HEWLETT PACKARD

Installation/Service/Terminal
Interface Guide

Intel80386EX
Emulator/Analyzer (HP 64789C)

Notice

Printing History

New editions are complete revisions of the manual. Many product updates and fixes do not require manual changes, and manual corrections may be done without accompanying product changes. Therefore, do not expect a one-to-one correspondence between product updates and manual revisions.

Edition 1   64789-97003, September 1996

Edition 2   64789-97005, October 1996

Safety and Certification and Warranty

Safety information, and certification and warranty information can be found at the end of this manual on the pages before the back cover.

HP 64748C
Emulation Control Card

Egress Panel
(Part of HP 64748C)

Three Unique Cables
(Part of HP 64748C)

HP 64789C Probe
SRAM Optional

144-pin TQFP
probe adapter
(order separately)

132-pin QFP
probe adapter
(order separately)

External
Power Cable
(Part of
HP 64789C)

Demo Board
(Part of HP 64789C)
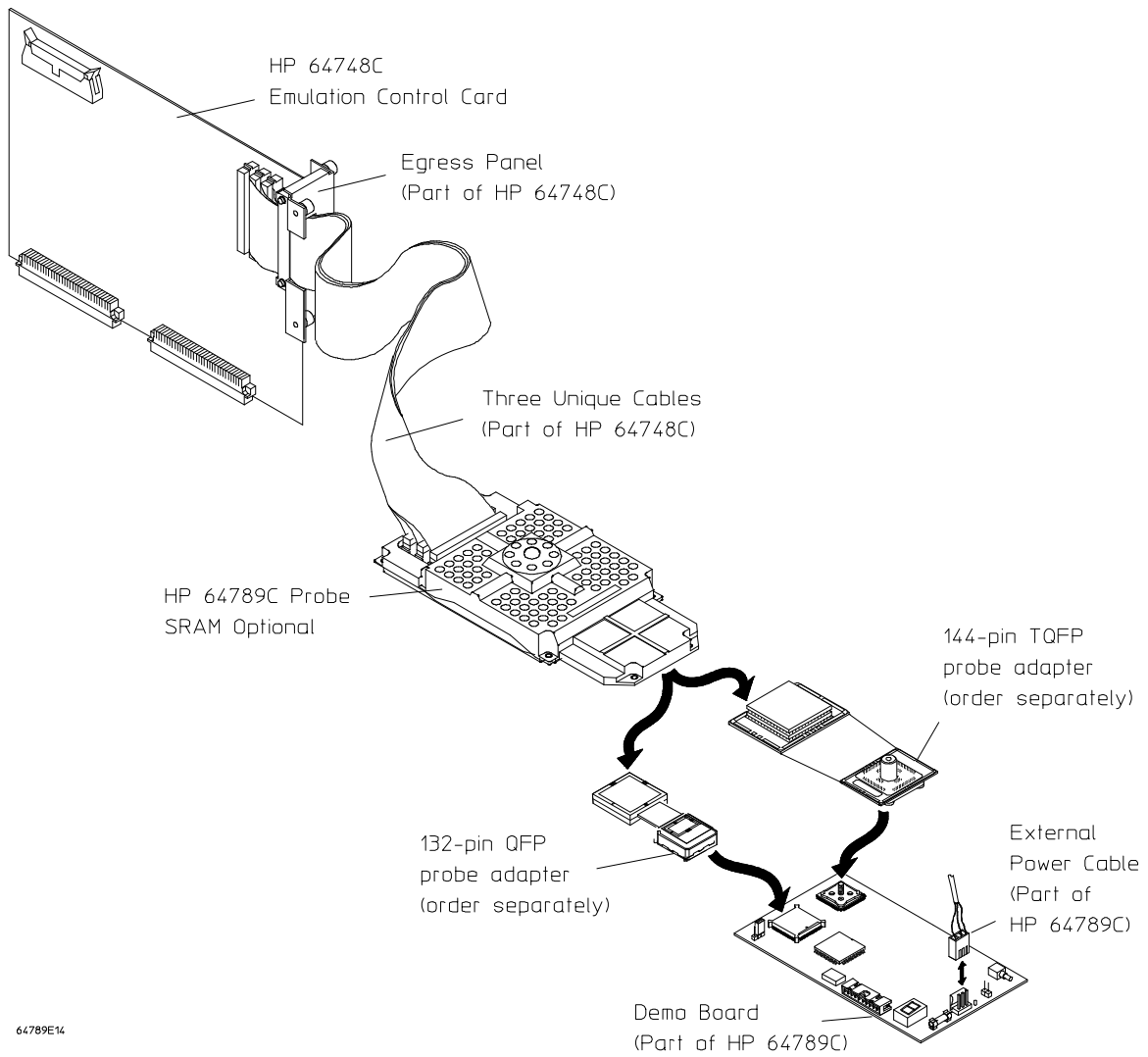
64789E14

The HP 64789C emulator at a glance

The HP 64789C Emulator

Description

The Hewlett-Packard Model 64789C emulator supports the Intel 80386EXTB and 80386EXTC microprocessors. In this manual, the HP emulator is referred to by Model Number 64789C, and the Intel microprocessor is referred to by Intel80386EX.

The emulator supports clock speeds up to 25 MHz (CLK2 speeds up to 50 MHz).

The emulator probe has a PGA-style connector. It can be plugged into either the 132-pin QFP or the 144-pin TQFP on the demo board.   The adapters to do this are not supplied as part of the HP 64789C emulator. They must be ordered separately. Part numbers for the probing accessories you need to connect this emulator to your target system are in the parts list in Chapter 7.

The emulator plugs into the modular HP 64700 instrumentation card cage and offers 80 channels of processor bus analysis with the HP 64794A or HP 64704A emulation-bus analyzer. Up to eight megabytes of emulation memory may be installed on the probe. High performance download is achieved through the use of a LAN (standard in HP 64700B; optional in HP 64700A) or RS-422 interface. An RS-232 port and a firmware-resident interface allow debugging of a target system at remote locations.

For software development, Microtec Research Inc. 80386 language tools are available on IBM-compatible personal computers and can be used through the HP Real-Time C Debugger Interface.

Language support is also available from several third-party vendors. This capability is provided through the HP 64700's ability to consume the Intel Standard OMF386 file format.

Features

HP 64789C Emulator

- Active probe emulator; supports the fastest processor speeds currently available from Intel. At the time this manual was printed, the emulator supported:
    - 25 MHz for Intel80386EX.
- No wait states to target memory
- Unlimited software breakpoints
- Symbolic support
- 36 inch cable and 219 mm (8.8") x 102 mm (4") probe
- Background and foreground monitors
- Consumes OMF86 and OMF386
- Multiprocessor emulation
    - synchronous start of 32 emulation sessions
    - cross triggerable from another emulator, logic analyzer, or oscilloscope
- Demo board and self test module included

Emulation-bus analyzer

- 80-channel emulation-bus analyzer
- Post-processed trace with symbols
- Eight events, each consisting of address, status, and data comparators
- Events may be sequenced eight levels deep and can be used for complex trigger qualification and selective store

Emulation memory

- Up to 8 Mbytes of emulation memory
- All emulation memory is dual-ported
- Mapping resolution is 256 bytes
- The wait states required for accesses to emulation memory depend on the speed of CLK2, as shown below:

CLK2 Speed	Wait States Required
< 42 MHz	0 wait states
> 42 MHz	1 wait state

In This Book

This manual covers the Hewlett-Packard Model 64789C emulator for the Intel Intel80386EX microprocessor. It is divided into the following parts:

Part 1, "Installation," shows you how to install and connect all of the emulator/analyzer hardware in the card cage, connect the card cage to a PC, and connect the emulator probe into the demo board and into your target system.

Chapter 4 in Part 1 leads you through a detailed procedure designed to help you connect the emulator into an unknown target system and obtain satisfactory operation. Even if you have extensive emulator experience, you should read this chapter to become familiar with problems that are specific to the Intel80386EX processor and emulator.

Part 2, "Service," shows you how to install and update emulator/analyzer firmware, solve problems you may encounter while using the emulator/analyzer, and obtain replacement parts for the emulator/analyzer from Hewlett-Packard.

Part 3, "Terminal Interface Reference," introduces the interfaces available to use with the emulator/analyzer, and shows you how to use the terminal interface for the emulator/analyzer.

This manual replaces the Terminal Interface Reference which accompanied earlier HP emulators. For information on the Terminal Interface, see Part 3.

You should read the book *Concepts of Emulation and Analysis* when you have the chance to do so; it contains a good conceptual introduction to the emulation process, and also describes how an emulation monitor works. Another book, the *HP 64700 Card Cage Installation/Service Guide*, tells you more about installation and configuration of the HP 64700 Card Cage. If you have a problem with the emulator and don't understand how to fix it, a listing of HP Sales and Service offices is in the *Support Services Guide* in the back of this binder.

Contents

4 Plugging the Emulator into a Target System

Part 1

Installation Guide

1

Preparing the Emulator

How to connect the emulator probe and power cord.

Preparing the Emulator

This chapter shows you how to install the emulation and analysis hardware in the emulator card cage.

The installation tasks are described in the following steps:

1   Install optional memory modules on the deep analyzer card, if desired.

2   Connect the HP 64789C emulator probe to the HP 64748C emulator control card.

3   Install cards into the HP 64700 card cage.

4   Install emulation memory modules on the emulator probe.

5   Connect a power cord to the HP 64700 Card Cage.

What you need

Equipment supplied

- HP 64789C Intel80386EX Emulator Probe.
- Demo target system (shipped with the emulator probe).
- HP 64748C Emulation Control card.
- HP 64794A/C/D Emulation-Bus Analyzer (deep analyzer) card, or
  HP 64704A 80-channel Emulation-Bus Analyzer (1K analyzer) card.
- 80-Channel Analyzer Extender Ribbon Cable.
- HP 64700A or HP 64700B Card Cage.

Equipment required but not supplied

- 132-pin QFP or 144-pin TQFP probe adapter (order separately).

  Refer to Chapter 7, "Parts List," for the part number of these.

Optional equipment

- HP 64172A 256-Kbyte Memory Modules for additional memory depth.
- HP 64172B 1-Mbyte Memory Modules for additional memory depth.
- HP 64173A 4-Mbyte Memory Modules for additional memory depth.
- HP 64701A LAN Interface card (HP 64700A only).

Equipment and tools needed

In order to install and use the Intel80386EX emulation system, you need:

- Flat-blade screwdriver with shaft at least 5 inches long (13 mm approx).
- Torx T-10 screwdriver (if installing the optional LAN card for the
  HP 64700A).

The illustrations in this manual show the HP 64700B Card Cage. The
locations of some components may be slightly different if you are using an
HP 64700A Card Cage.

Antistatic Precautions

Printed-circuit boards contain electrical components that are easily damaged by small amounts of static electricity. To avoid damage to the emulator boards, follow these guidelines:

- If possible, work at a static-free workstation.
- Handle the boards only by the edges; do not touch components or traces.
- Use a grounding wrist strap that is connected to the HP 64700 chassis.

Note If you already have an HP 64700-Series Card Cage and want to remove the existing emulator and insert an HP 64789C emulator in its place, the HP 64700-Series generic firmware and analyzer firmware may NOT be compatible, and the software will indicate incompatibility. In this event, you must purchase a Flash EPROM board to update the firmware. Instructions for installing this board and programming it from a PC or HP 9000 are provided in the HP 64700 Card Cage Installation/Service manual. Instructions for installing and updating emulator firmware are covered in Chapter 5, "Installing/Updating Emulator Firmware" in this manual.

Note If you already have an HP 64700-Series Card Cage and want to remove the 1K analyzer and install the deep analyzer in its place, the analyzer firmware will be updated by your installation because the analyzer firmware is contained on the analyzer card.

Step 1. Install optional memory modules on Deep Analyzer card (if using the Deep Analyzer)

Observe antistatic precautions

With no optional memory modules installed on the deep analyzer card, the trace memory depth is 8K. If you are going to use the deep analyzer with this default trace memory depth, skip this step.

1 Determine placement of the optional memory modules. Two types of modules may be installed: 256-Kbyte (HP 64172A), and 1-Mbyte (HP 64172B). Either module type may be installed in the banks on the analyzer card. Do not use HP 64171A/B or HP 64173A memory modules; they are too slow.

If you install no memory modules, the deep analyzer will have 8K maximum memory depth.
If you install four 256-Kbyte memory modules, the analyzer will have 64K maximum memory depth.
If you install four 1-Mbyte memory modules, the analyzer will have 256K maximum memory depth.

If you install a combination of 256-Kbyte memory modules and 1-Mbyte memory modules, the analyzer will have 64K maximum memory depth. All four connectors must have memory modules installed before the analyzer depth will be increased.

Bank 4
Bank 3
Bank 2
Bank 1

64749E02

2 To ensure correct installation of optional memory modules on the deep analyzer card, there is a cutout at one end of the memory modules so they can only be installed the correct way.

To install a memory module:

Align the groove in the memory module with the alignment rib in the connector.

Align the cutout in the memory module with the projection in the connector.

Place the memory module into the connector groove at an angle.

Firmly press the memory module into the connector and make sure it is completely seated.

Rotate the memory module forward so that the pegs on the connector fit into the holes on the memory module.

Make sure the release tabs at each end of the connector snap around the memory module to hold it in place.

Groove in
Memory Module
and Alignment
Rib in Connector

Cutout in
Memory Module

Release Tabs
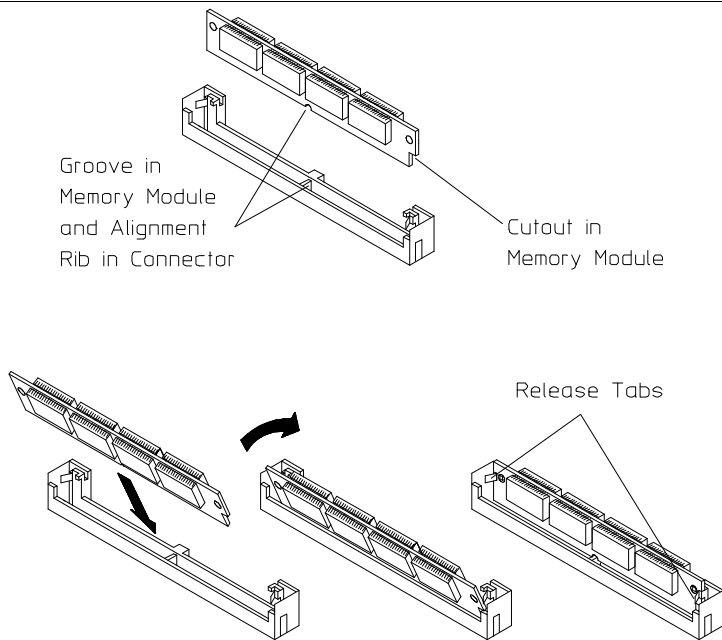
64794E03

Step 2. Connect the emulator probe cables

Three ribbon cables connect the HP 64748C emulation control card to the HP 64789C emulator probe.

The shortest cable connects from J1 of the emulation control card to J3 of the emulator probe. The medium length cable connects from J2 of the emulation control card to J2 of the emulator probe. The longest cable connects from J3 of the emulation control card to J1 of the emulator probe.

Make sure the cable connectors are seated. There are stainless steel clips on the cable connectors; these must be properly latched inside the sockets. Otherwise, the cables will work loose and you will see erratic operation. See illustration next page (step 2).

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1 Connect the emulator probe cables to the emulation control card.
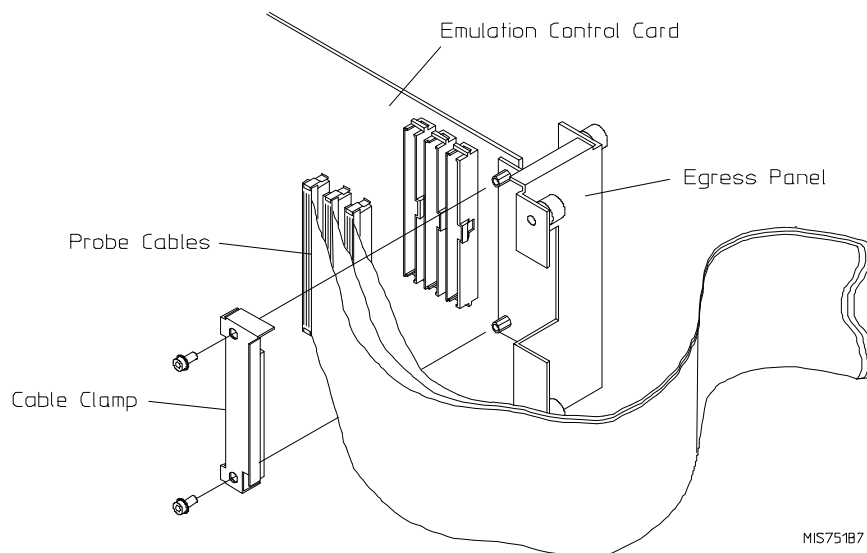
Emulation Control Card

Egress Panel

Probe Cables

Cable Clamp

MIS7518

2 When inserting cable connectors into the sockets, press inward on the connector clips so that they hook into the sockets as shown. The order of connecting cables was given in step 1.

Push in on clips
so they hook into
socket
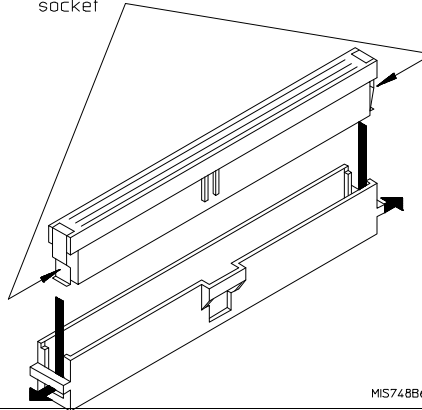
MIS748B6

3 Connect the other ends of the cables to the emulator probe. Make sure the stainless steel clips on the cable connectors are properly latched within the sockets.

Probe Cables

Active Probe

Top Plastic Cover

Bottom Plastic Cover

64783E26

10
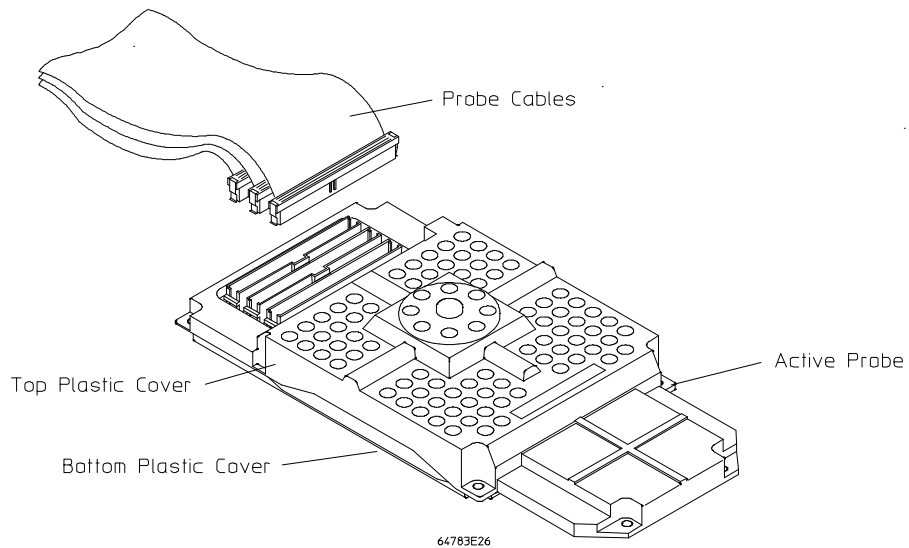
Step 3. Install boards into the HP 64700 Card Cage

WARNING

Before removing or installing parts in the HP 64700 Card Cage, make sure that the card cage power is off and that the power cord is disconnected.

CAUTION

Do NOT stand the HP 64700 Card Cage on the rear panel. You could damage the rear panel ports and connectors.

1 Use a ground strap when removing or installing boards into the HP 64700 Card Cage to reduce the risk of damage to the circuit cards from static discharge. A jack on the rear panel of the HP 64700 Card Cage is provided for this purpose.

GROUND STRAP
PLUG

64700E07

2 Turn the thumb screw and remove the top cover by sliding the cover toward the rear and up.

LOOSEN THUMB SCREW
AND SLIDE COVER
TO REMOVE.

64700E08

3 Remove the side cover by unsnapping the two latches and lifting off.

EMULATOR SIDE COVER

LATCHES
(ON BOTTOM PANEL)

TAB SLOTS

64783E08
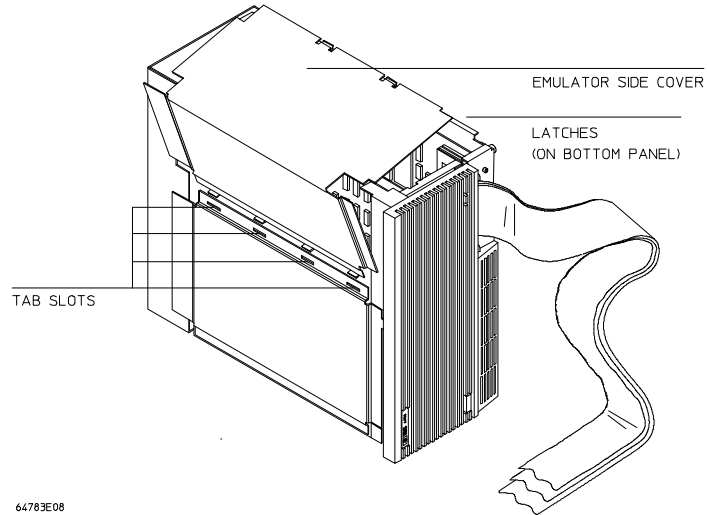
4 Remove the card supports.

NUMBER HERE
INDICATES SLOT I

CARD SUPPORTS

64700E01

5 First, completely loosen the four egress thumb screws.

To remove emulator cards, insert a flat blade screwdriver in the access hole and eject the emulator cards by rotating the screwdriver.

Emulator Card

Four Egress
Thumb Screws

Probe Cables

With flat blade screwdriver
eject emulator card, Egress
and probe cable as an assembly

64783E06

6 Insert a screw driver into the third slot of the right side of the front bezel, push to release catch, and pull the right side of the bezel about one-half inch away from the front of the HP 64700. Then, do the same thing on the left side of the bezel. When both sides are released, pull the bezel toward you approximately 2 inches.

Be careful because the plastic ears are easily broken on the front bezel.
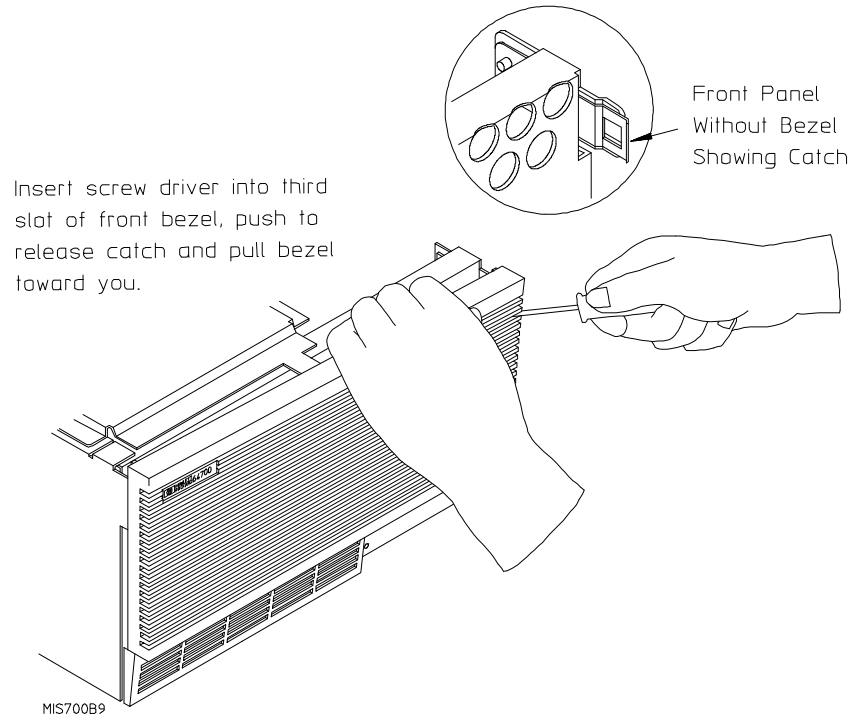
Front Panel
Without Bezel
Showing Catch

Insert screw driver into third
slot of front bezel, push to
release catch and pull bezel
toward you.

