# NI-488.2™

## GPIB Analyzer User Manual

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| | |
|---|---|
| <> | Angle brackets that contain numbers separated by an ellipsis represent a range of values associated with a bit or signal name—for example, DIO<3..0>. |
| » | The » symbol leads you through nested menu items and dialog box options to a final action. The sequence **File»Page Setup»Options** directs you to pull down the **File** menu, select the **Page Setup** item, and select **Options** from the last dialog box. |
| **bold** | Bold text denotes items that you must select or click in the software, such as menu items and dialog box options. Bold text also denotes parameter names. |
| *italic* | Italic text denotes variables, emphasis, a cross reference, or an introduction to a key concept. This font also denotes text that is a placeholder for a word or value that you must supply. |
| `monospace` | Text in this font denotes text or characters that you should 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 code excerpts. |
| **`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. |

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# 1

# GPIB Analyzer Overview

This chapter gives an overview of the GPIB analyzer software.

## 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 Microsoft Windows and with one of the National Instruments GPIB interfaces that supports the GPIB analyzer. This manual assumes you are already familiar with the Windows system you are using.

## GPIB Analyzer Overview

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.

## 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 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 GPIB data and control line.
- **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 nonintrusive 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 timestamp captured events. The number of recorded capture events can be configured to be between 10 and 99999999 and is limited 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 previously captured data in another display.

# Starting the GPIB Analyzer

Launch the GPIB analyzer application from Measurement & Automation Explorer (MAX), which is started by selecting **Start»Programs»National Instruments»NI-488.2»Explore GPIB**. To start the GPIB analyzer, select **Tools»NI-488.2»GPIB Analyzer**.

# 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 GPIB data and control line.
- **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.

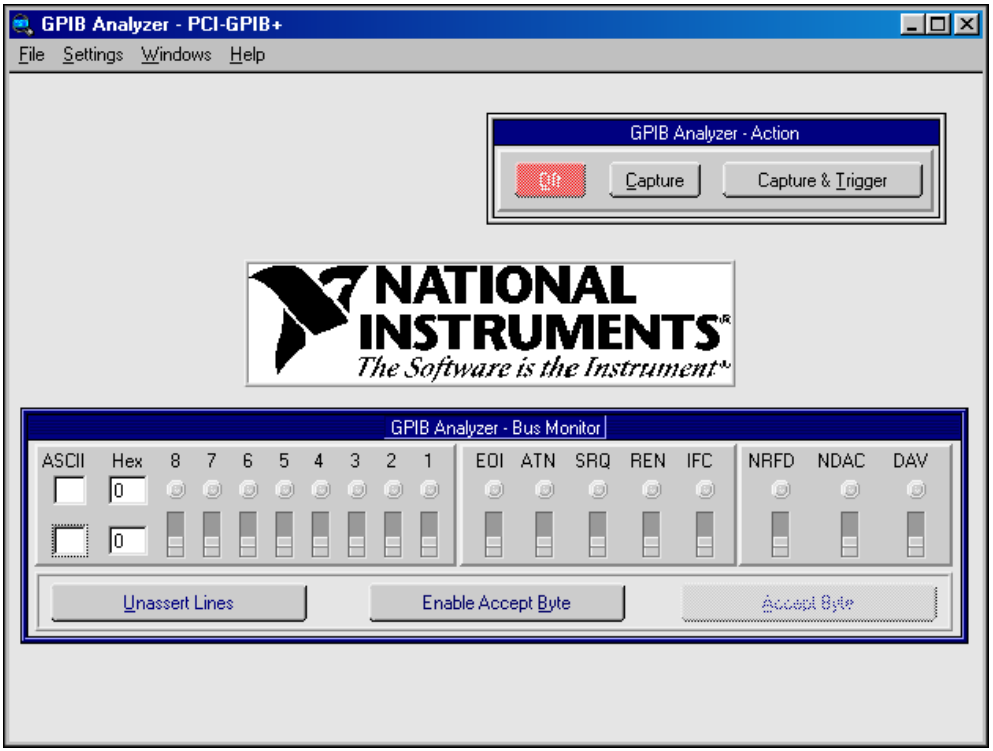



**Figure 2-1.** Main Window of the GPIB Analyzer

# 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 the events in the active capture display.

## File»Open Capture Display

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. Refer to the *Settings Configuration* section 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 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.

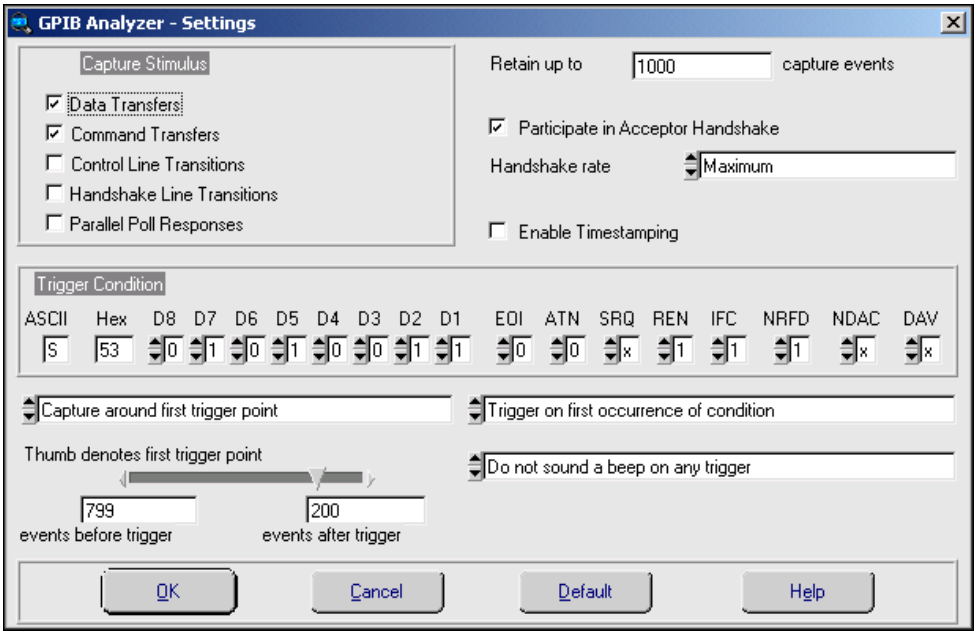



**Figure 2-2.** Settings Configuration Dialog Box

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 manage the GPIB interface system.

The **Handshake Line Transitions** checkbox enables the capture of GPIB handshake line transitions (NRFD, NDAC, DAV). The handshake lines control the transfer of both GPIB data and command bytes. Selecting this option causes a large amount of GPIB events to be captured and could cause overflow errors; therefore, 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 the *Configure the Settings* section of 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. Also notice 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 occur 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 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 the **Cancel** button cancels the changes made to the settings and closes the window.

Clicking 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, select **Windows»Action Window** to bring it to the front.

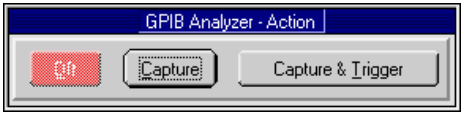



**Figure 2-3.** Action Window

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

Clicking 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 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.

Clicking 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, select **Windows»Bus Monitor** to bring it to the front.

