# GPIB Analyzer Help

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This help file describes the GPIB analyzer software. The GPIB analyzer is an application that you can use for testing, debugging, and analysis. It can monitor, capture, and participate in bus activity on the GPIB.

To navigate this help file, use the **Contents**, **Index**, and **Search** tabs to the left of this window.

For more information about this help file, refer to the following topics:

Conventions—formatting and typographical conventions in this help file

Glossary

Important Information

Technical Support and Professional Services

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# Conventions

This help file uses the following conventions:

| | |
|---|---|
| » | 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, emphasis, or an introduction to a key concept. |
| green | Underlined text in this color denotes a link to a help topic, help file, or Web address. |
| *italic* | Italic text denotes variables or cross references. 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. |

# Glossary

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

| | |
|---|---|
| ASCII | American Standard Code for Information Interchange |
| DIO | digital input/output |
| EOI | end or identify |
| EOS | End-of-String |
| FIFO | first-in-first-out |
| GPIB | General Purpose Interface Bus |
| hex | hexadecimal |
| HS488 | high-speed IEEE 488 transfers |
| IEEE | Institute of Electrical and Electronic Engineers |
| LED | light-emitting diode |
| m | meters |
| s | seconds |

# GPIB Analyzer Overview

The GPIB analyzer is an application that you can use 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 User Manual* includes a tutorial chapter and a chapter containing examples to show you how you might use the analyzer. The user manual is available on your *NI-488.2 for Windows* CD. To view this document online, insert your *NI-488.2 for Windows* CD. When the **NI-488.2 for Windows** screen appears, select the **Getting Started Documentation** option. The Getting Started Documentation utility helps you find the documentation you want to view.

For detailed information about using the GPIB analyzer, see GPIB Analyzer Features.

**See also:**

Capturing Data with the GPIB Analyzer

Analyzing Captured Data with the GPIB Analyzer

Exiting the GPIB Analyzer

# 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.

Note 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.
- Multiple capture displays can be viewed simultaneously.

# 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.

# 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.

# GPIB Analyzer Features

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.

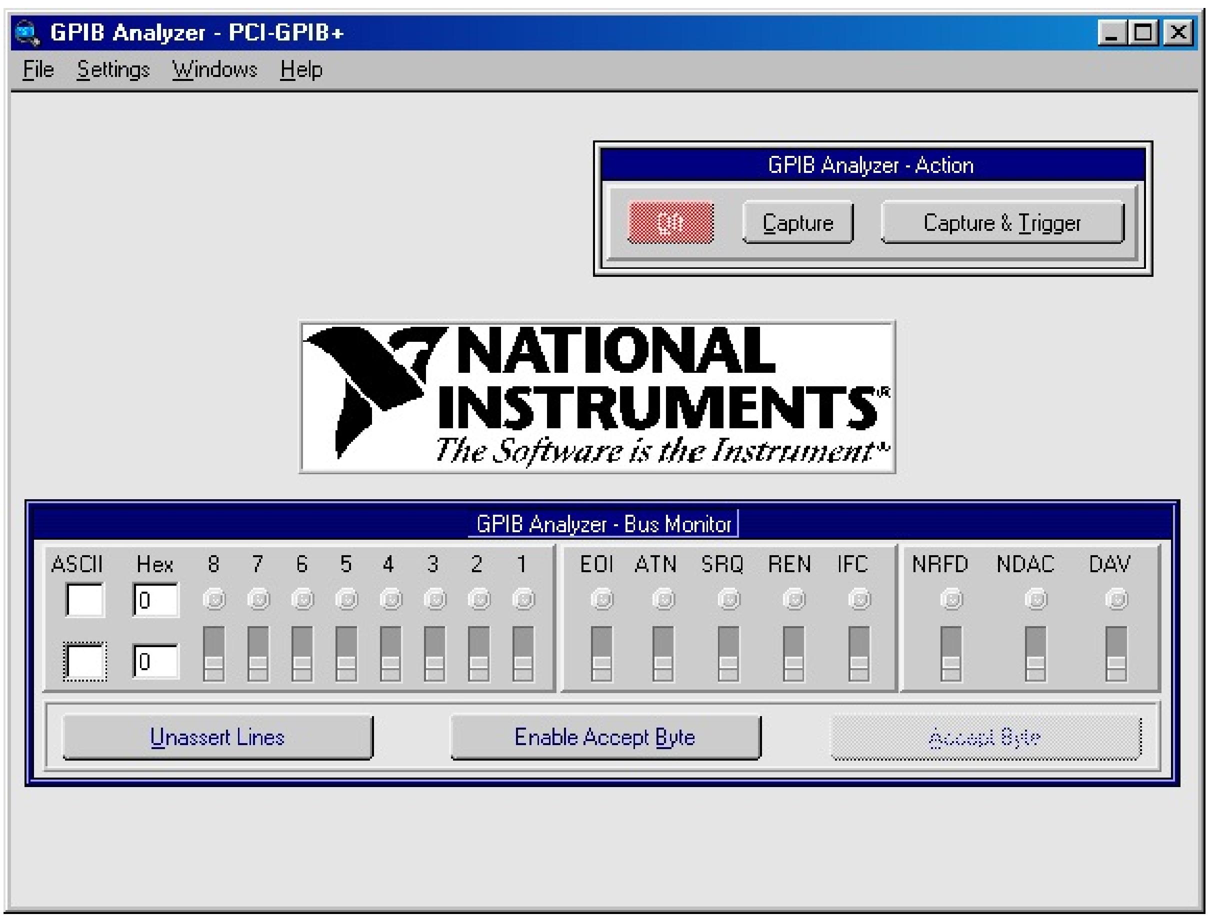
Bus Monitor window—Displays and allows you to modify the state of each of the GPIB data and control lines.

Capture Display window—Displays captured GPIB events.

Search capability—Allows searches within a capture display.

The main GPIB analyzer window is shown below. The Action and Bus Monitor windows are always open.

