ARM7 and ARM9

Emulation and Analysis Solutions for Microprocessors

Product Overview
Debug and Integrate Real-Time Embedded Systems

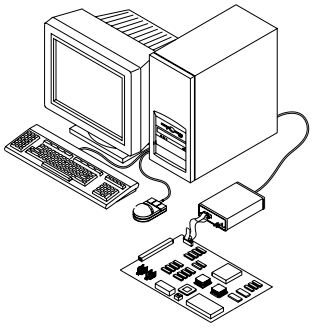
Quickly and accurately determine the root cause of your team's most difficult hardware, software, and system integration problems with Agilent Technologies powerful emulation and logic analysis solutions.

Agilent's emulation and analysis solutions for ARM combine the powerful tools of run control, code download, debugger connections, and logic analysis for a complete, scalable system debug environment.

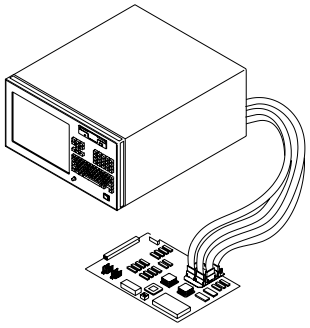
With a scalable solution from Agilent, your design team members can customize Agilent's product offerings to meet their unique requirements. Solutions range from emulation probes combined with the industry's leading debuggers to emulation with real-time trace to solve today's most complex ARM7/ARM9 design problems. 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.

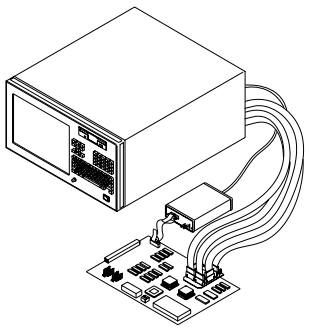


JTAG Emulation
- Verify Interrupt Routines
- Debug Assembly Code
- Optimize Code



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

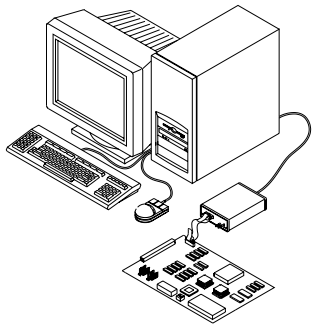


Emulation Solution with Real-Time Trace
- Debug Hardware/Software Interaction
- Profile Hardware/Software Interaction
- Optimize System Performance
- Perform System Test

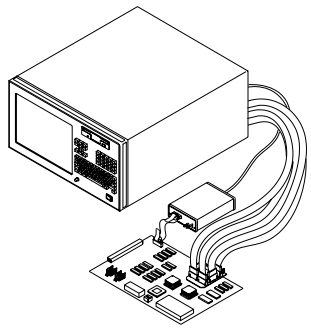
Agilent Technologies
Innovating the HP Way

Agilent Scalable Solutions

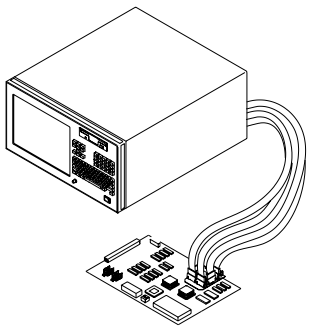
Agilent's emulation and logic analysis solutions are scalable for each member of the digital design team. The following are three typical configurations for firmware/software debug, hardware debug, and system integration. Components of these solutions include a logic analyzer, emulation probe/module, 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
JTAG Emulation • Microprocessor run control on your target system • Debugger connection	• Emulation Probe: (see p. 3) - Exceptional down load speed and signel stepping - View and modify memory, view and modify register on your target system or evaluation board from the debugger interface • Connection to industry-leading debuggers from ARM, Inc., GreenHills Software, Inc., and Wind River Systems Inc.



