HEWLETT PACKARD

HP 28650A
HP-PB HP-IB Adapter
Installation Manual

HP 9000 Series 800 Computers

HP 28650A

HP-PB HP-IB Adapter

Installation Manual

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Notice

Preface

This manual gives you information for installation, configuration and basic troubleshooting of the Hewlett-Packard Precision Bus Hewlett-Packard Interface Bus (HP-IB) device adapter. The audience for this material is the Hewlett-Packard Customer Engineer who will install this device adapter and verify operation when connected to a bus serving compatible external (peripheral) devices.

Chapter 3 presents a brief functional description. If you require more detailed information, please contact your local HP Sales and Support Office who can supply you with manuals which explain the HP-IB standard. You will find a list of these offices in the back of the computer system manuals.

The design of the HP-IB interface is primarily as a high speed data bus for use between the host computer and one or more disc or tape drive units. However, there are many other devices using the HP-IB (or IEEE-488 "GP-IB") standard which will also function on this bus. Many of these devices are "intelligent" and use the full capabilities of the bus, others are more dependent and require host intervention to operate. This means that you must carefully design the HP-IB bus to use the capabilities of the devices and the device adapter for the required task.

The design of the bus goes beyond the scope of this manual, and we suggest that you read the *Tutorial Description of the Hewlett-Packard Interface Bus* (part number 5952-0156) if you are unfamiliar with the bus standard. Similar books are available from the IEEE and other organizations. Contact your local Hewlett-Packard Sales and Support Office to get a copy of the tutorial.

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1 General Information

The Hewlett-Packard Precision Bus HP-IB device adapter fits all HP Precision Architecture (HP-PA) computers using the Precision Bus (HP-PB) backplane. There are no switches or jumpers to set for configuration. The operating system driver controls all device adapter functions, including HP-IB address and speed. To configure the device adapter, you may have to remove or replace a resistor pack, depending on the speed and number of peripherals attached to the bus.

The computer software downloads the commands that control the device adapter, its speed and address. Configuration commands allow you to change the HP-IB address and the speed of the bus, but for most applications you will not need to change the default address (30_{DEC}). The speed you use depends largely on the number and type of the HP-IB devices you attach to the bus and on the length of the HP-IB cables required in your application. Chapter 2, "Installation", explains how to choose the speed. You also need your system manuals at hand for reference.

The printed circuit assembly (PCA) is a single-high HP-PB device adapter. The default slot for a bootpath HP-IB is slot 5. However, the HP-IB PCA fits any available single-high slot in an HP-PA Computer. If no such slot is available, you install the PCA in a double-high slot with a slot divider. This product does not include a slot divider, but you may order one through your local HP Sales and Support Office listed in the back of Hewlett-Packard computer systems manuals.

Description

This product is a low-cost, high speed, data transfer device. It adapts a Hewlett-Packard Precision Bus computer to use the Hewlett-Packard interface bus (IEEE 488 GP-IB) standard.

Equipment Supplied

This HP-IB product is made up of three separate parts:

- The Printed Circuit Assembly (PCA), (part number 28650-60001).
- An HP-IB cable, (part number 8120-5147).
- This manual (part number 28650-90001).

There are also a replaceable ROM chip (IO_DC), and a resistor pack on the PCA. You may have to remove or replace the resistor pack when configuring the HP-IB device adapter.

Note

Users who attempt to replace any of the on-board components (except the equivalent load resistor pack and IO_DC ROM chip) or who otherwise modify the HP-IB PCA will invalidate the warranty for the product.

Options

By selecting from the two options, you can tailor the HP-IB to your needs:

#0B0 Deletes the manual (part number 28650-90001).

#001 Deletes the cable (part number 8120-5147).

Additional Hardware

There are several items you may need to install the HP-IB PCA, but not included with the device adapter:

- An anti-ESD work area, used to configure the HP-IB PCA. Use a work station kit (part number 9300-1155) if you do not have one.
- A slot divider (part number 5062-3336), used to divide a double high computer backplane slot into two single high slots. Two single-high PCAs can share a double-high slot with one divider.
- An HP-IB extension cable (many lengths and configurations are available), used if your physical layout requires a cable longer than the one supplied.
- An HP-IB backing plate (part number 30070-00043), used to ensure a tight connection between two HP-IB cables used as an extension cable.

Typical HP-IB Configurations

The HP-IB specification allows for many possible configurations, as long as they fall within the general total cable length, speed of bus and load requirements of the bus standard. Some typical installation arrangements are shown in figure 1-1.

Notice the long linked, or "daisy chain," configuration in the left figure. Often, this configuration is more reliable than the "star" topology in the right hand figure. This occurs because the common connection tends to generate large capacitance values at a single plane on the line.

Note

In either case, the total length of cable must be less than the specification allows to insure reliability and the maximum speed possible on the bus. See chapter 2 for details.

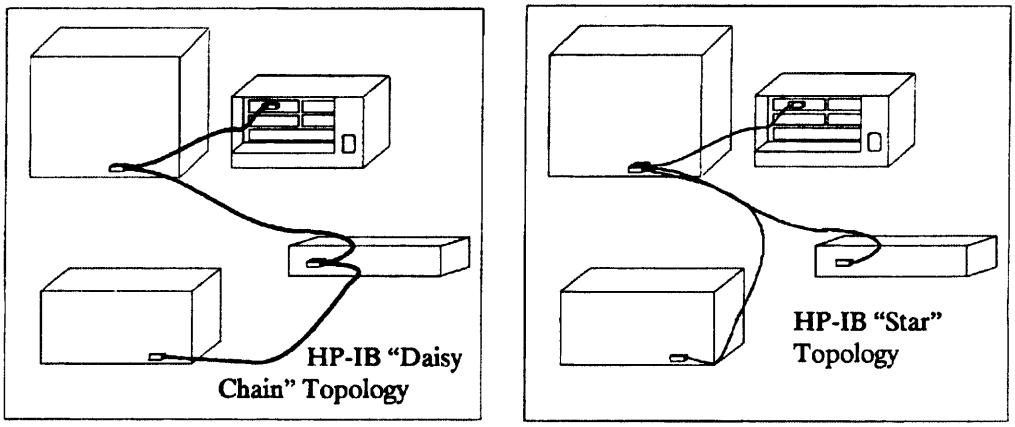


Figure 1-1. Typical HP-IB Configurations

While neither illustration shows the use of an extension cable, you may use two HP-IB cables in series with a backing plate to secure the connection. However, rather than using extension cables, Hewlett-Packard Company recommends getting a longer cable.

Identification

To identify the PCA, we have marked it with a series of codes. These identification codes are on stickers affixed to the front or back of the fiberglass board. If you call HP support personnel, have this information ready to give to them.

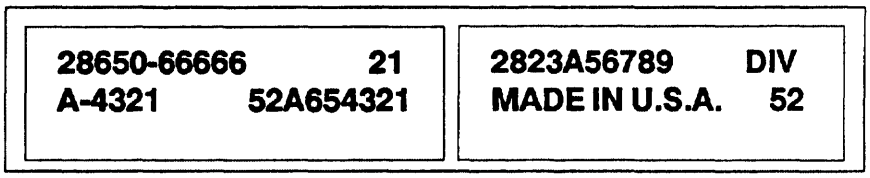


Figure 1-2. Generalized PCA Identification Stickers

Two generalized stickers, similar to those on the PCA, are shown above. On the first, the 28650-66666 represents the part number of the PCA, and A-4321, the revision-date code. The other numbers are production serial codes which HP uses to identify the specific components used on the PCA. The digits on the second sticker are the PCA serial number and manufacturing division identification. Record this information in the system logbook where it will be available if you need to contact the Hewlett-Packard Sales and Support Office regarding this device adapter.

2 Configuration and Installation

Configuring and installing the Hewlett-Packard Precision Bus HP-IB device adapter requires six steps:

1. Planning the configuration of the interface bus. This step includes selecting the bus speed. (Based on the configuration of your installation, you may need to remove or change the resistor pack in step 3 below.)

2. Configuring the operating system to recognize the HP-IB device adapter. (See appendix A and your HP-UX System Administrator's Manual for more information.)

3. Unpacking the PCA and other components. Carefully examine each item for damage. During unpacking, and throughout installation, be careful to follow good anti-electrostatic discharge (ESD) procedures to avoid damaging the electronic components on the PCA. Hewlett-Packard computer reference manuals explain anti-ESD procedures under "Safety Considerations". If the speed or cable length requires changing the resistor pack, you will do so now.

4. Inserting the PCA into the card cage in an available single-high slot. (If no divided card slot exists, you must install a slot divider.)

Caution

Power the computer down, including shutting down the operating system, before installing the HP-IB device adapter. Check in the system manual to learn how to do this.

5. Connecting the interface cable to the PCA connector: The cable makes a secure RFI ground connection through the connector shield to the grounding bus of the computer. Neither electrical nor signal lines require a separate ground.

6. Configuring the device adapter. This includes identifying the HP-IB to the host computer and setting the speed and changing the HP-IB address, if required by step 1 or 3.

Unpacking the Interface

This step consists of removing the printed circuit assembly and other components from their protective containers and preparing the device adapter for installation into the host computer backplane. If your bus design requires removing or replacing the resistor pack, you will do it here.

Before unpacking anything more, carefully check the condition of the box and other packaging material. If you see any serious damage to the outside of the carton, stop and call the HP Sales and Support Office nearest you to help you take care of claim details. The carrier's agent should be present to ensure that your claim will be upheld if there is any damage to the product.

Retain the packaging material for possible later use. See "Repacking the Device Adapter" in appendix B.

