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GPIB-422CV
User Manual

MicroGPIB®
IEEE 488 ⟷ RS-422 Converter

December 1993 Edition

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This equipment generates and uses radio frequency energy and, if not installed and used in strict accordance with the instructions in this manual, may cause interference to radio and television reception. This equipment has been tested and found to comply with the following two regulatory agencies:

Federal Communications Commission

This device complies with Part 15 of the Federal Communications Commission (FCC) Rules for a Class A digital device. Operation is subject to the following two conditions:

1. This device may not cause harmful interference in commercial environments.

2. This device must accept any interference received, including interference that may cause undesired operation.

Canadian Department of Communications

This device complies with the limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications (DOC).

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de classe A prescrites dans le règlement sur le brouillage radioélectrique édicté par le ministère des communications du Canada.

Instructions to Users

These regulations are designed to provide reasonable protection against harmful interference from the equipment to radio reception in commercial areas. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

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Table B-1. Typical RS-422 Serial Port Signals (DTE to DTE) B-3
Table B-2. Typical DTE-to-DTE RS-422 Serial Cable Configuration B-4
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About This Manual

The *GPIB-422CV User Manual* describes the features, functions, and operation of the product. The GPIB-422CV is one of National Instruments family of MicroGPIB products. These products are high-performance, low-cost IEEE 488 support items, packaged in small all-metal cases, capable of being rack mounted.

Organization of This Manual

The *GPIB-422CV User Manual* is organized as follows:

- Chapter 1, *Description of the GPIB-422CV*, contains an overview of the GPIB-422CV, lists the contents of your kit and optional equipment, and gives a description of the panels on the GPIB-422CV.
- Chapter 2, *Installation and Operation*, describes the steps for configuring and operating the GPIB-422CV.
- Chapter 3, *Operation of the GPIB-422CV*, describes how to choose between D mode configuration and C mode configuration and contains information about operating the GPIB-422CV in D mode or C mode, data buffering, and handshaking schemes.
- Appendix A, *GPIB-422CV Specifications*, contains tables which specify the electrical, environmental, and physical characteristics of the GPIB-422CV.
- Appendix B, *Interfacing to a Serial Device*, describes the RS-422 serial port on the GPIB-422CV and explains how to interface a DCE or DTE serial device to the RS-422 serial port.
- Appendix C, *Application Examples*, contains two GPIB-422CV application examples. The first example shows how to use a GPIB-422CV as a high-speed print spooler and the second example shows how to connect a HP7475 GPIB plotter to an IBM PC running AUTOCAD.

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- Appendix D, *Customer Communication*, contains forms you can use when requesting help from National Instruments or to comment on our products and manuals.
- The *Glossary* contains an alphabetical list and description of terms used in this manual including abbreviations, acronyms, metric prefixes, mnemonics, and symbols.
- The *Index* contains an alphabetical list of key terms and topics in this manual, including the page where you can find each one.

Conventions Used in This Manual

The following conventions are used in this manual:

italic	Italic text denotes emphasis, a cross reference, or an introduction to a key concept.
`monospace`	Text in this font denotes text or characters that are to be literally input from the keyboard, sections of code, programming examples, syntax examples, and names of variables.
bold	Bold text in this manual denotes a signal name or a front panel LED indicator.
<>	Angle brackets enclose the ASCII character symbols for certain keystrokes. For example, <CR> for carriage return and <LF> for linefeed.
-	A hyphen between two or more key names enclosed in angle brackets denotes that you should simultaneously press the named keys–for example, <Control-Alt-Delete>.
IEEE 488 and IEEE 488.2	IEEE 488 and IEEE 488.2 are used throughout this manual to refer to the ANSI/IEEE Standard 488.1-1987 and the ANSI/IEEE Standard 488.2-1987, respectively, which define the GPIB.
RS-422	RS-422 is used throughout this manual to refer to the ANSI/EIA RS-422-A standard.

Abbreviations, acronyms, metric prefixes, mnemonics, and terms are listed in the *Glossary*.

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Related Documentation

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

- ANSI/EIA RS-422-A, *Electrical Characteristics of Balanced Voltage Digital Interface Circuits.*
- ANSI/IEEE Standard 488.1-1987, *IEEE Standard Digital Interface for Programmable Instrumentation.*
- ANSI/IEEE Standard 488.2-1987, *IEEE Standard Codes, Formats, Protocols, and Common Commands.*

Customer Communication

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

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Chapter 1
Description of the GPIB-422CV

This chapter contains an overview of the GPIB-422CV, lists the contents of your kit and optional equipment, and gives a description of the panels on the GPIB-422CV.

GPIB-422CV Overview

The GPIB-422CV provides a method of connecting a device with an RS-422 port to the IEEE 488 bus (GPIB). The GPIB-422CV transparently converts data between the two ports so that control codes or special commands are not required. The GPIB-422CV also increases the efficiency of the interface system by isolating the slower device from the faster port with a character buffer. This buffer is used to offload the host computer during printer and plotter applications.

The GPIB-422CV is capable of interfacing either a GPIB Controller or a GPIB device to a computer or instrument with an RS-422 port. It can be used to interface a GPIB device to a computer with an RS-422 port, or to connect an RS-422 device such as a printer or plotter to a GPIB network. Data transfers in either direction are possible at all times.

The GPIB-422CV is actually a powerful 8-bit microcomputer tailored for use as an IEEE 488-to-RS-422 protocol converter. The unit's operating system is contained in Read-Only Memory (ROM) and can address up to 256K of dynamic Random-Access Memory (RAM). The GPIB-422CV microprocessor contains an integrated Direct Memory Access (DMA) Controller for high-speed data transfers from the GPIB circuitry. The processor also contains an integrated memory management unit, a dynamic RAM Controller, a clock generator, a programmable timer unit, a full duplex UART (Universal Asynchronous Receiver Transmitter), and an interrupt controller.

The serial port has been designed to be fully compatible with all electrical specifications in the RS-422 standard as well as the Macintosh implementation of the RS-422 port. All GPIB functionality is provided by the NEC µPD7210 chip, which is programmed and maintained by the operating system. Both the serial port and the GPIB port are interrupt driven and feature extremely fast response times to external data transfers.

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Special Note for Macintosh Users

The Macintosh serial port has been designed to be compatible with both the RS-422 and the RS-232 serial ports. The GPIB-422CV is fully compatible with the Macintosh serial port. For more information about the use of the GPIB-422CV with a Macintosh, refer to the sections entitled *The RS-422 Connector*, in this chapter, and *Step 2. Configure the Operating Characteristics* in Chapter 2.

What Your Kit Contains

Your kit should contain the following components:

Component	Part Number
One of the following boxes:	
• GPIB-422CV (256K RAM - 115 VAC)	180465-02
• GPIB-422CV (256K RAM - 230 VAC)	180465-32
GPIB-422CV User Manual	320110-01

Make sure each of these items is in your kit. If any item is missing, contact National Instruments.

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Optional Equipment

You can order the following optional equipment from National Instruments:

Component	Part Number
Rack mount Kit:	
Single (1 unit)	180480-01
Dual (2 units)	180480-02
Serial Cables:	
9-pin D-Sub to 9-pin D-Sub (use with Mac)	180269-10
9-pin D-Sub to circular mini 8 (use with Mac Plus, Mac SE, Mac II)	180314-10
Double-Shielded GPIB Cables*:	
GPIB Type X2 Cable – 1 m	763061-01
GPIB Type X2 Cable – 2 m	763061-02
GPIB Type X2 Cable – 4 m	763061-03

* In order to meet FCC emission limits for a Class A device, you must use double-shielded (Type X2) GPIB cables. Operating this equipment with an single-shielded (Type X1) or unshielded cable may cause interference to radio and television reception in commercial areas.

Inspection

Before you install the GPIB-422CV, inspect the shipping container and its contents for damage. If damage appears to have been caused in shipment, file a claim with the carrier. Retain the packing material for possible inspection or reshipment.

If the equipment appears to be damaged, do not attempt to operate it. Contact National Instruments for instructions.

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The GPIB-422CV Panels

The following sections describe the panels on the GPIB-422CV.

The GPIB-422CV Front Panel

The power switch and six Light Emitting Diodes (LEDs) are mounted on the GPIB-422CV front panel. Figure 1-1 shows the front panel.

