GPIB

GPIB Analyzer User Manual

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About This Manual

This manual contains instructions to help you use the GPIB analyzer software. The GPIB analyzer software is meant to be used with Windows 95, Windows 98, or Windows NT, and with one of the National Instruments GPIB interfaces that supports the GPIB analyzer. This manual assumes that you are already familiar with the Windows system you are using.

Organization of This Manual

The *GPIB Analyzer User Manual* is organized as follows:

- Chapter 1, *GPIB Analyzer Overview*, gives an overview of the GPIB analyzer software.

- Chapter 2, *GPIB Analyzer Features*, describes the features of the GPIB analyzer application.

- Chapter 3, *How To...*, describes how to accomplish specific tasks within the GPIB analyzer application.

- Chapter 4, *Tutorial*, contains a hands-on tutorial to help you practice using the different features of the GPIB analyzer.

- Chapter 5, *Examples*, contains several examples that illustrate how to use the GPIB analyzer application to solve your IEEE 488 problems.

- Appendix A, *Common Questions*, answers common questions about the GPIB analyzer.

- Appendix B, *Capture Display Mnemonics*, explains the mnemonics that appear in the capture display of the GPIB analyzer.

- Appendix C, *Customer Communication*, contains forms you can use to request help from National Instruments or to comment on our products and manuals.

- The *Glossary* contains an alphabetical list and description of terms used in this manual, including abbreviations, acronyms, metric prefixes, mnemonics, and symbols.

Conventions Used in This Manual

This manual uses the following conventions:

<>   Angle brackets enclose the name of a key on the keyboard—for example, <shift>. Angle brackets containing numbers separated by an ellipsis represent a range of values associated with a bit or signal name—for example, DBIO<3…0>.

»   The » symbol leads you through nested menu items and dialog box options to a final action. The sequence **File»Page Setup»Options»Substitute Fonts** directs you to open the **File** menu, select the **Page Setup** item, select **Options**, and finally select the **Substitute Fonts** option from the last dialog box.

bold   Bold text denotes the names of menus, menu items, parameters, dialog boxes, dialog box buttons or options, icons, windows, or LEDs.

italic   Italic text denotes variables, emphasis, a cross reference, or an introduction to a key concept. This font also denotes text from which you supply the appropriate word or value, as in Windows 3.*x*.

monospace   Text in this font denotes text or characters that you should literally enter from the keyboard, sections of code, programming examples, and syntax examples. This font is also used for the proper names of disk drives, paths, directories, programs, subprograms, subroutines, device names, functions, operations, variables, filenames and extensions, and for statements and comments taken from programs.

monospace bold   Bold text in this font denotes the messages and responses that the computer automatically prints to the screen. This font also emphasizes lines of code that are different from the other examples.

Related Documents

The following documents contain information that you may find helpful as you read this manual:

- ANSI/IEEE Standard 488.1-1987, *IEEE Standard Digital Interface for Programmable Instrumentation*
- ANSI/IEEE Standard 488.2-1992, *IEEE Standard Codes, Formats, Protocols, and Common Commands*
- *Microsoft Windows 95/98 User's Guide,* Microsoft Corporation
- *Microsoft Windows NT User's Guide,* Microsoft Corporation

Customer Communication

National Instruments wants to receive your comments on our products and manuals. We are interested in the applications you develop with our products, and we want to help if you have problems with them. To make it easy for you to contact us, this manual contains comment and configuration forms for you to complete. These forms are in Appendix C, *Customer Communication*, at the end of this manual.

1

GPIB Analyzer Overview

This chapter gives an overview of the GPIB analyzer software.

You can use the GPIB analyzer application for testing, debugging, and analysis. It can monitor, capture, and participate in bus activity on the GPIB. You can use the GPIB analyzer to test and debug your own applications by monitoring and capturing GPIB activity while your application is running. The analyzer also has tools to help you analyze the data that you capture. Analyzing this data can help you solve many of the difficulties associated with GPIB communication, such as addressing inconsistencies, protocol violations, and simple bus timeout conditions.

The GPIB analyzer software works under Windows 95/98 only when an AT-GPIB/TNT+ or PCMCIA-GPIB+ is installed. It works under Windows NT only when an AT-GPIB/TNT+ or PCI-GPIB+ is installed.

Online Help

The GPIB analyzer application includes an online help system, which you can access while running the analyzer by pressing <F1> or using the **Help** menu. The online help contains basically the same information as this user manual.

Features of the GPIB Analyzer

The GPIB analyzer, created with the National Instruments LabWindows/CVI development environment, has several major features.

- Settings configuration—Allows configuration of capture and trigger settings.

- Action window—Starts and stops capturing and/or triggering.

- Bus Monitor window—Displays and allows you to modify the state of each of the GPIB data and control lines.

- Capture Display window—Displays captured GPIB events.

- Search capability—Allows searches within a capture display.

Capturing Data with the GPIB Analyzer

The analyzer can capture and display data, including any combination of the following GPIB events: data transfers, command transfers, control line transitions, handshake line transitions, and parallel poll responses. You can participate in handshaking or do a non-intrusive capture.

You might want to capture and display data based on a specific bus event without knowing when the event might occur. In this case, you can specify a trigger condition and capture any number of events before and after the trigger condition occurs. The capture operation proceeds according to the settings configuration.

The analyzer can perform the acceptor handshake while capturing, and it can time stamp captured events. The number of recorded capture events can be configured and is limited only by the memory available on your computer.

Analyzing Captured Data with the GPIB Analyzer

The GPIB analyzer provides several features to help you analyze data that you have captured:

- Use markers for highlighting and examining specific transactions in the captured data and for determining elapsed time between captured events.
- Use the flexible pattern-search utility to locate specific bus patterns.
- Store captured data to disk for later review in the capture display.
- Print captured data to a selected printer.

You can reload previously saved capture events for later review and analysis. You can even have multiple capture displays open so that you can analyze current bus activity in one display and the previously captured data in another display.

Installing the GPIB Analyzer

For detailed instructions on how to install the GPIB analyzer software, refer to the getting started manual that came with your GPIB hardware.

Starting the GPIB Analyzer

Launch the GPIB analyzer application by selecting the **GPIB Analyzer** item under **Start»Programs»National Instruments GPIB Analyzer**.

Exiting the GPIB Analyzer

Choose **File»Exit** to close the GPIB analyzer application. The analyzer prompts you to save any capture display that contains unsaved GPIB events. The current settings for capturing and triggering are saved automatically, and they are automatically loaded the next time you start the GPIB analyzer application.

2

GPIB Analyzer Features

This chapter describes the features of the GPIB analyzer application.

The features are as follows:

- Settings configuration—Allows configuration of capture and trigger settings.
- Action window—Starts and stops capturing and/or triggering.
- Bus Monitor window—Displays and allows you to modify the state of each of the GPIB data and control lines.
- Capture Display window—Displays captured GPIB events.
- Search capability—Allows searches within a capture display.

Figure 2-1 shows the main GPIB analyzer window. The **Action** and **Bus Monitor** windows are always open.
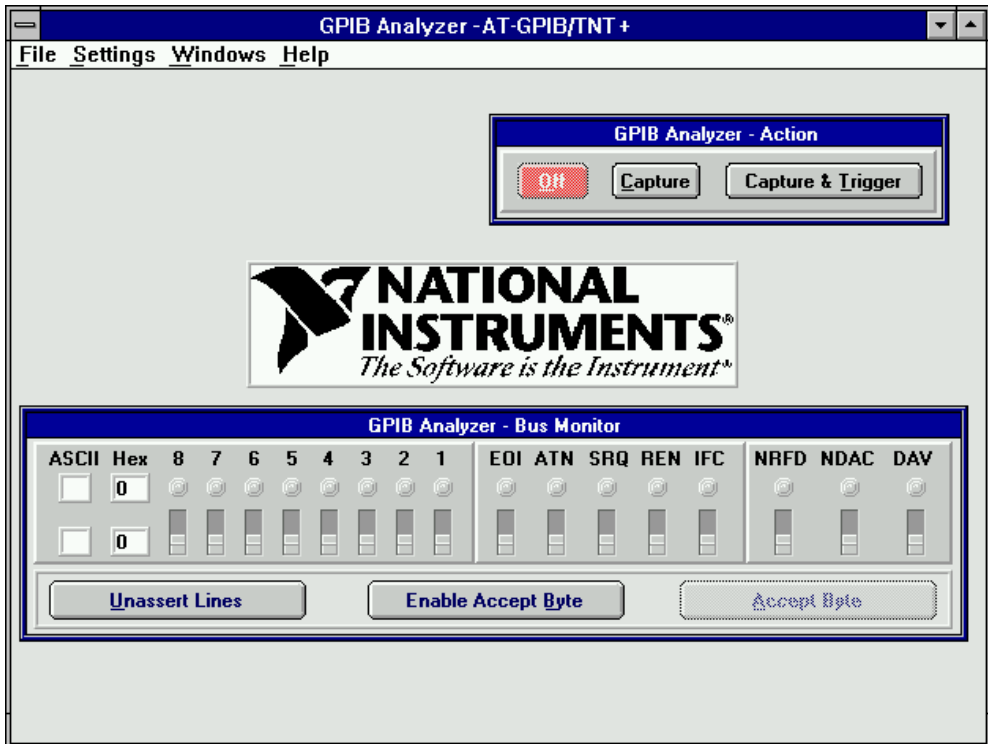
Figure 2-1. Main Window of the GPIB Analyzer

Main GPIB Analyzer Window

The GPIB analyzer opens with the main window, which includes the **Action** and **Bus Monitor** windows. The following sections describe the menu choices from the main window of the GPIB analyzer.

File»New Capture Display

Choosing **New Capture Display** from the **File** menu opens a new, active capture display. When you start capturing GPIB events by selecting one of the capture buttons in the **Action** window, you can view them in the active capture display.

File»Open Capture File…

Choosing **Open Capture Display** from the **File** menu in the main window opens a previously saved window of captured GPIB events as an inactive

display. Filenames for GPIB analyzer capture files typically use the .CAP extension.

File»Exit

Choosing **Exit** from the **File** menu in the main window closes the GPIB analyzer application. The analyzer prompts you to save any capture display that contains unsaved GPIB events. The current settings for capturing and triggering are saved automatically, and they are automatically loaded the next time you start the GPIB analyzer.

Settings»Change Settings…

Choosing **Change Settings** from the **Settings** menu in the main window opens the **Settings** configuration dialog box so that you can change the settings used for capturing GPIB events and triggering on specific GPIB events. See the *Settings Configuration* section, later in this chapter, for more information.

Settings»Load Settings…

Choosing **Load Settings** from the **Settings** menu in the main window opens a file of previously saved settings to be used for capturing GPIB events and triggering on specific GPIB events. Filenames for GPIB analyzer settings typically use the .SET extension.

Settings»Save Settings As…

Choosing **Save Settings As** from the **Settings** menu in the main window allows you to save the current settings used for capturing GPIB events and triggering. Whenever possible, use the .SET extension for GPIB analyzer settings filenames.

Windows Menu

The **Windows** menu in the main window lists all of the currently open GPIB analyzer windows. When you select a window from this menu, it moves to the front.

Help Menu

The **Help** menu in the main window accesses the online help for the GPIB analyzer. It also accesses information about the analyzer software, such as version number and hardware configuration.

Settings Configuration

To configure capture and trigger settings, select **Change Settings** from the **Settings** menu in the main window. Figure 2-2 shows the **Settings** configuration dialog box
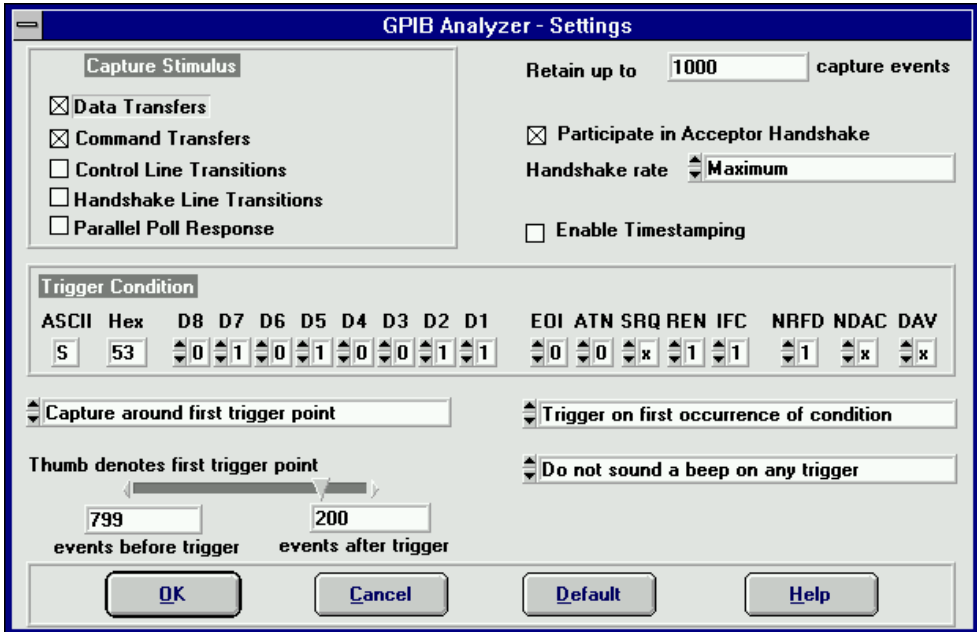
Figure 2-2. Settings Configuration Dialog Box

The configured settings apply only to active capture displays. Notice that the settings in this window cannot be changed unless capturing and triggering are turned off (use the **Action** window to turn off capturing and triggering).