Observe Anti-ESD Precautions

Some of the components used in this product are susceptible to damage by electrostatic discharge (ESD). Refer to the safety information at the front of your host system manual. Leave the PCA in the static-shielding shipping bag until you install it in the computer system. When handling it outside of the bag, do not touch any components. Hold the PCA by its edges, avoid working in a carpeted area, use a grounding wrist strap, reduce unnecessary movements; all of these precautions will reduce the chances of ESD damage.

Caution

ESD can destroy any electronic assembly. Failure to follow anti-ESD procedures can invalidate your warranty.

To install the device adapter, you need an anti-ESD work area. If you do not have one, we suggest a work station kit (part number 9300-1155). It contains a grounding wrist strap, a conductive work mat and other items to shunt any charge safely to ground. Instructions for use come with the kit.

Planning the Interface Bus

Detailed planning instructions for the interface bus are in the Tutorial Description of the Hewlett-Packard Interface Bus (part number 5952-0156), available through your HP Sales and Support Office. The information presented here describes the general applications for HP-IB installations.

There are two principle considerations in planning the bus. The first is the devices attached to the bus and the second is bus speed. The bus speed depends on the number and performance characteristics of the devices attached to it. Both high speed and slow/medium speed are available to you on the HP-IB device adapter. The terms "slow/medium speed" and "high speed" are taken from the HP-IB Standard. For this device adapter, the actual highest speed possible may be slower than the theoretical maximum.

Caution

To avoid data loss or corruption, and possible damage to equipment, there are three principles you must adhere to in your bus design. Table 2-1 lists these constraints.

- No high speed device may operate on a slow/medium speed bus.
- All cables used on the bus contribute to the bus length, whether you use a star, daisy-chain or combination topology (see figure 1-1).
- Neither the number of loads nor devices attached to the bus can exceed the limits for the speed configured.

The Devices Attached to the Bus

HP-IB (and IEEE 488) devices fall into one of two categories: High speed and slow/medium speed. Slow/medium speed (up to 500K-bytes/sec) is appropriate for most instrument and sensor applications, while high speed (up to 750K-byte/sec) is suited for data transfer to and from mass storage devices, terminals and other such external devices.

High speed devices must have the following characteristics:

- The capacitance of each line [except IFC (Interface Clear) and REN (Remote Enable)] connected to the bus must be less than 50 pF at <2 V dc.
- All high rate talkers must have a minimum multiline message settling time (T1 in IEEE 488 standard) of 350 ns.
- The drivers must be 48 mA, tristate.

Consider all devices possessing other characteristics as slow/medium speed.

Changing the Resistor Pack

The resistor pack shipped (part number 1810-0081) with the HP-IB product simulates seven loads. Some applications may require changing the pack to meet a need for more devices attached to the bus. Table 2-1 lists the other resistor packs available with their equivalent loads. Contact the HP Sales and Support Office to order.

Table 2-1. Equivalent Load Resistor Pack Part Numbers

Part Number	Equivalent Loads
1810-0408 1810-0410	1 2
1810-0409 1810-0081	4 7

To locate the resistor pack, hold the PCA with the component side up, and the extractor levers near you. Immediately beyond the bulkhead, near the center of the PCA, there is a socket holding an eighteen-pin chip with pins 1, 9, 10 and 18 numbered. This is the resistor pack. See figure 2-1.

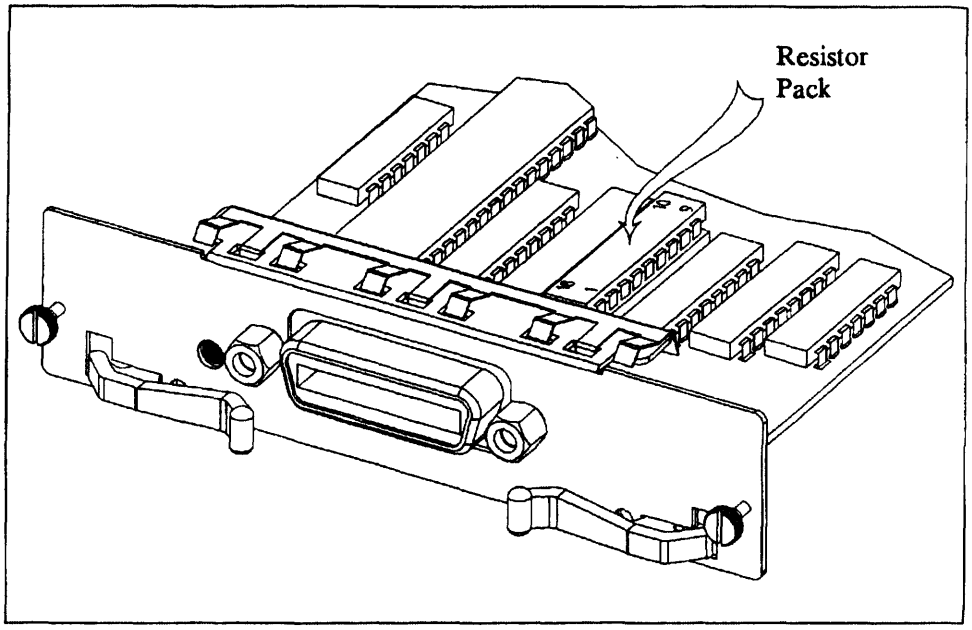


Figure 2-1. Resistor Pack Location and Identification

Selecting the Bus Speed

The HP-IB speed depends on the number and performance characteristics of the devices attached to the bus. The other determinant of bus speed is the length of cable required by your installation. For most applications the default (high speed) will be appropriate. Using tables 2-2 and 2-3, determine the bus speed.

Table 2-2. HP-IB Design Constraints

Constraint	High Speed Bus	Slow/Medium Speed Bus
Maximum Number of Loads (see peripheral specification)	15, count HP-IB device adapter as 1 + # resistor pack equivalent loads.	15, count HP-IB device adapter as 1 + # resistor pack equivalent loads.
Maximum number of devices (see peripheral specification)	15, count HP-IB device adapter as 1 + # resistor pack equivalent loads. Mixed slow/medium and high speed devices allowed.*	15, count HP-IB device adapter as 1 + # resistor pack equivalent loads. Slow/medium speed devices only. High speed devices not allowed.
Cable Length	1 m per load to a maximum of 15 m	2 m per load to a maximum of 20 m

*To operate on a high speed bus, signal lines on a slow/medium speed device must not exceed 50 pF (@ < 2 V dc) per line (except IFC and REN) and must use 48 mA, tristate drivers.

Table 2-3 shows the maximum cable lengths possible with the seven equivalent load resistor pack included on the HP-IB PCA. If your installation requires more than 15 meters of cable, you cannot use a high speed bus.

Table 2-3. Maximum Cable Lengths Using a Seven Load Resistor

Number Devices Attached	With resistor pack 1810-0081	Maximum Cable Length (meters)	
		High Speed	Slow/Medium
1	...HP-IB device adapter	9	18
2	plus seven equivalent loads...	10	20
3		11	20
4		12	20
5	(see table 2-3 for equivalent	13	20
6	loads of other resistor packs	14	20
7	available)	15	20

High Speed Bus

If your bus will be slow/medium speed, you need not read this section. If you will be using a high speed bus, you will not have to read the section titled "Slow/Medium Speed".

For high speed operation, there are two mechanical limits placed on your bus design:

- There must be at least one device (or equivalent load) for each meter of cable on the bus.
- The limit on the length of the cables connecting the devices is 1 meter per load up to 15 meters.

To calculate this, to the HP-IB device adapter, add the number of devices and the equivalent load value of the resistor pack you are using. This total is the number of meters of cable allowed for the bus (do not exceed 15):

$$1_{(\text{HP-IB})} + \#ext\ dev + \#equiv\ loads_{(\text{resistorpack})} = max\ cable$$

Caution For high speed, turn on all devices attached to the bus.

Slow/Medium Speed

If your bus will be high speed, you need not read this section. If you will be using a slow/medium speed bus, you will not have to read the section titled "High Speed".

A slow/medium speed HP-IB allows up to fifteen (15) devices. Maximum cable length is two meters per device up to 20 meters.

To calculate this, to the HP-IB device adapter, add the number of devices and the equivalent load value of the resistor pack you are using. Double this total for the number of meters of cable allowed for the bus (do not exceed 20):

$$2 * [1_{(\text{HP-IB})} + \#ext\ dev + \#equiv\ loads_{(\text{resistorpack})}] = max\ cable$$

Caution

Be sure to turn on at least four of every five devices attached to the bus. A device turned off when attached puts heavy loads on the bus which can slow the bus and cause data corruption.

Configuring the Operating System

You will need to "regenerate" the kernel to use the HP-IB device adapter. This process goes beyond the scope of this manual. You will find an example S800 file in appendix A. See the *HP-UX System Administrator's Manuals* for details.

Installing the HP-IB PCA

This PCA, marked with an open circle, has standard level HP-PB current and cooling requirements. See figure 2-2. Each computer system will identify the slot or slots where the HP-IB device adapter can go. You will find this information in the system administrator's manual(s) for your computer. The default slot is 5.

Before selecting a slot, you should check in your current system configuration documentation. Choose a slot that complements the system configuration in use, then record the number for this PCA in your system logbook.

Caution

Before attaching any device (including the HP-IB device adapter) to the bus, be sure to power the computer system down, according to the instructions in your systems manual.

