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Errata

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HP References in this Manual

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, semiconductor products and chemical analysis businesses are now part of Agilent Technologies. We have made no changes to this manual copy. The HP XXXX referred to in this document is now the Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A.

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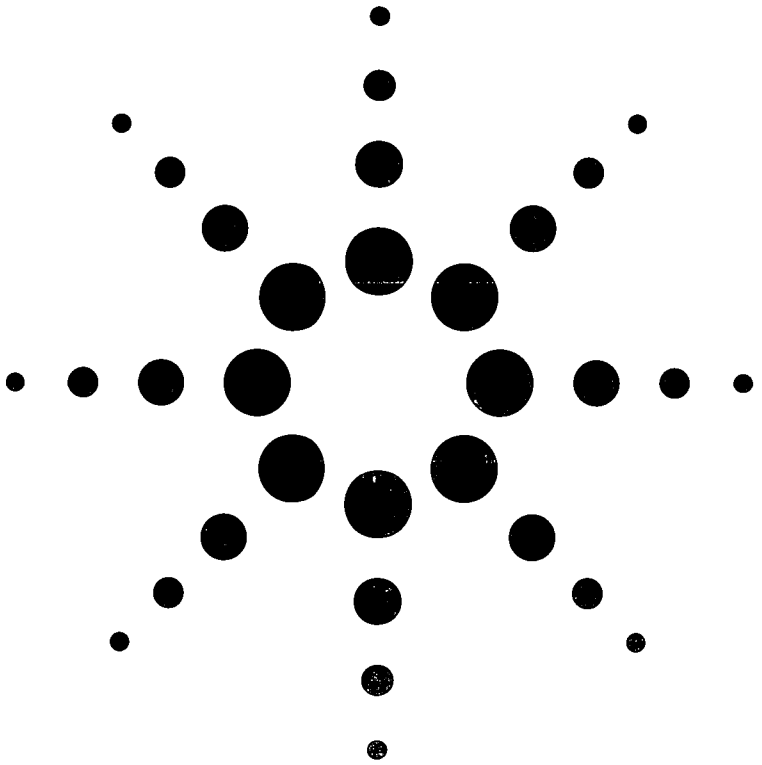
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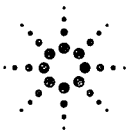
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CISPR 22:1993 + A1:1995/EN55022:1994 + A1:1995: Class A*
EN50082-1:1992
IEC 801-2: 1991/prEN55024-2:1992 4kV CD, 8kV AD
IEC 801-3: 1984/prEN55024-3:1991 3V/m
IEC 801-4: 1988/prEN55024-4:1992 1kV Power Line, 0.5kV Signal Lines

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CSA C22.2 #950 (1995)
UL 1950 (1995)

EMC: CISPR 22:1993 + A1:1995/EN55022:1994 + A1:1995 Class A
IEC 801-2: 1991/EN50082-1 (1992) 4kV CD, 8kV AD
IEC 801-3: 1984/EN50082-1 (1992) 3V/m
IEC 801-4: 1988/EN50082-1 (1992) 1kV Power Line
0.5kV Signal Lines

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Model Number: HP 82341D

Product Options: All

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CSA C22.2 #950 (1995)
UL 1950 (1995)

EMC: CISPR 22:1993 + A1:1995/EN55022:1994 + A1:1995 Class A
IEC 801-2: 1991/EN50082-1 (1992) 4kV CD, 8kV AD
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IEC 801-4: 1988/EN50082-1 (1992) 1kV Power Line
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Introduction

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Introduction

Welcome to the *HP-IB Interface Installation Guide for HP I/O Libraries*. This manual will guide you through the configuration and installation of the HP 82335, HP 82340, or HP 82341 HP-IB interface card when using one of the HP I/O Libraries. The HP I/O Libraries include:

- HP Virtual Instrument Software Architecture (VISA) library
- HP Standard Instrument Control Library (SICL)

If you are using the HP Command Library, see the manual for that product for installation and configuration information.

Once you have installed your HP-IB interface, refer to the *HP I/O Libraries Installation and Configuration Guide for Windows* for information on how to configure your HP-IB interface with the HP I/O Libraries on Microsoft® Windows 95® or Windows NT®.

This guide contains the following chapters and appendices:

- **Chapter 1 - Introduction** (this chapter) describes what you will find in this manual and where to go for additional information. This chapter also explains the radio and television interference and environmental specifications for the HP-IB interface hardware.
- **Chapter 2 - Hardware Installation** describes how to configure the HP-IB interface card's switches and how to install the card into your PC.
- **Appendix A - HP-IB Fundamentals** provides a summary of HP-IB bus theory and connectivity.
- **Appendix B - Using Fast Talker Mode with the HP 82341** explains how to use the Fast Talker mode with this HP-IB interface and HP SICL.

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Other Documentation

- HP I/O Libraries Manuals:
  - *HP I/O Libraries Installation and Configuration Guide for Windows* explains how to install and configure the HP I/O Libraries (including VISA and SICL) on Microsoft Windows.
  - *HP VISA User's Guide* provides detailed information on how to use the VISA library.
  - *HP SICL User's Guide for Windows* provides detailed information on how to use the SICL library.
  - *HP SICL Reference Manual* provides the function syntax and description of each SICL function.
- *Installing the HP-IB Interface* describes the installation and configuration procedures for the HP 82335 HP-IB interface when it is used with the HP Command Library.