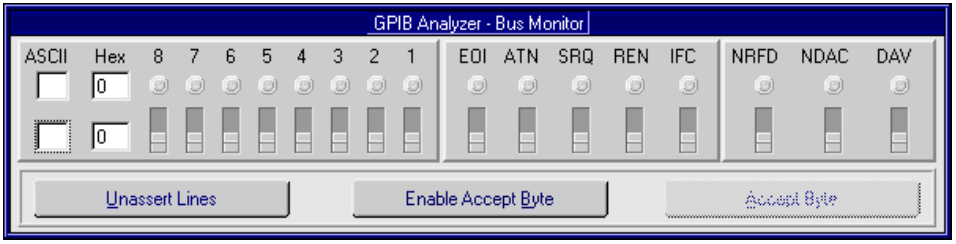



**Figure 2-4.** Bus Monitor Window

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

Clicking 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 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 you are finished accepting data, clicking 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 **Accept Byte** has no effect because no data is available to be accepted. If DAV is asserted, clicking **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 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. To switch between active and inactive capture modes, you can click the **Switch to Active (Inactive) Display** button to toggle between the two modes. Figure 2-5 shows an example of an inactive **Capture Display** window.

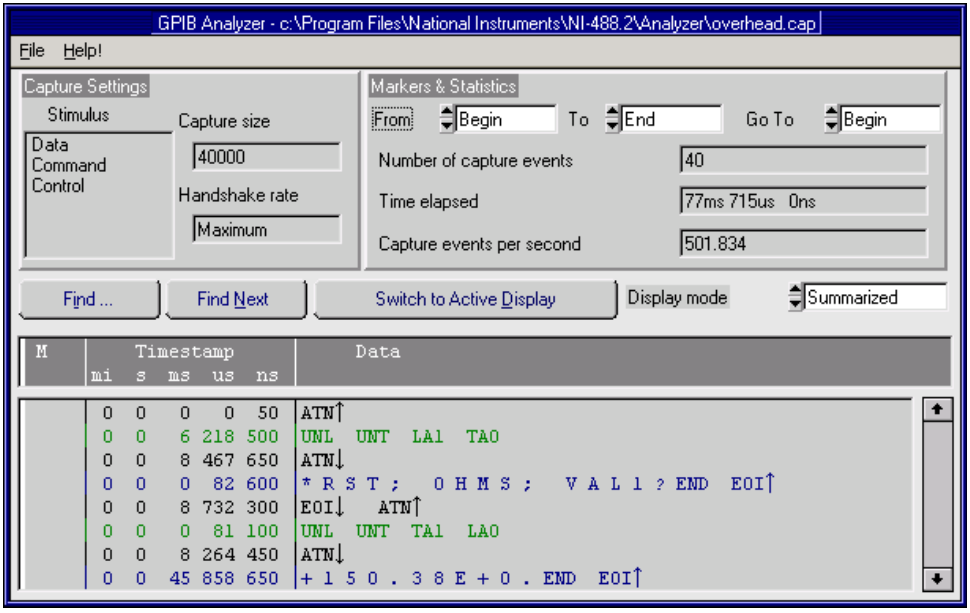



**Figure 2-5.** Capture Display Window (Inactive)

## 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 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 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 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 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 the **Find Next** button in the inactive capture display.

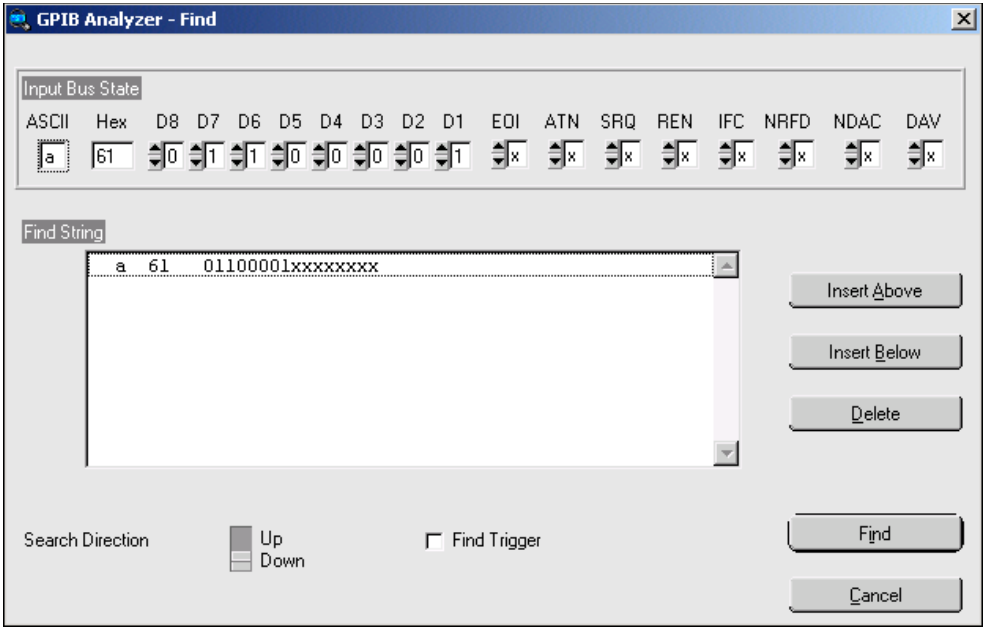



**Figure 2-6.** Find Dialog Box

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

## Install the GPIB Analyzer

The GPIB analyzer software is installed along with the other NI-488.2 software components from the *NI-488.2 for Windows* CD. To install the GPIB analyzer, insert the CD and choose the **Install Software** option from the CD autorun screen.

## Start the GPIB Analyzer

Launch the GPIB analyzer application from Measurement & Automation Explorer (MAX), which is started by selecting **Start»Programs»National Instruments»NI-488.2»Explore GPIB**. To start the GPIB analyzer, select **Tools»NI-488.2»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 the **Capture** or **Capture & Trigger** button in the **Action** window to begin capturing data.

To stop capturing new data, click 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 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 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 the **Enable Accept Byte** button in the **Bus Monitor** window. Then click 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 **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 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* section and the *Configuration of Other Trigger Settings* section of Chapter 2, *GPIB Analyzer Features*, for details on all the trigger settings you can configure.
4. When you are finished making changes, click **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 Nonintrusive 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.

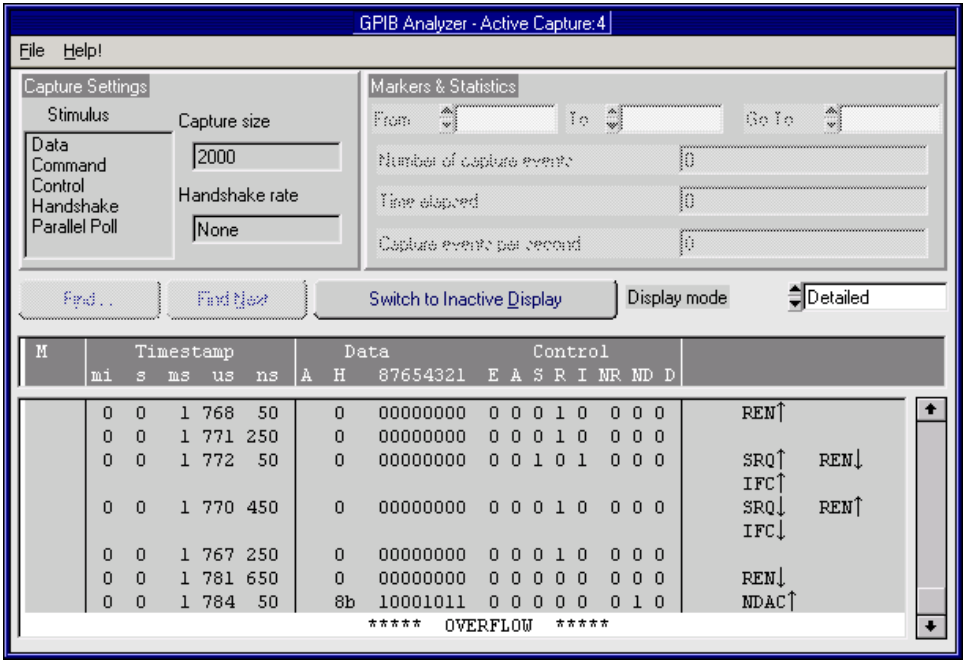



**Figure 3-1.** Overflow Error

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↑ and NRFD↓, 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, select **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. 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 | µs |
| Milliseconds | ms |

**Table 3-2.** Timestamp Abbreviations in the Capture Display Window (Continued)

| Time Unit | Abbreviation |
|---|---|
| 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 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 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 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 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, select **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 also can 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 NI-488.2 software, GPIB analyzer software, and GPIB analyzer hardware are installed on your computer. For installation instructions, refer to the *Install the GPIB Analyzer* section of Chapter 3, *How To…*.

