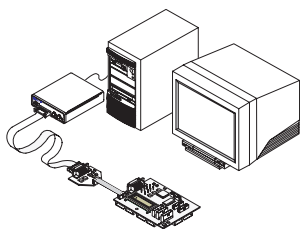

Emulation and Analysis Solutions for Motorola MPC 505 and 509 Microprocessors

Product Overview

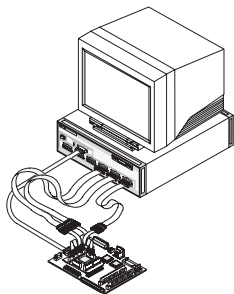
Debug and Integrate Real-Time Embedded Systems



BDM Emulation

- Verify Interrupt Routines
- Debug Assembly Code
- Optimize Code

Emulation and Analysis Solutions for the Design Team



Emulation Solution with Real-Time Trace

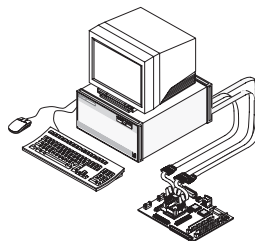
- Debug Hardware/Software Interaction
- Profile Hardware/Software Interaction
- Optimize System Performance
- Perform System Test

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 MPC 505/509 microprocessors 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-



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

try's leading debuggers to emulation with real-time trace to solve today's most complex Motorola MPC 505/509 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.

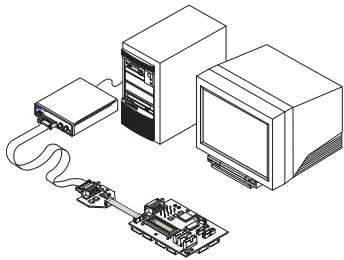
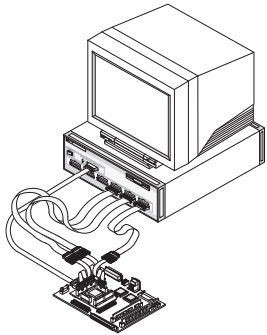
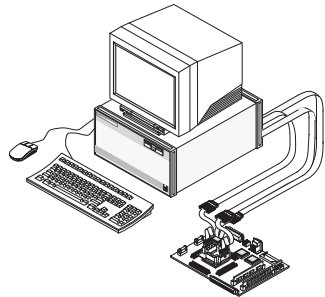
The logic analyzer is nonintrusive, allowing you to run your target system at full speed. A system trace, up to 2 M deep, can be combined with complex triggering to find the toughest problems. The microprocessor instruction set execution can be correlated to the high-level source code with the HP source 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	System Components and Functionality
	BDM Emulation - Microprocessor run control on your target system - Debugger connection	- MPC 505/509 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 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 - PQFP 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 - MPC 505/509 Analysis Probe: (see p. 8) - Connect to target using 160-pin PQFP probing solution - Disassemble trace listing into MPC 505/509 mnemonics - Integrated 505/509 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 and SDS - HP Source Correlation Tool Set: (see p. 10) - 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 - PQFP 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 - MPC 505/509 Analysis Probe: (see p. 8) - Connect to target using 160-pin BGA probing solution - Disassemble trace listing into MPC 505/509 mnemonics

Microprocessor	Package Type	Microprocessor Speed	BDM Emulation	Emulation Solution with Real-Time Trace	Logic Analysis Solution
MPC 505	160 PQFP	Up to 40 MHz	X	X	X
MPC 509	160 PQFP	Up to 40 MHz	X	X	X

Table 1: Emulation and Analysis Solutions for Motorola MPC 505/509 Microprocessors

Emulation Probe and Module

The emulation probe and module provide the same functionality. The emulation probe is a stand-alone 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 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 10-pin Berg style connector or an analysis probe.

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.