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Radio and Television Interference

This device has been verified to comply with FCC Rules Part 15. Operation is subject to these two conditions:

1. this device may not cause radio interference, and

2. this device must accept any interference received (including interference that may cause undesired operation).

This equipment generates and uses radio frequency energy. If not installed and used in accordance with this manual, it can cause interference to radio and television communications. The rules with which it must comply afford reasonable protection against such interference when it is used in most locations. However, there can be no guarantee that such interference will not occur in a particular installation. If you think your computer is causing interference, turn off the system. If the radio or television reception does not improve, your computer is probably not causing the interference.

If your computer does cause interference to radio and television reception, you are encouraged to try to correct the interference by one or more of the following measures:

- Relocate the radio or TV antenna.
- Move the computer away from the radio or television.
- Plug the computer into a different electrical outlet, so that the computer and the radio or television are on separate electrical circuits.
- Make sure you use only shielded cables to connect peripherals to your computer.
- Consult your dealer, Hewlett-Packard Company, or an experienced radio/television technician for other suggestions.
- Order the FCC booklet *How to Identify and Resolve Radio-TV Interference Problems* from the U.S. Government Printing Office, Washington, D.C. 20402. The stock number of this booklet is 004-000-00345-4.

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Environmental Specifications

Table 1-1. Environmental Specifications for the HP 82335, 82340, and 82341 HP-IB Interface Card

Table 1-1. Environmental Specifications for the HP 82335, 82340, and 82341 HP-IB Interface Card

Specification	Minimum	Maximum
Power Supply Voltage	+4.75 volts	+5.25 volts
Power Supply Current	0.5 amperes typical (HP 82335) 1.3 amperes typical (HP 82340 and 82341)	
Operating Temperature	0°C	+55°C
Non-Operating Temperature	-40°C	+70°C
Operating Humidity	15% RH	95% RH
Non-Operating Humidity		90% RH/24 hours

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Hardware Installation

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Hardware Installation

This chapter explains how to configure and install your HP-IB interface hardware in your personal computer for use with the HP I/O Libraries. The main sections of this chapter are as follows:

- Product Package
- Hardware Requirements
- I/O Library Support
- Unpacking the HP-IB Interface
- Setting the Configuration Switches
- Installing the HP-IB Interface
- Where to Go Next

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Product Package

You should have received the following items with your HP-IB interface card:

- HP I/O Libraries for Windows installation software (includes VISA and SICL)
- HP I/O Libraries manuals, including:
  - ❑ HP I/O Libraries Installation and Configuration Guide for Windows
  - ❑ HP VISA User's Guide
  - ❑ HP SICL User's Guide for Windows
  - ❑ HP SICL Reference Manual
- HP Software Product License Agreement
- Computer Plug-in Accessories Warranty and Support information
- Customer Registration/Questionnaire Card

If you also ordered HP-IB cables, these may be shipped separately.

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Hardware Requirements

The HP 82335, HP 82340, and HP 82341 HP-IB interfaces require a personal computer (PC) with an available ISA or EISA I/O slot for the plug-in HP-IB interface card, as follows:

- 16-bit slot for an HP 82340 or HP 82341 interface
- 8-bit slot (or better) for an HP 82335 interface

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I/O Library Support

The HP 82340 and HP 82341 HP-IB interfaces are supported with all versions of the HP I/O Libraries, including the VISA and SICL libraries.

However, the HP 82335 HP-IB interface is *only* supported with 32-bit and 16-bit SICL on Windows 95. The HP 82335 is *not* supported with:

- 32-bit or 16-bit VISA on Windows 95
- 32-bit VISA or SICL on Windows NT

In addition, SICL does *not* support interrupt, SRQ, or non-controller functions with the HP 82335. If you require this functionality, you must use the HP 82340 or HP 82341 HP-IB interface.

See the *HP I/O Libraries Installation and Configuration Guide for Windows* for more information on system software requirements.

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Unpacking the HP-IB Interface

CAUTION

Observe the following precautions to reduce the risk of damaging the HP-IB interface card.

- Protect the interface card from static electricity. The interface can be damaged by static electricity. For protection, the interface is packed in an anti-static bag. Leave the interface card in its anti-static bag until you are ready to install it.

  Also, save the anti-static bag so you can protect the interface if you have to remove it from the computer in the future.
- Handle the interface card gently. Do not drop it or handle it roughly. Be careful while unpacking and installing the interface card.
- Hold the interface only by its edges. Never touch any other part of the interface, including the ISA connector tab.

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Setting the Configuration Switches

Personal computer (PC) plug-in interface cards can use four possible resources:

- I/O Addresses
- Memory Addresses
- IRQ (interrupt) Lines
- DMA Channels

The HP 82340 and HP 82341 cards use I/O address space, and the HP 82335 uses memory address space. You must set I/O address DIP switches on the HP 82340 and HP 82341A-C, and memory address DIP switches on the HP 82335, to prevent conflicts with other PC cards or system resources. On Windows 95, the Plug and Play HP 82341D card's I/O address is automatically set for you during the HP I/O Libraries software configuration.

The HP 82335, HP 82340, and HP 82341 interface cards use an IRQ line. You must set the IRQ line during the HP I/O Libraries software configuration for the HP 82340 or HP 82341A-C on Windows NT. The Plug and Play HP 82341D *is not* recommended for use on Windows NT 4.0 (or earlier versions) due to possible conflicts with a sound card (the sound card may or may not work properly with the HP 82341D on Windows NT depending on the individual PC). It is supported on Windows 95 where the card's IRQ line is automatically set for you during the HP I/O Libraries software configuration. The IRQ line on the HP 82335 card has two IRQ line switches that you must set on the card.

