User’s Guide

Publication number E3472-97001

For Safety information, Warranties, and Regulatory information, see the pages preceding the table of contents.

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HP E3472A/73A Emulator
for SH7040/50
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Printing History

New editions are complete revisions of the manual. The date on the title page changes only when a new edition is published.

A software code may be printed before the date; this indicates the version level of the software product at the time the manual was issued. Many product updates and fixes do not require manual changes, and manual corrections may be done without accompanying product changes. Therefore, do not expect a one-to-one correspondence between product updates and manual revisions.

Edition 1
E3472-97000, Oct. 1996
Edition 2
E3472-97001, Mar. 1997
Certification

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

Warranty

This Hewlett-Packard instrument product is warranted against defects in material and workmanship for a period of one year from the date of shipment, except that in the case of certain components listed in General Information of this manual, the warranty shall be for the specified period. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products that prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by HP. Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

HP warrants that its software and firmware designated by HP for use with an instrument will execute its programming instruction when properly installed on that instrument. HP does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

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

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

Assistance

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

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.
Safety Summary

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

**Note**

The HP E3472A/73A complies with INSTALLATION CATEGORY I and POLLUTION DEGREE 2 in IEC1010-1. The HP E3472A/73A is INDOOR USE product.

**Note**

LEDs in this product are Class 1 in accordance with IEC825-1.

**CLASS 1 LED PRODUCT**

**Ground The Instrument**

To avoid electric shock hazard, the AC/DC adapter must be connected to a safety earth ground by the supplied power cable with earth blade.

**DO NOT Operate in an Explosive Atmosphere**

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

**Keep Away From Live Circuits**

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

**DO NOT Service or Adjust Alone**

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

**DO NOT Substitute Parts or Modify Instrument**

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

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

**Warning**

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

### Power Requirements

The HP E3472A/73A requires the following power source:
- **Voltage**: 90 to 132 Vac, 198 to 264 Vac
- **Frequency**: 47 to 63 Hz
- **Power**: 300 VA maximum

**Power Cable**

In accordance with international safety standards, this instrument is equipped with a three-wire power cable. When connected to an appropriate ac power outlet, this cable grounds the instrument frame.

The type of power cable shipped with each instrument depends on the country of destination. Refer to Figure 1 for the part numbers of the power cables available.

**Warning**

For protection from electrical shock, the power cable ground must no be defeated.

The power plug must be plugged into an outlet that provides a protective earth ground connection.
Figure 1. Power Cords Available for Each Destination

NOTE: Each option number includes a family of cords and connectors of various materials and plug body configurations (straight, 90° etc.).

* Plug option 905 is frequently used for interconnecting system components and peripherals.
Safety Symbols

General definitions of safety symbols used on equipment or in manuals are listed below.

Instruction manual symbol: the product is marked with this symbol when it is necessary for the user to refer to the instruction manual.

Alternating current.

Direct current.

On(Supply).

Off(Supply).

**Warning**

This warning sign denotes a hazard. If calls attention to a procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in injury or death to personnel.

**Caution**

This caution sign denotes a hazard. If calls attention to a procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product.

**Note**

This note sign denotes important information. If calls attention to a procedure, practice, condition or the like, which is essential to highlight.
Outline of this manual

Chapter 1 describes the product overview and its outer features.
Chapter 2 lists the contents of the product.
Chapter 3 shows you how to assemble the Emulator and install memory modules.
Chapter 4 shows you how to configure LAN parameters to connect the Emulator to the host computer.
Chapter 5 shows you how to connect the Emulator to your target system.
Chapter 6 describes instructions in designing target system.
Chapter 7 shows you how to use the Emulator with a logic analyzer connected.
Chapter 8 describes the specifications and characteristics of the product.
Chapter 9 shows you how to update the firmware of the Emulator.
Chapter 10 shows you, if a problem occurs when working with the Emulator, how to isolate its causes.
Appendix A lists the register classes available with the Emulator.
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Product Overview

The HP E3472A/73A Emulator provides distributed emulation environment for the Hitachi SH7040/50 Series processors. Depending on size and requirements of your development, you can use it either as a simple emulator working standalone, or as a powerful debugging environment by connecting it to a logic analyzer.

Hooking up the HP E3472A/73A Emulator to an HP’s logic analyzer enables high-speed real-time tracing. You can control the emulator and logic analyzer through the HP E3755A/56A Debug User Interface, allowing you to operate the emulation environment with a feel similar to conventional debuggers.

![Figure 1-1. Distributed Emulation Environment with HP E3472A/73A](image-url)
Emulator Components

Emulation controller

1. TRIGGER OUT connector Sends out the trigger signal.
2. BREAK IN connector Receives the trigger signal from the logic analyzer.
3. 50-pin connector Connected to the emulation probe through the 50-pin flat cable.
4. Status LEDs Indicate the operating status of the emulation controller.
5. Auxiliary power connector Supplies power to the emulation probe.
1. Power connector
   Connects the power cable.
   Connecting/disconnecting the power cable will switch ON/OFF the emulator.

2. DIP switches
   Configure the settings of the Emulator.
   Instructions are printed on the bottom of the emulation controller.

3. RS-232 connector
   Connects the RS-232 cable to communicate with the host computer via the serial connection.

4. LAN status LEDs
   Indicate the communication status of the Emulator working on the LAN.

5. LAN connector (10BASE-T)
   Connects the LAN cable when the Emulator communicates with the host computer via 10BASE-T LAN.

6. LAN connector (10BASE2)
   Connects the LAN cable when the Emulator communicates with the host computer via 10BASE2 LAN.
Emulation probe

1. PGA connector Connects to the QFP socket/adapter seated on the target system.

2. Power LED Indicates that power is supplied to the emulation probe.

3. Power connector Connects the auxiliary power cable from the emulation controller.

4. 50-pin connector Connected to the emulation controller through the 50-pin flat cable.

5. Pod connector Connects the pods of the logic analyzer.
Usage - Quick Guide

The target connection

The HP E3472A/73A Emulator connects to your target system via a flexible cable. The cable plugs into a QFP socket/adapter on the target system.

The host computer connection

The HP E3472A/73A Emulator can communicate with a host computer via a LAN connection (10 BASE-T or 10 BASE2).

The configuration switches

Use the DIP switches on the emulation controller to configure communication to the host computer. There is a guide to these switches on the bottom of the emulation controller.

The status LEDs

LEDs show the status of the power supply, the target system, and the connection to the host computer.
Contents of HP E3472A/73A

This chapter provides you the information necessary for the followings.

- Incoming Inspection
- Instruction for Cleaning
Incoming Inspection

WARNING

To avoid hazardous electrical shock, do not turn on the HP E3472A/73A when there are signs of shipping damage to any portion of the outer enclosure (for example, covers, or panel).

Inspect the shipping container for damage. If the shipping container of cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the HP E3472A/73A Processor Probe has been checked mechanically and electrically. The contents of the shipment should be as listed in next page. If the contents are incomplete, if there is mechanical damage or defect, or if the HP E3472A/73A does not pass the performance verification test, notify the nearest Hewlett-Packard office. If the shipping container is damaged, or the cushioning materials shows signs of unusual stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for the carrier's inspection.
### Contents (HP E3472A)

<table>
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<tr>
<th>Description</th>
<th>Qty.</th>
<th>HP Part Number</th>
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<td>SH7040 emulation probe board</td>
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<td>E3472-66501</td>
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<tr>
<td>Emulation probe top cover</td>
<td>1</td>
<td>E3472-04101</td>
</tr>
<tr>
<td>Emulation probe bottom cover</td>
<td>1</td>
<td>64783-04102</td>
</tr>
<tr>
<td>SH7040 demo board</td>
<td>1</td>
<td>E3472-66502</td>
</tr>
<tr>
<td>Emulation controller</td>
<td>1</td>
<td>E3472-65001</td>
</tr>
<tr>
<td>50-pin flat cable</td>
<td>1</td>
<td>E3496-61601</td>
</tr>
<tr>
<td>AUX power cable</td>
<td>1</td>
<td>E3496-61602</td>
</tr>
<tr>
<td>AC/DC adapter</td>
<td>1</td>
<td>0950-3043</td>
</tr>
<tr>
<td>Power cable</td>
<td>1</td>
<td>8120-4753</td>
</tr>
<tr>
<td>3-wire to 2-wire adapter</td>
<td>1</td>
<td>5080-3149</td>
</tr>
<tr>
<td>Loop-back board</td>
<td>1</td>
<td>E3496-66502</td>
</tr>
<tr>
<td>Coaxial cable (120 cm)</td>
<td>1</td>
<td>8120-1840</td>
</tr>
<tr>
<td>Thin LAN T-connector</td>
<td>1</td>
<td>92227N</td>
</tr>
<tr>
<td>Thin LAN 50 ohm terminator (2 pcs)</td>
<td>1</td>
<td>92227P</td>
</tr>
<tr>
<td>Plastic rivet kit</td>
<td>1</td>
<td>64748-68700</td>
</tr>
<tr>
<td>Others (including manuals)</td>
<td></td>
<td></td>
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</table>

1 This cable is not suitable for LAN but for trigger input to the Emulator or performance verification test. Do not use this as a LAN cable.
## Contents (HP E3473A)

<table>
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<th>Description</th>
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<th>HP Part Number</th>
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<td>AUX power cord</td>
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<td>1</td>
<td></td>
</tr>
</tbody>
</table>

1 This cable is not suitable for LAN but for trigger input to the Emulator or performance verification test. Do not use this as a LAN cable.
Instruction for Cleaning

For cleaning the case and operation panel of the Emulation Controller, wipe with soft cloth that is soaked with water and wrung tightly, without undue pressure.

Ventilation Requirements

To ensure adequate ventilation, make sure that there is adequate clearance around the emulation controller, the emulation probe, and the AC/DC adapter.
Setting up the Emulator
Setting up the Emulator

Caution

To prevent the emulator and the target system from being damaged, be sure to follow the cautions below when handling them.

- When connecting/disconnecting the emulation controller and emulation probe, first disconnect the power cable from the emulation controller to stop supplying power and then the emulation probe from the target system.
- To prevent the emulator from being damaged by static electricity, store and use the emulator in a place resistant to static electricity.
- When supplying power to the emulator, check that the emulation probe is plugged into the target system or demo board.

Before connecting the Emulator to the power supply, be sure to follow the instructions below regarding the power cable.

The HP E3472A/73A Emulator is shipped from the factory with a power supply and cord appropriate for your country. Use only the supplied HP power supply and cord. Failure to use the proper power cable could result in electric shock.

Warning

For protection from electrical shock, the power cable ground must not be defeated.

The power plug must be plugged into an outlet that provides a protective earth ground connection.
Procedure

1. Connect the power supply cord between the emulation probe and emulation controller.
2. Connect the 50-pin ribbon cable between the emulation probe and the emulation controller.
3. Plug the emulation probe into the target system.

Figure 3-1. Connecting the Emulation Controller and the Emulation Probe
To connect the power cord and turn on the HP E3472A/73A Emulator

The HP E3472A/73A Emulator does not have an On/Off switch. To turn the HP E3472A/73A Emulator on or off, plug or unplug it from the power supply.

1. Plug the power cable into the adapter and outlet.

2. Connect the 5-V power cable to the receptacle in the rear panel of the HP E3472A/73A Emulator.

**Note**

The power lights on the emulation controller and the emulation probe are lit, indicating the HP E3472A/73A Emulator is powered on. Note that the Emulator does not have power switch.
To test the HP E3472A/73A Emulator

If this is the first time you have used the HP E3472A/73A Emulator, you should run the built-in performance verification test before you connect to a target system.