MIS700B9

7 Lift the bezel panel to remove. Be careful not to put stress on the power switch extender.

Lift bezel panel and
tip toward you to
remove.
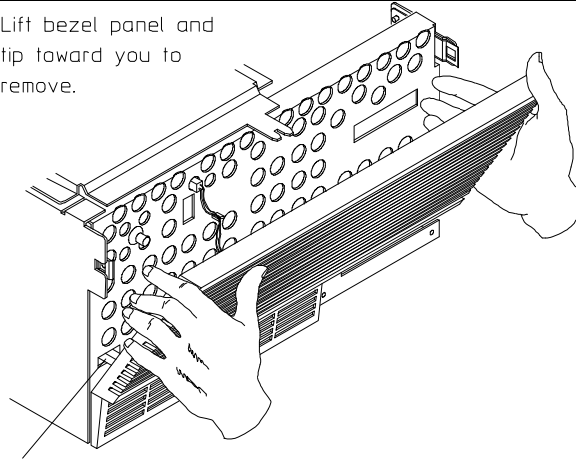
Be careful not to
put stress on power
switch extender.

MIS70011

8 If you're removing an existing analyzer card that provides external analysis, remove the right-angle adapter board by turning the thumb screws counterclockwise.

MIS70018

16
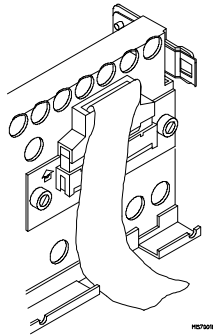
9 To remove the analyzer card, insert a flat blade screwdriver in the access hole and eject the analyzer card by rotating the screwdriver.

MIS76016   Eject Analyzer Card
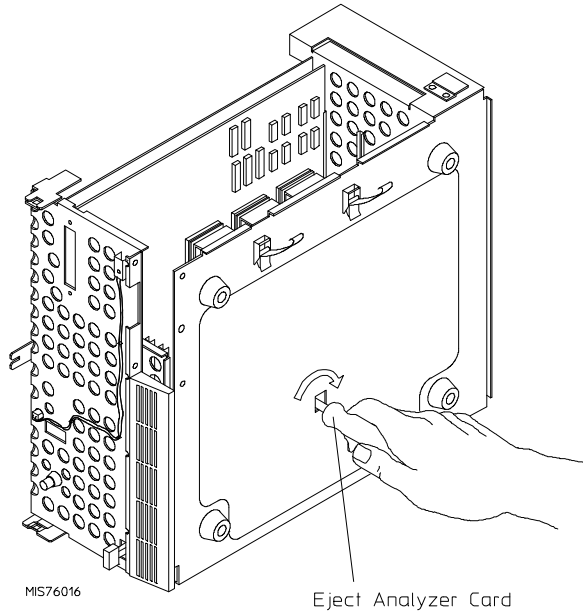
Do not remove the system control board. This board is used in all HP 64700 emulation and analysis systems.

10 Install the analyzer and emulation control cards. The analyzer is installed in the slot next to the system control card. The emulation control card is installed in the first slot from the bottom of the card cage. The software performance analyzer card may occupy any slot between the emulation-bus analyzer and the emulation control card. These cards are identified with labels that show their model numbers and serial numbers.   Note that components on the analyzer card face the opposite direction to the other cards.

To install a card, insert it into the plastic guides. Make sure the connectors are properly aligned; then, press the card into the mother board socket. Ensure that each card is seated all the way into its socket. If the cards can be removed with your fingers, the cards are NOT seated all the way into the mother board sockets.

Attach the ribbon cable from the emulation control card to the analyzer card, and to the software performance analyzer, if installed. Tighten the thumbscrews that hold the emulation control card to the cardcage frame.
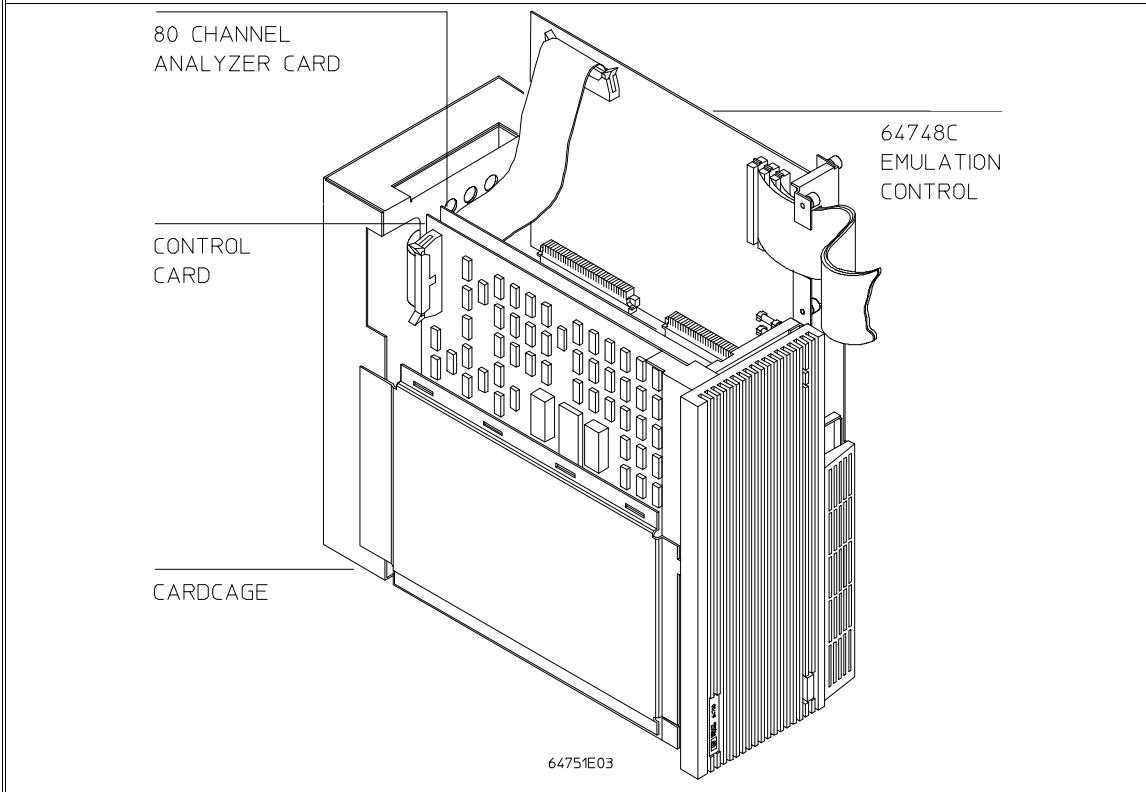
80 CHANNEL
ANALYZER CARD

64748C
EMULATION
CONTROL

CONTROL
CARD

CARDCAGE

64751E03

11 Connect the +5 V power cable to the connector in the HP 64700 front panel.
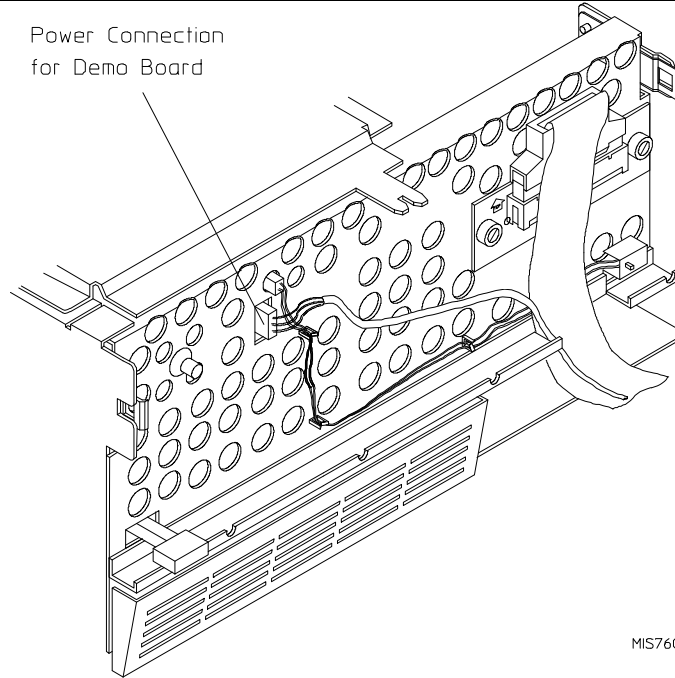
Power Connection for Demo Board

MIS76021

12 To reinstall the front bezel, be sure that the bottom rear groove of the front bezel is aligned with the lip as shown below.

Be sure back groove
of bezel is aligned
with lip.

Push front bezel
into place.
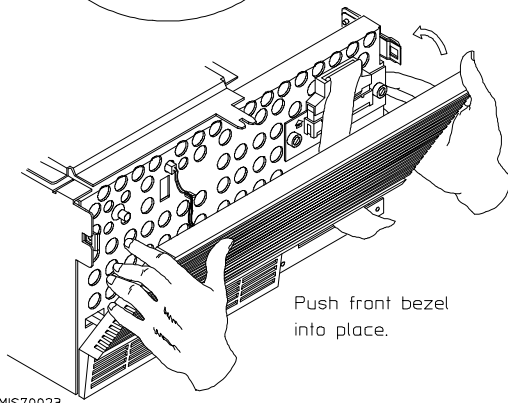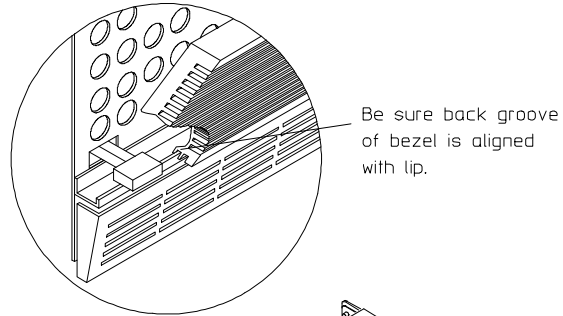
MIS70023

13 *This step applies only to the HP 64700A.* The HP 64700B has a built-in LAN interface.

Before you install the LAN card, you must remove the rear panel cover plate that is replaced by the bracket shown in the figure below.

To install the LAN card, position the BNC and 15-pin connectors of the LAN card through the openings in the rear panel, press the card into the mother board socket, secure the card with the two Torx T-10 screws, and mount the bracket to the rear panel with the four Torx T-10 screws.
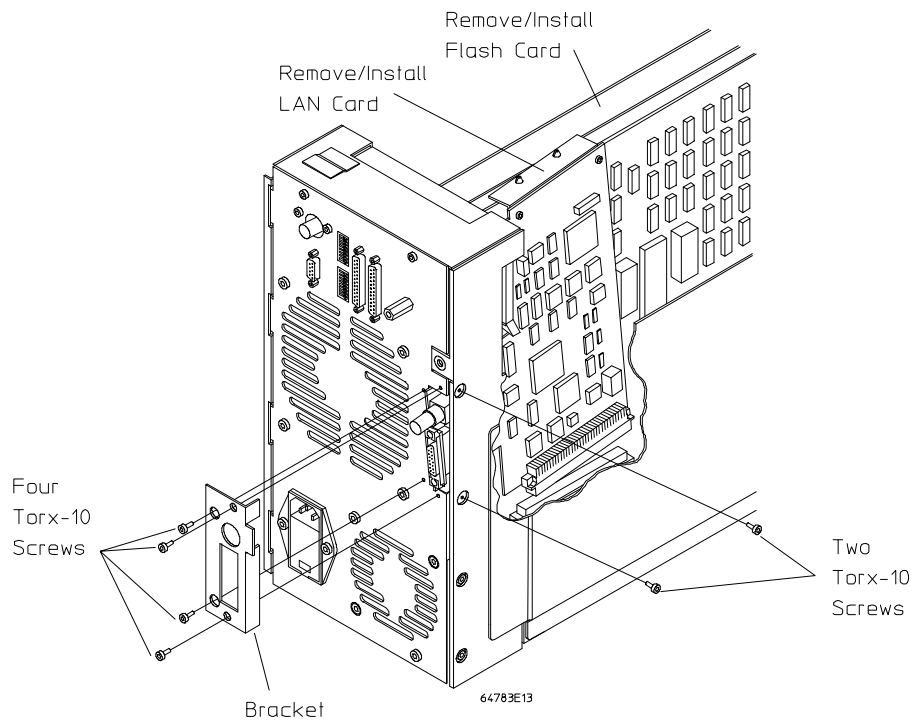
14 *This step applies only to the HP 64700A.* If you wish to install the flash card (used for updating firmware, see Chapter 5), refer to the diagram above. Install the flash card in any available slot between the 80-channel analyzer card and the HP 64748C control card in the cardcage. Insert the flash card in the plastic guides. Make sure the connectors are properly aligned. Then press the card all the way into the mother board sockets.

15 Install the card supports.

NUMBER HERE
INDICATES SLOT I

CARD SUPPORTS

64700E01
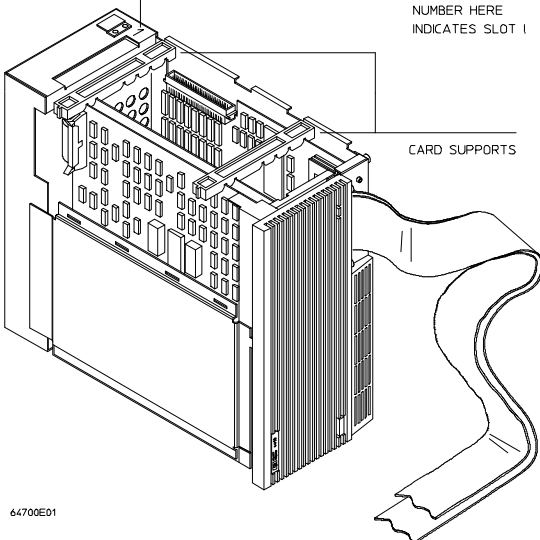
16 To install the side cover, insert the side cover into the tab slots and fasten the two latches.
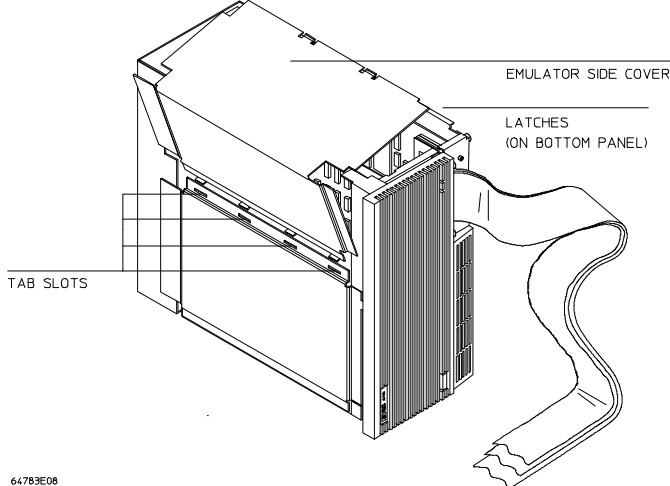
EMULATOR SIDE COVER

LATCHES
(ON BOTTOM PANEL)

TAB SLOTS

64783E08

17 Install the top cover in reverse order of its removal, but make sure that the side panels of the top cover are attached to the side clips on the frame.

SIDE CLIP

64700E09
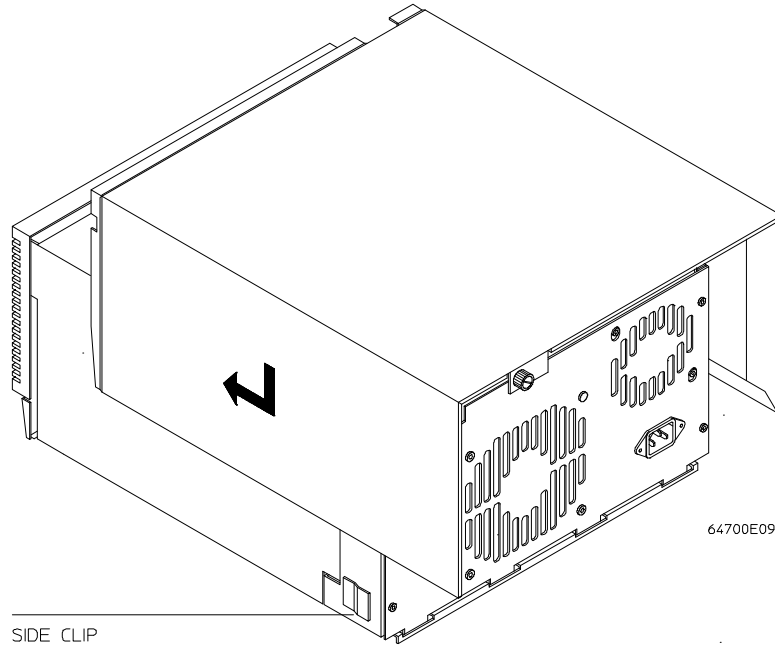
Step 4. Install emulation memory modules on emulator probe

Observe antistatic precautions

1 Remove plastic rivets that secure the plastic cover on the top of the emulator probe, and remove the cover. The bottom cover is only removed when you need to replace a defective active probe on the exchange program.

To install rivet
push down on rivet
head

To remove rivet
push up on center
shaft

MIS74810

MEMORY SLOT 0

MEMORY SLOT 1

ADD PLASTIC
WASHERS TO
FOUR POSITIONS

64789E11

2 Determine the placement of the emulation memory modules. Three types of modules may be installed: 256 Kbyte (HP 64172A), 1 Mbyte (HP 64172B), and 4 Mbyte (HP 64173A). Any of the emulation memory modules can be installed in either memory slot on the probe.

A configuration question will ask if CLK2 is greater than 42 MHz. If you answer yes, one wait state will be added by the emulator to all accesses to these memory modules.

Do not use HP 64171A/B memory modules. They are too slow.

Memory in slot 0 is divided into four equal blocks. Memory in slot 1 is divided into two equal blocks. For maximum flexibility, HP suggests you install the largest memory module into slot 0 if you have two different size memory modules.

If you need new rivets or washers to complete this installation procedure, refer to Chapter 7, "Parts List," for the part number of the Plastic Rivets Kit.

3 Install emulation memory modules on the emulator probe. There is a cutout at one end of the memory modules so they can only be installed the correct way.

To install a memory module:

1 Align the groove in the memory module with the alignment rib in the connector.
2 Align the cutout in the memory module with the projection in the connector.
3 Place the memory module into the connector groove at an angle.
4 Firmly press the memory module into the connector and make sure it is completely seated.
5 Rotate the memory module to the vertical position so that the pegs on the connector fit into the holes on the memory module.
6 Make sure the release tabs at each end of the connector snap around the memory module to hold it in place.
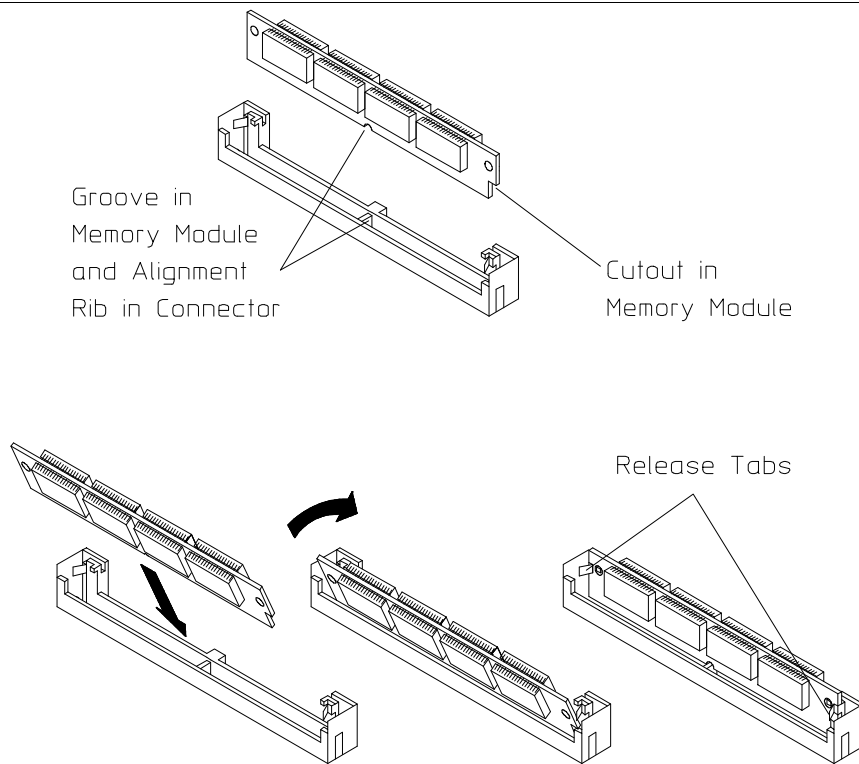
4 Replace the plastic cover, and insert new plastic rivets (supplied with the emulator) to secure the cover.

To install rivet
push down on rivet
head

To remove rivet
push up on center
shaft

MIS74810

MEMORY SLOT 0

MEMORY SLOT 1

ADD PLASTIC
WASHERS TO
FOUR POSITIONS

64789E11
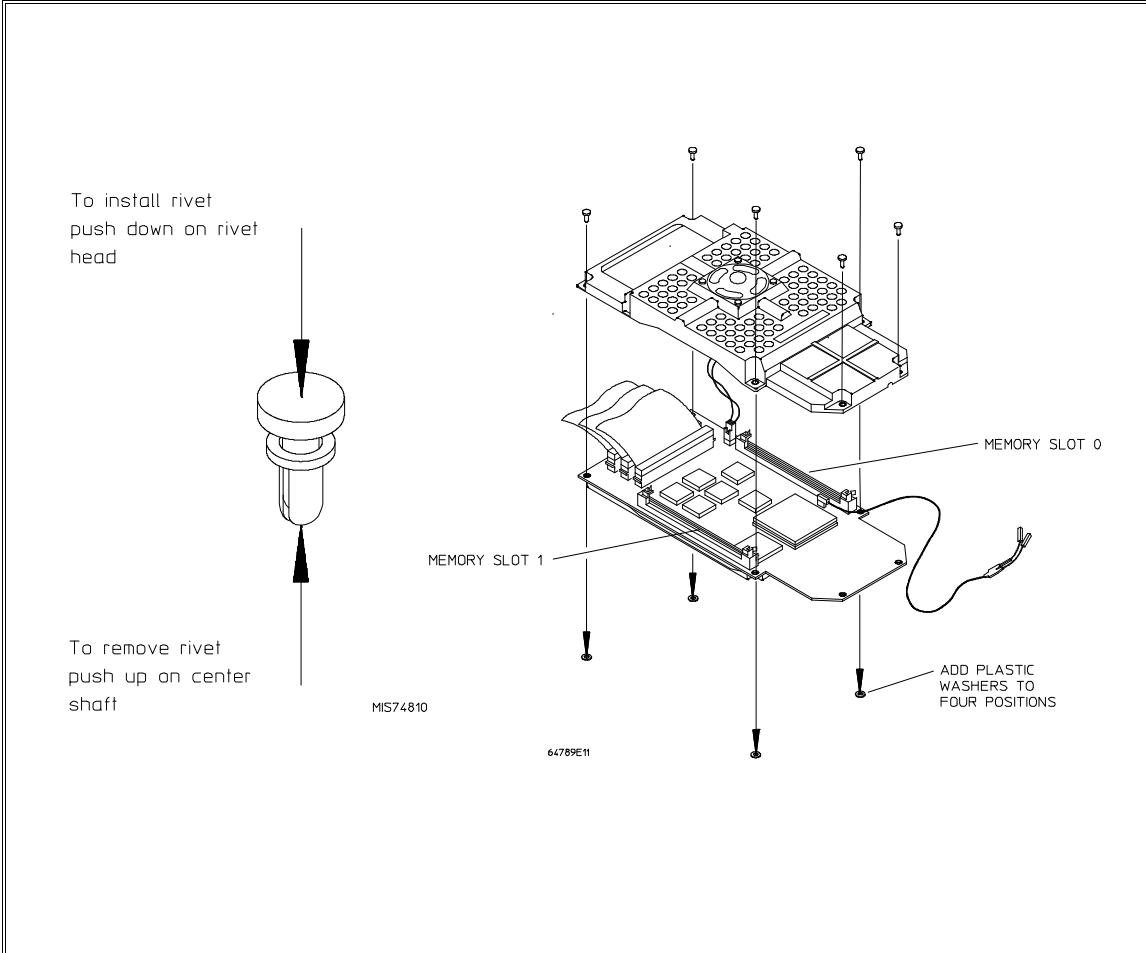
Step 5. Connect the power cord

The HP 64700B automatically selects the 115 Vac or 220 Vac range. In the 115 Vac range, the HP 64700B will draw a maximum of 345 W and 520 VA. In the 220 Vac range, the HP 64700B will draw a maximum of 335 W and 600 VA.