The **Retain up to _____ capture events** edit control specifies the number of captured GPIB events that can be kept in the internal capture memory buffer. When the buffer becomes full, the oldest GPIB events are discarded to make space for new GPIB events.

The **Participate in Acceptor Handshake** checkbox selects whether the GPIB analyzer participates in acceptor handshake on the GPIB. If it is checked, the analyzer hardware participates in the GPIB handshake at the handshake rate selected from the **Handshake rate** list box. You can use this

feature to slow down GPIB transfers to a particular rate or to avoid overflow errors.

The **Handshake rate** list box selects the rate at which the GPIB analyzer accepts data and command bytes. It is disabled unless **Participate in Acceptor Handshake** is checked. The **Maximum** option allows the analyzer to accept bytes at the fastest rate possible without causing overflow errors. The other options slow down all GPIB transfers to a rate no greater than that specified.

The **Enable Timestamping** checkbox enables or disables timestamping of captured GPIB events by the GPIB analyzer. Timestamp resolution is at 50 ns intervals. When checked, timestamping is enabled and the GPIB analyzer records the time that has elapsed between each GPIB event captured.

Capture Stimulus Configuration

The **Capture Stimulus** group box in the **Settings** dialog box lets you choose the various types of GPIB events to capture.

The **Data Transfers** checkbox enables the capture of GPIB data bytes. Both IEEE 488 and HS488 data bytes are captured.

The **Command Transfers** checkbox enables the capture of GPIB command bytes.

The **Control Line Transitions** checkbox enables the capture of EOI, ATN, SRQ, REN, and IFC GPIB control line transitions. These lines are used to manage the GPIB interface system.

The **Handshake Line Transitions** checkbox enables the capture of GPIB handshake line transitions (NRFD, NDAC, DAV). The handshake lines are used to control the transfer of both GPIB data and command bytes. Selecting this option causes a large amount of GPIB events to be captured and may cause overflow errors; therefore, you should select it only when you need to debug a problem with the handshaking of a particular GPIB device. Notice that some handshake line transitions may fall within the 50 ns resolution of the analyzer, so they might be captured and displayed as a single event when you check this box.

The **Parallel Poll Responses** checkbox enables the GPIB analyzer to capture all GPIB parallel poll responses. To delimit the beginning of a GPIB parallel poll, the analyzer captures the assertion of ATN and EOI. The next capture, after 2 µs, denotes the beginning of the parallel poll

response. The analyzer then captures data each time the response on a GPIB data line changes. To delimit the end of a GPIB parallel poll, the analyzer captures the point at which EOI is unasserted.

For more information about setting the capture stimulus, refer to *Configure the Settings* in Chapter 3, *How To...*.

Trigger Condition Configuration

The **Trigger Condition** group box in the **Settings** dialog box lets you configure the GPIB data and control lines that define the trigger condition.

You can enter the GPIB data lines trigger condition as an ASCII value in the **ASCII** edit control, a hexadecimal value in the **Hex** edit control, or a binary value in the **D8** to **D1** spin controls. Notice that the GPIB data trigger condition is replicated in all three representations: ASCII, hexadecimal, and binary. Notice also that the **D8** to **D1** spin controls have the added feature of letting you select **x** ("don't care") values for particular GPIB data lines whose states are not relevant to the GPIB data trigger condition. For example, if you want to configure the GPIB data trigger so that any non-ASCII GPIB data causes a trigger, set **D8** to **1** and set **D7**, **D6**, **D5**, **D4**, **D3**, **D2**, and **D1** to **x**.

You can enter the GPIB control lines trigger condition for each of the GPIB control lines using the spin controls for **EOI**, **ATN**, **SRQ**, **REN**, **IFC**, **NRFD**, **NDAC**, and **DAV**. Notice that the **x** value ("don't care") can be chosen for GPIB control lines whose state is not relevant to the trigger condition.

Configuration of Other Trigger Settings

Immediately below the **Trigger Condition** group box in the **Settings** dialog box are the controls that allow you to configure the other trigger settings. Three of these controls are spin controls.

The spin control on the left configures how to capture data around the first trigger point. The choices are **Capture around first trigger point** and **Capture indefinitely after trigger point**. If you select **Capture around first trigger point**, capture is stopped at a specified point after the first trigger is noticed, and the three controls below that spin control are enabled. These controls are the **Thumb denotes first trigger point** slider control, the **events before trigger** edit control, and the **events after trigger** edit control. These three additional controls specify the exact location in the capture buffer for the first trigger point. If you select **Capture indefinitely**

after trigger point, these three controls are disabled and capture continues, even after the trigger condition is noticed.

The two spin controls on the right side below the **Trigger Condition** group box configure the number of triggers that get recorded and whether beep sounds should be made when the trigger condition is noticed. If you select **Trigger on first occurrence of condition**, a single trigger is recorded in the capture buffer. If you select **Trigger on all occurrences of condition**, every instance of the trigger condition is recorded in the capture buffer. To configure beeping that you want to accompany trigger conditions, select **Do not sound a beep on any trigger**, **Sound a beep on first trigger point**, or **Sound a beep on all trigger points**.

For more information about selecting the trigger settings, refer to the *Configure Trigger Settings* section of Chapter 3, *How To...*.

Exiting the Settings Dialog Box

Clicking on the **OK** button in the **Settings** dialog box saves the changes made to the settings and closes the window. These settings are used the next time you start capturing and/or triggering. If you want to save these settings to a file for later use, choose **Save Settings As** in the **Settings** menu of the main window.

Clicking on the **Cancel** button cancels the changes made to the settings and closes the window.

Clicking on the **Default** button restores the settings to match the default values, without closing the window.

Action Window

The **Action** window contains controls you can use to turn capturing and/or triggering on and off. The **Action** window, shown in Figure 2-3, is always open. If the window is hidden, use **Windows»Action Window** to bring it to the front.
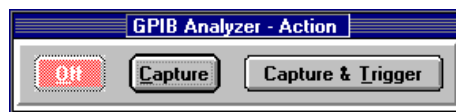

Figure 2-3. Action Window

When the GPIB analyzer application is started, capture and trigger are both off.

Clicking on the **Capture** button causes the analyzer to begin capturing GPIB events into the active capture display. Data is captured according to the current capture configuration settings. Triggering is not enabled.

Clicking on the **Capture & Trigger** button causes the analyzer to begin capturing GPIB events into the active capture display and monitoring for trigger conditions. Data is captured according to the current capture configuration settings, and triggers are monitored according to the current trigger configuration. The capture and trigger configuration can be modified using the settings configuration described in the *Settings Configuration* section, earlier in this chapter.

Clicking on the **Off** button causes the analyzer to stop capturing GPIB events and stop monitoring for trigger conditions.

Notice the following capabilities concerning captures:

- You can switch back and forth between **Capture** and **Capture & Trigger** during the capture without losing data.
- The GPIB analyzer timer resolution is 50 ns, so the fastest rate of capturing GPIB events possible is one GPIB event every 50 ns.
- You can view multiple capture displays simultaneously.

Bus Monitor Window

The **Bus Monitor** window allows you to monitor and control each of the 16 GPIB data and control lines. It also allows you to accept GPIB data, one byte at a time. The **Bus Monitor** window, shown in Figure 2-4, is always open. If the **Bus Monitor** window is hidden, use **Windows»Bus Monitor** to bring it to the front.
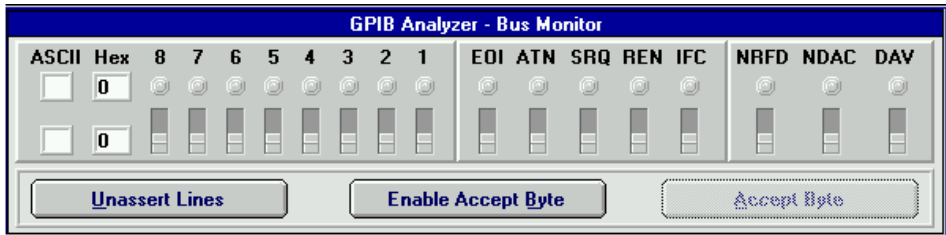
Figure 2-4. Bus Monitor Window

The state of the GPIB data and control lines is displayed on the row of LEDs and the upper **ASCII** and **Hex** edit controls. You can alter the value of the GPIB data and control lines using the row of binary switches and the lower **ASCII** and **Hex** edit controls.

You can enter the GPIB data value as an ASCII value in the **ASCII** edit control, a hexadecimal value in the **Hex** edit control, or a binary value in the **8** to **1** binary switches. Notice that the GPIB data value is replicated in all three representations: ASCII, hexadecimal, and binary.

You can enter the GPIB control value using the **EOI**, **ATN**, **SRQ**, **REN**, **IFC**, **NRFD**, **NDAC**, and **DAV** binary switches. The up position corresponds to the assertion of the line.

Clicking on the **Unassert Lines** button moves all of the binary switches to the down (unasserted) position and disables the **Accept Byte** button.

Clicking on the **Enable Accept Byte** button prepares the analyzer to accept either GPIB data or command bytes, one byte at a time, and changes the button title to **Disable Accept Byte**. The analyzer unasserts NRFD and asserts NDAC. When another GPIB device on the bus asserts the DAV signal, indicating that data is available, clicking on the **Accept Byte** button accepts the byte and prepares for the next byte. Enabling this feature disables the manual binary switches for the NRFD and NDAC control lines. When finished accepting data, clicking on the **Disable Accept Byte** button releases control of the handshaking lines.

The **Accept Byte** button causes the analyzer to examine the state of the DAV line to determine whether another GPIB device is trying to send a byte. If DAV is unasserted, clicking on **Accept Byte** has no effect because no data is available to be accepted. If DAV is asserted, clicking on **Accept Byte** accepts a single byte of GPIB data by automatically toggling NRFD and NDAC in the proper sequence. Before you can use this button, you must click on the **Enable Accept Byte** button in the **Bus Monitor** window.

Capture Display Window

The **Capture Display** window displays captured GPIB events. You can
have more than one capture display open at one time, and capture displays
can be either active or inactive. Active capture displays show GPIB events
as they are being captured. Inactive capture displays show previously
captured events, so that they are unaffected by newly captured GPIB
events.

To open an active **Capture Display** window, choose **New Capture
Display** from the **File** menu in the main window. To open an inactive
Capture Display window, choose **Open Capture File** from the **File** menu
in the main window. You can also use the **Switch to Inactive (Active)
Display** button in an active (or inactive, respectively) **Capture Display**
window to switch back and forth between the two types of **Capture
Display** windows. Figure 2-5 shows an example of an inactive **Capture
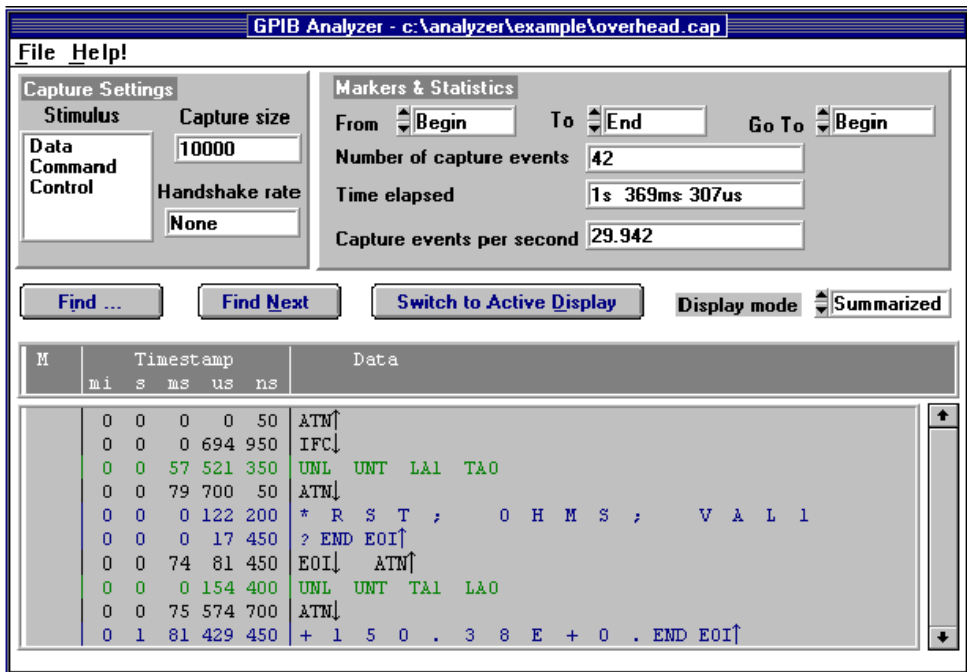Display** window.

