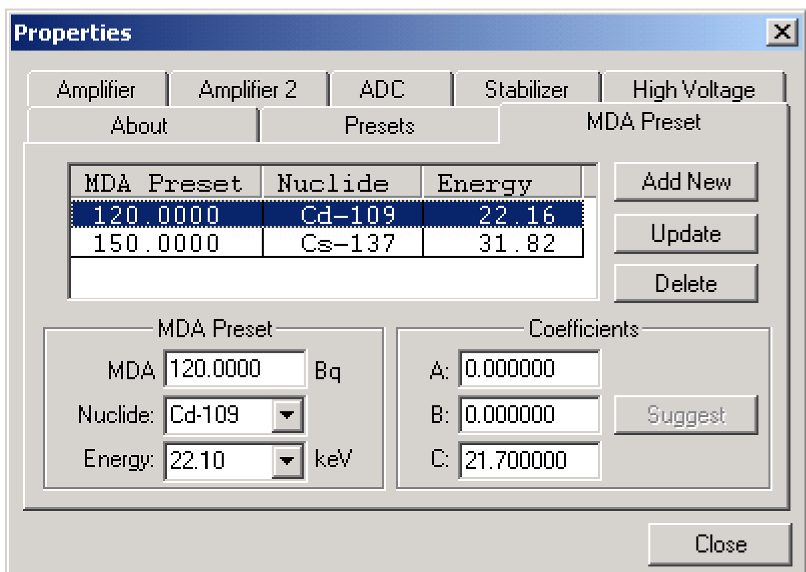

Figure 66. DSPEC Plus: The MDA Preset Tab.

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

If the application supports efficiency calibration and the DSPEC Plus is efficiency calibrated, the **MDA** is entered in the units selected in the application. If the unit is not efficiency calibrated (e.g., in MAESTRO, which does not support efficiency calibration), the **MDA** field is labeled

Correction, the efficiency (*Eff*) is set to 1.0 and the preset operates as before. If the **Correction** factor is the actual MDA times the efficiency (known from other sources), the MDA preset will function normally.

3.2.4. DSPEC

3.2.4.1. Amplifier

Figure 67 shows the Amplifier tab. This tab contains the controls for **Gain**, **Baseline Restore**, **Preamplifier Type**, **Input Polarity**, and optimization. Be sure that all of the controls on the tabs have been set *before* clicking the **Start Auto** (optimize) button.

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

Gain

Set the amplifier coarse gain by selecting from the **Coarse** droplist, then adjust the **Fine** gain with the horizontal slider bar or the edit box, in the range of 0.33 to 0.99. The resulting effective gain is shown at the top of the **Gain** section. The two controls used together cover the entire range of amplification from 0.33 to 99.99.

Baseline Restore

The **Baseline Restore** is used to return the baseline of the pulses to the true zero between incoming pulses. This improves the resolution by removing low frequency noise such as dc shifts or mains power ac pickup. The baseline settings control the time constant of the circuit that returns the baseline to zero. There are three fixed choices (**Auto**,[4] **Fast**, and **Slow**). The fast setting is used for high count rates, the slow for low count rates. **Auto** adjusts the time constant as appropriate for the input count rate. The settings (**Auto**, **Fast**, or **Slow**) are saved in the DSPEC even when the power is off.

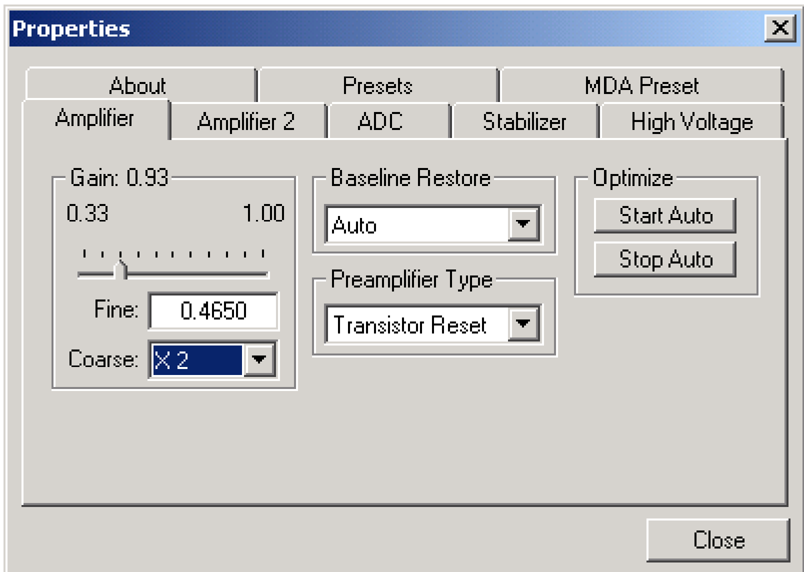

Figure 67. DSPEC: The Amplifier Tab.

You can view the time when the baseline restorer is active on the InSight display as a **Mark** region (see the discussion on Marks, p. 142). In the automatic mode, the current value is shown on the InSight sidebar (Fig. 161). For a low-count-rate system, the value will remain at about 90.

Preamplifier Type

Use the **Preamplifier Type** section to choose **Transistor Reset** or **Resistive Feedback** preamplifier operation. Your choice will depend on the preamplifier supplied with the type of germanium detector being used.

Optimize

The DSPEC is equipped with both automatic pole-zero logic[5] and automatic flattop logic.[6] The **Start Auto** (optimize) button uses these features to automatically choose the best pole-zero and flattop tilt settings. Note that if you selected **Transistor Reset** as the **Preamplifier Type** for this DSPEC, the optimization buttons do not perform the pole zero.

As with any system, the DSPEC should be optimized any time the detector is replaced or if the flattop width or cusp parameter is changed. For optimization to take place, the DSPEC must be processing pulses. The detector should be connected in its final configuration before optimizing is started. There should be a radioactive source near the detector so that the count rate causes a dead time of ~5%. Dead time is displayed on the DSPEC front panel and on the Status Sidebar during data acquisition.

Select either the **Resistive Feedback** or **Transistor Reset** option and click on **Start Auto** (optimize). This optimize command is sent to the DSPEC and, if the DSPEC is able to start the operation, a series of short beeps sounds to indicate that optimization is in progress. When optimizing is complete, the beeps stop.

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

You should repeat the optimization if the flattop width or the cusp settings are changed.

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

3.2.4.2. Amplifier 2

Figure 68 shows the Amplifier 2 tab, which accesses the advanced DSPEC resolution, throughput, and shaping controls including the InSight Virtual Oscilloscope mode (see Section 3.3).

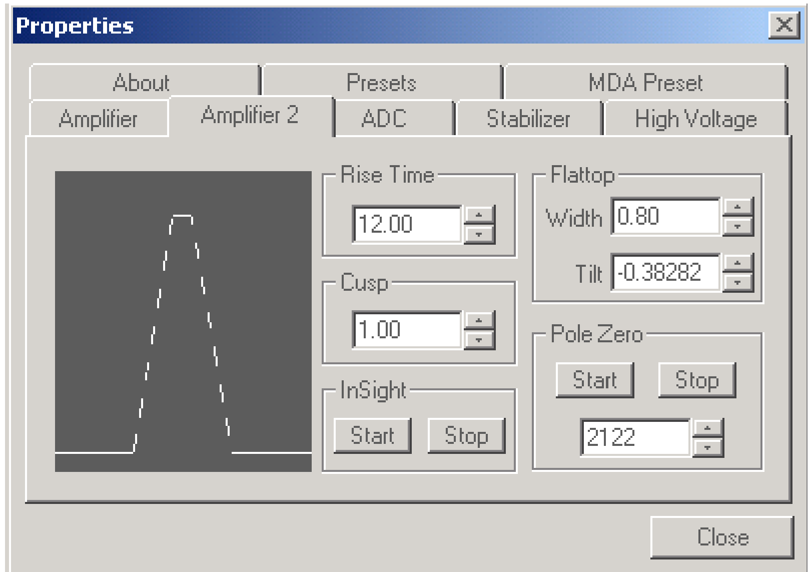

Figure 68. DSPEC: The Amplifier 2 Tab.

The **Rise Time** field allows you to precisely control the tradeoff between resolution and throughput. Section 3.8 discusses this tradeoff and contains a guide to choosing rise time according to count rate. The value of the rise time parameter in the DSPEC is roughly equivalent to twice the integration time set on a conventional analog spectroscopy amplifier. Thus, a DSPEC value of 12 corresponds to 6 in a conventional amplifier. Starting with the nominal value of 12.0, you should increase values of the rise time for better resolution for expected lower count rates, or when unusually high count rates are anticipated reduce the rise time for higher throughput with somewhat worse resolution.

Use the up/down arrows to adjust the rise time within the range of 0.8 to 25.6. After all the controls have been adjusted, go to the Amplifier tab and click on **Start Auto**. The most recent settings are saved in the DSPEC firmware even when the power is turned off.

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

Note that the Amplifier 2 tab graphically presents a *modeled shape*. This is *not* a sampled waveform of actual pulse shape(s), only a model based on the current parameters. The modeled shape is nominally a quasi-trapezoid whose sides and top may be adjusted by the controls in this dialog. While a particular control is being adjusted, the model is updated to represent the changes made.

The **Rise Time** and **Cusp** values are for both the rise and fall times; thus, changing the rise time has the effect of spreading or narrowing the quasi-trapezoid symmetrically. The **Cusp** value controls the curvature of the "sides" with larger values (approaching 1.00) giving a nearly straight-line shape for the rise and fall. The cusp value can range from 0.99 to 0.5. Under normal conditions, the cusp value will be in the upper part of the range.

The **Flattop** controls adjust the top of the quasi-trapezoid. The **Width** adjusts the extent of the flattop (from 0.8 to 2.4 µs). The **Tilt** adjustment varies the "flatness" of this section slightly. The **Tilt** can be positive or negative. Choosing a positive value results in a flattop that slopes downward; choosing a negative value gives an upward slope. Alternatively, the optimize feature on the Amplifier tab can set the tilt value automatically. This automatic value is normally the best for resolution, but it can be changed on this dialog and in the InSight mode to accommodate particular throughput/resolution tradeoffs. The optimize feature also automatically adjusts the pole-zero setting.

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

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

Once data acquisition is underway, the advanced user may wish to return to **MCB Properties...** and click on the **InSight Start** button to adjust the shaping parameters interactively with a "live" waveform showing the actual pulse shape, or just to verify that all is well. Section 3.3 provides detailed instructions on using the InSight mode.

3.2.4.3. ADC

This tab (Fig. 69) contains the **Gate**, **Conversion Gain**, and **Lower Level Disc**riminator controls. In addition, the current real time and live time are monitored at the bottom of the dialog.

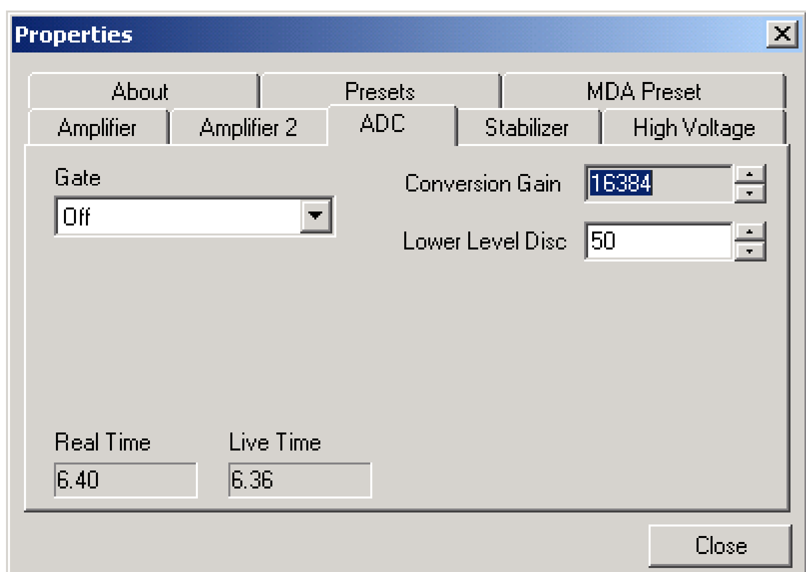

Figure 69. DSPEC: The ADC Tab.

Gate

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

Conversion Gain

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

Lower-Level Discriminator

The **Lower Level Disc**riminator sets the level of the lowest amplitude pulse that will be stored. In the DSPEC this is under computer control; in older systems it was implemented via a hard-ware potentiometer adjustment. This level establishes a lower-level cutoff, by channel number, for ADC conversions. Setting that level above random noise increases useful throughput because the MCB is then not unproductively occupied processing noise pulses.

3.2.4.4. Stabilizer

The DSPEC has both a gain stabilizer and a zero stabilizer. These are discussed in detail in Sections 3.4 and 3.5, respectively.

The Stabilizer tab (Fig. 70) shows the current values for the stabilizers. The value in each **Adjustment** section shows how much adjustment is currently applied. The **Initialize** buttons set the adjustment to 0. If the value approaches 90% or above, the amplifier gain should be adjusted so the stabilizer can continue to function — when the adjustment value reaches 100%, the stabilizer cannot make further corrections in that direction. The **Center Chan**nel and **Width** fields show the peak currently used for stabilization.

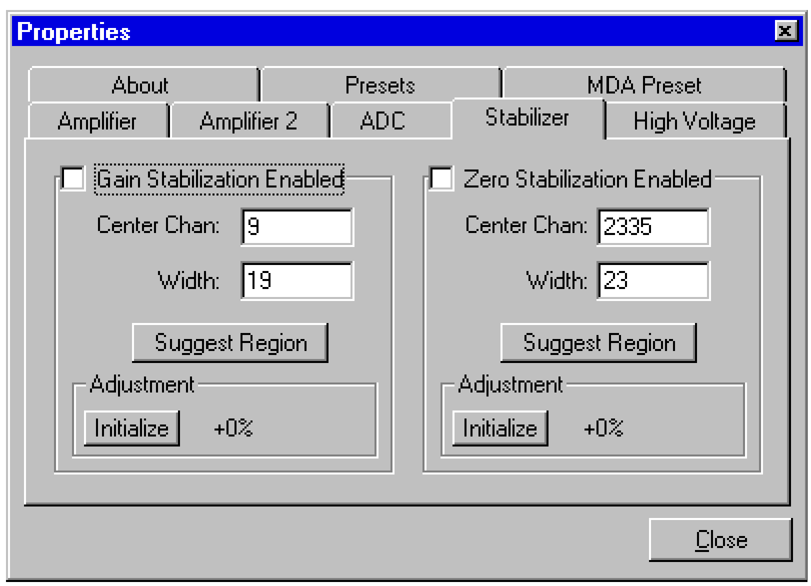

Figure 70. DSPEC: The Stabilizer Tab.

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

3.2.4.5. High Voltage

Figure 71 shows the High Voltage tab. The **On** and **Off** buttons apply and remove the high voltage. This function is overridden by the detector bias remote shutdown signal from the detector; high voltage cannot be enabled if the remote shutdown or overload signals prevent it. The **Target** voltage level is displayed on this tab but cannot be modified from the dialog. It is controlled by the hardware and can be adjusted by a rear-panel potentiometer. High-voltage polarity is set with an internal jumper. See the DSPEC hardware manual for more information.

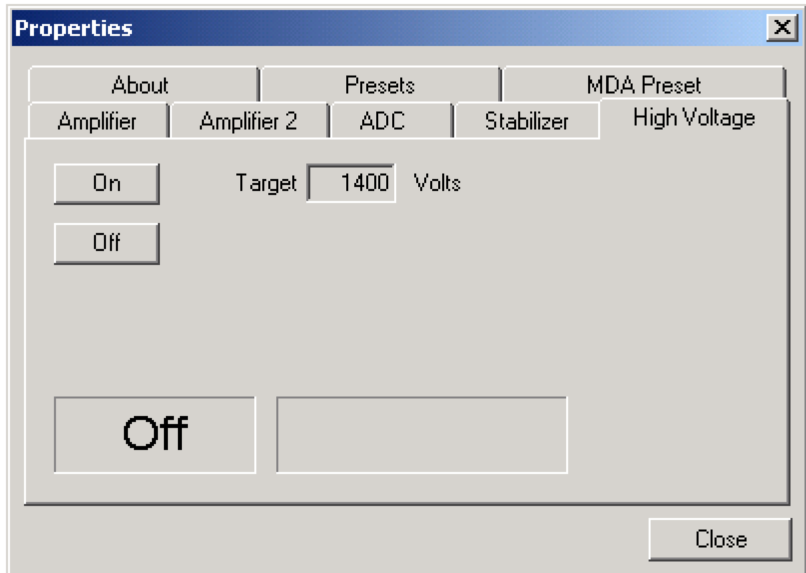

Figure 71. DSPEC: The High Voltage Tab.

3.2.4.6. About

This tab (Fig. 72) displays hardware and firmware information about the currently selected DSPEC, as well as the data **Acquisition Start Time** and **Sample** description. In addition, the **Access** field shows whether the MCB is currently locked with a password; **Read/Write** indicates that the MCB is unlocked; **Read Only** means it is locked.

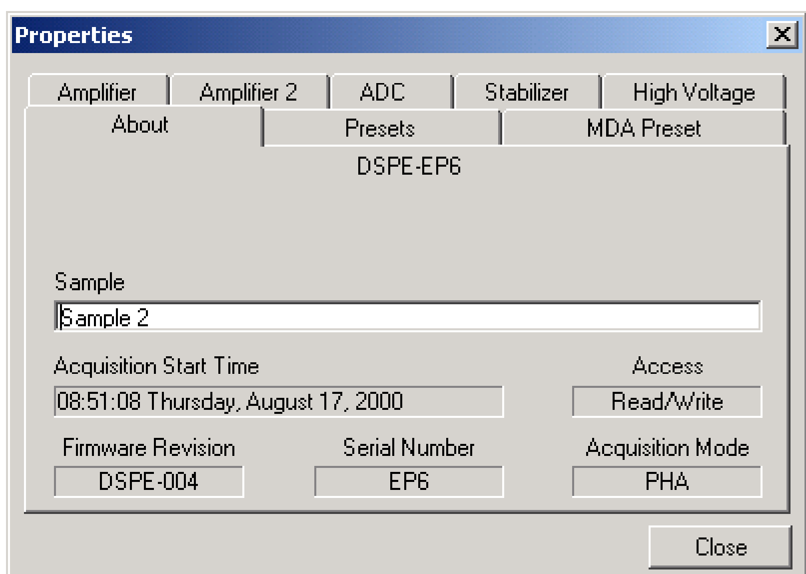

Figure 72. DSPEC: The About Tab.

3.2.4.7. Presets

Figure 73 shows the Presets tab. The presets can only be set on an MCB that is *not* acquiring data. You can use any or all of the presets at one time. To disable a preset, enter a value of zero. If you disable all of the presets, data acquisition will continue until manually stopped.

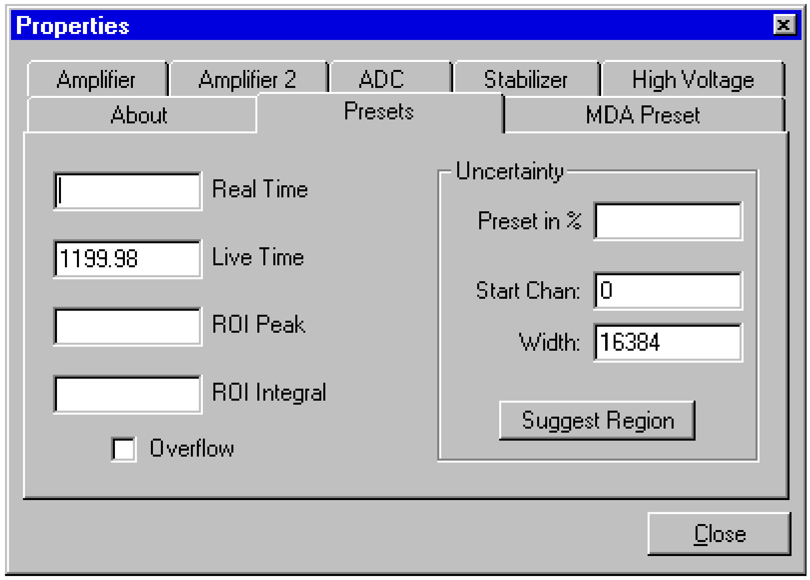

Figure 73. DSPEC: The Presets Tab.

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

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

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

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

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

The **Uncertainty** preset stops acquisition when the statistical or counting uncertainty of a user-selected net peak reaches the value you have entered. Enter the **Preset in %** value as percent uncertainty at 1 sigma of the net peak area. The range is from 99% to 0.1% in 0.1% steps. You

have complete control over the selected peak region. The region must be at least 7 channels wide with 3 channels of background on each side of the peak. As the uncertainty is calculated approximately every 30 seconds, the uncertainty achieved for a high count-rate sample may be better than the preset value.

Use the **Start Chan**nel and **Width** fields to enter the channel limits directly, or click on **Suggest Region**. If the marker is positioned in an ROI around the peak of interest, **Suggest Region** reads the limits of the ROI with the marker and display those limits in the **Start Chan** and **Width** fields. The ROI can be cleared after the preset is entered without affecting the uncertainty calculation. If the marker is not positioned in an ROI, the start channel is 1.5 times the FWHM below the marker channel and the width is 3 times the FWHM. The net peak area and statistical uncertainty are calculated in the same manner as for the MAESTRO **Peak Info** command, which is discussed in Section 3.7. Note that the **Suggest Region** button is not displayed during data acquisition.

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

3.2.4.8. MDA Preset

The MDA preset (Fig. 74) stops data collection when the minimum detectable activity for a single user-specified MDA nuclide reaches the designated value. The MDA preset is implemented in the hardware. The formulas for the MDA are given in various textbooks and in the “Analysis Methods” chapter in the GammaVision user manual and can be generally represented as follows:

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

The coefficients *a*, *b*, and *c* are determined by the MDA formula to be used. The *Eff* (detector efficiency) is determined from the calibration. The *Yield* (branching ratio) is read from the working library using the nuclide and energy specified. The **MDA** value is the one you have entered in the dialog. *Counts* is the gross counts in the specified region and *Live time* is the live time. The *MDA* value is calculated in the MCB given the values *a*, *b*, *c*, *Live time*, *Eff*, and *Yield*. The calculated value is compared with the **MDA** value on the dialog and when it is lower, acquisition is stopped.

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

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

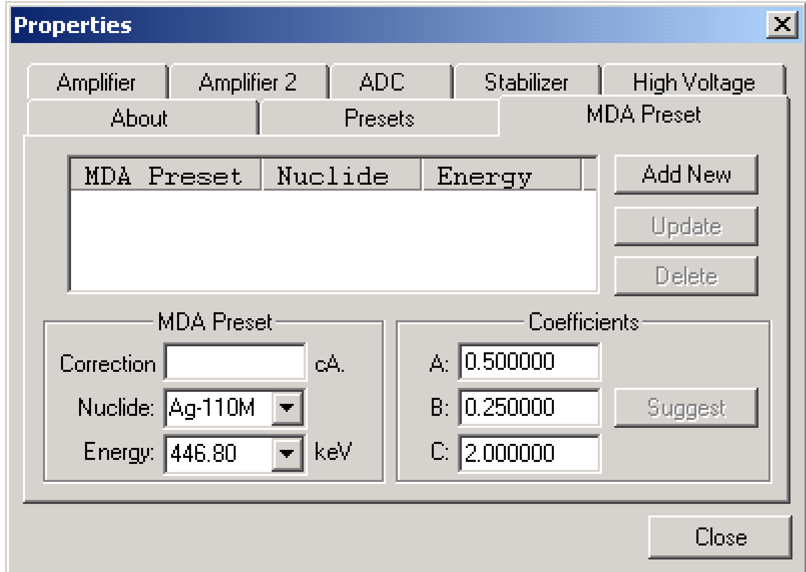

Figure 74. DSPEC: The MDA Preset Tab.

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

3.2.5. 92X-II

3.2.5.1. Amplifier

Figure 75 shows the Amplifier tab. This tab contains the controls for **Gain**, **Shaping Time**, **Preamplifier Type**, and **Pole Zero**. Be sure that all of the controls on the tabs have been set *before* clicking the **Start Auto** (pole zero) button.

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

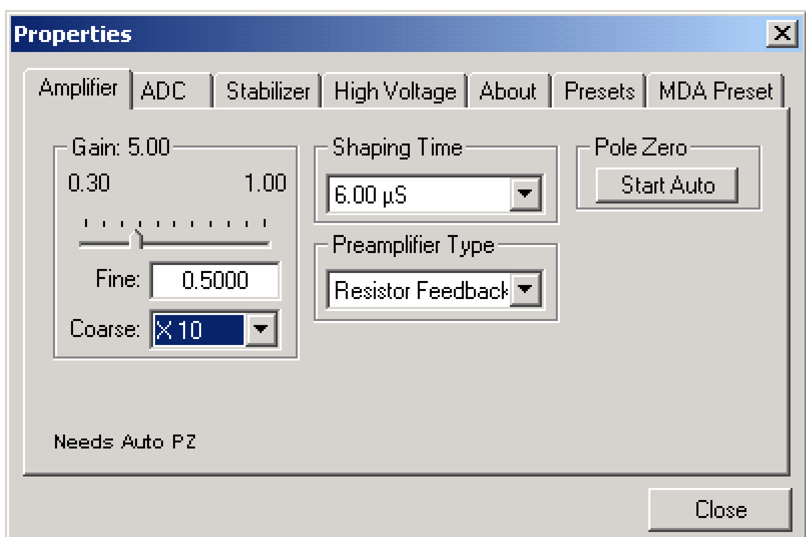

Figure 75. 92X-II: The Amplifier Tab.

Gain

Set the amplifier coarse gain by selecting from the **Coarse** droplist, then adjust the **Fine** gain with the horizontal slider bar or the edit box, in the range of 0.3 to 1.0. The resulting effective gain is shown at the top of the **Gain** section. The two controls used together cover the entire range of amplification from 3.0 to 1000.0.

Shaping Time

Use the **Shaping Time** droplist to select the 92X-II amplifier pulse shaping-time constant. The displayed values are the values available for this 92X-II. The selections are 2 µs and 6 µs.

Preamplifier Type and Pole Zero

The **Preamplifier Type** section lets you choose **Transistor Reset** or **Resistive Feedback** preamplifier operation. The 92X-II amplifier is equipped with an automatic pole-zero circuit. If **Transistor Reset Preamplifier** is selected for this 92X-II, the pole zero is not needed.

When the **Resistive Feedback** option is selected, you must set the pole zero. To do this, go to the **Pole Zero** section of the dialog and click on **Start Auto**. The pole-zero command will be sent to the 92X-II and if the 92X-II is able to start the pole-zero, a series of short beeps will sound to indicate that the pole zero is in progress. When the pole zeroing is finished, the beeps will stop.

As with any system, the amplifier should be pole zeroed any time the detector is changed or the shaping time of the amplifier is changed. Pole-zeroing requires the amplifier to be amplifying pulses. The detector should be connected in the final configuration before pole zeroing is started. There should be a radioactive source near the detector so that the count rate will be high enough (about 5 to 10% dead time) to accomplish the pole zero in the proper time.

Without an oscilloscope connected to the amplifier output to display the pulse shape, the effect of the pole zero operation is not always easy to see. The most common effect of an incorrect pole-zero setting is tailing on the peak shape in the spectrum. Here, tailing refers to abnormally high counts on either side of the peak. If the amplifier was close to the proper pole zero setting before the operation, the spectrum peak shape may not change enough to be seen.

3.2.5.2. ADC

This tab (Fig. 76) contains the **Gate** and **Conversion Gain** controls. In addition, the current real time and live time are monitored at the bottom of the dialog.

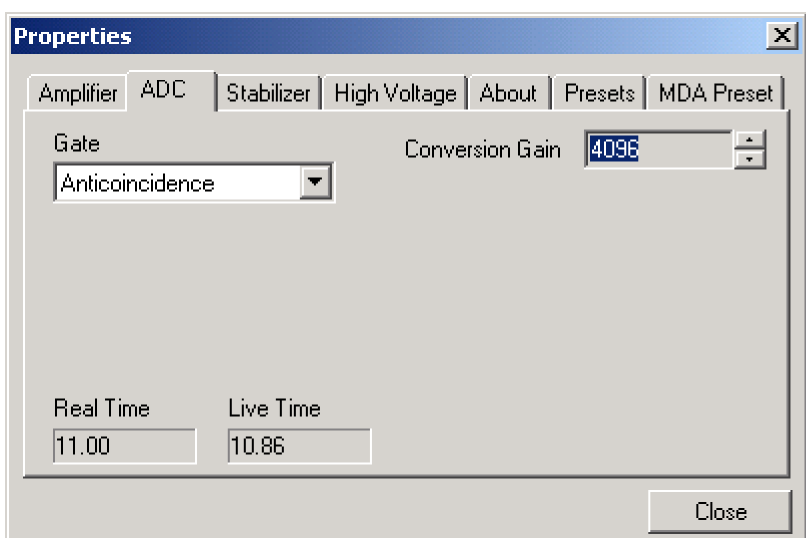

Figure 76. 92X-II: The ADC Tab.

Gate

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

Conversion Gain

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

3.2.5.3. Stabilizer

The 92X-II has both a gain stabilizer and a zero stabilizer. These are discussed in detail in Sections 3.4 and 3.5, respectively.

The Stabilizer tab (Fig. 77) shows the current values for the stabilizers. The value in each **Adjustment** section shows how much adjustment is currently applied. The **Initialize** buttons set the adjustment to 0. If the value approaches 90% or above, the amplifier gain should be adjusted so the stabilizer can continue to function — when the adjustment value reaches 100%, the stabilizer cannot make further corrections in that direction. The **Center Chan**nel and **Width** fields show the peak currently used for stabilization.

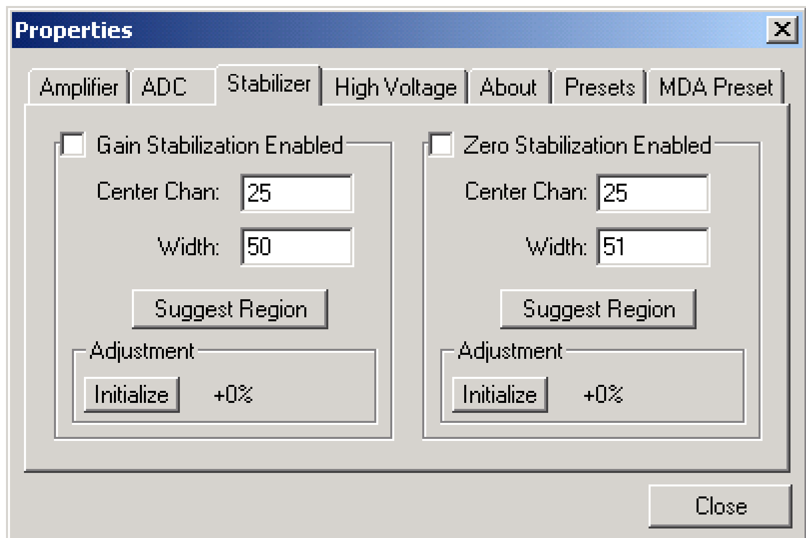

Figure 77. 92X-II: The Stabilizer Tab.

