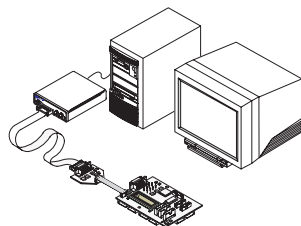

Emulation and Analysis Solutions for Motorola/IBM PowerPC 740/750 Microprocessors

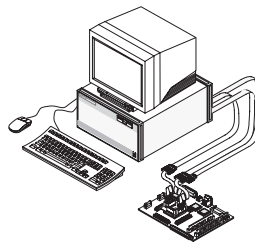
Product Overview

Debug and Integrate Real-Time Embedded Systems



JTAG Emulation

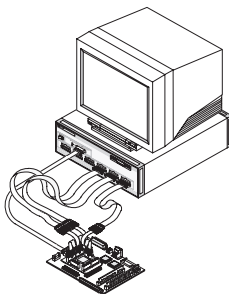
- Verify Interrupt Routines
- Debug Assembly Code
- Optimize Code



Logic Analysis Solution

- Perform Basic Signal Measurements
- Profile Hardware Operation
- Verify Signal Integrity
- Verify Conformance to Specifications
- Exercise Microprocessor and Other Hardware
- Debug Boot Code

Emulation and Analysis Solutions for the Design Team



Emulation Solution with Real-Time Trace

- Debug Hardware/Software Interaction
- Profile Hardware/Software Interaction
- Optimize System Performance
- Perform System Test

Quickly and accurately determine the root cause of your team's most difficult hardware, software, and system integration problems with Hewlett-Packard's powerful emulation and logic analysis solutions.

HP's emulation and analysis solutions for the Motorola/IBM PowerPC 740/750 combine the powerful tools of run control,

code download, debugger connections, and logic analysis for a complete, scalable system debug environment.

With a scalable solution from HP, design team members can customize HP's product offerings to meet their unique requirements. Solutions range from emulation probes combined with the indus-

try's leading debuggers to emulation with real-time trace to solve today's most complex Motorola/IBM PowerPC 740/750 design problems. HP's solutions are designed to meet your needs today and protect your investment as your needs change in the future.

With logic analysis providing timing and state analysis, you can monitor microprocessor activity in relation to other important system signals such as a PCI bus, other microprocessors, or I/O devices. Traditional emulation systems don't allow you to time-correlate events across your entire system using timing, analog, and state analysis for your most difficult integration problems.

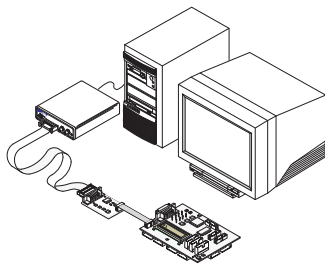
The logic analyzer is nonintrusive, allowing you to run your target system at full speed. A system trace, up to 2 M deep, can be combined with complex triggering to find the toughest problems. The microprocessor instruction set execution can be correlated to high-level source code with the HP source correlation tool set.

HP Scalable Solutions

HP emulation and logic analysis solutions are scalable for each member of the digital design team. The following are three typical configurations for firmware/software debug, hardware debug, and system integration.

Components of these solutions include a logic analyzer, emulation probe/module, analysis probe, inverse assembler, source correlation tool set, and system performance analysis tool set.

Information on each of these components is included in this document.



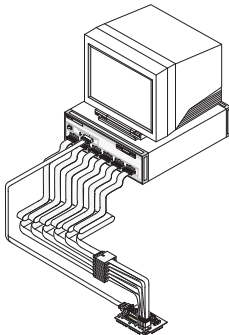
System Features

JTAG Emulation

- Microprocessor run control on your target system
- Debugger connection

System Components and Functionality

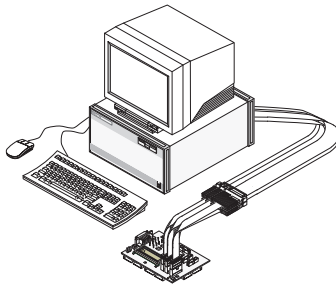
- Emulation Probe: (see p. 3)
 - Download code, view and modify memory, and view registers on your target system or evaluation board from the debugger interface
- Connection to industry-leading debuggers from Green Hills, Microtec, and SDS



Emulation Solution with Real-Time Trace

- Microprocessor run control on your target system
- Debugger connection
- Real-time logic analysis trace solution:
 - Assembly level trace
 - Source code trace
- BGA probing solution

