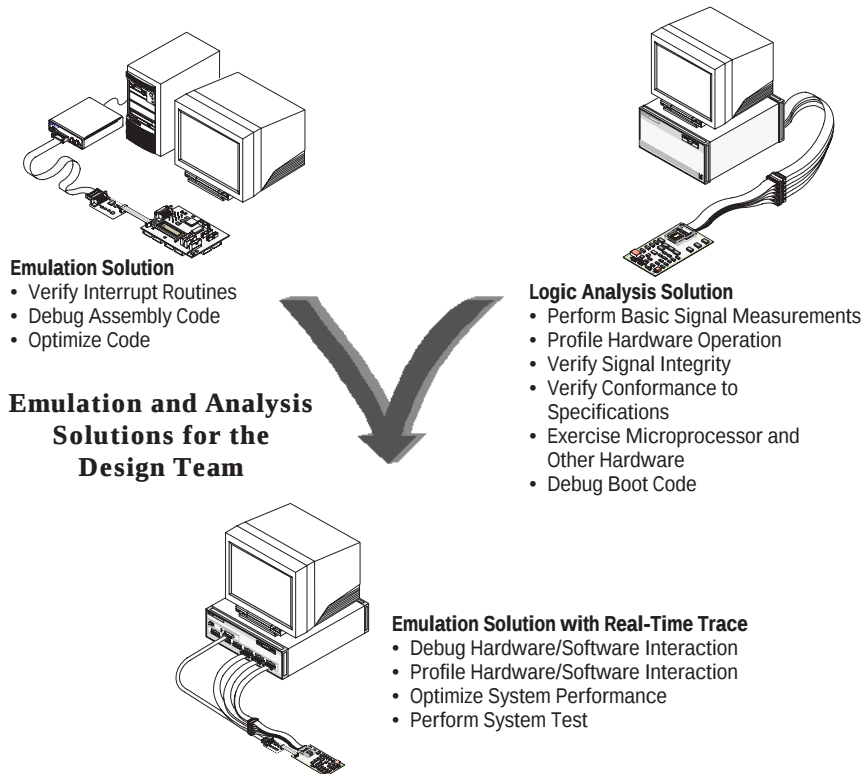

Emulation and Analysis Solutions for Intel Pentium® Processors and Pentium Processors with MMX™ Technology

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 Hewlett-Packard's powerful emulation and logic analysis solutions.

HP's emulation and analysis solutions for Intel Pentium processors and Pentium processors with MMX Technology 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 Pentium system 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.

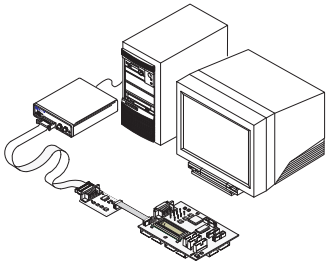
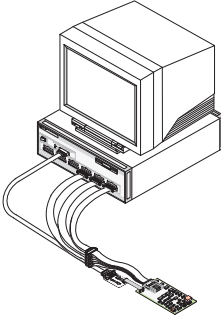
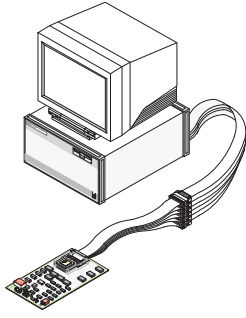
The logic analyzer is nonintrusive, allowing you to run your target system at full speed. A system trace, up to 2 M deep, can be combined with complex triggering to find the toughest problems. The microprocessor instruction set execution can be correlated to the high-level source code with the HP source 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
  	Emulation Solution • Microprocessor run control on your target system • Debugger connection	• 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 debugger from CAD-UL
	Emulation Solution with Real-Time Trace • Microprocessors run control on your target system • Debugger connection • Real-time logic analysis trace solution: - Assembly level trace - Source code trace • SPGA probing devices	• 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 • Analysis Probe: (see p. 7 & 9) - Connect to target using SPGA interposer compatible with 296 pin, Socket 7 - Disassemble trace listing into Pentium processor 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 debugger from CAD-UL • HP Source Correlation Tool Set: (see p. 7) - 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 code trace • SPGA 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 • Analysis Probe: (see p. 7 & 9) - Connect to target using SPGA interposer compatible with 296 pin, Socket 7 - Disassemble trace listing into Pentium processor mnemonics