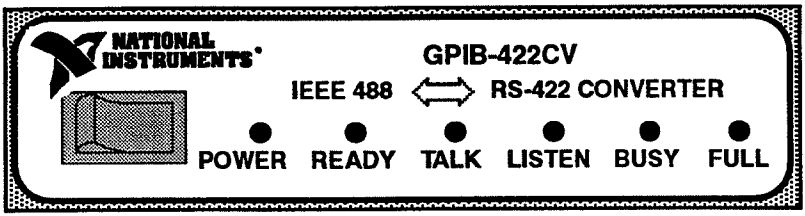


Figure 1-1. The GPIB-422CV Front Panel

The LEDs show the current status of the GPIB-422CV at all times. Table 1-1 describes each LED.

Table 1-1. LED Descriptions

LED	Indication
POWER	Indicates that power has been applied to the unit and the ON/OFF switch is in the ON position.
READY	Indicates that the power-on self-test has successfully passed and the unit is ready to operate.
TALK	Indicates that the GPIB-422CV is configured as a GPIB Talker.
LISTEN	Indicates that the GPIB-422CV is configured as a GPIB Listener.
BUSY	Indicates that the GPIB-422CV is currently accepting serial data. Each serial character received toggles the status of the **BUSY** LED.
FULL	Indicates that one of the GPIB-422CV data buffers is full. This is not an error condition. It is a signal that bus performance may be reduced to the speed of the slower port.

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The GPIB-422CV Rear Panel

The power cable, RS-422 cable, and GPIB cable are connected to the rear panel of the GPIB-422CV. Figure 1-2 shows the rear panel.

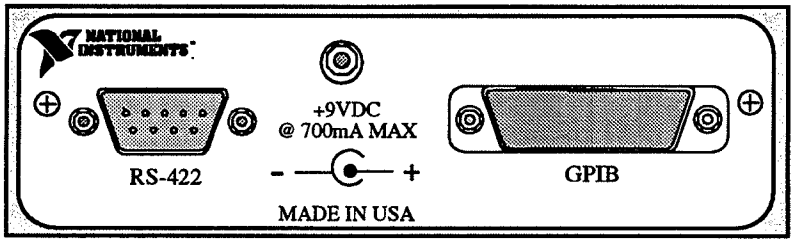


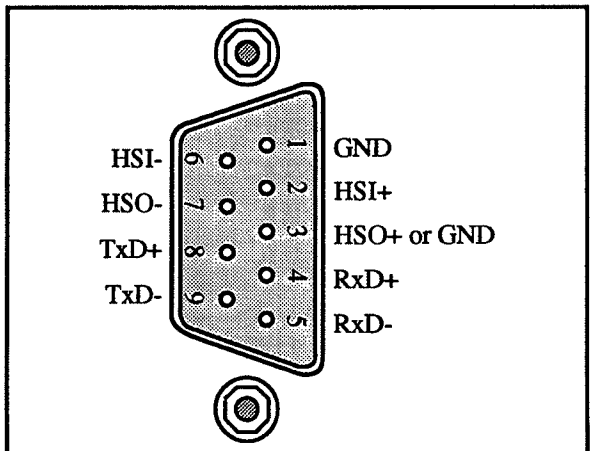
Figure 1-2. The GPIB-422CV Rear Panel

The RS-422 Connector

The RS-422 port on the GPIB-422CV is configured to support the Macintosh implementation of the RS-422 as well as the standard RS-422 electrical specification. The positions of jumpers across pins W-4 through W-6 determine whether the RS-422 port is Macintosh compatible or standard RS-422. For specific jumper settings, refer to *Step 2. Configure the Operating Characteristics* in Chapter 2.

The RS-422 port on the GPIB-422CV uses a standard 9-pin D-subminiature male connector with screwlock assemblies and accepts a standard 9-pin DB-subminiature female connector. A diagram of the serial connector and the signals supported is shown in Figure 1-3. For more information on the RS-422 signals, refer to Appendix B, *Interfacing To a Serial Device*.

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Pin	Key	
1	GND	GROUND (Logic and Chassis)
2	HSI+	Handshake Input (Non-inverting)
3	HSO+ or GND	Handshake Output (Non-inverting) or GROUND (Jumper Selectable)
4	RxD+	Receive Data (Non-inverting)
5	RxD-	Receive Data (Inverting)
6	HSI-	Handshake Input (Inverting)
7	HSO-	Handshake Output (Inverting)
8	TxD+	Transmit Data (Non-inverting)
9	TxD-	Transmit Data (Inverting)

Figure 1-3. The RS-422 Connector and Signal Designations

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The GPIB Connector

The GPIB connector is a standard 24-pin shielded AMP Champ female connector with metric screwlock hardware. A diagram of the GPIB connector and the signals supported is shown in Figure 1-4. A * suffix indicates that the signal is active low.

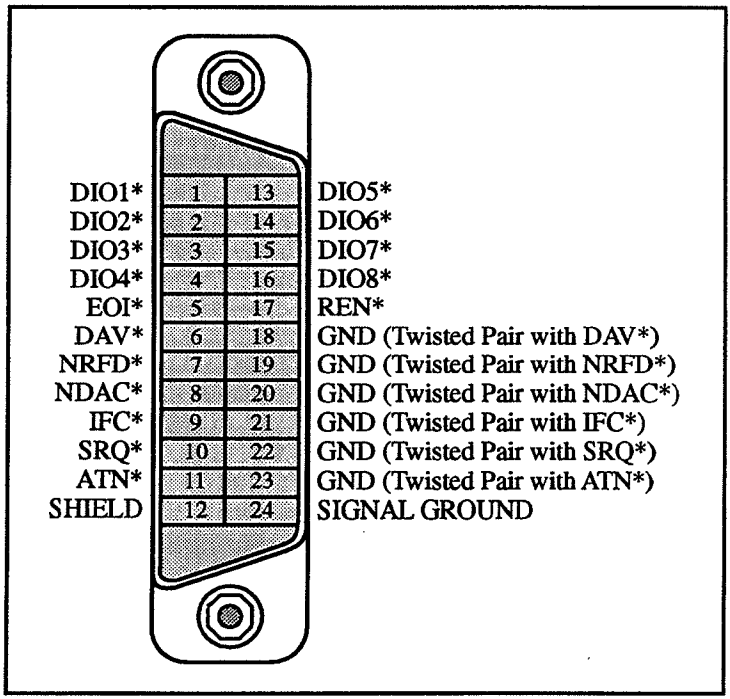


Figure 1-4. The GPIB Connector and Signal Designations

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Chapter 2
Configuration and Installation

This chapter describes the steps for configuring and installing the GPIB-422CV.

Configure the Hardware

There are two basic steps to configure your GPIB-422CV.

1. Verify the voltage requirement.

2. Configure the operating characteristics.

These steps are described in more detail in the following paragraphs.

Step 1. Verify the Voltage Requirement

Your GPIB-422CV is shipped from the factory with either a 115V or 230V internal power supply. Verify that the voltage specified on the GPIB-422CV matches the voltage supplied in your area.

Caution: Operating the unit at any voltage other than the one specified could damage the unit.

Step 2. Configure the Operating Characteristics

The GPIB-422CV is shipped from the factory configured to operate in D mode and is set to GPIB primary address 5. The serial port is configured at 9600 baud, 1 stop bit, no parity, and 7 data bits with XON/XOFF protocol disabled. The serial port is also configured to use the electrical specifications as defined in the RS-422 standard.

If you want to change any of the GPIB-422CV parameters, you must open the unit and set the configuration switches and jumpers. For more information about operating characteristics, refer to Chapter 3, *Operation of the GPIB-422CV.*

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To open the unit and change the GPIB-422CV configuration, follow these steps:

1. Disconnect power to the unit and disconnect any cables that might be connected to the unit.

2. Unscrew the two screws on the opposite sides of the rear panel.

3. Pull the rear panel bezel straight away from the unit. The card should slide out the back of the enclosure.

Caution: Most of the circuitry in the GPIB-422CV uses advanced CMOS technology and can be damaged by static electricity. Avoid touching any of the components and take any necessary CMOS handling precautions.

Figure 2-1 shows the location of the configuration switches on the GPIB-422CV board.

