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HP References in this Manual

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, semiconductor products and chemical analysis businesses are now part of Agilent Technologies. We have made no changes to this manual copy. In other documentation, to reduce potential confusion, the only change to product numbers and names has been in the company name prefix: where a product number/name was HP XXXX the current name/number is now Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A.

User's Guide

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For Safety information, Warranties, and Regulatory information, see the pages behind the index.

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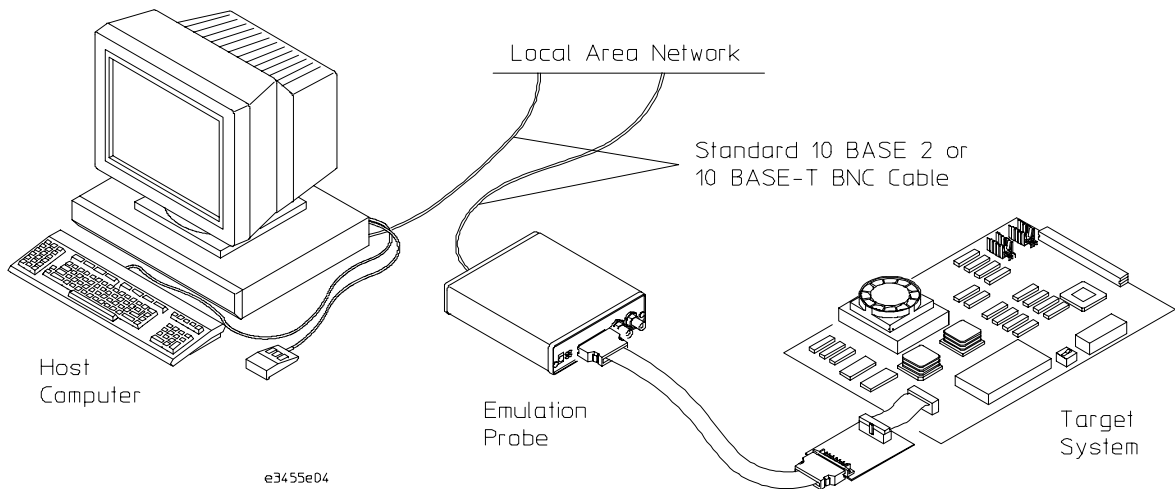
Emulation for the Motorola M•CORE

Emulation for the Motorola M•CORE—At a Glance

Emulation Probe

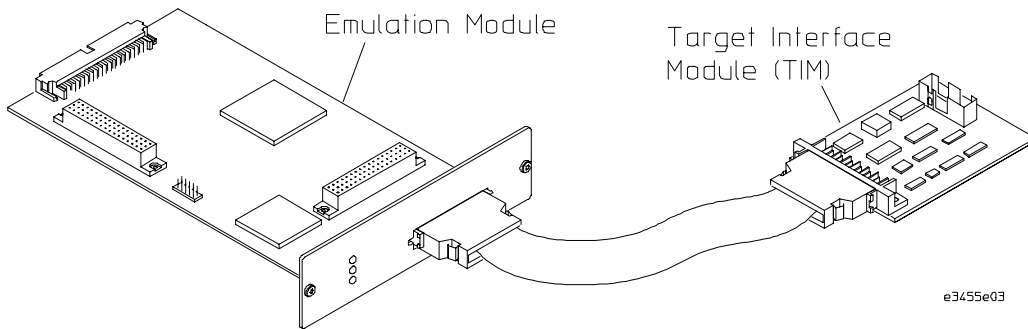
The emulation probe is a stand-alone emulator. You can connect the emulation probe to a debug port on the target system through the provided target interface module (TIM). The emulation probe can be controlled by a debugger on a host computer or by the Emulation Control Interface on an HP 16600A/700A-series logic analysis system.

The emulation probe lets you use the target processor's built-in JTAG debugging features, including run control and access to registers and memory



Emulation Module

The emulation module plugs into your HP 16600A/700A-series logic analysis system frame. It can be controlled by a debugger on a host computer or by the Emulation Control Interface on an HP 16600A/700A-series logic analysis system. The emulation module lets you use the target processor's built-in JTAG debugging features, including run control and access to registers and memory.



In This Book

This book documents the following products:

Emulation Probe		
Processors supported	Product ordered	Includes
M•CORE Rev 1.5 Core MMC2001	E5900A Option #090	HP E3455A emulation probe, HP E3455-66501 target interface module (TIM)

Emulation Module		
Processors supported	Product ordered	Includes
M•CORE Rev 1.5 Core MMC2001	E5901A Option #090	HP 16610A emulation module, HP E3455-66501 target interface module (TIM)

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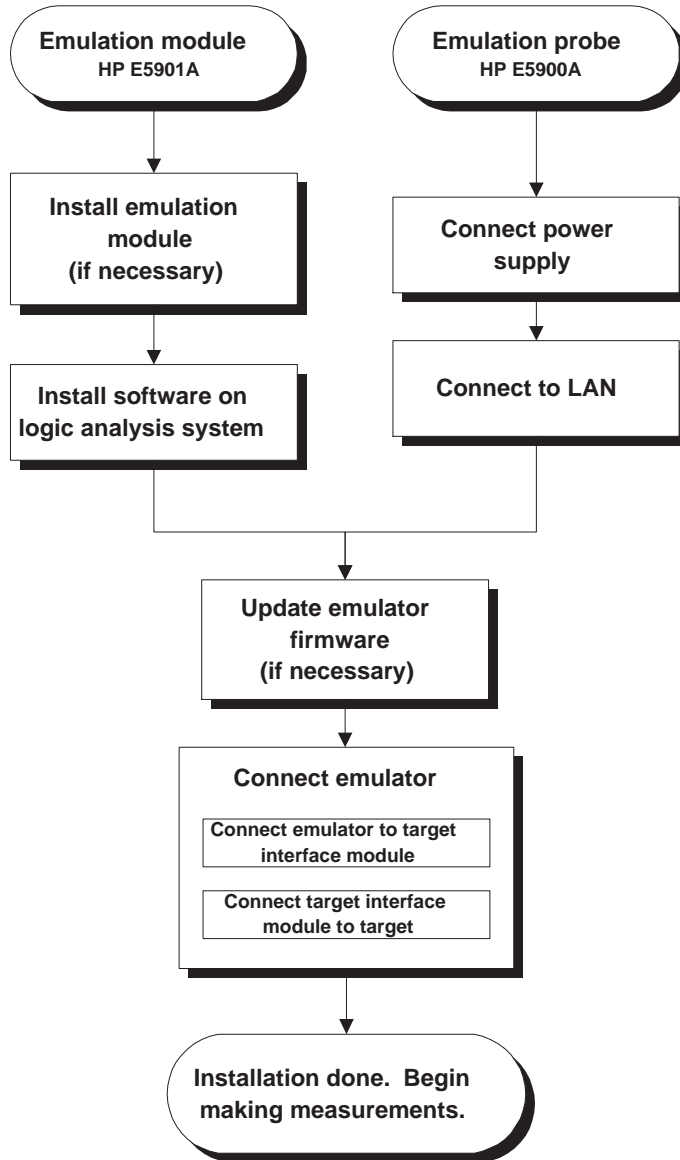
Overview

Overview

This chapter describes:

- Setup flowchart
- Equipment used with the emulation probe
- Connection sequences for the emulation probe
- Equipment used with the emulation module
- Additional information sources

Setup Flowchart

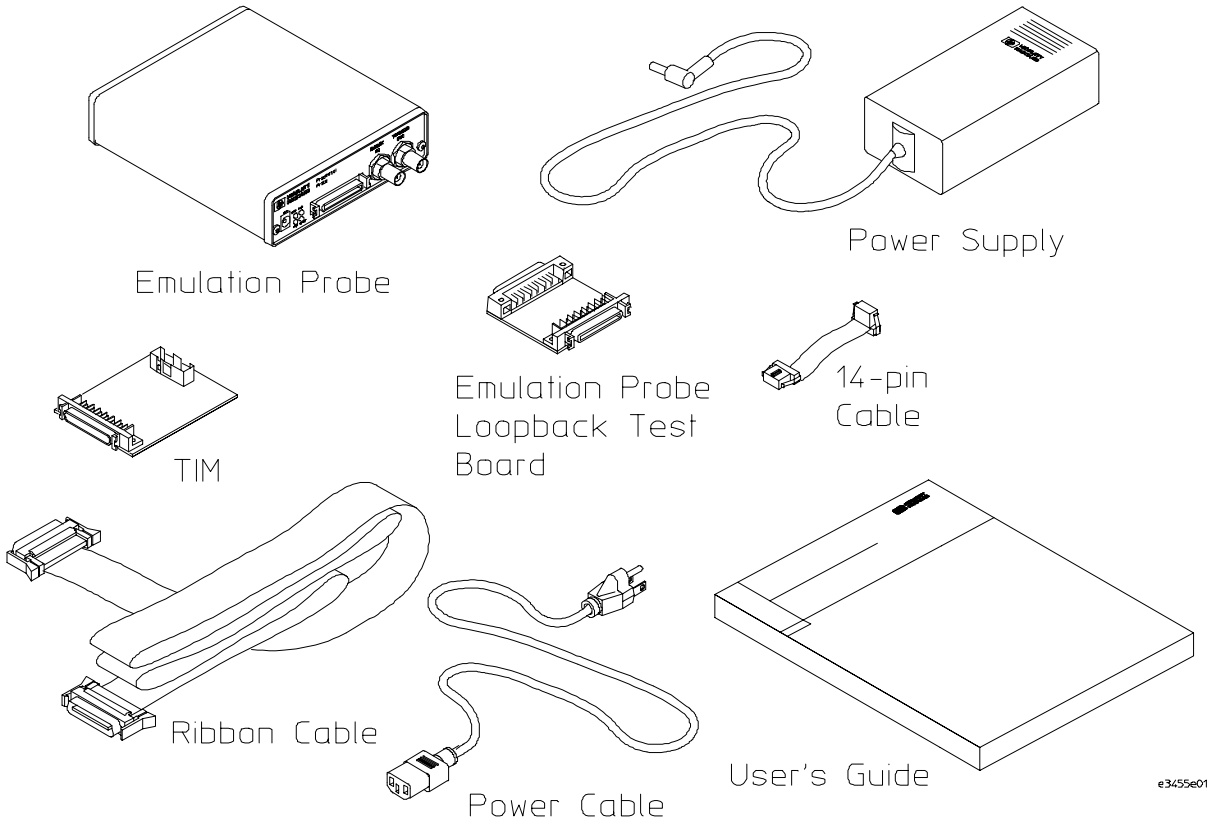


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Emulation Probe

Equipment supplied

- An emulation probe.
- A 12V power supply for the emulation probe.
- A power cord.
- A target interface module (TIM) circuit board (HP part number E3455-66501).
- An emulation probe loopback test board (HP part number E3496-66502).
- A 50-pin ribbon cable (connects the emulation probe to the target interface module).
- A 14-pin low density ribbon cable (connects the target interface module to your target system).
- This *User's Guide*.



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Minimum Equipment Required

The following equipment is required to use the emulation probe:

- A target system with the appropriate connector. The target system must meet the criteria in chapter 7.
- A host computer, such as a PC or workstation. You can also connect the emulation probe to an HP 16600A or HP16700A logic analysis system.
- A LAN (local area network) to connect the emulation probe to the host computer.
- A user interface on the host computer, such as a high-level source debugger or the logic analysis system's Emulation Control Interface.

Power-On/Power-Off Sequence for the Emulation Probe

To power on the system

With all components connected, power on your system as follows:

- 1** Logic analyzer, if you are using one.
- 2** Emulation probe.
- 3** Your target system.

To power off the system

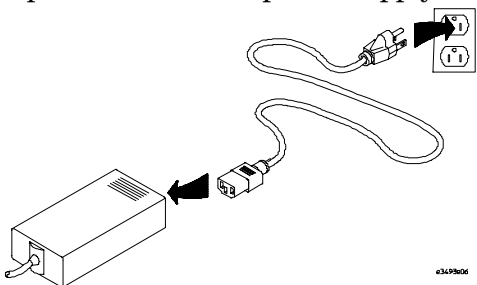
Power off your system as follows:

- 1** Your target system.
- 2** Emulation probe.
- 3** Logic analyzer, if you are using one.

