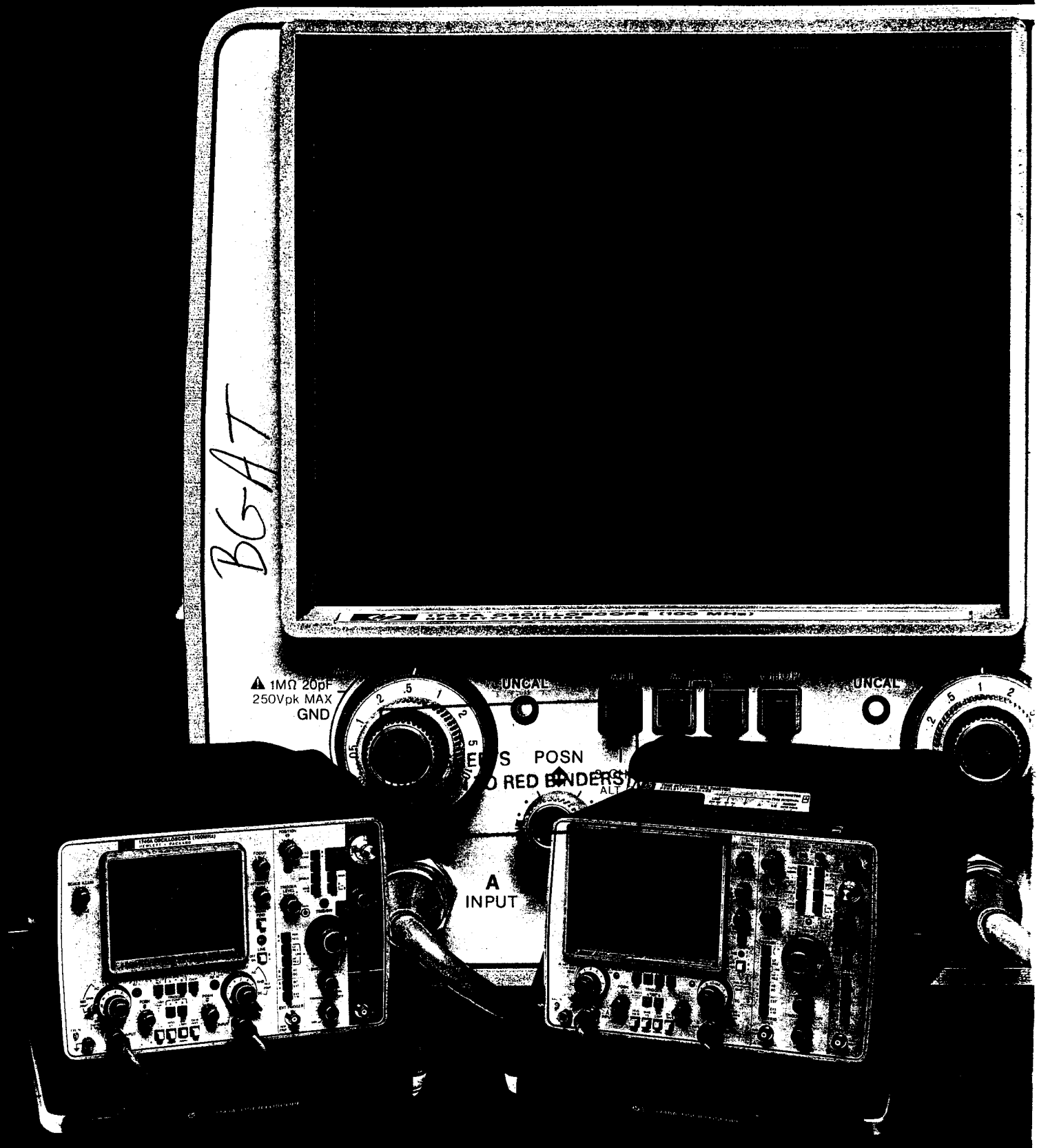
HEWLETT PACKARD

100 MHz OSCILLOSCOPES

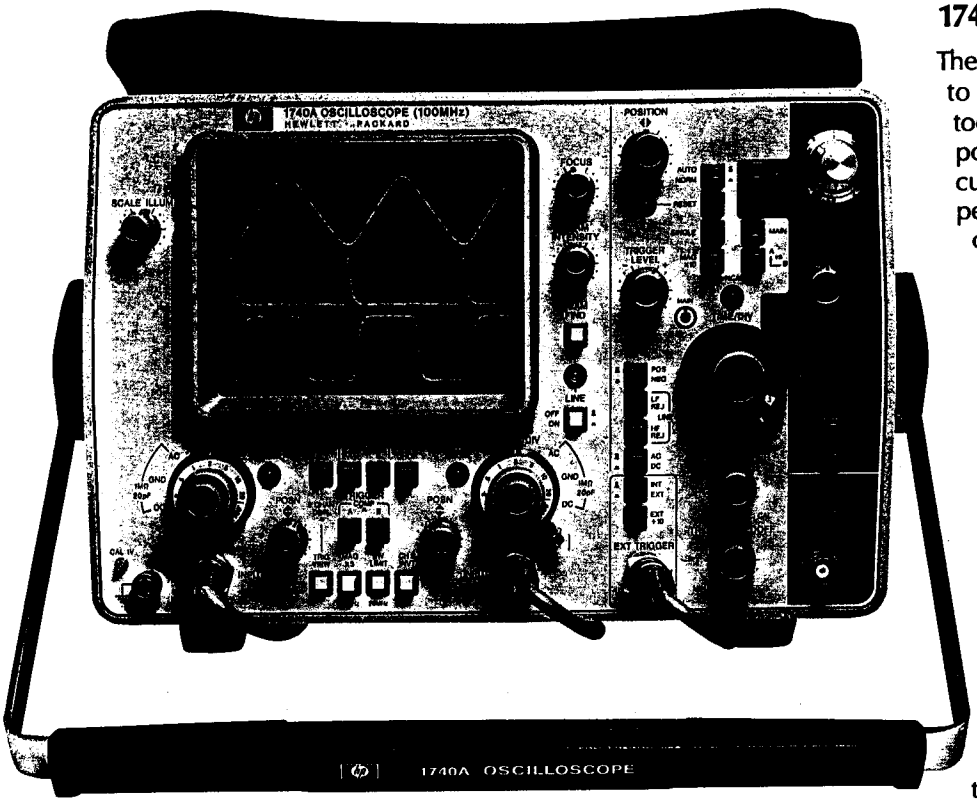
Δ time, delayed sweep, and large screen CRT

Models
1740A
1742A
1745A
1746A

TECHNICAL DATA 15 DEC 82



INTRODUCTION



1740A/1742A

The HP 1740A and 1742A have proven to be highly reliable measurement tools by passing the toughest test possible—years of use by satisfied customers. The 1740A continues to perform year after year in a variety of environments and operating conditions. This record of reliable performance, coupled with a versatile feature set and highly competitive pricing, offers an exceptional value for the user of 100 MHz oscilloscopes.

The 1740A/1742A provide measurement features which users have found to be particularly valuable. Both vertical channels provide 1 mV/div deflection factors from dc to 40 MHz, the full 100 MHz performance is achieved with deflection factors of 5 mV/div to 20 V/div. Third channel trigger view, first offered in the 1740A, permits simultaneous viewing and timing of the external trigger signal with both vertical channels. A X10 horizontal magnifier provides main and delayed sweep speeds to 5 ns/div . . . to allow full use of the 1740A/1742A's 100 MHz bandwidth amplifiers, which have a Gaussian roll-off characteristic for accurate pulse response.

The 1740A/1742A also offer a TV/video sync option that allows a variety of measurements to be made on complex video waveforms, and an optional auto-ranging DMM with 3-1/2 digit resolution for ac/dc voltage, ac/dc current, and resistance measurements.

The 1742A incorporates HP's dual-marker, delta time measurement system; adding an optional, built-in, 3-1/2 digit, autoranging DMM to the 1742A provides a direct readout of time interval measurements. The 1742A has the same front panel as the 1740A except that the 1742A replaces the 1740A's Delay control with several delta time controls.

The most critical component in an oscilloscope is the cathode ray tube (CRT). The 8X10 cm 1740A/1742A CRT has been perfected to the point where it has been described as having "the brightest, crispest trace in the industry." Since the CRT is also the most expensive part of an oscilloscope, it is imperative that it be extremely reliable. With the 1740A/1742A, HP's CRT improvements have led to less than 1.4 failures per year per 1000 instruments—believed to be the best reliability record of any comparable CRT in the industry.

