Agilent Emulation and Analysis Solutions for Hitachi SH4 Series 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 solution for the Hitachi SH4 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 design problems. Agilent's solutions are designed to meet your needs today and protect your investment as your needs change in the future.

Logic analysis provides timing and state analysis so 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 2M deep, can be combined with complex triggering to find the toughest problems. Microprocessor instruction set execution can be correlated to the high-level source code to help track down problems in your design.

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 two typical configurations for firmware/software debug, hardware debug, and system integration.

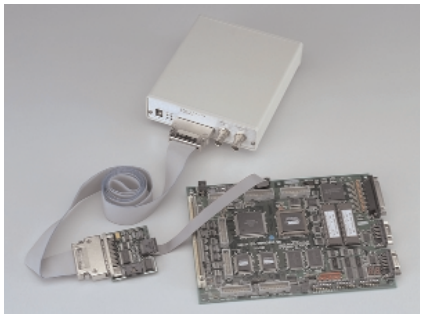
Components of these solutions include a logic analyzer, emulation probe/module, analysis probe, and emulation solution interface software.

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

System Features	System Components and Functionality

Run Control
• Microprocessor run control on your target system
• Debugger connection
	• Emulation Probe:
	  • Download code, view and modify memory and view registers on your target system or evaluation board from the debugger interface
	• Agilent Emulation Solution Interface:
	  • C-level run control
	• Connection to industry-leading debuggers

Emulation Solution with Real-Time Logic Analysis Trace
• Microprocessor run control on your target system
• Debugger connection
• Real-Time Logic Analysis Trace Solution
  • Assembly & C source level trace
  • Source correlation
	• 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
	• Integrated Emulation Module:
	  • 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
	• Agilent Emulation Solution Interface:
	  • C-level run control
	  • Bus Trace Interface
	  • Bus Trigger Interface



Emulation Probe and Module

The Agilent emulation probe and module provide the same functionality. The emulation probe is a standalone product, as shown in figure 1. The emulation module is an integrated plug-in for the 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 and module can be controlled by either an industry-leading debugger, an emulation control interface, or an emulation solution interface. These interfaces are described on pages 5 and 6.

The emulation probe and module can be controlled over your local area network (LAN) by the debugger and connect to your target through a 14-pin 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.

Emulation Module Triggering Integration with Logic Analyzer

With the emulation module, use the powerful triggering of the 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.

