The HP 1670-Series Benchtop Logic Analyzers

Technical Data

Identifying the cause of problems in embedded microprocessor system designs can be difficult. The Hewlett-Packard 1670-series benchtop logic analyzers have the features to help the embedded system design team find hardware and software defects quickly.

With 64K of acquisition memory (1M optional) the HP 1670-series logic analyzers are the first benchtop logic analyzers which display processor mnemonics and verify critical hardware timing relationships over a long period of time.

With the standard Ethernet LAN interface, the software designer can now capture a real-time microprocessor trace and time-correlate it to source code in C++ or other high-level languages on a PC or workstation. For time-correlation of source code, order the HP B3740A Software Analysis package.

The combination of deep memory, large internal disk drive, and LAN make the HP 1670-series of benchtop logic analyzers especially well suited to solving your integration problems.

- Mass storage is provided by an internal hard drive which provides quick storage and retrieval of files.
- The 3.5-inch high-density flexible disk drive supports both DOS and LIF formats.
- The LAN interface enables access to the logic analyzer files via FTP or NFS. Use X11 windows to control or view the logic analyzer on a PC or workstation. The LAN interface includes both Ethertwist (10BASE-T) and ThinLan (10BASE 2) connectors.
- Store data as ASCII files and screen images in TIFF, PCX, and EPS (encapsulated PostScript™) formats.

Get to the root cause of problems quickly

- New graphical trigger macros make trigger setup easier.
- Centronics, RS-232, HP-IB and LAN communication ports make connecting to other devices easier than ever. All of these come standard on all models of the HP 1670-series.
- The HP 1670-series operating system includes System Performance Analysis (SPA). SPA provides state histograms, state overview, and time interval analysis.
- The HP E2450A Symbolic Download Utility is included with the HP 1670-series. This utility provides the capability to extract symbolic information from popular object module formats.

PostScript™ is a trademark of Adobe Systems Incorporated.

Logic Analyzer Key Specifications and Characteristics

Model Number	HP 1670D	HP 1671D	HP 1672D
State and Timing Channels	136	102	68
Timing Analysis	Conventional: 125 MHz all channels, 250 MHz half channels		
State Analysis Speed	100 MHz, all channels		
State Clocks/ Qualifiers	4	4	4
Memory Depth per Channel	64K per channel, 128K in timing half-channel mode (1M per channel optional memory, 2M in timing half-channel mode)		

Human Interface

Front Panel	A knob and keypads make up the front-panel human interface. Keys include control, menu, display navigation, and alpha-numeric entry functions.
Mouse	A DIN mouse is shipped as standard equipment. It provides full instrument control. Knob functionality is replicated by holding down the right button and moving the mouse left or right.
Keyboard	The logic analyzer can also be operated using a DIN keyboard. Order the HP Logic Analyzer Keyboard Kit, model number HP E2427B.

Input/Output, Control, and Printing

I/O Ports	All units ship with a Centronics parallel printer port, RS-232, and HP-IB as standard equipment.
LAN Interface	An Ethernet LAN interface is standard with the HP 1670-series. The LAN interface comes with both Ethertwist (10BASE-T) and ThinLan (10BASE2) connectors.The LAN supports FTP and PC/NFS connection protocols. It also works with X11 window packages.
Software Analysis Capability	The HP B3740A Software Analyzer provides true source line referencing and symbol download capabilities. Standard object module formats are supported.
Programmability	Each instrument is fully programmable from a computer via HP-IB and RS-232 connections. This feature is standard on all models.
HP Printer Support	Printers which use the HP Printer Control Language (PCL) and have a parallel Centronics, RS-232 or HP-IB interface are supported: HP DeskJet, LaserJet, QuietJet, PaintJet, and ThinkJet models.
Alternate Printer Supported	The Epson FX80, LX80 and MX80 printers with an RS-232 or Centronics interface supported in the Epson 8-bit graphics mode.
Hard Copy Output	Screen images can be printed in black and white from all menus using the *Print* field. State or timing listings can be printed in full or part (starting from center screen) using the *Print All* selection.