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

High Voltage

Figure 78 shows the High Voltage tab. The **On** and **Off** buttons apply and remove the high voltage. This function is overridden by the detector bias remote shutdown signal from the detector; high voltage cannot be enabled if the remote shutdown or overload signals prevent it. The **Target** voltage level is displayed on this tab but cannot be modified from the dialog. It is controlled by the hardware and is adjusted by a rear-panel potentiometer. High-voltage polarity is set with an internal jumper. See the hardware manual for more information.

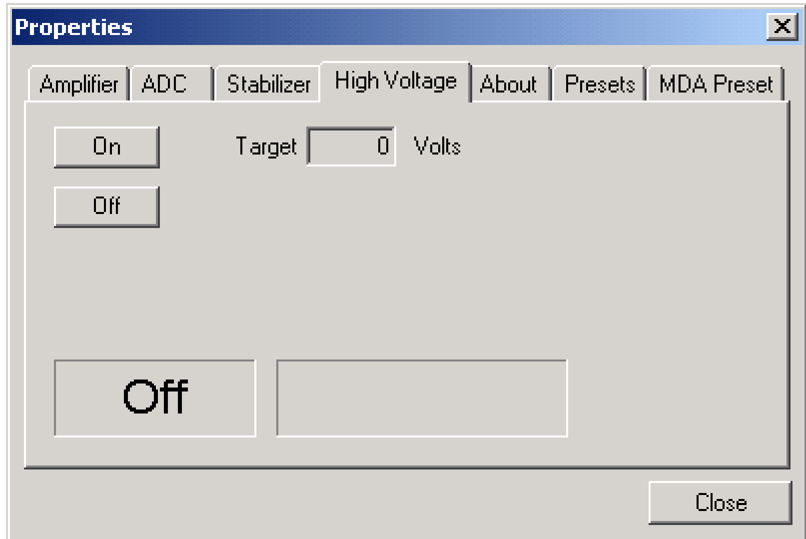

Figure 78. 92X-II: The High Voltage Tab.

3.2.5.4. About

This tab (Fig. 79) displays hardware and firmware information about the currently selected 92X-II, as well as the data **Acquisition Start Time** and **Sample** description. In addition, the **Access** field shows whether the MCB is currently locked with a password; **Read/ Write** indicates that the MCB is unlocked; **Read Only** means it is locked.

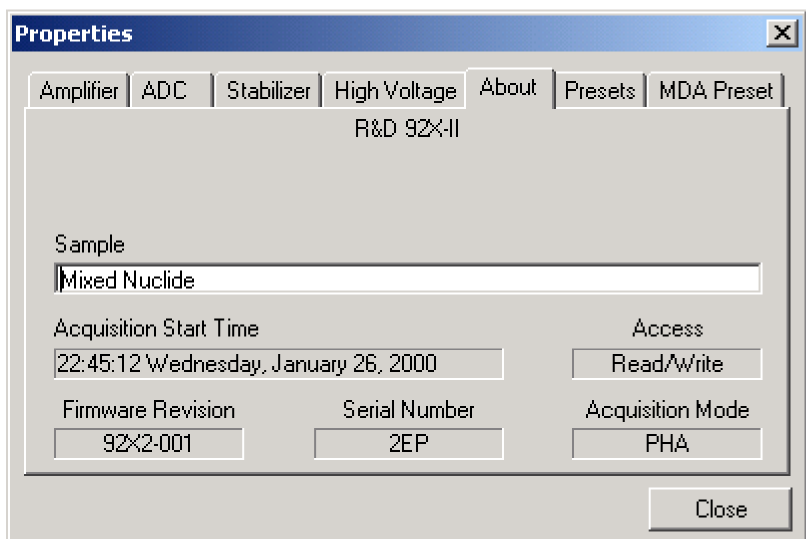

Figure 79. 92X-II: The About Tab.

3.2.5.5. Presets

Figure 80 shows the Presets tab. The presets can only be set on an MCB that is *not* acquiring data. You can use any or all of the presets at one time. To disable a preset, enter a value of zero. If you disable all of the presets, data acquisition will continue until manually stopped.

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

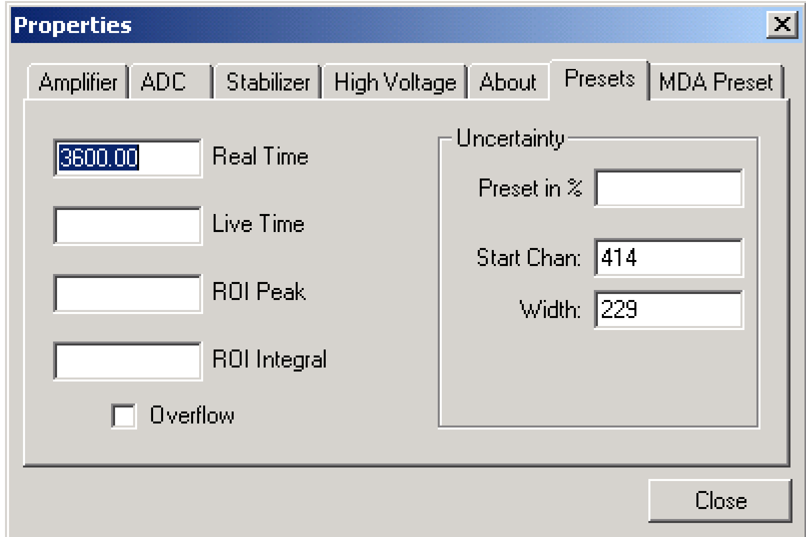

Figure 80. 92X-II: The Presets Tab.

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

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

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

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

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

Use the **Start Chan**nel and **Width** fields to enter the channel limits directly, or click on **Suggest Region**. If the marker is positioned in an ROI around the peak of interest, **Suggest Region** reads the limits of the ROI with the marker and display those limits in the **Start Chan** and **Width** fields. The ROI can be cleared after the preset is entered without affecting the uncertainty calculation. If the marker is not positioned in an ROI, the start channel is 1.5 times the FWHM below the marker channel and the width is 3 times the FWHM. The net peak area and statistical uncertainty are calculated in the same manner as for the MAESTRO **Peak Info** command, which is discussed in Section 3.7. Note that the **Suggest Region** button is not displayed during data acquisition.

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

3.2.5.6. MDA Preset

The MDA preset (Fig. 81) stops data collection when the minimum detectable activity for a single user-specified MDA nuclide reaches the designated value. The MDA preset is implemented in the hardware. The formulas for the MDA are given in various textbooks and in the "Analysis Methods" chapter in the GammaVision user manual and can be generally represented as follows:

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

The coefficients *a*, *b*, and *c* are determined by the MDA formula to be used. The *Eff* (detector efficiency) is determined from the calibration. The *Yield* (branching ratio) is read from the working library using the nuclide and energy specified. The **MDA** value is the one you have entered in the dialog. *Counts* is the gross counts in the specified region and *Live time* is the live time. The *MDA* value is calculated in the MCB given the values *a*, *b*, *c*, *Live time*, *Eff*, and *Yield*. The calculated value is compared with the **MDA** value on the dialog and when it is lower, acquisition is stopped.

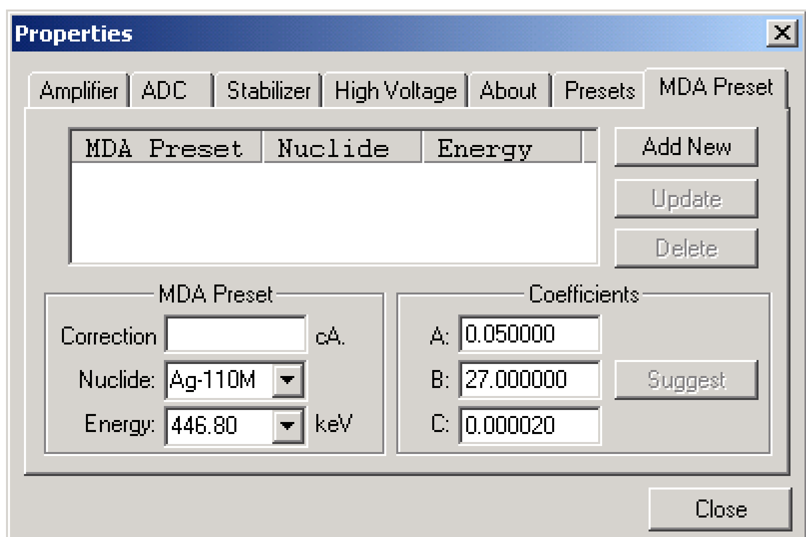

Figure 81. 92X-II: The MDA Preset Tab.

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

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

If the application supports efficiency calibration and the 92X-II is efficiency calibrated, the **MDA** is entered in the units selected in the application. If the unit is not efficiency calibrated (e.g., in MAESTRO, which does not support efficiency calibration), the **MDA** field is labeled **Correction**, the efficiency (*Eff*) is set to 1.0 and the preset operates as before. If the **Correction** factor is the actual MDA times the efficiency (known from other sources), the MDA preset will function normally.

3.2.6. DART

3.2.6.1. Amplifier

Figure 82 shows the Amplifier tab. This tab contains the controls for **Gain**, **Shaping Time**, **Preamplifier Type**, **Pole Zero**, **Input Polarity**, and **Pileup Rejection**. Be sure that all of the controls on the tabs have been set *before* clicking the **Start Auto** (pole zero) button.

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

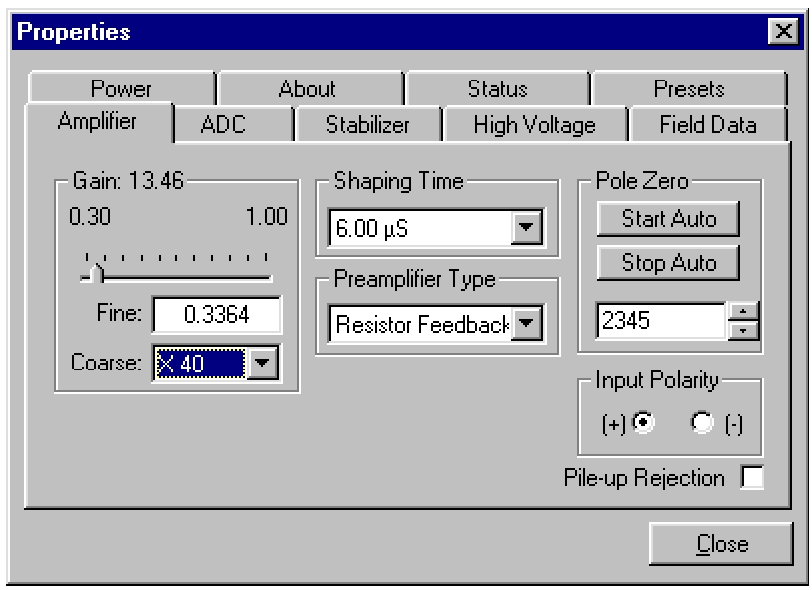

Figure 82. DART: The Amplifier Tab.

Gain

Set the amplifier coarse gain by selecting from the **Coarse** droplist, then adjust the **Fine** gain with the horizontal slider bar or the edit box, in the range of 0.3 to 1.0. The resulting effective gain is shown at the top of the **Gain** section. The two controls used together cover the entire range of amplification from 3.0 to 1000.0.

Shaping Time

Use the **Shaping Time** droplist to select the DART amplifier pulse shaping-time constant. The displayed values are the values available for this DART. The selections are usually either 1 and 6 µs, or 1 and 2 µs.

Preamplifier Type and Pole Zero

The **Preamplifier Type** section lets you choose **Transistor Reset** or **Resistive Feedback** preamplifier operation. The DART amplifier is equipped with an automatic pole-zero circuit. If **Transistor Reset** is selected for this DART, the pole zero is not needed.

When the **Resistive Feedback** option is selected, you must set the pole zero. To do this, go to the **Pole Zero** section of the dialog and click on **Start Auto**. The pole-zero command will be sent to the DART and if the DART is able to start the pole-zero, a series of short beeps will sound to indicate that the pole zero is in progress. When the pole zeroing is finished, the beeps will stop.

As with any system, the amplifier should be pole zeroed any time the detector is changed or the shaping time of the amplifier is changed. Pole-zeroing requires the amplifier to be amplifying pulses. The detector should be connected in the final configuration before pole zeroing is started. There should be a radioactive source near the detector so that the count rate will be high enough (about 5 to 10% dead time) to accomplish the pole zero in the proper time. If the detector does not pole zero in a few minutes, there may be some problem with the detector or cables. Click on **Stop Auto** to halt the pole-zeroing operation.

By entering a value in the **Pole Zero** field, you can set the pole-zero value to any value you wish much the same as with the old-fashioned screwdriver potentiometer, but with much greater reproducibility. The setting has no units. This gives you the ability to exactly set the pole zero for any detector to the value used previously, ensuring data quality and reproducibility.

Without an oscilloscope connected to the amplifier output to display the pulse shape, the effect of the pole zero operation is not always easy to see. The most common effect of an incorrect pole-zero setting is tailing on the peak shape in the spectrum. Here, tailing refers to abnormally high counts on either side of the peak. If the amplifier was close to the proper pole zero setting before the operation, the spectrum peak shape may not change enough to be seen.

Input Polarity

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

Pileup Rejection

Pileup Rejection (PUR) is used to reject overlapping pulses, improving the peak shape. This checkbox allows you to disable the PUR. This feature is normally enabled and is only turned off for special detectors.

3.2.6.2. ADC

This tab (Fig. 83) contains the **Gate**, **Conversion Gain**, **Lower Level Disc**riminator, **Upper Level Disc**riminator and **Zero Adjustment** controls. In addition, the current real time and live time are monitored at the bottom of the dialog.

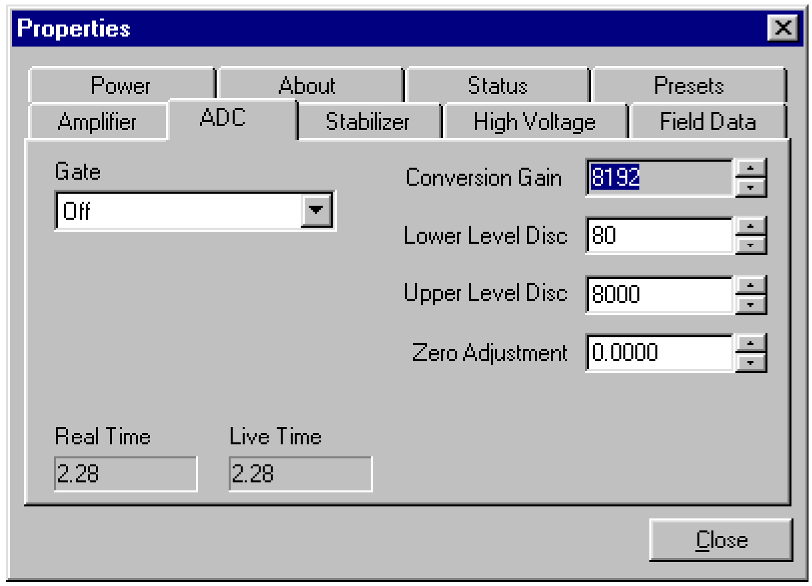

Figure 83. DART: The ADC Tab.

Gate

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

Conversion Gain

If set to 8192, the energy scale will be divided into 8192 channels. The conversion gain is entered in powers of 2 (e.g., 8192, 4096, 2048, ...). The up/down arrow buttons step through the valid settings.

Upper- and Lower-Level Discriminators

In the DART the lower- and upper-level discriminators are under computer control.

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

The **Upper Level Disc**riminator sets the level of the highest amplitude pulse that will be stored. This level establishes an upper-level cutoff, by channel number, for ADC conversions.

The lower- and upper-level discriminators are used in the multichannel scaler (MCS) mode as the single-channel-analyzer settings. Only the pulses between these two settings will be counted in the MCS spectrum. (See the DART-MCS [A71-B32] *Software User's Manual*.)

Zero Adjustment

The **Zero Adjustment** is used to set the dc offset voltage on the preamplifier input. The control ranges plus and minus, with 2048 being 0 V offset. The setting is normally 0 V or slightly negative. Setting the value too far in the positive direction (above 2048) can cause "lock-up" by putting the input value above the pulse reset discriminator value. A lock-up has occurred if the live time stops and the real time continues to count. The full range of offset is ±125 mV. Therefore, a setting of 3100 corresponds to a zero offset of +64.2 mV.

3.2.6.3. Stabilizer

The DART has both a gain stabilizer and a zero stabilizer. These are discussed in detail in Sections 3.4 and 3.5, respectively.

The Stabilizer tab (Fig. 84) shows the current values for the stabilizers. The value in each **Adjustment** section shows how much adjustment is currently applied. The **Initialize** buttons set the adjustment to 0. If the value approaches 90% or above, the amplifier gain should be adjusted so the stabilizer can continue to function — when the adjustment value reaches 100%, the stabilizer cannot make further corrections in that direction. The **Center Chan**nel and **Width** fields show the peak currently used for stabilization.

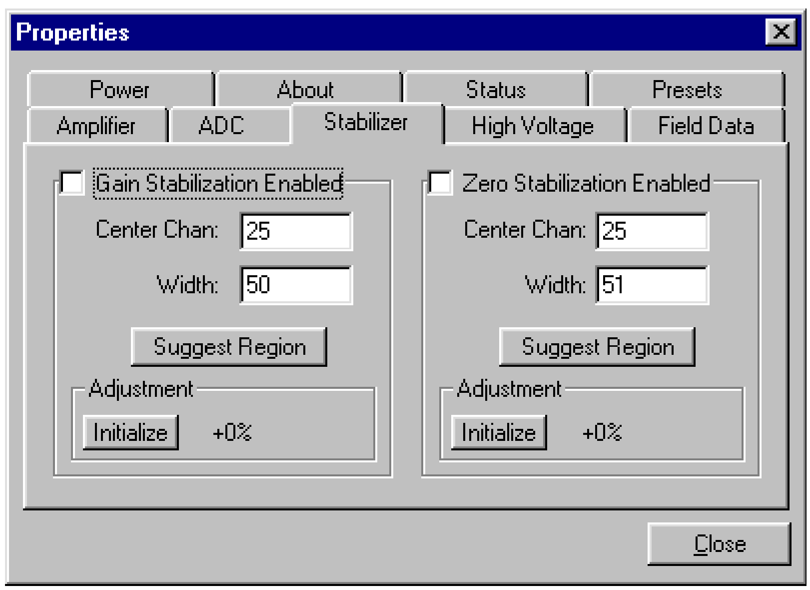

Figure 84. DART: The Stabilizer Tab.

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

If the **Sodium Iodide Detector** box is marked on the High Voltage tab, the gain stabilizer adjusts the amplifier fine gain. For germanium detectors the amplifier superfine gain is adjusted.

3.2.6.4. High Voltage

Figure 85 shows the High Voltage tab, which allows you to turn the high voltage on or off; set and monitor the voltage; select the **Polarity**; choose the **Shutdown** mode, and indicate whether this is a **Sodium Iodide Detector**.

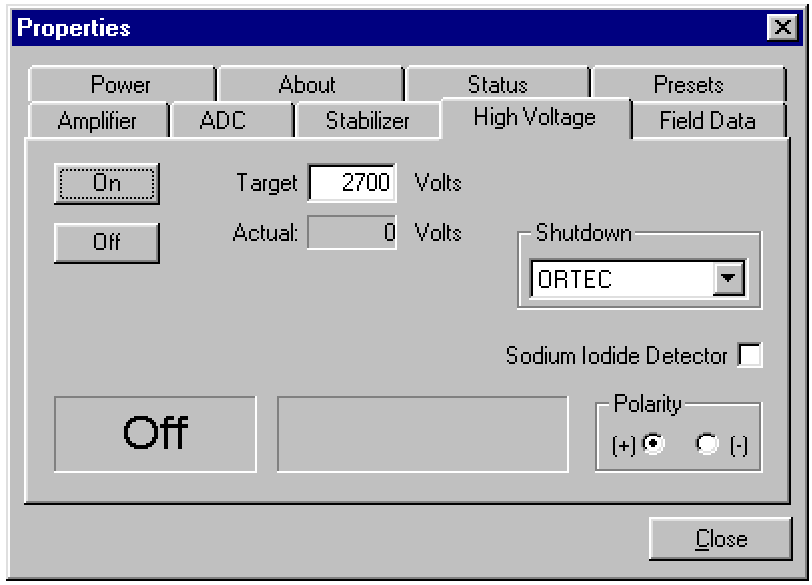

Figure 85. DART: The High Voltage Tab.

The high voltage is overridden by the detector bias remote shutdown signal from the detector; high voltage cannot be enabled if the remote shutdown or overload signals prevent it. Enter the detector high voltage in the **Target** field, click **On**, and monitor the voltage in the **Actual** field. The limit is ±5000 for Ge detectors and ±1500 for NaI detectors. Click the **Off** button to turn off the high voltage.

Choose the **Polarity** with the **(+)** and **(−)** radio buttons (the high voltage is disabled when you change the polarity). In NaI mode, this selection is disabled.

3.2.6.5. Field Data

This tab (see Fig. 86) is used to **Enter** and **Exit** the Field Mode (remote operation detached from a PC) or to view the DART spectra collected in field mode. The DART can only be set in Field Mode by clicking on the **Enter** button on this tab, and stays in Field Mode unit you return to this tab and click on **Exit**. It cannot be removed from Field Mode when disconnected from the PC. The spectrum can then be viewed in the application as the “active” spectrum in the DART. The active spectrum is the spectrum where the new data are collected. The current active spectrum is lost.

When the DART is in field mode, the spectrum is collected in the active spectrum position until the preset is met and then it is stored as the next stored spectrum. The DART waits until the next trigger and then starts the collection of the new spectrum. The trigger is either the trigger signal on the back of the DART or input from the barcode reader connected to the DART.

The lower left of the tab shows the total number of spectra (not counting the active spectrum) stored in the DART memory. The spectrum ID of the active spectrum is shown in the lower right. The stored spectra cannot be viewed or stored in the computer until they are moved to the active spectrum position.

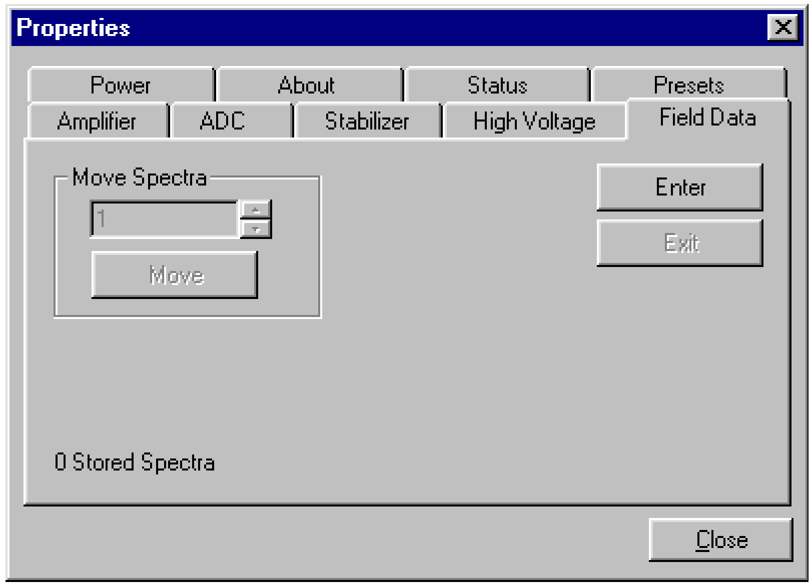

Figure 86. DART: The Field Mode Tab.

To move a spectrum from the stored memory to the active memory, enter the spectrum number and click on **Move**. Use the up/down arrow buttons to scroll through the list of spectra. The label on the lower right does not update until a spectrum is moved. Note that this only moves the spectrum inside the DART. To save the stored spectrum to the PC disk, move it to the active position and use the **File/Save** commands in your application.

The **Acquire/Download Spectra** command can also be used to download all the stored spectra and save them to disk automatically. They can then be viewed in a buffer window.

3.2.6.6. Power

The Power tab is shown in Fig. 87. This tab displays information about the DART's current power source, its power mode, and voltage of the two batteries. The power **Source** can be **Battery 1**, **Battery 2**, or **External**. The DART internal hardware automatically switches from a discharged battery to the good battery. The discharged battery can then be replaced without turning off the power or stopping operation.

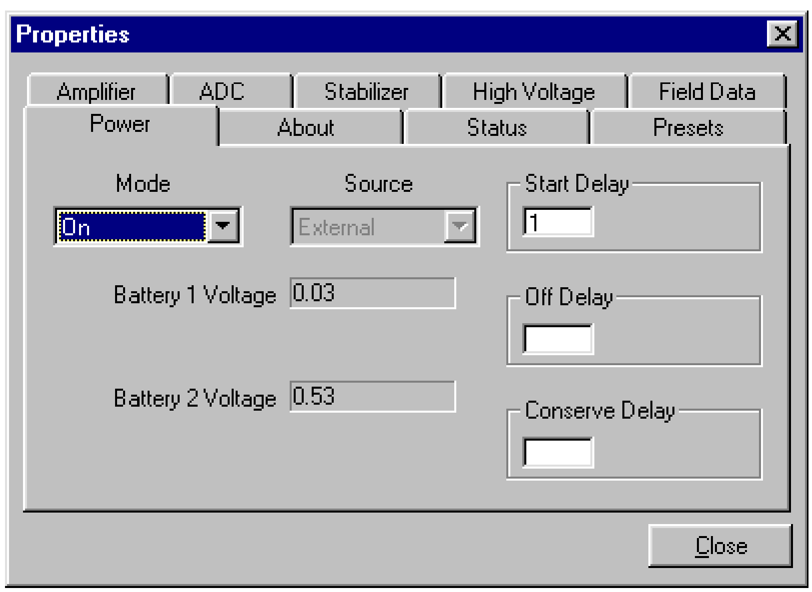

Figure 87. DART: The Power Tab.

DART's advanced power management allows you to set the unit for automatic shutdown when it is not being used. The power **Mode** droplist lets you manually switch the DART between the always-**On** and **Conserve** modes. Use the delay fields to set the time delays, from 0 to 65535 seconds, before the unit switches to Conserve mode or to complete power-off. In the example shown, the DART will go from **On** mode to **Conserve** mode 100 seconds after the last command, when not in active data-acquisition mode. It will then power off 600 seconds later if no commands are sent to it.

Start Delay is used in Field Mode and is the wait time between the barcode reading and the start of the data acquisition.

3.2.6.7. About

This tab (Fig. 88) displays hardware and firmware information about the currently selected DART as well as the data **Acquisition Start Time** and **Sample** description. The **Access** field shows whether the MCB is currently locked with a password; **Read/Write** indicates that the MCB is unlocked; **Read Only** means it is locked.

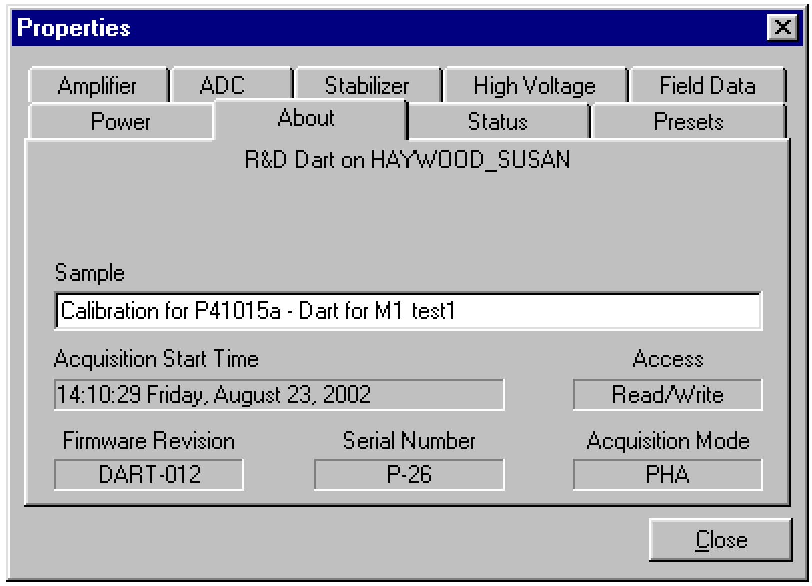

Figure 88. DART: The About Tab.

This screen displays the DART's serial number; all DARTs have a unique serial number which is read by the software and stored in the spectrum file for verification of the spectrum. The PC to which the DART is attached is shown at the top of the dialog.

3.2.6.8. Status

The DART can monitor a thermistor, usually located on a NaI detector. The **Thermistor** reading shown on the Status tab (Fig. 89) is in ohms. This can be used by other programs to monitor the gain of the photomultiplier tube.

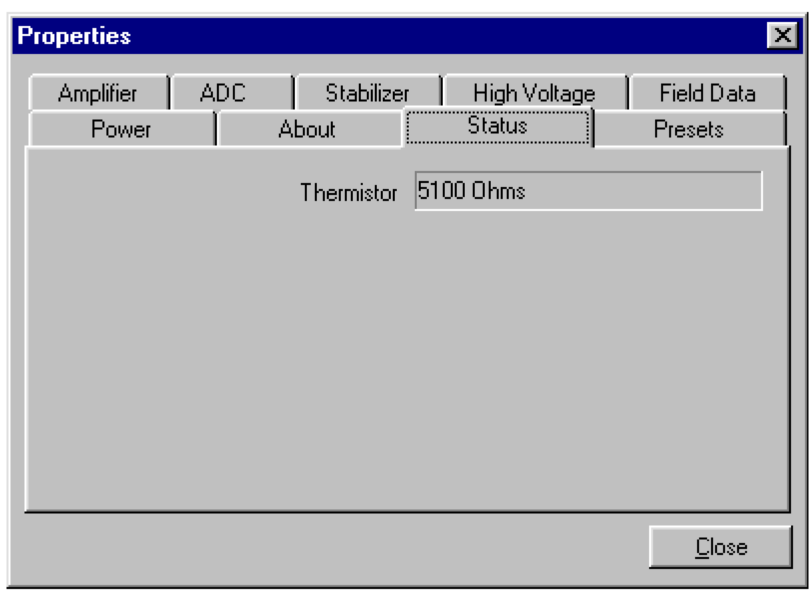

Figure 89. DART: The Status Tab.

3.2.6.9. Presets

Figure 90 shows the Presets tab. The presets can only be set on an MCB that is *not* acquiring data. Use any or all of the presets at one time. To disable a preset, enter a value of zero. If you disable all of the presets, data acquisition will continue until manually stopped.