If you have the emulator installed in an HP 64700A card cage, select the line voltage using a thumb-wheel switch inside the power control module on the rear panel of the card cage. The input frequency must be in the range of 48 to 66 Hz. At 115 VAC, the emulator will draw a maximum of 3.0 A. At 220 VAC, it will draw a maximum of 1.5 A.

The HP 64700 is shipped from the factory with a power cable appropriate for your country. You should verify that you have the correct power cable for installation.

If the cable you received is not appropriate for your electrical power outlet type, contact your Hewlett-Packard sales and service office.

Fuse Holder

Thumb Wheel

MIS70014
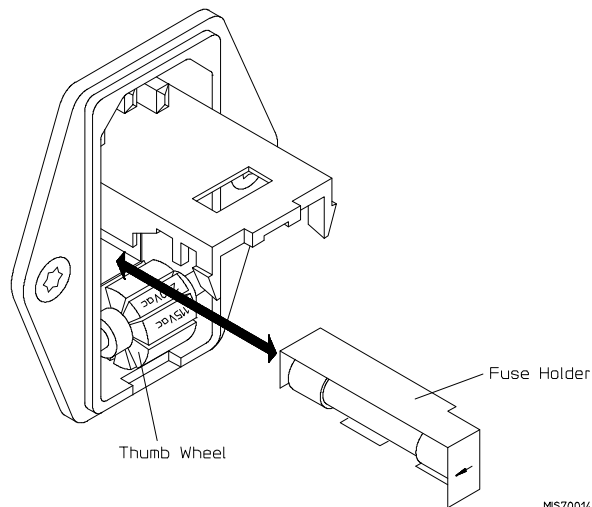
1 Connect the power cord and turn on the HP 64700.

The line switch is a pushbutton located at the lower, left-hand corner of the front panel. To turn ON power to the HP 64700, push the line switch button in to the ON (1) position. The power lamp at the lower, right-hand corner of the front panel will light.

64700E03

2
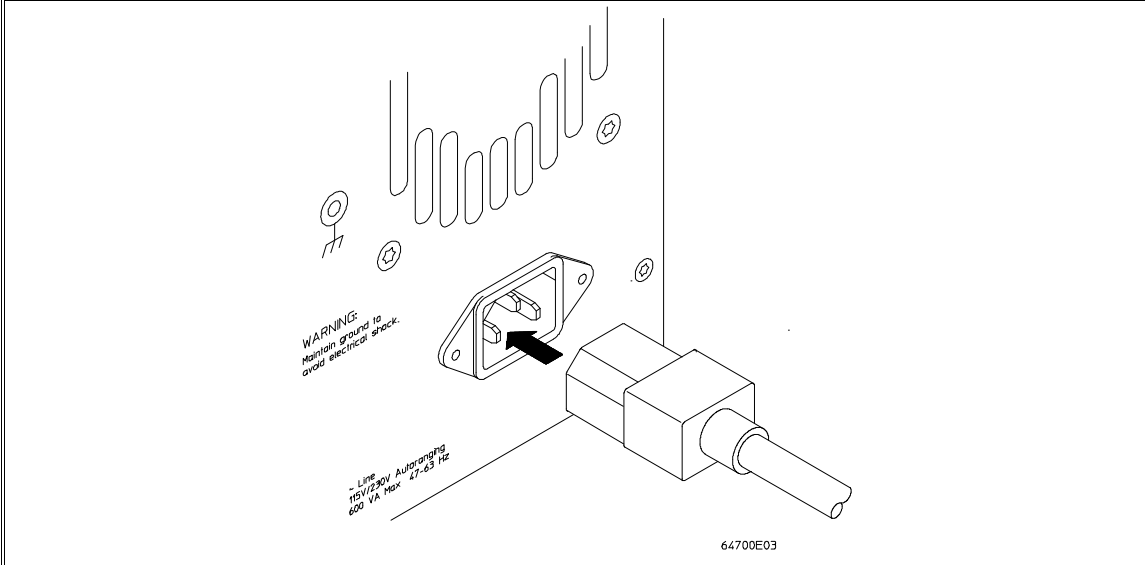
Connecting to a Host Computer

How to connect the emulator to a PC or terminal.

As you follow the steps in this chapter, you will need to refer to the *64700 Card Cage Installation/Service Guide*.

Step 1: Choose a system configuration

1 Decide how you will connect the emulator to your host computer. Refer to the "Concepts" chapter in the *64700 Card Cage Installation/Service Guide*.

2 If you will be using a LAN connection, continue with the steps in this chapter.

If you will be using a serial connection, refer to the information in the *64700 Card Cage Installation/Service Guide*; you may skip the rest of this chapter.

Step 2: Connect the LAN cable

• Connect the LAN to either the BNC connector or the 15-pin AUI connector.

The card cage can communicate with computers on an IEEE 802.3 or Ethernet Local Area Network. (If you have a 64700A card cage, you need the HP 64701A LAN card to connect to a LAN.) You can use either of two LAN connectors:

• A BNC connector that can be directly connected to a ThinLAN (HP's implementation of IEEE 802.3 Type 10BASE2) cable. The card cage provides the functional equivalent of a Medium Attachment Unit (MAU) for ThinLAN.

• A 15-pin connector for an Attachment Unit Interface (AUI) cable. The AUI cable allows you to connect to an off-board MAU for ThinLAN, a ThickLAN (HP's implementation of IEEE 802.3 Type 10BASE5)

connection, or to a Pod for a StarLAN 10 (HP's implementation of IEEE 802.3 Type 10BASE-T) connection.

CAUTION

CORRUPTED DATA! The LAN connection to the BNC will maintain software integrity and can maintain communication when subjected to low levels of Electrostatic Discharge (ESD) directly to the LAN connector.

When operating in an environment where ESD pulses are in excess of 2500 volts, using a ThinMAU adapter (instead of a direct connection) is more reliable and less susceptible to data corruption from ESD to the LAN cable.

Use either the BNC or the AUI connector. Do NOT use both. The LAN interface will not work with both connected at the same time.

Step 3: Install host software

If you have not already done so, install the LAN software on your host computer.

Step 4: Update emulator firmware

If you did not receive your HP 64700 Card Cage and HP 64789C Emulator together (e.g. you are installing your HP 64789C Emulator in a card cage that had a different emulator installed in it), update the emulator firmware according to the steps in Chapter 5, "Installing/Updating Emulator Firmware."

Step 5: Configure the LAN parameters

- To configure the LAN parameters using the HP Real-Time C Debugger interface on a PC, refer to the instructions in your Real-Time C Debugger interface manual.

To configure LAN parameters using the terminal interface

1 Set all of the rear panel switches to the down position. This will set the serial port (Port A on a 64700A card cage) to 9600 baud and DCE.

2 Connect an ASCII terminal to the serial port with a 25-pin RS-232 cable.

You can also connect to a computer's RS-232 port and use a terminal emulation program on the computer. Refer to the "Connecting the HP 64700 Using RS-232/RS-422" chapter in the *64700 Card Cage Installation/Service Guide*.

3 Turn ON the emulator card cage. Press the terminal's <RETURN> key a couple times. You should see the "R>" prompt.

4 Display the current LAN configuration values by entering the **lan** command:

```
R>lan
lan -i 0.0.0.0
lan -g 0.0.0.0
lan -s 0.0.0.0
lan -p 6470
Ethernet Address : 08000903212f
```

Note the Ethernet Address, also known as the link-level address. This address is preassigned at the factory, and is printed on the rear panel.

5 Enter the **lan -i <internet> [-g <gateway>] [-s <subnet>] [-p <port>]** command.

The lan command parameters are:

-i <internet>   The Internet Address must be obtained from your local system administrator. The value is entered in integer dot notation. For example, 192.35.12.6 is an Internet Address.

-g <gateway>   The Gateway Address is also an Internet Address and is entered in integer dot notation. This entry is optional and will default to 0.0.0.0, meaning all connections are to be made on the local network or subnet. If connections are to be made to workstations on other networks or subnets, this address must be set to the address of the gateway machine. The gateway address must be obtained from your local system administrator.

-s <subnet>   The Subnet Mask (in integer dot notation) is optional and only available when using the HP 64700A. It defaults to 0.0.0.0. The default is valid only on networks that are not subnetted. (A network is subnetted if the host portion of the Internet address is further partitioned into a subnet portion and a host portion.) If the network is subnetted, a subnet mask is required in order for the emulator to work correctly. The subnet mask should be set to all "1"s in the bits which correspond to the network and subnet portions of the Internet address and all "0"s for the host portion. The subnet mask must be obtained from your system administrator.

-p <port>   This changes the base TCP service port number. The host computer interfaces communicate with the emulator through two TCP service ports. The default base port number is 6470. The second port has the next higher number (default 6471). If you change the base port, the new value must also be entered in the /etc/services file on the host computer. For example, you could modify the line:

hp64700   6470/tcp

The default numbers (6470, 6471) can be changed if they conflict with some other product on your network. TCP service port numbers must be greater than 1024.

For example, to assign an Internet Address of 192.6.94.2 to the emulator, enter the following command:

```
R>lan -i 192.6.94.2 <RETURN>
```

The Internet Address and any other LAN parameters you change are stored in nonvolatile memory and will take effect the next time the emulator is powered off and back on again.

6 Turn power to the emulator OFF, and connect the the emulator to your network. This connection can be made by using either the 15 Pin AUI connector or the BNC connector.

7 Set the rear panel dip switches to indicate the type of connection that is to be made:

Switch 16 must be set to one (1) indicating that a LAN connection is being made.

Switch 15 should be zero (0) if you are connecting up to the BNC connector or set to one (1) if a 15 pin AUI connection is made.

Switch 14 should be zero (0).

Set all other switches to zero (0).
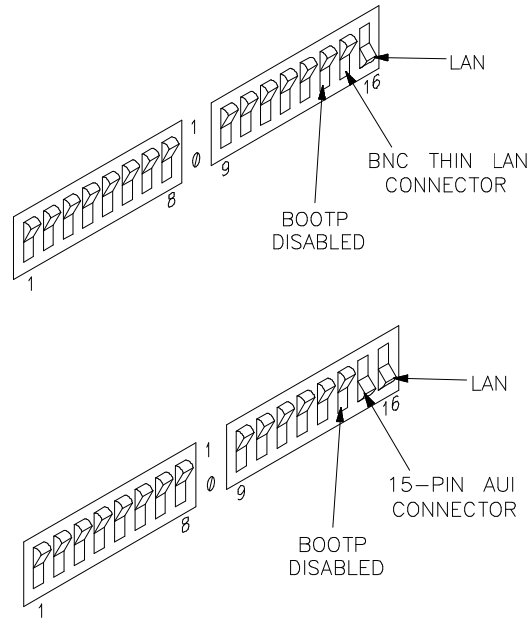
8 Turn ON power to the emulator card cage.

9 Verify your emulator is now active and on the network by issuing a **telnet** to the Internet Address. For example:

```
$ telnet 192.6.94.2 <RETURN>
```

This connection will give you access to the built-in terminal interface. To exit from this telnet session, type <CTRL>d at the emulator prompt.

The next time LAN parameters need to be configured, telnet to the emulator and use the terminal interface lan command.

If "telnet" does not access the emulator

You must use the telnet command on the host computer to access the emulator's built-in terminal interface. After powering up the emulator, it takes a minute before the it can be recognized on the network. After a minute, try the telnet <internet address> command.

If telnet does not make the connection:

☐ Make sure that you have connected the emulator to the proper power source and that the power light is lit.

☐ Make sure that the LAN cable is connected. Refer to your LAN documentation for testing connectivity.

☐ Make sure the rear panel communication configuration switches are set correctly. Switch settings are only used to set communication parameters when power is turned OFF and then ON.

☐ Make sure that the Internet Address is set up correctly. You must use the RS-232/RS-422 port to verify this that the Internet Address is set up correctly. While accessing the emulator via the RS-232/RS-422 port, run performance verification on the LAN interface hardware with the **lanpv** command.

If telnet makes the connection, but no terminal interface prompt (for example, R>, M>, U>, etc.) is supplied:

☐ It's possible that the emulator interface software is in the process of running a command (for example, if a repetitive command was initiated from telnet in another window). You can use <CTRL>c to interrupt the repetitive command and get the terminal interface prompt.

☐ It's also possible for there to be a problem with the emulator firmware while the LAN interface is still up and running. In this case, you must cycle power on the emulator card cage.

3

Connecting to the Demo Board

How to connect the emulator to the demonstration target system.

Installation

This chapter shows you how to connect the emulator to the demo target system which is shipped with the emulator. It also shows you how to verify installation by starting the emulator/analyzer interface for the first time.

Step 1 shows how the probe is to be connected to the demo board.

When disconnecting from a 132-pin Intel80386EX, use the extractor tool and removal instructions provided with the probe adapter to avoid damage.

Removing a retainer from a 144-pin Intel80386EX could cause damage to your TQFP. Removal instructions are in the installation guide provided with the Elastomeric Probing System.

Step 2 shows how to set the demo board to operate with 3.3 Vcc and with 5.0 Vcc. You will want to test the performance of the emulator when it is connected to the demo board using the same voltage used in your target system.

Step 3 shows how to connect power from the HP 64700 Instrumentation Card Cage to the demo target system.

Step 4 shows how to connect the reset flying lead from the emulator probe to the demo target system.

After connecting the emulator probe to the demo board, do the performance verification procedure described in Chapter 6, "Solving Problems."

Step 1. Connect the emulator probe to the demo target system

Probe adapters are not supplied as part of the emulator. Find the probing accessories in the parts list in Chapter 7 and select the adapter you need.

If you are using the 132-pin QFP Probe Adapter Assembly, refer to the operating note supplied with it for specific instructions on connecting and removing the probe adapter.

If you are using the 144-pin TQFP Elastomeric Probing System, refer to the installation guide supplied with it to adhere a retainer to the TQFP before installing the probe adapter and making the connections.

Transition Socket

Flexible Adapter

Male-to-male Header

TQFP Elastomeric Probe Adapter

Clamp Retainer

Retainer

Clip

PQFP Probe Adapter

144-pin Processor

Demo Board

132-pin Processor

64789E12
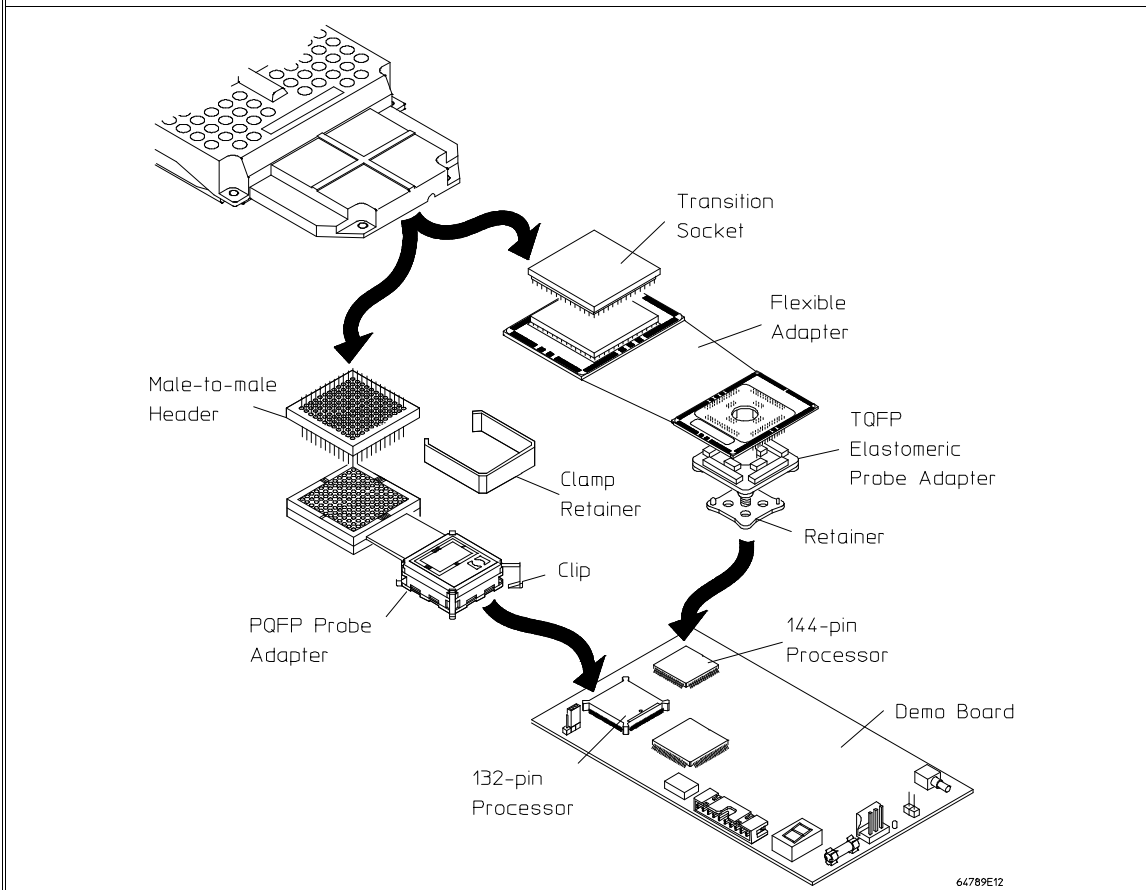
Step 2. Setting the demo board operating voltage

Use the jumper on the demo board to set the operating voltage of the demo board to either 3.3 Vcc or 5.0 Vcc. You will want to test the performance of the emulator when it is connected to the demo board using the same voltage as is used in your target system.
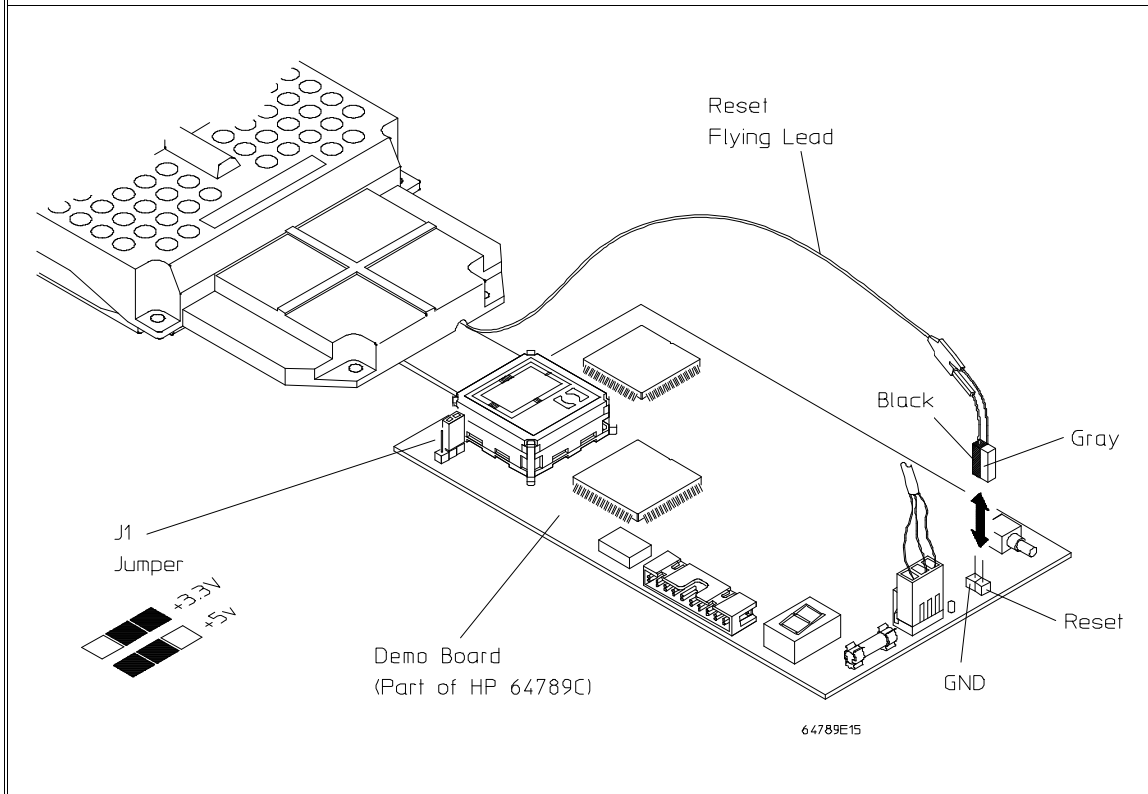
Step 3. Connect the Demo Board Power

Connect the power supply cable from the HP 64700 Instrumentation Card Cage to the demo target system. The 3-wire cable has one power wire and two ground wires. When attaching the 3-wire cable to the demo target system, make sure the connector *is aligned properly* so that all three pins are connected.