None of these cards use DMA channels.

The following subsections explain switch setting requirements for the HP 82335, HP 82340, and HP 82341 HP-IB interfaces. Refer to the subsection for the interface you are using.

Setting Switches on the HP 82335

The configuration switches on the HP 82335 interface set the interface's operating parameters. They are set at the factory as shown in the Figure 2-1, which specifies memory segment `DC00`. Switches 1 through 4 determine the memory address of the interface. Switches 5 and 6 set the interrupt (IRQ) line. Switches 7 and 8 are not used by SICL.

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Note

The HP 82335 HP-IB interface is *only* supported with 32-bit and 16-bit SICL on Windows 95. The HP 82335 is *not* supported on:

- 32-bit or 16-bit VISA on Windows 95
- 32-bit VISA or SICL on Windows NT

In addition, SICL does *not* support interrupt, SRQ, or non-controller functions with the HP 82335. If you require this functionality, you must use the HP 82340 or HP 82341 HP-IB interface.

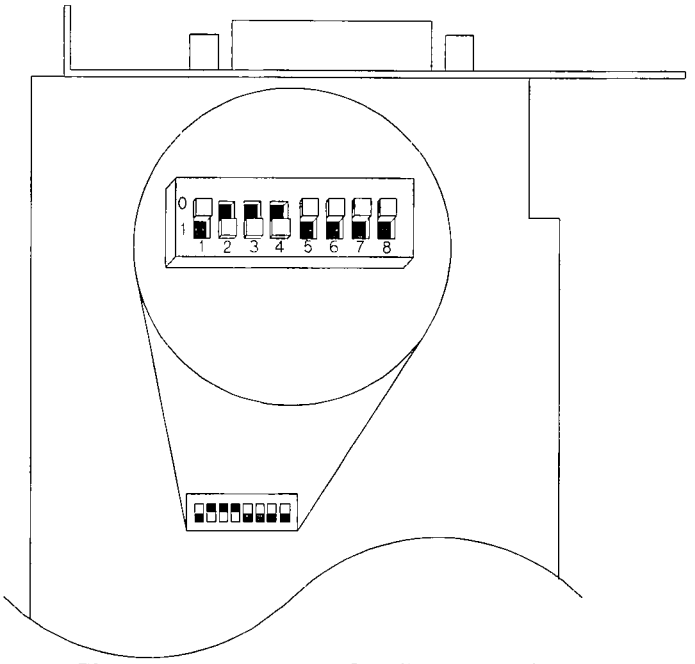


Figure 2-1. HP 82335 Configuration Switch

In most cases, you will not need to change the default switch setting. However, if you are installing more than one HP 82335 interface, you will need to change the switch settings on the additional interfaces so that each one has a unique switch setting.

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Use Table 2-1 of switch positions to select the desired memory address ranges for each HP 82335 interface.

Table 2-1. HP 82335 Switch Settings for Memory Address Ranges

Switches				Memory Segment Range
1	2	3	4	
0	1	1	1	DC00-DFFF
0	1	1	0	D800-DBFF
0	1	0	1	D400-D7FF
0	1	0	0	D000-D3FF
0	0	1	1	CC00-CFFF

Note

The chosen memory address ranges must not conflict with other interfaces installed in your computer, including other manufacturer's products. Refer to the documentation for the other interfaces and the previous table to select unique memory addresses for all interfaces in your computer.

Additionally, these memory ranges may be used by memory management software including 16-bit Windows. You must specifically exclude the use of the segment required by the HP 82335 from those segments available to the memory management software.

Before installing the HP 82335 and booting the computer, check for a memory manager device line (for example, `DEVICE=EMM386.EXE`) in the `CONFIG.SYS` file in the root directory. Add a parameter to exclude the memory segment to the memory manager line for the segment used by the HP 82335 interface. For example, `DEVICE=EMM386.EXE X=DC00-DFFF` is used for the card's default memory range. Remember, you must reboot the computer for any changes to take effect.

Before you start Windows, you must also edit the `SYSTEM.INI` file in your Windows directory and add a memory exclude line to the `[386enh]` section. For example, `EMMEXCLUDE=0DC00-0DFFF` is used for the card's default memory range.

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Use Table 2-2 to select the desired interrupt (IRQ) line for each HP 82335 interface.

Table 2-2. HP 82335 Switch Settings for Interrupt Lines

Switches		
5	6	IRQ Line
0	0	3
0	1	4
1	0	5
1	1	7

Note

The IRQ line assigned for an HP 82335 interface must be reserved for exclusive use by the interface. If this interrupt line is already being used by another interface, this will cause unpredictable behavior (such as system crashes, LAN problems, mouse tracking problems, etc.).

If you suspect an interrupt line conflict exists between an HP 82335 interface and another interface on your system, assign another interrupt line for the interface by resetting switches 5 and 6, as shown in Table 2-2.

Setting Switches on the HP 82340 or HP 82341A-C

The configuration switches on the HP 82340 and HP 82341A-C (non-Plug and Play) interfaces set the interface's I/O (port) base address. They are set at the factory as shown in Figure 2-2, which selects the default hexadecimal I/O base address of 250.

Note

This section does *not* apply to Plug and Play HP 82341D interfaces (which do not have DIP switches). If you have an HP 82341D interface, simply skip this section and go on to the section titled "Installing the HP-IB Interface" beginning on page 21.