Mass Storage Files and Software

Updating the Operating System	The operating system resides in Flash ROM and can be updated from the flexible disk drive or the hard disk drive.
Mass Storage	Is supported by an internal hard disk drive and by a 1.44 Mbyte, 3.5-inch flexible disk drive. Supports DOS and LIF formats. A disk drive provides quick storage and retrieval of files.
Screen Image Files	An image file of any display screen can be stored to disk via the display's *Print* field. Black & white TIFF, PCX, Encapsulated PostScript (EPS) , and gray-scale TIFF file formats are available.
ASCII Data Files	State or timing listings can be stored as ASCII files on a flexible disk via the display's *Print* field. These files are equivalent in character width and line length to hardcopy listings printed via the *Print All* selection.
Configuration and Data Files	Logic analyzer files that include configuration and data information (if present) are encoded in a binary format. They can be stored to or loaded from the hard disk drive or a flexible disk.
Recording of Acquisition and Storage Times	Binary format configuration/data files are stored with the time of acquisition and the time of storage.

Acquisition Arming

Initiation	Arming is started by *Run* or the Port In BNC.
Cross Arming	The analyzer machines can cross-arm each other.
Output	An output signal is provided at the Port Out BNC.

HP 1670-series Logic Analyzer Specifications and Characteristics

Port In/Out

PORT IN Signal and Connection	Port In is a standard BNC connection. The input operates at TTL logic signal levels. Rising edges are valid input signals.
PORT OUT Signal and Connection	Port Out is a standard BNC connection with TTL logic signal levels. A rising edge is asserted as a valid output.

Arming Times

PORT IN Arms Logic Analyzer [1]	15 ns typical delay from signal input to a *don't care* logic analyzer trigger.
Logic Analyzer Arms PORT OUT [1]	120 ns typical delay from logic analyzer trigger to signal output.

Operating Environment

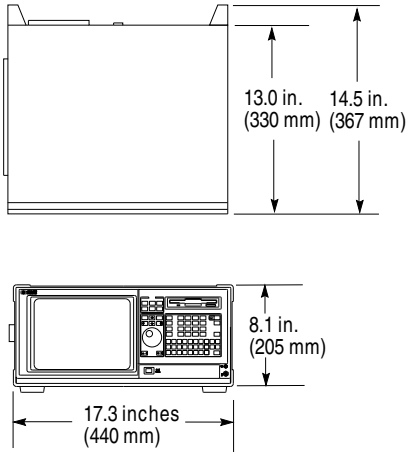
Power	115 Vac or 230 Vac, –22% to +10%, single phase, 48-66 Hz, 320 VA max
Temperature	Instrument, 0° to 50° C (+32° to 122° F). Disk media, 10° to 40° C (+50° to 104°F). Probes and cables, 0° to 65° C (+32° to 149° F)
Humidity	Instrument, up to 95%, relative humidity at +40° C (+140° F). Disk media and hard drive, 8% to 85% relative humidity.
Altitude	To 3,048 m (10,000 ft)
Vibration: Operating	Random vibrations 5–500Hz, 10 minute per axis, ~ 0.3 g (rms).
Vibration: Non Operating	Random vibrations 5–500 Hz,10 minutes per axis,~ 2.41 g (rms); and swept sine resonant search, 5–500 Hz, 0.75 g (0-peak), 5 minute resonant dwell @ 4 resonances per axis.