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	• Agilent 16700 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. 7) - Connect to target using Mictor connection - Disassemble trace listing into "ARM" or "Thumb" mnemonics • Integrated Emulation Module: (see p. 3) - Exceptional download speed and single-stepping - View and modify memory, view and modify registers on your target system or evaluation board from the debugger interface - Connect to industry-leading debugger from GreenHills, ARM, and Wind River. • Agilent Source Correlation Tool Set: (see p. 8) - 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 - Optional source correlation	• Agilent 16700 Series Logic Analysis System: - Capture and analyze code flow and data flow with out 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. 7) - Connect to target using Mictor connection - Disassemble trace listing into "ARM" or "Thumb" mnemonics • Agilent Source Correlation Tool Set: (see p. 8) - Time-correlate acquired logic analysis trace to high-level source code - Step through in assembly or high-level code

Microprocessor	JTAG Emulation	Emulation Solution with Real-Time Trace	Logic Analysis Solution
ARM7 Thumb Family	X	X	X
ARM9 Thumb Family	X	X	X

Table 1: Emulation and Analysis Solutions for ARM Microprocessor

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 16700 Series logic analysis systems.

The emulation probe and module have been improved to provide the exceptional download speed and single stepping. These improvements include:

- 32 bit microprocessor
- 100 base TX LAN
- New scan-chain controller

Both the probe and module 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, run/break, and set/modify break-point. You can also run code at full speed in the target. Agilent's new emulation probe and modules allow you to complete these tasks more quickly so you can bring your products to market sooner.

An industry leading debugger can be used to control both the emulation probe and module. Alternatively, they can be controlled by the emulation control interface provided with the logic analyzer. These interfaces are described on page 4.

The Agilent emulation probe and emulation module can be controlled over your local area network (LAN) by the debugger and connect to your target through a dedicated connector.

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.

Download Speed

For ARM CPU's typical code download transfers occur at 158k bytes per second.

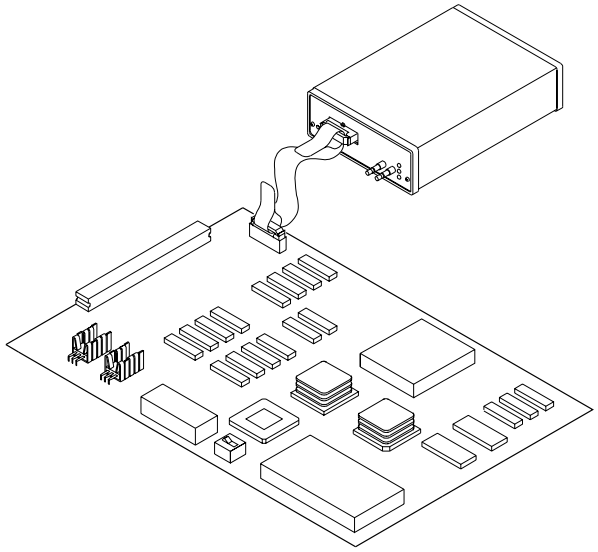


Figure 1: Standalone Agilent Emulation Probe

Figure 2: Agilent 16700 Logic Analysis System with Integrated Emulation Module

Debugger Interface

Industry-leading debuggers can control the Agilent emulation probe and emulation 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

ARM Inc.
750 University Ave., Suite 150
Los Gatos, CA 95032 USA
408-399-5199
http://www.arm.com

GreenHills Software, Inc.
30 West Sola Street
Santa Barbara, CA 93101 USA
805-965-6044
http://www.ghs.com

Wind River Systems
500 WindRiver Way
Alameda, CA 94501 USA
510-748-4100
http://www.windriver.com

Please check with your local Agilent sales office or visit our web site at http://www.agilent.com/find/las_data for the current list of validated debugger connections.