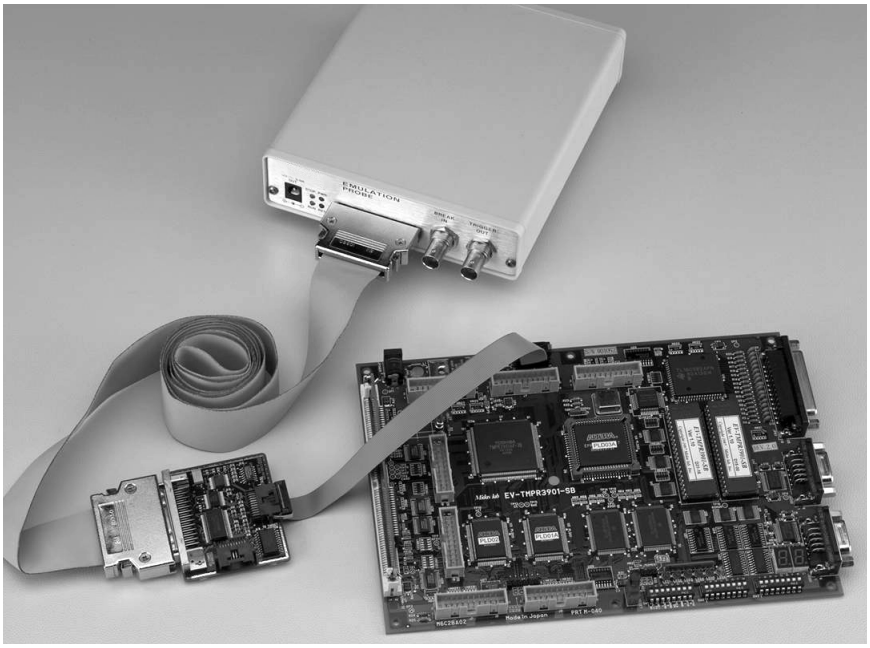


Figure 1: Stand-alone Emulation Probe

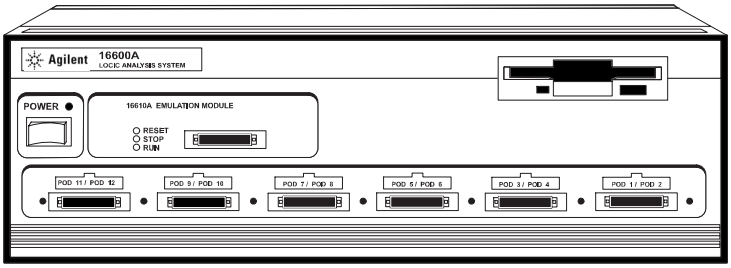


Figure 2: Agilent 16600A Logic Analysis System with Integrated Emulation Module

Analysis Probe

The analysis probe allows easy connection of an Agilent logic analyzer to your Hitachi SH4 QFP 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 Hitachi SH4 analysis probe consists of:

- Analysis probe board
- Configuration files
- Elastomeric probing solution
- Four E5346A high-density termination adapters
- User's guide

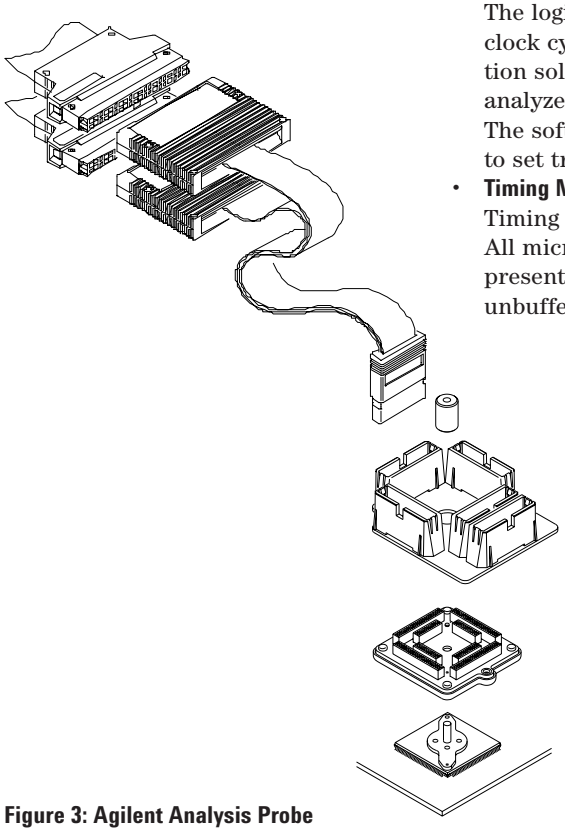


Figure 3: Agilent Analysis Probe

Elastomeric Probing Solution

The elastomeric probing solution included in the analysis probe offers an inexpensive, rugged, and easy-to-use probing solution for the Hitachi SH4 QFP package. The probes require a minimal "keep out" area around the device, as shown in figure 8.

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.

Additional retainers and locator tools may be ordered. E5363A option 201 offers a kit of five additional retainers and adhesive. An additional locator tool is available as E5363A option 202.

Modes of Operation

- **State-Per-Clock**
  The logic analyzer records all clock cycles and then the emulation solution interface software analyzes and displays the cycles. The software can also be used to set trigger sequences.
- **Timing Mode**
  Timing analysis is supported. All microprocessor signals are presented to the logic analyzer unbuffered.

System Correlation

With the Agilent logic analysis systems, you can time-correlate bus information from other microprocessors or bus interfaces in your system, such as a PCI bus, with the Hitachi SH4. Analysis probes are available for additional microprocessors. (Contact your local Agilent Test and Measurement sales office or visit our web site at www.agilent.com/go/las-data for more information.)

Optional Mictor Connection Solution for the Hitachi SH4

If system constraints won't allow use of the analysis probe, you can design high-density AMP Mictor connectors into your target system for connection to the microprocessor signals. The emulation solution interface software 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 four Mictor connectors. The AMP Mictor connectors can be located around the microprocessor.

Four 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 E5346-68701 Mictor connector kit.

Select Interface Software

There are several different user interfaces available for the Hitachi SH4 emulation solution. You may connect to leading industry debuggers, a standard logic analysis emulation control interface, and Agilent Technologies' emulation solution interface software.

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.

