

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.

Test equipment Solutions Ltd
Unit 8 Elder Way
Waterside Drive
Langley
Berkshire
SL3 6EP

T: +44 (0)1753 596000
F: +44 (0)1753 596001

Email: info@TestEquipmentHQ.com
Web: www.TestEquipmentHQ.com



OSCILLOSCOPES

Digitizing Oscilloscopes HP 54600-Series Oscilloscopes

- 100 MHz bandwidth
- Analog-like look and feel
- Automatic and cursor measurements of frequency, time, and voltage
- Waveform storage
- Save/recall of 16 setups
- Autoscale
- Optional pass/fail testing
- Optional HP-IB or RS-232 remote control
- Optional hard copy to parallel, RS-232, or HP-IB printers or plotters
- 3-year warranty, optional 5 years
- CSA, IEC 348, and UL 1244 certified



54600A 2-Channel and 54601A 4-Channel Oscilloscopes

The HP 54600A and 54601A oscilloscopes offer you the ability to view waveforms that can't be seen with an analog-based product, while maintaining an analog-like, highly interactive display and familiar controls. To solve your most difficult test problems, powerful digital features, such as negative time, storage, measurement, automation, hard-copy, and computer control are provided. This new class of oscilloscopes is made possible through HP's advanced integrated-circuit technology in a small-size, lightweight package at an affordable price.

These oscilloscopes notably enhance your troubleshooting with their unique combination of analog look and feel with digital power. Bright, crisp displays of your most demanding signals are presented at all sweep speeds and delayed sweep magnifications. Storage for glitch and transient analysis is as simple as pressing a button. Negative time lets you view events that would be missed by analog scopes.

The unique 3-processor architecture of these oscilloscopes lets you view waveforms never before visible with a digital oscilloscope. The display speed of 1 million points/s provides a display with unprecedented interactivity. For example, AM-modulated and other rapidly changing signals are displayed as expected.

The 2-channel HP 54600A is ideally suited for production, field-service, and education applications where simple controls let you quickly solve your problems. The 4-channel HP 54601A is best suited for research and development labs and applications where more complex digital circuits are being designed and tested.

These oscilloscopes are produced with HP's advanced SMT production process to give you the reliability you expect of your most critical measurement instrument.

You can increase the power of these oscilloscopes by adding an optional module.

Computer control can be provided with either HP-IB or RS-232 interface modules. Using HP's ScopeLink software, these powerful oscilloscopes can be interfaced to a PC for waveform documentation, analysis, or storage. You can make simple hard copies with either printers or plotters using the parallel module.

The Test Automation Module adds built-in pass/fail testing, 40 masks, 100 sequence steps, and foot-switch control.

The Measurement/Storage Module adds real-time clock, 100 stored traces, and additional automatic measurements to any HP 54600 Series oscilloscope.

Performance Characteristics

Vertical System (all channels)

Bandwidth (-3dB) (ac-coupled):	dc to 100 MHz, 10 Hz to 100 MHz
Rise time	3.5 ns (calculated)
Math functions	Ch 1 + or - Ch 2
Channels 1 and 2 Accuracy¹	2 mV/div to 5 V/div ±1.5%
Vernier Accuracy¹	Fully calibrated, approximately ±3%
Cursor Accuracy^{1,2}	
Single cursor:	Vert. Acc. ±1.2% of full scale, ±0.5% of position value
Dual cursor:	Vert. Acc. ±0.4% of full scale
Bandwidth limit	Approximately 20 MHz
Coupling	Ground, ac, and dc
Inversion	Ch 1 and Ch 2
CMRR	Approximately 20 dB at 50 MHz
Input R&C	1 Ω, approximately 13 pf
Maximum input	400 V (dc + peak ac)
Channels 3 and 4 (HP 54601A)	0.1 and 0.5 V/div
Accuracy¹:	±1.5%
Coupling:	Ground and dc

Horizontal System

Sweep speeds	5 s/div to 2 ns/div Main and Delayed
Accuracy	±0.01%
Resolution	100 ps
Vernier accuracy	±0.05%
Cursor Accuracy (Δt & 1/Δt)³	±0.01% ±0.2% of full scale ±200 ps

