

# **GPIB-232CV-A**

## **User Manual**

*IEEE 488 ↔ RS-232 Converter*

**July 1997 Edition**

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## **FCC/DOC Radio Frequency Interference Compliance**

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**

The AC version of the GPIB-232CV-A 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**

The AC version of the GPIB-232CV-A 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.

There is no guarantee that interference will not occur in a particular installation. However, the chances of interference are much less if the equipment is installed and used according to this instruction manual.

If the equipment does cause interference to radio or television reception, which can be determined by turning the equipment on and off, one or more of the following suggestions may reduce or eliminate the problem.

- Operate the equipment and the receiver on different branches of your AC electrical system.
- Move the equipment away from the receiver with which it is interfering.
- Reorient or relocate the receiver's antenna.
- Be sure that the equipment is plugged into a grounded outlet and that the grounding has not been defeated with a cheater plug.

**Notice to user:** Changes or modifications not expressly approved by National Instruments could void the user's authority to operate the equipment under the FCC Rules.

If necessary, consult National Instruments or an experienced radio/television technician for additional suggestions. The following booklet prepared by the FCC may also be helpful: *How to Identify and Resolve Radio-TV Interference Problems*. This booklet is available from the U.S. Government Printing Office, Washington, DC 20402, Stock Number 004-000-00345-4.

## **FCC/DOC Radio Frequency Interference Compliance**

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:

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### **Canadian Department of Communications**

The DC version of the GPIB-232CV-A 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 B 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 interference from the equipment to radio and television reception in residential areas.

There is no guarantee that interference will not occur in a particular installation. However, the chances of interference are much less if the equipment is installed and used according to this instruction manual.

If the equipment does cause interference to radio or television reception, which can be determined by turning the equipment on and off, one or more of the following suggestions may reduce or eliminate the problem.

- Operate the equipment and the receiver on different branches of your AC electrical system.
- Move the equipment away from the receiver with which it is interfering.
- Reorient or relocate the receiver's antenna.
- Be sure that the equipment is plugged into a grounded outlet and that the grounding has not been defeated with a cheater plug.

**Notice to user:** Changes or modifications not expressly approved by National Instruments could void the user's authority to operate the equipment under the FCC Rules.

If necessary, consult National Instruments or an experienced radio/television technician for additional suggestions. The following booklet prepared by the FCC may also be helpful: *How to Identify and Resolve Radio-TV Interference Problems*. This booklet is available from the U.S. Government Printing Office, Washington, DC 20402, Stock Number 004-000-00345-4.

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# About This Manual

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The *GPIB-232CV-A User Manual* describes the features, functions, and operation of the GPIB-232CV-A. This manual assumes that you have a general knowledge of RS-232 serial communications and the General Purpose Interface Bus (GPIB).

## Organization of This Manual

The *GPIB-232CV-A User Manual* is organized as follows:

- Chapter 1, *Description of the GPIB-232CV-A*, contains an overview of the GPIB-232CV-A, lists what you need to get started and optional equipment you can order, and gives a description of the panels on the GPIB-232CV-A.
- Chapter 2, *Hardware Configuration and Installation*, describes the steps for configuring and installing the GPIB-232CV-A.
- Chapter 3, *Operation of the GPIB-232CV-A*, describes how to choose between D mode configuration and C mode configuration and contains information about operating the GPIB-232CV-A in D mode or C mode, data buffering, and handshaking schemes.
- Appendix A, *GPIB-232CV-A Specifications*, describes the electrical, environmental, and physical characteristics of the GPIB-232CV-A.
- Appendix B, *Interfacing to a Serial Device*, describes the RS-232 serial port on the GPIB-232CV-A and explains how to interface a DCE or DTE serial device to the RS-232 serial port.
- Appendix C, *Application Examples*, contains two GPIB-232CV-A application examples. The first example shows how to use a GPIB-232CV-A as a high-speed print spooler and the second example shows how to connect a HP7475 GPIB plotter to an IBM PC running AUTOCAD.
- Appendix D, *Customer Communication*, contains forms you can use to request help from National Instruments or to comment on our products and manuals.

## About This Manual

- 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.

<b>bold</b>	Bold text denotes a signal name or LED indicator.
<i>italic</i>	Italic text denotes emphasis, a cross reference, or an introduction to a key concept.
<b><i>bold italic</i></b>	Bold italic text denotes a note, caution, or warning.
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.
<>	Angle brackets enclose the name of a key on the keyboard—for example, <PageDown>.
-	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 refer to the ANSI/IEEE Standard 488.1-1987 and the ANSI/IEEE Standard 488.2-1987, respectively, which define the GPIB.
RS-232	RS-232 refers to the ANSI/EIA-232-C standard.

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

## **Related Documentation**

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

- *NI-488.2 Software Reference Manual for MS-DOS*, National Instruments Corporation
- *ANSI/EIA-232-C, Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange*
- *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.

# Chapter 1

## Description of the GPIB-232CV-A

---

This chapter contains an overview of the GPIB-232CV-A, lists what you need to get started and optional equipment you can order, and gives a description of the panels on the GPIB-232CV-A.

### GPIB-232CV-A Overview

The GPIB-232CV-A has a powerful 8-bit microcomputer tailored for use as an IEEE 488-to-RS-232 protocol converter. Both the RS-232 serial port and the GPIB (IEEE 488) port are interrupt-driven and feature extremely fast response times to external data transfers. The GPIB-232CV-A can transparently convert data between the two ports so that control codes or special commands are not required. Data transfers in either direction are possible at all times.

The GPIB-232CV-A microprocessor contains an integrated Direct Memory Access (DMA) controller for high-speed data transfers from the GPIB circuitry. The GPIB-232CV-A also increases the efficiency of the interface system by using a 256 KB RAM buffer to isolate the slower device from the faster port. You can use the GPIB-232CV-A to interface either a GPIB Controller or a GPIB device to a computer or instrument with a RS-232 port. The RS-232 serial port is fully compatible with all electrical specifications in the RS-232 standard.

The operating system of the GPIB-232CV-A is contained in read-only memory (ROM) and can address up to 256 KB of dynamic random-access memory (RAM). The operating system programs and maintains the LSI GPIB Controller chip, the NAT4882, which implements all IEEE 488 interface functions. The GPIB-232CV-A microprocessor 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.

## What You Need to Get Started

- One of the following boxes:**
  - GPIB-232CV-A (100-120 VAC)
  - GPIB-232CV-A (220-240 VAC)
  - GPIB-232CV-A (DC)
  
- If you have the GPIB-232CV-A AC version, you need one of the following power cords:**
  - U.S.A. standard power cord
  - Switzerland power cord
  - Australian power cord
  - Universal European power cord
  - North American power cord
  - U.K. power cord
  
- If you have the GPIB-232CV-A DC version, you need one of the following DC power supplies:**
  - 100-120 VAC, 9 V 1 A, wall-mount power supply
  - 220-240 VAC, 9 V 1 A, desktop power supply

## Optional Equipment

You can order the following optional equipment from National Instruments.

Component	Part Number
RS-232 Shielded Cable: GPIB-232CV-A to IBM PC (9-pin) – 2m	181139-02
Single-Shielded GPIB Cables*: GPIB Type X1 Cable – 1 m GPIB Type X1 Cable – 2 m GPIB Type X1 Cable – 4 m	763001-01 763001-02 763001-03
Double-Shielded GPIB Cables*: GPIB Type X2 Cable – 1 m GPIB Type X2 Cable – 2 m GPIB Type X2 Cable – 4 m	763061-01 763061-02 763061-03
* To meet FCC emission limits for this device you must use a shielded (Type X1 or X2) GPIB cable. Operating this equipment with a non-shielded cable may cause interference to radio and television reception.	

## Inspection

Before you operate the GPIB-232CV-A, inspect the shipping container and its contents for damage. Keep the packing material for possible inspection and/or reshipment.

If the equipment appears to be damaged, do not attempt to operate it. Contact National Instruments for instructions. If the damage appears to have been caused in shipment, file a claim with the carrier.

## The GPIB-232CV-A Panels

The following sections describe the panels of the GPIB-232CV-A.

### The GPIB-232CV-A AC Front Panel

The power switch, fuse holder, and power cord receptacle are located on the GPIB-232CV-A front panel, on the AC version only. Figure 1-1 shows the front panel of the AC version.

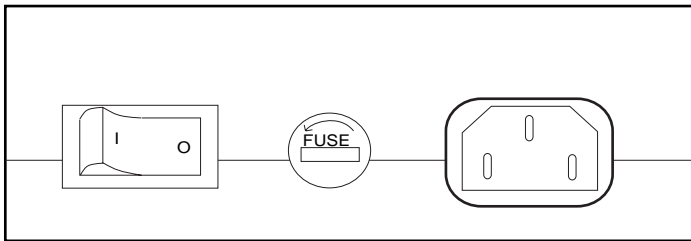


Figure 1-1. The GPIB-232CV-A AC Front Panel

### The GPIB-232CV-A Top Panel

The six light-emitting diodes (LEDs) are located on the GPIB-232CV-A top panel. Figure 1-2 shows the top panel.

