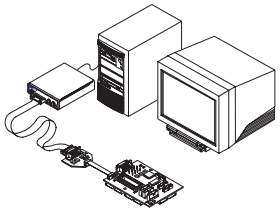
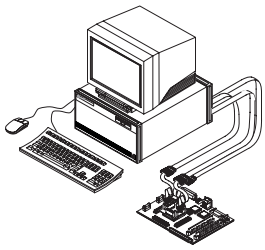
Agilent Emulation and Analysis Solutions for Motorola MPC 5XX Microprocessors

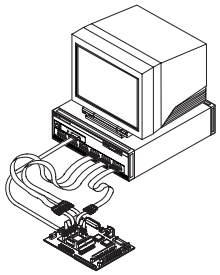
Overview



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

Emulation and Analysis Solutions for the Design Team

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

Agilent's emulation and analysis solutions for the Motorola MPC 5XX 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 Agilent, design team members can customize Agilent'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 5XX design problems.

Debug and Integrate Real-Time Embedded Systems

Agilent'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 Agilent source correlation tool set.

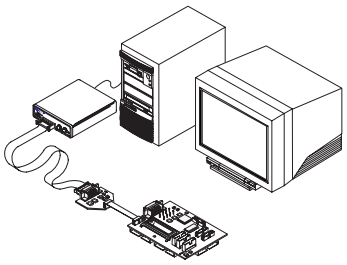
Agilent Technologies
Innovating the HP Way

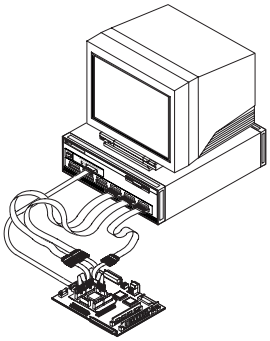
Agilent Scalable Solutions

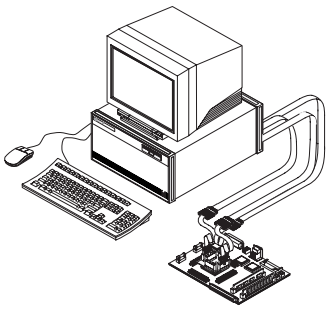
Agilent emulation and logic analysis solutions are scalable for each member of the digital design team. The following are three typical configurations for firmware/software debug, hardware debug, and system integration.

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 505/509/555 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
	• 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 505/509/555 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
	• Source Correlation Tool Set: (see p. 11)
	  • Time-correlate acquired logic analysis trace to high-level source code
	  • Step through in assembly or high-level code
	• MPC 555 Inverse Assembler: (see p. 10)
	  • Mictor probing solution

Logic Analysis Solution
• Real-time logic analysis trace solution:
  • Assembly level trace
• PQFP probing solution
	• 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 555 Inverse Assembler
	  • Mictor probing solution
	• 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

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

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
MPC 555	Any	Up to 40 MHz	X	X	X

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 Agilent 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 Agilent 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.

