OSCILLOSCOPES

General-Purpose and Troubleshooting

HP 54600 Series

Performance Characteristics

Vertical system

Channels 1 and 2	2 mV/div to 5 V/div
Accuracy[1]	±1.5%
Vernier accuracy[1]	Fully calibrated: ±3%
Bandwidth (−3dB), ac-coupled	dc to 100/150 MHz[2] 10 Hz to 100/150 MHz[2]
Rise time	<3.5/2.33 ns[2] (calculated)
Coupling	dc, ac, and ground
Channels 3 and 4	0.1 and 0.5 V/div
Accuracy[1]	±1.5%
Bandwidth (−3dB)	dc to 100/250 MHz[2]
Rise time	<3.5/1.4 ns[2] (calculated)
Coupling	dc and ground
Math functions	CH 1 + CH 2
Cursor accuracy[1,3]	
Single cursor	Vertical accuracy ±1.2% of full scale ±0.5% of position value
Dual cursor	Vertical accuracy ±0.1% of full scale
Bandwidth limit (channels 1 and 2)	≈20 MHz
Inversion	CH 1 and CH 2
CMRR	≈20 dB at 50 MHz
Dynamic range	±8 div from center screen
Input R&C	1 MΩ, ≈13 pf
Maximum input	400 V (dc + peak ac)

Horizontal system

Sweep speeds, main and delayed	5 s/div to 2 ns/div
Accuracy	±0.01%
Resolution	100 ps
Vernier accuracy	±0.05%
Cursory accuracy (t and 1/f)[3]	±0.01% ±0.2% of full scale ±200 ps
Delay jitter	10 ppm
Pre-trigger delay (negative time)	10 div
Post-trigger delay (trigger to start of sweep)	At least 2560 div or 50 ms. Not to exceed 100 s.

Delayed sweep

Main sweep	Delayed sweep
5 s/div to 10 ms/div	Up to 200 × main
5 ms/div and faster	Up to 2 ns/div

Trigger system

Sensitivity all channels	dc to 25 MHz, 0.35 div or 3.5 mV
Channels 1 and 2	dc to 100/150 MHz[2], 1 div or 10 mV
Channels 3 and 4	dc to 100/250 MHz[2], 1 div or 10 mV
Sources	HP 54601A and 54602A: Channels 1, 2, 3, 4, or line. HP 54600A: Channels 1, 2, line, and external.
Coupling	ac, dc, LF reject, HF reject, and noise reject. LF & HF: −3db at 50 kHz.
Modes	Auto, Autolevel, Normal, Single, and TV
TV triggering	TV line and field. Requires 0.5 div of composite sync for stable display (Channels 1 and 2).
Holdoff	Adjustable from 200 ns to 13 s

External trigger (HP 54600A only)

Range sensitivity	±18 V dc to 25 MHz: 50 mV dc to 100 MHz: 100 mV
Coupling	dc, HF reject and noise reject
Input R&C	1 MΩ, ≈ 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	±3° at 100 kHz

Display system

Display	7-in raster CRT
Resolution	255 vertical × 500 horizontal points
Controls	Front-panel intensity control
Graticule	8 × 10 grid or frame
Autostore	Saves previous sweeps in half-bright display and the most recent sweep in full-bright display

Acquisition system

Max 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 points single shot)
Max 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 μs/div and greater
Average	Number of averages selectable from 8, 64, 256

Advanced functions

Automatic measurements	Continuously updated
Voltage	Vavg, Vrms, Vpp, Vtop, Vbase, Vmin, and Vmax
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	2 volatile pixel memories
TV functions	
Line counting	Delay time calibrated in NTSC and PAL line numbers
HP 54602A only: All-field trigger (both fields selected)	Oscilloscope triggers on the vertical sync pulse in both fields, allowing use with noninterlaced video