Delay Jitter	10 ppm
Pretrigger Delay (Negative time)	≥ 10 div
Posttrigger Delay (Trigger to start of sweep)	At least 2,560 div or 50 ms (not to exceed 100 s)

Delayed Sweep Operation

Main Sweep	Delayed Sweep
5 s/div to 10 ms/div	up to 200X main
5 ms/div and faster	up to 2 ns/div

Trigger System

Sensitivity	dc to 25 MHz, 0.35 div or 3.5 mV; dc to 100 MHz, 1 div or 10 mV
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Sources	Channels 1, 2, 3, and 4 and line (HP 54601A); Channels 1 and 2, line, & Ext. (HP 54600A)
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Coupling	ac, dc, LF reject, HF reject, and noise reject LF & HF: - 3 db at approximately 50 kHz
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Modes	Auto, Autolevel, Normal, Single, and TV
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TV Triggering	TV line and field 0.5 div. of composite sync for stable display (Ch 1 and Ch 2)
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Holdoff	Adjustable from 200 ns to approximately 13 s
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External Trigger (HP 54600A only)	
Range:	±18 volts
Sensitivity:	dc to 25 MHz, 50 mV dc to 100 MHz, 100 mV



OSCILLOSCOPES

Digitizing Oscilloscopes (cont'd)

HP 54600A

External Trigger (Cont'd.)

Coupling	dc, HF rej., and noise rej.
Input R&C	1 M Ω , approximately 13 pF
Maximum Input	400 V (dc + peak ac)

X-Y Operation

Z-Blanking	TTL High blanks trace
Bandwidth	X and Y same as vertical system
Phase Difference	$\pm 3^\circ$ at 100 kHz

Display System

Display	7-inch Raster CRT
Resolution	255 vertical by 500 horizontal points
Controls	Front-panel intensity control
Graticule	8 \times 10 grid or frame
Autostore	Autostore saves previous sweeps in half-bright display and the most recent sweep in full-bright display

Acquisition System

Maximum Sample Rate	20 MSa/s
Resolution	8 bits
Simultaneous channels	Channels 1 and 2 or channels 3 and 4
Record length	4,000 points (2,000 single-shot)
Maximum update rate	1,000,000 points/s
Single-shot bandwidth	2 MHz, single-channel 1 MHz, dual-channel
Peak detect	50 ns glitch capture (100 ns dual-channel) at sweep speeds of 50 μ s/div and greater
Average	Number of averages selectable at 8, 64, or 256

Advanced Functions

Automatic Measurements	Measurements are continuously updated: Voltage: V_{avg} , V_{rms} , V_{pp} , V_{top} , V_{base} , V_{min} , and V_{max}
Time:	Frequency, Period, + Width, - Width, Duty Cycle, Rise Time, and fall time
Cursors:	Manually or automatically placed

Setup Functions

Autoscale:	Sets the vertical and horizontal deflection and the trigger level
Save/recall:	16 front-panel setups
Trace memory:	Two volatile pixel memories

Power Requirements

Line voltage range	100 Vac to 240 Vac
Line voltage selection	Automatic
Line frequency	45 Hz to 440 Hz
Max power consumption	220 VA

General

Size (excluding handle)	172 mm H \times 322 mm W \times 317 mm D (6.8 in \times 12.7 in \times 12.5 in) (excluding handle)
Weight	6.2 kg (14 lb)
Safety	CSA certification and IEC 348, UL 1244

*Temperature is $\pm 10^\circ$ C from calibration.

*Use full scale of 80 mV for 2 mV/div and 5 mV/div ranges.

*Use full scale of 50 ns for 2 ns/div.

*Tested to Hewlett-Packard environmental specification section 758 for Class B-1 products.

Accessories for the HP 54600 Series Oscilloscopes

HP 54650A, 54651A, 54652A, 54653A, 54654A, 54655A, 54656A, 54657A, 54658A

HP 54650A HP-IB Interface Module

Provides full remote control and hard copy to HP-IB printers and plotters. Programming is in accordance with IEEE 488.2. With the addition of this module, the scope's two pixel trace memories become nonvolatile. An operating and programming manual and a programming-examples disk are supplied.