Figure 2-5. Capture Display Window (Inactive)

Menu Choices from a Capture Display

Choosing **Save As** from the **File** menu saves the GPIB events in the capture display to a file. Both inactive and active (provided capture is turned off) capture displays can be saved. Whenever possible, use the `.CAP` extension for GPIB analyzer capture files.

Choosing **Print** from the **File** menu prints the contents of an inactive capture display to a selected printer.

Choosing **Export** from the **File** menu saves the GPIB events in an inactive capture display to an ASCII text file, which can be imported into other applications such as word processors. You cannot import the ASCII file back into the GPIB analyzer.

Choosing **Close** from the **File** menu closes the **Capture Display** window. The analyzer program prompts you to save any unsaved GPIB events.

The **Help** menu accesses the online help for the GPIB analyzer.

Capture Settings in a Capture Display

The **Capture Settings** group box contains information on the capture settings configuration that was defined when the capture was made. It contains the following items:

- The **Stimulus** field lists the capture stimuli (as defined by the settings configuration) used during capture of the GPIB events in the capture display.

- The **Capture size** field lists the capture buffer size (as defined by the settings configuration) used during capture of the GPIB events in the capture display.

- The **Handshake rate** field lists the value of the handshake rate (as defined by the settings configuration) used during capture of the GPIB events in the capture display.

Markers & Statistics in an Inactive Capture Display

The **Markers & Statistics** group box provides capture statistics based on various markers in the capture buffer. In addition to **Begin**, **End**, and **Cursor** markers, you can add markers (**M0**, **M1**, **M2**, and so on) to the capture buffer by double-clicking on the entry to be marked. The capture statistics displayed include the **Number of capture events** between markers, the **Time elapsed** between markers, and the **Capture events per**

second for the data between the markers. Notice that markers and statistics are available only in inactive **Capture Display** windows.

The **From** box is used to select the beginning marker used to calculate the capture statistics.

The **To** box is used to select the ending marker used to calculate the capture statistics.

The **Go To** box allows you to go to a particular marker in the capture display.

Controls in a Capture Display

The controls in a **Capture Display** window include **Find**, **Find Next**, and **Switch to Inactive/Active Display** buttons and a **Display Mode** spin control.

Click on the **Find** button to open the **Find** dialog box, which you can use to specify search criteria for finding a particular GPIB event in an inactive **Capture Display** window.

Click on the **Find Next** button to search for the next occurrence of your search criteria in the inactive capture display. This button is disabled if you have not yet entered your search criteria in the **Find** dialog box.

Click on the **Switch to Active/Inactive Display** button to switch between active and inactive capture display modes. Active capture displays show GPIB events as they are being captured. Inactive displays show previously captured GPIB events. With inactive displays, you can place markers, view statistics about the captured GPIB events, and search for specific GPIB events. Switching from inactive to active display deletes all captured GPIB events and markers, but the analyzer prompts you to save your data before switching to an active display.

The **Display mode** spin control chooses the display mode used for the captured GPIB events. In **Detailed** display mode, captured GPIB events are shown one per line. In **Summarized** display mode, multiple events can be shown on each line. Line transitions are displayed on separate lines, but data and command transfers are grouped on the same line. In both display modes, data transfers are shown in blue, command transfers are shown in green, and control line transitions, handshake line transitions, and parallel poll responses are all shown in black.

Capture Data in a Capture Display Window

The capture display shows captured GPIB events, markers, timestamps, and helpful mnemonics. It can also show control line and handshake line transitions. If the line name is followed by an up arrow, the line went from unasserted to asserted. If the line name is followed by a down arrow, the line went from asserted to unasserted. This field might also display an overflow error message if the FIFO is full and events are lost.

For specific information about how to interpret the capture display, refer to the *Analyze Captured Data* section of Chapter 3, *How To...*, or to Appendix B, *Capture Display Mnemonics*.

Search Capability

The **Find** and **Find Next** buttons in the capture display allow you to search for specific GPIB data and control line patterns, data strings, or trigger points in an inactive capture display.

To do a new search, click on the **Find** button in an inactive capture display to bring up a **Find** dialog box similar to the one shown in Figure 2-6. To repeat the search, click on the **Find Next** button in the inactive capture display.
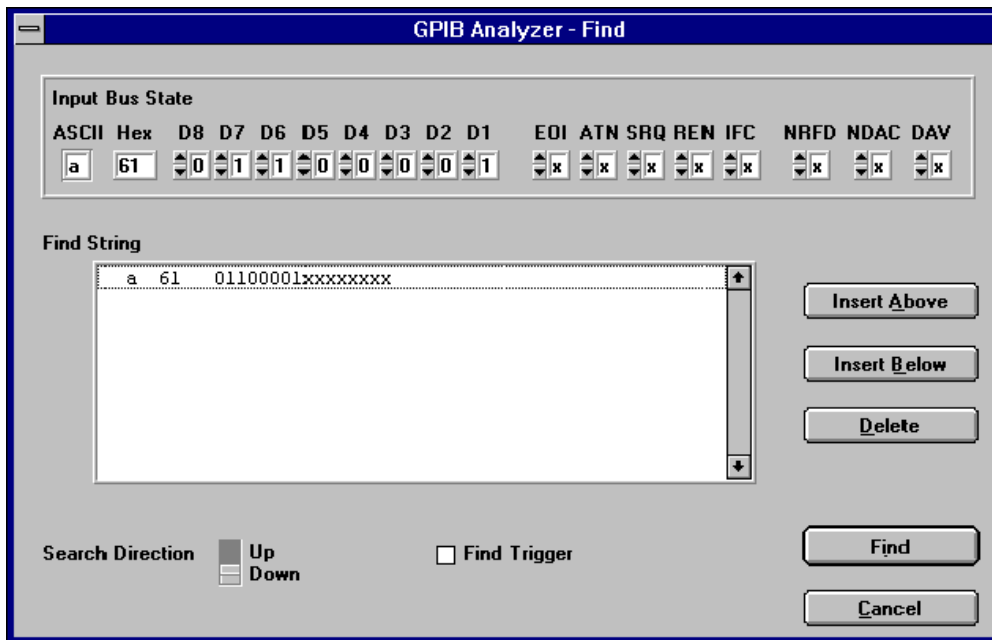
Figure 2-6. Find Dialog Box

To find a trigger point in the **Capture Display** window, check the **Find Trigger** checkbox and then click on the **Find** button.

To find a particular data and control line pattern, set the pattern of the data lines using either the **ASCII** or **Hex** edit controls or the **D8** to **D1** spin controls (for binary values), and set the pattern of the control lines using the **EOI**, **ATN**, **SRQ**, **REN**, **IFC**, **NRFD**, **NDAC**, and **DAV** spin controls. Notice that the spin controls allow you to select **0** (unasserted), **1** (asserted), or **x** ("don't care") for each data and control line. When the data and control lines have been selected, click on the **Find** button.

To find a series of GPIB data and control line patterns, use the **Insert Above**, **Insert Below**, and **Delete** buttons to add and remove entries from the **Find String** list box until it contains the desired series of GPIB data and control line patterns. Click on the **Find** button to conduct the search.

Use the **Search Direction** switch to specify the direction to search from the current cursor position in the capture display.

Click on the **Cancel** button to cancel the search and close the **Find** dialog box.

3

How To…

This chapter describes how to accomplish specific tasks within the GPIB analyzer application.

Start the GPIB Analyzer

Launch the GPIB analyzer application by selecting the **GPIB Analyzer** item under **Start»Programs»National Instruments GPIB Analyzer**.

Exit the GPIB Analyzer

Choose **File»Exit** to close the GPIB analyzer application. The analyzer prompts you to save any capture display that contains unsaved GPIB events. The current settings for capturing and triggering are saved automatically, and they are automatically loaded the next time you start the GPIB analyzer.

Start and Stop Capture of Data

To begin capturing data, complete the following steps:

1. Configure the capture settings and trigger conditions using **Settings»Change Settings**.

2. If an active display is not already open, open a new **Capture Display** window using **File»New Capture Display**.

3. Bring the **Action** window to the front using **Windows»Action Window**.

4. Click on the **Capture** or **Capture & Trigger** button in the **Action** window to begin capturing data.

To stop capturing new data, click on the **Off** button in the **Action** window.

Monitor or Participate in GPIB Activity

View/Change the State of GPIB Data and Control Lines

You can view or change the state of the GPIB data and control lines from within the **Bus Monitor** window.

The state of the GPIB data and control lines is displayed on the row of LEDs and the upper **ASCII** and **Hex** edit controls. You can alter the value of the GPIB data and control lines using the row of binary switches and the lower **ASCII** and **Hex** edit controls.

You can enter the GPIB data value as an ASCII value in the **ASCII** edit control, a hexadecimal value in the **Hex** edit control, or a binary value in the **8** to **1** binary switches. Notice that the GPIB data value is replicated in all three representations: ASCII, hexadecimal, and binary.

You can enter the GPIB control value using the **EOI**, **ATN**, **SRQ**, **REN**, **IFC**, **NRFD**, **NDAC**, and **DAV** binary switches. The up position corresponds to the assertion of the line.

To accept a byte of data on the bus, use the **NRFD** and **NDAC** binary switches to simulate the IEEE 488 handshake, or use the **Accept Byte** button, which automatically toggles NRFD and NDAC in the correct sequence. The **Accept Byte** button is enabled by clicking on the **Enable Accept Byte** button.

If you are using the Bus Monitor to assert GPIB lines, do not use the NI-488.2 `ibfind` or `ibdev` functions. These functions unassert the lines on the bus, even though the switches in the **Bus Monitor** window show that the lines are asserted. If you encounter this problem, click on the **Unassert Lines** button and avoid using the `ibfind` or `ibdev` functions.

Accept a Single Byte

To accept a single byte of data on the GPIB, first click on the **Enable Accept Byte** button in the **Bus Monitor** window. Then click on the **Accept Byte** button in the **Bus Monitor** window. This action automatically toggles the NRFD and NDAC lines in the correct IEEE 488 handshaking sequence to accept a single byte. If you disable the Accept Byte feature, you can control the NRFD and NDAC lines manually using the binary switches in the **Bus Monitor** window.

If you try to accept a byte when no GPIB device is currently trying to source a byte (DAV unasserted), toggling the handshake lines or clicking on **Accept Byte** has no effect.

View Previously Captured Data

To open a **Capture Display** window to view previously saved GPIB events, choose **File»Open Capture File**.

Configure the Settings

Settings are configured with the **Settings** configuration dialog box, which you can open by choosing **Settings»Change Settings**.

Configure Capture Settings

Complete the following steps to configure the capture settings:

1. Click the **Off** button in the **Action** window. (Selecting **Windows»Action Window** brings the **Action** window to the front.)

2. Open the **Settings** dialog box by choosing **Settings»Change Settings**.

3. Configure the capture settings. Refer to the *Settings Configuration* section of Chapter 2, *GPIB Analyzer Features*, for details on all the capture settings you can configure.

4. When you are finished making changes, click on **OK** in the **Settings** dialog box.

You can save your capture settings by choosing **Settings»Save Settings As** and reload them by choosing **Settings»Load Settings**.

Configure Trigger Settings

Complete the following steps to configure the trigger settings for your capture:

1. Click on the **Off** button in the **Action** window. (Selecting **Windows»Action Window** brings the **Action** window to the front.)

