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GPIB-120A
User Manual

October 1994 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.

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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.

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.

Danger

The GPIB-120A does not generate high voltages; however, you must use extreme caution if your system or application can cause high voltages on the shield or logic ground of the GPIB cable you attach to the electrically isolated connector (GPIB Port B) located on the rear panel of the GPIB-120A. Many GPIB cables use a metal shell to enclose the GPIB piggyback connectors. This metal shell is normally connected to the cable shield. Therefore, if the shield is at a high potential with respect to the chassis ground of the GPIB-120A, the high voltage is also present, in most cases, on the cable connector housing.

The chassis, back panel, and front panel of the GPIB-120A are electrically connected to the earth ground pin of the AC power connector on the back panel. If the AC wiring in your building is installed correctly, you can safely operate the GPIB-120A. Because the EMI shield and jack screws of rear panel connector 'GPIB A' are electrically shorted to the rear panel, a GPIB cable attached to GPIB Port A has its shield and connector housing connected to earth ground, as well, and no danger should exist associated with GPIB Port A. There may be, however, a hazardous voltage between the cable connector housings of the GPIB cable attached to GPIB Port A and the GPIB cable attached to GPIB Port B.

Do not touch the GPIB-120A case, power cord, or any GPIB cable connected to the GPIB-120A unless you are absolutely sure that there are no hazardous voltages present. In addition, never open the GPIB-120A case unless you have removed the power cord and all GPIB cables from the back panel.

The GPIB-120A is not recommended for use when ground potential differences in excess of 30 V are present between the two rear panel GPIB connectors and associated cables, unless sufficient precautions are taken to ensure human safety.

Contents

About This Manual ix
Organization of This Manual ix
Conventions Used in This Manual ix
Related Documentation x
Customer Communication x

Chapter 1
Introduction 1-1
Description of the GPIB-120A 1-1
What You Need to Get Started 1-3
Optional Equipment 1-3
Unpacking Your GPIB-120A 1-3

Chapter 2
Connection 2-1
Isolation Considerations 2-1
Placing Your Instruments 2-2
Connecting the GPIB-120A 2-2
Connecting to Hewlett-Packard Controllers 2-2
Mounting the GPIB-120A 2-2

Chapter 3
Theory of Operation 3-1
Circuitry of the GPIB-120A 3-1
The GPIB-120A Front Panel 3-2
Power On 3-2
System Controller Detection 3-2
Active Controller Detection 3-2
Source Handshake Detection 3-2
Data Direction Control 3-3
Parallel Poll Detection 3-3
Acceptable Identification Codes 3-4

Appendix A
Operation of the GPIB A-1
History of the GPIB A-1
GPIB Operation A-1
Types of Messages A-1
Talkers, Listeners, and Controllers A-2
The Controller-In-Charge and System Controller A-2
GPIB Signals and Lines A-3
Data Lines A-3
Handshake Lines A-3
NRFD (Not Ready For Data) A-3

NDAC (Not Data Accepted) A-3
DAV (Data Valid) A-3
Interface Management Lines A-4
ATN (Attention) A-4
IFC (Interface Clear) A-4
REN (Remote Enable) A-4
SRQ (Service Request) A-4
EOI (End Or Identify) A-4
Physical and Electrical Characteristics A-5
Configuration Restrictions: The Role of Expanders and Extenders A-8
Related Document A-8

Appendix B
Specifications B-1

Appendix C
Multiline Interface Messages C-1

Appendix D
Customer Communication D-1

Figures

Figure 1-1. Typical GPIB-120A Extension System (Physical Configuration) 1-1
Figure 1-2. Typical GPIB-120A Extension System (Logical Configuration) 1-2

Figure 3-1. GPIB-120A Block Diagram 3-1

Figure A-1. GPIB Connector and the Signal Assignment A-5
Figure A-2. Linear Configuration of the GPIB Devices A-6
Figure A-3. Star Configuration of the GPIB Devices A-7

Tables

Table 3-1. IEEE 488 Capability Identification Codes 3-4

Table B-1. System Configuration B-1
Table B-2. Performance Characteristics B-1
Table B-3. Electrical Characteristics B-2
Table B-4. Environmental Characteristics B-2
Table B-5. Physical Characteristics B-2

About This Manual

This manual describes how to use the National Instruments GPIB-120A bus expander/isolator.

Organization of This Manual

This manual is organized as follows:

- Chapter 1, *Introduction*, contains a description of the GPIB-120A, lists what you need to get started and optional equipment you can order, and explains how to unpack the GPIB-120A.
- Chapter 2, *Connection*, contains information for connecting your GPIB-120A.
- Chapter 3, *Theory of Operation*, describes the operational theory of the GPIB-120A.
- Appendix A, *Operation of the GPIB*, contains a brief history of the GPIB and describes the operation of the GPIB.
- Appendix B, *Specifications*, lists the specifications of the GPIB-120A.
- Appendix C, *Multiline Interface Messages*, contains an interface message reference list, which describes the mnemonics and messages that correspond to the interface functions.
- Appendix D, *Customer Communication*, contains forms you can use to request help from National Instruments or to comment on our products or manuals.
- The *Glossary* contains an alphabetical list and a description of terms used in this manual, including abbreviations, acronyms, metric prefixes, mnemonics, and symbols.

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.
bold italic	Bold italic text denotes a note, caution, warning, or danger statement.

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

Related Documentation

The following document contains information that you may find helpful as you read this manual.

- ANSI/IEEE Standard 488.1-1987, *IEEE Standard Digital Interface for Programmable Instrumentation*

Customer Communication

National Instruments wants to receive your comments on our products and manuals. We are very 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 to you complete. These forms are in Appendix D, *Customer Communication*, at the end of this manual.

Chapter 1
Introduction

This chapter contains a description of the GPIB-120A, lists what you need to get started and optional equipment you can order, and explains how to unpack the GPIB-120A.

Description of the GPIB-120A

The GPIB-120A is a high-speed bus expander/isolator with the following features:

- It is transparent to user software.
- It electrically isolates two GPIB systems.
- It expands the GPIB to interface up to 28 devices.
- It extends the GPIB by effectively doubling the 20 m cable limit.
- It has optional rack-mount hardware.