For details on the procedure of the performance verification test, see page 108.

Installing the Emulation Memory Module

There are three types of emulation memory modules that can be inserted into sockets on the probe.

Note: Installing the emulation memory requires the plastic rivet kit (HP Parts No. 64748-68700).

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

2. Insert emulation memory module on the emulation probe. There is a cutout on one side of the memory modules so that they can only be installed one way.

To install memory modules, place the memory module into the socket groove at an angle. Firmly press the memory module into the socket to make sure it is completely seated. Once the memory module is seated in the connector groove, pull the memory module forward so that the notches on the socket fit into holes on board.

![Diagram of memory module installation]

TILT BOARD SLOWLY AND SEAT INTO GROOVE

NOTE CUTOUT

PULL BOARD FORWARD SO NOTCHES ON SOCKET FIT INTO HOLES ON BOARD

A09N
into the holes on the memory module. There are two latches on the sides of the socket that hold the memory module in place.

3 Replace the plastic cover, and insert new plastic rivets to secure the cover.
Connecting to the Host Computer
Connecting to the Host Computer

To use the HP E3472A/73A Emulator you need to:

- Connect the HP E3472A/73A Emulator to the target system (described in the next chapter)
- Connect the HP E3472A/73A Emulator to a power source. See "Assembling the Emulator" for the connection procedure.
- Power on the target system
- Connect the HP E3472A/73A Emulator to the host computer via a LAN
- Set up the host software

If you plan to use the HP E3472A/73A on a PC, you will need to set up a serial connection to set the IP address for LAN.

As a debugger controlling the Emulator, you can use the HP E3755A/56A Debug User Interface on a UNIX workstation or a PC.

**Note**

When supplying power to the emulator, check that the emulation probe is plugged into the target system or demo board.
Setting Up a LAN Connection

The HP E3472A/73A Emulator 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 HP E3472A/73A Emulator provides the functional equivalent of a Medium Attachment Unit (MAU) for ThinLAN.
- An IEEE 802.3 Type 10BASE-T connector.

Use either the 10BASE2 or the 10BASE-T connector. Do not use both. The HP E3472A/73A Emulator will not work with both connected at the same time.

You must assign an IP address (Internet address) to the HP E3472A/73A Emulator 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 HP E3472A/73A Emulator.

The HP E3472A/73A Emulator 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. This is the most reliable method.
- Using `ipconfig700`. The `ipconfig700` program is supplied with the HP E3755A/56A Debug User Interface on HP and Sun workstations.
- Using `BOOTP`. `BOOTP` is part of the HP-UX 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 HP E3472A/73A Emulator.
   - 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 HP E3472A/73A Emulator through two TCP service ports. The default base port number is 6470. The second port has the next higher number (default 6471).

   The default numbers (6470, 6471) can be changed if they conflict with some other products 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`

   To change the port numbers, see page 23. If you have already set the IP address, you can use a telnet connection instead of a serial connection to connect to the HP E3472A/73A Emulator.

   Also you have to be sure that the port number you use does not conflict with the one for the logic analyzer.

3 Write down the link-level address of the HP E3472A/73A Emulator.

   You will need this address if you use BOOTP or ipconfig700 to set the IP address.

   The link-level address (LLA) is printed on a label above the LAN connectors on the HP E3472A/73A Emulator. This address is configured in each HP E3472A/73A Emulator shipped from the factory and cannot be changed.
To configure LAN parameters using the built-in terminal interface

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

Switch settings are printed on the bottom of the HP E3472A/73A Emulator. 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 HP E3472A/73A Emulator’s RS-232 port with a 9-pin RS-232 cable.

Complete instructions for setting up a serial connection are described at "Setting Up a Serial Connection" in this chapter.

3 Plug in the HP E3472A/73A Emulator’s power cord. Press the terminal’s <RETURN> key a couple times. You should see a "R", "p" or "c" prompt.

At this point, you are communicating with the HP E3472A/73A Emulator’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 HP E3472A/73A Emulator.

   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:
Connecting to the Host Computer

To configure LAN parameters using the built-in terminal interface

- \( \text{i <internet>} \) The IP address which you obtained from your network administrator.

- \( \text{g <gateway>} \) The gateway address. Setting the gateway address allows access outside your local network or subnet.

- \( \text{p <port>} \) This changes the base TCP service port number.

The default numbers (6470, 6471) can be changed if they conflict with some other products 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
```

6 Disconnect the power cord from the HP E3472A/73A Emulator, and connect the HP E3472A/73A Emulator to your network.

This connection can be made by using either the 10BASE-T connector or the 10BASE2 (BNC) connector on the HP E3472A/73A Emulator. 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 OPEN, indicating that a LAN connection is being made.

Switch S5 should be 1 if you are connecting to the BNC connector:

```
1 2 3 4 5 6 7 8
OPEN
```

Switch S5 should be 0 if you are connecting to the 10BASE-T connector:

```
1 2 3 4 5 6 7 8
CLOS
```

Set all other switches to CLOSED.

8 Connect the power cord to the HP E3472A/73A Emulator.

9 Verify your HP E3472A/73A Emulator is now active and on the network. See "To verify LAN communications" in this chapter.

---

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Once you have set a valid IP address, you can use the telnet utility to connect to the HP E3472A/73A Emulator, and use the lan command to change LAN parameters.

**Example**

For example, to assign an IP address of 192.6.94.2 to the HP E3472A/73A Emulator, enter the following command:

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

The IP address and any other LAN parameters you change are stored in nonvolatile memory and will take effect the next time the HP E3472A/73A Emulator is powered off and back on again.

**See Also**

"Solving Problems," page 103, if you have problems verifying LAN communication.
To configure LAN parameters using "ipconfig700"

When you are using HP 9000/700 computer or Sun SPARCsystem with HP B3755A/56A installed in it, you can use ipconfig700 command to configure LAN parameters.

The ipconfig700 command sets the IP address and gateway address for the HP E3472A/73A Emulator. An IP address must be configured before a network interface connection can be made.

The ipconfig700 command cannot be used if your workstation is running a bootp daemon. If this is the case, use BOOTP to configure LAN parameters. To determine if BOOTP is enabled on your computer, see "To configure LAN parameters using BOOTP" in this chapter.

The following steps need to be taken when configuring the network parameters with ipconfig700.

1 Connect the HP E3472A/73A Emulator to your network. This connection can be made by using either the 10BASE-T connector or the 10BASE2 BNC connector on the HP E3472A/73A Emulator.

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

Switch S1 must be set to OPEN, indicating that a LAN connection is being made. Switch S6 must be set to OPEN, to allow programming of the LAN parameters.
Switch S5 should be 1 if you are connecting to the BNC connector:

![Switch S5 BNC Connector]

Switch S5 should be 0 if you are connecting to the 10BASE-T connector:

![Switch S5 10BASE-T Connector]

Set all other switches to CLOSED.

3 Turn ON power to the HP E3472A/73A Emulator.

4 Wait at least 20 seconds for the HP E3472A/73A Emulator to connect to the LAN.

5 Become the root user on the system from which you wish to configure the HP E3472A/73A Emulator.

6 Enter the following command:

   `ipconfig700 -l <link> -i <internet> [-g <gateway>]`

   The `ipconfig700` parameters are:

   `-l <link>`  The link-level address. Enter any letters in the address in upper case.

   `-i <internet>`  The IP address.

   `-g <gateway>`  The gateway address.

   If the `ipconfig700` command is entered without any options, the program interactively prompts for the necessary information.

7 Disconnect the power cable from the emulation controller. Set switch S6 back to CLOSED and connect the power cable again.

8 Verify your HP E3472A/73A Emulator is now active and on the network. See "To verify LAN communications" in this chapter.
Example
If the link-level address on your HP E3472A/73A Emulator read 08000F090F30, and your system administrator gave you the IP address 192.35.12.6, you could enter the following command:

```
$ ipconfig700 -l 08000F090B30 -i 192.35.12.6 <RETURN>
```

Because no gateway address was entered, this value would default to 0.0.0.0. When the IP address is successfully programmed, ipconfig700 will display the HP E3472A/73A Emulator version information.

Limitations of ipconfig700
The ipconfig700 command generally will not work if:

- the workstation and the HP E3472A/73A Emulator are on different subnets

OR

- a BOOTP daemon running elsewhere on your network is configured to respond to the link-level address of the HP E3472A/73A Emulator.
To configure LAN parameters using BOOTP

This method is applicable only if your HP-UX workstation is already running bootpd, the BOOTP daemon. The ipconfig700 command does the same thing as BOOTP and is easier to use.

The BOOTP software is shipped with HP-UX version 8.0 or later.

1 Make sure that your host computer supports BOO TP.

If the following commands yield the results shown below, your machine supports the BOOTP protocol.

```
$ 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 HP E3472A/73A Emulator 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.
# Gateway addresses can be specified differently 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.

hpprobe.div.hp.com:\
   :tc=hp64700.global:
   :ha=080009090B0E:
   :ip=192.6.29.31
```
In the example above, the "ha=080009090B0E" identifies the link-level address of the HP E3472A/73A Emulator.

The "ip=192.6.29.31" specifies the IP address that is assigned to the HP E3472A/73A Emulator.

The node name is "hpprobe.div.hp.com".

For additional information about using bootpd, refer to the HP-UX man pages.

3 Connect the HP E3472A/73A Emulator to your network.
   This connection can be made by using either LAN connector on the HP E3472A/73A Emulator.

4 Set the configuration switches to indicate the type of connection that is to be made.
   Switch S1 must be set to OPEN, indicating that a LAN connection is being made.
   Switch S6 must be set to OPEN to enable BOOTP mode.
   Switch S5 should be set to CLOSED if you are connecting to the BNC connector.
Switch S5 should be set to OPEN if you are connecting to the 10BASE-T connector.

Set all other switches to CLOSED.

5 Connect the power cord to the HP E3472A/73A Emulator. Verify that the power light stays on after 10 seconds. The IP address will be stored in EEPROM.

6 Disconnect the power cable from the emulation controller. Set switch S6 back to CLOSED and connect the power cable again. Do this so that the HP E3472A/73A Emulator 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 HP E3472A/73A Emulator is now active and on the network. See "To verify LAN communications" in this chapter.
To set the 10BASE-T configuration switches

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

- **If the LAN cable exceeds the standard length, set switch S7 to OPEN.**
  The HP E3472A/73A Emulator has a switch-selectable, twisted-pair receiver threshold. With switch S7 set to OPEN, 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 CLOSED, 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 HP E3472A/73A Emulator is connected to a non 10BASE-T network set this switch to LINK BEAT OFF (0 or OPEN).**
  In normal mode (switch S8 set to CLOSED), 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 Emulator is used on a non 10BASE-T network set this switch to LINK BEAT OFF (OPEN).

**Note**
Setting switch S8 to OPEN 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 HP E3472A/73A Emulator is now active and on the network by issuing a `telnet` to the IP address.
   This connection will give you access to the HP E3472A/73A Emulator'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 HP E3472A/73A Emulator's IP address, once it has already been set, is to telnet to the HP E3472A/73A Emulator 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 "Solving Problems" chapter (page 99).

Example