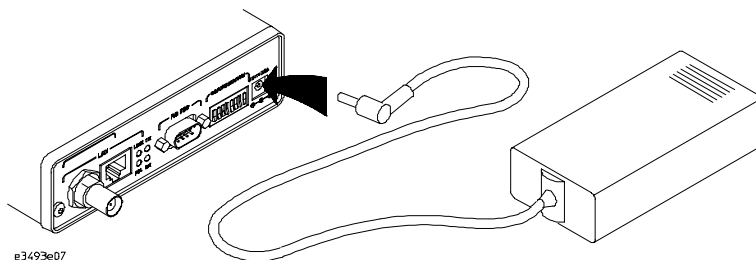
To connect the emulation probe to a power source

The emulation probe does not have an On/Off switch. To power on the emulation probe:

- 1 Connect the power cord to the power supply and to a socket outlet.



- 2 Connect the 12V power cord to the back of the emulation probe.



The power light on the target side of the emulation probe will be illuminated.

The emulation probe is shipped from the factory with a power supply and cord appropriate for your country. If the cord you received is not appropriate for your electrical power outlet type, contact your Hewlett-Packard sales and service office.

Warning

Use only the supplied HP power supply and cord.
Failure to use the proper power supply could result in electric shock.

Caution

Use only the supplied HP power supply and cord.
Failure to use the proper power supply could result in equipment damage.

Connection Sequence (Probe only)

Disconnect power from the target system, emulation probe, and logic analyzer before you make or break connections.

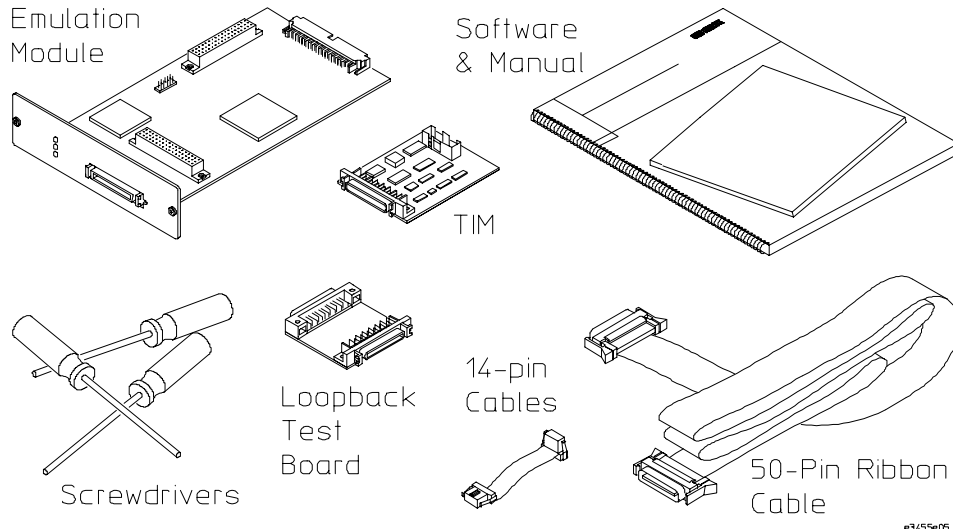
- 1** Connect the emulation probe to a LAN (page 15).
- 2** Connect the emulation probe to your target system (page 41).
- 3** Configure the emulator (page 45).

Emulation Module

Equipment supplied

The equipment supplied with your emulation module includes:

- An HP16610A emulation module. If you ordered an emulation module as part of your HP16600A or HP16700A-series logic analysis system, it is already installed in the frame.
- A target interface module (TIM) circuit board.
- An emulation module loopback test board (HP part number E3496-66502).
- Firmware for the emulation module and/or updated software for the Emulation Control Interface on a CD-ROM.
- A 50-pin ribbon cable for connecting the emulation module to the target interface module.
- A 14-pin low density ribbon cable (connects the target interface module to your target system).
- One Torx T-10 and one Torx T-15 and one Torx T-8 screwdriver (if the emulation module was not installed at the factory).
- This User's Guide.



Minimum equipment required

The following equipment is required to use the emulation module:

- An HP16600A or HP16700A logic analysis system.
- A user interface, such as a high-level source debugger or the logic analysis system's Emulation Control Interface.

Additional Information Sources

Additional or updated information can be found in the following places:
Newer editions of this manual may be available. Contact your local HP representative.

- Application notes may be available from your local HP representative or on the World Wide Web at:
<http://www.hp.com/go/logicanalyzer>
- If you have an HP 16600A or HP 16700A logic analysis system, the online help for Emulation Control Interface has additional information on using the emulation module.
- The measurement examples include valuable tips for making emulation and analysis measurements. You can find the measurement examples under the system help in your HP 16600A/700A-series logic analysis system.
- If you cannot easily find the information you need, send email to documentation@col.hp.com. Your comments will help HP improve future manuals. (This address is for comments only; contact your local HP representative if you need technical support.)

Connecting the Emulation Probe to a LAN

Connecting the Emulation Probe to a LAN

You can connect your PC, workstation, or logic analysis system to the emulation probe via a serial or LAN connection.

Serial connection

A serial connection allows you to complete all of the performance verification tests and set LAN parameters. Other use of the serial port is not supported.

LAN connection

A LAN connection will allow you to make your measurements quickly and easily. A few of the performance verification tests cannot be run over a LAN.

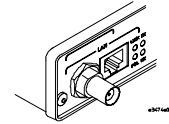
Recommended connection

Use a LAN connection for routine use, and a serial connection for LAN configuration and for troubleshooting.

Setting Up a LAN Connection to a PC or Workstation

The emulation probe has two LAN connectors:

- A BNC connector that can be directly connected to a IEEE 802.3 Type 10BASE2 cable (ThinLAN). When using this connector, the emulation probe provides the functional equivalent of a Medium Attachment Unit (MAU) for ThinLAN.
- An IEEE 802.3 Type 10BASE-T (StarLAN) connector.



Use either the 10BASE2 or the 10BASE-T connector. Do *not* use both. The emulation probe will not work with both connected at the same time.

You must assign an IP address (Internet address) to the emulation probe before it can operate on the LAN. You can also set other network parameters such as a gateway address. The IP address and other network parameters are stored in nonvolatile memory within the emulation probe.

The emulation probe automatically sets a subnet mask based on the subnet mask used by other devices on the network.

You can configure LAN parameters in any of the following ways:

- Using the built-in terminal interface over a serial connection. This is the most reliable method.
- Using BOOTP. BOOTP is part of the HP-UX, SunOS, and Solaris operating systems.

To obtain an IP address

1 Obtain the following information from your local network administrator or system administrator:

- An IP address for the emulation probe.

You can also use a "LAN name" for the emulation probe, but you must configure it using the integer dot notation (such as 127.0.0.1).

- The gateway address.

The gateway address is an IP address and is entered in integer dot notation. The default gateway address is 0.0.0.0, which allows all connections 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.

2 Find out whether port numbers 6470 and 6471 are already in use on your network.

The host computer interfaces communicate with the emulation probe through two TCP service ports. The default base port number is 6470. The second port has the next higher number (default 6471).

In almost all cases, the default numbers (6470, 6471) can be used without change. If necessary, the default numbers can be changed if they conflict with some other product on your network.

To change the port numbers, see page 19. If you have already set the IP address, you can use a telnet connection instead of a serial connection to connect to the emulation probe.

3 Write down the link-level address of the emulation probe.

You will need this address if you use BOOTP to set the IP address.

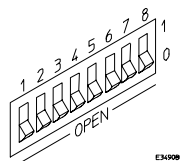
The link-level address (LLA) is printed on a label above the LAN connectors on the emulation probe. This address is configured in each emulation probe shipped from the factory and cannot be changed.

IP Address of Processor probe
LAN Name of Emulation Probe
Gateway Address
Link-Level Address of Emulation Probe

To configure LAN parameters using the built-in terminal interface

- 1 Set configuration switches S1 through S4 to ON, and set the other switches as appropriate for your serial interface.

Switch settings are printed on the bottom of the emulation probe. If you will use a baud rate of 9600 baud, set the switches like this:



- 2 Connect an ASCII terminal (or terminal emulator) to the emulation probe's RS-232 port with a 9-pin RS-232 cable.

Complete instructions for setting up a serial connection begin on page 26.

- 3 Plug in the emulation probe's power cord. Press the terminal's <RETURN> key a couple times. You should see a prompt such as "p>", "?>", or "c>".

At this point, you are communicating with the emulation probe's built-in terminal interface.

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

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

The "lan -i" line shows the current IP address (IP address) of the emulation probe.

The Ethernet address, also known as the link level address, is preassigned at the factory, and is printed on a label above the LAN connectors.

- 5 Enter the following command:

```
lan -i <internet> [-g <gateway>] [-p <port>]
```

The lan command parameters are:

-i <internet> The IP address which you obtained from your network administrator.

Chapter 2: Connecting the Emulation Probe to a LAN
To configure LAN parameters using the built-in terminal interface

- g <gateway> The gateway address. Setting the gateway address allows access outside your local network or subnet.
- p <port> This changes the base TCP service port number.

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. 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 IP address and any other LAN parameters you change are stored in nonvolatile memory and will take effect the next time the emulation probe is powered off and back on again.

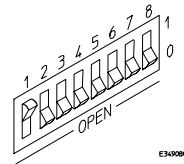
6 Disconnect the power cord from the emulation probe, and connect the emulation probe to your network.

This connection can be made by using either the 10BASE-T connector or the 10BASE2 (BNC) connector on the emulation probe. Do not use both connectors at the same time.

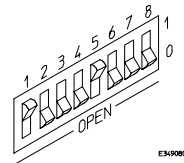
7 Set the configuration switches to indicate the type of connection that is to be made.

Switch S1 must be set to OFF, indicating that a LAN connection is being made.

Switch S5 should be ON if you are connecting to the BNC connector:



Switch S5 should be OFF if you are connecting to the 10BASE-T connector:



Set all other switches to ON.

8 Connect the power cord to the emulation probe.

9 Verify your emulation probe is now active and on the network. See "To verify LAN communications" on page 25.

Once you have set a valid IP address, you can use the telnet utility to connect to the emulation probe, and use the lan command to change LAN parameters.

Example

To assign an IP address of 192.6.94.2 to the emulation probe, enter the following command:

```
R>lan -i 192.6.94.2
```

Now, cycle power on the emulation probe so that the new address will take effect.

See Also

"Solving Problems," page 83, if you have problems verifying LAN communication.

To configure LAN parameters using BOOTP

Use this method only on a workstation which is running bootpd, the BOOTP daemon.

1 Make sure that BOOTP is enabled on your host computer.

If the following commands yield the results shown below, the BOOTP protocol is enabled:

```
$ grep bootp /etc/services
bootps      67/udp
bootpc      68/udp
$ grep bootp /etc/inetd.conf
bootps dgram udp wait root /etc/bootpd bootpd
```

If the commands did not yield the results shown, you must either add BOOTP support to your workstation or use a different method to configure the emulation probe LAN parameters.

2 Add an entry to the host BOOTP database file, /etc/bootptab. For example:

```
# Global template for options common to all HP 64700
# emulators and Emulation Probes.
# Use a different gateway addresses if necessary.
hp64700.global:\
    :gw=0.0.0.0:\
    :vm=auto:\
    :hn:\
    :bs=auto:\
    :ht=ether

# Specific emulator entry specifying hardware address
# (link-level address) and ip address.
hprobe.div.hp.com:\
    :tc=hp64700.global:\
    :ha=080009090B0E:\
    :ip=192.6.29.31
```

In this example, the "ha=080009090B0E" identifies the link-level address of the emulation probe. The "ip=192.6.29.31" specifies the IP address that is assigned to the emulation probe. The node name is "hprobe.div.hp.com".

3 Connect the emulation probe to your network.

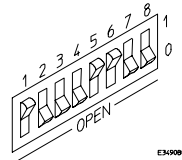
This connection can be made by using either LAN connector on the emulation probe.

4 Set the configuration switches to indicate the type of connection that is to be made.

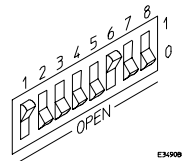
Switch S1 must be set to OFF, indicating that a LAN connection is being made.

Switch S6 must be set to OFF to enable BOOTP mode.

Switch S5 should be set to OFF if you are connecting to the BNC connector



Switch S5 should be set to ON if you are connecting to the 10BASE-T connector.



Set all other switches to ON.

5 Connect the power cord to the emulation probe.

Verify that the power light stays on after 10 seconds.

The IP address will be stored in EEPROM.

6 Set switch S6 back to ON.

Do this so that the emulation probe does not request its IP address each time power is cycled. The IP address is stored in EEPROM, so BOOTP does not need to be run again. Leaving this switch on will result in slower performance, increased LAN traffic, and even failure to power up (if the BOOTP server becomes inactive).