2. Open the **Settings** dialog box by choosing **Settings»Change Settings**.

3.   Configure the trigger settings. Refer to the *Trigger Condition Configuration* and *Configuration of Other Trigger Settings* sections of Chapter 2, *GPIB Analyzer Features*, for details on all the trigger settings you can configure.

4.   When you are finished making changes, click on **OK** in the **Settings** dialog box.

You can save your trigger settings by choosing **Settings»Save Settings As** and reload them by choosing **Settings»Load Settings**.

To use the configured trigger settings, start capture using the **Capture & Trigger** button in the **Action** window, instead of the **Capture** button.

Timestamp Capture Events

Timestamping shows you the elapsed time between GPIB events captured by the GPIB analyzer. The timestamp information appears in the timestamp column of the capture display.

To enable timestamping, check the **Enable Timestamping** checkbox in the **Settings** dialog box.

Do a Non-Intrusive Capture

To prevent the GPIB analyzer from participating in acceptor handshaking, uncheck the **Participate in Acceptor Handshake** checkbox in the **Settings** dialog box. If this checkbox is checked, the analyzer participates in all handshaking on the GPIB. You might want to select this checkbox to slow down the GPIB transfers or to avoid overflow errors.

Avoid Overflow Errors

An overflow error occurs when the GPIB analyzer FIFO hardware buffer fills up with GPIB events faster than the software can receive them. If this happens, an error message with asterisks and the word "OVERFLOW" appears in the capture display, as shown in Figure 3-1.
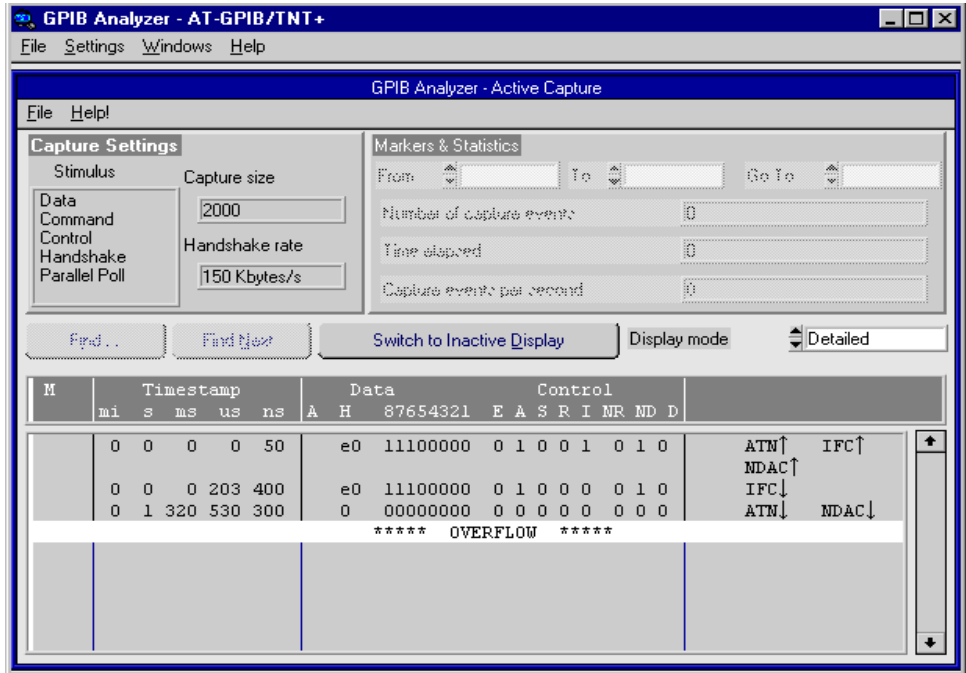
Figure 3-1. Overflow Error

If an overflow error occurs, one or more GPIB events have been lost. You can usually avoid overflow errors by making one of the following changes:

- Check the **Participate in Acceptor Handshake** checkbox in the **Settings** dialog box, and set the **Handshaking rate** to **Maximum**. This configuration causes the analyzer to hold off when the FIFO is almost full. It prevents high speed GPIB data transfers when the FIFO is almost full, which can be a common cause of overflow errors.

- Uncheck the **Handshake Line Transitions** checkbox in the **Settings** dialog box. If this option is selected, you might capture up to six times as many GPIB events as when choosing to capture only data and command transfers. The reason for this is that when you enable the capture of handshake line transitions, you start getting GPIB events such as NDAC$\uparrow$ and NRFD$\downarrow$, which reflect the multiple changes that occur to the states of the GPIB handshake lines for *each* byte transferred on the GPIB. This high volume of events is likely to cause overflow errors.

- Uncheck the **Enable Timestamping** checkbox in the **Settings** dialog box. If you do not need to see the timestamping information, disabling this option can reduce the amount of data transferred from the FIFO and reduce the possibility for overflow errors.

- Uncheck the **Control Line Transitions** checkbox in the **Settings** dialog box. Some GPIB devices may toggle the control lines incorrectly, and overflow errors could result.

- Close all active capture displays while capturing. The analyzer captures GPIB events more efficiently if they do not need to be displayed immediately.

- Increase the **Retain up to _____ capture events** value in the **Settings** dialog box. This field specifies the maximum number of capture events retained in the capture buffer.

Save and Reload Capture/Trigger Settings

The analyzer uses the current capture and trigger settings until you change them again and automatically saves them when you exit the analyzer program. If you want to save the current settings for later use, use **Settings»Save Settings As**. Whenever possible, use the `.SET` extension for analyzer settings filenames.

To load a file of previously saved settings, use **Settings»Load Settings**.

Analyze Captured Data

After you have captured GPIB events, you are ready to view and interpret the captured data, calculate statistics, search for specific capture events, print the captured data, or save the captured data.

View the Captured Data

You can view the captured GPIB events in either detailed display mode or summarized display mode. With detailed display mode, captured GPIB events are shown one per line. In summarized display mode, multiple events are combined on single lines. Line transitions are displayed on separate lines, but data and command transfers are grouped on the same line. In either display mode, lines are color coded based on the type of event captured. Table 3-1 shows the color coding scheme.

Table 3-1. Color Coding in the Capture Display

Type of Event	Color
Data transfers	Blue
Command transfers	Green
Control line transitions	Black
Handshake line transitions	Black
Parallel poll responses	Black
Trigger event	Dotted box
Overflow	White

Read the Timestamp Column

In detailed mode, where each line represents a single capture event, the timestamp value represents the time elapsed between the event on that line and the event on the previous line. So if you want to determine the time elapsed between the capture of the first event and the fifth event, add up the timestamp values on the second, third, fourth, and fifth lines. Alternatively, you can switch to an inactive display using the **Switch to Inactive Display** button, and put markers on the first and last event of interest, then use the **From** and **To** fields in the **Markers & Statistics** group box to have the GPIB analyzer calculate a **Time elapsed** value for you.

In summarized mode, where more than one event can be present on a line, the timestamp value represents the time elapsed between the first event on that line and the first event on the previous line.

The timestamp column in the capture display shows the timestamp in a minute, second, millisecond, microsecond, and nanosecond notation. If the timestamp exceeds 60 minutes, the timestamp is shown in an hour, minute, and second notation. The abbreviations used for the various time scales are listed in Table 3-2. The smallest recordable timestamp is 50 ns.

Table 3-2. Timestamp Abbreviations in the Capture Display Window

Time Unit	Abbreviation
Nanoseconds	ns
Microseconds	us
Milliseconds	ms
Seconds	s
Minutes	mi
Hours	hr

Read the Mnemonics Column

Various mnemonics appear in the right column of the capture display to provide a quick interpretation of the captured GPIB events. The column may also show line transitions. If the line name is followed by an up arrow (↑), the line transitioned from unasserted to asserted. If the line name is followed by a down arrow (↓), the line transitioned from asserted to unasserted. Notice that if the analyzer is capturing handshake line transitions, the assertion of DAV represents a GPIB data byte or command byte. For a detailed list of the mnemonics and their meanings, refer to Appendix B, *Capture Display Mnemonics*.

Search for a Capture Event

To search for a specific GPIB event within a capture display from the current cursor location, complete the following steps:

1. Switch to an inactive **Capture Display** window.

2. Click on the **Find** button.

3. Enter your search criteria in the **Find** dialog box.

    To find a trigger point in the **Capture Display** window, check the **Find Trigger** checkbox.

    To find a particular data and control line pattern, set the pattern of the data lines using either the **ASCII** or **Hex** edit controls or the **D8** to **D1** spin controls (for binary values), and set the pattern of the control lines using the **EOI**, **ATN**, **SRQ**, **REN**, **IFC**, **NRFD**, **NDAC**, and **DAV** spin controls. Notice that the spin controls allow you to select **0** (unasserted), **1** (asserted), or **x** (don't care) for each data and control line.

To find a series of GPIB data and control line patterns, use the **Insert Above**, **Insert Below**, and **Delete** buttons to add and remove entries from the **Find String** list box until it contains the desired series of GPIB data and control line patterns.

Use the **Search Direction** switch to specify the direction to search from the current cursor position in the capture display.

4. Click on the **Find** button in the **Find** dialog box. This action automatically closes the **Find** dialog box and takes you from the current cursor position to the first GPIB event in the capture display that matches your search criteria.

To find the next occurrence, click on the **Find Next** button.

Mark Capture Events to Show Statistics

Markers are allowed only in inactive capture displays. All inactive capture displays contain at least two markers: **Begin** and **End**. Single-clicking places the cursor in a capture display. Double-clicking places markers in a capture display and removes placed markers. Markers are labeled **M0**, **M1**, **M2**, and so on, as they are created.

After you have placed your markers, you can use the **From** and **To** controls in the **Markers & Statistics** group box to examine statistics about the captured data.

If you are using summarized display mode, you might have more than one marker for each line. In this case, the letter **M** appears in the marker column. You can click on the **M** several times to see each marker for that line.

Print and Save Captured Data

To print the contents of an inactive **Capture Display** window, use **File»Print**. You can print the entire capture display or limit the printing to captured events between particular markers.

Both inactive and active (if capturing is turned off) capture displays can be saved to a file. To save the data in a **Capture Display** window, use **File»Save As**. Whenever possible, use the `.CAP` extension for saving capture display files. Captured data is saved in an analyzer-specific format and can be reopened as an inactive capture display.

You can also export an inactive capture display as an ASCII text file to another application, such as a word processor. Use **File»Export** to export the captured data. You can export captured data as text in both detailed and summarized formats. You cannot import the ASCII text file back into the GPIB analyzer.

4

Tutorial

This chapter contains a hands-on tutorial to help you practice using the different features of the GPIB analyzer application.

Before you start the tutorial, check the following:

- Make sure that the GPIB software, GPIB analyzer software, and GPIB hardware are installed on your computer. For installation instructions, refer to your getting started manual.

- Disconnect all GPIB cables from your GPIB hardware.

Part 1. Capture and View New Data

1. Open the GPIB analyzer application by selecting **Start» Programs»National Instruments GPIB Analyzer»GPIB Analyzer**.

   When you open the application, a new **Capture Display** window and the **Action** window are visible.

2. Choose **Settings»Change Settings** to bring up the **Settings** dialog box.

3. In the **Settings** dialog box, click on the **Default** button to reset to the default settings.

4. In the **Capture Stimulus** section, choose to capture the following stimuli: data transfers, command transfers, control line transitions, and parallel poll responses. Do not select handshake line transitions.

5. Click in the **Retain up to _____ capture events** box and change the setting to 60,000 capture events.

   You do not need to change the trigger settings because this part of the tutorial does not use triggering.

   The **Settings** dialog box should now look like the following screen.
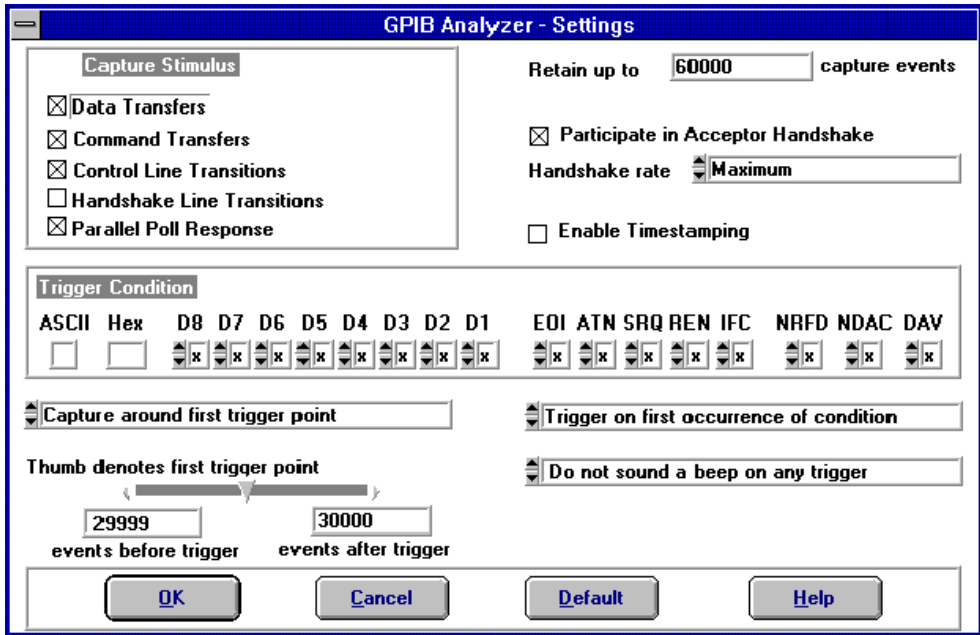
6. Click on **OK** to use these settings.

