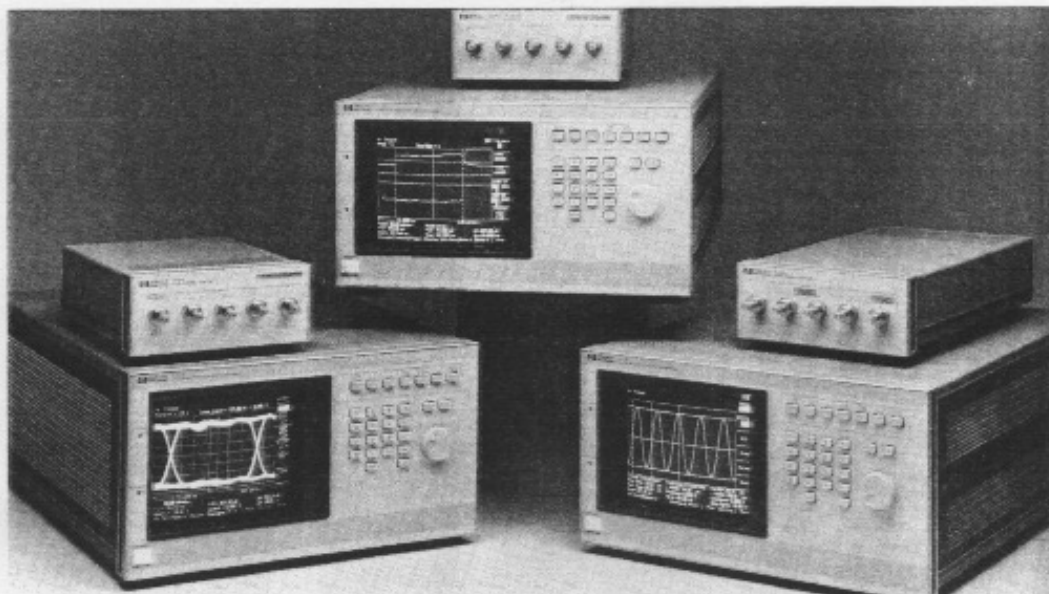


OSCILLOSCOPES & WAVEFORM ANALYZERS

Digitizing Oscilloscopes (cont'd)

HP 54121T, 54122T, 54123T

- 12.4 GHz, 20 GHz, 34 GHz bandwidth
- 0.25 ps timing resolution
- Built-in histograms
- 2.5 GHz edge trigger
- Time domain reflectometry
- HP PaintJet printer output



The HP 54120-series of high bandwidth digitizing oscilloscopes featuring digital feedback sampling for repeatable, accurate, and operator-independent measurement results.

HP 54120-series High Bandwidth Digitizing Oscilloscopes

The HP 54120-series of digitizing oscilloscopes combines high bandwidth, a time domain reflectometer (HP 54121T and HP 54123T only), four input channels, and superb stability in an easy-to-use, fully programmable oscilloscope that needs no manual loop gain adjustment. Whether your application involves high-speed device and circuit characterization, high-speed telecom analysis, or microwave design, the HP 54120-series of digitizing oscilloscopes give you a new confidence in state-of-the-art measurements.

Key Contributions

- dc - 12.4 GHz bandwidth (HP 54122T) - 28.2 ps risetime
- dc - 20 GHz bandwidth (HP 54121T) - 17.5 ps risetime
- dc - 34 GHz bandwidth (HP 54123T) - 10.3 ps risetime
- 10 ps time interval accuracy
- 0.25 ps time interval resolution
- 10 ps/div to 1 s/div
- 0.4 % vertical accuracy
- 32 microvolt resolution
- 1 mV/div to 80 mV/div (HP 54121T and HP 54123T)
- 1 mV/div to 2.4 V/div (HP 54122T)
- Automatic pulse parameter measurements
- Fully HP-IB programmable
- Pushbutton hardcopy documentation

- Four input channels
- Step generator with 35 ps risetime and 1% flatness (HP 54121T and HP 54123T)
- Reflection (TDR)/transmission (TDT) normalization¹ (HP 54121T and HP 54123T)
- Time and voltage histograms

Picosecond measurements

The 0.25 ps time interval resolution and typically 1 ps time interval accuracy of the HP 54120 family reduce the oscilloscope's contribution to errors in digital pulse parameter measurements in semiconductors and computers.

Quantify Noise and Jitter

Time and voltage histograms, which quantify noise and jitter measurements, characterize the eye patterns in telecommunications applications. Eye height and width, location of one and zero, are easily found with histograms. With no loop gain control, you can obtain repeatable results that do not vary between operators or between oscilloscopes over the entire input dynamic range.

Eliminate Reflections with TDR

Ringings and waveform distortion can be eliminated by using time domain reflectometry on the HP 54121T and the HP 54123T to locate and remove discontinuities in transmission line systems.

NOTE 1: Normalization uses the Bracewell transform, which is under license from Stanford University.