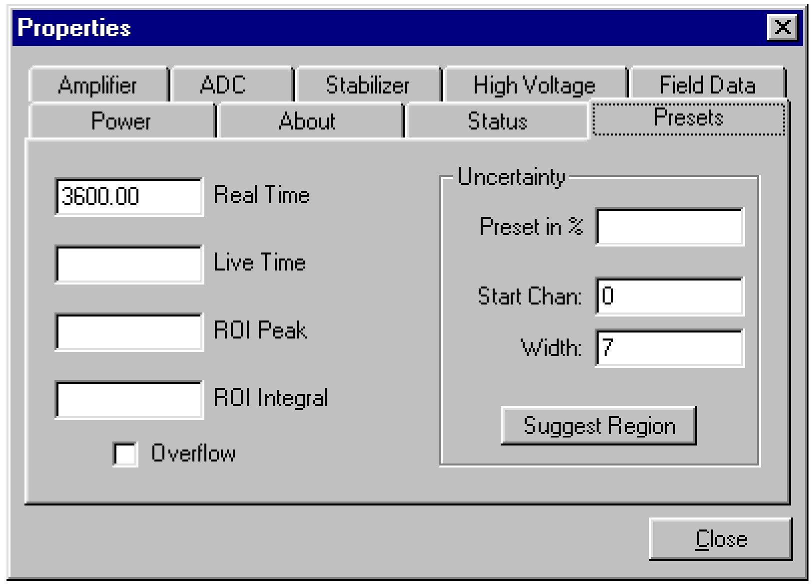

Figure 90. DART: The Presets Tab.

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

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

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

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

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

The **Uncertainty** preset stops acquisition when the statistical or counting uncertainty of a user-selected net peak reaches the value you have entered. Enter the **Preset in %** value as percent uncertainty at 1 sigma of the net peak area. The range is from 99% to 0.1% in 0.1% steps. You

have complete control over the selected peak region. The region must be at least 7 channels wide with 3 channels of background on each side of the peak. As the uncertainty is calculated approximately every 30 seconds, the uncertainty achieved for a high count-rate sample may be better than the preset value.

Use the **Start Channel** and **Width** fields to enter the channel limits directly, or click on **Suggest Region**. If the marker is positioned in an ROI around the peak of interest, **Suggest Region** reads the limits of the ROI with the marker and display those limits in the **Start Chan** and **Width** fields. The ROI can be cleared after the preset is entered without affecting the uncertainty calculation. If the marker is not positioned in an ROI, the start channel is 1.5 times the FWHM below the marker channel and the width is 3 times the FWHM. The net peak area and statistical uncertainty are calculated in the same manner as for the MAESTRO **Peak Info** command, which is discussed in Section 3.7. Note that the **Suggest Region** button is not displayed during data acquisition.

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

3.2.7. 92X, NOMAD, and NOMAD Plus

3.2.7.1. Amplifier

Figure 91 shows the Amplifier tab. This tab contains the controls for **Gain**, **Shaping Time**, **Preamplifier Type**, and **Pole Zero**. The **Start Auto** (pole zero) buttons should only be clicked *after* all of the controls on the tabs have been set.

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

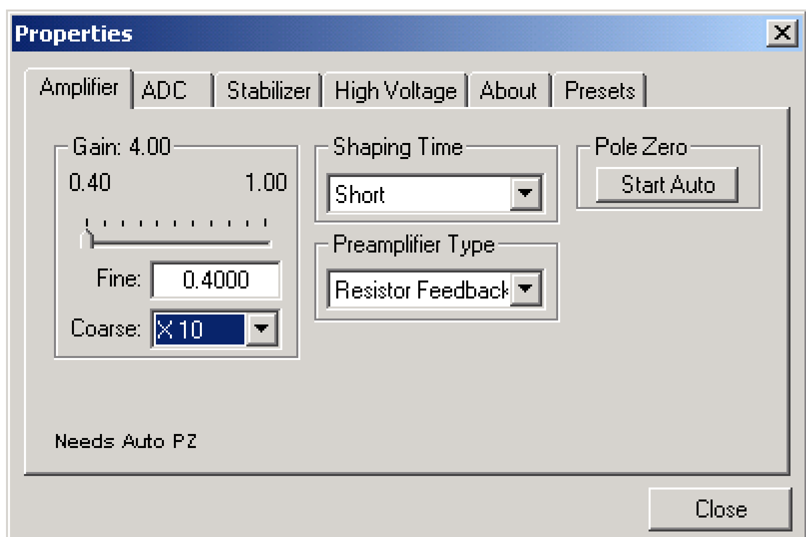

Figure 91. 92X, NOMAD, NOMAD Plus: The Amplifier Tab.

Gain

Set the amplifier coarse gain by selecting from the **Coarse** droplist, then adjust the **Fine** gain with the horizontal slider bar or the edit box, in the range of 0.4 to 1.0000. The resulting effective gain is shown at the top of the **Gain** section. The two controls used together cover the entire range of amplification from 4.0 to 1000.0.

Shaping Time

Use the **Shaping Time** droplist to select the amplifier pulse shaping-time constant. The available values, **Short** and **Long**, cover the time constants needed for high count-rate and high-resolution systems.

Preamplifier Type and Pole Zero

The **Preamplifier Type** section lets you choose **Transistor Reset** or **Resistive Feedback** preamplifier operation. The MCB amplifier is equipped with an automatic pole-zero circuit. If **Transistor Reset Preamplifier** is selected for this MCB, the pole zero is not needed.

When the **Resistive Feedback** option is selected, you must set the pole zero. To do this, go to the **Pole Zero** section of the dialog and click on **Start Auto**. The pole-zero command will be sent to the MCB. If the instrument is able to start the pole-zero, a series of short beeps will sound to indicate that the pole zero is in progress. When the pole zeroing is finished, the beeping stops.

As with any system, the amplifier should be pole zeroed any time the detector is changed or the shaping time of the amplifier is changed. Pole-zeroing requires the amplifier to be amplifying pulses. The detector should be connected in the final configuration before pole zeroing is started. There should be a radioactive source near the detector so that the count rate will be high enough (about 5 to 10% dead time) to accomplish the pole zero in the proper time.

Without an oscilloscope connected to the amplifier output to display the pulse shape, the effect of the pole zero operation is not always easy to see. The most common effect of an incorrect pole-zero setting is tailing on the peak shape in the spectrum. Here, tailing refers to abnormally high counts on either side of the peak. If the amplifier was close to the proper pole zero setting before the operation, the spectrum peak shape may not change enough to be seen.

3.2.7.2. ADC

This tab (Fig. 92) contains the **Gate** and **Conversion Gain** controls. In addition, the current real time and live time are monitored at the bottom of the dialog.

Gate

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

Conversion Gain

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

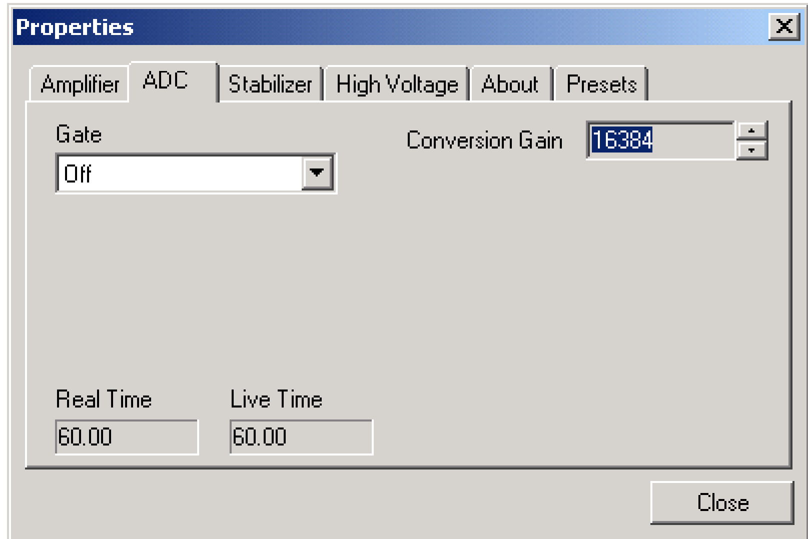

Figure 92. 92X, NOMAD, NOMAD Plus: The ADC Tab.

3.2.7.3. Stabilizer

The 92X, NOMAD, and NOMAD Plus have both a gain stabilizer and a zero stabilizer. Gain and zero stabilization are discussed in detail in Sections 3.4 and 3.5, respectively.

The Stabilizer tab (Fig. 93) shows the current values for the stabilizers. The value in each **Adjustment** section shows how much adjustment is currently applied. The **Initialize** buttons set the adjustment to 0. If the value approaches 90% or above, the amplifier gain should be adjusted so the stabilizer can continue to function — when the adjustment value reaches 100%, the stabilizer cannot make further corrections in that direction. The **Center Chan**nel and **Width** fields show the peak currently used for stabilization.

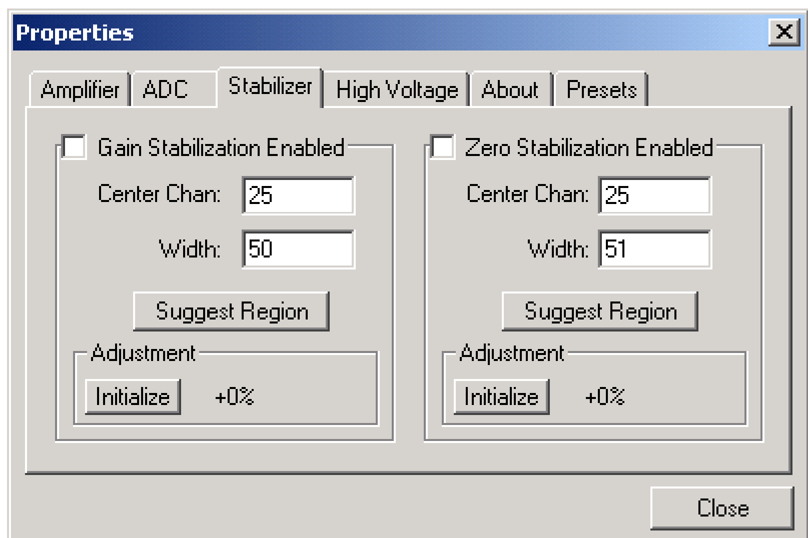

Figure 93. 92X, NOMAD, NOMAD Plus: The Stabilizer Tab.

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

3.2.7.4. High Voltage

Figure 94 shows the High Voltage tab. The **On** and **Off** buttons apply and remove the high voltage. This function is overridden by the detector bias remote shutdown signal from the detector; high voltage cannot be enabled if the remote shutdown or overload signals prevent it. The **Target** voltage level is displayed on this tab but cannot be modified from the dialog. It is controlled by the hardware and can be adjusted by a rear-panel potentiometer. High-voltage polarity is set with an internal jumper. See the MCB hardware manual for more information.

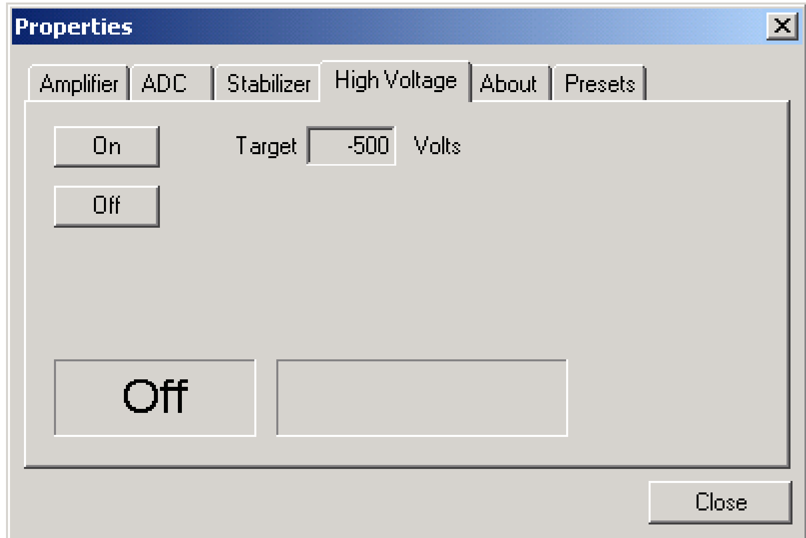

Figure 94. 92X, NOMAD, NOMAD Plus: The High Voltage Tab.

3.2.7.5. About

This tab (Fig. 95) displays hardware and firmware information about the currently selected 92X, NOMAD, or NOMAD Plus, as well as the data **Acquisition Start Time** and **Sample** description. In addition, the **Access** field shows whether the MCB is currently locked with a password; **Read/Write** indicates that the MCB is unlocked; **Read Only** means it is locked.

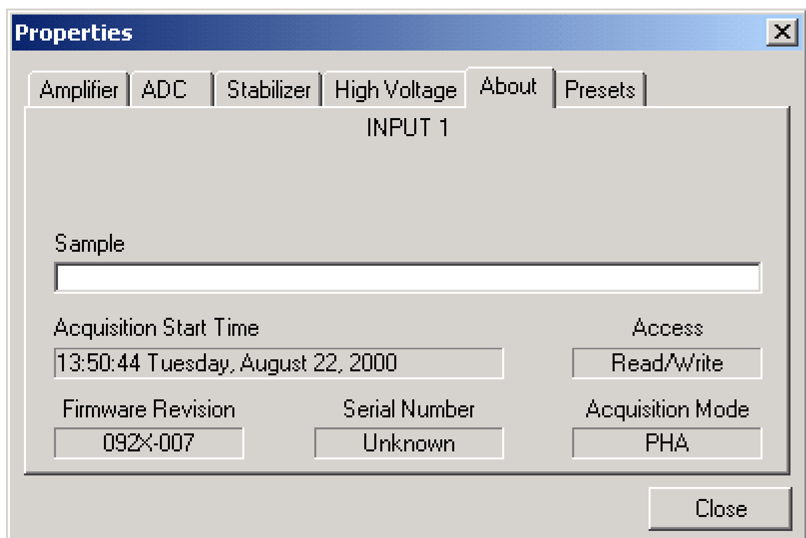

Figure 95. 92X, NOMAD, NOMAD Plus: The About Tab.

3.2.7.6. Presets

Figure 96 shows the Presets tab. The presets can only be set on an MCB that is *not* acquiring data. You can use any or all of the presets at one time. To disable a preset, enter a value of zero. If you disable all of the presets, data acquisition will continue until manually stopped.

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

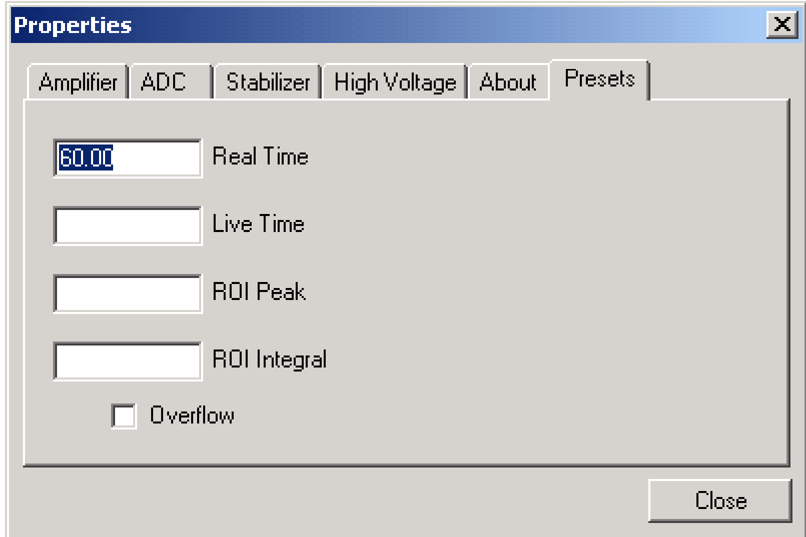

Figure 96. 92X, NOMAD, NOMAD Plus: The Presets Tab.

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

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

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

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

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

3.2.8. MatchMaker™ ADC Interface

3.2.8.1. ADC

The MatchMaker ADC interface is used to interface standalone ADCs from different manufacturers to the ***CONNECTIONS-32*** software. The ADC tab (Fig. 97) contains the **Gate** and **Conversion Gain** controls. In addition, the current real time and live time are monitored at the bottom of the dialog.

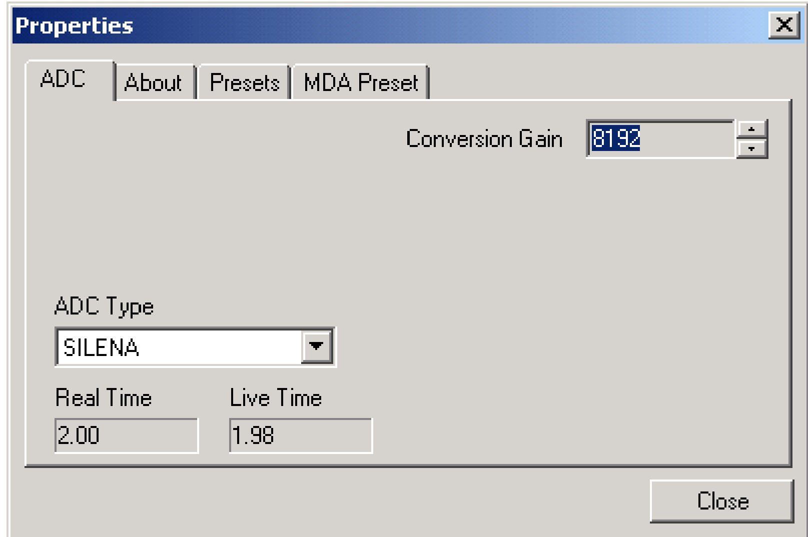

Figure 97 . MatchMaker: The ADC Tab.

The **Conversion Gain** set here is the number of channels that will be displayed when this ADC is selected. It is also the number of channels stored in the spectrum on disk. Normally this is set to the ADC conversion gain selected in the hardware unit, but can be different depending on the options available in the ADC hardware itself.

The **ADC Type** can be (1) ORTEC, (2) Canberra 26-pin, (3) Canberra 34-pin (including the S100), or (4) Silena. For these ADCs, all of the controls (such as conversion gain or amplifier settings) are in the hardware.

3.2.8.2. About

This tab (Fig. 98) displays hardware and firmware information about the currently selected MatchMaker, as well as the data **Acquisition Start Time** and **Sample** description. In addition, the **Access** field shows whether the MatchMaker is currently locked with a password; **Read/Write** indicates that the MatchMaker is unlocked; **Read Only** means it is locked.

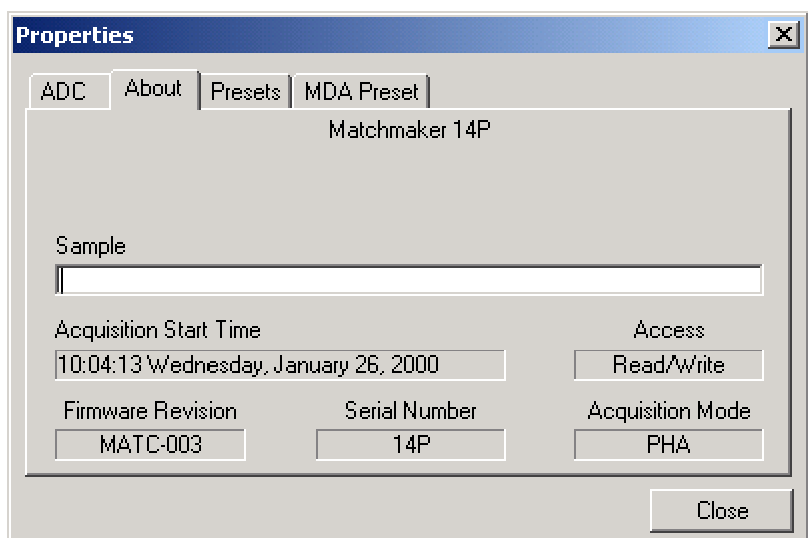

Figure 98. MatchMaker: The About Tab.

3.2.8.3. Presets

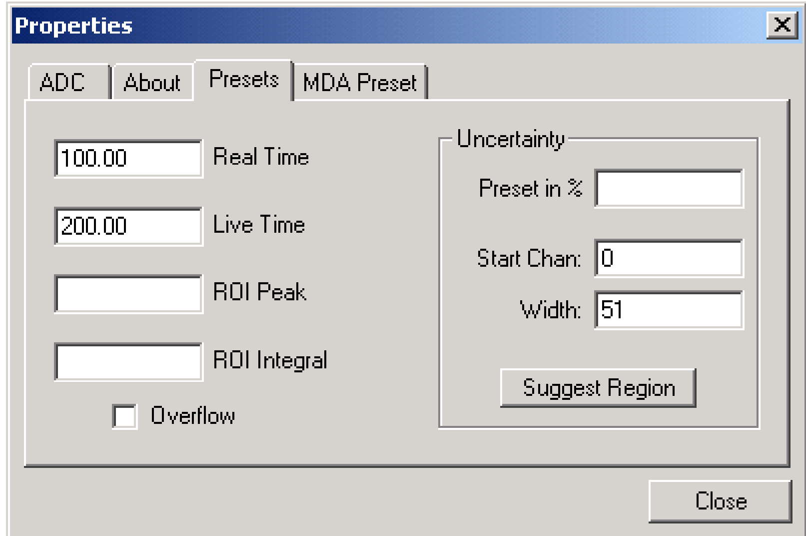

Figure 99. MatchMaker: The Presets Tab.

Figure 99 shows the Presets tab. The presets can only be set on an MCB that is *not* acquiring data. You can use any or all of the presets at one time. To disable a preset, enter a value of zero. If you disable all of the presets, data acquisition will continue until manually stopped.

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

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

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

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

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

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

Use the **Start Chan**nel and **Width** fields to enter the channel limits directly, or click on **Suggest Region**. If the marker is positioned in an ROI around the peak of interest, **Suggest Region** reads the limits of the ROI with the marker and display those limits in the **Start Chan** and **Width** fields. The ROI can be cleared after the preset is entered without affecting the uncertainty calculation. If the marker is not positioned in an ROI, the start channel is 1.5 times the FWHM below the marker channel and the width is 3 times the FWHM. The net peak area and statistical uncertainty are calculated in the same manner as for the MAESTRO **Peak Info** command, which is discussed in Section 3.7. Note that the **Suggest Region** button is not displayed during data acquisition.

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

3.2.8.4. MDA Preset

The MDA preset (Fig. 100) stops data collection when the minimum detectable activity for a single user-specified MDA nuclide reaches the designated value. The MDA preset is implemented in the hardware. The formulas for the MDA are given in various textbooks and in the “Analysis Methods” chapter in the GammaVision user manual and can be generally represented as follows:

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

The coefficients *a*, *b*, and *c* are determined by the MDA formula to be used. The *Eff* (detector efficiency) is determined from the calibration. The *Yield* (branching ratio) is read from the working library using the nuclide and energy specified. The **MDA** value is the one you have entered in the dialog. *Counts* is the gross counts in the specified region and *Live time* is the live time. The *MDA* value is calculated in the MCB given the values *a*, *b*, *c*, *Live time*, *Eff*, and *Yield*. The calculated value is compared with the **MDA** value on the dialog and when it is lower, acquisition is stopped.

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

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

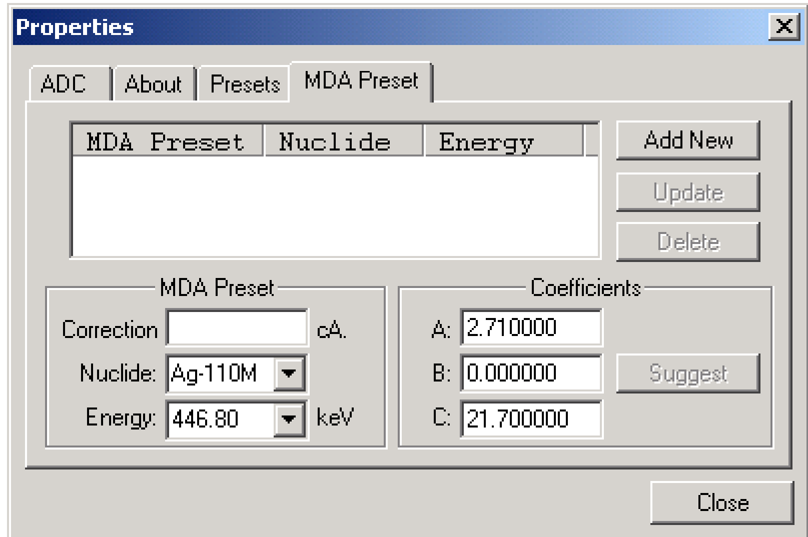

Figure 100. MatchMaker: The MDA Preset Tab.

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

3.2.9. 919 and 919E

The Model 919E has more features than the 919, as explained beginning in Section 3.2.9.6.

3.2.9.1. ADC

This tab (Fig. 101) contains the **Gate** and **Conversion Gain** controls. In addition, the current real time and live time are monitored at the bottom of the dialog.

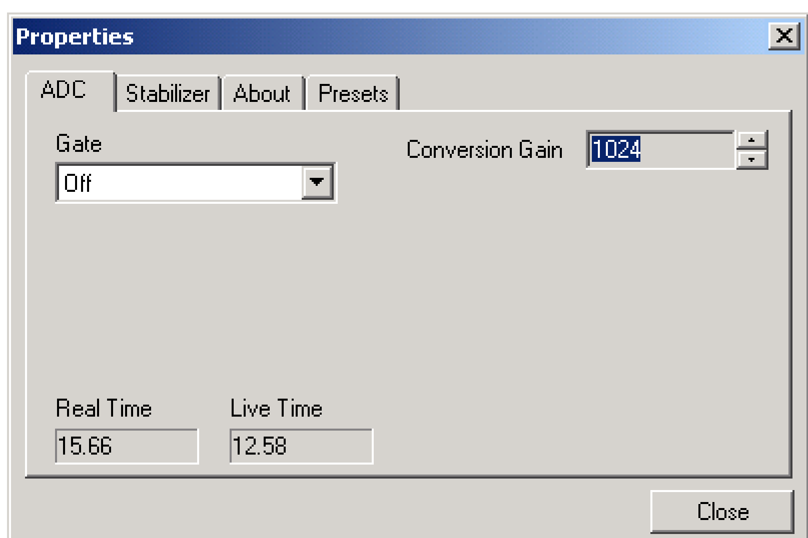

Figure 101. 919 and 919E: The ADC Tab.

3.2.9.2. Gate

The **Gate** control allows you to select a logic gating function. With this function **Off**, no gating is performed (that is, all detector signals are processed); with the function in **Coincidence**, a gating input signal *must be* present at the proper time for the conversion of the event;

in **Anticoincidence**, the gating input signal *must not be* present for the conversion of the detector signal. The gating signal must occur prior to and extend 500 nanoseconds beyond peak detect (peak maximum).

Conversion Gain

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

3.2.9.3. Stabilizer

The 919 and 919E have both a gain stabilizer and a zero stabilizer on input 1 only. Gain and zero stabilization are discussed in detail in Sections 3.4 and 3.5, respectively.

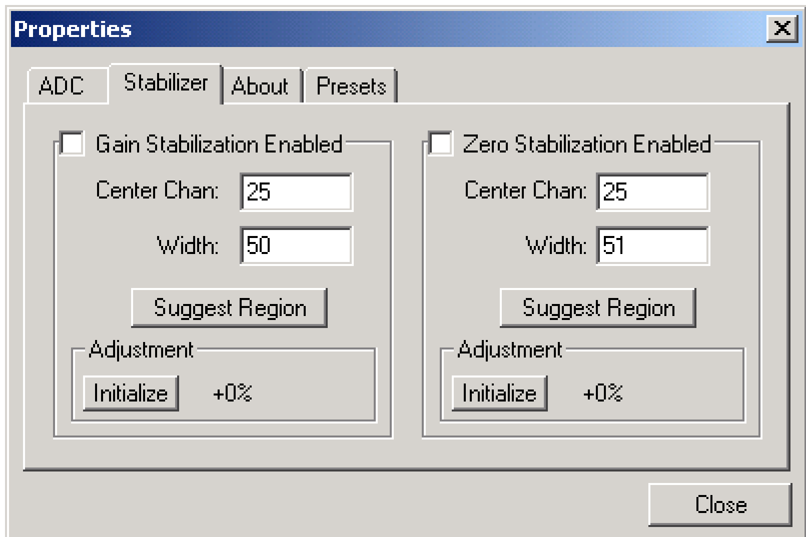

Figure 102. 919 and 919E: The Stabilizer Tab.

The Stabilizer tab (Fig. 102) shows the current values for the stabilizers. The value in each **Adjustment** section shows how much adjustment is currently applied. The **Initialize** buttons set the adjustment to 0. If the value approaches 90% or above, the amplifier gain should be adjusted so the stabilizer can continue to function — when the adjustment value reaches 100%, the stabilizer cannot make further corrections in that direction. The **Center Chan**nel and **Width** fields show the peak currently used for stabilization.

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

3.2.9.4. About

This tab (Fig. 103) displays hardware and firmware information about the currently selected 919 or 919E, as well as the data **Acquisition Start Time** and **Sample** description. In addition, the **Access** field shows whether the MCB is currently locked with a password; **Read/ Write** indicates that the MCB is unlocked; **Read Only** means it is locked.

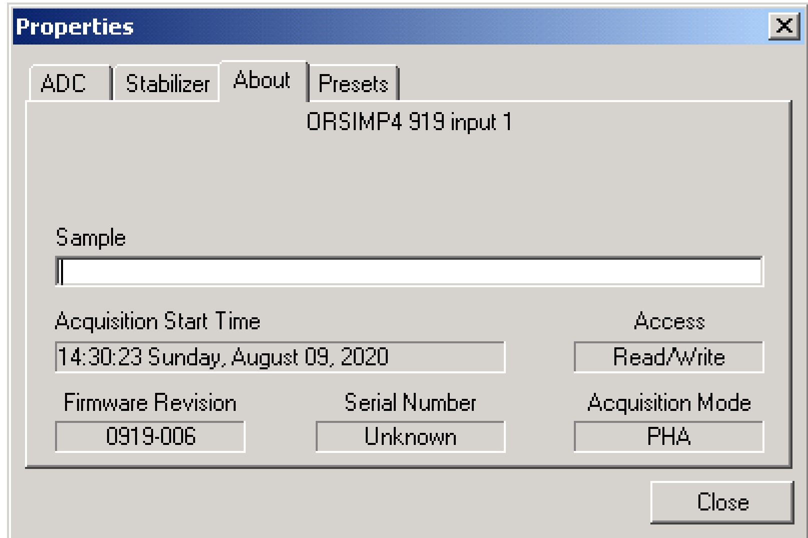

Figure 103. 919 and 919E: The About Tab.