  This assumes that the GPIB controller with GPIB analyzer capability is configured as GPIB0.
- Disconnect all GPIB cables from your GPIB hardware.

## Part 1. Capture and View New Data

1. Launch the GPIB analyzer application from Measurement & Automation Explorer (MAX) by selecting **Start»Programs»National Instruments»NI-488.2»Explore GPIB**. To start the GPIB analyzer, select **Tools»NI-488.2»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 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 Figure 4-1.

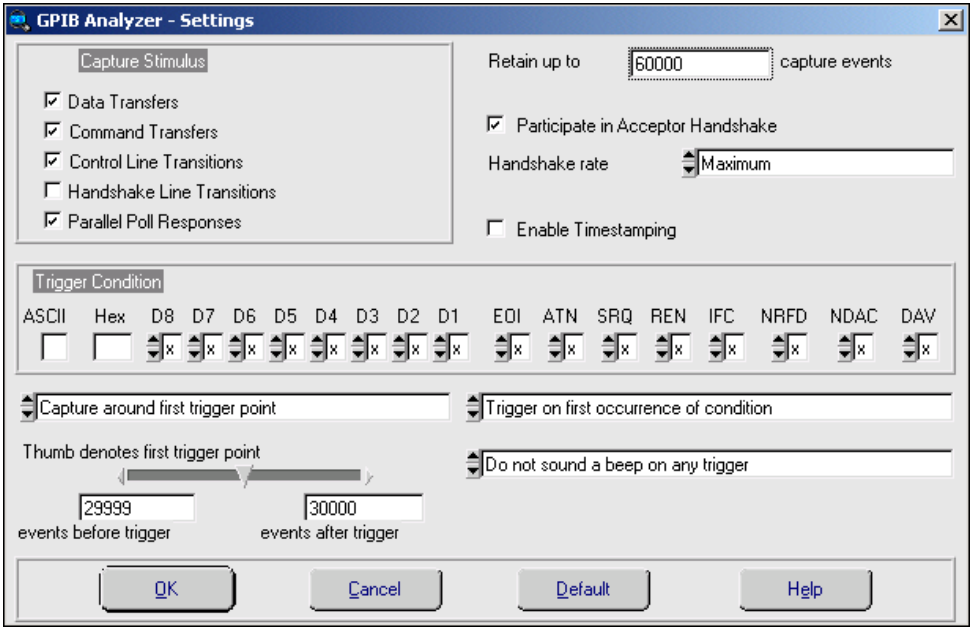



**Figure 4-1.** GPIB Analyzer Settings

6. Click **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.

8. Click the **Capture** button in the **Action** window. The analyzer is ready to capture GPIB events.

9. Open the Interactive Control utility from MAX, which is started by selecting **Start»Programs»National Instruments»NI-488.2» Explore GPIB**. To start Interactive Control, select **Tools» NI-488.2» Interactive Control**.

10. At the prompt, enter `$ "c:\Program Files\National Instruments\NI-488.2\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 Interactive Control utility.
12. Switch back to the GPIB analyzer, and click **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 Figure 4-2.

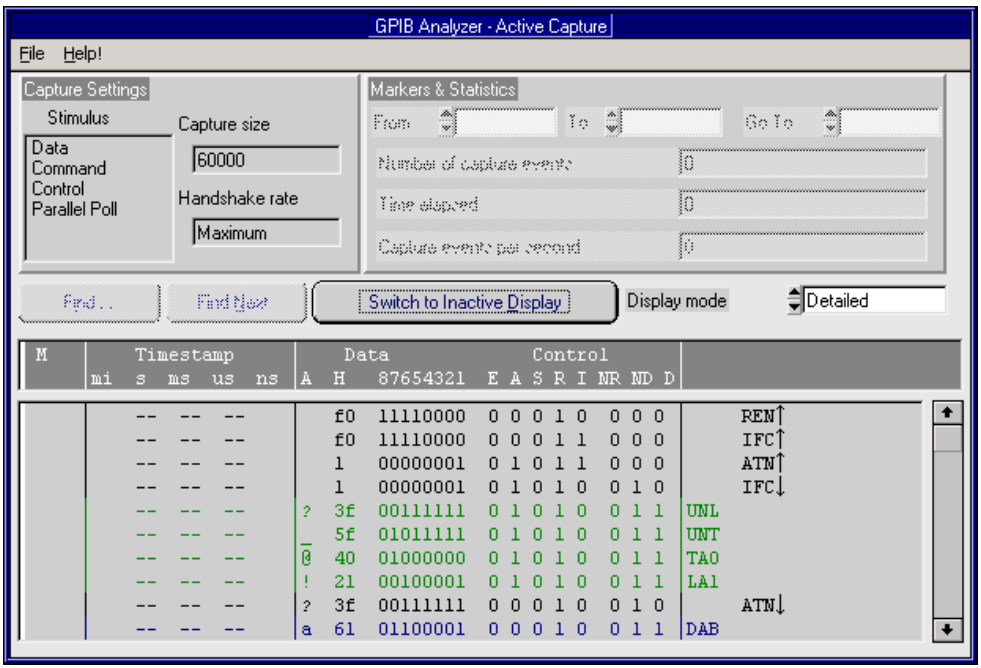



**Figure 4-2.** Capture Display Window

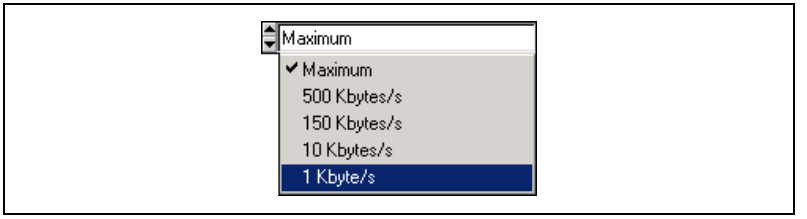
By default, the capture display is in detailed mode, which shows one GPIB event per line. This mode shows the greatest amount of detail, including the status of each GPIB line and helpful mnemonics. In this display, you can see that the tutorial script file issued the following commands: clear the GPIB 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. Deselect 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 **Maximum** in the **Handshake rate** box to see your choices. Then click 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 enable 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** to **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 that **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 shows five 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 Figure 4-3.