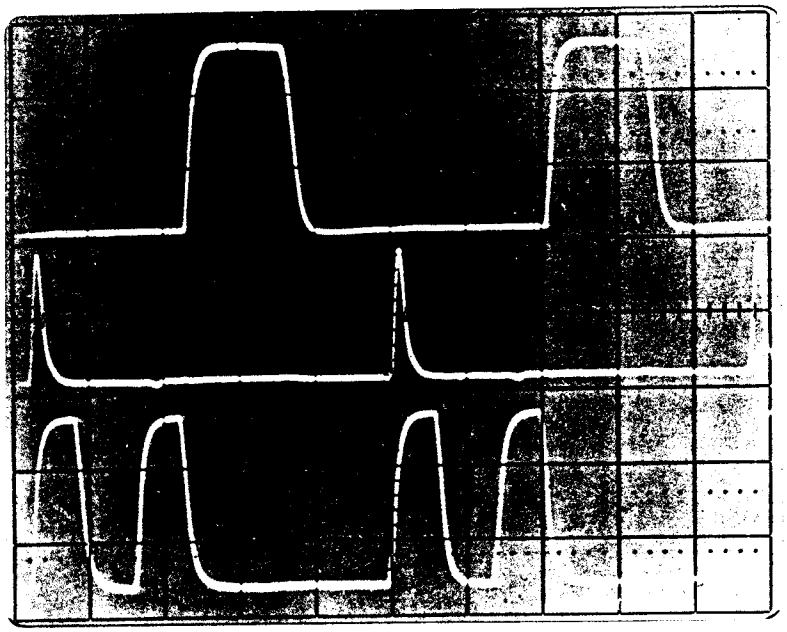
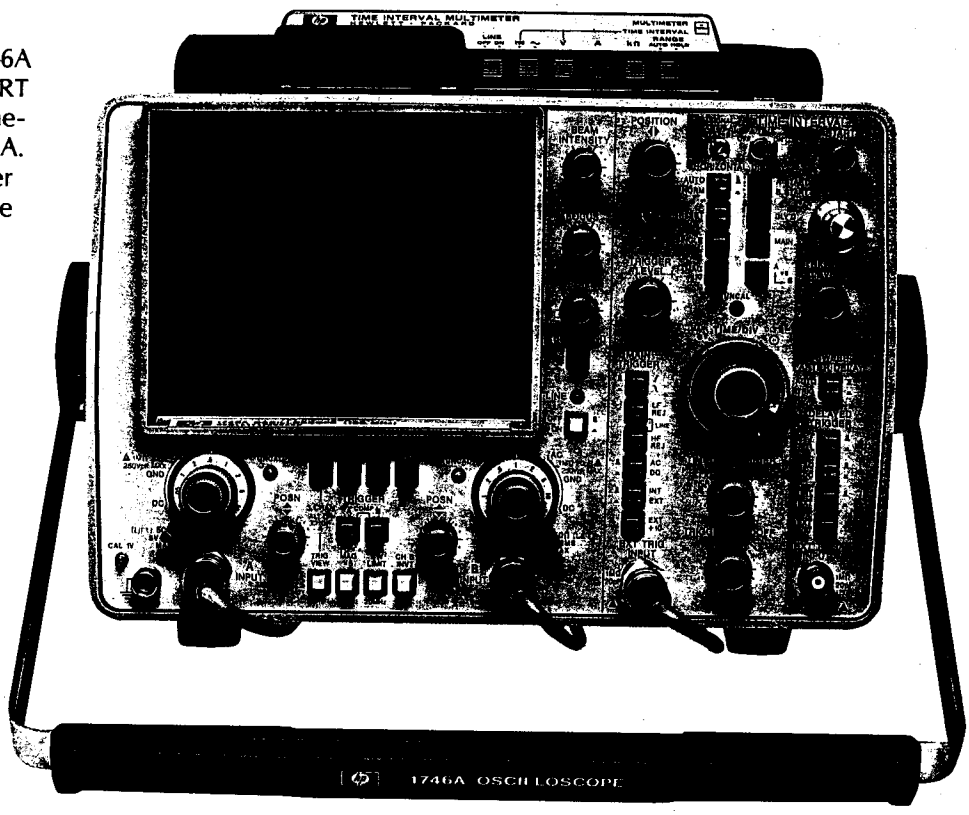