General

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
Environmental characteristics	Meets the requirements of MIL-T-28800D for type III, class 3, style D equipment as described later in this table
Ambient temperature	
Operating	−10° C to +55° C
Nonoperating	−51° C to +71° C
Humidity[4]	
Operating	95% RH at 40° C for 24 h
Nonoperating	90% RH at 65° C for 24 h
Altitude	
Operating	To 4,500 m (15,000 ft)
Nonoperating	To 15,000 m (50,000 ft)
EMI (Commercial) **EMI (MIL-T-28800D)**	Meets FTZ 1046 class B
CE01, CE03, CE07	Full limits
CS01, CS02, CS06	Full limits
RE01	15 dB relaxtion to 20 kHz; exceptioned from 20 kHz to 50 kHz
RE02 With Opt 002 installed	Full limits of class A1e and A1f
Without Opt 002 installed	10-dB relaxation from 14 kHz to 100 kHz
RS02	Exceptioned
RS03 With Opt 001 installed	Slight trace shift from 80 MHz to 200 MHz
Vibration	Operating 15 min along each of the 3 major axes: 0.025-in peak-to-peak displacement 10 Hz to 55 Hz in 1-min cycles. Held for 10 min at 55 Hz (4 g at 55 Hz).
Shock	Operating 30 g, 1/2 sine, 11-ms duration, 3 shocks/axis along major axis. Total of 18 shocks.
Size (excluding handle)	
Width	322 mm (12.7 in)
Height	172 mm (6.8 in)
Depth	317 mm (12.5 in)
Weight	6.2 kg (14 lbs)
Safety	CSA certification, IEC 348

[1] Temperature is ±10° C from calibration.
[2] Use full scale of 80 mV for 2 mV/div and 5 mV/div ranges.
[3] Use full scale of 50 ns for 2 ns/div.
[4] Tested to Hewlett-Packard environmental specification section 758 for class B-1 products.
[5] Second number is characteristic for the HP 54602A only.

HP 54655A and 54656A Test Automation Modules Operating Characteristics

The characteristics that follow apply to HP 54600 Series oscilloscopes with the module installed.

Trace memories	2, nonvolatile

Step sequencing

Number of steps	100, nonvolatile
Instrument setup	Entire front-panel setup. When mask template testing is used, automatic measurements will not be displayed.
Messages	Label (60 characters); pass, fail min, and fail max messages (30 characters each)
Branching	Branch based on the test result of pass, fail min, or fail max.
Operator-access permission	None: Mode allows use of only soft keys for sequencing. Adjust: Mode allows use of soft keys, V/div knobs, position knobs, delay knob, and time/div knob. All: Mode allows use of all keys and knobs.
Sequencing control	3 soft keys control the sequencing: Next, Previous, and Reset.
Editing	Copy a single step or mask template to a destination step.

Mask template testing

Number of mask templates	40, nonvolatile
Mask template generation	Automask generates mask templates from Autostore data with variable tolerance; mask editor allows pixel-by-pixel editing and line-drawing editing; smooth mask function performs a running average of 3 pixels.
Test region	Pixel-by-pixel selectable
Adjust mode	Adjustment mode is optimized for fastest screen update; some of the displayed data may not be tested.
Fail region	Inside: Signal fails if it falls inside the region bounded by the max and min limit line. Outside: Signal fails if it falls outside the region bounded by the max and min limit lines.
Failure indication	Failure-zone indicator shows where the signal fails the mask template.

Hard-copy output

Printer/plotter supported	HP ThinkJet, HP QuietJet, HP PaintJet, or HP LaserJet printer; HP-GL–compatible plotter. HP 54656A only: Epson FX-80 or compatible printer.

RS-232 configurations

Connector type	With adapter cable connected, the end of the cable is a 25-pin DTE port. A printer cable is required to connect to either hard-copy devices or computer.
Protocols	XON/XOFF, hard wire
Data bits	8
Stop bits	1
Parity	None
Baud rates	1200, 2400, 9600, 19200

Programmability

All instrument settings and operating modes may be remotely programmed via RS-232 or HP-IB (IEEE 488).

Input/output (HP 54656A only)

Input lines	2 lines for remote control of the Next, Previous, and Reset functions during sequencing.
Output lines	5 output lines definable in each step. Selections are on, off, pulse at start of step, pulse at end of step, pass, fail, fail min, and fail max. Output level is 0–5 V; output resistance is 120 Ω max. Output current is ≃24 mA.

HP 54657A and 54658A Measurement/Storage Modules Operating Characteristics

The characteristics that follow apply to HP 54600 Series oscilloscopes with the module installed.

Automatic measurements

Voltage	Vamp, Vavg, Vrms, Vpp, Vpre, Vovr, Vtop, Vbase, Vmin, and Vmax
Time	Delay, duty cycle, frequency, period, phase angle, rise time, fall time, +width, and −width
Thresholds	User selectable among 10%/90%, 20%/80%, or absolute voltage levels
Measurement formats	Voltage, time, percentage, and phase angle
Waveform math functions	Addition, subtraction, multiplication, differentiation, integration, and FFT.