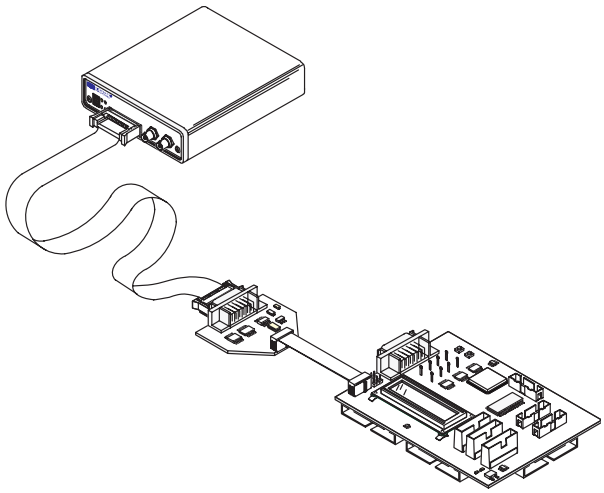


Figure 1: Stand-alone Agilent Emulation Probe

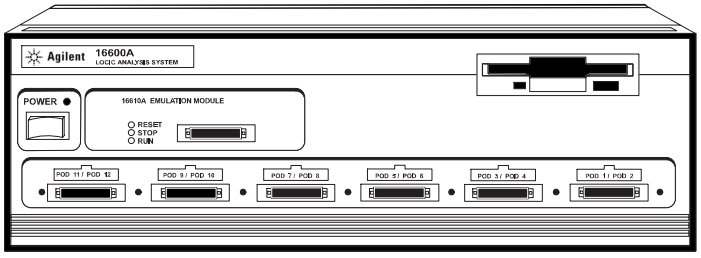


Figure 2: Agilent 16600A Logic Analysis System with Integrated Emulation Module

Debugger Interface

Industry-leading debuggers can control the Agilent 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
(805) 965-6044
www.ghs.com

Software Development Systems, Inc.
815 Commerce Drive, Suite 100
Oak Brook, IL 60523
(630) 368-0400
www.sdsi.com

Please check with your local Agilent Test and Measurement sales office or visit our web site at www.agilent.com/find/las-data for the current list of debugger connections.

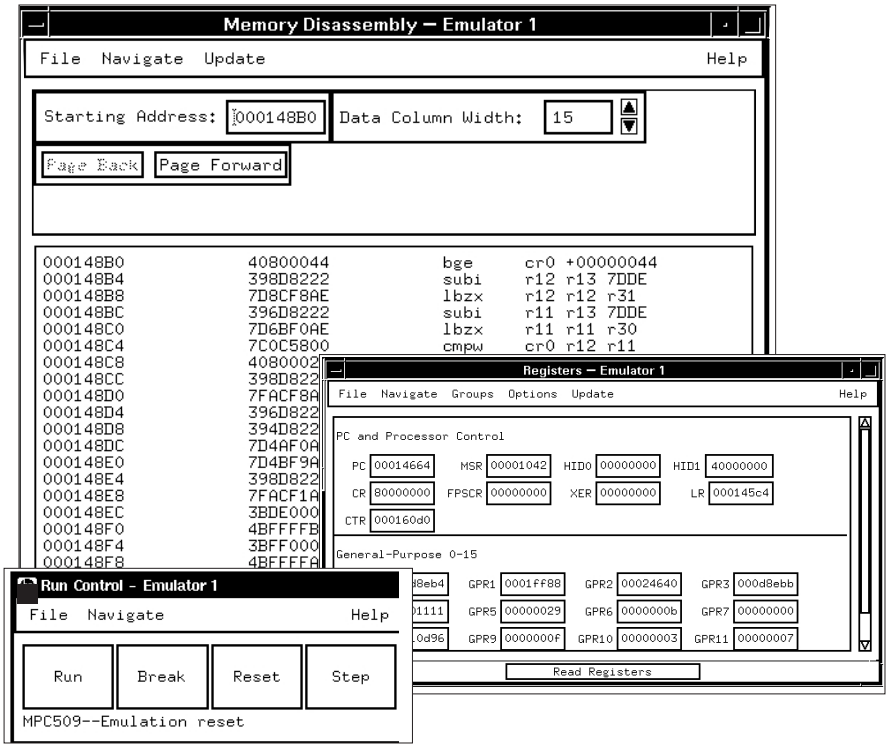


Figure 3: Emulation Control Interface

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 5XX 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.