3.2.9.5. Presets

Figure 104 shows the Presets tab. The presets can only be set on an MCB that is *not* acquiring data. You can use any or all of the presets at one time. To disable a preset, enter a value of zero. If you disable all of the presets, data acquisition will continue until manually stopped.

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

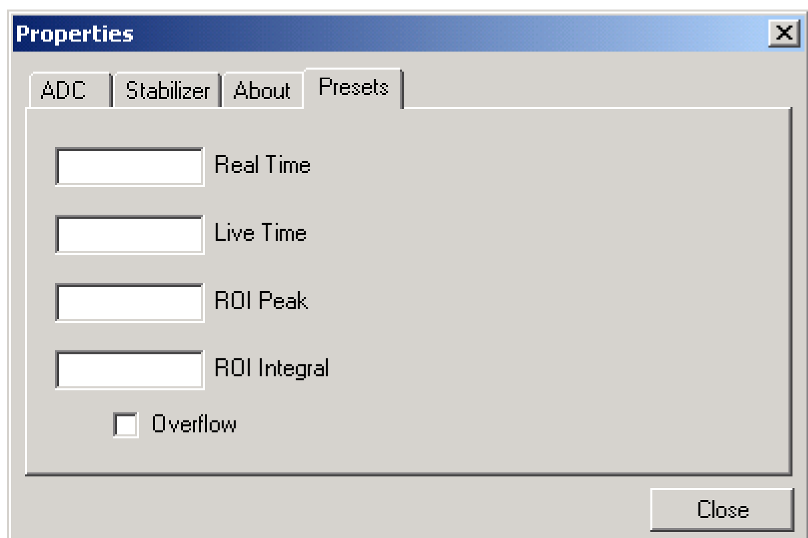

Figure 104. 919: The Presets Tab.

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

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

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

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

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

3.2.9.6. 919E: Uncertainty Preset

The 919E includes an **Uncertainty** preset on the Presets tab (see Fig. 99, page 90, for an example of this preset's data fields). The **Uncertainty** preset stops acquisition when the statistical or counting uncertainty of a user-selected net peak reaches the value you have entered. Enter the **Preset in %** value as percent uncertainty at 1 sigma of the net peak area. The range is from 99% to 0.1% in 0.1% steps. You have complete control over the selected peak region. The region must be at least 7 channels wide with 3 channels of background on each side of the peak. As the uncertainty is calculated approximately every 30 seconds, the uncertainty achieved for a high count-rate sample may be better than the preset value.

Use the **Start Chan**nel and **Width** fields to enter the channel limits directly, or click on **Suggest Region**. If the marker is positioned in an ROI around the peak of interest, **Suggest Region** reads the limits of the ROI with the marker and display those limits in the **Start Chan** and **Width** fields. The ROI can be cleared after the preset is entered without affecting the uncertainty calculation. If the marker is not positioned in an ROI, the start channel is 1.5 times the FWHM below the marker channel and the width is 3 times the FWHM. The net peak area and statistical uncertainty are calculated in the same manner as for the MAESTRO **Peak Info** command, which is discussed in Section 3.7. Note that the **Suggest Region** button is not displayed during data acquisition.

3.2.9.7. 919E: MDA Preset Tab

The MDA preset (Fig. 105) stops data collection when the minimum detectable activity for a single user-specified MDA nuclide reaches the designated value. The MDA preset is implemented in the hardware. The formulas for the MDA are given in various textbooks and in the "Analysis Methods" chapter in the GammaVision user manual and can be generally represented as follows:

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

The coefficients *a*, *b*, and *c* are determined by the MDA formula to be used. The *Eff* (detector efficiency) is determined from the calibration. The *Yield* (branching ratio) is read from the working library using the nuclide and energy specified. The **MDA** value is the one you have entered in the dialog. *Counts* is the gross counts in the specified region and *Live time* is the live time. The *MDA* value is calculated in the MCB given the values *a*, *b*, *c*, *Live time*, *Eff*, and *Yield*. The calculated value is compared with the **MDA** value on the dialog and when it is lower, acquisition is stopped.

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

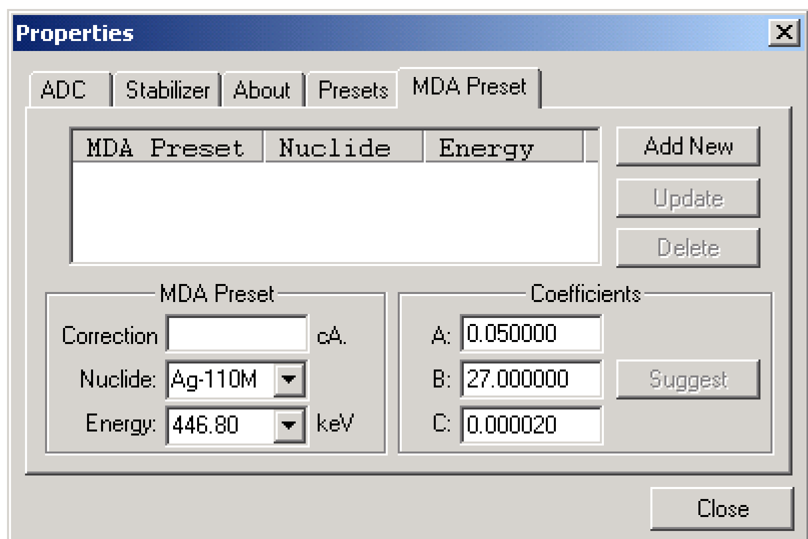

Figure 105. 919E: The MDA Preset Tab.

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

If the application supports efficiency calibration and the 919E is efficiency calibrated, the **MDA** is entered in the units selected in the application. If the unit is not efficiency calibrated (e.g., in MAESTRO, which does not support efficiency calibration), the **MDA** field is labeled **Correction**, the efficiency (*Eff*) is set to 1.0 and the preset operates as before. If the **Correction** factor is the actual MDA times the efficiency (known from other sources), the MDA preset will function normally.

3.2.10. 921 and 921E

The Model 921E has more features than the 921, as explained beginning in Section 3.2.10.5.

3.2.10.1. ADC

This tab (Fig. 106) contains the **Gate** and **Conversion Gain** controls. In addition, the current real time and live time are monitored at the bottom of the dialog.

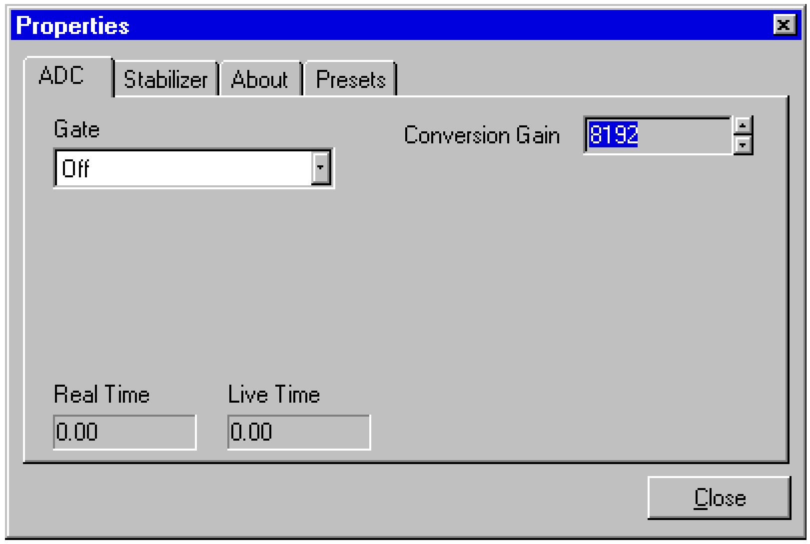

Figure 106. 921 and 921E: The ADC Tab.

Gate

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

Conversion Gain

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

3.2.10.2. Stabilizer

The 921 and 921E have both a gain stabilizer and a zero stabilizer. Gain and zero stabilization are discussed in detail in Sections 3.4 and 3.5, respectively.

The Stabilizer tab (Fig. 107) shows the current values for the stabilizers. The value in each **Adjustment** section shows how much adjustment is currently applied. The **Initialize** buttons set the adjustment to 0. If the value approaches 90% or above, the amplifier gain should be adjusted so the stabilizer can continue to function — when the adjustment value reaches 100%, the stabilizer cannot make further corrections in that direction. The **Center Chan**nel and **Width** fields show the peak currently used for stabilization.

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

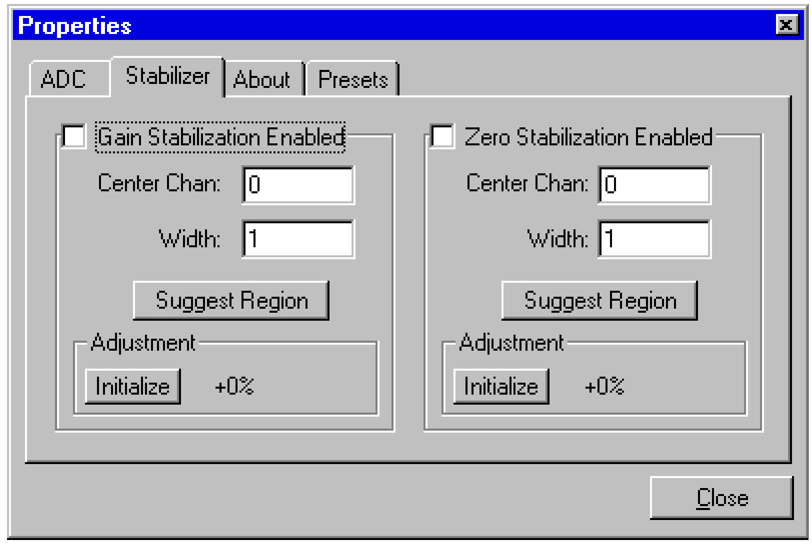

Figure 107. 921 and 921E: The Stabilizer Tab.

3.2.10.3. About

This tab (Fig. 108) displays hardware and firmware information about the currently selected 921 or 921E, as well as the data **Acquisition Start Time** and **Sample** description. In addition, the **Access** field shows whether the MCB is currently locked with a password; **Read/Write** indicates that the MCB is unlocked; **Read Only** means it is locked.

3.2.10.4. Presets

Figure 109 shows the Presets tab. The presets can only be set on an MCB that is *not* acquiring data. You can use any or all of the presets at one time. To disable a preset, enter a value of zero. If you disable all of the presets, data acquisition will continue until manually stopped.

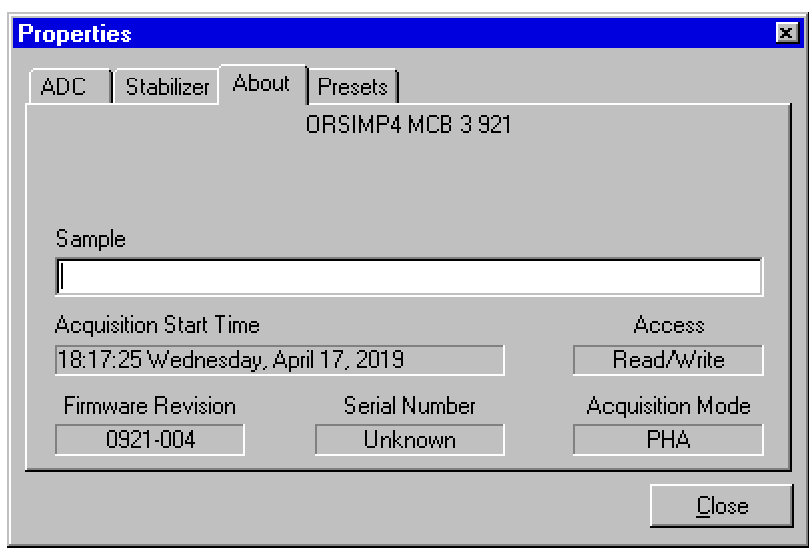

Figure 108. 921 and 921E: The About Tab.

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

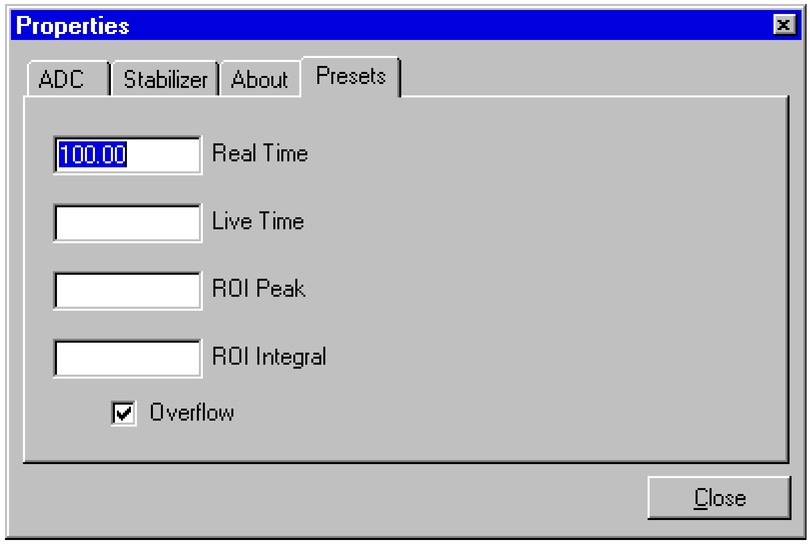

Figure 109. 921 and 921E: The Presets Tab.

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

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

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

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

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

3.2.10.5. 921E: Uncertainty Preset

The 921E includes an **Uncertainty** preset on the Presets tab (see Fig. 99, page 90, for an example of this preset's data fields). The **Uncertainty** preset stops acquisition when the statistical or counting uncertainty of a user-selected net peak reaches the value you have entered. Enter the **Preset in %** value as percent uncertainty at 1 sigma of the net peak area. The range is from 99%

to 0.1% in 0.1% steps. You have complete control over the selected peak region. The region must be at least 7 channels wide with 3 channels of background on each side of the peak. As the uncertainty is calculated approximately every 30 seconds, the uncertainty achieved for a high count-rate sample may be better than the preset value.

Use the **Start Chan**nel and **Width** fields to enter the channel limits directly, or click on **Suggest Region**. If the marker is positioned in an ROI around the peak of interest, **Suggest Region** reads the limits of the ROI with the marker and display those limits in the **Start Chan** and **Width** fields. The ROI can be cleared after the preset is entered without affecting the uncertainty calculation. If the marker is not positioned in an ROI, the start channel is 1.5 times the FWHM below the marker channel and the width is 3 times the FWHM. The net peak area and statistical uncertainty are calculated in the same manner as for the MAESTRO **Peak Info** command, which is discussed in Section 3.7. Note that the **Suggest Region** button is not displayed during data acquisition.

3.2.10.6. 921E: MDA Preset

The MDA preset (Fig. 110) stops data collection when the minimum detectable activity for a single user-specified MDA nuclide reaches the designated value. The MDA preset is implemented in the hardware. The formulas for the MDA are given in various textbooks and in the "Analysis Methods" chapter in the GammaVision user manual and can be generally represented as follows:

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

The coefficients *a*, *b*, and *c* are determined by the MDA formula to be used. The *Eff* (detector efficiency) is determined from the calibration. The *Yield* (branching ratio) is read from the working library using the nuclide and energy specified. The **MDA** value is the one you have entered in the dialog. *Counts* is the gross counts in the specified region and *Live time* is the live time. The *MDA* value is calculated in the MCB given the values *a, b, c*, *Live time, Eff*, and *Yield*. The calculated value is compared with the **MDA** value on the dialog and when it is lower, acquisition is stopped.

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

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

If the application supports efficiency calibration and the 921E is efficiency calibrated, the **MDA** is entered in the units selected in the application. If the unit is not efficiency calibrated (e.g., in MAESTRO, which does not support efficiency calibration), the **MDA** field is labeled **Correction**, the efficiency (*Eff*) is set to 1.0 and the preset operates as before. If the **Correction** factor is the actual MDA times the efficiency (known from other sources), the MDA preset will function normally.

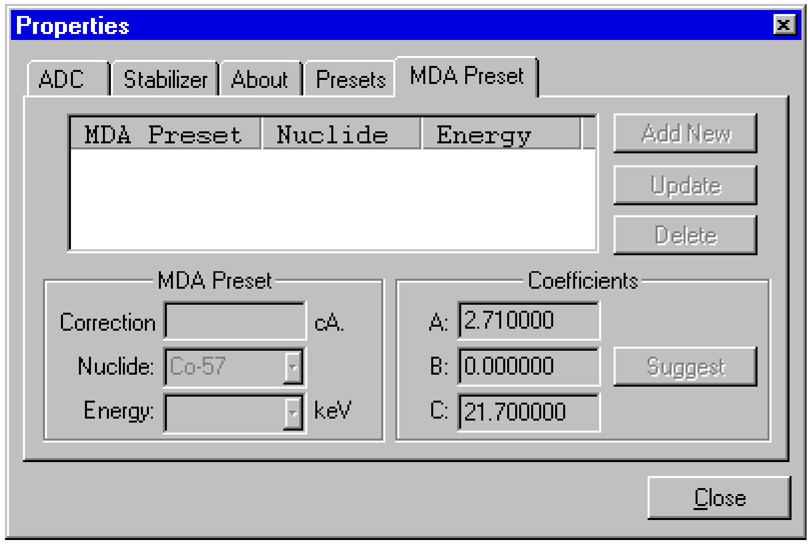

Figure 110. 921E: The MDA Preset Tab.

3.2.11. TRUMP-PCI

3.2.11.1. ADC

This tab (Fig. 111) contains the **Gate**, **Conversion Gain**, **Lower Level Disc**riminator, **Upper Level Discri**minator and **Zero Adjustment** controls. In addition, the current real time and live time are monitored at the bottom of the dialog.

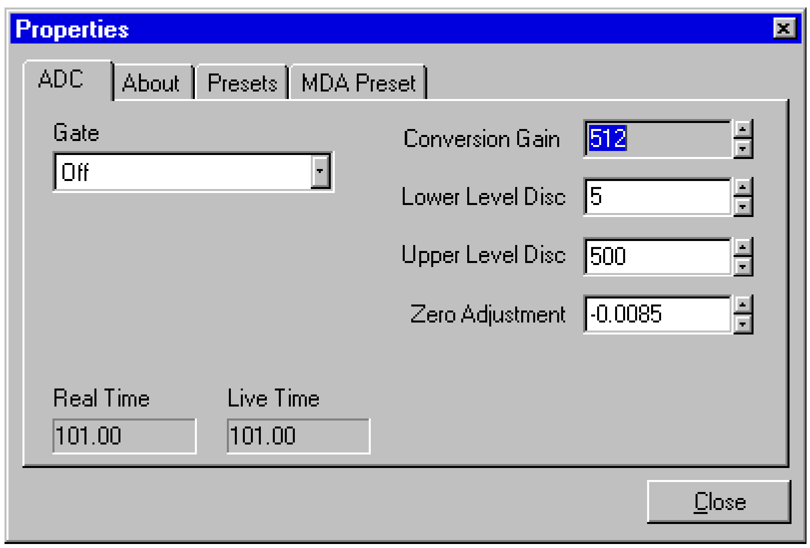

Figure 111. TRUMP-PCI: The ADC Tab.

Gate

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

Conversion Gain

If set to 8192, the energy scale will be divided into 8192 channels. The conversion gain is entered in powers of 2 (e.g., 8192, 4096, 2048, ...). The up/down arrow buttons step through the instrument's valid settings.

Upper- and Lower-Level Discriminators

In the TRUMP-PCI the lower- and upper-level discriminators are under computer control.

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

The **Upper Level Disc**riminator sets the level of the highest amplitude pulse that will be stored. This level establishes an upper-level cutoff, by channel number, for ADC conversions.

Zero Adjustment

The **Zero Adjustment** is used to set the dc offset voltage on the preamplifier input. The control ranges plus and minus, with 2048 being 0 V offset. The setting is normally 0 V or slightly negative. Setting the value too far in the positive direction (above 2048) can cause "lock-up" by putting the input value above the pulse reset discriminator value. A lock-up has occurred if the live time stops and the real time continues to count. The full range of offset is ±125 mV. Therefore, a setting of 3100 corresponds to a zero offset of +64.2 mV.

3.2.11.2. About

This tab (Fig. 112) displays hardware and firmware information about the currently selected TRUMP-PCI as well as the data **Acquisition Start Time** and **Sample** description. The **Access** field shows whether the MCB is currently locked with a password; **Read/Write** indicates that the MCB is unlocked; **Read Only** means it is locked.

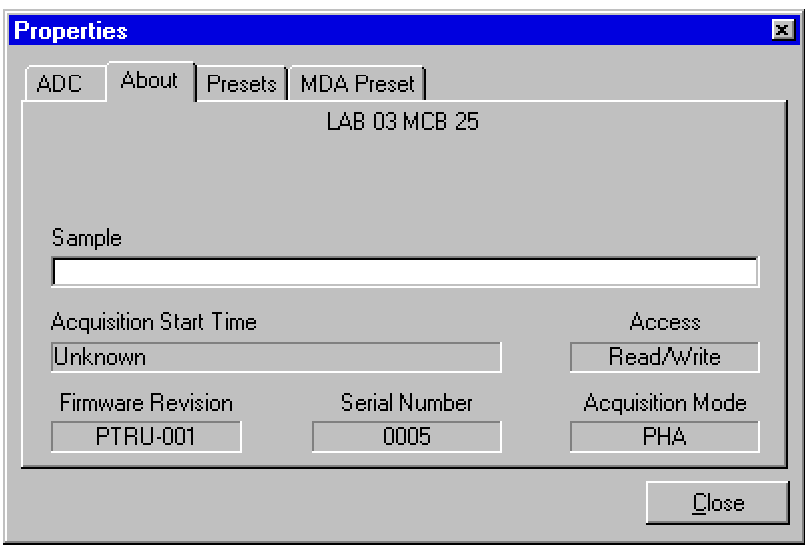

Figure 112. TRUMP-PCI: The About Tab.

This screen displays the TRUMP-PCI's serial number; all TRUMP-PCIs have a unique serial number which is read by the software and stored in the spectrum file for verification of the spectrum. The PC to which the TRUMP-PCI is attached is shown at the top of the dialog.

3.2.11.3. Presets

Figure 113 shows the Presets tab. The presets can only be set on an MCB that is *not* acquiring data. You can use any or all of the presets at one time. To disable a preset, enter a value of zero. If you disable all of the presets, data acquisition will continue until manually stopped.

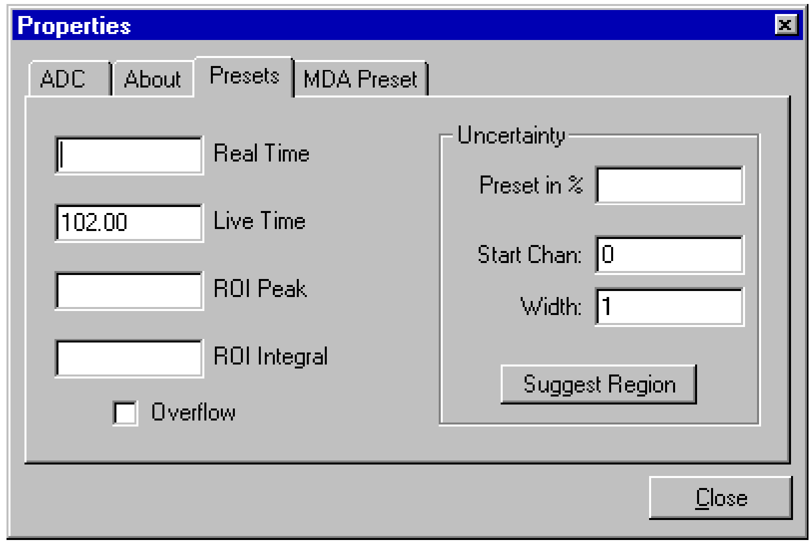

Figure 113. TRUMP-PCI: The Presets Tab.

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

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

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

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

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

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

Use the **Start Chan**nel and **Width** fields to enter the channel limits directly, or click on **Suggest Region**. If the marker is positioned in an ROI around the peak of interest, **Suggest Region** reads the limits of the ROI with the marker and display those limits in the **Start Chan** and **Width** fields. The ROI can be cleared after the preset is entered without affecting the uncertainty calculation. If the marker is not positioned in an ROI, the start channel is 1.5 times the FWHM below the marker channel and the width is 3 times the FWHM. The net peak area and statistical uncertainty are calculated in the same manner as for the MAESTRO **Peak Info** command, which is discussed in Section 3.7. Note that the **Suggest Region** button is not displayed during data acquisition.

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

3.2.11.4. MDA Preset

The MDA preset (Fig. 114) stops data collection when the minimum detectable activity for a single user-specified MDA nuclide reaches the designated value. The MDA preset is implemented in the hardware. The formulas for the MDA are given in various textbooks and in the "Analysis Methods" chapter in the GammaVision user manual and can be generally represented as follows:

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

The coefficients *a*, *b*, and *c* are determined by the MDA formula to be used. The *Eff* (detector efficiency) is determined from the calibration. The *Yield* (branching ratio) is read from the working library using the nuclide and energy specified. The **MDA** value is the one you have entered in the dialog. *Counts* is the gross counts in the specified region and *Live time* is the live time. The *MDA* value is calculated in the MCB given the values *a*, *b*, *c*, *Live time*, *Eff*, and *Yield*. The calculated value is compared with the **MDA** value on the dialog and when it is lower, acquisition is stopped.

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

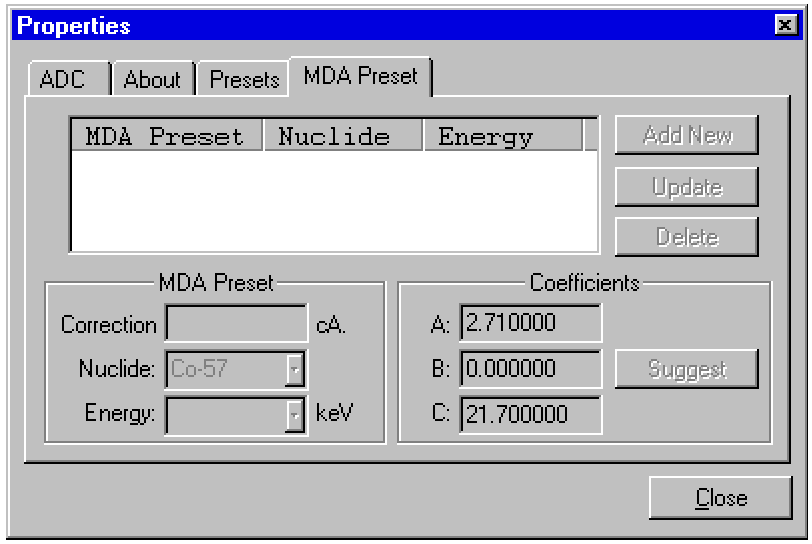

Figure 114. TRUMP-PCI: The MDA Preset Tab.

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

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

3.2.12. TRUMP and 926

3.2.12.1. ADC

This tab (Fig. 115) contains the **Gate** and **Conversion Gain** controls. In addition, the current real time and live time are monitored at the bottom of the dialog.

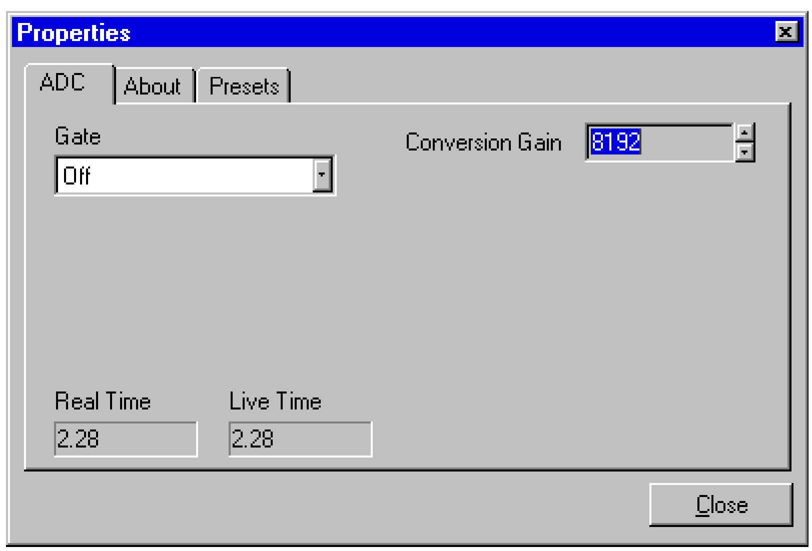

Figure 115. TRUMP and 926: The ADC Tab.

Gate

The **Gate** control allows you to select a logic gating function. With this function **Off**, no gating is performed (that is, all detector signals are processed); with the function in **Coincidence**, a gating input signal *must be* present at the proper time for the conversion of the event; in

Anticoincidence, the gating input signal *must not be* present for the conversion of the detector signal. The gating signal must occur prior to and extend 500 nanoseconds beyond peak detect (peak maximum).

Conversion Gain

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

3.2.12.2. About

This tab (Fig. 116) displays hardware and firmware information about the currently selected TRUMP or 926, as well as the data **Acquisition Start Time** and **Sample** description.

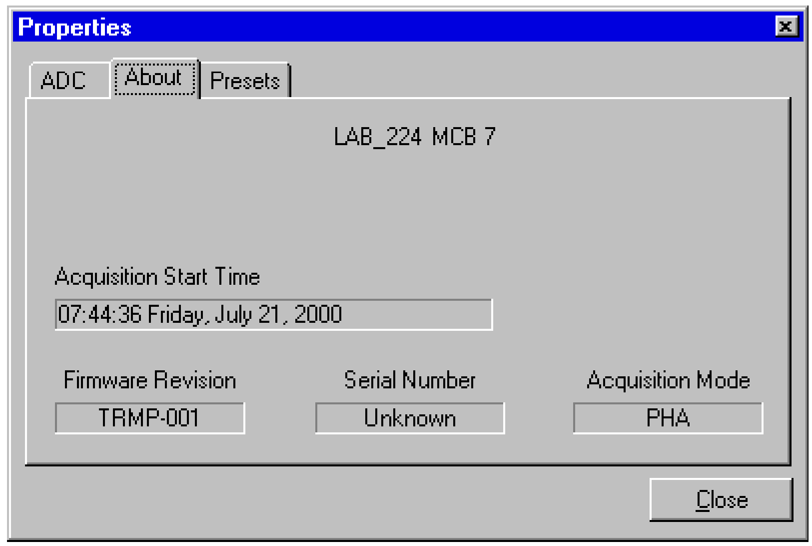

Figure 116. TRUMP and 926: The About Tab.

3.2.12.3. Presets

Figure 117 shows the Presets tab. The presets can only be set on an MCB that is *not* acquiring data. You can use any or all of the presets at one time. To disable a preset, enter a value of zero. If you disable all of the presets, data acquisition will continue until manually stopped.

