Emulation and Analysis Solutions for Motorola MPC 8XX Microprocessors
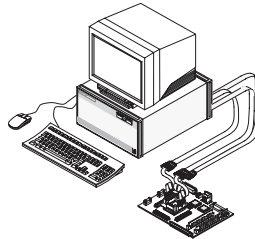
Product Overview

### Debug and Integrate Real-Time Embedded Systems
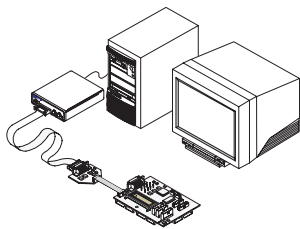
BDM Emulation
• Verify Interrupt Routines
• Debug Assembly Code
• Optimize Code

Emulation and Analysis Solutions for the Design Team

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
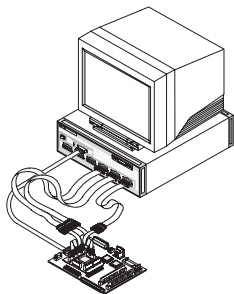
Emulation Solution with Real-Time Trace
• Debug Hardware/Software Interaction
• Profile Hardware/Software Interaction
• Optimize System Performance
• Perform System Test

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 8XX 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 industry's leading debuggers to emulation with real-time trace to solve today's most complex Motorola MPC 8XX 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.
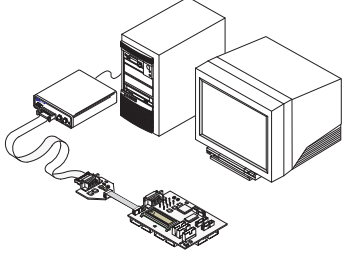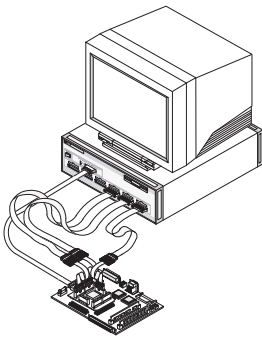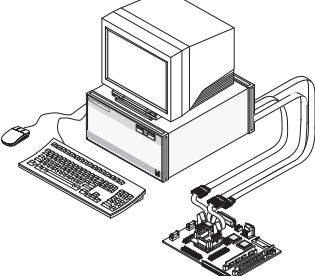
The logic analyzer is nonintrusive, allowing you to run your target system at full speed. A system trace, up to 2 M deep, can be combined with complex triggering to find the toughest problems. The microprocessor instruction set execution can be correlated to the high-level source code with the HP source 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 8XX 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
	• MPC 860/821 Analysis Probe: (see p. 8)
	  - Connect to target using 357 pin BGA probing solution
	  - Disassemble trace listing into MPC 860/821 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. 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
• 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
	• MPC 860/821 Analysis Probe: (see p. 8)
	  - Connect to target using 357 pin BGA probing solution
	  - Disassemble trace listing into MPC 860/821 mnemonics

Microprocessor	Package Type	Microprocessor Clock Speed	BDM Emulation	Emulation Solution with Real-Time Trace	Logic Analysis Solution
MPC 860/821 • DC, DE, DH, EN, MH, SAR, and T Versions	357 BGA	Up to 50 MHz	X	X	X
MPC 801	256 BGA	Up to 50 MHz	X		
MPC 850	256 BGA	Up to 50 MHz	X		

Table 1: Emulation and Analysis Solutions for Motorola MPC 8XX 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.

Figure 1: Standalone HP Emulation Probe

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.