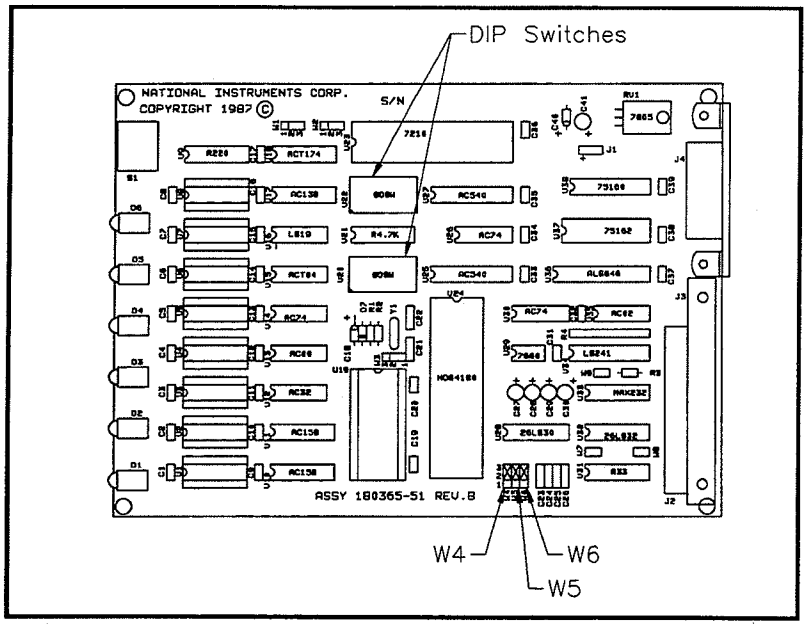


Figure 2-1. GPIB-422CV Parts Locator Diagram

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4. To change the electrical specifications of the RS-422 port so that it is compatible with the Macintosh serial port, locate the three jumpers at location W4 through W6. Move all three jumpers so that they rest across the pins labeled 1 and 2 (see Figures 2-2 and 2-3).

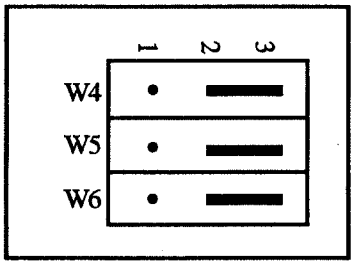


Figure 2-2. Standard RS-422 Configuration (Factory Configuration)

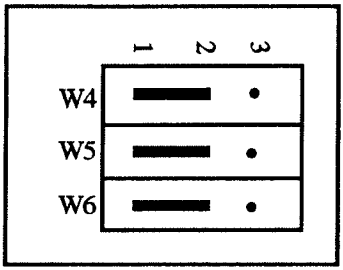


Figure 2-3. Macintosh Serial Port Configuration

5. Locate the configuration DIP switches (U20 and U22) on the printed wire board in Figure 2-1.

6. Set the switches for the desired mode of operation, as described in the next sections, *Configure the GPIB-422CV Parameters,* and *Configure the Serial Port Parameters.*

7. Close the unit and insert the screws removed in Step 2.

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Configure the GPIB-422CV Parameters

You can use the DIP switch at location U22 on the printed wire board to configure the GPIB-422CV mode of operation and the GPIB primary address. Figure 2-4 shows the factory default setting for the switches at U22.

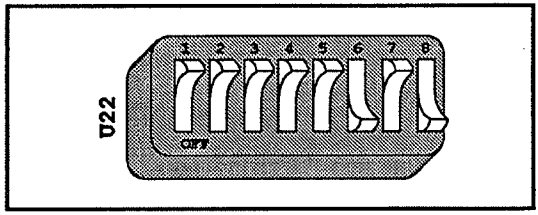


Figure 2-4. Factory Default Switch Settings for U22

In Figure 2-4 switch 1 is in the OFF position, indicating that the unit is configured to operate in D mode. Switches 2 and 3 are in the OFF position, indicating that SRQ is disabled and the small serial buffer has been selected. Switches 4 through 8 are in the OFF, OFF, ON, OFF, ON positions, respectively, which indicates a GPIB primary address of 5.

Tables 2-1, 2-2, and 2-3 show the possible configurations of the eight switches and what the configurations indicate. Default settings appear in bold italics.

Table 2-1. Configuration Switch Settings for U22 Switch 1

Switch 1	Indication
OFF	***GPIB-422CV Operates in D Mode***
ON	GPIB-422CV Operates in C Mode

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Table 2-2. Configuration Switch Settings for U22 Switches 2 and 3

Switches		Indication	
2	3	D Mode	C Mode
OFF	***OFF***	***Small Serial Buffer and SRQ Disabled***	***Timeout Termination***
OFF	ON	Small Serial Buffer and SRQ Enabled	CR Termination
ON	OFF	Large Serial Buffer and SRQ Disabled	LF Termination
ON	ON	Large Serial Buffer and SRQ Enabled	No Swapping

Table 2-3. Configuration Switch Settings for U22 Switches 4 through 8

Switches					Indication
4	5	6	7	8	
OFF	OFF	OFF	OFF	OFF	GPIB Primary Address 0
OFF	OFF	OFF	OFF	ON	GPIB Primary Address1
OFF	OFF	OFF	ON	OFF	GPIB Primary Address 2
OFF	OFF	OFF	ON	ON	GPIB Primary Address 3
OFF	OFF	ON	OFF	OFF	GPIB Primary Address 4
OFF	***OFF***	***ON***	***OFF***	***ON***	***GPIB Primary Address 5***
OFF	OFF	ON	ON	OFF	GPIB Primary Address 6
OFF	OFF	ON	ON	ON	GPIB Primary Address 7
OFF	ON	OFF	OFF	OFF	GPIB Primary Address 8
OFF	ON	OFF	OFF	ON	GPIB Primary Address 9
OFF	ON	OFF	ON	OFF	GPIB Primary Address 10
OFF	ON	OFF	ON	ON	GPIB Primary Address 11
OFF	ON	ON	OFF	OFF	GPIB Primary Address 12
OFF	ON	ON	OFF	ON	GPIB Primary Address 13

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Table 2-3. Configuration Switch Settings for U22 Switches 4 through 8 (continued)

Switches					Indication
4	5	6	7	8	
OFF	ON	ON	ON	OFF	GPIB Primary Address 14
OFF	ON	ON	ON	ON	GPIB Primary Address 15
ON	OFF	OFF	OFF	OFF	GPIB Primary Address 16
ON	OFF	OFF	OFF	ON	GPIB Primary Address 17
ON	OFF	OFF	ON	OFF	GPIB Primary Address 18
ON	OFF	OFF	ON	ON	GPIB Primary Address 19
ON	OFF	ON	OFF	OFF	GPIB Primary Address 20
ON	OFF	ON	OFF	ON	GPIB Primary Address 21
ON	OFF	ON	ON	OFF	GPIB Primary Address 22
ON	OFF	ON	ON	ON	GPIB Primary Address 23
ON	ON	OFF	OFF	OFF	GPIB Primary Address 24
ON	ON	OFF	OFF	ON	GPIB Primary Address 25
ON	ON	OFF	ON	OFF	GPIB Primary Address 26
ON	ON	OFF	ON	ON	GPIB Primary Address 27
ON	ON	ON	OFF	OFF	GPIB Primary Address 28
ON	ON	ON	OFF	ON	GPIB Primary Address 29
ON	ON	ON	ON	OFF	GPIB Primary Address 30
ON	ON	ON	ON	ON	Sets listen-only mode (D mode) or no addressing is performed (C mode)

Configure the Serial Port Parameters

The DIP switch at location U20 on the printed wire board is used to configure the serial port parameters of the GPIB-422CV. Figure 2-5 shows the factory default settings.

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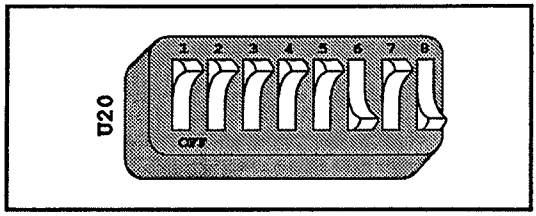


Figure 2-5. Factory Default Switch Settings for U20

In Figure 2-5 switch 1 is OFF, indicating that XON/XOFF is disabled. Switch 2 is OFF, indicating that the GPIB-422CV is using 7 bits per character for its serial data transfers. Switch 3 is OFF, which indicates 1 stop bit per character. Switches 4 and 5 are both OFF, which indicates that parity is disabled. Switches 6 through 8 are in the ON, OFF, ON positions, respectively, indicating that the serial port is operating at 9600 baud.

Tables 2-4 and 2-5 show the possible configurations of the eight switches and what the configurations indicate. Default settings appear in bold italics.