HP 54651A RS-232 Interface Module

Provides full remote control and hard copy to RS-232 printers and plotters. With the addition of this module, the scope's two pixel trace memories become nonvolatile. An operating and programming manual and a programming-examples disk are supplied.

HP 54652A Parallel Interface Module

Provides the lowest-cost hard-copy solution. This module supports printers that are Epson FX-80 or HP-PCL compatible. Remote control is not provided with this module. The scope's two pixel trace memories become nonvolatile with the addition of this module. An operating note is supplied.

HP 54653A ScopeLink Software

The HP 54653A ScopeLink software package provides a communication link between a personal computer and the HP 54500 and HP 54600 series oscilloscopes. Using the ScopeLink software, you can transfer the waveform image in TIFF or PCX graphic format to the PC for desktop publishing applications. In addition, waveform data can be transferred to the PC in ASCII format for general use. Additional formats can be selected that are compatible with Lotus 1-2-3, DADISP, and HP's Charting Gallery. Instrument setups can be saved to the computer and downloaded to the scope for simple automation applications.

Equipment Requirements

Computer: IBM PC/XT/AT or fully compatible personal computer with serial port (COM1, COM2, or COM3) or an IEEE-488 card (HP 82335A or HP 27209A HP-IB card or National Instruments GP-IB card, part number 181065-01 or 181065-02)

Disk Drive: 2 flexible disk drives or 1 flexible disk drive and 1 hard disk drive

Operating System: MS-DOS® version 2.0 or later

Memory: 512 K of conventional memory

Graphics Adapter: CGA, EGA, VGA, or HGC

Compatible Instruments: HP 54500 series oscilloscopes, HP 54600 Series oscilloscopes with HP-IB or RS-232 interface module installed, HP 16500A logic analysis system (screen imaging only), and HP 1650 series logic analyzers (screen imaging only)

Printers: HP-PCL and Epson FX-80 compatible printers

Supplied with User's Guide, 5/8-inch diskette, and 3/8-inch diskette

HP 54654A Operator's Training Kit

Consists of a training signal board and lab workbook. After completing these labs, an operator will be able to make measurements and operate the oscilloscope without any additional training. A signal board, manual, and 9 V battery are supplied.

HP 54655A, 54656A Test Automation Modules

The HP-IB 54655A and RS-232 54656A Test Automation Modules add built-in pass/fail testing with conditional branching to any 54600 series oscilloscope. With the addition of either of these modules, an unskilled operator can perform very exacting oscilloscope measurements by simply connecting the scope probe to the test point and following the instructions on the scope's display. The oscilloscope tests the trace against a template and determines if the trace is passing or not. Failures are indicated to the operator along with instructions as to which action to take.

The test sequence can branch to another test based on the result of the present test. Each step in the sequence has three branching decisions that can be selected. They are the pass condition, the fail upper limit condition, and the fail lower limit condition. Using these three branching conditions, the scope can lead an unskilled operator through a troubleshooting process.

These modules have 100 sequence steps with 40 masks that can be stored in nonvolatile memory. The sequence can be set up from the front panel of the scope without the use of a computer. The Automask function creates a mask template from a known good signal. A built-in mask editor allows the test limits to be precisely adjusted to the exact tolerance for the test. Once the setup has been defined, it can be protected from unintentional change. ScopeLink can be used to copy the setup to other scopes.

The HP-IB 54655A Test Automation Module is designed to improve the productivity of computer-controlled test systems by removing the pass/fail decisions from the computer.

The RS-232 54656A Test Automation Module offers a testing solution that bridges the gap between manual and computer-controlled situations. This version of the Test Automation Module contains a RJ-45 I/O connector that can be connected to a foot switch for operator control and five user-definable output lines. These lines can be used to drive external devices that control a test fixture, or simply external pass/fail indicators.

The HP-IB 54655A is supplied with an operating and programming manual and programming examples on disk. The RS-232 54656A is also supplied with a 9- to 25-pin RS-232 adapter cable and a RJ-45 connector with 10 ft of cable attached for use with the auxiliary I/O connector.