The high-speed GPIB-120A bus expander connects two GPIB (IEEE 488) bus systems in a functionally transparent manner.

The two bus systems are electrically isolated from each other. Isolating an instrument or group of instruments from an IEEE 488 bus Controller can eliminate ground loop noise and induced common-mode noise, which may cause measurement problems in both analog and digital systems. The two isolated bus systems are physically separate, as shown in Figure 1-1; however, the devices logically appear to be located on the same bus, as shown in Figure 1-2.

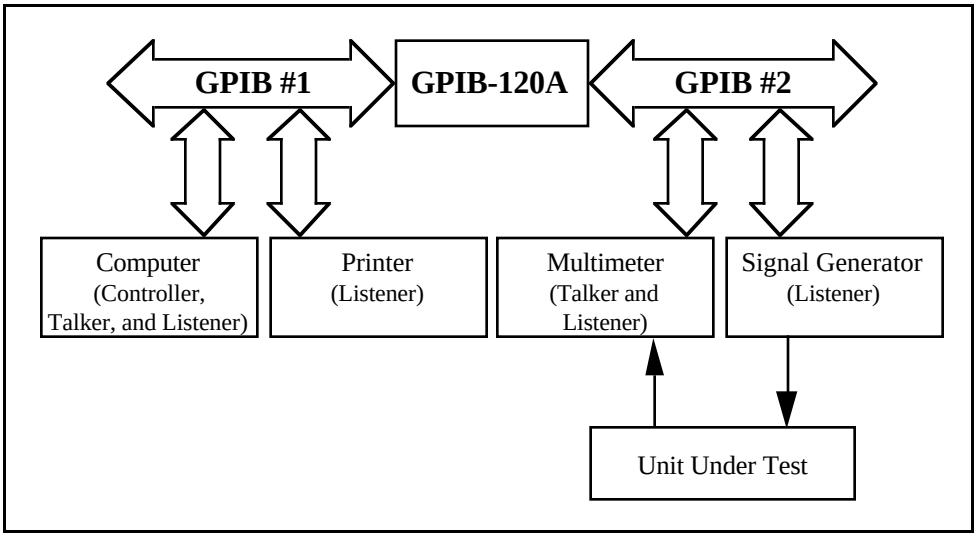


Figure 1-1. Typical GPIB-120A Extension System (Physical Configuration)

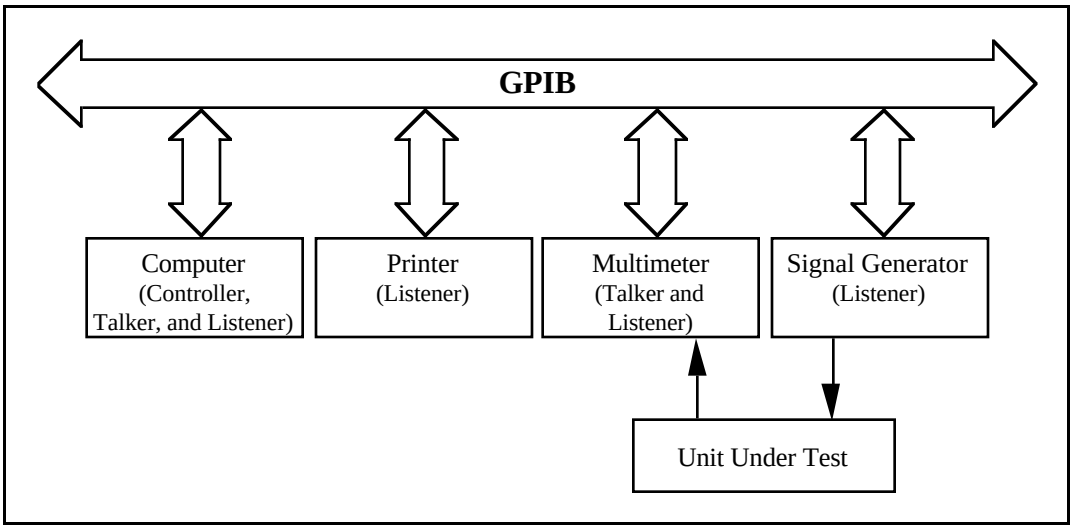


Figure 1-2. Typical GPIB-120A Extension System (Logical Configuration)

With the GPIB-120A, it is possible to overcome the following two configuration restrictions imposed by the ANSI/IEEE Standard 488.1-1987:

- An electrical loading limit of 15 devices per contiguous bus.
- A cable length limit of 20 m total per contiguous bus or 2 m times the number of devices on the bus, whichever is smaller.

With each GPIB-120A, you can add up to 14 additional devices to the bus. The GPIB-120A appears as a device load on each side of the expansion; therefore, one GPIB-120A increases the maximum load limit from 15 devices to 28 devices. The cable length limit for the system is also increased an additional 4 m to 20 m, depending on the number of devices on that side of the expansion.

All signal expansion is bidirectional, meaning that Controllers, Talkers, and Listeners can be on either side of the expander. The GPIB-120A front panel light-emitting diodes (LEDs) indicate the location of the System Controller, Active Controller, and Source Handshaker, with respect to the two sides of the expansion.

Because the GPIB-120A is a functionally transparent expander, the same GPIB communications and control programs that work with an unexpanded system can work unmodified with an expanded system.

What You Need to Get Started

❑ One of the following GPIB-120A Bus Expanders/Isolators:
GPIB-120A (100 to 120 VAC)
GPIB-120A (220 to 240 VAC)

❑ 2.2 m, 125 VAC Power Cord (When connected to a power source, this cord connects the equipment chassis to power ground.)

Optional Equipment

You can contact National Instruments to order any of the following optional equipment.

- Rack-Mount Kit
  Single Rack-Mount Kit
  Dual Rack-Mount Kit

- Shielded GPIB cables*
  Type X1 single-shielded GPIB cables (1 m, 2 m, or 4 m)
  Type X2 double-shielded GPIB cables (1 m, 2 m, or 4 m)

* To meet FCC emission limits for this Class A 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 in commercial areas.

Unpacking Your GPIB-120A

Follow these steps when unpacking your GPIB-120A.