Power Connection for Demo Board from HP 64700A/B

Demo Board

64789E08
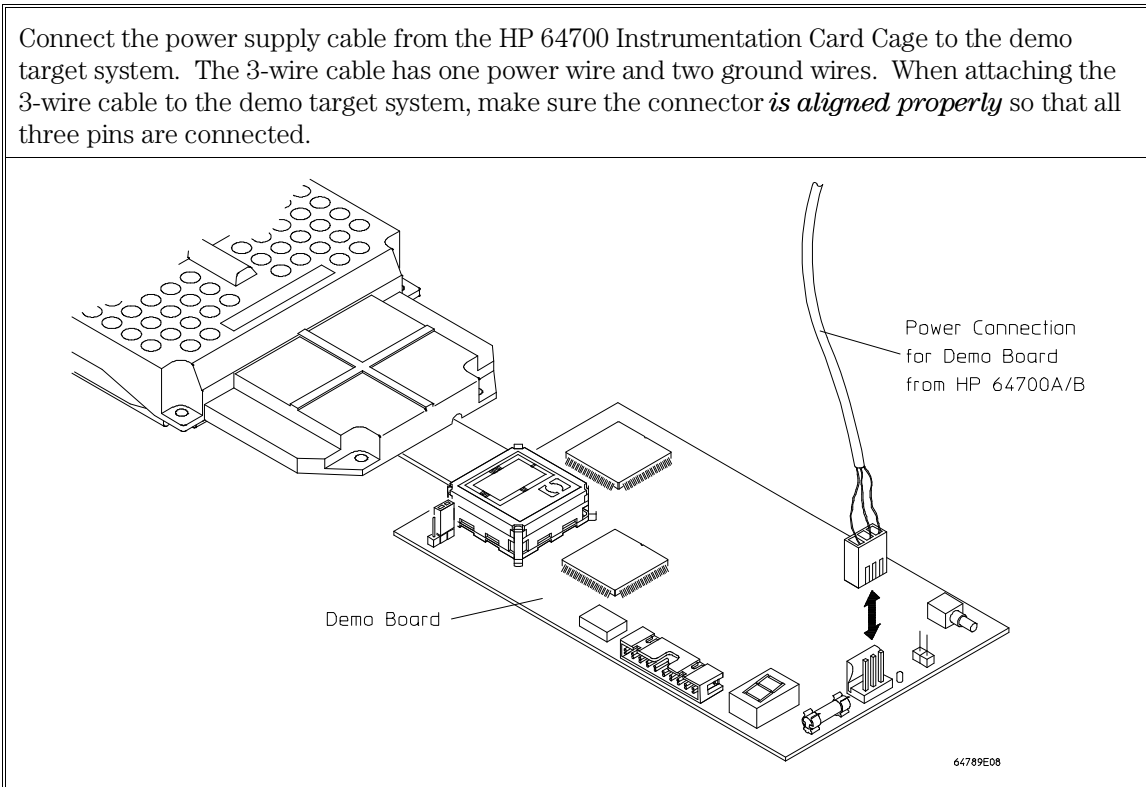
Step 4. Connect the Reset Flying Lead

Connect the reset flying lead from the probe to the demo board. Refer to Chapter 4, "Plugging the Emulator into a Target System" for details of using the reset flying lead.
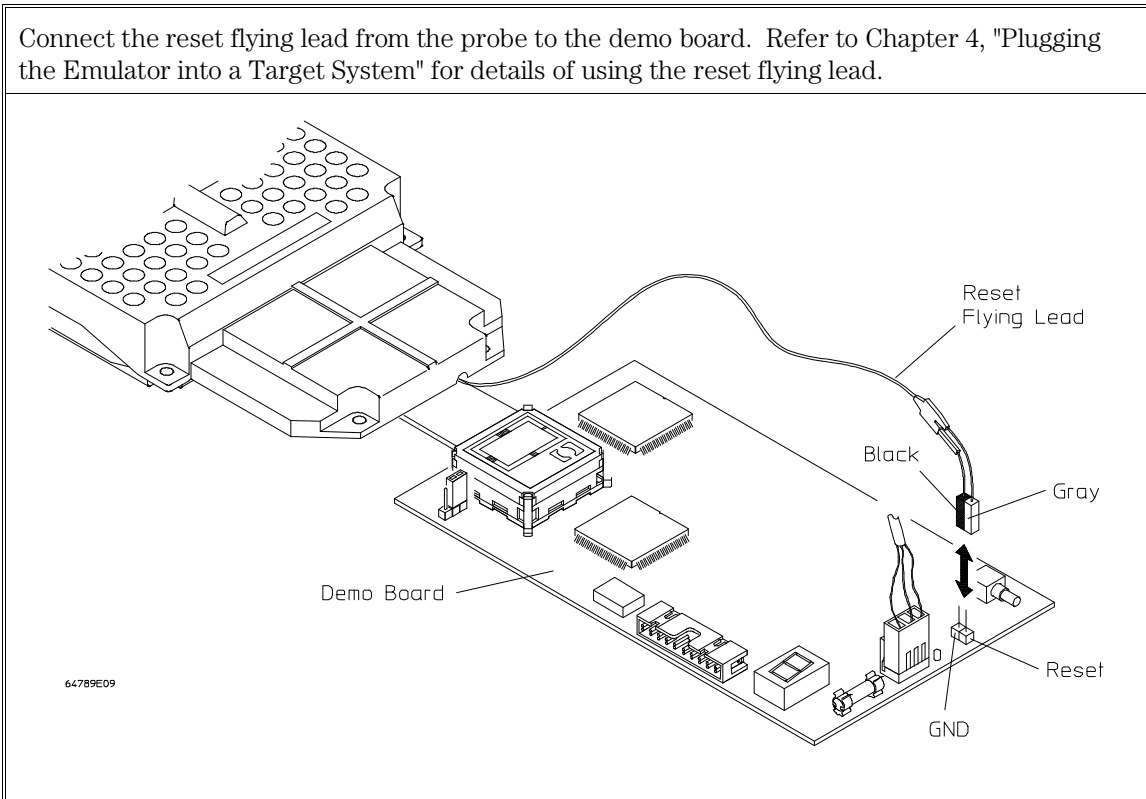
Step 5. Verify Performance as described in Chapter 6

4
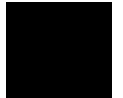
Plugging the Emulator into a Target System

Plugging the Emulator into a Target System

The purpose of this section is to help you plug the emulator into your target system. Most "plug-ins" are simple but due to hardware and software differences, some can be difficult. Even if you have extensive emulator experience, you should read this chapter to become familiar with issues or potential problems that are specific to the Intel80386EX processor and emulator.

This chapter is divided into two sections: a set of step-by-step instructions for plugging the emulator into a target system, and general information about the emulator signals. At appropriate places in the step-by-step instructions, you will be referred to the Specifications Chapter. You won't have to spend time reading about product specifications that you don't care about. Note that the step-by-step instructions do not have an exhaustive list of potential problems. The list is limited to the most likely causes of problems. These should aid you in finding the source of your plug-in problems.

These step-by-step instructions will lead you through the following:

- Assumptions and equipment you may need.

- No-intrusion plug-in.

- CLK2 signal integrity.

- Using emulation memory with no intrusion.

- Using the background monitor.

- Using the foreground monitor.

- Dealing with keep-alive circuitry by customizing the foreground monitor.

- Using software breakpoints and execution messages.

- Using the Reset Flying Lead.

Assumptions and Equipment you may need

The directions in this chapter use the RTC interface. They assume that the connection between the emulator and your PC has been made, the emulator firmware has been installed or updated according to Chapter 5, the probe is connected to the three cables from the HP 64700 Card Cage, and the emulator has passed its performance verification (PV) in Chapter 3.

To deal with problems that may occur during this procedure, you may need the following equipment:

- Oscilloscope. Two channels. Analog band width should be at least 500 MHz. If possible, single-shot sampling rate should be greater than 1 Gsample/second.

- Logic/timing analyzer. At least 16 channels. Sampling rate of timing analyzer should be at least twice the speed of CLK2 in your target system.

If you need to measure any internal signals, such as CLK2, remove the top plastic cover from the emulator and make the measurements on the pins of the emulator connector. The pins are through-hole pins, with the socket on the bottom of the board, so probing the pins is easy. Remember to use as short a ground lead as possible to achieve a realistic view of the signal. All signals measured will be at the emulator probe's PGA connector. Ground pins are plentiful and always nearby.

CAUTION   Always turn off the target system and then the emulator (in that order) prior to disconnecting them or making any other physical changes (such as soldering). It is also a good idea to turn both systems off when attaching probe leads to surface-mount chip leads to avoid problems caused by momentarily shorting adjacent leads.

No-Intrusion Plug-In

This section of Chapter 4 verifies operation of the hardware interface between the emulator and the target system. It is called "no_intrusion" because it makes no deliberate break into the monitor while the emulator is running. In this section, you will do the following:

- Make physical connection between the emulator and the target system.

- Configure the emulator for no intrusion.

- Start the analyzer and the target system.

- Verify the presence of power and the clock.

- Check quality of the CLK2, RESET, and READY# signals.

- Examine execution start which verifies the analyzer interface, and CPU operation in your target environment.

The emulator should work in any system designed to meet the worst-case timing and electrical specifications of the 25 MHz, Intel80386EX processor, as specified by Intel. To be more robust and to implement certain features, the emulator adds delay to some lines (such as NMI), and requires more setup time on some lines (such as the data lines) due to propagation delay across the flexible cable. However, typically (as in a lab setting) you should encounter no problems.

Make the physical connection between the emulator and the target system

Probe adapters are not supplied as part of the emulator. Find the probing accessories in the part list in Chapter 7 and select the adapter you need.

Use the following steps to connect the emulator probe to the target system.

CAUTION   Equipment Damage. To prevent equipment damage, be sure to remove power from both the target system and the logic analyzer whenever the emulator probe is being connected or disconnected.
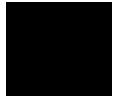
1 Turn off the target system and logic analyzer.

2 Select the orientation (shown on the next pages) that best suits your target system. Note the following indicators on the illustrations:

- position of Pin 1 on the microprocessor
- position of little pin on the retainer (if applicable)
- position of little hole on the probe adapter (if applicable)
- color/bar code on both ends of the flexible adapter
- position of indicator on the transition socket
- position of Pin A1 on the emulator

Flexible adapters can be installed in one of four orientations as shown in the following illustrations. This allows flexibility in attaching the emulator probe when target system components interfere.

3 If you are using a QFP Probe Adapater Assembly, refer to the operating note supplied with it for specific instructions when making the connections.

4 If you are using a TQFP Elastomeric Probing System, refer to the installation guide supplied with it to adhere a retainer to the TQFP before installing the probe adapter and making the connections.

(a) 80386EX emulator probe

Clamp retainer

Spring clip (4)

Male—to—male Header

Pin 1 of 80386EX

QFP probe adapter

Red (1 bar)

(b) Purple (4 bars)

Pin 1 of 80386EX

(c) Yellow (3 bars)

Pin 1 of 80386EX

(d) Blue (2 bars)

Blue (2 bars)

Pin 1 of 80386EX
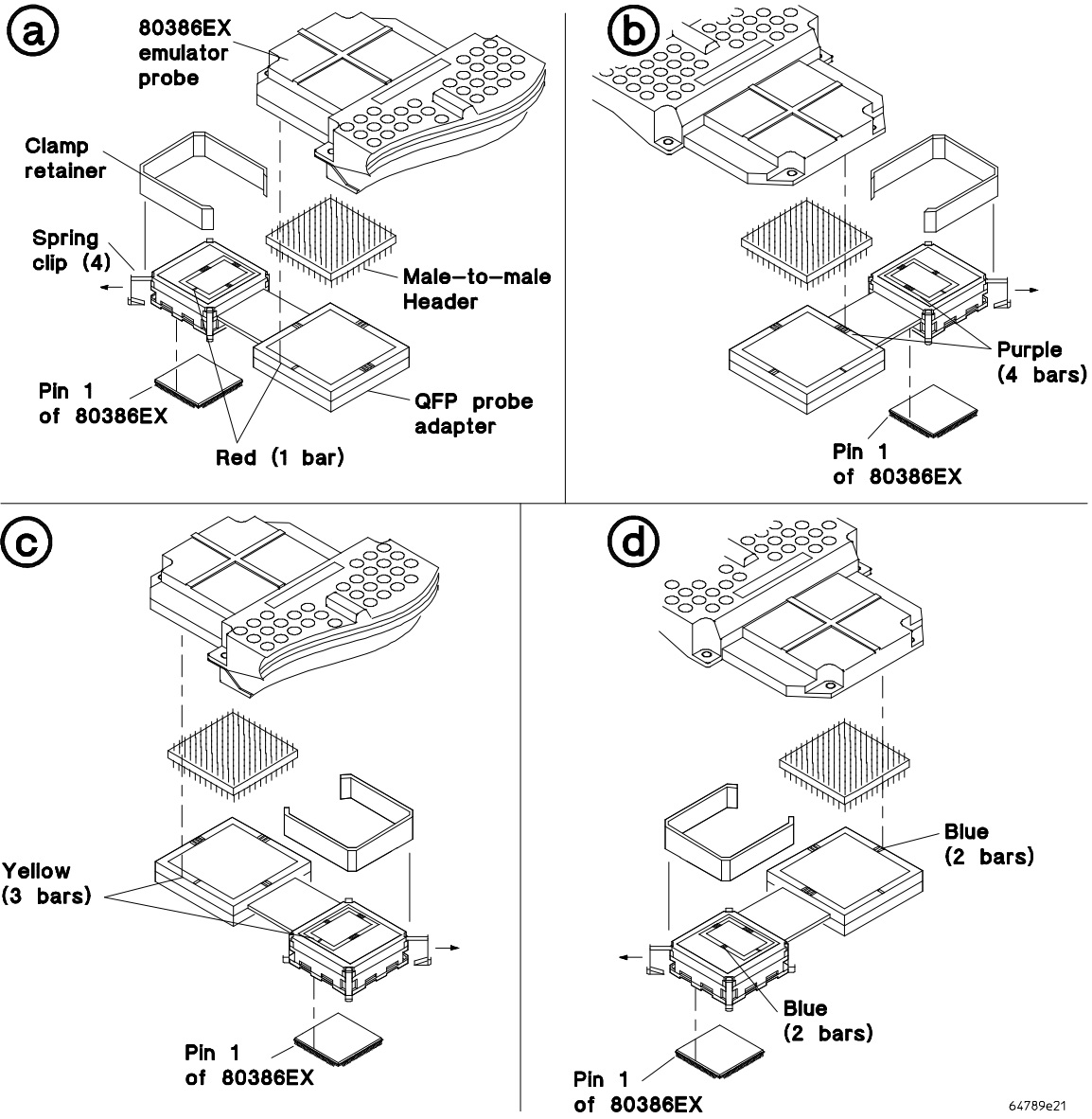
64789e21

Connecting using the 132-pin QFP Adapter Assembly

50

(a)

HP 80386EX
Emulator probe

PGA transition
socket

Notch

Red
(1 bar)

General
purpose
flexible
adapter

Little
pin/hole

Elastomeric
probe adapter

Pin 1 of
80386EX

(b)

Pin 1 side

Notch

Purple
(4 bars)

Little
pin/hole

Pin 1 of
80386EX

(c)

Notch

Yellow
(3 bars)

Little
pin/hole

Pin 1 of
80386EX

(d)

Pin 1
side

Notch

Blue
(2 bars)

Blue
(2 bars)

Little
pin/hole

Pin 1 of
80386EX
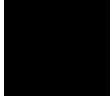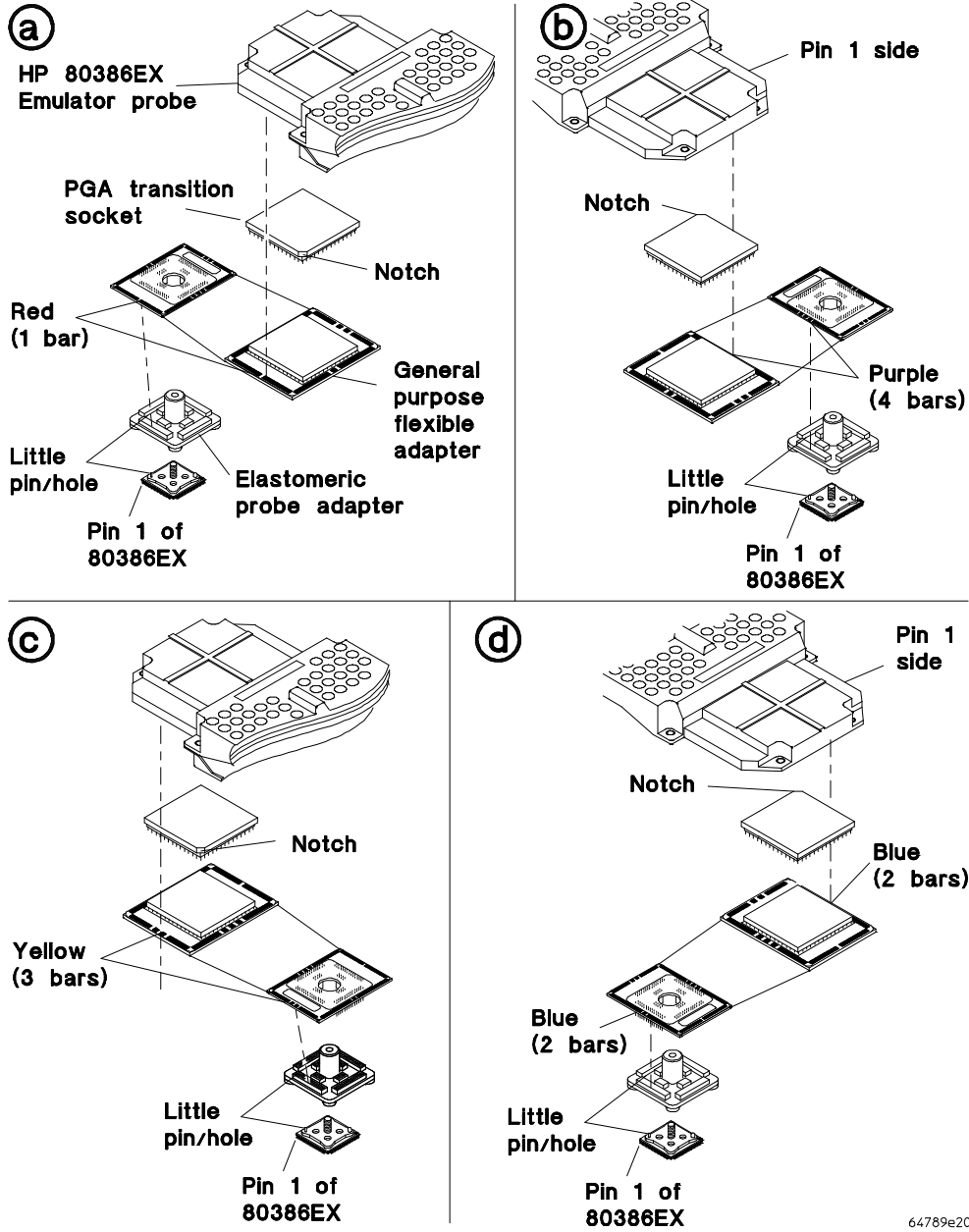
64789e20

Connecting using the 144-pin TQFP Elastomeric System

Power on the emulator

Turn on power to the emulator card cage. Do not yet apply power to your target system. That step comes after you have configured the emulator.

Configure the emulator for no intrusion

This step configures the monitor to do as little as possible.

1 Choose Execution→Reset (ALT, E, E).

2 In the emulator interface, choose the Settings→Emulator Config→Hardware... (ALT, S, E, H) command.

3 Make sure the boxes for "Enable Software Breakpoints" and "Enable Execution Trace Messages" are not checked.

Leaving the Enable Software Breakpoints and Enable Execution Trace Messages boxes unchecked prevents breaking into the monitor if your software makes use of the debug registers because these two capabilities also make use of the debug register.

4 Choose RealTime→Monitor Intrusion→Disallowed (ALT, R, T, D) in case your system cannot allow breaks while running.

5 If you have been executing programs without the emulator, do not map any emulation memory yet. Instead, go forward to "Start trace analyzer." Mapping emulation memory may make it more difficult to diagnose problems.

6 If you cannot run from reset out of your own target system memory, map memory as follows:

Choose Settings→Emulator Config→Memory Map... (ALT, S, E, M).

```
range: 03ffff00..03ffffff
Use Target Rdy: yes
Use dual-ported memory: yes
```

7 Choose the OK button.

8 Use the memory window to create the following program:

```
3fffff0 90 nop    ; 80386 reset address
3fffff1 90 nop
3fffff2 90 nop
3fffff3 90 nop
3fffff4 90 nop
3fffff5 90 nop
3fffff6 90 nop
3fffff7 90 nop
3fffff8 feeb jmp $
```

This test will use dual-port memory because you can change the content of dual-port memory even when the processor is reset or there is no target power. SIMM memory cannot be changed unless the processor is running (so that it can execute the monitor), and CLK2 is present in the target system.

Continue with the instructions below. To deal with problems you may encounter, refer to the section titled, "Using emulation memory with no monitor," later in this chapter.

Reset the emulator

- Choose the Execution→Reset (ALT, E, E) command.

This step forces the processor to the reset state.

Start the trace analyzer

1 Choose the Trace→Trigger Store (ALT, T, T) command.

2 Start the analyzer, configured to store all states.

3 Choose the "Clear" button, and then the "OK" button.

Because you reset the processor in the first step, the analyzer's internal pipeline is initialized properly so the analyzer will not miss the first one or two instruction fetches.

Start the target system

1 Choose the Execution→Run... (ALT, E, R) command.

2 Select User Reset in the Run dialog box.

3 Choose the Run button.

4 Turn power on to your target system.

The Execution→Run... (ALT, E, R) from User Reset command causes the emulator to start running as soon as power is applied. The target system

should start executing normally (behave as if an Intel80386EX microprocessor is plugged in). If the target system does execute normally, skip the remaining procedures in this section and go to the section titled, "Using the Background monitor" later in this chapter. If the target system does not execute normally, continue with the next paragraph.

Determine if power and clock are present

Read the status in the "Status" window. Then continue with the paragraph appropriate for the status shown, indicated in the following table.

If the status window shows:	Begin with paragraph titled:
no power	Target power not detected
no clock	Target CLK2 not detected
still in "Reset" mode	Target RESET not released
processor wait state	Processor wait state
any other status indication	Examine execution start

Target power not detected

CAUTION

Turn power off to your target system and verify that you have connected the emulator to the target system correctly. If your connection is misaligned by one rank of pins, this problem will occur.

This prompt means no target power has been detected. Usually this is caused by a poor physical connection. Make sure the PGA and PQFP or TQFP connectors are all parallel and plugged in as far as they will go.

Use the oscilloscope to verify that power supplied to the emulator target is between 3.3 and 5 volts and is "clean" (that is, it does not oscillate by more than a few millivolts). If the voltage is below 3.3 volts, increase the current or voltage of your power supply. The emulator uses very little more current than the processor by itself, but does use a little more current for a pull-up resistor and its input to an operational amplifier. Refer to the "Power Requirements" in Chapter 9, "Specifications and Characteristics," for exact information.

If the power supply is oscillating significantly, you may need to increase the value of the bypass capacitors around the processor socket. If necessary, simply solder some bypass capacitors in parallel with those that are already in use.

Target CLK2 not detected

This prompt indicates that no CLK2 signal is being detected. This is usually caused by a poor physical connection. Make sure the connectors are parallel and plugged in as far as they will go.

Use an oscilloscope to look at CLK2 on the emulator probe. Verify the following:

- CLK2 is oscillating at the frequency you think it should be.

- CLK2 is a square wave.

- CLK2 high voltage is greater than 0.7 Vcc.

- CLK2 low voltage is less than 0.8V.

CLK2 signal integrity

Depending on your hardware, the addition of a transmission line (the emulator) will have either no effect, minimal effect, or a dramatic effect on your CLK2 signal. While the Intel80386EX has proven to be quite forgiving of the CLK2 signal it receives, it is not so forgiving when the setup and hold times referenced to CLK2 are violated. This section will show you how to determine if CLK2 is degraded noticeably by the addition of the emulator, and how to fix the CLK2 problems, if necessary.
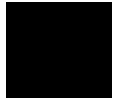
Measuring CLK2 quality

Use an oscilloscope with at least 500 MHz of analog band width and a high-impedance probe. Put the probe tip on the chip's leads you are measuring, and use a solid ground connection no more than 0.5 inch long (a spring clip, or equivalent).

Check the following chips to verify that the CLK2 signal goes TTL high (assuming the chips mentioned are TTL compatible) and remains high as long as the chip requires. Also, make sure there are no excessive overshoots or undershoots:

- The chip that generates RESET.

- The chip that generates READY#.

- The chip that tracks T1 and T2 (probably the same as the chip that generates RESET).

If the CLK2 signal fails the TTL high test in any of the above chips, refer to "Fixing a reflection problem," below.

If the CLK2 signal tests look OK, remove the bottom plastic cover from the emulator probe and check the following:

- Check the processor on the emulator. The signal is at location Q8, and a ground is at location R9. In a 5-volt system, CLK2 should reach 4.2 volts and remain there for a least 4 ns for reliable operation. The processor will run as long as CLK2 is high for at least 2 ns. CLK2 should be below

0.8 volt for at least 5 ns to satisfy specifications; the processor runs if CLK2 remains below 0.8V for at least 4 ns.

If CLK2 on the processor does not satisfy the measurements above, you may have a reflection problem (refer to "Fixing a reflection problem," below). Otherwise, connecting the emulator has caused a change in the slope of CLK2, and that change is causing timing differences between when the processor on the emulator sees the rise of CLK2 and when other chips on your board see the rise of CLK2. You may be able to fix this timing problem by following the steps in "Fixing a reflection problem," or you may need to modify your logic as follows:

- READY# should toggle only at the start of T2.

- If you use LBA#, you must add a wait state because LBA# can become valid 1 ns after the setup time required by READY# (at CLK2 = 50 MHz).

- RESET should be generated by a chip that can guarantee the 4-ns hold time required by the processor.

- Only recognize ADS# at the start of T1.

Fixing a reflection problem

Background: Transmission line characteristics of CLK2.

In a 5-volt system, CLK2 must be greater than 4.2 volts for 4 ns, and less than 0.8 volt for 5 ns. At 50 MHz, this means you have 11 ns for rise-time and fall-time transitions, jitter, and any other signal parameters. However, most target systems use parts that give CLK2 a rise time and fall time of less than 2 ns instead of the 5 ns available. The following table shows the minimum length of a trace when you must consider it a transmission line:

Rise Time or Fall Time	Length Where a Trace Becomes a Transmission Line (assuming FR-4 PC board)
10 ns	9.3 in.
5 ns	4.6 in.
4 ns	3.7 in.
3 ns	2.8 in.
2 ns	1.9 in.
1 ns	0.9 in.

