

# Test Equipment Solutions Datasheet

Test Equipment Solutions Ltd specialise in the second user sale, rental and distribution of quality test & measurement (T&M) equipment. We stock all major equipment types such as spectrum analyzers, signal generators, oscilloscopes, power meters, logic analysers etc from all the major suppliers such as Agilent, Tektronix, Anritsu and Rohde & Schwarz.

We are focused at the professional end of the marketplace, primarily working with customers for whom high performance, quality and service are key, whilst realising the cost savings that second user equipment offers. As such, we fully test & refurbish equipment in our in-house, traceable Lab. Items are supplied with manuals, accessories and typically a full no-quibble 2 year warranty. Our staff have extensive backgrounds in T&M, totalling over 150 years of combined experience, which enables us to deliver industry-leading service and support. We endeavour to be customer focused in every way right down to the detail, such as offering free delivery on sales, covering the cost of warranty returns BOTH ways (plus supplying a loan unit, if available) and supplying a free business tool with every order.

As well as the headline benefit of cost saving, second user offers shorter lead times, higher reliability and multivendor solutions. Rental, of course, is ideal for shorter term needs and offers fast delivery, flexibility, try-before-you-buy, zero capital expenditure, lower risk and off balance sheet accounting. Both second user and rental improve the key business measure of Return On Capital Employed.

We are based near Heathrow Airport in the UK from where we supply test equipment worldwide. Our facility incorporates Sales, Support, Admin, Logistics and our own in-house Lab.

All products supplied by Test Equipment Solutions include:

- No-quibble parts & labour warranty (we provide transport for UK mainland addresses).
- Free loan equipment during warranty repair, if available.
- Full electrical, mechanical and safety refurbishment in our in-house Lab.
- Certificate of Conformance (calibration available on request).
- Manuals and accessories required for normal operation.
- Free insured delivery to your UK mainland address (sales).
- Support from our team of seasoned Test & Measurement engineers.
- ISO9001 quality assurance.

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Monochrome: HP 54520A, 54522A, 54540A, 54542A; Color: HP 54520C, 54522C, 54540C, 54542C

- 500 MHz bandwidth
- Up to 4 channels at 2GSa/s
- 32 K/channel acquisition memory

- 1.44 MB DOS-compatible disk drive
- FFT standard
- 1 ns peak detect



HP 54542C

### HP 54520 and 54540 Series of Digitizing Oscilloscopes

The HP 54520 and 54540 series of digitizing oscilloscopes offer you the performance you need at a price you can afford. Like Hewlett-Packard's other digitizing oscilloscopes, these scopes offer features such as autoscale, pushbutton hardcopy, automatic measurements, nonvolatile setup and waveform memories, and full HP-IB programmability. The HP 54520 and 54540 series oscilloscopes feature a user interface with dedicated vertical, horizontal, and trigger knobs. These models have maximum sample rates from 1GSa/s to 2GSa/s, and offer several new features to make your testing easier, including an MS-DOS-compatible disk drive.

### Reduce Hardware Design and Troubleshooting Time with HP 54520 and 54540 Series Oscilloscopes

These powerful oscilloscopes speed hardware design and debugging with performance to match your needs. HP's advanced logic triggering is a standard feature. Use it to trigger on a wide variety of user-specified conditions. Trigger on edge, pattern, state, or trigger after delay to capture such elusive events as timing violations or transient bus phenomena. Use glitch triggering to isolate and trigger on a glitch as narrow as 1 ns. To pinpoint infrequent events and determine their cause, use HP's advanced logic triggering in conjunction with up to four channels to quickly isolate anomalies. Triggering on an anomaly will allow you to probe other points within the system during the failure condition to understand the cause of the problem quickly.