7 Verify your emulation probe is now active and on the network. See "To verify LAN communications" on page 25.

See Also

For additional information about using bootpd, refer to the bootpd (1M) man page.

To set the 10BASE-T configuration switches

Set switches S7 and S8 to ON unless one of the following conditions is true:

- **If the LAN cable exceeds the standard length, set switch S7 to OFF.**
The emulation probe has a switch-selectable, twisted-pair receiver threshold. With switch S7 set to OFF, the twisted-pair receiver threshold is lowered by 4.5 dB. This should allow you to use cable lengths of up to about 200 meters. If you use a long cable, you should consult with your LAN cabling installer to ensure that:
 - The device at the other end of the cable has long cable capability, and
 - The cable is high-grade, low-crosstalk cable with crosstalk attenuation of greater than 27.5 dB.

When switch S7 is set to ON, the LAN port operates at standard 10BASE-T levels. A maximum of 100 meters of UTP cable can be used.

- **If your network doesn't support Link Beat integrity checking or if the emulation probe is connected to a non 10BASE-T network (such as StarLAN) set this switch to LINK BEAT OFF (0 or OPEN).**

In normal mode (switch S8 set to ON), a link integrity pulse is transmitted every 15 milliseconds in the absence of transmitted data. It expects to receive a similar pulse from the remote MAU. This is the standard link integrity test for 10BASE-T networks. If your network doesn't support the Link Beat integrity checking or if the Software Probe is used on a non 10BASE-T network (such as StarLAN) set this switch to LINK BEAT OFF (OFF).

Note

Setting switch S8 to OFF when Link Beat integrity checking is required by your network will cause the remote MAU to disable communications.

To verify LAN communications

- 1 Verify your emulation probe is now active and on the network by issuing a **telnet** to the IP address.

This connection will give you access to the emulation probe's built-in terminal interface.

- 2 To view the LAN parameters, enter the **lan** command at the terminal interface prompt.

- 3 To exit from this telnet session, type <CTRL>D at the prompt.

The best way to change the emulation probe's IP address, once it has already been set, is to telnet to the emulation probe and use the terminal interface **lan** command to make the change. Remember, after making your changes, you must cycle power or enter a terminal interface **init -p** command before the changes take effect. Doing this will break the connection and end the telnet session.

If You Have Problems

If you encounter problems, refer to the "Problems" chapter (page 83).

Example

```
$ telnet 192.35.12.6
```

```
R>lan
lan is enabled
lan -i 192.35.12.6
lan -g 0.0.0.0
lan -p 6470
Ethernet Address : 08000F090B30
```

Setting Up a Serial Connection (Emulation probe only)

To set up a serial connection, you will need to:

- Set the serial configuration switches
- Connect a serial cable between the host computer and the emulation probe
- Verify communications

Serial connections on a workstation

If you are using a UNIX workstation as the host computer, you need to use a serial device file. If a serial device file does not already exist on your host, you need to create one. Once it exists, you need to ensure that it has the appropriate permissions so that you can access it. See the system documentation for your workstation for help with setting up a serial device.

Serial connections on a PC

Serial connections are supported on PCs. You must use hardware handshaking if you will use the serial connection for anything other than setting LAN parameters.

If you are using a PC as the host computer, you do not need to set up any special files.

To set the serial configuration switches

- 1 Set switch S1 to ON (RS-232).
- 2 Set switches S2-S4 to ON.
- 3 Set switch S5 to ON (HW HANDSHAKE ON) if your serial interface uses the DSR:CTS/RTS lines for flow control. Set S5 to OFF (HW HANDSHAKE OFF) if your serial interface uses software flow control (XON/XOFF).

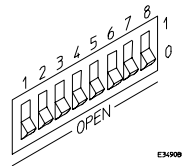
If your serial interface supports hardware handshaking, you should use it (set switch S5 to ON). Hardware handshaking will make the serial connection much more reliable.

- 4 Set switches S6-S8 for the baud rate you will use. These switch settings are listed on the bottom of the emulation probe.

The higher baud rates may not work reliably with all hosts and user interfaces. Make sure the baud rate you choose is supported by your host and user interface.

Example

To use a baud rate of 9600 baud, set the switches as follows:



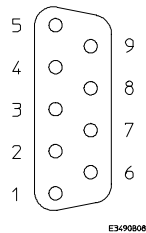
To connect a serial cable

CAUTION

Use a grounded, shielded cable. If the cable is not shielded, or if the cable is not grounded at the serial controller, the emulation probe may be damaged by electrostatic discharge.

Connect an RS-232C modem cable from the host computer to the emulation probe. The recommended cable is HP part number C2932A. This is a 9-pin cable with one-to-one pin connections.

If you want to build your own RS-232 cable, follow the pinout shown in the following figure:



If you want to build your own RS-232 cable, follow the pinout shown in the following figure:

Serial Cable Pinout

Pin Number	Signal	Signal Description
1	DCD	Data Carrier Detect (not used)
2	TD	Transmit Data (data coming from HP emulation probe)
3	RD	Receive Data (data going to HP emulation probe)
4	DTR	Data Terminal Ready (not used)
5	GND	Signal Ground
6	DSR	Data Set Ready (Output from HP emulation probe)
7	RTS	Request to Send (Input to HP emulation probe)
8	CTS	Clear to Send (connected to pin 6)
9	RING	Ring Indicator (not used)

To verify serial communications

1 Start a terminal emulator program on the host computer.

If you are using a PC, the Terminal application in Microsoft Windows will work fine.

If you are using a UNIX workstation, you can use a terminal emulator such as `cu` or `kermit`.

2 Plug the power cord into the emulation probe.

When the emulation probe powers up, it sends a message (similar to the one that follows) to the serial port and then displays a prompt:

```
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.
```

```
HPE3499A Series Emulation System
Version:  A.07.53 26Feb98
Location:  Generics
```

```
HPE3455A Motorola M-Core Emulator
Version:  A.01.00 31Mar98
```

R>

The version numbers may be different for your emulation probe.

3 Press the Return or Enter key a few times.

You should see a prompt such as "p>", "R>", or "?>".

For information about the commands you can use, enter `?` or `help` at the prompt.

See Also "Problems with the Serial Interface," page 101.

Installing the Emulation Module

Installing the Emulation Module

This chapter shows you how to install an emulation module in your HP 16600A/700A-series logic analysis system.

If your emulation module is already installed in your logic analysis system frame, you may skip this chapter.

Caution

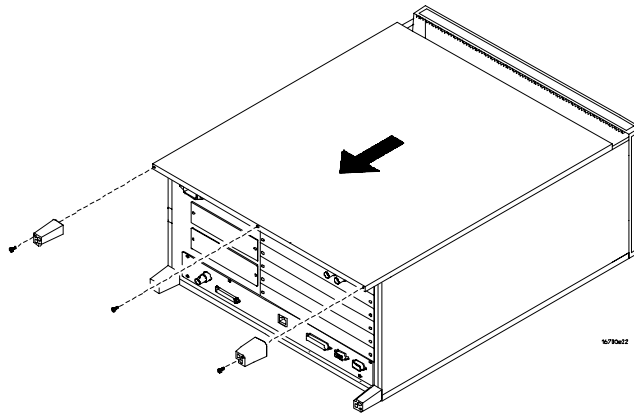
These instructions are for trained service personnel. To avoid dangerous electric shock, do not perform any service unless qualified to do so. Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

Electrostatic discharge can damage electronic components. Use grounded wriststraps and mats when you handle modules.

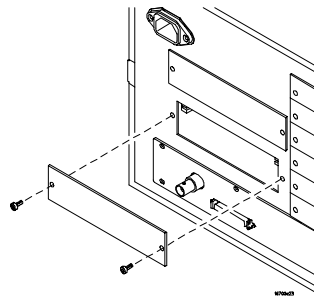
To install the emulation module in an
HP 16700A-series logic analysis system or an
HP 16701A expansion frame

You will need T-10 and T-15 Torx screw drivers (supplied with the module) .

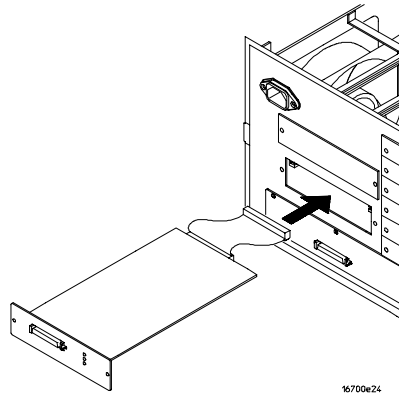
- 1 Turn off the logic analysis system and REMOVE THE POWER CORD.**
Remove any other cables (such as probes, mouse, or video monitor).
- 2 Turn the logic analysis system frame upside-down.**
- 3 Remove the bottom cover.**



- 4 Remove the slot cover.**
You may use either slot.

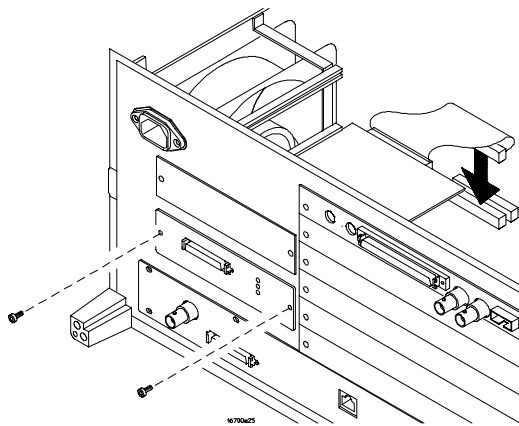


5 Install the emulation module.



6 Connect the cable and re-install the screws.

You may connect the cable to either of the two connectors. If you have two emulation modules, note that many debuggers will work only with the "first" module: the one toward the top of the frame ("Slot 1"), plugged into the connector nearest the back of the frame.



7 Reinstall the bottom cover, then turn the frame right-side-up.

8 Plug in the power cord, reconnect the other cables, and turn on the logic analysis system.

The new emulation module will be shown in the system window.

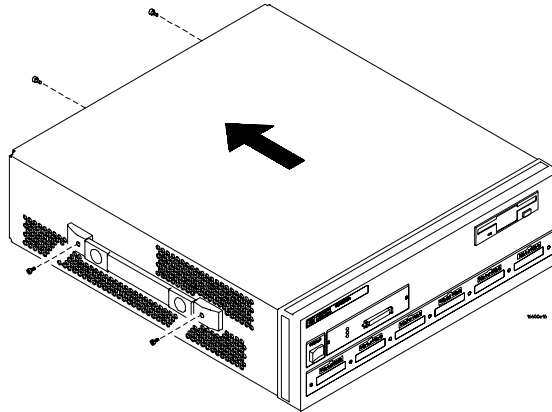
See Also

See page 67 for information on giving the emulation module a "personality" for your target processor.

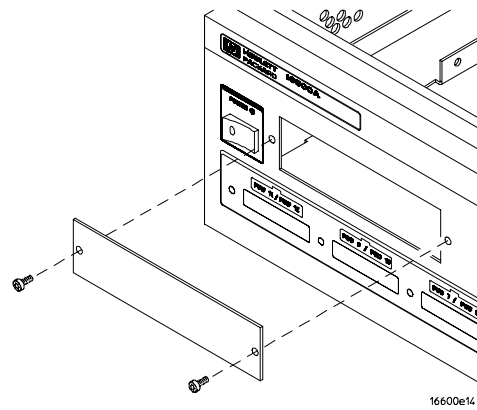
To install the emulation module in an HP 16600A-series logic analysis system

You will need a T-8, T-10, and T-15 Torx screw drivers (supplied with the modules).

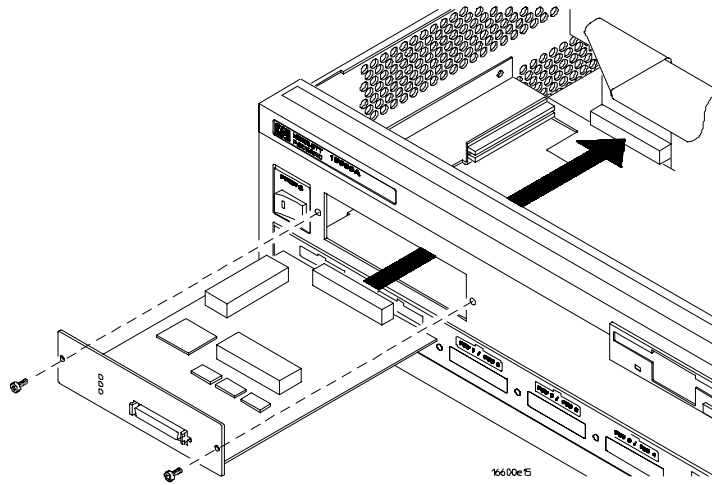
- 1 Turn off the logic analysis system and REMOVE THE POWER CORD.**
Remove any other cables (such as probes, mouse, or video monitor).
- 2 Slide the cover back.**



- 3 Remove the slot cover.**



- 4 Install the emulation module.
- 5 Connect the cable and re-install the screws.