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

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.
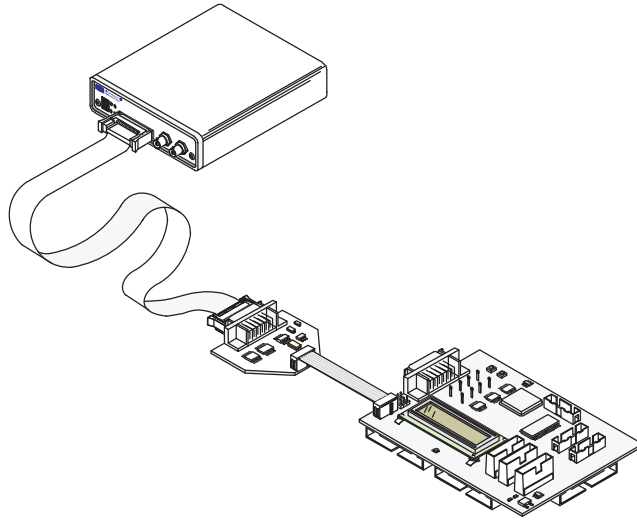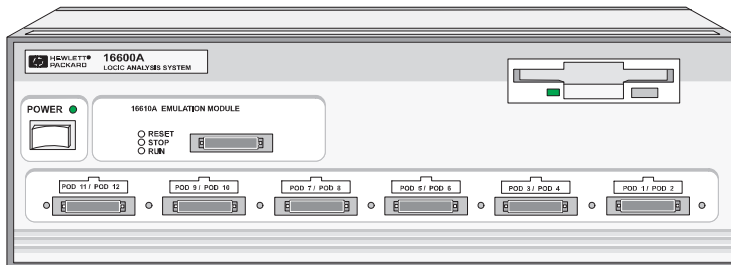
Debugger Interface

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.
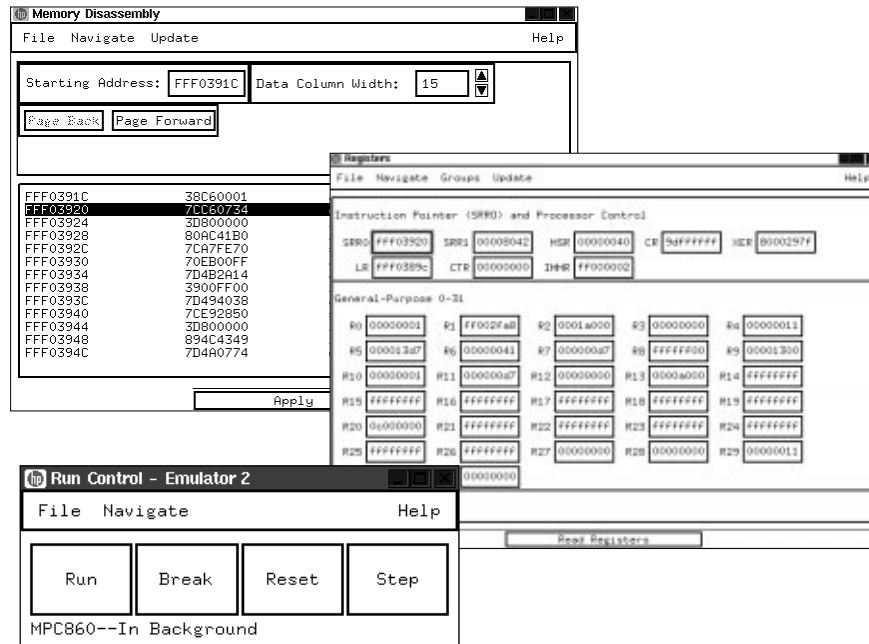