Emulation Control Interface

The emulation module or probe can be controlled directly by the emulation control interface. You can easily display and modify contents of microprocessor registers, system memory, and I/O.

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

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

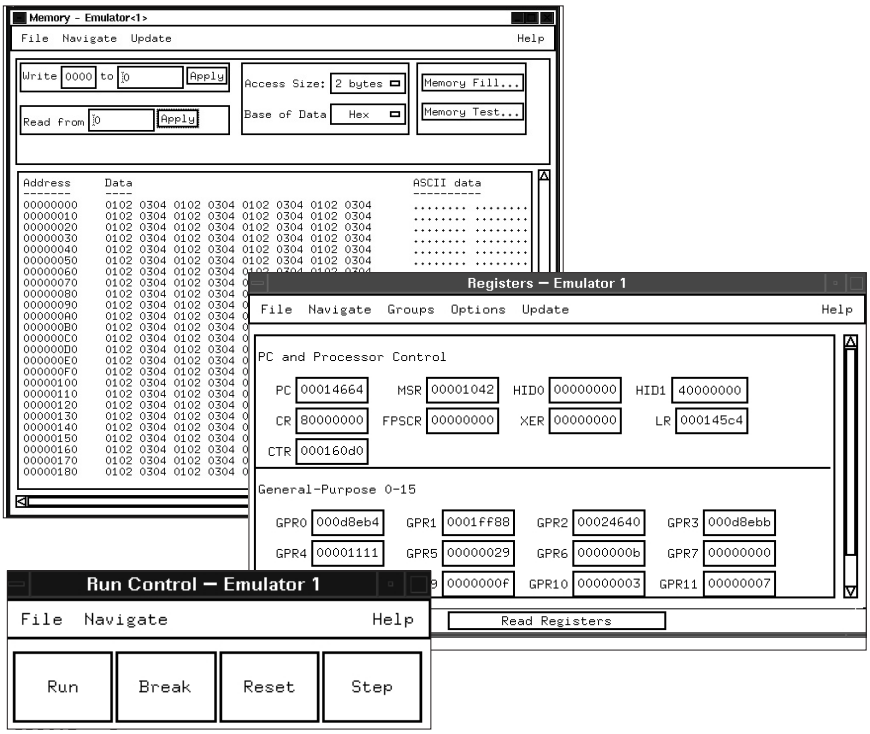


Figure 4: Emulation Control Interface

Emulation Solution Interface Software

All the features of the Agilent emulation and analysis solution are available through the emulation solution software interface. With this software you can access all the components of the debug solution with one easy-to-use interface.

The emulation solution interface software delivers standard debug features including single stepping through code, setting breakpoints, and displaying or modifying memory or registers in your C source code.

External bus data or I/O data can be displayed including symbol information. It is also possible to cross trigger external bus data with I/O activity. This software also provides a source level trace and triggering capability. You can see a complete source-level trace display, and can specify any trigger point by pointing to a source line in a source window.

Agilents' emulation solution interface software can also correlate source code to the trace listing by using built-in global markers, making it easy to diagnose hardware/software integration problems.

The interface software supports several kinds of memory systems. These memory systems are directly connected to a dedicated memory controller unit of the microprocessor. This interface enables you to direct the inverse assembler to easily capture several kinds of memory bus cycles, including DRAM, EDO-DRAM, SDRAM, PCMCIA, Burst-ROM, etc. You can capture and display every kind of memory cycle and bus state with ADDRESS, DATA, and STATUS schemes.