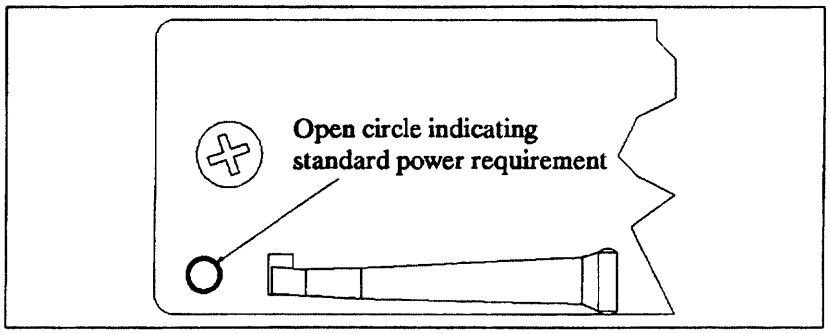


Figure 2-2. HP-IB Showing Its HP-PB Standard Power Marking

Selecting a Single-High Slot

The HP-IB interface is a single-high PCA. Installing this PCA requires a slot divider in the card cage. (The HP-IB product does not include a divider.) No matter which slot you use (the default is 5), the computer card cage probably has an appropriate slot available without your having to divide a double-high slot. If so, skip the section, "Installing Slot Dividers".

Warning

Before attempting to install a slot divider, ensure that the computer power supply is OFF. Failure to turn the power off produces an electrical shock hazard. If the operating system is running, be sure to follow the system "shut down" procedure prior to turning off the computer power. Failure to do so may result in data loss or corruption.

Installing Slot Dividers

Use a slot divider (p/n 5062-3336) to make two single-high slots of a double-high slot in the backplane. Usually, the computer will have a slot divider installed in each slot when you receive it. If yours does not, order the quantity you need through your HP Sales and Support Office. (One slot divider will make two single-high slots from one double-high slot.) You will also need a filler card (p/n 5041-3720) and a slot cover (p/n 5062-3337) unless you are installing another single-high PCA.

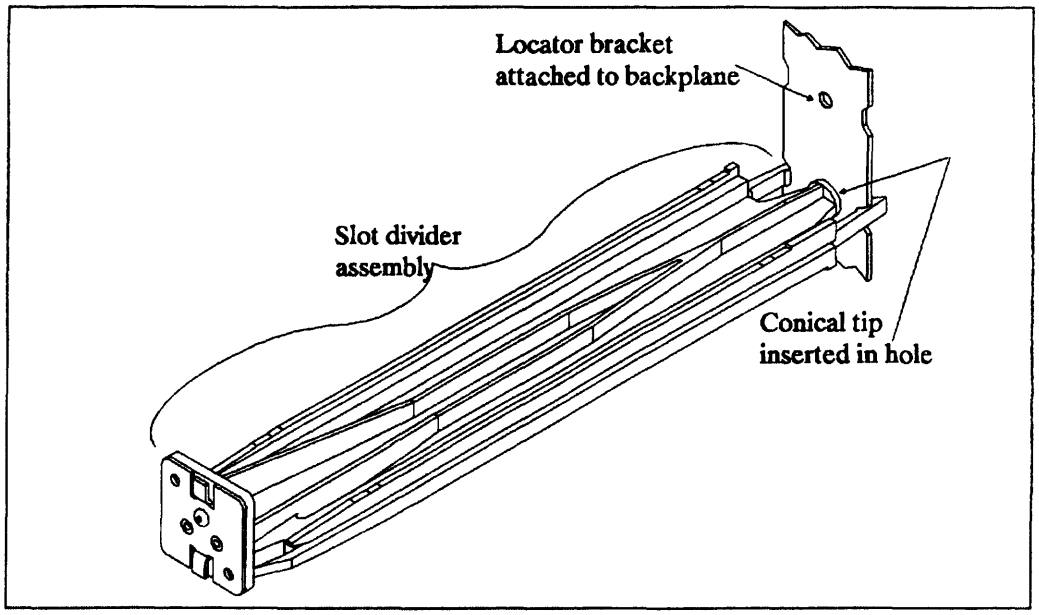


Figure 2-3. Slot Divider 5062-3336

To install a slot divider:

- Use a screwdriver to open the double-high card cage slot. Remove both screws and the cover. You will not use them in this installation.
- Orient the slot divider with the face plate toward you as in figure 2-3.
- Slide a filler card (p/n 5041-3720) into the left or right track of the divider, as needed, with the large hole in the plate to the front.
- Insert the divider/card combination into the center of the double-high slot you have chosen. Slide one edge of the filler card along in the card guides of the card cage frame. Align the conical tip in the hole at the rear of the slot (on the backplane locator bracket) and press firmly. The grip clamps will hold the sides of the locator bracket as shown in the illustration.
- Unless you are installing another single-high PCA, leave the filler card in place and install a single-high slot cover (p/n 5062-3334) in front of it, over the slot just formed. This will assure proper cooling air flow.

Inserting the HP-IB PCA into the Computer Card Cage

The information in your system manual and figure 2-4 in this manual illustrate inserting the PCA in the computer card cage. Detail A in the figure shows PCA insertion. The slot divider and card cage slot wall both have PCA tracks and threaded retaining screw holes to permit you to physically attach the PCA to the card cage.

Caution

Shut down the operating system of the computer. Turn the computer off. (See your system manual for details.)

With the PCA parallel to the slots in the card cage, hold the bulkhead and place the other end of the PCA in the track-like guide of the slot you have chosen for the interface. Close the extractor levers, as in the illustration, to avoid their interfering with installation. Slide the PCA into the card cage until it reaches the backplane connector. At this point, you will feel firm resistance. Push firmly, but gently, until the backplane receptacle on the PCA fits onto the connector in the computer.

The retaining screw holes in the computer card cage or slot divider have recessed threads to allow the screws to enter without having to engage them. This permits you to insert the PCA completely before tightening the screws.

Caution

If you seem to be using excessive pressure to seat the PCA, stop. There may be something blocking the path, or the PCA may not be in the track correctly. Pull it back out, check that the connector pins are straight, and try again. If the track or the connector is blocked or damaged, use care to correct the situation and reinstall the PCA.

Once the PCA is fully seated in the backplane, push the screws into the threaded holes and twist them to start. Then use a screwdriver to tighten them until the standoff spring is completely compressed. Be careful not over torque them, however.

Turn on the computer.

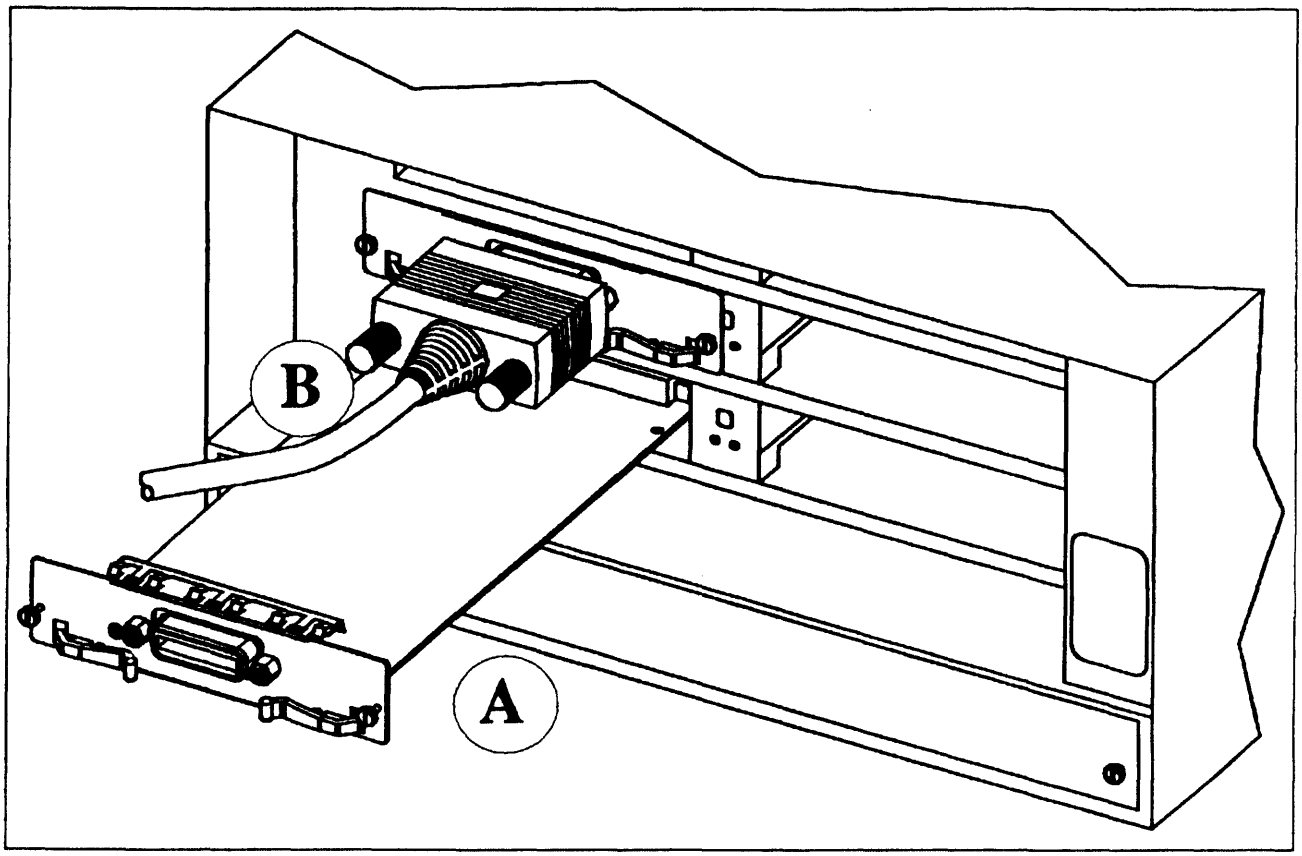


Figure 2-4. Installing the HP-IB PCA and Cable

Installing the HP-IB Cable

Figure 2-4, detail B, shows the PCA after you attach the cable. Once the PCA is secured in the card cage, put the cable connector onto the frontplane connector, and tighten the screws.

1. If the cable attaches directly to the peripheral device, press the male side of the connector into the device connector and tighten the screws.