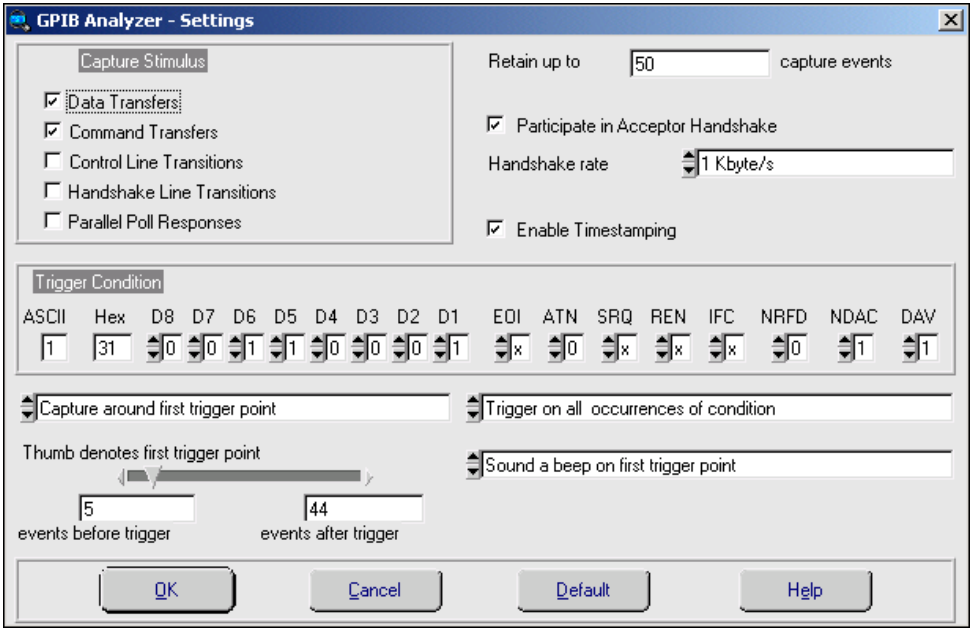



**Figure 4-3.** GPIB Analyzer Settings

11. Click **OK** to use these settings.
12. Bring the **Action** window to the front by choosing **Windows»Action Window**. Click 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 **Capture & Trigger**.

14. Open the Interactive Control utility from MAX, which is started by selecting **Start»Programs»National Instruments»NI-488.2» Explore GPIB**. To start Interactive Control, select **Tools» NI-488.2» Interactive Control**.
15. At the prompt, enter `$ "c:\Program Files\National Instruments\NI-488.2\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 **Off** in the **Action** window to stop the capture.
17. In the active **Capture Display** window, click **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 Figure 4-4.

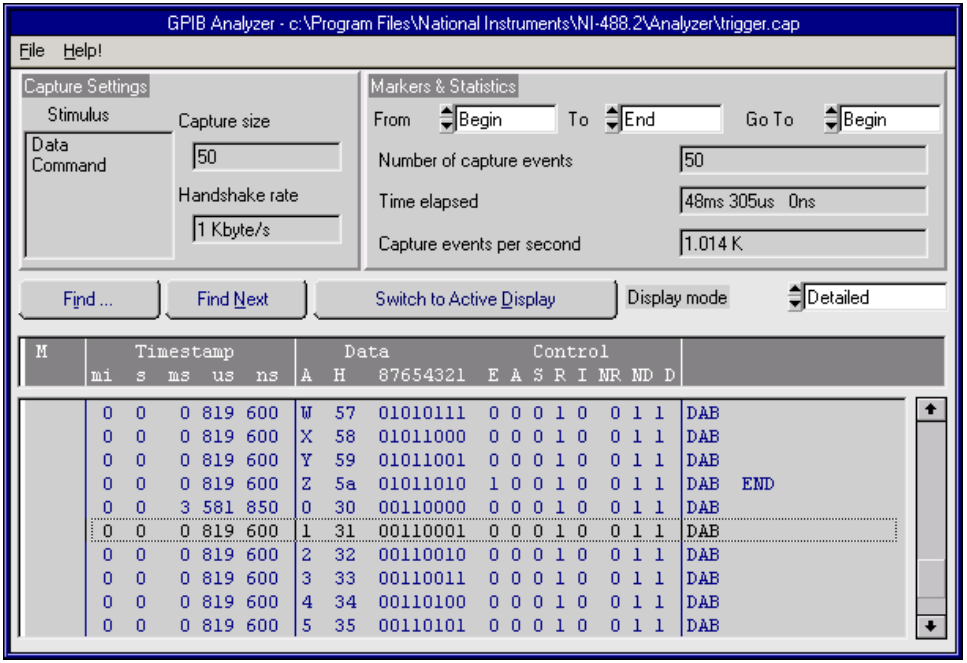



**Figure 4-4.** Capture Display Window

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 `trigger.cap` as the capture filename and click **Save**. Notice that `trigger.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 `trigger.cap` to retrieve the capture file that you saved in part 2 of this tutorial, and click **OK**. The capture file is automatically opened as an inactive display.
4. Click 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 **Find** to start the search. The result will be highlighted as shown in Figure 4-5. ASCII 1 appears in the “A” column of the highlighted row.

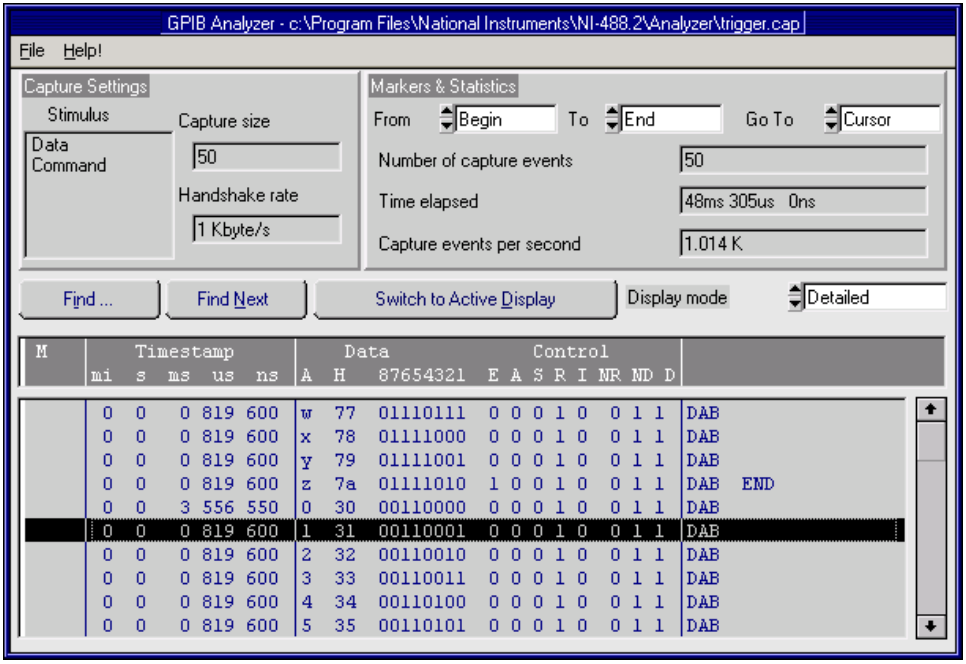



**Figure 4-5.** Capture Display Window

7. Click the **Find** button to bring up the **Find** dialog box.
8. Deselect the **Find Trigger** checkbox.
9. In the **Input Bus State** section, enter `5` in the **ASCII** edit control.
10. Click **Find** to locate the search pattern.
11. Return to the **Find** dialog box.
12. To create a string to search for, 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 searches for in the capture file. The **Find** dialog box should look like Figure 4-6.