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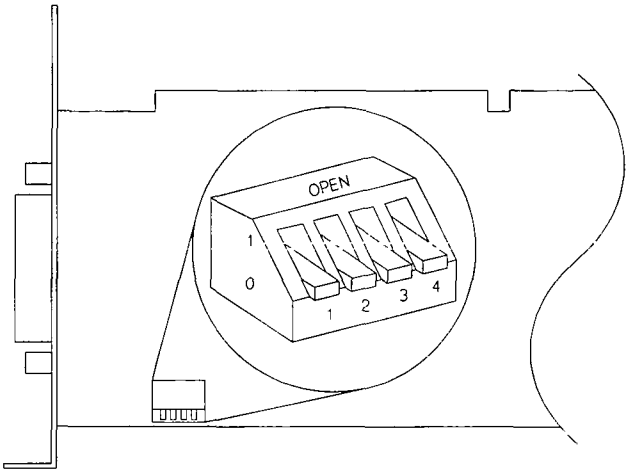


Figure 2-2. HP 82340/HP 82341A-C Configuration Switch

In most cases, you will not need to change the default switch setting. However, if you are installing more than one interface, you will need to change the switch settings on the additional interfaces so that each interface has a unique switch setting. Use Table 2-3 to select the desired address ranges for each interface.

Note

The selected I/O address ranges must not conflict with other I/O interfaces installed in your computer, including other manufacturer's products (for example, LAN interfaces, and so forth). Refer to the documentation for the other interfaces and Table 2-3 to select unique addresses for all the interfaces in your computer.

Because the HP 82340 and HP 82341A-C interfaces are I/O port mapped and not memory mapped, it is not necessary to exclude address ranges for memory management software on your computer.

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Table 2-3. HP 82340 and HP 82341A-C Switch Settings

Switches				I/O Base Address (Hexadecimal)	I/O Address Range Used (Hexadecimal)
1	2	3	4		
0	0	0	0	250	250-257
1	0	0	0	270	270-277
0	1	0	0	350	350-357
1	1	0	0	370	370-377
0	0	1	0	220	220-227
1	0	1	0	280	280-287
0	1	1	0	390	390-397
1	1	1	0	380	380-387

There is no way to reliably predict which I/O addresses are being used. Some trial and error may be required to determine a working address. If you are having problems, you can try removing other cards.

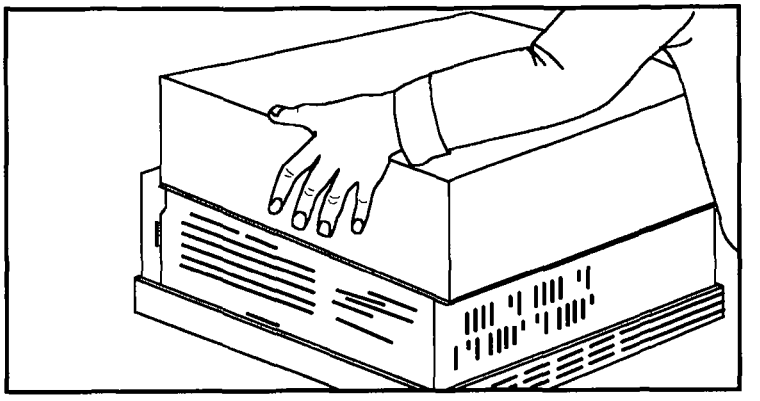
All other hardware settings for the interface are configured by the HP I/O Libraries software. See the HP I/O Libraries Installation and Configuration Guide for Windows for information on how to configure your HP-IB interface with the I/O software after you complete the HP-IB interface hardware installation.

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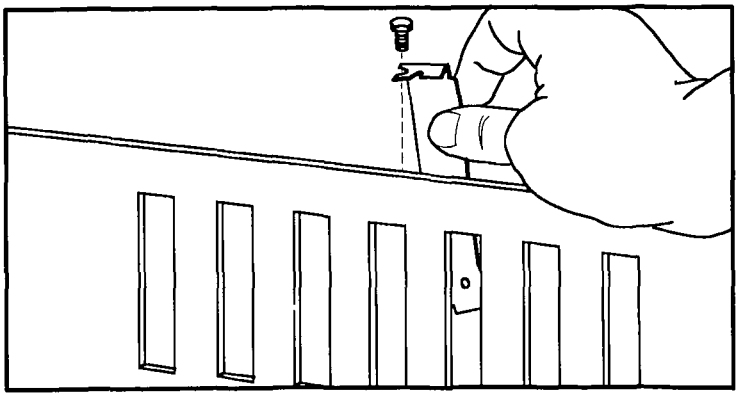
Installing the HP-IB Interface

Use the following steps to install the HP-IB interface in your computer:

1. Power down the computer and all its peripherals.
2. Disconnect the power cord from the computer.
3. Unlock and remove the cover from the computer. This gives access to the I/O slots. (See your computer documentation for detailed instructions.)



4. Remove the back panel's cover plate and look for a suitable ISA/EISA expansion slot. Choose a slot that gives good access to the HP-IB connector.