```bash
$ telnet 192.35.12.6
R> lan
lan is enabled using TP
lan -i 192.35.12.6
lan -g 0.0.0.0
lan -p 6470
Subnet Mask: 255.255.255.0
Ethernet Address: 08000F090B30
```
Setting Up a Serial Connection

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

• Set the serial configuration switches
• Connect the HP E3472A/73A Emulator to the RS-232 interface
• Connect a serial cable between the host computer and the HP E3472A/73A Emulator
• Verify communications

Serial connections on a workstation
You should not use a serial connection on a workstation, except to set LAN parameters.

Serial connections on a PC
You should not use a serial connection on a PC, except to set LAN parameters or to update the HP E3472A/73A firmware.
To set the serial configuration switches

1. Set switch S1 to CLOSED (RS-232).
2. Set switches S2-S4 to CLOSED.
3. Set switch S5 to CLOSED (HW HANDSHAKE ON) if your serial interface uses the DSR:CTS/RTS lines for flow control. Set S5 to OPEN (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 CLOSED). 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 HP E3472A/73A Emulator. 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

Connect an RS-232C modem cable from the host computer to the HP E3472A/73A Emulator. The recommended cable is HP part number C2932A. This is a 9-pin cable with one-to-one pin connections.

Caution

Use the recommended cable. If the cable is not shielded, or if the cable is not grounded at the serial controller, the HP E3472A/73A Emulator may be damaged by electrostatic discharge.
To verify serial communications

1 Start a terminal emulator program on the host computer.
   If you are using a PC, the Terminal application (HyperTerminal) in Microsoft Windows 95 will work fine.
   If you are using a UNIX workstation, you can use a terminal emulator such as kermit.

2 Plug the power cord into the HP E3472A/73A Emulator.
   When the HP E3472A/73A Emulator powers up, it sends a message (similar to the one that follows) to the serial port and then displays a prompt:

3 Press the Return or Enter key a few times.
   You should see a prompt such as "R>", "p>" or "c>".

See Also
"Problems with the Serial Interface" in Chapter 10.
Connecting to the Host Computer

Note
Connecting to a Target System

Attach the QFP socket/adapter to the target system in advance.
The HP E3472A/73A Emulator is connected to the target system by inserting the QFP cable attached to the emulation probe into the QFP socket/adapter.
QFP cable

Use one of the following QFP cables to connect the HP E3472A/73A Emulator to the target system.

• 112-pin QFP cable (HP Part Number E3472B)
• 144-pin QFP cable (HP Part Number E3472C)
• 168-pin QFP cable (HP Part Number E3473B)

QFP socket/adapter

The cables listed above come with a socket/adapter required for connecting to the target system.

When mounting and securing the processor to the target system, a socket cover is necessary.

The 112-pin cable comes with a socket cover. For 144- and 168-pin cables, you need to purchase it separately:

• 144-pin socket cover (HP Part Number E3472-61631)
• 168-pin socket cover (HP Part Number E3473-61630)
Connecting the HP E3472A/73A Emulator to the target system

**Caution**

To prevent the emulator and the target system from being damaged, be sure to follow the cautions below when handling them.

- Be sure to turn off the emulator and the target system before connecting them.
- Check that the orientation of the QFP socket/adapter and the QFP cable is correct.
- To prevent the emulator from being damaged by static electricity, store and use the emulator in a place resistant to static electricity.
- Check that the ground line of the emulator and that of the target system are properly connected.
- When turning the system on, switch on the target system first and then the emulator. When turning the system off, switch off the emulator first and then the target system.
- When supplying power to the emulator, check that the emulation probe is plugged into the target system or demo board.

**Caution**

Do not apply excessive force to the QFP cable. Doing so may damage the cable.
1 Check that the emulator and the target system are OFF.
2 Remove the processor from the target system.
3 Connect the QFP cable to the emulation probe.
4 Connect the QFP cable so that pin 1 of the QFP cable is inserted into pin 1 of the QFP socket/adapter on the target system (see Figure 5-1).
5 Switch on the target system; then switch on the emulator.

Figure 5-1. Connecting HP E3472A/73A Emulator into the Target System.
Designing a Target System

This chapter will help you design a target system that will work with the HP E3472A/73A Emulator and describe instructions for use of the target system.
QFP socket/adapter

The following list shows available QFP socket/adapters.

- 112 pins  HP Part Number E3472-61620 (with socket cover)
- 144 pins  HP Part Number E3472-61621
- 168 pins  HP Part Number E3473-61620

To mount the QFP socket/adapter, solder it directly onto the target system board.

To mount the 168-pin QFP socket/adapter, bore a 3.4-mmØ hole in the target system board so that the hole is located at the center of the bottom of the socket/adapter when mounted and make a 3-mm width pattern around the hole (see the figure below).

![Target System Board (Bottom View)]
Pin relationship between 177-pin connector and QFP socket/adapter

For pin assignment of the 177-pin connector for each of the 112-, 144-, and 168-pin QFP socket adapter, see Chapter 9 "Specifications and Characteristics."

Target interface

For electrical characteristics of the interface with the target system, see Chapter 9 "Specifications and Characteristics."

Cautions in designing target systems

You should remember the followings when designing target systems.

- For operating frequency and operating supply voltage:

  Supported range for the processor operation is 4.0 to 33.3 MHz in frequency and 5±0.25V in power. Processors that operate at 3.3 V are not supported.
Using the Logic Analyzer
Using the Logic Analyzer

This chapter describes you how to connect the logic analyzer to your emulator.
Connecting the Logic Analyzer

Follow the steps below to connect the logic analyzer to the HP E3472A/73A Emulator.

1. Disconnect the power source from the HP E3472A/73A Emulator.
2. Switch off the target system.
3. Connect the logic analyzer to the host computer via a LAN. Enter the Configuration Screen of the logic analyzer to specify LAN parameters. See LAN User’s Guide that comes with the logic analyzer for detail.

**Note**

If you specified the IP address for the logic analyzer when you installed HP B3755A/56A Debug User Interface, giving the same address will skip the addressing operation when you start the Debugger.

4. Connect the pods via the termination adaptors into the emulation probe.

Connect the appropriate pods into the emulation probe according to the label ("POD 1", "POD 2", ..., "POD 5") on it. See Figure 7-1 and Table 7-1 to find the connection mapping for your logic analyzer.

![Figure 7-1. Connecting the Pod](image)
Table 7-1 Correspondance Emulation Probe with Pod

<table>
<thead>
<tr>
<th>Emulation Probe</th>
<th>Logic Analyzer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HP 16550, HP 1660/1, HP 1671</td>
</tr>
<tr>
<td>POD 1</td>
<td>Pod 1</td>
</tr>
<tr>
<td>POD 2</td>
<td>Pod 2</td>
</tr>
<tr>
<td>POD 3</td>
<td>Pod 3</td>
</tr>
<tr>
<td>POD 4</td>
<td>Pod 4</td>
</tr>
<tr>
<td>POD 5</td>
<td>Pod 5</td>
</tr>
</tbody>
</table>

**Note**

- Be sure to use HP 01650-63203 for the termination adapters. None of the others can be used.
- Connect/disconnect the adapter with holding the connector side.

5 Connect the TRIGGER OUT terminal of the logic analyzer and the BREAK IN terminal of the emulation controller.
To verify the connection

Follow the steps below to verify the connection.

1. Power on the target system.
2. Connect the power source into the HP E3472A/73A Emulator.
3. Start the Debugger.
   Specify the IP address for the logic analyzer if necessary.
4. Use trace function to see tracing is properly performed with the logic analyzer.
Restrictions

Resource
When you use the logic analyzer with HP E3472A/73A Emulator, the following resources are reserved for the Emulator upon the activation of the trace function.

Pods
Pods listed in Table 7-2 are reserved for the Emulator. The rest of the pods can be used for Analyzer2 (See the table below).

Table 7-2 Available Pods When Connected to the Emulator

<table>
<thead>
<tr>
<th>Logic Analyzer</th>
<th>HP 16550, HP 1661, HP 1671</th>
<th>HP 1660</th>
<th>HP 16554/5/6</th>
<th>HP 1670</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not Available</td>
<td>Pod 6</td>
<td>Pod 6</td>
<td>Expand Pod 4</td>
<td>Pod 8</td>
</tr>
<tr>
<td>Available for Analyzer2</td>
<td>None</td>
<td>Pod 7, Pod 8</td>
<td>Master Pod 3, Master Pod 4</td>
<td>Pod 3, Pod 4</td>
</tr>
</tbody>
</table>

Trigger Terms
Trigger terms are partly reserved for the trace analyzer. The rest of the terms are available for Analyzer2, which can be configured as a timing analyzer or a state analyzer.

<table>
<thead>
<tr>
<th>Trigger terms reserved for the Debugger's trace analyzer</th>
<th>Trigger terms available for the logic analyzer's Analyzer2</th>
</tr>
</thead>
<tbody>
<tr>
<td>a f g h i j</td>
<td>h i</td>
</tr>
<tr>
<td>Range 1</td>
<td>Range 2</td>
</tr>
<tr>
<td>Timer 1</td>
<td>Timer 2</td>
</tr>
<tr>
<td>Edge 1</td>
<td>Edge 2</td>
</tr>
</tbody>
</table>
Trigger/Store Condition with the trace label "DATA" The data bus between the Emulator and the logic analyzer is 32 bit in width. The condition which determines the enable bits depends on the data bus width of the accessed area and the access size of the instruction. See the below.

<table>
<thead>
<tr>
<th>8/16/32-bit data bus area</th>
<th>Same as the processor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Built-in ROM</td>
<td>32-bit data bus area</td>
</tr>
<tr>
<td>Peripheral registers and built-in RAM</td>
<td>32-bit data bus area (Long word access)</td>
</tr>
</tbody>
</table>

Mnemonics in the Trace List Normally, trace list shows the mnemonics for the instructions which were actually executed and does not show mnemonics for such instructions that were fetched but not executed.

However, mnemonics may not be displayed when the corresponding instruction was actually executed, or vice versa.

This can be observed around the bottom of the trace list and when the store condition is set.
Using the Logic Analyzer

Note
Specifications and Characteristics

This chapter provides specifications and characteristics of HP E3472A/73A Emulator.

This chapter covers:
- Processor compatibility
- Supported logic analyzer
- Target system interface
- Electrical specification
Processor compatibility

The HP E3472A/73A Emulator supports the following Hitachi SH Series processors.

Table 8-1. Supported Processors (HP E3472A)

<table>
<thead>
<tr>
<th>Processor</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>SH7040</td>
<td>112-pin QFP</td>
</tr>
<tr>
<td>SH7041</td>
<td>144-pin QFP</td>
</tr>
<tr>
<td>SH7042</td>
<td>112-pin QFP</td>
</tr>
<tr>
<td>SH7043</td>
<td>144-pin QFP</td>
</tr>
<tr>
<td>SH7044</td>
<td>112-pin QFP</td>
</tr>
<tr>
<td>SH7045</td>
<td>144-pin QFP</td>
</tr>
</tbody>
</table>

Note: SH7040 Series processors that operate at low voltage (3.3V) are not supported.

Table 8-2. Supported Processors (HP E3473A)

<table>
<thead>
<tr>
<th>Processor</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>SH7050</td>
<td>168-pin QFP</td>
</tr>
<tr>
<td>SH7051</td>
<td>168-pin QFP</td>
</tr>
</tbody>
</table>
Supported Logic Analyzers

Main frame
16500B/C+16550A 102-channel logic analyzer card
16500B/C+16554A 68-channel logic analyzer card x 2
16500B/C+16555A/D 68-channel logic analyzer card x 2
16500B/C+16556A/D 68-channel logic analyzer card x 2

Portable
1660C/CS 136/102-channel portable logic analyzer
1661C/CS 136/102-channel portable logic analyzer
1670A/D 136/102-channel portable logic analyzer
1671A/D 136/102-channel portable logic analyzer

1 For 16500, a LAN card (16500H/L) is necessary.
2 LAN option is necessary.

Note
Five pieces of the termination adapter (HP 01650-63203) are required to connect the HP E3472A/73A to the logic analyzer. You cannot use other termination adapters.
Target System Requirements

Connection to the target systems that operate at the following voltage and frequency is supported.

- The HP E3472A Emulator
  Operating voltage: 5 ± 0.25 V
  Operating frequency: 4.0 - 33.3 MHz

- The HP E3473A Emulator
  Operating voltage: 5 ± 0.25 V
  Operating frequency: 4.0 - 25.0 MHz
Target Interface (HP E3472A)

Vcc, Vss

/RES, NMI, MD0 - 3

PE13

PF, AVcc, AVref, AVss
**EXTAL, XTAL**
Connect a circuit that meets the SH7040 Series specification.

**PLLVcc, PLLCAP, PLLVss**

<table>