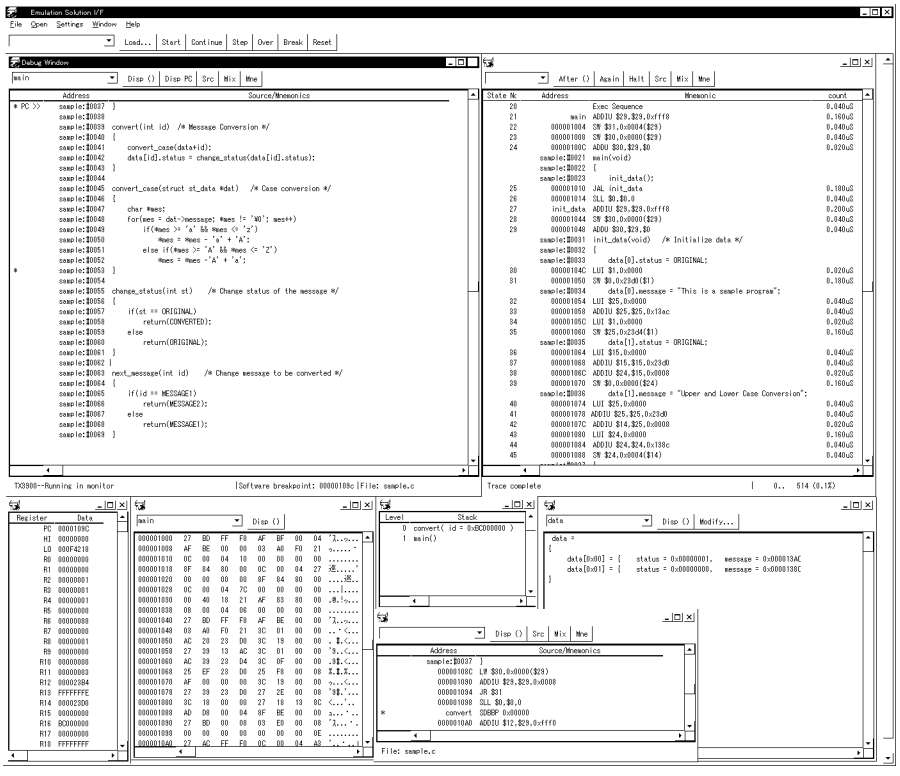


Figure 5: Emulation Solution Interface Software

Pods Required

Eight to ten 16-channel logic analyzer pods are required for inverse assembly. These pods are connected to four E5346A high-density termination adapters included with the analysis probe.

Probe Loading

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

Agilent Logic Analyzers Supported

Contact your Agilent field engineer for current logic analyzer information.

Table 1: Logic Analyzers Supported

External Bus Speed	Memory Types Combination: ROM or SRAM or BurstROM or PCMCIA	Memory Types Combination: Other Type	Required PODS	Minimum Logic Analyzer Supported
>40MHz(*2)	YES	D.C.	10	16600A 16700/2 + 16550A *2 16700/2A + 16555/6/7 A/D *3 16700/2A + 16710/11/12A *2
	NO	YES	8	16601A 16700/2A + 16550A *2 16700/2A + 16555/6/7 A/D *2 16700/2A + 16710/11/12A *2
<=40MHz(*1)(*2)	D.C.	D.C.	8	16601A 16700/2A +16550A *2 16700/2A + 16555/6/7 A/D *2 16700/2A + 16710/11/12A *2

D.C. = Don't Care
(*1) Condition of <=40 MHz : CKIO (cycle) = min 25ns, CKIO(low)=min 10ns, CKIO(high)=min 10ns
(*2) In case using the 16557, an external bus speed threshold would be up to 50 MHz.
Condition of <=50MHz: CKIO (cycle)=min 20ns, CKIO (low)=min 7.5ns, CKIO(high)=min 7.5ns

Table 2: Languages Supported by the Emulation Solution Interface

	Hitachi			Green Hills
	C	ASM	Linker	C / ASM
s700	5.0	4.1	6.0A	1.8.9
Sun (Sun OS)	5.0	4.1	6.0A	1.8.9
Sun Solaris	5.0	4.1	6.0A	1.8.9
Windows95/ NT	5.0	4.1	6.0A	1.8.9

Table 3: Host Computers Supported by the Emulation Solution Interface

Operating System
S-700 Work Station (HP-UX 9.00 or greater)
SUN Work Station (Solaris 2.4/SUN-OS 4.1.1 or greater)
PC (Windows 95 / Windows NT 4.0 or greater)

Emulation Probe and Module Target Connection Information

A connector is needed on the target development board to connect the Hitachi SH4 microprocessor interface assembly to the debug port of the microprocessor.