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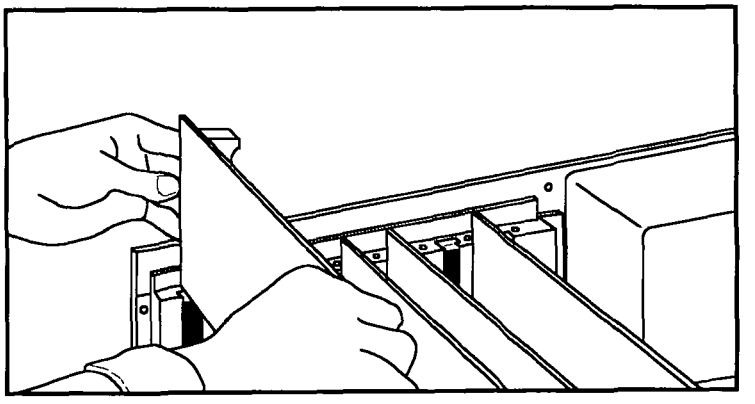
Note

If you are installing more than one HP-IB interface, you may not want to install the HP-IB cards in adjacent slots, as this can cause problems when connecting the HP-IB cables to the cards' connectors later. Instead, you may want to install the cards so there is at least one empty slot between every two HP-IB cards.

CAUTION

While inserting the HP-IB interface, be sure to hold the interface by its edges. Also be careful with the metal contact around the HP-IB connector -- it is easily bent.

5. Insert the HP-IB interface edge connector into the expansion slot connector of the computer. Make sure the interface is fully seated by pushing firmly on the edge of the card with the palm of your hand. The HP-IB connector should extend through the back panel opening to allow cable installation.



6. Replace the back panel cover plate screw to hold the interface in place. (Save the blank cover plate for use if the interface is later removed.)

7. Replace the covers as described in your computer's documentation.

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8. Connect an HP-IB cable to the interface using one of the following cables:

- HP 10833A (1 meter)
- HP 10833B (2 meters)
- HP 10833C (4 meters)
- HP 10833D (0.5 meter)
- HP 8120-3448 (6 meters)
- HP 8120-3449 (8 meters)
- Other cables designed for use with IEEE-488 HP-IB/GPIB buses

9. Tighten the HP-IB connector screws finger-tight only. (The screwdriver slots are for removal purposes only.)

10. Reconnect the power cord and power up the computer and peripherals.

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Where to Go Next

You have now completed the installation steps required for the HP-IB interface. See the *HP I/O Libraries Installation and Configuration Guide for Windows* for information on how to configure your HP-IB interface with the I/O software.

The rest of this manual contains an overview of the HP-IB interface and how it works with the I/O software:

- Appendix A - HP-IB Fundamentals provides a summary of HP-IB bus theory and connectivity.
- Appendix B - Using Fast Talker Mode with the HP 82341 explains how to use the Fast Talker mode with this HP-IB interface and the HP SICL software.

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A

HP-IB Fundamentals

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HP-IB Fundamentals

This appendix provides a summary of information contained in the IEEE-488 specification that defines the HP-IB bus. By using HP SICL device sessions, you can avoid the need to understand many of the bus intrinsics. But if you desire to program at the interface level or are doing extensive bus-level debugging, you may find this information helpful.

The following topics are discussed:

- HP-IB Description
- HP-IB Cabling
- Commands and Data
- Summary of HP-IB Command Abbreviations
- Controllers, Talkers, and Listeners
- Bus Commands
- Service Requests
- Table of ASCII Codes

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HP-IB Description

The Hewlett-Packard Interface Bus (HP-IB) is HP's implementation of the IEEE-488 communication interface. It is used by a variety of instruments, disk drives, and peripherals manufactured by Hewlett-Packard Company and other companies. HP-IB is a 16-line bus that connects up to 15 devices in parallel on a communication link.

Figure A-1 shows the HP-IB connector.

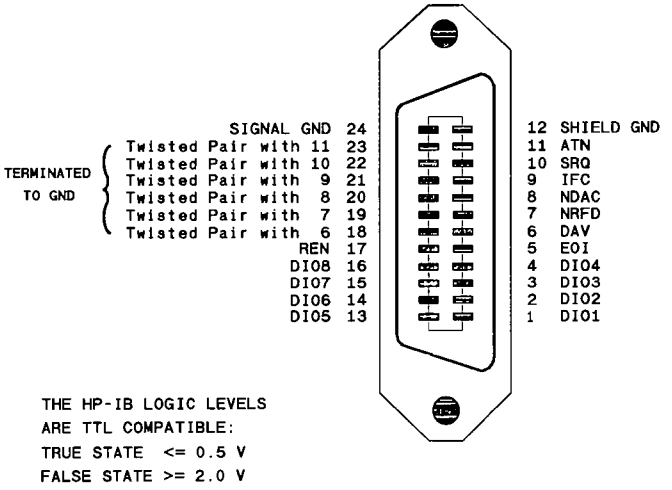


Figure A-1. HP-IB Connector

Of the 16 signal lines, 8 are data lines, 3 are for handshake purposes, and the remaining 5 are control lines. Information is transferred across the eight data lines in a bit-parallel, byte-serial fashion. Briefly, the eight control and handshake lines are used as follows:

ATN Attention is used primarily to differentiate between Command mode and Data mode. When ATN is true, information on the data lines is interpreted as a bus command; when ATN is false, the information is treated as a data byte.

EOI End Or Identify has two uses. EOI is asserted on the last byte of a data transfer—this signals all listening devices that no more data should be expected on the transfer. EOI is used in combination with ATN to perform a parallel poll.

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IFC Interface Clear is under the exclusive control of the system controller. When it is pulsed true, all device interfaces are returned to an idle state, and the state of the bus is cleared.

REN Remote Enable may be set by the system controller to permit devices to operate in Remote mode—that is, under programmed HP-IB control instead of via the device's front panel.

SRQ Service Request can be set by a device on the interface to indicate it is in need of service. SRQ might be set at the completion of a task such as taking a measurement, when an error is detected during device operation, or when requesting to be active controller.