Table 2-4. Configuration Switch Settings for U20 Switches 1 through 5

Switch	Position	Indication
1	***OFF***	***XON/XOFF protocol disabled***
	ON	XON/XOFF protocol enabled
2	***OFF***	***7 bits per character***
	ON	8 bits per character
3	***OFF***	***1 stop bit per character***
	ON	2 stop bits per character
4	***OFF***	***parity generation/checking disabled***
	ON	parity generation/checking enabled
5	***OFF***	***odd parity***
	ON	even parity

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Table 2-5. Configuration Switch Settings for U20 Switches 6 through 8

Switches 6	7	8	Indication
OFF	OFF	OFF	300 baud
OFF	OFF	ON	600 baud
OFF	ON	OFF	1200 baud
OFF	ON	ON	2400 baud
ON	OFF	OFF	4800 baud
ON	***OFF***	***ON***	***9600 baud***
ON	ON	OFF	19200 baud
ON	ON	ON	38400 baud

Connect the Hardware

There are three basic steps to connect the GPIB-422CV.

1. Shut down your system.
2. Connect the cables.
3. Power on your system and switch on the GPIB-422CV.

Step 1. Shut Down Your System

Complete the following steps before connecting the cables:

1. Shut down your system.
2. Turn off your computer and unplug the power cord.

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Step 2. Connect the Cables

Complete the following steps to connect the cables:

1. Connect the serial cable to the GPIB-422CV 9-pin D-subminiature connector and securely fasten the holding screws. Connect the other end of the cable to your serial device. *Be sure* to use only shielded serial cables, and follow all RS-422 cabling restrictions.

2. Connect the GPIB cable to the GPIB-422CV and tighten the thumb screws on the connector. Connect the other end to your GPIB system. *Be sure* to follow all IEEE 488 cabling restrictions, and use only double-shielded GPIB cable.

3. Connect the power jack of the wall-mount power supply to the power receptacle on the back panel of the GPIB-422CV, then plug the supply into an AC outlet of the correct voltage.

Step 3. Power On Your System and Switch On the GPIB-422CV

1. Plug the power cords for your computer system into a power outlet and power on all devices.

2. Use the front panel rocker switch to power on your GPIB-422CV.

   The **POWER** LED should come on immediately. The **READY** indicator should come on after the GPIB-422CV has passed its power-on self test, indicating the unit is ready for operation. If the **READY** indicator does not come on within seven seconds after the unit is powered on, recheck all connections and switch settings and retry the power-on sequence. If the **READY** light still does not come on, refer to Appendix D, *Customer Communication*, fill out the technical support and configuration forms, and contact National Instruments for technical support.

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Chapter 3
Operation of the GPIB-422CV

This chapter describes how to choose between D mode configuration and C mode configuration and contains information about operating the GPIB-422CV in D mode or C mode, data buffering, and handshaking schemes.

The following terms are specific to the discussions in this chapter:

- A * suffix after a mnemonic indicates active low.
- A **bold** mnemonic indicates that it is a signal name, or a front panel LED indicator.
- <CR> is the symbol for the Carriage Return character (hex 0D).
- <LF> is the symbol for the Linefeed character (hex 0A).

Choosing Between D Mode and C Mode Configuration

The GPIB-422CV can be configured either as a GPIB device that is addressed to talk or listen by a GPIB Controller on the bus (D mode), or as a GPIB Controller that addresses a single GPIB device to talk or listen (C mode).

When to Use D Mode

The GPIB-422CV should be set to operate in D mode if you want to connect a serial device to a GPIB system that has a GPIB Controller responsible for addressing the GPIB-422CV to talk or listen. An example of a system requiring D mode includes a serial device, such as a printer, connected to a GPIB system with an existing GPIB Controller, such as an IBM PC AT computer with a National Instruments IEEE 488.2 board installed (such as AT-GPIB), as shown in Figure 3-1.

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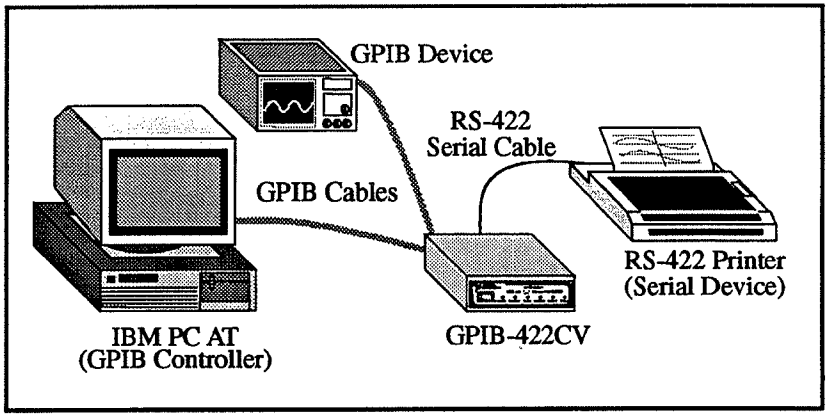


Figure 3-1. Example of D Mode System Setup

When to Use C Mode

The GPIB-422CV should be set to operate in C mode when transferring data between a GPIB device that has no Controller capabilities and a serial device. An example of a system requiring C mode includes a GPIB device, such as a digital multimeter, connected to a Macintosh serial port through a GPIB-422CV as shown in Figure 3-2.

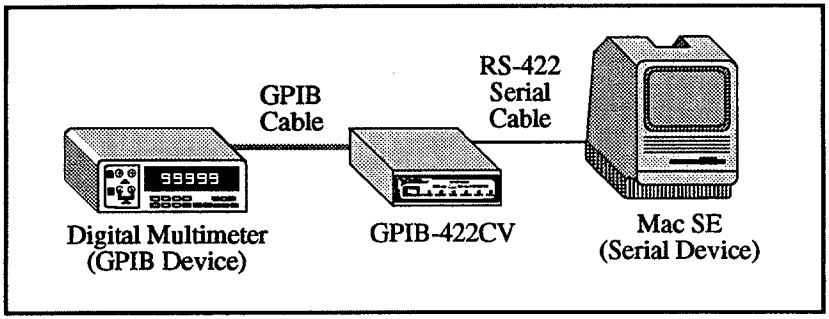


Figure 3-2. Example of C Mode System Setup

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D Mode Overview

In D mode, the GPIB-422CV acts as another device on the bus. Figure 3-3 shows the D mode system layout.

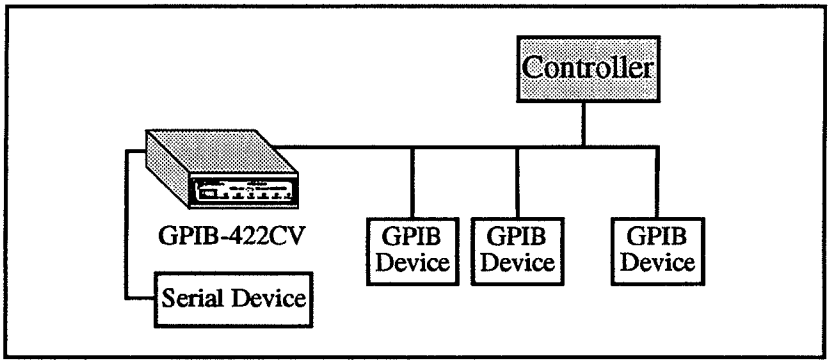


Figure 3-3. D Mode System Layout

In D mode, the GPIB-422CV can act only as a GPIB Talker or Listener. Do *not* pass control to the GPIB-422CV when using D mode. If you do, the GPIB circuitry in the GPIB-422CV accepts control and immediately asserts the **ATN*** signal, a system error condition that you should avoid.

Because the GPIB-422CV is not System Controller in D mode, it expects to receive GPIB commands from the Controller-In-Charge (CIC). If the GPIB -422CV receives the universal Device Clear (DCL) command or is addressed to listen and receives the Selected Device Clear (SDC) command, it clears its internal data buffers and resets to its power-up state. Neither Trigger (GET) nor Go To Local (GTL) have any effect on the GPIB -422CV.

Data Transfers in D Mode

When you are ready to send data to the GPIB-422CV in D mode, address the GPIB-422CV to listen, if not already in listen-only mode. All GPIB data received by the GPIB-422CV is buffered and passed along to the serial device. When you are expecting to receive data from the serial device, address the GPIB-422CV to talk, and all data received over the serial port is passed along to the GPIB port.

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Data Buffering in D Mode

When operating in D mode, the GPIB-422CV accepts data from the GPIB port using the onboard DMA Controller. The DMA controller transfers the data directly to the memory buffer without processor intervention. As a result, very high-speed GPIB transfer rates are possible–as high as 900 kbytes/sec. This means that the GPIB system performance is not degraded by connecting a slow printer or plotter to the interface. The buffered data is then dumped to the device on the RS-422 serial port at its own rate. These two asynchronous events take place concurrently and without user interaction. All operations are completely transparent to the user. Refer to Appendix C, *Application Examples*, for a detailed example that shows how to use the GPIB-422CV as a high-speed print spooler.