- HP 16600A or 16700A Series Logic Analysis System:
 - Capture and analyze code flow and data flow without halting the target system
 - Time-correlate analog, timing, and state events across your entire system
 - Monitor microprocessor activity in relation to system buses, other microprocessors, or I/O devices
- Inverse Assembler: (see p. 8)
 - Connect to target using BGA probing solution with AMP Mictor connectors
 - Disassemble trace listing into PPC 740/750 mnemonics
- Integrated Emulation Module: (see p. 3)
 - Download code, view and modify memory, and view registers on your target system or evaluation board from the debugger interface
 - Connect to industry-leading debuggers from Green Hills, Microtec, and SDS
- HP Source Correlation Tool Set: (see p. 9)
 - Time-correlate acquired logic analysis trace to high-level source code
 - Step through in assembly or high-level code



Logic Analysis Solution

- Real-time logic analysis trace solution:
 - Assembly level trace
- BGA probing solution

- HP 16600A or 16700A Series Logic Analysis System:
 - Capture and analyze code flow and data flow without halting the target system
 - Time-correlate analog, timing, and state events across your entire system
 - Monitor microprocessor activity in relation to system buses, other microprocessors, or I/O devices
- Inverse Assembler: (see p. 8)
 - Connect to target using BGA probing solution with AMP Mictor connectors
 - Disassemble trace listing into PPC 740/750 mnemonics

Microprocessor	Package Type	Microprocessor Clock Speed	JTAG Emulation	Emulation Solution with Real-Time Trace	Logic Analysis Solution
PPC 740	BGA	Up to 300 MHz	X	X	X
PPC 750	BGA	Up to 300 MHz	X	X	X

Table 1: Emulation and Analysis Solutions for Motorola/IBM 740/750 Microprocessors

Emulation Probe and Module

The emulation probe and module provide the same functionality. The emulation probe is a standalone product, as shown in figure 1. The emulation module is an integrated plug-in for the HP 16600A and 16700A Series logic analysis systems.

Both help you debug your code by providing run control, code download, and memory/register display and modification. You can control program execution through single stepping, start/stop, run/break, and set/modify breakpoints. You can also run code at full speed in the target.

The emulation probe can be controlled by an industry-leading debugger. The emulation module can be controlled by either a debugger or the emulation control interface provided with the logic analyzer. These interfaces are described on page 4.

The HP emulation probe and module can be controlled over your local area network (LAN) by the debugger and connect to your target through a 16-pin Berg style connector, as shown in figure 4.

Unlike traditional emulators, the emulation probes and modules provide more stable operation by accessing only the debug pins of the microprocessor. You don't need a serial port on your target system to download code. Unlike ROM monitors, they don't require user memory.

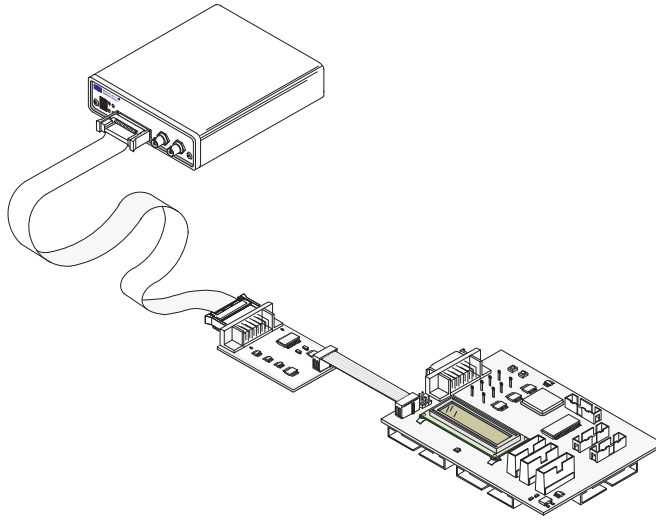


Figure 1: Standalone HP Emulation Probe

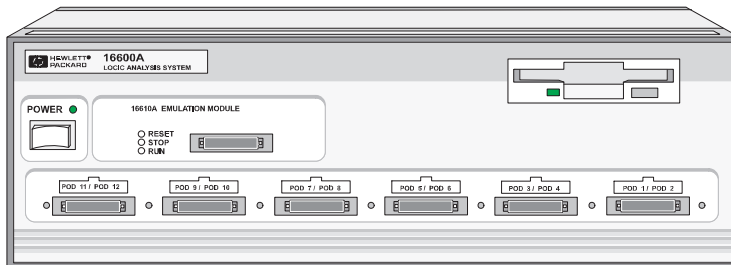


Figure 2: HP 16600A Logic Analysis System with Integrated Emulation Module

Debugger Interface

Industry-leading debuggers can control the HP emulation probe and module. You can set break-points, single-step through code, examine variables, and modify source code variables from the high-level source code debugger interface.

