



# Combine a High-Performance Scope With the Triggering Power of HP's State and Timing Analyzers

Hewlett-Packard. the leader in logic analysis, now provides a 2 GSa/s, multichannel oscilloscope in a logic analyzer. The HP 16534A digitizing oscilloscope module gives you the performance you need to make highly accurate, repeatable, single-shot measurements across as many as 8 channels on a single time base. This performance, combined with the triggering power of HP's highperformance state and timing analyzers, give you the ideal analysis tool for today's highspeed CMOS, GTL, and ECLbased designs. The HP 16533A is a remarkable value in a 250-MHz, 1-GSa/s oscilloscope integrated into a modular logic analysis system.

> Triggering the oscilloscope from the state analyzer provides context for waveform measurements. Here the state analyzer is used to arm the scope only on read cycles. The scope is used to check timing and signal integrity on the address strobe and read/write signals.

# **Key Specifications**

	HP 16533A	HP 16534A
Bandwidth	250 MHz	500 MHz
Sampling rate	1 GSa/s	2 GSa/s
Vertical resolution	8 bits	8 bits
Time interval measurement accuracy	± [(0.005% of ∆T) + (2E–6 × delay setting) + 100 ps]	
Number of channels		
Per card	2	2
On a single time base and trigger	8	8
In a single system	20	20

Tackle Your ToughestDebugging Problems With 8-bitVertical Resolution and 0.005%±100-ps Time Interval AccuracyEasily troubleshoot signal problemsdue to noise, ringing, overshoot,crosstalk, or simultaneous switching.

Quickly characterize the effects of slow rise times, propagation delays, and marginal setup and hold times with time interval accuracy of  $\pm$  (0.005% + 100 ps). Accurate and reliable measurements give you the confidence you need when evaluating tight timing margins in today's high-speed digital systems.

# **Correlate Software and Analog Hardware Problems Using Full Cross-Domain Analysis**

Dense circuit boards and fast logic designs can cause noise or crosstalk-induced functional problems. As you know, these problems can be very difficult to trace to root cause. With the HP 16500 system, you can trigger on software execution with the state analyzer, while viewing the behavior of the hardware with high-speed timing and oscilloscope modules, all time-correlated on the same display.



## Improve Productivity With Automatic Parametric Measurements

- Analyze a signal's behavior with automatic measurements of rise time, voltage, and frequency.
- Measure voltage and time relationships precisely with time markers.
- Characterize your circuit's properties with automatic marker placement and statistics.
- Identify timing violations with limit testing.



Automatic measurements save time in characterizing signal parameters.

2GS 32H V Marke On	K Scope D Marker Autoscale Cancel Run ers Va On Va Volts Vb On Vb Volts Va to Vb Center D1 -1.816 V D1 -804 mV
s/Div 2.00 n	7 Delay 3.48 ns Auto Auto Tx to To 4.95 ns Trig to X 5.48 ns
D2	

Time and voltage markers allow you to measure signal details precisely.

### **Flexible Display Modes**

- Observe differential logic signals with (A-B) display mode.
- Find signals buried in uncorrelated noise with signal averaging.
- Catch infrequent error conditions using accumulate mode over multiple acquisitions.
- Display channels individually or overlaid to observe timing relationships.

## **Flexible Channel Count**

Analyze complex handshake signals or bus cycles with multiple scope cards. Measure critical timing relationships precisely by simultaneously capturing as many as eight single-shot channels at 500-MHz bandwidth. Install as many as 20 channels in a single system using the HP 16501A expansion frame.

### **Pick the Optimum Probe**

For the most accurate high-frequency measurements, HP recommends either an active probe, such as the HP 1145A 750-MHz dual active probe, the HP 1144A 800-MHz active probe, or passive resistive divider probes, such as the HP 10442A, 10:1, 500  $\Omega$  probe or the HP 10443A, 20:1, 1000  $\Omega$  probe. Power is provided by the HP 16533A and 16534A for the HP 1144A or 1145A active probe. To use two HP 1144A active probes with one HP 16533A or 16534A, use the HP 01144-61604 power divider. For more information and guidelines on probing, refer to HP product note 54720A-3, pub. no. 5091-3758, "Selecting Oscilloscope **Probes for High-Speed Digital** Circuit Measurements."



The HP 1145A's 750-MHz bandwidth and 2-pF input capacitance make it the right choice for dependable measurements on highspeed logic.

(100/500MHz LA A) (Mixed Display)				Cancel Group Run						
Label>	ADDR	DATAH1		STAT		R/-W	SIZ	FC	DSACK	IFE
	Hex	ASCII		Symbol		Hex	Hex	Не	Hex	Hex
-4	20041		Data	Write		0	1	7	3	0
-3	20041		Data	Write		, o	1	7	3	0
-2	20041		Data	Read Read		1	1	4	3 7	ů ů
	20041	}	Data	Read		1	1		3	0
ĩ	0800E	5	Data	Write		ó	i	ż	3	ŏ
2	41DF4		Орсон	de Fetch		1	2	7	3	1
3	41DE8	a	Opcor	de Fetch		1	2	7	3	1
sec/Div 1.00 us	De	lay 27 us			X to 246	0 ns (	Trig t -22.49	.o X I us	Trig -22.2	to O 24 us
E1 F	<u>(</u>		~ <u>`</u> ~					` <u> </u>	· · ·	
E2 5					<u>Y</u>			`		
B_DATA 1 DSP_EN						1		1		
R/_W -										

Time-correlated state, timing, and analog displays give you the critical insight to solve tough digital circuit debugging problems.