    You can save these settings for later use. To save them, choose
    Settings»Save Settings As from the main window. To retrieve saved
    settings, choose **Settings»Load Settings** from the main window.

7. If the **Action** window is hidden, bring it to the foreground by choosing
    Windows»Action Window from the main window. A picture of the
   **Action** window follows.
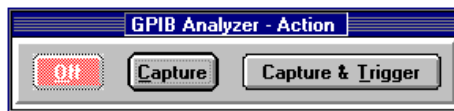
8. Click on the **Capture** button in the **Action** window. The analyzer is
    ready to capture GPIB events.

9. Open the Win32 Interactive Control utility by selecting
    Start»Programs»GPIB Software»Win32 Interactive Control.

10. At the prompt, enter $ "c:\Program Files\National
    Instruments\GPIB\Analyzer\tutorial.txt" to run the
    tutorial script. (The path to the file might be different if you did not use
    the default installation directory when you installed the GPIB analyzer

software.) Wait until the script has executed. The NI-488.2 commands in this script file write data on the GPIB, and the analyzer portion of the GPIB hardware captures the data.

11. At the **:** prompt, type quit and press <Enter> to exit the Win32 Interactive Control utility.

12. Switch back to the GPIB analyzer, and click on **Off** in the **Action** window to stop the capture.

13. In the active **Capture Display** window, use the scroll bar to go to the beginning of the capture file.

    The **Capture Display** window should look like the following screen.
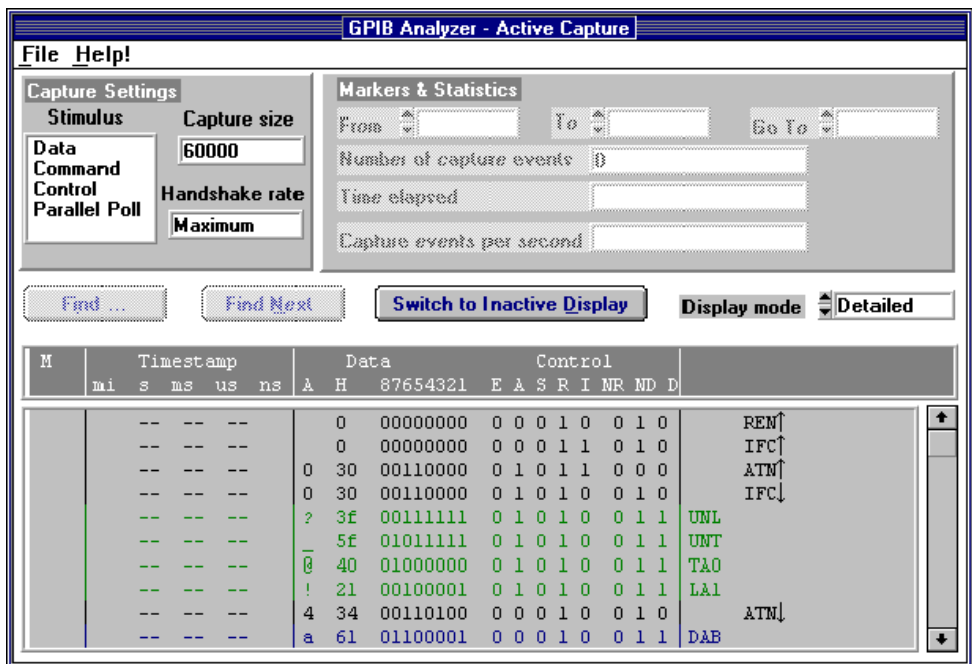
By default, the capture display is in detailed mode, which shows one GPIB event per line. This mode shows the greatest amount of detail, including the status of each GPIB line and helpful mnemonics. In this display, you can see that the tutorial script file issued the following commands: clear the GPIB interface, address a device to listen, and write data to the device.

14. Change the display mode from detailed to summarized by clicking on the arrow beside the **Display Mode** spin control. Summarized display mode is often easier to read if you do not need to see one event per line, but it displays less information.

Part 2. Capture and View New Data with a Trigger Condition

1. Choose **Settings»Change Settings** to bring up the **Settings** dialog box.

2. In the **Capture Stimulus** section, choose to capture data transfers and command transfers. Unselect the checkboxes for the other types of transfers. This restricts the analyzer to capture only data and command transfer events on the bus.

3. Click on **Maximum** in the **Handshake rate** box to see your choices. Then click on the 1 Kbyte/s option. This handshake rate slows down the GPIB transfers.

4. Choose to retain up to 50 capture events.

5. Select the **Enable Timestamping** box to turn on the timestamping feature.

6. In the **Trigger Condition** section, enter 1 in the **ASCII** edit control and notice the corresponding changes in the **Hex** box and the **D8**-**D1** toggle switch boxes.

7. Use the binary switches to set the **ATN** line to **0**, **NRFD** to **0**, **NDAC** to **1**, and **DAV** to **1**. Leave the **EOI**, **SRQ**, **REN**, and **IFC** lines set as don't care (**x**).

8. Make sure **Capture around first trigger point** shows up as the current setting. This option stops the capture when a certain number of events have been captured after the trigger point. Use the **Thumb denotes first trigger point** to specify how many events to capture before and after the trigger point. Move the slider below **Thumb denotes first trigger point** so that the capture file will show 5 events before the trigger point and 44 events after the trigger point.

9. Click in the spin control with the words **Trigger on first occurrence of condition** to see your choices. Select **Trigger on all occurrences of condition**. This option captures and displays all occurrences of the trigger condition.

10. Click in the spin control with the words **Do not sound a beep on any trigger** to see your choices, then select **Sound a beep on first trigger point**.

     The **Settings** dialog box should look like the following screen.
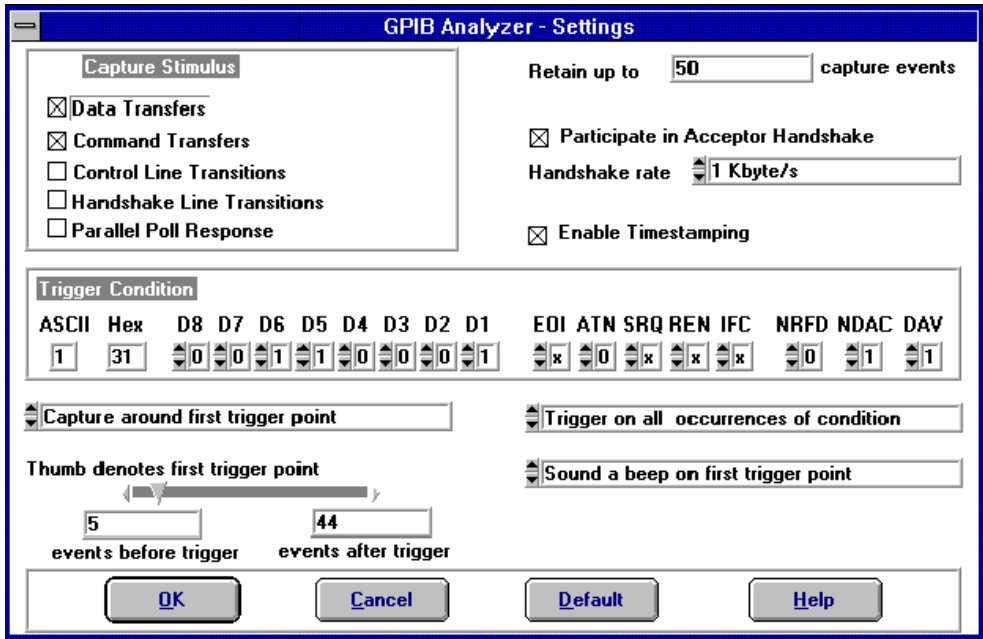
11. Click on **OK** to use these settings.

12. Bring the **Action** window to the front by choosing **Windows»Action Window**. Click on the **Capture & Trigger** button. The analyzer is ready to capture data and look for the trigger condition specified in the **Settings** dialog box.

13. Bring the **Capture Display** window to the front, and notice that the changes you made in the **Settings** dialog box are shown in the **Capture Settings** section because you clicked on **Capture & Trigger**.

14. Open the Win32 Interactive Control utility by selecting **Start»Programs»GPIB Software»Win32 Interactive Control**.

15. At the prompt, enter $ "c:\Program Files\National Instruments\GPIB\Analyzer\tutorial.txt" to run the tutorial script again. (The path to the file might be different if you did not use the default installation directory when you installed the GPIB analyzer software.)

16. Switch back to the analyzer program, and click on **Off** in the **Action** window to stop the capture.

17. In the active **Capture Display** window, click on **Switch to Inactive Display**.

18. If necessary, switch to detailed display mode. Scroll to the top of the capture display.

    The **Capture Display** window should look something like the following screen.
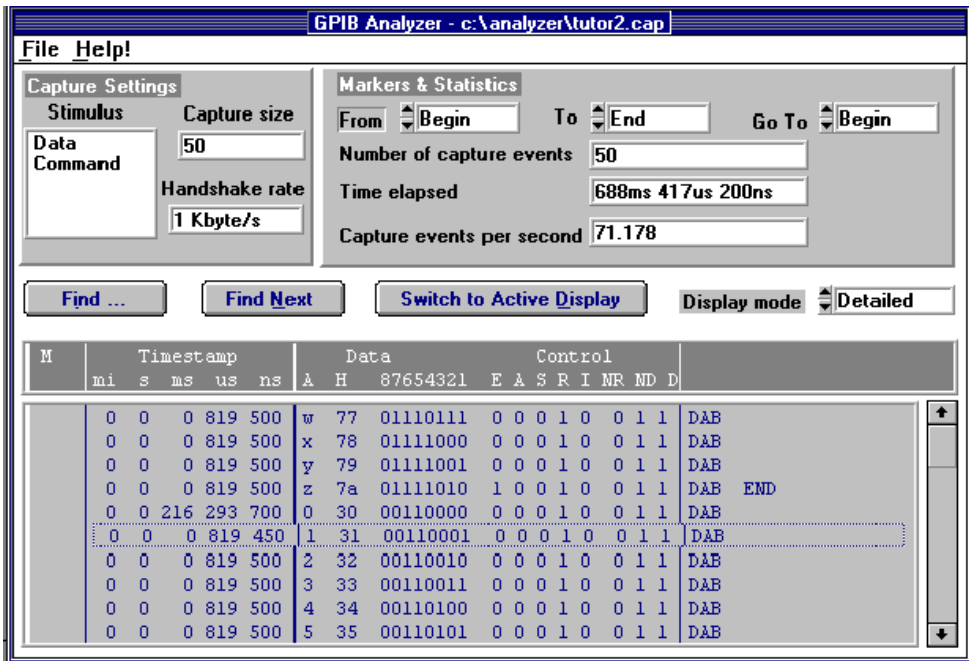
The trigger points are enclosed in dotted boxes and the display shows five events before the first trigger point.

19. Choose **File»Save As**.

20. Enter `tutor2.cap` as the capture filename and click on **Save**. Notice that `tutor2.cap` appears on the title bar of the **Capture Display** window.

21. From the main **File** menu, choose **Exit** to quit the analyzer application.

Part 3. Search for Data in a Capture Display

1. Open the GPIB analyzer application.

2. Choose **File»Open Capture File**.

3. In the dialog box, enter tutor2.cap to retrieve the capture file that you saved in part 2 of this tutorial, and click on **OK**. The capture file is automatically opened as an inactive display.

4. Click on the **Find** button in the **Capture Display** window to bring up the **Find** dialog box.

5. Select the **Find Trigger** checkbox to search for the captured trigger event, ASCII 1, which was the trigger point specified in part 2 of this tutorial. The trigger pattern is displayed in the **Input Bus State** field and the **Find String** field.