The emulator adds about 2 inches to the CLK2 line when it is attached. The additional length can cause a line that is not a transmission line on your board to act like a transmission line when the emulator is attached. So a board that works fine without the emulator can start failing when it is attached to the emulator simply because the CLK2 line becomes an unterminated transmission line. The following diagram shows a typical CLK2 line with reflection problems:

50% voltage "shelf" due to reflections.

64789M03

Changing termination on the emulator

By default, the emulator does not terminate CLK2. This is the correct termination when a series termination scheme is already in place on the target board and the processor is the only part on the line, or when CLK2 is terminated on the target board by parallel termination. In some cases, adding a parallel termination at the end of the emulator's CLK2 trace will fix a reflection problem. To make this easier, there is a place at the bottom of the emulator where you can bridge a short gap and add a termination.

Heat both the solder dot and the nearest side of the 68-ohm resistor with a soldering iron to create a solder bridge (you can remove the solder bridge by using solder wick). The termination is a 68-ohm resistor in series with a 68-pF capacitor. Those values were chosen to provide a little overshoot and undershoot, which allows for a slightly faster edge speed.

64789M04
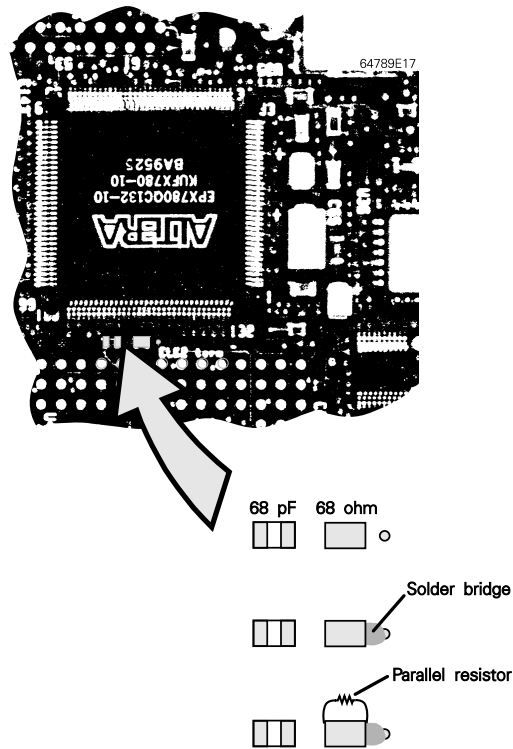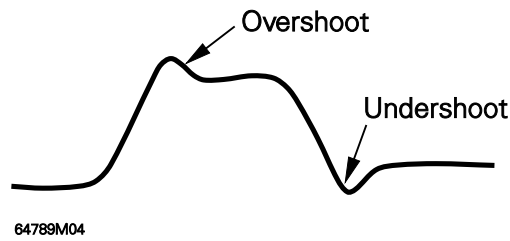
If the solder bridge causes too much overshoot, try reducing the value of the 68-ohm resistor by putting another resistor in parallel with it. Refer to the diagram on the preceding page to see where to connect the parallel resistor. Suggested values for the parallel resistor are shown in the table below:

Parallel Resistor Values	Resulting Resistance
400 ohms	58 ohms
200 ohms	50 ohms
100 ohms	40 ohms

If you still have too much undershoot after adding the parallel resistor, you probably cannot use this system. Remember, however, that the processor can work with relatively narrow clocks. The important point is to ensure CLK2 is within specifications on your board.

Changing termination on your PC board

Unfortunately the most common way to repair the overshoot problem is to convert a series termination to a parallel termination for the CLK2 line. This can only be done on your board, not the emulator. The following diagram shows a typical series termination. See if your board uses this:
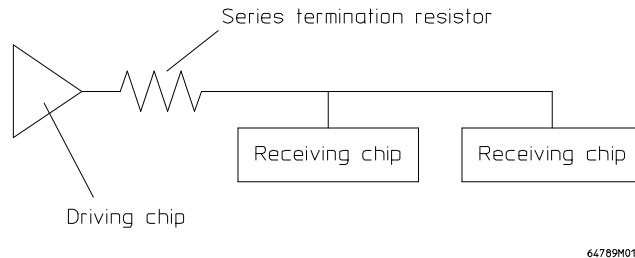
To convert your series termination to a parallel termination, add a capacitor/resistor at the end of the CLK2 trace farthest from the CLK2 driver. If you have a series resistor following the CLK2 driver, short it out.
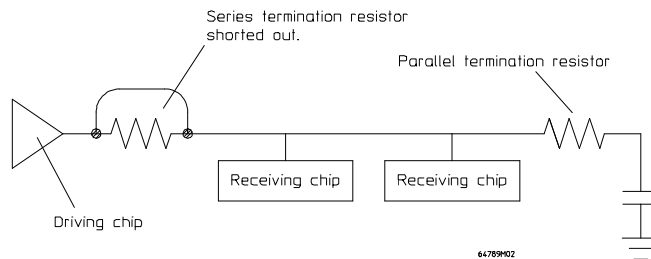
The reason it is usually necessary to convert a series termination to a parallel termination is that a series termination is guaranteed to cause the "shelf" shown in the earlier diagram when a stub is added to the line (which is what physically happens when the emulator is attached).

The value of the resistor is the same as the impedance of the CLK2 trace: usually between 40 ohms and 60 ohms. If the chip driver can drive the resistance to ground (an unusual situation), do not use the capacitor.

Checks to make when the board doesn't run correctly

The following is a list of problems you may see when an emulator is attached to a target system:

RC time constants

If you have a resistor and capacitor on a line that is attached to the processor, the emulator will add capacitance to the line, changing the RC time constant of the line. Be conservative in your estimations of the time constant, or calculate the effect of the added capacitance. Refer to the HP 64789C AC electrical specifications listed in Chapter 9, "Specifications and Characteristics," for the exact capacitance added.

Pull-up and pull-down resistors

If you use pull-up or pull-down resistors on any lines attached to the processor (and those lines do not need to be driven by the processor), there may be a slightly different current load on the line than simply the load of the processor. Also, remember that even if I_{ih} and I_{il} are in the micro-amp range, the load may be much greater when the voltage is in the uncertainty region. This added load can cause problems with pull-up resistors. Be conservative with your pull-up and pull-down resistor values. If you are attaching them to lines with high impedance inputs, there is no significant additional power consumption for using a 1K ohm pull-up resistor than for using a 10K pull-up resistor, and you will gain a lot of noise immunity by using the smaller resistor value. A good rule-of-thumb for TTL-level logic is to use 1K pull-ups and 100-ohm pull-downs because the noise margin for a logic low (0.8 volts) is less than that for a logic high (>2 volts).

Worst case design

Because attaching an emulator to the processor adds capacitive loading, it is important to use worst-case design methods for reliable operation with any emulator or preprocessor. For example, if your design causes a signal to just barely meet the setup time requirements of a clock, adding a preprocessor that causes even a 0.5 ns change in clock signal timing can cause problems. The general rule is that if a target system is designed using worst-case methods, it will typically work with emulators and preprocessors, and even oscilloscope probes.

QFP adapter not solidly on part

Sometimes the PQFP adapter can "slide up" a bit and cause problems. Try simply pushing down on the adapter to see if problems disappear. If this solves your problems, be sure to use the "legs" on the adapter so that they go under the PQFP Intel80386EX on your target system board.

Target RESET not released

1 Choose Trace→Halt (ALT, T, H).

2 View the trace list.

If the trace list shows no cycles were executed, RESET was never released. Investigate the conditions that must be satisfied before the target system will release the RESET line and use the logic analyzer or oscilloscope to determine why these conditions did not occur. For example, in a multiple-board system, an external master may hold the processor in the reset state while it uses DMA to do a checksum of memory. Because this emulator does not support DMA accesses into emulation memory, the checksum will fail if code is in emulation memory hardware. Consequently the external master may choose to not release the RESET line.

If there are any cycles shown in the trace list, RESET was released, and then reasserted. In this case, go to the paragraph titled, "Examine execution start."

Processor wait state

This status indicates that the processor started a read cycle or a write cycle but did not complete it. This means that the READY# signal was not asserted (high) correctly. Check the timing.

Examine execution start

After problems with the power and clock have been fixed, look at the trace by displaying the trace window. The trace list should start with address 03fffff0h and be similar to the following:

```
0 SEQ 03fffff0 9090 NOP                                           ----------- TG
     =03fffff1      NOP
1    03fffff2 9090 NOP                                                  2.82uS
     =03fffff3      NOP
2    03fffff4 9090 NOP                                                  2.84uS
     =03fffff5      NOP
3    03fffff6 9090 NOP                                                  2.84uS
     =03fffff7      NOP
4    03fffff8 feeb JMP   03FFFFF8H                                      2.82uS
5    03fffffa 0000 -   0000H      code read                            2.84uS
6    03fffffc 0000 -   0000H      code read                            2.84uS
7    03fffff8 feeb JMP   03FFFFF8H                                      2.82uS
8    03fffffa 0000 -   0000H      code read                            2.84uS
9    03fffffc 0000 -   0000H      code read                            2.84uS
```

You may need to choose Trace→Halt (ALT, T, H), and from the Trace window's control menu, choose the Display→Bus Cycle ON (ALT, -, D, B) command to obtain the display of execution start.

☐ Check to see that the address of the first state in your trace list is 3fffff0.

☐ Check to see if the data that was fetched is correct.

If the data fetched for the first address is not correct

☐ Check to see if your target system has special circuitry that needs to be active in order for the first fetch to be correct. For example, many target systems do not have memory at high address space. Instead, they have a special circuit that forces a jump instruction on the data bus as the first instruction after a RESET.

☐ Make sure you set the emulation microprocessor for 'no intrusion' (see "Configure the emulator for no intrusion" earlier in this chapter). If not, the bond-out will emit an extra fetch from 3fffff0, enter the monitor, and then fetch again from address 3fffff0. If this is the case, map memory at 3fffff0, and insert the op code fetched by your circuitry.

☐ Make sure monitor intrusion is disallowed while running from reset (RealTime→Monitor Intrusion→Disallowed (ALT, R, T, D)). Otherwise, the first cycle of the emulator may be used to read memory to update a display instead of being used to fetch the reset address.

☐ The emulator adds a few states of delay to the standard RESET cycle, and this delay may be affecting your circuit. Because Intel80386EX RESET-to-ADS times are fairly long, the design of the emulator anticipates that any such circuits will key off of the ADS, and not count cycles. If your target system circuit counts cycles, you may need to add one or more cycles to use the emulator. Furthermore, you will not be able to use the 'enable software breakpoints' and 'enable execution messages' options from reset because using these options causes a delay from the first to the second occurrence of ADS.

☐ See if your target system circuitry uses DMA to place the data into memory prior to the first fetch. The emulator allows DMA (HOLD) to occur at all times (even when the emulator is executing in the background monitor) so the emulator should not effect DMA transactions. However, the additional states of RESET may confuse synchronization circuitry in your target system. Read the previous paragraph with your DMA in mind.

☐ Check that the additional delay for ADS is not causing problems for circuitry in your target system. If the delay is causing problems, you may need to have your system add a wait state. Refer to the section titled, "Timing specifications comparing the emulator with the Intel80386EX," later in this chapter, and to Chapter 9, "Specifications and Characteristics," for detailed timing information.

☐ Check that CLK generation (from the falling edge of RESET) is correct. If not, invert it.

☐ Verify sufficient hold time is maintained for the rise of CLK2 to the fall of RESET even with the drop in CLK2 qualify when the emulator is connected. See "CLK2 signal integrity."

☐ Check that your data meets the additional setup time required by the emulator. If it does not, try adding a wait state.

If the data fetched after the first address is not correct

Usually if the first data fetched is correct, all data fetched after it will be correct, too. However if that is not true:

☐ Check to see if the fetches that are correct have a different number of wait states than those that are not correct. If they do:

- Verify sufficient hold time is maintained for the rise of CLK2 to the fall of RESET even with the drop in CLK2 qualify when the emulator is connected. See "CLK2 signal integrity."

- Check that the additional delay due to use of the flexible cable is not causing problems in your target system circuitry. If it is causing problems, you may need to have your target system add a wait state. Refer to the section titled, "Timing specifications comparing the emulator with the Intel80386EX," and to Chapter 9, "Specifications and Characteristics," for detailed timing information.

- Check CLK generation (from the falling edge of RESET). If it is not correct, invert it.

- Check that your data meets the additional setup time required by the emulator. If it does not, you may need to add a wait state.

☐ Check to see if there is some pattern to the 'bad' read states. For example, see if there are HOLD states just before or after the bad reads? This might indicate more places for you to look for timing problems.

If you cannot write/read memory (or I/O) correctly

☐ Check the reset timing to make sure that you are detecting phase 1 and 2 correctly.

☐ If data fetches work but memory reads or writes, and I/O cycles do not occur normally, you may have a timing problem due to different decoding of those cycles in your target system. Check the items listed in the paragraph titled, "If the data fetched after the first address is not correct," above.

If the program runs correctly for a while and then dies (assuming that it does not die when the processor is plugged in)

Read the status in the "Status" window. Then continue with the paragraph appropriate for the status shown, indicated in the following table.

If the status window shows:	Begin with paragraph titled:
HALTED	Program halts, no intrusion
SHUTDOWN	Program shuts down, no intrusion
No bus cycles	Program stops, no intrusion
any other status indication	Program dies, no intrusion

Program halts, no intrusion

The only way a program can halt is to execute the hlt opcode. To observe where hlt is being executed, bring up the source window. If no source lines appear, use the window-specific menu; choose Display→Mixed Mode (ALT, -, D, M).

The source window will show the address of the opcode. Check your map file and listings to determine whether or not the code should have been executed. If there is no code in the source window (or there is no hlt at that address), then the target system is having problems fetching data; check the items listed under the paragraph titled, "If the data fetched after the first address is not correct."

- If the hlt instruction is in your code, determine if that code should have been executed (for example, perhaps you forgot to hook up an interface cable within your target system before you powered up the system).
- If the hlt instruction is not in your code, try replacing the emulator with the target processor.
- If the problem does not occur when using the target processor, the emulator is probably having problems reading I/O or memory. In this case, go to the paragraph titled, "If you cannot write/read memory (or I/O) correctly," earlier in this chapter.

If you have similar problems when the target processor is plugged in, see if the problem could be a programming problem. Did the target system act this way before the emulator was plugged in? Were any connections unplugged when inserting the emulator?

If the answer to the above questions is "no", you may have a problem with excessive ringing on the lines the emulator drives; they may have driven your circuitry into latchup (which can occur if the ringing rises above VCC=+0.7V for 5 ns or more). With the emulator plugged in again, use the oscilloscope to check for ringing on the address, data, and control lines. You may need to rethink your physical connection to the emulator. Refer to the paragraph titled, "Make physical connection between emulator and target system," earlier in this chapter. If you cannot change the physical connection to the emulator, try adding some small capacitors on the lines that ring too much.

Program shuts down, no intrusion

The Intel80386EX enters "shutdown" mode when it tries to execute the "double fault" routine twice. Likely causes of this event include:

- reading bad data from the GDT or LDT.
- getting bad vectors from an interrupt.
- reading bad data from the IDT.

To determine the cause of the problem, set the analyzer up to trace until shutdown occurs, as follows:

1 Choose the Trace→Trigger Store... (ALT, T, T) command.

2 In the Trigger Store Trace dialog box, select trigger end, and choose the OK button.

3 Choose Trace→Until Halt (ALT, T, U).
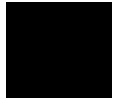
4 Turn off power to your target system and then turn it on again, and wait until the shutdown occurs.

5 When shutdown occurs, choose Trace→Halt (ALT, T, H).

Display the trace list and view the states leading up to the shutdown (state -1). If the trace list indicates an interrupt vector was fetched a few states prior to the shutdown, check to see if the vector was correct. If the vector was not correct, there may be a timing problem related to decoding and responding to the interrupt acknowledge cycle. If the vector was correct, there is likely a problem reading memory; refer to the paragraph titled, "If you cannot write/read memory (or I/O) correctly," earlier in this chapter.

Program stops, no intrusion

It is a good idea is to only change READY# at the start of phase 2 because READY# is only sampled at the start of phase 1.

Another possibility is that on external device is currently asserting HOLD and not releasing it. The emulator can only decode this as "Bus Hold" if you have informed it that Port 1, bit 7 is programmed as HOLDA. To do this, set up the emulator configuration "emplcfg = exp/dir" to show how your program sets them up.

Program dies, no intrusion

Before you spend a lot of time characterizing the problem, check your physical connection, as discussed in the paragraph titled, "Make physical connection between emulator and target system," earlier in this chapter. Also check the paragraph titled, "If the data fetched after the first address is not correct" and "CLK2 signal qualify," earlier in this chapter.

If you have done all of the checks listed above, you will need to see what happens at the point where the program stops operating correctly. Generally, you will find a timing problem, but it may be very difficult to find.

Using Emulation Memory with no Intrusion

This step in the procedure uses some emulation memory to verify that the target system works with emulation memory.

Specifying a CLK2 speed

By default, the emulator assumes your CLK2 speed is greater than 42 MHz, which causes it to add wait states when accessing emulation memory. No wait states are ever added when accessing I/O or target memory. If you wish, you can enter your CLK2 speed with the configuration command, "cf clk2=<speed>" and the emulator will decide whether or not it must add a wait state, according to the following specifications:

- CLK2 < 42 MHz - Add no wait states.

- CLK2 > 42 MHz - Add one wait state.

Mapping the memory

1 Determine an address space that can be replaced with emulation memory.

2 Choose Settings→Emulator Config→Memory Map... (ALT, S, E, M).

3 Within the memory map, replace system memory with emulation memory. If the target system would normally generate the READY# signal for the address space, select the "Use target RDY:" option so that any state machines in your target system will remain synchronized with the processor.

If you are using paging, note that the address range of the memory is a physical address, not linear.

Loading the memory

1 Choose Execution→Reset (ALT, E, E).

2 Power up your target system.

3 Choose Execution→Break (ALT, E, B).

4 At this point you can download code to the emulation memory with the File→Load Object... (ALT, F, L) command. (This assumes you are receiving the CLK2 signal, see above.)

The emulator is placed in the reset state before the target system is powered up to prevent the target system from attempting to run immediately when it is power up.

If you are mapping emulation memory over addresses in target-system ROM, you must load the emulation memory with the ROM code.

Run your program with emulation memory

1 Turn off power to your target system.

2 Choose Execution→Run... (ALT, E, R).

3 Choose Trace→Until Halt (ALT, T, U).

4 Turn on power to your target system.

This step runs the target program from emulation memory. The analyzer traces target system execution until you halt the trace.

If the target system executes with no problems, go to the paragraph titled, "Using the Background Monitor."

If the target system runs but its power-on self test indicates an error, one of the following is the likely cause of the problem:

- The self test failed because some of the memory address space which is normally found in dynamic memory was mapped to emulation memory, which is static memory. (In some target systems, if any portion of address space in a range residing in dynamic memory can be written to and read, the refresh system is not turned on. The address space in emulation memory could be written to and read so refresh was not turned on, failing to refresh the portion of the address space residing in dynamic memory.

- The self test failed because of a checksum error. This probably means that your loaded program has 'unprogrammed' bytes in it, and the checksum routine assumes these bytes will be 00's or ff's. If this is the case, set the emulation memory first to the appropriate value (all 00's or all ff's), and then reload your program and try again.

- If the target system halted, shutdown, or began executing in unknown address space, the problem is probably that you should have used the "Use target RDY" option when you mapped memory. Select the memory map and use the "Use target RDY" option for the emulation memory address space.
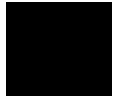
- If the status indication is "waiting", no READY# signal was generated (when you accessed emulation memory). You should not have used the "Use target RDY" option when you mapped this memory address space, or you are using 4-Mbyte SIMMs and your system did not have READY# true after the first cycle (refer to the paragraph titled, "Specifying a CLK2 speed," earlier in this chapter.)

Using the Background Monitor

If your target system does not need to service interrupts when you are in the monitor, you should use the background monitor (the default monitor) because it is easier to use. You use the monitor when:

- You use the Execution→Break command, or break into the background monitor as the result of executing a breakpoint.

- You are single-stepping code in your program.

- You configure real-time for "Monitor Intrusion→Allowed", and you are viewing a window that uses monitor routines to update its display content, such as the I/O, source, memory, or GDT window. If the content to be updated is mapped to dual-port emulation memory, the monitor is not needed to update it.
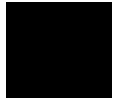
Emulation with the background monitor

1 Run your target system; then choose Execution→Break (ALT, E, B).

☐ Use the memory window to look at memory provided by your system. If some of the memory space that is to contain code contains all 0's or all 1's instead, you cannot use the background monitor (memory refresh activity has failed to occur, or some other hardware has reset your memory system).

2 If all memory content appears to be OK, choose Execution→Run (ALT, E, U).

☐ See if the target system runs OK. If it does, try Execution→Break and Execution→Run several times. You may find that your target system will tolerate not servicing interrupts only if you happen to break at certain locations in your code, but not at all locations. It is common to discover that your target system can safely break within certain interrupt routines, but no place else.

Using the Foreground Monitor

In order to use a foreground monitor, there are two items you must provide: monitor address, and monitor selector. You can see these items in the dialog box that appears when you choose Settings→Emulator Config→Monitor...(ALT, S, E, O).

Monitor address

You need to provide a physical and linear address space (16 Kbytes) to contain the monitor. It is OK if a self-test destroys the content of this address space because prior to entering the monitor, the emulator checks it for validity and reloads it, if necessary. If you place the monitor within the lowest 1 Mbyte of address space (address between 0 and 0fffff), you can use the foreground monitor while in real mode (prior to entering protected mode). If the monitor is not located in the lowest 1 Mbyte of address space, you can still break (etc.), but the background monitor will automatically be used.

If you are not using paging, go to the paragraph titled, "Monitor Selector".

Considerations when using the foreground monitor and paging

The physical address and linear address must be identical. Furthermore, there must be a valid page table (and therefore page directory) for the associated linear addresses, but the page table entry does not need to be valid. The emulator will update it prior to entering the monitor. Generally, this means that you will need to find an unused physical address with an identical linear address and ensure there is a valid page directory entry pointing to an allocated page table for that linear address.

Monitor selector

The monitor selector is a selector in your GDT (Global Descriptor Table) that you are not using. Note that the monitor selector must be a multiple of 8 (ending in 0 or 8). You do not need to put any data into the GDT table; before entering the monitor, the emulator will update the table entries automatically to point to the monitor.

The best way to make room in your GDT is to rebuild your table with an empty selector. If you can do this, rebuild your table with an empty selector and go to the paragraph titled, "Executing the foreground monitor". If you cannot rebuild your table with an empty selector, proceed with the next paragraph.

Manually making room in the GDT

The objective of this step is to increase the size of the table by eight bytes. If the table is static, you can:

1 Map emulation memory over the GDT.

2 Copy the data using the Memory Window Utilities→Image (ALT, -, U, I) command.

3 The LGDT command references a "GDT pointer", containing the base of the GDT and the limit of the GDT. Use the Memory Window Utilities→Image (ALT, -, U, I) command to copy this into emulation memory as you did with the GDT itself, and then increase the limit by 8.

If the GDT is loaded in some other way, use this same idea (suitably modified) to increase the size of the table by eight bytes.

Executing the foreground monitor

At this point, both the target system and the emulator are configured appropriately. Simply use the emulator. When you are executing in the foreground monitor, interrupts will be serviced as if the program were running normally. If an interrupt routine takes a long time (or does not return), the status window will show "MONITOR INTERRUPTED BY TARGET."

In order to either trace your interrupt routines, or to avoid tracing your interrupt routines, refer to the paragraph titled, "Tracing Monitor Cycles" in the windows online help for the Real-Time C Debugger.