Choosing a Serial Port Buffer Size

All data that is sent to the GPIB-422CV is buffered and then passed along to the destination port. Thus, any serial data received is buffered and then passed along to the GPIB port whenever the GPIB-422CV is addressed to talk. The GPIB-422CV has 256K of RAM for buffering. In D mode, this memory can be allocated between the serial and GPIB buffers in two possible configurations.

The size of the serial input buffer can be set to either 256 bytes (U22 switch 2 set to OFF), or 32K (U22 switch 2 set to ON) with the remainder of the 256K of RAM allocated to the GPIB buffer.

- Set the serial input buffer size to 256 bytes if only small amounts of data, such as status information from a plotter, are expected to be sent from the serial device to the GPIB-422CV.

- Set the serial input buffer size to 32K if you expect the serial device to send large amounts of data to the GPIB-422CV, such as an RS-422 instrument sending thousands of bytes of measurements.

In either case, the remainder of RAM space is used as the GPIB input buffer. Thus, if a large amount of GPIB data is expected to be sent to the GPIB-422CV, it would be advantageous to use the small 256 byte serial port buffer size if possible. Then the majority of RAM is used as the GPIB buffer. The larger serial buffer size is a means of capturing a larger percentage of the total RAM space for serial input use.

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Regardless of the buffer size you choose, serial data is not lost because the GPIB-422CV implements a hardware handshake scheme, and if selected, the XON/XOFF software handshake scheme. The variable buffer size is a means of optimizing the GPIB-422CV for your application.

Using the SRQ Feature

The GPIB bus performance might slow down if the Controller is constantly waiting for the GPIB-422CV to send or receive data. With SRQ enabled, the bus can be used by other devices until the GPIB-422CV requests service (asserts **SRQ***). When the GPIB-422CV asserts **SRQ***, the Controller serial polls the GPIB-422CV to determine what type of service it needs. After it is serial polled, the GPIB-422CV unasserts **SRQ***. You can enable the SRQ feature by setting switch 3 of U22 to the ON position.

Conditions That Cause SRQ to be Asserted

If SRQ is enabled, the GPIB-422CV asserts the **SRQ*** signal on two conditions:

- when the GPIB-422CV receives serial data that it needs to pass on to the GPIB port
- when the GPIB input buffer becomes empty

When the GPIB-422CV serial input buffer is empty and the GPIB-422CV receives a serial character to be sent along to the GPIB, the **SRQ*** signal is asserted. This alerts the GPIB Controller that the GPIB-422CV has data to send to a GPIB Listener. The Controller can then address the GPIB-422CV to talk so that the data can be read out of the GPIB-422CV serial buffer. When the serial buffer is empty, the Controller can unaddress the GPIB-422CV to talk and address other devices to transfer data on the bus.

SRQ* is also asserted when the GPIB input buffer becomes empty. When the GPIB-422CV has emptied out the buffer, it requests service, indicating it is ready for more data. The Controller can then readdress the GPIB-422CV to listen and continue sending data until all the data is sent.

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Maximizing Performance with SRQ

If large amounts of data (greater than the GPIB buffer size) are sent over the GPIB to the GPIB-422CV and the serial device is a very slow data acceptor, the GPIB-422CV internal GPIB data buffer might become full. If this occurs, the **FULL** indicator on the front panel illuminates and the GPIB transfer rate slows to approximately the same rate as the serial device that is accepting the data. Because the maximum data transfer rate on the GPIB is only as fast as the slowest Listener, the GPIB system performance may become unacceptable if other GPIB devices are required to transfer data on the bus.

To get maximum GPIB performance when large amounts of data are sent to the GPIB-422CV, enable the SRQ feature and send only data amounts up to but not exceeding the GPIB input buffer size. The Controller can then unaddress the GPIB-422CV to listen so that other devices can use the bus. When the GPIB-422CV is ready to receive more data, it asserts the **SRQ*** signal.

GPIB-422CV Serial Poll Responses

If the GPIB-422CV is serial polled, its response byte depends on the status of the internal data buffers.

- If the serial input buffer is empty, bit 1 of the status byte is set to 1.
- If the serial input buffer is not empty, bit 1 is set to 0.
- If the GPIB input buffer is empty, bit 0 of the status byte is set to 1.
- If the GPIB input buffer is not empty, bit 0 is set to 0.

In all cases, bit 6 is set to 1 if the GPIB-422CV is requesting service; otherwise it is set to 0.

GPIB-422CV Operation in Listen-Only Mode

In listen-only mode, no addressing is required to make the GPIB-422CV a GPIB Listener and it cannot be unaddressed to listen. All data transferred on the GPIB is accepted by the GPIB-422CV and output to the serial port even if the data was intended for another device. This configuration can be used to monitor all GPIB data bus activity. Notice that when the GPIB-422CV is configured as a listen-only device, it cannot be serial polled.

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The GPIB primary address for the GPIB-422CV is specified by switches 4 through 8 of the configuration DIP switch U22. If all GPIB address switches 4 through 8 are set to ON, the GPIB-422CV is configured as a listen-only device. Figure 3-4 shows the switch settings for listen-only mode.

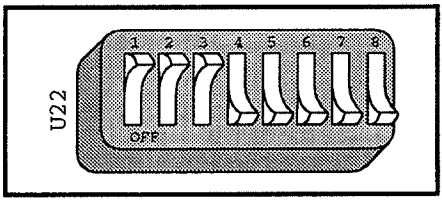


Figure 3-4. Switch U22 Settings for Listen-Only Mode

C Mode Overview

In C mode, the GPIB-422CV and a serial device together act as the GPIB System Controller. Figure 3-5 shows the C mode system layout.

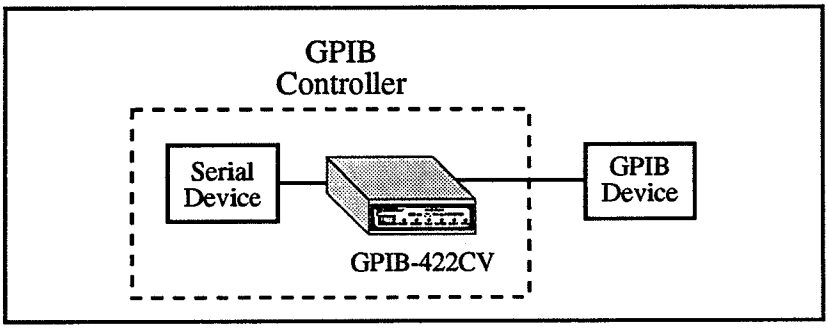


Figure 3-5. C Mode System Layout

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When you turn the power on with the GPIB-422CV in C mode, the GPIB-422CV asserts **IFC*** for 500 µsec and addresses the instruments to listen. On a GPIB system, asserting **IFC*** for at least 100 µsec initializes the GPIB and causes the System Controller to become Controller-In-Charge (CIC).

After the GPIB-422CV becomes CIC, it sends out the GPIB listen address indicated by U22 switches 4 through 8. If switches 4 through 8 are all ON, no addressing is performed. This configuration is useful if you are talking to a listen-only device that does not require addressing. The GPIB-422CV always asserts **REN*** when addressing other devices.

Data Transfers in C Mode

All incoming serial data to the GPIB-422CV is stored in an internal data buffer until it is accepted by the GPIB device. All GPIB data sent to the GPIB-422CV is passed immediately to the serial port without being buffered. You can send data to your serial port as if you had a serial device connected to it. The data is converted and sent to the GPIB instrument. When the instrument has data to send back, the GPIB-422CV addresses the instrument to talk and passes all received data to the RS-422 port.

Modes of Operation Within C Mode

Four different modes of operation are available within C mode to define when the GPIB device is addressed to talk or listen. These modes are as follows:

- timeout termination
- <CR> termination
- <LF> termination
- no-swap

In every mode, the device is addressed to listen after the GPIB-422CV becomes CIC, and all data received via the serial port is buffered and passed along to the device. The four modes of operation define the point at which the GPIB device is unaddressed to listen and addressed to talk so that data can be sent from the device to the GPIB-422CV. You can select these modes using U22 switches 2 and 3.

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Timeout Termination Mode

Timeout termination mode should be used for applications in which bidirectional communication is required and neither a <CR> nor <LF> character is used to signal the end of a command string to the GPIB device. To select timeout termination mode, set U22 switches 2 and 3 to OFF.

Figure 3-6 shows the cycle of events in timeout termination mode.