Microprocessor	Package Type	Microprocessor Clock Speed	Emulation Solution	Emulation Solution with Real-Time Trace	Logic Analysis Solution
Pentium Processor	296 SPGA	Up to 200 MHz	X	X	X
Pentium Processor with MMX Technology	296 SPGA	Up to 233 MHz	X	X	X

Table 1: Emulation and Analysis Solutions for Intel Pentium Processors and Pentium Processors with MMX Technology

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 solutions 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, start/stop, run/break, and set/modify breakpoints. You can also run code at full speed in the target.

The emulation probe can be controlled by an industry-leading debugger. The emulation module can be controlled by either a debugger or the emulation control interface provided with the logic analyzer. These interfaces are described on page 4.

The HP emulation probe and emulation module can be controlled over your local area network (LAN) and connect to your target through the 20- and 30-pin Pentium processor debug port connectors.

Unlike traditional emulators, the emulation probes and modules provide more stable operation by accessing only the debug pins of the microprocessor and they do not affect other signals. You don't need a serial port on your target system to download code. Unlike ROM monitors, they don't require user memory.

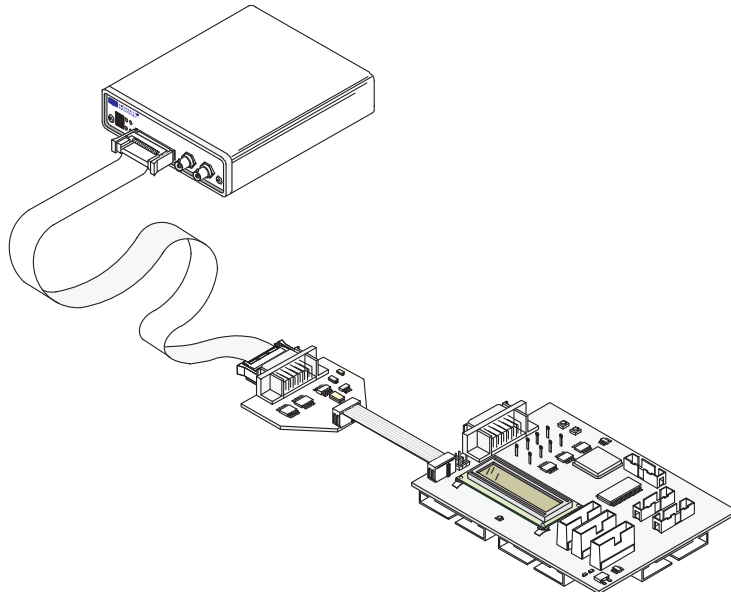


Figure 1: Standalone HP Emulation Probe

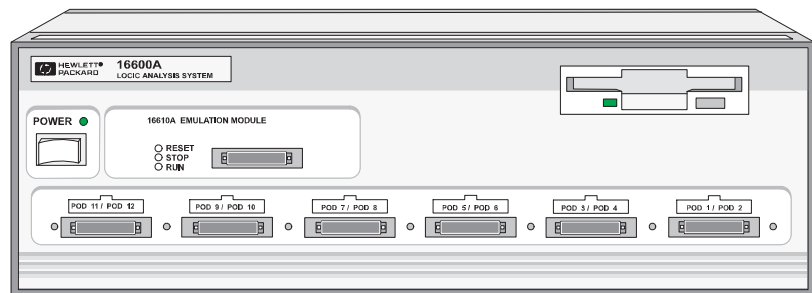


Figure 2: HP 16600A Logic Analysis System with Integrated Emulation Module

Debugger Interface

Industry-leading debuggers can control the HP emulation probe and 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

CAD-UL, Inc.
6330-1 E. Thomas Rd., Suite 100
Scottsdale, AZ 85251-7056
Phone: (602) 945-8188
<http://www.cadul.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.