- 6 Reinstall the cover.
Tighten the screws snugly (2 N•m or 18 inch-pounds).
- 7 Plug in the power cord, reconnect the other cables, and turn on the logic analysis system.
The new emulation module will be shown in the system window.

Installing Software on an HP 16600A/700A

Installing Software on an HP 16600A/700A

This chapter explains how to install the software you will need for your emulator.

Installing and loading

Installing the software will copy the files to the hard disk of your logic analysis system. Later, you will need to **load** some of the files into the appropriate hardware module.

What needs to be installed

If you ordered an emulator with your logic analysis system, the software was installed at the factory.

The following files are installed from the CD-ROM:

- Emulation module firmware
- Emulation Control Interface

To install the software from CD-ROM (HP 16600A/700A)

Installing a processor support package from a CD-ROM will take just a few minutes. If the processor support package requires an update to the HP 16600A/700A operating system, installation may take approximately 45 minutes.

If the CD-ROM drive is not connected, see the instructions printed on the CD-ROM package.

- 1** Turn on the CE-ROM drive first and then turn on the logic analysis system.
- 2** Insert the CD-ROM in the drive.
- 3** Click the **System Admin** icon.
- 4** Click **Install...**
- 5** Select CD-ROM as the media, and click **Apply**.
- 6** From the list of types of packages, double-click "PROC-SUPPORT."
A list of the processor support packages on the CD-ROM will be displayed.
- 7** Click on the **M•CORE** package.
If you are unsure if this is the correct package, click Details for information on what the package contains.
- 8** Click **Install...**
The dialog box will display "Progress: completed successfully" when the installation is complete.
- 9** Click **Close**.

The firmware is stored in /hplogic/run_control/firmware

See Also

The online help for more information on installing, licensing, and removing software.

Connecting to the Target System

Connecting to a Target System

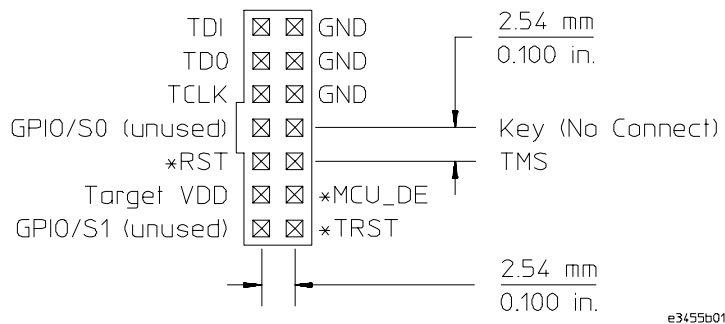
To test the HP emulator

If this is the first time that you have used the emulator, you should run the built-in performance verification test before you connect to a target system. Refer to the "Solving Problems" chapter (beginning on page 83) for information on performance verification.

To connect to a target system via the OnCE port

In order to connect the emulator to the microprocessor, one of the supported connectors must be available on the target system (see page 55 for information on designing a target system for use with the emulator).

- 1 Remove power from the target system and the emulator.
- 2 Plug one end of the 50-pin cable into the emulator.
- 3 Plug the other end of the 50-pin cable into the target interface module.
- 4 Connect the 14-pin cable from the TIM to the target system OnCE connector.



- 5 Turn on the power to the emulator.
- 6 Turn on the power to the target.

Configuring the Emulator

Configuring the Emulator

The HP emulator has a number of user configurable parameters. These parameters may be customized for specific target systems and saved in configuration files for future use.

The easiest way to configure the emulation module is through the Emulation Control Interface in the HP 16600A/700A-series logic analysis system.

If you use the Emulation Control Interface, please refer to the online help in the Configuration window for information on each of the configuration options.

Other ways to configure the emulator are:

- the emulator's built-in terminal interface
- your debugger

To configure using the Emulation Control Interface

The easiest way to configure the emulator is to use the Emulation Control Interface.

1 Start an Emulation Control Interface session.

For an emulation module:

- In the system window, click the HP Emulation Control Interface icon, and select "Start Session...".

For an emulation probe:

- In the workspace window, drag the emulation probe icon onto the workspace, then select "Start Session."

2 Open a Configuration window.

Select "Configuration..." from the Emulation Control Interface icon or from the Navigate menu in any Emulation Control Interface window.

3 Set the configuration options, as needed.

The configuration selections will take effect when you close the configuration window or when you move the mouse pointer outside the window.

4 Save the configuration settings.

To save the configuration settings, open the File Manager window and click **Save...**

See Also

Help → **Help on this window** in the Configuration window for information on each of the configuration options.

Help in the Emulation Control Interface menu for help on starting an Emulation Control session.

To configure using the built-in commands

If you are unable to configure the emulator with the Emulation Control Interface or a debugger interface, you can configure the emulator using the built-in "terminal interface" commands.

- 1** Connect a terminal or terminal emulator to the emulator's serial port, or use a telnet session over the LAN.
- 2** Enter `cf` to see the current configuration settings.
- 3** Use the `cf` command to change the configuration settings.

See Also

Enter `help cf` for help on the configuration commands.

For information on connecting a serial terminal or terminal emulator, see page 26.

For information on other built-in commands, see page 89.

Example

To see a complete list of configuration items, use the command "help cf". For example:

```
cf - display or set emulation configuration

cf                - display current settings for all config items
cf <item>         - display current setting for specified <item>
cf <item>=<value> - set new <value> for specified <item>
cf <item> <item>=<value> <item> - set and display can be combined

help cf <item>   - display long help for specified <item>

--- VALID CONFIGURATION <item> NAMES ---
rrt              - Restrict to real-time runs
speed           - Set JTAG clock
proc            - Set processor type
breakin         - Select BNC break input option
trigout         - Select BNC trigger output option
M>
```

To see a more detailed description of any configuration item, use the command "help cf <item>". For example:

```
M>help cf rrt
```

```
Restrict to real-time runs
```

```
cf rrt=yes  
cf rrt=no
```

If yes (and while the processor is running the user program), any command that requires the processor to be stopped will be rejected. For example 'reg' and 'm'.

If no, commands that require the processor to be stopped will actually stop the processor, execute then resume running the processor.

To configure using a debugger

Because the HP emulator can be used with several third-party debuggers, specific details for sending the configuration commands to the probe cannot be given here. However, all debuggers should provide a way of directly entering terminal mode commands to the probe. Ideally, you would create a file that contains the configuration entries you need modified that can be sent to the probe at the beginning of each debugger session. See your debugger manual for more details.

General Configuration Items

The general configuration items must be set correctly for each target system.

To configure restriction to real-time runs

Real-time runs configuration

Value	Emulator configured for	Built-in command
no	Allows commands which break to the monitor. Examples include commands which display memory or registers. These commands break to the monitor to access the target processor, then resume the user program.	cf rrt=no
yes	No commands are allowed which break to the monitor, except "break," "reset," "run," or "step." The processor must be explicitly stopped before these commands can be performed. (Default)	cf rrt=yes

If your debugger allows displaying or modifying memory or registers while the processor is running, you must set rrt=no in order to use this feature.

To configure processor type	Built-in command
M•CORE - Default Revision 1.5 Core	cf proc=mc90re

To configure the JTAG clock speed (communication speed)

The HP emulator needs to be configured to communicate at a rate which is compatible with your target processor. The JTAG Clock speed is independent of processor clock speed. In general, `cf speed=7` can always be used and provides the best performance. With some target systems that have additional loads on the JTAG lines or with target systems that do not quite meet the requirements described in the "Designing a Target System" chapter (page 55), setting speed to a slower setting may enable the probe to work.

TCK clock speed configuration

Value	TCK is at least	Built-in command
1	10 MHz (default)	<code>cf speed=7</code>
2	5 MHz	<code>cf speed=6</code>
3	2.5 MHz	<code>cf speed=5</code>
4	1.25 MHz	<code>cf speed=4</code>
5	625 kHz	<code>cf speed=3</code>
6	312 kHz	<code>cf speed=2</code>
7	156 kHz	<code>cf speed=1</code>

To configure the Trigger Out BNC (Emulation Probe only)

Trigger out configuration

Value	The Trigger Out BNC will	Built-in command
fixhigh	Always be high	<code>cf trigout=fixhigh</code>
fixlow	Always be low	<code>cf trigout=fixlow</code>
monhigh	Go high when the processor is running in background (Default)	<code>cf trigout=monhigh</code>
monlow	Go low when the processor is running in background	<code>cf trigout=monlow</code>

With an emulation module, this configuration item is always set to the default setting and cannot be changed with a `cf` command. The Intermodule window of the logic analyzer must be used instead.

To configure the Trigger In BNC (Emulation Probe only)

Trigger in configuration

Value	Meaning	Built-in command
off	Inputs to the Break In BNC will be ignored.	<code>cf breakin=off</code>
rising	The emulator will cause a break on a rising edge. (Default)	<code>cf breakin=rising</code>
falling	The emulator will cause a break on a falling edge.	<code>cf breakin=falling</code>

With an emulation module, this configuration item is always set to the default setting and cannot be changed with a `cf` command. The Intermodule window of the logic analyzer must be used instead.

Designing a Target System

Designing a Target System

This chapter will help you design a target system that will work with the HP Emulator.

Target System Requirements for M•CORE

Required Signals

V_{DD}

The V_{DD} signal is used to sense when the target system is connected to the Emulator. This signal is also used as a reference voltage for all signals driven by the Emulator. The Emulator does not use this pin for power.

TDI signal

The TDI signal is a core JTAG signal and should be connected to TDI on the target.

TDO signal

The TDO signal is a core JTAG signal and should be connected to TDO on the target.

TCK signal

The TCK signal is a core JTAG signal.

$\overline{\text{TRST}}$ signal

The $\overline{\text{TRST}}$ signal is a core JTAG signal.

MCU_DE signal

The $\overline{\text{MCU_DE}}$ signal is used to quickly enter debug mode after receiving a "BREAK IN" signal from the logic analyzer. This allows the logic analyzer triggering capability to be used for complex breakpoints. Without $\overline{\text{MCU_DE}}$, the processor must be stopped by using the JTAG scan chains, and the processor may not stop until several hundred instructions have been executed. This may cause complications when attempting to correlate the state of the logic analyzer and the Emulator after the breakpoint has been reached. This signal is not required. However, it is strongly recommended.

TDO, TDI, TCK, TMS and $\overline{\text{TRST}}$ signals

TDO, TDI, TCK, TMS and $\overline{\text{TRST}}$ signal traces between the JTAG connector and the M•CORE target must be less than 3 inches long. If these signals are connected to other nodes, the other nodes must be daisy chained between the JTAG connector at one end and the M•CORE microprocessor at the other end. These signals are sensitive to crosstalk and must not be routed along active signals such as clock lines on the target board.

The TDI, TCK, TMS and $\overline{\text{TRST}}$ signals must not be actively driven by the target system when the debug port is being used.

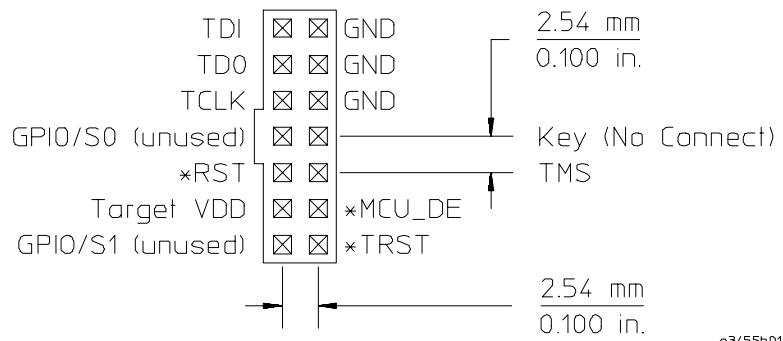
Pull-up Resistors

The following signals should contain a 10K OHM pull-up resistor:

- TDI
- TCK
- *RST
- TMS
- *TRST
- *MCU_DE

M•CORE JTAG Interface Connections and Resistors

The target system must have the Motorola 14-pin OnCE connector.