Figure 3: Emulation Control Interface

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 MPC 860/821 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.
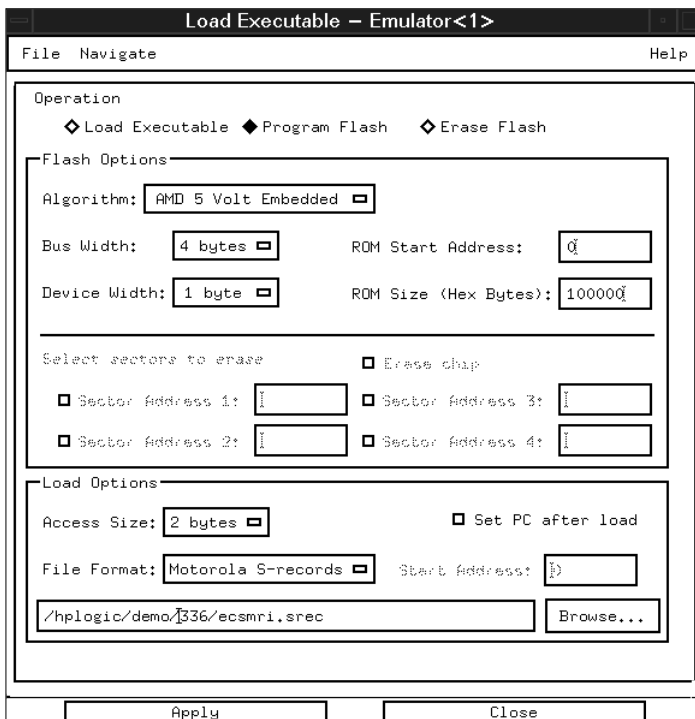
Figure 4: Flash Programming from Emulation Control Interface

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, Microtec, 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 860/821 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.
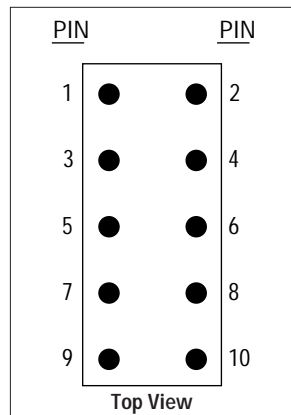
Figure 5: Header Pin Assignment

Probe Pin #	Signal	MPC860/821 Pin #
1	VFLS0	H2
2	*SRESET[3]	P2
3	GND	
4	DSCK[1]	H16
5	GND	
6	VFLS1	J3
7	*HRESET[3]	N4
8	DSD1[1]	H17
9	VDD[2]	
10	DSD0[1]	G17

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

[2] VDD should be one of the four internal power pins : A8,M1,W8, H19

[3] *SRESET and *HRESET will be driven low at times through a 100 Ohm resistor. A conflict may arise if *SRESET and/or *HRESET are driven high by the target.

Table 2: Emulation Probe/Module Signal Information

Supported Processor	MPC 8XX See page 2 for versions
Highest Clock Frequency	50 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 IW) x73 mm (D) x33 mm (H)
Environmental	
Temperature	Operating 5°C to +40°C (+41°F to + I04°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 860/821 microprocessor, acquisition of relevant data, and analysis of the real-time captured bus information.

Physical connection to the microprocessor is provided by either of the two probing alternatives listed below. With the analysis probe, a physical connection to the microprocessor is provided with a BGA probing solution. An optional AMP Mictor probing solution is also available.

Real-time trace analysis solutions are available for both probing alternatives. These include inverse assembly, source correlation, and system performance analysis for the Motorola MPC 860/821.

For information on the data acquisition modules for the HP 16600A and 16700A Series logic analyzers please refer to related HP literature on page 15.

MPC 8XX Microprocessor	Supported Speed	Probing Solutions	Real-Time Trace Solutions
MPC 821 MPC 860 (DC, DE, DH, EN, MH, SAR and T versions supported)	Up to 50 MHz	Analysis Probe: • 357 pin BGA probing solution • Inverse assembler included • Access to all microprocessor signals for logic analysis	Inverse Assembly: • Disassembly of bus information into MPC 860/821 microprocessor mnemonics • MPC 860/821 configuration files for logic analyzer
			Source Correlation: • Time-correlation of acquired trace to high-level source code • Trigger and search through trace in high-level source code
		Optional Mictor Connector Solution: • Mictor connectors designed in target for access to critical signals for logic analysis	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

Analysis Probe

The analysis probe allows easy connection of an HP logic analyzer to your Motorola MPC 860/821 BGA target system for real-time analysis. With the analysis probe, you don't need to design special debug connectors into your target system.