### Eight Models to Meet Your Measurement Needs

Model number	Number of channels	Repetitive bandwidth	Single-shot bandwidth	Sample rate maximum
54520A Monochrome or 54520C Color	2	500 MHz	125 MHz (2 ch on) 250 MHz (1 ch on)	500 MSa/s (2 ch on) 1 GSa/s (1 ch on)
54522A Monochrome or 54522C Color	2	500 MHz	500 MHz	2 GSa/s
54540A Monochrome or 54540C Color	4	500 MHz	125 MHz (3 or 4 ch on) 250 MHz (2 ch on) 500 MHz (1 ch on)	500 MSa/s (3 or 4 ch on) 1 GSa/s (2 ch on) 2 GSa/s (1 ch on)
54542A Monochrome or 54542C Color	4	500 MHz	500 MHz	2 GSa/s

### Characterize Your Signals Accurately

Speed your characterization by using the automatic measuring capabilities offered by the HP 54520 and 54540 series oscilloscopes. You have a choice of up to 23 measurements based on standard- or user-definable thresholds. Use measurement statistics to continuously display the maximum, minimum, and mean value for each measurement. Also available for characterization are the automask generator and waveform compare mode. Put a reference waveform on screen and have the scope build a pass-fail mask around it with a test tolerance that you specify. Use the compare mode to test incoming waveforms against the mask. If the signal fails, the scope will store the failed waveform, with a time-date stamp, to either internal memory or an external printer or plotter. The fast Fourier transforms (FFTs) are also useful tools for characterizing signals. With the high sample rate of these oscilloscopes, you can now analyze your signal by using a single-shot FFT.

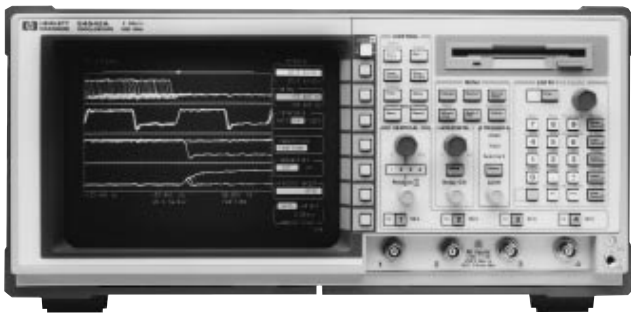
If you are characterizing several events separated in time, the sequential single-shot capability allows you to capture the pulses without capturing the dead time in between. You can then analyze the pulses individually or all together in normal, averaged, or envelope mode.

### HP 54520 and 54540 Series Oscilloscope Features

- 500MHz bandwidth
- Up to 2GSa/s sample rate
- 2- and 4-channel models (all channels are simultaneous)
- 32K/channel acquisition memory
- 1 ns glitch trigger
- Sequential single shot with time tagging
- FFT
- Fast screen update
- Fast front-panel response
- 1 ns peak detect
- Waveform math
- Waveform masks
- Waveform compare
- Test failure logging
- Measurement statistics
- 1.44MB disk drive
- Measurement limit test
- TIFF/PCX/EPS screen image files
- 23 automatic measurements
- Pan and zoom
- Advanced logic trigger
- TV trigger
- Telecom mask Option 001

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# OSCILLOSCOPES



HP 54542A



## HP 54520A, 54522A, 54540A, 54542A HP 54520C, 54522C, 54540C, 54542C Digitizing Oscilloscopes

It's your choice. This series of eight Hewlett-Packard portable oscilloscopes lets you choose the channel count and sample-rate performance that you need. Now, you can also choose between models with monochrome-CRT or color flat-panel displays. Each scope includes a rich feature set that helps remove the stress and strain from your testing. The HP 54522A/C and 54542A/C have two and four channels, respectively. Both offer 500-MHz bandwidth and 2-GSa/s sample rate. These are the specifications that you need for testing today's high-speed designs.

However, if you need less single-shot bandwidth, the two-channel HP 54520A/C and four-channel HP 54540A/C offer the same 500-MHz repetitive (equivalent time) bandwidth, but offer lower sample rates. All eight oscilloscopes have dedicated knobs for vertical, time base, and trigger. These familiar controls are coupled with 32K of memory per channel and an extensive problem-solving feature set that is ideally suited to your everyday bench use.

### Feature Rich

This new series of HP scopes has all of the features that you would expect in a scope plus more. Use sequential single-shot when you need to capture successive single-shot events without capturing the dead time in between. It is a great tool for applications such as pulsed-laser research, high-energy physics, and pulse echo. Use glitch trigger to find the causes of anomalies in circuit operation. Trigger on hard-to-see narrow glitches down to 1 ns wide. Use FFTs to get a second perspective of your test waveform. This feature is good for identifying signals, determining signal fidelity, or to analyze high-speed transients in the frequency domain.