<thead>
<tr>
<th>PLLVcc</th>
<th>nc</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLLCAP</td>
<td>nc</td>
</tr>
<tr>
<td>PLLVss</td>
<td>nc</td>
</tr>
</tbody>
</table>

**Others**

![Diagram](image-url)
Target Interface (HP E3473A)

Vcc, Vss

/RES, /HSTBY, NMI, MD0 - 3

PC14

PH, AVcc+, +AVre, AVss
**Vpp, EXTAL, XTAL**

Connect a circuit that meets the SH7050 Series specification.

**PLLVcc, PLLCAP, PLLVss**

- PLLVcc: **nc**
- PLLCAP: **nc**
- PLLVss: **nc**

**Others**
### Table 8-3. E3472B PGA to QFP112 Adaptor Pin Assignment

<table>
<thead>
<tr>
<th>PGA177 pin #</th>
<th>QFP112 pin #</th>
<th>Function name</th>
<th>PGA177 pin #</th>
<th>QFP112 pin #</th>
<th>Function name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>nc</td>
<td>24</td>
<td>49</td>
<td>PA2</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>nc</td>
<td>25</td>
<td>nc</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>nc</td>
<td>26</td>
<td>nc</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>PE15</td>
<td>27</td>
<td>56</td>
<td>PD12</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>PC1</td>
<td>28</td>
<td>nc</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>nc</td>
<td>29</td>
<td>57</td>
<td>PD11</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>PC7</td>
<td>30</td>
<td>58</td>
<td>PD10</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>nc</td>
<td>31</td>
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Specifications and Characteristics
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Figure 8-1. Pin Locations of the 177-pin Connector
Electrical Specifications

BNC, labeled TRIGGER OUT

Output Drive Logic high level >= 2.0 V when occurring monitor
program with 50-ohm load or when in reset. Logic low level <= 0.4 V
when running user code with 50-ohm load.

BNC, labeled TRIGGER IN

Input Edge-triggered TTL level input (positive high), 20 pf, with 2K
ohms to ground in parallel. Maximum input: 5 V above VCC; 5 V below
ground.

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).

10BASE2 LAN Port 50-ohm BNC connector. IEEE 802.3 10BASE2
(ThinLAN). When using this connector, the HP E3472A/73A Emulator
provides the functional equivalent of a Medium Attachment Unit (MAU)
for ThinLAN.

Power Supply

Input 100-240Vac, 1.0Amax, 50/60Hz.

Output 12Vdc, 3.3A
<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Symbol</th>
<th>SH7040</th>
<th>Typical (*)</th>
<th>Worst Case</th>
<th>Unit</th>
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<td></td>
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<td>min</td>
<td>max</td>
<td>min</td>
<td>max</td>
</tr>
<tr>
<td>Operating frequency</td>
<td>( f_{op} )</td>
<td>4</td>
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<td>4</td>
<td>33.3</td>
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<td>( t_{cyc} )</td>
<td>34.8</td>
<td>250</td>
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<td>250</td>
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<tr>
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<td>( t_{CL} )</td>
<td>10</td>
<td>-</td>
<td>13</td>
<td>7</td>
</tr>
<tr>
<td>Clock high-pulse width</td>
<td>( t_{CH} )</td>
<td>10</td>
<td>-</td>
<td>15</td>
<td>7</td>
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<td>Clock rise time</td>
<td>( t_{cr} )</td>
<td>-</td>
<td>5</td>
<td>-</td>
<td>4</td>
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<td>( t_{cf} )</td>
<td>-</td>
<td>5</td>
<td>-</td>
<td>3</td>
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<td>( t_{EX} )</td>
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<td>10</td>
<td>4</td>
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*1 Typical outputs measured with 50pF load
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<th>Unit</th>
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<td>- 200</td>
<td>ns</td>
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<td>20 -</td>
<td>tCYC</td>
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<td>20 -</td>
<td>tCYC</td>
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<td>(edge detection time)</td>
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<tr>
<td>(level detection time)</td>
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<td>tNMIH</td>
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*1 Typical outputs measured with 50pF load
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*1 Typical outputs measured with 50pF load
Table 8-8. Bus Timing (E3472A)
(Continued)

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*1 Typical outputs measured with 50pF load
### Table 8-9. DMAC Timing (E3472A)

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<th>Characteristic</th>
<th>Symbol</th>
<th>SH7040</th>
<th>Typical (*)</th>
<th>Worst Case</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>min</td>
<td>max</td>
<td>min</td>
</tr>
<tr>
<td>DREQ0 setup time</td>
<td>t_{DRQS}</td>
<td>18</td>
<td>-</td>
<td>-</td>
<td>28</td>
</tr>
<tr>
<td>DREQ0 hold time</td>
<td>t_{DRQH}</td>
<td>18</td>
<td>-</td>
<td>-</td>
<td>18</td>
</tr>
<tr>
<td>DREQ0 pulse width</td>
<td>t_{DRQW}</td>
<td>1.5</td>
<td>-</td>
<td>-</td>
<td>1.5</td>
</tr>
<tr>
<td>DRAK output delay time</td>
<td>t_{DRAKD}</td>
<td>-</td>
<td>18</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*1 Typical outputs measured with 50pF load
## Table 8-9. Clock Timing (E3473A)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Symbol</th>
<th>SH7050</th>
<th>Typical</th>
<th>Worst Case</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating frequency</td>
<td>( f_{\text{op}} )</td>
<td>TBD</td>
<td>20</td>
<td>4</td>
<td>25</td>
</tr>
<tr>
<td>Clock cycle time</td>
<td>( t_{\text{cyc}} )</td>
<td>50</td>
<td>TBD</td>
<td>50</td>
<td>250</td>
</tr>
<tr>
<td>Clock low-pulse width</td>
<td>( t_{\text{CL}} )</td>
<td>20</td>
<td>-</td>
<td>19</td>
<td>-</td>
</tr>
<tr>
<td>Clock high-pulse width</td>
<td>( t_{\text{CH}} )</td>
<td>20</td>
<td>-</td>
<td>24</td>
<td>-</td>
</tr>
<tr>
<td>Clock rise time</td>
<td>( t_{\text{cr}} )</td>
<td>-</td>
<td>5</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>Clock fall time</td>
<td>( t_{\text{cf}} )</td>
<td>-</td>
<td>5</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>EXTAL input frequency</td>
<td>( t_{\text{EX}} )</td>
<td>TBD</td>
<td>10</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>EXTAL input cycle time</td>
<td>( t_{\text{EXyc}} )</td>
<td>100</td>
<td>TBD</td>
<td>100</td>
<td>250</td>
</tr>
<tr>
<td>EXTAL input low-level pulse width</td>
<td>( t_{\text{EXL}} )</td>
<td>TBD</td>
<td>-</td>
<td>40</td>
<td>-</td>
</tr>
<tr>
<td>EXTAL input high-level pulse width</td>
<td>( t_{\text{EXH}} )</td>
<td>TBD</td>
<td>-</td>
<td>40</td>
<td>-</td>
</tr>
<tr>
<td>EXTAL input rise time</td>
<td>( t_{\text{EXR}} )</td>
<td>-</td>
<td>TBD</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>EXTAL input fall time</td>
<td>( t_{\text{EXF}} )</td>
<td>-</td>
<td>TBD</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>Reset Oscillation setting time</td>
<td>( t_{\text{OSC1}} )</td>
<td>10</td>
<td>-</td>
<td>10</td>
<td>-</td>
</tr>
<tr>
<td>Software standby oscillation setting time</td>
<td>( t_{\text{OSC2}} )</td>
<td>10</td>
<td>-</td>
<td>10</td>
<td>-</td>
</tr>
</tbody>
</table>

*1 Typical outputs measured with 50pF load
### Specifications and Characteristics

#### Electrical Specifications

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Symbol</th>
<th>SH7050 Typical</th>
<th>Worst Case</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>min</td>
<td>max</td>
<td>min</td>
</tr>
<tr>
<td>RES rise time</td>
<td>tRESr</td>
<td>-</td>
<td>200</td>
<td>-</td>
</tr>
<tr>
<td>RES fall time</td>
<td>tRESf</td>
<td>-</td>
<td>200</td>
<td>-</td>
</tr>
<tr>
<td>RESET pulse width</td>
<td>tRESW</td>
<td>20</td>
<td>-</td>
<td>20</td>
</tr>
<tr>
<td>MRESET pulse width</td>
<td>tMRESW</td>
<td>TBD</td>
<td>-</td>
<td>TBD</td>
</tr>
<tr>
<td>NMI rise time</td>
<td>tNMIr</td>
<td>-</td>
<td>200</td>
<td>-</td>
</tr>
<tr>
<td>NMI fall time</td>
<td>tNMIf</td>
<td>-</td>
<td>200</td>
<td>-</td>
</tr>
<tr>
<td>RES setup time</td>
<td>tRESS</td>
<td>30</td>
<td>-</td>
<td>80</td>
</tr>
<tr>
<td>MRES setup time</td>
<td>tMRESS</td>
<td>TBD</td>
<td>-</td>
<td>TBD+10</td>
</tr>
<tr>
<td>NMI setup time</td>
<td>tNMISS</td>
<td>30</td>
<td>-</td>
<td>90</td>
</tr>
<tr>
<td>IRQ0 - IRQ(_7) setup time</td>
<td>tIRQES</td>
<td>30</td>
<td>-</td>
<td>40</td>
</tr>
<tr>
<td>(edge detection time)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IRQ0 - IRQ(_7) setup time</td>
<td>tIRQLS</td>
<td>30</td>
<td>-</td>
<td>40</td>
</tr>
<tr>
<td>(level detection time)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NMI hold time</td>
<td>tNMIH</td>
<td>TBD</td>
<td>-</td>
<td>TBD</td>
</tr>
<tr>
<td>IRQ0 - IRQ(_7) hold time</td>
<td>tIRQEH</td>
<td>TBD</td>
<td>-</td>
<td>TBD</td>
</tr>
<tr>
<td>IRQOUT output delay time</td>
<td>tIRQOD</td>
<td>-</td>
<td>25</td>
<td>-</td>
</tr>
<tr>
<td>Bus request setup time</td>
<td>tBRQS</td>
<td>TBD</td>
<td>-</td>
<td>TBD+10</td>
</tr>
<tr>
<td>Bus acknowledge delay time 1</td>
<td>tBACD1</td>
<td>TBD</td>
<td>-</td>
<td>TBD+5</td>
</tr>
<tr>
<td>Bus acknowledge delay time 2</td>
<td>tBACD2</td>
<td>TBD</td>
<td>-</td>
<td>TBD+5</td>
</tr>
<tr>
<td>Bus 3-state delay time</td>
<td>tBZD</td>
<td>TBD</td>
<td>-</td>
<td>TBD+5</td>
</tr>
</tbody>
</table>

* Typical outputs measured with 50pF load
<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Symbol</th>
<th>SH7050</th>
<th>Typical (*)</th>
<th>Worst Case</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address delay time</td>
<td>tAD</td>
<td>(TBD)</td>
<td>25 - 12</td>
<td>30</td>
<td>ns</td>
</tr>
<tr>
<td>CS delay time 1</td>
<td>tCSD1</td>
<td>- 30</td>
<td>- 11</td>
<td>- 35</td>
<td>ns</td>
</tr>
<tr>
<td>CS delay time 2</td>
<td>tCSD2</td>
<td>- 30</td>
<td>- 7</td>
<td>- 35</td>
<td>ns</td>
</tr>
<tr>
<td>Read strobe delay time 1</td>
<td>tRSD1</td>
<td>- 25</td>
<td>- 12</td>
<td>- 30</td>
<td>ns</td>
</tr>
<tr>
<td>Read strobe delay time 2</td>
<td>tRSD2</td>
<td>- 25</td>
<td>- 10</td>
<td>- 30</td>
<td>ns</td>
</tr>
<tr>
<td>Read data setup time</td>
<td>tRDS</td>
<td>(15)</td>
<td>- 15</td>
<td>25</td>
<td>ns</td>
</tr>
<tr>
<td>Read data hold time</td>
<td>tRDH</td>
<td>0 -</td>
<td>0 -</td>
<td>0 -</td>
<td>ns</td>
</tr>
<tr>
<td>Write strobe delay time 1</td>
<td>tWSD1</td>
<td>(TBD)</td>
<td>25 - 11</td>
<td>30</td>
<td>ns</td>
</tr>
<tr>
<td>Write strobe delay time 2</td>
<td>tWSD2</td>
<td>(TBD)</td>
<td>25 - 7</td>
<td>30</td>
<td>ns</td>
</tr>
<tr>
<td>Write data delay time</td>
<td>tWDH</td>
<td>- 40</td>
<td>- 12</td>
<td>45</td>
<td>ns</td>
</tr>
<tr>
<td>Write data hold time</td>
<td>tWDD</td>
<td>- 5</td>
<td>5 -</td>
<td>-5</td>
<td>ns</td>
</tr>
<tr>
<td>Wait setup time</td>
<td>tWTS</td>
<td>15 -</td>
<td>15 -</td>
<td>25</td>
<td>ns</td>
</tr>
<tr>
<td>Wait hold time</td>
<td>tWTH</td>
<td>10 -</td>
<td>10 -</td>
<td>10</td>
<td>ns</td>
</tr>
<tr>
<td>Read data access time</td>
<td>tACC</td>
<td>65 -</td>
<td>65 -</td>
<td>55</td>
<td>ns</td>
</tr>
<tr>
<td>RD to read data access time</td>
<td>tOE</td>
<td>40 -</td>
<td>40 -</td>
<td>30</td>
<td>ns</td>
</tr>
<tr>
<td>DACK0-DACK1 delay time 1</td>
<td>tDACKD1</td>
<td>- 30</td>
<td>(omitted)</td>
<td>35</td>
<td>ns</td>
</tr>
</tbody>
</table>

*1 Typical outputs measured with 50pF load
### Table 8-12. DMAC Timing (E3473A)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Symbol</th>
<th>SH7050</th>
<th>Typical (*)</th>
<th>Worst Case</th>
<th>Unit</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>min</td>
<td>max</td>
<td>min</td>
<td>max</td>
</tr>
<tr>
<td>DREQ0 setup time</td>
<td>tDRQs</td>
<td>27</td>
<td></td>
<td>37</td>
<td>-</td>
</tr>
<tr>
<td>DREQ0 hold time</td>
<td>tDRQH</td>
<td>30</td>
<td></td>
<td>30</td>
<td>-</td>
</tr>
<tr>
<td>DREQ0 pulse width</td>
<td>tDRQW</td>
<td>1.5</td>
<td></td>
<td>1.5</td>
<td>-</td>
</tr>
<tr>
<td>DRAK output delay time</td>
<td>tDRAKD</td>
<td>-</td>
<td>25</td>
<td>-</td>
<td>30</td>
</tr>
</tbody>
</table>

*1 Typical outputs measured with 50pF load
Environmental Specifications

**Temperature**
Operating, 0 to +40 °C (+32 to +104 °F); non-operating, -40 to +60 °C (-40 to +140 °F).

**Altitude**
Operating, 0 to 2,000 m (6,500ft); non-operating, 4,600 m (15,000 ft).

**Relative Humidity**
15% to 95% (@40 °C).

Regulatory Compliance

This product complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC, and conforms to the following specifications:

**Electromagnetic Compatibility**
- CISPR 11:1990 / EN 55011:1991 Group 1, Class A
- IEC 1000-3-3:1994 / EN 61000-3-3:1995
- 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 Signal Lines, 1 kV Power Lines

**Safety**
- CSA-C22.2 No.1010.1 - 92
Specifications and Characteristics