Mechanical dimensions are included in figure 11. The BGA socket is soldered down in place of the microprocessor, as shown in figure 6. The microprocessor is inserted into a BGA chip carrier socket, as shown in figure 12. The BGA chip carrier socket can also be used directly with the BGA socket on the target board without the analysis probe.

"Keep Out" Area

The analysis probe requires a minimal amount of "keep out" space around the microprocessor. The analysis probe also has an overhang, as shown on page 12. The maximum height of components under the analysis probe in this area cannot exceed 19 mm or 0.748 in (see figure 11).

If components are too high for the clearance, order the HP E2476-87602 extender to add an additional 0.25 inches of clearance. Do not exceed two extenders with the analysis probe.
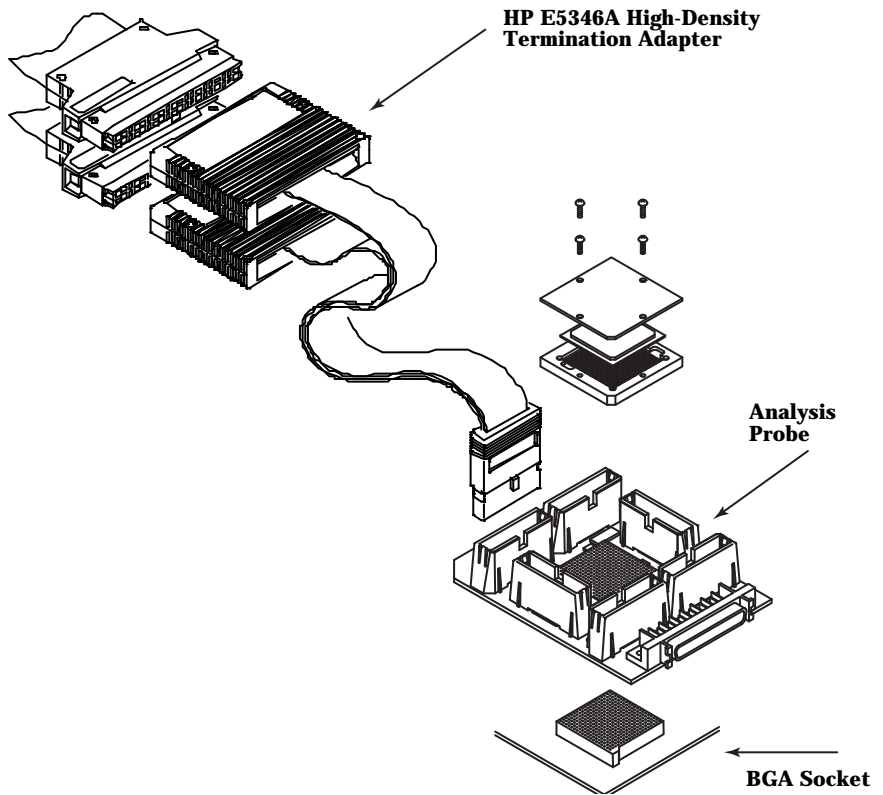
HP E5346A High-Density Termination Adapter

Analysis Probe

BGA Socket

Figure 6: MPC 860/821 Analysis Probe

The Motorola MPC 860/821 analysis probe consists of:

- Analysis probe board
- Inverse assembler and configuration files
- HP E5355A 357-pin BGA probing kit
- Two surface mount BGA sockets
- Soldering kit and instructions
- One HP E2476-87602 extender
- Three HP E5346A high-density termination adapters.

Additional Accessories

- HP E2476-87602 extender
- HP E5346A high-density termination adapter
- HP E5355A BGA probing kit

Modes of Operation

State Modes
In state-per-clock mode, the analyzer captures the microprocessor state on every rising edge of the CPU clock.

In state-per-transfer mode, the analyzer captures only those states in which the transfer acknowledge signal (TEA) is asserted. This mode will filter out wait and idle states. The inverse assembler only works in this mode.