Generate and store your own template masks, then compare test waveforms to the stored template for pass-fail testing. Or set your own limits on any of the 23 automatic waveform parameter tests. Incoming waveforms are measured with up to three tests at a time and passed or failed according to your limits. Waveforms can be saved and time-stamped upon failure of either waveform compare or limit test. Up to 665 failures of 500 points each can be stored in multiple memory and sent to a printer, plotter, or a computer via HP-IB.

Use peak detect to improve your confidence when using the scope at lower sweep speeds. Scopes without peak detect can miss narrow events at slow sweep speeds. Peak detect allows you to see any event as narrow as 1 ns wide.

All eight scopes have an internal 3½-inch, 1.44MB, MS-DOS®-compatible disk drive which can be used to download software upgrades to the instrument's flash ROMs. The disk can also store waveforms, instrument setups, and screen images in standard formats such as TIFF and PCX. Other features included are: advanced logic triggering, push-button automatic setup, hardcopy output, full HP-IB programmability, pre-trigger viewing, TV triggering, voltage and time markers, pan and zoom, user-controlled sample rate independent of sweep speed, user-controlled record length, fast update rate, fast overdrive recovery, and more.

## HP 54520A /C, 54522A /C, 54540A /C, 54542A /C Specifications and Characteristics

### Acquisition System

<b>Maximum sample rate (Real-time mode)</b>	HP 54520A /C:	1 GSa/s (1 channel on) 500 MSa/s (2 channels on)
	HP 54522A /C: HP 54540A /C:	2 GSa/s (all channels) 2 GSa/s (1 channel on) 1 GSa/s (2 channels on) 500 MSa/s (3 or 4 channels on)
<b>(Repetitive mode)</b>	HP 54542A /C:	2 GSa/s (all channels) 1GSa/s all models
<b>Record length</b>		32,768 pts. (real time) 501 pts. (repetitive)
	<b>Resolution</b>	8 bits (10 bits via HP-IB with averaging)
<b>Peak detect</b>	Captures and displays events as narrow as 1 ns in real-time mode at sample rates of 250 MSa/s or less, sequential single shot turned off.	

### Vertical

<b>Repetitive bandwidth</b>	500 MHz (equivalent time)	
<b>Real-time bandwidth</b>	HP 54520A /C:	250 MHz (1 channel on) 125 MHz (2 channels on)
	HP 54522A /C: HP 54540A /C: HP 54542A /C:	500 MHz (all channels) 500 MHz (1 channel on) 250 MHz (2 channels on) 125 MHz (3 or 4 channels on) 500 MHz (all channels)
<b>Number of channels (all are simultaneous acquisition)</b>	HP 54540A /C, 54542A /C: 4 HP 54520A /C, 54522A /C: 2	
<b>Sensitivity</b>	1 mV/div to 5 V/div	
<b>DC gain accuracy</b>	±1.25% of full scale	
<b>Input impedance</b>	R: 1 MΩ, ±1% or 50 Ω, ±1% C: 7 pF nominal	
<b>Input coupling</b>	ac, dc	
<b>Maximum input</b>	1 MΩ: ±250 V (dc + ac) [ac < 10 kHz] 50 Ω: 5 V rms	
<b>Switchable bandwidth Limits (-3 dB freq. typical)</b>	ac-coupled: 10 Hz LF Reject: 400 Hz    B andwidth Limit: 30 MHz	
<b>Channel-to-channel isolation</b>	(with channels at equal sensitivity) dc to 50 MHz: 50 dB; 50 MHz to 500 MHz: 40 dB	
<b>Offset range</b>	<b>Vertical sensitivity</b>	<b>Available offset</b>
	1 mV to 50 mV/div	±2 V
	>50 mV to 250 mV/div	±10 V
	>250 mV to 1.25 V/div	±50 V
>1.25 V/div to 5 V/div	±250 V	
<b>Offset accuracy</b>	±(1.25% of channel offset + 2% of full scale)	
<b>Voltage measurement accuracy</b>	Dual cursor: ±[(1.25%) (full scale) + (0.032) (V/div)] Single cursor: ±[(1.25%) (full scale) + (offset accuracy) + (0.016) (V/div)]	

<sup>1</sup>Magnification is used below 7 mV/div range. Below 7 mV/div full scale is defined as 56 mV.