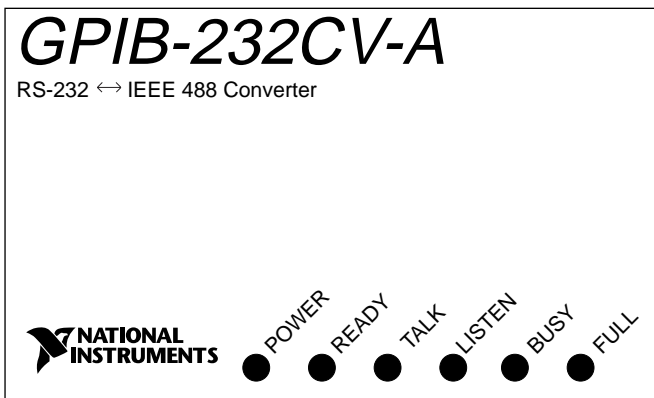


Figure 1-2. The GPIB-232CV-A Top Panel

The LEDs show the current status of the GPIB-232CV-A. Table 1-1 describes each LED.

Table 1-1. LED Descriptions

<b>LED</b>	<b>Indication</b>
<b>POWER</b>	Indicates that power has been applied to the unit and the ON/OFF switch is in the ON position.
<b>READY</b>	Indicates that the power-on self-test has successfully passed and the unit is ready to operate.
<b>TALK</b>	Indicates that the GPIB-232CV-A is configured as a GPIB Talker.
<b>LISTEN</b>	Indicates that the GPIB-232CV-A is configured as a GPIB Listener.
<b>BUSY</b>	Indicates that the GPIB-232CV-A is currently accepting serial data. Each serial character received toggles the status of the <b>BUSY</b> LED.
<b>FULL</b>	Indicates that one of the GPIB-232CV-A data buffers is full. This is not an error condition, but is merely a signal that bus performance may be reduced to the speed of the slower port.

### The GPIB-232CV-A Rear Panel

The configuration switches are located on the rear panel of the GPIB-232CV-A. The power switch of the DC version is also located on the rear panel.

Figure 1-3 shows the rear panel of the AC version. Figure 1-4 shows the rear panel of the DC version.

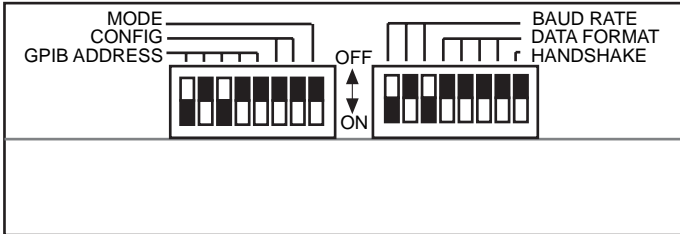


Figure 1-3 The GPIB-232CV-A AC Rear Panel

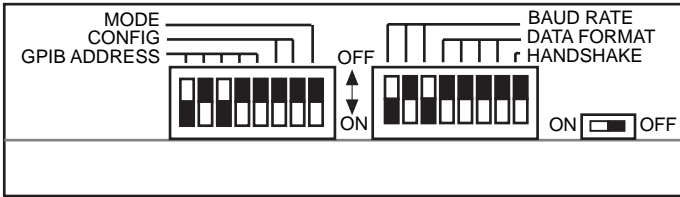


Figure 1-4. The GPIB-232CV-A DC Rear Panel

## The GPIB-232CV-A Side Panels

The GPIB connector and the RS-232 connector are mounted on opposite side panels. On the DC version, the DC power jack is on the same end as the serial connector.

Figure 1-5 shows the location of the RS-232 and GPIB connectors and the DC power jack.

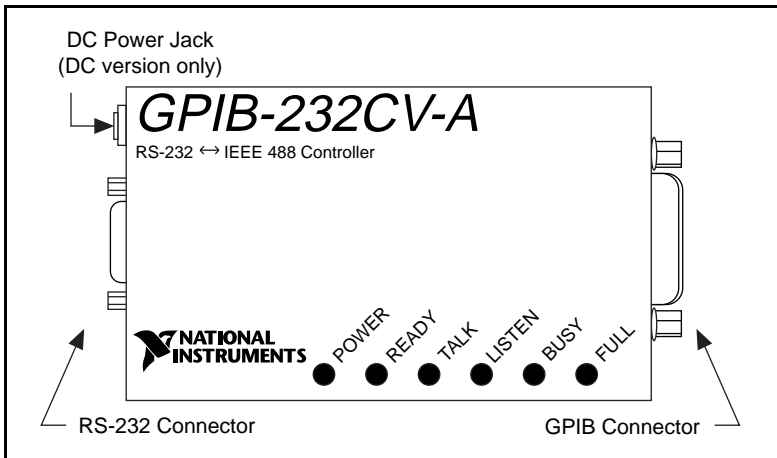


Figure 1-5. Location of the Connectors and the DC Power Jack

## The RS-232 Connector

The RS-232 port on the GPIB-232CV-A is configured as a DTE (Data Terminal Equipment) and uses a standard 9-pin shielded D-Subminiature male connector with screwlock assemblies. The RS-232 connector accepts standard 9-pin D-Subminiature female connectors. Figure 1-6 shows a diagram of the serial connector and the signals supported. For more information on the RS-232 signals refer to Appendix B, *Interfacing to a Serial Device*.

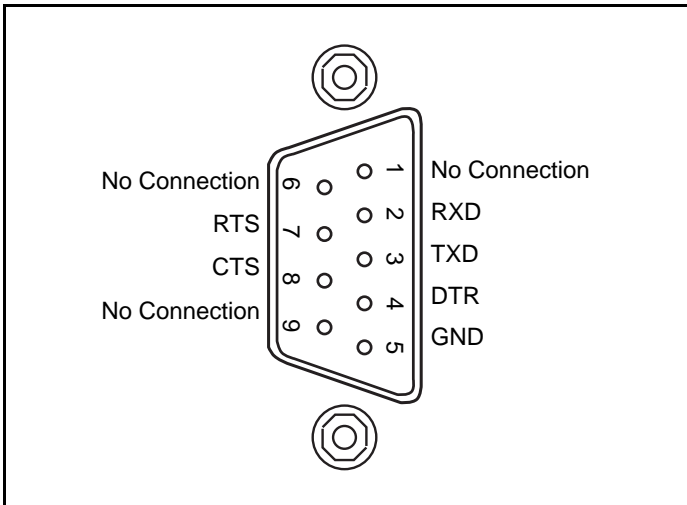


Figure 1-6. The RS-232 Connector and Signal Designations

## The GPIB Connector

The GPIB connector is a standard 24-pin shielded Champ female connector with metric screwlock hardware. Figure 1-7 shows a diagram of the GPIB connector and the signals supported. A \* suffix indicates that the signal is active low.

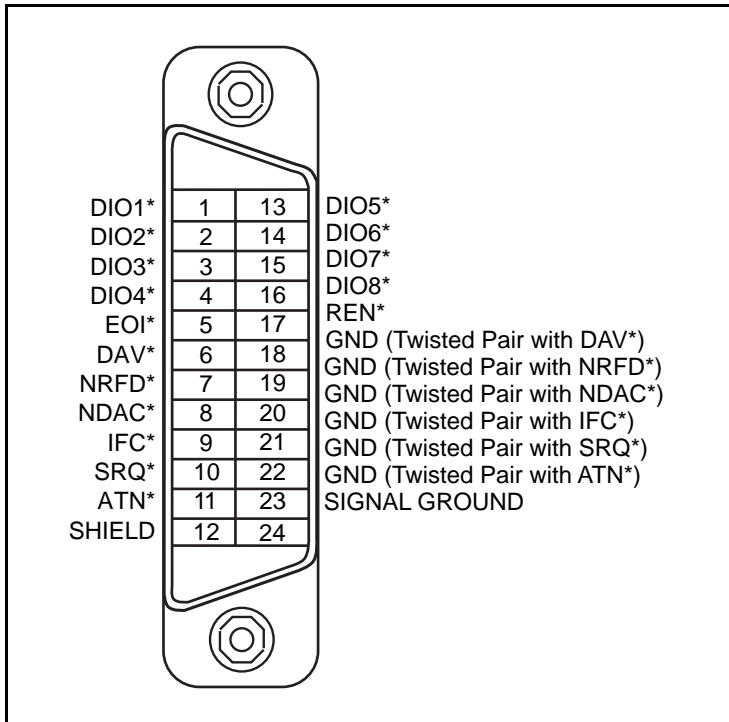


Figure 1-7. The GPIB Connector and Signal Designations

# Chapter 2

## Hardware Configuration and Installation

---

This chapter describes the steps for configuring and installing the GPIB-232CV-A.

