General-Purpose Oscilloscopes

The HP 54600B-Series Oscilloscopes offer exceptional waveform viewing and measurements in a small, lightweight package. The two-channel HP 54600B and HP 54603B are suited for production, field service, and education applications. The four-channel HP 54601B is best suited for research and design labs, and applications involving digital circuit test and troubleshooting. For higher frequency applications, the HP 54602B provides 150 MHz bandwidth and triggering up to 250 MHz. Each of these oscilloscopes gives you:

- 60-MHz bandwidth (HP 54603B)
  100-MHz bandwidth (HP 54600B and HP 54601B)
  150-MHz bandwidth (HP 54602B)
- Automatic setup of the front panel
- Automatic and cursor measurements of frequency, time, and voltage
- Waveform storage
- Save and recall of 16 front-panel setups
- Peak detect

These oscilloscopes are easy to use with familiar controls and high display update rate, but with none of the viewing problems that are associated with analog oscilloscopes. A bright, crisp display is obtained at all sweep speeds and delayed sweep magnifications. Storage is as simple as pressing a button. Negative time allows the viewing of events that occur before the trigger event. Cursors and automatic measurements greatly simplify the analysis of these events.

You can upgrade this oscilloscope for hardcopy or remote control with the addition of an interface module. Unattended waveform monitoring and additional waveform math, such as FFT, can be added with the addition of one of the Measurement/Storage modules.

Bring your scope and PC together with BenchLink software. BenchLink, which runs under Windows, allows easy transfer of scope traces and waveform data to your PC for incorporation into documents or storage.

Accessories supplied

- Two 1.5 meter, 10:1 Probes (HP 10071A)
- Power cord for country of destination
- This *User and Service Guide*
- *Programmer's Guide* with Microsoft Windows Help file, ascii help file, and sample programs.

Accessories available

- HP 34810B BenchLink/Scope Software for Windows
- HP 54650A HP-IB Interface Module
- HP 54652A Parallel Interface Module
- HP 54654A Operator's Training Kit
- HP 54655A and HP 54656A Test Automation Modules
- HP 54657A HP-IB Measurement Storage Module
- HP 54659B Serial/Parallel Measurement/Storage Modules
- HP 5041-9409 Carrying Case
- HP 5062-7345 Rackmount Kit
- HP 10070A 1.5 meter, 1:1 Probe
- HP 10100C 50 Ω Termination

Options available

- Option 001 RS-03 Magnetic Interference Shielding Added to CRT
- Option 002 RE-02 Display Shield Added to CRT
- Option 005 Enhanced TV/Video Trigger (HP 54602B only)
- Option 090 Deletes Probes
- Option 101 Accessory Pouch and Front-Panel Cover
- Option 102 Two Additional HP 10071A 10:1 Probes (HP 54602B only)
- Option 103 Operator's Training Kit (HP 54654A)
- Option 104 Carrying Case (HP 5041-9409)
- Option 106 BenchLink/Scope Software (HP 34810B)
- Option 1CM Rackmount Kit (HP 5062-7345)
- Power Cords (see the table of Replaceable Parts at the end of Chapter 4, Service.)

Vertical System

All channels

Bandwidth[1]

HP 54600B and HP 54601B

dc to 100 MHz –3 dB
ac coupled, 10 Hz to 100 MHz –3 dB

HP 54602B

dc to 100 MHz –3 dB (1, 2, & 5 mV/div)
dc to 150 MHz –3 dB (channels 1 & 2)
dc to 250 MHz –3 dB (channels 3 & 4)
ac coupled, 10 Hz to 150 MHz –3 dB (channels 1 & 2)

HP 54603B

dc to 60 MHz –3 dB
ac coupled, 10 Hz to 60 MHz

Rise time

3.5 ns (calculated, HP 54600B & HP 54601B)
<2.33 ns (calculated, channels 1 & 2, HP 54602B)
<1.4 ns (calculated, channels 3 & 4, HP 54602B)
5.8 ns (calculated, HP 54603B)

Dynamic range ±32 V or ±8 divisions, whichever is less

Math functions Channel 1 + or – channel 2

Input resistance 1 MΩ

Input capacitance ≈13 pf

⚠ **Maximum input voltage** 400 V (dc + peak ac)

[1] Tested, see "To verify bandwidth," on page 4–10.