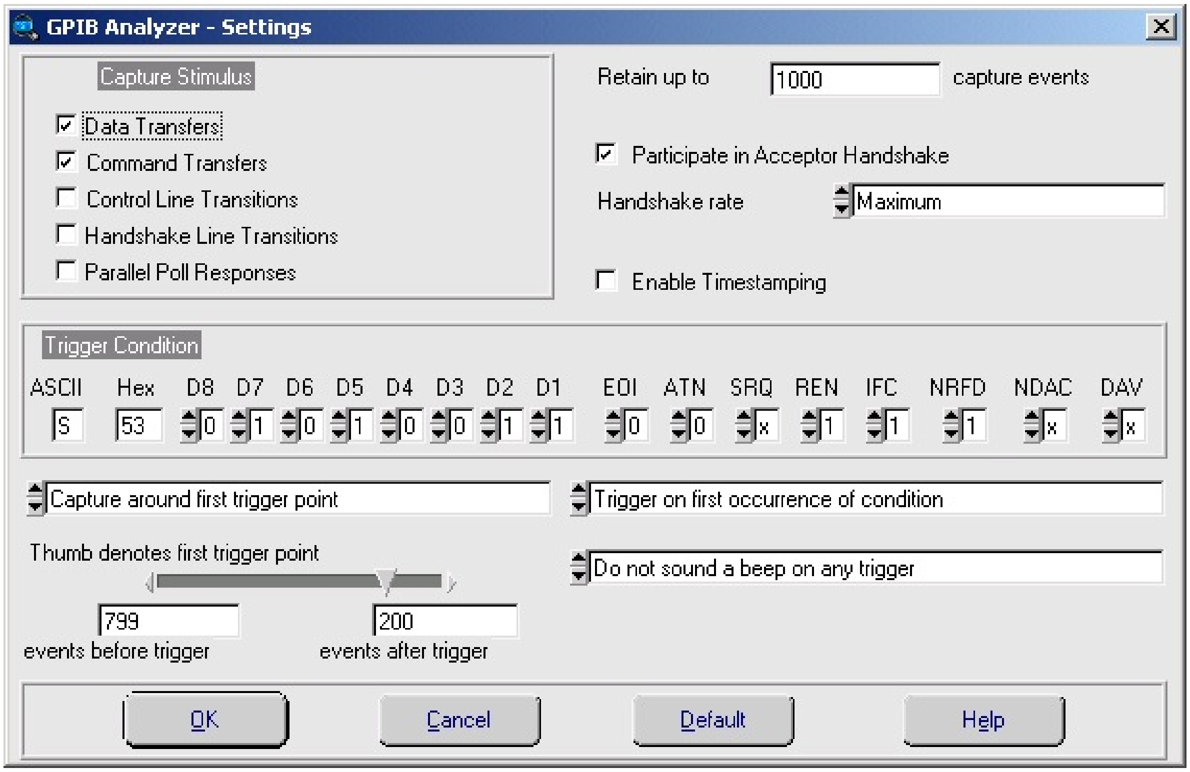
Click areas of the picture to see detailed information about each menu, button, and option available in the main window.



# Settings Configuration

Capture and trigger settings can be configured by selecting **Change Settings...** from the **Settings** menu. The following picture shows the **Settings** configuration dialog box.

Click areas of the picture to see detailed information about each menu, button, and option available in the **Settings** dialog box.




The configured settings apply only to active capture displays. Note 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).

See also:

Configure Capture Settings

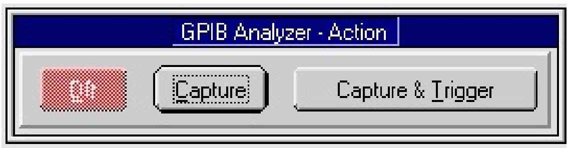
Configure Trigger Settings

# Action Window

The Action window contains controls you can use to turn capturing and/or triggering on and off. When the GPIB analyzer application is started, capture and trigger are both off.

The Action window, shown below, is always open. If the window is hidden, use **Windows»Action Window** to bring it to the front.

Click areas of the picture to see detailed information about the Action window.

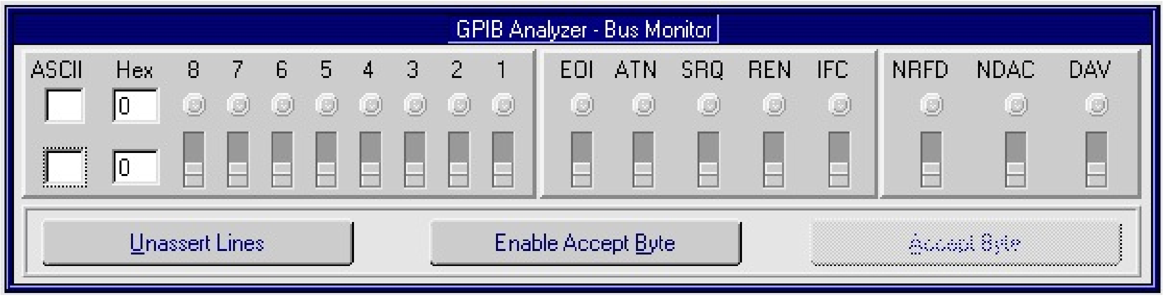



Note that you can switch back and forth between Capture and Capture & Trigger during the capture without losing data.

# 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 below, is always open. If the Bus Monitor window is hidden, use **Windows»Bus Monitor** to bring it to the front.

Click areas of the picture below to see detailed information about each button and option available in the Bus Monitor window.

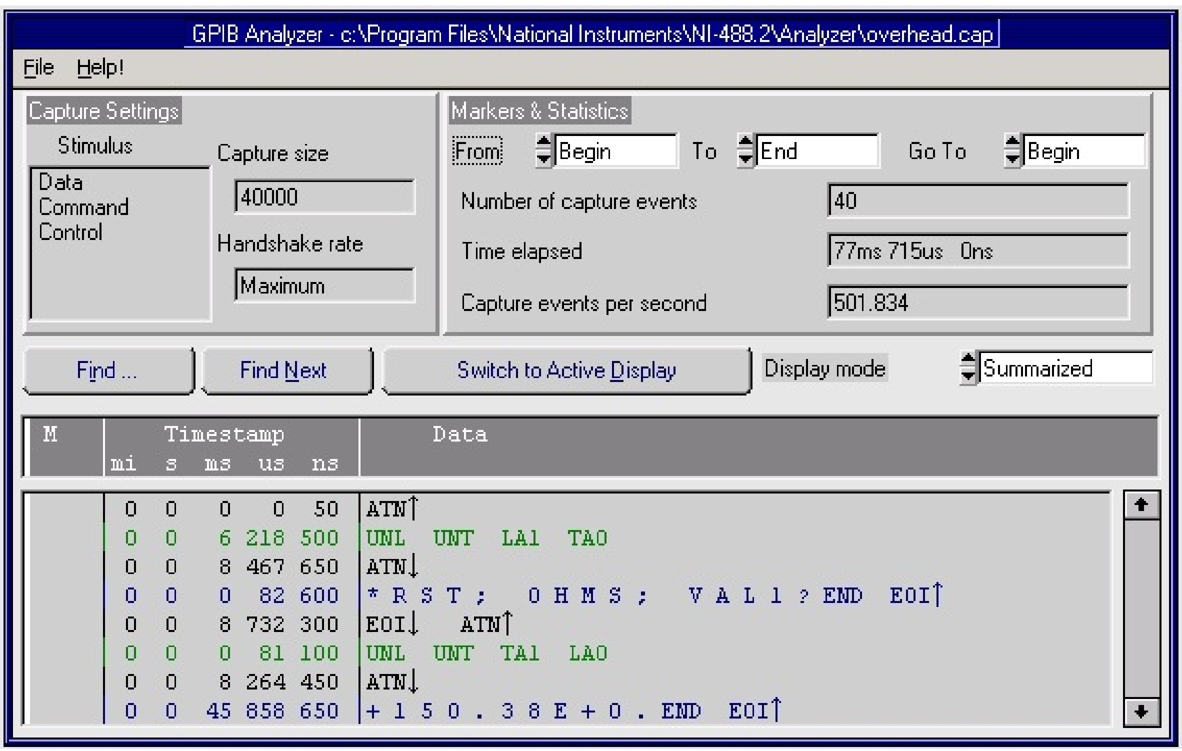


# Capture Display Window

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. The following picture shows an example of an inactive Capture Display window.