2. If the installation requires an extension cable, use a backing plate (part number 30070-00043) to ensure a secure connection between the cables. (Where one is available, use a longer cable instead.)

    a. Attach the backing plate to the male side of either connector first, then press the male side of the second connector into the female side of the first and secure with attachment screws.

    b. Now attach the other end of the extension cable to the device, as explained in 1 above.

Configuring the HP-IB Device Adapter

Configuring the HP-IB requires only setting the speed and the bus address used for the device adapter. You need read only the section that applies to your bus speed.

To use the programs in this section, you may have to load them onto the system from the support tape for HP-UX version 7.0. See appendix A for the program installation instructions.

Once you have installed the configuration programs, you can determine the current speed, bus address and system controller status by using the following program:

```
/usr/contrib/hpibstat <specialfilename>
```

Appendix A explains how to identify the correct *<specialfilename>* for your HP-IB device adapter. The command returns

```
SPEED: HIGH (or slow/medium)
ADDRESS: 30 (or current address)
SYSTEM CONTROLLER: YES (or no).
```

Configuring for High Speed

The default setting in the software driver for this device adapter is high speed. If your installation can use high speed (based on devices, resistor pack and cable length), do not change the default configuration.

There are two ways to reconfigure the HP Interface Bus to high speed if you have already changed the configuration. Which of the two you choose will depend on the situation:

Method 1

You can use the following command:

```
/usr/contrib/hpibspeed <specialfilename>
```

or

```
/usr/contrib/hpibspeed -h   <specialfilename>
```

The speed option -h selects high speed. The default (no speed selected) is high speed. In this example <specialfilename> is a "raw mode" special file from the `/dev/hpib` directory. Appendix A explains how to identify the correct *<specialfilename>*. This method works best when you cannot stop the system to reboot.

Method 2

Reboot your system. Be sure the slow/medium speed command to reconfigure your HP-IB device adapter is not in the boot script. After restarting, the HP-IB device adapter will operate at the default (high) speed.

Configuring for Slow/Medium Speed

If your HP-IB cannot accommodate the high speed requirements, it will have to operate as a slow/medium speed bus. This means, however, that you cannot connect any high speed devices to the bus. To change the speed of the HP-IB device adapter, you must use the following command:

```
/usr/contrib/hpibspeed -s  <specialfilename>
```

The speed option -s selects slow/medium speed. The default (no speed selected) is high speed. Appendix A explains how to identify the correct *<specialfilename>*.

Note

Include the command above in the boot script so the device adapter will operate at slow/medium speed whenever the computer is working.

Configuring the HP-IB System Controller and Address

Like the bus speed, software programs control the bus address and system controller/system slave status. The defaults for these settings are system controller and 30_{DEC}.

Caution

Be sure to configure only one HP-IB system controller on any one bus. Having more than one will cause data loss or corruption. Never use two HP-IB device adapters, if they both have an equivalent load resistor pack. If you do, you risk misloading the bus and data will not transfer between devices correctly.

If you attach a boot path device to this PCA, the HP-IB device adapter must retain both its default address (30_{DEC}) and system controller status. Many other HP-IB devices also expect to find the host at address 30.

To choose this HP-IB device adapter as the system controller, type:

```
/usr/contrib/hpibctlr <specialfilename>
```

or its variant, specifying the system controller address,

```
/usr/contrib/hpibctlr -a30 <specialfilename>
```

To change the system controller status or bus address for the HP-IB device adapter, the command looks like this:

```
/usr/contrib/hpibctlr -axy <specialfilename>
```

The option -axy is the character "a" and the new address (in decimal notation) that the HP-IB device adapter will have. Legal addresses are 00 through 30. The default is 30 which also selects the HP-IB device adapter as the system controller.

Appendix A tells how to identify the *<specialfilename>* associated with your HP-IB device adapter.

Verifying HP-IB Operation

This section deals with verification of the link, from the HP Computer to the peripheral devices connected to this bus. We assume that our Customer Engineer has installed the computer and the device adapter, and that the computer itself was working properly when the PCA was installed.

Self-test

The test for this device adapter is written in ROM on the device adapter. For the boot path disc controller, the host uploads this hardware test and runs it automatically at power up. It takes less than two seconds to complete. If the self-test runs successfully, the "Selftest Fail LED" will light for less than a second and then go out. If it remains lit, the PCA has failed the test.

Note

Some Hewlett-Packard computer systems do not automatically report the results of the hardware test, either to the console screen or using the LED on the PCA. For these, and all systems where the HP-IB device adapter is not the bootpath disk controller, you must explicitly call the boot handler that runs the test to read the results.

Manual Self-test

For the HP 9000 Model 815, as an example, to run the self-test manually the command required is:

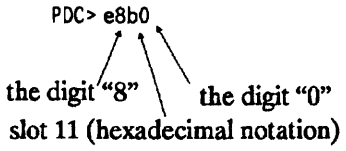
```
PDC> e8slot0 RETURN
```

Where

slot — is the physical slot number (0–F) where the HP-IB device adapter is installed.

0 — is the digit "0" (zero), an internal PCA address.

Note there is no space between the values. The result might look like



Your system manuals explain the commands for other HP-PA computers.

Device Adapter Diagnostic

The individual on-line device diagnostic provided as part of the diagnostic package can also test the device adapter and report the results to the system monitor. (See the On-Line Diagnostic Subsystem Manual.) For initial verification, run only the second, third and fifth sections of the test.

To run these sections, type `usr/diag/bin/sysdiag` RETURN (lower case) at a system prompt. The prompt will change to "DUI n>" or "DUI>". Type:

```
RUN HPIBDAD dev=/dev/diag/hpib1/hp28650A/# sec=2,3,5   RETURN
```

where # is the diagnostic special file name for the device adapter under test. If you used insf to install the special file (or if you used the standard filename with the HP-UX mknod() command), # is the logical unit (LU) number assigned to the diagnostic driver (diaghpib) for the device adapter.

Note

Appendix A explains how to identify the correct logical unit number or <*specialfilename*> associated with your HP-IB device adapter.

If the device adapter is working, you will see a series of messages which tell you either that it passed that section, or that the section is complete. If it fails any of the tests, the message will tell you which test, and will identify the component that caused the failure. However, since the only authorized repair is to replace the PCA, you must do so now.

3 Functional Description

The Precision Bus HP-IB device adapter uses two proprietary CMOS III chips to provide fast, reliable I/O communications with a wide variety of HP-IB peripheral devices. They are the Frontplane, or HP-IB, Controller Chip and the Backplane, or Precision Bus, Controller Chip. They are linked by an 8-bit peripheral data bus and an I/O control bus that coordinate their activities. This chapter gives an overview of the functions of these chips and their supporting circuitry.

General Design

The HP-IB design has two functional blocks, the frontplane and backplane, that perform the tasks of decoding, transmitting and re-encoding signals from the peripheral device to the host computer backplane and back again.

Figure 3-1 is a simplified block diagram of the HP-IB.

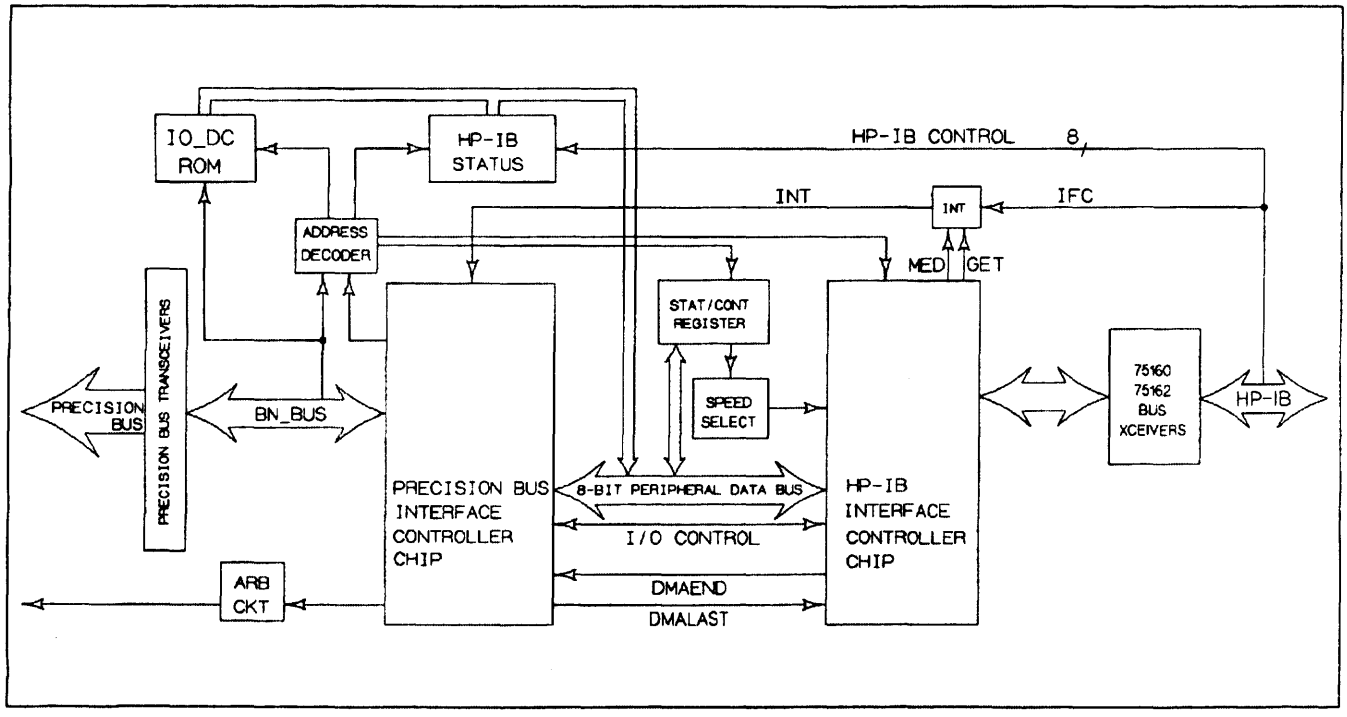


Figure 3-1. HP-IB Simplified Block Diagram

While they actually work in tandem, it is helpful to think of each block as working independently to process the data before handing it off to the

host, the next layer, or the peripheral device. These blocks also provide a convenient way of discussing the operation of the interface.