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 Intel Pentium processor and Pentium Processor with MMX Technology assembly instructions.

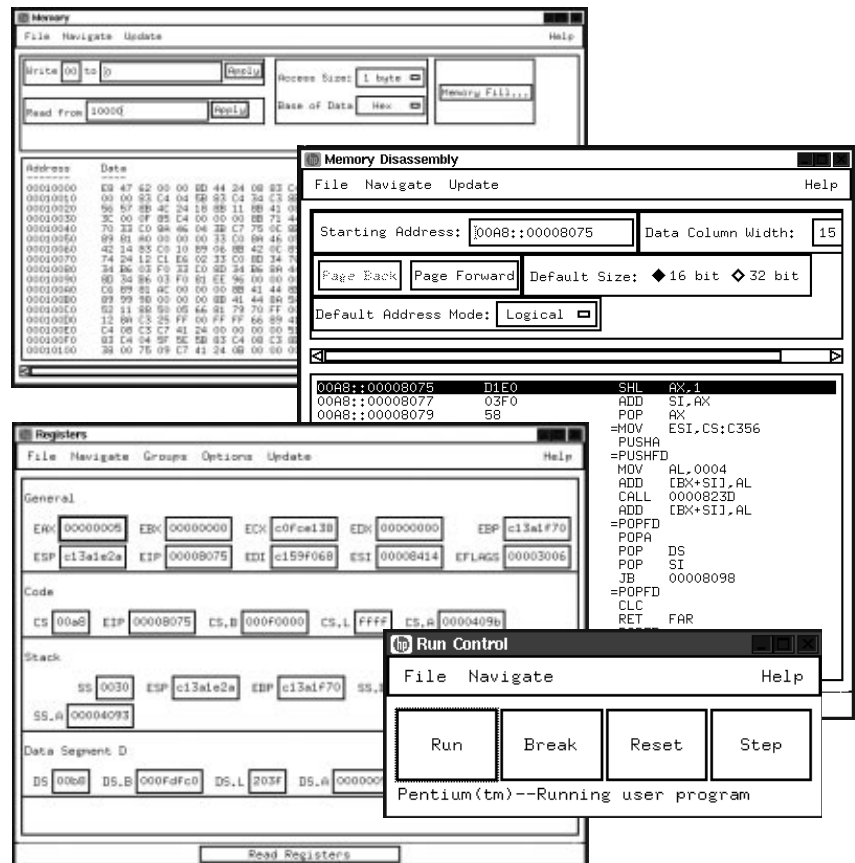


Figure 3: Emulation Control Interface

From the run control window you can instruct the microprocessor to run, break, reset, or single-step. You can also 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 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, you can 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 correlation between the debugger interface environment and the logic analyzer.

Emulation Probe and Module Target Connection Information

Simply connect the control port of the emulation probe or module to the Pentium processor debug port on your board or the HP E9592A analysis probe for the Pentium processor. The emulation probe or module supports both the 20-pin and 30-pin Pentium processor debug port connectors. For more details regarding the Pentium processor debug port, refer to the *Intel Pentium Family User's Manual; Data Book*.

Specifications	Description
Supported Processors	Pentium processors and/or Pentium processors with MMX technology
RS-232-C	1200 - 115200 baud
LAN	10base2 or 10baseT Ethernet connections TCP/IP protocol Compatible with Pentium processor debug port ¹ 20 pin or 30 pin connectors
Physical	155 mm width × 161 mm depth × 65 mm height
Environmental	
Temperature	Operating: 0 to +55 °C (+32 °F to 131 °F) Nonoperating: – 40 °C to 70 °C (– 40 °F to + 158 °F)
Altitude	Operating: 4,600m (15,000 ft.) Nonoperating: 15,300m (50,000 ft.)
Humidity	15% to 95% relative
Supplied with HP 5900A #500	• Pentium emulation probe • 20 pin cable • 30 pin cable • Power supply module
¹ As documented in the Intel Pentium Family User's Manual; Data Book	

Table 2: HP Emulation Probe and Module Specifications

Real-Time Trace Analysis

Real-time trace analysis consists of a physical connection to signals on the Intel Pentium processor, acquisition of relevant data, and analysis of the captured bus information.