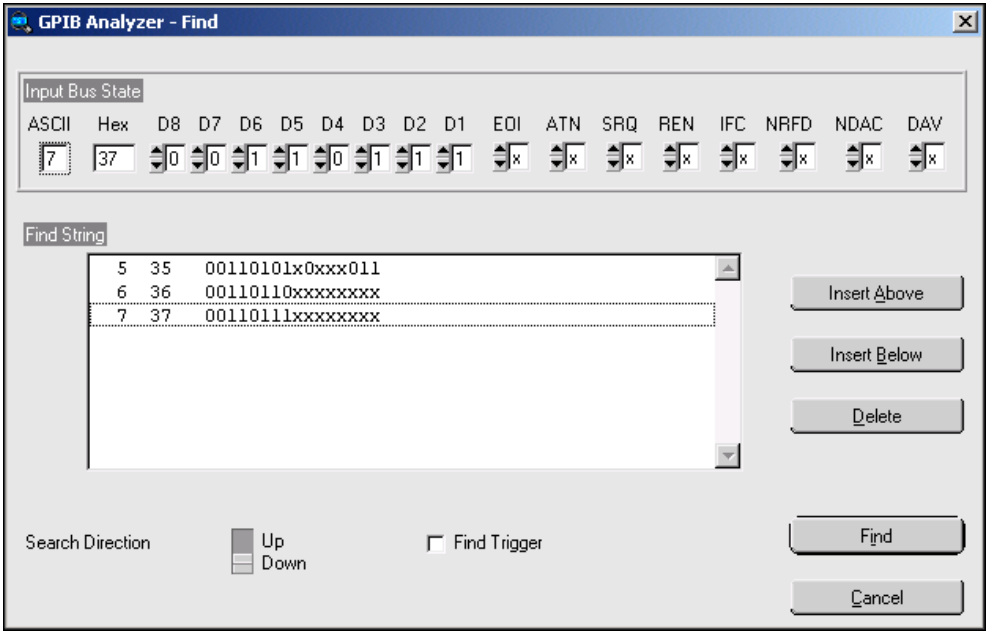



**Figure 4-6.** Find Dialog Box

15. Click **Find** to search for the string “567.”

16. The first character of the matched search string, “5,” will be highlighted as shown in Figure 4-7.

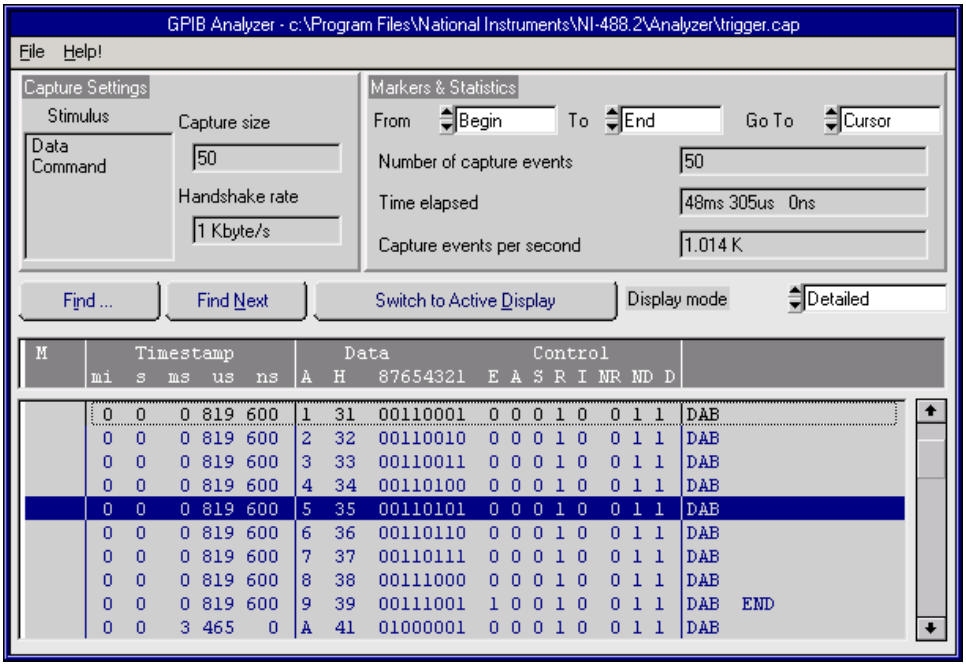



**Figure 4-7.** Capture Display Window

17. Click 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 `trigger.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 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 Figure 4-8.

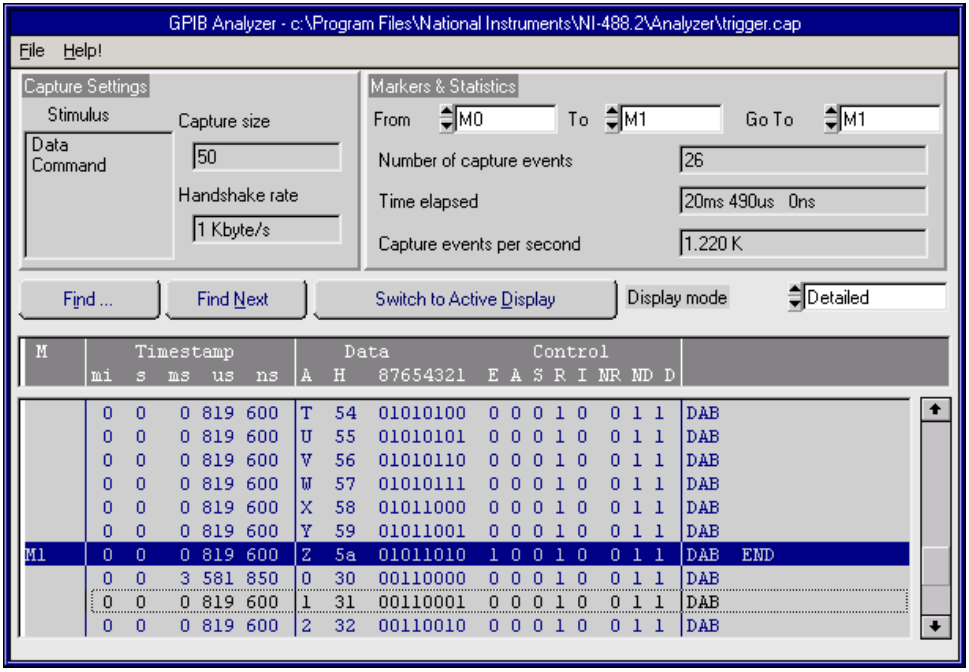



**Figure 4-8.** Capture Display Window

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 `trigger.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 **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 `trigger.txt` in the export dialog box, and click **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 in which a GPIB interface 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 Figure 5-1.