6. Click on **Find** to start the search. The result will be highlighted as shown in following screen. ASCII 1 appears in the "A" column of the highlighted row.

7. Click on the **Find** button to bring up the **Find** dialog box.

8. Unselect the **Find Trigger** checkbox.

9. In the **Input Bus State** section, enter 5 in the **ASCII** edit control.

10. Click on **Find** to locate the search pattern.

11. Return to the **Find** dialog box.

12. To create a string to search for, first choose **Insert Below** to enter another pattern in the Input Bus State.

13. Enter 6 in the **ASCII** edit control to indicate the second pattern in the search.

14. Choose **Insert Below** again, but this time enter 7. These characters form a string ("567") that the analyzer will search for in the capture file. The **Find** dialog box should look like the following screen.
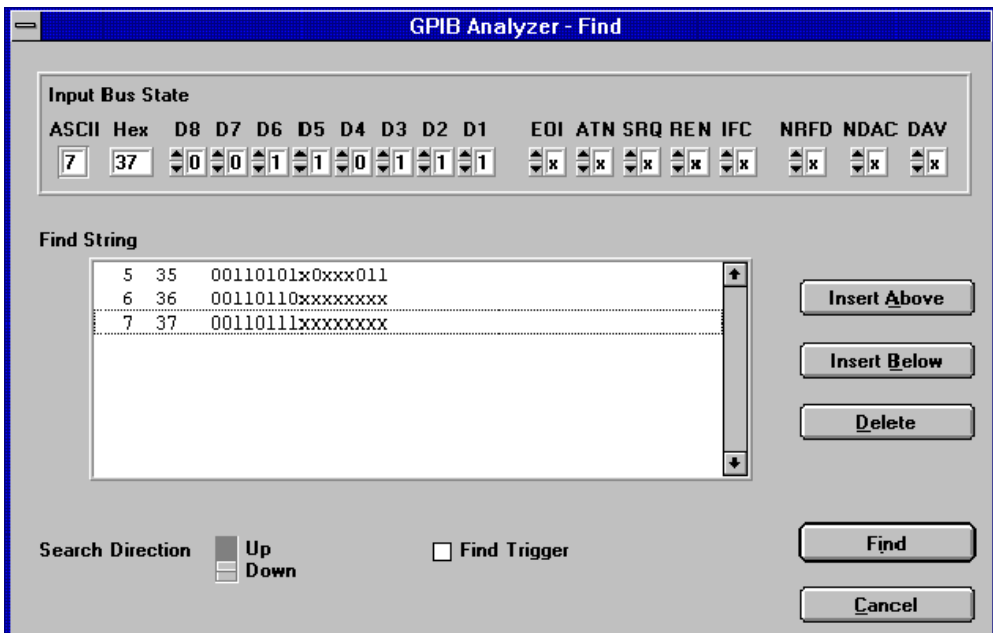
15. Click on **Find** to search for the string "567".

16. The first character of the matched search string, "5", will be highlighted as shown in the following screen.
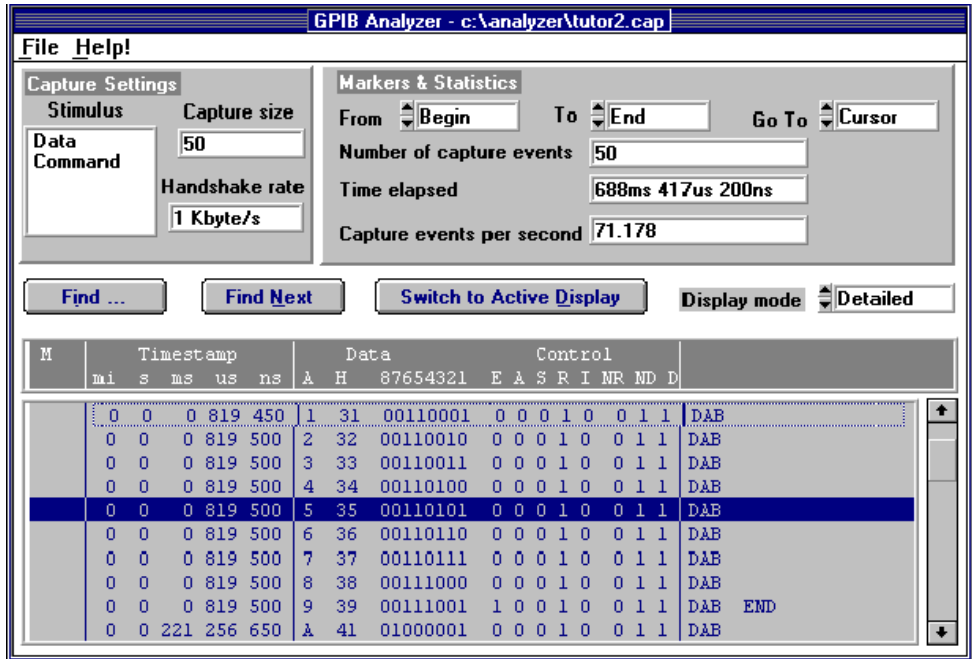
17. Click on the **Find Next** button to continue your search. The next successful search result will be highlighted.

Part 4. Show Statistics for Captured Data

Use the tutor2.cap capture file that you obtained in part 2 and opened in part 3 of this tutorial.

1. In the **Capture Display** window create a marker at the line containing the ASCII character "A" by double-clicking on that line. The marker **M0** appears in the marker column of that line.

2. Create another marker at the line containing the letter "Z". **M1** appears in the marker column of that line.

3. Click on the word **Begin** in the **From** spin control in the **Markers & Statistics** group box to see your choices, then select **M0**, the marker for the letter "A".

4. Choose **M1** for the **To** list box.

   The analyzer calculates and displays statistics as shown in the following screen.
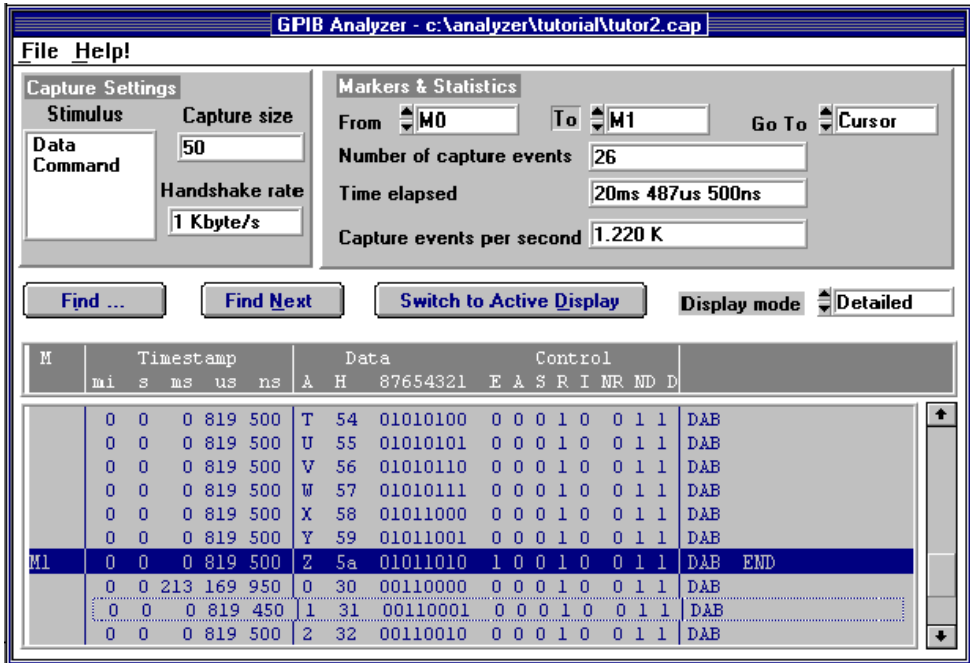
The capture display statistics show the total number of captured events from marker **M0** to marker **M1**. The **Time elapsed** statistic shows you the total time to transfer this block of data. The **Capture events per second** box shows system performance during this period of time.

5. Choose **M0** in the **Go To** list box to highlight the line with the letter "A" again.

Part 5. Print and Export a Capture File

This part of the tutorial is continued from part 4. Use the `tutor2.cap` capture file that you used in part 4.

1. Choose **File»Print**.

2. In the print dialog box, select **M0** for the **From Marker** and **M1** for the **To Marker**.

3. Click on **OK**. The portion of the capture display from **M0** to **M1** will be printed. If you want to print the entire capture display, choose **Begin** for the **From Marker** and **End** for the **To Marker**.

4. Save the capture file as ASCII text by choosing **File»Export**.

5. Enter `sample.txt` in the export dialog box, and click on **Save**. You can view the exported file in a text editor, but you cannot import it back to the analyzer.

6. From the **File** menu in the main window, choose **Exit** to quit the analyzer application.

5

Examples

This chapter contains several examples that illustrate how to use the GPIB analyzer application to solve your IEEE 488 problems.

Example 1. Slow Communication

Description of Problem

A technician is running a GPIB application program in which an AT-GPIB/TNT+ board is communicating with a multimeter. In the application, the Controller instructs the instrument to reset to its default settings, measure Ohms, and return a reading. The application seems to be running slowly, and the technician wants to determine the cause of the slow performance.

Setting up the GPIB Analyzer

By using the timestamping feature of the GPIB analyzer, the technician can determine what is causing the application to run slowly. In the **Settings** dialog box of the GPIB analyzer, he chooses the following settings:

- Capture data transfers, command transfers, and control line transitions

- Retain 10,000 events

- Timestamping feature enabled

- Do not participate in acceptor handshake

The **Settings** dialog box looks like the following screen.
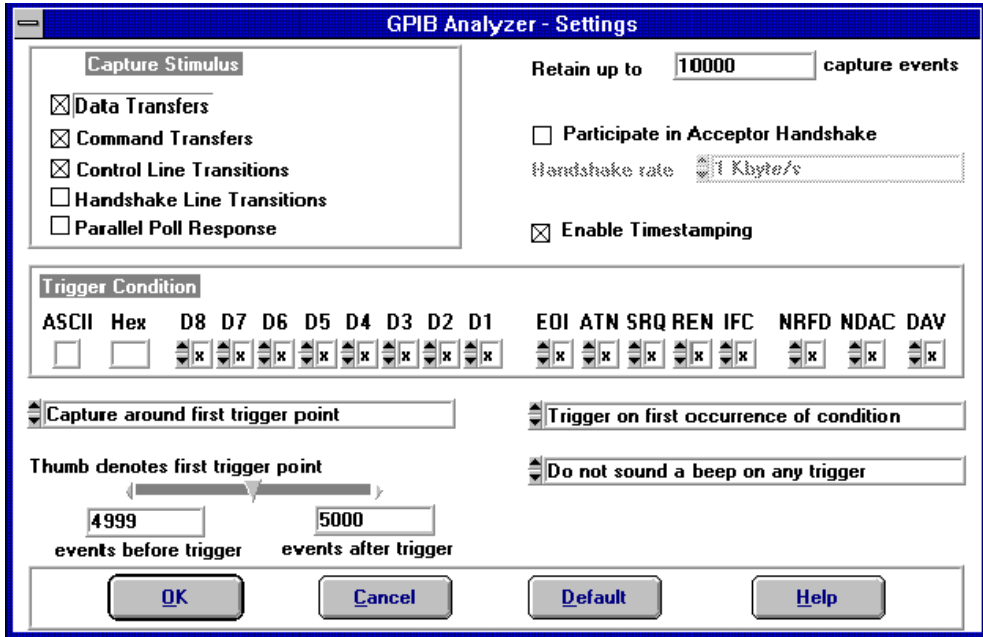
The technician clicks on **OK** to close the **Settings** dialog box and clicks on
Capture in the **Action** window to start capture, then runs his application.
After the application executes, he switches back to the analyzer and clicks
on **Off** in the **Action** window to stop capture.

Reading the Capture Display

The following picture shows the resulting capture display.

The technician has chosen **Summarized** display mode. In the capture display, he sees the string "RST; OHMS; VAL1?", which instructs the multimeter to reset, measure Ohms, and send a reading to the Controller. The next string, "+150.38E+0" is the reading from the device. The technician switches back to detailed display, and after he places the markers in the capture display, he selects various markers in the **From** and **To** list boxes. For example, he calculates the time the device takes to start sending its measurement, which is 1 s, 81 ms, 429 μs, and 450 ns. The statistics that the technician sees reveal that the system performance is satisfactory, but the instrument is slow in returning a measurement.