Because the hardware has only one adjustment (as the speed is changed, you must use a different resistor pack), control of the interface is a software exercise. Use of the software is beyond the scope of this manual. See the computer system manager's manuals for this kind of instruction.

Backplane Circuitry

Each slot in the backplane is independent of all others and the cards in them must arbitrate for use of the backplane bus. Once the HP-IB card has accessed the bus and completed the current transaction, it will wait until an idle state on the bus to try again. (In HP-PB, this scheme is called "fair arbitration.") Arbitration is a function of the backplane controller chip.

The backplane circuitry takes data from the host computer, processes it for the frontplane circuitry and passes it on. In the case of incoming data, it accepts the frontplane input and processes it for the host. There may be more data than the destination can accept. If so, a 24-byte FIFO buffer temporarily stores the data until there is space available for it.

There are two kinds of backplane operations the HP-IB interface transacts: Direct Memory Access (DMA) and Direct I/O. For these operations, the Backplane Controller chip also has address, counter and link registers for chaining DMA. As a slave, it passes those accesses not addressed to one of its local registers through to the destination required. Any access that is going to one of its registers is stopped and the chip does the transaction.

Error Conditions and Interrupts

The HP-IB specification permits both master and slave operation of the interface. If the HP-IB interface is bus master on the host computer Precision Bus, and the designated HP-IB slave device fails to acknowledge a call, the backplane controller chip sends an ERROR_L to the host.

When another interface is set up to transmit data over the backplane to this HP-IB interface, it acts as a slave on that bus. In this mode, it checks for errors only in the HP-PB Slave Address and Data cycles while ignoring all parity errors. In case of an error, the interface asserts ERROR_L: First, logic low for 3 clock cycles; then high for one.

Any interrupt to the host requires that DMA be enabled. The backplane controller chip can send any of 32 different levels of interrupt to the host. The interrupt message is in Register1 (IO_EIM). Either direct or broadcast interrupts are allowed.

Backplane/Frontplane Interaction

There are two types of controller-to-host interactions: Direct I/O and DMA transfers. These transactions take place on the on-card peripheral bus between the backplane and HP-IB controller chips. Since the bus is eight bits wide, byte transactions are mandatory.

Direct I/O Transactions

Any time the host (or another Precision Bus master) accesses the HP-IB device adapter, it acts as a slave. All direct I/O transactions are treated as READ4 or WRITE4 operations, regardless of the original command form. The backplane controller chip recognizes BROAD4 word broadcasts without acknowledgment.

Note

The HP-IB Controller Chip has eight registers, each 8-bits wide. When the Backplane Controller reads from or writes to the second (register 2), your software should check the status of the frontplane controller FIFO buffer. If full, writing to register 2 may cause loss; reading may return invalid data.

While the HP-IB controller has both 8 and 10-bit capability, in direct I/O, only 8-bit reads and writes are valid. (The two remaining bits are stored in register 3. Since they are overwritten with each new transaction, fetching them as soon as they are written is imperative.)

Direct Memory Access Transactions

Once the interface has initiated DMA I/O, the backplane controller chip becomes bus master and fetches and follows data chains. The HP-IB controller chip and its circuitry may then start transferring data.

For an inbound transfer, the backplane controller reads the data from the HP-IB controller and stores the data in its own FIFO buffer. (This activity is sometimes called a "READ DMA" operation.) As soon as there are 16 bytes stored in the buffer, the Backplane Controller executes a WRITE16 and sends the data to the host memory.

For an outbound data transfer, the backplane controller does a READ16 operation on the Precision Bus by fetching 16 bytes of data when its FIFO has room, then writes to the HP-IB Controller chip registers ("WRITE DMA.")

There are three ways a DMA transaction can terminate:

1. The DMA count can reach 0. That is, the host runs out of buffer space, or there is no more outbound data.

2. The HP-IB peripheral device hangs up. The host software will then time out and reset the HP-IB circuit. (The actual byte count is stored in the Backplane Controller chip registers.)

3. The data from a peripheral device ends with EOI.

The Frontplane Circuitry

The HP-IB controller chip handles operation of the frontplane. It provides controller, talker and listener functions, and 8-bit FIFO buffers in both inbound and outbound directions.

There is an HP-IB Status Register which is part of the frontplane circuitry, that allows a snapshot of the bus itself.

The data bus is ten bits wide, but for DMA (when the device adapter must control the host bus) only the lowest 8 bits are accessible unless the application software uses special precautions to retrieve bits 8 and 9. These two bits are stored in register 3, but are overwritten with each new data entry. The DMA operation must pause while reading them.

Register 2 is the data transfer register. Each read to register 2 ends by checking data register 1. DMA activity ends when there is a "1" in any of the bits in the register. The contents of register 1 are inverted and fed to the DMA ENDING circuit.

Handshake Speed Control Circuit

This circuit controls the speed of the HP-IB by selecting one of two resistors. It does so by setting the speed control bit in the Control Register. The default is high speed.

Control/Handshake Signals

HP-IB has eight signals to control the bus. These are all tied to the bus through the HP-IB transceivers on the card. Each signal on this interface is both bi-directional and tri-state.

When the HP-IB controller is bus master, it drives HP-IB signal ATN low and listens to the SRQ line.

Command Structure for HP-IB

The HP-IB interface deals with two sets of commands: HP-IB commands and Command Set 80 (CS80), which drives intelligent disc and tape drive devices.

Figure 3-2 illustrates the merging of these command sets.

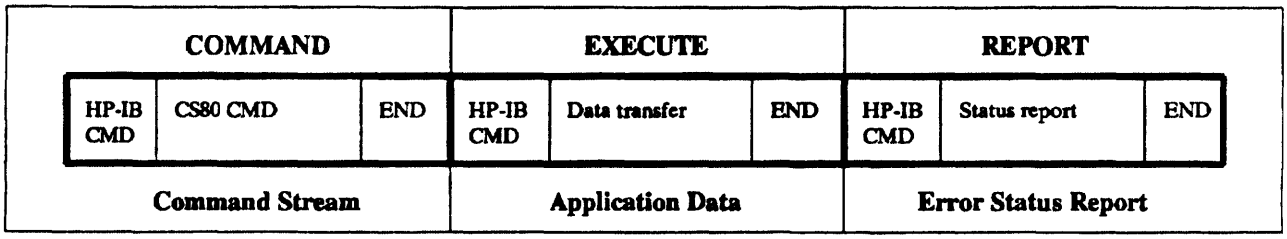


Figure 3-2. HP-IB/CS80 Command Requests Merged

In figure 3-2, the sequence "END" consists of the HP-IB instructions UNTALK and UNLISTEN which terminate HP-IB transactions.

CS80 Transactions

HP-IB commands are available in many sources and we will therefore not discuss them here. Even though the CS80 commands are also widely available, they have unique application modes with this interface.

The CS80 protocol is a message based, COMMAND - EXECUTE - REPORT facility, to drive intelligent disk and tape units. It works with HP-IB, but many other transport systems could use it, as well. There are three classes of CS80 commands:

- Real Time (optimized for execution time)
- General Purpose (provides support functions)
- Diagnostic (locates and identifies problems)

Of these, only the real time commands LOCATE AND READ and LOCATE AND WRITE significantly affect the speed of data transfer. A number of support commands, called complementary commands, provide addressing and strategy information for the real time commands.

CS80 Command Phase

The HP-IB controller sends the CS80 commands to the selected device as HP-IB data. The device controller gets a preparatory command, a secondary HP-IB command: CS80 COMMAND PHASE, marked † in table 3-1. CS80 complementary commands then follow (marked § in the table), and last, the CS80 command LOCATE READ or LOCATE WRITE.

Table 3-1. Typical CS80 Read Write Commands

HP-UX Command Sequence	MPE XL Command Sequence
HP-IB: CS80 COMMAND †	HP-IB: CS80 Command†
Set Unit §	Set Unit §
Set Address §	Set Addr §
Set Length §	NOP §
LOCATE READ/WRITE	NOP §
	NOP §
	Set Length §
	LOCATE READ/WRITE

The CS80 complementary commands listed above have the following meanings:

Command	Description
Set Unit	Identifies one of several units which a single HP-IB bus master controls. The command includes the unit address.
Set Address	Describes the starting sector address from the beginning of the device. The next six bytes describe the address.
Set Length	Defines the length of the data to be transferred on the next data operation. The following four bytes define the length.
NOP	Non-operational byte in the command string.
Locate and Read Locate and Write	Notifies the device to search for the selected record and to transfer the data to the system in the EXECute phase. The controller knows the transfer direction and performs anticipatory buffering.

CS80 Execute Phase

The CS80 Execute Command is a single HP-IB secondary command. Once the device controller has received the information needed to accomplish the command, it begins execution phase. For READ/WRITE commands, this is the data transfer phase: Outbound for LOCATE AND READ, inbound for LOCATE AND WRITE.

CS80 Report Phase

When the data have been received, the device transmits a report command. The sending device requests the controller to verify correct reception by returning QSTAT (a single HP-IB status byte) if the data were correct. (Otherwise, a non-zero return identifies the type of error.)