Physical Factors

Weight	28.6 lbs. (13 kg)
Dimensions	See figure 1
Safety	IEC 348/ HD 401, UL 1244, and CSA Standard C22.2 No. 231 (series M-89)

EMC

CISPR 11:1990/EN 55011 (1991): Group 1 Class A
IEC 801-2:1991/EN 50082-1 (1992): 4kV CD, 8 kV AD
IEC 801-3:1984/EN 50082-1 (1992):3V/m
IEC 801-4:1988/EN 50082-1 (1992): 1kV



Weight 28.6 lb. (13kg)

Figure 1

Logic Analyzer Probes

Input Resistance	100 kΩ ±2%
Input Capacitance	approx. 8 pF (see figure 2)

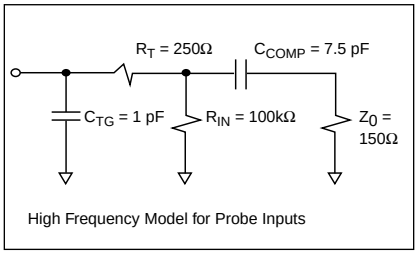


Figure 2

Minimum Input Voltage Swing	500 mV peak-to-peak
Minimum Input Overdrive	250 mV or 30% of input amplitude, whichever is greater
Threshold Range	–6.0 V to +6.0 V in 50-mV increments
Threshold Setting	Threshold levels may be defined for pods (17-channel groups) on an individual basis
Threshold Accuracy*	± (100 mV +3% of threshold setting)
Input Dynamic Range	± 10 V about the threshold
Maximum Input Voltage	± 40 V peak
+5 V Accessory Current	1/3 amp maximum per pod
Channel Assignment	Each group of 34 channels (a pod pair) can be assigned to Analyzer 1, Analyzer 2 or remain unassigned.

[1] Time may vary depending upon the mode of logic analyzer operation.
* Warranted Specification

State Analysis

Maximum State Speed	100 MHz	
Channel Count [2]	HP 1670D HP 1671D HP 1672D	136/68 102/51 68/34
Memory Depth per Channel		
Standard	**64K** (65,536) samples	
Time Tags On	32K (32,768) samples)	
Compare Mode On	32K (32,768) samples)	
Compare Mode and Time Tags On	32K (32,768) samples)	
Option 030	**1M** (1,032,192) samples	
Time Tags On	500K (507,904) samples	
Compare Mode On	250K (245,760) samples	
Compare Mode and Time Tags On	120K (114,688) samples	
State Clocks	HP 1670D HP 1671D HP 1672D	4 clocks 4 clocks 4 clocks
	Clocks can be used by either one or two state analyzers at any time. Clock edges can be ORed together and operate in single phase, two-phase demultiplexing, or two-phase mixed mode. Clock edge is selectable as positive, negative, or both edges for each clock.	
State Clock Qualifier	The high or low of the clocks can be ANDed or ORed with the clock specification.	
Setup/Hold [3]		
one clock, one edge	3.5/0 ns to 0/3.5 ns (in 0.5 ns increments)	
one clock, both edges	4.0/0 ns to 0/4.0 ns (in 0.5 ns increments)	
multi-clock, multi-edge	4.5/0 ns to 0/4.5 ns (in 0.5 ns increments)	
Minimum State Clock Pulse Width [3]	3.5 ns	
Minimum Master to Master Clock Time [3]	10 ns	
Minimum Slave to Slave Clock Time [3]	10 ns	
Minimum Master to Slave Clock Time [3]	0.0 ns	
Minimum Slave to Master Clock Time [3]	4.0 ns	
Clock Qualifiers Setup/Hold [3]	4.0/0 ns (fixed)	
State Tagging [4]	Counts the number of qualified states between each stored state. Measurement can be shown relative to the previous state or relative to trigger. Max. count is 4.29×10^9.	
State Tag Count	0 to 4.29×10^9	
State Tag Resolution	1 count	
Time Tagging [4]	Measures the time between stored states, relative to either the previous state or to the trigger. Max. time between states is 34.4 sec. Min. time between states is 8 ns.	
Time Tag Value	8 ns to 34.4 seconds ± (8 ns + 0.01% of time tag value)	
Time Tag Resolution	8 ns or 0.1% (whichever is greater)	

Timing Analysis

Conventional Timing	Data stored at selected sample rate across all timing channels.	
Maximum Timing Speed [2]	125 MHz/250 MHz	
Channel Count [2]	HP 1670D HP 1671D HP 1672D	136/68 102/51 68/34
Sample Period [2]	8 ns/4 ns minimum 41 µs/10 µs maximum	
Memory Depth per Channel [2]	**64K standard** 64K/128K samples (65,536/131,072)	
	1M option 1M/2M samples (1,032,192/2,080,768)	
Time Covered by Data [2]	Sample period × memory depth	