DAV Data Valid is a handshake line indicating that the active talker has placed data on the data lines (DIO1 through DIO8).

NRFD Not Ready For Data is a handshake line indicating that one or more active listeners is not ready for more data, and the active talker should wait before sending new data on the bus.

NDAC Not Data Accepted is a handshake line indicating that one or more active listeners has not accepted the current data byte, and the active talker should leave the current byte asserted on the data lines.

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HP-IB Cabling

The recommended method for connecting an HP-IB system is linear with the system controller at one end. However, an HP-IB system can be connected together in a star, linear, or a combination configuration as long as the following rules are followed:

- The total number of devices is less than or equal to 15.
- It is recommended that no more than three cable connector blocks be stacked on top of one another to minimize stress on connector mountings.
- The connector screws are designed to be tightened with fingers only. The screwdriver slots in the lock screws are for removal purposes only.
- For operation with data transfer rates less than 500 Kbytes/sec, the total length of the all cables used is less than or equal to 2 meters times the number of devices connected together, up to a maximum of 20 meters. For example, the maximum cable length for 2 devices is 4 meters. The length between adjacent devices is not critical as long as the overall restriction is met. Systems should operate normally with up to one third of the devices powered off. Systems using older devices that do not use tri-state drivers will be limited to transfer rates of less than 250 Kbytes/sec.
- For operation with data transfer rates over 500 Kbytes/sec, the total length of the all cables used is less than or equal to 1 meter times the number of devices connected together, up to a maximum of 15 meters. You should minimize cable length as much as possible. All devices must have tri-state drivers and must be powered on. Few instruments are capable of running at these speeds.
- Turning a device on or off while a system is running may cause faulty operation.

HP-IB bus extenders are also available that will allow operation over much greater distances.

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Command Mode and Data Mode

There are two modes of communication on HP-IB: Command mode and Data mode.

In **Command Mode**, information transmitted across the eight data lines is interpreted as talk or listen addresses, or universal address or unaddress commands (explained later). In this mode, only seven of the data lines are used. Some devices use the eighth line as a parity check for certain protocols.

In **Data Mode**, any eight-bit value can be transmitted. The HP-IB can therefore be used for transmission of binary data as well as ASCII characters.

The three-line handshake scheme has several advantages. First, data transfer is synchronous—the data rate is usually limited by the speed of the devices actively involved in the transfer. A second, related advantage is that devices with different I/O speeds can be interconnected without the need for other synchronization mechanisms. Also, multiple devices can be addressed concurrently.

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Summary of HP-IB Command Abbreviations

The following list summarizes the standard, low-level HP-IB command abbreviations (mnemonics) in common use. They are discussed in more detail in the following sections.

Mnemonic	Definition
ATN	Attention
DCL	Device Clear
EOI	End or Identify
EOL	End of Line
GET	Group Execute Trigger
GTL	Go To Local
IFC	Interface Clear
LAD	Listen Address
LLO	Local Lockout
MLA	My Listen Address
MTA	My Talk Address
OSA	Other Secondary Address
PPC	Parallel Poll Configure
PPD	Parallel Poll Disable
PPU	Parallel Poll Unconfigure
REN	Remote Enable
SDC	Selected Device Clear
SPD	Serial Poll Disable
SPE	Serial Poll Enable
SRQ	Service Request
TAD	Talk Address
UNL	Unlisten
UNT	Untalk

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Controllers, Talkers, and Listeners

To understand communication among devices, you should be familiar with the concepts of controller, talker, and listener.

Controller

Two types of controllers are defined within an HP-IB system: system controller and active controller.

There must be a single system controller capable of taking control of the interface at any time. The system controller has exclusive control over the IFC and REN lines.

Each system also has one or more devices capable of being active controller (sometimes referred to as controller-in-charge), although there may be only one active controller at any given time. The active controller has the ability to perform tasks such as establishing listeners and talkers, sending bus commands, and performing serial polls.

In most systems, a single computer will be both the system controller and the only active controller. Some non-system controller devices may request service, indicating their desire to be active controller, in order to perform some operation such as plotting data or directly accessing disk drives. The current active controller may "pass control" to a requesting device to make it the active controller. In other systems, a system controller may not be capable of operating as non-active controller, and therefore no pass-control capabilities will exist. Note that system controller capabilities may not be transferred.

An HP-IB system can be configured in one of three ways, and it affects the transfer of data as described:

- No controller. This mode of data transfer is limited to a direct transfer between one device manually set to talk only, and one or more devices manually set to listen only.
- Single controller. In this configuration, data transfer can be from controller to devices (Command or Data mode), from a device to controller (Data mode only), or from a device to other devices (Data mode only).
- Multiple controllers. This mode of data transfer is similar to that of a single controller, with the requirement that active controller status be passable from one controller to another. In this configuration, one controller must be

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designated as the system controller. This controller is the only one that can control the IFC and REN lines.

Control is passed to another controller by addressing it as a talker and commanding it to "take control" (TCT).

Talker

In each system, there can be at most one device addressed as talker at any given time. A device becomes addressed as talker by receiving its talk address from the active controller. Each device on the bus must have a unique bus address. This address is usually set at the manufacturing site, but it may be set by switches on the instrument.

The addresses are in the range 0 to 30. A talk address is formed by adding the primary bus address to the talk address base value of 64 and transmitting that value across the data lines while ATN is asserted. For example, talk address 9 would be formed by asserting ATN and transmitting a byte whose value is 73 (64 + 9 = 73, ASCII character "I").