1. Verify that the package you received contained everything you need to get started, as listed earlier in this chapter.

2. Inspect the shipping container and contents for damage. If the container is damaged and the damage appears to have been caused in shipment, file a claim with the carrier. If the equipment is damaged, do not attempt to operate it. Contact National Instruments for instructions. Retain the shipping material for possible inspection by carrier or reshipment of the equipment.

3. Verify that the voltage you will be using is the same as that marked on the rear panel of the GPIB-120A.

Note: ***The GPIB-120A is shipped from the factory set at a certain operating voltage, either 100 to 120 VAC or 220 to 240 VAC. Operating the unit at the wrong voltage can damage the unit. If the GPIB-120A is set at a voltage other than the one you will be using, contact National Instruments for further instructions.***

Chapter 2
Connection

This chapter contains information for connecting your GPIB-120A.

Danger: ***The GPIB-120A does not generate high voltages; however, you must use extreme caution if your system or application can cause high voltages on the shield or logic ground of the GPIB cable you attach to the electrically isolated connector (GPIB Port B) located on the rear panel of the GPIB-120A. Many GPIB cables use a metal shell to enclose the GPIB piggyback connectors. This metal shell is normally connected to the cable shield. Therefore, if the shield is at a high potential with respect to the chassis ground of the GPIB-120A, the high voltage is also present, in most cases, on the cable connector housing.***

The chassis, back panel, and front panel of the GPIB-120A are electrically connected to the earth ground pin of the AC power connector on the back panel. If the AC wiring in your building is installed correctly, you can safely operate the GPIB-120A. Because the EMI shield and jack screws of rear panel connector 'GPIB A' are electrically shorted to the rear panel, a GPIB cable attached to GPIB Port A has its shield and connector housing connected to earth ground, as well, and no danger should exist associated with GPIB Port A. There may be, however, a hazardous voltage potential between the cable connector housings of the GPIB cable attached to GPIB Port A and the GPIB cable attached to GPIB Port B.

Never touch the GPIB-120A case, power cord, or any GPIB cable connected to the GPIB-120A unless you are absolutely sure that there are no hazardous voltages present. In addition, never open the GPIB-120A case unless you have removed the power cord and all GPIB cables from the back panel.

The GPIB-120A is not recommended for use when ground potential differences in excess of 30 V are present between the two rear panel GPIB connectors and associated cables unless sufficient precautions are taken to ensure human safety.

Isolation Considerations

Noise and ground loop problems are common when performing small signal analysis. You can solve such problems by isolating a group of sensitive GPIB instruments from other noisier instruments.

Your GPIB-120A has two GPIB connectors that are electrically isolated from each other: Bus A and Bus B. Bus B is also isolated from the chassis and back panel of the GPIB-120A.

Placing Your Instruments

Identify the instruments or devices in your system that are sensitive to ground loop noise. In the next section, *Connecting the GPIB-120A*, you will connect these instruments or devices to Bus B of your GPIB-120A. Then, you will connect the other instruments or devices to Bus A. Usually you connect your computer or other device acting as the GPIB System Controller to Bus A.

Connecting the GPIB-120A

To connect the GPIB-120A, follow these instructions:

1. Make sure that the power switch on the back panel is in the *off* position.

2. Plug the utility power cord into an acceptable electrical outlet (100 to 120 VAC or 220 to 240 VAC, depending upon which model of the GPIB-120A you have). Plug the other end of the power cord into the back panel of the GPIB.

3. Link your GPIB instrument(s), board(s), and other device(s) to the GPIB-120A with appropriate cables (type X1 or X2). Use Bus A for devices that do not need to be electrically isolated. Use Bus B for devices that need to be electrically isolated from devices on Bus A.

4. Move the power switch to the *on* position.

Connecting to Hewlett-Packard Controllers

To achieve very high data transfer rates and long cable spans between devices, many HP Controllers and computers, such as the 64000 series, use a *preload* technique on the unit designated Master Controller. When preloaded, the GPIB lines of the Master Controller are terminated to represent six device loads. HP has two types of preloading: Class A, in which all 16 GPIB lines are loaded, and Class B, in which all lines, except NRFD and NDAC lines, are loaded.

Preloading increases ringing on signal transitions and can cause improper operation of the GPIB-120A. If this happens, set all signals on the Master Controller to normal (1 unit) load. This is done using a back panel switch on your HP Controller. In addition, you must also strictly conform to the cabling rule of no more than two meters per device.

Mounting the GPIB-120A

The GPIB-120A is designed for table-top or rack-mount operation. Single- and dual-unit rack-mount kits are available from National Instruments. Refer to the *Optional Equipment* section of Chapter 1, *Introduction*, for ordering information on the rack-mount kits.

Chapter 3
Theory of Operation

This chapter describes the operational theory of the GPIB-120A. This chapter assumes that you have a basic knowledge of the GPIB. If you are a first-time user or you would like to review the basics, refer to Appendix A, *Operation of the GPIB*, for a history and the basic operation of the GPIB.

Circuitry of the GPIB-120A

The GPIB-120A consists of two sides: Bus A and Bus B. The circuitry for both sides is logically identical and the two sides are electrically isolated from each other. The only difference between the two sides is that logic ground on Bus A is connected to the chassis ground while the logic ground for Bus B is not. Thus, Bus B is the isolated side of the expansion. To reduce measurement problems caused by noise and ground loops, the measurement instruments must be located on the isolated Bus B and all other devices must be located on Bus A. A block diagram for the GPIB-120A is shown in Figure 3-1.