### Configure the Hardware

The GPIB-232CV-A AC version is shipped from the factory with a 100-120 V or 220-240 V internal power supply. The GPIB-232CV-A DC version is shipped with a 100-120 V or 220-240 V, wall-mount or desktop power supply.

Before configuring your GPIB-232CV-A, verify that the voltage marked on the GPIB-232CV-A or on the power supply matches the voltage that is supplied in your area.

**Caution:** *Operating the GPIB-232CV-A at any voltage other than the one specified could damage the unit. Replacement fuses for the AC version must be the proper type and size. Refer to Appendix A, GPIB-232CV-A Specifications, for fuse specifications.*

The GPIB-232CV-A is shipped from the factory to operate with the following configuration:

- D mode
- GPIB primary address 5
- SRQ feature disabled
- Serial port is configured to:
  - 9600 baud
  - 1 stop bit per character
  - parity generation/checking disabled
  - 7 data bits per character
  - XON/XOFF protocol disabled

If you want to change any of the GPIB-232CV-A characteristics, you must change the configuration switches. For information on choosing the mode of operation, refer to *Choosing Between D Mode and C Mode Configuration* in Chapter 3, *Operation of the GPIB-232CV-A*. Chapter 3 also contains information about choosing whether or not to use other available features.

If you are already using the GPIB-232CV-A and decide to change its operating characteristics, you must first shut down your system and then continue with the following steps.

## Configure the GPIB-232CV-A Parameters

You can use the DIP switches on the rear panel (see Figures 1-4 and 1-5) to configure the GPIB-232CV-A. Figure 2-1 shows the factory default setting for SW1. In Figure 2-1, the black side of the switch is the position of the switch handle.

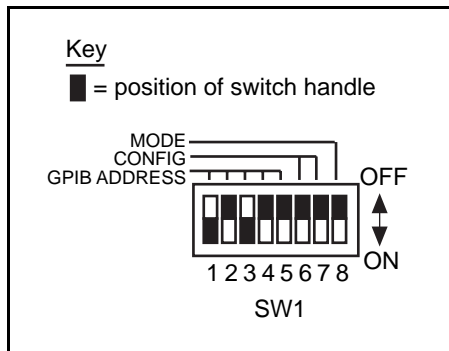


Figure 2-1. Factory Default Switch Settings for SW1

In Figure 2-1, switches 1 through 5 are ON, OFF, ON, OFF, and OFF, respectively, indicating a GPIB primary address of 5. Switches 6 and 7 are in the OFF position, indicating that SRQ is disabled and the small serial buffer is used. Switch 8 is in the OFF position, indicating that the unit is configured to operate in D mode.

Tables 2-1, 2-2, and 2-3 show the possible configurations of SW1 and what the configurations indicate. Default settings appear in ***bold italics***.

Table 2-1. Configuration Parameters for SW1 Switches 1 through 5

Switches					Indication
1	2	3	4	5	
OFF	OFF	OFF	OFF	OFF	GPIB Primary Address 0
ON	OFF	OFF	OFF	OFF	GPIB Primary Address 1
OFF	ON	OFF	OFF	OFF	GPIB Primary Address 2
ON	ON	OFF	OFF	OFF	GPIB Primary Address 3
OFF	OFF	ON	OFF	OFF	GPIB Primary Address 4
<b><i>ON</i></b>	<b><i>OFF</i></b>	<b><i>ON</i></b>	<b><i>OFF</i></b>	<b><i>OFF</i></b>	<b><i>GPIB Primary Address 5</i></b>
OFF	ON	ON	OFF	OFF	GPIB Primary Address 6
ON	ON	ON	OFF	OFF	GPIB Primary Address 7
OFF	OFF	OFF	ON	OFF	GPIB Primary Address 8
ON	OFF	OFF	ON	OFF	GPIB Primary Address 9
OFF	ON	OFF	ON	OFF	GPIB Primary Address 10
ON	ON	OFF	ON	OFF	GPIB Primary Address 11
OFF	OFF	ON	ON	OFF	GPIB Primary Address 12
ON	OFF	ON	ON	OFF	GPIB Primary Address 13
OFF	ON	ON	ON	OFF	GPIB Primary Address 14
ON	ON	ON	ON	OFF	GPIB Primary Address 15
OFF	OFF	OFF	OFF	ON	GPIB Primary Address 16
ON	OFF	OFF	OFF	ON	GPIB Primary Address 17
OFF	ON	OFF	OFF	ON	GPIB Primary Address 18
ON	ON	OFF	OFF	ON	GPIB Primary Address 19
OFF	OFF	ON	OFF	ON	GPIB Primary Address 20
ON	OFF	ON	OFF	ON	GPIB Primary Address 21

(continues)

Table 2-1. Configuration Parameters for SW1 Switches 1 through 5  
(continued)

<b>Switches</b>					<b>Indication</b>
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	
OFF	ON	ON	OFF	ON	GPIB Primary Address 22
ON	ON	ON	OFF	ON	GPIB Primary Address 23
OFF	OFF	OFF	ON	ON	GPIB Primary Address 24
ON	OFF	OFF	ON	ON	GPIB Primary Address 25
OFF	ON	OFF	ON	ON	GPIB Primary Address 26
ON	ON	OFF	ON	ON	GPIB Primary Address 27
OFF	OFF	ON	ON	ON	GPIB Primary Address 28
ON	OFF	ON	ON	ON	GPIB Primary Address 29
OFF	ON	ON	ON	ON	GPIB Primary Address 30
ON	ON	ON	ON	ON	Listen-Only Operation (D Mode) or No Addressing Performed (C Mode)

Table 2-2. Configuration Parameters for SW1 Switches 6 and 7

<b>Switches</b>		<b>Indication</b>	
<b>6</b>	<b>7</b>	<b>D Mode</b>	<b>C Mode</b>
<i>OFF</i>	<i>OFF</i>	<i>SRQ Disabled and Small Serial Buffer</i>	<i>Timeout Termination</i>
ON	OFF	SRQ Enabled and Small Serial Buffer	CR Termination
OFF	ON	SRQ Disabled and Large Serial Buffer	LF Termination
ON	ON	SRQ Enabled and Large Serial Buffer	No Swapping

Table 2-3. Configuration Parameters for SW1 Switch 8

Switch 8 Position	Indication
OFF	<i>GPIB-232CV-A Operates in D Mode</i>
ON	GPIB-232CV-A Operates in C Mode

## Configure the Serial Port Parameters

You can use the DIP switch SW2 on the rear panel (see Figures 1-4 and 1-5) to configure the serial port parameters of the GPIB-232CV-A. Figure 2-2 shows the factory default setting. In Figure 2-2, the black side of the switch is the position of the switch handle.

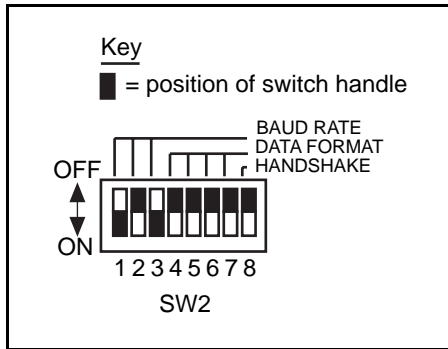


Figure 2-2. Factory Default Switch Settings for SW2

In Figure 2-2, switches 1 through 3 are ON, OFF, and ON, respectively, indicating that the serial port is operating at 9600 baud. Switches 4 and 5 are both OFF, which indicates that parity is disabled. Switch 6 is OFF, which indicates 1 stop bit per character. Switch 7 is OFF, indicating that the GPIB-232CV-A is using 7 bits/character for its serial data transfers. Switch 8 is OFF, indicating that XON/XOFF software handshaking is disabled.

Tables 2-4 and 2-5 show the possible configurations of SW2 and what the configurations indicate. Default settings appear in ***bold italics***.

Table 2-4. Configuration Parameters for SW2 Switches 1 through 3

Switches			Indication
1	2	3	
OFF	OFF	OFF	300 baud
ON	OFF	OFF	600 baud
OFF	ON	OFF	1200 baud
ON	ON	OFF	2400 baud
OFF	OFF	ON	4800 baud
<b><i>ON</i></b>	<b><i>OFF</i></b>	<b><i>ON</i></b>	<b><i>9600 baud</i></b>
OFF	ON	ON	19200 baud
ON	ON	ON	38400 baud

Table 2-5. Configuration Parameters for SW2 Switches 4 through 8

Switch	Position	Indication
4	<b><i>OFF</i></b>	<b><i>odd parity</i></b>
	ON	even parity
5	<b><i>OFF</i></b>	<b><i>parity generation/checking disabled</i></b>
	ON	parity generation/checking enabled
6	<b><i>OFF</i></b>	<b><i>1 stop bit per character</i></b>
	ON	2 stop bits per character
7	<b><i>OFF</i></b>	<b><i>7 bits per character</i></b>
	ON	8 bits per character
8	<b><i>OFF</i></b>	<b><i>XON/XOFF protocol disabled</i></b>
	ON	XON/XOFF protocol enabled

## Connect the Hardware

After configuring the switch settings on your GPIB-232CV-A, complete the following steps to connect the GPIB-232CV-A.