Mask template testing

Number of mask templates	2, nonvolatile
Mask generation	Automask generates mask template from displayed data with variable tolerance. Mask editor allows pixel-by-pixel editing.
Test region	Pixel-by-pixel resolution
Fail region	Inside: Signal fails if it falls inside the region bounded by the max and min limit lines. Outside: Signal fails if it falls outside the region bounded by the limit lines.
Failure indication	Failure-zone indicator shows where the signal fails the mask template.

Trace memory (all nonvolatile)

Locations 1–3	High-speed storage without compression
Locations 4–100	Storage with compression; number of traces is a function of complexity. Storage time is approximately 7 s.
Real-time clock	24-h format with battery backup. Can be set from front panel.

Hard-copy output

Printer/plotter supported	HP ThinkJet, HP QuietJet, HP PaintJet, or HP LaserJet printer; HP-GL–compatible plotters. HP 54658A only: Epson FX-80 or compatible printer

Programmability

All instrument settings and operating modes may be remotely programmed via RS-232 or HP-IB (IEEE 488).

RS-232 configurations (HP 54658A only)

Connector type	25-pin DTE port; a printer cable is required to connect with hard-copy devices or with a computer.
Protocols	XON/XOFF, hard wire
Data bits	8
Stop bits	1
Parity	None
Baud rates	1200, 2400, 9600, 19200

OSCILLOSCOPES

General Purpose and Troubleshooting

HP 54600 Series

Ordering Information	Price
HP 54600A Two-Channel, 100-MHz Oscilloscope Includes two 1.5 m 10X probes (10071A), operating and service manual, and line cord.	$2,495 ☎
HP 54601A Four-Channel, 100-MHz Oscilloscope Includes two 1.5 m 10X probes (10071A), operating and service manual, and line cord.	$2,895 ☎
HP 54602A Four-Channel, 150-MHz Oscilloscope Includes two 1.5 m 10X probes (10071A), operating and service manual, and line cord.	$3,270 ☎
Accessories	
HP 54650A HP-IB Interface Module	$475 ☎
HP 54651A RS-232 Interface Module	$475 ☎
HP 54652A Parallel Interface Module	$275 ☎
HP 54653A ScopeLink Software	$200 ☎
HP 54654A Operator's Training Kit	$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
HP 10070A 1.5 m 1X Probe	$55
HP 85901A ac Power Source	$1,290 ☎
Options	
Opt 101 Accessory Pouch and Front-Panel Cover (HP 10098A)	$50 ☎
Opt 102 Two Additional 10071A Probes (HP 54601A, 54602A only)	$110
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
Opt 104 Carrying Case (HP 5041-9409) Designed to protect the oscilloscope for shipment or for checking as airline baggage.	$290
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 desktop publishing software.	$200
Opt 090 Delete Probes	– $110
Opt 908 Rackmount Kit (HP 5062-7345) 7-in EIA standard rack	$255 ☎
Opt W50 Additional Two-Year Warranty (for a total of five years)	
HP 54600A	$45
HP 54601A	$45
HP 54602A	$85

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

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

For the Educators

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

HP 54600 Interfacing and Hard Copy Output Information

Compatibility Chart

The following table describes the devices supported by the HP 54600 Series oscilloscopes

	HP-IB modules	RS-232 modules	Parallel modules
HP-PCL Printers	Yes	Yes	Yes
HP-GL Plotters	Yes	Yes	N/A
Epson Printers (FX-80 or Compatible)	Yes	Yes	Yes
Computers	Yes	Yes	N/A

Ordering Information	Price
HP Printers and Plotters	
HP 2225A ThinkJet Printer	$595
HP 2227A QuietJet Printer	$849
HP 33481A LaserJet IIIP Printer	$1,595
HP 7440A Color Pro Plotter	$1,395
HP 7475A Plotter	$1,995
HP-IB Cables	
HP 10833A 1 m Cable	$80
HP 10833B 2 m Cable	$90
HP 10833C 4 m Cable	$100
HP 10833D 0.5 m Cable	$80
RS-232 Cables	
For connection to printers and plotters:	
HP 13242G 5 m, 25 Pin (M) to 25 Pin (M)	$49
HP 17255M 1.5 m, 25 Pin (M) to 25 Pin (M)	$44
For connection to IBM PC/XT computers:	
HP 17255D 1.5 m, 25 Pin (M) to 25 Pin (F)	$44
HP 92219J 5 m, 25 Pin (M) to 25 Pin (F)	$61
For connection to HP Vectra computers:	
HP 24542G 3 m, 25 Pin (M) to 9 Pin (F)	$45
Parallel Cable	
HP 92284A Cable	$39