JTAG Header Connector (top view)

The connector on the target system should be placed as close as possible to the processor to ensure signal integrity.

Using the Emulator with a Debugger

Using the Emulator with a Debugger

Several prominent companies design and sell state-of-the-art source debuggers which work with the HP emulation modules and emulation probe.

Benefits of using a debugger

The debugger will enable you to control the execution of your processor from the familiar environment of your debugger. Using a debugger lets you step through your code at the source-code level.

With a debugger connection, you can set breakpoints, single-step through source code, examine variables, and modify source code variables from the debugger interface. The debugger can also be used to download executable code to your target system.

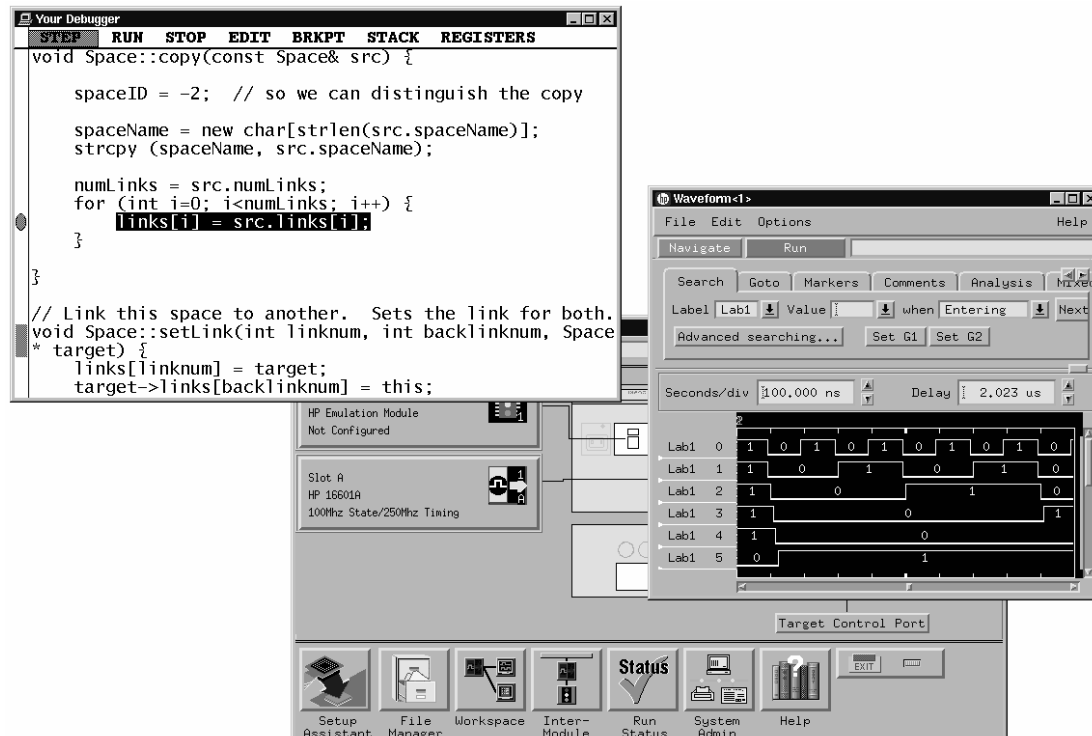
Using a debugger to connect the emulator allows the entire design team to have a consistent interface from software development to hardware/software integration.

Debugger interfaces must be ordered directly from the debugger vendor.

Compatibility with other logic analysis system tools

You can use your logic analysis system to collect and analyze trace data while you use your debugger. If you are using an X windows workstation or a PC with an X terminal emulator, you can display the logic analyzer windows right next to your debugger.

Here is an example of what the display on your PC or workstation might look like:



Minimum requirements

To use a debugger with the emulator, you will need:

- A debugger which is compatible with the emulation probe
- A LAN connection to the PC or workstation that is running the debugger
- X windows or an X terminal emulator, such as Reflection X on a PC. This is required only if you wish to have the logic analysis system user interface displayed on your PC or workstation screen, along with the debugger.

Is your debugger compatible with the emulation probe?

Ask your debugger vendor whether the debugger can be used with an HP emulation module or HP emulation probe (also known as a "processor probe" or "software probe").

LAN connection

You will use a LAN connection to allow the debugger to communicate with the emulator.

Compatibility with the Emulation Control Interface

Do not use the logic analysis system's Emulation Control Interface and your debugger at the same time.

Setting up Debugger Software

The instructions in this manual assume that your PC or workstation is already connected to the LAN, and that you have already installed the debugger software according to the debugger vendor's documentation.

To use your debugger with the emulator, follow these general steps:

- Connect the emulator to your target system (see page 41).
- Connect the logic analysis system to the LAN (page 64).
- Export the logic analysis system's display to your PC or workstation (page 66).
- Configure the emulation module (page 45).
- Begin using your debugger.

If you use the Emulation Control Interface to configure the emulator, remember to end the Emulation Control Interface session before you start the debugger.

Caution

Do not use the Emulation Control Interface at the same time as a debugger.

The Emulation Control Interface and debuggers do not keep track of commands issued by other tools. If you use both at the same time, the tools may display incorrect information about the state of the processor, possibly resulting in lost data.

See Also

Refer to the documentation for your debugger for more information on connecting the debugger to the emulation module.

To connect the logic analysis system to the LAN

Information on setting up a LAN connection is provided in the online help or installation manual for your logic analysis system.

You debugger will require some information about the LAN connection before it can connect to the emulator. This information may include:

- IP address (Internet address) or LAN name of the logic analysis system.
- Gateway address of the logic analysis system.
- Port number of the emulator.

Port numbers

Port number	Use for
Debugger connections	
6470	Slot 1 (First emulator in an HP 16600A/700A-series logic analysis system)
6474	Slot 2 (Second emulator in an HP 16700A-series system)
6478	Slot 3 (Third emulator in an expansion frame)
6482	Slot 4 (Fourth emulator in an expansion frame)
Telnet connections	
6472	Slot 1 (First emulator)
6476	Slot 2 (Second emulator)
6480	Slot 3 (Third emulator)
6484	Slot 4 (Fourth emulator)

Write the information here for future reference:

IP Address of Logic Analysis System _____

LAN Name of Logic Analysis System _____

Gateway Address _____

Port Number of Emulator _____

To change the port number of an emulator

Some debuggers do not provide a means to specify a port number. In that case, the debugger will always connect to port 6470 (the first emulation module). If you need to connect to another module, or if the port number of the first module has been changed, you must change the port number to be 6470.

To view or change the port number:

- 1** Click on the emulation module icon in the system window of the logic analysis system, then select **Update Firmware**.
- 2** Select **Modify Lan Port...**
- 3** If necessary, enter the new port number in the **Lan Port Address** field.

The new port number must be greater than 1024 and must not already be assigned to another emulation module.

To verify communication with the emulator

- 1** telnet to the IP address.

For example, on a UNIX system, enter "telnet <IP_address> 6472". This connection will give you access to the emulator's built-in terminal interface. You should see a prompt, such as "M>".

- 2** At the prompt, type:

```
ver
```

You should then see information about the emulator and firmware version.

- 3** To exit from this telnet session, type <CTRL>D at the prompt.

See Also

The online help or manual for your logic analysis system, for information on physically connecting the system to the LAN and configuring LAN parameters.

If you have problems verifying LAN communication, see page 97.

To export the logic analysis system's display to a workstation

By exporting the logic analyzer's display, you can see and use the logic analysis system's windows on the screen of your workstation. To do this, you must have telnet software and X windows installed on your computer.

- 1 On the workstation, add the host name of the logic analysis system to the list of systems allowed to make connections:

```
xhost +<IP_address>
```

- 2 Use **telnet** to connect to the logic analysis system.

```
telnet <IP_address>
```

- 3 Log in as "hplogic".

The logic analysis system will open a Session Manager window on your display.

- 4 In the Session Manager window, click **Start Session on This Display**.

Example

On a UNIX workstation, you could use the following commands to export the display of a logic analysis system named "mylogic":

```
$ xhost +mylogic
```

```
$ telnet mylogic
```

```
Trying...
```

```
Connected to mylogic.mycompany.com.
```

```
Escape character is '^]'.
```

```
Local flow control on
```

```
Telnet TERMINAL-SPEED option ON
```

```
HP Logic Analysis System
```

```
Please Log in as: hplogic [displayname:0]
```

```
login: hplogic
```

```
Connection closed by foreign host.
```

```
$
```

To export the logic analysis system's display to a PC

By exporting the logic analyzer's display, you can see and use the logic analysis system's windows on the screen of your PC . To do this, you must have telnet software and an X terminal emulator installed on your computer. The following instructions use the Reflection X emulator from WRQ, running on Windows 95, as an example.

1 On the PC, start the X terminal emulator software.

To start Reflection X, click the Reflection X Client Startup icon.

2 Start a telnet connection to the logic analysis system.

Log in as "hplogic".

For Reflection X, enter the following values in the Reflection X Client Startup dialog:

- a** In the Host field, enter the LAN name or IP address of the logic analysis system.
- b** In the User Name field, enter "hplogic".
- c** Leave the Password field blank.
- d** Leave the Command field blank.
- e** Click Run to start the connection.

The logic analysis system will open a Session Manager window on your display.

3 In the Session Manager window, click **Start Session on This Display.**

Using the Software Development Systems debugger

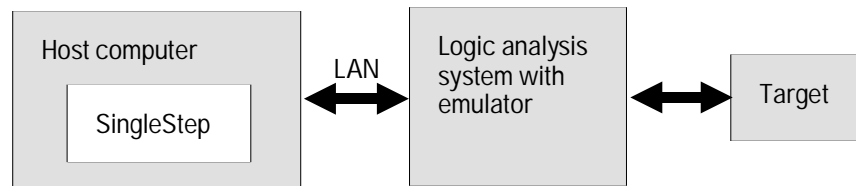
Compatibility

Version 7.3 of the SingleStep debugger from Software Development Systems, Inc. is one of several debuggers which connect to the HP emulation module.

This section provides information that is specific to using SingleStep with the HP emulator. It is intended to be used in conjunction with the SingleStep documentation provided by SDS.

Overview

Startup behavior



The following actions are performed at the start of a session and when you select **File→Debug**:

- If the target reset option is selected, the target is reset and programmed with the register values in the configuration file (<filename>.cfg).
- Hardware breakpoints are disabled.
- Software breakpoints are enabled.
- All breakpoints are cleared.
- main() _exit breakpoints are set, if that option is selected.

Getting started

- 1 Check that your Emulator is programmed with firmware for an M•CORE processor:

If you are using an emulation probe, telnet to the emulation probe and enter the 'ver' command. Make sure that the emulation probe is programmed for M•CORE.

- 2 Connect to the emulator:

- a Start SingleStep running on your PC or workstation.
- b When the small Debug dialog box appears in the middle of the screen, click the Connection tab and then enter the IP address of the HP logic analysis system.

If the Debug dialog box is not visible, select **File→Debug**.

Note: SingleStep is hard-coded to connect to the emulator at port 6470 of the logic analysis system frame. See page 65 for more information on port numbers.

- 3 Configure the emulation module with the processor clock speed.

In the Debug dialog box, click the Connection tab and then enter the JTAG clock speed. Select 10 MHz for processors running at >25 MHz.

- 4 Initialize the target system.

The target system must have various registers and memory locations initialized before it can access RAM and before SingleStep can download an application. Normally, code in the target's boot ROM performs this initialization. However, when SingleStep resets the target, it immediately places the processor in debug mode. Any initialization code which may exist on the target board has not been run.

SingleStep provides a way for target initialization to occur without running application code through the use of the "_config" alias. _config is used to define a list of commands that will be used to initialize the target after a reset. The _config alias should be defined in the sstep.ini file (in the "cmd" directory) and will point to a file of type .cfg which contains the actual initialization commands.

An alternate way of creating the `_config` alias is to use the Target Configuration tab in the "Debug" dialog box. The "Debug" dialog method and the `sstep.ini` method are mutually exclusive. Use one or the other, but not both.

5 Set up the download and execution options in the Options tab of the Debug dialog.

6 Download the application and run:

Select the File tab and enter the application file name. Exit the "Debug" dialog box by clicking OK.