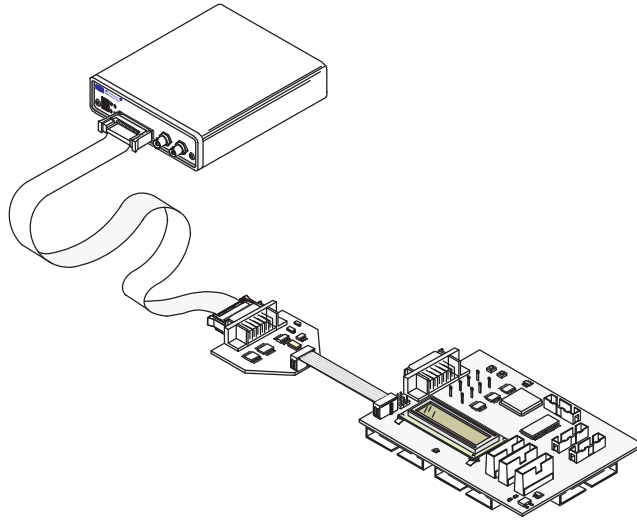


Figure 1: Standalone HP Emulation Probe

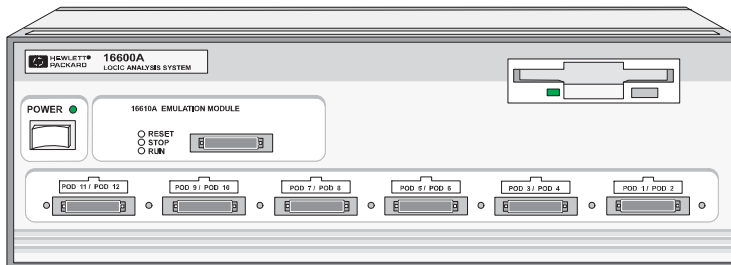


Figure 2: HP 16600A Logic Analysis System with Integrated Emulation Module

Debugger Interface

Industry-leading debuggers can control the HP emulation probe and module. You can set breakpoints, 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>

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.

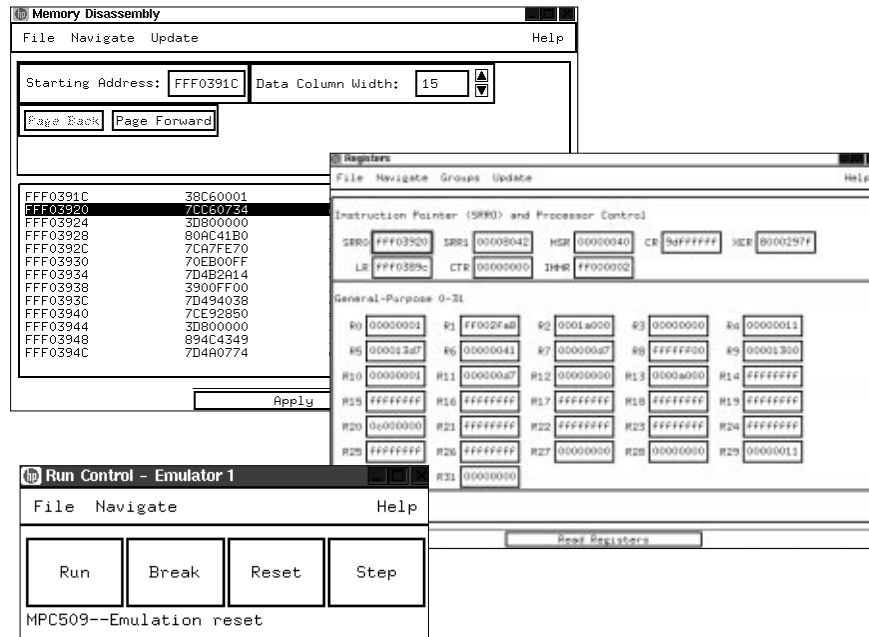


Figure 3: Emulation Control Interface

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 MPC 505/509 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. The emulation control interface does not reference back to the high-level source code, unlike a debugger interface.

