



OSCILLOSCOPES

100 MHz crystal delta time, storage

Models 1740A, 1741A, 1742A, 1743A & 1744A

- Delta time measurements
- Optional built-in DMM for increased accuracy, flexibility
- Dual channel, 5 mV/div to 100 MHz
- 3rd Channel trigger view and selectable input impedance



1742A

1740A, 1741A, 1742A, 1743A, 1744A Description

Hewlett-Packard's 1740 series of 100 MHz, dual-channel oscilloscopes offer the high performance necessary to meet the demanding requirements of both laboratory and field applications. These oscilloscopes have the performance and features to make accurate measurements with ease. The front panel includes a large, high-resolution CRT with color-coded controls which reduce operator learning time and make repetitious measurements easier. Several features that add to the versatility of these 100 MHz portable oscilloscopes include a third channel trigger view for viewing the external signal with both vertical channels; a X5 vertical magnifier for 1 mV/div deflection factors on both channels; selectable input impedance (1 M Ω /50 Ω) for general purpose probing and precise rise time measurements; and a Logic State Display option (except for the 1744A) for convenient switching between logic state and electrical analysis.

8 X 10 cm Display

1740A, 1742A, 1743A Conventional CRT

The CRT has a crisp, bright trace over the fully specified 8 x 10 cm display area. An accelerating potential of 15 kV makes the display compatible with the 5 ns/cm sweep speeds for easier viewing of low rep rate, fast transition time signals. The small spot size of the lab quality CRT along with the no parallax internal graticule makes critical and difficult timing measurements easier to perform. An internal floodgun uniformly illuminates the CRT phosphor for high quality trace photos with a sharp well defined internal graticule.

3rd Channel Trigger View

In many measurements, especially in digital applications, it is desirable to externally trigger the main sweep using a signal synchronous with the displayed waveforms. The third channel trigger view offers several measurement conveniences in dual channel timing applications.

– The external trigger signal can be displayed without the need to physically connect it to one of the vertical input channels.

– Trigger threshold can be viewed for either an internal or external trigger source. Trigger threshold is the center horizontal graticule line and the trigger point is selected by positioning the trigger waveform vertically using the Sweep Trigger Level control.

– With the trigger view mode, the shape of the trigger waveform can be viewed to verify that the correct signal is used as the trigger source. Trigger view also allows you to verify that the trigger threshold is not set to portions of a waveform containing irregularities and reflections.

– With trigger view, three channels of information are displayed so that timing analysis can be accomplished. The trigger channel is displayed with a specified delay of ≤ 3.5 ns ± 1 ns relative to the two vertical channels.

Stable Flexible Triggering

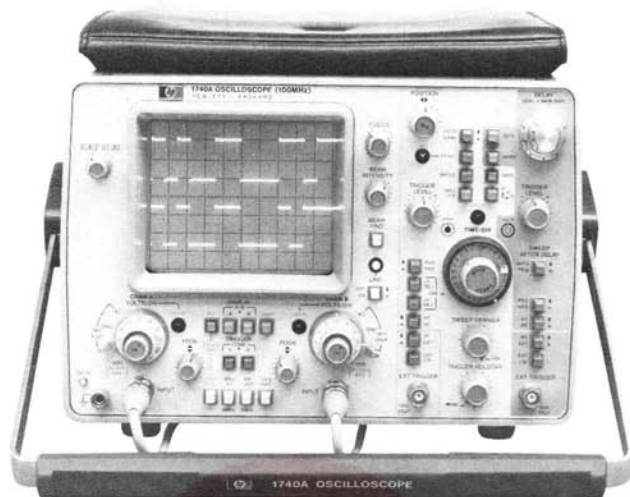
Stable internal triggering to greater than 100 MHz requires only 1 cm of vertical deflection. The internal trigger sync take-off is immediately after the attenuator which maintains a stable display regardless of changes in position, vernier, or polarity controls. The desired trigger signal conditioning for your measurement application is quickly achieved with easy-to-use push-button controls. In the external trigger mode, signals of only 100 mV trigger the oscilloscope to 100 MHz (only 50 mV to 50 MHz).

Vertical Amplifiers

To meet many measurement requirements, vertical deflection factors from 5 mV/div to 20 V/div are provided with 3% accuracy. For low level, dual channel measurements, a times five vertical magnifier provides 1 mV/div and 2 mV/div capability which allows you to analyze both input and output signals such as those on tape and disc heads or power supply ripple and its influence on other waveforms.



- Dual channel, 5 mV/div to 100 MHz
- Selectable input impedance
- 3rd Channel trigger view



1740A

Selectable Input Impedance

For maximum measurement flexibility, switchable 50 Ω and 1 M Ω inputs are provided. The internal 50 Ω input with low reflections is useful for measurements requiring a 50 Ω termination for accurate pulse reproduction.

Serviceability

Innovations in circuit design along with custom integrated hybrid circuits reduce calibration time because of a minimum of adjustments. Wire harnesses and interconnection cables between boards are reduced with an interface board which connects the main boards together. This interface board helps to reduce service time and reassembly errors normally encountered with instruments containing many cables. These oscilloscopes, with the exception of the high writing speed 1744A, do not require a fan or ventilating holes for convection cooling which reduces the amount of dust and dirt that can accumulate internally.