Debugger interfaces must be ordered directly from the debugger vendor.

Debugger Connections

Green Hills Software, Inc.
30 West Sola Street
Santa Barbara, CA 93101 USA
Phone: (805) 965-6044
<http://www.ghs.com>

Microtec, A Mentor Graphics Company
880 Ridder Park Drive
San Jose, CA 95131 USA
Phone: (800) 950-5554
Phone: (408) 487-7000
<http://www.mri.com>

Software Development Systems, Inc.
815 Commerce Drive, Suite 100
Oak Brook, Illinois 60523 USA
Phone: (630) 368-0400
<http://www.sdsi.com>

Please check with your local HP Test and Measurement sales office or visit our web site at <http://www.hp.com/go/las-data> for the current list of debugger connections.

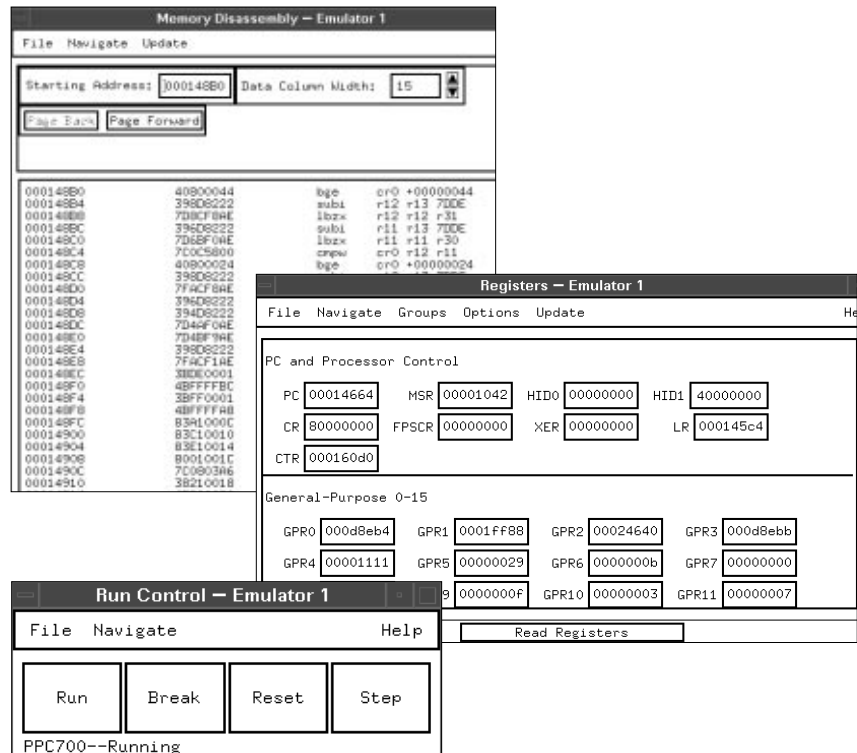


Figure 3: Emulation Control Interface

Emulation Control Interface

The emulation module integrated into the logic analysis system can be controlled directly by the emulation control interface. You can easily display and modify contents of microprocessor registers, system memory, and I/O. You can also view memory code segments disassembled into familiar Motorola/IBM PowerPC 740/750 assembly instructions.

From the run control window you can instruct the microprocessor to run, break, reset, or single-step. You also can choose whether the memory, I/O, and register displays are updated for breaks and single steps.

Writing command files that set up registers, memory, and I/O in your system is easy with the command language. Once the command file is written, save it on the logic analyzer hard disk. When you want to initialize your hardware system to a particular state, simply recall and execute the command file. Unlike a debugger interface, the emulation control interface does not reference back to the high-level source code.

Emulation Module and Probe Migration

HP protects your current investment by providing a migration path for the emulation modules and probes as your needs change. To move from one processor family to another, simply order a migration kit for the emulation module or probe, which will provide all the necessary hardware, firmware, and cables to support your new processor family at a fraction of the cost of a new system.