Dealing with Keep-Alive Circuitry by Customizing the Foreground Monitor

There are three types of "keep-alive" circuitry in common use (see below). Only one of these three types require modification of the foreground monitor:

Bus-cycle monitor

This type of keep-alive circuit simply verifies that bus cycles are occurring. Because the foreground monitor's bus cycles are visible to the target system, bus-cycle keep-alive circuits should be updated with no problem.
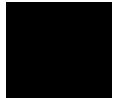
Interrupt-response checking

This type of keep-alive circuit generates an interrupt and verifies that the interrupt is serviced correctly. Because interrupts are serviced while in the foreground monitor, an interrupt-response keep-alive circuit should operate with no problem.

Idle-loop detect

This type of keep-alive circuit requires a specific memory or I/O address to be accessed in order to prevent the keep-alive circuit from resetting the processor. Because the code to access the watchdog address is not being executed, you will have to modify the monitor to prevent watchdog shutdown. There are two possible ways to deal with the problem: (1) turn off the keep-alive timer on entry to the monitor and re-enable it on exit from the monitor, or (2) have the monitor's idle-loop access the address.

The source code for the monitor is named "mon.asm". Look for the comments:

USER_MODIFICATION

within the source code to find the appropriate places to make modifications. Be sure to read the comments at the top of the mon.asm file before making any changes.

To disable and re-enable the keep-alive timer

1 Disable the timer after the FG_IDLE_ENTRY: label (there is a USER_MODIFICATION comment at this point).

2 Re-enable the timer prior to the "icebp" command prior to the RESTORE_CREGS: label. (There is another USER_MODIFICATION comment this point, too).

To access the keep-alive address within the idle loop

- This is done at the IDLE_LOOP: label in the mon.asm file.

Using Software Breakpoints and Execution Messages

Unless your target system needs to use the debug registers, you can easily use the software breakpoints. Simply enable them in the Hardware Configuration dialog box. Choose Settings→Emulator Config→Hardware... (ALT, S, E, H).

When software breakpoints are enabled, there is a longer delay from the release of RESET to initiation of the first cycle. If this delay causes problems, refer to the paragraph titled, "Start target system," earlier in this chapter. If your program attempts to modify the debug registers, the emulator will break into the monitor and inform you of the problem.

To use the execution messages, simply enable them in the Hardware Configuration dialog box, as accessed above. Use of the execution messages will also cause the first cycle after RESET to be delayed. In addition, whenever a jump occurs, the processor will appear to have an additional "idle" cycle. In reality, it is emitting the target address of the jump for the trace analyzer, but to the target system hardware, it merely looks like an idle state. This should not cause problems for your target system unless you have an extremely tight timing loop in your code.
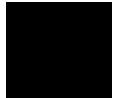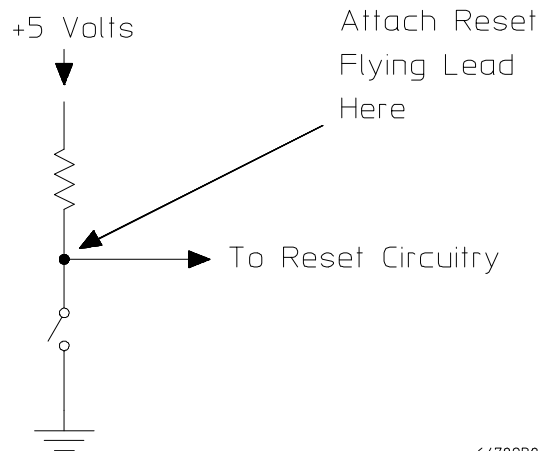
Using the Reset Flying Lead

The Intel80386EX does not have a 'reset out' line. This is unfortunate because typical target systems have hardware that must be reset whenever the processor is reset in order for the power up sequence to complete correctly. Although you can reset your target system by turning its power off and then on again, this procedure is inconvenient. A reset button installed in your target system can be another way to reset the system. It is most convenient, however, to simply choose Execution→Reset (ALT, E, E) and have the Intel80386EX and any associated target system hardware all reset at the same time.

In order to use this command and have your target system reset at the same time that the emulation processor resets, you must attach the "Reset Flying Lead" to your target system.

Reset switch method

If your system has a reset button, find out if it grounds a signal that is pulled up by a resistor. If it does, simply attach the Reset Flying Lead to the pull-up resistor as shown in the diagram.

```
+5 Volts                Attach Reset
                        Flying Lead
                        Here


        ≶


        •——————————————▶  To Reset Circuitry

        o
        /
        o


        ⏚                              64789B02
```

Power-on circuit method

If the power-on reset circuit has a simple resistor-capacitor delay, connect the Reset Flying Lead to the capacitor as shown:

64789B03
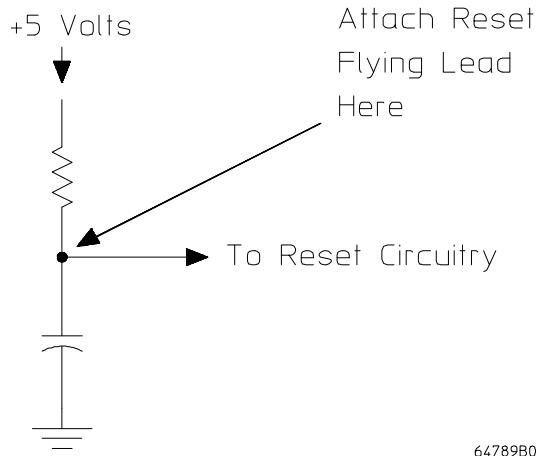
General Information about the Emulator

Timing and loading specifications comparing the emulator with the Intel80386EX

Refer to Chapter 9, "Specifications and Characteristics," for a listing of detailed information that compares each emulator signal with its same signal in the Intel80386EX microprocessor.

Issues relating to the code that enables expanded I/O space

The following code is used to initialize the expanded I/O space on the Intel80386EX microprocessor. It is run as part of the system bootup routine:

```
IN            AL, 023H
MOV           AX, 08000H            ; Enable expanded I/O space
OUT           REMAPCFGH, AL         ; and unlock the re-map bits.
XCHG          AL, AH
OUT           REMAPCFGL, AL
OUT           REMAPCFG, AX
```

The microprocessor must not execute any extra I/O cycles while it is executing the above code. If extra I/O cycles are executed while the microprocessor is executing the above code, it will not allow access to the expanded I/O space when it has finished.

To execute the code that enables expanded I/O space

1 Choose RealTime→Monitor Intrusion→Disallowed (ALT, R, T, D).

2 Power up the target system.

3 Choose Execution→Run... (ALT, E, R).

4 Select User Reset in the Run dialog box, and choose the OK button.

5 Choose RealTime→Monitor Intrusion→Allowed (ALT, R, T, A).

```
IN              AL, 023H
MOV             AX, 08000H            ; Enable expanded I/O space
OUT             REMAPCFGH, AL         ; and unlock the re-map bits.
XCHG            AL, AH
OUT             REMAPCFGL, AL
OUT             REMAPCFG, AX
.....   ← Put breakpoint here
```

The above procedure ensures that the emulator will not execute any extra I/O cycles when executing the code that enables expanded I/O space during the system bootup routine.

If you wish to single-step through your bootup routine, HP recommends you use the RTC breakpoint command (Breakpoint→Edit...) to put a breakpoint at the end of the I/O space code. For example:

Then after the code has run and the emulator has broken into the monitor, you can choose RealTime→Monitor Intrusion→Allowed (ALT, R, T, A), and then single-step through the remaining instructions of your bootup routine.

If you must single-step through the entire bootup routine with RealTime→Monitor Intrusion→Allowed (ALT, R, T, A), iconify all RTC interface windows except the Source window and the Register windows. The RTC interface asynchronously breaks processor execution to perform timed window updates. If it performs a window update during execution of the code that enables expanded I/O space, the target microprocessor will not be able to access the expanded I/O space after the execution is finished.

Part 2

Service

5
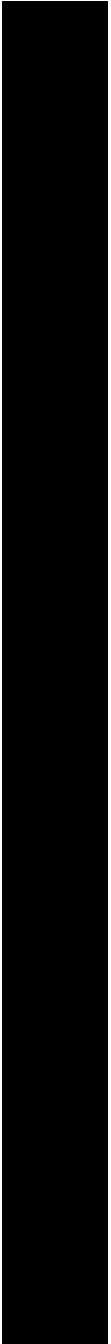
Installing/Updating HP 64700
Firmware

Installing/Updating HP 64700 Firmware

You need to update the emulator firmware if:

- You ordered the emulator probe and the HP 64748C emulation control card separately.

- You are using an HP 64748C that has been previously used with a different emulator probe.

- You are upgrading to a newer version of the emulator.

- You received a firmware update disk from HP.

If you ordered the emulator probe and the HP 64748C emulation control card together, you can ignore this chapter. The control card already contains the correct firmware for the emulator probe.

This chapter shows you how to install or update HP 64700 firmware.

Note

If you are using an HP 64700A, it must contain the optional Flash EPROM memory card before you can install or update HP 64700 system firmware. Flash EPROM memory is standard in the HP 64700B card cage.

The firmware, and the program that downloads it into the HP 64700, are included with the debugger on floppy disks labeled HP64700 EMUL/ANLY FIRMWARE.

The steps to install or update HP 64700 firmware are:

- Step 1. Connect the HP 64700 card cage to your PC.

- Step 2. Install the firmware update utility.

- Step 3. Run PROGFLASH to update HP 64700 firmware.

- Step 4. Verify emulator performance.

The above steps are described in detail on the following pages.

Step 1. Connect the HP 64700 card cage to your PC

1 Set the COMM CONFIG switches for RS-232C communication. To do this, locate the DIP switches on the HP 64700 rear panel, and set them as shown below.

You may wish to make a note of the COMM CONFIG switch settings before you change them. That way, you can restore the switch settings when you finish updating the firmware.
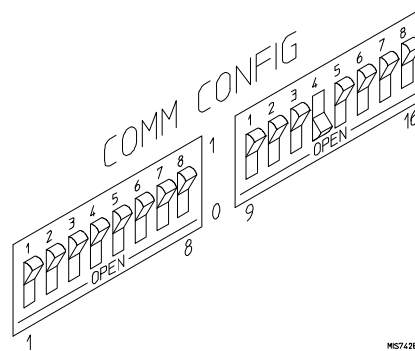
Switches 12 and 13 are set to 1 and 0, respectively. This sets the RTS/CTS hardware handshake, which is needed to make sure all characters are processed.

Switches 1, 2, and 3 are set to 0. This sets the baud rate to 9600.

Switch 16 is the LAN/RS-232 switch.

The switch settings are read during the HP 64700 power up routine.

2 Connect an RS-232C modem cable from the PC to the HP 64700 (for example, an HP 24542M 9-pin to 25-pin cable or an HP 13242N 25-pin to 25-pin cable).

You can also use an RS-232C printer cable, but if you do, you must set COMM CONFIG switch 4 to 1.

Insert the 25-pin male connector of the cable into PORT A on the HP 64700 rear panel. See which COM port the cable is connected to on your PC. Some PCs label COM ports as Serial ports (eg: COM1 may be labeled Serial A).

3 Turn ON power to the HP 64700.

The power switch is located on the lower left-hand corner of the front panel. The power lamp at the lower right-hand corner of the front panel will light.

4 Start MS Windows in the 386 enhanced mode.

To ensure your PC is running in the 386 Enhanced Mode, double-click the PIF Editor in the Main or Accessories window. Choose the Mode pulldown in the PIF Editor menu bar. A check mark should be beside "386 Enhanced" in the Mode pulldown.

5 Verify RS-232 communication by using the Terminal program that is found in the Windows "Accessories" group box.

Double-click on the "Terminal" icon to open the Terminal window. Then, choose the Settings→Communications... (ALT, S, C) command, and select: 9600 Baud Rate, 8 Data Bits, 1 Stop Bit, Parity None, Hardware Flow Control, and the PC's RS-232 interface connector to which the RS-232 cable is attached (example: COM1). Choose the OK button.

You should now be able to press the Enter key in the Terminal window to see the HP 64700's Terminal Interface prompt (for example, p>, R>, M>, U>. A -> prompt indicates the present firmware does not match the emulator probe, or there is no probe connected). If you see a prompt, you have verified RS-232 communication. If you do not see a prompt, refer to "If you have RS-232 connection problems" in Chapter 6.

6 Exit the Terminal window.
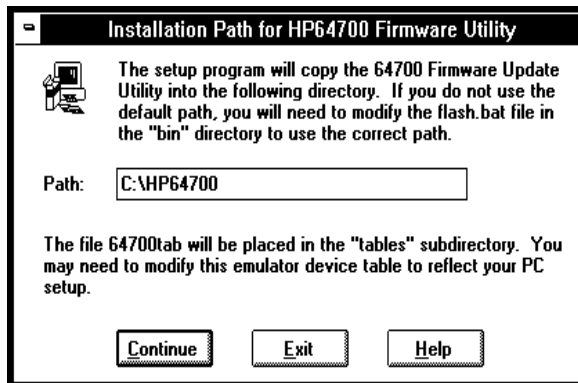
Step 2. Install the firmware update utility

The firmware update utility and emulation and analysis firmware require about 1.5 Mbytes of disk space.

1 Start MS Windows in the 386 enhanced mode.

2 Insert HP64700 EMUL/ANLY FIRMWARE Disk 1 of 2 into floppy disk drive A or B.

3 Choose the File→Run... (ALT, F, R) command in the Windows Program Manager. Enter "a:\setup" (or "b:\setup" if you installed the floppy disk into drive B) in the Command Line text box.
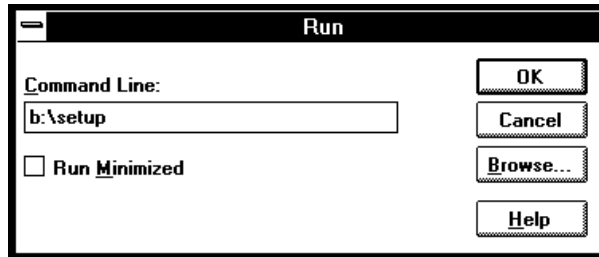
Then, choose the OK button. Follow the instructions on the screen.

You will be asked to enter the installation path. The default installation path is C:\HP64700.

Wait until the Setup Exit Message dialog box appears. This indicates installation of the firmware update utility is complete.

4 After completing the installation, use the editor of your choice to edit the C:\CONFIG.SYS file to include these lines:

```
BREAK=ON
FILES=20
```

BREAK=ON allows the system to check for two break conditions: CTRL+Break, and CTRL+c.

FILES=20 allows 20 files to be accessed concurrently. This number must be at LEAST 20 to allow the firmware update utility to operate properly.

5 If you installed the files in a path other than the default (C:\HP64700), edit the C:\AUTOEXEC.BAT and C:\HP64700\BIN\FLASH.BAT files, as follows:

- Edit AUTOEXEC.BAT to set the HP64700 and HPTABLES environment variables. For example:

```
SET HP64700=C:\<installation_path>
SET HPTABLES=C:\<installation_path>\TABLES
```

- Edit FLASH.BAT to identify the location of PROGFLAS.EXE. For example:

```
C:\<installation_path>\PROGFLAS.EXE
```

6 The default <installation_path>\TABLES\64700TAB file contains entries to establish communications connections for COM1 and COM2. The content of this file is:

```
EMUL_COM1 unknown COM1 OFF 9600 NONE ON 1 8
EMUL_COM2 unknown COM2 OFF 9600 NONE ON 1 8
```

7 You can edit this file to identify your emulator, if desired:

```
EMUL_COM1 i386ex  COM1 OFF 9600 NONE ON 1 8
EMUL_COM2 unknown COM2 OFF 9600 NONE ON 1 8
```

8 If you are using the COM3 or COM4 port to update your firmware, you need to edit the <installation_path>\TABLES\64700TAB file. Either add another line or modify one of the existing lines. For example:

```
EMUL_COM3 i386ex  COM3 OFF 9600 NONE ON 1 8
EMUL_COM4 unknown COM4 OFF 9600 NONE ON 1 8
```

9 Exit Windows and reboot your PC to activate the changes made to the CONFIG.SYS and AUTOEXEC.BAT files (CTRL+ALT+DEL). Installation of the firmware update utility is now complete.

Step 3. Run PROGFLASH to update HP 64700 firmware

1 Start MS Windows in the 386 enhanced mode.

2 If the "HP 64700 Firmware Utility" group box is not opened, open it by double-clicking the icon.

3 Double-click the "PROGFLASH" icon. (You can abort the PROGFLASH command by pressing CTRL+c.)

4 Enter the number that identifies the emulator you want to update. For example, enter "1" if you want to update the emulator identified by the line, "1 emul_com1 my_emul."

5 Enter the number that identifies the product whose firmware you wish to update. For example, if the HP 64789C product is listed as number 13, enter "13".

```
    Product
1   64782
2   E3490
     .
     .
13  64789C
     .
```

6 Enter "y" to enable progress messages.

The PROGFLASH program downloads code from files on the host computer into Flash EPROM memory in the HP 64700. During this download, you will see messages like:

```
Rebooting HP64700...with init -r

Downloading flash programming code: '/hp64700/lib/npf.X'
Checking Hardware id code...
Erasing Flash ROM
Downloading ROM code: '/hp64700/update/64789C.X'
    Code start 280000H
    Code size 29ABAH
Finishing up...

Rebooting HP64700...
Flash programming SUCCEEDED
```

You can display firmware version information and verify the update by choosing the Help→About Debugger/Emulator... (ALT, H, D) command in the Real-Time C Debugger.

Step 4. Verify emulator performance

- Perform the procedure titled, "To verify the performance of the emulator" in Chapter 6 of this manual.

6
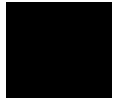
Solving Problems

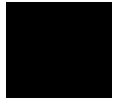What to do when the emulator does not behave as expected.

Sometime during your use of the emulator, you will encounter a problem that is not adequately explained by an error message or obvious target system symptoms. This chapter explains how to solve some of these problems.

To verify the performance of the emulator

1 If you have a special configuration or session in progress, save it now. This procedure will cause your session to be lost.

2 Turn off power to the HP 64700 Card Cage.

3 Plug the emulator probe into the Demo Board. (See Chapter 3.)

4 Connect Demo Board power cable from the Demo Board to the HP 64700 Card Cage front panel. (See page 19.)

5 Turn on power to the HP 64700 Card Cage.

6 Establish communication with the emulator from your host or ASCII terminal and obtain a prompt (such as **R>**). (See Chapter 2.)

7 Enter: **pv 1** <return>

There are different hardware system configurations for the HP 64700 Series system. For information on hardware configurations, refer to the HP 64700 Installation/Service manual.

Examples

If you are using a LAN, you can use the telnet capability with the Terminal Interface:

1   From your host computer enter the command:
telnet <emulator_name>.

2   Now enter the command: **pv 1**

Note: the HP 64700 telnet capability is not supported by Hewlett-Packard.

After about a minute, the emulator should display a list of tests which were performed, and whether they were passed or failed.

If you have an emulation failure, you can replace the assembly that failed. Refer to the list of replacable parts in Chapter 7. Contact your local Hewlett-Packard representative. Refer to the list of Sales Offices in the Support Services book supplied with this manual.

When your performance verification test is complete, use the keyboard <CTRL>d keys to end the emulation session.

To verify installation of memory modules in the deep analyzer card or in the emulation probe, type the ver command as follows:

M>**ver**

The emulator should display a message similar to the following:

```
                Copyright (c) Hewlett-Packard Co. 1987
All Rights Reserved.  Reproduction, adaptation, or translation without prior
written permission is prohibited, except as allowed under copyright laws.

  HP64700 Series Emulation System
    Version:   A.04.00 22Oct92

  HP64789B Intel 80386 Emulator
    Version:   A.00.00 01Jun94 Lab Proto
    Control:   HP64748C  Emulation Control Board
    Speed:     25.1 MHz
    Memory:    256 Kbytes
      Bank 0:  HP64172A (20ns) 256 Kbyte Memory Module

  HP64740 Emulation Analyzer
    Version:   A.02.02 13Mar91

  HP64701A LAN Interface
    Version:   A.00.04 21Oct91
```

Note that the HP 64789B and HP 64789C use the same firmware.

What is pv doing to the Emulator?

The performance verification procedures provide a thorough check of the functionality of all of the products installed in the HP 64700 Card Cage. The following is an example Test Suite for an HP 64700 Card Cage containing an HP 64789C Emulator. To see the exact Test Suite for the HP 64789C Emulator and associated modules in your HP 64700 Card Cage, enter the command: pv -l.

```
M>pv -l
  Tests available in Emulator Subsystem:
   test # 1 (ABG 68000 RAM)          test # 2 (ABG Type Map)
   test # 3 (ABG DeMMU Map)          test # 4 (low DMMU RAM)
   test # 5 (up DMMU RAM)            test # 6 (68000 side RAM)
   test # 7 (iFX780 JTAG id)         test # 8 (Host DP RAM)
   test # 9 (Noclk2 Test)            test #10 (386 access dp)
   test #11 (Emulation RDY)          test #12 (386 self test)
   test #13 (Reset to bg mon)        test #14 (Byte enables)
   test #15 (hw reg test)            test #16 (Reset to fg pgm)
   test #17 (Check rst lead)         test #18 (Reset to fg mon)
   test #19 (Port 92 detect)         test #20 (DP interaction)
   test #21 (Mon Transition)         test #22 (Proc Version)
   test #23 (Break Detection)        test #24 (Dual Port RAM)
   test #25 (Emul Mem Bank 0)        test #26 (Emul Mem Bank 1)
   test #27 (Exec Emul Mem)          test #28 (DP RAM BS8)
   test #29 (Emul Mem BS8)           test #30 (W/S gen)
   test #31 (ERY_L gen)              test #32 (NMI)
   test #33 (INTR)                   test #34 (Targ Ready)
   test #35 (NA# Reset)              test #36 (Analysis Intrfc)
   test #37 (Addr/Data Test)         test #38 (Status Tests)
   test #39 (Ports 1, 2, &3)         test #40 (BS8 Test)
   test #41 (Stop CLK2)              test #42 (UCS#,CS5#,CS6#)
   test #43 (Hold Test)              test #44 (WDTMR Test)
   test #45 (Display Test)           test #46 (CMB)
cycle count=1  failure count=0
```
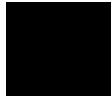
Troubleshooting

The test results for all of these modules are indicated by a simple PASS/FAIL message. The PASS message gives a high level of confidence that all major functions and signals are operating because the PV test includes a loopback test that performs read and write tests to the demo board. The demo board also stimulates inputs to the emulator.

A FAIL message indicates that one or more of the tested functions is NOT working. In this event, call your local Hewlett-Packard field representative.

To ensure software compatibility

There are various sets of firmware resident in the assemblies contained in the HP 64700 Card Cage. It is important to ensure that all the versions are compatible among the products you have installed. You can determine which versions of firmware you have by entering the terminal interface ver command.

There are at least four assemblies that have separate firmware in the HP 64700 Card Cage. These assemblies are:

- Host Controller card
- Emulator card
- Analyzer card
- Local Area Network card

If you purchased a complete Emulation/Analysis System from HP, you can be assured that all the products contained in the HP 64700 Card Cage contain compatible firmware at the time of sale. Software compatibility problems can occur when you swap the host controller card, emulator card, analyzer card, or local area network (LAN) card from one HP 64700 Card Cage to another, or from a recently purchased subassembly.

For example, you might purchase only the emulator subassembly (Emulation Control Card, Probe, and interconnecting ribbon cable) and replace the original emulator subassembly with the one you just purchased. In this case, the host controller may contain a version of firmware that is older than required to operate the new emulator; hence, compatibility problems can be

caused by a newer emulator. All emulators will work with the latest software versions. The emulator software will warn you of incompatible software.

This emulator and the LAN card in the HP 64700B card cage have Flash EPROMs that can be updated with current versions of firmware. Other products (assemblies) that do not use the Flash EPROM technology can also be updated with the latest firmware by using the Flash EPROM in the HP 64700B card cage.

If you are using an HP 64700A card cage, you can obtain an optional LAN card and an optional Flash EPROM card from your local Hewlett-Packard representative. The optional Flash EPROM card can be inserted in an available slot in the HP 64700A card cage to override old versions of firmware in products with conventional EPROMs. The host controller in the HP 64700A card cage is already programmed to look for a Flash EPROM card if one is installed. To obtain an optional LAN card and/or optional Flash EPROM card, refer to the list of HP Sales Offices in the Support Services book supplied with this manual.