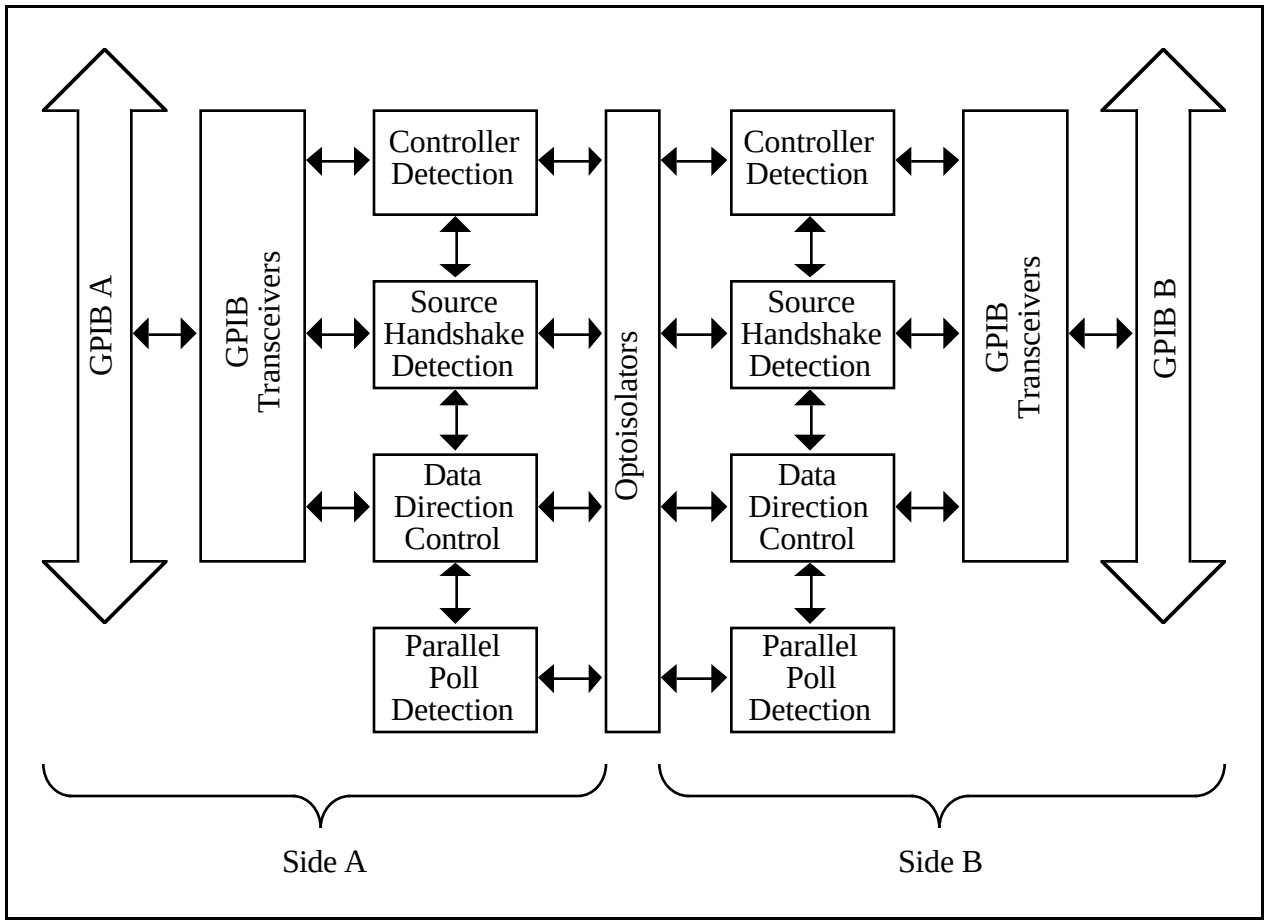


Figure 3-1. GPIB-120A Block Diagram

The circuitry on each side of the expansion monitors local GPIB states and converts the signals monitored into X signals (for transmit) which drive the R signals (for receive) on the opposite side of the expansion. The X signals are optically isolated from the R signals. Each GPIB signal is sensed or driven depending on the System Controller, Active Controller, and Source Handshake states of each side of the expansion.

The GPIB-120A Front Panel

The GPIB-120A front panel has seven light-emitting diodes (LEDs). The POWER LED on the left-hand side of the front panel is lit whenever you power on the GPIB-120A.

For each bus, an LED indicates the status of the System Controller, Active Controller, or Source Handshake state.

Power On

When you power on the GPIB-120A, all circuitry is cleared to an initialized state. The GPIB-120A expansion system is fully operational when you power on the GPIB-120A and your instruments are connected. Where there is GPIB activity, it is recommended that you keep at least two-thirds of the devices on both buses powered on.

System Controller Detection

After you power on, Bus A and Bus B System Controller states are false.

If a GPIB device on Bus A asserts IFC or REN, the Bus A System Controller state becomes true and the Bus B System Controller state becomes false.

If a GPIB device on Bus B asserts IFC or REN, the Bus B System Controller state becomes true and the Bus A System Controller state becomes false.

Active Controller Detection

After you power on, Bus A and Bus B Active Controller states are false.

If a GPIB device on Bus A asserts ATN, the Bus A Active Controller state becomes true and the Bus B Active Controller state becomes false.

If a GPIB device on Bus B asserts ATN, the Bus B Active Controller state becomes true and the Bus A Active Controller state becomes false.

Source Handshake Detection

A device is considered a source handshaker if it is an active Controller sourcing command bytes or if it is a Talker sourcing data bytes.

After you power on, Bus A and Bus B Source Handshake states are false.

If a GPIB device on Bus A asserts DAV, the Bus A Source Handshake state becomes true and the Bus B Source Handshake state becomes false.

If a GPIB device on Bus B asserts DAV, the Bus B Source Handshake state becomes true and the Bus A Source Handshake state becomes false.

Bus A and Bus B Source Handshake states also become false when a parallel poll begins or when the ATN signal changes states.

Data Direction Control

Bus B sends the data lines to Bus A if the Bus B Source Handshake state is true or if a Controller on Bus A is conducting a parallel poll.

Bus A sends the data lines to Bus B if the Bus A Source Handshake state is true or if a Controller on Bus B is conducting a parallel poll.

Parallel Poll Detection

Controllers can conduct parallel polls on Bus A or Bus B with no modification of user software. Devices on both Bus A and Bus B can respond to parallel polls.

If a Controller on Bus A conducts a parallel poll, the parallel poll detection circuitry on side B conducts a parallel poll on Bus B. The result of the parallel poll is driven on the data lines of Bus A.

If a Controller on Bus B conducts a parallel poll, the parallel poll detection circuitry on side A conducts a parallel poll on Bus A. The result of the parallel poll is driven on the data lines of Bus B.