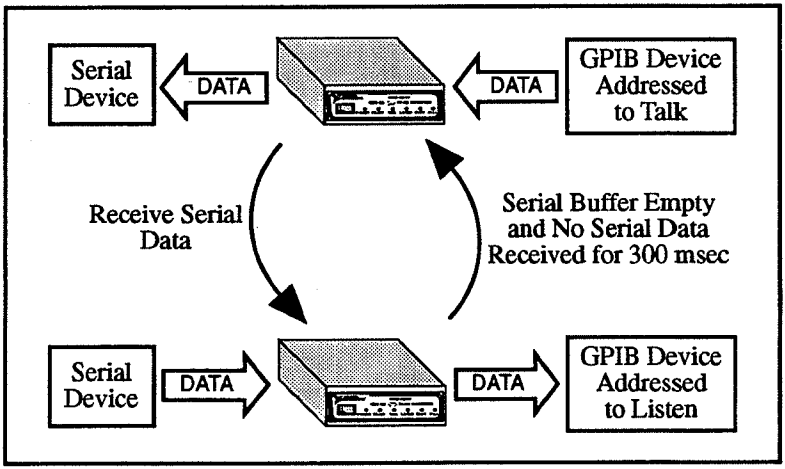


Figure 3-6. Timeout Termination Mode Cycle

In timeout termination mode, the GPIB-422CV addresses the GPIB device to talk, and any characters read from the GPIB port are passed along immediately to the serial port. When a serial character is received by the GPIB-422CV, it immediately readdresses the GPIB device to listen and passes the character to it. It remains in this mode until its serial input buffer becomes empty and no serial characters are received for 300 msec. After this period of inactivity, the GPIB-422CV assumes that since no more serial data is being sent, the device might have data that it needs to send back to the GPIB-422CV. It then readdresses the device to talk and passes any characters read from the GPIB port along to the serial port.

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<CR> or <LF> Termination Mode

If a command string to the GPIB instrument can be terminated with either a <CR> (carriage return) or <LF> (linefeed) character, you can use either termination with <CR> or <LF> to readdress the GPIB device to send data. To select <CR> mode, set U22 switch 2 to OFF and 3 to ON. To select <LF> mode, set U22 switch 2 to ON and 3 to OFF.

In these modes, when the GPIB-422CV receives the terminating character from the serial port, it addresses the device to talk so that any GPIB data can be input by the GPIB-422CV. Then any serial character received by the GPIB-422CV signals the GPIB-422CV to readdress the GPIB device as a Listener. For example, you might want to connect an HP7475 GPIB plotter to an IBM PC serial port using the GPIB-422CV. To then draw a line, get plotter status, and draw a circle you could use the following BASIC commands:

```
10  OPEN "COM1:9600,n,8,1" AS #1        'Assumes
                                        'GPIB-422CV is
                                        'at 9600 baud,
                                        'no parity, 8
                                        'data bits, 1
                                        'stop bit.

20  PRINT #1,"pa1000,1000 os"           'Plot absolute to
                                        '1000,1000 then
                                        'output status.

30  LINE INPUT #1,RESPONSE$             'Get status
                                        'response from
                                        'plotter.

40  PRINT #1 "ci100";                   'Draw circle
                                        'with radius of
                                        '100 units.
```

Line 20 of the program outputs plotter commands to the serial port to both draw a line and obtain status. Because neither a <CR> nor <LF> is sent between these commands, the GPIB-422CV keeps the GPIB plotter addressed to listen and sends all serial data received to the plotter. Because the PRINT statement is not ended with a semicolon after the double quotation mark, BASIC automatically sends a <CR> after the last character in the ASCII string is sent. If the GPIB-422CV is set up for <CR> termination, the GPIB-422CV then readdresses the plotter to talk so that its status can be output.

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Line 30 inputs the status response from the plotter into the string variable RESPONSE$.

Line 40 outputs the plotter command to the GPIB-422CV to draw a circle. As soon as the GPIB-422CV receives the first character in this string, it readdresses the plotter to listen and then sends these characters to it. Notice that for this PRINT statement a semicolon is included after the last double quotation mark. This means a <CR> is not sent. Because no information is requested from the plotter, there is no need to send a <CR> at the end of the string to address the plotter to talk.

No-Swap Mode

In no-swap mode, the GPIB-422CV never readdresses a GPIB device after it has initially been addressed as a Listener. To select no-swap mode, set U22 switches 2 and 3 to ON.

This mode is useful if your device is intended only to receive data. In the example given in the *<CR> or <LF> Termination Mode* section of this chapter, you could use the no-swap mode to talk to the plotter if you never needed to obtain status information from it. By adding a semicolon after the double quotation mark at the end of line 20 as shown below, you suppress the <CR>. Since you cannot readdress in no-swap mode, the <CR> is not needed to obtain status as it was in the previous example.

```
10  OPEN "COM1:9600,n,8,1" AS #1      'Assumes
                                      'GPIB-422CV is
                                      'at 9600 baud,
                                      'no parity, 8
                                      'data bits, 1
                                      'stop bit.

20  PRINT #1,"pa1000,1000";           'Plot absolute to
                                      '1000,1000.

30  PRINT #1 "ci100";                 'Draw circle
                                      'with radius of
                                      '100 units.
```


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Data Buffering and Handshaking Schemes

Two protection mechanisms are used to ensure that the GPIB-422CV does not lose incoming serial data: data buffering and handshaking.

The GPIB-422CV has an internal RAM buffer that stores incoming serial data until it can output the data to the GPIB port. The size of this RAM buffer determines how much serial data the GPIB-422CV can accept before the buffer is completely full.

When its RAM buffer is nearly full, the GPIB-422CV can handshake with the serial host to stop data transmission. When the buffer is almost empty, the GPIB-422CV can again handshake with the serial host to start data transmission. The GPIB-422CV is capable of using both the XON/XOFF software handshaking and the hardware handshaking protocols.

Hardware Handshaking

The hardware handshake function is always active during RS-422 transfers and uses the Handshake Out (HSO) and Handshake In (HSI) signal lines. When the GPIB-422CV is ready to accept serial data, it asserts the HSO lines. This signal remains asserted until the GPIB-422CV's data buffer is almost full. At this point, the GPIB-422CV unasserts the HSO lines, signaling to the serial host that the GPIB-422CV is no longer ready to accept data. The serial host should monitor the HSO lines and suspend data transmission whenever the HSO lines become unasserted. The GPIB-422CV asserts HSO when it is again ready to receive serial data.

The GPIB-422CV is also able to suspend transmission when the serial device is no longer ready to accept data. The GPIB-422CV is configured to immediately stop transmission of serial data when HSI becomes unasserted. The GPIB-422CV resumes transmission as soon as HSI is reasserted.

Because most serial devices use the same form of hardware handshaking as the GPIB-422CV, you can achieve bidirectional flow control by using a serial cable that connects the GPIB-422CV HSO signals to the serial device HSI signals. In addition, the serial device HSO signals should be connected to the GPIB-422CV HSI signals. This setup allows each device to monitor the other device HSO signals and to suspend transmission when necessary to prevent data loss. Refer to Appendix B, *Interfacing to a Serial Device*, for more information on wiring schemes.

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Note: HSI must be asserted for the GPIB-422CV to transmit data.

XON/XOFF Software Handshaking

If your serial device does not implement or recognize the hardware handshake scheme, your cable does not support the necessary handshake lines, or your application software requires XON/XOFF handshaking, you might need to enable the XON/XOFF handshaking protocol by setting switch 1 of U20 to ON. This handshaking protocol performs a similar function as the hardware handshake scheme but does so by sending special control codes over the data lines instead of changing logic levels on dedicated control lines.

When you enable the XON/XOFF protocol, the GPIB-422CV sends the XOFF character (decimal 19 or <CTRL-S>) before the internal buffer overflows. When the GPIB-422CV is able to start receiving characters again, it sends the XON character (decimal 17 or <CTRL-Q>). Similarly, if the GPIB-422CV is transmitting data and receives the XOFF character, it suspends transmission of any further data until it receives the XON character.

If you are transmitting binary data, do *not* configure the GPIB-422CV to use XON/XOFF software handshaking. Because the binary data could contain any binary sequence, including decimal 19 (<CTRL-S>) or decimal 17 (<CTRL-Q>), the GPIB-422CV would not be able to distinguish between data values or handshake control codes. If XON/XOFF handshaking were enabled, the GPIB-422CV would handshake erratically.

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Appendix A
GPIB-422CV Specifications

This appendix contains tables which specify the electrical, environmental, and physical characteristics of the GPIB-422CV.