Note
You can update the firmware in the HP E3472A/73A Emulator by running the `progflash` utility program. `progflash` downloads code from files on the host computer into Flash EPROM memory which is built-in to the HP E3472A/73A Emulator.

This chapter describes how to:

- Components of the software updates.
- Update firmware with the "progflash" command.
- Display current firmware version information.
Components of the software updates

If you're using the HP E3472A/73A Emulator with an HP 9000/700 computer or a Sun SPARCsystem computer:

The HP E3755A/56A Debug User Interface contains the `progflash` program and flashware for the HP E3472A/73A Emulator.

If you're using an IBM PC AT compatible computer:

The HP 64700 SW Update Utility product included in the HP E3755A/56A Debug User Interface contains the `progflash` program and flashware for the HP E3472A/73A Emulator.
Setting up the Host Software

Before you can use `progflash` command, you may need to configure some communication parameters:

- If you will be using on a workstation, you have to set up the `64700tab.net` file. After setting up, you can use `progflash` command via a LAN.
- If you will be using on a PC, you have to set up the `64700tab` file and connect your PC to the Emulator with an RS-232 cable.

To set up the `64700tab.net` file

When you use the HP E3472A/73A Emulator on a workstation and want to update firmware using `progflash` command, you need to set up `64700tab.net` file to specify the destination Emulator.

1. **Make up a logical name** for the HP E3472A/73A Emulator.
   You will use this name to identify the HP E3472A/73A Emulator. This name can be same as in `/etc/hosts` file.

2. **Find the IP address** of the HP E3472A/73A Emulator.

3. **Edit the** `/usr/hp64000/etc/64700tab.net` **file** and add one line with the following format:

   ```plaintext
   lan: <logical_name> <processor_type> <connection_info>
   ```

   - `<logical_name>`: The logical name. This name is to identify the Emulator.
   - `<processor_type>`: A general classification of the processor type. For the HP E3472A/73A Emulator, the processor_type is "+".
   - `<connection_info>`: The IP address of the HP E3472A/73A Emulator.

   The `64700tab.net` file is located in the directory `$HP64000/etc` (/usr/hp64000/etc by default).
To set up the 64700tab file

1. Add following one line to \hp64700\tables\64700tab file.
   In this case, <logical_name> is `emul_com1` and the baud rate is set to 9600.
   ```
   emul_com1 unknown COM1 OFF 9600 NONE ON 1 8
   ```

Example

To use a baud rate of 9600 baud, set the switches as follows:
To update firmware with "progflash"

1 In the case of a workstation, make sure your HP E3472A/73A Emulator is listed in the 64700tab.net file.
2 In the case of a PC, make sure your HP E3472A/73A Emulator is listed in the 64700tab file.
3 Install the update software on your computer.

The following table describes the files that are used when updating firmware.

<table>
<thead>
<tr>
<th>File</th>
<th>Description</th>
<th>Location on HP 9000 or Sun SPARCsystem computers</th>
<th>Location on IBM PC AT compatible computers</th>
</tr>
</thead>
<tbody>
<tr>
<td>progflash</td>
<td>Executable program.</td>
<td>$HP64000/bin</td>
<td>\hp64700\bin</td>
</tr>
<tr>
<td>&lt;product&gt;.cfg</td>
<td>Product configuration file.</td>
<td>$HP64000\inst\update</td>
<td>\hp64700\update</td>
</tr>
<tr>
<td>&lt;product&gt;.X</td>
<td>Product code file.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4 Enter the `progflash` command.

5 Answer the questions asked by the `progflash` command.

The `progflash` command downloads code from files on the host computer into Flash EPROM memory in the HP E3472A/73A Emulator.

Instead of running progflash interactively, you may use options to the progflash command:

`progflash [-v] [emul_name] [products_to_update ...]`

The `-v` option means "verbose". It causes progress status messages to be displayed during operation.

The `emul_name` option is the logical emulator name as specified in the 64700tab or 64700tab.net file.

The `products_to_update` option names the products whose firmware is to be updated. For the HP E3472A/73A Emulator, the product name is "E3472".

If you enter the `progflash` command without options, it becomes interactive. If you don't include the `emul_name` option, it displays the logical names in the 64700tab or 64700tab.net file and asks you to choose one. If you don't include the `products_to_update` option, it displays the products which have firmware update files on the system and asks you to
choose one. (In the interactive mode, only one product at a time can be updated.) You can abort the interactive \texttt{progflash} command by pressing <CTRL>c.

\texttt{progflash} will print "Flash programming SUCCEEDED" and return 0 if it is successful; otherwise, it will print "Flash programming FAILED" and return a nonzero (error).

You can verify the update by displaying the firmware version information.

Example

To update the firmware in "myprobe", you could enter the following command:

\texttt{progflash -v myprobe E3472}
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 HP E3472A/73A Emulator.

If the firmware doesn’t appear to be updated

Though Flash EPROM is very reliable, it can fail. If the HP E3472A/73A Emulator determines the Flash EPROM is not working, it will try to use the boot code in its Flash EPROMs. The only useful operation the boot code allows is running **progflash**.

- Make sure the current version information is incorrect by comparing it with the version numbers of the update software.

- Try updating the firmware again.
  
  If none of these steps solves the problem, contact your local HP Representative.

If there is a power failure during a firmware update

If there is a power glitch during a firmware update, some bits may be lost during the download process, possibly resulting in an HP E3472A/73A Emulator that will not boot up.

- Set switch S4 to OPEN, then cycle power. This tells the HP E3472A/73A Emulator to ignore everything in the Flash EPROM except the boot code.

- Repeat the firmware update process.

- Set switch S4 to CLOSED, then cycle power. This restores the HP E3472A/73A Emulator to its normal mode.

See Also

"If the data in ROM is corrupt" in Chapter 10.
Solving Problems

If you have problems with the HP E3472A/73A Emulation Probe System, your first task is to determine the source of the problem. Problems may originate in any of the following places:

- The HP E3472A/73A Emulator itself
  - Emulation controller
  - Emulation probe
  - 50-pin ribbon cable
- The connection between the HP E3472A/73A Emulator and your host computer
- The interface software on the host computer
- The connection between the HP E3472A/73A Emulator and the target system
- The target system

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

- The status lights on the emulation controller
- Error messages displayed on the host computer
- Diagnostic tests performed using the host computer
- HP E3472A/73A Emulator "performance verification" tests

You can run these tests for each of the emulation controller and emulation probe.
Status Lights

The HP E3472A/73A Emulator communicates various modes and error conditions via the status lights.

The following illustration shows the status lights on both sides of the HP E3472A/73A Emulator and what they mean:
Lit when the target processor is running in normal (user program) mode

Lit when the target processor is running in background debug mode

Lit when the target system is in a reset state

Lit when the power supply is properly connected

Lit when LAN data is being transmitted

Lit when 10BASE-T connection has a good link; not used for 10BASE2

Lit when the polarity on the receive twisted pair is reversed for a 10BASE-T connection

Lit when LAN data is being received
Problems with the LAN Interface

If you cannot verify LAN communication

Use the "telnet" command on the host computer to verify LAN communication. After powering up the HP E3472A/73A Emulator, it takes up to a minute before the HP E3472A/73A Emulator can be recognized on the network. After a minute, try the "telnet <internet address>" command. If "telnet" does not make the connection:

☐ Make sure that you have connected the HP E3472A/73A Emulator to the proper power source and that the power light is lit.

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

☐ Make sure that only one of the LAN ports is connected.

☐ Make sure the HP E3472A/73A Emulator communication configuration switches are set correctly. Unplug the HP E3472A/73A Emulator power cord, then plug it in again to make sure the switch settings are read correctly by the HP E3472A/73A Emulator.

☐ Make sure that the HP E3472A/73A Emulator’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 HP E3472A/73A Emulator’s LAN interface with the "pv" command.

If "telnet" makes the connection, but no prompt (for example, R>, M>, U>, etc.) is supplied:
It's possible that the host software is in the process of running a command. You can use <CTRL>c to interrupt and get the Terminal Interface prompt.

It's also possible for there to be a problem with the HP E3472A/73A Emulator firmware while the LAN interface is still up and running. In this case, you must reboot the HP E3472A/73A Emulator by disconnecting power to the HP E3472A/73A Emulator and reconnecting it again.

If you have LAN connection problems

- Try to "ping" the HP E3472A/73A Emulator. At your operating system prompt, type:
  
  `ping <hostname or IP address>`
  
  If it does not respond:
  
  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 HP E3472A/73A Emulator still does not respond to a "ping", you need to verify the IP address and gateway mask of the HP E3472A/73A Emulator. To do this, connect the HP E3472A/73A Emulator to a terminal or terminal emulator (see page 34), 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, 0.0.0.0 if you are connecting from the local subnet.

"lan -p" shows the port is 6470. If the port is not 6470, you must change it with the "lan -p 6470" command (unless you have deliberately set the port number to a different value because of a conflict).
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 HP E3472A/73A Emulator.

The HP E3472A/73A Emulator 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 HP E3472A/73A Emulator may take a very long time to connect to the network after it is turned on.
Problems with the Serial Interface

If you cannot verify RS-232 communication

If the HP E3472A/73A Emulator prompt does not appear in the terminal emulator window:

☐ Make sure that you have connected the HP E3472A/73A Emulator 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 HP E3472A/73A 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 HP E3472A/73A Emulator as a DTE device instead of as a DCE device. If you are using the wrong type of cable, no prompt will be displayed.

Caution

Use the recommended cable. If the cable is not shielded, or if the cable is not grounded at the serial controller, the HP E3472A/73A Emulator may be damaged by electrostatic discharge (Recommended cable part number is HP C2032A).
Problems with the HP E3472A/73A Emulator Itself

To execute the built-in performance verification test

In addition to the powerup tests, there are additional tests available through the built-in "terminal interface." Three of these tests can be invoked through either a telnet session to the HP E3472A/73A Emulator or through a terminal emulator on the RS-232 port. The LAN tests can only be executed through the RS-232 port. The HP E3472A/73A Emulator provides the tests for each of the emulation controller and emulation probe, enabling you to easily isolate a faulty device.

The remainder of this section assumes that the tests are being run from a terminal emulator connected to the RS-232 port. When using a terminal emulator via LAN, configure the emulator using the DIP switches.

Test procedure for the emulation controller

Procedure
1. Dismount the power supply from the emulation controller.
2. Remove the emulation probe.
3. Disconnect the 50-pin ribbon cable and AUX power cable.
4. Set all of the DIP switches to CLOSED.
5. Loop-back the BREAK IN and TRIGGER OUT BNC connectors by connecting a coaxial cable between them.
6. Connect the E3496-66502 loop-back board to the 50-pin connector.
7. To execute the LAN feedback tests, disconnect the LAN BNC connector from the network and terminate with two 50 ohm terminators on a tee.
7 Connect the power supply to the emulation controller.

8 Enter the pv command through the terminal emulator.

Options available for the "pv" are explained in the help screen displayed by typing "help pv" or "? pv" at the prompt. The help screen output will appear similar to the screen shown below:

```
c>? pv

pv <options> <count> - Execute the performance verification diagnostics.

pv              - display pv warning message
pv -l           - list available pv tests only (do not execute)
pv -d           - execute emulator subsystem tests only
pv -t <x[-y]>   - select system test number <x> or range <x-y> only
pv -t *         - select all system tests
pv -d -t <x>    - select emulation subsystem test <x> only
pv -v <verbose> - set verbose level;  valid levels: 0-9
pv -f           - force tests to execute (HP internal use only)
pv -n           - do not initialize system (HP internal use only)
pv <count>      - execute diagnostics <count> number of times,
                 <count> of 0 repeats until keyboard break

--- SYSTEM SETUP ---
  - Connect a coaxial cable between the BREAK IN and TRIGGER OUT BNCs.
  - Replace the target cable with the SELFTEST LOOPBACK connector.
  - To execute the LAN Feedback tests, disconnect the LAN BNC connector
    from the network and terminate with two 50 ohm terminators on a tee.
    (Run pv from the RS232 Port with LAN disabled)

*** WARNING *** This command performs a system initialization after
  all pv execution is completed.
```

c>

Examples

To execute all 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 tests available through this command can be displayed as follows:

```
c>pv -l
Testing: HPE3499A Series Emulation System
Test  1: Powerup PV Results
Test  2: LAN 10Base2 Feedback Test
Test  3: LAN 10BaseT Feedback Test
Test  4: Break In and Trigger Out BNC Feedback Test
Test  5: Target Probe Feedback Test
Test  6: Boundary Scan Master Test
Test  7: I2C Test

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!
Test  7: I2C Test                                       Passed!

c>
```

On a good system, when the E3496-66502 loop-back board is plugged into the 50-pin target connector, the RST LED will light and the BKG and USER LEDs will be out.

The results on a good system are as follows:

```
c>pv 1
Testing: HPE3499A 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!
Test  7: I2C Test Passed!

FAILED Number of tests: 1           Number of failures: 0

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HPE3499B Series Emulation System
Version:   A.01.00 17Aug96
Location:  Generics

If a failure is found on one of these tests, details of Failure can be obtained through using a verbose level of 2 or more.

```
TEST 2: LAN 10BASE2 Feedback Test

For LAN 10BASE2 test, the following is an example of a failure which is *not* caused by a broken HP E3472A/73A Emulator.

R>pv -t2 -v2 1

Testing: HPE3499A 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: HPE3499A 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: HPE3499A 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, their is a failure in the FLASH ROM which requires service from HP.

Test 3: 10BaseT Feedback Test

R>pv -t3 -v2 1

Testing: HPE3499A Series Emulation System
Test # 3: LAN 10BaseT Feedback Test                     passed!
PASSED  Number of tests: 1           Number of failures: 0
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.

If the HP E3472A/73A Emulator passes this "pv" test, additional testing can be performed through exercising the connection to the network. To run this test, set configuration switch 1 and switch 5 to OPEN, all other configuration switches CLOSED (this enables LAN using 10BaseT). Cycle power and wait for 15 to 30 seconds. Then "ping" the HP E3472A/73A Emulator from your host computer or PC. See the LAN documentation for your host computer for the location and action of the "ping" utility. If the HP E3472A/73A Emulator fails to respond to the "ping" request, verify that the lan parameters (IP address and gateway address) are set correctly and that your host computer recognizes the IP address of the HP E3472A/73A Emulator. If all else is good, then failure to respond to ping indicates a faulty HP E3472A/73A Emulator.

**TEST 4: Break In and Trigger Out BNC Feedback Test**

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

Testing: HPE3499A 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 HP E3472A/73A Emulator is bad.

**TEST 5: Target Probe Feedback Test**

A verbose output on this test can be extensive. For example, the following is the output of this test if you forget to plug in the E3496-66502 loop-back board.