General Purpose 1740A

The Model 1740A contains all of the standard 1740 series features described, such as third channel trigger view, flexible triggering, 1 mV/div deflection factor in the X 5 mode, large 8 X 10 cm CRT, and selectable input impedance. The versatility of this 100 MHz oscilloscope simplifies both real-time and data domain measurements.

Delta Time Measurements

1742A Time Interval Measurements

Model 1742A provides two methods for making time interval measurements. One is the familiar single marker delayed sweep using the helical delay control for differential time relationship measurements or for convenient expansion of selected areas of waveforms. The second method is the Hewlett-Packard developed system of dual intensified markers, known as delta time, which greatly simplifies time interval measurements while improving the accuracy and resolution. In delta time mode, Start and Stop markers are alternately displayed on the Main Intensified sweep and the time interval between the markers are read directly on the optional DMM or on the calibrated ten turn dial, or available as a rear panel scaled voltage output compatible with most DVM's. When the delayed sweep mode is selected, the region of the intensified markers is expanded and alternately displayed with the increased resolution of the faster delayed sweep. Now, when the waveforms are overlapped, the maximum precision of delta time interval measurement is obtained. The delta time measure-

- Precise delta time measurements with crystal timing reference
- Dual channel, 5 mV/div to 100 MHz
- 3rd Channel trigger view and selectable input impedance



1743A

ment system with Option 034 improves the percent of full scale error by a factor of two over the single marker delayed sweep method.

1743A Crystal Accurate Timing

The 1743A incorporates a second generation delta time system based on a 100 MHz crystal timing reference rather than the traditional analog ramp reference. This internal crystal reference offers additional measurement capability and increased accuracy. The time between the two intensified marks is displayed on a five digit LED readout with an accuracy of 0.002% plus or minus one count. For main sweep speeds of five microseconds or less, the one count corresponds to plus or minus 100 ps.

First pulse measurements: The 1743A, by using a crystal reference, allows you to measure time intervals relative to the leading edge of the first pulse in the main sweep display. The first pulse measurement capability makes high resolution measurements possible on asynchronous pulses that are common in digital system interfaces.

Triggered measurements: The triggered delay mode of the 1743A offers a major improvement in measurement ease, as well as increased capability. Simply select the proper trigger level and slopes for the Start and Stop markers and the 1743A will perform the measurement with minimum operator involvement. The oscilloscope will track changes in the signal, making this mode well suited for production test applications.

There is no need to operate the 1743A in the delayed sweep mode when the triggered delta time mode is used. This mode expands the measurement window to that of the main sweep.

Sweep vernier: Crystal timing now allows you to use the sweep vernier out of its detent position to calibrate the CRT divisions for various measurements without uncalibrating the LED time readout. For example, you can set up the graticule lines to represent clock periods and then make two channel measurements of other signals related to the pre-calibrated "clock" signal.

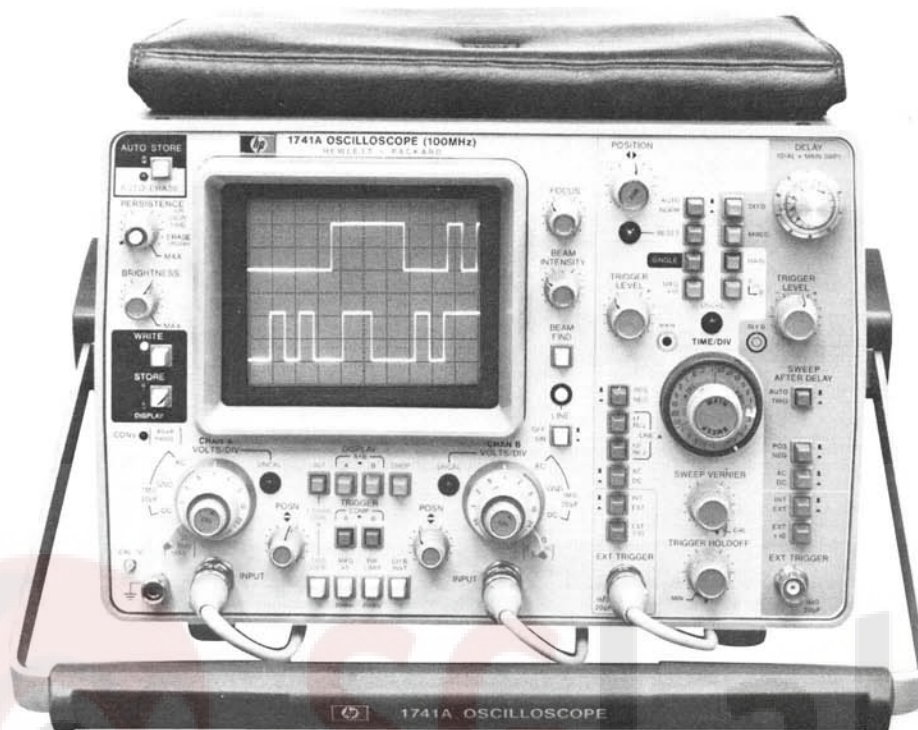
The sweep vernier also increases the display resolution by up to three times. With the vernier in detent, the resolution of a full screen display is a maximum of one part in 50 000 and with the vernier full ccw, full screen resolution is a maximum of one part in 150 000.