Table 4: Debug Adapter

Adapter Name	3M Part Number
Straight	2514-6002 uB
Right Angle	2514-5002 uB

Table 5: Debug CPU Pin Assignment

Probe Pin Assignment	SH7750 QFP Pin Number	SH7750 BGA	Signal
1	198	A5	TCK
3	200	C4	TRST
5	194F	A6	TDO
7	193	B7	ASEBRK/BRKACK
9	197	B6	TMS
11	199	B5	TDI
13	2	B1	RESET
8			IOFf VDD
2, 4, 6, 10, 12, 14			GND

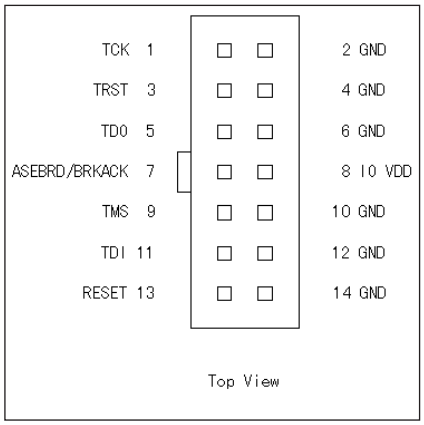


Figure 6: Target Development Board Header Connector (Top View)

Analysis Probe Mechanical Specifications

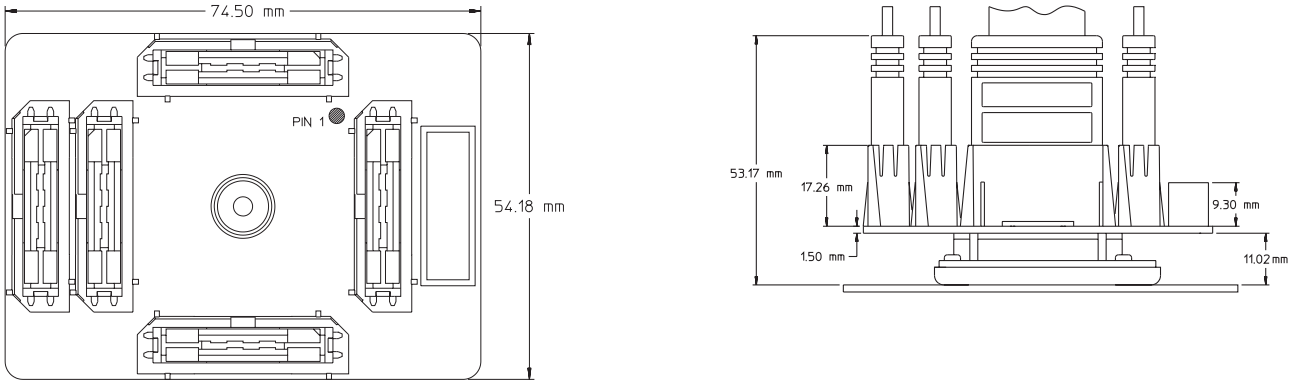


Figure 7: E9598A Analysis Probe Dimensions

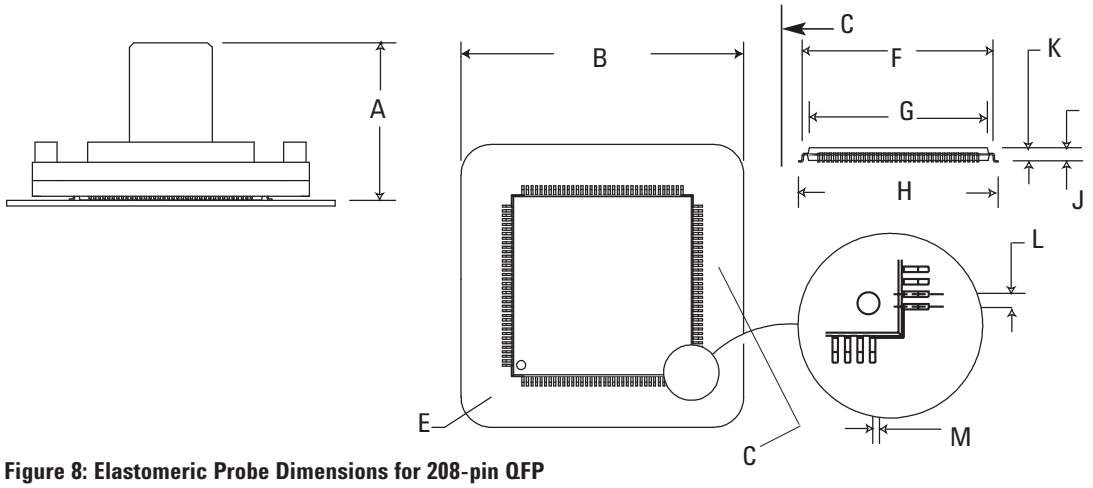


Figure 8: Elastomeric Probe Dimensions for 208-pin QFP

Adapter	A	B	E	F	G	H	J	K	L	M
208-pin QFP (inches)	0.76	1.507	0.149	1.14 (min)	1.11 (max)	1.197 to 1.F213	0.126 to 0.146	0.136 to 0.161	0.0197 +/-0.0012	0.0087 +/-0.0015
(millimeters)	19.2	38.3	3.8	28.85 (min)	28.20 (max)	30.4 to 30.8	3.20 to 3.70	3.45 to 3.60	0.500 +/-0.03	0.220 +/-0.16