Acceptable Identification Codes

Bus A and Bus B of the GPIB-120A are each capable of appearing as a GPIB device having the GPIB capabilities listed in Table 3-1. For a complete description of each code, consult the ANSI/IEEE Standard 488.1-1987, *IEEE Standard Digital Interface for Programmable Instrumentation*.

Table 3-1. IEEE 488 Capability Identification Codes

Capability Code	Description
SH1	Source Handshake
AH1	Acceptor Handshake
T5, TE5	Talker, Extended Talker
L3, LE3	Listener, Extended Listener
SR1	Service Request
RL1	Remote/Local
PP1, PP2	Parallel Poll
DC1	Device Clear
DT1	Device Trigger
C1, C2, C3, C4, C5	Controller
E1, E2	Three-state bus drivers with automatic switch to open collector during parallel poll

Appendix A
Operation of the GPIB

This appendix contains a brief history of the GPIB and describes the operation of the GPIB.

History of the GPIB

The original GPIB was designed by Hewlett-Packard (where it is called the HP-IB) to connect and control programmable instruments manufactured by Hewlett-Packard. Because of its high data transfer rates of up to 1 Mbytes/s, the GPIB quickly gained popularity in other applications such as intercomputer communication and peripheral control. It was later accepted as the industry standard IEEE 488. The versatility of the system prompted the name General Purpose Interface Bus.

National Instruments expanded the use of the GPIB among users of computers manufactured by companies other than Hewlett-Packard. National Instruments specializes both in high-performance, high-speed hardware interfaces and in comprehensive, full-function software that helps users bridge the gap between their knowledge of instruments and computer peripherals and of the GPIB itself.

GPIB Operation

The GPIB is a link, or interface system, through which interconnected electronic devices communicate. Communication among interconnected GPIB devices is achieved by passing messages through the interface system.

Types of Messages

The GPIB carries device-dependent messages and interface messages.

- Device-dependent messages, often called *data* or *data messages*, contain device-specific information such as programming instructions, measurement results, machine status, and data files.

- Interface messages manage the bus itself. They are usually called *commands* or *command messages*. Interface messages perform such tasks as initializing the bus, addressing and unaddressing devices, and setting device modes for remote or local programming.

The term *command* as used here should not be confused with some device instructions which can also be called commands. Such device-specific instructions are actually data messages.

Talkers, Listeners, and Controller

There are three types of GPIB communicators: Talkers, Listeners, and Controllers. A Talker sends data messages to one or more Listeners. The Controller manages the flow of information on the GPIB by sending commands to all devices.

Devices can be Listeners, Talkers, and/or Controllers. A digital voltmeter, for example, is a Talker and may be a Listener as well.

The GPIB is a bus like an ordinary computer bus, except that the computer has its circuit cards interconnected via a backplane bus, whereas the GPIB has standalone devices interconnected via a cable bus.

The role of the GPIB Controller can also be compared to the role of the CPU of a computer, but a better analogy is to the switching center of a city telephone system.

The switching center (Controller) monitors the communications network (GPIB). When the center (Controller) notices that a party (device) wants to make a call (send a data message), it connects the caller (Talker) to the receiver (Listener).

The Controller addresses a Talker and a Listener before the Talker can send its message to the Listener. After the message is transmitted, the Controller may unaddress both devices.

Some bus configurations do not require a Controller. For example, one device may always be a Talker (called a Talk-only device) and there may be one or more Listen-only devices.

A Controller is necessary when the active or addressed Talker or Listener must be changed. The Controller function is usually handled by a computer.

With a GPIB interface board and its software, your personal computer plays all three roles.

- Controller – to manage the GPIB
- Talker – to send data
- Listener – to receive data

The Controller-In-Charge and System Controller

Although there can be multiple Controllers on the GPIB, only one Controller at a time is active or Controller-In-Charge (CIC). Active control can be passed from the current CIC to an idle Controller. Only one device on the bus, the System Controller, can make itself the CIC. A GPIB interface board in a computer is usually the System Controller.

GPIB Signals and Lines

The interface system consists of 16 signal lines and 8 ground return or shield drain lines.

The 16 signal lines are divided into the following three groups.

- Eight data lines
- Three handshake lines
- Five interface management lines

Data Lines

The eight data lines, DI01 through DI08, carry both data and command messages. All commands and most data use the 7-bit ASCII or ISO code set, in which case the eighth bit, DI08, is unused or used for parity.

Handshake Lines

Three lines asynchronously control the transfer of message bytes among devices. The process is called a three-wire interlocked handshake, and it guarantees that message bytes on the data lines are sent and received without transmission error.

NRFD (Not Ready For Data)

NRFD indicates when a device is ready or not ready to receive a message byte. The line is driven by all devices when receiving commands and by Listeners when receiving data messages.

NDAC (Not Data Accepted)

NDAC indicates when a device has or has not accepted a message byte. The line is driven by all devices when receiving commands and by Listeners when receiving data messages.

DAV (Data Valid)

DAV indicates when the signals on the data lines are stable (valid) and can be accepted safely by devices. The Controller drives DAV when sending commands and the Talker drives it when sending data messages.

Interface Management Lines

Five lines are used to manage the flow of information across the interface.

ATN (Attention)

The Controller drives ATN true when it uses the data lines to send commands and false when it allows a Talker to send data messages.

IFC (Interface Clear)

The System Controller drives the IFC line to initialize the bus and become CIC.

REN (Remote Enable)

The System Controller drives the REN line, which is used to place devices in remote or local program mode.

SRQ (Service Request)

Any device can drive the SRQ line to asynchronously request service from the Controller.

EOI (End Or Identify)

The EOI line has two purposes: the Talker uses the EOI line to mark the end of a message string, and the Controller uses the EOI line to tell devices to identify their response in a parallel poll.

Physical and Electrical Characteristics

Devices are usually connected with a cable assembly consisting of a shielded 24 conductor cable with both a plug and receptacle connector at each end. With this design, devices can be linked in either a linear configuration (shown in Figure A-2) or a star configuration (shown in Figure A-3), or a combination of the two.

The standard connector is the Amphenol or Cinch Series 57 *Microribbon* or *Amp Champ* type. An adapter cable using a non-standard cable and/or connector is used for special interconnecting applications.