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

Target Signal Timing
Data must be valid for a 4.5 nsec window with respect to the logic analyzer clock edge. The analyzer captures the data on the rising edge of the clock. There is a 1.25 nsec propagation delay between the target and mounted analysis probe for DSDI, DSDO, and DSCK signals.

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.

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

- 25 pF on *SRESET, *HRESET, PORESET, DSDI, DSDO, and DSCK
- 15 pF on TMS and *TRST
- <10 pF on all other 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 860/821. The software includes an inverse assembler, which gives you MPC 860/821 mnemonics in the trace listing for easy correlation between captured data and target code. The inverse assembler works with the HP B4620B source correla-tion 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 860/821 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.
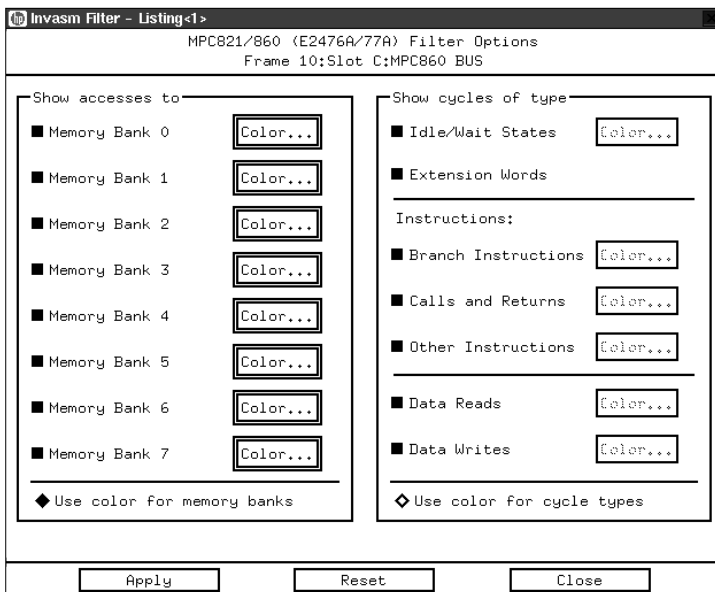

Figure 7: Inverse Assembler Filter Options

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 860/821. 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 pro-vides 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.
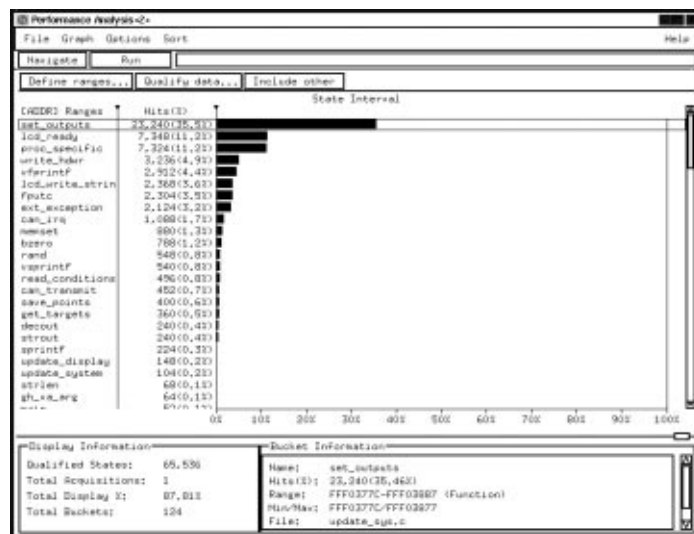

Figure 9: Statistical Performance Information from the HP System Performance Analysis Tool Set

Optional Mictor Connection Solution

If system constraints won't allow the analysis probe to be used, you can design high-density AMP Mictor connectors into your target system for connection to the microprocessor signals. The inverse assembler can be ordered separately to provide inverse assembly and configuration files to set up the logic analyzer.