Click areas of the picture to see detailed information about each menu, button, and option available in the Capture Display window.

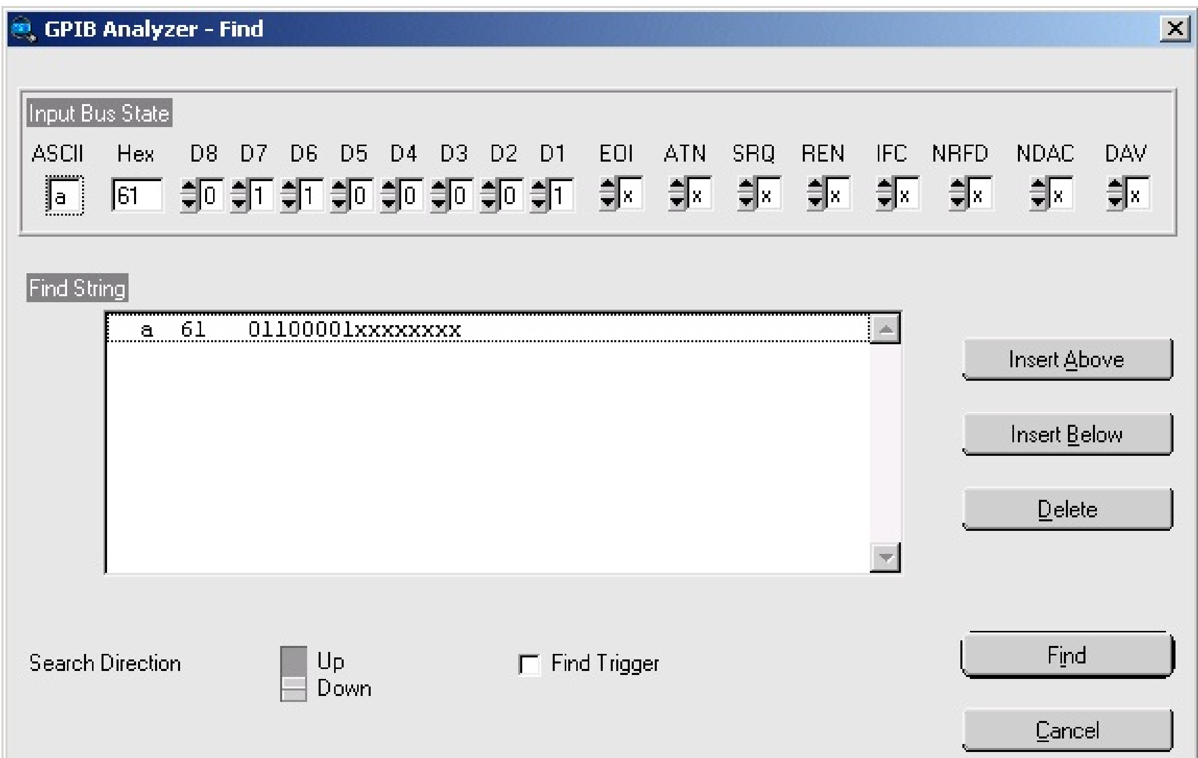


# Search Capability

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 the following picture. To repeat the search, click the **Find Next** button in the inactive capture display.

Click areas of the picture below to see detailed information about each button and option available in the **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.

# 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.

# 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. Note 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 will 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 **Accept Byte** has no effect.

# 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.

# View Previously Captured Data

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

# 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 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 picture in the Settings Configuration section for details on all the trigger conditions 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.

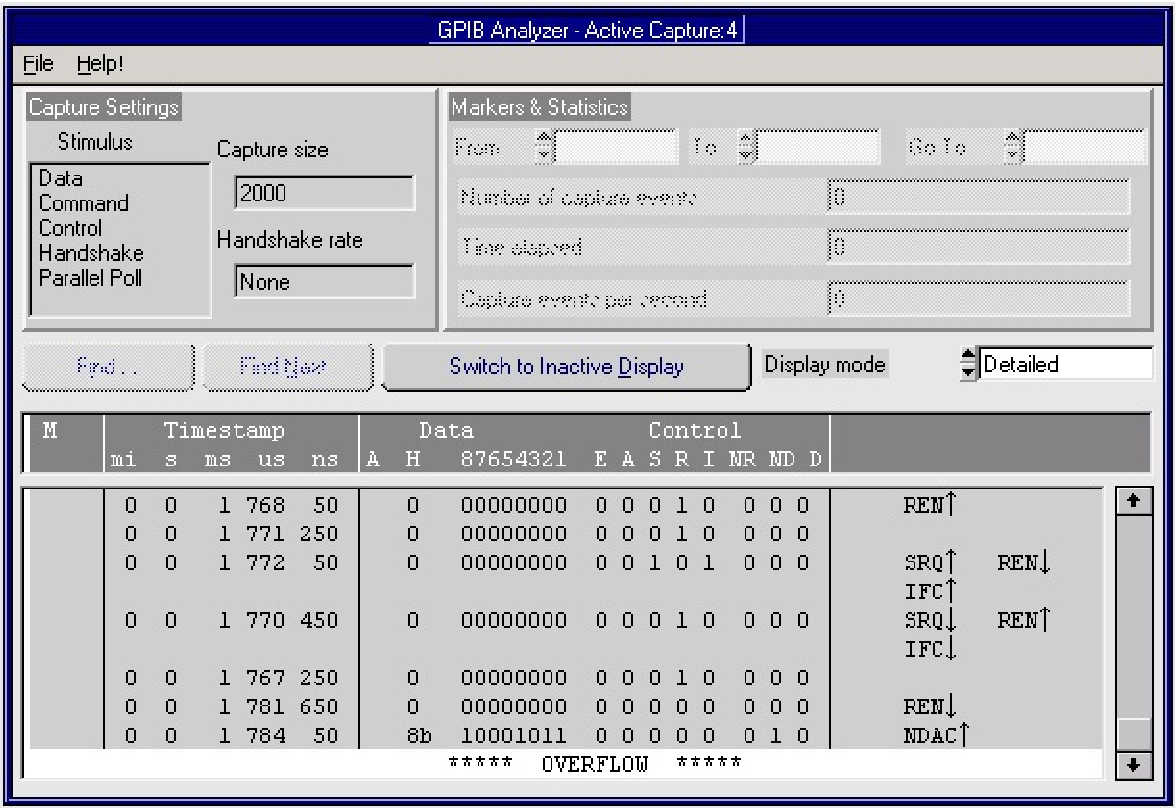
To enable timestamping, check the **Enable Timestamping** checkbox in the **Settings** dialog box.