### 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.

### Step 2. Verify That You Have a Null-Modem Serial Cable

You must use a null-modem serial cable (also known as a file transfer cable or a DTE-to-DTE cable) to connect your computer to the GPIB-232CT-A. The following National Instruments cables are null-modem serial cables:

Table 2-6. National Instruments Null-Modem Serial Cables

National Instruments Part Number	Cable Type
182238-01	9-pin to 9-pin, 1 m
182238-02	9-pin to 9-pin, 2 m
182238-04	9-pin to 9-pin, 4 m
181074-10	9-pin to 25-pin, 1 m

See Appendix B, *Interfacing to a Serial Device*, for more information regarding cable pinouts.

### Step 3. Connect the Cables

Complete the following steps to connect the cables.

1. Connect the serial cable to the GPIB-232CV-A 9-pin D-Sub 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-232 cabling restrictions.
2. Connect the GPIB cable to the GPIB-232CV-A 24-pin Champ connector and tighten the thumb screws on the connector. Connect the other end to your GPIB system. *Be sure* to use only shielded GPIB cables, and follow all IEEE 488 cabling restrictions.
3. If you have an AC version, connect the power cord to the power receptacle on the front panel of the GPIB-232CV-A, then plug the supply into an AC outlet of the correct voltage.

If you have a DC version, connect the DC power plug of the DC power supply to the power jack on the serial end of the GPIB-232CV-A, then plug the supply into an AC outlet of the correct voltage.

### Step 4. Power On Your System and Switch On the GPIB-232CV-A

1. Plug the power cords for your computer system into a power outlet and power on all devices.
2. If you have an AC version, use the front panel rocker switch to power on your GPIB-232CV-A. If you have a DC version, use the power switch on the rear panel to power on your GPIB-232CV-A.

The **POWER** LED indicator should come on immediately. The **READY** LED indicator should come on after the GPIB-232CV-A has passed its power-on self test, indicating the unit is ready for operation. If the **READY** LED 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** LED 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.

# Chapter 3

## Operation of the GPIB-232CV-A

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This chapter describes how to choose between D mode configuration and C mode configuration and contains information about operating the GPIB-232CV-A 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 top 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-232CV-A 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-232CV-A 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-232CV-A 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 AT-GPIB IEEE 488.2 board installed, as shown in Figure 3-1.

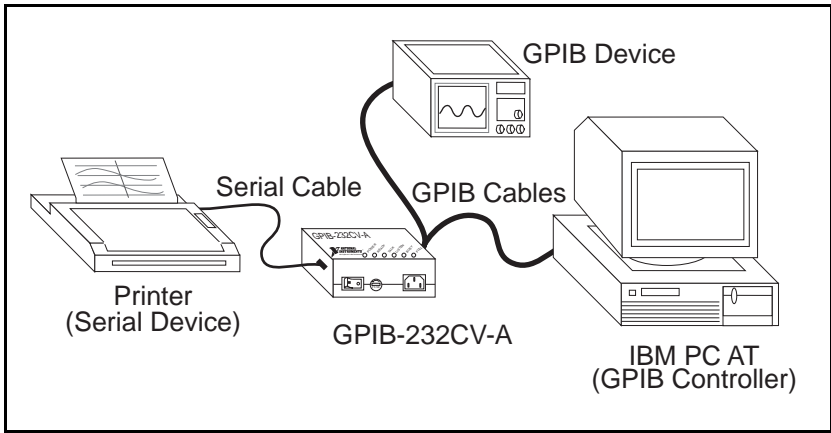


Figure 3-1. Example of D Mode System Setup

### When to Use C Mode

The GPIB-232CV-A 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 an IBM PC serial port through a GPIB-232CV-A as shown in Figure 3-2.

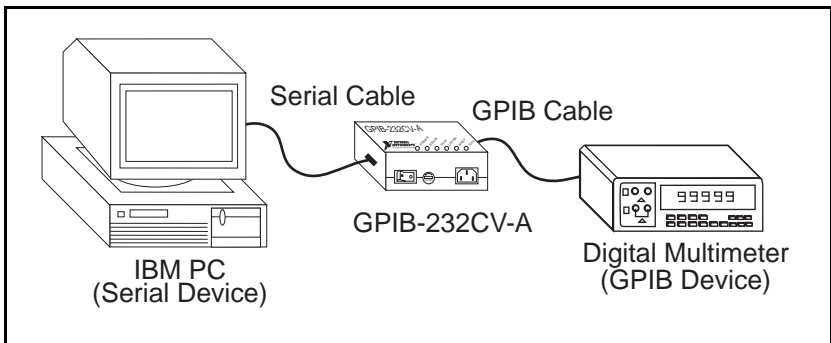


Figure 3-2. Example of C Mode System Setup

## D Mode Overview

In D mode, the GPIB-232CV-A acts as another device on the bus. Figure 3-3 shows the D mode system layout.

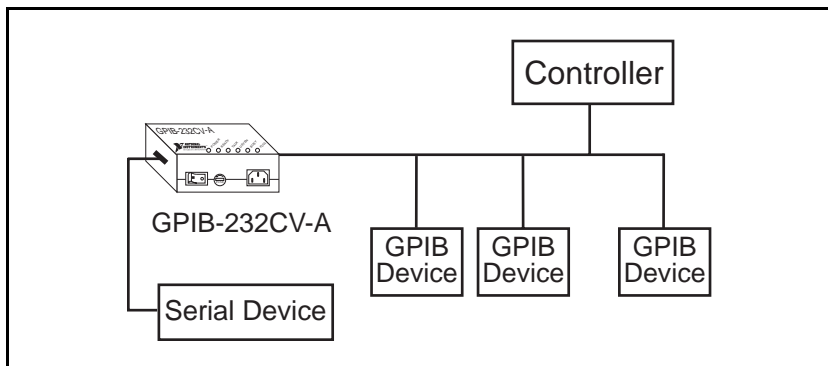


Figure 3-3. D Mode System Layout

In D mode, the GPIB-232CV-A can act only as a GPIB Talker or Listener. Do *not* pass control to the GPIB-232CV-A when using D mode. If you do, the GPIB circuitry in the GPIB-232CV-A accepts control and immediately asserts the **ATN\*** signal, a system error condition that you should avoid.

Because the GPIB-232CV-A is not System Controller in D mode, it expects to receive GPIB commands from the Controller-In-Charge (CIC). If the GPIB-232CV-A 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-232CV-A.

## Data Transfers in D Mode

When you are ready to send data to the GPIB-232CV-A in D mode, address the GPIB-232CV-A to listen, if not already in listen-only mode. All GPIB data received by the GPIB-232CV-A is buffered and passed along to the serial device. When you are expecting to receive data from the serial device, address the GPIB-232CV-A to talk, and all data received over the serial port is passed along to the GPIB port.

## Data Buffering in D Mode

When operating in D mode, the GPIB-232CV-A 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, GPIB transfer rates as high as 625 kbytes/s are possible. 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-232 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-232CV-A as a high-speed print spooler.

## Choosing a Serial Port Buffer Size

All data that is sent to the GPIB-232CV-A 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-232CV-A is addressed to talk. The GPIB-232CV-A has 256 KB 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 (SW1 switch 7 set to OFF), or 32 KB (SW1 switch 7 set to ON) with the remainder of the 256 KB 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-232CV-A.
- Set the serial input buffer size to 32KB if you expect the serial device to send large amounts of data to the GPIB-232CV-A, such as an RS-232 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-232CV-A, 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.

Regardless of the buffer size you choose, serial data is not lost because the GPIB-232CV-A 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-232CV-A for your application.

## Using the SRQ Feature

The GPIB bus performance might slow down if the Controller is constantly waiting for the GPIB-232CV-A to send or receive data. With SRQ enabled, the bus can be used by other devices until the GPIB-232CV-A requests service (asserts **SRQ\***). When the GPIB-232CV-A asserts **SRQ\***, the Controller serial polls the GPIB-232CV-A to determine what type of service it needs. After it is serial polled, the GPIB-232CV-A unasserts **SRQ\***. You can enable the SRQ feature by setting switch 6 of SW1 to the ON position.

### Conditions That Cause SRQ to be Asserted

If SRQ is enabled, the GPIB-232CV-A asserts the **SRQ\*** signal on two conditions:

- when the GPIB-232CV-A receives serial data that it needs to pass on to the GPIB port
- when the GPIB input buffer becomes empty

When the GPIB-232CV-A serial input buffer is empty and the GPIB-232CV-A receives a serial character to be sent along to the GPIB, the **SRQ\*** signal is asserted. This alerts the GPIB Controller that the GPIB-232CV-A has data to send to a GPIB Listener. The Controller can then address the GPIB-232CV-A to talk so that the data can be read out of the GPIB-232CV-A serial buffer. When the serial buffer is empty, the Controller can unaddress the GPIB-232CV-A 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-232CV-A has emptied out the buffer, it requests service, indicating it is ready for more data. The Controller can then readdress the GPIB-232CV-A to listen and continue sending data until all the data is sent.