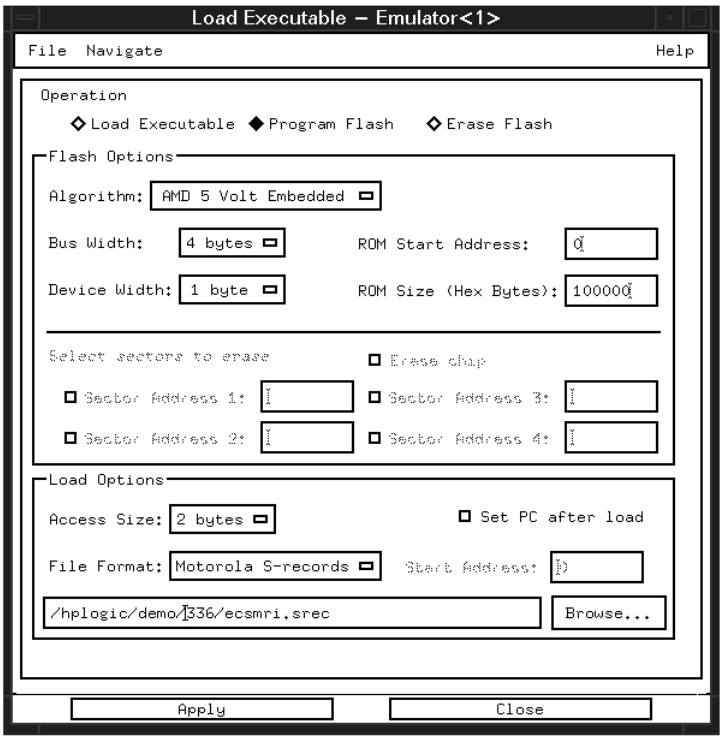


Figure 4: Flash Programming from Emulation Control Interface

Flash Support

Agilent 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

Agilent 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 Agilent 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 MPC 5XX target system. Most evaluation boards already have the 10-pin connector with the standard pin-out. Refer to figure 5 for pin-out information.

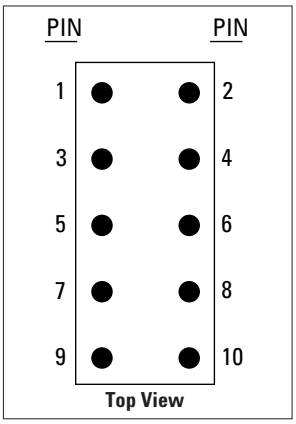


Figure 5: Header Pin Assignment

Table 2: Emulation Probe/Module Signal Information

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 3: Agilent Emulation Probe and Module Specifications

Supported Processor	MPC 505/509/555
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 lW) 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

Real-Time Trace Analysis

Real-time trace analysis consists of a physical connection to signals on the Motorola MPC 5XX 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 5XX.

For information on the data acquisition modules for the Agilent 16600A and 16700A Series logic analyzers please refer to Related Agilent Literature on page 15.

Table 4: Real-Time Trace and Probing Alternative

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 microprocessor mnemonics 5xx 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
MPC555	Up to 40 MHz	Mictor Connector Probing Solution: • Mictor connectors designed into target	

MPC 505/509 Analysis Probe

The analysis probe allows easy connection of an Agilent 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 Agilent 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 12.

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. Agilent E5373A option 201 offers a kit of five additional retainers and adhesive. An additional locator tool is available as Agilent E5373A option 202.

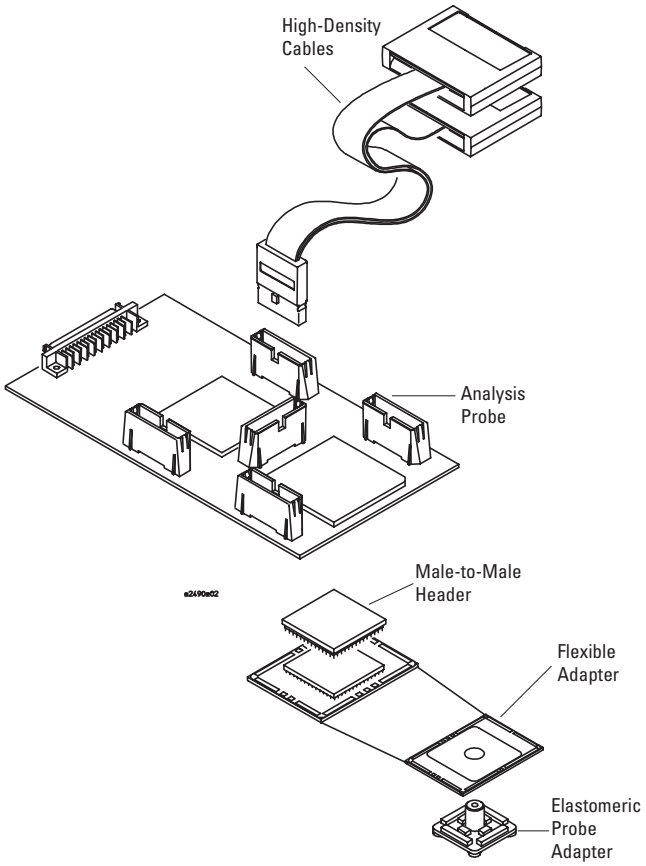


Figure 6: MPC 505/509 Analysis Probe

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 Agilent 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, DSDI, DSDO, and DSCK
- 15 pF on TMS and *TRST
- <10 pf on all signals