This same migration path works for the emulation probes or emulation modules.

Emulation Module Triggering Integration with Logic Analyzer

With the emulation module, use the powerful triggering of the HP 16600A and 16700A Series logic analysis systems to halt on events such as microprocessor activity, system buses, or other external events. The emulation module also can trigger the logic analyzer when a breakpoint is hit. This provides powerful event correlation between the debugger interface environment and the logic analyzer.

Specification	Description
Microprocessors Supported	Motorola/IBM PowerPC 740/750
Physical Connections	Ethernet 10base2 or 10baseT Ethernet connections RS-232-C 1200 through 115 Kbaud rates supported
Number of Breakpoints	Virtually unlimited software breakpoints or one hardware breakpoint
Physical Size	155 mm width x 161 mm depth x 65 mm height
Environmental	
Temperature	Operating: 5 °C to +40 °C (+41 °F to +104 °F) Nonoperating: -40 °C to +70 °C (-40 °F to +158 °F)
Altitude	Operating: 4,600 m (15,000 ft) Nonoperating: 4,600 m (15,000 ft)
Humidity	15% to 80% @ 40 °C for 24 hours
Regulatory Compliance	EMC CISPR 11:1990/EN 55011:1991 Group 1, Class A IEC 801-2:1991/EN 50082-1:1992 4 kV CD, 8 kV AD IEC 801-3:1984/EN 50082-1:1992 3 V/m, (1 kHz 80% AM, 27-1 kHz) IEC 801-4: 1988 / EN 50082-1:1992 0.RkV Sig lines, 1 kV Power lines
Safety Approvals	IEC 1010-1:1990 AMD 1:1992 UL 1244 CSA-C22.2 No. 231 (Series M-89)

Table 2: HP Emulation Probe and Module Specifications

Emulation Probe and Module Target Connection Information

A 16-pin male 2X8 header Berg style connector is needed on the target development board to connect the PowerPC 740/750 microprocessor interface assembly to the JTAG debug port of the microprocessor.

The header should be placed as close as possible to the processor to ensure signal integrity. TD0, TD1, TCK, TMS, and /TRST signal traces between the JTAG connector and the PowerPC 740/750 must be less than three inches. If these signals are connected to other nodes, you must connect in a daisy chain between the JTAG debug connector and the PowerPC 740/750. These signals are sensitive to crosstalk and cannot be routed next to active signals, such as clock lines on the target board.

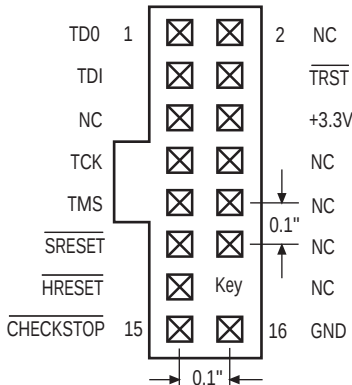


Figure 4: Target Development Board Header Connector (Top View)

Header Pin No.	PPC 740/750 I/O	Signal Name	Resistor
1	Out	TD0	
2		NC	
3	In	TDI	1K Ω pulldown
4	In	TRST	10K Ω pullup
5		NC	
6		Power*	1K Ω series
7	In	TCK	10K Ω pullup
8		NC	
9	In	TMS	10K Ω pullup
10		NC	
11	In	SRESET	10K Ω pullup
12		NC	
13	In	HRESET	10K Ω pullup
14		KEY	
15	Out	CHECKSTOP	1K Ω pullup
16		GND	

Table 3. JTAG Interface Connections

* The +POWER signal is sourced from the development board and is used as a reference signal. It should be the power signal supplied to the processor (either +3.3V or +5V). It does not supply power to the HP emulation probe.

Note: NC Refers to No Connect

Notes and Information:

1. HRESET, SRESET, and TRST from the JTAG connector must be logically ORed with the HRESET, SRESET, and TRST signals that connect to the processor on the target system. They cannot be “dotted” or “wire-ORed” on the board.
2. If the target board does not use the QACK signal, the board must have a pull-down resistor to pull this signal low. This allows the PowerPC to enter the state required for reading and writing processor scan string data.

Real-Time Trace Analysis

Real-time trace analysis consists of a physical connection to signals on the Motorola/IBM PPC 740/750 microprocessors, acquisition of relevant data, and analysis of the real-time captured bus information.