All the necessary signals for inverse assembly can be routed to three Mictor connectors. Refer to the product note, *Passively Probing a Motorola MPC 860/821 BGA Target System with HP E5346A High-Density Termination Adapters* (publication number 5966-4165E) for signal pin-out information. The AMP Mictor connectors can be located around the microprocessor, as shown in figure 10.

Three HP E5346A high-density termination adapters are required for connection to the logic analyzer pods. Mictor connectors can be purchased directly from AMP or from HP. Five Mictor connectors and recommended support shrouds are included in the HP E5346-68701 Mictor connector kit.
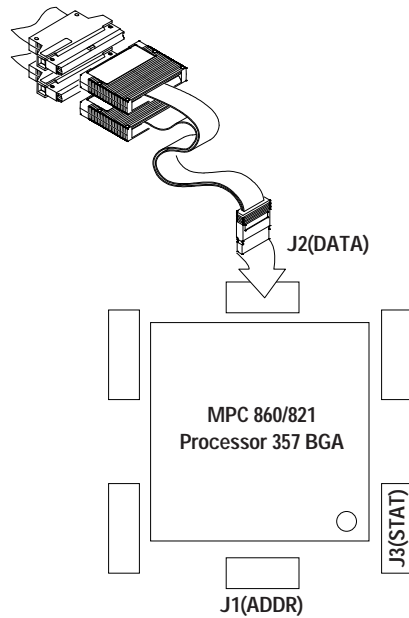

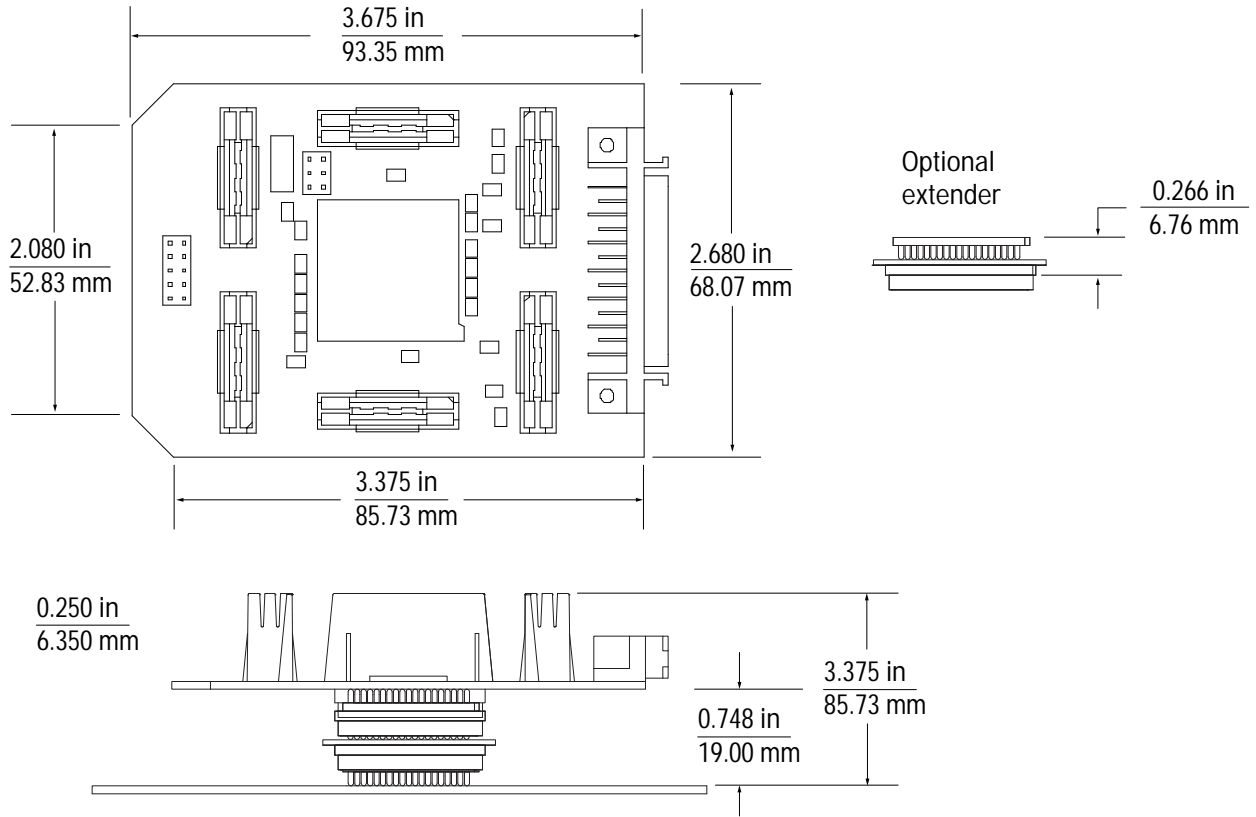**Figure 10: AMP Mictor Connector Layout**