Emulator initialization and target initialization occur every time the "Debug" dialog is terminated via the OK button. A summary of the actions taken by SingleStep is given here:

- Initialize the emulation module with the communication speed specified in the "Debug" dialog.
- If "reset target" was selected then execute the commands specified by the `_reset` alias. The `_reset` alias should be used to specify commands that are specific to initializing the processor. It is executed each time the processor is reset. The value of the `_reset` alias can be viewed by issuing a "alias `_reset`" from the command window.
- Execute the commands specified by the `_config` alias. The `_config` alias should be used to specify commands that are specific to initializing (configuring) the target system. It is executed each time the processor is reset and each time the debug dialog is exited. The value of the `_config` alias can be viewed by issuing an "alias `_config`" from the command window.
- If "load image" was selected then download the application and set the PC based on object module file contents.
- If "execute until main" was selected then set a breakpoint at `main()` and run.

To send commands to the emulator

To view commands sent by SingleStep

SingleStep communicates to the emulator using the emulator's "terminal interface" commands. SingleStep automatically generates and sends the commands required for normal operation. This communication between SingleStep and the emulator can be observed by entering the following command in the SingleStep command window:

```
control -ms
```

To send commands

"Terminal interface" commands may be sent directly to the emulator from the SingleStep command window or included in SingleStep's .cfg or .dbg command files.

Commands should be enclosed in double quotes and given the prefix:
control -c.

Examples

To see the speed that the emulator is using to communicate with the target system you would issue the following command in the SingleStep command window:

```
control -c "cf speed"
```

To change the speed to match a 25MHz processor clock you would issue the following command in the command window:

```
control -c "cf speed=7"
```

On-chip breakpoints and debugging ROM code

The M•CORE has a built-in hardware breakpoint capability. When SingleStep steps one source line or sets a user defined breakpoint, it will first try to use a software breakpoint. If the breakpoint does not work because the breakpoint address is located in ROM, SingleStep will automatically attempt to use one of the available hardware breakpoints. For more information, see the SingleStep release notes.

To debug ROM based code, unselect "load application image" in the options tab of the "Debug" dialog.

Error conditions

"!ERROR 800! Invalid command: bcast" usually means that there is not a target interface module (TIM) connected to the emulator or the emulator does not have firmware for the M•CORE family. Verify that the emulator is connected to the target. Next, go to the system window of the logic analyzer interface and verify that the Emulation Module icon (stop-light) is described as a Motorola M•CORE Emulator. If it is not, follow the steps on page 142 to update the firmware in the Emulator for M•CORE processors.

"command socket connection failed: WSAECONNREFUSED: connection refused" usually means the emulator is not at port #6470 on the Logic Analysis System. See step 2 of the getting started section above.

"unrecognized hostname" usually means that the debugger is unable to establish communication with the emulator. Verify communication to the emulator by doing a ping to the logic analyzer. If you are unable to ping the logic analyzer refer to page 97 for more information.

See Also

The SDS web site: <http://www.sdsi.com>

The *SDS SingleStep Users Guide*.

The configuration section beginning on page 59 for more information on configuration options and the "cf" command.

Specifications and
Characteristics

Processor Compatibility

The E3455A HP Emulator supports the M•CORE rev 1.5 core and the MMC2001.

Electrical Characteristics

Maximum Ratings

Characteristics for HP emulator	Symbol	Min	Max
TDO, RTCK	V_{ih}	$0.8 \times V_{DD}$	5 V
	V_{il}		$0.2 \times V_{DD}$
	I_i		$\pm 1 \mu\text{A}$
	C_{in}		15 pF
TDI, TCK, TMS, TRST ¹ , MCU-DE	$V_{oh} @ I_{oh} = -32 \text{ mA}$	$0.8 \times V_{DD}$	2.7 V
	$V_{ol} @ I_{ol} = 64 \text{ mA}; V_{CC}=4.5\text{V}$		$0.2 \times V_{DD}$
TDI, TMS, TRST, MCU-DE	C_o		25 pF
TCK	C_o		45 pF
V_{DD}	V_{ih}	1.2 V	5 V
	V_{il}		0.8 V

¹ These signals must not be actively driven by the target system when the debug port is being used.

² Power Sense is used only to determine target powered status. The emulator does not draw power from this source.

³ Open collector outputs, pulled up to a generated voltage equivalent to the Power Sense voltage with a 2.61 K pullup resistor

Emulation probe electrical characteristics

BNC, labeled TRIGGER OUT

Output Drive Logic high level with 50-ohm load ≥ 2.0 V. Logic low level with 50-ohm load ≤ 0.4 V. Output function is selectable, see the configuration chapter (page 59).

BNC, labeled BREAK IN

Input Edge-triggered TTL level input, 20 pf, with 2K ohms to ground in parallel. Maximum input: 5 V above V_{CC} ; 5 V below ground. Input function is selectable, see the configuration chapter (page 59).

Communications

Serial Port 9-pin female type “D” subminiature connector. RS-232 DCE to 115.2 kbaud.

10BASE-T LAN Port RJ-45 connector. IEEE 802.3 10BASE-T (StarLAN).

10BASE 2 LAN Port 50-ohm BNC connector. IEEE 802.3 10BASE2 (ThinLAN). When using this connector, the HP emulator provides the functional equivalent of a Medium Attachment Unit (MAU) for ThinLAN.

Accessory Power Out 12 V, 3.0A, center negative

Power Supply

Input 100-240 V, 9.75 A, 50/60 Hz, IEC 320 connector.

Output 12 V, 3.3 A

Emulation probe environmental characteristics

Temperature	Operating, +5 °C to +40 °C (+41 to +104 °F); nonoperating, -40 to +70 °C (-40 to +158 °F).
Altitude	Operating/nonoperating 4600 m (15 000 ft).
Relative Humidity	15% to 95%.

Emulation module electrical characteristics

Maximum Ratings

Characteristics for HP Emulation Module	Symbol	Min	Max	Unit
Input voltage rand	V_{in}	-0.5	5.5	V
Input voltage range (Vt)		1.3	1.7	V
Input High Voltage	V_{ih}	$2/3V_{tt} + 0.2$		V
Input Low Voltage	V_{il}		$2/3V_{tt} - 0.2$	V
Input High Current	I_{ih}		-15	μA
Input Low Current	I_{il}		100	μA
Output High Voltage	V_{oh}	2.4	3.3	V
Output Low Voltage	V_{ol}		0.5	V
Output High Current	I_{oh}	8		mA
Output Low Current	I_{ol}	-16		mA

Updating Firmware

Updating Firmware

Firmware gives your emulator a “personality” for a particular processor or processor family.

After you have connected the emulator to your target system, you may need to update the firmware to give it the right personality for your processor.

You must update the firmware if:

- You have an emulation module which was not shipped already installed in the logic analysis system.
- You need to change the personality of the emulator for a new processor.
- You have an updated version of the firmware from HP.

The procedure for updating firmware for an emulation probe is different from the procedure for updating firmware for an emulation module.

Emulation Probe Firmware

To display current firmware version information

- Use telnet or a terminal emulator to access the built-in "terminal interface" and use the ver command to view the version information for firmware currently in the emulation probe.

To update firmware for an emulation probe

To update the firmware, you must have access to the World Wide Web and a PC or a workstation connected to your emulation probe.

1 Download the new firmware from the following World Wide Web site:

<http://www.hp.com/go/emulator>

The firmware will be in the "Technical Support Information" section of this web site.

2 Follow the instructions on the web site for installing the firmware.

If HP sends you firmware on a floppy disk, install the firmware from the floppy disk. The README file on the floppy disk contains instructions for installing the firmware using a PC or workstation.

Emulation Module Firmware

Always update firmware by installing a processor support package. This will ensure that the version of the Emulation Control Interface software is compatible the version of the emulator firmware.

To display current firmware version information

- 1** In the Update Firmware window, click Display Current Version.

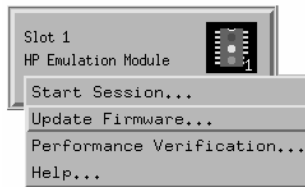
There are usually two firmware version numbers: one for “Generics” and one for the personality of your processor.

To update firmware for an emulation module using the Emulation Control Interface

- 1** End any run control sessions which may be running.
- 2** In the Workspace window, remove any Emulator icons from the workspace.
- 3** Install the processor support package from the CD-ROM, if necessary.

In the system window, click the emulation module and select

4 Update Firmware.



5 In the Update Firmware window, select the firmware to load into the emulation module.

6 Click Update Firmware.

In about 20 seconds, the firmware will be installed and the screen will update to show the current firmware version.

See also

“Installing Software” beginning on page 38 for instructions on how to install the processor support package from the CD-ROM.

To update firmware for an emulation module using the Setup Assistant

The Setup Assistant is an online tool for connecting and configuring your logic analysis system for microprocessor and bus analysis. The Setup Assistant is available on the HP 16600A and HP 16700A-series logic analysis systems.

This menu-driven tool will guide you through the connection procedures for connecting the logic analyzer to an analysis probe, an emulation module, or other supported equipment. It will also guide you through connecting an analysis probe to the target system.

1 Install the processor support package from the CD-ROM.

2 Start the Setup Assistant by clicking its icon in the system window.

3 Follow the instructions displayed by the Setup Assistant.

See also

Page 51 for instructions on how to install a the processor support package from the CD-ROM.

Solving Problems

Solving Problems

If you have problems with the emulator, your first task is to determine the source of the problem. Problems may originate in any of the following places:

- The connection between the emulator and your workstation, PC, or logic analyzer
- The emulator itself
- The connection between the emulator and the target interface module
- The connection between the target interface module and the target system
- The target system

You can use several means to determine the source of the problem:

- The troubleshooting guide on the next page
- The status lights on the emulator
- The emulator "performance verification" tests
- The emulator's built-in "terminal interface" commands

Troubleshooting Guide

Common problems and what to do about them

Symptom	What to do	See also
Host computer reports LAN connection problems	Follow the checklist in the "If you have LAN problems" section.	page 97
Commands from the Emulation Control Interface or debugger have no effect	1 Verify LAN communication.	page 25
	2 Check that you are using the correct firmware for your chip and mask revision.	page 84
	3 Use a telnet connection (or serial connection) to try a few built-in commands. If this works, your debugger may not be configured properly. If this does not work, continue with the next procedure....	page 89
Emulation probe built-in commands do not work	1 Check that the emulator has been properly configured for your target system.	page 46
	2 Run the emulator performance verification tests.	page 105
	3 If the performance verification tests pass, then there is an electrical problem with the connection to the target processor OR the target system may not have been designed according to "Designing a Target System."	page 55, page 91
"Slow or missing clock" message after a logic analyzer run	Check that the target system is running user code or is in reset. (This message can appear if the processor is in background mode.)	
"Slow clock" message in the Run Control tool or "c>" prompt in the built-in terminal interface	Check that the clock rate is properly configured.	page 52
Some commands fail	Check the "restrict to real-time runs" configuration	page 51

Emulation Probe Status Lights

The emulation probe communicates various modes and error conditions via the status lights. The meanings of the status lights are shown on the previous page.

The following table gives more information about the meaning of the power and target status lights.