Table A-1. Electrical Characteristics

Characteristic	Specification
Power Supply Unit	Wall mount type, 115 VAC or 230 VAC, 50/60 Hz input, 9 VDC @ 1A max output
Current	640 mA typical; 750 mA max

Table A-2. Environmental Characteristics

Characteristic	Specification
Operating Temperature	0° to 50° C
Storage Temperature	-10° to 70° C
Relative Humidity	10% to 95% noncondensing conditions
EMI	FCC Class A Verified

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Table A-3. Physical Characteristics

Characteristic	Specification
Case Size	1.6 in. by 5.7 in. by 8.4 in. (40.6 mm by 144.8 mm by 213.4 mm)
Case Material	All metal enclosure
Rack Mounting	Single or dual kits available
Weight	28 oz (without power supply unit)

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Appendix B
Interfacing To a Serial Device

This appendix describes the RS-422 serial port on the GPIB-422CV and explains how to interface a DCE or DTE serial device to the RS-422 serial port.

The GPIB-422CV transfers serial data using the electrical signals and specifications as defined in the RS-422 standard. The RS-422 port on the GPIB-422CV provides an asynchronous serial communication link to the host serial peripheral device. The RS-422 connector is located on the rear panel of the GPIB-422CV.

The RS-422 Standard

The RS-422 standard (Electrical Characteristics of Balanced Voltage Digital Interface Circuits) was formulated in 1978 and defines the interchange of serial binary signals between two devices. Enhancements of RS-422 circuits compared to those defined by RS-422 include:

- Data signal rates up to 10M bits/sec
- Cable lengths up to 4000 ft. (but only at rates to 90K bits/sec)
- Less interference from extraneous noise sources.

The RS-422 specification defines a balanced interface; that is, instead of a voltage on one signal line being referenced to a common ground, as in RS-232, the signal is carried on two lines that are always in a complementary state. The threshold criteria for the state of a signal is the voltage difference between the two signals (not the absolute value of either with respect to ground). If the voltage on TXD+ is greater than the voltage on TXD-, that represents a logic 1. If the voltage on TXD+ is less than the voltage on TXD-, a logic 0 is being transmitted. Thus, if an interconnecting cable is exposed to electrical noise, the noise is induced in both signals, and the voltage difference between them remains relatively constant.

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For more information on the RS-422 standard, write to:

EIA Engineering Department
Standards Sales Office
2001 Eye Street, N.W.
Washington, D.C. 20006

Special Note for Macintosh Users

In an effort to remain compatible with the magnitude of RS-422 and RS-232 devices on the market, Apple had to forego strict compliance with the RS-422 standard in the design of their serial port of the Macintosh line of computers. To be compatible with the Apple implementation of the RS-422 standard, National Instruments has three jumpers on the GPIB-422CV that determine the type of interface you are using. To configure the GPIB-422CV to be compatible with the Macintosh serial port, refer to the *Step 2. Configure the Operating Characteristics* section in Chapter 2.

Description of the RS-422 Port

The RS-422 serial port on the GPIB-422CV uses a male 9-pin D-subminiature connector with a DTE interface configuration. Table B-1 shows the signal lines supported on the GPIB-422CV.

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Table B-1. Typical RS-422 Serial Port Signals (DTE to DTE)

Pin	Signal Description	Function
1	GROUND	Logic and chassis ground.
2	HSI+ or NC (Handshake In, non-inverting, or Not Connect)	If the unit is configured to be compatible with the Macintosh port, this pin is not used. Otherwise, it should be connected to the non-inverting Handshake Output pin of the serial host. This signal can be used together with HSI- to stop serial data transmission from the GPIB-422CV.
3	HSO+ or GND (Handshake Out, non-inverting, or Logic and chassis ground)	If the unit is configured to be compatible with the Macintosh serial port, this pin will be connected to the unit's logic and chassis ground. Otherwise, it should be connected to the non-inverting Handshake Input pin of the serial host. This signal will become asserted when the internal buffer of the GPIB-422CV is full.
4	RXD+ (Receive Data Line, non-inverting)	This line should be connected to TXD+ of the serial host device.
5	RXD- (Receive Data Line, inverting)	This line should be connected to TXD- of the serial host device.
6	HSI- (Handshake In, inverting)	This signal line should be connected to the inverting Handshake Output pin of the serial host. This signal can be used together with HSI+ to stop serial data transmission from the GPIB-422CV.
7	HSO- (Handshake Out, inverting)	This signal line should be connected to the inverting Handshake Input pin of the serial host and will become asserted when the internal buffer of the GPIB-422CV is full.
8	TXD (Transmit Data Line, non-inverting)	This line should be connected to RXD of the serial host device.
9	TXD- (Transmit Data Line, inverting)	This line should be connected to RXD- of the serial host device.

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Interfacing Serial Devices to the RS-422 Serial Port

To interface other serial devices to the RS-422 serial port on the GPIB-422CV, first refer to the manual that came with your serial device to determine if the device is configured as a DTE or DCE. Also, determine from the manual how the control lines are used and whether they must be driven for the serial port to operate.

Interfacing the GPIB-422CV to a DTE Device

For RS-422 devices set up as DTEs, you must wire a DTE-to-DTE interface cable, commonly known as a null modem cable. The null modem cable connects the transmit lines of one device to the receive lines of the other device and vice versa. Table B-2 shows a typical DTE-to-DTE interface cable. If a custom cable is required for your application, review the RS-422 characteristics of your serial device and build the cable to perform the desired functions.

Table B-2. Typical DTE-to-DTE RS-422 Serial Cable Configuration

GPIB-422CV (DTE)		RS-422 DEVICE (DTE)
GROUND	⟷	GROUND
HSI+	⟷	HSO+
HSO-	⟷	HSI-
RXD+	⟷	TXD+
RXD-	⟷	TXD-
HSI+	⟷	HSO+
HSO-	⟷	HSI-
TXD+	⟷	RXD+
TXD-	⟷	RXD-

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Interfacing the GPIB-422CV to a DCE Device

For RS-422 devices set up as DCEs, you must wire a DTE-to-DCE interface cable. This cable is wired *straight across*: the transmit lines of each device are connected together and the receive lines of each device are connected together. Table B-3 shows a typical DTE-to-DCE interface cable. If a custom cable is required for your application, review the RS-422 characteristics of your serial device and build the cable to perform the desired functions.

Table B-3. Typical DTE-to-DCE RS-422 Serial Cable Configuration

GPIB-422CV (DTE)		RS-422 DEVICE (DCE)
GROUND	⟷	GROUND
HSI+	⟷	HSI+
HSO-	⟷	HSO-
RXD+	⟷	RXD+
RXD-	⟷	RXD-
HSI+	⟷	HSI+
HSO-	⟷	HSO-
TXD+	⟷	TXD+
TXD-	⟷	TXD-

Note: The GPIB-422CV serial port is configured as a DTE and the HSI signal must be asserted for the GPIB-422CV to transmit data. If your serial device does not implement any hardware handshaking, the GPIB-422CV hardware handshaking can be satisfied by connecting HSO+ to HSI+ and HSO- to HSI-. This forces the HSO lines into a continual asserted state so that the GPIB-422CV can transmit data. But it also prevents the RS-422 serial device from being able to suspend transmission from the GPIB-422CV, which could result in data loss. In many cases, you can use XON/XOFF handshaking instead of hardware handshaking to prevent data loss.

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Appendix C
Application Examples

This appendix contains two GPIB-422CV application examples. The first example shows how to use the GPIB-422CV as a high-speed print spooler, and the second example shows how to connect a HP7475 GPIB plotter to an IBM PC running AUTOCAD.

Using the GPIB-422CV as a High-Speed Print Spooler

Because mechanical printers and plotters are slow relative to the processing speed of a computer, computers must output data at a slow rate. This forces you to wait for the data to be output or tolerate decreased performance if the data transfer occurs in the background. One common solution to this problem is to use a print spooler to relieve the computer of this task.

Standard print spoolers are able to store incoming data in a RAM buffer until the printer or plotter is able to accept it, allowing the PC to output data at a rate faster than printer or plotter rates. You can use the GPIB-422CV in this way.

With a GPIB-422CV, you can transfer data at GPIB rates instead of RS-422 rates. The GPIB-422CV uses a DMA Controller to input data from the GPIB port to the RAM buffer and can input GPIB data at rates up to 900 kbytes/sec. Therefore, the transfer rate is limited only by the rate at which the GPIB Talker can write data.

This example shows you how to connect and use your GPIB-422CV as a high-speed print spooler which returns control to you quickly, so that you do not have to wait for the PC to finish printing or plotting a file.

The following example is based on the assumption that a National Instruments GPIB interface board (such as the AT-GPIB) is installed in your computer and that you are familiar with the software configuration utility `ibconf`. Use the following procedure to set up the system the first time.