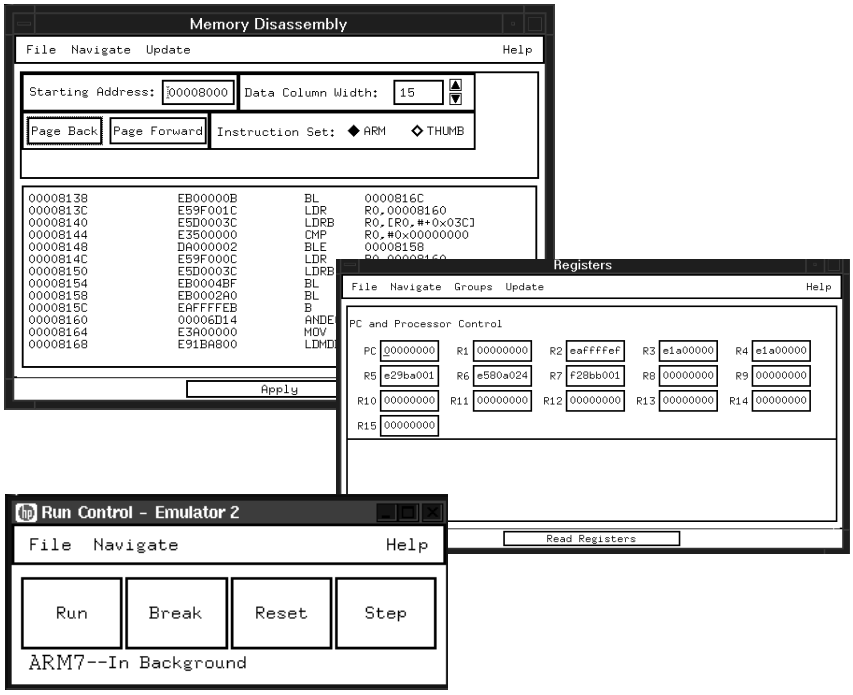


Figure 3. Emulation Control Interface

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 ARM or Thumb assembly instructions. Download code into RAM or Flash ROM.

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 procedure 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 the debugger interface, the emulation control interface does not reference back to the high-level source code.

Emulation Module Triggering Integration with Logic Analyzer

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

This migration path works for the emulation probes or emulation modules. Migration is available for those processors in the E5900B Series

Emulation Probe and Module Target Connection Information

A 20-pin Berg style connector, the preferred connector, should be designed into the target system. Connectors for standards already in use on manufacturer's evaluation boards are also provided. These include a 14-pin TI connector, 14-pin ARM Embedded Ice connector, 20-pin Arm Multi-Ice connector, and 14-pin VLSI Technology connector. Documentation is provided in the Emulation Probe manual.

Supported Processor	ARM7TDMI, ARM7DI,ARM9TDMI	
Highest JTAG Clock Frequency	10 MHz	
Target Power Voltage	1.2 - 5.0 V	
Physical Cponnections	Ethernet	Autosensing 10/100 Ethernet
	RS-232-C	9600 kbaud rate
Environmental		
Temperature	Operating: 5°C +0 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 kMz) IEC 801-4: 1988/EN 50082-1:1992 0.RkV Signal Lines, 1 kV Power Lines	
Safety Approvals	IEC 1010-1: 1990 AMD 1:1992 UL 1244 CSA-C22.2 No. 231 (Series M-89	
Physical Size	105mm width x 151 mm depth x 40 mm height	

Table 2: Emulation Probe and Module Specifications

Real-Time Trace Analysis

Real-time trace analysis consists of a physical connection to signals on the IC containing the ARM microprocessor, acquisition of relevant data, and analysis of the real-time captured bus information.

Connecting to your target system depends on several factors. If you are implementing an ASIC containing an ARM microprocessor, examine available documentation (see page 12) to develop a strategy for making required and optional signal and control pins accessible.

If you are using a catalog part offered by an ARM Silicon Partner, documentation may be available on connection strategies already implemented. For either type of product, Agilent provides a range of probing adapters for PQFP and TQFP packages that may be useable with your ARM based IC. Please check Agilent's probing adapters product listing for the latest information about package types supported.

The real-time trace analysis solutions for the ARM microprocessor include inverse assembly, source correlation, and system performance analysis.

For information on the data acquisition modules for the Agilent 16700 Series logic analysis systems, please refer to related literature on page 11.