Channels 1 and 2

Range 2 mV/div to 5 V/div (lower limit is 1 mV/div for the HP 54602B)

Accuracy[1] ±1.9% (HP 54600B, HP 54601B, and HP 54602B)
±2.4% (HP 54603B)

Verniers[1] Fully calibrated, accuracy about ±3.5%

Cursor accuracy[1, 2, 3]

Single cursor accuracy vertical accuracy ±1.2% of full scale ±0.5% of position value (HP 54602B at <10 mV/div: vertical accuracy ±2.4% of full scale ±0.5% of position value)

Dual cursor accuracy vertical accuracy ±0.4% of full scale

Bandwidth limit ≈20 MHz

Coupling Ground, ac, and dc

Inversion Channel 1 and channel 2

CMRR (common mode rejection ratio) ≈ 20 dB at 50 MHz

Channels 3 and 4

(HP 54601B & HP 54602B only)

Range 0.1 V/div and 0.5 V/div ranges

Accuracy[1] ±1.5%

Coupling Ground and dc

[1] When the temperature is within ±10 °C from the calibration temperature.
[2] Use a full scale of 16 mV for 1 mV/div range for HP 54602B.
Use a full scale of 80 mV for 2 mV/div and 5 mV/div ranges for all other scopes.
[3] Tested, see "To verify voltage measurement accuracy," on page 4–7.

Horizontal System

Sweep speeds

5 s/div to 2 ns/div main and delayed (HP 54600B, HP 54601B, HP 54602B
5 s/div to 5 ns/div main and delayed (HP 54603B)

Accuracy ±0.01% ±0.2% of full scale ±200 ps

Vernier Accuracy ±0.05%

Horizontal resolution 100 ps

Cursor accuracy[1,2] **(Δt and 1/Δt)** ±0.01% ±0.2% of full scale ±200 ps

Delay jitter 10 ppm

Pretrigger delay (negative time) ≥10 divisions

Posttrigger delay (from trigger point to start of sweep) at least 2560 divisions or 50 ms. Not to exceed 100 s.

Delayed sweep operation

Main sweep	**Delayed sweep**
5 s/div to 10 ms/div	up to 200 times main sweep
5 ms/div and faster	up to 2 ns/div

[1] Use full scale of 50 ns on 2 ns/div range.
[2] Tested, see "To verify horizontal Δt and 1/Δt accuracy," on page 4–16.

Trigger System

Internal trigger

Sensitivity[1]

HP 54600B	dc to 25 MHz	0.35 div or 3.5 mV
	dc to 100 MHz	1 div or 10 mV
HP 54601B	dc to 25 MHz	0.35 div or 3.5 mV
	dc to 100 MHz	1 div or 10 mV
HP 54602B	dc to 25 MHz	0.35 div or 3.5 mV (>5 mV/div)
		1.0 div or 2 mV (1, 2, or 5 mV/div)
	25 MHz to 100 MHz	1.5 div or 3 mV (1, 2, or 5 mV/div)
	dc to 150 MHz	1 div or 10 mV (chan 1&2)(>5 mV/div)
	dc to 250 MHz	1 div or 100 mV (chan 3&4)
HP 54603B	dc to 25 MHz	0.35 div or 3.5 mV
	dc to 60 MHz	1 div or 10 mV

Sources Channels 1, 2, 3, 4, and line on HP 54601B & HP 54602B
Channels 1, 2, line, and external on HP 54600B and HP 54603B

Coupling ac, dc, LF reject, HF reject, and noise reject
LF reject and HF reject –3 dB at ≈50 kHz

Modes Auto, Autolevel, Normal, Single, and TV

TV triggering Available on channels 1 and 2 only

TV line and field 0.5 division of composite sync for stable display

Holdoff Adjustable from 200 ns to ≈13 s

External trigger (HP 54600B and HP 54603B only)

Range ±18 V

Sensitivity[1]

HP 54600B	dc to 25 MHz	50 mV
	dc to 100 MHz	100 mV
HP 54603B	dc to 25 MHz	50 mV
	dc to 60 MHz	100 mV

Coupling dc, HF reject, and noise reject

Input resistance 1 MΩ

Input capacitance ≈13 pf

⚠ **Maximum input voltage** 400 V (dc + peak ac)

[1] Tested, see "To verify trigger sensitivity," on page 4–18.

XY Operation

Z Blanking TTL high blanks trace

Bandwidths X and Y same as vertical system

Phase difference ±3 degrees at 100 kHz

Display System

Display 7-inch raster CRT

Resolution 255 vertical by 500 horizontal points

Controls Front-panel intensity control

Graticule 8×10 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

Vectors off 4,000 points
Vectors on and/or single shot 2,000 points

Maximum update rate

Vectors off 1,500,000 points/sec
Vectors on 60 full screens/sec, independent of the number of waveforms being displayed

Single-shot bandwidth 2 MHz single channel, 1 MHz dual channel

Peak detect 50 ns glitch capture (100 ns dual channel) from 5 s/div to 50 µs/div

Average Number of averages selectable at 8, 64, and 256

Roll Mode At sweep speeds of 200 ms/div and slower, waveform data moves across the display from right to left with no dead time.