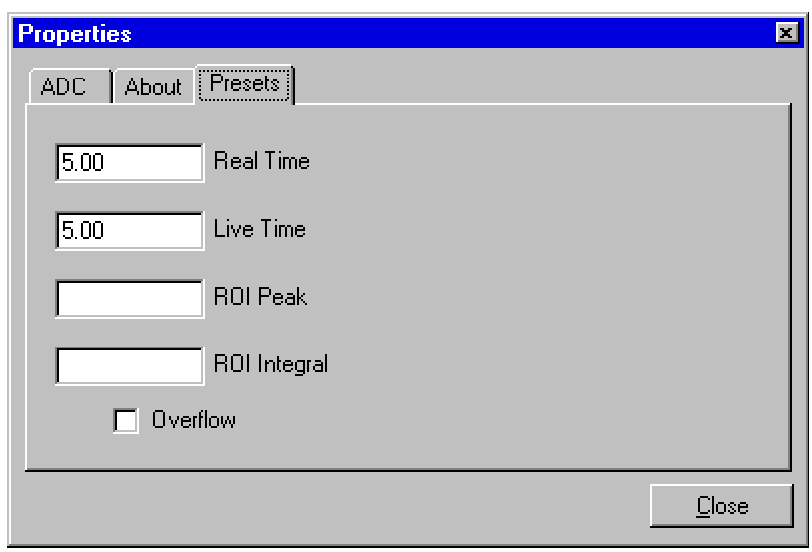

Figure 117. TRUMP and 926: The Presets Tab.

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

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

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

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

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

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

3.2.13. 918

3.2.13.1. ADC

The 918 does not have computer-adjustable ADC controls. The current instrument's real time and live time are monitored at the bottom of the ADC tab (Fig. 118).

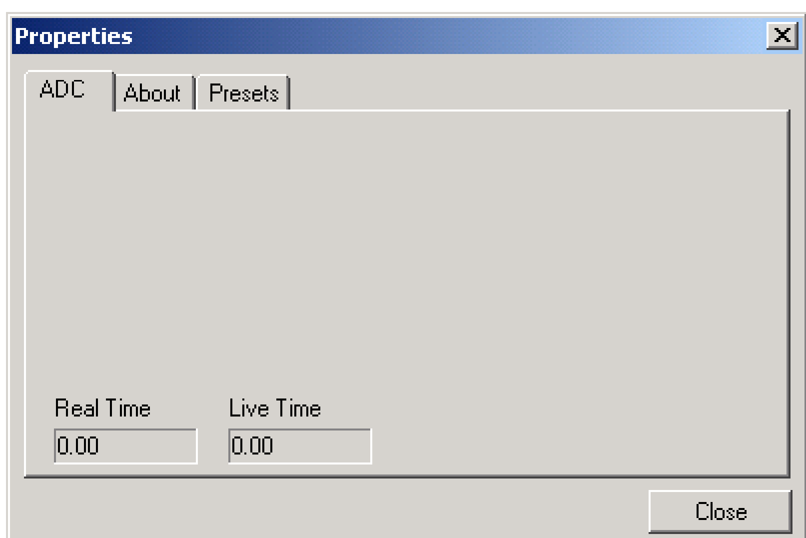

Figure 118. 918: The ADC Tab.

3.2.13.2. About

This tab (Fig. 119) displays hardware and firmware information about the currently selected 918, as well as the data **Acquisition Start Time** and **Sample** description. In addition, the **Access** field shows whether the MCB is currently locked with a password; **Read/Write** indicates that the MCB is unlocked; **Read Only** means it is locked.

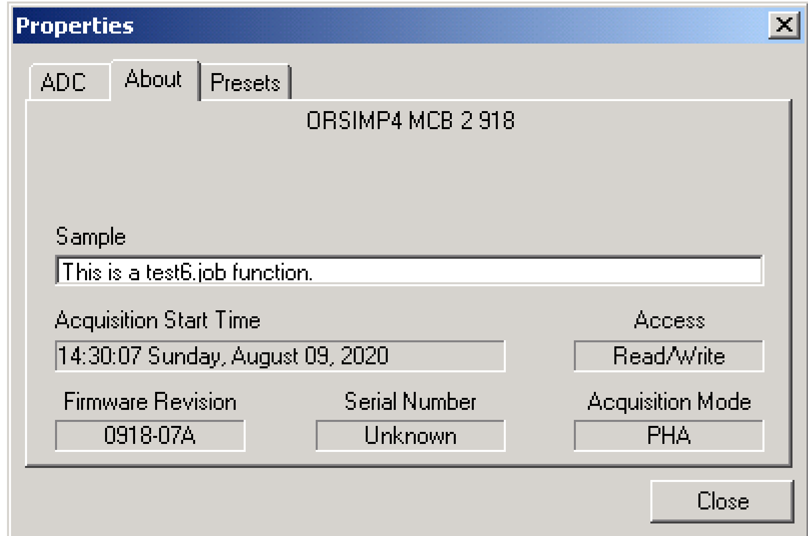

Figure 119. 918: The About Tab.

3.2.13.3. Presets

Figure 120 shows the Presets tab. The presets can only be set on an MCB that is *not* acquiring data. You can use any or all of the presets at one time. To disable a preset, enter a value of zero. If you disable all of the presets, data acquisition will continue until manually stopped.

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

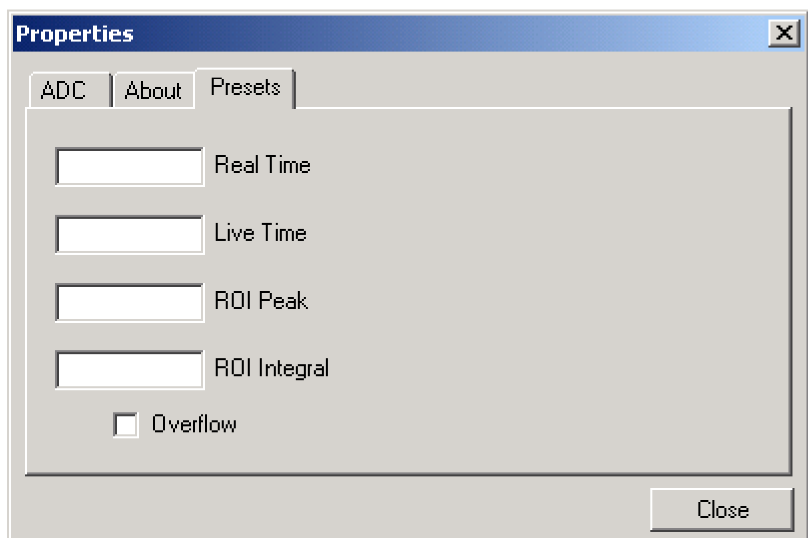

Figure 120. 918: The Presets Tab.

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

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

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

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

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

3.2.14. 916, 916A, ACE, and Spectrum ACE

3.2.14.1. ADC

This tab (Fig. 121) contains the **Conversion Gain** control. In addition, the current real time and live time are monitored at the bottom of the dialog.

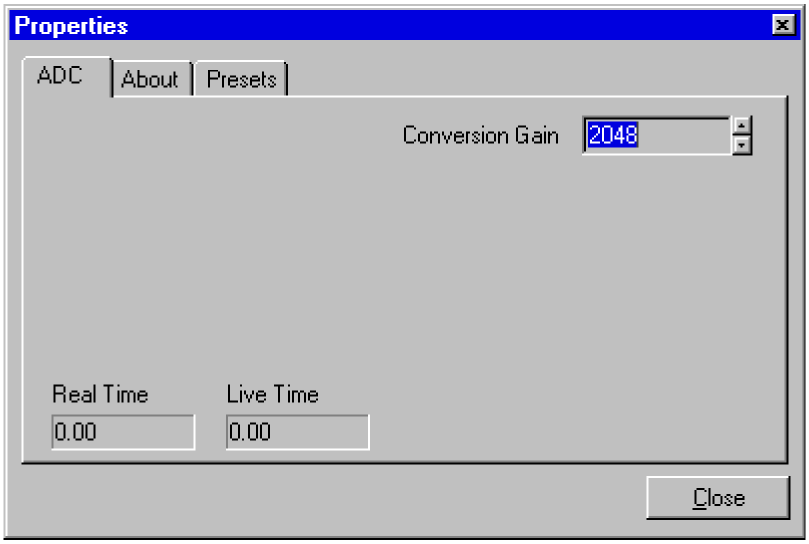

Figure 121. 916, 916A, ACE, and Spectrum ACE: The ADC Tab.

Conversion Gain

The **Conversion Gain** sets the maximum channel number in the spectrum. If set to 2048, the energy scale will be divided into 2048 channels. The conversion gain is entered in powers of 2 (e.g., 2048, 1024, 512, ...). The up/down arrow buttons step through the valid settings for each instrument type.

3.2.14.2. About

This tab (Fig. 122) displays hardware and firmware information about the currently selected instrument, as well as the data **Acquisition Start Time** and **Sample** description. In addition, the **Access** field shows whether the MCB is currently locked with a password; **Read/ Write** indicates that the MCB is unlocked; **Read Only** means it is locked.

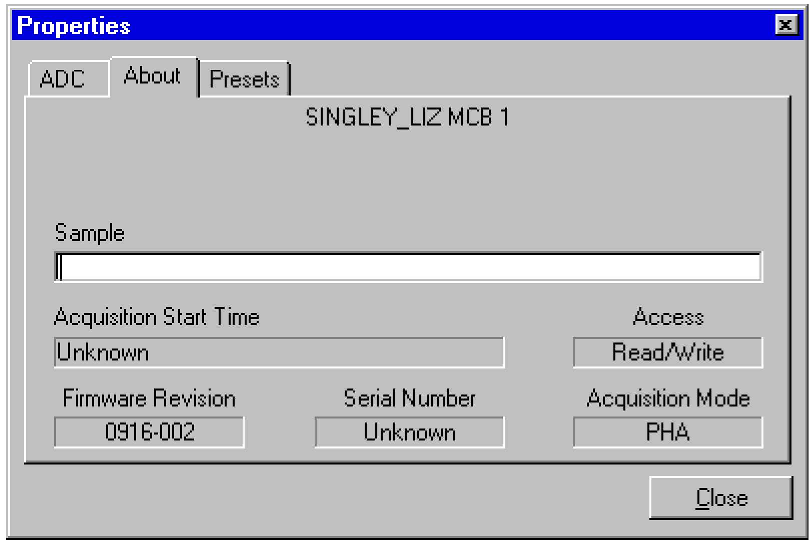

Figure 122. 916, 916A, ACE, and Spectrum ACE: The About Tab.

3.2.14.3. Presets

Figure 123 shows the Presets tab. The presets can only be set on an MCB that is *not* acquiring data. You can use any or all of the presets at one time. To disable a preset, enter a value of zero. If you disable all of the presets, data acquisition will continue until manually stopped.

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

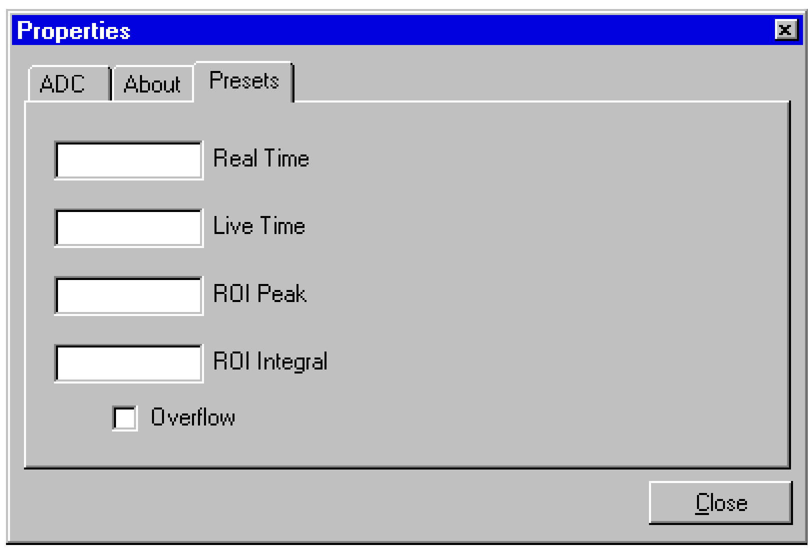

Figure 123. 916, 916A, ACE, and Spectrum ACE: The Presets Tab.

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

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

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

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

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

3.2.15. 917

3.2.15.1. ADC

The 917 does not have computer-adjustable ADC controls. The current instrument's real time and live time are monitored at the bottom of the ADC tab (Fig. 124).

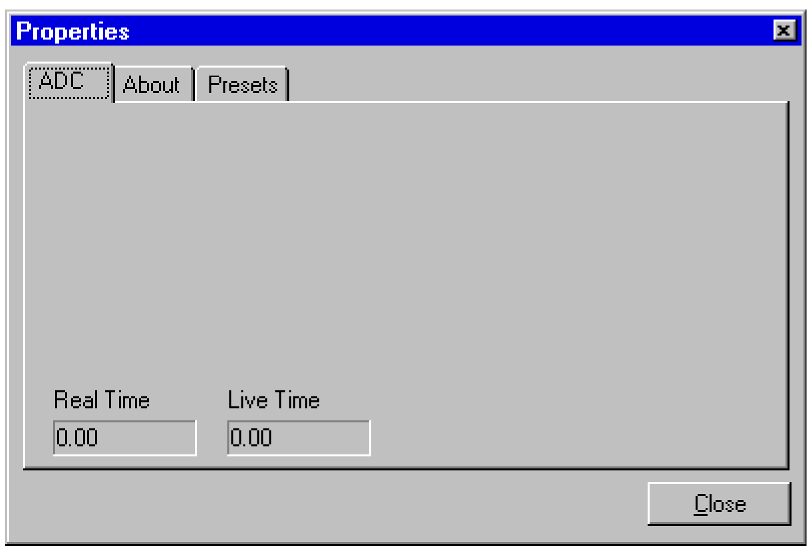

Figure 124. 917: The ADC Tab.

3.2.15.2. About

This tab (Fig. 125) displays hardware and firmware information about the currently selected 917, as well as the data **Acquisition Start Time** and **Sample** description. In addition, the **Access** field shows whether the MCB is currently locked with a password; **Read/Write** indicates that the MCB is unlocked; **Read Only** means it is locked.

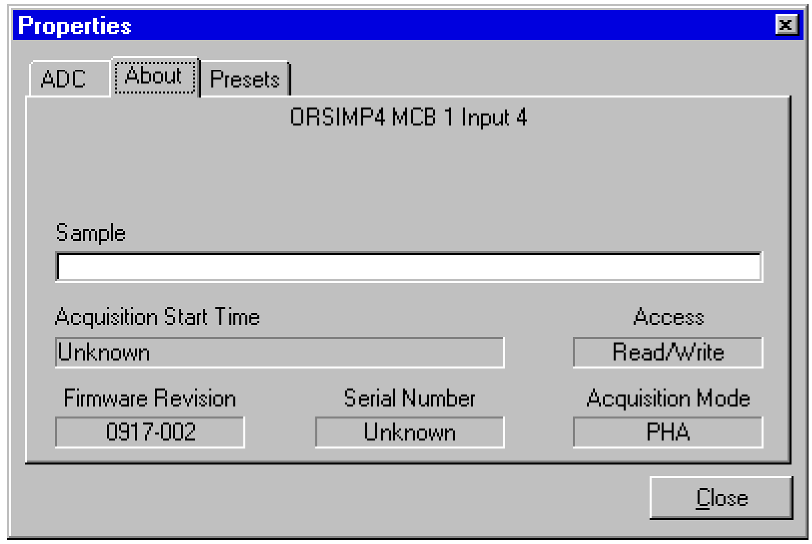

Figure 125. 917: The About Tab.

3.2.15.3. Presets

Figure 126 shows the Presets tab. The presets can only be set on an MCB that is *not* acquiring data. You can use any or all of the presets at one time. To disable a preset, enter a value of zero. If you disable all of the presets, data acquisition will continue until manually stopped.

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

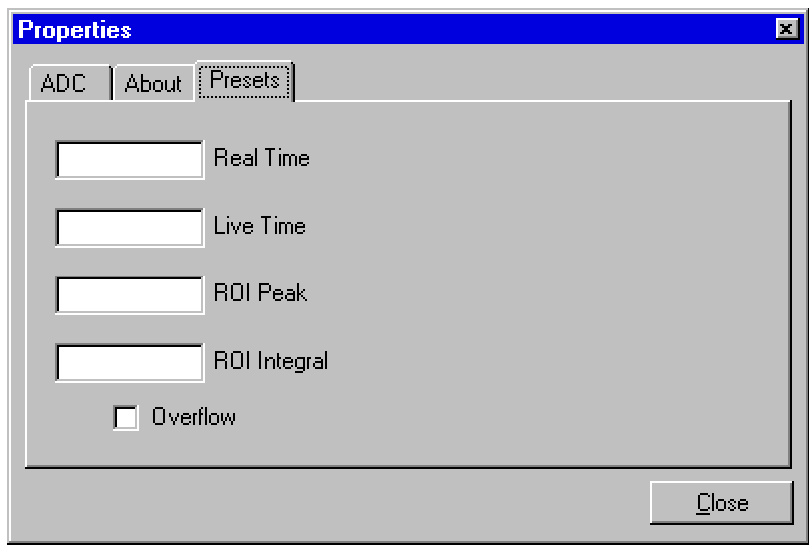

Figure 126. 917: The Presets Tab.

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

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

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

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

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

3.2.16. MicroNOMAD

3.2.16.1. Amplifier

Figure 127 shows the Amplifier tab, which contains the **Gain** control.

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

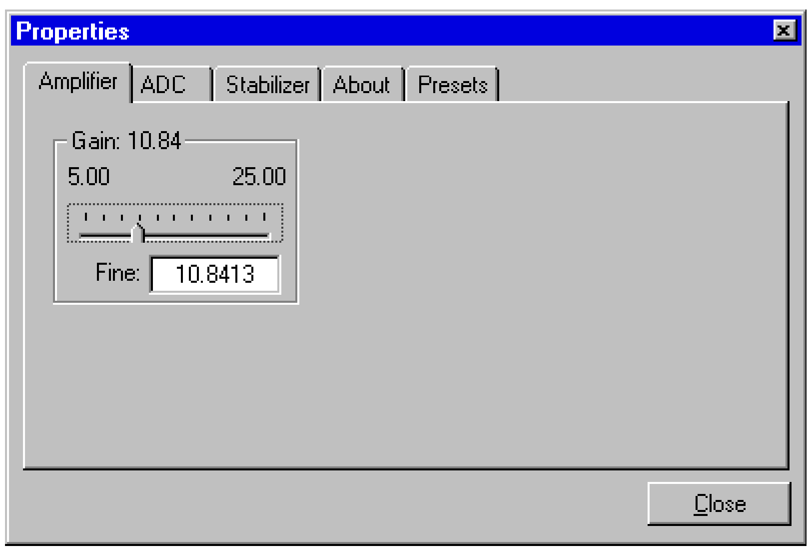

Figure 127. MicroNOMAD: The Amplifier Tab.

Gain

Set the amplifier **Gain** with the horizontal slider bar or the edit box, in the range of 5.00 to 25.00. The resulting effective gain is shown at the top of the **Gain** section.

3.2.16.2. ADC

This tab (Fig. 128) contains the **Gate** and **Conversion Gain** controls. In addition, the current real time and live time are monitored at the bottom of the dialog.

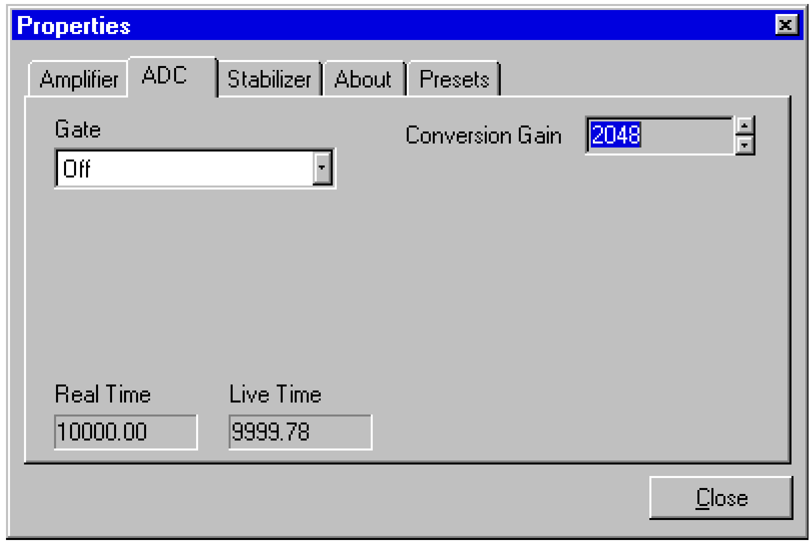

Figure 128. MicroNOMAD: The ADC Tab.

Gate

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

NOTE The **Gate** should be left **Off** because the MicroNOMAD gate control input is normally not accessible.

Conversion Gain

The **Conversion Gain** sets the maximum channel number in the spectrum. If set to 2048, the energy scale will be divided into 2048 channels. The conversion gain is entered in powers of 2 (e.g., 2048, 1024, 512, ...). The up/down arrow buttons step through the valid settings for the MicroNOMAD.

3.2.16.3. Stabilizer

The MicroNOMAD has a gain stabilizer. Gain stabilization is discussed in detail in Section 3.4.

The Stabilizer tab (Fig. 129) shows the current gain stabilizer setting. The value in the **Adjustment** section shows how much adjustment is currently applied. The **Initialize** button sets the adjustment to 0. If the value approaches 90% or above, the amplifier gain should be adjusted so the stabilizer can continue to function — when the adjustment value reaches 100%, the stabilizer cannot make further corrections in that direction. The **Center Channel** and **Width** fields show the peak currently used for stabilization.

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

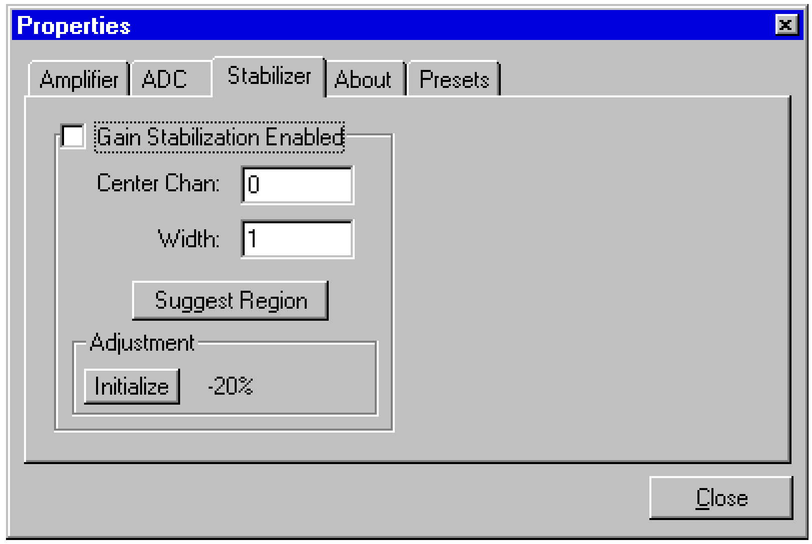

Figure 129. MicroNOMAD: The Stabilizer Tab.

3.2.16.4. About

This tab (Fig. 130) displays hardware and firmware information about the currently selected MicroNOMAD, as well as the data **Acquisition Start Time** and **Sample** description. In addition, the **Access** field shows whether the MCB is currently locked with a password; **Read/Write** indicates that the MCB is unlocked; **Read Only** means it is locked.

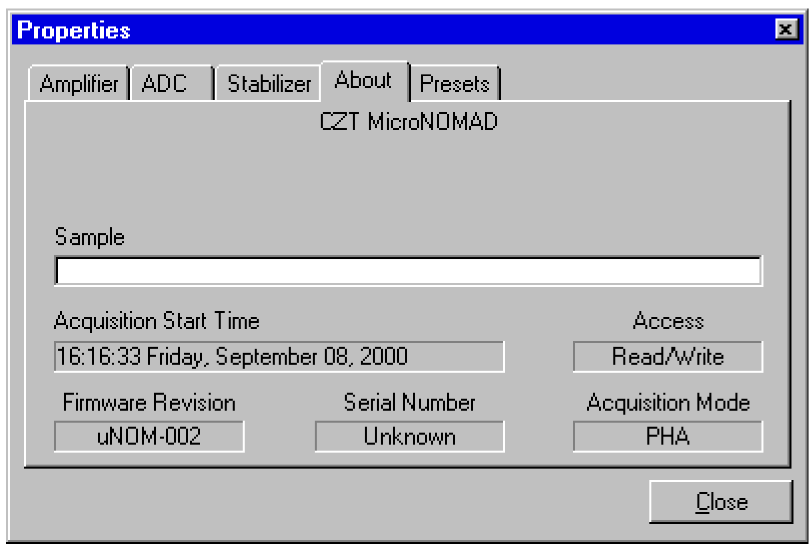

Figure 130. MicroNOMAD: The About Tab.

3.2.16.5. Presets

Figure 131 shows the Presets tab. The presets can only be set on an MCB that is *not* acquiring data. You can use any or all of the presets at one time. To disable a preset, enter a value of zero. If you disable all of the presets, data acquisition will continue until manually stopped.

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

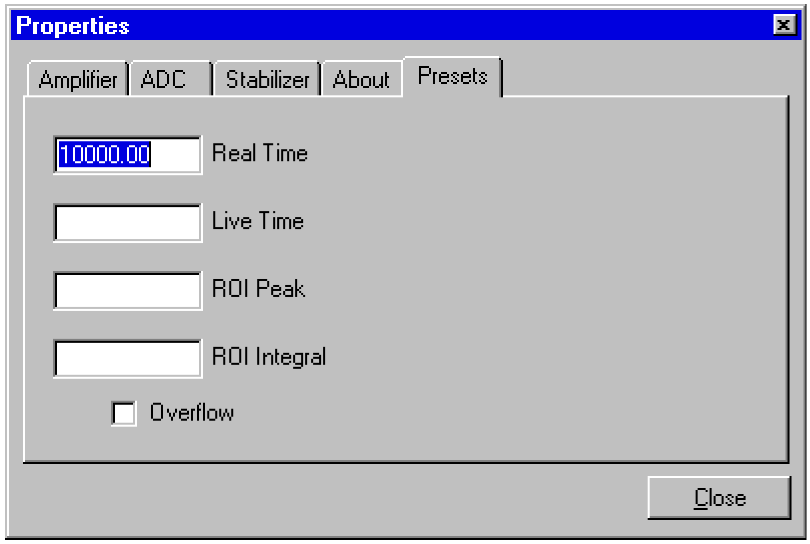

Figure 131. MicroNOMAD: The Presets Tab.

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

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

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

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

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

3.2.17. MicroACE

3.2.17.1. Amplifier

Figure 132 shows the Amplifier tab. This tab contains the fine **Gain** control.

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

Adjust the **Fine** gain with the horizontal slider bar or the edit box, in the range of 5.00 to 25.00.

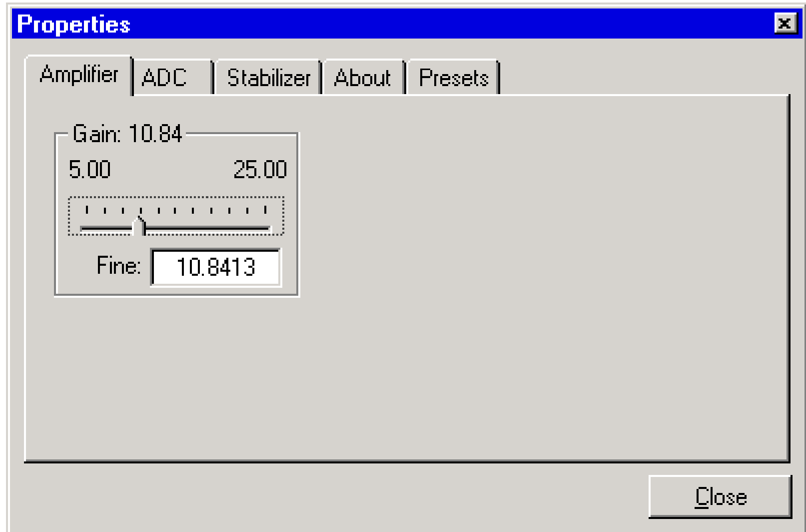

Figure 132. MicroACE: The Amplifier Tab.

3.2.17.2. ADC

This tab (Fig. 133) contains the **Gate** and **Conversion Gain** controls. In addition, the current real time and live time are monitored at the bottom of the dialog.

Gate

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

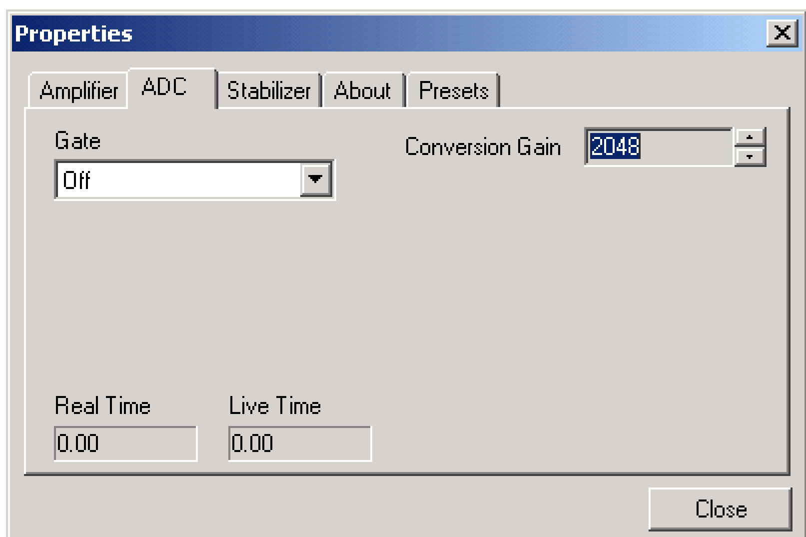

Figure 133. MicroACE: The ADC Tab.

Conversion Gain

The **Conversion Gain** sets the maximum channel number in the spectrum. If set to 2048, the energy scale will be divided into 2048 channels. The conversion gain is entered in powers of 2 (e.g., 2048, 1024, 512). The up/down arrow buttons step through the valid settings.

3.2.17.3. Stabilizer

The MicroACE has a gain stabilizer; gain stabilization is discussed in detail in Section 3.4.

The Stabilizer tab (Fig. 134) shows the current values for the stabilizer. The value in the **Adjustment** section shows how much adjustment is currently applied. The **Initialize** button sets the adjustment to 0. If the value approaches 90% or above, the amplifier gain should be adjusted so the stabilizer can continue to function — when the adjustment value reaches 100%, the stabilizer cannot make further corrections in that direction. The **Center Chan**nel and **Width** fields show the peak currently used for stabilization.