This increased resolution is obtained by using a faster main sweep speed. For example, by switching from a 1 μ s/div range to a 0.5 μ s/div range the last digit of the five digit display becomes hundreds of picoseconds instead of nanoseconds. The same display of the 1 μ s/div sweep can now be obtained on the 0.5 μ s/div sweep by adjusting the sweep vernier.

Models 1740A, 1741A, 1742A, 1743A & 1744A (cont.)

- Variable persistence storage, auto-store, auto-erase, 100 cm/ μ s writing speed; auto-intensity circuit
- Dual channel, 5 mV/div to 100 MHz
- 3rd Channel trigger view and selectable input impedance

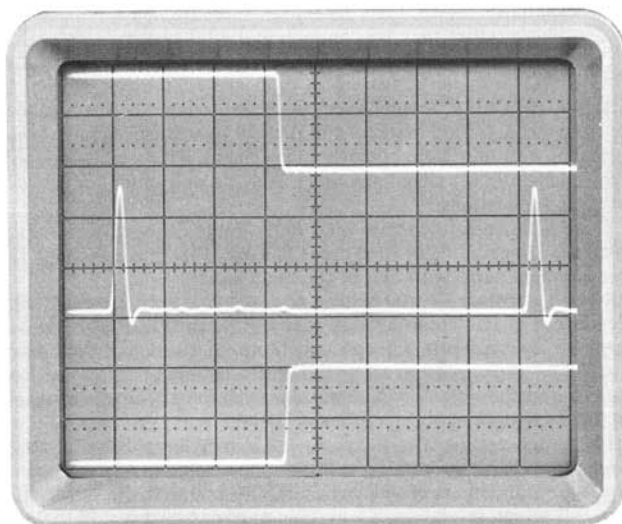
1741A

**1741A, 1744A, Variable Persistence Storage**

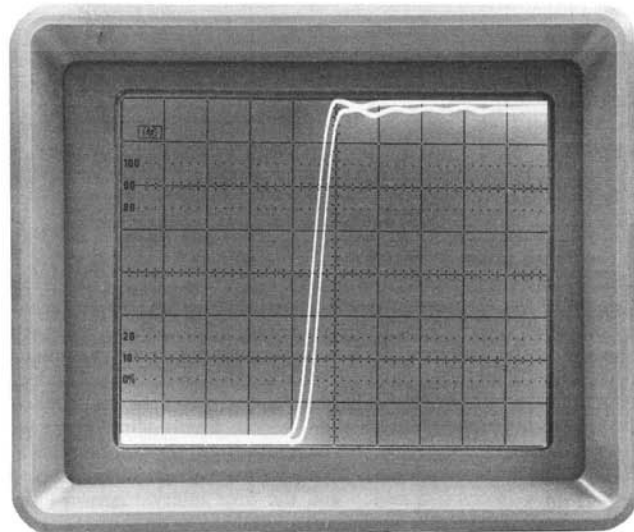
The Hewlett-Packard variable persistence CRT extends the oscilloscope's usefulness into areas beyond the capabilities of conventional CRT technology. The 1741A and 1744A provide well-defined, easily viewed traces in applications that otherwise require a camera or produce annoying flicker. Applications that require sweep speeds slower than 2 ms/div produce a flickering display on a conventional CRT and as the sweep speed is reduced further the display decays to a moving dot. The variable persistence CRT solves these problems by allowing adjustment of the persistence control to obtain an easily viewed display.

Low repetition rate signals at fast sweep speeds produce very low light output from conventional CRT's, requiring use of a viewing hood or CRT photography to obtain a viewable display. In these applications the variable persistence CRT becomes a light amplifier by integrating several sweeps to produce bright sharp traces.

The variable persistence storage oscilloscope allows convenient analysis of single-shot events without use of a camera. The 100 cm/ μ s writing rate of the 1741A is comparable with that of ASA 3000 film. The 1800 cm/ μ s writing rate of the 1744A is higher than can be obtained with ASA 10 000 film without special techniques such as post fogging.



Third channel trigger view of external trigger signal adds measurement convenience. Center screen trigger threshold allows you to see which portion of the signal is triggering the display. Specified delay of ≤ 3.5 ns between external trigger input and either vertical channel offers valid timing measurements.



Exceptionally fine trace in the variable persistence mode permits high resolution timing measurements as shown with this dual trace, alternate sweep display at a sweep speed of 5 ns/div.

- Variable persistence storage with auto-store, auto-erase; auto-intensity circuit
- Expansion storage CRT for 1800 cm/μs writing speed

- Dual channel, 5 mV/div to 100 MHz
- 3rd Channel trigger view and selectable input impedance



The cathode-ray tube technology used in both the 1741A and 1744A results in full variable persistence performance in all storage operating modes. Neither of these CRT's requires reduced scan display modes or unusually long erase cycle times. With minimum erase cycle time, these oscilloscopes are not "blind" to transients that might be present in the system under test.

Model 1741A's CRT has a writing rate greater than 100 cm/μs and a highly burn resistant storage surface which results in an oscilloscope that is ideally suited to the majority of applications.

For the ultimate in writing rate performance, the 1744A provides a writing rate of 1800 cm/μs. This writing rate allows capture of a 100 MHz sine wave with an amplitude of 8 divisions. Any signal within the bandwidth of the 1744A's 100 MHz vertical amplifier system can be captured and displayed in one sweep.