ARM Microprocessor	Supported Bus Width, Mode and Speed	ASIC or Catalog Part Probing Approaches	Real-Time Trace Solutions
ARM7 ARM710T ARM720T ARM7TDMI ARM7DI ARM9TDMI (AMBA) ARM920T (AMBA) ARM940T (AMBA)	Widths: • 8 bit • 16 bit • 32 bit • Mixed width Byte Fetch Order: • Hi-to-low address order • Low-to-high address order Instruction Mode • ARM instruction mode • Thumb instruction mode Speed: To maximum specification of logic analyzer (up to 400 MHz)	Connector-Cable: • Design Mictor high-density connectors in target system for access to critical signals for real-time trace. • Design medium-density connectors into target system. Purchase termination adapters (Agilent part #: 01650-63203)	Inverse Assembly: • Disassembly of bus information into ARM7/9 or Thumb microprocessor mnemonics • ARM7 Core, AMBA Bus, ARM9 (AMBA) configuration files for logic analyzer • Chip select decoding for linear address display • Ability to function with few or no status lines from the ARM microprocessor
		Agilent general-purpose probing adapters available for popular TQFP/PQFP packages	Source Correlation: • Time-correlation of acquired trace to high-level source code • Trigger and search through trace in high-level source code
		Analysis probes may be custom designed for your ASIC's signal availability, timing, and packaging by an Agilent Channel Partner such as Corelis, Inc.	System Performance Analysis: • Statistical performance measurements on trace data • State overview, state interval, time interval, and time overview measurements

Table 3: Real-Time Trace and Probing Alternatives

Inverse Assembler

Software provided for analysis quickly configures the logic analyzer by labeling address, data, and status signals for the ARM microprocessor. The software includes an inverse assembler, which gives you "ARM" or "Thumb" mnemonics in the trace listing for easy correlation between captured data and target code. The inverse assembler also works with the Agilent B4620B source correlation tool set to provide time-correlation between the assembly-level trace and the high-level source code.

Because you may implement your ASIC's external memory interface in a variety of ways, the inverse assembler can be configured to work where your data bus width is 8, 16, 32 bits or a mixture of widths. If, for cost reasons, you reduce the number of pins on your ASIC by deleting some of the ARM-core status lines, Agilent's inverse assembler will still function using information supplied by you to the configuration input screens. See figures 4 and 5.

The inverse assembler provides filters and color coding to show and/or suppress different types of instructions such as data reads, data writes, unexecuted instructions, "cc Failed" instructions, etc.

AMP Mictor Connector Probing Solution

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 application note, "Target Requirements for Agilent ARM Logic Analysis and ARM7TDMI/ARM9 Emulation Tools" (page 11) for signal pin-out information.