# 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 the following figure.




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, use **Settings»Load Settings...**.

# 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. The following table shows the color coding scheme.

## 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

Read the Mnemonics Column

# 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. Alternately, 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 the following table. The smallest recordable timestamp is 50 ns.

## Timestamp Abbreviations in the Capture Display Window

| Time Unit | Abbreviation |
|---|---|
| Nanoseconds | ns |
| Microseconds | µs |
| 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. Note 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 Capture Display Mnemonics.

# Print and Save

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.

# 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.

# Common Questions

### 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.

# GPIB Basics

The ANSI/IEEE Standard 488.1-1987, also known as GPIB (General Purpose Interface Bus), describes a standard interface for communication between instruments and controllers from various vendors. It contains information about electrical, mechanical, and functional specifications. The GPIB is a digital, 8-bit parallel communications interface with data transfer rates of 1 Mbytes/s and above. The bus supports one System Controller, usually a computer, and up to 14 additional instruments. The ANSI/IEEE Standard 488.2-1987 extends IEEE 488.1 by defining a bus communication protocol, a common set of data codes and formats, and a generic set of common device commands.

## Talkers, Listeners, and Controllers

GPIB devices can be Talkers, Listeners, or Controllers. A Talker sends out data messages. Listeners receive data messages. The Controller, usually a computer, manages the flow of information on the bus. It defines the communication links and sends GPIB commands to devices.

Some devices are capable of playing more than one role. A digital voltmeter, for example, can be a Talker and a Listener. If your personal computer has a National Instruments GPIB interface board and the NI-488.2 software installed, it can function as a Talker, Listener, and Controller.

## Controller-In-Charge and System Controller

You can have multiple Controllers on the GPIB, but only one Controller at a time can be the active Controller, or Controller-In-Charge (CIC). The CIC can either be an active or inactive (Standby) Controller. Control can pass from the current CIC to an idle Controller, but only the System Controller, usually a GPIB interface board, can make itself the CIC.

# GPIB Addressing

All devices and boards connected to the GPIB must be assigned a unique GPIB address. The Controller uses the addresses to identify each device when sending or receiving data. A GPIB address is made up of two parts: a primary address and an optional secondary address. You usually set the address using switches on the board or device.

The primary address is a number in the range 0 to 30. The GPIB Controller uses the primary address to form a talk or listen address that is sent over the GPIB when communicating with a device.

A talk address is formed by setting bit 6, the TA (Talk Active) bit of the GPIB address. A listen address is formed by setting bit 5, the LA (Listen Active) bit of the GPIB address. For example, if a device is at address 1, the Controller sends hex 41 (address 1 with bit 6 set) to make the device a Talker. Because the Controller is usually at primary address 0, it sends hex 20 (address 0 with bit 5 set) to make itself a Listener. The following table shows the configuration of the GPIB address bits.

| Bit Position | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| Meaning | 0 | TA | LA | GPIB Primary Address (range 0 to 30) | | | | |

With some devices, you can use secondary addressing. A secondary address is a number in the range hex 60 to hex 7E. When secondary addressing is in use, the Controller sends the primary talk or listen address of the device, followed by the secondary address of the device.

## Data and Command Messages

Eight data lines, DIO1 through DIO8, carry both data messages and command messages. All commands and most data use the 7-bit ASCII or ISO code set, in which case the eighth bit, DIO8, is either not used or used for parity. Command messages are sent with the ATN line asserted; data messages are sent with the ATN line unasserted.

# Handshaking

Three hardware handshake lines asynchronously control the transfer of message bytes between devices. This process is a three-wire interlocked handshake, and it guarantees that devices send and receive message bytes on the data lines without transmission errors.

| Line | Description |
|---|---|
| NRFD (not ready for data) | Listening device is ready/not ready to receive a data byte. This line is driven by all devices when receiving commands, but only by Listeners when receiving data messages. It is also used by the Talker to signal high-speed transfers (HS488). |
| NDAC (not data accepted) | Listening device has/has not accepted a message byte. This line is driven by all devices when receiving commands, but only by Listeners when receiving data messages. |
| DAV (data valid) | Talking device indicates signals on data lines are stable (valid) data and can be accepted safely by devices. The Controller controls DAV when sending commands and the Talker controls DAV when sending data messages. |

The handshaking sequence is as follows:

1. The Talker unasserts DAV and then monitors the NDAC and NRFD lines that are controlled by the Listener.
2. The Talker places a byte of data on the DIO lines.
3. The Talker waits for NRFD to be unasserted by the Listener.
4. The Talker asserts DAV.
5. The Listener(s) immediately assert(s) NRFD, which acknowledges to the Talker that the current byte is being processed.
6. Listener accepts the current byte and unasserts NDAC.
7. The Talker unasserts DAV.
8. The Listener(s) assert(s) NDAC in preparation for the next byte.

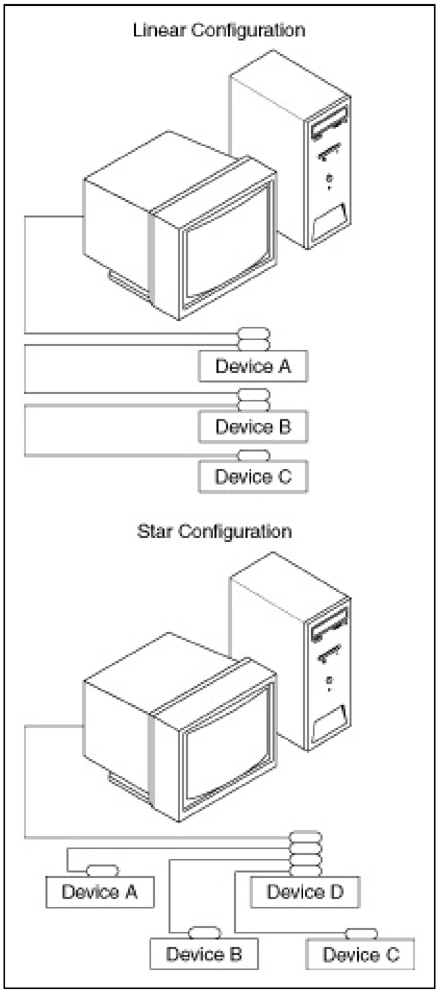
# Managing and Controlling the GPIB

Five GPIB hardware lines manage the flow of information across the bus. These lines are referred to as interface management lines or control lines.

| Line | Description |
| --- | --- |
| ATN (attention) | The Controller-In-Charge (CIC) drives this line to indicate the type of message present on the data lines. ATN is asserted when the message is a command from the CIC; it is unasserted when the message is a data byte from a Talker. |
| IFC (interface clear) | The System Controller drives the IFC line to initialize the bus and make itself CIC. When IFC is asserted, all devices return to a known, quiescent state. |
| REN (remote enable) | The System Controller drives the REN line to place devices in remote or local program mode. |
| SRQ (service request) | Any device can assert the SRQ line to asynchronously request service from the Controller-In-Charge. SRQ remains asserted until the device is serial polled. The CIC should monitor the SRQ line, poll the device, and determine the type of service that the device needs. |
| EOI (end or identify) | If a device uses the EOI line to mark the end of a data message, it asserts EOI along with the last byte of data. A Listener stops reading data when EOI is asserted. The Controller also asserts the EOI line when it conducts a parallel poll. |