○ = LED is off

● = LED is on

* = Not applicable (LED is off or on)

Power/Target Status Lights

Pwr/Target LEDs	Meaning
○○	Emulation probe is not connected to power supply
○○	
○●	No target system power, or emulation probe is not connected to the target system
○○	
○●	Target system is in a reset state
○●	
●●	Only boot firmware is good (other firmware has been corrupted)
●○	
●●	The target processor is executing in the background monitor
○○	
○●	The target processor is executing user code
●○	

Emulation probe status lights

The following illustration shows the status lights on both sides of the emulation probe and what they mean:

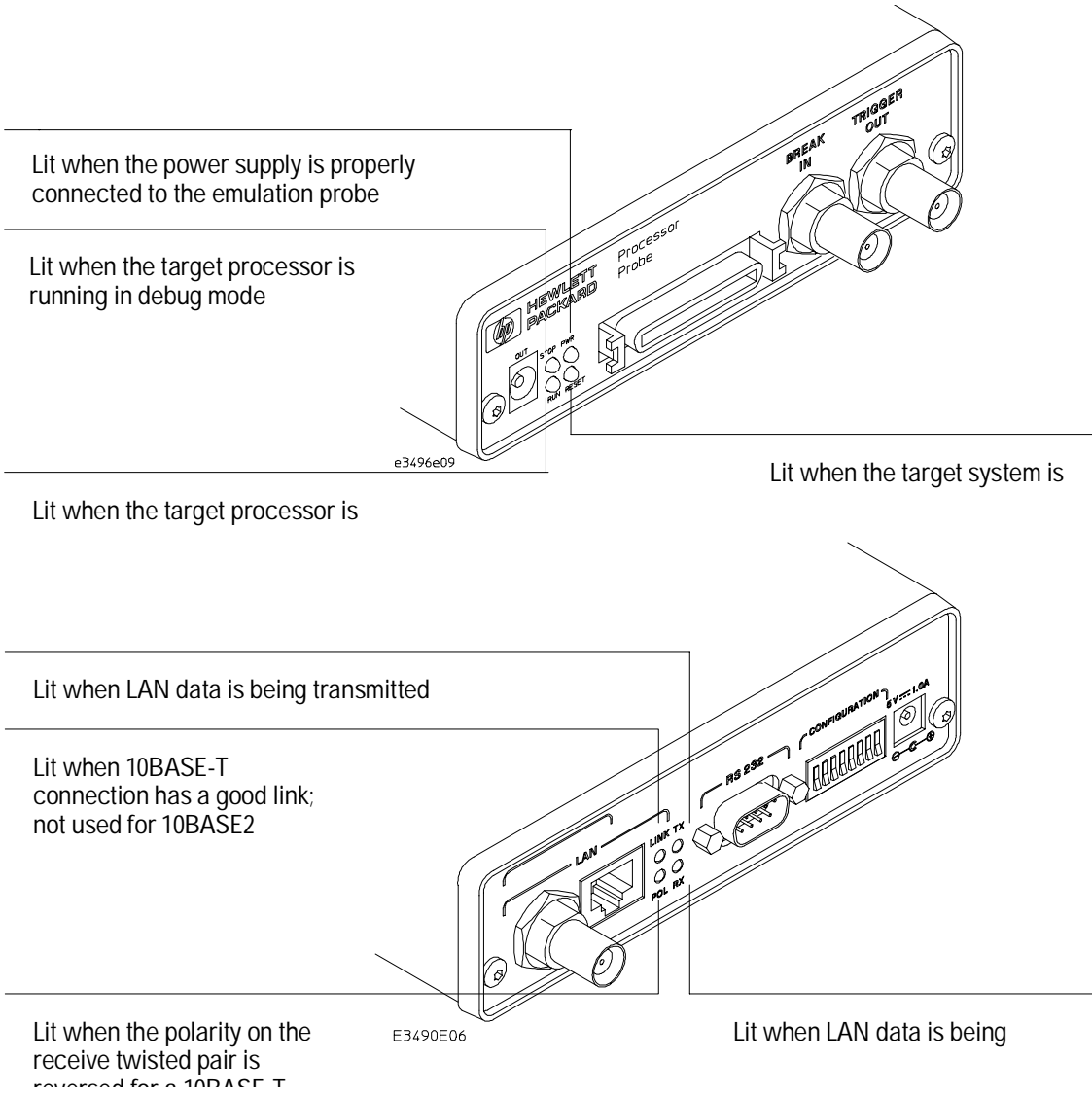


Figure 7. Status Lights

Emulation Module Status Lights

The emulation module uses status lights to communicate various modes and error conditions.

The following table gives more information about the meaning of the power and target status lights.

○ = LED is off

● = LED is on

* = Not applicable (LED is off or on)

Power/Target Status Lights

Pwr/Target LEDs	Meaning
<input type="radio"/> Reset <input type="radio"/> Break <input type="radio"/> Run	No target system power, or emulation module is not connected to the target system
<input checked="" type="radio"/> Reset <input type="radio"/> Break <input type="radio"/> Run	Target system is in a reset state
<input type="radio"/> Reset <input checked="" type="radio"/> Break <input type="radio"/> Run	The target processor is executing in Debug Mode
<input type="radio"/> Reset <input type="radio"/> Break <input checked="" type="radio"/> Run	The target processor is executing user code
<input type="radio"/> Reset <input checked="" type="radio"/> Break <input checked="" type="radio"/> Run	Only boot firmware is good (other firmware has been corrupted)

Built-in Commands

The emulator has some built-in "terminal interface" commands which you can use for troubleshooting.

You can access the terminal interface via:

- A serial connection (Emulation probe only, see page 26)
- A telnet (LAN) connection
- The Command Line window in the Emulation Control interface
- A "debugger command" window in your debugger

Here are a few useful commands:

Useful built-in commands

b	Break—go into the background monitor state
cf	Configuration—read or write configuration options
help	Help—display online help for built-in commands
init	Initialize—init -c reinitializes everything in the emulator except for the LAN software; init -p is the equivalent of cycling power (it will break LAN connections)
lan	configure LAN address
m	Memory—read or write memory
reg	Register—read or write a register
r	Run—start running user code
rep	Repeat—repeat a command or group of commands
rst	Reset—reset the target processor (the emulator will wait for you to press the target's RESET button)
s	Step—do a low-level single step
ver	Version—display the product number and firmware version of the emulator

The prompt indicates the status of the emulator:

Emulator prompts

U	Running user program
M	Running in background monitor
R	Emulation reset
r	Target reset
p	No target power
?	Unknown state

Examples

To set register GPR0, then view GPR0 to verify that it was set, enter:

```
M>reg ro=ffff
M>reg ro
   reg ro=0000ffff
```

To break execution then step a single instruction, enter:

```
R>
M>b
M>s
   PC=xxxxxxxx
M>
```

To determine what firmware version is installed in the emulator, enter:

```
M>ver
```

See Also

Use the `help` command for more information on these and other commands. Note that some of commands listed in the help screens may not be available. If you are writing your own debugger, contact HP for more information.

Problems with the Target System

What to check first

- 1 Try some basic built-in commands (using a serial or telnet connection):

```
U>rst  
R>
```

This should reset the target and display a "R>" prompt. If you get a different prompt, see page 82.

```
R>b  
M>
```

This should stop the target and display an "M>" prompt.

```
M>reg r1  
    reg r1=007fd6a0  
M>
```

This should read the value of the GPR1 register (the value will probably be different on your target system).

```
M>m 0..  
    00000000    7c3043a6 7c2802a6 7c3143a6 4bf04111  
    00000010    00000000 00000000 00000000 00000000  
    00000020    00000000 00000000 00000000 00000000  
    00000030    00000000 00000000 00000000 00000000  
    00000040    00000000 00000000 00000000 00000000  
    00000050    00000000 00000000 00000000 00000000  
    00000060    00000000 00000000 00000000 00000000  
    00000070    00000000 00000000 00000000 00000000  
M>
```

This should display memory values starting at address 0.

```
M>s
```

This should execute one instruction at the current program counter.

If any of these commands don't work, there may be a problem with the design of your target system, a problem with the revision of the processor you are using, or a problem with the configuration of the emulator. The following steps will help you identify the problem.

- 2 Check that the emulator firmware matches your processor. To do this, enter:

M>**ver**

- 3 Check that the mask version for your processor is supported by the emulator. See "Designing a Target System" beginning on page 55.

See Also

Page 89 for information on entering built-in commands.

To interpret the initial prompt

The initial prompt can be used to diagnose several common problems.

- 1 Connect the emulator to your target system.
- 2 Set the default configuration settings. Enter:

```
M>init -c
```

You can enter this command at any prompt. The emulator will respond with the same information as printed by the "ver" command.

If the response is "!ERROR 905! Driver firmware is incompatible with ID of attached device"

Make sure the target interface module is connected to the cable of the emulator, then try the "init -c" command again.

If the initial prompt is "p>"

Check pin 6 on header, 3.3V (V_{DD}).

If the initial prompt is "M>"

The processor entered debug mode without the help of the emulator. Is another debugger connected?

If the initial prompt is "U>"

The emulator is scanning the instruction register correctly. Now you can do some more tests:

3 Enter the reset command:

```
U>rst  
R>
```

The "R>" prompt is a good response that indicates RESET is working.

If the prompt after rst is "U>"

The RESET lines are not working. Continue with more tests:

4 Enter the break command:

```
U>b  
M>
```

If you see memory-related problems

1 Enter:

```
M>m -d4 -a4 0=11111111,22222222,33333333,44444444
M>m -d4 -a4 0..
00000000  11111111 02222222 33333333 44444444
00000010  00000000 00000000 00000000 00000000
00000020  00000000 00000000 00000000 00000000
00000030  00000000 00000000 00000000 00000000
00000040  00000000 00000000 00000000 00000000
00000050  00000000 00000000 00000000 00000000
00000060  00000000 00000000 00000000 00000000
00000070  00000000 00000000 00000000 00000000
M>
```

- RAM must be at address 0.
- Read value not equal to the written value implies that the memory controller is not setup correctly.

3 Hand load a little program:

```
M>m -d4 -a4 200000=2002,1200,1200,F7FC
M>reg r2=0
M>
```

This means: Add 1, GPR2, NOP, NOP, JMP .-4
Set the PC to this program:

```
M>reg PC=200000
M>
```

Step, then check the register:

```
M>s
    PC=200002
M>reg r2
    reg r2=00000001
M>
```

This should return "reg r2=00000001" .

Step some more and verify that GPR1 increments after every four steps:

```
M>s 4
    PC=200002
M>reg r2
    reg r2=00000002
M>
```

Problems with the LAN Interface (Probe only)

For LAN interface problems with the emulation module, refer to the online help in the logic analysis system.

If you cannot verify LAN communication

If you cannot verify connection using the procedure in "To verify LAN communication", or if the commands are not accepted by the emulation probe:

- Make sure that you have connected the emulation probe to the proper power source and that the power light is lit.
- Make sure that you wait for the power-on self test to complete before connecting.
- Make sure that the LAN cable is connected. Watch the LAN LED's to see whether the emulation probe is seeing LAN activity. Refer to your LAN documentation for testing connectivity.
- Make sure that only one of the LAN ports is connected.
- Make sure the emulation probe communication configuration switches are set correctly. Unplug the emulation probe power cord, then plug it in again to make sure the switch settings are read correctly by the emulation probe.
- Check that the Emulation Control Interface or debugger was configured with the correct LAN address. If the emulation probe is on a different subnet than the host computer, check that the gateway address is correct.
- Make sure that the emulation probe's IP address is set up correctly. Use the RS-232 port to verify this that the IP address is set up correctly. When you are connected to the RS-232 port, run performance verification on the emulation probe's LAN interface with the "pv" command.

- It's also possible for there to be a problem with the emulation probe firmware while the LAN interface is still up and running. In this case, you must reboot the emulation probe by disconnecting power to the emulation probe and reconnecting it again.
 - Use a serial connection to run the LAN performance verification tests (see page 105).
-

If you have LAN connection problems

- If the emulation probe does not accept commands from the logic analyzer:
 1. Check that switch S1 is "0" (attached to LAN, not RS-232).
 2. Check that switch S5 is in the correct position for your LAN interface (either 10BASE2 or 10BASE-T).(Remember: if you change any switch settings, the changes do not take effect until you cycle power.)
- If the emulation probe still does not respond, you need to verify the IP address and gateway mask of the emulator. To do this, connect the emulation probe to a terminal or terminal emulator (see page 26), change the switch settings so it is connected to RS-232, and enter the "lan" command. The output looks something like this:

```
lan -i 15.5.24.116
lan -g 15.5.23.1
lan -p 6470
Ethernet Address : 08000909BAC1
```

"lan -i" shows the internet address is 15.5.24.116 in this case. If the Internet address (IP) is not what you expect, you can change it with the 'lan -i <new IP>' command.

"lan -g" shows the gateway address. Make sure it is the address of your gateway if you are connecting from another subnet, or 0.0.0.0 if you are connecting from the local subnet.

"lan -p" shows the port is 6470.

If the "POL" LED is lit

The "POL" LED indicates that the polarity is reversed on the receive pair if you are using a 10BASE-T connection. The emulation probe should still work properly in this situation, but other LAN devices may not work.

If it takes a long time to connect to the network

- Check the subnet masks on the other LAN devices connected to your network. All of the devices should be configured to use the same subnet mask.

Subnet mask error messages do not indicate a major problem. You can continue using the emulation probe.

The emulation probe automatically sets its subnet mask based on the first subnet mask it detects on the network. If it then detects other subnet masks, it will generate error messages.

If there are many subnet masks in use on the local subnet, the emulation probe may take a very long time to connect to the network after it is turned on.

To "clean up" the network, connect a terminal to the emulation probe. You can then see error messages which will help you identify which devices on the network are using the wrong subnet masks.

Problems with the Serial Interface (Emulation probe only)

If you cannot verify RS-232 communication

If the emulation probe prompt does not appear in the terminal emulator window:

- Make sure that you have connected the emulation probe to the proper power source and that the power light is lit.

- Make sure that you have properly configured the data communications switches on the emulator and the data communications parameters on the host computer. You should also verify that you are using the correct cable.

The most common type of data communications configuration problem involves the configuration of the emulation probe as a DTE device instead of as a DCE device. If you are using the wrong type of cable, no prompt will be displayed.