Physical connection to the Pentium processor bus is made through an HP E9592A analysis probe.

The real-time trace solutions available for the Intel Pentium processor include inverse assembly, source correlation, and system performance analysis.

For information on the data acquisition modules for the HP 16600A and 16700A Series logic analysis systems, please refer to related HP literature on page 12.

Pentium Processor	Supported Speeds	Probing Solution	Real-Time Trace Solutions
Pentium Processor	Up to 200 MHz	SPGA Interposer Compatible with 296 pin, Socket 7	Inverse Assembler: - Disassembly of bus information into Pentium Processor mnemonics - Pentium Processor configuration files for logic analyzer
			Source Correlation: - Time-correlate acquired trace to high-level source code - Trigger and search through trace in high-level source code
Pentium Processor with MMX Technology	Up to 233 MHz		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

The inverse assembler quickly configures the logic analyzer by labeling address, data, and status signals for the Pentium processor. The inverse assembler also provides Pentium processor mnemonics in the trace listing for easy correlation between captured data and target code. The inverse assembler works with the HP B4620B source correlation tool set to provide time correlations 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 types of instructions such as data reads, data writes, I/O reads and I/O writes.

The inverse assembler has several modes of operation, depending on your processor configuration. The inverse assembler provides Pentium processor mnemonics when the cache is disabled and branch trace messages (BTM) are enabled.

HP B4620B Source Correlation Tool Set

The inverse assembler can be used with the HP B4620B source correlation tool set for the HP 16600A and 16700A logic analysis systems. This allows you to time-correlate an acquired trace to source code. The source correlation tool set uses the 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 also can easily locate the cause of a problem by stepping

The screenshot shows the 'Listing<1>' window with a menu bar (File, Edit, Options, Invasm, Help) and a toolbar (Navigate, Run). Below the toolbar are tabs for Search, Goto, Markers, Comments, Analysis, and Mixed Signal. A search bar contains 'A20M#', 'Value', and 'when Present'. Below the search bar are buttons for 'Advanced searching...', 'Set G1', and 'Set G2'. The main display area shows a table of assembly instructions:

State #	IP	Pentium(R) Inverse Assembly with MMX	DATA_B	DATA
Decimal	Hex	Mnemonics/Hex	Hex	Hex
44	000FE07B	BC81E0 MOV SP,0E081h		
	000FE07E	E94508 JMP 000FEB0Ch		
	000FE8C6	8EC4 MOV ES,SP	60000000	00000000
	000FE8C8	87F2 XCHG DX,SI		
	000FE8CA	BCD0E8 MOV SP,0E8D0h		
	000FE8CD	E9780D JMP 000FF648h		
50	000FF648	C3 RET near	80000000	00000000
54	000FE8D0	xxxxxxx xxxxE8D2 mem read	cpu0	00700465 BAFCE8D2
56	000FE8D2	87F2 XCHG DX,SI	20000000	00000000
	000FE8D4	B0BD MOV AL,0BDh		
	000FE8D6	32E4 XOR AH,AH		
	000FE8D8	BCDEE8 MOV SP,0E8DEh		
	000FE8DB	E9680A JMP 000FF346h		
61	000FF346	8AB8 MOV BL,AL	60000000	00000000
	000FF348	E670 OUT 70h,AL		
67	000FF34A	E300 JCXZ 000FF34Ch		
70	00000070	xxxxxxx xxxxxBD i/o write	cpu0	000000BD 000000BD
	000FF34C	E471 IN AL,71h	C0000000	00000000
	000FF34E	E300 JCXZ 000FF350h		
75	00000071	xxxxxxx xxxxx9Bxx i/o read	cpu0	00700465 00E39BE6
77	000FF350	22E0 AND AH,AL	00000000	00000000
	000FF352	8AC3 MOV AL,BL		
	000FF354	E670 OUT 70h,AL		
	000FF356	E300 JCXZ 000FF358h		
81	00000070	xxxxxxx xxxxxBD i/o write	cpu0	000000BD 000000BD
85	000FF358	86C4 XCHG AH,AL	80000000	00000000
	000FF35A	87BD XCHG BX,BX		
	000FF35C	E671 OUT 71h,AL		
	000FF35E	E300 JCXZ 000FF360h		