Listen/Talk Commands

The HP-IB command sequence identifies the devices on the bus which will talk and which will listen. In addition, for CS80, it identifies the current phase. The HP-IB command sequences for CS80 operation include the HP-IB secondary commands COMMAND, EXEC and STATUS as well as:

LISTEN 31 and LISTEN n	One device is instructed to receive data: If LISTEN 31, the HP-IB interface (the Controller-in-charge) is selected, if LISTEN n, it is the selected device on a write operation.
TALK 31 and TALK n	This command instructs the Controller-in-charge (if TALK 31) or the selected device to write out data following the command sequence.
UNLISTEN and UNTALK	A global request to all devices on the HP-IB not to listen or talk to the following HP-IB command or data unless addressed specifically to that device. Any TALK or LISTEN command automatically has the same effect as if proceeded by UNTALK or UNLISTEN.

A HP-IB Configuration Files

To modify the default configuration of the HP-IB device adapter, you will first need to know the <*specialfilename*> used to identify the HP-IB device adapter. You will then need to know how to load the HP-IB configuration programs from the support tape. Both of these items are in this appendix.

Identifying The HP-IB Device Adapter

To use the HP-IB requires generating the kernel for the HP-UX operating system. The kernel tells the computer the locations of all device adapters and any external devices attached to them. For the kernel to do this, you first make a file called */etc/conf/S800* . The *HP-UX System Administrator's Manual* explains how to write the file and "regen" the kernel.

Note

Each device adapter must have an entry using the *instr0* software driver. This entry is mandatory because it is the driver used to configure the device adapter. You will use the logical unit number associated with *instr0* to identify a specific HP-IB device adapter when modifying the speed or address.

Identifying the Device Adapter for Diagnostics

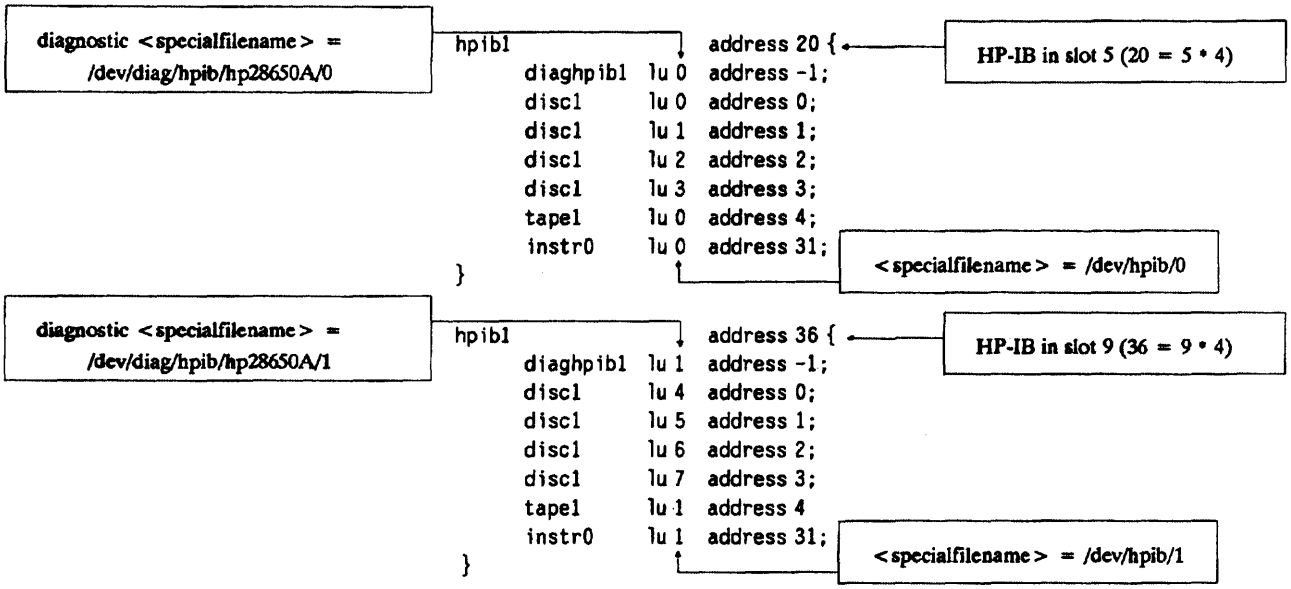
The device adpater diagnostic does not use the same <*specialfilename*> as the configuration programs. The way you determine this is explained in the sections "The /etc/conf/S800 file" and "The /etc/devices File" below.

Note

Each device adapter must have an entry using the *diaghpib1* software driver. This entry is mandatory because it is the driver used to test the device adapter. You will use the logical unit number associated with - *diaghpib1* to identify a specific HP-IB device adapter when testing the device adapter.

The /etc/conf/S800 File

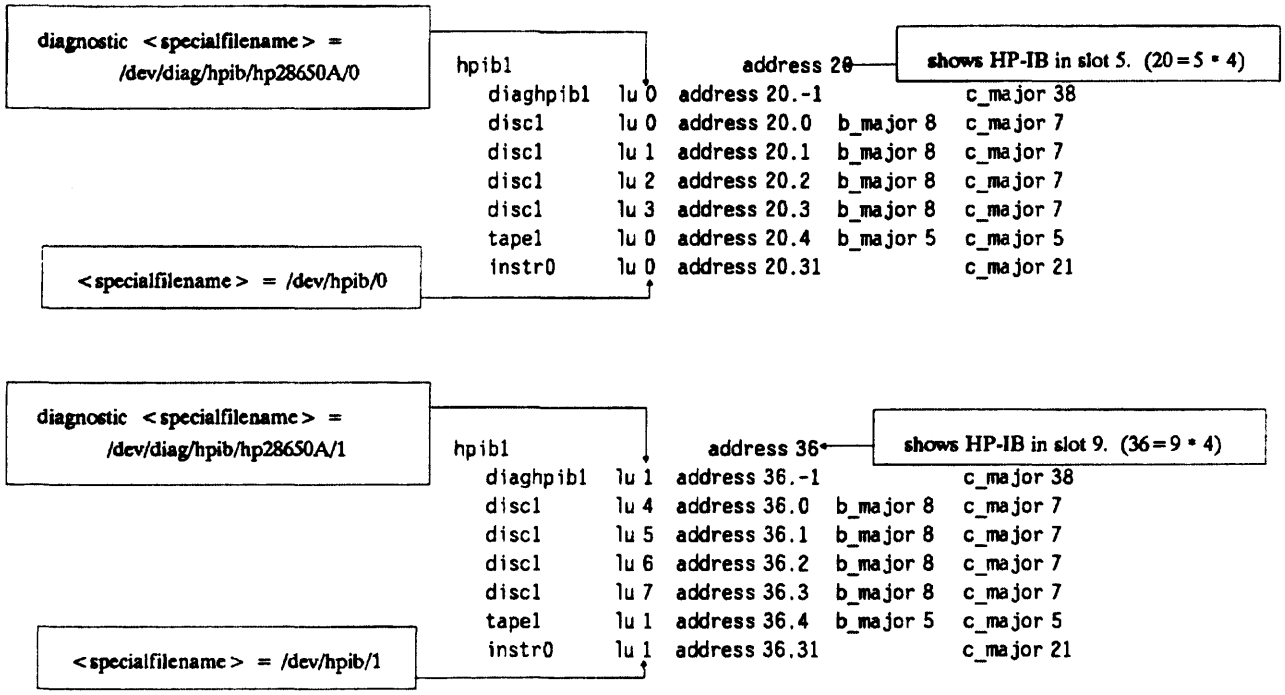
The */etc/conf/S800* file is where you identify the HP-IB device adapter. This is part of the file for a system with two HP-IB device adapters:



- The first line of each entry is the *hpib1* driver for the HP-IB device adapter. The address equals four times the physical slot number.
- The other lines identify the drivers for devices on the bus.
  - The first entry is the software driver name.
  - The second entry is the logical unit assigned to a specific device.
  - The last entry is the HP-IB address of that device

The /etc/devices File

When you regenerate a kernal for the host computer, it reads the */etc/conf/S800* file and creates the */etc/devices* file. For a system with two HP-IB device adapters, the file will look, in part, like this:



- The first entry in each line is the driver used to access the device in question. For instance, *hpib1* is associated with HP-IB device adapters, and *disc1* handles system disc storage devices.
- Most entries include a logical unit number (lu *n*). This identifies the physical device attached to the HP-IB at the address in the next entry.
- Only the HP-IB device adapter has no logical unit number. The address is four times the number of the HP-IB card cage slot.
- For other devices with an logical unit number, the address has two parts: The first is the address of the HP-IB device adapter. The second, following a dot, is the HP-IB address on the bus.
- The digits following the b_major and c_major entries are the block and character major numbers for each driver.

Installing HP-IB Configuration Files

The HP-IB configuration programs source code is part of the HP-UX 7.0 support tape. There are two possible media for the support tape. The first is a standard, open reel tape used with a large tape drive like the HP 7978B. The second is a cartridge used in the HP 9144A tape drive, for instance. Instructions for both media types make up this section. More information is available in the *Support Tape Users' Manual* (92453-90010).

Because installing the HP-IB configuration files requires the same steps as installing the IOFIX programs, you may decide to do the installations together to save time. Those steps marked "optional" and commands in parentheses are part of IOFIX installation.

Note

To install the HP-IB configuration or IOFIX programs from the support tape, you must first log in as "root" with superuser privileges.

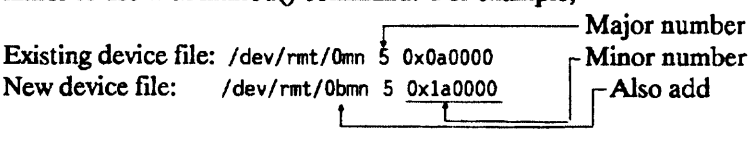
IOFIX is a verification and troubleshooting support tool. It automatically performs various I/O device adapter subsystem activities or tests you require. For further details, see the *IOFIX Information Guide for HP Customer Engineers* (5958-9046).