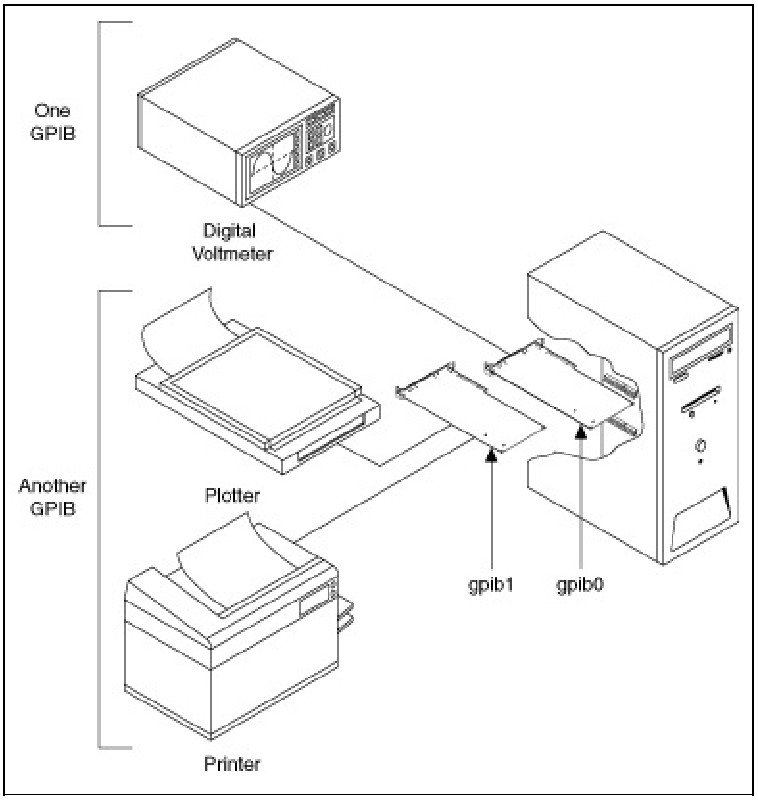
# Setting Up and Configuring Your System

Devices are usually connected with a cable assembly consisting of a shielded 24-conductor cable with both a plug and receptacle connector at each end. With this design, you can link devices in a linear configuration, a star configuration, or a combination of the two. The following picture shows the linear and star configurations.



## Controlling More Than One Board

Multiboard drivers, such as the NI-488.2 driver for Windows, can control more than one interface board. The following picture shows an example of a multiboard system configuration. gpib0 is the access board for the voltmeter, and gpib1 is the access board for the plotter and printer. The control functions of the devices automatically access their respective boards.



## Configuration Requirements

To achieve the high data transfer rate that the GPIB was designed for, you must limit the physical distance between devices and the number of devices on the bus. The following restrictions are typical:

- A maximum separation of 4 m between any two devices and an average separation of 2 m over the entire bus.
- A maximum total cable length of 20 m.
- A maximum of 15 devices connected to each bus, with at least two-thirds powered on.

For high-speed operation, the following restrictions apply:

- All devices in the system must be powered on.
- Cable lengths should be as short as possible up to a maximum of 15 m of cable in each system.
- At least one equivalent device load per meter of cable.

If you want to exceed these limitations, you can use bus extenders to increase the cable length or expanders to increase the number of device loads. Extenders and expanders are available from National Instruments.

## Serial Polling

You can use serial polling to obtain specific information from GPIB devices when they request service. When the GPIB SRQ line is asserted, it signals the Controller that a service request is pending. The Controller must then determine which device asserted the SRQ line and respond accordingly.

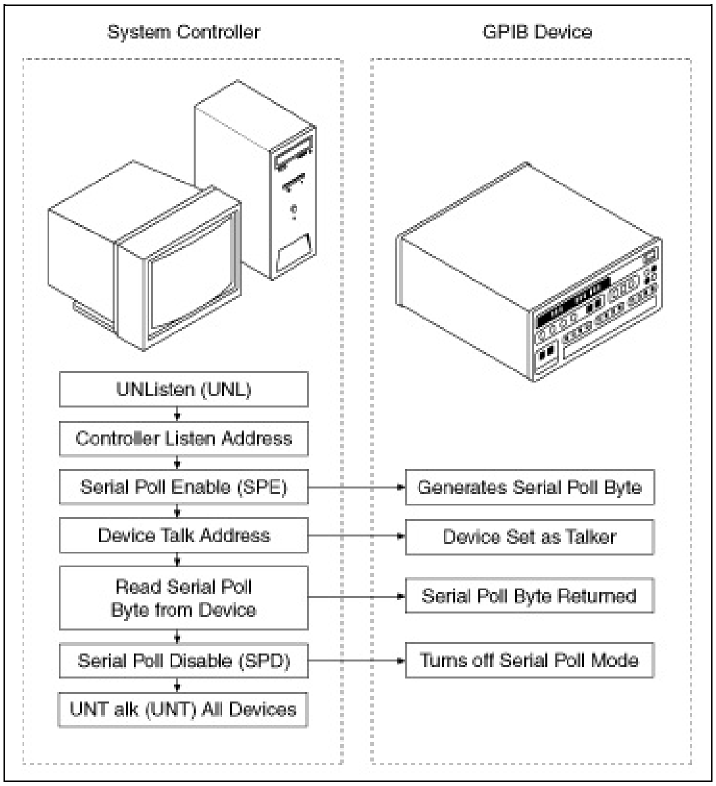
IEEE 488 devices request service from the GPIB Controller by asserting the GPIB SRQ line. When the Controller acknowledges the SRQ, it serial polls each open device on the bus to determine which device requested service. Any device requesting service returns a status byte with bit 6 set and then unasserts the SRQ line. Devices not requesting service return a status byte with bit 6 cleared. Manufacturers of IEEE 488 devices use lower order bits to communicate the reason for the service request or to summarize the state of the device.

In addition to setting bit 6 when requesting service, IEEE 488.2 devices also use two other bits to specify their status. Bit 4, the Message Available bit (MAV), is set when the device is ready to send previously queried data. Bit 5, the Event Status bit (ESB), is set if one or more of the enabled IEEE 488.2 events occurs. These events include power-on, user request, command error, execution error, device-dependent error, query error, request control, and operation complete. The device can assert SRQ when ESB or MAV is set, or when a manufacturer-defined condition occurs.