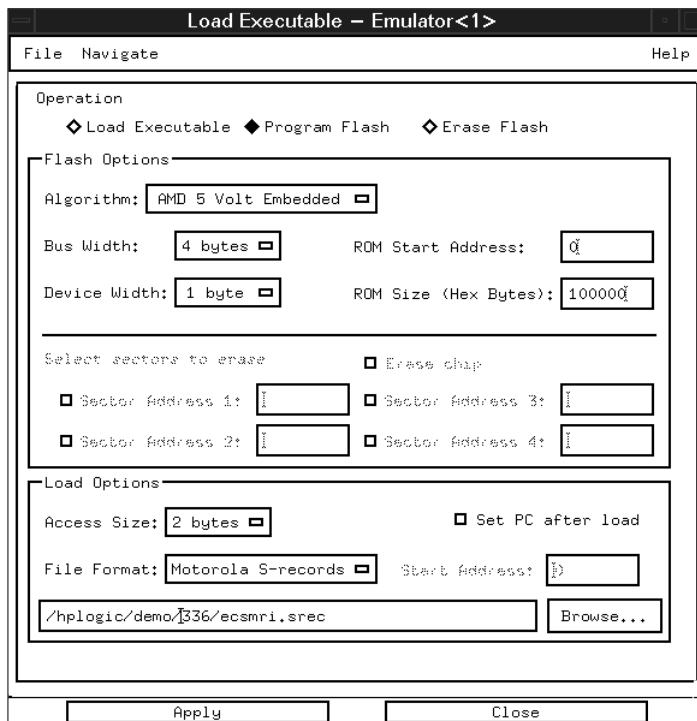


Figure 4: Flash Programming from Emulation Control Interface

Flash Support

HP emulation modules and probes support flash download. AMD 12V, AMD 5V, Intel Auto, and Intel Quickpulse (AMD Flashwrite) are supported.

Contact Green Hills or SDS for flash algorithms supported by their debugger interface.

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 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.

Emulation Probe and Module Target Connection Information

The emulation probe and module can be used directly with the MPC 505/509 analysis probe. When used together, the 10-pin connector is not necessary because the debug port pins are accessed directly through the analysis probe.

If the analysis probe is not used, a 10-pin Berg style connector must be designed into the target system. Most evaluation boards already have the 10-pin connector with the standard pin-out. Refer to figure 5 for pin-out information.

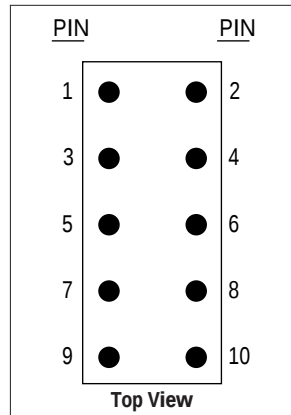


Figure 5: Header Pin Assignment

Probe Pin #	Signal
1	VFLS0
2	*SRESET ³
3	GND
4	DSCK ¹
5	GND
6	VFLS1
7	*HRESET ³
8	DSD1 ¹
9	VDD ²
10	DSD0 ¹

1 Do not series terminate DSCK, DSD1, or DSD0. All of the signal termination is done by the emulation probe and module.

2 *RESET will be driven low at times through a 100 Ohm resistor. A conflict may arise if *RESET is driven high by the target.

Table 2: Emulation Probe/Module Signal Information

Supported Processor	MPC 505/509
Highest Clock Frequency	40 MHz
Target Power Voltage	3.3±0.3 V
RS-232-C	1200-115200 baud
LAN	10BASE-T or 10BASE2 Ethernet Connections TCP/IP Protocol
Physical	142 mm (W) x200 mm (D) x42 mm (H)
Physical (AC adapter)	126 mm (W) x73 mm (D) x33 mm (H)
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 15,300 m, (50,000 ft)
Humidity	15% to 95% relative
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, 27-1000 MHz) IEC 801-4: 1988/EN 50082-1:1992 0.5 kV Signal Lines, 1 kV Power Lines
Safety Compliance	IEC 1010-1 (1990) + Amendment + (1992) CSA-C22.2 No. 1010.1-92

Table 3: HP Emulation Probe and Module Specifications

Real-Time Trace Analysis

Real-time trace analysis consists of a physical connection to signals on the Motorola MPC 505/509 microprocessor, acquisition of relevant data, and analysis of the real-time captured bus information.

The analysis probe provides physical connection to the PQFP package of the microprocessor. Real-time trace is available, which includes inverse assembly, source correlation, and system performance analysis for the Motorola MPC 505/509.

For information on the data acquisition modules for the HP 16600A and 16700A Series logic analyzers please refer to related HP literature on page 14.