Configuration Files on the Open Reel Medium

There are eight steps to installing the HP-IB configuration programs onto your system. The programs are in a file called `hpibcnfg.tar.Z`, which is in the `usr/contrib/bin` directory of section 5 on the support tape. You can copy the file `hpibcnfg.tar.Z` on-line from the tape as with any other file. This is the process:

1. This procedure requires a Berkeley-style tape device file. If one does not already exist create it using the `mknod()` command. Set the no-rewind flag in the minor number.

   A Berkeley-style tape device file will have a name like `/dev/rmt/0bmn`. The "b" symbolizes a Berkeley-style device. You may use an existing device file to determine the correct major number and form of the minor to use with mknod() command. For example,



If there is no appropriate device file, use mknod() to create it:

```
mknod /dev/rmt/0bmn c 5 0x1a0000
```

Note

The "0" in "0bmn" is logical unit number of the tape drive. The actual logical unit number may be different than the one in this example. The minor number (0x1a0000) should show the logical unit number of the tape drive you are using. For example, LU1 would be 0x1a0100.

2. Load the support tape on the drive and place the drive on line.

3. Position the tape to the beginning of section 5 using the following mt command (the example assumes the same device file as above):

```
mt -t /dev/rmt/0bmn fsf 6
```

4. Use the cd command to go to the root directory

```
cd /
```

Note

This step involves the use of the tar command. The tar command will archive (copy) the HP-IB configuration program source code to the /usr/contrib/bin directory. The command creates any directories that do not exist.

Copy the configuration source code with the following command:

```
tar -xvf /dev/rmt/0mn ./usr/contrib/bin/hpibcnfg.tar.Z ./usr/contrib/bin/iofix.tar.Z
                                                       ↑
                                                   Optional
```

Note

This command uses the regular tape device file, not the Berkeley device file.

5. Change directories again, to /usr/contrib/bin.

```
cd /usr/contrib/bin
```

6. Uncompress the hpibcnfg.tar.Z file (and the iofix.tar.Z file)

```
uncompress hpibcnfg.tar.Z
```
optionally
```
(uncompress iofix.tar.Z)
```

7. Extract the files from the archive with the following command:

```
tar -xvf hpibcnfg.tar
```
optionally
```
(tar -xvf iofix.tar)
```

These files are:

hpib_compile	(compilation script)
hpibspeed.c	(speed configuration source code)
hpibctlr.c	(controller and address source code)
hpibstat.c	(read status source code)

If you installed the IOFIX programs, they are now ready to run.

8. To compile the source code, type

```
./hpib_compile
```

The HP-IB configuration programs are now ready to run. In the examples below, we have included the full pathnames to each file. If you include the `usr/contrib/bin` path in your environment, you will not need to specify the pathname.

```
/usr/contrib/bin/hpibspeed [-sh] <specialfilename>
/usr/contrib/bin/hpibctlr [-a][0-30] <specialfilename>
/usr/contrib/bin/hpibstat <specialfilename>
```

See "Configuring HP-IB" in chapter 2 for instructions on running the three HP-IB configuration programs.

If you installed the IOFIX programs, you may run them by typing:

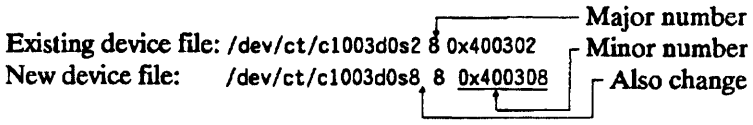
`./iofix.hp`	(if you have an HP terminal)
or	
`./iofix.ibm`	(if you have an IBM terminal)

More information is available in the *IOFIX Information Guide for HP Customer Engineers* (p/n 5958-9046).

Configuration Files on the Cartridge Tape Medium

There are eight steps to installing the HP-IB configuration programs onto your system. The programs are in a file called `hpibcnfg.tar.Z`, which is in the `usr/contrib/bin` directory of section 8 of the support tape. Section 8 is a mountable file system. You can copy the file `hpibcnfg.tar.Z` on-line from the tape to an HP-UX system by mounting the cartridge tape as if it were a disk. This is the process:

1. Insure there is a device file corresponding to section 8 of the cartridge tape drive. You may use and existing device file to determine the correct major number and form of the minor number to use with the mknod() command. The section number is the least significant digit of the minor number, as in the example below:



   If not, use the `mknod()` command, like this:

```
mknod /dev/ct/c1003d0s8 b 8 0x400308
```

Note

The "3" in "c1003d0s8" is the logical unit number of the cartridge tape drive. The actual logical unit number may be different from the one used in this example. In the minor number, the digit we show as "3" must match the logical unit number of the drive you are using.

2. Load the support tape into the cartridge tape drive. Be sure the drive is ready.

   Mount the cartridge tape file system on a directory you name (such as `/dirname`). The example assumes the device filename and directory used above:

```
mount /dev/ct/c1003d0s8 /dirname
```

3. Copy the file `/dirname/usr/contrib/bin/hpibcnfg.tar.Z` to the `/usr/contrib/bin` directory.

```
cp /dirname/usr/contrib/bin/hpibcnfg.tar.Z /usr/contrib/bin
```

   Optionaly:
   Copy the file `/dirname/usr/contrib/bin/iofix.tar.Z` to the `/usr/contrib/bin` directory

```
cp /dirname/usr/contrib/bin/iofix.tar.Z /usr/contrib/bin
```

4. Use the `cd` command to go to the `/usr/contrib/bin` directory.

   ```
   cd /usr/contrib/bin
   ```

5. Uncompress the `hpibcnfg.tar.Z` (and, optionally, `iofix.tar.Z`) file using the following command:

   ```
   uncompress hpibcnfg.tar.Z
   ```
   optionally
   ```
   (uncompress iofix.tar.Z )
   ```

6. Extract the files from the tar archive with the following command:

   ```
   tar -xvf hpibcnfg.tar
   ```
   optionally
   ```
   (tar -xvf hpibconfg.tar)
   ```

7. Unmount the cartridge tape file system:

   ```
   unmount /dev/ct/c1003d0s8
   ```

   The IOFIX files (if you installed them) are now ready for use.

8. Compile the HP-IB configuration files by typing:

   ```
   ./hpib_compile
   ```

   The configuration programs are now ready to run.

   ```
   /usr/contrib/bin/hpibspeed [-sh] <specialfilename>
   /usr/contrib/bin/hpibctlr [-a] [0-30] <specialfilename>
   /usr/contrib/bin/hpibstat <specialfilename>
   ```

See "Configuring HP-IB" in chapter 2 for instructions on running the three HP-IB configuration programs.

If you installed the IOFIX programs, you may run them by typing:

`./iofix.hp`	(if you have an HP terminal)
or	
`./iofix.ibm`	(if you have an IBM terminal)

More information is available in the *IOFIX Information Guide for HP Customer Engineers* (p/n 5958-9046).

B Repair Procedure

This section is for Hewlett-Packard employees or customers who have received specialized training in troubleshooting and hardware replacement.

An item you replace is a field replaceable unit (FRU). For the HP-IB product, the FRUs are:

- The HP-IB PCA (part number 28650-60001).
- The HP-IB cable (part number 8120-5147).

In addition, there are two parts on the PCA designed for removal: The equivalent load resistor pack and the firmware ROM (part number 28650-82001). You may remove the DIP resistor pack supplied or replace it with any of several available from Hewlett-Packard, as shown in table B-1.

Table B-1. Equivalent Load Resistor Pack Part Numbers

Part Number	Equivalent Loads
1810-0408 1810-0410	1 2
1810-0409 1810-0081	4 7

Code in the ROM chip may undergo updating. If so, a new chip will come with instructions for installation.

Caution Users who modify or repair other components on the PCA may invalidate their warranties. Hewlett-Packard may decline to repair any such devices and will not accept them in exchange for replacement assemblies.

We supply component identification and other detailed information in this manual solely for application development. Their inclusion does not imply HP support for user-level repair or modification.

Troubleshooting

This section explains troubleshooting the HP-IB device adapter and the cables connected to it. Unless noted otherwise in the text, we make the following assumptions:

- The computer and peripheral devices are installed properly and have worked in the past (unless this HP-IB interface is for the bootpath disk drive).
- You have some familiarity with the HP-IB protocol and the operating system your computer system uses.
- You have access to and can use the on-line troubleshooting system (part of the Fundamental Operating System supplied with your computer).

Before you return the PCA for replacement, identify the failed FRU. It will speed the process if you have identified it before you call the HP Sales and Support Office.

Testing Tools Required

There are no special tools required to test or troubleshoot the HP-IB.

Self Test

The host computer retrieves the hardware upload test coded in the EPROM on command through the host console. The on-line diagnostic runs a more extensive hardware test and reports the results to the screen. For more detail, see the *On-line Diagnostic Test Manual*.

Note

Running the on-line diagnostic requires specialized training from HP. The information in this manual will aid a trained person to run the HP-IB specific portion of the diagnostic. If you cannot do this test yourself, call the HP Sales and Support Office (listed in the back of the computer system manuals) for assistance.

The On-Line Device Diagnostic

For a quick reference and help in using the diagnostic, use section 1, "More Help". However, for initial verification, run only sections 2, 3, and 5. First, respond /usr/diag/bin/sysdiag (lower case only) to the system prompt. Then type either

```
RUN HPIBDAD dev=/dev/diag/hpib/hp28650A/# sec=2,3,5 RETURN
```

or

```
RUN HPIBDAD pdev=(slot*4) sec=2,3,5 RETURN
```

at the DUI n> prompt on the console, where

#	is the diagnostic special file name for the device adapter under test, or (if you used *insf* to install the special file or if you used the standard filename) # is the logical unit (LU) number assigned to the diagnostic driver (diaghpib1) for the device adapter under test. See appendix A.
slot*4	is the physical device identifier. This integer equals four times the physical slot number. For the default slot (5), use pdev=20.