Agilent Logic Analyzers Supported:

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

MPC 505/509 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 Agilent 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 Agilent source correlation tool set.

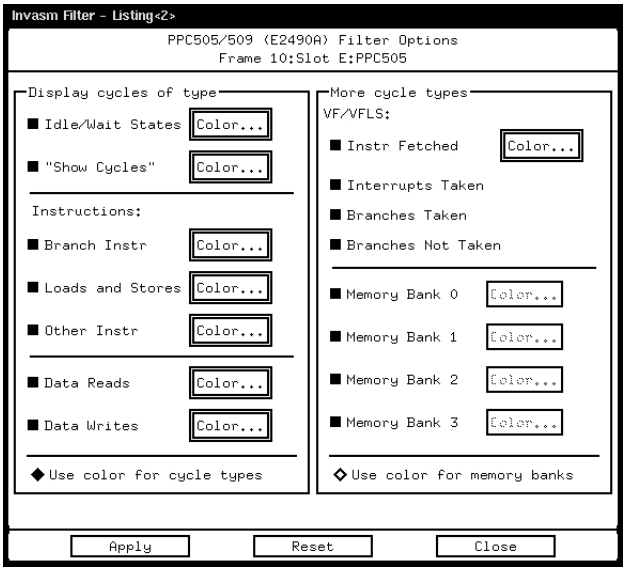


Figure 7: Inverse Assembler Filter Options

MPC 555 Inverse Assembler

The inverse assembler quickly configures the logic analyzer by labeling address, data, and status signals for the MPC 555 microprocessors. It also provides MPC 555 mnemonics in the trace listing for easy correlation between captured data and target code. The inverse assembler works with the Agilent 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 MPC555 IA makes use of indirect branch show cycles and provides full trace reconstruction. This allows the processor to run full speed from internal flash or cache.

Agilent Logic Analyzers Supported

Contact your Agilent field engineer for latest logic analyzer information.

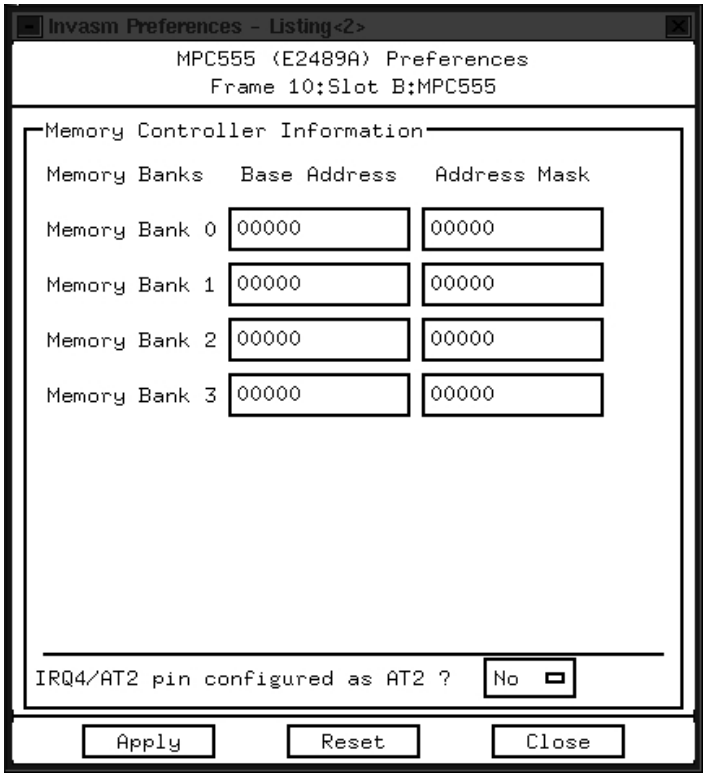


Figure 8: MPC 555 Inverse Assembler Preferences

Agilent B4620B Source Correlation Tool Set

The inverse assembler can be used with the Agilent 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, Agilent provides powerful solutions for your most difficult hardware/ soft-ware integration problems.