Example 2. A Service Request Problem

Description of Problem

A test engineer has a GPIB system with two GPIB devices connected. The engineer expects that when a device requests service, it asserts the SRQ line. He has specified in his application that when SRQ is asserted, the Controller serial polls the active devices to determine which device is requesting service and then takes the appropriate action. In this particular application, the time between the device asserting SRQ and the device receiving service is too long, so the engineer wants to check the SRQ and serial poll response of his system.
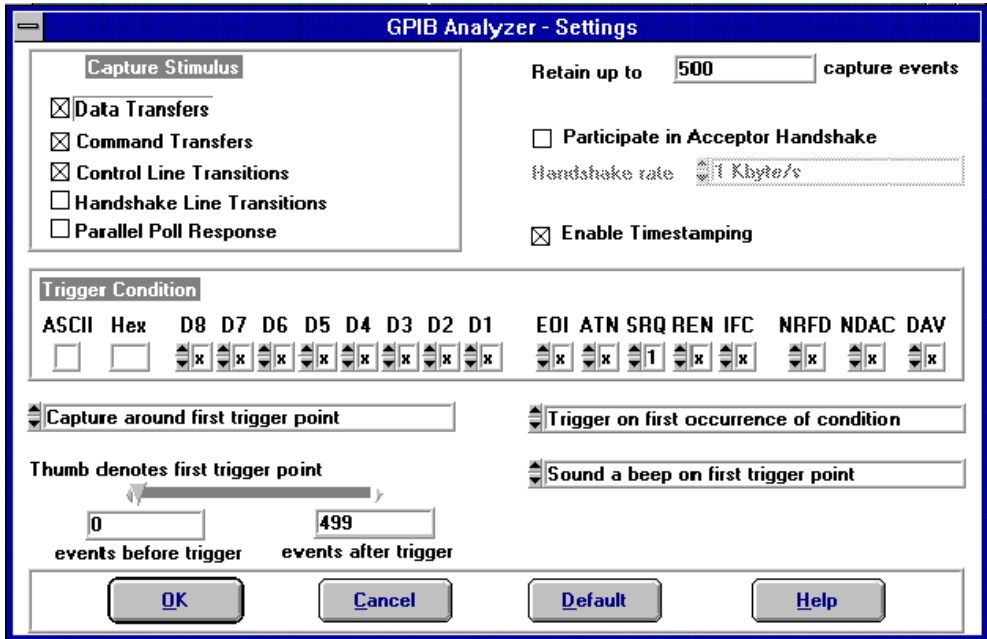
Setting up the GPIB Analyzer

By using the timestamping feature of the GPIB analyzer, the engineer is able to view the service request process and measure response times. He configures the analyzer to trigger at the assertion of SRQ and to capture GPIB events afterwards. By observing the captured events with timestamping information, he learns more about the sequence of events during a serial poll of his system.

In the **Settings** dialog box of the GPIB analyzer, the engineer chooses the following settings:

- Capture data transfers, command transfers, and control line transitions

- Capture 500 events after the trigger point

- Trigger condition set to SRQ asserted (SRQ = 1) and all other lines equal to "x"

- Timestamping feature enabled

- Capture around the first trigger point

The **Settings** window looks like the following screen.

GPIB Analyzer - Settings

Capture Stimulus

☒ Data Transfers
☒ Command Transfers
☒ Control Line Transitions
☐ Handshake Line Transitions
☐ Parallel Poll Response

Retain up to   500   capture events

☐ Participate in Acceptor Handshake

Handshake rate   1 Kbyte/s

☒ Enable Timestamping

Trigger Condition

ASCII Hex   D8 D7 D6 D5 D4 D3 D2 D1   EOI ATN SRQ REN IFC   NRFD NDAC DAV

Capture around first trigger point   Trigger on first occurrence of condition

Thumb denotes first trigger point   Sound a beep on first trigger point

0   499

events before trigger   events after trigger

OK   Cancel   Default   Help

The engineer chooses **Capture & Trigger** in the **Action** window and runs his application program.

Reading the Capture Display

The resulting capture with two added markers (**M0** and **M1**) looks like the following screen.

The marker **M0** appears on the first line, which shows the assertion of the SRQ line. The engineer places a marker **M1** where the Controller starts the serial poll by sending the Unlisten command (UNL). By choosing **M0** in the **From** list box and **M1** in the **To** list box to calculate the **Time elapsed** statistic, he sees that the Controller takes 851 ms, 449 μs, and 200 ns to respond to the serial poll.

The Controller sends its listener address (LA0 in this case) and the serial poll enable (SPE) command. The Controller sends TA1 so that the first device can talk, then unasserts ATN and reads the status byte (0x00) from the device. By reading the timestamp information on the line where the first device sends 0x00, the engineer knows that the device takes 103 ms, 3 μs, and 40 ns to send its status byte.

Because the first device is not the one requesting service (because its status byte does not have bit 6 set), the Controller addresses the second device to talk. The Controller then reads the device's status byte (0x40), which indicates that it is requesting service. By reading the timestamp information on the line where the second device sends 0x40, the engineer sees that the device takes only 1 μs and 50 ns to send its status byte.

Because the response time of the second device polled is shorter than the first device, the engineer changes his application so that the Controller always polls the faster device first. If the faster device is the one requesting service, the Controller will not need to poll the slower device.

# Example 3. Device Not Responding

Description of Problem

A programmer has written a GPIB application program, but her device is not responding to the program.

Setting up the GPIB Analyzer

The programmer configures the analyzer so that she can check for communication problems. In the **Settings** dialog box of the GPIB analyzer, she chooses the following settings:

- Capture data transfers, command transfers, and control line transitions
- Retain 60,000 events
- Participate in handshaking and transfer rate set to maximum
- Timestamping disabled

The **Settings** dialog box looks like the following screen.
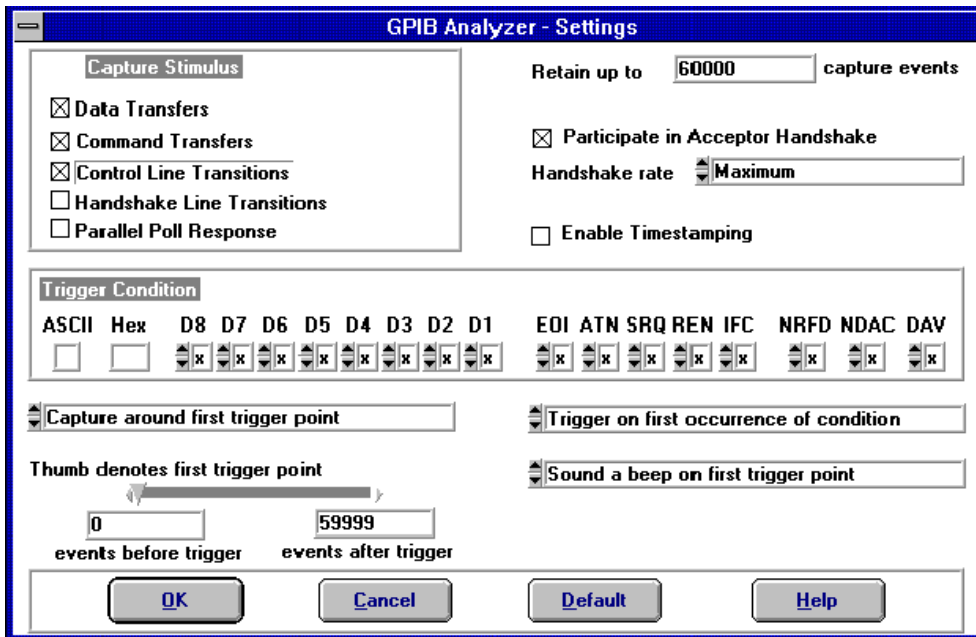
The programmer chooses **Capture** in the **Action** window and captures the sequence of events on the GPIB. She then clicks on **Off** in the **Action** window of the analyzer.

Reading the Capture Display

The resulting capture display looks like the following screen.

In this example, the Controller does not seem to be sending any data bytes. In her application program, the programmer set up the device to have primary address 3 and secondary address 96. She notices, however, that at the line containing the marker **M0**, the Controller configures the device to be a Listener at primary address 3 with no secondary address. The device is not responding because the Controller is not addressing it correctly. The programmer corrects her application and runs the capture again. The Controller can now write to the device, and the capture display looks like the following screen.
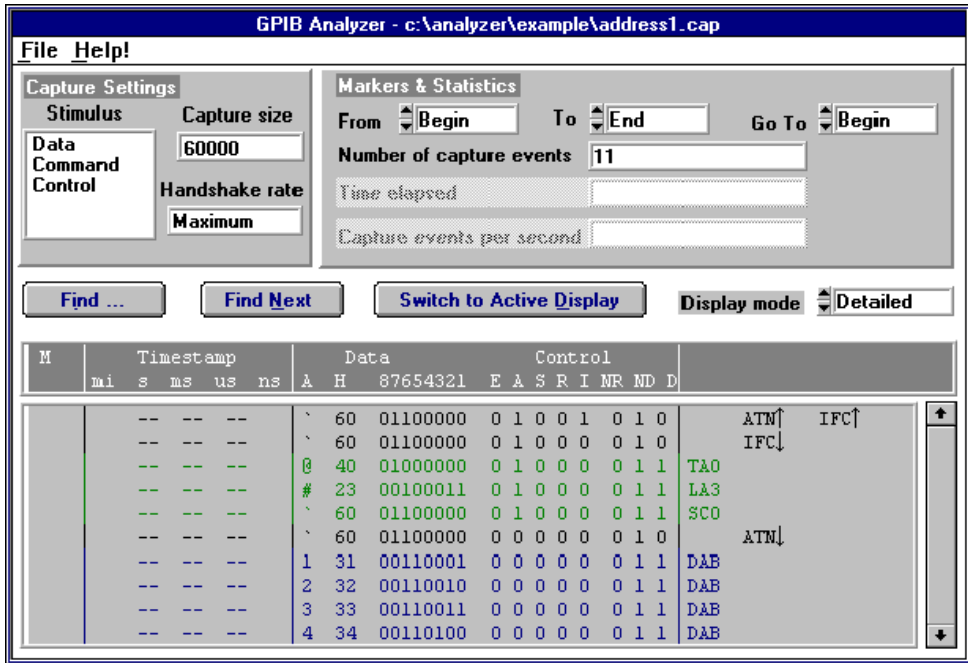
Example 4. Timeout Error During a Read

Description of Problem

A programmer's application returns a timeout error while waiting to receive data from a device.

Setting up the GPIB Analyzer

The programmer configures the analyzer so that he can examine the GPIB activity during a read from the device. In the **Settings** dialog box of the GPIB analyzer, he chooses the following settings:

- Capture data transfers, command transfers, and control line transitions

- Retain 60,000 events

- Participate in handshaking and transfer rate set to maximum

- Timestamping disabled

The **Settings** dialog box looks like the following screen.
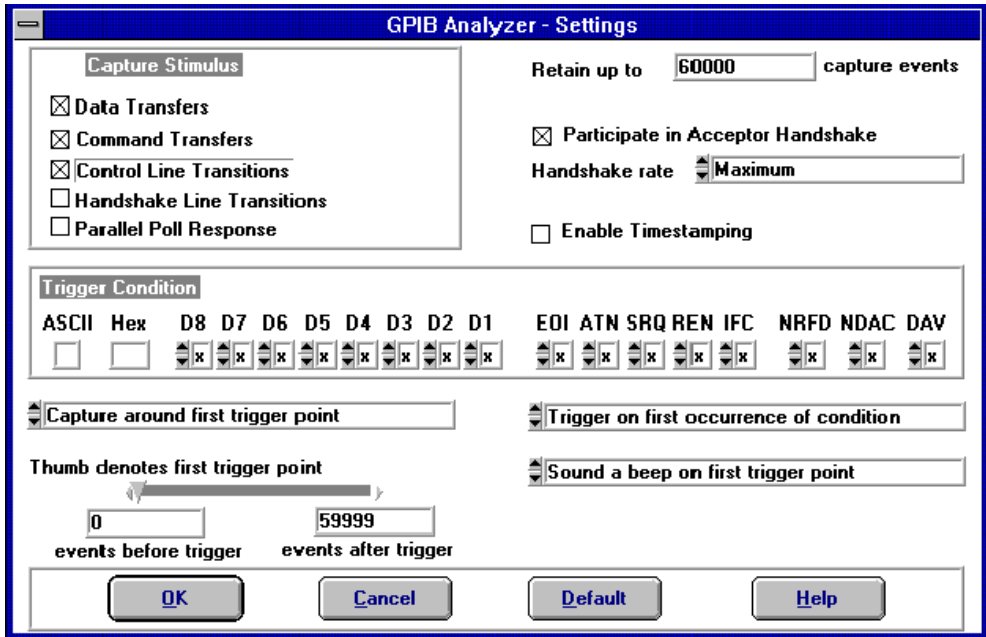
The programmer chooses **Capture** in the **Action** window and captures the sequence of events as the device sends data on the bus. He then clicks on **Off** in the **Action** window of the analyzer.