Capture of transients at the full bandwidth of the 1744A vertical deflection system is achieved with a new CRT technology called Expansion Storage. The waveform to be captured is written on a storage mesh positioned close to the deflection plates. The storage mesh is about the size of a postage stamp and is capable of storing very sharp waveform images. A flood gun electron cloud projects the image

through a lens system onto the CRT phosphor for viewing. This combination of a small storage surface and an expansion lens system provides a storage CRT capable of capturing transients at or beyond the slew rate of the 100 MHz deflection systems.

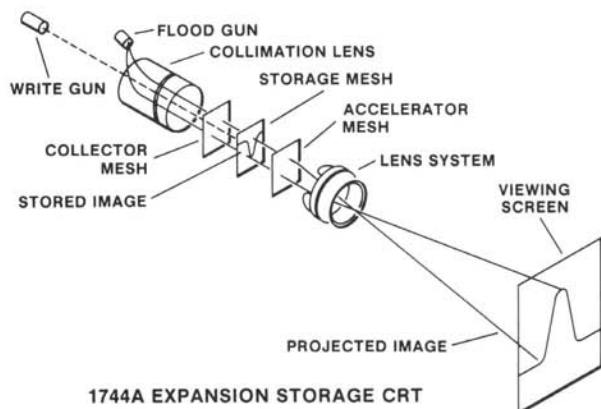
1741A, 1744A Operation

A new automatic intensity circuit simplifies operation of these oscilloscopes. A bloom-free trace is displayed over a wide range of beam intensity and sweep speed settings, greatly reducing the possibility of accidental storage surface burns. The brightness control allows the display to be adjusted for optimum contrast at various writing speeds and scan rates.

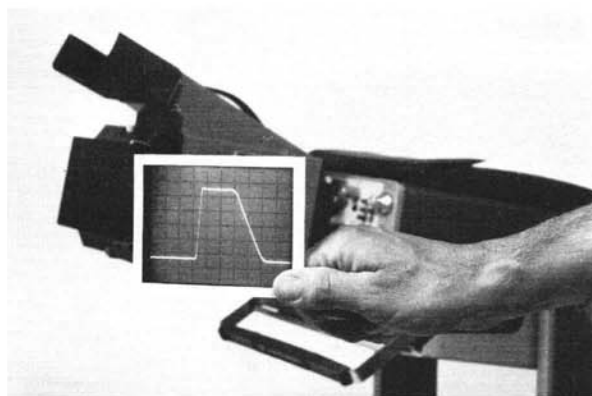
The storage control mode LED indicators provide positive indication of the oscilloscope's operational condition. Two automatic operating modes further simplify operation of these oscilloscopes.

The auto-erase mode provides a series of individual "snapshots" of a waveform automatically, freeing the operator to simply probe a circuit at desired points and observe the display. The auto-erase mode also provides a convenient method of setting the focus and intensity for single-shot events. If you are displaying traces on two or more channels, the 1741A or 1744A will wait for the required number of sweeps to be displayed before automatically erasing the display.

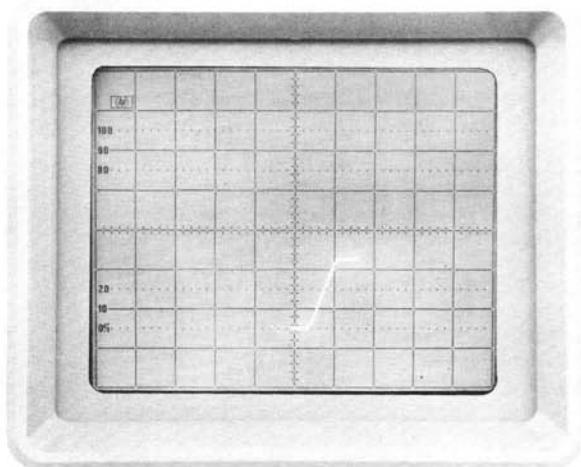
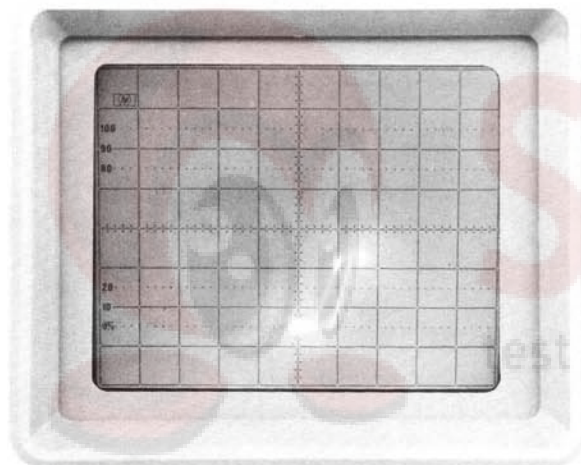
For maximum convenience in single-shot applications, an auto-store mode, which operates in single-shot mode, makes it easy to capture random events. To prevent the possibility of recording the wrong event, the 1741A and 1744A automatically switch from Write mode to Store mode at the end of the sweep. This is shown by the mode indicators. To view the signal, a press of the Store/Display pushbutton displays the trace. For convenience, a push of the Erase pushbutton erases the CRT and resets the time base.



1744A EXPANSION STORAGE CRT



Long term monitoring of circuits to capture random events is simplified with the 1741A Auto-camera Option 003. You can set up the oscilloscope/camera, leave them unattended, and automatically capture single-shot events.