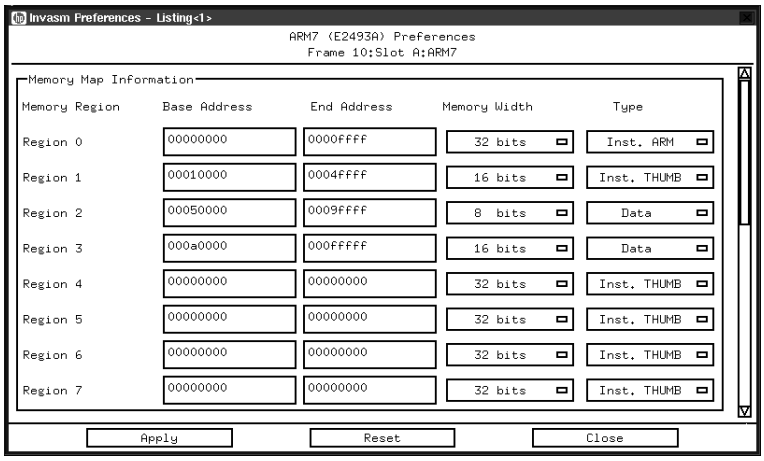


Figure 4: Inverse Assembler Configuration Screen

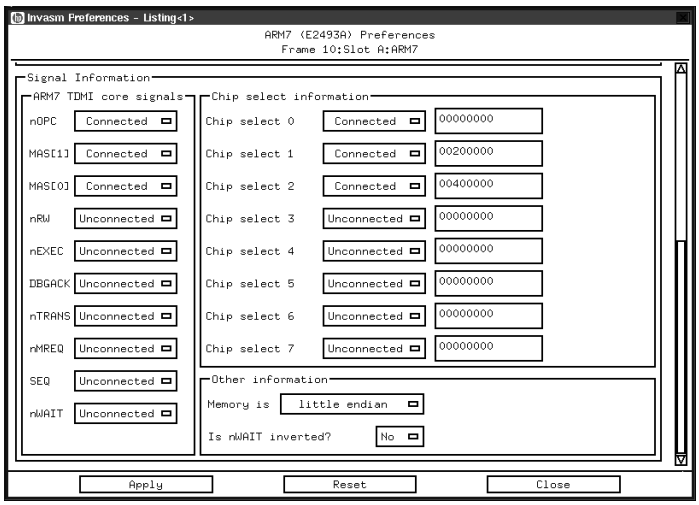


Figure 5: Inverse Assembler Signal Selection Screen

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

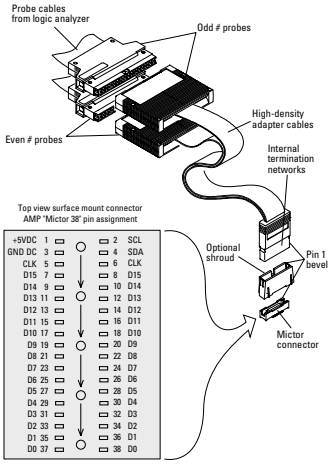


Figure 6: Agilent E5346A High-Density Adapter and Mictor Connector

Analysis Probes

Where required, customized analysis probes for ASIC's containing ARM microprocessors are available from Agilent Channel Partners such as Corelis, Inc. This allows you more flexibility in selecting what signals to "pin out" to support real-time analysis. The Agilent inverse assembler can function by post-processing without the benefit of ARM-core status lines but logic analyzer triggering power is reduced. A custom analysis probe can be implemented which externally reconstructs or de-multiplexes signals, thus restoring triggering power.

Agilent Logic Analyzers Supported

Your choice of logic analyzer depends, in part, on how many signal lines are to be monitored. Four, 16-channel logic analyzer pods are the minimum required for inverse assembly. Six pods may be required, depending on the number of address lines used and the width of the data bus. See table 4.

Contact your Agilent field engineer for latest logic analyzer information

Note: The Agilent B4620B source correlation tool set operates only with the Agilent 16700 Series logic analyzer mainframes.

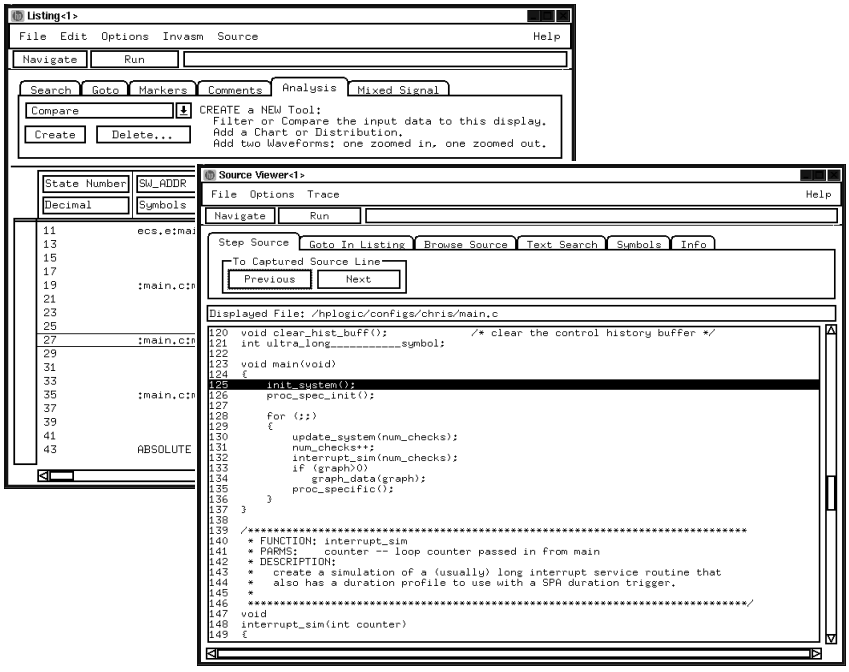


Figure 7: Inverse Assembler Trace Time-Correlated to Source Code using the Agilent Source Correlation Tool Set

Pod Count Required	Address and Chip Select Lines	External Data Bus Width
4	Up to 32	8
4	Up to 24	8 / 16
6	Up to 32	8 / 16 / 32

Table 4: Compatible Logic Analyzers Which Have Four (or More) Pods.