Serial polling obtains specific information from a device. When you serial poll, the Controller sends a special command message—Serial Poll Enable (SPE)—to the device, directing it to return its serial poll status byte. The SPE message sets the IEEE 488.1 serial poll mode in the device, so when the device is addressed to talk, it returns a single 8-bit status byte. This serial poll status byte is different for each type of instrument; except for one bit, you must refer to the instrument user manual for information on the other bits. Bit 6 (hex 40) of any serial poll status byte indicates whether a device requested service by asserting the SRQ line. The device uses the other seven bits of the status byte to specify why it needs attention.

After the Controller reads the status byte, it sends another command message, Serial Poll Disable (SPD), to the device. The SPD message terminates the serial poll mode, thus returning the device to its normal Talker/Listener state. Once a device requesting service is serial polled, it usually unasserts the SRQ line.

When a serial poll is conducted, the following sequence of events occurs:



# Parallel Polling

Although parallel polling is not widely used, it is a useful method for obtaining the status of more than one device at the same time. The advantage of a parallel poll is that it can easily check up to eight individual devices at once. In comparison, eight separate serial polls would be required to check eight devices for their serial poll response bytes.

You can implement parallel polling with either NI-488 functions or NI-488.2 routines. If you use NI-488.2 routines to execute parallel polls, you do not need extensive knowledge of the parallel polling messages. However, you should use the NI-488 functions for parallel polling when the GPIB board is not the Controller and must configure itself for a parallel poll and set its own individual status bit (ist).

A parallel poll is an exchange of messages between the Controller and other system devices. The Controller sends the IDY message true to the other devices; each device responds to the IDY message by sending one PPR message (PPR1, PPR2, PPR3, PPR4, PPR5, PPR6, PPR7, or PPR8) to the Controller. Each device usually sends a different PPR message. Each device can send its PPR message either true or false. Each device examines its local ist message and its Sense bit (S) to determine whether it will send its PPR message true or false. The following table illustrates how the ist message and the Sense bit affect the value of the PPR message.

| ist message | Sense Bit (S) | PPR Message Sent |
|---|---|---|
| 0 (False) | 0 | True |
| 0 (False) | 1 | False |
| 1 (True) | 0 | False |
| 1 (True) | 1 | True |

The ist message usually reflects a bit of status information about the device. For example, when the device has taken a measurement, it can assert its local ist message. The Sense bit is part of the configuration of a device. Each device has an independent Sense bit.

The meaning of the PPR message and the local ist message is device dependent.

## Configuring a Device for Parallel Polls

To configure a device to respond to parallel polls, you must supply the device with two pieces of data:

- The PPR message that the device should send to the Controller (PPR1, PPR2, . . , or PPR8).
- The value of the Sense bit of the device.

You can configure devices locally or remotely. You locally configure (Parallel Poll function subset PP2) a device by setting knobs or switches on the front panel of the device (or by physically manipulating the device in some other way). You remotely configure (Parallel Poll function subset PP1) a device by sending messages across the GPIB from the Controller to the device.

## Determining the PPE Message

The Parallel Poll Enable (PPE) message contains the parallel poll configuration data for a device. When configuring remotely, the PPE message is always preceded by the Parallel Poll Configure (PPC) message. The following table shows how you determine the value of DIO[7:1] for the PPE message. As with all commands, the DIO[8] is a "don't care" bit.

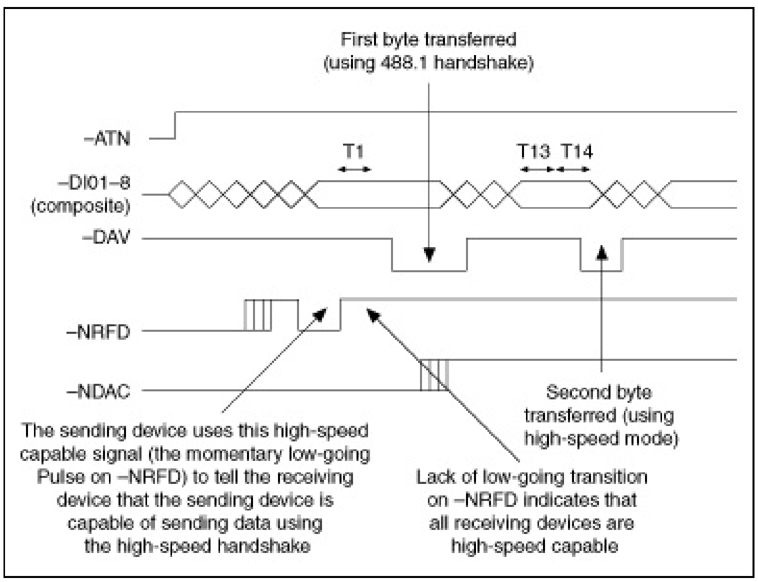
| Sense Bit (S) | PPR Message to Send | PPE Message (hex) |
|---|---|---|
| 0 | PPR1 | 60 |
| 0 | PPR2 | 61 |
| 0 | PPR3 | 62 |
| 0 | PPR4 | 63 |
| 0 | PPR5 | 64 |
| 0 | PPR6 | 65 |
| 0 | PPR7 | 66 |
| 0 | PPR8 | 67 |
| 1 | PPR1 | 68 |
| 1 | PPR2 | 69 |
| 1 | PPR3 | 6A |
| 1 | PPR4 | 6B |
| 1 | PPR5 | 6C |
| 1 | PPR6 | 6D |
| 1 | PPR7 | 6E |
| 1 | PPR8 | 6F |

# HS488 Transfers

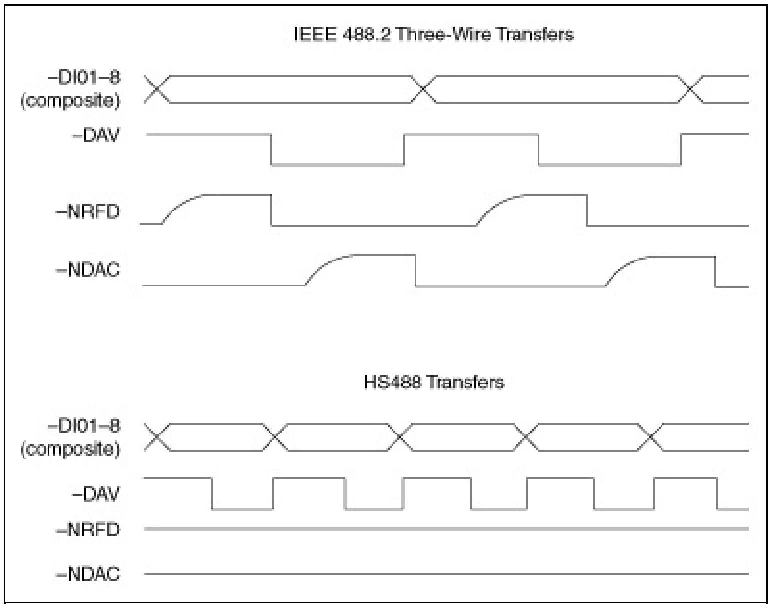
National Instruments has designed a high-speed data transfer protocol for IEEE 488 called HS488. This protocol increases performance for GPIB reads and writes up to 8 Mbytes/s, depending on your system.