1741A Triggered A vs B Option 002. The display of signals (top trace) in main sweep, A vs B mode shows total signal parameters. With delayed sweep A vs B, the display can be qualified (lower trace) to show only changing parameters which eliminates the bright dots caused by stationary values and confusion caused by unnecessary information.

1741A Auto-camera Option

Model 1741A Auto-camera Option 003 produces automatic photographic records of a stored display. This mode is particularly valuable for applications which require the long term monitoring of circuits. Setup involves simply mounting a Model 197B Camera on the 1741A and selecting the auto-store mode. When the trigger signal is received, the oscilloscope switches automatically to store mode. Camera control circuits then command a display of the stored trace, and the camera shutter is actuated. After the first exposure of the waveform, the 1741A executes an erase cycle, and the camera takes a second exposure to superimpose the graticule on the photograph. The combination of a 1741A and 197B can save hours of "baby-sitting" time. For example, the 1741A can be set up to monitor a signal node over a long weekend to see if plant start-up power transients are the cause of a problem.

1741A Optional Parametric Measurements

A new dimension of measurement capability is added to the 1741A with Option 002, Triggered A vs B mode. This option allows you to generate many non-time related displays commonly found in engineering problems, such as the familiar Lissajous pattern. Other common non-time related displays include transducer linearization and power transistor safe-area testing.

Phase corrected display

Modern, high bandwidth oscilloscopes incorporate a delay line in the vertical axis to permit viewing of the leading edge of internally triggered signals. This delay line introduces a significant phase error in A vs B plots for signals above 20 kHz. Option 002, Triggered A vs B, adds a variable delay line in the horizontal axis which eliminates phase error and enables the 1741A to produce matched phase response up to the 5 MHz bandwidth of the horizontal deflection system. Additionally, linear phase errors due to differential delay in the probing system can be corrected. With this option, the 1741A produces phase corrected displays, even when using probes with unequal propagation delays, across the full horizontal system bandwidth.

Display windows

Main and delayed sweeps are useful tools to window a waveform of interest in normal oscilloscope modes. Usually this facility is lost when the oscilloscope operates in A vs B mode because the CRT beam is always "on," which results in a confusing display. In this mode, the display is not qualified and all cycles of the system under test are shown. Periods of inactivity produce a bright dot that can mask the information display.

Model 1741A Option 002 overcomes these problems by allowing the main and delayed sweeps to window the A vs B display. The A vs B display mode button becomes a display format control. In the "out" position, the display is the normal time-related oscilloscope display. When A vs B is selected, the plot of A channel input is displayed as a function of B channel input. However, the display is qualified by the main and/or delayed sweeps. The normal main and delayed sweep modes are active in the A vs B mode, with the A vs B mode "on" for the length of the selected sweep. This allows you to use the main sweep to window several cycles of an event, and then select the delayed sweep A vs B mode to examine each cycle. Bright spots can be eliminated by using the delayed sweep to remove periods of inactivity from the display. The 1741A Option 002 can switch from normal time-related displays to a parametric phase corrected display at the push of a button.

Logic State Display Option

As digital circuits are used more extensively, and become more complex, there is a corresponding growth in the need for troubleshooting and debugging tools in digital systems. The "Gold Button," Option 101, combines the real time data analysis of a Model 1607A Logic Analyzer with the measurement sets of the 1740A, 1741A, 1742A, 1743A, 1715A, 1722B, or 1725A Oscilloscopes. The 1607A pattern trigger output allows you to window the oscilloscope volts vs time display to a point in program execution determined by a 16-bit parallel trigger point. Option 101 for the 1740 series oscilloscopes removes the A vs B mode and replaces it with a state display pushbutton and associated control circuits.



1740A, 1741A, 1742A, 1743A, 1744A

Specifications

Vertical Display Modes

Channel A; channel B; A and B displayed alternately on successive sweeps (ALT); A and B displayed by switching between channels at ≈ 250 kHz rate with blanking during switching (CHOP); A plus B (Algebraic addition); and trigger view.

Vertical Amplifiers (2) Bandwidth and Rise Time at all deflection factors from 0°C to +55°C.

Bandwidth: 3 dB down from 8 div reference signal; 3 dB down from 6 div reference signal for 1741A, 1744A.

DC-coupled: dc to 100 MHz in both 50 Ω and 1 M Ω input modes.

AC-coupled: ≈ 10 Hz to 100 MHz.

Bandwidth limit: limits upper bandwidth to ≈ 20 MHz.

Rise Time: ≤ 3.5 ns measured from 10% to 90% points of a 6 div (5 div, 1744A) input step.

Deflection factor

Ranges: 5 mV/div to 20 V/div (12 calibrated positions) in 1, 2, 5 sequence, attenuator accuracy $\pm 3\%$.

Vernier: extends deflection factor to ≥ 50 V/div.

Polarity: channel B may be inverted.

Input coupling: selectable AC or DC, 50 Ω (dc), or ground.

Input RC (selectable): AC or DC, 1 M $\Omega \pm 2\%$ shunted by ≈ 20 pF; 50 Ω , 50 $\Omega \pm 3\%$, SWR ≤ 1.4 at 100 MHz.

Maximum input: AC or DC, 250 V (dc + peak ac) or 500 V p-p at ≤ 1 kHz; 50 Ω , 5 V rms.

A + B operation

Amplifier: bandwidth and deflection factors are unchanged; channel B may be inverted for A-B operation.