HP 54120-Series Specifications Channels

(Vertical) ¹	HP 54121T	HP 54122T	HP 54123T
Bandwidth (-3 dB)			
High Bandwidth*	dc to 20 GHz chs 2,3,4 (ch 1 is 3.5 dB @ 20 GHz) dc to 18 GHz, ch 1	dc to 12.4 GHz	dc to 34 GHz chs 2,3,4 dc to 20 GHz, ch 1
Low Bandwidth	dc to 12.4 GHz	dc to 10 GHz	dc to 18 GHz chs 2,3,4 dc to 12.4 GHz, ch 1
Transition Time (10% to 90%) (calculated from Tr=35/BW)			
High bandwidth	<17.5 ps, Chs 2,3,4 <19.4 ps, Ch 1	<28.2 ps	<10.3 ps Chs 2,3,4 <17.5 ps, Ch 1
Low bandwidth	<28.2 ps	<35.0 ps	<19.4 ps, Chs 2,3,4 <28.2 ps, Ch 1
Noise (rms)			
High bandwidth	<2 mV	<2 mV (1:1 attenuation)	<2 mV
Low bandwidth	<1 mV	<1 mV (1:1 attenuation)	<1 mV
Scale factor (full-scale is 8 divisions)			
Minimum	1 mV/div	1 mV/div	1 mV/div
Maximum	80 mV/div	2.4 V/div	80 mV/div
Atten. factors	N/A	X1, X3, X10, X30	N/A
Programmable dc Offset²	± 500 mV	± 500 mV x atten. factor	± 500 mV
dc Accuracy Single Voltage Marker³	Average mode: ± 0.4% of full-scale or marker reading (whichever is greater) ± 2 mV x attenuation factor⁴ High bandwidth Persistence mode: ± 0.4% of full-scale or marker reading (whichever is greater) ± 2 mV x attenuation factor⁵ ± 3.0% of⁶ (reading - channel offset) Low bandwidth Persistence mode: ± 0.4% of full-scale or marker reading (whichever is greater) ± 2 mV x attenuation factor⁵ ± 1.5% of⁶ (reading - channel offset)		
Inputs			
Number	Four	Four	Four
Dynamic range	± 320 mV relative to channel offset	± 320 mV x attenuation factor	± 320 mV relative to channel offset
Maximum safe input voltage	± 2 V dc +peak ac (+16 dBm)	± 5 V dc +peak ac (+24 dBm)	± 2 V dc +peak ac (+16 dBm)
Nominal impedance	50 Ω	50 Ω	50 Ω
Percent reflection	<5% for 30 ps risetime	<5% for 30 ps risetime	<5% for 30 ps risetime
Connections	3.5 mm (m)	3.5 mm (m)	3.5 mm (m)

- When operated within ± 5°C (± 9°F) of the temperature of the last front panel calibration.
- The input samplers are biased differently for increased bandwidth in the high bandwidth mode.
- An effective offset of ± 800 mV x attenuation factor can be achieved by using the ± 500 mV attenuation factor mV of channel offset and adding ± 320 mV x attenuation factor of offset with the waveform math offset scaling function.⁴
- When driven from a 0 Ω source.
- The attenuation factor of the HP 54121T and the HP 54123T is 1.
- For the HP 54123T, the 3% changes to 5% and the 1.5% changes to 2%.

TDR System (HP 54121T and HP 54123T only)

	Combined Oscilloscope and TDR Performance	Normalized Characteristics ¹
Risetime^{2,3}	<45 ps	Adjustable: allowable values based on time- base setting Minimum: 10 ps or 0.08 X time/div, whichever is greater Maximum: 5 X time/div
Flatness³	< + 1% after 1 ns from edge; < + 5%, - 3% to 1 ns from edge	< 0.1%
Levels: Low	0 V ± 2 mV	0 V ± 2 mV
High	+ 200 mV ± 2 mV	+ 200 mV ± 2 mV
- Normalized information is a characteristic, not a specification. The information is presented here for comparison purposes only. Normalization characteristics are achieved only with the use of the normalization calibrations and firmware routines. - Measured in the low bandwidth and average display modes. - The risetime of the generator is less than 35 ps, as calculated by $(Tr_{system})^2 = (Tr_{generator})^2 + (Tr_{scope})^2$		
Time base (Horizontal)		
Scale factor (full-scale is 10 divisions)		
Minimum		10 ps/division
Maximum		1 s/division
Delay (time offset relative to trigger)		
Minimum		16 ns
Maximum		1000 screen diameters or 10 seconds, whichever is smaller.
Time Interval Accuracy (Dual marker measurement)		<10 ps ± 0.1% of reading
Time Interval Resolution		0.25 ps ¹ or .02 division, whichever is larger
At 10 ps/division, data points are plotted at 0.2 ps intervals to match the display pixel resolution.		
Trigger-External Input Only		
Sensitivity		
dc - 100 MHz		40 mV peak-to-peak
100 MHz to 2.5 GHz		Increasing linearly from 40 mV at 100 MHz to 200 mV at 2.5 GHz.
Pulse width		<200 ps, > 200 mV
High frequency reject		Trigger bandwidth reduced to approximately 100 MHz.
Trigger level range		± 1 V
Jitter		
(Trigger and time base combined one standard deviation)		< 2.5 ps + 5E-5 × delay setting (Tested using 2 GHz synthesized source at 200 mV peak-to-peak with High Frequency Sensitivity ON and High Frequency Reject OFF.)
Trigger Input		
Maximum Safe Input Voltage		± 2 V dc ac peak (+16 dBm)
Nominal Impedance		50 Ω
Percent Reflection		<10% for 100 ps risetime
Connector		3.5 mm (m)