## Maximizing Performance with SRQ

If large amounts of data (greater than the GPIB buffer size) are sent over the GPIB to the GPIB-232CV-A and the serial device is a very slow data acceptor, the GPIB-232CV-A 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-232CV-A, 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-232CV-A to listen so that other devices can use the bus. When the GPIB-232CV-A is ready to receive more data, it asserts the **SRQ\*** signal.

## GPIB-232CV-A Serial Poll Responses

If the GPIB-232CV-A 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-232CV-A is requesting service; otherwise it is set to 0.

## GPIB-232CV-A Operation in Listen-Only Mode

In listen-only mode, no addressing is required to make the GPIB-232CV-A a GPIB Listener and it cannot be unaddressed to listen. All data transferred on the GPIB is accepted by the GPIB-232CV-A 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-232CV-A is configured as a listen-only device, it cannot be serial polled.

The GPIB primary address for the GPIB-232CV-A is specified by switches 1 through 5 of the DIP switch SW1. If GPIB address switches 1 through 5 are all set to ON, the GPIB-232CV-A is configured as a listen-only device. Figure 3-4 shows the switch settings for listen-only mode.

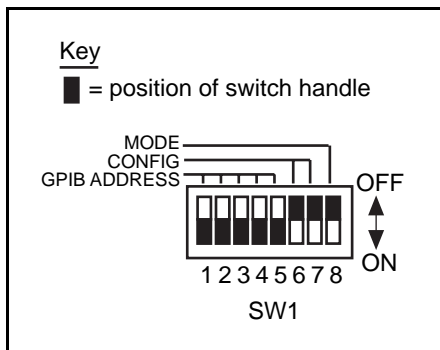


Figure 3-4. Switch Settings for Listen-Only Mode

## C Mode Overview

In C mode, the GPIB-232CV-A and a serial device together act as the GPIB System Controller. Figure 3-5 shows the C mode system layout.

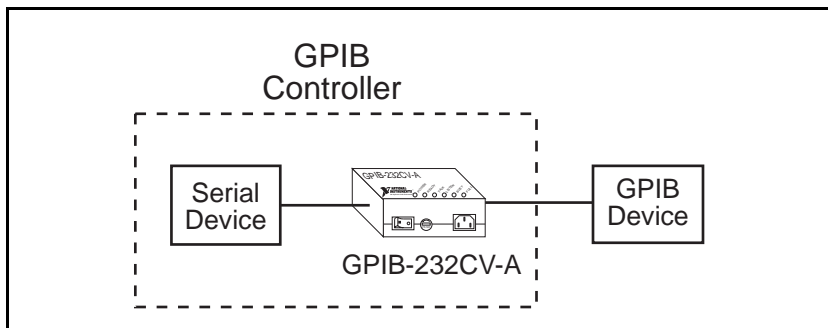


Figure 3-5. C Mode System Layout

When you turn the power on with the GPIB-232CV-A in C mode, the GPIB-232CV-A asserts **IFC\*** for 500  $\mu$ s and addresses the instruments to listen. On a GPIB system, asserting **IFC\*** for at least 100  $\mu$ s initializes the GPIB and causes the System Controller to become Controller-In-Charge (CIC).

After the GPIB-232CV-A becomes CIC, it sends out the GPIB listen address indicated by SW1 switches 1 through 5. If switches 1 through 5 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-232CV-A always asserts **REN\*** when addressing other devices.

## Data Transfers in C Mode

All incoming serial data to the GPIB-232CV-A is stored in an internal data buffer until it is accepted by the GPIB device. All GPIB data sent to the GPIB-232CV-A 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-232CV-A addresses the instrument to talk and passes all received data to the RS-232 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-232CV-A 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-232CV-A. You can select these modes using SW1 switches 6 and 7.

### 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 SW1 switches 6 and 7 to OFF.

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

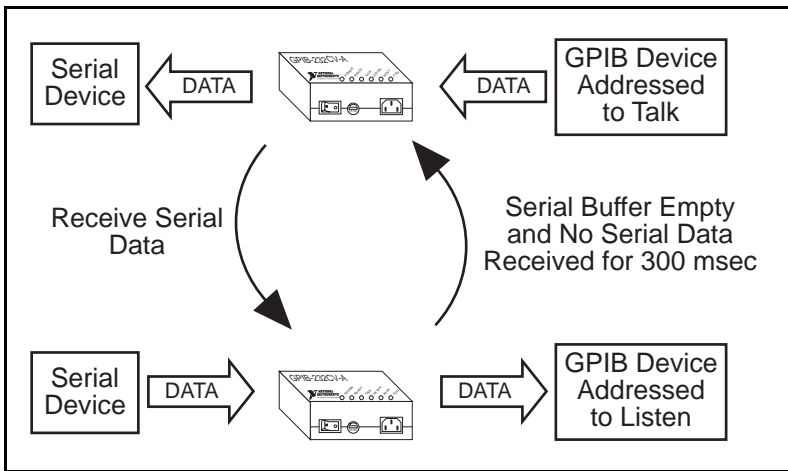


Figure 3-6. Timeout Termination Mode Cycle

In timeout termination mode, the GPIB-232CV-A 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-232CV-A, 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 ms. After this period of inactivity, the GPIB-232CV-A assumes that since no more serial data is being sent, the device might have data that it needs to send back to the GPIB-232CV-A. It then readdresses the device to talk and passes any characters read from the GPIB port along to the serial port.

**<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 SW1 switch 6 to ON and 7 to OFF. To select <LF> mode, set SW1 switch 6 to OFF and 7 to ON.

In these modes, when the GPIB-232CV-A 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-232CV-A. Then any serial character received by the GPIB-232CV-A signals the GPIB-232CV-A 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-232CV-A. 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-232CV-A 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-232CV-A 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-232CV-A is set up for <CR> termination, the GPIB-232CV-A then readdresses the plotter to talk so that its status can be output.