Figure 4: Inverse Assembly Listing

The screenshot shows the 'Source Viewer' window with a menu bar (File, Options, Trace, Help) and a toolbar (Navigate, Monitor). Below the toolbar are tabs for Step Source, Goto In Listing, Browse Source, Text Search, Symbols, and Info. A search bar contains 'A20M#', 'Value', and 'when Present'. Below the search bar are buttons for 'Advanced searching...', 'Set G1', and 'Set G2'. The main display area shows a table of source code and its correlation to assembly instructions:

State #	IP	Pentium(R) Inverse Assembly with MMX	DATA_B	DATA
Decimal	Line #	Mnemonics/Hex		
396453	users+7E00	xxxxxxx 0000xxxx mem read	cpu0	
396455	users+7E02	xxxx10B4 xxxxxxx mem read	cpu0	
396457	users+7E04	7EE6xxxx xxxxxxx mem read	cpu0	
396459	users+7E06	xxxxxxx xxx0079 mem read	cpu0	
396461	users+7E08	xxxxxxx 400Bxxxx mem read	cpu0	
396463	update: 65	NO POP DS		
update: 66	IF POP BP			
update: 68	BD RET far			
396465	users+7E0E	xxxx10B4 xxxxxxx mem read	cpu0	
396467	users+7E10	7EE6xxxx xxxxxxx mem read	cpu0	
396469	users+7E12	xxxxxxx xxx001D mem read	cpu0	
396471	users+7E14	xxxxxxx 400Bxxxx mem read	cpu0	
396473	main: 125	59 POP DI		
main: 126	FF060402	INC word ptr [000h]		
main: 126	801E02000	CMF byte ptr [020h+1,00h]		
main: 126	7403	JC ecx,main:main+002C		
396475	users+7E1A	xxxx0ED1 xxxxxxx mem read	cpu0	
396477	_naa_check	xxxx0ED1 xxxxxxx mem read	cpu0	
396479	_naa_check	xxxx0ED2 xxxxxxx mem write	cpu0	
396480	[main]+rbc	xxxx000x xxxxxxx mem read	cpu0	
396482	main: 127	40402 MOV RC,[0004h]		
main: 127	50	PUSH RC		
main: 127	5A55000040	CALL 4500h:005h		
396484	_naa_check	xxxx0ED2 xxxxxxx mem read	cpu0	
396486	main: 144	55 PUSH BP		

Figure 5: Inverse Assembled Trace Time-Correlated to Source Code using the HP Source Correlation Tool Set

backward to the root cause. With time-correlated analysis in both the digital and analog domains, HP provides powerful insight into your most difficult hardware/software integration problems.

OMF 386 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 Pentium processor. 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).

HP B4600B System Performance Analysis Tool Set

The system performance analyzer (SPA) tool set is an optional software package for the HP 16600A and 16700A Series logic analysis systems. The SPA tool set provides such statistical performance measurements 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 analysis tool set, as shown in figure 7.