Display can be either free-running (non-triggered) or triggered to stop on a trigger event.

Advanced Functions

Automatic measurements (measurements are continuously updated)

Voltage Vavg, Vrms, Vp-p, Vtop, Vbase, Vmin, Vmax
Time Frequency, period, + width, – width, duty cycle, rise time, and fall time
Cursors Manually or automatically placed

Setup functions

Autoscale Sets vertical and horizontal deflections and trigger level forsignals with a frequency ≥50 Hz, duty cycle >1%, and voltage level channels 1 and 2 >20 mVp-p, channels 3 and 4 >100 mVp-p, external trigger (HP 54600B and HP 54603B only) >100 mVp-p.
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

Maximum power consumption 220 VA

General

Environmental characteristics

The instrument meets or exceeds the environmental requirements of MIL-T-28800D for Type III, Class 3, Style D equipment as described below.

Ambient temperature (Tested to MIL-T-28800D paragraphs 4.5.5.13 option 2 and 4.5.5.14)

Operating –10 °C to +55 °C
Nonoperating –51 °C to +71 °C

Humidity (tested to Hewlett-Packard environmental specification section 758 paragraphs 4.0, 4.1, and 4.2 for class B-1 products)

Operating 95% relative humidity at +40 °C for 24 hours
Nonoperating 90% relative humidity at +65 °C for 24 hours

Altitude (Tested to MIL-T-28800E paragraph 4.5.5.2)

Operating to 4,500 m
Nonoperating to 15,000 m

EMI

EMI (commercial) CISPR 11 (ISM, Group 1, class A equipment)

EMI Meets the requirements in accordance with MIL-T-28800D,

CE01 Part 2 narrow band requirements up to 15 kHz

CE03 Part 4

CS01 Part 2

CS02 Part 2

CS06 Part 5 limited to 300 V

RE01 Parts 5 and 6 measured at 30.5 cm, 15 dB relaxation to 20 kHz, and exceptioned from 20 kHz to 50 kHz.

RE02 Part 2 (limited to 1 GHz) Full limits of class A1c and A1f, with option 002 installed without option 002 installed 10 dB relaxation, 14 kHz to 1 GHz

RS02 Part 2, Part I Exceptioned

RS02 Part 2, Part II Exceptioned

RS03 Part 2, limited to 1 V/meter from 14 kHz to 1 GHz (with option 001 installed) Slight trace shift from 80 MHz to 200 MHz

Vibration

Operating 15 minutes along each of the 3 major axes; 0.635 mm p-p displacement, 10 Hz to 55 Hz in one-minute cycles. Held for 10 minutes at 55 Hz (4 g at 55 Hz).

Shock

Operating 30 g, 1/2 sine, 11 ms duration, 3 shocks per axis along major axis. Total of 18 shocks.

Physical characteristics

Size (excluding handle)

Height 172 mm
Width 322 mm
Depth 317 mm

Weight 6.2 kg

Option 005 General Performance Characteristics
(HP 54602B only)

Video Standards

NTSC
PAL
PAL-M
SECAM
Generic

Video Trigger Modes

Line (number) of Field 1
Field 2
Alternate Fields

All Lines

Field 1 Defined as that field with the 3 lines of vertical sync starting at line 4. Is actually color field 1 or color field 3.

Field 2 Defined as that field with the 3 lines of vertical sync starting at the midpoint of line 3. Is actually color field 2 or color field 4.

All Fields

Option 005 Trigger System (HP 54602B only)

Internal trigger

Sensitivity Performance remains unchanged

Coupling Performance remains unchanged

Modes Performance remains unchanged

Holdoff Performance remains unchanged

TV triggering Available on channels 1 and 2 only

TV line and field 0.5 division of composite sync for stable display

External trigger

Performance remains unchanged

Vertical output

Connector Rear panel BNC (f)

Source Impedance 50Ω (nominal)

Signal source selected by internal trigger source

Amplitude approximately 90mVp-p into 50Ω for a full scale display at full bandwidth of the oscilloscope

TV Trigger output

Connector Rear panel BNC (f)

Amplitude TTL

Pulse width a function of TV trigger mode, Minimum approximately 5us in line modes to the width of a field in field modes

Delay from Vertical Output approximately 400ns.