Differential (A-B) common mode: CMR is at least 20 dB from dc to MHz. Common mode signal amplitude equivalent to 8 div (6 div, 1744A) with one vernier adjusted for optimum rejection.

Vertical Magnification (X5)

Bandwidth: 3 dB down from 8 div (6 div, 1744A) reference signal.

DC-coupled: dc to ≈ 40 MHz; dc to ≈ 30 MHz for 1741A, 1744A.

AC-coupled: ≈ 10 Hz to 40 MHz; ≈ 10 Hz to 30 MHz for 1741A, 1744A.

Rise time: ≤ 9 ns, ≤ 12 ns for 1741A, 1744A (measured from 10% to 90% points of 8 div, 5 div 1744A, input step).

Deflection factor: increases sensitivity of 5 and 10 mV settings by a factor of 5 with max sensitivity of 1 mV on channels A and B.

Trigger Source

Selectable from channel A, channel B, composite, or line frequency.

Trigger View

Displays internal or external trigger signal. In Alternate or Chop mode, channel A, channel B, and the trigger signals are displayed. In channel A or B mode, trigger view overrides that channel. Internal trigger signal amplitude approximates vertical signal amplitude. Ext trigger signal deflection factor is 100 mV/div or 1 V/div in EXT $\div 10$. Triggering point is approx center screen. With identically timed signals to a vertical input and the EXT trigger input, trigger signal delay is ≤ 3.5 ns.

Horizontal Display Modes

Main, Δ time with channel A or B start (1742A, 1743A), main intensified, mixed (except 1743A), delayed, mag X 10, and A vs. B.

Main and Delayed Time Bases

Ranges

Main: 50 ns/div to 2 s/div (24 ranges) in 1, 2, 5 sequence.

Delayed: 50 ns/div to 20 ms/div (18 ranges) in 1, 2, 5 sequence.

Accuracy

Sweep Time/Div	*Accuracy		Temp Range
50 ns to 20 ms	X1	X10	
	$\pm 3\%$	$\pm 4\%$	0°C to +15°C
	$\pm 2\%$	$\pm 3\%$	+15°C to +35°C
	$\pm 3\%$	$\pm 4\%$	+35°C to +55°C

*Add 1% for 50 ms to 2 s ranges

Main sweep vernier: extends slowest sweep to at least 5/s div.

Magnifier (X10): extends fastest sweep to 5 ns/div.

Calibrated Sweep Delay (except 1743A)

Delay time range: 0.5 to 10 X Main Time/Div settings of 100 ns to 2 s (min delay 150 ns).

Differential time measurement accuracy

(Using one intensified marker and helidial control)

Main Time Base Setting	Accuracy* (+15°C to +35°C)
100 ns/div to 20 ms/div	$\pm (0.5\% \text{ of reading} + 0.1\% \text{ of fs})$
50 ms/div to 2 s/div	$\pm (1\% \text{ of reading} + 0.1\% \text{ of fs})$

*Add 1% for temperature from 0°C to +15°C and +35°C to +55°C.

Delay jitter: $< 0.002\%$ (1 part in 50 000) of max delay in each step from +15°C to +35°C; $< 0.005\%$ (1 part in 20 000) from 0°C to +15°C and +35°C to +50°C.

Differential Time Measurement Accuracy (1742A)

(Using Δ time dual intensified markers)

Main Time Base Setting	Accuracy* (+15°C to +35°C)		
	Opt 034/035	External DVM	Helidial
100 ns** to 20 ms/div	$\pm (0.5\% \text{ of reading} + 0.5\% \text{ of fs})$	$\pm (0.5\% \text{ of reading} + 0.05\% \text{ of fs})$	$\pm (0.5\% \text{ of reading} + 0.1\% \text{ of fs})$
50 ms to 2 s/div	$\pm (1\% \text{ of reading} + 0.1\% \text{ of fs})$	$\pm (1\% \text{ of reading} + 0.1\% \text{ of fs})$	$\pm (1\% \text{ of reading} + 0.1\% \text{ of fs})$

*On 100 ns/div range, specification applies after first cm of main sweep.

**Add 1% for temperatures from 0°C to +15°C and +35°C to +55°C.

Time Interval (Δ Time) 1742A

Function: measures time interval between two events on channel A (A display); two events on channel B (B display); or two events starting from an event on either channel A or B and ending with an event on either channel A or B (alt display).

Time interval output voltage: varies from 50 V to 100 mV full scale. Full scale output voltage can be determined by multiplying the number on the Time/Div dial by 10 V (e.g. 0.05 s, 0.05 ms, or 0.05 μ s per div gives 0.5 V output full-scale).

Stability (0°C to +55°C): short-term 0.005%. Temperature, $\pm 0.03\%/^{\circ}\text{C}$ deviation from calibration temperature range.

Crystal Referenced Δ Time (1743A)

Delay time range: 0 to 10 X Main Time/Div settings of 100 ns to 2 s.

Differential time measurement accuracy

Accuracy: $\pm 0.002\%$ of reading ± 1 count from +15°C to +35°C; $\pm 0.005\%$ of reading ± 1 count from 0°C to +15°C and +35°C to +55°C.