Figure 1 — *1740A/1742A CRT - this 8X10 cm CRT has been described as having the brightest, crispest trace in the industry, and has an outstanding reliability record of 1.4 failures per 1000 1740A's per year.*

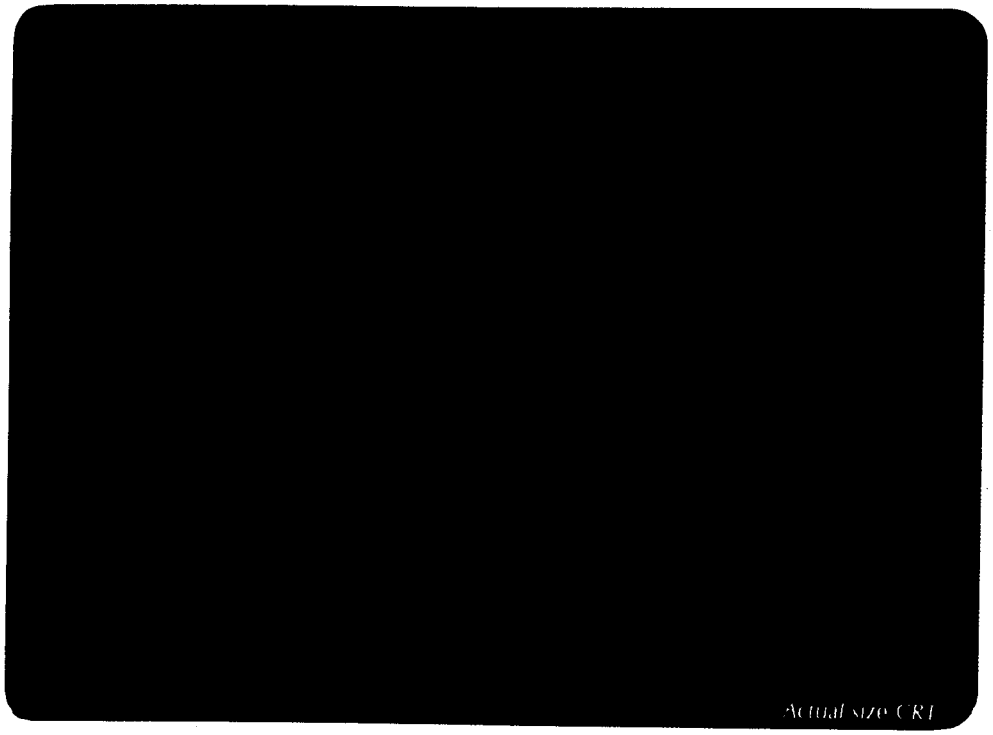
1745A/1746A

Both the HP Model 1745A and 1746A oscilloscopes add a large screen CRT and a revised front panel to the time-tested design of the 1740A/1742A. The new CRT offers a 43% larger viewing area while maintaining the high standards of the 1740A's trace quality. This provides more resolution for more accurate measurements, especially with three-channel measurements that use trigger view.



Voltage measurements are also simplified. The CRT graticule is 10X10 divisions instead of 8X10 divisions. Full-scale voltage display is ten times the deflection factor — reducing the amount of mental arithmetic required by the user.

The 1745A and 1746A both offer a new contrast screen which is treated with proprietary antireflection coating. You obtain bright, sharp trace definition without annoying light reflections. To match the new contrast screen, the color coding of the controls has also been changed. The dark buttons control the display functions while all trigger functions are medium gray. Miscellaneous functions are light gray, and all delayed sweep functions are highlighted with a shaded background.



The 1746A adds HP's dual marker delta time measurement capability to the 1745A for faster and more accurate timing measurements. When combined with the optional DMM a direct readout of time interval measurements is provided on the LED display. For R&D and production applications, the 1746A with optional DMM offers high resolution waveform viewing, accurate time interval, ac/dc voltage, ac/dc current and resistance measurements.