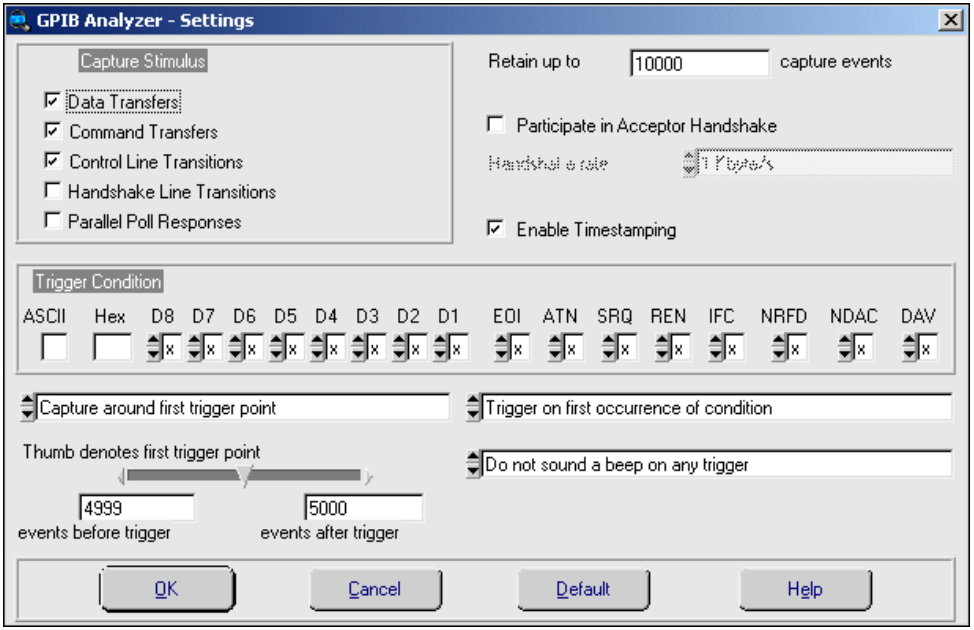



**Figure 5-1.** GPIB Analyzer Settings

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

## Reading the Capture Display

Figure 5-2 shows the resulting capture display.

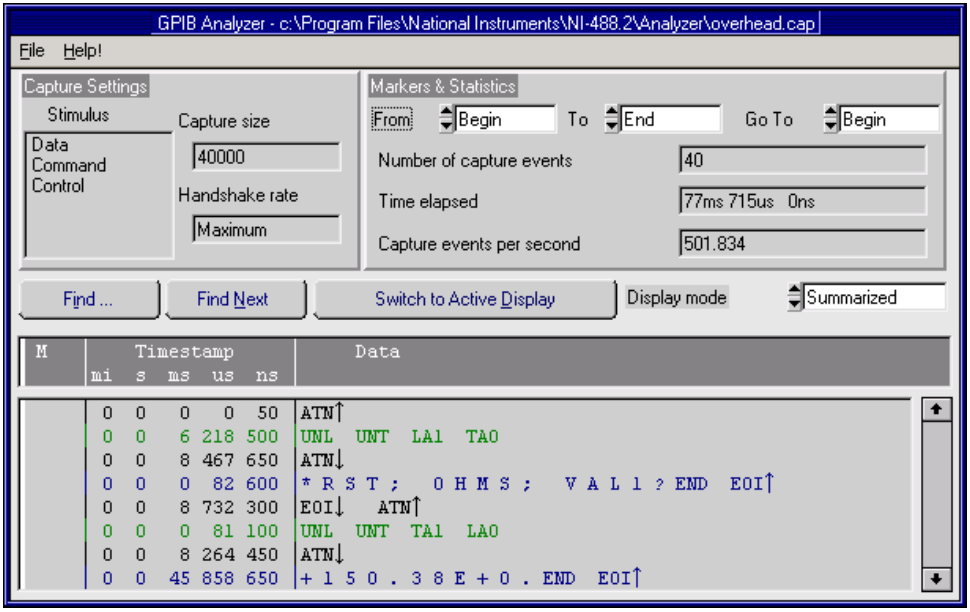



**Figure 5-2.** Capture Display WIndow

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 45 ms, 858 µs, and 650 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 can 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 Figure 5-3.

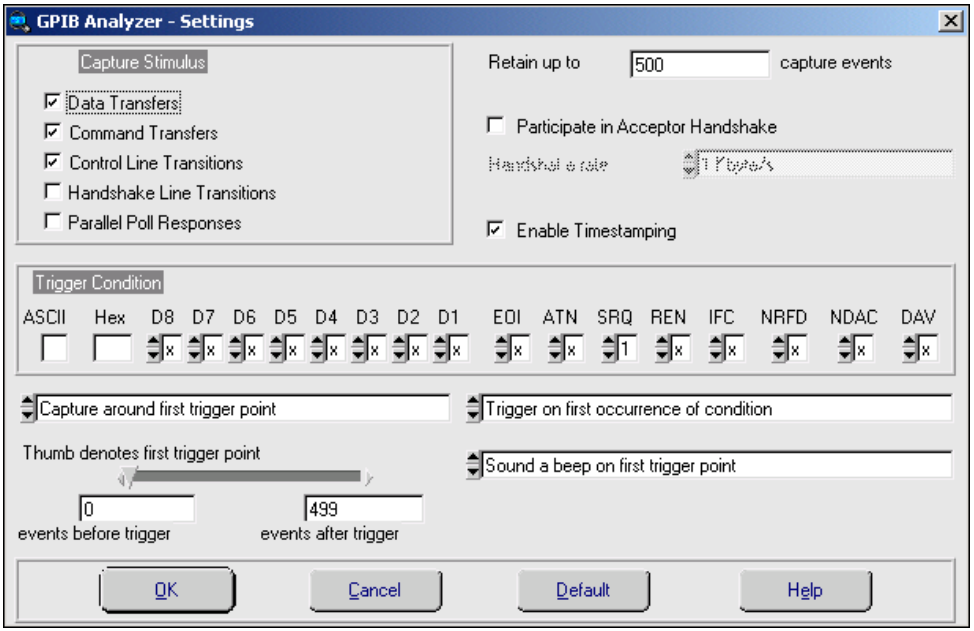



**Figure 5-3.** GPIB Analyzer Settings

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 Figure 5-4.

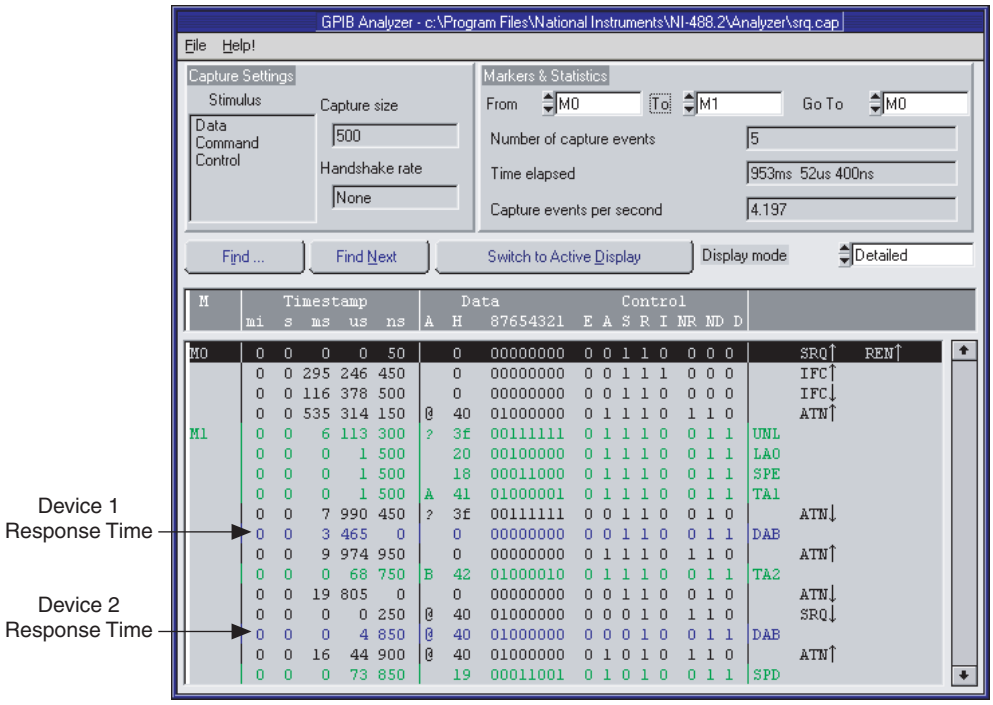



**Figure 5-4.** Capture Display Window

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 953 ms, 52 µs, and 400 ns to respond to the service request.