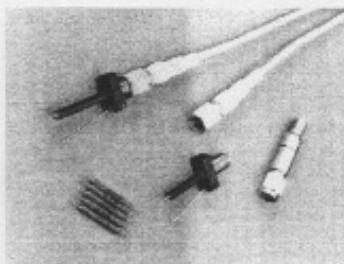
OSCILLOSCOPES & WAVEFORM ANALYZERS

Accessories For The HP 54120 Series Digitizing Oscilloscopes

HP 54006A, 54007A, 54008A, 54118A, 10086A



HP 54118A



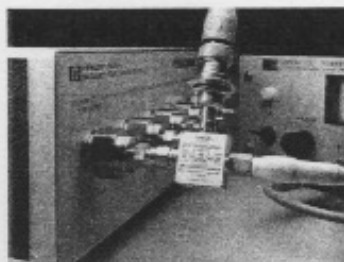
HP 54006A



HP 54008A



HP 54007A



HP 10086A

Hewlett-Packard has a large number of accessories for use with wideband digital sampling oscilloscopes that will help you build a multi-gigahertz system that is tailored to your unique needs.

The HP 54118A, 500 MHz to 18 GHz Trigger Simple/Stable Triggering at Microwave Frequencies

For applications requiring more than 2.5 GHz trigger bandwidth, use the HP 54118A 18 GHz Trigger. The HP 54118A gives your HP 54120-series oscilloscope true event triggering from 500 MHz to 18 GHz with less than 1.7 ps of rms jitter at 18 GHz. This powerful and versatile accessory extends the oscilloscope's measurement capabilities to applications in lightwave communications, pulsed RF, gigabit logic, pseudo random bit stream eye patterns, and other microwave signals.

True event triggering is not possible with countdown synchronizers, but with the event triggering capability of the HP 54118A, you are no longer restricted to the limitations of countdown synchronizers. An HP microwave thinfilm IC locks onto your input signal and holds it, even if the signal has frequency drift or large deviations in FM modulation.

Independent control of arming and triggering levels let you make measurements that simply were not possible before, such as triggering on a carrier of a radar pulse or CW signals with large noise components. And the trigger's variable holdoff feature makes it a snap to trigger on the carrier of a burst RF signal.

The HP 54006A 6 GHz Probe High Frequency Hand-held Probing

Probing multi-GHz systems with the HP 54006A, 10:1, 500 Ω and 20:1, 1 k Ω resistive divider probes lets you access circuit nodes that do not have a 50 Ω connector. These probes let you see the signal at specific points, such as the input to a gate. You can also use them to probe circuits that are not nominally 50 Ω .

The HP 54008A 22 ns Delay Line

Viewing the Trigger Signal

The HP 54008A delay line provides 22 ns of delay with a usable frequency response of 20 GHz. By adding this accessory to your HP 54120 oscilloscope system, you will be able to view the trigger event. The HP 54008A has enough delay to view the trigger event with the HP 54118A Trigger installed in the trigger path also.

The HP 54007A Accessory Kit

Low-loss Measurements For the HP 54120 Oscilloscope Systems

The HP 54007A Accessory Kit provides an assortment of parts with 3.5 mm connectors for low-loss measurements. This kit is highly recommended for low-loss reflection and transmission measurements. It also includes semi-rigid coax, formed for use with the HP 11667B power splitter.

Contents of HP 54007A Accessory Kit:

17-inch cable, APC 3.5 (f-f)	17-inch cable, APC 3.5 (m-f)
Coaxial short, APC 3.5 (f)	Coaxial short, APC 3.5 (m)
50 Ω termination, APC 3.5 (m)	50 Ω termination, APC 3.5 (f)
7.5 cm airline, APC 3.5 (m-f)	Power splitter, APC 3.5 mm (f)
6 cm. semi-rigid "L", SMA (m-m)	3 cm. semi-rigid "L", SMA (m-m)
6 dB attenuator, APC 3.5 (m-f)	40 dB attenuator, APC 3.5 (m-f)
Adapter, APC 3.5 mm (m-m)	

HP 10086A ECL Terminator

Safe, Reliable Termination For Measuring ECL Devices

Create a simple high-performance 10 GHz interface between an ECL-compatible output and a 50 Ω instrument input. The ECL terminator provides bias and termination for your device under test, while presenting an undistorted and level-shifted signal to your measurement equipment. It also provides proper termination to ECL output devices, thereby reducing the risk of destroying sensitive output devices.