The GPIB uses negative logic with standard TTL logic levels. When DAV is true, for example, it is a TTL low level (≤ 0.8 V), and when DAV is false, it is a TTL high level (≥ 2.0 V).

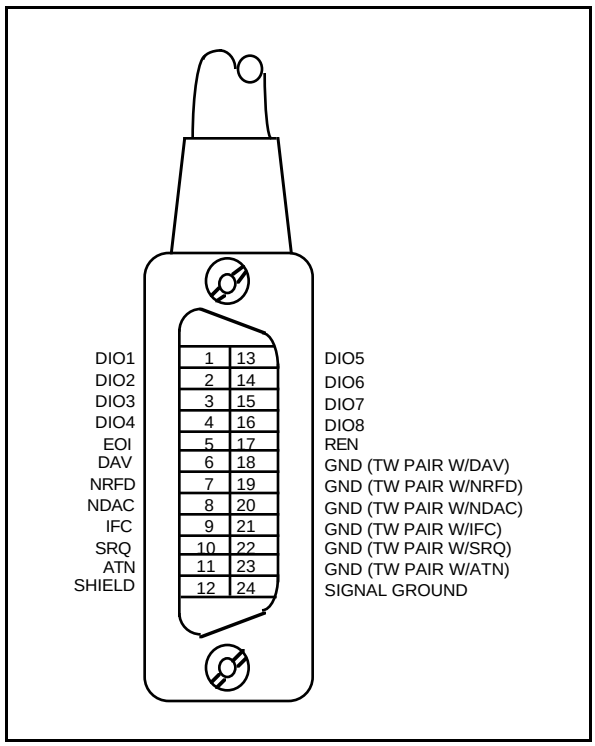


Figure A-1. GPIB Connector and the Signal Assignment

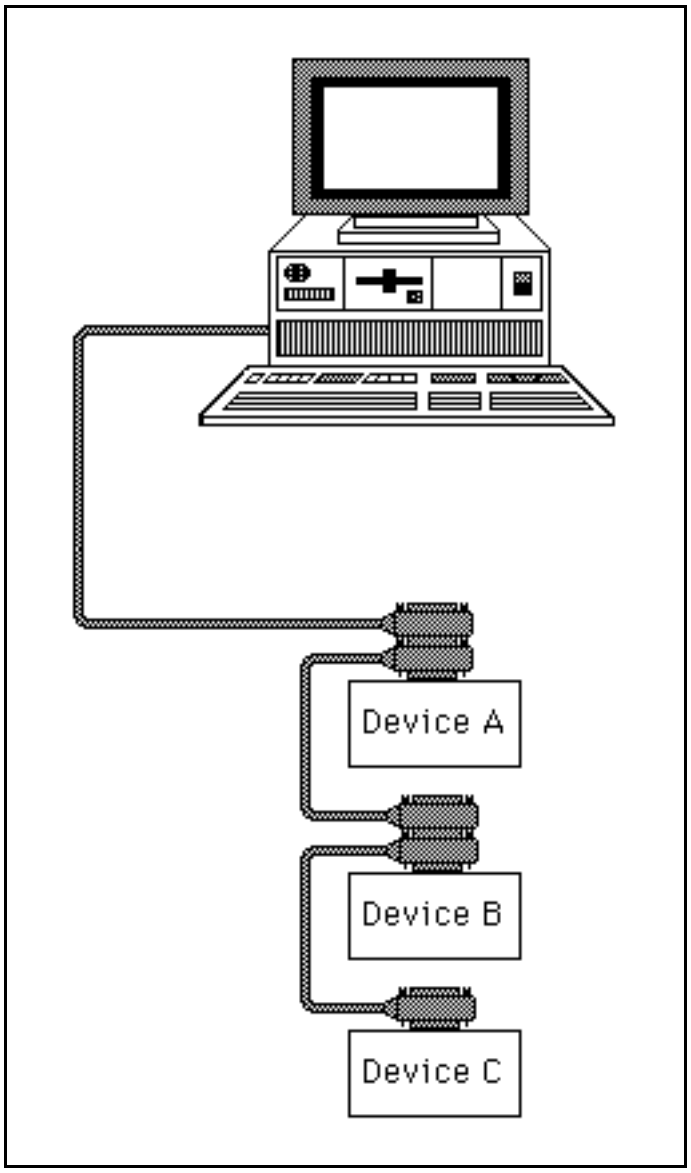


Figure A-2. Linear Configuration of the GPIB Devices

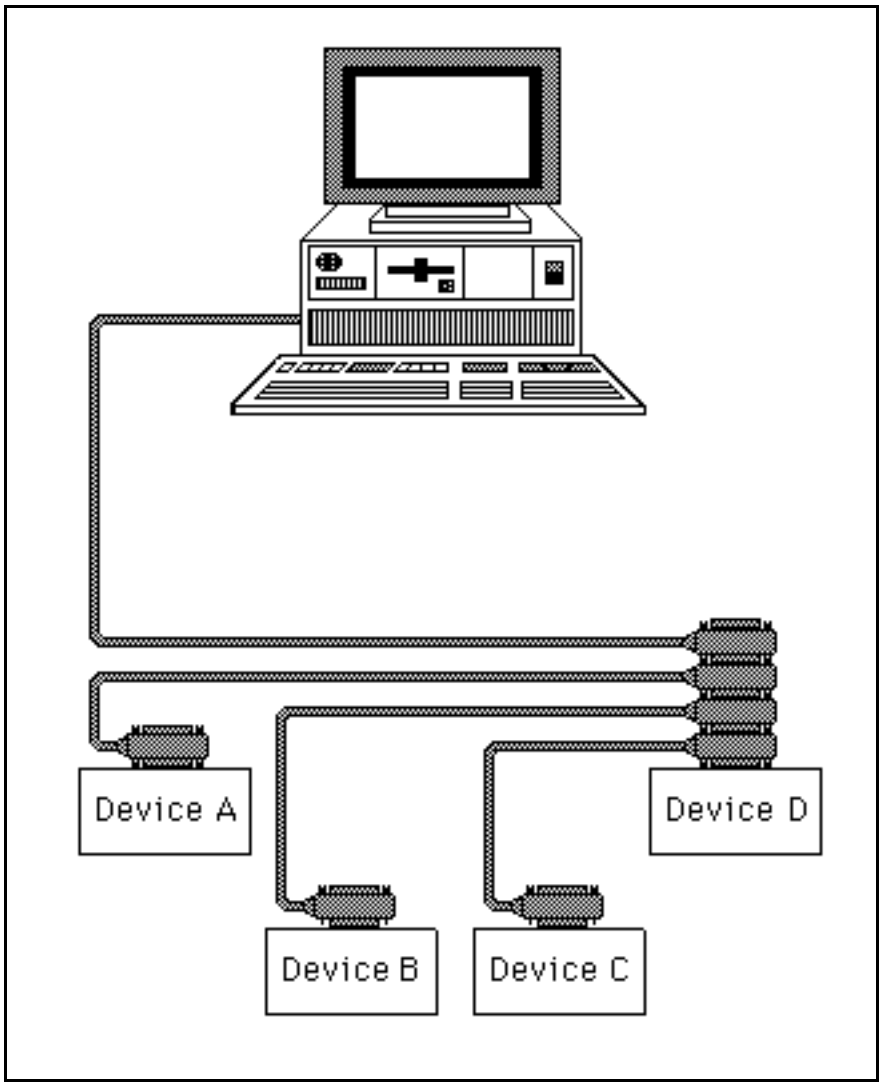


Figure A-3. Star Configuration of the GPIB Devices

Configuration Restrictions: The Role of Expanders and Extenders

To achieve the high data transfer rate for which the GPIB is designed, the physical distance between devices and the number of devices on the bus are limited.

The following restrictions are typical:

- A maximum separation of 4 m between any two devices and an average separation of 2 m over the entire bus.
- A maximum total cable length of 20 m.
- No more than 15 devices connected to each bus, with at least two-thirds of the devices powered on.

It is usually possible to connect a cluster of lab instruments without exceeding these restrictions, but many applications require longer cable spans or additional loading. From the time the GPIB was invented, the need has existed for bus extenders and expanders (repeaters).

Extenders connect two separate buses via a transmission medium and the distance between the buses can be quite long. Expanders generally buffer one bus from an adjacent bus, allowing a doubling of the total cable and loading limits.

National Instruments offers several products that accept longer cable spans. These extenders can functionally connect GPIB systems separated by distances from 20 m to over 2 km. For more information about which extender may be right for your application, contact National Instruments.

The GPIB-120A is a high-speed bus expander which allows up to 14 additional devices to be connected to the bus and 20 m of cable to be added to the system. In addition, the two connected GPIBs are optically isolated to prevent ground loop and noise problems. Only one GPIB-120A is required per expansion.

Related Document

For more information on topics covered in this appendix, consult the ANSI/IEEE Standard 488.1-1987, *IEEE Standard Digital Interface for Programmable Instrumentation*.

