

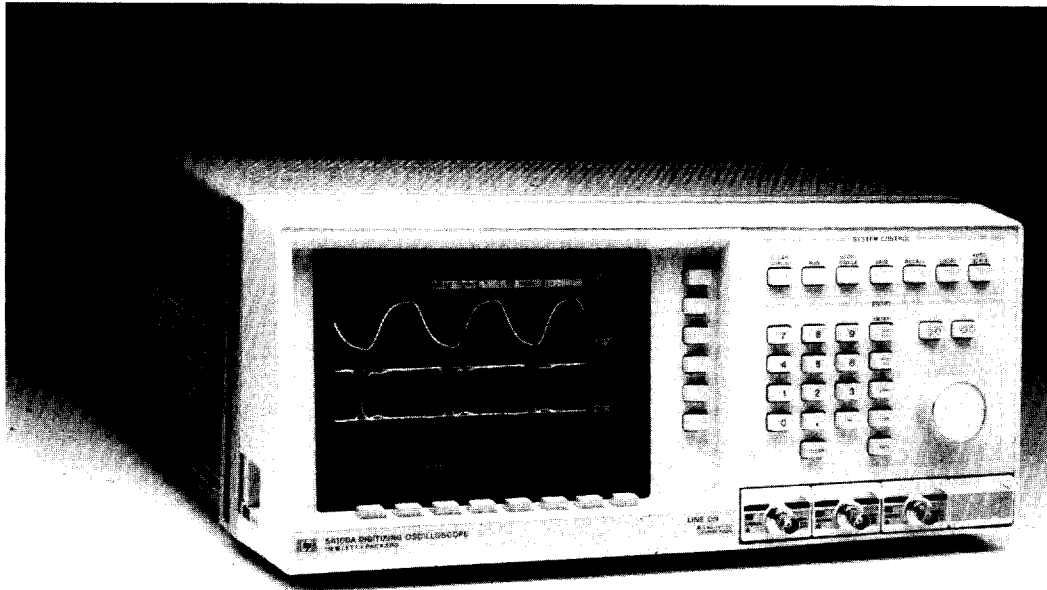
# OSCILLOSCOPES & WAVEFORM ANALYZERS

## Digitizing Oscilloscopes

Models 54100A/D, 54300A

- 1 GHz bandwidth
- Automatic pulse parameter and time interval measurements
- Digital storage

- Flexible probing solution
- Pre-trigger viewing
- Logic triggering capability



### The HP 54100A/D Description

In the HP 54100A/D Digitizing Oscilloscope, Hewlett-Packard combines a new oscilloscope architecture with state-of-the-art technologies, creating a general-purpose oscilloscope for engineers involved with digital design and test. The HP 54100A/D simplifies analog time-domain measurements on high-speed logic circuits: it can make the new measurements needed when working with the most recently developed logic families, and it can make standard measurements faster and more accurately than conventional oscilloscopes can.

#### Measurement Performance for High-Speed Logic Design

- 350 ps rise time.
- Stable triggering on pulses 1 ns wide.
- 100 ps/div time base.
- 40 megasample/sec digitizing rate.

#### Digital Storage

- Bright, stable display of low duty-cycle signals.
- Retain waveforms as long as desired for worst-case analysis.
- Fade-free, non-blooming display.
- Store as many waveforms as needed for comparison or reference.
- Make measurements after signal is acquired. This is especially useful on single-shot signals or infrequent error conditions.
- Waveform data available over the HP-IB.
- Signal averaging for noise rejection and increased resolution.

#### Automatic Measurements

- Automatic edge finders save time, eliminate uncertainty, and reduce operator error in time-interval measurements.
- Measure pulse parameters automatically, without a controller.
- Markers indicate where the measurement was made, providing confidence in measurement results.

#### Pre-trigger Display

- Find causes of events.
- Displayed time can be any time before or after the trigger, and is not limited to one screen width before the trigger. Time intervals

can be measured with a resolution of parts per million, before and after the trigger.

#### Stable, Precise, Accurate Time Base

- Stability of 0.1 parts per million allows you to measure small time increments over a large time range with minimal jitter.
- With 0.002% time base linearity, 50 ps aperture jitter, and 10 ps resolution, you can measure critical timing parameters in high-speed logic circuits confidently.
- Channel-to-channel skew calibration allows you to measure time intervals accurately at the probe tips.