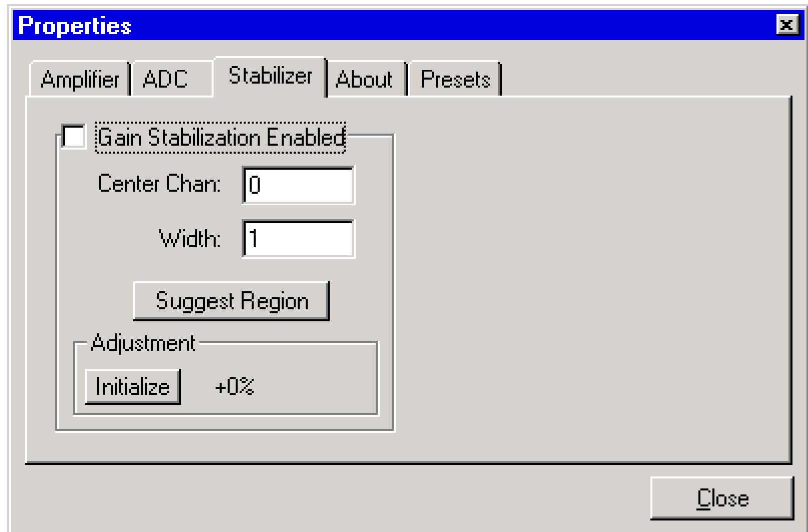

Figure 134. MicroACE: The Stabilizer Tab.

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

3.2.17.4. About

This tab (Fig. 135) displays hardware and firmware information about the currently selected MicroACE, as well as the data **Acquisition Start Time** and **Sample** description. In addition, the **Access** field shows whether the MCB is currently locked with a password; **Read/Write** indicates that the MCB is unlocked; **Read Only** means it is locked.

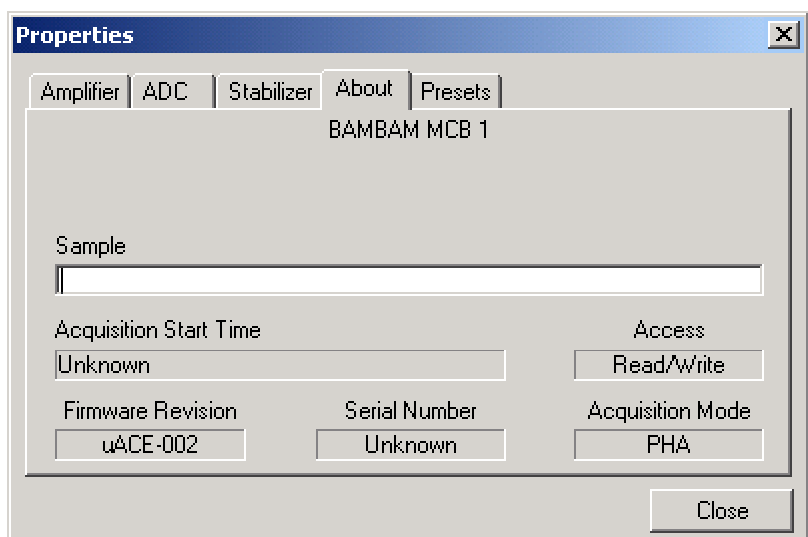

Figure 135. MicroACE: The About Tab.

3.2.17.5. Presets

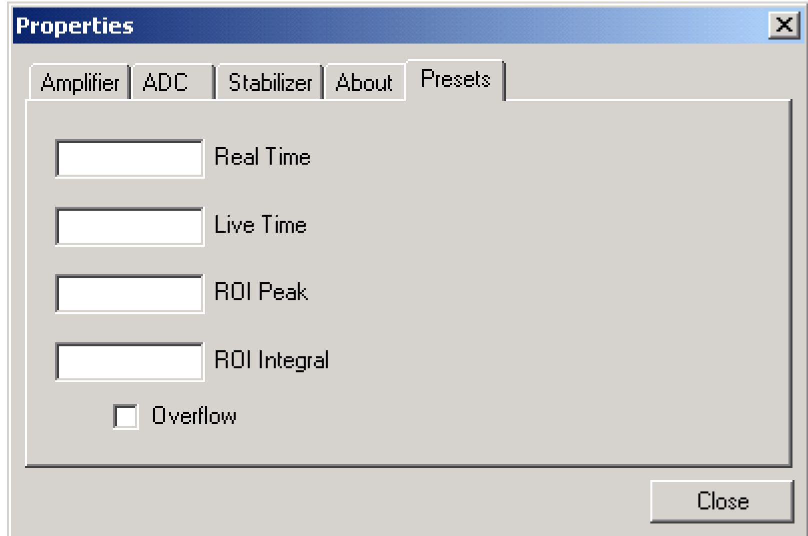

Figure 136. MicroACE: The Presets Tab.

Figure 136 shows the Presets tab. The presets can only be set on an MCB that is *not* acquiring data. You can use any or all of the presets at one time. To disable a preset, enter a value of zero. If you disable all of the presets, data acquisition will continue until manually stopped.

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

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

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

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

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

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

3.2.18. 920 and 920E

The Model 919E has more features than the 919, as explained beginning in Section 3.2.18.4.

3.2.18.1. ADC

This tab (Fig. 137) contains the **Gate**, **Conversion Gain** and **Digital Offset** controls. In addition, the current real time and live time are monitored at the bottom of the dialog.

Gate

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

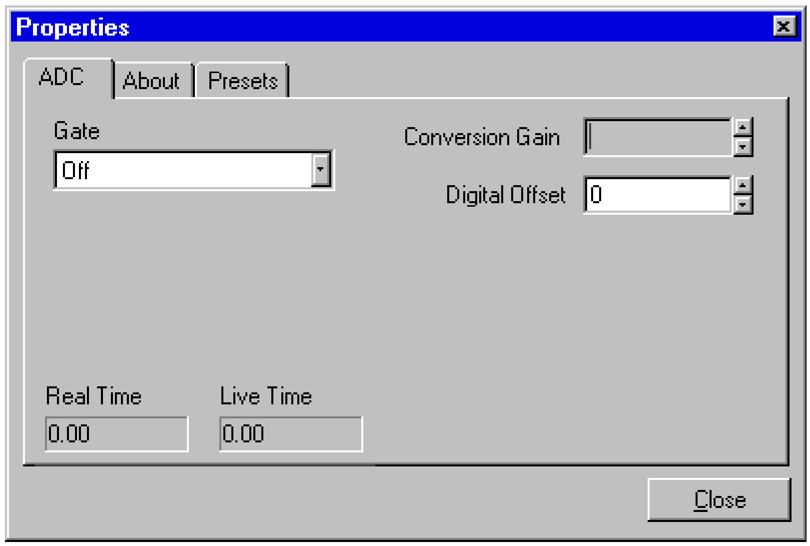

Figure 137. 920 and 920E: The ADC Tab.

Conversion Gain and Digital Offset

The **Digital Offset** and **Conversion Gain** are used to control the starting energy and energy range of the spectrum collected. In many cases the low-energy portion of the spectrum contains no data of interest and can be discarded. The 920 and 920E use digital offset in the MCB to accomplish this. The conversion gain is the number of channels corresponding to a full-scale input of 10 V. In the 920 and 920E, the amplifier gain is set at the factory so that a 10-MeV alpha particle corresponds to a 10-V output. All amplifier connections are internal to the system.

Table 1 shows the offset and gain settings, with the spectrum size[7] set to 512 channels, for some commonly used spectrum energy ranges. The energy range can be the same for all inputs, different for all inputs, or any combination in between. Each input has its own energy calibration in the system. These are only examples; any other combination can be used.

Table 1. Offset and Conversion Gain Settings.

Starting Energy (MeV)	Ending Energy (MeV)	Offset	Conversion Gain
3.0	5.5	600	2048
3.0	8.0	300	1024
4.0	6.5	800	2048
4.0	9.0	400	1024
5.0	7.5	1000	2048
6.0	8.5	1200	2048
Spectrum size is 512 channels.			

3.2.18.2. About

This tab (Fig. 138) displays hardware and firmware information about the currently selected 920 or 920E, as well as the data **Acquisition Start Time** and **Sample** description. In addition, the **Access** field shows whether the MCB is currently locked with a password; **Read/Write** indicates that the MCB is unlocked; **Read Only** means it is locked.

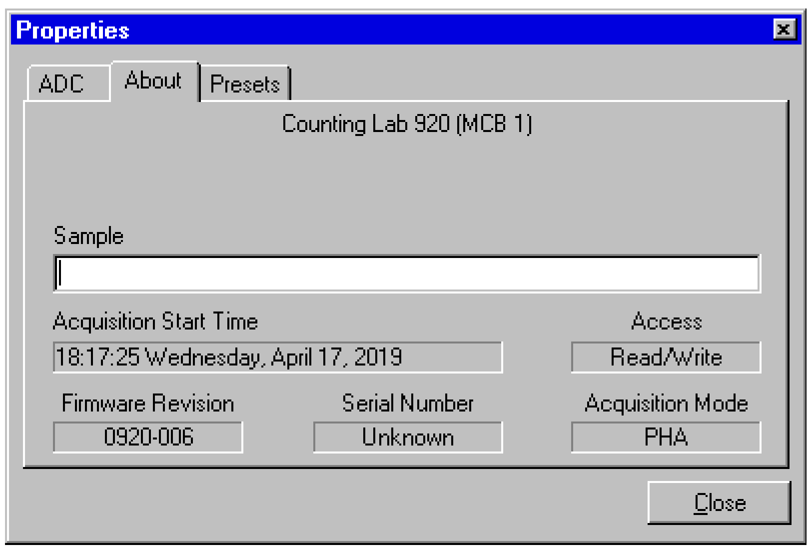

Figure 138. 920 and 920E: The About Tab.

3.2.18.3. Presets

Figure 139 shows the Presets tab. The presets can only be set on an MCB that is *not* acquiring data. You can use any or all of the presets at one time. To disable a preset, enter a

[7]The total memory size and number of segments in the 920 and 920E can be changed. See the hardware manual and the SET920 program for details. After any changes to these settings, you must run the MCB Configuration program to register the changes.

value of zero. If you disable all of the presets, data acquisition will continue until manually stopped.

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

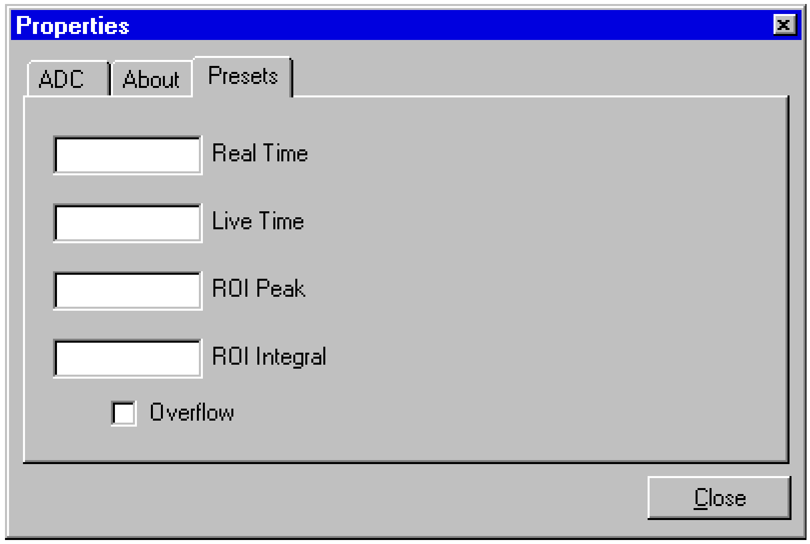

Figure 139. 920 and 920E: The Presets Tab.

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

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

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

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

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

3.2.18.4. 920E: Uncertainty Preset

The 920E includes an **Uncertainty** preset on the Presets tab (see Fig. 99, page 90, for an example of this preset's data fields). The **Uncertainty** preset stops acquisition when the statistical or counting uncertainty of a user-selected net peak reaches the value you have entered. Enter the **Preset in %** value as percent uncertainty at 1 sigma of the net peak area. The range is from 99% to 0.1% in 0.1% steps. You have complete control over the selected peak region. The region must be at least 7 channels wide with 3 channels of background on each side of the peak. As the uncertainty is calculated approximately every 30 seconds, the uncertainty achieved for a high count-rate sample may be better than the preset value.

Use the **Start Chan**nel and **Width** fields to enter the channel limits directly, or click on **Suggest Region**. If the marker is positioned in an ROI around the peak of interest, **Suggest Region** reads the limits of the ROI with the marker and display those limits in the **Start Chan** and **Width** fields. The ROI can be cleared after the preset is entered without affecting the uncertainty calculation. If the marker is not positioned in an ROI, the start channel is 1.5 times the FWHM below the marker channel and the width is 3 times the FWHM. The net peak area and statistical uncertainty are calculated in the same manner as for the MAESTRO **Peak Info** command, which is discussed in Section 3.7. Note that the **Suggest Region** button is not displayed during data acquisition.

3.2.18.5. 920E: MDA Preset

The MDA preset (Fig. 140) stops data collection when the minimum detectable activity for a single user-specified MDA nuclide reaches the designated value. The MDA preset is implemented in the hardware. The formulas for the MDA are given in various textbooks and in the "Analysis Methods" chapter in the GammaVision user manual and can be generally represented as follows:

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

The coefficients *a*, *b*, and *c* are determined by the MDA formula to be used. The *Eff* (detector efficiency) is determined from the calibration. The *Yield* (branching ratio) is read from the working library using the nuclide and energy specified. The **MDA** value is the one you have entered in the dialog. *Counts* is the gross counts in the specified region and *Live time* is the live time. The *MDA* value is calculated in the MCB given the values *a*, *b*, *c*, *Live time*, *Eff*, and *Yield*. The calculated value is compared with the **MDA** value on the dialog and when it is lower, acquisition is stopped.

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

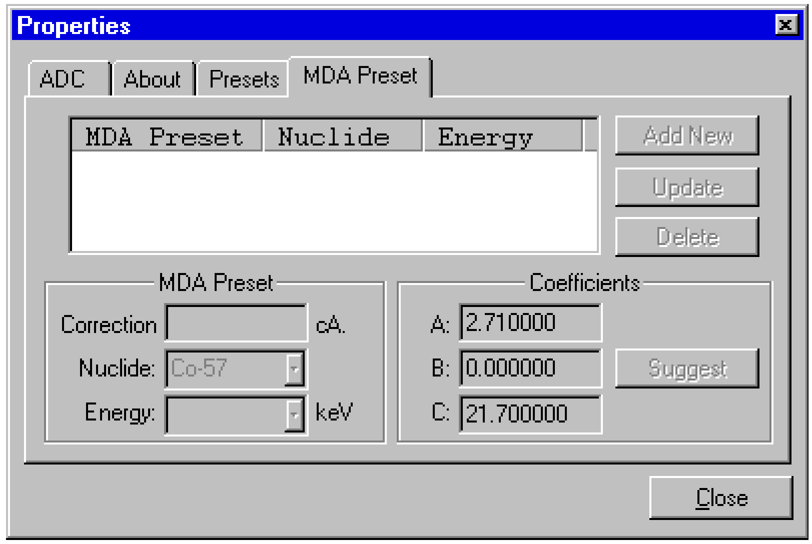

Figure 140. 920E: The MDA Preset Tab.

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

If the application supports efficiency calibration and the 920E is efficiency calibrated, the **MDA** is entered in the units selected in the application. If the unit is not efficiency calibrated (e.g., in MAESTRO, which does not support efficiency calibration), the **MDA** field is labeled **Correction**, the efficiency (*Eff*) is set to 1.0 and the preset operates as before. If the **Correction** factor is the actual MDA times the efficiency (known from other sources), the MDA preset will function normally.

3.2.19. OCTÊTE PC and OCTÊTE Plus

The OCTÊTE Plus has more features than the OCTÊTE PC, as explained beginning in Section 3.2.19.6.

3.2.19.1. ADC

This tab (Fig. 141) contains the **Gate**, **Conversion Gain**, and **Digital Offset** controls. In addition, the current real time and live time are monitored at the bottom of the dialog.

Gate

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

Conversion Gain and Digital Offset

The **Digital Offset** and **Conversion Gain** are used to control the starting energy and energy range of the spectrum collected. In many cases the low-energy portion of the spectrum contains no data of interest and can be discarded. The OCTÊTE PC uses digital offset in the MCB to accomplish this. The conversion gain is the number of channels corresponding to a full-scale input of 10 V. In the OCTÊTE PC, the amplifier gain is set at the factory so that a 10-MeV alpha particle corresponds to a 10-V output. All amplifier connections are internal to the system.[8]

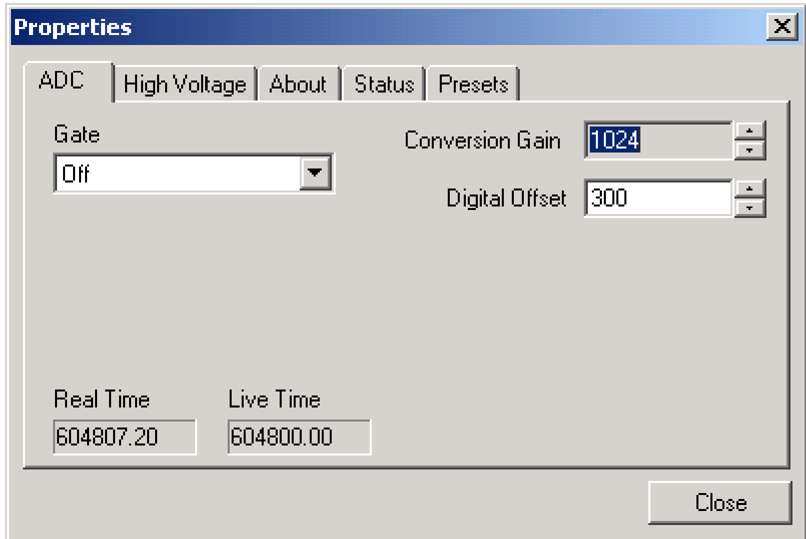

Figure 141. OCTÊTE PC and OCTÊTE Plus: The ADC Tab.

Table 2 shows the offset and gain settings, with the spectrum size set to 512 channels, for some commonly used spectrum energy ranges. The energy range can be the same for all inputs, different for all inputs, or any combination in between. Each input has its own energy calibration in the system. These are only examples; any other combination can be used.

Table 2. Offset and Conversion Gain Settings.

Starting Energy (MeV)	Ending Energy (MeV)	Offset	Conversion Gain
3.0	5.5	600	2048
3.0	8.0	300	1024
4.0	6.5	800	2048
4.0	9.0	400	1024
5.0	7.5	1000	2048
6.0	8.5	1200	2048

[8]To change the total memory size or enable the second 8 inputs in the OCTÊTE Plus, see the hardware manual and the SET920 program for details. After any changes to these settings, you must run the MCB Configuration program to register the changes.

3.2.19.2. High Voltage

Figure 142 shows the High Voltage tab, which allows you to turn the MCB bias on or off, and monitor the MCB voltage (**Actual**) and leakage **Current**.

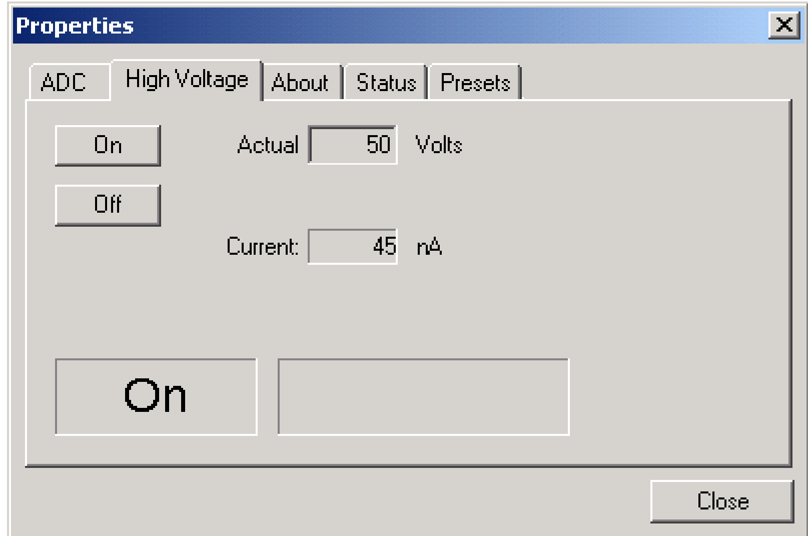

Figure 142. OCTÊTE PC and OCTÊTE Plus: The High Voltage Tab.

The OCTÊTE PC has a rear-panel Vacuum/Bias Interlock switch that can disabled the bias when chamber pressure rises above the cutoff value. When the cutoff value is exceeded and the interlock shuts off the bias, the dialog's **On** button remains in the on (depressed) position. In this condition, bias will be automatically reapplied when the vacuum improves sufficiently or the interlock switch is set to off.

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

While the Properties dialog is open, the computer monitors the OCTÊTE PC in real time, continuously updating the **Actual** voltage, leakage **Current**, and chamber pressure information.

3.2.19.3. About

This tab (Fig. 143) displays hardware and firmware information about the currently selected OCTÊTE as well as the data **Acquisition Start Time** and **Sample** description. The **Access** field shows whether the MCB is currently locked with a password; **Read/Write** indicates that the MCB is unlocked; **Read Only** means it is locked.

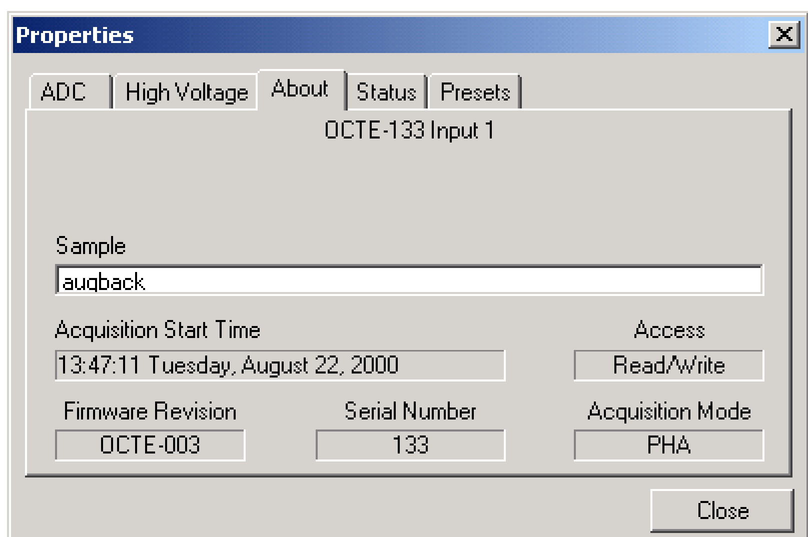

Figure 143. OCTÊTE PC and OCTÊTE Plus: The About Tab.

This screen displays the OCTÊTE's serial number; all OCTÊTEs have a unique serial number which is read by the software and stored in the spectrum file for verification of the spectrum. The OCTÊTE input currently being monitored is shown at the top of the dialog.

3.2.19.4. Status

The Status tab (Fig. 144) monitors the currently selected OCTÊTE chamber's pressure. Chamber pressure is displayed in millitorr (mT). If the pressure is above the range of the vacuum gauge (about 1000 mT), the **Vacuum** is displayed as **OVER**.

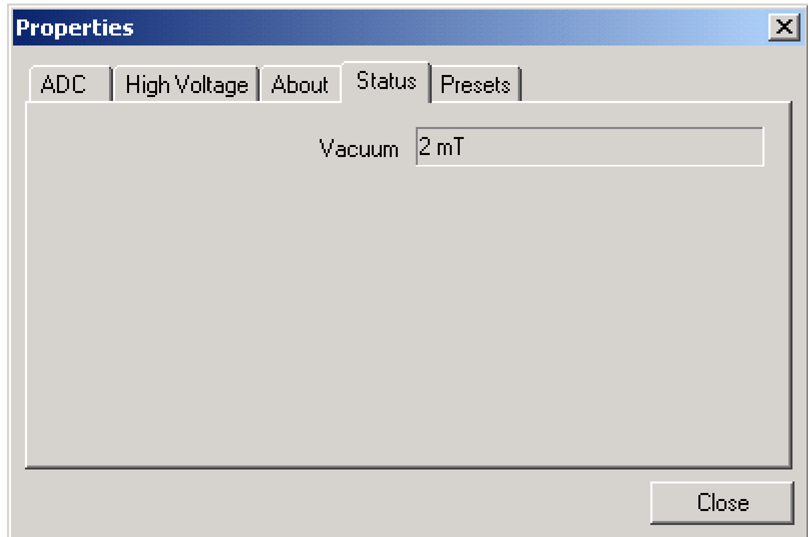

Figure 144. OCTÊTE PC and OCTÊTE Plus: The Status Tab.

The cutoff pressure can be set to either 100 mT or 500 mT (see the hardware manual for the factory setting and how to change it). The vacuum is controlled by the valve on the front of the unit. The computer continuously monitors the vacuum whenever this dialog is open.

3.2.19.5. Presets

Figure 145 shows the Presets tab. The presets can only be set on an MCB that is *not* acquiring data. You can use any or all of the presets at one time. To disable a preset, enter a value of zero. If you disable all of the presets, data acquisition will continue until manually stopped.

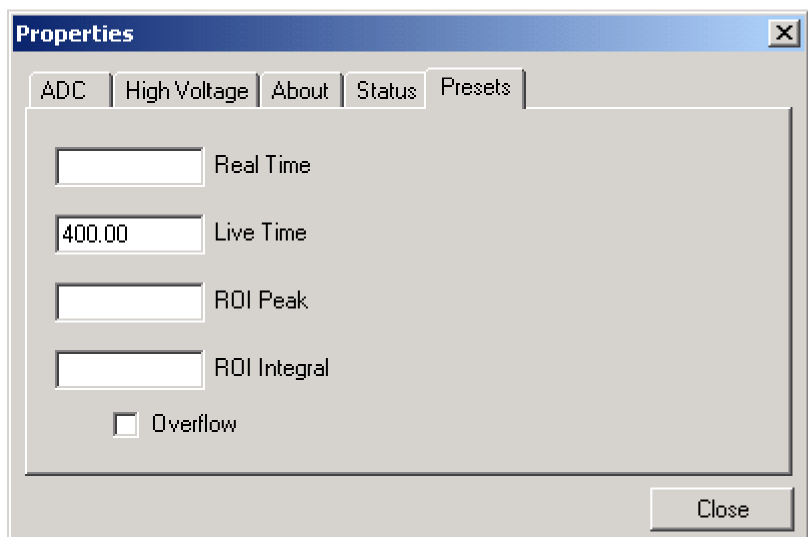

Figure 145. OCTÊTE: The Presets Tab.

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

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

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

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

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

3.2.19.6. OCTÊTE Plus: Uncertainty Preset

The OCTÊTE Plus includes an **Uncertainty** preset on the Presets tab (see Fig. 99, page 90, for an example of this preset’s data fields). The **Uncertainty** preset stops acquisition when the statistical or counting uncertainty of a user-selected net peak reaches the value you have entered. Enter the **Preset in %** value as percent uncertainty at 1 sigma of the net peak area. The range is from 99% to 0.1% in 0.1% steps. You have complete control over the selected peak region. The region must be at least 7 channels wide with 3 channels of background on each side of the peak. As the uncertainty is calculated approximately every 30 seconds, the uncertainty achieved for a high count-rate sample may be better than the preset value.

Use the **Start Chan**nel and **Width** fields to enter the channel limits directly, or click on **Suggest Region**. If the marker is positioned in an ROI around the peak of interest, **Suggest Region** reads the limits of the ROI with the marker and display those limits in the **Start Chan** and **Width** fields. The ROI can be cleared after the preset is entered without affecting the uncertainty calculation. If the marker is not positioned in an ROI, the start channel is 1.5 times the FWHM below the marker channel and the width is 3 times the FWHM. The net peak area and statistical uncertainty are calculated in the same manner as for the MAESTRO **Peak Info** command, which is discussed in Section 3.7. Note that the **Suggest Region** button is not displayed during data acquisition.

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

3.2.19.7. OCTÊTE Plus: MDA Preset

The MDA preset (Fig. 146) stops data collection when the minimum detectable activity for a single user-specified MDA nuclide reaches the designated value. The MDA preset is implemented in the hardware. The formulas for the MDA are given in various textbooks and in the "Analysis Methods" chapter in the GammaVision user manual and can be generally represented as follows:

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

The coefficients *a*, *b*, and *c* are determined by the MDA formula to be used. The *Eff* (detector efficiency) is determined from the calibration. The *Yield* (branching ratio) is read from the working library using the nuclide and energy specified. The **MDA** value is the one you have entered in the dialog. *Counts* is the gross counts in the specified region and *Live time* is the live time. The *MDA* value is calculated in the MCB given the values *a*, *b*, *c*, *Live time*, *Eff*, and *Yield*. The calculated value is compared with the **MDA** value on the dialog and when it is lower, acquisition is stopped.

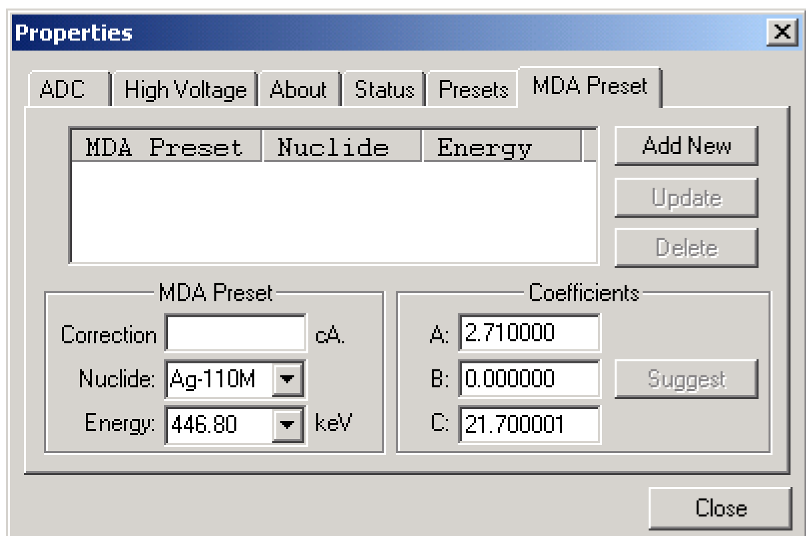

Figure 146. OCTÊTE Plus: The MDA Preset Tab.