Physical connection to the microprocessor is provided by an AMP Mictor probing solution.

The real-time trace analysis solutions for the Motorola/IBM PPC 740/750 include inverse assembly, source correlation, and system performance analysis.

For information on the data acquisition modules for the HP 16600A and 16700A Series logic analysis systems, please refer to related HP literature on page 13.

MPC 7XX Microprocessor	Supported Speed	Probing Solutions	Real-Time Trace Solutions
PPC 740	Up to 300 MHz	Mictor Connector Probing Solution: Mictor connectors designed in target for access to critical signals for logic analysis	Inverse Assembly: - Disassembly of bus information into PPC 740/750 microprocessor mnemonics - PPC 740/750 configuration files for logic analyzer
PPC 750	Up to 300 MHz		Source Correlation: - Time-correlation of acquired trace to high-level source code - Trigger and search through trace in high-level source code
			System Performance Analysis: - Statistical performance measurements on trace data - State overview, state interval, time interval, and time overview measurements

Table 4: Real-Time Trace and Probing Alternatives

Inverse Assembler

The inverse assembler quickly configures the logic analyzer by labeling address, data, and status signals for the PPC 740/750 microprocessors. It also provides PPC 740/750 mnemonics in the trace listing for easy correlation between captured data and target code. The inverse assembler works with the HP B4620B source correlation tool set to provide time correlation between the assembly-level trace and the high-level source code.

The inverse assembler provides filters and color coding to show and/or suppress different instructions such as data reads, data writes, unexecuted prefetches, and memory map regions.

The inverse assembler has several modes of operation, depending on your microprocessor configuration. The inverse assembler provides PPC 740/750 mnemonics, but the cache must be off to see all cycles on the microprocessor.

7xx Filter Options	
Frame 10:Slot A:PPC740/750	
Wait/Idle states	Suppress
Instructions	Show
Probable overfetch	Show
Possible overfetch	Show
Operand reads	Show
Operand writes	Show
Address-only states	Suppress
Apply Reset Close	

Figure 5: Inverse Assembler Filter Options

Modes of Operation

State Modes

In state-per-address or data-cycle modes, the logic analyzer only records those states in which one or more of the strobes AACK, ARTRY, TA, DRTRY, or TEA are asserted. This mode filters wait states and exposes the PowerPC 740/750 microprocessor's decoupled address and data buses.

In state-per-clock mode, address, data, and status are captured on each CPU clock. This mode is useful in hardware validation and analysis during system crashes.

Timing Mode

Timing analysis is supported. All processor signals are connected directly to the logic analyzer pods.

HP Logic Analyzers Supported

- HP 1660A/D, 1670A/D
- HP 16550A
- HP 16554A/D, 16555A/D, 16556A/D
- HP 16600A, 16601A

HP B4620B Source Correlation Tool Set

The inverse assembler can be used with the HP B4620B source correlation tool set for the HP 16600A and 16700A Series logic analysis systems. This allows time correlation of an acquired trace to source code. The source correlation tool set uses the symbolic information provided in your object file to build a database of source files, line numbers and symbol information.

Once the logic analyzer acquires the real-time trace, you can step through the trace at assembly-code level or source-code level. You can also easily locate the cause of a problem by stepping backward to the root cause. With time-correlated analysis in both the digital and analog domains, HP provides powerful solutions for your most difficult hardware/software integration problems.

IEEE 695, Elf/Dwarf, and ASCII symbol files are supported.

System Correlation

With the HP logic analysis systems, you can time-correlate bus information from other microprocessors or bus interfaces in your target system, such as a PCI bus, with the PPC 740/750. Analysis probes are available for additional microprocessors. (Contact your local HP Test and Measurement sales office or visit our web site at <http://www.hp.com/go/las-data> for more information).