```
p>pv -t5 -v2 1
```

Testing: HPE3499A Series Emulation System
Test # 5: Target Probe Feedback Test failed!
  Bad 20 Pin Status Read when unconnected = 0x7fb7
  Expected Value = 0xfff7
  Bad 20 Pin Status Read when connected= 7fb7
  Expected Value = 0x7fb7
Output 19 Low not received on Input 11
Output 11 Low not received on Input 19
Output 13 Low not received on Input 1
Output 12 High not received on Input 6
Output 12 and Input 6 not pulled high on release
Output 8 Low not received on Input 10
Output 7 Low not received on Input 20
Output 4 Low not received on Input 14
Output 2 Low not received on Input 18

FAILED Number of tests: 1 Number of failures: 1

If the you get a verbose output like this, check to make sure that the self test
loop-back board was connected properly.

Note

You can check the 50-pin ribbon cable by connecting it between the
emulation controller and loop-back board and performing this test.

Test procedure for the emulation probe

Procedure

1 Dismount the power supply from the emulation controller.
2 Connect the emulation probe and the emulation controller.
   Connect the 50-pin ribbon cable and AUX power cable.
3 Plug the demo board into the 177-pin PGA connector.
4 Set the DIP switch on the demo board to "TEST MODE."
5 Set all of the DIP 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.
6 Connect a coaxial cable between the BREAK IN and TRIGGER OUT
   BNCs.
   Connect the power supply to the emulation controller.
8 Enter the pv command through the terminal emulator.
   After testing, return the DIP switch on the demo board to the "DEMO MODE."

The results on a good system are as follows:

c>pv 1
Testing: HPE3499A 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!
Test 7: I2C Test                                       Passed!
Testing: HPE3472A Hitachi SH7040 Series Emulator
    Test 1: Monitor Memory Test                          Passed!
    Test 2: Mapper Memory Test                           Passed!
    Test 3: Run Control Test                             Passed!
    Test 4: On-Chip ROM Test                             Passed!
    Test 5: On-Chip RAM Test                             Passed!
    Test 6: Emulation Memory Test                        Passed!
    Test 7: Target Interface Feedback Test               Passed!
    Test 8: Analyzer Interface Test                      Passed!
FAILED  Number of tests: 1           Number of failures: 0

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HPE3499B Series Emulation System
  Version:   A.01.00 17Aug96
  Location:  Generics

HPE3472A Hitachi SH7040 Series Emulator
  Version:   A.01.00 17Aug96
  Speed:     33.3 MHz
  Memory:    0 KBytes
  PC Board:  f200-00e0-0000-78ff

  If a failure is found on one of these tests, details of Failure can be obtained
  through using a verbose level of 2 or more.
If the data in ROM is corrupt

Sometimes the data in the FLASH ROM can be corrupt. This can be caused while programming of the FLASH ROM if one of the following things happens:

- A system fault
- A loss of power to the HP E3472A/73A Emulator or host computer
- A break in the communications channel

If this happens, try the following steps:

1. **Cycle power on the HP E3472A/73A Emulator and try the flash programming utility (progflash) again.**
   
   If this doesn't work, continue with the next step:

2. **Set switch S4 to OPEN, then cycle power.**
   
   This will force the HP E3472A/73A Emulator to use only the boot ROM. Try running the programming utility again. If this is successful, return the switches to their normal configuration (S3 and S4 CLOSED) and cycle power.
Note
Registers List
The HP E3472A Emulator has the following register classes.

* Basic registers
  - intc Interrupt controller
  - ubc User break controller
  - dtc Data transfer controller
  - cac Cache controller
  - bsc Bus state controller
  - dmac0 DMA controller 0
  - dmac1 DMA controller 1
  - dmac2 DMA controller 2
  - dmac3 DMA controller 3
  - mtu0 Multi-function timer pulse unit 0
  - mtu1 Multi-function timer pulse unit 1
  - mtu2 Multi-function timer pulse unit 2
  - mtu3 Multi-function timer pulse unit 3
  - mtu4 Multi-function timer pulse unit 4
  - wdt Watch-dog timer
  - sci0 Serial communication interface 0
  - sci1 Serial communication interface 1
  - adc A/D converter
  - cmt0 Compare match timer 0
  - cmt1 Compare match timer 1
  - pfc Pin function controller
  - port I/O port
  - poe Port output enable
  - sys System control
The following list shows registers included in each register class.

- **Basic registers (*)**

  - **pc**  Program counter
  - **sr**  Status register
  - **r0**  General purpose register 0
  - **r1**  General purpose register 1
  - **r2**  General purpose register 2
  - **r3**  General purpose register 3
  - **r4**  General purpose register 4
  - **r5**  General purpose register 5
  - **r6**  General purpose register 6
  - **r7**  General purpose register 7
  - **r8**  General purpose register 8
  - **r9**  General purpose register 9
  - **r10** General purpose register 10
  - **r11** General purpose register 11
  - **r12** General purpose register 12
  - **r13** General purpose register 13
  - **r14** General purpose register 14
  - **r15** General purpose register 15
  - **sp**  Hardware stack pointer
  - **gbr** Global base register
  - **vbr** Vector base register
  - **pr**  Procedure register
  - **mach** Multiple and accumulate register H
  - **macl** Multiple and accumulate register L
• Interrupt controller (intc)
  ipra  Interrupt priority register A
  iprb  Interrupt priority register B
  iprc  Interrupt priority register C
  iprd  Interrupt priority register D
  ipre  Interrupt priority register E
  iprf  Interrupt priority register F
  iprg  Interrupt priority register G
  iprh  Interrupt priority register H
  icr   Interrupt control register
  isr   IRQ status register

• User break controller (ubc)
  ubar  User break address register
  ubamr User break address mask register
  ubbr  User break bus cycle register

• Data transfer controller (dtc)
  dtea  DTC enable register A
  dtcb  DTC enable register B
  dtcc  DTC enable register C
  dtcd  DTC enable register D
  dtce  DTC enable register E
  dtcsr DTC control/status register
  dtcb  DTC data base register

• Cache controller (cac)
  ccr   Cache control register

• Bus state controller (bsc)
  bcr1  Bus control register 1
  bcr2  Bus control register 2
  wcr1  Wait control register 1
  wcr2  Wait control register 2
  dcr   DRAM area control register
  rtcsp Refresh timer control/status register
  rtcnt Refresh timer counter
  rtcet Refresh timer constant register
• DMA controller 0 (dmac0)
  dmaor  DMA operation register
  sar0   DMA source address register 0
  dar0   DMA destination address register 0
  dmatcr0 DMA transfer count register 0
  chcr0  DMA channel control register 0

• DMA controller 1 (dmac1)
  dmaor  DMA operation register
  sar1   DMA source address register 1
  dar1   DMA destination address register 1
  dmatcr1 DMA transfer count register 1
  chcr1  DMA channel control register 1

• DMA controller 2 (dmac2)
  dmaor  DMA operation register
  sar2   DMA source address register 2
  dar2   DMA destination address register 2
  dmatcr2 DMA transfer count register 2
  chcr2  DMA channel control register 2

• DMA controller 3 (dmac3)
  dmaor  DMA operation register
  sar3   DMA source address register 3
  dar3   DMA destination address register 3
  dmatcr3 DMA transfer count register 3
  chcr3  DMA channel control register 3

• Multi-function timer pulse unit 0 (mtu0)
  tstr   Timer start register
  tsyr   Timer synchronization register
  tcr0   Timer control register 0
  tmdr0  Timer mode register 0
  tior0  Timer I/O control register 0
  tier0  Timer interrupt enable register 0
  tsr0   Timer status register 0
  tcnt0  Timer counter 0
  tgr0a  General register 0A
  tgr0b  General register 0B
  tgr0c  General register 0C
  tgr0d  General register 0D
• Multi-function timer pulse unit 1 (mtu1)
  tstr  Timer start register
  tsyr  Timer synchronization register
  tcr1  Timer control register 1
  tmdr1 Timer mode register 1
  tior1 Timer I/O control register 1
  tier1 Timer interrupt enable register 1
  tsr1  Timer status register 1
  tcnt1 Timer counter 1
  tgr1a General register 1A
  tgr1b General register 1B

• Multi-function timer pulse unit 2 (mtu2)
  tstr  Timer start register
  tsyr  Timer synchronization register
  tcr2  Timer control register 2
  tmdr2 Timer mode register 2
  tior2 Timer I/O control register 2
  tier2 Timer interrupt enable register 2
  tsr2  Timer status register 2
  tcnt2 Timer counter 2
  tgr2a General register 2A
  tgr2b General register 2B
- Multi-function timer pulse unit 3 (mtu3)
  
  tstr  Timer start register  
  tsyr  Timer synchronization register  
  toer  Timer output master enable register  
  tocr  Timer output control register  
  tgrc  Timer gate control register  
  tcdr  Timer cycle data register  
  tddr  Timer dead time data register  
  tcnts  Timer sub-counter (for reference only)  
  tcbr  Timer cycle buffer register  
  tcr3  Timer control register 3  
  tmdr3  Timer mode register 3  
  tior3  Timer I/O control register 3  
  tier3  Timer interrupt enable register 3  
  tsr3  Timer status register 3  
  tcnt3  Timer counter 3  
  tgr3a  General register 3A  
  tgr3b  General register 3B  
  tgr3c  General register 3C  
  tgr3d  General register 3D  

- Multi-function timer pulse unit 4 (mtu4)
  
  tstr  Timer start register  
  tsyr  Timer synchronization register  
  toer  Timer output master enable register  
  tocr  Timer output control register  
  tgrc  Timer gate control register  
  tcdr  Timer cycle data register  
  tddr  Timer dead time data register  
  tcnts  Timer sub-counter  
  tcbr  Timer cycle buffer register  
  tcr4  Timer control register 4  
  tmdr4  Timer mode register 4  
  tior4  Timer I/O control register 4  
  tier4  Timer interrupt enable register 4  
  tsr4  Timer status register 4  
  tcnt4  Timer counter 4  
  tgr4a  General register 4A  
  tgr4b  General register 4B  
  tgr4c  General register 4C  
  tgr4d  General register 4D
• Watch-dog timer (wdt)
  wdtcsr  Timer control/status register
  wdtcnt  Timer counter
  rstcsr  Reset control/status register

• Serial communication interface 0 (sci0)
  smr0    Serial mode register 0
  brr0    Bit rate register 0
  scr0    Serial control register 0
  tdr0    Transmit data register 0
  ssr0    Serial status register 0
  rdr0    Receive data register 0 (for reference only)

• Serial communication interface 1 (sci1)
  smr1    Serial mode register 1
  brr1    Bit rate register 1
  scr1    Serial control register 1
  tdr1    Transmit data register 1
  ssr1    Serial status register 1
  rdr1    Receive data register 1 (for reference only)

• A/D converter (adc)
  addra   A/D data register A (for reference only)
  addrb   A/D data register B (for reference only)
  addrd   A/D data register D (for reference only)
  addrc   A/D data register C (for reference only)
  addrd   A/D data register E (for reference only)
  addrf   A/D data register F (for reference only)
  addrg   A/D data register G (for reference only)
  addrh   A/D data register H (for reference only)
  adcsr   A/D control/status register
  adcr    A/D control register

• Compare match timer0 (cmt0)
  cmstr   Compare match timer start register
  cmcsr0  Compare match timer control/status register 0
  cmcnt0  Compare match timer counter 0
  cmcor0  Compare match timer constant register 0
• Compare match timer1 (cmt1)
  cmstr  Compare match timer start register
  cmcsr1 Compare match timer control/status register 1
  cmcnt1 Compare match timer counter 1
  cmcor1 Compare match timer constant register 1

• Pin function controller (pfc)
  paior  Port A IO register
  pacrh  Port A control register H
  pacrl1 Port A control register L1
  pacrl2 Port A control register L2
  pbior  Port B IO register
  pbcr1  Port B control register 1
  pbcr2  Port B control register 2
  pcior  Port C IO register
  pccr   Port C control register
  pdior  Port D IO register
  pdcrh1 Port D control register H1
  pdcrh2 Port D control register H2
  pdcr1  Port D control register L
  peior  Port E IO register
  pecr1  Port E control register 1
  pecr2  Port E control register 2
  ifcr   IRQOUT function control register

• I/O port (port)
  padr  Port A data register
  pbdr  Port B data register
  pcdr  Port C data register
  pddr  Port D data register
  pedr  Port E data register
  pfdr  Port F data register (for reference only)

• Port output enable (poe)
  icsr  Input level control/status register
  ocsr  Output level control/status register

• System control (sys)
  sbycr Standby control register
The HP E3473A Emulator has the following register classes.

* Basic registers
  intc Interrupt controller
  ubc User break controller
  bsc Bus state controller