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

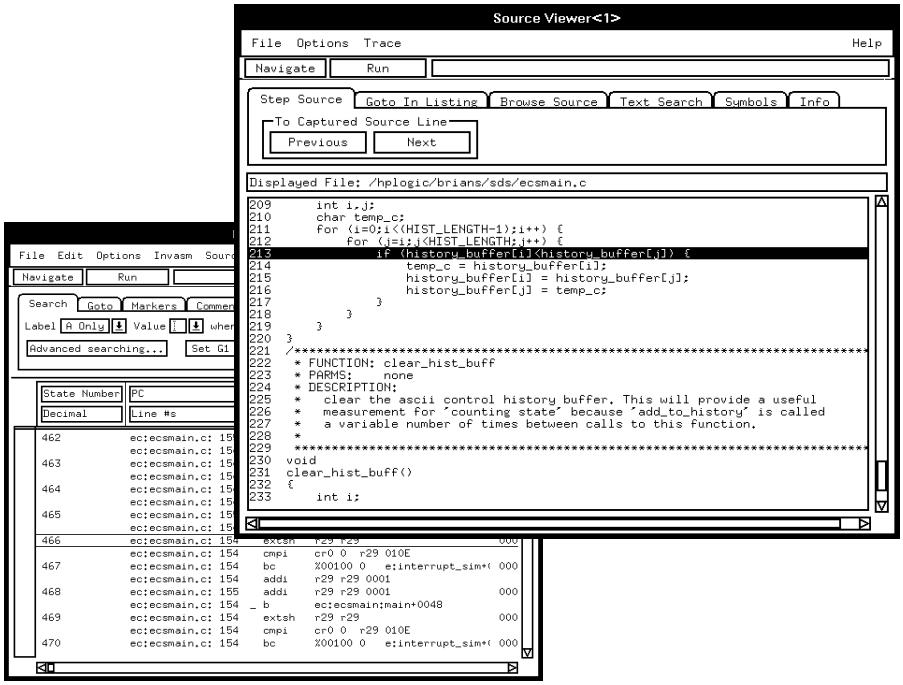


Figure 9: Inverse Assembled Trace Time-Correlated to Source Code Using the Agilent Source Correlation Tool Set

System Correlation

With the Agilent 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 Agilent Test and Measurement sales office or visit www.agilent.com/find/las-data for more information.)

Agilent B4600A System Performance Analysis Tool Set

The system performance analysis (SPA) tool set is an optional software package for the Agilent 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 10.

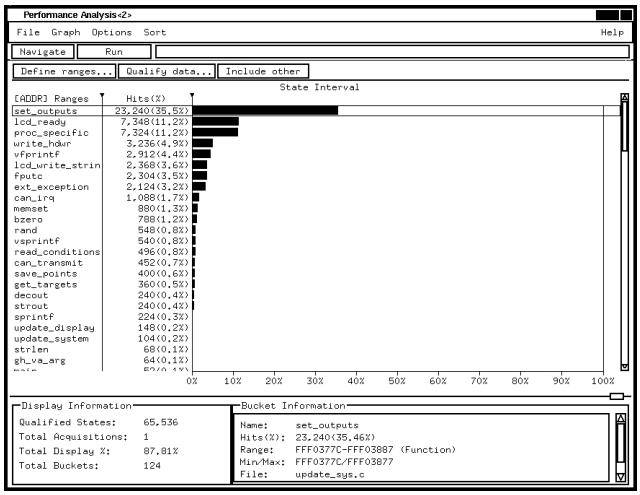


Figure 10: Statistical Performance Information from the Agilent System Performance Analysis Tool Set