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 written 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/software integration problems.

IEEE 695, OMF X86, OMF96, Elf/Dwarf v1.1, TI COFF and TI COFF2 symbol files are supported.

System Correlation

With the Agilent logic analysis systems, you can time-correlate bus information from other microprocessors or bus interfaces in your target system with the ARM. Analysis probes are available for additional microprocessors. (Contact your local Agilent Test and Measurement sales office or visit our web site at http://www.hp.agilent.com/find/las-data for more information).

Agilent B4600B System Performance Analysis Tool Set

The system performance analysis (SPA) tool set is an optional software package for the Agilent 16700A Series logic analysis systems. The SPA tool set provides 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 8.

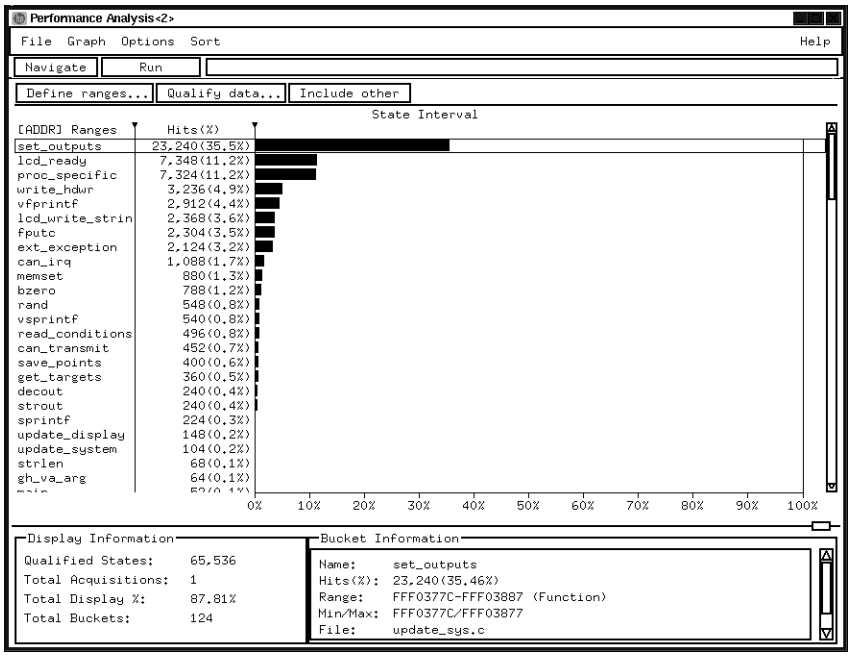
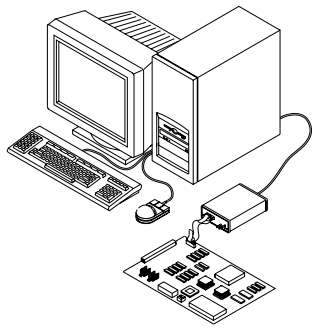


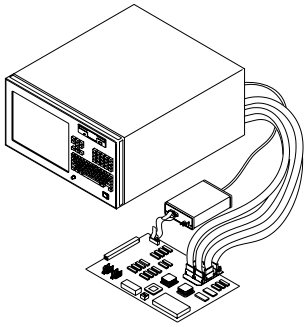
Figure 8: Statistical Performance Information from the Agilent System Performance Analysis Tool Set

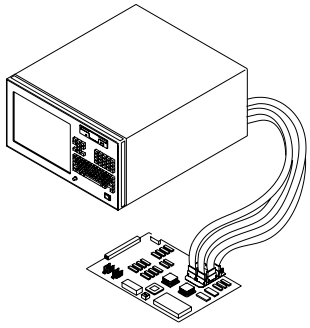
System Configuration and Ordering Information

Agilent makes it easier and more economical to order your emulation or analysis solution by providing solution product numbers. The table below shows the system components you need to order and what is included in each one. The solution product numbers do not include logic analysis. The Agilent 16700A Series logic analysis systems need to be ordered separately.