[2] Full Channel /Half Channel Modes

[3] Specified for an input signal VH= – 0.9V, VL = – 1.7V, slew rate = 1V/ns, and threshold = –1.3V

[4] Time or-state-tagging (Count Time or Count State) is available in the full-channel state mode. There is no speed penalty for tag use. Memory is halved when time or state tags are used unless a pod pair (34-channel group) remains unassigned in the Configuration menu.

Time Interval Accuracy

Sample Period Accuracy	± 0.01%
Channel-to-Channel Skew	2 ns typical, 3 ns maximum
Time Interval Accuracy	± (Sample Period + channel-to-channel skew + 0.01% of time interval reading)
Maximum Delay After Triggering	Sample Period 4-8 ns : 8.389 ms Sample Period > 8 ns: 1,048,575 × sample period

Trigger Specifications

Trigger Macros	Trigger setups can be selected from a categorized list of trigger macros. Each macro is shown in graphical form and has a written description. Macros can be chained together to create a custom trigger sequence.
Pattern Recognizers	Each recognizer is the AND combination of bit (0,1, or X) patterns in each label.
Pattern Recognizers	10
Pattern Width (in channels) [2]	HP 1670D 136/68 HP 1671D 102/51 HP 1672D 68/34
Minimum Pattern and Range Recognizer Pulse Width	125 MHz and 250 MHz Timing Modes: 13 ns + channel-to-channel skew ≤ 125 MHz Timing Modes : 1 sample period + 1 ns + channel-to-channel skew + 0.01%
Range Recognizers	Recognize data which is numerically between or on two specified patterns (ANDed combination of zeros and/or ones).
Range Recognizers	2
Range Width	32 channels
Edge/Glitch Recognizers	Trigger on glitch or edge on any channel. Edge can be specified as rising, falling or either.
Edge/Glitch Recognizers	2 (in timing mode only)
Edge/Glitch Width (in channels) [2]	HP 1670D 136/68 HP 1671D 102/51 HP 1672D 68/34
Edge/Glitch Recovery Time	Sample Period 4-8 ns: 28 ns Sample Period > 8 ns: 20 ns + sample period
Greater than Duration (timing only)	Sample period 4-8 ns: 8 ns to 8.389 ms. Accuracy is –2 ns to +10 ns Sample period > 8 ns: (1 to 2^{20}) × sample period. Accuracy is –2 ns + sample period + 2 ns ± 0.01%
Less than Duration (timing only)	Sample period 4-8 ns: 8 ns to 8.389 ms. Accuracy is –2 ns to +10 ns. Sample period > 8 ns: (1 to 2^{20}) × sample period. Accuracy is 2 ns + sample period – 2 ns ± 0.01%
Qualifier	A user-specified term that can be any state, no state, any recognizer, (pattern, ranges or edge/glitch), any timer, or the logical combination (NOT, AND, NAND, OR, NOR, XOR, NXOR) of the recognizers and timers.
Branching	Each sequence level has a branching qualifier. When satisfied, the analyzer will branch to the sequence level specified.
Occurrence Counters	Sequence qualifier may be specified to occur up to 1,048,575 times before advancing to the next level. Each sequence level has its own counter.
Maximum Occurrence Count	1,048,575
Storage Qualification (state only)	Each sequence level has a storage qualifier that specifies the states that are to be stored.
Maximum Sequencer Speed	125 MHz
State Sequence Levels	12
Timing Sequence Levels	10

[2] Full Channel /Half Channel Modes

Timers	Timers may be Started, Paused, or Continued at entry into any sequence level after the first.
Timers	2
Timer Range	400 ns to 500 seconds
Timer Resolution	16 ns or 0.1% whichever is greater
Timer Accuracy	± 32 ns or ± 0.1%, whichever is greater
Timer Recovery Time	70 ns
Data In to Trigger Out BNC Port	110 ns typical