MPC 5XX Microprocessor	Supported Speed	Probing Solutions	Real-Time Trace Solutions
MPC 505 MPC 509	Up to 40 MHz	Analysis Probe: • MPC 505/509 160-pin QFP probing solution • Inverse assembler included • Access to all microprocessor signals for logic analyzer	Inverse Assembly: • Disassembly of bus information into MPC 505/509 microprocessor mnemonics • MPC 505/509 configuration files 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 Alternative

Analysis Probe

The analysis probe allows easy connection of an HP logic analyzer to your Motorola MPC 505/509 PQFP target system for real-time analysis. With the analysis probe solution, you don't need to design special debug connectors into your target system.

The Motorola MPC 505/509 analysis probe consists of:

- Analysis probe board
- Inverse assembler and configuration files
- 160-pin elastomeric probing solution
- Generic Flex Adapter
- Three HP E5346A high-density termination adapters
- User's guide

Elastomeric Probing Solution

The elastomeric probing solution included in the analysis probe offers an inexpensive, rugged, and easy-to-use probing solution for the 160-pin PQFP MPC 505/509 package. The probes require a minimal "keep out" area around the device as shown in figure 11.

A retainer is glued to the top of the device, which ensures a solid connection to each pin of the device. Five retainers, a locator tool, and adhesive are included with each probe adapter.

The elastomeric probe is then connected to a generic flex adapter to ensure maximum flexibility while probing your target system.

Additional retainers and locator tools may be ordered. HP E5373A option 201 offers a kit of five additional retainers and adhesive. An additional locator tool is available as HP E5373A option 202.

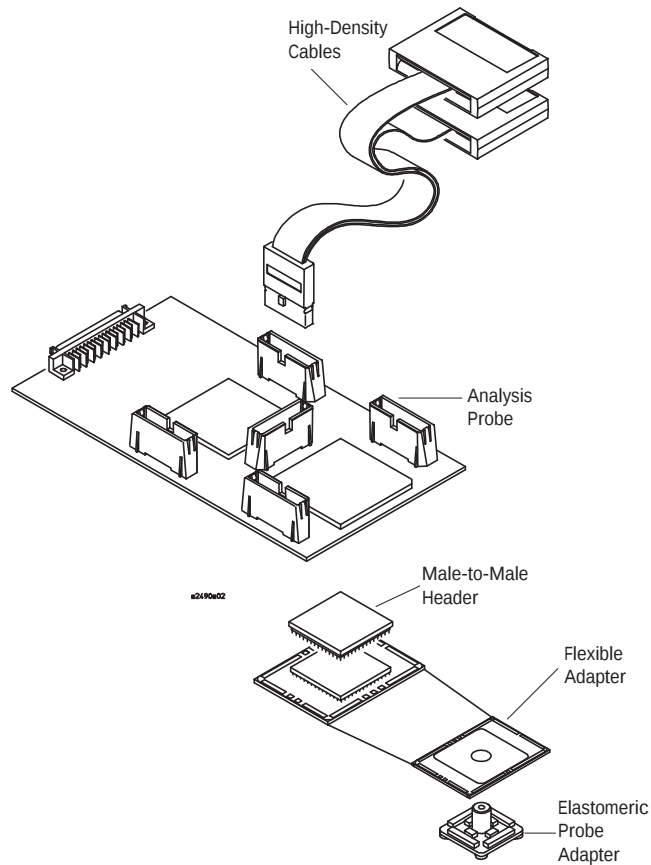


Figure 6: MPC 505/509 Analysis Probe

Modes of Operation

State Modes

In state-per-cycle mode, the analyzer will capture the show cycle information with the qualifiers CLK (rising edge), TA, DS, and TEA.

In state-per-clock mode, the analyzer captures the processor state with every rising edge of CLKOUT.

Timing Mode

Timing analysis is supported. All microprocessor signals are presented to the logic analyzer unbuffered.

Show Cycles

Address reconstruction of internal accesses, such as memory mapped registers and internal RAM is supported. Show cycles also support instruction and data accesses when cache is enabled.

Pods Required

Six, 16-channel logic analyzer pods are required for inverse assembly. These six pods are connected to three HP E5346A high-density termination adapters included with the analysis probe. Three of these adapters are included with the analysis probe.