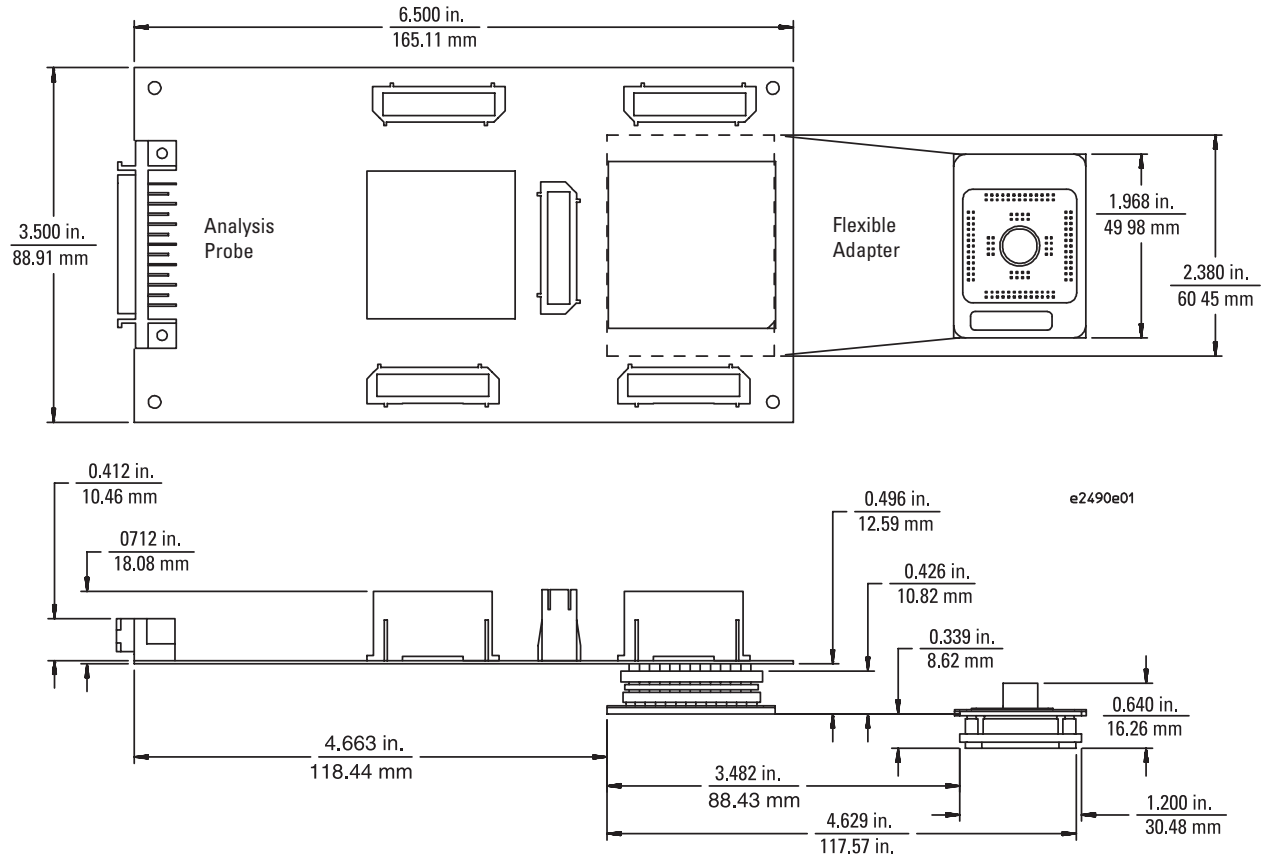


Figure 11: Analysis Probe

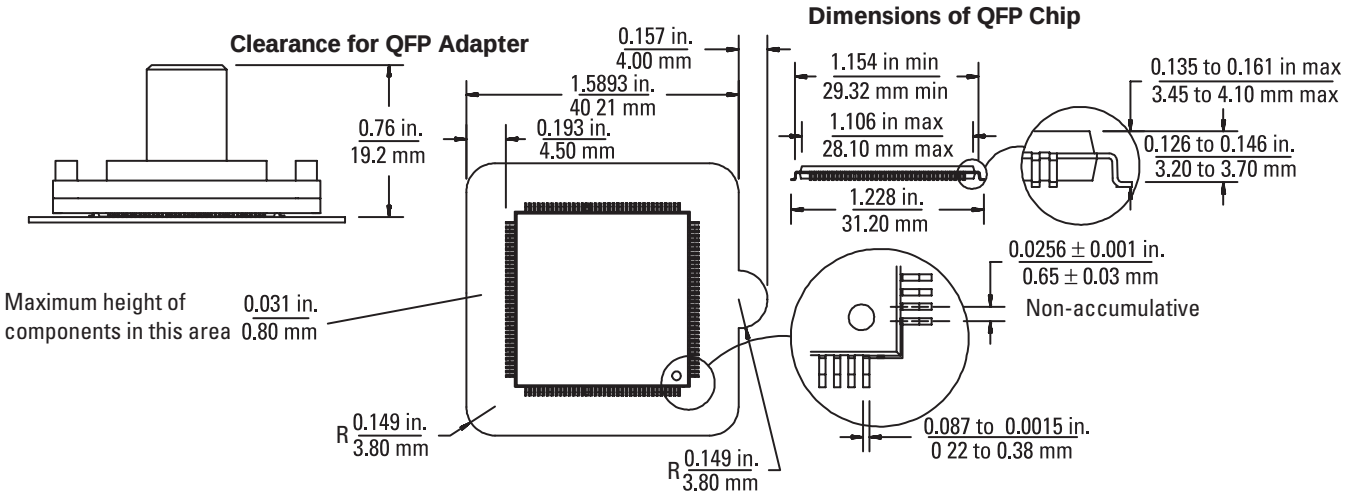
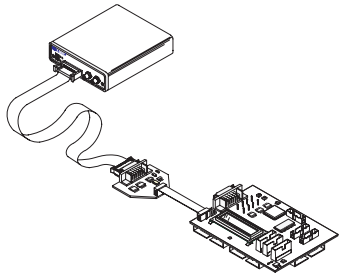


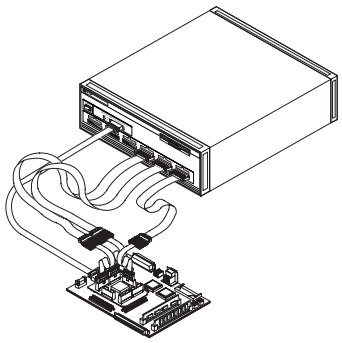
Figure 12: Elastomeric Probe Dimensions for 160-Pin PQFP

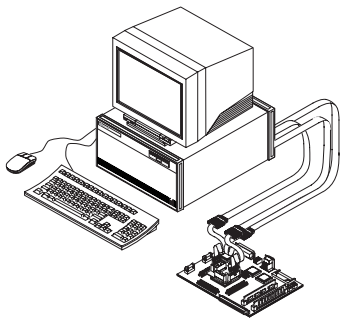
System Configuration and Ordering Information

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 Agilent 1600A and 16700A Series logic analysis systems must be ordered seperately.

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
BDM Emulation Solution		
• MPC 505/509/555 Emulation Probe	• E5900A #050	
• Debugger Connection	• Order directly from Green Hills or SDS	
Emulation Solution with Real-Time Trace		
• 16600A or 16700A Series Logic Analysis System	• Refer to Agilent publication 5966-3148E for logic analyzer configuration • Supported logic analyzers: 16600A, 16601A, 16602A, 16550/554/555 A/D	
• MPC 505/509 Emulation Using Analysis Probe	• E9485A #002	• QFP Analysis Probe • Source Correlation Tool Set • Emulation Module • Inverse Assembler
•MPC 555 Emulation using Inverse Assembler	• E9510A #001	
• Debugger	• Order directly from Green Hills, Microtec, or SDS	
• Optional System Performance Analysis Tool Set	• B4600B	
Logic Analysis Solution		
• 16600A or 16700A Series Logic Analysis System	• Refer to Agilent publication 5966-3148E for logic analyzer configuration • Supported logic analyzers: 16600A, 16601A, 16602A, 16550/554/555 A/D	
• MPC 505/509 Logic Analysis Solution Using Analysis Probe	• E9585A #002	• QFP Analysis Probe • Inverse Assembler
• MPC 555 Logic Analysis Solution using Inverse Assembler	• E9610A #001	• Inverse Assembler
• Optional System Performance Analysis Tool Set	• B4600B	
• Optional Source Correlation	• B4620B	
• Optional Emulation Module	• E5901A #050	