System Configuration and Ordering Information

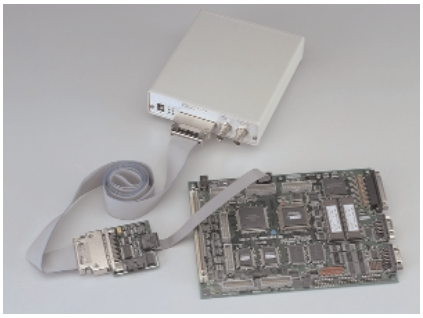
The table below shows the system components you need to order and what is included in each. For real-time trace, two alternatives are available to fit your needs. The solution product numbers do not include solution product numbers do not include logic analysis. The Agilent 16600A and 16700A Series logic analysis systems must be ordered separately.

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

Solution	Products to Order	Included Components
Run Control		
• Hitachi SH4 Emulation Probe • Debugger Connection	• E5900A #710, B3759A #710 • Order directly from SDS	
Emulation Solution with Real-Time Logic Analysis Trace		

• 16600A or 16700A Series Logic Analysis System	• Refer to publication 5966-3148E for logic analyzer configuration
	• Supported logic analyzers:
	  • 16600A, 16601A
	  • 16700A, 16702A
	  • 16550A
	  • 16555A/D, 16556A/D, 16557D, 16710A, 16711A, 16712A	

• Emulation Solution SH7750	• E9498A #002 • Four E5346A High-Density Termination Adapters • E5346-68701 Mictor Connector Kit	• Emulation Module • Emulation Solution Interface Software • Analysis Probe
• Debugger Connection	• Order directly from debugger vendor	



Protecting Your Investment

Agilent protects your current investment by providing a migration path for 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 and for emulation modules.

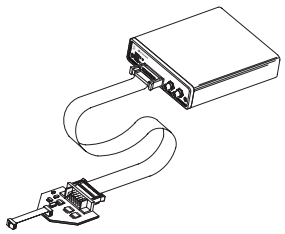
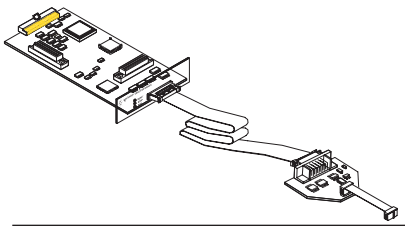
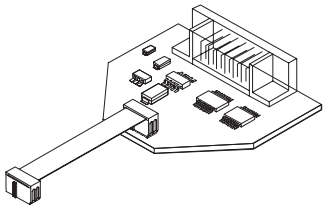
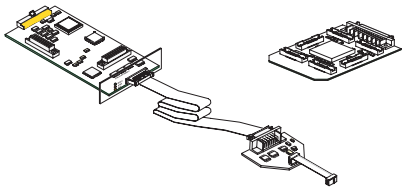
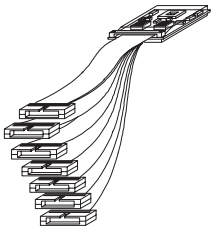
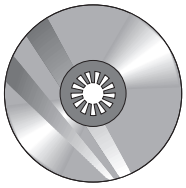
	E5900A #710	Emulation Probe
	E5901A #710	Emulation Module
	E5902A #710	Emulation Migration
	E9498A #002	Emulation and Analysis Solution
	E9598A #002	Analysis Probe
	B3759A #710	Emulation Solution Interface Software

Figure 9: Individual Components Ordering Information

Related Literature	Pub. Number
Agilent 16600A and 16700A Logic Analysis System Mainframes	5966-3107E
Processor and Bus Support for Logic Analyzers	5966-4365E
State and Timing Modules for Logic Analysis Systems	5966-3367E

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.

Get assistance with all your test and measurement needs at:

www.agilent.com/find/assist

Or check your local phone book for the Agilent office near you.

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