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

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

If the application supports efficiency calibration and the OCTÊTE Plus is efficiency calibrated, the **MDA** is entered in the units selected in the application. If the unit is not efficiency calibrated (e.g., in MAESTRO, which does not support efficiency calibration), the **MDA** field is labeled

Correction, the efficiency (*Eff*) is set to 1.0 and the preset operates as before. If the **Correction** factor is the actual MDA times the efficiency (known from other sources), the MDA preset will function normally.

3.2.20. M³CA

3.2.20.1. Amplifier

Figure 147 shows the Amplifier tab. This tab contains the controls for **Gain**, **Baseline Restore**, **Preamplifier Type**, **Input Polarity**, and **Pileup Rejection**.

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

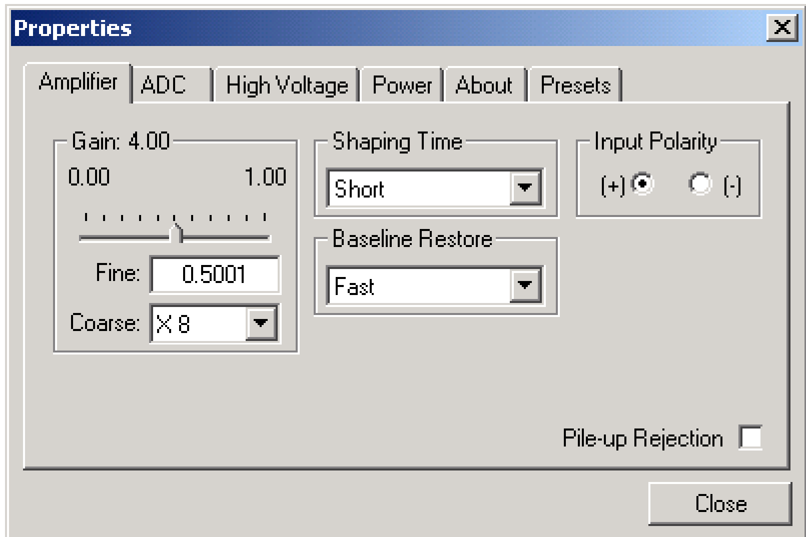

Figure 147. M³CA: The Amplifier Tab.

Gain

Set the amplifier coarse gain by selecting from the **Coarse** droplist, then adjust the **Fine** gain with the horizontal slider bar or the edit box, in the range of 0.00 to 1.00. The resulting effective gain is shown at the top of the **Gain** section. The two controls used together cover the entire range of amplification from 0.00 to 64.00.

Shaping Time

Use the **Shaping Time** droplist to select the amplifier pulse shaping-time constant. The available values, **Short** and **Long**, cover the time constants needed for high-count-rate and high-resolution systems.

Input Polarity

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

Baseline Restore

The **Baseline Restore** is used to return the baseline of the pulses to the true zero between incoming pulses. This improves the resolution by removing low frequency noise such as dc shifts or mains power ac pickup. The baseline settings control the time constant of the circuit that returns the baseline to zero. There are three fixed choices (**Auto**,[4] **Fast**, and **Slow**). The fast setting is used for high count rates, the slow for low count rates. **Auto** adjusts the time constant as appropriate for the input count rate. The settings (**Auto, Fast, or Slow**) are saved in the M^{3}CA even when the power is off.

Pileup Rejection

Pileup Rejection (PUR) is used to reject overlapping pulses, improving the peak shape. This checkbox allows you to disable the PUR. This feature is normally enabled and is only turned off for special detectors.

3.2.20.2. ADC

This tab (Fig. 148) contains the **Conversion Gain**, **Lower Level Disc**riminator, and **Upper Level Disc**riminator controls. In addition, the current real time and live time are monitored at the bottom of the dialog.

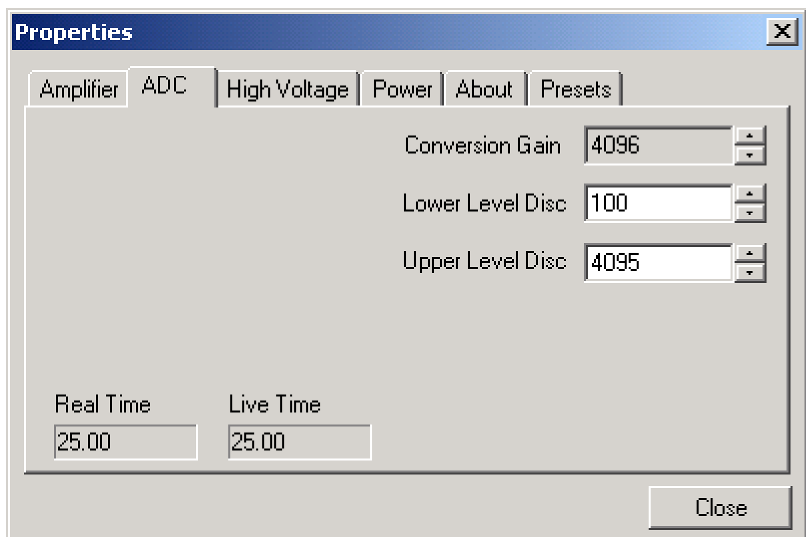

Figure 148. M^{3}CA: The ADC Tab.

Conversion Gain

The **Conversion Gain** sets the maximum channel number in the spectrum. If set to 4096, the energy scale will be divided into 4096 channels. The conversion gain is entered in powers of 2 (e.g., 4096, 2048, 1024, ...). The up/down arrow buttons step through the valid settings for the M^{3}CA.

Upper- and Lower-Level Discriminators

In the M^{3}CA the lower- and upper-level discriminators are under computer control.

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

The **Upper Level Discr**iminator sets the level of the highest amplitude pulse that will be stored. This level establishes an upper-level cutoff, by channel number, for ADC conversions.

3.2.20.3. High Voltage

Figure 149 shows the High Voltage tab, which allows you to turn the high voltage on or off, set and monitor the voltage, and select the **Polarity**.

Enter the detector high voltage in the **Target** field, click **On**, and monitor the voltage in the **Actual** field. Click the **Off** button to turn off the high voltage. The high voltage is overridden by the detector bias remote shutdown signal from the detector; high voltage cannot be enabled if the remote shutdown or overload signals prevent it.

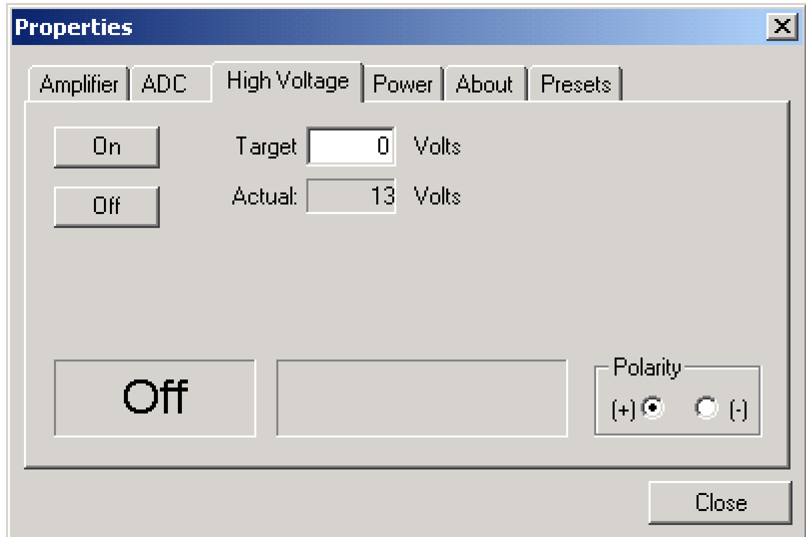

Figure 149. M^{3}CA: The High Voltage Tab.

The **Polarity** selection determines the output polarity on the rear-panel connector.

3.2.20.4. Power

The Power tab is shown in Fig. 150. This tab displays information about the M^{3}CA's current power source and the battery voltage. The power **Source**s are **Battery 1** or **External**.

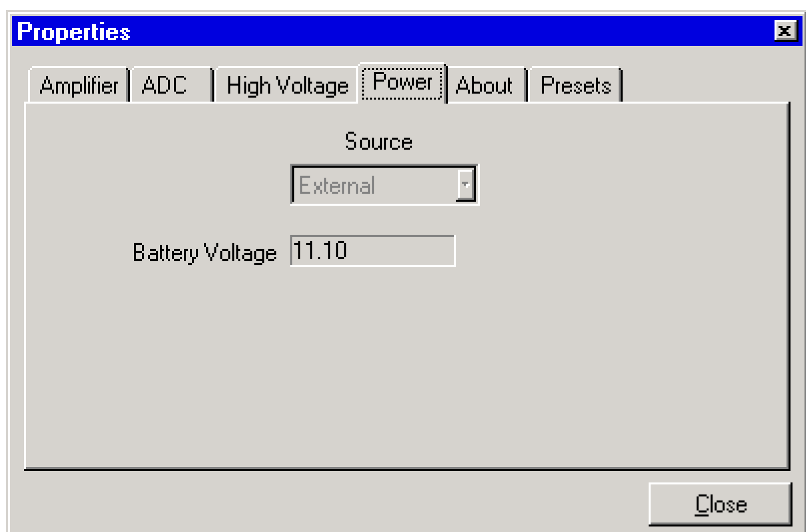

Figure 150. M^{3}CA: The Power Tab.

3.2.20.5. About

This tab (Fig. 151) displays hardware and firmware information about the currently selected M^{3}CA as well as the data **Acquisition Start Time** and **Sample** description. In addition, the **Access** field shows whether the MCB is currently locked with a password; **Read/ Write** indicates that the MCB is unlocked; **Read Only** means it is locked.

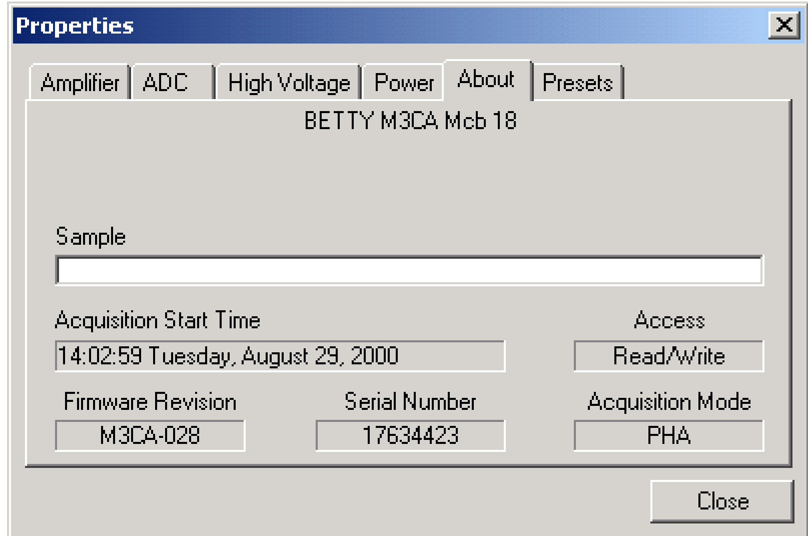

Figure 151. M^{3}CA: The About Tab.

3.2.20.6. Presets

Figure 152 shows the Presets tab. The presets can only be set on an MCB that is *not* acquiring data. You can use any or all of the presets at one time. To disable a preset, enter a value of zero. If you disable all of the presets, data acquisition will continue until manually stopped.

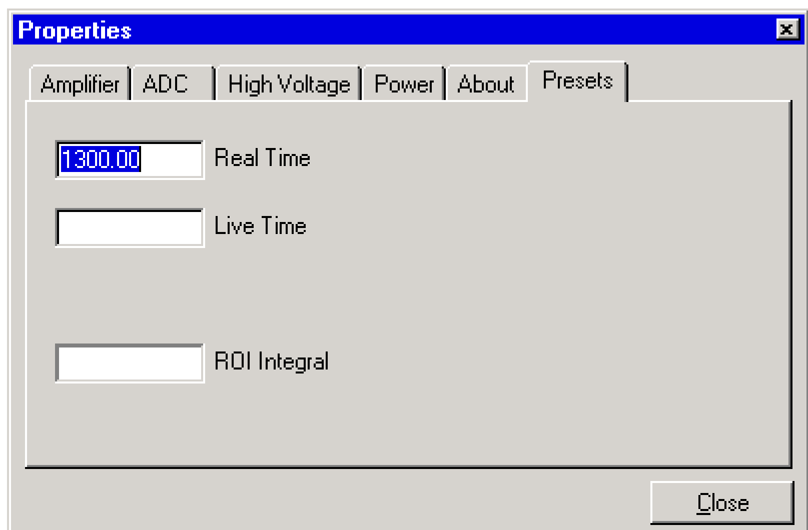

Figure 152. M^{3}CA: The Presets Tab.

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

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

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

The ROI Integral preset operates differently than in ORTEC MCBs. In the M^{3}CA, this preset is maintained separately for each distinct ROI. Up to 29 ROIs can be marked. When the integral of all counts in any single region reaches the preset value, acquisition is stopped. Note, however, that this "variable-integral-count" feature can only be activated by issuing the SEND_MESSAGE command as part of a **.JOB** file. The M^{3}CA hardware manual contains the necessary command details. Entering an **ROI Integral** preset on the **Acquisition Presets** dialog sets the preset *the same for all regions*.

3.2.21. MiniMCA-166 Portable MCA

3.2.21.1. Amplifier

Figure 153 shows the Amplifier tab. This tab contains the controls for **Gain**, **Shaping Time**, **Pole Zero**, **Input Polarity**, and **Pileup Rejection**.

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

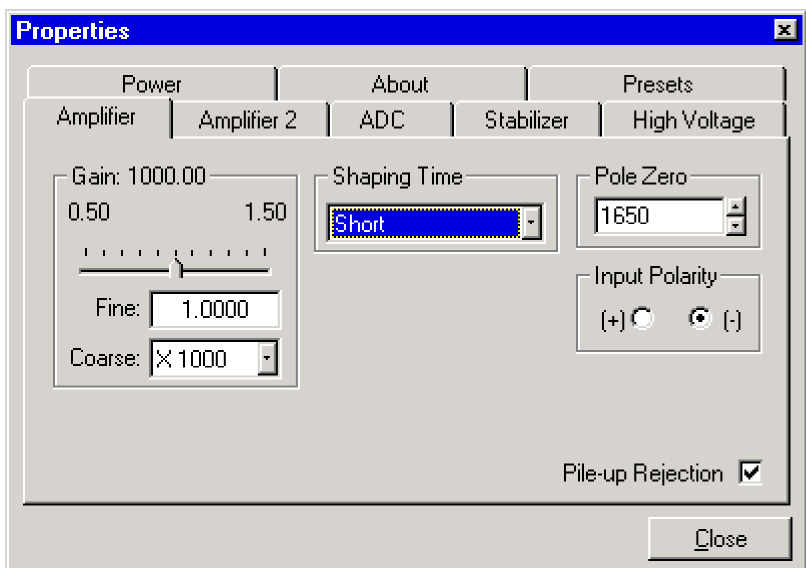

Figure 153. MiniMCA-166: The Amplifier Tab.

Gain

Set the amplifier coarse gain by selecting from the **Coarse** droplist, then adjust the **Fine** gain with the horizontal slider bar or the edit box, in the range of 0.5 to 1.50. The resulting effective gain is shown at the top of the **Gain** section. The two controls used together cover the entire range of amplification from 1.0 to 1000.0.

Shaping Time

Use the **Shaping Time** droplist to select the amplifier pulse shaping-time constant. The available values, **Short** and **Long**, cover the time constants needed for high count-rate and high-resolution systems. See the hardware manual for the specific time constants used.

Input Polarity

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

Pole Zero

This field allows you to set the **Pole Zero** to any value you wish much the same as with the old-fashioned screwdriver potentiometer, but with much greater reproducibility. This gives you the ability to exactly set the pole zero for any detector to the value used previously, ensuring data quality and reproducibility. To see if the pole zero is correctly set, collect a spectrum and observe the peak shape. When the high-energy side is Gaussian and the width is minimized, the pole zero is correct.

Without an oscilloscope connected to the amplifier output to display the pulse shape, the effect of the pole zero operation is not always easy to see. The most common effect of an incorrect pole-zero setting is tailing on the peak shape in the spectrum. Here, tailing refers to abnormally high counts on either side of the peak. If the amplifier was close to the proper pole zero setting before the operation, the spectrum peak shape may not change enough to be seen.

Pileup Rejection

Pileup Rejection (PUR) is used to reject overlapping pulses, improving the peak shape. This checkbox allows you to disable the PUR. This feature is normally enabled and is only turned off for special detectors.

3.2.21.2. Amplifier 2

The Amplifier 2 tab (Fig. 154) contains the **Signal Routing** and **Analog Threshold** controls.

The **Signal Routing** droplist allows you to route the detector input signal directly to the ADC as positive (**Direct [0 to +3V]**), negative (**Direct [0 to −3V]**), or **Through Amplifier**.

The **Analog Threshold** can be 2–60% of full scale. Pulses below the threshold do not contribute to ADC dead time.

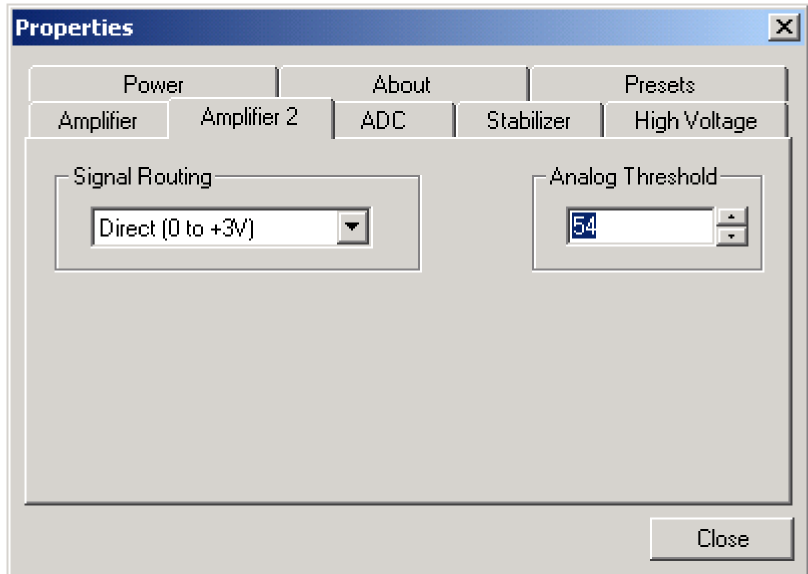

Figure 154. MiniMCA-166: The Amplifier 2 Tab.

3.2.21.3. ADC

This tab (Fig. 155)contains the **Conversion Gain**, **Lower Level Disc**riminator, and **Upper Level Disc**riminator controls. In addition, the current real time, live time, and count rate are monitored at the bottom of the dialog.

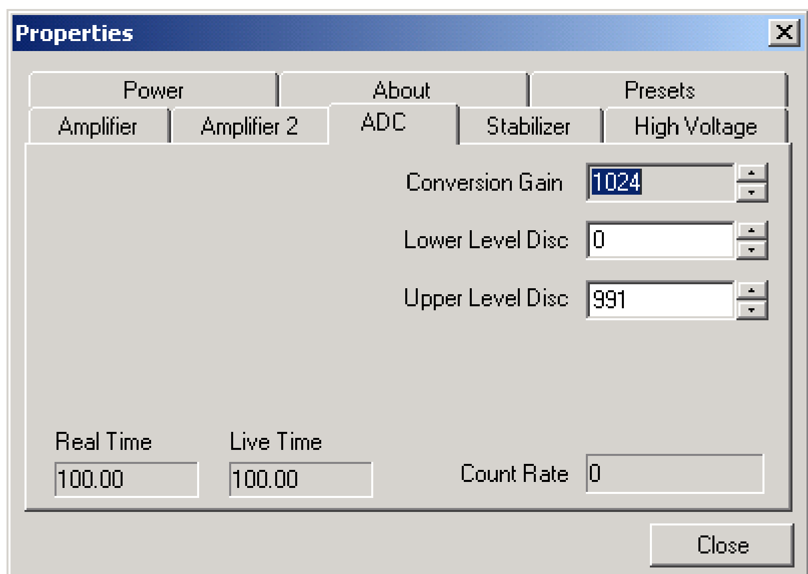

Figure 155. MiniMCA-166: The ADC Tab.

Conversion Gain

The **Conversion Gain** sets the maximum channel number in the spectrum. If set to 4096, the energy scale will be divided into 4096 channels. The conversion gain is entered in powers of 2 (e.g., 4096, 2048, 1024, ...). The up/down arrow buttons step through the valid settings.

Upper- and Lower-Level Discriminators

In the MiniMCA-166 the lower- and upper-level discriminators are under computer control.

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

The **Upper Level Disc**riminator sets the level of the highest amplitude pulse that will be stored. This level establishes an upper-level cutoff, by channel number, for ADC conversions.

3.2.21.4. Stabilizer

The Stabilizer tab (Fig. 156) allows you to control the MiniMCA-166 gain stabilizer. Gain stabilization is discussed in detail in Section 3.4.

The value in the **Adjustment** section shows how much adjustment is currently applied. The **Initialize** button sets the adjustment to 0. If the value approaches 90% or above, the amplifier gain should be adjusted so the stabilizer can continue to function — when the adjustment value reaches 100%, the stabilizer cannot make further corrections in that direction. The **Center Chan**nel and **Width** fields show the peak currently used for stabilization.

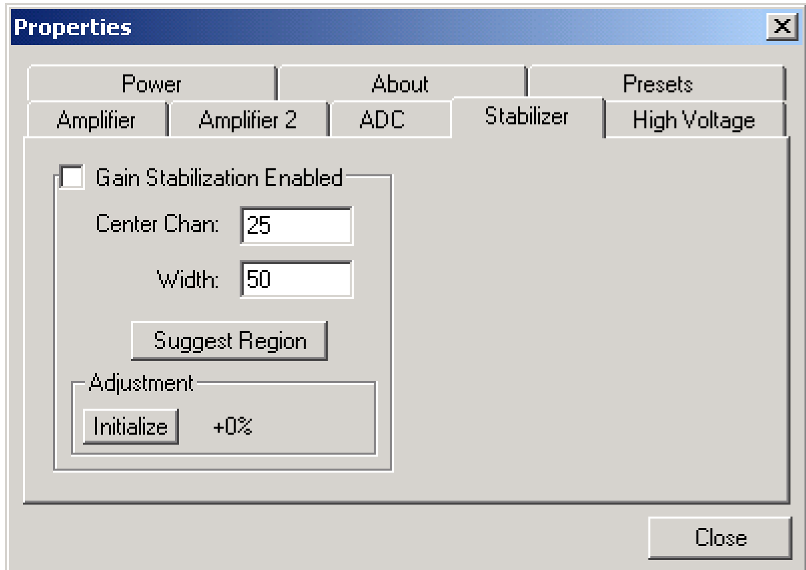

Figure 156. MiniMCA-166: The Stabilizer Tab.

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

3.2.21.5. High Voltage

Figure 157 shows the High Voltage tab, which allows you to turn the high voltage on or off; set and monitor the voltage, monitor the leakage **Current**, show the **Polarity**, and select the **Shutdown** mode.

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

The **Polarity** selection is an indicator. To change polarity, see the hardware manual.

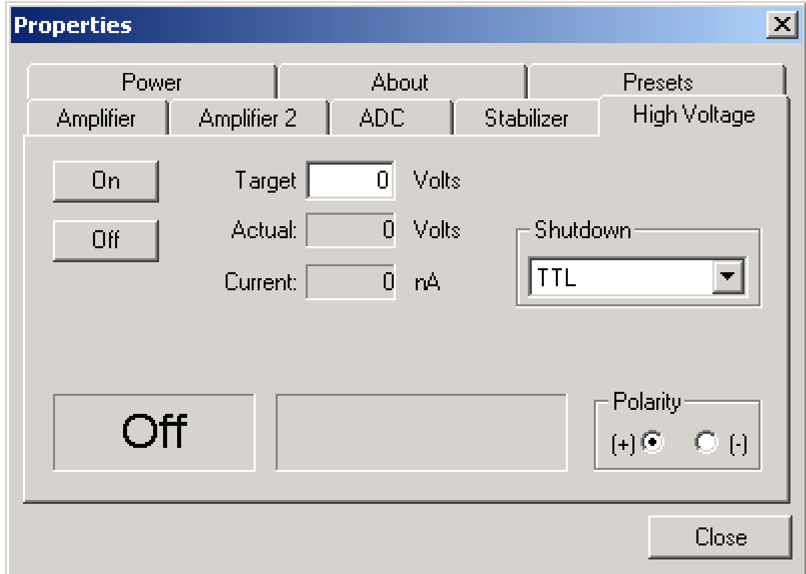

Figure 157. MiniMCA-166: The High Voltage Tab.

3.2.21.6. Power

The Power tab (Fig. 158) displays the MiniMCA-166's current battery voltage.

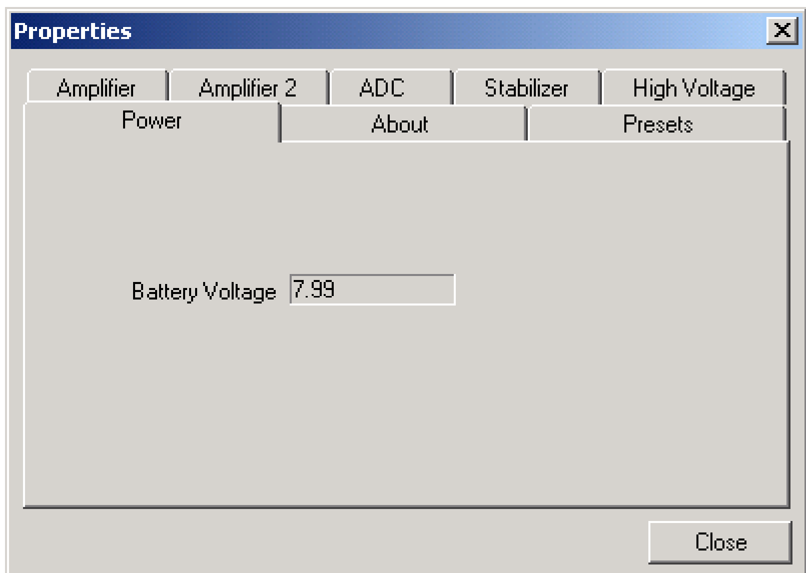

Figure 158. MiniMCA-166: The Power Tab.

3.2.21.7. About

This tab (Fig. 159) displays hardware and firmware information about the currently selected MiniMCA-166, as well as the data **Acquisition Start Time** and **Sample** description. In addition, the **Access** field shows whether the MCB is currently locked with a password; **Read/Write** indicates that the MCB is unlocked; **Read Only** means it is locked.

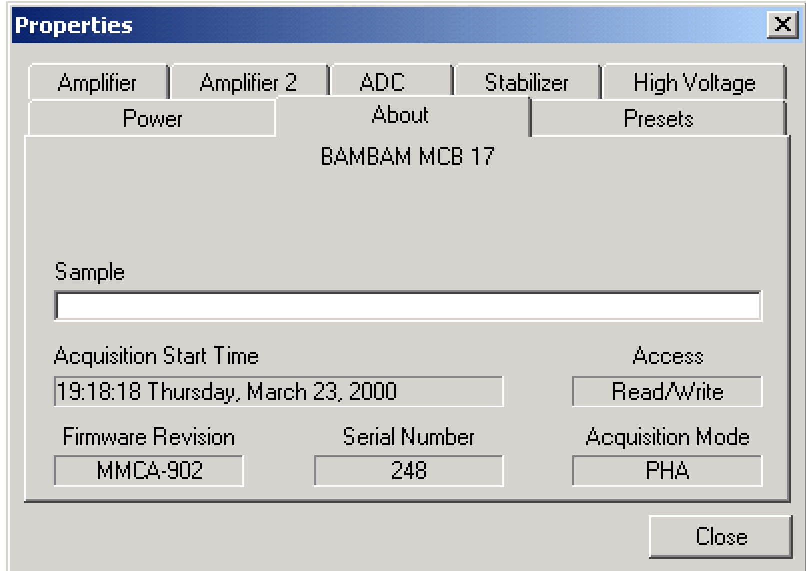

Figure 159. MiniMCA-166: The About Tab.

3.2.21.8. Presets

Figure 160 shows the Presets tab. The presets can only be set on an MCB that is *not* acquiring data. You can use any or all of the presets at one time. To disable a preset, enter a value of zero. If you disable all of the presets, data acquisition will continue until manually stopped.

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

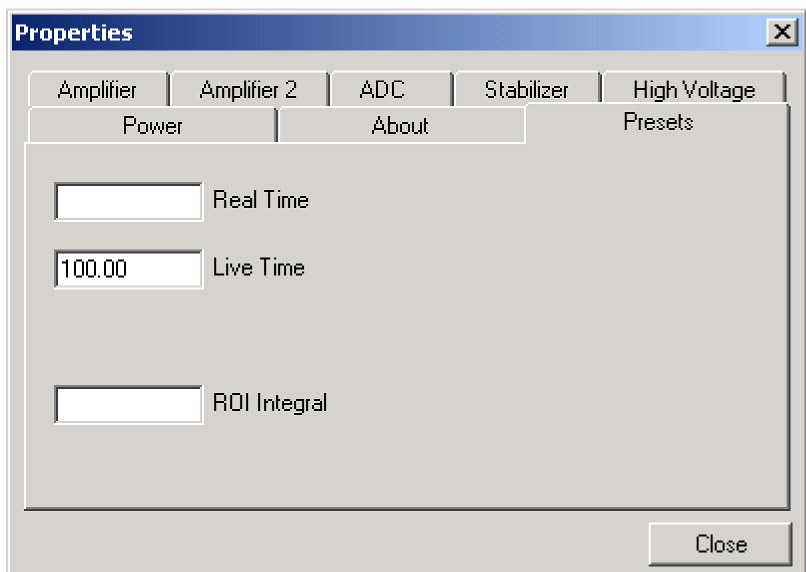

Figure 160. MiniMCA-166: The Presets Tab.

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

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

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

3.3. Using the InSight Virtual Oscilloscope

To assist in setting up ORTEC digital MCBs, advanced users can return to the Amplifier 2 tab under **Acquire/MCB Properties...**, go to the **InSight** section, and click on the **Start** button to adjust the shaping parameters interactively with a "live" waveform showing the actual pulse shape, or just to verify that the settings are correct. The InSight display (Fig. 161) shows the actual sampled waveform in the digital processing units on a reference graticule. The Properties dialog remains active and can be used to change settings as you view the pulses. Because none of the traditional analog signals are available in digital spectrometers such as the DSPEC jr, digiDART, DSPEC Plus, and DSPEC, this mode is the only way to display the equivalent amplifier output pulse. Note that at the bottom of the window the marker channel is displayed in units of time.

To exit the InSight mode and return to the PHA display, press **<Esc>** or go to the **InSight** section on the Amplifier 2 tab and click on **Stop**. The PHA mode is set to STOP when you enter the InSight mode.