HS488 is a superset of the IEEE 488 standard; thus, you can mix IEEE 488.1, IEEE 488.2, and HS488 devices in the same system. If HS488 is enabled, the TNT4882C hardware implements high-speed transfers automatically when communicating with HS488 instruments.

The following picture shows a typical IEEE 488.1 data transfer. The HS488 protocol modifies the IEEE 488.1 Source Handshake and Acceptor Handshake functions. At the beginning of each data transfer, the HS488 source and acceptor functions determine whether all active Talkers and Listeners are capable of HS488 transfers. If the addressed devices are HS488 capable, they use the HS488 noninterlocked handshake protocol for that data transfer. If any addressed device is not HS488 capable, the transfer continues using the standard three-wire handshake.




The following steps describe a typical sequence of events in an HS488 data transfer in which the Talker and Listener are both HS488 capable.




1. The Controller addresses devices and becomes Standby Controller by unasserting ATN.
2. The Listener asserts NDAC and NRFD.
3. The Listener unasserts NRFD as it becomes ready to accept a byte.
4. After allowing time for the Listener to detect NRFD unasserted, the Talker indicates that it is capable of HS488 operation by sending the HSC message. To send the HSC message true, the Talker asserts the NRFD signal.
5. After allowing time for the Listener to respond to the HSC message, the Talker sends the HSC message false. To send the HSC message false, the Talker unasserts the NRFD signal.
6. When the Talker has a byte ready to send, it drives the data on the DIO signal lines, allows some settling time, and asserts DAV.
7. The Listener unasserts NDAC. HS488 Listeners do not assert NRFD as IEEE 488.1 devices would. Because of this behavior, the Talker determines that the addressed Listener is capable of HS488 transfers.
8. The Talker unasserts DAV and begins to drive the next data byte on the GPIB.
9. After allowing some settling time, the Talker asserts DAV.
10. The Listener latches the byte in response to the assertion (falling) edge of DAV.
11. After allowing some hold time, the Talker unasserts DAV and drives the

next data byte on the DIO signal lines.

12. Steps 9-11 are repeated for each data byte.

## System Configuration

The HS488 Acceptor Handshake and Source Handshake interface functions depend on several time delays. Some of these delays are a function of the total system cable length.

The Controller must communicate this system configuration data to HS488 devices after the system powers on. The Controller configures HS488 devices by sourcing two multiline messages while ATN is true. The first message is the CFE message. The Controller sends the CFE message by driving a bit pattern (1E hex) that the IEEE 488.1 standard does not define on the DIO signal lines. The CFE message enables HS488 devices to interpret the SCG message that follows. The second message is a Secondary Command Group (SCG) message that contains the configuration data. The Secondary command has the bit pattern 6*n* hex, where *n* is the meters of cable in the system.

## Terminating Data Transmissions

GPIB data transfers are terminated either when the GPIB EOI line is asserted with the last byte of a transfer or when a preconfigured end-of-string (EOS) character is transmitted. By default, the NI-488.2 driver asserts EOI with the last byte of writes, and the EOS modes are disabled.

If EOT mode is enabled, the NI-488.2 driver asserts the GPIB EOI line when the last byte of a write is sent out on the GPIB. If it is disabled, the EOI line is not asserted with the last byte of a write.

EOS mode configuration includes the following information:

- A 7-bit or 8-bit EOS byte.
- EOS comparison method. This method indicates whether the EOS byte has seven or eight significant bits. For a 7-bit EOS byte, the eighth bit of the EOS byte is ignored.
- EOS write method. If this method is enabled, the NI-488.2 driver automatically asserts the GPIB EOI line when the EOS byte is written to the GPIB. If the buffer passed into an ibwrt call contains five occurrences of the EOS byte, the EOI line is asserted as each of the five EOS bytes are written to the GPIB. If an ibwrt buffer does not contain an occurrence of the EOS byte, the EOI line is not asserted (unless the EOT mode is enabled, in which case the EOI line is asserted with the last byte of the write).
- EOS read method. If this method is enabled, the NI-488.2 driver terminates ibrd, ibrda, and ibrdf calls when the EOS byte is detected on the GPIB, when the GPIB EOI line is asserted, or when the specified count is reached. If the EOS read method is disabled, ibrd, ibrda, and ibrdf calls terminate only when the GPIB EOI line is asserted or the specified count has been read.

You can use the ibconfig function to configure the software to inform you whether the GPIB EOI line was asserted when the EOS byte was read. Use the IbcEndBitIsNormal option to configure the software to report only the END bit in ibsta when the GPIB EOI line is asserted. By default, the NI-488.2 driver reports END in ibsta when either the EOS byte is read in or the EOI line is asserted during a read.

# GPIB Commands

GPIB commands are used to manage the GPIB interface system. They include commands such as untalk (UNT), which commands all GPIB devices to stop sourcing data bytes. The IEEE 488 standard also refers to GPIB command bytes as multiline interface messages. The IEEE 488 multiline interface messages are shown in the following table.

In the following table, the first group of columns (hex 00-1F) represents the primary GPIB commands. The next group of columns (hex 20-3F) corresponds to listen addresses (MLA). The listen address of a device is formed by adding hex 20 to the GPIB primary address. The next group of columns (hex 40-5F) correspond to talk addresses (MTA). The talk address of a device is formed by adding hex 40 to the GPIB primary address. (You may need to stretch this window to see the table correctly.)