3.675 in
93.35 mm

Optional extender

0.266 in
6.76 mm

2.080 in
52.83 mm

2.680 in
68.07 mm

3.375 in
85.73 mm

0.250 in
6.350 mm

3.375 in
85.73 mm

0.748 in
19.00 mm

Figure 11: Analysis Probe Dimensions

1.143 in
29.30mm

0.095 in
2.413 mm

1.143 in
29.30 mm

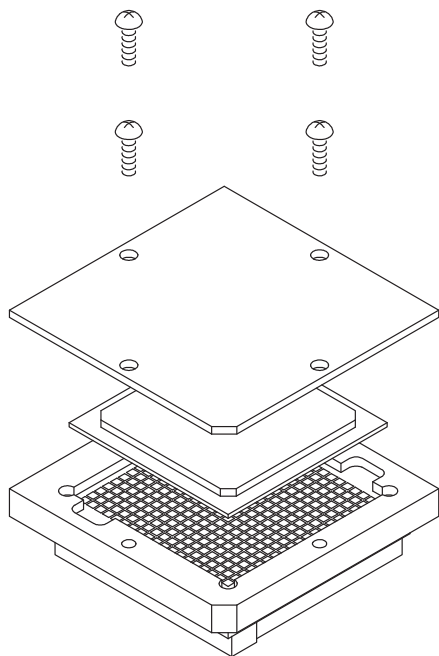0.050 in
1.270 mm
(TYP.)

PIN 1
Corner

0.050 in
1.270 mm
(TYP.)
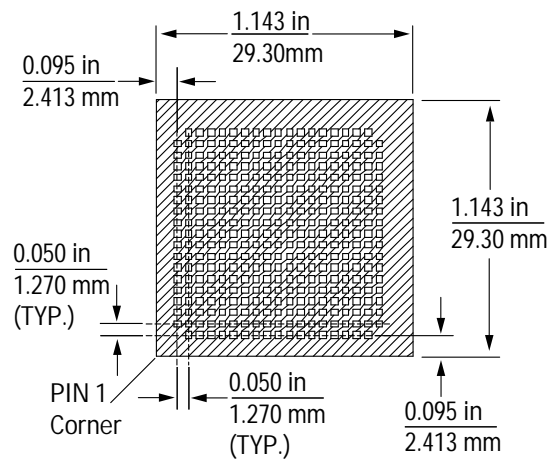
0.095 in
2.413 mm

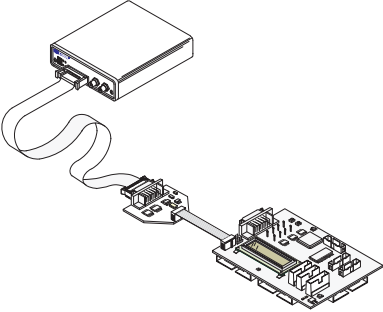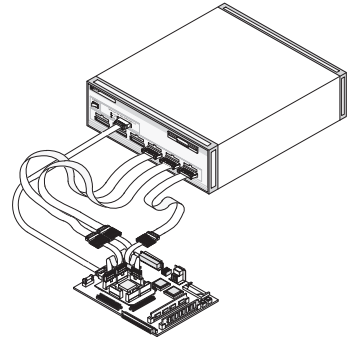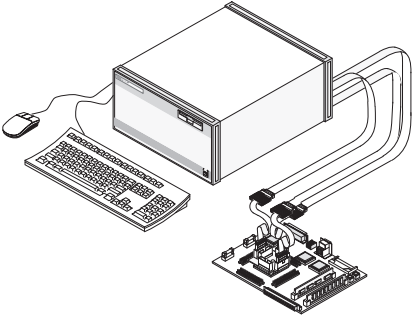**Figure 12: BGA Chip Carrier**