Time resolution of ± 1 count

Sweep Ranges/div	± 1 Count	Averages
0.1 μ s, 0.2 μ s, 0.5 μ s	± 100 ps	10 000
1 μ s, 2 μ s, 5 μ s	± 1 ns	1 000
10 μ s, 20 μ s, 50 μ s	± 10 ns	100
0.1 ms, 0.2 ms, 0.5 ms	± 100 ns	direct

Readout: 5 digit LED plus exponent.

Crystal Aging: 0.0005% per year.

Delay jitter: same as other 1740 series oscilloscopes.

Triggering

Main sweep

Normal: sweep is triggered by internal or external signal.

Automatic: baseline displayed in absence of input signal. Above 40 Hz, triggering is same as normal.

Single: sweep occurs once with same triggering as Normal. Reset arms sweep and lights indicator. (1741A, 1744A) Single sweep is also initiated with Erase, sweep is armed after the erase cycle.

Internal: dc to 25 MHz on signals ≥ 0.3 div vertical deflection, increasing to 1 div vertical deflection at 100 MHz in all display modes (required signal level is increased by 2 when in Chop mode and by 5 when X5 vertical magnifier is used).

External: dc to 50 MHz on signals of 50 mV p-p or more, increasing to 100 mV p-p at 100 MHz (required signal level is increased by 2 when in Chop mode).

Delayed sweep (sweep after delay)

Auto: delayed sweep starts at end of delay period.

Trig: delayed sweep armed and triggerable at end of delay period.

Internal: same as Main Sweep except 1743A is dc to 25 MHz on signals causing 1 div or more vertical deflection, increasing to 2 div of vertical deflection at 100 MHz.

External: same as Main sweep except 1743A is dc to 50 MHz on signals 100 mV p-p increasing to 200 mV p-p at 100 MHz.



OSCILLOSCOPES

Models 1740A, 1741A, 1742A, 1743A, & 1744A (cont.)

External input RC: $\approx 1\text{ M}\Omega$ shunted by $\approx 20\text{ pF}$; max external input, 250 V (dc + peak ac) or 500 V p-p at $\leq 1\text{ kHz}$.

Level and slope: internal, at any point on positive or negative slope of displayed waveform; external, continuously variable from +1 V to -1 V on either slope of trigger signal, +10 V to -10 V in $\div 10$.

Coupling: AC, DC, LF REJ, OR HF REJ.

Trigger holdoff (main sweep): increases sweep holdoff, all ranges.

Calibrated Mixed Time Base (except 1743A)

Dual time base in which the main time base drives the first portion of sweep and the delayed time base completes the sweep at the faster delayed sweep. Also operates in single sweep mode. Accuracy, add 2% to main time base accuracy.

A vs. B Operation

Bandwidth: channel A (Y-axis), same as channel A; channel B (X-axis), dc to 5 MHz.

Deflection factor: 5 mV/div to 20 V/div (12 cal positions) in 1, 2, 5 sequence; phase difference between channels, $< 3^\circ$, dc to 100 kHz (75 kHz, 1743A).

Cathode-ray Tube and Controls (1740A, 1742A, 1743A)

Type: 12.7 cm (5 in.) rectangular CRT, post accelerator, $\approx 15\text{ kV}$ accelerating potential, aluminized P31 phosphor.

Graticule: 8 x 10 div (1 div = 1 cm) internal non-parallax graticule, 0.2 subdivision markings on major horizontal and vertical axes and markings for transition time measurements. Internal floodgun graticule illumination.

Beam finder: returns trace to CRT screen.

Z-axis input (intensity modulation): +4 V, $\geq 50\text{ ns}$ width pulse blanks trace of any intensity, usable to $\leq 10\text{ MHz}$ for normal intensity. Input R, 1 k Ω $\pm 10\%$. Max input $\pm 20\text{ V}$ (dc + peak ac).

Rear panel controls: astigmatism and trace align.

Cathode-ray Tube and Controls (1741A)

Type: 12.7 cm (5 in.) rectangular CRT, post accelerator, $\approx 7.5\text{ kV}$ accelerating potential, aluminized P31 phosphor.

Graticule: 8 x 10 div (1 div = 0.85 cm) internal, non-parallax graticule, 0.2 subdivision markings on major horizontal and vertical axes, with markings for transition time measurements. Graticule illumination is achieved with Persistence control set to min.

Beam finder: returns trace to CRT screen.

Z-axis input (intensity modulation): same as 1740A.

Operating modes: write, store, display, auto-store, auto-erase, and conventional (rear panel control).

Persistence: variable, $\approx 100\text{ ms}$ to 1 min; conventional, natural persistence of P31 phosphor ($\approx 40\text{ }\mu\text{s}$).

Storage writing speed: $\geq 100\text{ cm}/\mu\text{s}$ (118 div/ μs) over center 7 x 9 div (with viewing hood).

Storage time: display mode, at least 10 s at 22°C; store mode, at least 30 s at 22°C.

Brightness: $\approx 170\text{ cd}/\text{m}^2$ (50 fl) increasing to $\approx 340\text{ cd}/\text{m}^2$ (100 fl) depending on brightness control setting.

Erase time: $\approx 300\text{ ms}$.

Rear panel controls: astigmatism, trace align, conventional push-button, and view time.

Cathode-ray Tube and Controls (1744A)

Type: 12.7 cm (5 in.) rectangular CRT, post accelerator, $\approx 10\text{ kV}$ accelerating potential, aluminized P31 phosphor.