Appendix B
Specifications

This appendix lists the specifications of the GPIB-120A.

Table B-1. System Configuration

Configuration	Specification
Loading per expansion	Up to 14 additional devices
GPIB driver output circuit and T1 timing of source device	No restrictions
Note: ***T1 is the data settling time (DIO valid to DAV) and varies according to the type of drivers and the system configuration used.***	

Table B-2. Performance Characteristics

Characteristic	Specification
Data transfer rate degradation	250 ns per byte, typical
Propagation delay	
All signals except DAV	140 ns typical for signal assertion edge 180 ns typical for signal unassertion edge 200 ns maximum
DAV (first byte)	2.5 µs typical for signal assertion edge 180 ns typical for signal unassertion edge
DAV (subsequent bytes)	140 ns typical for signal assertion edge 180 ns typical for signal unassertion edge 200 ns maximum
Transfer Rate	
Read from isolated GPIB instrument	800 kbytes/s maximum
Write to isolated GPIB instrument	800 kbytes/s maximum
GPIB commands to isolated GPIB instruments	320 kbytes/s maximum

Table B-3. Electrical Characteristics

Characteristic	Specification
Isolation	60 V operating 1600 V breakdown
Power supply selectable	90 to 130 VAC, 235 mA, (250 mA, 250 V, slow blow), 50 to 60 Hz or 180 to 260 VAC, 120 mA, (200 mA, 250 V, slow blow), 50 to 60 Hz
GPIB interface load	One standard load, AC and DC
Power	27 VA typical

Table B-4. Environmental Characteristics

Characteristic	Specification
Operating temperature	0° to 45° C
Humidity	5% to 95% noncondensing conditions
EMI	FCC Class A Verified

Table B-5. Physical Characteristics

Characteristic	Specification
Case style	CS2
Case size	89 mm by 216 mm by 330 mm (3.5 in. by 8.5 in. by 13 in.)
Case material	UL94V-0 flame retardant polystyrene DOW 60875F or Noryl FN-215

Appendix C
Multiline Interface Messages

This appendix contains an interface message reference list, which describes the mnemonics and messages that correspond to the interface functions. These multiline interface messages are sent and received with ATN TRUE.

For more information on these messages, refer to the ANSI/IEEE Standard 488.1-1987, *IEEE Standard Digital Interface for Programmable Instrumentation.*