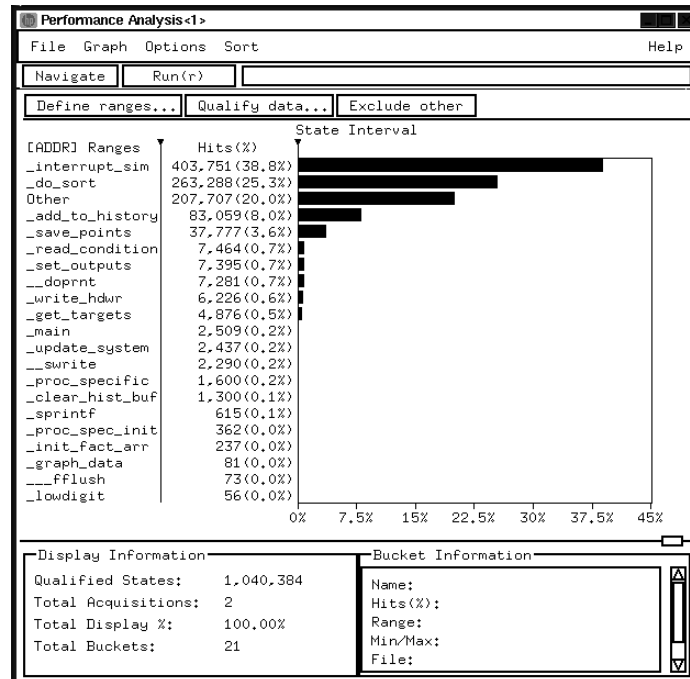


Figure 6: State Interval Measurement from the HP System Performance Analysis Tool Set

Analysis Probe

The analysis probe allows easy connection of an HP logic analyzer to your Pentium system for real-time analysis. With the analysis probe solution, you don't need to design special debug connectors into your target system. Mechanical dimensions are included in figure 7.

Modes of Operation

State Modes

State-per-transfer mode; in state-per-transfer mode, the logic analyzer is clocked upon completing data transfer cycles. In this mode, the analysis probe keeps track of the address pipeline and aligns data with its parent address.

In state-per-clock mode, address, data, and status are captured on each bus clock. This mode is useful in hardware validation and analysis during system crashes.

Timing Mode

Timing analysis is supported. All processor signals are buffered and passed on to the logic analyzer pods.

Technical Specifications

The analysis probe can be used with the 296-pin SPGA package for the Pentium processor and Pentium processor with MMX technology.

Capabilities

Disassembly of floating point and MMX instructions are supported.

Burst mode addresses are calculated and displayed in the state trace listing.

Timing analysis is supported. All signals go through 6.3 ns maximum buffers. (P/N 74FCT646AT).

The analysis probe can be configured to prequalify the logic analyzer clock on BRDY#, ADS#, EADS#, BOFF#, and HLDA, saving logic analyzer resources.