The software for the HP 64700 Intel80386EX Real-Time C Debugger for PCs is shipped on two floppy disks that also contain the latest versions of firmware for the host controller card, analyzer card, LAN card, and a program called *progflash*.

When you load all your new versions of software onto your host computer, you are ready to load the new version of firmware from your host computer to the assemblies in the HP 64700 Card Cage. To load the new firmware, follow the procedures described in Chapter 5, "Installing/Updating HP 64700 Firmware."
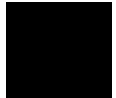
To display the emulator status

The emulator status is displayed on a status line in the graphical interface. If you need to display the emulator status using the built-in Terminal Interface:

- Display the emulator status by typing: **es**

The emulation prompts tell you most information about the emulator's status: whether the emulator is reset, running a user program, or running in monitor. If you need more information than is given by the prompt, you can use the es command.

Example

```
R>es
  80386--Emulation reset
R>
```

To check the version of the terminal interface software

☐ Type **ver** to display the version numbers of the Terminal Interface system software and emulator software.

The Intel80386EX emulator firmware must be used with the correct version of the emulation system and emulation analyzer firmware. See the paragraph titled, "To ensure software compatibility" earlier in this chapter for more information.

If the emulator appears to be malfunctioning

☐ Check to make sure that the cables connecting the Emulation Control Board to the Emulation Probe are connected correctly.

☐ Run the performance verification procedure as described in this chapter. If the emulator fails this test, contact your Hewlett-Packard representative.

☐ If the emulator passes the performance verification procedure, look for other reasons for the problem. Performance Verification is a thorough test, but it cannot find every hardware failure in the emulator. It is a good indication that the emulator is functioning correctly, but if you are still convinced the emulator is malfunctioning, contact your local Hewlett-Packard representative.
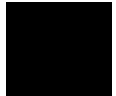
If you suspect the emulator is broken

☐ Run the Performance Verification procedure as described in the first paragraph of this chapter. If either the emulator or analyzer fail the performance verification, check the installation of those modules. If the installation is correct, contact your local HP Sales and Service office for assistance.

If you have RS-232 connection problems

☐ Windows 3.1 only allows two active RS-232 connections at a time. To be warned when you violate this restriction, choose Always Warn in the Device Contention group box under 386 Enhanced in the Control Panel.

☐ Use the "Terminal" program (usually found in the Accessories windows program group) to set up the "Communications..." settings as follows:

```
Baud Rate" 9600
Data Bits: 8
Parity: None
Flow Control: Hardware
Stop Bits: 1
```

When you are connected, press the Enter key. You should get a prompt back. If nothing echos back, check the switch settings on the back of the emulator:

Switches 1 thru 3 set the baud rate as follows:

```
S1    S2    S3
0     0     0     9600
0     0     1     19200
0     1     0     2400
```

Switches 12 and 13 must be set to 1 and 0, respectively. This sets the RTS/CTS hardware handshake which is needed to make sure all characters are processed.

All other switches should be in the "0" position, especially switch 16 on the HP 64700 (which selects LAN/Serial interface).

Remember that if you change any of the switch positions, you must turn OFF power to the HP 64700 and turn it ON again before the changes will take effect.

☐ If the switches are in the correct position and you still do not get a prompt when you press return, check the following:

- Turn OFF power to the HP 64700 and then turn it ON again. Press return to see if you get a prompt.

- Check to make sure the RS-232 cable is connected to the correct port on your PC, and that the cable is appropriate for connecting the PC to a DCE device. If the cable is intended to connect the PC to a DTE device, set switch 4 to "1" (which makes the emulator a DTE device), turn OFF power to the HP 64700, turn power ON, and try again.

- Check to make sure your RS-232 cable has the RTS, CTS, DSR, DCD, and DTR pins supported. If your PC RS-232 connection is a 9-pin male connection, HP cable number 24542M will work (set switch 4 to 0 if you use this cable). If your PC has a 25-pin RS232 connector, HPO cable number 13242N will work (set switch 4 to 0).

☐ Always turn ON the HP 64700 before attempting to connect via RS-232. When using certain RS-232 cards, connecting to an RS-232 port where the HP 64700 is turned OFF (or not connected) will halt the PC. The only way to restore operation is to reboot the PC.

☐ If the PC fails to connect to the HP 64700, or connects but soon reports over-run errors or times out, check the following:

- The serial interface in your PC may be insufficiently buffered. Use serial interface cards that include 16550AF UARTs (or better). To see which UART is used in your serial interface card:

  1. Enter the DOS command, "MSD".
  2. Within the window that appears, click on "COM Ports...".
  3. Within the COM Ports window, look at the entry beside "UART Chip Used."

- Turn off all unnecessary TSR's and other applications to allow the processor to more frequently service the serial interface.

If emulation memory behavior is erratic

☐ Verify the signal quality of CLK2. Refer to Chapter 4, "CLK2 signal integrity" for details.

If the analyzer won't trigger

☐ The processor fetches instructions in multiples of four. For example, if an instruction starts at address 1001H, the processor fetches it from address 1000H. Make sure you use trigger addresses that are multiples of four (addresses ending in 0, 4, 8, or C) when specifying instruction-fetch addresses in your trigger specifications.

If the analyzer triggers on a program address when it should not

☐ Check to see if the analyzer is triggering on an instruction prefetch. The analyzer cannot distinguish between prefetch and execution because the processor does not provide that information. For a detailed description of the problem and its solution, refer to the subject titled "Understanding 80386 analysis" in the online help screens part of the Intel80386EX Emulator product.

☐ Try to pad the program code with NOP instructions to move the trigger address away from the other code so that it won't be prefetched until it is time to trigger.

☐ You may be able to insert a write instruction to a meaningless variable in your code immediately following the trigger address. Then you can trigger on a write to the address of the variable. Write transactions never appear in instruction prefetches.

If you see unexplained states in the trace list

☐ Check to see that the sequence, storage, and trigger specifications are set up to exclude the states you don't need.

☐ If you are using the built-in terminal interface, try using the **tl <instruction_state> <operand_state>** command to inform the disassembler which operand state belongs with the named instruction state.

☐ If you are using the built-in terminal interface, try using the **-o <#>** option to the **tl** command to begin disassembly from the low word of the starting state, instead of the high word.

☐ Check to see if some of the program in the range covered by the trace might have executed from internal processor RAM memory. If so, these cycles won't appear in the trace list, which will confuse the disassembler. Use the *show cycles* feature of the processor to make internal RAM cycles visible to the analyzer. Obtain the show cycles feature by setting the two least-significant bits in the third byte of register SIM_MCR to "11".

If you see exclamation marks "!" in count columns of the trace lists

☐ This is a normal condition. It indicates the counter overflowed (began again at 0) before the present state was captured. The exclamation mark warns you that the counter value may not be accurate because the analyzer is unable to determine how many times the counter overflowed between the preceding state and the state where the exclamation mark is shown.

If you were to scroll through a trace list of the entire trace memory in relative count mode, a "!" would be seen beside the first state after each occurrence of counter overflow (each 22.9 minutes). If you were to scroll through the entire trace memory in absolute count, the "!" would be seen beside every state after the first occurrence of counter overflow.

If you see negative time or state counts in trace lists

☐ If counter overflow occurs during a trace measurement, you may see a count of negative time or negative states in trace lists using the absolute time count mode. This indicates that the counter value stored with the trigger state was greater than the counter value stored with the present state. In absolute time counts, negative times will continue to be seen until a state is captured whose counter value is greater than the trigger state counter value. In relative time counts, the counter value is corrected so no negative time is seen.

If you do not see the counter overflow indication "!" where you expected to see it in a trace list

☐ This may be a normal indication. If you scroll through a reduced portion of the trace memory, one that contains no counter overflow, no counter overflow indication will be seen, even if counter overflow occurred before the line range you specified in your **display/store/copy** command. The routine that reads trace memory to compose a trace list only reads the portion of the trace memory you specify in your **display/store/copy** command.

If the performance verification reports massive pv failures

☐ Check to make sure mapper chip U84 on Emulation Control Card Subassembly HP 64748C is installed properly in its socket.

☐ Make sure the PGA to PQFP (or TQFP) connectors and connections are good.

7

Parts List

Parts List

Part numbers for the B3637B floppies

The floppies supplied with this product contain the Real-Time C Debugger
software and the HP 64789C firmware, along with firmware for the host
controller card, analyzer card, LAN card, and the progflash routine used for
updating product firmware in HP 64700 Card Cages. The part numbers for
these floppies change each time a change is made to any of the software or
firmware products on the floppies. If you need new floppies for your B3637B
emulator, order the latest HP64700 EMUL/ANLY FIRMWARE floppies, not
necessarily the part numbers shown in this Parts List.

What is an exchange part?

Exchange parts are shown on the parts list. A defective part can be returned
to HP for repair in exchange for a rebuilt part.

Probe (exchange)

To replace the Probe on the exchange program, you must remove certain
parts, and return only that part considered an exchange part. When
returning the Probe, you must remove the:

*   cable assembly.
*   top and bottom plastic covers.
*   SRAM modules.
*   demo board.
*   reset flying lead.

Emulation Control Card (exchange)

To replace the Emulation Control Card on the exchange program, you must
remove certain parts, and return only that part considered an exchange part.
When returning the Emulation Control Card, you must remove the:

*   ribbon cable that connects the Emulation Control Card to the analyzer
    card.
*   cable assembly.
*   egress panel.

Main Assembly		
Component Part	**New**	**Exchange**
HP 64789C Probe and Demo Board		
HP64700 EMUL/ANLY FIRMWARE (1 of 2)	64700-17562	
HP64700 EMUL/ANLY FIRMWARE (2 of 2)	64700-17563	
Foot, Stick-on, Square	0403-0286	
Label, Static Caution	7121-5441	
I. D. Label	64789-93402	
Label, Pin 1	64747-94302	
Intel80386EX Probe Board Assy for HP 64789C	64789-66507	64789-69507
(Order the following parts separately:)		
Top Plastic Cover	64783-04101	
Bottom Plastic Cover	64783-04102	
Plastic Rivets Kit (rivets and washers)	64748-68700	
PGA Pin Protector, plastic	5181-0206	
Cable, Reset Flying Lead	64762-61602	
Male header, male/male double header	1200-1658	
PGA Pin protector socket, male/female	5181-0206	
Fan Assembly	3160-0825	
Intel80386EX Emulator Product Refurbished	64789C #8ZE	
Demo Board for Intel80386EX	64789-66506	
(Order the following part separately:)		
External +5V Power Cable	5181-0201	
Fuse 3A 250V	2110-0837	
Probing Accessories (order separately for your target connection):		
132-pin QFP Probe Adapter Assembly	E3417A	
144-pin TQFP Elastomeric Probing System		
Probe Adapter	E5336A	
Flexible Adapter	E5338A	
Transition Socket	E3442A	

Main Assembly		
Component Part	**New**	**Exchange**
HP 64748C Emulation Control Card Subassembly		
Egress Panel	64748-00205	
Bracket (used with Egress Panel)	64748-01201	
Spacer, Hex M3X6	0515-1146	
Screw, Machine M3X8	0515-0372	
Cable-100 36"	64748-61601	
Cable-100 37"	64748-61602	
Cable-100 38"	64748-61603	
Cable Clamp	64744-01201	
Rubber Strip	64744-81001	
Emulation Control Card	64748-66515	64748-69515
(without external cable or egress panel)		
Wrist strap	9300-1405	
HP 64172A 256-Kbyte, 20-nS SRAM Module	64172A	64172-69501
HP 64172B 1-Mbyte, 20-nS SRAM Module	64172B	64172-69502
HP 64173A 4-Mbyte, 25-nS SRAM Module	64173A	64173-69501
HP 64794A Emulation-Bus Analyzer (deep) card	64794-66502	64794-69502
34-pin ribbon cable	64708-61601	
Analyzer Card HP 64740 with 1K memory depth	64740-66526	64740-69526
34-pin ribbon cable	64708-61601	

Part 3

Reference

8
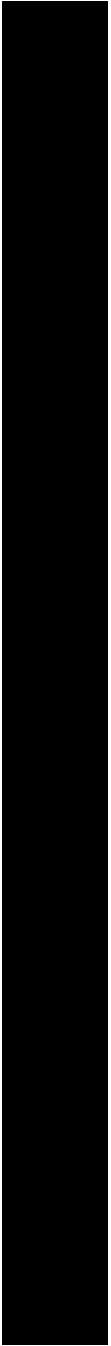
Using the Terminal Interface

An introduction to the emulator's built-in terminal interface.

The emulator has a built-in, host-independent Terminal Interface. The Terminal Interface provides all the commands you need to make emulation and analysis measurements. The interface includes tools for emulator initialization, command entry and recall, and command help.

When to Use the Terminal Interface

Hewlett-Packard suggests that you control the emulator with a graphical interface on a PC host computer (page 123). You may need to use the Terminal Interface, however, for tasks such as:

- Troubleshooting emulator hardware.

- Troubleshooting the connection between the emulator and your host computer.

- Developing a custom interface (such as a debugger) for the emulator.

- Using the emulator when a PC is not available, but a terminal or terminal emulator is available.

- Using the emulator if you are already an expert user of the Terminal Interface and you do not need the improved ease of use of the graphical interfaces.

Learning About the Terminal Interface

You should be able to find most of what you need to know about the Terminal Interface commands from the on-line help.

To start the terminal interface

- To connect the emulator to a terminal or host computer, see Chapter 2.

- If the emulator is connected to a LAN, type the following command to log in to the emulator:

```
C:> telnet <hostname>
```

Where <hostname> is the name of the emulator. You could use the Internet Protocol (IP) address (or internet address) in place of the emulator name, if desired.

Note

The "telnet" capability of the HP64700 card cage is unsupported. It is provided at no cost. Hewlett-Packard makes no warranty on its quality or fitness for a particular purpose.

- If the emulator is connected to your host computer or terminal via a serial port, press <return> a few times and you should see an emulator prompt.

The Terminal Interface is active when you connect a terminal or terminal emulator to the emulator via a serial or LAN connection.

Example

If the IP address of your emulator is 15.35.226.210, type:

```
C:> telnet 15.35.226.210
```

You should see messages similar to:

```
Trying...
Connected to 15.35.226.210
Escape character is '^]'
```

After you connect to the emulator, you should see a prompt similar to:

```
R>
```

To view a list of available commands

1 Display the main help menu by typing: **help**

The main help menu lists groups of commands.

2 Display the commands in one of the groups by typing **help** followed by the name of the command group.

You can see a list of all of the commands by typing help *. This list may be too long to fit on your terminal display.

Example   To display the main help menu, enter:

R>**help**

The emulator will list the command groups:

```
help  - display help information

  help <group>         - print help for desired group
  help -s <group>      - print short help for desired group
  help <command>       - print help for desired command
  help                   - print this help screen

 --- VALID <group> NAMES ---
  gram     - system grammar
  proc     - processor specific grammar

  sys      - system commands
  emul     - emulation commands
  trc      - analyzer trace commands
  *        - all command groups
```

To display help information for the emulation command group, enter:

R>**help emul**

The emulator will list the emulation commands. They will be similar to the following:

```
emul - emulation commands
 ----------------------------------------------------------------------------
 b......break to monitor  cp.....copy memory       mo.....modes
 bc.....break condition   dump...dump memory        r......run user code
 bp.....breakpoints       es.....emulation status  reg....registers
 cf.....configuration     info...config info       rst....reset
 cim....copy target image io.....input/output      rx.....run at CMB execute
 ck.....check config      load...load memory        s......step
 cmb....CMB interaction   m......memory            ser....search memory
 cov....coverage          map....memory mapper     sync...sync sim and ems
```
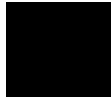
To view help on individual commands

- To display help information for a particular command, type: **help <command_name>**

The emulator will display the command syntax, description, and examples.

To display help information for the processor step command, enter:

R>**help s**

The emulator will display:

```
s - step emulation processor

  s                      - step one from current PC
  s <count>              - step <count> from current PC
  s <count> $            - step <count> from current PC
  s <count> <addr>       - step <count> from <addr>
  s -q <count> <addr>    - step <count> from <addr>, quiet mode
  s -w <count> <addr>    - step <count> from <addr>, whisper mode

 --- NOTES ---
  STEPCOUNT MUST BE SPECIFIED IF ADDRESS IS SPECIFIED!
  If <addr> is not specified, default is to step from current PC.
  A <count> of 0 implies step forever.
```

To view help on command syntax

- Type: **help gram**

Graphical Interfaces

HP provides a two interfaces for this emulator:

- The built-in Terminal Interface.

- A graphical interface for MS-Windows.

HP also provides other instruments and software tools for developing, debugging, and optimizing embedded systems.

Note

Ask your HP sales representative for more information about these interfaces. Other interfaces may also be available from HP.

Why use a graphical interface?

- Use your PC's windowing environment.

- Reduce many commands (such as setting breakpoints or stepping through source lines) to a single mouse-click.

- Show different kinds of information about your target system at the same time (for example, register contents, memory contents, and high-level source code) in separate windows on the display.

- Simplify emulator configuration by clearly displaying configuration options and their relationship to one another.

- Automate frequent tasks through menu selections, user-defined buttons in the button window, and command files.

- Work with compilers and assemblers to shorten the edit-compile-execute cycle.

9

Specifications and Characteristics

Processor compatibility

The HP 64789C Emulator supports Intel 80386EX microprocessors. The emulator plugs directly into a 132-pin PGA socket, and it can be plugged into a PQFP target system using optional accessories.

Electrical

Clock speed

The maximum clock speed of the emulator is 25 MHz with no wait states required for target memory, and 1 wait state for emulation memory. There is no minimum clock speed. It is OK to stop CLK2.

Power Requirements

The V_{cc} range is 3.3V to 5.0V +/- 10%.
The current requirement from the target system is negligible in addition to the current requirements for the Intel80386EX
All other power is supplied by the card cage.

Real and protected addressing modes

The emulator supports real and protected addressing modes.

Emulation memory

The emulator supports use of up to 8 Megabytes of emulation memory.

HP 64789C maximum ratings

Characteristic	Symbol	Value	Unit
Supply Voltage	V_{CC}	–0.3 to +5.5	V
Input Voltage	V_{in}	–0.5 to +5.5	V
Maximum Operating Ambient Temperature	T_A	45	^oC
Minimum Operating Ambient Temperature	T_A	0	^oC
Storage Temperature Range	T_{stg}	–40 to +70	^oC

HP 64789C AC electrical specifications

The following table lists the target socket, and the pinout for the 12x12 PGA to PQFP adapter. It shows the effect of the emulator on the user's lines. Note that additional current loading is negligeable (less than 100 uA in all cases).

Signal Name	I/O	Definition/Comments	Added Capacitance, pF[a]	Added Delay[b]
addr[25:1]	O		16	0
data[15:0]	IO		16	0
bhe# ble# d/c# w/r#	O		8	0
m/io#	O		16	0
bs8# na#	I		8	0
DACK1#/TXD1	O/O	DMA ack channel 1 or transmit data channel 1	8	0
DACK0#/CS5#	O/O	DMA ack channel 0 or chip select 5	8	0
UCS#	O	Upper chip select	8	0
SMI#	I	System management interrupt (falling edge)	0	1 to 2 CLK2 cycles
SMIACT#	O	System Management mode active	16	0
P1.0/DCD0#	IO/I	Port 1 bit 0 or data carrier detect channel 0	8	0
P1.1/RTS0#	IO/O	Port 1 bit 1 or ready to send channel 0	8	0
P1.2/DTR0#	IO/O	Port 1 bit 2 or data terminal ready channel 0	8	0
P1.3/DSR0#	IO/I	Port 1 bit 3 or data set ready channel 0	8	0
P1.4/RI0#	IO/I	Port 1 bit 4 or ring indicator channel 0	8	0

Signal Name	I/O	Definition/Comments	Added Capacitance, pF[a]	Added Delay[b]
P1.5/LOCK#	IO/O	Port 1 bit 5 or bus cycle locked	16	0
P1.6/HOLD	IO/I	Port 1 bit 6 or hold request	16	0
P1.7/HLDA	IO/O	Port 1 bit 7 or hold acknowledge	16	0
P2.0/CS0#	IO/O	Port 1 bit 0 or chip select 0	16	0
P2.1/CS1#	IO/O	Port 1 bit 1 or chip select 1	16	0
P2.2/CS2#	IO/O	Port 1 bit 2 or chip select 2	16	0
P2.3/CS3#	IO/O	Port 1 bit 3 or chip select 3	16	0
P2.4/CS4#	IO/O	Port 1 bit 4 or chip select 4	16	0
P2.5/RXD0	IO/I	Port 1 bit 5 or receive data channel 0	16	0
P2.6/TXD0	IO/O	Port 1 bit 6 or transmit data channel 0	16	0
P2.7/CTS0#	IO/I	Port 1 bit 7 or clear to send channel 0	16	0
P3.0/TMROUT0	IO/O	Port 3 bit 0 or timer out bit 0	16	0
P3.1/TMROUT1	IO/O	Port 3 bit 1 or timer out bit 1	16	0
P3.2/INT0	IO/O	Port 3 bit 2 or interrupt 0	16	0
P3.3/INT1	IO/I	Port 3 bit 3 or interrupt 1	16	0
P3.4/INT2	IO/I	Port 3 bit 4 or interrupt 2	16	0
P3.5/INT3	IO/I	Port 3 bit 5 or interrupt 3	16	0
P3.6/PWRDOWN	IO/O	Port 3 bit 6 or powerdown status	24	0
P3.7/COMCLK	IO/I	Port 3 bit 7 or async communications baud clock	16	0
CS6#/REFRESH#	O/O	Chip select 6 or refresh active	8	0

Signal Name	I/O	Definition/Comments	Added Capacitance, pF[a]	Added Delay[b]
PEREQ/TMRCLK2	I/I	Coprocessor error or timer clock #2	0	0
DTR1#/SRXCLK	O/IO	Data Terminal Ready channel 1 or SSIO receive clock	0	0
RI1#/SSIORX	I/I	Ring Indicator channel 1 or SSIO receive data	0	0
RTS1#/SSIOTX	O/O	Ready to Send channel 1 or SSIO send serial data	0	0
NMI	I	NMI input	0	1 to 2 CLK2 cycles
ERROR#/TMROUT2	I/O	Coprocessor error or Timer #2 output	0	0
BUSY#/TMRGATE2	I/I	Coprocessor busy or timer #2 gate	0	0
INT4/TMRCLK0	I/I	Interrupt request 4 or timer #1 clock input	8	0
INT5/TMRGATE0	I/I	Interrupt request 5 or timer #0 gate	8	0
INT6/TMRCLK1	I/I	Interrupt request 6 or timer #1 clock input	8	0
INT7/TMRGATE1	I/I	Interrupt request 7 or timer #1 gate	8	0
DSR1#/STXCLK	I/IO	Data set ready channel 1 or sync data transmit clock	0	0
EOP#/CTS1#	IO/O	End of Processor (DMA finished) or Clear to Send channel 1	0	0
WDTOUT	O	Watchdog timer expired output	8	0

Signal Name	I/O	Definition/Comments	Added Capacitance, pF[a]	Added Delay[b]
DRQ0/DCD1#	I/I	DMA external request channel 0 or Data Carrier Detect channel 1	0	0
DRQ1/RXD1	I/I	DMA external request channel 1 or Receive data channel 1	0	0
LBA#	O	Processor provided READY because internal cycle or chip select unit provided it.	24	0
TDI/TDO/TMS/TRST#/TCK5	IO	JTAG test. Not connected on probe board		0
ADS#	O		8	0
RD#	O	Cycle is a read (t1.5 through end of t2)	0	0
READY#	IO		30	0
RESET	I		0	2 CLK2 cycles
WR#	O	Cycle is a write	0	0

Notes:
   Time is shown in ns.
   The "-" entry means unspecified.
   a. Without capacitance of PGA to PQFP or TQFP adapter. The adapter is a transmission line with about 10 pF capacitance.
   b. Without added delay due to PGA to PQFP adapter; delay is about 1 ns.

Refer to Chapter 4 for additional information about the signals in the table above.