Listener

Listen addresses are formed in a similar manner to talk addresses, except that listen addresses use a base of 32. For example, listen address 9 is sent as value 41 transmitted with ATN true (32 + 9 = 41, ASCII character ")").

Multiple devices may be addressed to listen at any time, and data bytes will be received by all listeners in parallel. However, most devices cannot be addressed to both talk and listen at the same time. (See Table A-3 on page 38 for ASCII Codes.)

Extended Addressing

The descriptions of talk address and listen address refer to a device's primary address. Some devices also have extended talker or extended listener capabilities, sometimes used as secondary addresses or as device-dependent commands. With extended addressing, talk and listen addresses are represented by two command bytes. The first byte is the primary talk or listen address as previously described. The second byte is a secondary address command.

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Secondary addresses may be in the range 0 to 30. The secondary commands transmitted are formed by adding the secondary address to the base value 96 and transmitting the byte with ATN true.

Extended addresses can be used, for example, to access a specific I/O card within an instrument that allows multiple I/O cards, such as a VXI cardcage. For example, if you are connecting to a VXI card cage through an HP E1405/6 Command Module or equivalent, the primary address passed to `iopen` corresponds to the address of the Command Module, and then a secondary address must be specified to select a specific instrument in the card cage. Secondary addresses of 0, 1, 2,...30 by default correspond to VXI instruments at logical addresses of 0, 8, 16,...240, respectively. For example, the `iopen` address string "`hpib7,16,0`" would specify the VXI instrument at logical address 0 (usually the Command Module), accessed through a Command Module at address 16 on the HP-IB bus.

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Bus Commands

Five types of information are transmitted when the bus is operating in Command mode (that is, when ATN is asserted):

- Talk addresses
- Listen addresses
- Universal commands
- Addressed commands
- Unaddress commands

Talk addresses and listen addresses were discussed earlier in this appendix. The other categories are described in the following subsections.

Universal Commands

Universal commands are received by all responding devices on the bus whether addressed to listen or not. The commands are listed in Table A-1..

Table A-1. Universal Commands

Mnemonic	Command	Description
LLO	Local Lockout	Disables the front panel of the responding device. The REN line must be asserted in order for LLO to have any effect. If the instrument is already in Remote mode, the lockout will be immediate. Otherwise, the lockout will commence when the device receives its listen address.
DCL	Universal Device Clear	All devices capable of responding are returned to some known, device-dependent state. In some cases, a device will perform a self-test in response to a Universal Device Clear.
PPU	Parallel Poll Unconfigure	Directs all devices on the HP-IB that have parallel poll configure capabilities to not respond to a parallel poll.
SPE	Serial Poll Enable	Enables Serial Poll mode on the interface.
SPD	Serial Poll Disable	Disables Serial Poll mode on the interface.

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Addressed Commands

Addressed commands are executed only by those devices that are currently addressed as listeners. They allow the controller to initiate a simultaneous action by a selected group of devices on the bus, such as triggering them to take readings at the same time. The commands are listed in Table A-2.

Table A-2. Addressed Commands

Mnemonic	Command	Description
SDC	Selected Device Clear	Similar to a Universal Device Clear (DCL) with only those devices addressed to listen responding.
GTL	Go To Local	Returns devices that are addressed to listen to Local mode (re-enables front panel programming). REN stays asserted when a GTL is sent, and devices will be returned to Remote upon receipt of their listen address.
GET	Group Execute Trigger	Initiates some preprogrammed action by listening devices. This may be used to simultaneously start action in a group of devices that are addressed to listen.
PPC	Parallel Poll Configure	Configures a device to respond to a parallel poll on a specified data line with either a positive or negative signal. A secondary command sent after PPC contains the data that configures the device.
TCT	Take Control	Transfers active controller status to another device on the bus. (This command is executed by the current talker, not the current set of listeners.)

Unaddress Commands

The two unaddress commands can be considered as extensions of talk and listen addresses.

- UNL (Unlisten) causes all devices on the bus (except those that have a built-in switch set to Listen Only) to stop being listeners. UNL is equivalent to listen address 31.
- UNT (Untalk) directs any device on the interface to no longer be addressed as talker. Since there may only be one device addressed to talk at any time, receipt of another device's talk address is equivalent to receiving a UNT. UNT is equivalent to talk address 31.

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Service Requests

Some devices that operate on the interface have the ability to request service from the system controller. A device may request service when it has completed a measurement, when it has detected a critical condition, or under many other circumstances.

A service request (SRQ) is initiated when the device sets the SRQ line true. The controller, sensing that SRQ has been set (typically either by polling the status of the line, or by enabling an SRQ interrupt), can poll devices in one of two ways: serial poll or parallel poll.

Serial Poll

A typical sequence of events in performing a serial poll is:

- Establish a device as a talker.
- Send SPE to set up Serial Poll mode.
- Wait for the addressed device to send its serial poll response byte.
- Send an SPD and UNT to disable the Serial Poll mode.

The meaning of the serial poll response byte depends upon the individual device. However, if bit 6 of the response byte (bit value 64) is 1, the device is indicating it has requested service. If bit 6 is 0, the polled device is not the one that requested service. Individual device manuals provide additional information on the meanings of serial poll response bytes.

Parallel Poll

Parallel polling permits the status of multiple devices on the HP-IB to be checked simultaneously. Each device is assigned a data line (DIO1 through DIO8) that the device sets true during the parallel poll routine if it requires service.