Figure 13: BGA Socket Keep-Out Area

System Configuration and Ordering Information

The table below shows the system components you need to order and what is included in each. For real-time trace, two alternatives are available to fit your needs. 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 14 for individual product number information.

	Solution	Products to Order	Included Components
	Emulation Solution		
	• MPC 8XX Emulation Probe	• HP E5900A #080	
	• Debugger Connection	• 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 5966-3148E for logic analyzer configuration • Supported logic analyzers: HP 16600A, 16601A, 16602A, 16550/554/555/556 A/D	
	• MPC 860/821 Emulation Using Analysis Probe*	• HP E9484A #002	• Analysis Probe • Source Correlation Tool Set • Emulation Module
	• MPC 860/821 Emulation Using Mictor Probing*	• HP E9484A #001	• Source Correlation Tool Set • Emulation Module • Inverse Assembler
		• Three HP E5346A High-Density Termination Adapters • HP E5346-68701 Mictor Connector Kit	
	• Debugger Connection	• Order directly from Green Hills, Microtec, or SDS	
	• Optional System Performance Analysis Tool Set	• HP B4600B	
	Logic Analysis Solution		
	• HP 16600A or 16700A Series Logic Analysis System	• Refer to HP publication 5966-3148E for logic analyzer configuration • Supported logic analyzers: HP 16600A, 16601A, 16602A, 16550/554/555/556 A/D	
	• MPC 860/821 Logic Analysis Solution Using Analysis Probe*	• HP E9584A #002	• Analysis Probe • Inverse Assembler
	• MPC 860/821 Logic Analysis Solution Using Mictor Probing*	• HP E9584A #001 • Three HP E5346A High-Density Termination Adapters • HP E5346-68701 Mictor Connector Kit	• Inverse Assembler
	• Optional Source Correlation Tool Set	• HP B4620B	
	• Optional System Performance Analysis Tool Set	• HP B4600B	
	• Optional Emulation Module	• HP E5901A #080	

* Only the analysis probe solution OR Mictor probing solution is necessary, not both.

Individual Components Ordering Information

Description	HP Product
Emulation Probe	HP E5900A #080
Emulation Module	HP E5901A #080
Analysis Probe	HP E9584A #002
Inverse Assembler	HP E9584A #001
Emulation Module and Emulation Probe Migration	HP E5902A #080
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
Extender	HP E2476-87602
BGA Probing Kit	HP E5355A

Training and Consulting

HP has experienced Digital Systems Consultants who can help you max-
imize 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 8XX 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
HP 16600A and 16700A Logic Analysis System Mainframes, Product Overview	5966-3107E
HP Logic Analysis Systems Upgrade, Product Overview	5966-3059E
System Configuration for the HP 16600A and 16700A Series Logic Analysis Systems, Configuration Guide	5966-3148E
Passively Probing a Motorola MPC 860/821 BGA Target System with HP E5346A High-Density Termination Adapters, Product Note	5966-4165E

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.

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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.

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Test and Measurement Call Center
P.O. Box 4026
Englewood, CO 80155-4026
1 800 452 4844

Canada:
Hewlett-Packard Canada Ltd.
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L4W 5G1
(905) 206 4725

Europe:
Hewlett-Packard
European Marketing Centre
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The Netherlands
(31 20) 547 9900

Japan:
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Measurement Assistance Center
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