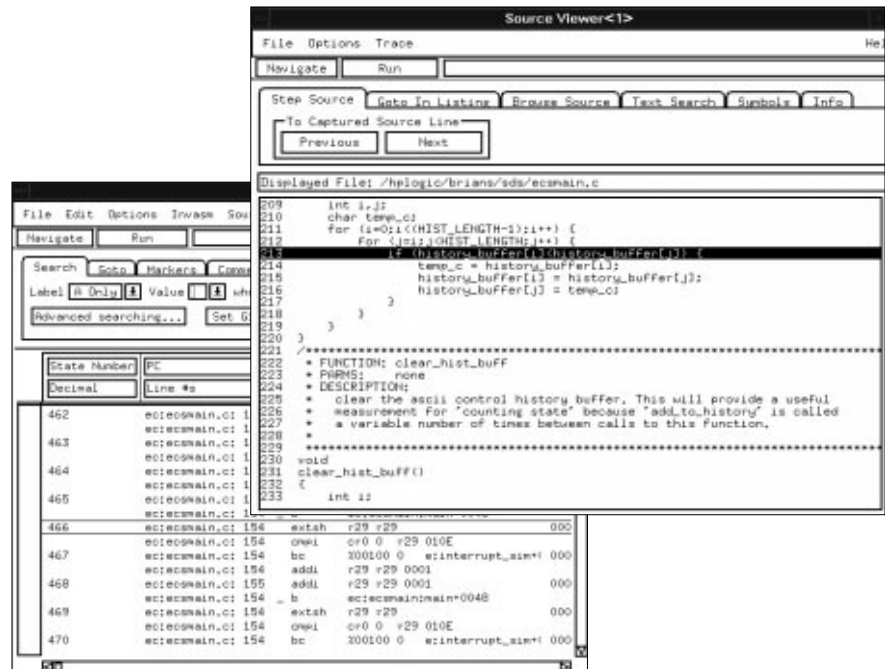


Figure 6: Inverse Assembled Trace Time-Correlated to Source Code Using the HP Source Correlation Tool Set

HP B4600B System Performance Analysis Tool Set

The system performance analysis (SPA) tool set is an optional software package for the HP 16600A and 16700A Series logic analysis systems. The SPA tool set pro-

vides such statistical performance measurements as state overview, state interval, time interval, and time overview. The same symbol file used with the source correlation tool set provides symbolic support for the system performance analyzer, as shown in figure 7.

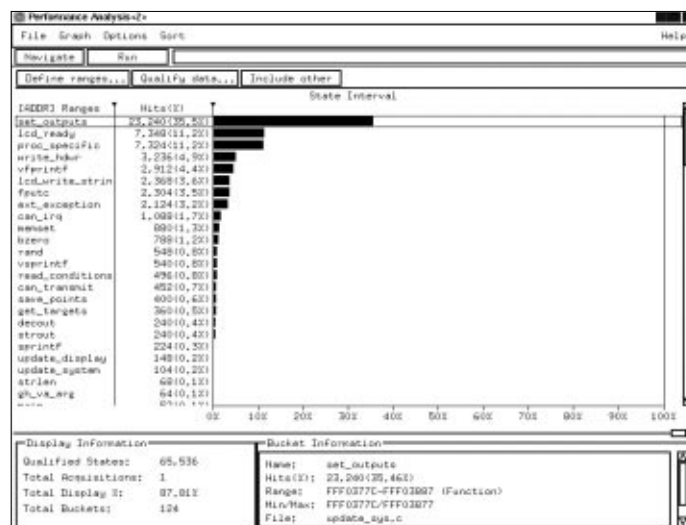


Figure 7: Statistical Performance Information from the HP System Performance Analysis Tool Set

AMP Mictor Connector Probing Solution

Signals required for inverse assembly must be routed to a minimum of four AMP Mictor 38 connectors for connection to the logic analyzer. The AMP Mictor connectors use a minimal amount of board space and provide a convenient connection for real-time trace analysis. Additional Mictor connectors can be used to probe other signals of interest.

Eight, 16-channel logic analyzer pods are required for inverse assembly. These eight pods are connected to four HP E5346A high-density termination adapters not included with the inverse assembler. The termination networks are located in the probe tip of the HP E5346A for easy application and use. A schematic of this termination is shown in figure 8.

An HP support shroud is also recommended to provide additional strain relief between the HP E5346A adapter and the AMP Mictor connector. Five shrouds are included with five AMP Mictor connectors in the HP E5346-68701 Mictor connector kit. The AMP Mictor connectors are also available from AMP (P/N 2-767004-2).

When locating each Mictor connector on your board, try to minimize the trace lengths of signals routed to the Mictor connectors. This will prevent reflections from the long traces and stubs.

For more detailed connection information, including pin-out, please refer to the product note, *Passively Probing a Motorola/IBM PowerPC 740/750 Target System with HP E5346A High-Density Termination Adapters* (publication number 5966-4166E).