Multiline Interface Messages

Hex	Oct	Dec	ASCII	Msg	Hex	Oct	Dec	ASCII	Msg
00	000	0	NUL		20	040	32	SP	MLA0
01	001	1	SOH	GTL	21	041	33	!	MLA1
02	002	2	STX		22	042	34	"	MLA2
03	003	3	ETX		23	043	35	#	MLA3
04	004	4	EOT	SDC	24	044	36	$	MLA4
05	005	5	ENQ	PPC	25	045	37	%	MLA5
06	006	6	ACK		26	046	38	&	MLA6
07	007	7	BEL		27	047	39	'	MLA7
08	010	8	BS	GET	28	050	40	(	MLA8
09	011	9	HT	TCT	29	051	41	)	MLA9
0A	012	10	LF		2A	052	42	*	MLA10
0B	013	11	VT		2B	053	43	+	MLA11
0C	014	12	FF		2C	054	44	,	MLA12
0D	015	13	CR		2D	055	45	-	MLA13
0E	016	14	SO		2E	056	46	.	MLA14
0F	017	15	SI		2F	057	47	/	MLA15
10	020	16	DLE		30	060	48	0	MLA16
11	021	17	DC1	LLO	31	061	49	1	MLA17
12	022	18	DC2		32	062	50	2	MLA18
13	023	19	DC3		33	063	51	3	MLA19
14	024	20	DC4	DCL	34	064	52	4	MLA20
15	025	21	NAK	PPU	35	065	53	5	MLA21
16	026	22	SYN		36	066	54	6	MLA22
17	027	23	ETB		37	067	55	7	MLA23
18	030	24	CAN	SPE	38	070	56	8	MLA24
19	031	25	EM	SPD	39	071	57	9	MLA25
1A	032	26	SUB		3A	072	58	:	MLA26
1B	033	27	ESC		3B	073	59	;	MLA27
1C	034	28	FS		3C	074	60	<	MLA28
1D	035	29	GS		3D	075	61	=	MLA29
1E	036	30	RS		3E	076	62	>	MLA30
1F	037	31	US		3F	077	63	?	UNL

Message Definitions

DCL Device Clear
GET Group Execute Trigger
GTL Go To Local
LLO Local Lockout
MLA My Listen Address
MSA My Secondary Address
MTA My Talk Address
PPC Parallel Poll Configure
PPD Parallel Poll Disable

Multiline Interface Messages

Hex	Oct	Dec	ASCII	Msg	Hex	Oct	Dec	ASCII	Msg
40	100	64	@	MTA0	60	140	96	`	MSA0,PPE
41	101	65	A	MTA1	61	141	97	a	MSA1,PPE
42	102	66	B	MTA2	62	142	98	b	MSA2,PPE
43	103	67	C	MTA3	63	143	99	c	MSA3,PPE
44	104	68	D	MTA4	64	144	100	d	MSA4,PPE
45	105	69	E	MTA5	65	145	101	e	MSA5,PPE
46	106	70	F	MTA6	66	146	102	f	MSA6,PPE
47	107	71	G	MTA7	67	147	103	g	MSA7,PPE
48	110	72	H	MTA8	68	150	104	h	MSA8,PPE
49	111	73	I	MTA9	69	151	105	i	MSA9,PPE
4A	112	74	J	MTA10	6A	152	106	j	MSA10,PPE
4B	113	75	K	MTA11	6B	153	107	k	MSA11,PPE
4C	114	76	L	MTA12	6C	154	108	l	MSA12,PPE
4D	115	77	M	MTA13	6D	155	109	m	MSA13,PPE
4E	116	78	N	MTA14	6E	156	110	n	MSA14,PPE
4F	117	79	O	MTA15	6F	157	111	o	MSA15,PPE
50	120	80	P	MTA16	70	160	112	p	MSA16,PPD
51	121	81	Q	MTA17	71	161	113	q	MSA17,PPD
52	122	82	R	MTA18	72	162	114	r	MSA18,PPD
53	123	83	S	MTA19	73	163	115	s	MSA19,PPD
54	124	84	T	MTA20	74	164	116	t	MSA20,PPD
55	125	85	U	MTA21	75	165	117	u	MSA21,PPD
56	126	86	V	MTA22	76	166	118	v	MSA22,PPD
57	127	87	W	MTA23	77	167	119	w	MSA23,PPD
58	130	88	X	MTA24	78	170	120	x	MSA24,PPD
59	131	89	Y	MTA25	79	171	121	y	MSA25,PPD
5A	132	90	Z	MTA26	7A	172	122	z	MSA26,PPD
5B	133	91	[	MTA27	7B	173	123	{	MSA27,PPD
5C	134	92	\	MTA28	7C	174	124	|	MSA28,PPD
5D	135	93	]	MTA29	7D	175	125	}	MSA29,PPD
5E	136	94	^	MTA30	7E	176	126	~	MSA30,PPD
5F	137	95	_	UNT	7F	177	127	DEL	

PPE	Parallel Poll Enable	SPE	Serial Poll Enable
PPU	Parallel Poll Unconfigure	TCT	Take Control
SDC	Selected Device Clear	UNL	Unlisten
SPD	Serial Poll Disable	UNT	Untalk

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.

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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
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Netherlands	03480-33466	03480-30673
Norway	32-848400	32-848600
Singapore	2265886	2265887
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
Taiwan	02 377 1200	02 737 4644
U.K.	0635 523545	0635 523154

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 _____

National Instruments software product _____ Version _____

Configuration _____

The problem is _____

_____

_____

_____

_____

List any error messages _____

_____

_____

_____

_____

The following steps will reproduce the problem _____

_____

_____

GPIB-120A Hardware and Software Configuration Form

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

National Instruments Products

- GPIB Software Revision Number on Disk _____
- Programming Language Interface Revision _
- Types of National Instruments GPIB boards installed in your computer and their respective hardware settings:

Board Type	Interrupt Line Setting	DMA Channel Setting	Base I/O Address Setting
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Other Products

- Computer Make and Model _____
- Other GPIB Devices or Instruments _____
- Application Programming Language (BASICA, QuickBASIC, C, Pascal, and so on) _____

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-120A User Manual**

Edition Date: **October 1994**

Part Number: **370893A-01**

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

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

Thank you for your help.

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Glossary

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

°	degrees
%	percent
A	amperes
AC	alternating current
ANSI	American National Standards Institute
ASCII	American Standard Code for Information Interchange
ATN	Attention
C	Celsius
CIC	Controller-In-Charge
CPU	central processing unit
DAV	Data Valid
DC	direct current
DIO	Data Input/Output
EMI	electromagnetic interference
EOI	End Or Identify
FCC	Federal Communications Commission
GPIB	General Purpose Interface Bus
Hz	hertz
IFC	Interface Clear
in.	inches
ISO	International Standards Organization
LED	light-emitting diode
m	meters
MB	megabytes of memory
NDAC	Not Data Accepted
NRFD	Not Ready For Data
RAM	random-access memory
REN	Remote Enable
s	seconds
SRQ	Service Request
TTL	transistor-transistor logic
V	volts
VA	volt amperes
VAC	volts alternating current

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