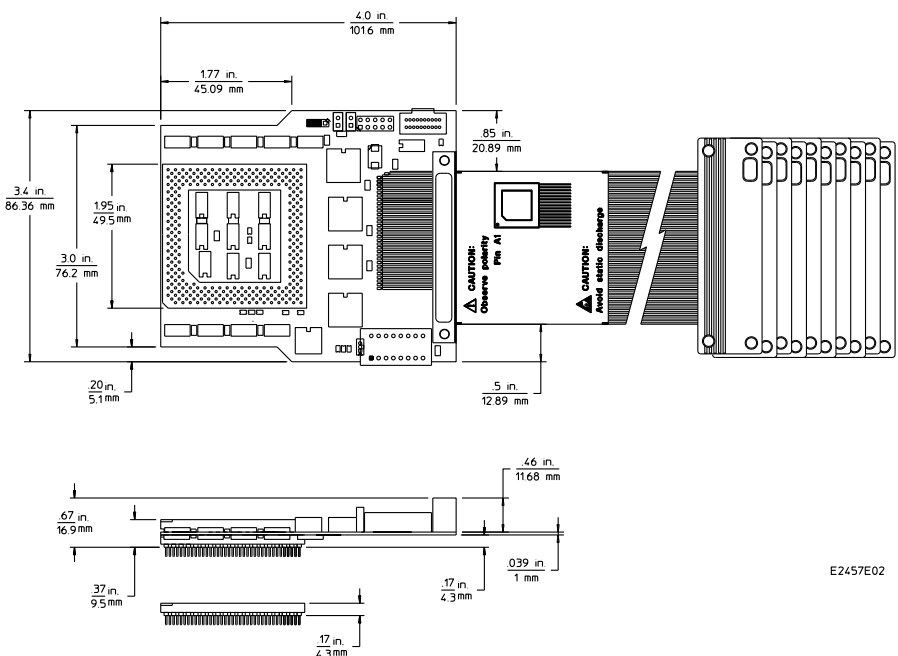
Pods Required

Eight 16-channel pods are required for inverse assembly. Two additional pods provide monitoring of other status signals.

Maximum Bus Clock Speed
66 MHz CLK external

Probe Loading

- 7 pF in series with 100 Ω on CLK.
- 14 pF in series with 50 Ω on ADS#, BOFF#, BRDY#, BRDYC#, HLDA, KEN#, and W/R#.
- 14 pF on INIT, TDO, SMIACK#, R/S#, RESET, BF0, STPCLK#, and D/P#.
- 10 pF on all other signals.



E2457E02

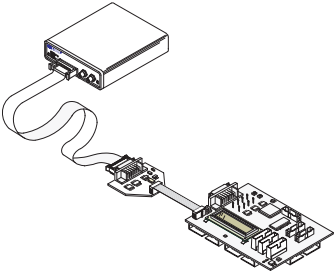
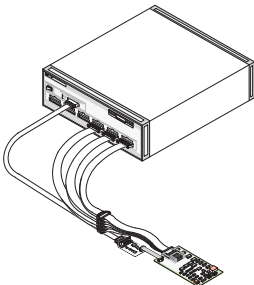
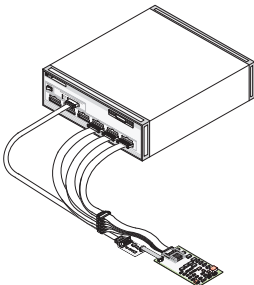
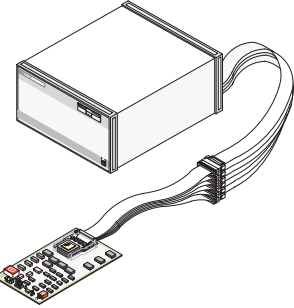
Figure 7: HP Analysis Probe Mechanical Dimensions

System Configuration and Ordering Information

HP makes it easier and more economical and easier to configure and 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 product numbers do not include logic analysis. The HP 16600A and 16700A Series logic analysis systems need to be ordered separately.

If you want to configure or upgrade your system with individual products, see page 12 for individual product number information.

	Solution	Products to Order	Included Components
	Emulation Solution		
	• Emulation Probe • Debugger Connection	• HP E5900A #500 • Order directly from CAD-UL	
	Emulation Solution with Real-Time Trace		
	• HP 16600A or 16700A Series Logic Analysis System	• Refer to HP publication number 5966-3148E for logic analyzer configuration • Supported logic analyzers: - HP 16600A - Two HP 16650 or three HP 16555/556 A/D cards	
	• Emulation Solution	• HP E9492A #002	• Analysis Probe • Source Correlation Tool Set • Emulation Module
	• Debugger Connection • Optional System Performance Analysis Tool Set	• Order directly from CAD-UL • HP B4600B	
	Logic Analysis Solution		
	• HP 16600A or 16700A Series Logic Analysis System	• Refer to HP publication number 5966-3148E for logic analyzer configuration • Supported logic analyzers: - HP 16600A - Two HP 16650 or three HP 16555/556 A/D cards	
• Analysis Probe Solution • Optional Source Correlation Tool Set • Optional System Performance Analysis Tool Set • Optional Emulation Module		• HP E9592A #002 • HP B4620B • HP B4600B • HP E5901A #500	• Analysis Probe • Inverse Assembler

Individual Components Ordering Information

Description	Product
Emulation Probe	HP E5900A #500
Emulation Module	HP E5901A #500
Analysis Probe	HP E9592A #002
Source Correlation Tool Set	HP B4620B
System Performance Analysis Tool Set	HP B4600B

Training and Consulting

HP has experienced Digital Systems Consultants who can help you maximize the utilization of your emulation and analysis system through training and consulting. Digital Systems Consultants are peaked in debugging complex digital hardware/software problems and hardware/software integration.