# Specifications\*

Bandwidth HP 16533A HP 16534A	dc to 250 M dc to 500 M	1Hz 1Hz
dc offset accuracy	±(1% of offs full scale)	set + 2% of
dc voltage measurement accuracy	±(1.25% of t offset accu + 0.016 div)	full scale + racy
Time interval measurement accuracy at maximum sampling rate, on a single scope card, on a single acquisition	±[(0.005% o +(2E–6 × de + 100 ps]	of $\Delta$ T) Elay setting)
Trigger sensitivity	10 mV/div to 10 V/div	4mV/div
dc to 50 MHz	0.25 div	0.63 div
50 MHz to 500 MHz	0.5 div	1.25 div
Input resistance	1 MΩ ±1% 50 Ω ±1%	

 $^{\star}\mbox{(specifications refer to the input to the BNC connector)}$ 

### Note:

Specifications apply only within  $\pm$  10 °C of the temperature at which the most recent calibration was performed.

# Characteristics

# GENERAL

Maximum compling rat	
iviaximum samping rat	e
HP 16533A	1 GSa/s
HP 16534A	2 GSa/s
Number of channels	2 to 8 using the same time base and trigger. Up to 10 channels may be installed in a single
	HP 16500B frame, or up
	to 20 in a single system
	expansion frame.
Waveform record length	32768 points
Compatibility	Requires an HP 16500B
	Trame or an HP 16500A
	upgrade installed.
	 ?F)
(characteristics refer to	the input at the BNC
connector)	P
Vertical sensitivity	4 mV/div to 10 V/div in
range	1:2:4 steps
Vertical resolution	8 bits over 4 vertical divisions
Rise time (calculated from bandwidth)	700 ps
dc gain accuracy	±(1.25% of full scale + 0.08% per °C difference from cali- bration temperature)
dc offset range	N
Vertical sensitivity 4 mV/div–100 mV/div	Offset range ±2 V
100 mV/div-400 mV/div	±10 V
400 mV/div–2.5 V/div	±50 V
2.5 V/div–10 V/div	±250 V
Probe attenuation	Any integer ratio from 1:1 to 1000:1 factor
Channel-to-channel isolation (with	
equal)	
equal) dc–50 MHz	40 dB
equal) dc–50 MHz 50 MHz–500 MHz	40 dB 30 dB
dc–50 MHz 50 MHz–500 MHz Maximum safe input voltage	40 dB 30 dB
equal) dc–50 MHz 50 MHz–500 MHz Maximum safe input voltage 1 MΩ	40 dB 30 dB ±250 V dc + peak ac (<10 kHz)

# HORIZONTAL (TIME)

HORIZONTAL (TIM	E)
Time base ranges	0.5 ns/div to 5 s/div
Time base resolution	10 ps
Delay range	
pretrigger	81.8 s – 5 divisions
posttrigger	2.5E3 seconds
Time interval	±{(0.005% of Δ T)
measurement	+(2E–6 $\times$ delay setting)
accuracy for	+[0.15/(sample rate)]}
other than maximum.	
for bandwidth-limited	
signals [signal rise time	9
> 1.4/(sampling rate)],	
on a single acquisition	
Time interval measure-	+ [(0.005% of AT)
ment accuracy for 2, 3,	+ $(2E-6 \times \text{delay setting})$
or 4 HP 16533As or	+ 550 ps
16534As operating	
on a single time	
ments made between	
channels on different	
cards, at maximum sampling rate	
TRIGGER	
Trigger level range	Within display window (vertical offset ±2 divisions)
Trigger modes	
Immediate	Triggers immediately after arming condition is met
Edge	Triggers on rising or falling edge on channel 1 or channel 2
Pattern	Triggers on entering or exiting a specified pattern across both channels
Auto condition	Self-triggers if trigger is not satisfied within approximately 50 ms after arming
Events delay	The trigger can be set to occur on the nth occurrence of an edge or pattern, $n \le 32000$
Intermodule	Arms another measurement module or activates a trigger output on the rear panel BNC connector when the trigger condition is met



# **Ordering Information**

### HP 16533A, 1-GSa/s oscilloscope module\* HP 16534A, 2-GSa/s oscilloscope module\*

Includes:

1 User's Reference

1 Programming Reference

2 HP 10441A, 10:1, 10 pF, 1 M  $\Omega$  probes

\* Note: Requires HP 16500B logic analyzer mainframe, or HP 16500A upgraded with HP 16500U upgrade kit

### Options

001 Add one HP 1145A, dual, active, 750-MHz probe

ABJ Japanese User's Reference

0B0 Delete manuals

1BP MIL STD. 45662A calibration with test data

W03 Three month on-site warranty instead of one-year return-to-HP warranty

### Accessories Available

HP 1144A active, 800-MHz probe (power for the HP 1144A is provided by the HP 16533A and HP 16534A)

HP 01144-61604 power splitter, allows operating two HP 1144A active probes from one HP 16533A or HP 16534A

HP 1145A dual active, 750-MHz probe (power for the HP 1145A is provided by the HP 16533A and HP 16534A)

HP 1141A 200-MHz differential probe (requires an HP 1142A power supply)

HP 1142A probe power supply

HP 10442A, 10:1, 500 Ω, 1.2-pF probe

HP 10443A, 20:1, 1000  $\Omega$ , 1.2-pF probe

### 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 Access HP 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 5301 Stevens Creek Blvd. Bldg. 51L-SC Santa Clara, CA 95052-8059 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

### Japan:

Yokogawa-Hewlett-Packard Ltd. Measurement Assistance Center 9-1, Takakura-Cho, Hachioji-Shi, Tokyo 192, Japan (81) 426 48 3860

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