Two additional adapters and a total of ten analyzer pods are required to probe all the signals on the microprocessor. The additional high-density termination adapters can be purchased separately.

Probe Loading

Analysis probe only:

- 25 pF on *RESET, DSD1, DSD0, and DSCK
- 15 pF on TMS and *TRST
- <10 pf on all signals

HP Logic Analyzers Supported:

- HP 1660A/D, 1661A/D, 1670A/D
- HP 16550A
- HP 16554A/D, 16555A/D, 16556A/D
- HP 16600A, 16601A, 16602A

Inverse Assembler

Software provided with the analysis probe quickly configures the logic analyzer by labeling address, data, and status signals for the MPC 505/509. The software includes an inverse assembler, which gives you MPC 505/509 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 MPC 505/509 mnemonics, but the cache must be off to see all cycles on the microprocessor. If the cache is on and branch trace messages are enabled, a separate execution tracker reconstructs the addresses of the branch trace messages. This does not provide inverse assembly, but allows code flow measurements using the HP source correlation tool set.

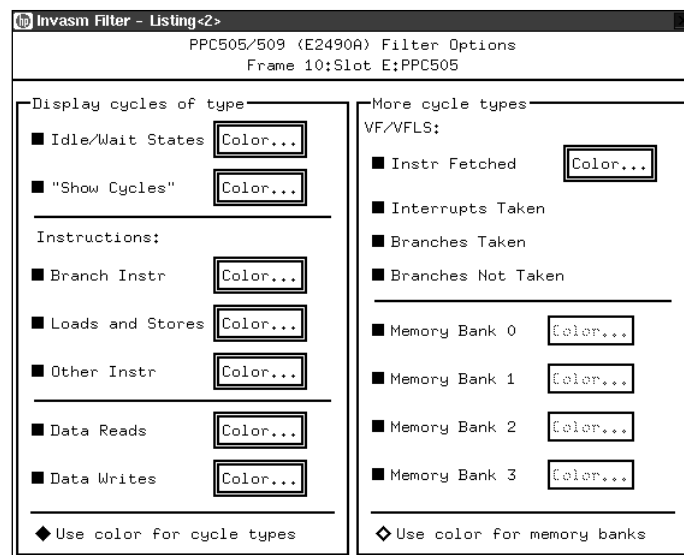


Figure 7: Inverse Assembler Filter Options

HP B4620B Source Correlation Tool Set

The inverse assembler can be used with the HP B4620B source correlation tool set. 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 MPC 505/509. 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 8: Inverse Assembled Trace Time-Correlated to Source Code Using the HP Source Correlation Tool Set

HP B4600A 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 provides

such statistical performance measurements on your system 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 9.

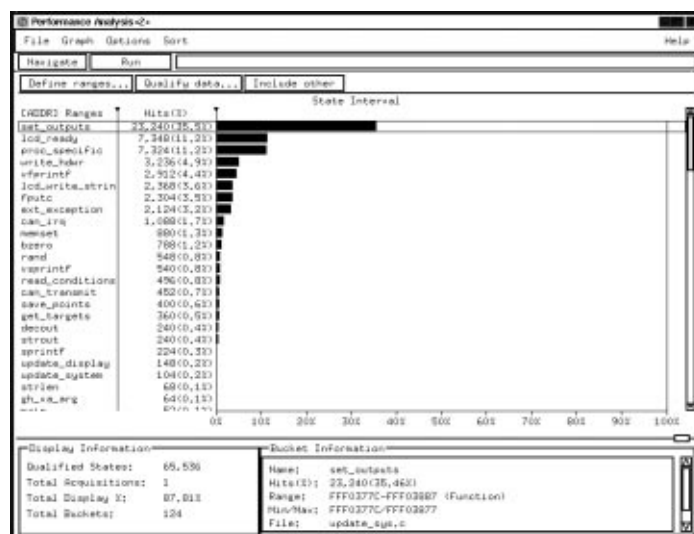


Figure 9: Statistical Performance Information from the HP System Performance Analysis Tool Set