3.3.1. The Status Sidebar in the InSight Mode

The Status Sidebar changes from the PHA mode controls to the InSight controls for adjusting the peak display. On the left is a vertical scrollbar for adjusting the vertical offset of the waveform. The value of the offset is shown on the display. Double-clicking the mouse in the scrollbar will set the vertical offset to the vertical value of the channel at the marker position. This lets you conveniently zoom in on a particular part of the waveform (such as the tail for pole-zeroing).

In the **Auto** trigger mode, the display is updated every time a new pulse exceeds the trigger level. To keep a single pulse displayed, select **Single**. Click on **Reset** to refresh the display to see the next pulse. There will usually be one or two pulses in the "pipeline" that will be displayed before

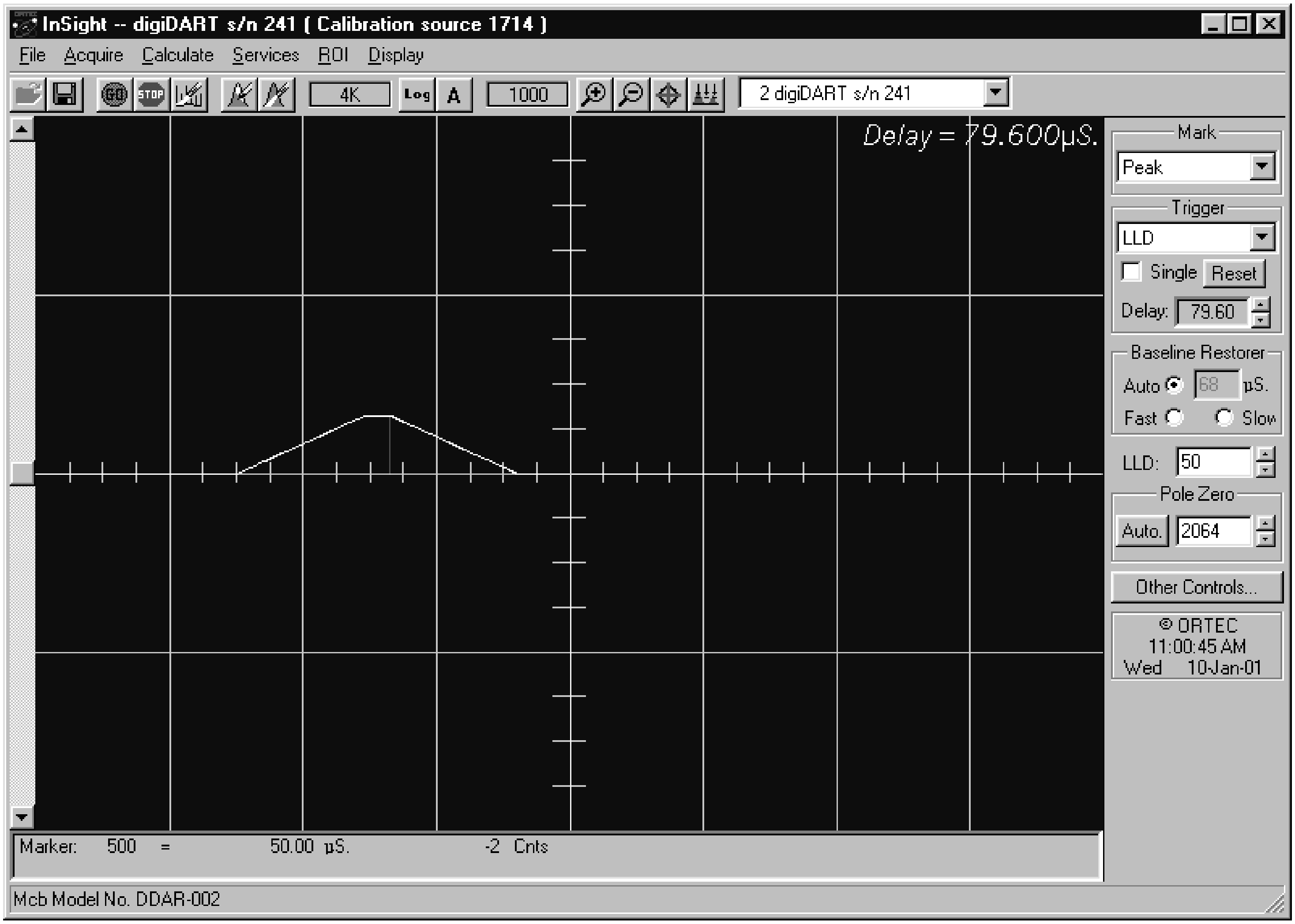

Figure 161. digiDART InSight Mode.

any change entered will be seen. If the trigger is turned off, the display will be redrawn periodically, even if no pulse is there.

The **Delay** setting is the time delay between the pulse shown on the display and the trigger level crossing. The value of the time delay is shown on the display.

3.3.2. The InSight Display

Just as for the PHA mode display, the vertical scale can be adjusted with the vertical adjustments. The display can be set to Log mode, but the peak shapes do not have a familiar shape in this display. The Auto mode will adjust the vertical scale for each pulse. The pulse is shown before the amplifier gain has been applied, so the relation between channel number and pulse height is not fixed.

The horizontal scale extends from 16 to 256 channels. The display is expanded around the marker position which means that in some cases the peak will disappear from the display when it is expanded.

The display can be switched from the MCB to another detector or the buffer. In this case the other detector will be shown in the mode selected for it. The buffer will always be shown in PHA mode. The display will return to the InSight mode when you return to the first MCB. If you exit the program with the MCB in InSight mode, it will be in InSight mode on the next startup.

The display can include a **Mark** to indicate one of the other signals shown in Fig. 162. The Mark is a solid-color region displayed similarly to that of an ROI in the spectrum. This Mark can be used to set the timing for the gate pulse. It can also be used to set the shaping times and flattop parameters to get the best performance.

Figure 162. Mark Display Selection.

For example, suppose you want to get the best resolution at the highest throughput possible. By viewing the pulses and the pileup reject marker, you can increase or decrease the rise time to obtain a minimum of pileup reject pulses.

Mark Types — For the **Mark,** choose either "points" or "filled" (to the zero line) display. This is controlled by the selection in the **Display/Preferences** menu item. That choice does not affect the PHA mode choice. The colors are the same as for the PHA mode.

- **None** No channels are marked in the display.
- **PileUpReject** The region marked indicates when the PUR circuit has detected pileup and is rejecting the marked pulses.
- **NegBLDisc** This shows when the negative baseline discriminator has been triggered. Typically this signal only marks the TRP reset pulse. The signal is used internally in the live-time correction, baseline restoration, and pile-up rejection circuits.
- **BaseLineR** This shows when the baseline restorer is actively restoring the baseline.
- **PosBLDisc** This shows when the positive baseline discriminator has been triggered. The signal is used internally in the live-time correction, baseline restoration, and pile-up rejection circuits.

- **Busy** When the DSPEC Plus busy signal is active, **Busy** shows in the **Mark** box. It represents the dead time.

- **Gate** This shows when the gate signal is present on the gate input connector. If the **Gate** mode on the ADC tab (see Fig. 50) is set to **Off**, then all regions are marked. If the mode is set to **Coincidence**, then the marked region must overlap the pulse peak (that is, must start before the beginning of the flattop and stop after the end of the flattop) for the pulse to be counted. If the mode is set to **Anticoincidence**, then the marked region will show the pulses that are accepted. That is, the rejected peaks will not be marked. Simply put, in all modes the accepted peaks are marked.

- **Peak** This is the peak detect pulse. It indicates when the peak detect circuit has detected a valid pulse. The Mark occurs about 1.5 µs after the pulse maximum on the display.

3.3.3. Shaping Parameter Controls

On the lower right of the InSight sidebar are the shaping parameter controls. The controls are split into two groups, and the **other controls...** button switches between them.

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

The **Flattop** controls adjust the top of the quasi-trapezoid. The **Width** adjusts the extent of the flattop (for the adjustment range, see the Amplifier 2 tab for this MCB). The **Tilt** adjustment varies the slope of this section slightly. The **Tilt** can be positive or negative. Choosing a positive value results in a flattop that slopes downward; choosing a negative value gives an upward slope. Alternatively, **Optimize** can set the tilt value automatically. This value is normally the best for resolution, but it can be changed on this dialog and in the InSight mode to accommodate particular throughput/resolution tradeoffs. The **Optimize** button also automatically adjusts the pole-zero setting.

3.4. Gain Stabilization

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

$$Channel\ number = Intercept + Gain * pulse\ height \tag{1}$$

where:

Intercept = The channel number of the zero-height input pulse
Gain = The relation between pulse height and channel number (slope of the curve)

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

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

The coarse and fine gains should be set to the desired values, both stabilizers initialized, and the pole zero triggered before setting either stabilization peak. For example, on the 92X this is done in the Amplifier tab; on the Model 919 it is done externally.

The **Initialize** dialog button sets the gain on the stabilization amplifier to its midpoint (that is, halfway between minimum gain and maximum gain). This should be done before selecting the ROI for the peak because the initialization might move the peak in the spectrum, and because it ensures that the maximum range is available for the stabilization process. If the peak is moved by this command, use the amplifier fine-gain control (the Amplifier tab or hot keys) to move the peak to the desired channel.

When starting a new system, the zero-initialize command should also be given before starting the gain stabilization.

The **Suggest** button is used to set the peak center and peak width of the peak area used by the stabilizer. Before selecting this command, the ROI must be marked and the marker put in the region to be used. When operating, the peak will be centered in the ROI. After the region has been recorded, the stabilization is turned on. If the stabilization is turned on when this command is executed, the old stabilization region is replaced by the new peak defined by the marker, and stabilization continues using the new peak.

The **Gain Stabilizer Enabled** checkbox enables or disables the gain stabilization. It can only be turned on after the **Suggest** button has been used to select a working peak.

3.5. Zero Stabilization

Zero stabilization enables you to control the zero-level (or offset) stabilizer on MCBs so equipped. The zero-level stabilizer uses a peak in the spectrum to monitor the changes in the zero level of the system amplifier. The zero stabilizer controls the offset bias level so the peak will be maintained in its original position. The input pulse-height-to-channel-number relationship is as in **Eq. 1**.

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

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

The zero stabilization dialog **Initialize** button sets the zero offset to its midpoint (that is, halfway between minimum offset and maximum offset). This should be done before selecting the ROI for the peak because the initialization might move the peak in the spectrum, and because it ensures that the maximum range is available for the stabilization process.

The **Suggest** button is used to set the peak center and peak width of the peak area used by the stabilizer. Before selecting this command, the ROI must be marked and the marker put in the region to be used. When operating, the peak will be centered in the ROI. After the region has been recorded, the stabilization is turned on. If the stabilization is turned on when this command is executed, the old stabilization region is replaced by the new peak defined by the marker, and stabilization continues using the new peak.

The **Zero Stabilizer Enabled** checkbox enables or disables the zero stabilization. It can only be turned on after the **Suggest** button has been used to select a working peak.

3.6. ZDT Mode

An extended live-time clock increases the collection time (real time) of the acquisition to correct for input pulse train losses incurred during acquisition due to system dead time. This corrected time value, known as the “live time,” is then used to determine the net peak count rates necessary to determine nuclide activities. As an example, consider the case where the spectrometry amplifier and ADC are 25% dead during the acquisition. If a live-time preset of 100 seconds is selected, the spectrometer counts for a total of 133.33 seconds (real time). The extra 33.33 seconds make up for the gamma rays lost due to system-busy time. The total counts in a peak can then be divided by 100 to determine the number of gamma rays per second recorded in the spectrum.

Unfortunately, extending the counting time to make up for losses due to system-busy results in an incorrect result *if the gamma-ray flux is changing as a function of time*. If an isotope with a very short half-life is placed in front of the detector, the spectrometer may start out with a very high dead time, but the isotope will decay during the count and there will be no dead time. If the spectrometer extends the counting time to make up for the lost counts, it will no longer be counting the same source as when the losses occurred. As a result, the number of counts in the peak will not be correct.

When the MCB operates in ZDT[9] mode, it adjusts for the dead-time losses by taking very short acquisitions and applying a correction in ***real time*** — that is, as the data are coming in — to the number of counts in the spectrum. This technique allows the gamma-ray flux to change while the acquisition is in progress, yet the total counts recorded in each of the peaks are correct. The resulting spectrum has no dead time at all — in ZDT mode, the *data* are corrected, not the acquisition time. Thus, the net counts in a peak are divided by the real time to determine the count rate.

ZDT mode has a unique feature in that it can store both the corrected spectrum and the uncorrected spectrum, or the corrected spectrum and the uncertainty spectrum.

The uncorrected spectrum (also called the live-time-corrected [LTC] spectrum) can be used to determine exactly how many pulses at any energy were processed by the spectrometer. The corrected spectrum gives the best estimate of the total counts that would have been in the peak if the system were free of dead-time effects. The uncertainty spectrum can be used to calculate the counting uncertainty, channel by channel, in the corrected spectrum.

NOTE When the spectrometer is placed in ZDT mode, the throughput of the instrument is reduced somewhat as extra processing must be done on the spectrum; therefore, if the gamma-ray flux is not changing as a function of time, but absolute highest throughput is desirable, you may wish to store only the LTC spectrum in the DSPEC Plus memory.

When ZDT counting is enabled (in mode 0; **ZDT Mode** field set to **NORM_CORR** on the ADC tab), the two spectra stored are the LTC spectrum (live time and real time with dead-time losses)

[9]Patent number 6,327,549.

and the spectrum corrected for the dead-time losses (real time only). Unfortunately, in the analysis of the ZDT spectrum, the uncertainty of the measurement cannot be determined using either spectrum.

In the second ZDT mode (**ZDT Mode** field set to **CORR_ERR** on the ADC tab), the estimation of the statistical uncertainty is stored in place of the LTC spectrum, and is referred to as the *error spectrum* (ERR). In this mode, the corrected spectrum is used to measure the counts in a peak, and the error spectrum is used to determine the uncertainty of the measurement made in the corrected spectrum. Table 3 shows which spectra are collected in the three possible DSPEC Plus modes.

For example, if the area of a peak is measured in the corrected spectrum by summing channels 1000 to 1100, the variance of the measurement can be determined by summing the counts in channels 1000 to 1100 in the error spectrum. Or, shown another way, the counts in channel *i* can be expressed as $N(i) \pm \sqrt{V(i)}$ with a 1-sigma confidence limit, where *N* is the corrected spectral data and *V* is the variance (error) spectral data.

Table 3. DSPEC Plus ZDT Modes.

Mode	Uncorrected Spectrum	ZDT Corrected Spectrum	ZDT Error Spectrum
ZDT Disabled	Yes	No	No
ZDT–LTC Mode	Yes	Yes	No
ZDT–ERR Mode	No	Yes	Yes

3.7. The MAESTRO Peak Info Calculation

A number of ORTEC MCBs support an uncertainty preset, which requires that you select a peak. This peak can be defined by (1) entering the start channel and peak width for the peak of interest; or (2) marking the peak of interest as an ROI, position the marker in the ROI, and click on the **Suggest Region** button. If the marker is not positioned in an ROI, the start channel is 1.5 times the FWHM below the marker channel and the width is 3 times the FWHM. The net peak area and statistical uncertainty are calculated in the same manner as for the MAESTRO **Peak Info** command, as described below.

The background on the low channel side of the peak is the average of the first three channels of the ROI (see Fig. 163).

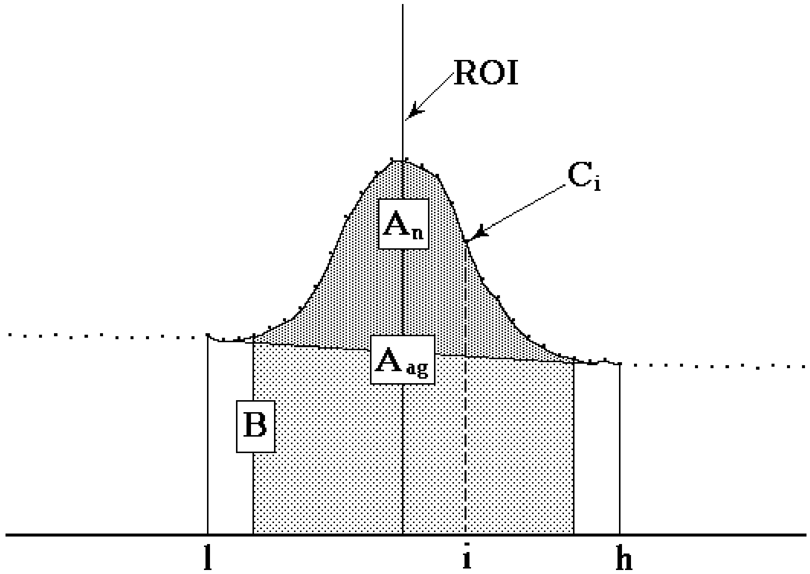

Figure 163. Background Calculation Details.

The channel number for this background point is the middle channel of the three points. The background on the high channel side of the peak is the average of the last three channels of the ROI. The channel number for this background point is also the middle channel of the three points. These two points on each side of the peak form the end points of the straight-line background.

The background is given by the following:

$$B = \left(\sum_{i=l}^{l+2} C_i + \sum_{i=h-2}^{h} C_i \right) \frac{h - l + 1}{6} \qquad \textbf{(2)}$$

where:

B	=	the background area
l	=	the ROI low limit
h	=	the ROI high limit
C_i	=	the contents of channel i
6	=	the number of data channels used (three on each end)

The gross area is the sum of all the channels marked by the ROI according to the following:

$$A_g = \sum_{i=l}^{h} C_i \qquad \textbf{(3)}$$

where:

A_g = the gross counts in the ROI
l = the ROI low limit
h = the ROI high limit
C_i = the contents of channel i

The adjusted gross area is the sum of all the channels marked by the ROI but not used in the background according to the following:

$$A_{ag} = \sum_{i=l+3}^{h-3} C_i \tag{4}$$

where:

A_{ag} = the adjusted gross counts in the ROI
l = the ROI low limit
h = the ROI high limit
C_i = the contents of channel i

The net area is the adjusted gross area minus the adjusted calculated background, as follows:

$$A_n = A_{ag} - \frac{B\,(h-l-5)}{(h-l+1)} \tag{5}$$

The uncertainty in the net area is the square root of the sum of the squares of the uncertainty in the adjusted gross area and the weighted error of the adjusted background. The background uncertainty is weighted by the ratio of the adjusted peak width to the number of channels used to calculate the adjusted background. Therefore, net peak-area uncertainty is given by:

$$\sigma_{An} = \sqrt{A_{ag} + B\left(\frac{h-l-5}{6}\right)\left(\frac{h-l-5}{h-l+1}\right)} \tag{6}$$

where:

A_{ag} = the adjusted gross area
A_n = the net area
B = the background area
l = the ROI low limit
h = the ROI high limit

3.8. Setting the Rise Time in Digital MCBs

To achieve the best results for your application, when using a digital spectrometer, such as the DSPEC jr, digiDART, DSPEC Plus, or DSPEC, we recommend that you set the rise time of the pulses being processed by the digital filter.

The pulse rise time (and also fall time) is based on the time required for each pulse to reach its peak value. This "peaking time" is about twice that indicated by the conventional time constants displayed on the front panel of commercial analog amplifiers. For example, germanium detectors are often specified at a 6-µs time constant; this setting is equivalent to 12-µs peaking (rise) time in our digital spectrometers.

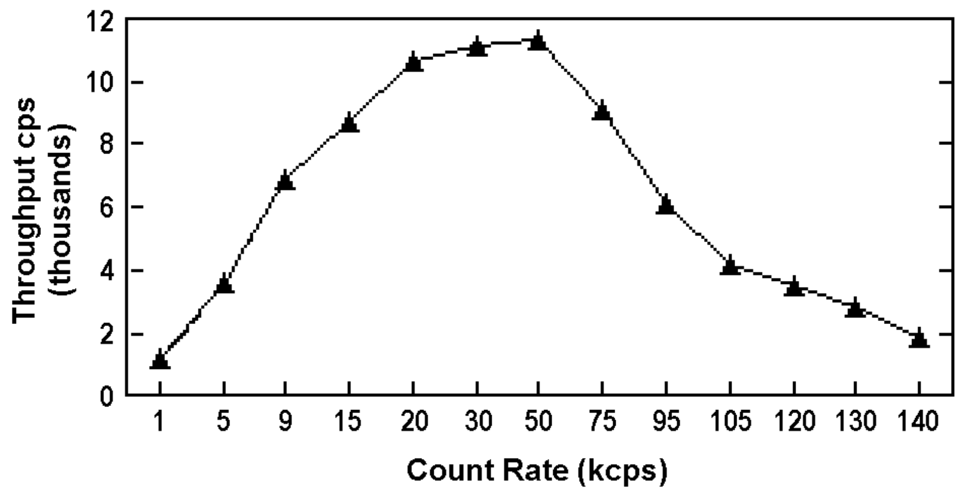

Figure 164. An Example of the Tradeoff Between Throughput and Count Rate.

Up to some value of rise time, one can expect improved resolution with increasing rise time; there will, however, be a tradeoff in maximum throughput to memory. Figure 164 illustrates an example of this tradeoff. ORTEC digital spectrometers operate well above the peak of the throughput curve. Operating there allows these instruments to handle an even higher rate of incoming counts, but with less data into memory and, therefore, longer counting time to the same detection limit. It is possible to move the peak of the curve to the right (more counts to memory with higher input count rate) by reducing the pulse rise (and fall) time, thereby trading off resolution for maximum count rate.

Table 1 is a guide to choosing a count rate that will ensure that the most efficient operation of your digital spectrometer over the range of anticipated input count rates for your application — that is, at or below the throughput peak — while achieving the best resolution obtainable from the detector consistent with that requirement. Enter the rise time that best matches your dynamic range of count rate (note that the available rise-time settings will vary by instrument; this chart is a general guide only).

Table 4. Rise Time Selection Guide.

Input Count Rate Dynamic Range	Maximum Throughput	Rise Time (µs)
0--->20000	9000	12
0--->50000	12500	8
0--->75000	23500	4
0--->100000	37000	2.4
0--->150000	50000	1.6
0--->200k	70000	0.8
0--->220k	85000	0.6
0--->250k	100000	0.4
0--->300k	120000	0.2

The longest rise time shown in the table is 12 µs, even though some digital instruments can be set for rise times as long as 23 µs. If throughput is not an issue because all samples are low rate, increasing the rise time beyond 12 µs might achieve a small improvement in resolution. For planar detectors, such as ORTEC's GLP, Si(Li), IGLET, and IGLET-X Series, operating at longer rise times frequently gives improved resolution.

APPENDIX A. ADDITIONAL CONFIGURATION INFORMATION

A.1. Operating *CONNECTIONS* Software on a Network

MAESTRO and other ***CONNECTIONS*** software operates the same for local MCBs (those connected directly to the PC running MAESTRO), for remote MCBs connected by Ethernet (those connected to PCs other than the one running MAESTRO), and for MCBs connected using the PC parallel port, as illustrated in Fig. 165.

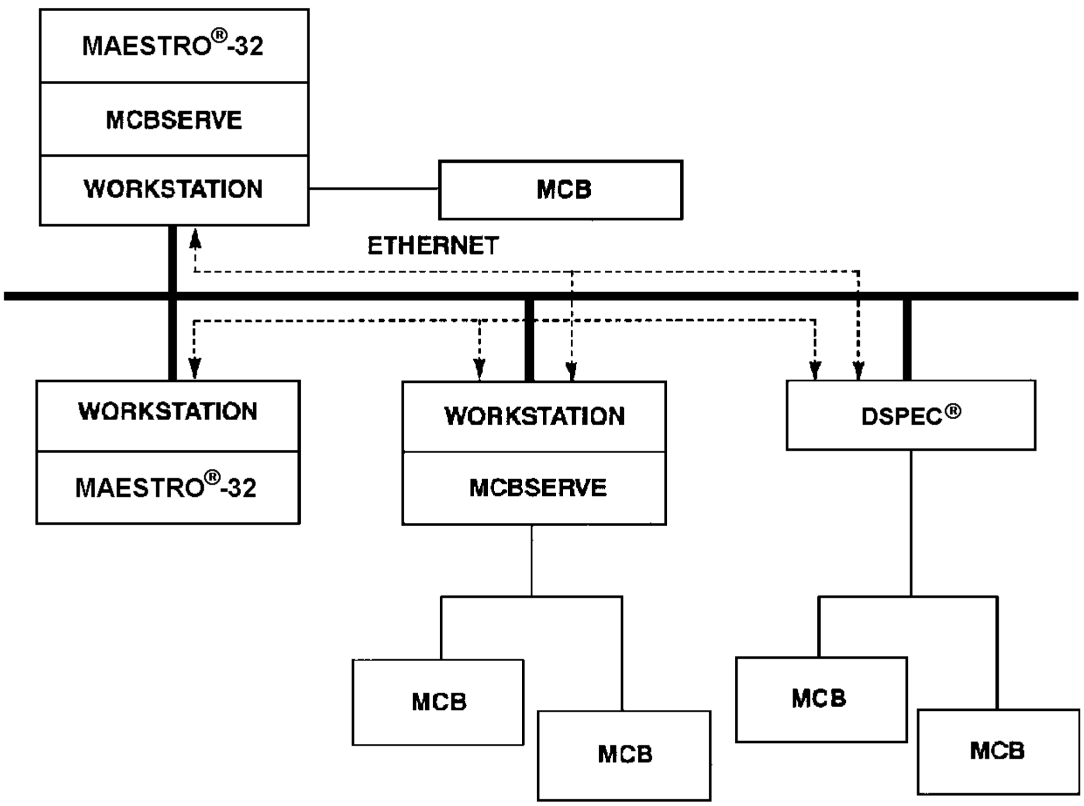

Figure 165. Example Network Setup.

Each time ***CONNECTIONS*** software is installed on a PC in the network, and the network is connected and operational, the MCB Configuration program will find all the MCBs attached to PCs on which the MCB Server program is running. It will then build a Master Instrument List, update the local PC's MCB pick list so that is identical to the Master Instrument List, and, optionally, broadcast the new Master Instrument List to all PCs that are connected to the network and currently running MCB Server.

At this point, your ***CONNECTIONS*** program is ready to use. The MCB pick list for each ***CONNECTIONS*** program on each PC in the system can be tailored to a specific list of MCBs.

A.2. Port 292 or Page D Conflict

In some PCs and laptops, output port 292Hex is used for a system-reset signal. In some PCs, memory page D is not available. These two conditions conflict with the use of a dual-port memory card. Therefore, the ORTEC dual-port memory card cannot be used in PCs that use port 292 or page D. *This does not affect PCI cards.*

One symptom of this conflict is that the PC reboots each time any of the MCB programs, including the installation program, are executed. Another symptom is system failure each time an MCB program is executed.

To use this type of PC with a ***CONNECTIONS*** instrument, the PRN port interface, serial, add-in, PCI, or network units must be used. This is selected during ***CONNECTIONS*** application installation. To check the settings, look in the file **MCBLOC32.INI**.

For PRN instruments:

```
\WINDOWS\MCBLOC32.INI

[CONFIG]
PRINTERMCBS=1
DPMMCBS=0
COMMCBS=0
PCIMCBS=0
```

For serial instruments:

```
\WINDOWS\MCBLOC32.INI

[CONFIG]
PRINTERMCBS=1
DPMMCBS=0
COMMCBS=0
PCIMCBS=0
ComLib=C:\Program Files\Common Files\ORTEC Shared\UMCBI\McbM3CA.Dll
```

For network-only MCBs:

```
\WINDOWS\MCBLOC32.INI

[CONFIG]
PRINTERMCBS=0
DPMMCBS=0
COMMCBS=0
PCIMCBS=0
```

NOTE A 0 (zero) means do not use, and a 1 means use.

NOTE Windows NT users should substitute **`\WINNT\`** for **`\WINDOWS\`**.

Any combination of the connection methods can be used.

NOTE ***Do not change*** other values in **`MCBLOC32.INI`**.

A.3. MCBLOC32.INI

The **`MCBLOC32.INI`** file controls which types of local interfaces to be used for communication with the MCBs listed in the file. Only the local MCBs are affected by these settings. The installation process sets these according to the choices you make in the install wizard. MCBs with built-in Ethernet adapters, such as the DSPEC and ORSIM III, are always used if there is a network interface and Windows 95/98 or Windows NT.

The list of interfaces is contained in the **`[CONFIG]`** section of **`MCBLOC32.INI`**. Interfaces can be manually enabled or disabled by modifying **`MCBLOC32.INI`** in an ASCII text editing program such as Windows Notepad. *Make sure that no programs that use **CONNECTIONS**/UMCBI functions, including MCBSER32, are running when you change this file.* The changes will be implemented the next time you start a ***CONNECTIONS*** program.

`MCBLOC32.INI` also includes information on the local MCBs. This information must not be changed. Part of a file is shown in Fig. 166. The **`[CONFIG]`** section can be anywhere in the file. If there is no **`[CONFIG]`** section, create one by entering **`[CONFIG]`** as shown. The local interface parameters shown in Fig. 166 *must be in the* **`[CONFIG]`** *section.*

```
[CONFIG]
PRINTERMCBS=0
DPMMCBS=1
COMMCBS=0
PCIMCBS=0

[M1S01]
(Description of MCB
hardware)
```

Figure 166. MCBLOC32.INI.

`PRINTERMCBS= <0|1>`

If **`PRINTERMCBS`** is set to 0, the printer port will not be used for communication with the MCBs. If no printer port

MCBs are used, it should be set to 0 to avoid sending unwanted characters to the printer when MAESTRO is started. It must be set to 1 to use the MicroNOMAD or DART.

The default is 0, to include printer port interfaces.

DPMMCBS= <0|1>

If **DPMMCBS** is set to 0, the dual port memory interface will not be used for communication with the MCBs. If dual port memory interface MCBs are used, it must be set to 1 for MAESTRO to communicate with them.

The default is 1, to include dual port memory interfaces.

COMMCBS= <0|1>

If **COMMCBS** is set to 0, the serial port will not be used for communication with the MCBs. If serial-port MCBs such as the M^3CA or MiniMCA-166 are used, it must be set to 1 for MAESTRO to communicate with them. In addition, the location and name of the serial port driver is included in the file. The **COMLIB=[driver path]** statement defines which serial port driver is used. This is specified during installation.

The default is 0, to exclude serial-port interfaces.

PCIMCBS= <0|1>

If **PCIMCBS** is set to 0, the PCI interface will not be used for communication with the MCBs. If PCI-interface MCBs are used, this parameter must be set to 1 for MAESTRO to communicate with them.

The default is 1, to include PCI interfaces.

If all are set to 0, only network MCBs will be used.

It may be necessary to remove and reinstall MAESTRO if these values are changed because only the drivers requested during installation are loaded.