Figure 2 - *1745A/1746A CRT - the 9.5x12 cm, 10x10 division 1745A/1746A CRT provides 43% more viewing area than does the traditional 8x10 cm CRT, and it has a sharp trace for increased resolution and accuracy. Also, a neutral density contrast screen reduces reflections and enhances brightness.*

THIRD CHANNEL TRIGGER VIEW

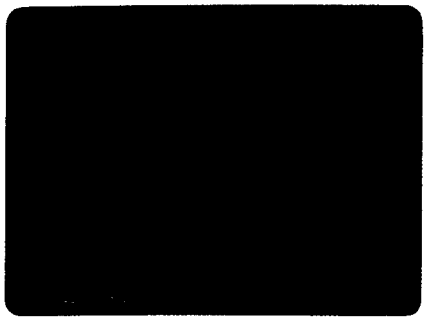


Figure 3 - *third channel trigger view provides a display of the trigger signal along with the two vertical channels. The center horizontal graticule line represents the trigger level. For multichannel timing measurements, the external trigger delay relative to the vertical channels is ≤ 3.5 ns*

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

- The trigger threshold can be viewed relative to the trigger waveform 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 on the reference graticule line using the Main Sweep Trigger Level control. This also allows you to view the shape of the trigger waveform to verify that the correct signal is used as the trigger source and 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 relationships can be analyzed. The displayed trigger signal has a specified delay of ±3.5 ns relative to the two vertical channels.

STABLE FLEXIBLE TRIGGERING

Stable internal triggering to greater than 100 MHz requires only one division of vertical deflection. The internal trigger signal is picked off immediately after the attenuator which assures a stable display regardless of changes in position, vernier, or polarity controls. Easy to use pushbutton trigger controls assure you of the desired trigger signal conditioning for your measurement applications. In the external trigger mode, signals of only 100 mV trigger the oscilloscope to 100 MHz, only 50 mV to 50 MHz. In the composite trigger mode, the oscilloscope internally triggers on asynchronous signals. This allows stable simultaneous viewing of asynchronous logic signals such as those in a computer interface.

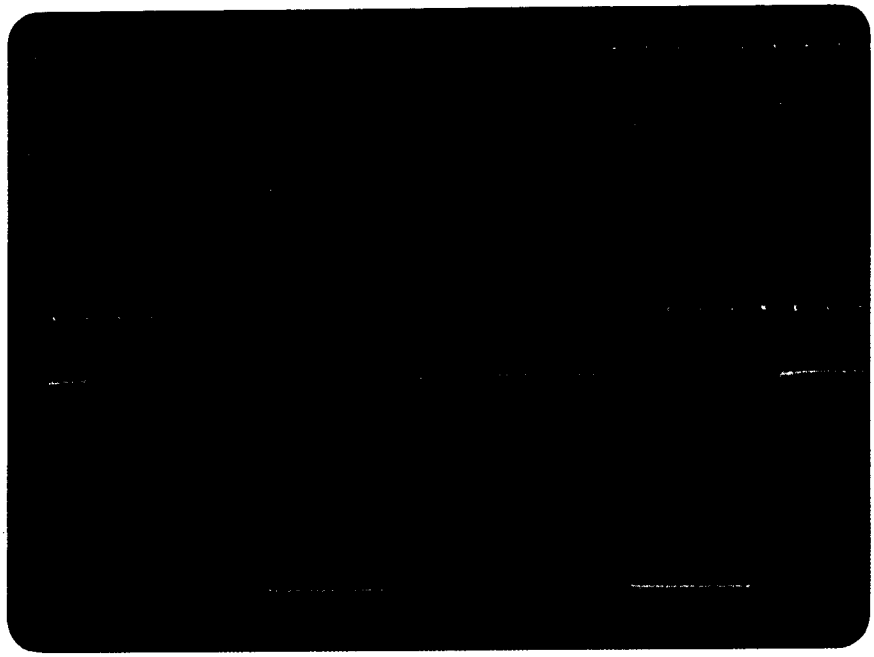


Figure 4 — *the composite trigger mode produces a stable display of two asynchronous signals, such as in data lines between a computer and a peripheral.*

OPTIMUM SIGNAL TERMINATION

For maximum measurement flexibility, switchable 50 Ω and 1 MΩ inputs are provided. The internal 50Ω input with low reflections eliminates the need for an external 50Ω coaxial feedthrough termination and provides optimal pulse response.