More than one device can be assigned to a particular data line. If a shared line is sensed true, a serial poll can typically be performed to determine which device set the line. A parallel poll is started when the controller asserts ATN and EOI together. After a short period of time, the controller reads the poll byte and begins its interpretation thereof.

Some devices can be configured (by the PPC command) to respond on specific data lines. Other devices may respond on lines selected by switches or jumpers in the devices. Some devices do not have parallel poll capability.

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ASCII Codes

Table A-3 lists ASCII codes in decimal and hex, characters, and corresponding HP-IB commands. You may find these codes helpful for debugging, or for creating interface session commands.

Table A-3. ASCII Codes

Dec	Hex	Char	Cmd	Dec	Hex	Char	Cmd	Dec	Hex	Char	Cmd	Dec	Hex	Char	Cmd
0	00	NUL		32	20	SP	L0	64	40	@	T0	96	60	`	
1	01	SOH	GTL	33	21	!	L1	65	41	A	T1	97	61	a	
2	02	STX		34	22	"	L2	66	42	B	T2	98	62	b	
3	03	ETX		35	23	#	L3	67	43	C	T3	99	63	c	
4	04	EOT	SDC	36	24	$	L4	68	44	D	T4	100	64	d	
5	05	ENQ	PPC	37	25	%	L5	69	45	E	T5	101	65	e	
6	06	ACK		38	26	&	L6	70	46	F	T6	102	66	f	
7	07	BEL	GET	39	27	¢	L7	71	47	G	T7	103	67	g	
8	08	BS		40	28	(	L8	72	48	H	T8	104	68	h	
9	09	HT	TCT	41	29	)	L9	73	49	I	T9	105	69	i	
10	0A	LF		42	2A	*	L10	74	4A	J	T10	106	6A	j	
11	0B	VT		43	2B	+	L11	75	4B	K	T11	107	6B	k	
12	0C	FF		44	2C	,	L12	76	4C	L	T12	108	6C	l	
13	0D	CR		45	2D	-	L13	77	4D	M	T13	109	6D	m	
14	0E	SO		46	2E	.	L14	78	4E	N	T14	110	6E	n	
15	0F	SI		47	2F	/	L15	79	4F	O	T15	111	6F	o	
16	10	DLE		48	30	0	L16	80	50	P	T16	112	70	p	
17	11	DC1	LLO	49	31	1	L17	81	51	Q	T17	113	71	q	
18	12	DC2		50	32	2	L18	82	52	R	T18	114	72	r	
19	13	DC3		51	33	3	L19	83	53	S	T19	115	73	s	
20	14	DC4	DCL	52	34	4	L20	84	54	T	T20	116	74	t	
21	15	NAK	PPU	53	35	5	L21	85	55	U	T21	117	75	u	
22	16	SYN		54	36	6	L22	86	56	V	T22	118	76	v	
23	17	ETB		55	37	7	L23	87	57	W	T23	119	77	w	
24	18	CAN	SPE	56	38	8	L24	88	58	X	T24	120	78	x	
25	19	EM	SPD	57	39	9	L25	89	59	Y	T25	121	79	y	
26	1A	SUB		58	3A	:	L26	90	5A	Z	T26	122	7A	z	
27	1B	ESC		59	3B	;	L27	91	5B	[	T27	123	7B	{	
28	1C	FS		60	3C	<	L28	92	5C	\	T28	124	7C	|	
29	1D	GS		61	3D	=	L29	93	5D	]	T29	125	7D	}	
30	1E	RS		62	3E	>	L30	94	5E	^	T30	126	7E	~	
31	1F	US		63	3F	?	UNL	95	5F	_	UNT	127	7F	DEL	

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B

Using Fast Talker Mode with the HP 82341

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Using Fast Talker Mode with the HP 82341

The HP 82341 high performance HP-IB card is capable of high-speed HP-IB operation while using HP SICL, but only under the conditions specified by the IEEE 488 specification for such operation. To turn on Fast Talker mode, use the following SICL function:

```
igpibsett1delay (intf_id, I_GPIB_T1DELAY_MIN);
```

This will turn on Fast Talker mode for all session attached to the interface specified by `intf_id`.

To turn Fast Talker mode off, use the following SICL function:

```
igpibsett1delay (intf_id, I_GPIB_T1DELAY_MAX);
```

For more information, refer to `igpibgett1delay` and `igpibsett1delay` in the *HP SICL Reference Manual.*

The critical parameter is the so-called "T1 delay," or settling time for multi-line messages, as defined in the IEEE 488 specification. The specified value for this parameter is 2 microseconds minimum. However, it can be reduced to 350 nanoseconds minimum if the following special considerations are met:

- The device capacitance per line (except for REN and IFC) should be less than 50 picofarads per device. This requires the use of tri-state electrical HP-IB drivers, instead of open-collector HP-IB drivers.

  While it is difficult to determine this specification unless it is published for a particular instrument, in practice devices designed for fast operation will meet the specification. It can be assumed that a device not specified for fast operation will not meet it.

- All devices in the system should be powered-up.
- The total length of HP-IB cables connected to the HP-IB interface should be no more than 15 meters, and there should be one device for each meter (or less) of cable.

If these specifications are not met by all devices on the interface, reliable high-speed operation cannot be guaranteed.

In practice, this means that a system where speed is of critical importance may require the use of two HP-IB cards: one for slow-speed operation with most of the accessory devices, and one with only the fast device(s) on it for high-speed operation.

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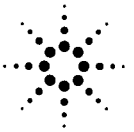
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