Probe Loading

- 10 pf on all signals
- 100 Kohms on all signals

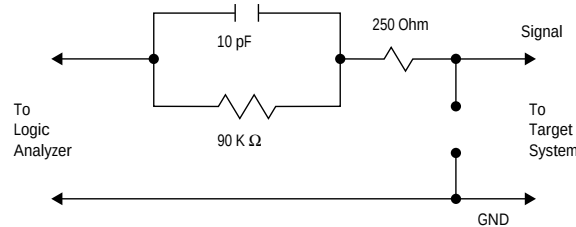


Figure 8: RC Network for Signal Termination

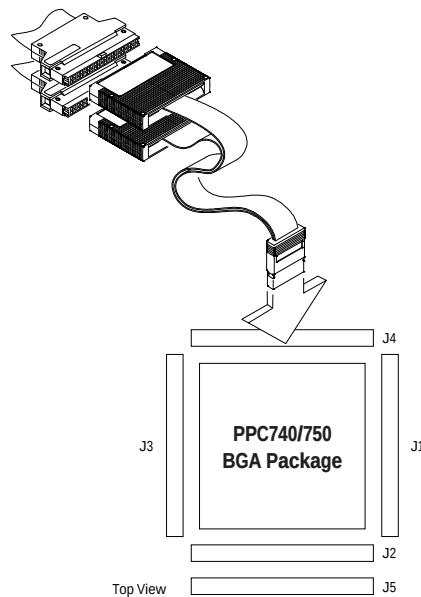


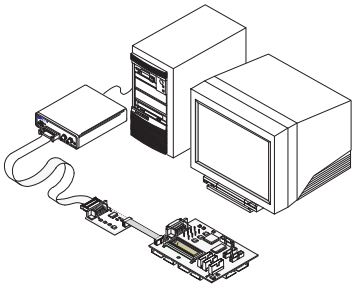
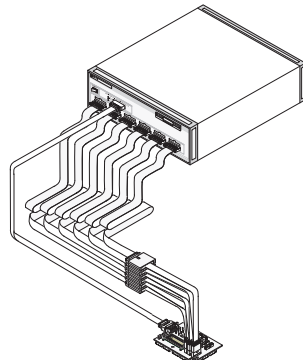
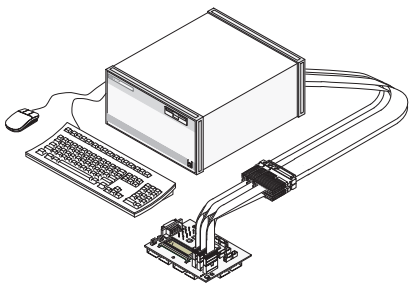
Figure 9: AMP Mictor Connector Layout

System Configuration and Ordering Information

The table below shows the system components you need to order and what is included in each. The solution product numbers do not

include logic analysis. The HP 16600A and 16700A Series logic analysis systems must be ordered separately.

If you want to configure or upgrade your system with individual products, see page 12 for individual product number information.

	Solution	Products to Order	Included Components
	JTAG Emulation		
	• PPC 7XX Emulation Probe • Debugger Connection	• HP E5900A #070 • Order directly from Green Hills, Microtec, or SDS	
	Emulation Solution with Real-Time Trace		
	• HP 16600A or 16700A Series Logic Analysis System	• Refer to HP publication number 5966-3148E for logic analyzer configuration • Supported logic analyzers: HP 16600A, 16601A, 16550/554/555/556 A/D	
	• Emulation Using Mictor Probing	• HP E9486A #001 • Four HP E5346A High-Density Termination Adapters • HP E5346-68701 Mictor Connector Kit	• Inverse Assembler • Source Correlation Tool Set • Emulation Module
	• Debugger Connection • Optional System Performance Analysis Tool Set	• Order directly from Green Hills, Microtec, or SDS • HP B4600B	
	Logic Analysis Solution		
	• HP 16600A or 16700A Series Logic Analysis System	• Refer to HP publication number 5966-3148E for logic analyzer configuration • Supported logic analyzers: HP 16600A, 16601A, 16550/554/555/556 A/D	
	• Logic Analysis Solution Using Mictor Probing • Optional Source Correlation Tool Set • Optional System Performance Analysis Tool Set • Optional Emulation Module	• HP E9586A #001 • HP B4620B • HP B4600B • HP E5901A #070	• Inverse Assembler

Individual Components Ordering Information

Description	HP Product
Emulation Probe	HP E5900A #070
Emulation Module	HP E5901A #070
Inverse Assembler	HP E9586A #001
Emulation Module and Emulation Probe Migration	HP E5902A #070
Source Correlation Tool Set	HP B4620B
System Performance Analysis Tool Set	HP B4600B
High-Density Termination Adapter	HP E5346A
Mictor Connector Kit	HP E5346-68701

Training and Consulting

HP has experienced Digital Systems Consultants who can help you maximize the utilization of your emulation and analysis system through training and consulting. Digital Systems Consultants are peaked in debugging complex digital hardware/software problems and hardware/software integration.