Individual Components Ordering Information

Description	Agilent Product
MPC 505/509/555 Emulation Probe	E5900A #050
MPC 505/509/555 Emulation Module	E5901A #050
MPC 505/509/555 Emulation Migration	E5902A #050
MPC 505/509 Analysis Probe	E9585A #002
MPC 555 Inverse Assembler	E9610A #001
Source Correlation Tool Set	B4620B
System Performance Analysis Tool Set	B4600B
High-Density Termination Adapter	E5346A

Training and Consulting

Agilent 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.

Agilent training may be delivered through scheduled courses, on-site classes, or one-on-one consulting. Agilent 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 Agilent Test and Measurement education web site: www.agilent.com/go/tmeducation.

For consulting services, contact your local Agilent Test and Measurement sales office. An Agilent Digital Systems Consultant can help you solve tough digital debug problems by showing you how to apply Agilent 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
- Agilent 16700A/HP1660XA Networking.

Related Agilent Literature	Pub. Number
Agilent 16600A and 16700A Logic Analysis System Mainframes	5966-3107E
Passively Probing a Motorola MPC555 Target System with Agilent E5346A High-Density Termination Adapters	5968-2502E

Agilent Technologies' Test and Measurement Support, Services, and Assistance

Agilent Technologies aims to maximize the value you receive, while minimizing your risk and problems. We strive to ensure that you get the test and measurement capabilities you paid for and obtain the support you need. Our extensive support resources and services can help you choose the right Agilent products for your applications and apply them successfully. Every instrument and system we sell has a global warranty. Support is available for at least five years beyond the production life of the product. Two concepts underlie Agilent's overall support policy: "Our Promise" and "Your Advantage."

Our Promise

"Our Promise" means your Agilent test and measurement equipment will meet its advertised performance and functionality. When you are choosing new equipment, we will help you with product information, including realistic performance specifications and practical recommendations from experienced test engineers. When you use Agilent equipment, we can verify that it works properly, help with product operation, and provide basic measurement assistance for the use of specified capabilities, at no extra cost upon request. Many self-help tools are available.

Your Advantage

"Your Advantage" means that Agilent offers a wide range of additional expert test and measurement services, which you can purchase according to your unique technical and business needs. Solve problems efficiently and gain a competitive edge by contracting with us for calibration, extra- cost upgrades, out-of-warranty repairs, and on-site education and training, as well as design, system integration, project management, and other professional services. Experienced Agilent engineers and technicians worldwide can help you maximize your productivity, optimize the return on investment of your Agilent instruments and systems, and obtain dependable measurement accuracy for the life of those products.

By Internet, phone, or fax, get assistance with all your test and measurement needs.

Online

www.agilent.com/find/assist

Phone or Fax

United States:
Agilent Technologies
(tel) 1 800 452 4844

Canada:
Agilent Technologies Canada Inc.
(tel) 1 877 894 4414

Europe:
Agilent Technologies
Test and Measurement
European Marketing Organisation
(tel) (31 20) 547 2000

Japan:
Agilent Technologies Japan Ltd.
(tel) (81) 426 56 7832
(fax) (81) 426 56 7840

Latin America:
Agilent Technologies
Latin American Region Headquarters, U.S.A.
(tel) (305) 267 4245
(fax) (305) 267 4286

Australia/New Zealand:
Agilent Technologies Australia Pty Ltd
Australia
(tel) 1 800 629 485
(fax) (61 3) 9272 0749
New Zealand
(tel) 0 800 738 378
(fax) (64 4) 802 6881

Asia Pacific:
Agilent Technologies, Hong Kong
tel: (852) 3197-7777
fax: (852) 2506-9284

Printed in U.S.A. (4/00)
5968-2504E

Agilent Technologies

Innovating the HP Way