1. Use `ibconf` to configure the system so that a device named either *printer* or *plotter* is connected to the GPIB interface board. Be sure to enable DMA transfers and to use high-speed timing.

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2. Configure the GPIB-422CV to operate in D mode with the small (256 bytes) serial port buffer and SRQ disabled. The serial buffer is set to the smallest size to allow the GPIB port, which is the data source, to use the majority of RAM. Set the GPIB address to the same address assigned to the device plotter or printer in `ibconf`. Configure the serial port parameters to match those of the printer or plotter.

3. Connect the GPIB cable from the PC to the GPIB-422CV, and connect the serial cable from the GPIB-422CV to the printer or plotter. The system should resemble the diagram in Figure C-1.

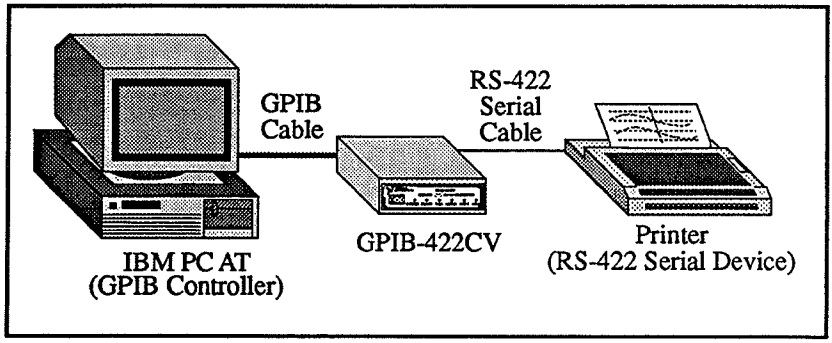


Figure C-1. Example of Print Spooler Setup

4. Provide a means to transfer data to the printer or plotter easily via the GPIB port on your PC. You can simply redirect the serial output to the GPIB device as explained in the *NI-488.2 Software Reference Manual for MS-DOS* that comes with the National Instruments AT-GPIB board, but the overhead associated with the DOS calls makes this method inherently slow. The fastest way to transfer data to the GPIB port is to write a small program that executes a GPIB file write. The following program is an example of how to do a GPIB file write in the C programming language. You can use other languages in the same way.

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```
/* FASTPRINT - dumps specified data file out GPIB
to device named printer */

#include "decl.h"
#include <stdio.h>

main (argc, argv)
char **argv;
{
   char fname [16],*filename;
   int f;

/* prompt for file name if not provided */
   if (argc <=1) {
        printf ("Enter filename:  ");
        gets (fname);
        filename = fname;
   }
   else
        filename = argv[1]

/* find device printer */
   if ((f = ibfind ("printer"))<0) {
        fprintf(stderr, "Can't find printer\n");
        exit(1);
   }


/* write file */
   if (ibwrtf(f, filename) & ERR) {
        fprintf(stderr, "Can't open %s\n", argv[1]);
        exit(1);

   }
}
```

After the program is compiled and linked, you can run it just like the DOS print routine. Then, as long as you are not sending an amount of data greater than the buffer size of the GPIB-422CV, the data transfer should complete in a few seconds.

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Using the GPIB-422CV to Connect a HP7475 GPIB Plotter to a PC Serial Port

Many software packages provide printing and plotting utilities which use your computer serial port. If GPIB support is not specifically provided in the package, you *cannot* communicate with a GPIB device. If your computer has an RS-422 serial port, the GPIB-422CV can solve this communication problem by creating a link between the serial port and the GPIB devices.

For example, an IBM PC which has an RS-422 serial port and is running AUTOCAD sends data to the plotter by transferring data through the computer's serial port. It cannot send data to a GPIB plotter such as the HP7475 GPIB plotter. Because AUTOCAD supports the HP7475 *serial* plotter, you can use the GPIB-422CV to convert the serial data from AUTOCAD into GPIB data for the plotter. The GPIB-422CV automatically takes care of the GPIB addressing and transparently converts the data from one format to the other. To use the GPIB-422CV in this way, follow these steps:

1. Start AUTOCAD and select *Configure AUTOCAD* from the Main Menu. Select the HP7475 plotter and configure the rest of the operating parameters that you need.

2. Configure your GPIB-422CV. Set it to operate in C mode with timeout termination. Set the GPIB address of the plotter using the GPIB-422CV configuration switches. Set the serial port parameters to XON/XOFF disabled, 9600 baud, 7 data bits, 1 stop bit, and even parity.

3. Power on the plotter, then power on the GPIB-422CV.

When the GPIB-422CV is powered on, it addresses the GPIB plotter. Any data sent to the serial port by AUTOCAD is received by the GPIB-422CV and stored in its internal buffer. The GPIB-422CV transfers the data to the plotter over the GPIB connection as fast as the plotter can receive it. Because the GPIB-422CV provides a data buffer that spools the data as it is sent, the PC will be able to send data at serial rates instead of plotter rates. Therefore, your data is output to the GPIB plotter by AUTOCAD in less time than it would have taken to use the HP7475 serial plotter.

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Appendix D
Customer Communication

For your convenience, this appendix contains forms to help you gather the information necessary to help us solve technical problems you might have as well as a form you can use to comment on the product documentation. Filling out a copy of the *Technical Support Form* before contacting National Instruments helps us help you better and faster.

National Instruments provides comprehensive technical assistance around the world. In the U.S. and Canada, applications engineers are available Monday through Friday from 8:00 a.m. to 6:00 p.m. (central time). In other countries, contact the nearest branch office. You may fax questions to us at any time.

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(512) 794-5678

Branch Offices	Phone Number	Fax Number
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Austria	(0662) 435986	(0662) 437010-19
Belgium	02/757.00.20	02/757.03.11
Denmark	45 76 26 00	45 76 71 11
Finland	(90) 527 2321	(90) 502 2930
France	(1) 48 14 24 00	(1) 48 14 24 14
Germany	089/741 31 30	089/714 60 35
Italy	02/48301892	02/48301915
Japan	(03) 3788-1921	(03) 3788-1923
Netherlands	03480-33466	03480-30673
Norway	32-848400	32-848600
Spain	(91) 640 0085	(91) 640 0533
Sweden	08-730 49 70	08-730 43 70
Switzerland	056/20 51 51	056/20 51 55
U.K.	0635 523545	0635 523154

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Technical Support Form

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

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

Name _____

Company _____

Address _____

_____

Fax (___)_____ Phone (___)_____

Computer brand _____

Model _____ Processor _____

Operating system _____

Speed _____MHz RAM _____MB

Display adapter _____

Mouse _____yes _____no

Other adapters installed _____

Hard disk capacity _____MB Brand _____

Instruments used _____

National Instruments hardware product model _____

Revision _____

Configuration _____

(continues)

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National Instruments software product _____

Version _____

Configuration _____

The problem is _____

_____

_____

_____

_____

_____

_____

_____

List any error messages _____

_____

_____

_____

_____

_____

_____

_____

The following steps will reproduce the problem _____

_____

_____

_____

_____

_____

_____

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GPIB-422CV Hardware and Software Configuration Form

Record the settings and revisions of your hardware and software on the line to the right of each item. Update this form each time you revise your software or hardware configuration, and use this form as a reference for your current configuration.

National Instruments Products

- GPIB-422CV Model and Revision _____
- Application Programming Language _____
- U20 Switch Setting _____
- U22 Switch Setting _____

Other Products

- Operating System and Version _____
- Computer Make and Model _____
- Number of GPIB Devices on Bus _____
- Serial Handshaking Used:

  (hardware: HSO+, HSO-, HSI+, HSI- wired in cable) _____

  (software: XON/XOFF) _____
- Serial Cable Configuration _____

_____

(continues)

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- Connected to which Macintosh serial port _____
- Brand and model number of RS-422 instrument or serial cord _____

- If possible, include a copy of the application program you are using when you contact National Instruments.

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Documentation Comment Form

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

Title: **GPIB-422CV User Manual**

Edition Date: **December 1993**

Part Number: **320110-01-01**

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

(continues)

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

_____

_____

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_____

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Thank you for your help.

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Glossary

Prefix	Meaning	Value
µ-	micro-	10^{-6}
m-	milli-	10^{-3}
k-	kilo-	10^{3}
M-	mega-	10^{6}

°	degree
%	percent
A	amperes
C	Celsius
hex	hexadecimal
Hz	hertz
in.	inches
K	kbytes of memory
M	megabytes of memory
m	meters
oz.	ounces
sec	seconds
V	volts
VAC	volts alternating current
VDC	volts direct current

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