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 3 ms and 465 µs 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 4 µs and 850 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 an NI-488.2 application, but her device is not responding to the application.

## 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 Figure 5-5.

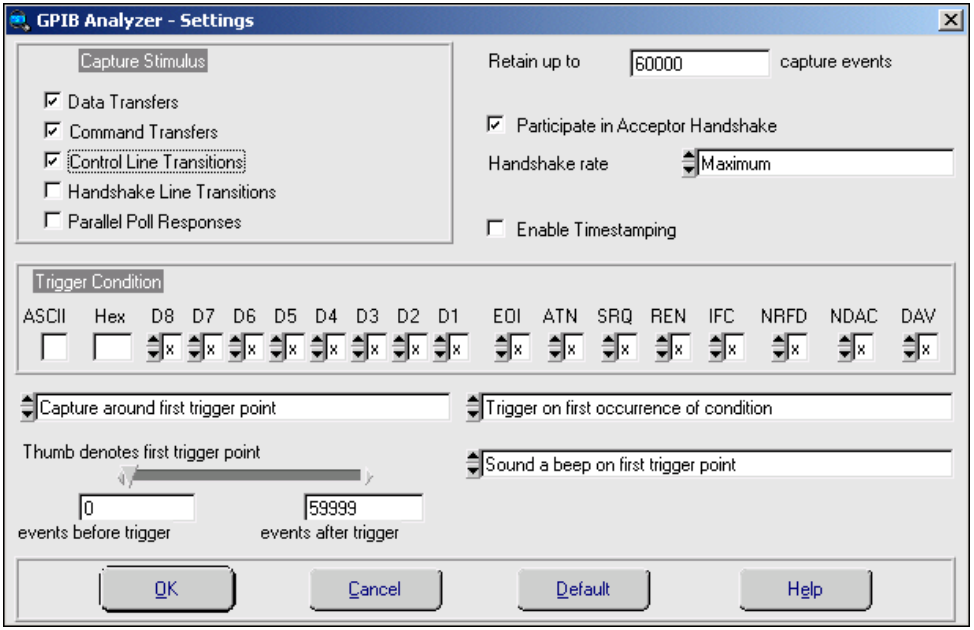



**Figure 5-5.** GPIB Analyzer Settings

The programmer chooses **Capture** in the **Action** window and captures the sequence of events on the GPIB. She then clicks **Off** in the **Action** window of the analyzer.

## Reading the Capture Display

The resulting capture display looks like Figure 5-6.

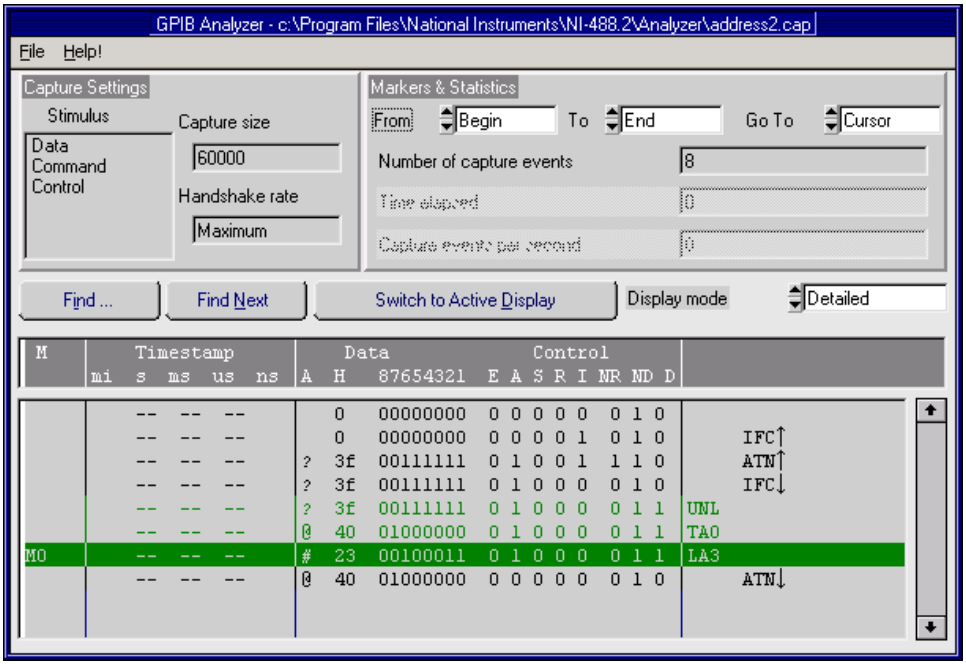



**Figure 5-6.** Capture Display WIndow

In this example, the Controller does not seem to be sending any data bytes. In her application, the programmer set up the device to have primary address 3 and secondary address 0. 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 Figure 5-7.