Press RETURN as prompted on the screen.

Section two resets the device adapter to clear all registers, section three returns the identity of the device adapter and the software driver. Section five runs an extended hardware test. When these test sections run, they return the results to the screen. If any FAIL message appears, replace the HP-IB PCA.

Troubleshooting Procedure

If the device adapter is the bootpath controller, check the Selftest Fail LED when the computer is turned on. Should the test fail, the only recourse is to replace the PCA. Figure B-1 on the next page illustrates the troubleshooting procedure outlined below.

Host Computer

If your HP-IB is not working, you should check the host computer system to be sure it is operating correctly. If not, see your systems operating manuals for its troubleshooting procedures.

Cables and Addresses

Each peripheral device attached to the HP-IB must operate correctly and the cables between them must be connected properly. If either of these is a problem, including the maximum length of cable per bus, be sure to correct the situation. Turn the peripherals on. For a loose cable connector not attached to a device (an extension cable), use a backing plate (part number 30070-00043) at the connector junction or use a longer cable. If the cables show signs of excessive wear, replace them. Check for dirty connectors and broken wiring.

Each device on the bus (including the HP-IB device adapter) has a unique address. The device adapter address is set by software (30_{DEC} unless you have changed it). If two devices have the same address, the bus cannot function. Change any conflicting address, and reset the system.

On-Line Diagnostic System

If the HP-IB still fails, running the On-Line Diagnostic System is the next action. To run the program is beyond the scope of this manual: See the *On-Line SPU and Device I/O Diagnostics* manual for details. If any of the report screens shows a failure, replace the HP-IB PCA.

Check Other Hardware

Run the selftest or other diagnostic for each device on the bus. If an HP device failed, check for warranty or service agreements and repair or replace it. If another vendor supplied the peripheral, contact the supplier.

Bus Still Fails

If the bus is still down, you may have installed one of the replacement items incorrectly. Start the troubleshooting procedure again.

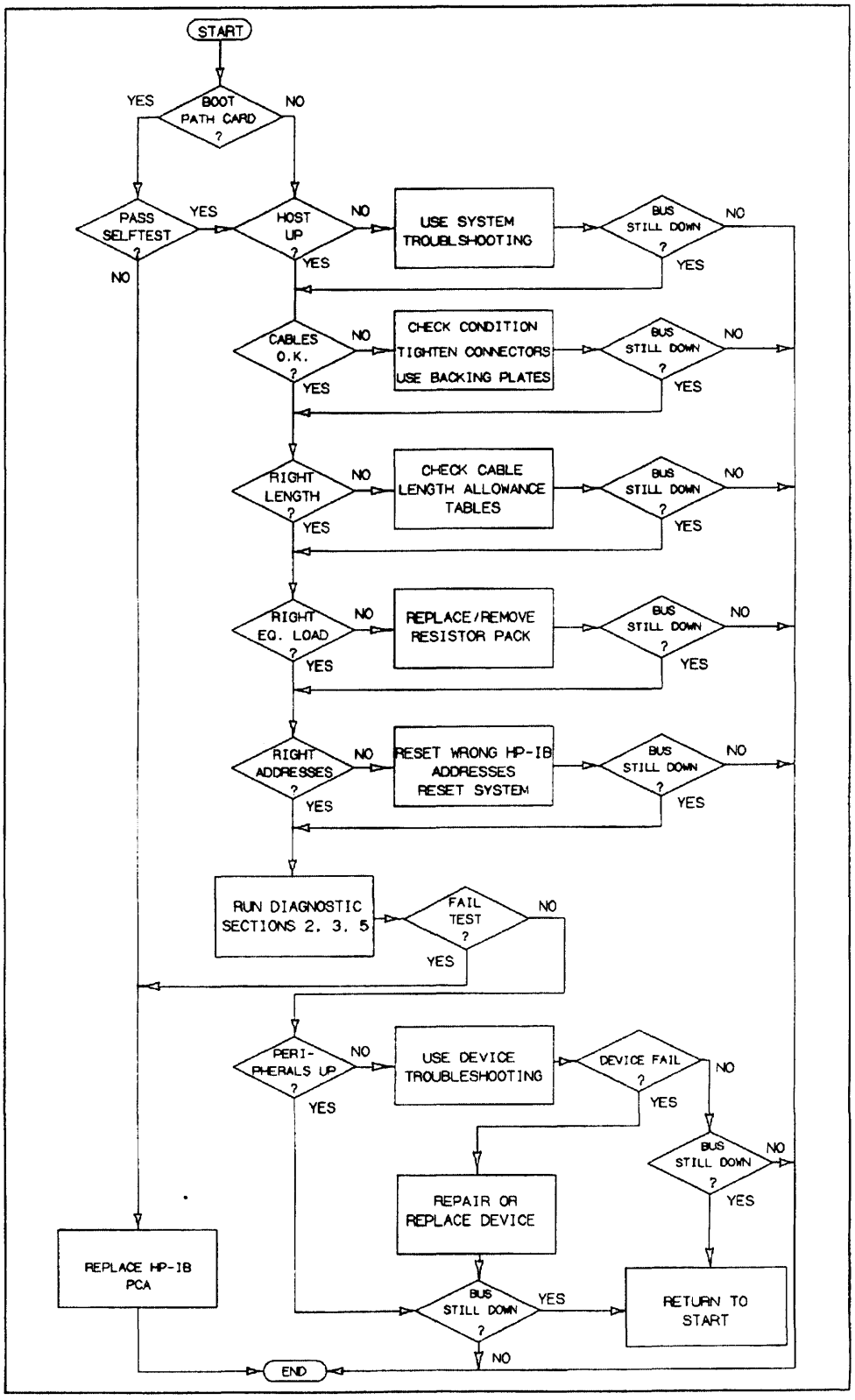


Figure B-1. Troubleshooting Tree for Precision Bus HP-IB

Removing the PCA

If the device adapter fails these tests, you should remove it from the host computer in preparation for reshipment to Hewlett-Packard. Be sure to contact the Sales and Support Office before shipping the PCA.

To remove the PCA:

1. Remove the cable by loosening the retaining screws on the cable coupling and pulling it off the connector. If there are several cables attached directly to the PCA, remove them all.

2. Use a screwdriver to completely loosen the two retaining screws on the bulkhead.

3. Grasp each extractor lever handle on the end nearer the center of the bulkhead and pivot them toward you and outward.

4. Holding either the bulkhead or the extractor levers, pull the PCA from the slot. Do not touch any of the components or the traces on the PCA itself.

Please take care not to damage the PCA. Observe the same anti-ESD procedures we described in chapter 2.

Figure B-2 shows the process of removing the HP-IB PCA.

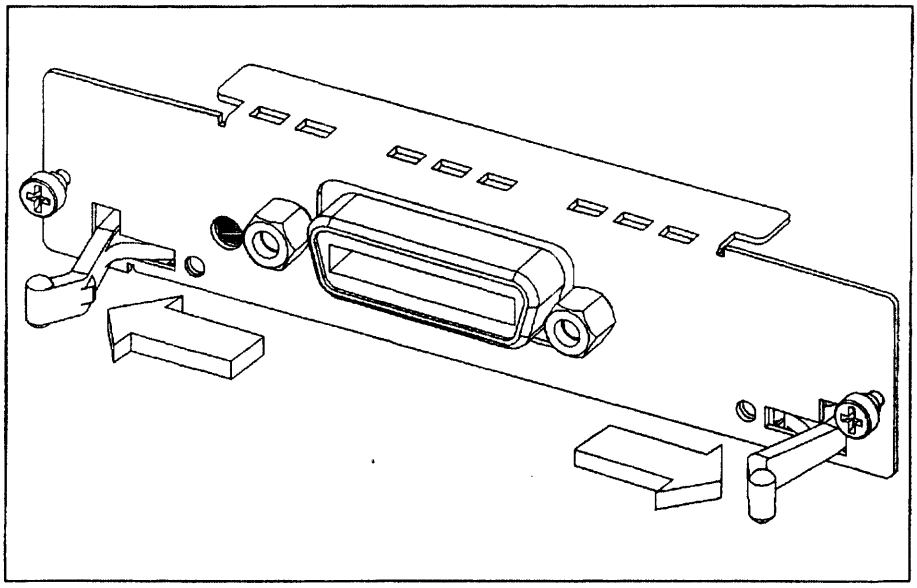


Figure B-2. Removing the HP-IB PCA

C Specifications

The HP-IB printed circuit assembly is only one of several components of the HP-IB device adapter. This appendix lists each component and its Hewlett-Packard part number.

Replaceable Parts

A complete HP-IB device adapter has the following parts:

- HP-IB printed circuit assembly (part number 28650-60001).
- An equivalent load resistor pack (part number 1810-0081). (See table 2-1 for other resistor pack part numbers, if needed.)
- HP-IB cable (part number 8120-5147).
- This installation and verification manual (part number 28650-90001).
- Firmware ROM (part number 28650-81003) containing the host-run hardware verification test. This component may change part number if HP makes improvements to the code it contains. If you need such a change, HP will notify you of the procedure to install the new chip.

Caution

Users who replace any components (except the firmware ROM and equivalent load resistor pack) or modify the HP-IB PCA may invalidate their warranties. Hewlett-Packard Company will not accept such device adapters for replacement or repair.

Environmental limits

There are environmental limits beyond which HP cannot assure reliable operation of the HP-IB. However, the computer operating limits are more restrictive than those for the HP-IB.

Table C-1. Operating Requirements

Operating Temperatures	0 ~ 70°C
Operating Humidity	5 ~95% relative humidity (non-condensing), at 40°C.
Electrical Requirements	< 2 A at 5 V dc no 12 V dc requirement

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