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

Line 40 outputs the plotter command to the GPIB-232CV-A to draw a circle. As soon as the GPIB-232CV-A 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-232CV-A never readdresses a GPIB device after it has initially been addressed as a Listener. To select no-swap mode, set SW1 switches 6 and 7 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-232CV-A 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.
```

## **Data Buffering and Handshaking Schemes**

Two protection mechanisms are used to ensure that the GPIB-232CV-A does not lose incoming serial data: data buffering and handshaking.

The GPIB-232CV-A 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-232CV-A can accept before the buffer is completely full.

When its RAM buffer is nearly full, the GPIB-232CV-A can handshake with the serial host to stop data transmission. When the buffer is almost empty, the GPIB-232CV-A can again handshake with the serial host to start data transmission. The GPIB-232CV-A 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-232 transfers and uses the Request to Send (RTS) and Clear to Send (CTS) signal lines. When the GPIB-232CV-A is ready to accept serial data, it asserts the RTS line. This signal remains asserted until the data buffer of the GPIB-232CV-A is almost full. At this point, the GPIB-232CV-A unasserts the RTS line, signaling to the serial host that the GPIB-232CV-A is no longer ready to accept data. The serial host should monitor the RTS line and suspend data transmission whenever the RTS line becomes unasserted. The GPIB-232CV-A asserts RTS when it is again ready to receive serial data.

The GPIB-232CV-A is also able to suspend transmission when the serial device is no longer ready to accept data. The GPIB-232CV-A is configured to immediately stop transmission of serial data when CTS becomes unasserted. The GPIB-232CV-A resumes transmission as soon as CTS is reasserted.

Because most serial devices use the same form of hardware handshaking as the GPIB-232CV-A, you can achieve bidirectional flow control by using a serial cable that connects the RTS signal of the GPIB-232CV-A to the CTS signal of the serial device. In addition, the RTS signal of the serial device should be connected to the CTS signal of the GPIB-232CV-A. This setup allows each device to monitor the RTS signal of the other device 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.

## **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 8 of SW2 to ON. This handshaking protocol performs the same function as the hardware handshake 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-232CV-A sends the XOFF character (decimal 19 or <CTRL-S>) before the internal buffer overflows. When the GPIB-232CV-A is able to start receiving characters again, it sends the XON character (decimal 17 or <CTRL-Q>). Similarly, if the GPIB-232CV-A 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-232CV-A 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-232CV-A would not be able to distinguish between data values or handshake control codes. If handshaking were enabled, the GPIB-232CV-A would handshake erratically.

# Appendix A

## GPIB-232CV-A Specifications

---

This appendix describes the electrical, environmental, and physical characteristics of the GPIB-232CV-A .

Table A-1. Electrical Characteristics - AC Version

<b>Characteristic</b>	<b>Specification</b>
Power Supply Unit	100-120 VAC $\pm$ 10%, 50-60 Hz or 220-240 VAC $\pm$ 10%, 50-60 Hz
Current	100-120 VAC 23 mA or 220-240 VAC 20 mA
Fuse Rating and Type	100-120 VAC 300 mA, UL/CSA approved or 220-240 VAC 500 mA, IEC approved

Table A-2. Electrical Characteristics - DC Version

<b>Characteristic</b>	<b>Specification</b>
Power Supply Unit	Wall-mount type, 100-120 VAC $\pm$ 10% 50-60 Hz input , 9 VDC @ 1A output or Desktop type, 220-240 VAC $\pm$ 10% 50-60 Hz input, 9 VDC @ 1 A output
DC Input	+5 to +13 Regulated
Current	300 mA typical; 400 mA maximum

Table A-3. Environmental Characteristics - AC Version

<b>Characteristic</b>	<b>Specification</b>
Operating Temperature	10° to 40° C
Storage Temperature	0° to 70° C
Relative Humidity	10% to 95% noncondensing conditions
EMI	FCC Class A Verified

Table A-4. Environmental Characteristics - DC Version

<b>Characteristic</b>	<b>Specification</b>
Operating Temperature	10° to 40° C
Storage Temperature	0° to 70° C
Relative Humidity	10% to 95% noncondensing conditions
EMI	FCC Class B Certified

Table A-5. Physical Characteristics - AC Version

<b>Characteristic</b>	<b>Specification</b>
Case Size	4.65 in. by 3.0 in. by 1.74 in. (118.1 mm by 76.2 mm by 44.2 mm)
Case Material	All metal enclosure
Weight	12 oz (340 g)

Table A-6. Physical Characteristics - DC Version

<b>Characteristic</b>	<b>Specification</b>
Case Size	4.65 in. by 3.0 in. by 1.11 in. (118.1 mm by 76.2 mm by 28.2 mm)
Case Material	All metal enclosure
Weight	7 oz (198 g)

# Appendix B

## Interfacing to a Serial Device

---

This appendix describes the RS-232 serial port on the GPIB-232CV-A and explains how to interface a DCE or DTE serial device to the RS-232 serial port.

The GPIB-232CV-A transfers serial data using the electrical signals, mechanical connections, data format, and control protocols defined in the RS-232C standard. The RS-232 port on the GPIB-232CV-A is an asynchronous serial communication link to a serial peripheral device.

### The RS-232C Standard

The RS-232C standard (international standard CCITT V.24) was formulated in 1969 largely from the efforts of the Electronic Industries Association (EIA) and Bell Laboratories. The standard describes the electrical specifications and arrangement of control and data signals on both sides of a serial communications interface. Its original intent was to interface terminals to modems. Many manufacturers of computers and instruments have adopted the standard for their serial communications needs. For more information on the RS-232C standard, contact

Global Engineering Documents  
7730 Carondelet Avenue, Suite 4007  
St. Louis, MO 63105  
(800) 854-7179

### Description of the RS-232 Port

The RS-232 serial port on the GPIB-232CV-A uses a male 9-pin D-Subminiature connector with a DTE interface configuration. Table B-1 shows the signal lines supported on the GPIB-232CV-A.

Table B-1. RS-232 Serial Port Signal Configuration

<b>Pin Number</b>	<b>Signal Description</b>	<b>RS-232 Code</b>	<b>Function</b>
2	RXD (Receive Data)	BB	This signal carries serial data from the serial device to the GPIB-232CV-A.
3	TXD (Transmit Data)	BA	This signal carries serial data from the GPIB-232CV-A to the serial device.
4	DTR (Data Terminal Ready)	CD	This signal is asserted by the GPIB-232CV-A to signal that it has been powered on and is ready to operate.
5	GND (Ground)	AB	This signal establishes a reference point for all interface voltages.
7	RTS (Request to Send)	CA	This signal is driven by the GPIB-232CV-A. When asserted, it indicates that the GPIB-232CV-A is ready to accept serial data. When unasserted, it indicates that the GPIB-232CV-A is no longer ready to accept serial data because the buffer is full.
8	CTS (Clear to Send)	CB	This signal is sensed by the GPIB-232CV-A. When asserted, it indicates that the serial device is ready to accept serial data. When unasserted, it indicates that data transmission should be disabled.

## Interfacing Serial Devices to the RS-232 Serial Port

To interface other serial devices to the RS-232 serial port on the GPIB-232CV-A, 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.