#### Triggering on Complex Digital Waveforms

- Logic pattern triggering allows you to trigger on the complex events found in typical digital systems.
- Trigger holdoff can be specified by events or by time for stable triggering on long, complex sequences of events.
- Independent trigger threshold adjustments for each channel. No need to reset the trigger level each time you switch from one trigger source to another.

#### Easy-to-Use

- Pressing the Auto-Scale button automatically sets up the time base, sensitivity, offset, and trigger for a stable display over a wide range of input signals.
- Save up to ten front panel setups in non-volatile memory; simplify a sequence of repeated measurements quickly.
- Instant hardcopy with either a pen plotter or a graphics printer eliminates time-consuming, expensive photography.

#### Simplified Programming

- Simple, logical, structured programming mnemonics make programs easy to edit, easy to understand, and easy to modify for new applications.
- Measurement-oriented, English-like mnemonics.
- Complies with the recommendations of IEEE standard 728-1982, *Recommended Practice for Code and Format Conventions*.



### Configurable Inputs

- 50 ohm inputs and probes for a wide variety of environments, without the expense of amplifier plug-ins.
- 1 GHz active miniature probes for densely-packed, high-speed logic circuits.
- 1 megohm probes for circuits sensitive to resistive loading.
- 50 ohm BNC inputs for measurements where terminated lines are important.

### The HP 54100D - Extensive Logic Triggering

The HP 54100D adds the following triggering features to the basic capabilities of the HP 54100A.

#### Fourth Input

The HP 54100D has four inputs: two are vertical channels, and two are trigger inputs. The HP 54100A has three inputs; two vertical channels and one trigger input.

#### Pattern Trigger

In the HP 54100D's pattern trigger mode, each of the four inputs can be selected as high, low, or don't care. In the HP 54100A, the pattern selection is limited to the three inputs. The additional bit in the pattern specification extends the usefulness of pattern triggering to more complex data buses.

#### Time-Qualified Pattern

In addition to triggering on entering or exiting the specified pattern, the HP 54100D can be set to trigger when a specified pattern is present for less than or greater than a specified duration, from 10 ns to 5 seconds. Applications include glitch detection, triggering on timing violations, and capturing bus hangup conditions.

#### Pattern With Clock

The HP 54100D can be set to trigger on an edge of either polarity on any one of the four inputs, when a specified pattern exists at the other three inputs. This is useful when it is necessary to synchronize the display to a system clock and detect a system state.

#### Delayed Trigger

The HP 54100D can be set up to arm on an edge on any one of its four inputs, then trigger on an edge on any other input after a specified time or after a specified number of edges. The delay time can be varied from 20 ns to 5 seconds. The edge count can be set from 1 to 99999999. The delay-by-events mode is particularly useful in systems where the data rate fluctuates or jitters, as in a disc drive. You could use the delay-by-events mode to arm on the index pulse in a disc drive, then trigger on a data pulse anywhere around the track. This stabilizes the display on a particular pulse.

### Designed for the Digital Designer's Bench

#### Save Time and Reduce Errors in Complex Measurement Setups

Automate a sequence of measurements on your design bench, without a controller, with the HP 54100A/D's save and recall keys, to save time and reduce errors. Step through a series of complex measurements by pressing only two keys for each new setup. Increase confidence in measurement correlation by not spending time between measurements changing setups.

#### Locate and Measure Waveform Features Quickly and Accurately

The HP 54100A/D allows you to make precise time-interval measurements at specified voltage thresholds by pressing a button. Making a delay measurement between two signals is as simple as positioning voltage markers on each channel, then specifying the desired edge number and edge polarity for each channel.

#### Measure Pulse Parameters Automatically

The HP 54100A/D automatically locates and measures pulse features. Markers indicate where the measurement was made, so you are confident that the measurement was valid.

#### Store Multiple Waveforms for Comparison or Reference

With the HP 54100A/D, you can easily store waveforms by pressing a button. Because each waveform is stored exactly as it is displayed, many waveforms can be stored in each of the HP 54100A/D's two waveform storage memories. Stored waveforms are overlaid, facilitating precise visual comparisons between stored waveforms, or

from a stored waveform to a live waveform. The time and voltage markers can be used for quantitative measurements on stored waveforms.

#### Logic Family Presets

ECL and TTL presets scale the vertical gain, offset, and trigger levels for the selected logic family. This saves time in setting up for a measurement.