### Multiline Interface Command Messages

| Hex | Oct | Dec | ASCII | Msg | Hex | Oct | Dec | ASCII | Msg |
|---|---|---|---|---|---|---|---|---|---|
| 00 | 000 | 0 | NUL | | 20 | 040 | 32 | SP | MLA0 |
| 01 | 001 | 1 | SOH | GTL | 21 | 041 | 33 | ! | MLA1 |
| 02 | 002 | 2 | STX | | 22 | 042 | 34 | " | MLA2 |
| 03 | 003 | 3 | ETX | | 23 | 043 | 35 | # | MLA3 |
| 04 | 004 | 4 | EOT | SDC | 24 | 044 | 36 | $ | MLA4 |
| 05 | 005 | 5 | ENQ | PPC | 25 | 045 | 37 | % | MLA5 |
| 06 | 006 | 6 | ACK | | 26 | 046 | 38 | & | MLA6 |
| 07 | 007 | 7 | BEL | | 27 | 047 | 39 | ' | MLA7 |
| 08 | 010 | 8 | BS | GET | 28 | 050 | 40 | ( | MLA8 |
| 09 | 011 | 9 | HT | TCT | 29 | 051 | 41 | ) | MLA9 |
| 0A | 012 | 10 | LF | | 2A | 052 | 42 | * | MLA10 |
| 0B | 013 | 11 | VT | | 2B | 053 | 43 | + | MLA11 |
| 0C | 014 | 12 | FF | | 2C | 054 | 44 | , | MLA12 |
| 0D | 015 | 13 | CR | | 2D | 055 | 45 | - | MLA13 |
| 0E | 016 | 14 | SO | | 2E | 056 | 46 | . | MLA14 |
| 0F | 017 | 15 | SI | | 2F | 057 | 47 | / | MLA15 |
| 10 | 020 | 16 | DLE | | 30 | 060 | 48 | 0 | MLA16 |
| 11 | 021 | 17 | DC1 | LLO | 31 | 061 | 49 | 1 | MLA17 |
| 12 | 022 | 18 | DC2 | | 32 | 062 | 50 | 2 | MLA18 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 13 | 023 | 19 | DC3 | | 33 | 063 | 51 | 3 | MLA19 |
| 14 | 024 | 20 | DC4 | DCL | 34 | 064 | 52 | 4 | MLA20 |
| 15 | 025 | 21 | NAK | PPU | 35 | 065 | 53 | 5 | MLA21 |
| 16 | 026 | 22 | SYN | | 36 | 066 | 54 | 6 | MLA22 |
| 17 | 027 | 23 | ETB | | 37 | 067 | 55 | 7 | MLA23 |
| | | | | | | | | | |
| 18 | 030 | 24 | CAN | SPE | 38 | 070 | 56 | 8 | MLA24 |
| 19 | 031 | 25 | EM | SPD | 39 | 071 | 57 | 9 | MLA25 |
| 1A | 032 | 26 | SUB | | 3A | 072 | 58 | : | MLA26 |
| 1B | 033 | 27 | ESC | | 3B | 073 | 59 | ; | MLA27 |
| 1C | 034 | 28 | FS | | 3C | 074 | 60 | < | MLA28 |
| 1D | 035 | 29 | GS | | 3D | 075 | 61 | = | MLA29 |
| 1E | 036 | 30 | RS | | 3E | 076 | 62 | > | MLA30 |
| 1F | 037 | 31 | US | CFE | 3F | 077 | 63 | ? | UNL |
| | | | | | | | | | |
| 40 | 100 | 64 | @ | MTA0 | 60 | 140 | 96 | ` | MSA0,PPE |
| 41 | 101 | 65 | A | MTA1 | 61 | 141 | 97 | a | MSA1,PPE,CFG1 |
| 42 | 102 | 66 | B | MTA2 | 62 | 142 | 98 | b | MSA2,PPE, CFG2 |
| 43 | 103 | 67 | C | MTA3 | 63 | 143 | 99 | c | MSA3,PPE,CFG3 |
| 44 | 104 | 68 | D | MTA4 | 64 | 144 | 100 | d | MSA4,PPE,CFG4 |
| 45 | 105 | 69 | E | MTA5 | 65 | 145 | 101 | e | MSA5,PPE,CFG5 |
| 46 | 106 | 70 | F | MTA6 | 66 | 146 | 102 | f | MSA6,PPE,CFG6 |
| 47 | 107 | 71 | G | MTA7 | 67 | 147 | 103 | g | MSA7,PPE,CFG7 |
| | | | | | | | | | |
| 48 | 110 | 72 | H | MTA8 | 68 | 150 | 104 | h | MSA8,PPE,CFG8 |
| 49 | 111 | 73 | I | MTA9 | 69 | 151 | 105 | i | MSA9,PPE,CFG9 |
| 4A | 112 | 74 | J | MTA10 | 6A | 152 | 106 | j | MSA10,PPE,CFG10 |
| 4B | 113 | 75 | K | MTA11 | 6B | 153 | 107 | k | MSA11,PPE,CFG11 |
| 4C | 114 | 76 | L | MTA12 | 6C | 154 | 108 | l | MSA12,PPE,CFG12 |
| 4D | 115 | 77 | M | MTA13 | 6D | 155 | 109 | m | MSA13,PPE,CFG13 |
| 4E | 116 | 78 | N | MTA14 | 6E | 156 | 110 | n | MSA14,PPE,CFG14 |
| 4F | 117 | 79 | O | MTA15 | 6F | 157 | 111 | o | MSA15,PPE,CFG15 |
| | | | | | | | | | |
| 50 | 120 | 80 | P | MTA16 | 70 | 160 | 112 | p | MSA16,PPD |
| 51 | 121 | 81 | Q | MTA17 | 71 | 161 | 113 | q | MSA17,PPD |
| 52 | 122 | 82 | R | MTA18 | 72 | 162 | 114 | r | MSA18,PPD |
| 53 | 123 | 83 | S | MTA19 | 73 | 163 | 115 | s | MSA19,PPD |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 54 | 124 | 84 | T | MTA20 | 74 | 164 | 116 | t | MSA20,PPD |
| 55 | 125 | 85 | U | MTA21 | 75 | 165 | 117 | u | MSA21,PPD |
| 56 | 126 | 86 | V | MTA22 | 76 | 166 | 118 | v | MSA22,PPD |
| 57 | 127 | 87 | W | MTA23 | 77 | 167 | 119 | w | MSA23,PPD |
| | | | | | | | | | |
| 58 | 130 | 88 | X | MTA24 | 78 | 170 | 120 | x | MSA24,PPD |
| 59 | 131 | 89 | Y | MTA25 | 79 | 171 | 121 | y | MSA25,PPD |
| 5A | 132 | 90 | Z | MTA26 | 7A | 172 | 122 | z | MSA26,PPD |
| 5B | 133 | 91 | [ | MTA27 | 7B | 173 | 123 | { | MSA27,PPD |
| 5C | 134 | 92 | \ | MTA28 | 7C | 174 | 124 | \| | MSA28,PPD |
| 5D | 135 | 93 | ] | MTA29 | 7D | 175 | 125 | } | MSA29,PPD |
| 5E | 136 | 94 | ^ | MTA30 | 7E | 176 | 126 | ~ | MSA30,PPD |
| 5F | 137 | 95 | _ | UNT | 7F | 177 | 127 | DEL | |

## Message Definitions

| | |
|---|---|
| CFE | Configuration Enable |
| CFG | Configure |
| DCL | Device Clear |
| GET | Group Execute Trigger |
| GTL | Go To Local |
| LLO | Local Lockout |
| MLA | My Listen Address |
| MSA | My Secondary Address |
| MTA | My Talk Address |
| PPC | Parallel Poll Configure |
| PPD | Parallel Poll Disable |
| PPE | Parallel Poll Enable |
| PPU | Parallel Poll Unconfigure |
| SDC | Selected Device Clear |
| SPD | Serial Poll Disable |
| SPE | Serial Poll Enable |
| TCT | Take Control |
| UNL | Unlisten |
| UNT | Untalk |

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Clicking the **Capture** button in the Action window 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 in the Action window causes the analyzer to begin capturing GPIB events into the active capture display and to monitor 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.

# Capture Display Mnemonics

The mnemonics that appear in the capture display of the GPIB analyzer are defined below.

| | |
|---|---|
| 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). |

This multiline interface message is a proposed extension to the IEEE 488.1 specification to support the HS488 high-speed protocol.

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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.