HP training may be delivered through scheduled courses, on-site classes, or one-on-one consulting. HP has courses for the beginner as well as advanced users migrating from the 16500 Series system. Call 1-800-593-6632 in the U.S. for information about training schedules and location or to register. For training offered in other geographies and languages, consult the HP Test and Measurement education web site: <http://www.hp.com/go/tmeducation>.

For consulting services, contact your local HP Test and Measurement sales office. An HP Digital Systems Consultant can help you solve tough digital debug problems by showing you how to apply HP tools and debug best practices. Topics covered can include:

- System Installation
- Complex Triggering
- Multiple Bus Analysis
- Source-Line Referencing
- System Performance Analysis
- Instrumenting Code to Solve Specific Issues
- Bus Signal Timing Analysis
- Signal Integrity Analysis
- HP 16700A/HP1660XA Networking

Topics related to debug of PPC 740/750 microprocessor-based targets can include:

- Instruction/Data Cache Issues
- Checkstop Analysis
- Single and Multiple Beat Bus Cycles
- Pipelining and Bursts

Related HP Literature**Pub. Number**

<i>HP 16600A and 16700A Logic Analysis System Mainframes, Product Overview</i>	5966-3107E
<i>HP Logic Analysis Systems Upgrade, Product Overview</i>	5966-3059E
<i>System Configuration for the HP 16600A and 16700A Series Logic Analysis Systems, Configuration Guide</i>	5966-3148E
<i>State and Timing Analyzers for the HP 16500C Logic Analysis System, Product Overview</i>	5962-7245E
<i>Passively Probing a Motorola/IBM PowerPC 740/750 Target System with HP E5346A High-Density Termination Adapters, Product Note</i>	5966-4166E

Warranty Information

These Hewlett-Packard products have a warranty against defects in material and workmanship for a period of one year from date of shipment. During this warranty period, Hewlett-Packard Company will, at its option, either repair or replace products that prove to be defective.

For more information about the HP 16600A and 16700A Series logic analysis systems visit our web site at, <http://www.hp.com/go/las-data>

For more information about Hewlett-Packard test & measurement products, applications, services, and for a current sales office listing, visit our web site, <http://www.hp.com/go/tmdir>

You can also contact one of the following centers and ask for a test and measurement sales representative.

United States:
Hewlett-Packard Company
Test and Measurement Call Center
P.O. Box 4026
Englewood, CO 80155-4026
1 800 452 4844

Canada:
Hewlett-Packard Canada Ltd.
5150 Spectrum Way
Mississauga, Ontario
L4W 5G1
(905) 206 4725

Europe:
Hewlett-Packard
European Marketing Centre
P.O. Box 999
1180 AZ Amstelveen
The Netherlands
(31 20) 547 9900

Japan:
Hewlett-Packard Japan Ltd.
Measurement Assistance Center
9-1, Takakura-Cho, Hachioji-Shi,
Tokyo 192, Japan
Tel: (81-426) 56 7832
Fax: (81-426) 56 7840

Latin America:
Hewlett-Packard
Latin American Region Headquarters
5200 Blue Lagoon Drive
9th Floor
Miami, Florida 33126
U.S.A.
Tel: (305) 267 4245/4220
Fax: (305) 267 4288

Australia/New Zealand:
Hewlett-Packard Australia Ltd.
31-41 Joseph Street
Blackburn, Victoria 3130
Australia
Tel: 1 800 629 485 (Australia)
Tel: 0 800 738 378 (New Zealand)
Fax: (61 3) 9210 5489

Asia Pacific:
Hewlett-Packard Asia Pacific Ltd
17-21/F Shell Tower, Times Square,
1 Matheson Street, Causeway Bay,
Hong Kong
Tel: (852) 2599 7777
Fax: (852) 2506 9285

Technical information in this document is subject to change without notice