Reading the Capture Display

The resulting capture display looks like the following screen.

This capture display shows that the device asserts EOI with the last byte.
The programmer remembers that he set up his application to expect an
End-of-String character to terminate the data transfer from the device. He
changes the program so that it expects the assertion of EOI to terminate the
data transfer. The application then runs without an error.

A

Common Questions

This appendix answers common questions about the GPIB analyzer.

Why can't I use the analyzer to monitor a GPIB application which uses the NI-488.2 `ibln` or `FindLstn` command?

You can use the analyzer to monitor an application with these commands, but you cannot select **Participate in Acceptor Handshaking** in the **Settings** dialog box of the analyzer. Selecting this feature asserts/unasserts the NDAC and NRFD lines in response to the Talker's assertion/unassertion of DAV in the GPIB handshake sequence. Therefore, when you run an application that executes a `FindLstn` or `ibln` command, all possible GPIB addresses are returned.

How does selecting "Participate in Acceptor Handshake" in the Settings dialog box affect the GPIB?

When **Participate in Acceptor Handshake** is selected, the analyzer circuitry behaves like a GPIB Listener for the duration of the capture and participates in acceptor handshaking on the GPIB. You can use this feature to slow down GPIB transfers to a particular rate and to avoid overflow errors.

How do I choose a handshake rate? What does "Maximum" mean?

You can use the handshake rate to slow down the transfer rate on the GPIB while debugging timing-related problems. Choosing a particular handshake rate guarantees that the transfer rate on the bus will be less than or equal to that rate. Choosing the **Maximum** rate causes the analyzer to respond as a Listener as fast as it can without causing overflow errors.

How do I define a trigger point to capture a command byte such as TA0?

In the Settings dialog box, set the data lines of the trigger condition by entering either the ASCII or hex equivalent of TA0 or set each of the data lines independently to represent TA0. Set the ATN, DAV, and NDAC lines to 1. Set NRFD to 0. The remainder of the control lines should be set to x.

This state of the handshake lines is necessary to guarantee that valid data is present on the data lines.

What do the rows of lights and switches in the Bus Monitor window represent?

The LEDs represent the state of the bus lines at all times. The toggle switches represent the assertion of lines from within the **Bus Monitor** window of the analyzer. So if the LED for a particular line is on, and the switch for that line is off (down position), the line is asserted, but not by the Bus Monitor.

What is the difference between active and inactive capture displays?

Active capture displays show GPIB events as they are being captured. In other words, active capture displays are windows into the single capture buffer used to store new GPIB events. Inactive capture displays show previously captured GPIB events statically, so that they are unaffected by newly-captured GPIB events. You must make the capture display inactive if you want to use the search or print features.

What do the "Capture Settings" in the Capture Display window mean?

The **Capture Settings** section of the **Capture Display** window shows the capture settings that were used when the data in the window was captured. They help you interpret the captured data in the **Capture Display** window. They are not necessarily the same as the current capture settings.

How do I use the timestamping information in detailed display mode and summarized display mode?

In detailed display mode, where each line can correspond to only one capture event, the timestamp value represents the time elapsed between the event on that line and the previous event. So if you want to determine the time elapsed between the capture of the first event and the fifth event, add up the timestamp values on the second, third, fourth, and fifth lines.

In summarized display mode, where more than one event can be present on a line, the timestamp value represents the time elapsed between the first event on that line and the first event on the previous line.

How can I prevent overflow errors?

For detailed information about avoiding overflow errors, refer to the *Avoid Overflow Errors* section in Chapter 3, *How To...*.

What information should I have before I call National Instruments?

Before you call National Instruments, make sure you have filled out the configuration form in Appendix C, *Customer Communication*.

B

Capture Display Mnemonics

This appendix explains the mnemonics that appear in the capture display of the GPIB analyzer application.

DAB   GPIB data byte captured using the data transfer or handshake line transition.

GPIB command bytes captured using the command transfer or handshake line transition:

ACG	Addressed command group.
CFE	Configuration enable.
DCL	Device clear.
GET	Group execute trigger.
GTL	Go to local.
LA0-LA30	Listen addresses 0-30.
LLO	Local lock out.
PPC	Parallel poll configure.
PPU	Parallel poll unconfigure.
SC0-SC30	Secondary command 0-30*.
SDC	Selected device clear.
SPD	Serial poll disable.
SPE	Serial poll enable.
TCT	Take control.
TA0-TA30	Talk addresses 0-30.
UCG	Universal command group.
UNL	Unlisten.
UNT	Untalk.

GPIB parallel poll responses captured using the parallel poll response capture stimulus:

PP-B	Parallel poll is beginning.
PP-E	Parallel poll is ending.
PP-R	Parallel poll response (occurs between PP-B and PP-E).

---

* If SC appears after a talk or listen address, it is a secondary address. If it appears after a parallel poll configure, it is either a parallel poll enable (PPE) or a parallel poll disable (PPD) command. If it appears after configuration enable (CFE), it is the cable length for HS488.

C

Customer Communication

For your convenience, this appendix contains forms to help you gather the information necessary to help us solve your technical problems and a form you can use to comment on the product documentation. When you contact us, we need the information on the Technical Support Form and the configuration form, if your manual contains one, about your system configuration to answer your questions as quickly as possible.

National Instruments has technical assistance through electronic, fax, and telephone systems to quickly provide the information you need. Our electronic services include a bulletin board service, an FTP site, a fax-on-demand system, and e-mail support. If you have a hardware or software problem, first try the electronic support systems. If the information available on these systems does not answer your questions, we offer fax and telephone support through our technical support centers, which are staffed by applications engineers.

Electronic Services

Bulletin Board Support

National Instruments has BBS and FTP sites dedicated for 24-hour support with a collection of files and documents to answer most common customer questions. From these sites, you can also download the latest instrument drivers, updates, and example programs. For recorded instructions on how to use the bulletin board and FTP services and for BBS automated information, call 512 795 6990. You can access these services at:

United States: 512 794 5422
Up to 14,400 baud, 8 data bits, 1 stop bit, no parity

United Kingdom: 01635 551422
Up to 9,600 baud, 8 data bits, 1 stop bit, no parity

France: 01 48 65 15 59
Up to 9,600 baud, 8 data bits, 1 stop bit, no parity

FTP Support

To access our FTP site, log on to our Internet host, `ftp.natinst.com`, as `anonymous` and use your Internet address, such as `joesmith@anywhere.com`, as your password. The support files and documents are located in the `/support` directories.

Fax-on-Demand Support

Fax-on-Demand is a 24-hour information retrieval system containing a library of documents on a wide range of technical information. You can access Fax-on-Demand from a touch-tone telephone at 512 418 1111.

E-Mail Support (Currently USA Only)

You can submit technical support questions to the applications engineering team through e-mail at the Internet address listed below. Remember to include your name, address, and phone number so we can contact you with solutions and suggestions.

`support@natinst.com`

Telephone and Fax Support

National Instruments has branch offices all over the world. Use the list below to find the technical support number for your country. If there is no National Instruments office in your country, contact the source from which you purchased your software to obtain support.

Country	Telephone	Fax
Australia	03 9879 5166	03 9879 6277
Austria	0662 45 79 90 0	0662 45 79 90 19
Belgium	02 757 00 20	02 757 03 11
Brazil	011 288 3336	011 288 8528
Canada (Ontario)	905 785 0085	905 785 0086
Canada (Québec)	514 694 8521	514 694 4399
Denmark	45 76 26 00	45 76 26 02
Finland	09 725 725 11	09 725 725 55
France	01 48 14 24 24	01 48 14 24 14
Germany	089 741 31 30	089 714 60 35
Hong Kong	2645 3186	2686 8505
Israel	03 6120092	03 6120095
Italy	02 413091	02 41309215
Japan	03 5472 2970	03 5472 2977
Korea	02 596 7456	02 596 7455
Mexico	5 520 2635	5 520 3282
Netherlands	0348 433466	0348 430673
Norway	32 84 84 00	32 84 86 00
Singapore	2265886	2265887
Spain	91 640 0085	91 640 0533
Sweden	08 730 49 70	08 730 43 70
Switzerland	056 200 51 51	056 200 51 55
Taiwan	02 377 1200	02 737 4644
United Kingdom	01635 523545	01635 523154
United States	512 795 8248	512 794 5678

Technical Support Form

Photocopy this form and update it each time you make changes to your software or hardware, and use the completed copy of this form as a reference for your current configuration. Completing this form accurately before contacting National Instruments for technical support helps our applications engineers answer your questions more efficiently.

If you are using any National Instruments hardware or software products related to this problem, include the configuration forms from their user manuals. Include additional pages if necessary.

Name _____

Company _____

Address _____

_____

Fax (___) _____Phone (___) _____

Computer brand_____ Model _____Processor_____

Operating system (include version number) _____

Clock speed _____MHz RAM _____MB   Display adapter _____

Mouse ___yes   ___no   Other adapters installed_____

Hard disk capacity _____MB Brand_____

Instruments used _____

_____

National Instruments hardware product model _____ Revision _____

Configuration _____

National Instruments software product _____ Version _____

Configuration _____

The problem is: _____

_____

_____

_____

_____

List any error messages: _____

_____

_____

The following steps reproduce the problem: _____

_____

_____

_____

_____

GPIB Hardware and Software Configuration Form

Record the settings and revisions of your hardware and software on the line to the right of each item. Complete a new copy of this form each time you revise your software or hardware configuration, and use this form as a reference for your current configuration. Completing this form accurately before contacting National Instruments for technical support helps our applications engineers answer your questions more efficiently.

National Instruments Products

GPIB Hardware Product and Revision _____

GPIB Analyzer Software Version _____

GPIB Software Version Number on Distribution Disk(s) _____

Programming Language Interface Version _____

Board Settings

	Base Address	Interrupt Level	DMA Channel	Board Type
gpib0	_____	_____	_____	_____
gpib1	_____	_____	_____	_____
gpib2	_____	_____	_____	_____
gpib3	_____	_____	_____	_____

Other Products

Computer Make and Model_____

Microprocessor _____

Clock Frequency _____

Type of Monitor Card Installed_____

Windows Version _____

Application Programming Language (BASICA, Microsoft C, and so on) _____

_____

Other Boards in System_____

Base I/O Address of Other Boards _____

Interrupt Level of Other Boards _____

DMA Channels of Other Boards_____

Documentation Comment Form

National Instruments encourages you to comment on the documentation supplied with our products. This information helps us provide quality products to meet your needs.

Title: *GPIB Analyzer User Manual*

Edition Date: June 1998

Part Number: 320931C-01

Please comment on the completeness, clarity, and organization of the manual.

_____

_____

_____

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If you find errors in the manual, please record the page numbers and describe the errors.

_____

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Thank you for your help.

Name _____

Title _____

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Glossary

Prefix	Meanings	Value
n-	nano-	10^{-9}
μ-	micro-	10^{-6}
m-	milli-	10^{-3}
k-	kilo-	10^3
M-	mega-	10^6

ANSI	American National Standards Institute
applet	program that can only be used within another application
ASCII	American Standard Code for Information Interchange
B	bytes
DIO	digital input/output
DMA	direct memory access
EOI	end or identify
EOS	End-of-String
FCC	Federal Communications Commission
FIFO	first-in-first-out
FTP	file transfer protocol
GPIB	General Purpose Interface Bus
hex	hexadecimal
HS488	high-speed IEEE 488 transfers
Hz	hertz
IEEE	Institute of Electrical and Electronic Engineers

in.	inches
I/O	input/output
IRQ	interrupt request
ISA	Industry Standard Architecture
Kbytes	kilobytes
LED	light-emitting diode
legacy board	ISA board whose system resources are chosen by changing physical switches or jumpers on the board
m	meters
MB	megabytes of memory
PC	personal computer
PCI	Peripheral Component Interconnect
PCMCIA	Personal Computer Memory Card International Association
PLC	Programmable Logic Controller
RAM	random-access memory
resource	hardware settings used by devices in a computer system, including ISA interrupt level, DMA channel, and base I/O address
s	seconds
VCCI	Voluntary Control Council for Interference
VDC	volts direct current
VXI	VME eXtensions for Instrumentation