#### Document Results

Active as well as stored waveforms, setup conditions, and measurement results can be printed or plotted for instant, low-cost documentation. HP printers provide report-quality hardcopy for articles or printed reports at minimal cost, and without the delay of photographic reproduction.

#### Hold That Waveform!

When the input signal is removed, the display is retained on-screen. The display can also be frozen by pressing the Stop button. This is useful when it's difficult to hold the probe on a test point, or to see the oscilloscope screen and the test point simultaneously. You can also capture rapidly-changing or transient signals for viewing and analysis. You can use the markers to make measurements on the stored waveform; you can print or plot the captured waveform at leisure.

#### Automate Probing

Connect up to 16 probes to your circuit, then select any one or two at a time with the HP 54300A probe multiplexer. No need to move probes between measurements. You can be confident that all of your measurements were made under identical conditions because you didn't have to shut off power to the circuit under test, disturb test points by moving probes, or restart the test program. The time saved can be a significant portion of the time required to test a complex circuit with many measurements on each of several nodes.

You can cascade HP 54300A probe multiplexers to two levels for probing up to 128 points. You can store multiplexer setups in the HP 54300A's non-volatile memory in up to 100 lists of up to 100 steps each (3700 steps max), which you can then step through manually by pressing a button on the front panel or automatically under HP-IB control. This capability, together with the HP 54100A/D's save/recall feature, makes it easy to automate a series of measurements with or without a controller.

#### Your Computer: A Valuable Ally

Your desktop scientific or personal computer can be a powerful companion for making measurements with the HP 54100A/D digitizing oscilloscope and the HP 54300A probe multiplexer. Simple, English-like mnemonics and a logical, hierarchical structure make it easy to create and modify programs.

### For Computer-aided Test Applications

#### Simplified Programming

Easily understood, English-like commands with a logical structure facilitate programming with minimum documentation, and they can simplify editing or modifying programs.

#### Save Setups in the HP 54100A/D's Memory

Speed up tests by storing setups in local memory. At execution time, simply recall the desired setups.

#### Data Or Measurements—Whichever You Need

Complete waveform data are available for analysis in a variety of formats. If you need to measure pulse parameters or time intervals, the HP 54100A/D can make these measurements automatically. This simplifies your program and reduces traffic on the HP-IB.

#### Select the Kind of Data You Need

- Program the HP 54100A/D to acquire the data in the format you need and transmit it as a binary block quickly and efficiently.
- Use the averaged data mode when the signal is noisy and you must analyze small reflections or perturbations.
- Select the envelope mode when you need to know the waveform's minimum and maximum values over a period of time; for example, when capturing soft errors that occur only once every million or more bits.
- Use the pixel format when you need to analyze every sample acquired on an eye pattern to detect random timing.



# OSCILLOSCOPES & WAVEFORM ANALYZERS

## Digitizing Oscilloscopes (Cont.)

### Models 54100A/D, 54300A (Cont.)

- Use the random data format for statistical analysis, such as histogramming.

#### Probe Multiplexing Complements the HP 54100A/D

The HP 54300A is a dual eight-to-one probe multiplexer that can be used with either the HP 54100A/D oscilloscope or other 50 ohm input HP instrumentation to provide a complete probing solution.

- Accepts all of the HP 54100A/D's input pods.
- You can store up to 100 sequences of up to 100 steps each (3700 steps max) in the HP 54300A's non-volatile memory. Then, step through them under computer control or from the front panel.
- Programmable over the HP-IB.
- Up to 16 pods in two groups of eight each.
- HP 54300As may be cascaded in two levels to provide up to 128 inputs.
- Connect all the probes to the circuit under test, then step through the tests desired. Save time, avoid turning power on and off repeatedly, and avoid restarting programs.

#### A Choice of Input Pods

**HP 54001A 1 GHz miniature active probe:** use the HP 54001A in applications such as high-speed logic measurements, where high bandwidth is essential and where capacitive probe loading dominates the probe's effect on the signal. At 1.5 metres, it provides excellent access to those hard-to-reach areas of a system rack or backplane. Its small tip diameter and low mass make it easy to get into crowded circuits without electrical degradation, by getting the probe close to the node you need to measure. The combined system rise time with the HP 54100A/D is less than 400 ps, for measurements on subnanosecond logic.