  dmac0 DMA controller 0
  dmac1 DMA controller 1
  dmac2 DMA controller 2
  dmac3 DMA controller 3
  atu0 Advanced timer unit 0
  atu1 Advanced timer unit 1
  atu2 Advanced timer unit 2
  atu3 Advanced timer unit 3
  atu4 Advanced timer unit 4
  atu5 Advanced timer unit 5
  atu6 Advanced timer unit 6
  atu7 Advanced timer unit 7
  atu8 Advanced timer unit 8
  atu9 Advanced timer unit 9
  atu10 Advanced timer unit 10
  apc Advanced pulse controller
  wdt Watch-dog timer
  cmt0 Compare match timer 0
  cmt1 Compare match timer 1
  sci0 Serial communication interface 0
  sci1 Serial communication interface 1
  sci2 Serial communication interface 2
  adc A/D converter
  pfc Pin function controller
  port I/O port
  sys System control
The following list shows registers included in each register class.

- **Basic registers (*)**

  - pc  Program counter
  - sr  Status register
  - r0 General purpose register 0
  - r1 General purpose register 1
  - r2 General purpose register 2
  - r3 General purpose register 3
  - r4 General purpose register 4
  - r5 General purpose register 5
  - r6 General purpose register 6
  - r7 General purpose register 7
  - r8 General purpose register 8
  - r9 General purpose register 9
  - r10 General purpose register 10
  - r11 General purpose register 11
  - r12 General purpose register 12
  - r13 General purpose register 13
  - r14 General purpose register 14
  - r15 General purpose register 15
  - sp  Hardware stack pointer
  - gbr Global base register
  - vbr Vector base register
  - pr  Procedure register
  - mach Multiple and accumulate register H
  - macl Multiple and accumulate register L

- **Interrupt controller (intc)**

  - ipra Interrupt priority register A
  - iprb Interrupt priority register B
  - iprc Interrupt priority register C
  - iprd Interrupt priority register D
  - ipre Interrupt priority register E
  - iprf Interrupt priority register F
  - iprg Interrupt priority register G
  - iprh Interrupt priority register H
  - icr Interrupt control register
  - isr IRQ status register
• User break controller (ubc)
  ubar User break address register
  ubamr User break address mask register
  ubbr User break bus cycle register

• Bus state controller (bsc)
  bcr1 Bus control register 1
  bcr2 Bus control register 2
  wcr1 Wait control register 1
  wcr2 Wait control register 2

• DMA controller 0 (dmac0)
  dmaor DMA operation register
  sar0 DMA source address register 0
  dar0 DMA destination address register 0
  dmatcr0 DMA transfer count register 0
  chcr0 DMA channel control register 0

• DMA controller 1 (dmac1)
  dmaor DMA operation register
  sar1 DMA source address register 1
  dar1 DMA destination address register 1
  dmatcr1 DMA transfer count register 1
  chcr1 DMA channel control register 1

• DMA controller 2 (dmac2)
  dmaor DMA operation register
  sar2 DMA source address register 2
  dar2 DMA destination address register 2
  dmatcr2 DMA transfer count register 2
  chcr2 DMA channel control register 2

• DMA controller 3 (dmac3)
  dmaor DMA operation register
  sar3 DMA source address register 3
  dar3 DMA destination address register 3
  dmatcr3 DMA transfer count register 3
  chcr3 DMA channel control register 3
• Advanced timer unit 0 (atu0)
  tstr       Timer start register
  pscr1      Pre-scaler register 1
  tior0a     Timer I/O control register 0A
  tsrb       Trigger selection register
  itvrr      Interval interrupt request register
  tsrah      Timer status register AH
  tsral      Timer status register AL
  tier0a     Timer interrupt enable register A
  tcnt0      Free learning counter 0
  icr0a      Input capture register 0A
  icr0b      Input capture register 0B
  icr0c      Input capture register 0C
  icr0d      Input capture register 0D

• Advanced timer unit 1 (atu1)
  tstr       Timer start register
  pscr1      Pre-scaler register 1
  tcr1       Timer control register 1
  tior1a     Timer I/O control register 1A
  tior1b     Timer I/O control register 1B
  tior1c     Timer I/O control register 1C
  tsrb       Timer status register B
  tierb      Timer interrupt enable register B
  tcnt1      Free learning counter 1
  gr1a       General register 1A
  gr1b       General register 1B
  gr1c       General register 1C
  gr1d       General register 1D
  gr1e       General register 1E
  gr1f       General register 1F
  osbr       Offset base register
• Advanced timer unit 2 (atu2)
  tstr  Timer start register
  pscr1  Pre-scaler register 1
  tcr2  Timer control register 2
  tior2a  Timer I/O control register 2A
  tsre  Timer status register C
  tierc  Timer interrupt enable register C
  tcnt2  Free learning counter 2
  gr2a  General register 2A
  gr2b  General register 2B
• Advanced timer unit 3 (atu3)
  tstr  Timer start register
  pscr1  Pre-scaler register 1
  tmdr  Timer mode register
  tsrdh  Timer status register DH
  tsrdl  Timer status register DL
  tierdh  Timer interrupt enable register DH
  tierdl  Timer interrupt enable register DL
  tcr3  Timer control register 3
  tior3a  Timer I/O control register 3A
  tior3b  Timer I/O control register 3B
  tcnt3  Free learning counter 3
  gr3a  General register 3A
  gr3b  General register 3B
  gr3c  General register 3C
  gr3d  General register 3D
• Advanced timer unit 4 (atu4)
  tstr  Timer start register
  pscrl  Pre-scaler register 1
  tmdr  Timer mode register
  tsrdh  Timer status register DH
  tsrdl  Timer status register DL
  tierdh  Timer interrupt enable register DH
  tierdl  Timer interrupt enable register DL
  tcr4  Timer control register 4
  tior4a  Timer I/O control register 4A
  tior4b  Timer I/O control register 4B
  tcnt4  Free learning counter 4
  gr4a  General register 4A
  gr4b  General register 4B
  gr4c  General register 4C
  gr4d  General register 4D

• Advanced timer unit 5 (atu5)
  tstr  Timer start register
  pscrl  Pre-scaler register 1
  tmdr  Timer mode register
  tsrdh  Timer status register DH
  tsrdl  Timer status register DL
  tierdh  Timer interrupt enable register DH
  tierdl  Timer interrupt enable register DL
  tcr5  Timer control register 5
  tior5a  Timer I/O control register 5A
  tcnt5  Free learning counter 5
  gr5a  General register 5A
  gr5b  General register 5B
### Advanced timer unit 6 (atu6)
- **tstr** Timer start register
- **pscr1** Pre-scaler register 1
- **tsre** Timer status register E
- **tiereh** Timer interrupt enable register EH
- **tierel** Timer interrupt enable register EL
- **tcr6** Timer control register 6
- **tcnt6** Free learning counter 6
- **cylr6** Cycle register 6
- **bfr6** Buffer register 6
- **dtr6** Duty register 6

### Advanced timer unit 7 (atu7)
- **tstr** Timer start register
- **pscr1** Pre-scaler register 1
- **tsre** Timer status register E
- **tiereh** Timer interrupt enable register EH
- **tierel** Timer interrupt enable register EL
- **tcr7** Timer control register 7
- **tcnt7** Free learning counter 7
- **cylr7** Cycle register 7
- **bfr7** Buffer register 7
- **dtr7** Duty register 7

### Advanced timer unit 8 (atu8)
- **tstr** Timer start register
- **pscr1** Pre-scaler register 1
- **tsre** Timer status register E
- **tiereh** Timer interrupt enable register EH
- **tierel** Timer interrupt enable register EL
- **tcr8** Timer control register 8
- **tcnt8** Free learning counter 8
- **cylr8** Cycle register 8
- **bfr8** Buffer register 8
- **dtr8** Duty register 8
- **Advanced timer unit 9 (atu9)**
  
<table>
<thead>
<tr>
<th>Register</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>tstr</td>
<td>Timer start register</td>
</tr>
<tr>
<td>pscr1</td>
<td>Pre-scaler register 1</td>
</tr>
<tr>
<td>tsre</td>
<td>Timer status register E</td>
</tr>
<tr>
<td>tiereh</td>
<td>Timer interrupt enable register EH</td>
</tr>
<tr>
<td>tiere1</td>
<td>Timer interrupt enable register EL</td>
</tr>
<tr>
<td>tcr9</td>
<td>Timer control register 9</td>
</tr>
<tr>
<td>tcnt9</td>
<td>Free learning counter 9</td>
</tr>
<tr>
<td>cylr9</td>
<td>Cycle register 9</td>
</tr>
<tr>
<td>bfr9</td>
<td>Buffer register 9</td>
</tr>
<tr>
<td>dtr9</td>
<td>Duty register 9</td>
</tr>
</tbody>
</table>

- **Advanced timer unit 10 (atu10)**
  
<table>
<thead>
<tr>
<th>Register</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>pscr1</td>
<td>Pre-scaler register 1</td>
</tr>
<tr>
<td>tcr10</td>
<td>Timer control register 10</td>
</tr>
<tr>
<td>tsrf</td>
<td>Timer status register F</td>
</tr>
<tr>
<td>tierf</td>
<td>Timer interrupt enable register F</td>
</tr>
<tr>
<td>dstr</td>
<td>Down count start register</td>
</tr>
<tr>
<td>tcnr</td>
<td>Timer connection register</td>
</tr>
<tr>
<td>dcnt10a</td>
<td>Down counter 10A</td>
</tr>
<tr>
<td>dcnt10b</td>
<td>Down counter 10B</td>
</tr>
<tr>
<td>dcnt10c</td>
<td>Down counter 10C</td>
</tr>
<tr>
<td>dcnt10d</td>
<td>Down counter 10D</td>
</tr>
<tr>
<td>dcnt10e</td>
<td>Down counter 10E</td>
</tr>
<tr>
<td>dcnt10f</td>
<td>Down counter 10F</td>
</tr>
<tr>
<td>dcnt10g</td>
<td>Down counter 10G</td>
</tr>
<tr>
<td>dcnt10h</td>
<td>Down counter 10H</td>
</tr>
</tbody>
</table>

- **Advanced pulse controller (apc)**
  
<table>
<thead>
<tr>
<th>Register</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>popcr</td>
<td>Pulse output port control register</td>
</tr>
</tbody>
</table>

- **Watch-dog timer (wdt)**
  
<table>
<thead>
<tr>
<th>Register</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>wdtcsr</td>
<td>Timer control/status register</td>
</tr>
<tr>
<td>wdtcnt</td>
<td>Timer counter</td>
</tr>
<tr>
<td>rstcsr</td>
<td>Reset control/status register</td>
</tr>
</tbody>
</table>

- **Compare match timer0 (cmt0)**
  
<table>
<thead>
<tr>
<th>Register</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>cmstr</td>
<td>Compare match timer start register</td>
</tr>
<tr>
<td>cmcsr0</td>
<td>Compare match timer control/status register 0</td>
</tr>
<tr>
<td>cmcnt0</td>
<td>Compare match timer counter 0</td>
</tr>
<tr>
<td>cmcor0</td>
<td>Compare match timer constant register 0</td>
</tr>
</tbody>
</table>
• Compare match timer1 (cmt1)
  cmstr  Compare match timer start register
  cmcsr1 Compare match timer control/status register 1
  cmcnt1 Compare match timer counter 1
  cmcor1 Compare match timer constant register 1

• Serial communication interface 0 (sci0)
  smr0  Serial mode register 0
  brr0  Bit rate register 0
  scr0  Serial control register 0
  tdr0  Transmit data register 0
  ssr0  Serial status register 0
  rdr0  Receive data register 0 (for reference only)

• Serial communication interface 1 (sci1)
  smr1  Serial mode register 1
  brr1  Bit rate register 1
  scr1  Serial control register 1
  tdr1  Transmit data register 1
  ssr1  Serial status register 1
  rdr1  Receive data register 1 (for reference only)

• Serial communication interface 2 (sci2)
  smr2  Serial mode register 2
  brr2  Bit rate register 2
  scr2  Serial control register 2
  tdr2  Transmit data register 2
  ssr2  Serial status register 2
  rdr2  Receive data register 2 (for reference only)
• A/D converter (adc)
  addr0 A/D data register 0 (for reference only)
  addr1 A/D data register 1 (for reference only)
  addr2 A/D data register 2 (for reference only)
  addr3 A/D data register 3 (for reference only)
  addr4 A/D data register 4 (for reference only)
  addr5 A/D data register 5 (for reference only)
  addr6 A/D data register 6 (for reference only)
  addr7 A/D data register 7 (for reference only)
  addr8 A/D data register 8 (for reference only)
  addr9 A/D data register 9 (for reference only)
  addr10 A/D data register 10 (for reference only)
  addr11 A/D data register 11 (for reference only)
  addr12 A/D data register 12 (for reference only)
  addr13 A/D data register 13 (for reference only)
  addr14 A/D data register 14 (for reference only)
  addr15 A/D data register 15 (for reference only)
  adcsr0 A/D control/status register 0
  adcr0 A/D control register 0
  adcsr1 A/D control/status register 1
  adcr1 A/D control register 1
  adtrgr A/D trigger register

• Pin function controller (pfc)
  pairo Port A IO register
  pacr Port A control register
  pbior Port B IO register
  pbcr Port B control register
  pcor Port C IO register
  pccr1 Port C control register 1
  pccr2 Port C control register 2
  pdior Port D IO register
  pdcr Port D control register
  peior Port E IO register
  pecr Port E control register
  pfior Port F IO register
  pfcr1 Port F control register 1
  pfcr2 Port F control register 2
  pgior Port G IO register
  pgcr1 Port G control register 1
  pgcr2 Port G control register 2
• I/O Port (port)
  padr   Port A data register
  pbdr   Port B data register
  pcdr   Port C data register
  pddr   Port D data register
  pedr   Port E data register
  pfdr   Port F data register
  pgdr   Port G data register
  phdr   Port H data register (for reference only)

• System control (sys)
  sbycr  Standby control register
  syscr  System control register
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