Graticule: 8 x 10 div (1 div = 0.72 cm) internal graticule, 0.2 subdivision markings on major horizontal and vertical axes, with markings for transition time measurements. Graticule illumination is achieved with Persistence control set to min.

Beam finder, Z-axis input (intensity modulation): See 1741A.

Operating modes: write, store, display, auto-store, and auto-erase.

Storage writing speed: $\geq 1800\text{ cm}/\mu\text{s}$ over center 6 x 8 div (with viewing hood).

Storage time: store mode, at least 30 s; view mode, at least 10 s; wait time, at least 60 s, at 22°C.

Persistence: variable (100 ms min).

Erase time: $\approx 300\text{ ms}$.

Rear panel controls: astigmatism and trace align.

General

Rear Panel outputs: main and delayed gates, 0.8 V to $\geq +2.5\text{ V}$ capable of supplying $\approx 5\text{ mA}$.

Amplitude Calibrator (0°C to +55°C)

Output voltage	1 V p-p into $\geq 1\text{ M}\Omega$ 0.1 V p-p into 50 Ω	$\pm 1\%$
Rise time	0.1 μs	
Frequency	$\approx 1.4\text{ kHz}$	

Power: 100, 120, 220, 240 V ac $\pm 10\%$; 48 to 440 Hz; 100 VA max.

Weight: (1740, 1742) net, 13 kg (28.6 lb); shipping 15.7 kg (34.6 lb). (1741, 1743, 1744) net 13.8 kg (30.5 lb); shipping 17.7 kg (39 lb).

Operating environment: temperature 0°C to +55°C; humidity to 95% relative humidity at +40°C; altitude, to 4600 m (15 000 ft); vibration, vibrated in three planes for 15 min. each with 0.254 mm (0.010 in.) excursion, 10 to 55 Hz.

Size: (1740A) 197 H x 335 W x 597 mm D (7 $\frac{3}{4}$ " x 13 $\frac{1}{16}$ " x 23 $\frac{1}{2}$ ") with handle, 492 mm D (19 $\frac{3}{8}$ ") without; (1741A) 616 mm D (24 $\frac{1}{4}$ ") with handle, 552 mm D (21 $\frac{3}{4}$ ") without; (1742A) 570 mm D (22 $\frac{1}{16}$ ") with handle, 502 mm D (19 $\frac{3}{8}$ ") without; (1743A) 613 mm D (24 $\frac{1}{4}$ ") with handle, 549 mm D (21 $\frac{3}{8}$ ") without; (1744A) 635 mm D (25") with handle, 511 mm D (20 $\frac{1}{4}$ ") without.

Accessories furnished: one blue light filter HP P/N 01740-02701, one front panel cover, one 2.3 m (7.5 ft) power cord, one vinyl accessory storage pouch, one Operators Guide and one Service Manual, two Model 10041A 10:1 divider probes $\approx 2\text{ m}$ (6.6 ft) long. The 1741A and 1744A also include one Model 10173A RFI filter and contrast screen, and one Model 10140A viewing hood.

Options and Accessories

001: fixed power cord (U.S. only). add \$15

002 (1741A): Triggered A vs B Mode; phase shift $\leq 1^\circ$, dc to 5 mHz; internal triggering on channel B. add \$150

003: Auto Camera add \$75

005 (1740A and 1741A): TV sync add \$215

034 (1742A): built-in DMM (60 Hz operation) add \$325

035 (1742A): built-in DMM (50 Hz operation) add \$325

091: two 3 m (9.8 ft) 10042A 10:1 probes in lieu of 10041A probes N/C

096: two 1.8 m (6 ft) 10006D 10:1 probes in lieu of 10041A probes. N/C

101 (except 1744A): state display—single switch interface for use with 1607A Logic State Analyzer. add \$150

112: includes 1112A Inverter Power Supply, a portable power source for 1700 series oscilloscopes. add \$900

910: extra set of product manuals.

1740A Opt 910 add \$11

1741A, 1742A, or 1743A Opt 910 add \$12

Time interval multimeter kit (1742A): HP P/N 01742-69501 adapts standard 1742A to an Option 034/035, built-in LED readout, delta time oscilloscope. \$375

Kit includes: a multimeter, top oscilloscope cover, vinyl storage pouch, and mounting hardware.

Opt 101 Field Instl Kit: converts std 1740 series oscilloscopes (except 1744A) to Opt 101. Order HP P/N 01740-69501 for 1740A, 1742A, 1743A; order HP P/N 01741-69501 for 1741A. \$200

Logic State Analysis Equipment Required for Option 101

1607A: 16-Bit Logic State Analyzer including three data probes and one clock probe. \$2900

Four 10121A: 20 cm (8") cables. Three for X, Y, and Z and one for pattern trigger connections. \$15 ea.

Adapter plate and strap: (HP P/N 5061-1213) for mounting the oscilloscope on top of the 1607A. \$24

1740S: includes 1740A Opt 101, Model 1607A Logic State Analyzer, four 10121A 20 cm (8") BNC interconnecting cables with adapter plate and strap (HP P/N 5061-1213) for combining into a single package. \$5500

Ordering Information

1740A 100 MHz Oscilloscope \$2375

1741A 100 MHz Storage Oscilloscope \$4250

1742A 100 MHz Δ Time Oscilloscope \$2650

1743A 100 MHz Δ Time Oscilloscope \$3300

1744A 100 MHz Storage Oscilloscope \$5250