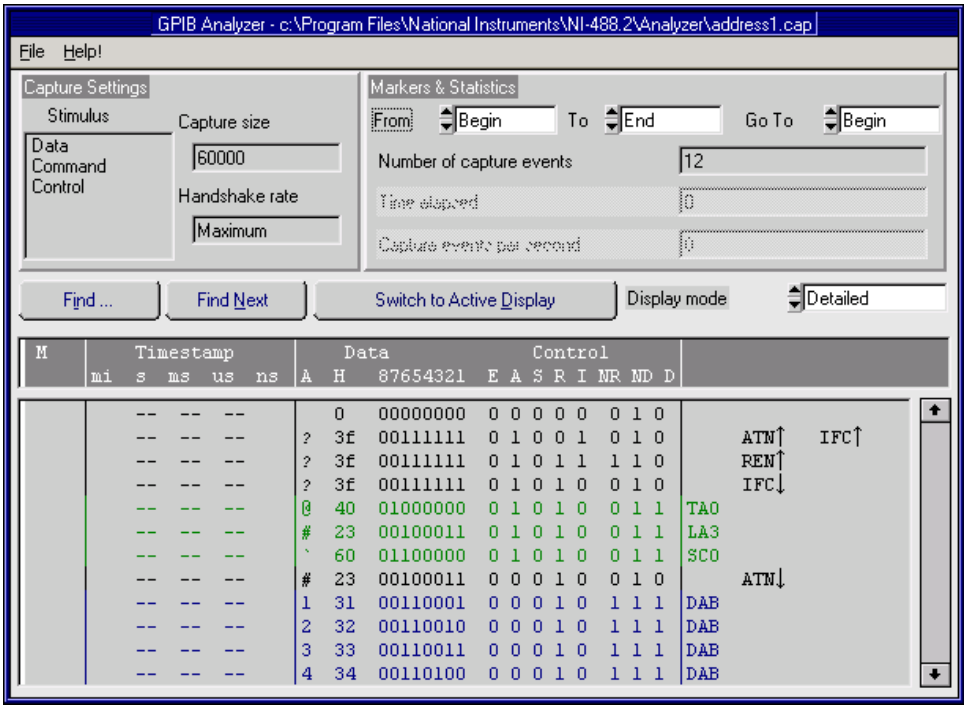



**Figure 5-7.** Capture Display Window

# 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 Figure 5-8.

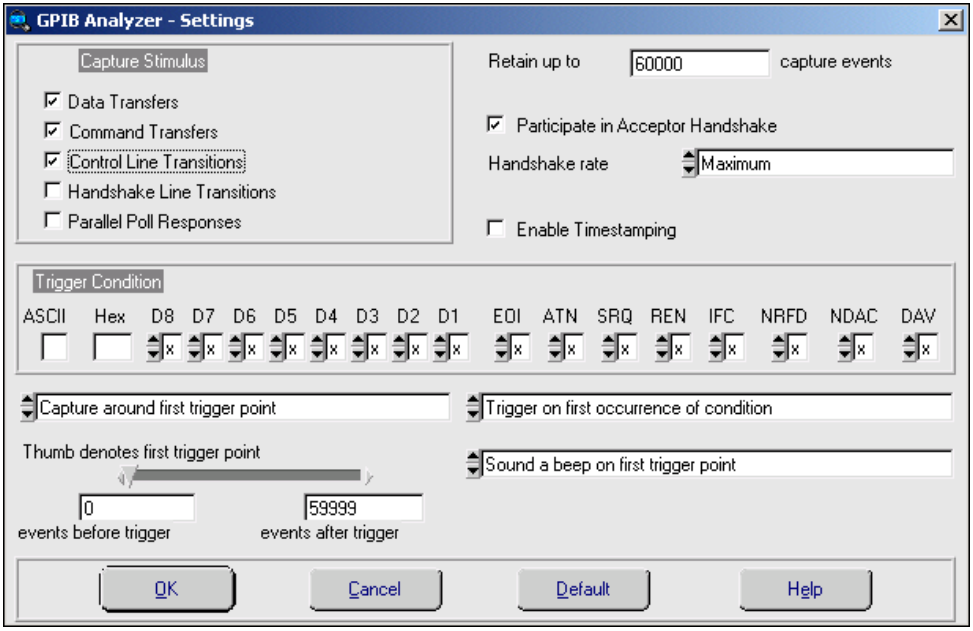



**Figure 5-8.** Capture Display Window

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 **Off** in the **Action** window of the analyzer.

## Reading the Capture Display

The resulting capture display looks like Figure 5-9.

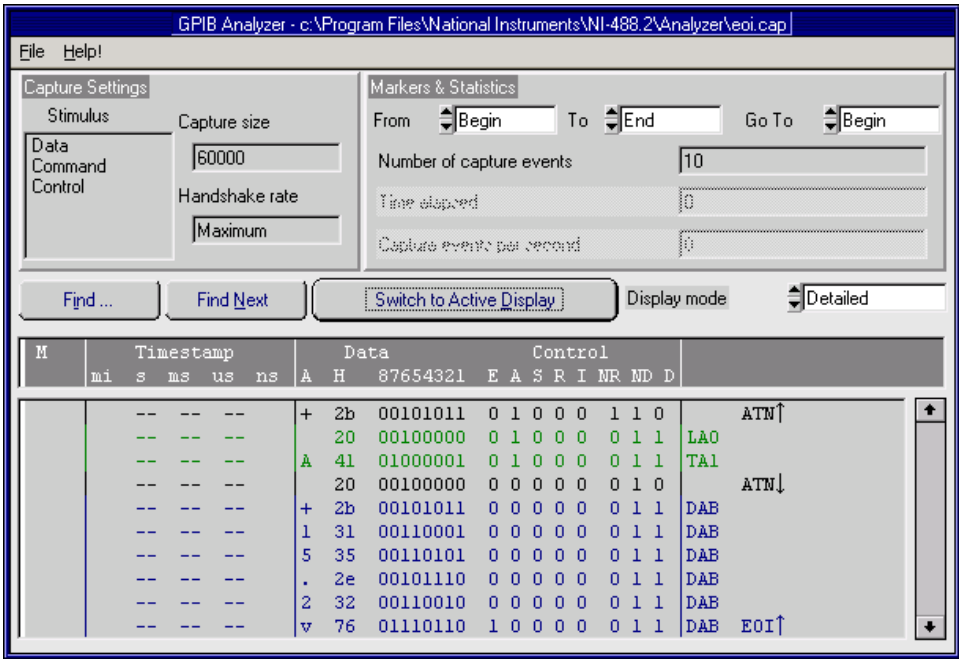



**Figure 5-9.** Capture Display Window

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 an NI-488.2 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. 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. 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 of Chapter 3, *How To…*.

# 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[1] |
| SDC | Selected device clear |
| SPD | Serial poll disable |
| SPE | Serial poll enable |
| TCT | Take control |

[1] 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.

| | |
|---|---|
| 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) |

# C

# Technical Support and Professional Services

Visit the following sections of the National Instruments Web site at ni.com for technical support and professional services:

- **Support**—Online technical support resources include the following:
  - **Self-Help Resources**—For immediate answers and solutions, visit our extensive library of technical support resources available in English, Japanese, and Spanish at ni.com/support. These resources are available for most products at no cost to registered users and include software drivers and updates, a KnowledgeBase, product manuals, step-by-step troubleshooting wizards, hardware schematics and conformity documentation, example code, tutorials and application notes, instrument drivers, discussion forums, a measurement glossary, and so on.
  - **Assisted Support Options**—Contact NI engineers and other measurement and automation professionals by visiting ni.com/ask. Our online system helps you define your question and connects you to the experts by phone, discussion forum, or email.
- **Training**—Visit ni.com/custed for self-paced tutorials, videos, and interactive CDs. You also can register for instructor-led, hands-on courses at locations around the world.
- **System Integration**—If you have time constraints, limited in-house technical resources, or other project challenges, NI Alliance Program members can help. To learn more, call your local NI office or visit ni.com/alliance.

If you searched ni.com and could not find the answers you need, contact your local office or NI corporate headquarters. Phone numbers for our worldwide offices are listed at the front of this manual. You also can visit the Worldwide Offices section of ni.com/niglobal to access the branch office Web sites, which provide up-to-date contact information, support phone numbers, email addresses, and current events.

# Glossary

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

## A

| | |
|---|---|
| ANSI | American National Standards Institute |
| applet | program that can only be used within another application |
| ASCII | American Standard Code for Information Interchange |

## B

| | |
|---|---|
| B | bytes |

## D

| | |
|---|---|
| DIO | digital input/output |
| DMA | direct memory access |

## E

| | |
|---|---|
| EOI | end or identify |
| EOS | End-of-String |

## F

| | |
|---|---|
| FCC | Federal Communications Commission |
| FIFO | first-in-first-out |
| FTP | file transfer protocol |

## G

| | |
|---|---|
| GPIB | General Purpose Interface Bus |

## H

| | |
|---|---|
| hex | hexadecimal |
| HS488 | high-speed IEEE 488 transfers |
| Hz | hertz |

## I

| | |
|---|---|
| I/O | input/output |
| IEEE | Institute of Electrical and Electronic Engineers |
| in. | inches |
| IRQ | interrupt request |
| ISA | Industry Standard Architecture |

## K

| | |
|---|---|
| Kbytes | kilobytes |

## L

| | |
|---|---|
| LED | light-emitting diode |
| legacy board | ISA board whose system resources are chosen by changing physical switches or jumpers on the board |

## M

| | |
|---|---|
| m | meters |
| MB | megabytes of memory |

## P

| | |
|---|---|
| PC | personal computer |
| PCI | Peripheral Component Interconnect |
| PCMCIA | Personal Computer Memory Card International Association |
| PLC | Programmable Logic Controller |

## R

| | |
|---|---|
| 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

| | |
|---|---|
| s | seconds |

# V

| | |
|---|---|
| VCCI | Voluntary Control Council for Interference |
| VDC | volts direct current |
| VXI | VME eXtensions for Instrumentation |

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