### Key Literature

Eight Portable Oscilloscopes: A Choice of Performance,  
p/n 5963-7246E

HP 54520 and 54540 Series Portable Oscilloscopes Technical Data,  
p/n 5963-7245EUS (US version), 5963-7245E (universal version)

Monochrome: HP 54520A, 54522A, 54540A, 54542A Color: HP 54520C, 54522C, 54540C, 54542C

### Horizontal

<b>Time base range</b>	500 ps/div to 5 s/div
<b>Resolution</b>	10 ps
<b>Δt Time accuracy</b>	
<b>Repetitive:</b>	
<b>(&gt; =8 average)</b>	$\pm[(0.005\%)(\Delta t) + (100 \text{ ps} + 0.1\% \text{ of full scale})]$
<b>Real time<sup>2</sup></b>	$\pm[(0.005\%)(\Delta t) + (0.2)(\text{sample period})]$
<b>Peak detect</b>	$\pm[(0.005\%)(\Delta t) + (1 \text{ sample period})]$
<b>Time tag</b>	
<b>Resolution</b>	100 ps
<b>Accuracy</b>	$\pm[0.005\% (\text{reading}) + 100 \text{ ps}]$
<b>Delay range</b>	10 <sup>3</sup> x sample period
<b>(Post-trigger)</b>	
<b>Delay range</b>	32 K x sample period
<b>(Pre-trigger)</b>	

### Trigger

<b>Sensitivity</b>	<b>dc to 100 MHz</b>	<b>100 MHz to 500 MHz</b>
<b>Internal</b>	0.5 div	1.0 div
<b>External</b>	0.0225 x (signal range)	0.045 x (signal range)
<small>(External trigger: 54520A, 54522A only)</small>		
<b>Auxiliary</b>	dc to 50 MHz z: 250 mV p-p	
<b>Pulse width (minimum)</b>	1 ns	
<b>Level range</b>	$\pm 1.5 \times \text{full scale from center screen}$	
<b>Internal</b>		
<b>External (54520A, 54522A)</b>	$\pm 25 \text{ V}$	
<b>Auxiliary</b>	$\pm 5 \text{ V}$	
<b>Modes</b>	Edge, pattern, glitch, time-qualified pattern, line, state, event-delayed, time-delayed, TV (including user-definable)	

<b>Screen update rate</b>	(typical at 500 ns/div)		
<b>Real time</b>	500	8K	16K
<b>Updates/s</b>	150	110	84
<b>Repetitive</b>	<b>Normal</b>	<b>8 A verages</b>	<b>128 A verages</b>
<b>Updates/s:</b>	150	91	91
<b>Power</b>	Voltage: 115/230 V ac, -25% to +15%, 48 to 440 Hz, 350 VA max.		
<b>Weight</b>	Net approx. 11.8 kg (26 lb); Shipping: approx. 21.3 kg (47 lb)		
<b>Size</b>	440 mm W x 218 mm H x 367 mm D (17.3 in x 8.6 in x 14.5 in)		

<sup>2</sup>For bandwidth limited signals,  $\tau \geq 1.4 \times \text{sample interval}$ .

### FFTs

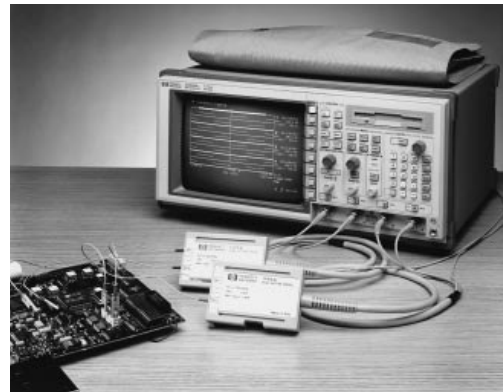
<b>Model number</b>	<b>HP 54520A /C</b>	<b>HP 54522A /C</b>	<b>HP 54540A /C</b>	<b>HP 54542A /C</b>
<b>Frequency range<sup>3</sup> dc to:</b>	500 MHz (1ch) 250 MHz (2ch)	1 GHz	250 MHz (3-4ch) 500 MHz (1-2ch) 1 GHz (1ch)	1 GHz
<b>Freq. accuracy</b>	$[\frac{1}{2}(\text{sample frequency}) \times 1/32768] + (5 \times 10^{-3})(\text{signal frequency})$			
<b>Signal-to-noise</b>	55 to 65 dB. Noise floor can be reduced by averaging the time-domain waveform or by increasing the number of points in the record.			