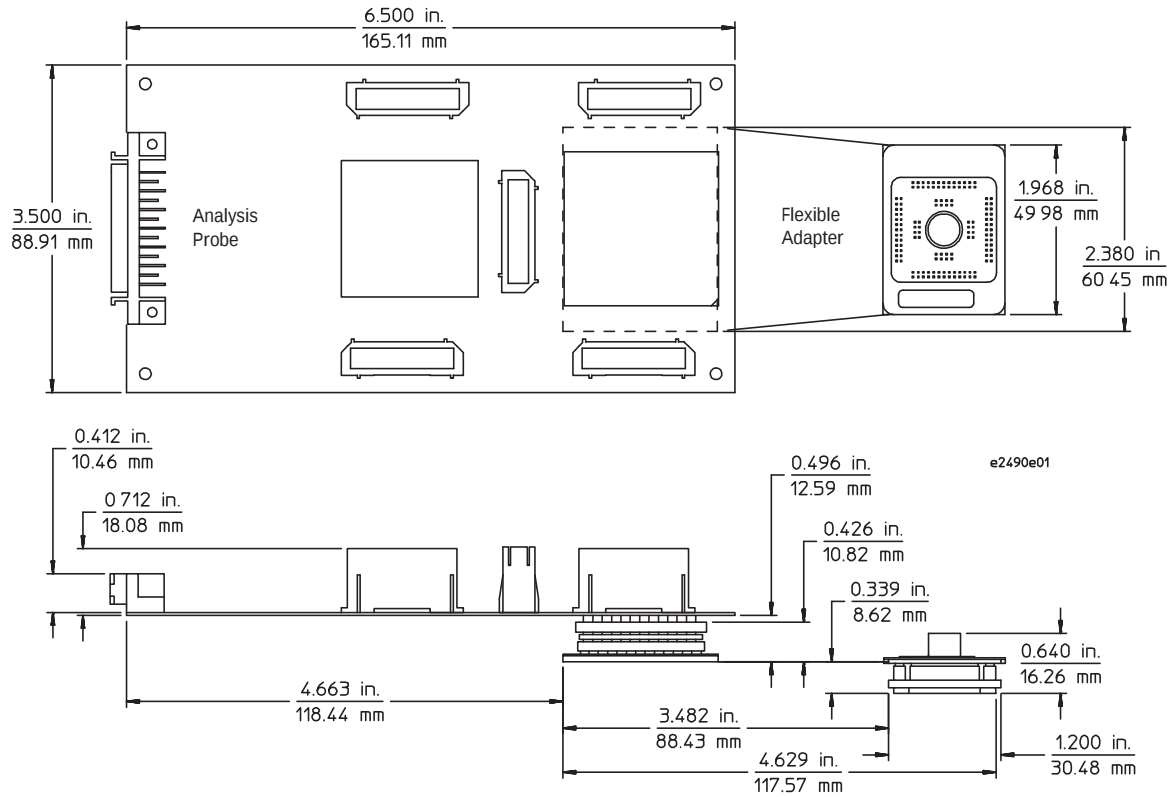


Figure 10: Analysis Probe

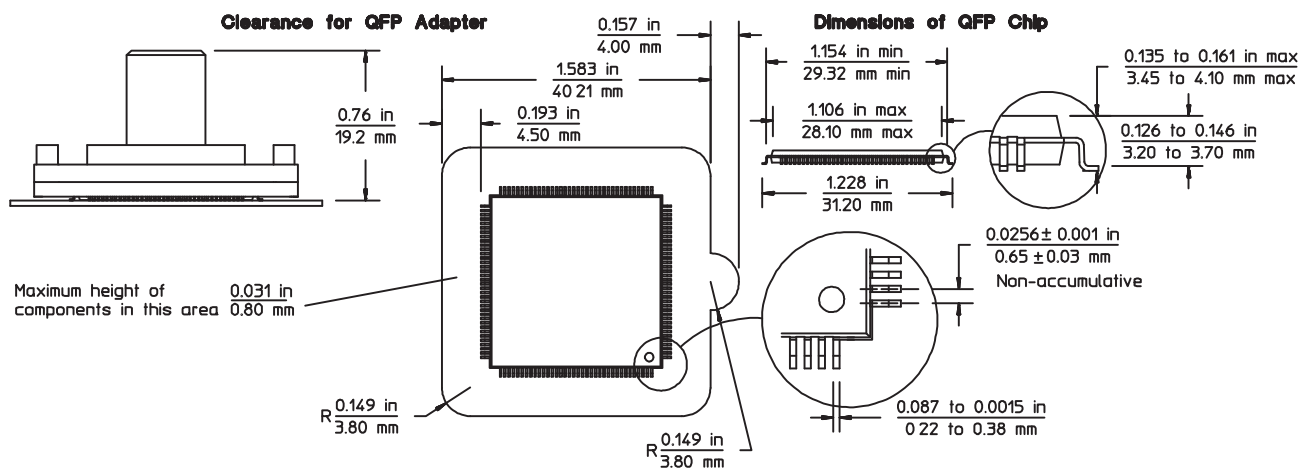


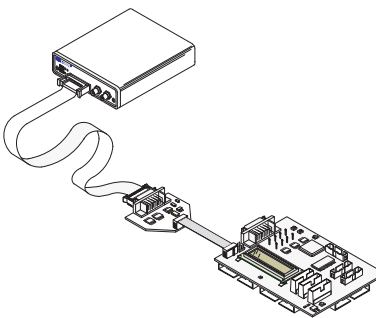
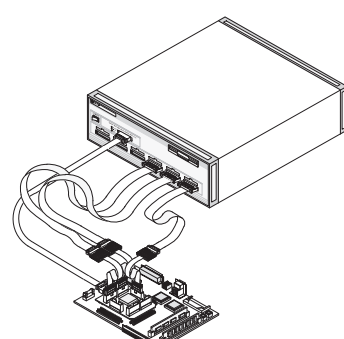
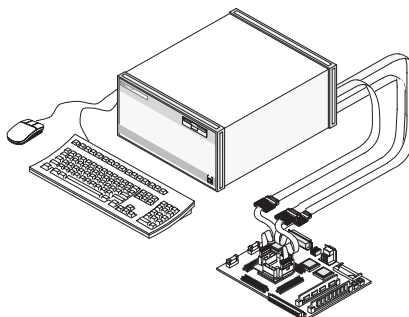
Figure 11: Elastomeric Probe Dimensions for 160-Pin PQFP

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 13 for individual product number information.

	Solution	Products to Order	Included Components
	BDM Emulation Solution		
	- MPC 505/509 Emulation Probe - Debugger Connection	- HP E5900A #050 - Order directly from Green Hills or SDS	
	Emulation Solution with Real-Time Trace		
	- HP 16600A or 16700A Series Logic Analysis System - MPC 505/509 Emulation Using Analysis Probe - Debugger - Optional System Performance Analysis Tool Set	- Refer to HP publication 5966-3148E for logic analyzer configuration - Supported logic analyzers: HP 16600A, 16601A, 16602A, 16550/554/555 A/D - HP E9485A #002 - Order directly from Green Hills, Microtec, or SDS - HP B4600B	- QFP Analysis Probe - Source Correlation Tool Set - Emulation Module - Inverse Assembler
	Logic Analysis Solution		
	- HP 16600A or 16700A Series Logic Analysis System - MPC 505/509 Logic Analysis Solution Using Analysis Probe - Optional System Performance Analysis Tool Set - Optional Source Correlation - Optional Emulation Module	- Refer to HP publication 5966-3148E for logic analyzer configuration - Supported logic analyzers: HP 16600A, 16601A, 16602A, 16550/554/555 A/D - HP E9585A #002 - HP B4600B - HP B4620B - HP E5901A #050	- QFP Analysis Probe - Inverse Assembler

Individual Components Ordering Information

Description	HP Product
MPC 505/509 Emulation Probe	E5900A #050
MPC 505/509 Emulation Module	E5901A #050
MPC 505/509 Analysis Probe	E9585A #002
Source Correlation Tool Set	B4620B
System Performance Analysis Tool Set	B4600B
High-Density Termination Adapter	E5346A

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 MPC 505/509 microprocessor-based targets can include:

- Instruction/Data Cache Related 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

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,
<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
1 800 629 485 (Australia)
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

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