HP training may be delivered through scheduled courses, on-site classes, or one-on-one consulting. HP has courses for the beginner as well as advanced users migrating from the 16500 Series system. Call 1-800-593-6632 in the U.S. for information about training schedules and location or to register. For training offered in other geographies and languages, consult the HP Test and Measurement education web site: <http://www.hp.com/go/tmeducation>.

For consulting services, contact your local HP Test and Measurement sales office. An HP Digital Systems Consultant can help you solve tough digital debug problems by showing you how to apply HP tools and debug best practices. Topics covered can include:

- System Installation
- Complex Triggering
- Multiple Bus Analysis
- Source-Line Referencing
- System Performance Analysis
- Instrumenting Code to Solve Specific Issues
- Bus Signal Timing Analysis
- Signal Integrity Analysis
- HP 16700A/HP1660XA Networking

Topics related to debug of Pentium processor-based targets can include:

- Triggering Techniques to Handle Transaction Tracking and Cache Related Issues
- Effective Use of Branch Trace Messaging

Related HP Literature**Pub. Number**

<i>HP 16600A and 16700A Logic Analysis System Mainframes, Product Overview</i>	5966-3107E
<i>HP Logic Analysis Systems Upgrade, Product Overview</i>	5966-3059E
<i>System Configuration for the HP 16600A and 16700A Series Logic Analysis Systems, Configuration Guide</i>	5966-3148E
<i>State and Timing Analyzers for the HP 16500C Logic Analysis System, Product Overview</i>	5962-7245E

Warranty Information

These Hewlett-Packard products have a warranty against defects in material and workmanship for a period of one year from date of shipment. During this warranty period, Hewlett-Packard Company will, at its option, either repair or replace products that prove to be defective.

For more information about the HP 16600A and 16700A Series logic analysis systems visit our web site, <http://www.hp.com/go/las-data>

For more information about Hewlett-Packard test & measurement products, applications, services, and for a current sales office listing, visit our web site, <http://www.hp.com/go/tmdir>

You can also contact one of the following centers and ask for a test and measurement sales representative.

United States:
Hewlett-Packard Company
Test and Measurement Call Center
P.O. Box 4026
Englewood, CO 80155-4026
1 800 452 4844

Canada:
Hewlett-Packard Canada Ltd.
5150 Spectrum Way
Mississauga, Ontario
L4W 5G1
(905) 206 4725

Europe:
Hewlett-Packard
European Marketing Centre
P.O. Box 999
1180 AZ Amstelveen
The Netherlands
(31 20) 547 9900

Japan:
Hewlett-Packard Japan Ltd.
Measurement Assistance Center
9-1, Takakura-Cho, Hachioji-Shi,
Tokyo 192, Japan
Tel: (81-426) 56-7832
Fax: (81-426) 56-7840

Latin America:
Hewlett-Packard
Latin American Region Headquarters
5200 Blue Lagoon Drive
9th Floor
Miami, Florida 33126
U.S.A.
Tel: (305) 267 4245/4220
Fax: (305) 267 4288

Australia/New Zealand:
Hewlett-Packard Australia Ltd.
31-41 Joseph Street
Blackburn, Victoria 3130
Australia
Tel: 1 800 629 485 (Australia)
Tel: 0 800 738 378 (New Zealand)
Fax: (61 3) 9210 5489

Asia Pacific:
Hewlett-Packard Asia Pacific Ltd
17-21/F Shell Tower, Times Square,
1 Matheson Street, Causeway Bay,
Hong Kong
Tel: (852) 2599 7777
Fax: (852) 2506 9285

Technical information in this document is subject to change without notice