Figure B-1 shows the location of the RS-232 connector.

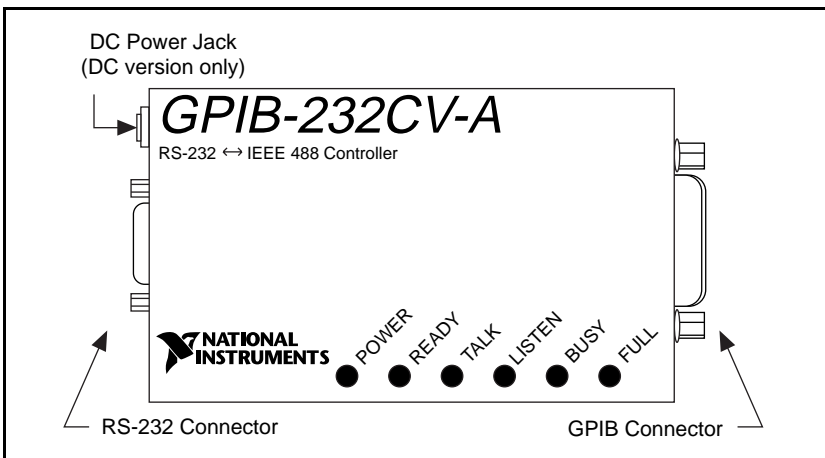


Figure B-1. Location of the RS-232 Connector

## Interfacing the GPIB-232CV-A to a DCE with Handshaking

A correctly configured DTE-to-DCE interface is wired *straight across*: GPIB-232CV-A TXD to DCE TXD, GPIB-232CV-A RXD to DCE RXD, and so on as shown in Table B-2.

Table B-2. Cable Wiring Scheme for GPIB-232CV-A DTE to Serial Device DCE

GPIB-232CV-A Signal to DCE Serial Device Signal	Standard DTE to DCE 9-pin 9-pin		Standard DTE to DCE 9-pin 25-pin	
	<i><b>RXD to RXD</b></i>	<i><b>2</b></i>	<i><b>to 2</b></i>	<i><b>2</b></i>
<i><b>TXD to TXD</b></i>	<i><b>3</b></i>	<i><b>to 3</b></i>	<i><b>3</b></i>	<i><b>to 2</b></i>
DTR to DTR	4	to 4	4	to 20
<i><b>GND to GND</b></i>	<i><b>5</b></i>	<i><b>to 5</b></i>	<i><b>5</b></i>	<i><b>to 7</b></i>
RTS to RTS	7	to 7	7	to 4
CTS to CTS	8	to 8	8	to 5

**Note:** Connections in *bold italics* must be implemented.

Figure B-2 shows a properly configured 9-pin DTE to 9-pin DCE cable including the hardware handshake lines RTS, CTS, and DTR. With this configuration, the GPIB-232CV-A can function properly (handshake) on buffer full conditions. Figure B-3 shows an equivalent 9-pin DTE to 25-pin DCE cable configuration.

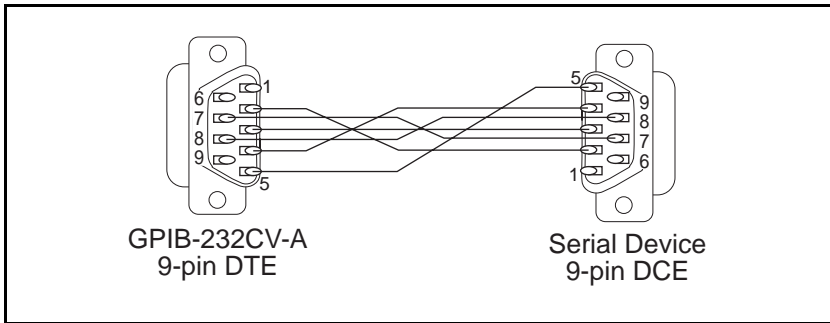


Figure B-2. Cable Configuration for 9-pin DTE to 9-pin DCE with Handshaking

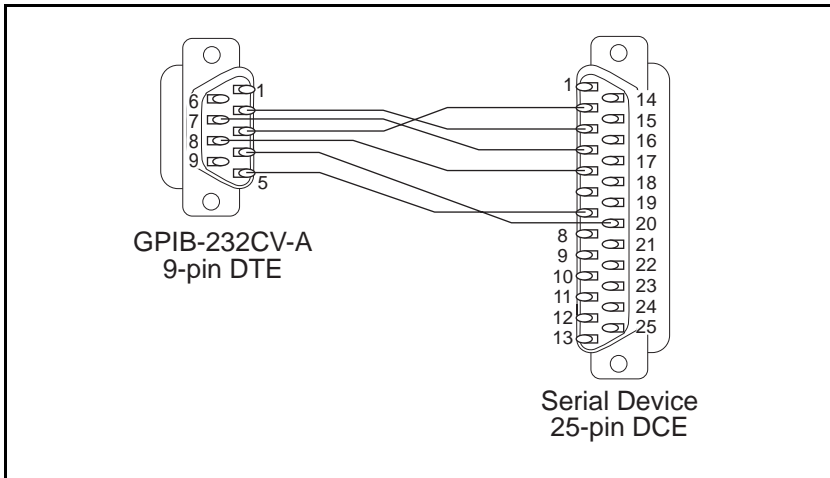


Figure B-3. Cable Configuration for 9-pin DTE to 25-pin DCE with Handshaking

## Interfacing the GPIB-232CV-A to a DCE without Handshaking

If your serial device does not require or use the hardware handshaking protocol used by the GPIB-232CV-A, you have two options:

- Use a minimum configuration cable which does not support hardware handshaking and use XON/XOFF software handshaking (if necessary). To create a minimum configuration cable, connect the signals shown in bold italics in Table B-2.
- Wire a custom cable that properly interfaces the GPIB-232CV-A hardware handshaking protocol to the handshaking protocol of your serial device.

### Minimum Configuration Cable

The minimum configuration cable assumes that the DCE does not require external hardware handshaking. The minimum configuration for a DTE 9-pin to DCE 9-pin cable is shown in Figure B-4. Figure B-5 shows an equivalent 9-pin to 25-pin cable.

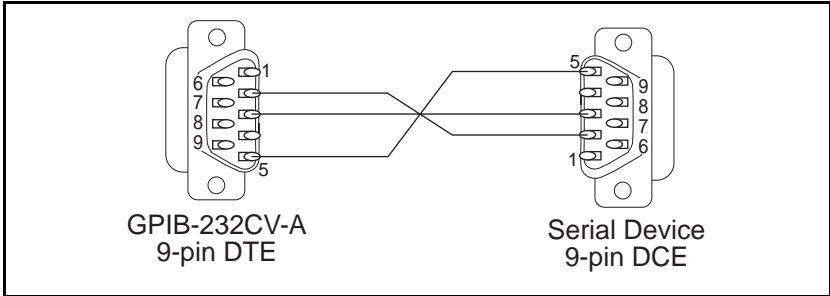


Figure B-4. Minimum Configuration for 9-pin DTE to 9-pin DCE

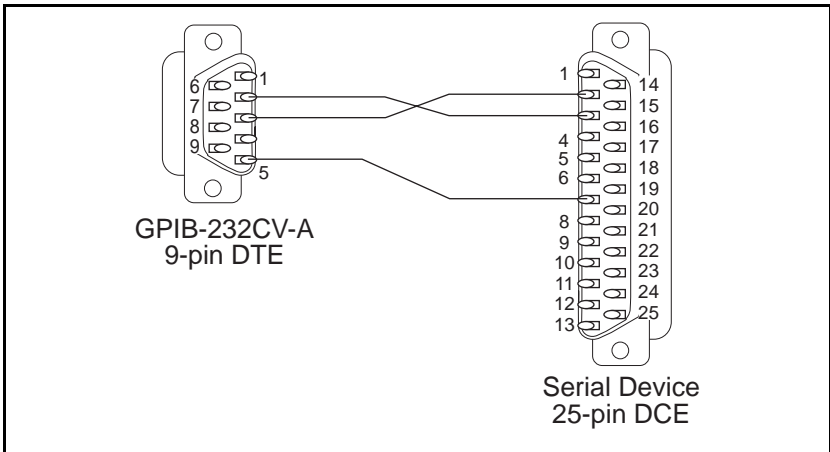


Figure B-5. Minimum Configuration for 9-pin DTE to 25-pin DCE

## Custom Cables

If your application requires a custom cable, you can construct one if you have a thorough knowledge of the handshaking protocols involved. Review the RS-232 characteristics of your serial device and build the cable to properly connect the handshake lines of the two devices. Because the DTE-to-DCE connection is a straight across connection, it often involves only connecting RTS to RTS, CTS to CTS, DTR to DTR, and so on. If the documentation for your serial device does not provide a thorough explanation of its handshaking protocol, the ANSI/EIA-232-C standard is a good reference, provided your device conforms to the RS-232 protocol.

**Caution:** *Although handshaking might not be required, it is best to use some form of handshaking to prevent loss of data.*

## Interfacing the GPIB-232CV-A to a DTE with Handshaking

For serial devices set up as DTEs, you must wire a DTE-to-DTE interface cable, commonly known as a null modem cable. The cable allows the GPIB-232CV-A to act as though it is communicating with a DCE, but it swaps the appropriate pins to achieve a DTE pinout. This wiring configuration is shown in Table B-3.

Table B-3. Cable Wiring Scheme for GPIB-232CV-A DTE to Serial Device DTE

GPIB-232CV-A Signal to DTE Serial Device Signal	Standard DTE to DTE 9-pin 9-pin	Standard DTE to DTE 9-pin 25-pin
<i>RXD to TXD</i>	<i>2 to 3</i>	<i>2 to 2</i>
<i>TXD to RXD</i>	<i>3 to 2</i>	<i>3 to 3</i>
DTR to DSR	4 to 6	4 to 6
<i>GND to GND</i>	<i>5 to 5</i>	<i>5 to 7</i>
RTS to CTS	7 to 8	7 to 5
CTS to RTS	8 to 7	8 to 4
<b>Note:</b> Connections in <i>bold italics</i> must be implemented.		

Figure B-6 shows a typical 9-pin to 9-pin null modem cable with the RTS, CTS, and DTR handshake lines implemented. Figure B-7 shows an equivalent 9-pin DTE to 25-pin DTE cable configuration.

The cable configuration in Figure B-6 allows you to connect to the 9-pin serial port of a personal computer. The cable in Figure B-7 shows how to connect to the 25-pin serial port of a personal computer.

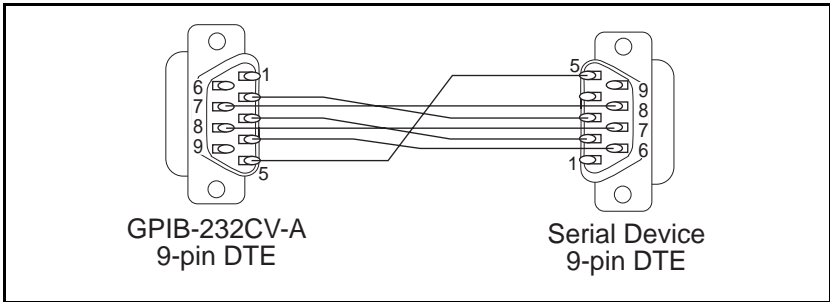


Figure B-6. Cable Configuration for 9-pin DTE to 9-pin DTE with Handshaking

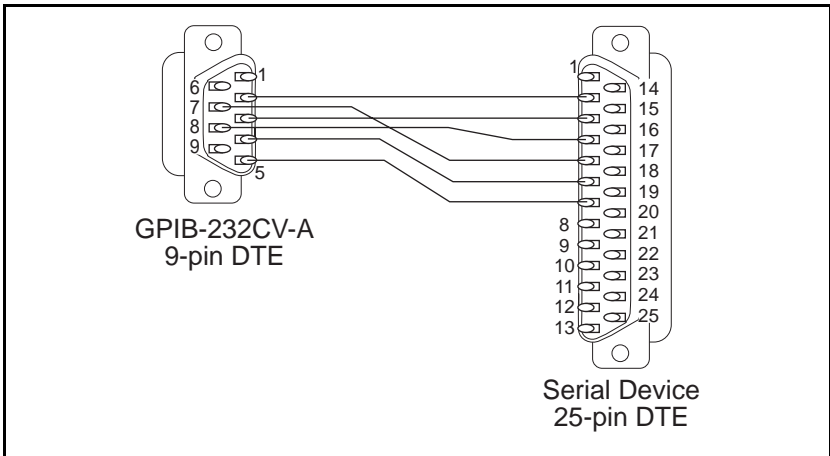


Figure B-7. Cable Configuration for 9-pin DTE to 25-pin DTE with Handshaking

## Interfacing the GPIB-232CV-A to a DTE without Handshaking

If your serial device does not require or use the same hardware handshaking protocol used by the GPIB-232CV-A, you have two options:

- Use a minimum configuration null modem cable which does not support the hardware handshake lines and use XON/XOFF software handshaking (if necessary). To create a minimum configuration cable, connect the signals shown in bold italics in Table B-3.
- Wire a custom cable that properly interfaces the GPIB-232CV-A hardware handshaking protocol to the handshaking protocol of your serial device.

### Minimum Configuration Cable

The minimum cable configuration assumes that the serial device does not require external hardware handshaking. The minimum configuration for a 9-pin to 9-pin null modem cable is shown in Figure B-8. Figure B-9 shows an equivalent 9-pin to 25-pin cable.

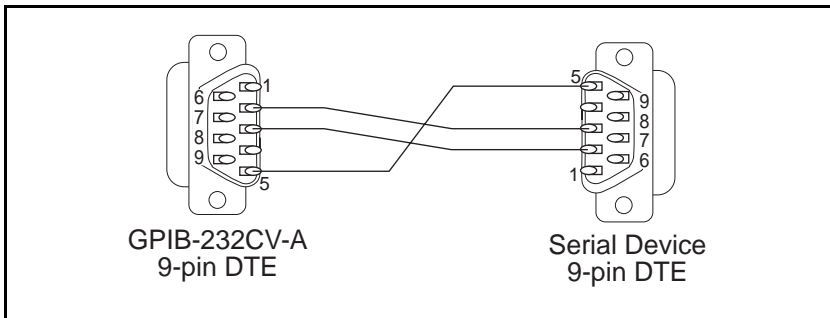


Figure B-8. Minimum Configuration for 9-pin DTE to 9-pin DTE

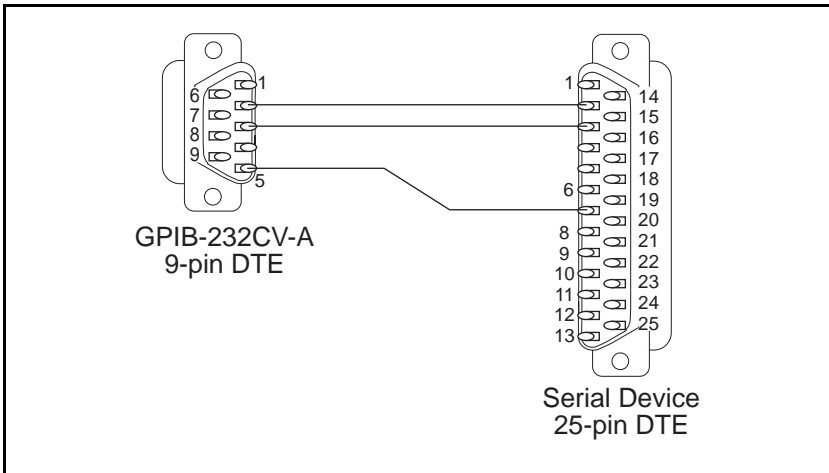


Figure B-9. Minimum Configuration for 9-pin DTE to 25-pin DTE

### Custom Cables

If your application requires a custom cable, you can construct one if you have a thorough knowledge of the handshaking protocols involved. Review the RS-232 characteristics of your serial device and build the cable to properly connect the handshake lines of the two devices. If the documentation for your serial device does not provide a thorough explanation of its handshaking protocol, the ANSI/EIA-232-C standard is a good reference, provided your device conforms to the RS-232 protocol.

**Caution:** *Although handshaking might not be required, it is best to use some form of handshaking to prevent loss of data.*

# Appendix C

## Application Examples

---

This appendix contains two GPIB-232CV-A application examples. The first example shows how to use the GPIB-232CV-A 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-232CV-A 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.

With a GPIB-232CV-A, you can transfer data at GPIB rates instead of RS-232 rates. The GPIB-232CV-A uses a DMA Controller to input data from the GPIB port to the RAM buffer and can input GPIB data at rates up to 625 kbytes/s. 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-232CV-A 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.

2. Configure the GPIB-232CV-A 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-232CV-A, and connect the serial cable from the GPIB-232CV-A to the printer or plotter. The system should resemble the diagram in Figure C-1.

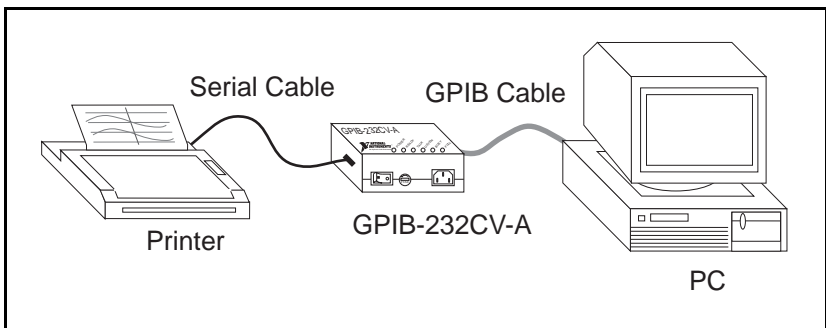


Figure C-1. Example of Print Spooler Setup

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*, 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.