<sup>3</sup>FFT amplitude readings are affected by input amplifier roll-off (3 dB at 500 MHz, with amplitude decreasing as frequency increases above 500 MHz).

### Telecommunications Test Option 001

- Standard telecom signal mask templates downloadable from DOS disk to waveform memory
- Automatic triggering on positive "isolated ones"<sup>4</sup> in live traffic for many standard telecom signals
- Automatic best-fit of test signals to mask templates
- Automatic pass-fail comparison of mask templates with corresponding input signals
- Automatic storage of up to 650 failures with time/date stamp; printing, or plotting of failed signals
- User-defined + or - pass-fail tolerance

<sup>4</sup>The term "isolated ones" is defined as a pulse sequence of at least two zeros followed by a one, followed by at least two zeros.



The HP 54542A shown with the HP 1145A, two-channel, 750-MHz, small geometry active probe for surface mount devices.

### Key Literature

Option 001 Product Overview, p/n 5965-5250EN (universal version)  
or p/n 5965-5250EUS (US version)

### PC Connectivity for 54500 Series Scopes

#### HP 34810A BenchLink Scope

HP BenchLink Scope lets you easily gather oscilloscope data in both waveform (time and voltage pairs) and image (screen dump) formats for display on your PC or transfer to files for use with other Windows-based applications. Use it to store a scope screen to the Windows clipboard and paste it into a lab report or manual. Ask your HP sales representative for a free HP BenchLink Evaluation Kit (p/n 5963-3810E).

#### HP 54551A ScopeView

Load the HP 54551A ScopeView disk on your PC and you have Microsoft® Windows-based control of HP 54500 series oscilloscopes—without any programming. ScopeView gives you a colorful virtual front panel with a fast update-rate to fully control your scope. For more information ask your HP sales representative for a ScopeView data sheet, p/n 5091-6378.

#### HP VEE for Windows

Collect, analyze, and present data without writing code (for HP 54500 series scopes).

### Ordering Information

The HP 54520A /C and 54522A /C oscilloscopes come with two HP 10441A 10:1, 1 MΩ probes; HP 54540A /C and 54542A /C come with four HP 10441A 10:1, 1 MΩ probes. All these oscilloscopes come with an accessories pouch, user's quick start, user's reference, programmer's reference, service guide, power cord and three-year warranty.

**HP 54520A** Two-C channel Oscilloscope (Monochrome)

**HP 54522A** Two-C channel Oscilloscope (Monochrome)

**HP 54540A** Four-Channel Oscilloscope (Monochrome)

**HP 54542A** Four-Channel Oscilloscope (Monochrome)

**HP 54520C** Two-C channel Oscilloscope (Color)

**HP 54522C** Two-C channel Oscilloscope (Color)

**HP 54540C** Four-Channel Oscilloscope (Color)

**HP 54542C** Four-Channel Oscilloscope (Color)

**Opt001** Telecommunications Mask Test Software

**Opt002** 1145A (shown above) 2-channel Active Probe

**Opt003** 1144A 800 MHz Active Probe

**HP 1141A\*** 200 MHz Differential Probe

**HP 1142A** Probe Control and Power Module

\*The 1141A must be used with the 1142A.

**Opt090D** elete Two Probes (HP 54520A, 54522A)

**Opt090D** elete Four Probes (HP 54540A, 54542A)

**Opt908** Rack-Mount Kit (HP p/n 5062-7379)

**Opt910** One Set Additional Manuals

**OptUK9** Front-Panel Cover

**HP 34810A** BenchLink Scope Software

**HP 54551A** ScopeView PC Software

For more information on HP probes and accessories, refer to page 107.

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