If you want to configure or upgrade your system with individual products, see page 11 for individual product number information.







Solution	Products to Order	Included Components
JTAG Emulation		
• ARM7/ARM9 Emulation Probe	• E5900B #300	
• Debugger Connection	• Order directly from ARM, Inc., GreenHills Software, Inc. or Wind River Systems, Inc.	
Emulation Solution with Real-Time Trace		
• Agilent 16700 Series Logic Analysis System	• Refer to Agilent publication 5968-9661E for logic analyzer configuration • Contact your Agilent field engineer for latest logic analyzer information	
• Emulation Solution with Real-Time Trace	• E9495B #001	• Source Correlation Tool Set • Emulation Module • Inverse Assembler
• Connection to Target with High-Density Connectors	• Three E5346A High-Density Termination Adapters • E5346-68701 Mictor Connector Kit	
• Connection to Target with Medium-Density Connectors	• Four to six 01650-63203 Termination Adapters	
• Connection to Target with QFP Probing Adapters	• Elastomeric Probing Adapter(s) for popular QFP packages • Agilent Flex Adapter(s)	
• Debugger Connection	• Order directly from ARM, Inc., GreenHills Software, Inc., or Wind River Systems Inc.	
• Optional System Performance Analyzer Tool Set	• B4600B	
Logic Analysis Solution		
• Agilent 16700 Series Logic Analysis System	• Refer to publication 5968-9661E for logic analyzer configuration • Contact your Agilent field engineer for latest logic analyzer information	
• Analysis Solution	• E9595B #001	• Inverse Assembler
• Connection to Target with High-Density Connectors	• Three E5346A High-Density Termination Adapters • E5346-68701 Mictor Connector Kit	
• Connection to Target with Medium-Density Connectors	• Four to six 01650-63203 Termination Adapters	
• Connection to Target with QFP Probing Adapters	• Elastomeric Probing Adapter(s) for popular QFP packages • Agilent Flex Adapter(s)	
• Optional Source Correlation Tool Set	• B4620B	
• Optional System Performance Analysis Tool Set	• B4600B	
• Optional Emulation Module	• E5901B #300	

Individual Components Ordering Information

Description	Product
Emulation Probe	E5900B #300
Emulation Module	E5901B #300
Inverse Assembler	E9595A #001
Source Correlation Tool Set	B4620B
System Performance Analysis Tool Set	B4600B
High-Density Termination Adapter	E5346A
Medium-Density Termination Adapter	01650-63203
Mictor Connector Kit	E5346-68701

Related Agilent Literature — Pub. Number

Agilent 16600A and 16700A Logic Analysis System Mainframes, Product Overview — 5968-9661E

System Configuration for the Agilent 16700 Series Logic Analysis Systems, Configuration Guide — 5966-4364EUS

Additional Information

"Target Requirements for Agilent ARM Logic Analysis and ARM7TDMI/ARM9 Emulation Tools" is available in an Acrobat PDF file format on HP's website at http/www.agilent.com/go/LogicAnalyzer.

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: http://www.hp.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 Networking

Topics related to debug of ARM microprocessor-based targets can include:

- Debugging Techniques to Handle 8/16/32 Bit Data Bus Sizes
- Design for Debug Techniques Which Signals to Bring Out of the ASIC, Target System Requirements, etc.

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 underlay 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:
(tel) 1 800 452 4844

Canada:
(tel) 1 877 894 4414
(fax) (905) 206 4120

Europe:
(tel) (31 20) 547 2000

Japan:
(tel) (81) 426 56 7832
(fax) (81) 426 56 7840

Latin America:
(tel) (305) 267 4245
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