Physical

Emulator Dimensions

173 mm height x 325 mm width x 389 mm depth (6.8 in. x 12.8 in. x 15.3 in.)

Emulator Weight

Probe alone: 0.3 kg (10 oz).

Cable Length

Emulation Control Card to Probe, approximately 914 mm (36 inches).

Probe dimensions
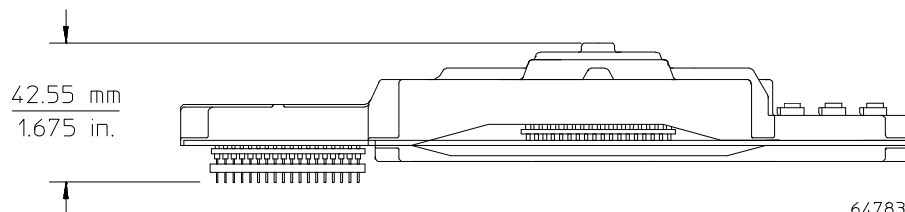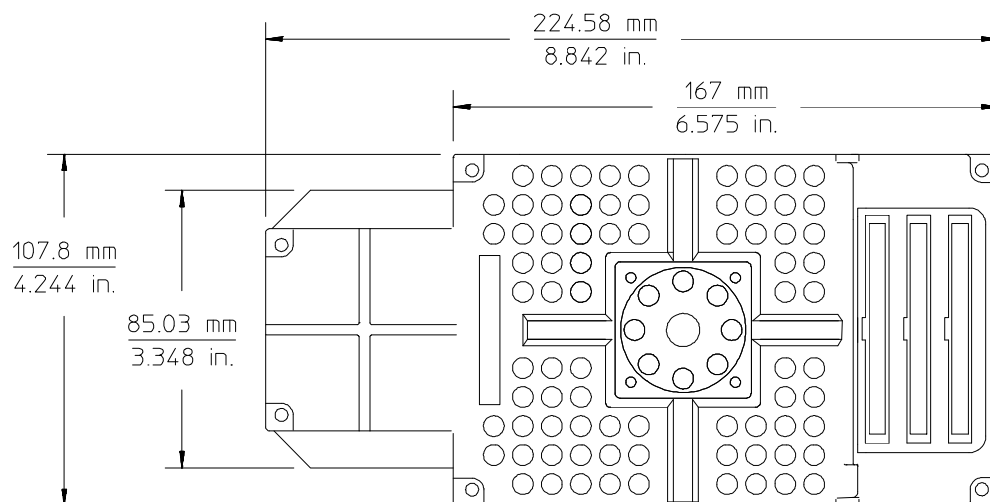
Environmental

Temperature

Operating, 0° to +40° C (+32° to +104° F).
Nonoperating, -40° C to +60° C (-40° F to +140° F).

Altitude

Operating/nonoperating 4600 m (15 000 ft).

Relative Humidity

15% to 95%.

BNC, labeled TRIGGER IN/OUT

Output Drive

Logic high level with 50-ohm load >= 2.0V.
Logic low level with 50-ohm load <= 0.4V.

Input

74HCT132 with 135 ohms to ground in parallel.

Maximum input:

5V above Vcc; 5V below ground.
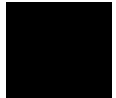
Communications

Host Port

25-pin female type "D" subminiature connector.

RS-232-C DCE or DTE to 38.4 kbaud.

RS-422 DCE only to 460.8 kbaud.

Auxiliary Port (64700A Only)

25-pin female type "D" subminiature connector.

RS-232-C DCE only to 19.2 kbaud.

CMB Port

9-pin female type "D" subminiature connector.

Glossary

Absolute Count

A count in the trace list count column that indicates the total count accumulated between the displayed state and the trigger state.

Absolute File

A file consisting of machine-readable instructions in which absolute addresses are used to store instructions, data, or both. These files are generated by the compiler/assembler/linker and are loaded into the emulator.

Access Breakpoint

A break from execution of your target program to execution of the emulation monitor when the emulator detects a read or write of an address or range of addresses.

Access Mode

Specifies the types of cycles used to access target system memory locations. For example a "byte" access mode tells the monitor program to use move byte instructions to access target memory.

Analyzer

An instrument that captures activity of signals synchronously with a clock signal. An emulation-bus analyzer captures emulator bus cycle information. An external analyzer captures activity on signals external to the emulator.
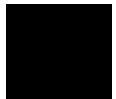
Analyzer Clock Speed

The bus cycle rate of the emulation processor. If the emulation processor is running at 21 MHz and the fastest bus cycle requires three clocks, then the analyzer clock speed (bus cycle rate) is 21/3 = 7 MHz.

Arm Condition

A condition that reflects the state of a signal external to the analyzer. The arm condition can be used in branch or storage qualifiers. External signals can be from another analyzer or an instrument connected to the CMB or BNC.

Assembler

A program that translates symbolic instructions into object code.

Background

The emulator mode in which foreground operation is suspended so the emulation processor can be used for communication with the emulation controller. The background monitor does not occupy any processor address space.

Background Memory

Memory space reserved for the emulation processor when it is operating in the background mode. Background memory does not take up any of the microprocessor's address space.

Background Monitor

A monitor program that operates entirely in background memory. The background monitor can execute when target program execution is temporarily suspended. The background monitor does not occupy any of the address space that is available to your target program.

BNC Connector

A connector that provides a means for the emulator to drive/receive a trigger signal to/from an external device (such as a logic analyzer, oscilloscope, or HP 64000-UX system).

Breakpoint

A point at which emulator execution breaks from the target program and begins executing in the monitor. (See also Execution Breakpoint and Access Breakpoint.)

Command File

A file containing a sequence of commands to be executed.

Compatible Mode

The compatible mode of the deep analyzer configures the analyzer to provide the same memory depth as the 1K analyzer: 1024 states deep when the analyzer is not configured to make a count of states or time during a measurement, and 512 states deep when the analyzer is configured to make a count of states or time during a measurement. If the emulator interface you are using along with the deep analyzer requires that you use the compatible mode, the deep analyzer will still be able to provide one of its benefits for your measurement; you will be able to make your counts of states or time at full emulator clock speed.

Compiler

A program that translates high-level language source code into object code, or produces an assembly language program with subsequent translation into object code by an assembler. Compilers typically generate a program listing which may list errors displayed during the translation process.
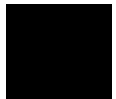
Counter Overflow

When the counter reaches maximum count and begins a new count from zero. The counter of the deep analyzer simply counts continuously once a trace begins; it increments its count every 20 ns, and reaches maximum count in about 22.9 minutes (22 minutes and 54 seconds). The deep analyzer sets a flag in memory and stores it along with the first state that is captured after the counter overflow occurs (first state captured after the counter begins again at zero).

Configuration File

A file in which configuration information is stored. Typically, configuration files can be modified and re-loaded to configure instruments (such as an emulator) or programs (such as the PC Interface).

Coordinated Measurement

A synchronized measurement made between the emulator and analyzer, between emulation-bus analyzer and external analyzer, or between multiple emulators or analyzers. For example, a coordinated measurement is made when two or more HP 64700 emulators/analyzers start executing together, or break into background monitors at the same time.

Coordinated Measurement Bus (CMB)

The bus that is used for communication between multiple HP 64700 Series emulators/analyzers or between HP 64700 emulators/analyzers and an HP 64306 IMB/CMB Interface to allow coordinated measurements.

Cross Trigger

The situation in which the trigger condition of one analyzer is used to trigger another analyzer. Two signals internal to the HP 64700 can be connected through the BNC on the instrumentation card cage to allow cross-triggering between the emulation-bus analyzer and other analyzers.

DCE (Data Communications Equipment)

A specific RS-232C hardware interface configuration. Typically, DCE is a modem.

Deep Analyzer

In this manual, the term "deep analyzer" refers to the HP 64794 Emulation-Bus Analyzer with deep trace memory.

Display Mode

When displaying memory, this mode tells the emulator the size of the memory locations to display. When modifying memory, the display mode tells the emulator the size of the values to be written to memory.

Downloading

The process of transferring absolute files from a host computer into the emulator.

DTE (Data Terminal Equipment)

A specific RS-232C hardware interface configuration. Typically, DTE is a terminal or printer.

Embedded Microprocessor System

The microprocessor system which the emulator plugs into.

Emulation Bus Analyzer

A system component built into the HP 64700 that captures the emulation processor's address, data, and status information.

Emulation Memory

High-speed memory (RAM) in the emulator that can be used in place of target system memory.
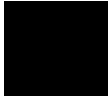
Emulator

An instrument that performs just like the microprocessor it replaces, but at the same time, it gives you information about the operation of the processor. An emulator gives you control over target system execution and allows you to view or modify the contents of processor registers, target system memory, and I/O resources.

Emulator Probe

The assembly that connects the emulator to the target system microprocessor socket.

Escape Sequence (transparent mode)

A keyboard input consisting of a special sequence of characters, beginning with the escape character (1C hexadecimal). This sequence is used to access an emulator while in transparent mode. When using multiple emulators and transparent mode to access the different emulators, each one must be given a unique escape character.

Execution Breakpoint

A special instruction placed in your software in RAM, replacing the normal instruction at the RAM address. Breakpoints for code in ROM are implemented by the Intel80386EX. When the breakpoint instruction is executed, emulation immediately transfers from execution of your target program to execution of the emulation monitor.

Expression

The information that can fit into a single pattern or a single range (a pattern such as addr=2105, data!=15, or a range such as addr=4012..401a). A complex expression is made up of pattern, range, and arm labels joined together by various operators that define the specific condition. Each of the pattern and range labels must be previously assigned to specific simple expressions using the terminal interface commands: tpat and trng.

Foreground

The mode in which the emulator is executing the user program. In other words, the mode in which the emulator operates as the target microprocessor would.

Foreground Monitor

A monitor program that executes in the foreground address space. When the monitor exists in foreground, it is directly accessible by, and can interact with, your target program.

Guarded Memory

An address range that is to be inaccessible to the emulation processor. The emulator will generate a break and display an error message if an access to guarded memory occurs.

Handshaking

A process that involves receiving and/or sending control characters which indicate a device is ready to receive data, that data has been sent, and that data has been accepted.

Host Computer

A computer to which an HP 64700 Series emulator can be connected. A host computer may run interface programs which control the emulator. Host computers may also be used to develop programs to be downloaded into the emulator.

Inverse Assembler

A program that translates absolute code into assembly language mnemonics.

Label

A set of one or more analyzer channels. Example, the label "addr" is used to identify the analyzer channels connected to the address bus of the emulation processor.
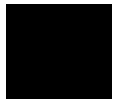
Linker

A program that combines relocatable object modules into an absolute file which can be loaded into the emulator and executed.

Logical Address Space

The addresses assigned to code during the process of compiling, assembling and linking to generate absolute files.

Macros

Custom made commands that represent a sequence of other commands. Entire sequences of commands defined in macros will be automatically executed when you enter the macro name. Macro nesting is permitted; this allows a macro definition to contain other macros.

Memory Mapper Term

A number assigned to a specific address range in the memory map. Term numbers are consecutive.

Memory Mapping

Defining ranges of the processor address space as emulation RAM or ROM, target RAM or ROM, or guarded memory.

Monitor Program

A program executed by the emulation processor that allows the emulation system controller to access target system resources. For example, when you display target system memory locations, the monitor program executes microprocessor instructions that read the target memory locations and send their contents to the emulation controller.

Operating System

Software which controls the execution of computer programs and the flow of data to and from peripheral devices.

Overflow

See counter overflow.

Parity Setting

The configuration of the parity switches. Depending on the configuration of the parity output switch and the parity switch, a parity check bit is added to the end of data to make the sum of the total bits either even or odd. A parity check is performed after data has been transferred, and is accomplished by testing a unit of the data for either odd or even parity to determine whether an error has occurred in reading, writing, or transmitting the data.

Path

Also referred to as a directory (for example \users\projects).

Pass Through Mode

See Transparent Mode.

PC Interface

A program that runs on the HP Vectra and IMB PC/AT compatible computers. This is a friendly interface used to operate an HP 64700 Series emulator.

Performance Verification

A program that tests the emulator to determine whether the emulation and analysis hardware is functioning properly.

Physical Address Space

The address space in hardware memory and hardware I/O that is accessed by the microprocessor during normal program execution.

P/O

An abbreviation for "part of." Used in illustrations to show that a part is shipped with other parts under a certain HP part number.

Prefetch

The ability of a microprocessor to fetch additional opcodes and operands before the current instruction is finished executing.

Prestore

The storage of states captured by the analyzer that precede states which are normally stored. If the normal storage qualifier specifies the entry address of a function or routine, prestore can be used to identify the callers of that function or routine.

Prestore Qualifier

A specification that must be met by a state before it can be saved in the analyzer prestore memory.

Primary Sequencer Branch

Occurs when the analyzer finds the primary branch state specified at a certain level and begins searching for the states specified at the primary branch's destination level.

Qualifier

A specification that must be met before an action can be taken by the analyzer. For example, a store qualifier is a specification that must be met by an incoming state before it can be stored in the trace memory. The "arm" condition can be used as an additional qualifier. For example, an external analyzer may be set up to supply a true signal to the rear panel BNC connector on the card cage when it detects a true condition in the target system. Then the analyzer can be set up to store qualify a certain kind of state, but only when the arm signal from the BNC is true.

Real-Time Execution

Continuous execution of the user program without interference from the emulator. (Such interference occurs when the emulator temporarily breaks into the monitor so that it can access register contents or target system memory or I/O.)

Relative Count

A count in the trace list count column that shows the count between the present displayed state and the state displayed immediately before it. Relative time count, for example, shows the elapsed time between the previous displayed state and the present state. Note that the count is between displayed states. If your trace list is inverse assembled and/or dequeued, several states may have been captured in memory between the present displayed state and the displayed state immediately before it.

Remote Configuration

The configuration in which an HP 64700 Series emulator is directly connected to a host computer via a single port. Commands are entered (typically from an interface program running on the host computer) and absolute code is downloaded into the emulator through that single port.

RS-232C

A standard serial interface used to connect computers and peripherals.

Secondary Sequencer Branch

Occurs when the analyzer finds the secondary branch state specified at a certain level before it found the primary branch state and begins searching for the states specified at the secondary branch's destination level.

Sequencer

The part of the analyzer that allows it to search for a certain sequence of states before triggering.
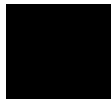
Single-step

The execution of one microprocessor instruction. Single-stepping the emulator allows you to view program execution one instruction at a time.

Software Breakpoint

Refer to execution breakpoint and access breakpoint in this glossary.

Software Performance Analyzer

An analyzer that measures execution of software modules, interaction between software modules, and usage of data points and I/O ports.

Standalone Configuration

The configuration in which a data terminal is used to control the HP 64700 Series emulator, and the emulator is not connected to a host computer.

stderr

An abbreviation for "standard error output." Standard error can be directed to various output devices connected to the HP 64700 ports.

stdin

An abbreviation for "standard input." Standard input is typically defined as your computer keyboard.

stdout

An abbreviation for "standard output." Standard output can be directed to various output devices connected to the HP 64700 ports.

Step

See Single-step.

Store Qualifier

A specification that must be met by a state before it can be saved in the analyzer trace memory.

Synchronous Execution

The execution of multiple HP 64700 Series emulators/analyzers at the same time (i.e., multiple emulator start/stop).

Syntax

The order in which expressions are structured in command languages. Syntax rules determine which forms of command language syntax are grammatically acceptable.

Target Program

The program you are developing for your product. It is also called user program.

Target System

The circuitry where the emulator probe is connected (typically a microprocessor-based system under development).

Target System Memory

Storage that is present in the target system.

Terminal Interface

The command interface present inside the HP 64700 Series emulators that is used when the emulator is connected to a simple data terminal. This interface provides on-line help, command recall, macros, and other features which provide for easy command entry from a terminal.
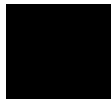
Trace

A collection of states captured synchronously by the analyzer.

Transparent Configuration

The configuration in which the HP 64700 Series emulator is connected between a data terminal and a host computer. When the emulator is in the transparent (pass through) mode, the data terminal acts like a normal terminal connected to the computer. In this configuration, you can develop code on the host computer and download absolute code into the emulator for debugging and testing.

Transparent Mode

The emulator mode in which all characters received on one port will be copied to the other port. This mode allows a data terminal (connected to one emulator port) to access a host computer (connected to the other emulator port) through the emulator.

Trigger

The condition that identifies a reference state within an analyzer trace measurement. Trigger also refers to the analyzer signal that becomes active when the trigger condition is found.

Trigger signals called trig1 and trig2 are bidirectional signal lines that can be used to coordinate measurement activity between emulators and analyzers installed in the instrumentation card cage, and between instruments connected to the BNC on the rear panel of the card cage.

Note that there is a delay when you use a trigger for measurement coordination. For example, you may specify that the emulator break to its monitor program when it receives trig1 from the analyzer. Several states may be executed in the emulator between the time the analyzer recognizes its trigger condition, generates trig1, delivers trig1 to the emulator, and the emulator responds to trig1 by breaking to its monitor program.

Uploading

The transfer of emulation or target system memory contents to a host computer.

Unlocked Exit

One of two methods used to leave the high level (Graphical or Softkey) Interface and return to the host computer operating system. An unlocked exit command allows you to exit the high level interface and re-enter later with the default configuration. (See also Locked Exit.) This is not available in the Terminal Interface.

User Program

Another name for your target program (the program you are developing for your product.

Viewport

See Window.

Wait States

Extra microprocessor clock cycles that increase the total time of a bus cycle. Wait states are typically used when slower memory is implemented.

Window

A specified rectangular area of virtual space shown on the display in which data can be observed.

1K Analyzer

The term "1K analyzer" refers to the HP 64704 Emulation-Bus Analyzer with 1K trace memory.

!

When shown in the trace list count column of the terminal interface or the PC interface, the exclamation mark "!" indicates counter overflow.

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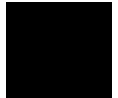
DECLARATION OF CONFORMITY

according to ISO/IEC Guide 22 and EN 45014

Manufacturer's Name: Hewlett-Packard Company

Manufacturer's Address: Colorado Springs Division
                                  1900 Garden of the Gods Road
                                  Colorado Springs, CO 80907 USA

declares, that the product

Product Name: Microprocessor Emulator (HP 64700 Series)

Model Number(s):   HP 64789A, B, C

Product Option(s):   All

conforms to the following Product Specifications:

Safety: IEC 348:1978 / HD 401 S1:1981
           UL 1244
           CSA-C22.2 No. 231 (Series M-89)
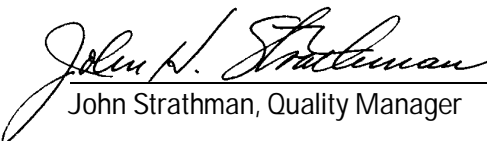
EMC: CISPR 11:1990 / EN 55011:1991   Group 1 Class A
           IEC 801-2:1991 / EN 50082-1:1992   4 kV CD, 8 kV AD
           IEC 801-3:1984 / EN 50082-1:1992   3 V/m, {1kHz 80% AM, 27-1000 MHz}
           IEC 801-4:1988 / EN 50082-1:1992   0.5 kV Sig. Lines, 1 kV Power Lines

Supplementary Information:

The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC.

This product was tested in a typical configuration with Hewlett-Packard test systems.

Colorado Springs, 7/11/94

John Strathman, Quality Manager

European Contact: Your local Hewlett-Packard Sales and Service Office or Hewlett-Packard GmbH, Department ZQ / Standards Europe, Herrenberger Strasse 130, D-71034 Böblingen Germany (FAX: +49-7031-14-3143)

Product Regulations

Safety   IEC 348:1978 / HD 401 S1:1981
UL 1244
CSA-C22.2 No.231 (Series M-89)

EMC   This Product meets the requirements of the European Communities (EC)
EMC Directive 89/336/EEC.

Emissions   EN55011/CISPR 11 (ISM, Group 1, Class A equipment)

Immunity	EN50082-1	Code[1]	Notes[2]
	IEC 801-2 (ESD) 8 kV AD	3	A, B, C
	IEC 801-3 (Rad.) 3 V/m	1	C
	IEC 801-4 (EFT) 1 kV	1	C

[1] Performance Codes:
   1 PASS - Normal operation, no effect.
   2 PASS - Temporary degradation, self recoverable.
   3 PASS - Temporary degradation, operator intervention required.
   4 FAIL - Not recoverable, component damage.

[2] Notes:
   A Electrostatic discharge (ESD) to the 64700B mainframe may cause
      degraduation in performance requiring operator intervention.
   B The active probe assembly is sensitive to ESD events. Use standard
      ESD preventative practices to avoid component damage.
   C The CMB and active probe power connectors were not subjected
      to immunity testing.

Sound Pressure   Less than 60 dBA
Level

Certification and Warranty

Certification

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

Warranty

This Hewlett-Packard system product is warranted against defects in materials and workmanship for a period of 90 days from date of installation. During the warranty period, HP will, at its option, either repair or replace products which prove to be defective.

Warranty service of this product will be performed at Buyer's facility at no charge within HP service travel areas. Outside HP service travel areas, warranty service will be performed at Buyer's facility only upon HP's prior agreement and Buyer shall pay HP's round trip travel expenses. In all other cases, products must be returned to a service facility designated by HP.

For products returned to HP for warranty service, Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country. HP warrants that its software and firmware designated by HP for use with an instrument will execute its programming instructions when properly installed on that instrument. HP does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

Limitation of Warranty

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environment specifications for the product, or improper site preparation or maintenance.

No other warranty is expressed or implied. HP specifically disclaims the implied warranties of merchantability and fitness for a particular purpose.

Exclusive Remedies

The remedies provided herein are buyer's sole and exclusive remedies. HP shall not be liable for any direct, indirect, special, incidental, or consequential damages, whether based on contract, tort, or any other legal theory.

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office.

Safety

Summary of Safe Procedures

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements.

Ground The Instrument

To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The instrument is equipped with a three-conductor ac power cable. The power cable must either be plugged into an approved three-contact electrical outlet. The power jack and mating plug of the power cable meet International Electrotechnical Commission (IEC) safety standards.

Do Not Operate In An Explosive Atmosphere

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

Keep Away From Live Circuits

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with the power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

Designed to Meet Requirements of IEC Publication 348

This apparatus has been designed and tested in accordance with IEC Publication 348, safety requirements for electronic measuring apparatus, and has been supplied in a safe condition. The present instruction manual contains some information and warnings which have to be followed by the user to ensure safe operation and to retain the apparatus in safe condition.

Do Not Service Or Adjust Alone

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

Do Not Substitute Parts Or Modify Instrument

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification of the instrument. Return the instrument to a Hewlett-Packard Sales and Service Office for service and repair to ensure that safety features are maintained.

Dangerous Procedure Warnings

Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed.

Warning   Dangerous voltages, capable of causing death, are present in this instrument. Use extreme caution when handling, testing, and adjusting.

Safety Symbols Used In Manuals

The following is a list of general definitions of safety symbols used on equipment or in manuals:

Instruction manual symbol: the product is marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect against damage to the instrument.

Hot Surface. This symbol means the part or surface is hot and should not be touched.

Indicates dangerous voltage (terminals fed from the interior by voltage exceeding 1000 volts must be marked with this symbol).
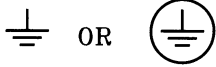
Protective conductor terminal. For protection against electrical shock in case of a fault. Used with field wiring terminals to indicate the terminal which must be connected to ground before operating the equipment.

Low-noise or noiseless, clean ground (earth) terminal. Used for a signal common, as well as providing protection against electrical shock in case of a fault. A terminal marked with this symbol must be connected to ground in the manner described in the installation (operating) manual before operating the equipment.
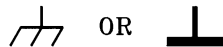
Frame or chassis terminal. A connection to the frame (chassis) of the equipment which normally includes all exposed metal structures.

Alternating current (power line).

Direct current (power line).

Alternating or direct current (power line).

Caution   The Caution sign denotes a hazard. It calls your attention to an operating procedure, practice, condition, or similar situation, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product.

Warning   The Warning sign denotes a hazard. It calls your attention to a procedure, practice, condition or the like, which, if not correctly performed, could result in injury or death to personnel.