**HP 54003A (1 m) 1 megohm probe:** use this 1 megohm probe when resistive loading is critical, as in operational amplifier measurements. The probe can be removed from the pod to provide a 1 megohm, approximately 12 pF BNC input. This is useful where a coaxial connection is desired, in applications where bandwidth and capacitive load are not as critical as resistive loading (e.g., moderate bandwidth measurements in an automatic test system). Use the HP 10014A (1.1 m) 10 megohm input probe with the HP 54003A pod for measurements in extremely high resistance circuits.

**HP 54002A 50 ohm BNC input pod:** three of these pods are included with the HP 54100A, and four with the HP 54100D. Use a 50 ohm terminated system, with the HP 54002A pod at the oscilloscope input, to preserve signal fidelity and to minimize the effects of the measurement on the circuit under test. The HP 54002A can be used with the HP 10020A resistive divider probe kit. It may also be used with a variety of active oscilloscope probes that require a 50 ohm input.

## SPECIFICATIONS - HP 54100A/D

#### Vertical (Voltage)

The following apply when the HP 54100A/D is used with the HP 54002A 50 ohm input pod.

**Bandwidth (-3 dB):** dc to 1 GHz; these specifications apply over ambient temperature range of +15° C to +35° C.

**Transition time (10% to 90%):** ≤350 ps

**Deflection factor (full-scale=8 divisions):** 10 mV/div to 1 V/div in 1-2-5 steps.

**DC accuracy, single voltage marker:** ±3% of full-scale ±2% of offset; when driven from a 50 ohm source.

**DC delta voltage accuracy using voltage markers on the same channel:** ±1% of full-scale ±3% of reading, when driven from a 50 ohm source.

#### DC Offset

**Range:** ±1.5 × full-scale (referenced to center screen).

**Magnifier:** expands displayed signal vertically from 1 to 16 times; adjustable in 0.5% steps.

**Inputs:** two inputs, configurable with HP 54000-series pods.

#### Horizontal (Time)

**Deflection Factor (full-scale is 10 divisions):** 100 ps/div to 1 sec/div.

#### Delay (Time Offset)

**Pre-trigger range:** up to -200 ms or -10 divisions, whichever is greater.

**Post-trigger range:** up to +1 second or +10 divisions, whichever is greater.

#### Time Base Accuracy

**Single-channel:** (100 ps ±2 × 10<sup>-5</sup> × delta T reading)

**Channel-to-channel:** (200 ps ±2 × 10<sup>-5</sup> × delta T reading)

**RMS Jitter:** (50 ps + 5 × 10<sup>-7</sup> × delay setting)

#### Trigger

The following apply when the HP 54100A/D is used with the HP 54002A 50 ohm input pod.

Trigger Source	Vertical Channel 1 or 2	Trigger Input 3 (HP 54100D: Trigger Input 3 or 4)
Trigger level range	±2 × full-scale	±2 V
Trigger sensitivity dc to 100 MHz 100 to 500 MHz	0.12 × full-scale 0.24 × full-scale	40 mV 50 mV

**Trigger Source:** channel 1, channel 2, trigger 3 input (HP 54100D, trigger 4 input).

**Trigger 3 Input (HP 54100D, trigger 4 input):** configurable with HP 54000-series pods.

#### Inputs

	HP 54002A	HP 54001A	HP 54003A
	50 Ω input	1 GHz miniature active probe	1 MΩ input, with 10:1 probe attached
Maximum input voltage	5 V rms	20 V peak	20 V peak
Coupling	dc	dc	dc
Input capacitance (nominal)	N/A	2 pF	8 pF
Input resistance (nominal)	50 Ω	10 kΩ	1 MΩ
Bandwidth (-3dB)	dc to 1 GHz	dc to 1 GHz	dc to 300 MHz
Transition time (10% to 90%)	≤350 ps	≤350 ps	≤1.2 ns
System bandwidth with HP 54100A/D (-3 dB)	dc to 1 GHz	dc to 700 MHz	dc to 300 MHz
System transition time with HP 54100A/D (10% to 90%)	≤350 ps	≤400 ps	≤1.2 ns
Division ratio	1:1	10:1 ±3%	10:1 ±3%

#### Ordering Information

HP 54100A digitizing oscilloscope	\$17,600
HP 54100D digitizing oscilloscope	\$19,300
HP 54300A dual 8:1 probe multiplexer	\$6,800

#### Price

#### Accessories and Peripherals

Input pods	
HP 54001A 1 GHz miniature active probe pod	\$750
HP 54002A 50 ohm BNC input pod	\$130
HP 54003A 1 megohm, 10:1 probe pod	\$550