Acquisition, Measurement and Display Functions

Arming	Each analyzer can be armed by the Run key, the other analyzer, or the Port In.
Run	Starts acquisition of data in specified trace mode.
Stop	Stop halts acquisition and displays the current acquisition data.
Trace Mode	Single mode acquires data once per trace specification; repetitive mode repeats single mode acquisitions until Stop is pressed or until pattern time interval or compare stop criteria are met.
Trigger	Displayed as a vertical dashed line in the timing waveform, state waveform and X-Y chart displays and as line 0 in the state listing and state compare displays.
Activity Indicators	Provided in the Configuration, State Format, and Timing Format menus for monitoring device-under-test activity while setting up the analyzer.
Labels	Channels may be grouped together and given a 6-character name called a *label*. Up to 126 labels in each analyzer may be assigned with up to 32 channels per label. Trigger terms may be given an 8-character name.

Measurement Functions

Markers	Two markers (x and o) are shown as dashed lines in the display.
Time Intervals	The x and o markers measure the time interval between events occurring on one or more waveforms or states. Available in state when time tagging is on.
Delta States	The x and o markers measure the number of tagged states between any two states (state only).
Patterns	The x or o marker can be used to locate the nth occurrence of a specified pattern before or after trigger, or after the beginning of data. The o marker can also find the nth occurrence of a pattern before or after the x marker.
Statistics	x to o marker statistics are calculated for repetitive acquisitions. Patterns must be specified for both markers, and statistics are kept only when both patterns can be found in an acquisition. Statistics are minimum x to o time, maximum x to o time, average x to o time, and ratio of valid runs to total runs.
Compare Mode Functions	Performs post-processing bit-by-bit comparison of the acquired state data and Compare Image data.
Compare Image	Created by copying a state acquisition into the compare image buffer. Allows editing of any bit in the Compare Image to a 1, X or O.
Compare Image Boundaries	Each channel (column) in the compare image can be enabled or disabled via bit masks in the Compare Image. Upper and lower ranges of states (rows) in the compare image can be specified. Any data bits that do not fall within the enabled channels and the specified range are not compared.
Stop Measurement	Repetitive acquisitions may be halted when the comparison between the current state acquisition and the current Compare Image is equal or not equal.
Compare Mode Displays	Reference Listing display shows the Compare Image and bit masks; Difference Listing display highlights differences between the current state acquisition and the Compare Image.

Data Entry/Display

Display Modes	State Listing, State Waveforms, State Chart, State Compare Listing, Compare Difference Listing, Timing Waveforms, Timing Listing, interleaved time-correlated listing of two state analyzers (time tags on), and time-correlated State Listing with Timing Waveforms on the same display.
State X-Y Chart Display	Plots value of a specified label (on y-axis) versus states or another label (on x-axis). Both axes can be scaled.
Markers	Correlated to State Listing, State Compare, and State Waveform displays. Available as pattern, time, or statistics (with time counting) and states (with state counting on).
Accumulate	Chart display is not erased between successive acquisitions.
State Waveform Display	Displays state acquisitions in waveform format.
States/div	1 to mem length/8
Delay	± memory length
Accumulate	Waveform display is not erased between successive acquisitions.
Overlay Mode	Multiple channels can be displayed on one waveform display line.
Displayed Waveforms	24 lines maximum on one screen. Up to 96 lines may be specified and scrolled through.
Timing Waveform Display	Displays timing acquisition in waveform format.
Sec/div [2]	1 ns to 4.4 sec/div/ 1 ns to 2.2 sec/div
Delay	– 2,500 s to + 2,500 s
Accumulate	Waveform display is not erased between successive acquisitions.
Overlay Mode	Multiple channels can be displayed on one waveform display line. When waveform size set to large, the value represented by each waveform is displayed inside the waveform in the selected base.
Displayed Waveforms	24 lines maximum on one screen. Up to 96 lines may be specified and scrolled through.
System Performance Analysis	SPA includes state histogram, state overview and time interval measurements to aid in the software optimization process. These tools provide a statistical overview of your synchronous design. For additional information, refer to HP 10390A System Performance Software technical data sheet, pub no. 5091-7850E.
Bases	Binary, Octal, Decimal, Hexadecimal, ASCII (display only), symbols, two's compliment.