HP 54657A, 54658A Measurement/Storage Modules

The HP-IB 54657A and RS-232 54658A Measurement/Storage modules add measurement power for R&D, field service, and analysis applications to any 54600 series oscilloscope. Both of these modules add the following:

- Additional automatic measurements of amplitude, channel-to-channel delay, pulse overshoot, pulse preshoot, and phase angle.
- Additional waveform math functions of addition, subtraction, multiplication, differentiation, and integration.
- User-definable measurement thresholds of 10%/90%, 20%/80%, and voltage levels.
- Additional cursor measurements of channel-to-channel delay, phase angle, and percentage.
- Addition of 100 nonvolatile trace memories.
- Addition of a real-time clock for time/date stamping of trace memories and hardcopy outputs.
- Automatic pass/fail testing by use of a mask template.

The automatic pass/fail testing simplifies circuit debugging by comparing a live scope trace to a test mask. If a failure is detected, the failed trace can be time stamped and stored in one of the 100 nonvolatile trace memories, or output to a hardcopy device.

The Automask feature easily creates the test mask from a known good trace, and the mask editor can be used to exactly define the mask to the precise limits of the desired test. Masks can be uploaded to a PC for storage by use of the ScopeLink software package.

Both the HP-IB 54657A and RS-232 54658A are supplied with an operating and programming manual, and programming examples on disk.

OSCILLOSCOPES

Digitizing Oscilloscopes (cont'd)

HP 54600 - Series Oscilloscopes

Ordering Information

HP 54600A 4-Channel
100 MHz Oscilloscope
(Includes two 1.5 meter 10X voltage probes (10071A),
operating and service manual, and line cord.)

Volume Discount:
2 to 3: Factory base price less 2%
4 or more: Factory base price less 10%

HP 54601A Four-Channel
100-MHz Oscilloscope
(Includes two 1.5 Meter 10X voltage probes (10071A),
operating and service manual, and line cord.)

Volume Discount:
2 to 3: Factory base price less 2%
4 or more: Factory base price less 10%

- HP 54650A** HP-IB Interface Module \$475
- HP 54651A** RS-232 Interface Module \$475
- HP 54652A** Parallel Interface Module \$275
- HP 54653A** Operator's Training Kit \$200
- HP 54654A** ScopeLink Software \$200
- HP 54655A** Test Automation Module with HP-IB Interface \$750
- HP 54656A** Test Automation Module with RS-232 Interface \$800
- HP 54657A** Measurement/Storage Module with HP-IB Interface \$750
- HP 54658A** Measurement/Storage Module with RS-232 Interface \$750
- HP 10079A** CRT Trace Camera \$595

☎ For off-the-shelf shipment, call 800-452-4844.

- | Price | | Opt | Price |
|------------|---|---|-------|
| \$2,395.00 | ☎ | Opt 101 Accessory Pouch and Front-Panel Cover (HP 10098A) | \$50 |
| | | Opt 102 Two Additional 10071A Probes (HP 54601 only) | \$90 |
| | | Opt 103 Operator's Training Kit (HP 54654A) (Consists of a training signal board and lab workbook. After completing these labs, an operator will be able to make measurements and operate the oscilloscope without any additional training.) | \$200 |
| \$2,347.50 | | Opt 104 Carrying Case (HP 5041-9409) (Designed to protect the oscilloscope for shipment or for checking as airline baggage.) | \$290 |
| \$2,157.50 | ☎ | Opt 105 ScopeLink Software (HP 54653A) (MS-DOS* software that interfaces the scope (with either HP-IB or RS-232 module installed) to a PC for storage analysis or easy integration of waveform data into popular desktop publishing software.) | \$200 |
| \$2,895.00 | | Opt 090 Delete Probes | -\$90 |
| | | Opt 908 Rackmount Kit (HP 5062-7345) (7-inch EIA standard rack) | \$255 |
| \$2,837.50 | | Opt 910 Additional User and Service Guide | \$15 |
| \$2,607.50 | | | |

MS-DOS* is a U.S. registered trademark of Microsoft Corporation.

Educators

These oscilloscopes are ideally suited for classroom use. Contact your local Hewlett-Packard sales office for details on specific education discount programs.