A cable with one-to-one connections will work with a PC or an HP Series 700 workstation.

If you have RS-232 connection problems with the MS Windows Terminal program

- Remember that 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) and set up the "Communications..." settings as follows:

```
Baud Rate: 9600 (or whatever you have chosen for the
emulator)
Data Bits: 8
Parity: None
Flow Control: hardware
Stop Bits: 1
```


When you are connected, hit the Enter key. You should get a prompt back. If nothing echos back, check the switch settings on the emulation probe.

- **If the switches are in the correct position and you still do not get a prompt when you hit return, try turning OFF the power to the emulation probe and turning it ON again.**
- **If you still don't get a prompt, 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.**

With certain RS-232 cards, connecting to an RS-232 port where the emulation probe is turned OFF (or is not connected) will hang the PC. The only way to get control back is to reboot the PC. Therefore, we recommend that you always turn ON the emulation probe before attempting to connect via RS-232.

Problems with the Emulation Probe Itself

To run the power up self test

- 1 Unplug the emulation probe, then plug it in.
- 2 Watch the status lights. They should show the following pattern:

○ = LED is off

● = LED is on

* = Not applicable (LED is off or on)

Normal sequence during power up self test

	Pwr/Target LEDs	Meaning
1	○● ○○	Initial power up, system reset
2	○● ○○	XILINX array initialized successfully
3	○● ●○	XILINX array tested successfully
4	●● ○○	BOOT ROM space tested successfully
5	○● ●○	GENERIC ROM space tested successfully
6	●● ○○	DRIVER ROM space tested successfully
7	○● ●○	RESERVED ROM space tested successfully
8	●● ○○	RAM tested successfully
9	○● ●○	LAN internal feedback tested successfully
10	○● ○○	Boundary scan master (BSM) test begun
11	●● ●○	BSM test completed, start system, load drivers, initialize LAN

If the power up self test fails, the RESET LED will flash the number of the test, then stay lit.

If any of the LEDs fail to change, or all of them remain on, there is a system failure.

Following power up, the LEDs will enter one of the following states:

- No target system power, or the emulation probe is not connected to the target system, or
-
- M•CORE is in debug mode
-
- M•CORE is running user code
-
- M•CORE is in an unknown state
-
- Only the boot ROM was used; other firmware in the Flash EPROM has been corrupted
-

Starting a user interface will change the pattern to the one requested by the interface.

If the power up self tests fail, try the following:

- Check and reset the LAN address. LAN powerup failures will occur if the emulation probe does not have a valid Link Level Address and IP Address.
- Disconnect all external connections, including the LAN, serial (RS-232), and BNC Break and Trigger cables, then cycle power.
- To ensure that the firmware is working as it should, reprogram the firmware, then cycle power.

To execute the built-in performance verification test

In addition to the powerup tests, there are several additional performance verification (PV) tests available.

Some of these tests can be performed through the logic analyzer. The LAN tests can only be executed through the RS-232 port.

To fully test the emulation probe, you will need to run the PV test with several hardware configurations:

- For the BREAK IN, TRIGGER OUT BNC FEEDBACK TEST, connect a coaxial cable between BREAK IN and TRIGGER OUT.
- For the TARGET PROBE FEEDBACK TEST, connect the emulator loopback test board (HP part number E3496-66502).

To run the built-in performance verification test using the logic analysis system

- 1 End any Emulation Control Interface or debugger sessions.
- 2 Disconnect the 50-pin cable from the emulator, and plug the loopback test board (HP part number E3496-66502) into the emulator.
- 3 In the system window, click the emulator and select **Performance Verification**.
- 4 Click **Start PV**.

The results will appear onscreen.

To perform complete PV tests for an emulation probe

The LAN tests can only be executed through the RS-232 port. The remainder of this section assumes that the tests are being run from a terminal emulator connected to the RS-232 port.

- 1** Disconnect the 50-pin cable from the emulation probe, and plug the emulator loopback test board (HP part number E3496-66502) directly into the emulation probe. Do not plug anything into the other end of the emulator loopback test board.

On a good system, the RESET LED will light and the BKG and USER LEDs will be out.

- 2** Connect a coaxial cable between BREAK IN and TRIGGER OUT.
- 3** Set all of the switches to CLOSED.

This is standard RS-232 at 9600 baud which can be connected directly to a 9 pin RS-232 interface that conforms to the IBM PC-AT 9 pin standard.

- 4** Use a terminal emulator to connect to the emulator.
- 5** Enter the **pv 1** command.
- 6** Plug the 16-pin cable of the stimulus board into the target interface module.
- 7** Enter the **pv -d** command.

See Also

Options available for the "pv" command are explained in the help screen displayed by typing "help pv" or "? pv" at the prompt.

Examples:

Here are some examples of ways to use the **pv** command.

To execute both tests one time:

```
pv 1
```

To execute test 2 with maximum debug output repeatedly until a ^C is entered:

```
pv -t2 -v9 0
```

To execute tests 3, 4, and 5 only for 2 cycles:

```
pv -t3-5 2
```

The results on a good system, with the BNC's connected, and with the loopback test board connected, are as follows:

```
c>pv 1
```

```
Testing: HPE3455A Series Emulation System
Test # 1: Powerup PV Results           passed!
Test # 2: LAN 10Base2 Feedback Test    passed!
Test # 3: LAN 10BaseT Feedback Test    passed!
Test # 4: Break In and Trigger Out BNC Feedback Test passed!
Test # 5: Target Probe Feedback Test   passed!
Test # 6: Boundary Scan Master Test    passed!
PASSED Number of tests: 1              Number of failures: 0
```

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```
HPE3499B Series Emulation System
Version:  A.07.53 26Feb98
Location:  Generics
```

```
HPE3455A Motorola M-Core Emulator
Version:  A.01.00 31Mar98
```

If a performance verification test fails

There are some things you can do if a failure is found on one of these tests. Details of the failure can be obtained through using a verbose level of 2 or more.

If the particular failure you see is not listed below, contact HP for assistance.

TEST 2: LAN 10BASE2 Feedback Test failed

For LAN 10BASE2 test, the following is an example of a failure which is *not* caused by a broken emulator.

```
R>pv -t2 -v2 1
```

```
Testing: HPE3455A Series Emulation System
  Test # 2: LAN 10Base2 Feedback Test                failed!
    FAILED - no lan connection (LAN probably not terminated)
FAILED Number of tests: 1          Number of failures: 1
```

Check to see that the port under test has a good cable connected to it and that the cable is properly terminated with a 50 ohm terminator on each end of the overall cable.

```
R>pv -t2 -v2 1
```

```
Testing: HPE3455A Series Emulation System
  Test # 2: LAN 10Base2 Feedback Test                failed!
    FAILED due to excessive collisions
FAILED Number of tests: 1          Number of failures: 1
```

The most common cause of this problem is poor termination of the cable or failure to remove the port under test from the LAN before performing the test. Check to see that the terminators are good (50 Ohms) and that you are isolated from any traffic on a system LAN.

```
R>pv -t2 -v2 1
```

```
Testing: HPE3455A Series Emulation System
  Test # 2: LAN 10Base2 Feedback Test                failed!
    FAILED - invalid Ethernet address in EEPROM
FAILED Number of tests: 1          Number of failures: 1
```

First check to see that a correct LLA and IP address have been set in the virtual EEPROM through the "lan" command. If the "lan" command shows bad information for the LLA and IP, then try to set them to correct values. If you are unable to set them to correct values, there is a failure in the FLASH ROM which requires service from HP.

Test 3: 10BaseT Feedback Test failed

```
R>pv -t3 -v2 1
```

```
Testing: HPE3455A Series Emulation System
  Test # 3: LAN 10BaseT Feedback Test                failed!
FAILED  Number of tests: 1                Number of failures: 1
```

In addition to the internal checks performed in Test 2, this test also checks for shorts on the cable connected to the network. If this test fails, disconnect the cable and run the test again. If it then passes, the cable is faulty. If it still fails, it requires service from HP.

Test 4: Break In and Trigger Out BNC Feedback Test

```
R>pv -t4 -v2 1
```

```
Testing: HPE3455A Series Emulation System
  Test # 4: Break In and Trigger Out BNC Feedback Test    failed!
  Break In not receiving Break Out HIGH
FAILED Number of tests: 1          Number of failures: 1
```

Before returning to HP, check to ensure that you have connected a good Coaxial cable between the two BNCs. If the cable is good, the emulator is bad.

TEST 5: Boundary Scan Master Test

TEST 6: I2C Test

If these tests are not executed, check that you have connected the emulator loopback test board.

If these tests fail, return the emulator to HP for replacement.

Target Interface Module tests (pv -d tests)

If these tests are not executed, check that you have connected the target interface module stimulus/loopback test board.

If these tests fail, return the target interface module to HP for replacement.

Returning the Parts to Hewlett-Packard for Service

To return a part to Hewlett-Packard

- 1** Follow the procedures in this chapter to make sure that the problem is caused by a failure in the emulator or power supply, not by configuration or communication problems.
- 2** In the U.S., call 1-800-403-0801. Outside the U.S., call your nearest HP sales office. Ask them for the address of the nearest HP service center.

A list of HP sales offices is included at the back of this binder.

- 3** Package the part and send it to the HP service center.

Keep any parts which you know are working. For example, if only the power supply is broken, keep the target interface module, emulator and cables.

- 4** When the part has been replaced, it will be sent back to you.

The unit returned to you will have the same serial number as the unit you sent to HP.

The HP service center can also troubleshoot the hardware and replace the failed part. To do this, send your entire measurement system to the service center, including the logic analysis system, target interface module, and cables.

In some parts of the world, on-site repair service is available. Ask an HP sales or service representative for details. To return a part to Hewlett-Packard

To obtain replacement parts

The repair strategy for this emulation solution is board replacement. The following table lists some parts that may be replaced if they are damaged or lost. Contact your nearest Hewlett-Packard Sales Office for further information on servicing the board.

Exchange assemblies are available when a repairable assembly is returned to Hewlett-Packard. These assemblies have been set up on the "Exchange Assembly" program. This allows you to exchange a faulty assembly with one that has been repaired, calibrated, and performance verified by the factory. The cost is significantly less than that of a new assembly.

Part numbers

Exchange Assemblies

Part Number	Description
E3455-69401	Programmed emulator

Replacement Assemblies

Part number	Description
0950-3043	Power Supply
E3494-61602	14-pin cable
E3496-61601	50-pin cable
E3496-66502	Processor probe loopback test board
E3455-66501	Target interface module (M•CORE)
E3481-66507	Stimulus/self-test board for the target interface module

To clean the emulator

If the emulator requires cleaning:

- 1** Remove power from the instrument.
- 2** Clean with a mild detergent and water.
- 3** Make sure that the instrument is completely dry before reconnecting it to a power source.

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About this edition

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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: Processor Probe

Model Number(s): HP E3455A

Product Option(s): All

conforms to the following Product Specifications:

Safety: IEC 1010-1:1990+A1 / EN 61010-1:1993
UL 3111
CSA-C22.2 No. 1010.1:1993

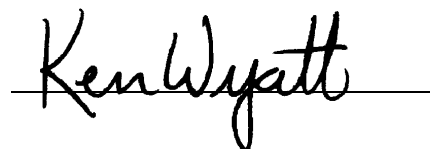
EMC: CISPR 11:1990 / EN 55011:1991 Group 1 Class A
IEC 555-2:1982 + A1:1985 / EN 60555-2:1987
IEC 555-3:1982 + A1:1990 / EN 60555-3:1987 + A1:1991
IEC 801-2:1991 / EN 50082-1:1992 4 kV CD, 8 kV AD
IEC 801-3:1984 / EN 50082-1:1992 3 V/m, {1kHz 80% AM, 27-1000 MHz}
IEC 801-4:1988 / EN 50082-1:1992 0.5 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 and carries the CE-marking accordingly.

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Colorado Springs, 01/23/98



Ken Wyatt / Product Regulations Manager

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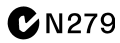
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UL 3111
CSA-C22.2 No.1010.1:1993

EMC This Product meets the requirement of the European Communities (EC)
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Emissions EN55011/CISPR 11 (ISM, Group 1, Class A equipment)
IEC 555-2 and IEC 555-3



Immunity EN50082-1 Code¹ Notes²

IEC 801-2 (ESD) 8kV AD	1	1
IEC 801-3 (Rad.) 3 V/m	1	
IEC 801-4 (EFT) 1kV	1	

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:

- 1 The target cable assembly is sensitive to ESD events. Use standard ESD preventative practices to avoid component damage.

Sound Pressure Level N/A