Symbols	
Pattern Symbols	User can define a mnemonic for the specific bit pattern of a label. When data display is SYMBOL, mnemonic is displayed where the bit pattern occurs.
Range Symbols	User can define a mnemonic covering a range of values. When data display is SYMBOL, values within the specified range are displayed as mnemonic + offset from base of range.
Number of Symbols	1000 maximum.

[2] Full Channel /Half Channel Modes

Ordering Information

HP 1670D-Series Benchtop Logic Analyzers

HP 1670D	136-Channel 100-MHz State/250-MHz Timing with 64K Memory Depth and Ethernet LAN
HP 1671D	102-Channel 100-MHz State/250-MHz Timing with 64K Memory Depth and Ethernet LAN
HP 1672D	68-Channel 100-MHz State/250-MHz Timing with 64K Memory Depth and Ethernet LAN

Additional HP 1660C/CS and 1670D-Series Product Options

Opt 030	Extended Memory depth to 1M samples/channel (ordered at the time of purchase)
Opt 0B3	Add Service Manual
Opt 1CM	Rack Mount Kit
Opt UK9	Front Panel Cover
Opt W30	3-Year extended repair service
Opt W50	5-Year extended repair service
Opt OBF	Add Programming Manual

Accessory Software

HP B3740A	Software Analyzer
Opt AJ4	IBM, 3.5-inch Media/Documentation
Opt AAY	HP 9000 Series 700 Media/Documentation
Opt AAV	SUN (Solaris and SUN OS) Media/Documentation
Opt UDY	IBM Single User License
Opt UBY	HP 9000 Series 700 Single User License
Opt UBK	SUN (Solaris and SUN 0S) Single User License
HP 10391B	Inverse Assembler Development Package

HP 1670D-Series Upgrades

HP E2471D	Upgrade HP 1670D-Series from 64K to 1M of memory
Opt 001	Upgrades HP 1670D from 64K to 1M of acquisition memory
Opt 002	Upgrades HP 1671D from 64K to 1M of acquisition memory
Opt 003	Upgrades HP 1672D from 64K to 1M of acquisition memory
HP E2427B	Add keyboard with DIN connector (PC style)

State/Timing Analyzer Probes & Lead Sets

HP 5959-9333	5 Grey Probe Leads for HP 1670D-Series
HP 5959-9334	5 Short Ground Leads for HP 1670D-Series
HP 5959-9335	5 Long Ground Leads for All State and Timing Analyzers
HP 01650-61608	16-Channel Probe Lead Set for State and Timing Analyzers
HP 01650-63203	Termination Adapter for State and Timing Analyzers
HP 1810-1278	9-Channel IC Termination DIP
HP 1810-1588	Termination IC SIP
HP 1251-8106	2 × 10, 0.1-inch Center Header (Similar to 3M p/n 2520-6002)
HP 5090-4356	Surface-Mount Grabbers (package of 20)
HP 5959-0288	Throughhole Grabbers (package of 20)

Other Accessories for HP Logic Analyzers

HP 1180B	Testmobile for the HP 1670-Series
HP 92199B	Power Strip
HP 5041-9456	Front Cover for HP 1670-Series
HP 5062-7379	Rack Mount Kit for HP 1670-Series

For more information on Hewlett-Packard Test & Measurement products, applications or services please call your local Hewlett-Packard sales offices. A current listing is available via Web through AccessHP at http://www.hp.com. If you do not have access to the internet, please contact one of the HP centers listed below and they will direct you to your nearest HP representative.

United States:
Hewlett-Packard Company
Test and Measurement Organization
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Bldg. 51L-SC
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