```

/* 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-232CV-A, the data transfer should complete in a few seconds.

## Using the GPIB-232CV-A to Connect a HP7475 GPIB Plotter to a PC Serial Port

Many software packages provide printing and plotting utilities which use your computer's serial port. If GPIB support is not specifically provided in the package, you *cannot* communicate with a GPIB device. By using the GPIB-232CV-A, you can avoid this situation because the GPIB-232CV-A allows communication between the serial port and GPIB devices.

For example, an IBM PC 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-232CV-A to convert the serial data from AUTOCAD into GPIB data for the plotter. The GPIB-232CV-A automatically takes care of the GPIB addressing and transparently converts the data from one format to the other. To use the GPIB-232CV-A 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-232CV-A. Set it to operate in C mode with timeout termination. Set the GPIB address of the plotter using the GPIB-232CV-A 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-232CV-A.

When the GPIB-232CV-A is powered on, it addresses the GPIB plotter. Any data sent to the serial port by AUTOCAD is received by the GPIB-232CV-A and stored in its internal buffer. The GPIB-232CV-A transfers the data to the plotter over the GPIB connection as fast as the plotter can receive it. Because the GPIB-232CV-A 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.

# Appendix D

## Customer Communication

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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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Fax-on-demand: (512) 418-1111

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# Technical Support Form

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Technical support is available at any time by fax. Include the information from your configuration form. Use 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 \_\_\_\_\_

National Instruments software product \_\_\_\_\_

Version \_\_\_\_\_

Configuration \_\_\_\_\_

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# GPIB-232CV-A Hardware and Software Configuration Form

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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-232CV-A Model and Revision \_\_\_\_\_
- SW1 Switch Setting \_\_\_\_\_
- SW2 Switch Setting \_\_\_\_\_

## Other Products

- Programming Language and Version \_\_\_\_\_
- Operating System and Version \_\_\_\_\_
- Computer Make and Model \_\_\_\_\_
- Number of GPIB Devices on Bus \_\_\_\_\_
- Serial Handshaking Used  
(hardware—DTR, RTS, CTS wired in cable) \_\_\_\_\_  
(software—XON/XOFF) \_\_\_\_\_
- Serial Cable Configuration Used \_\_\_\_\_
- Connected to which PC serial port \_\_\_\_\_
- If possible, include a copy of the application program you are using when you contact National Instruments.

# Documentation Comment Form

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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-232CV-A User Manual**

Edition Date:    **July 1997**

Part Number:    **320505B-01**

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

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

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Thank you for your help.

Name \_\_\_\_\_

Title \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_  
\_\_\_\_\_

Phone ( \_\_\_\_\_ ) \_\_\_\_\_

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National Instruments Corporation  
6504 Bridge Point Parkway  
Austin, TX 78730-5039

Fax to: Technical Publications  
National Instruments Corporation  
(512) 794-5678

# Glossary

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Prefix	Meaning	Value
μ-	micro-	10 <sup>-6</sup>
m-	milli-	10 <sup>-3</sup>
k-	kilo-	10 <sup>3</sup>
M-	mega-	10 <sup>6</sup>

°	degrees
%	percent
A	amperes
AC	alternating current
ANSI	American National Standards Institute
ASCII	American Standards Code for Information Interchange
ATN	Attention
C	Celsius
CIC	Controller-In-Charge
CR	carriage return
CSA	Canadian Standards Association
CTS	Clear to Send
DAV	Data Valid
DCE	Data Circuit-terminating Equipment
DIO	digital input/output
DIP	dual inline package
DMA	direct memory access
DTE	Data Terminal Equipment
DTR	Data Terminal Ready
EIA	Electronic Industries Association
EOI	end or identify
FCC	Federal Communications Commission
GND	ground

## *Glossary*

GPIB	General Purpose Interface Bus
hex	hexadecimal
Hz	hertz
I/O	input/output
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
IFC	Interface Clear
in.	inches
KB	kilobytes of memory
LED	light-emitting diode
LF	line feed
LSI	large scale integration
MB	megabytes of memory
m	meters
oz	ounces
PC	personal computer
RAM	random-access memory
REN	Remote Enable
ROM	read-only memory
RTS	Request to Send
RXD	Receive Data
s	seconds
SRQ	Service Request
TXD	Transmit Data
UL	Underwriters Laboratories
V	volts
VAC	volts alternating current
VDC	volts direct current

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