TIME INTERVAL MEASUREMENTS

SINGLE MARKER METHOD

Using this method time interval measurements can be performed with the 1740A, 1742A, 1745A, or 1746A. Time interval measurements can be performed with accuracies approaching ±1% as shown in the following steps.

To measure a pulse rise time, the intensified marker is placed over the rising edge by adjusting the delayed sweep speed to obtain the proper marker width and the delay time helidial pot to obtain the proper marker position (**Figure 5**).

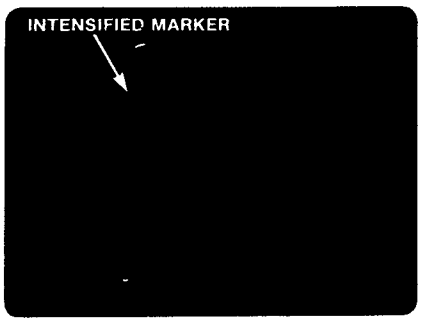


Figure 5

The rising edge display is then expanded to full screen by selecting the delayed sweep mode (**Figure 6**). The volts/div vernier is adjusted so that the waveform is aligned with 0%, 10%, 90%, and 100% levels. With the 1745A/1746A large screen CRT, the 0% level is positioned on the bottom graticule line and the 100% level on the top graticule line providing ten divisions of deflection. The 1740A/1742A CRT provides markings for the 0% and 100% levels with six divisions of deflection. A zero time reference is set by positioning the 10% level on a graticule crossing with the delay time helidial pot. Read and record the helidial setting as $t_{10\%}$. Rise time is then measured by positioning the 90% point at the zero reference ($t_{90\%}$) and performing the calculation:

$$(t_{90\%}-t_{10\%}) \text{ X main sweep time/div X } 10$$

The delay time helidial range is 0.000 to 0.999.

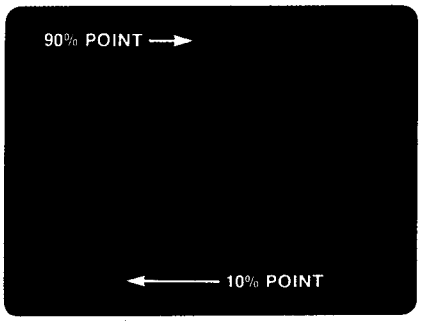


Figure 6

DUAL MARKER METHOD (1742A/1746A)

The 1742A/1746A use HP's dual marker ΔT method to enhance the accuracy and speed of time interval measurements. To measure a pulse width, simply perform the following steps:

Position the start and stop markers on the rising and falling edges with the delayed sweep speed, start control, and helidial stop control (**Figure 7**).

Expand the rising and falling edges to full screen by selecting the delayed sweep mode. Adjust the helidial stop control to overlap the traces at the 50% point (**Figure 8**). The answer is then obtained in one of three ways:

1) Multiply the helidial stop control setting by the main sweep speed to obtain the answer. With this method, accuracy is approximately the same as with the single marker method, but the measurement is easier and less error prone because there is no subtraction required.

2) The 1742A/1746A have a rear panel voltage output which is scaled to represent the time interval between the start and stop markers. Using an external DMM to measure this voltage yields a direct readout of the time interval. This method is both easier and more accurate, approaching accuracies of ±0.5%.

3) When the Option 034/035 DMM is added to the 1742A/1746A, the scaled voltage is measured directly by selecting the DMM time interval mode. Again measurement convenience is improved with an accuracy approaching ±0.5%.

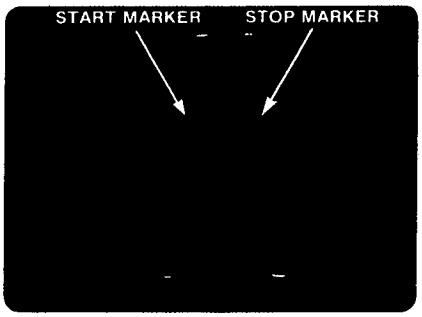


Figure 7

CHANNEL-TO-CHANNEL MEASUREMENTS (1742A/1746A)

In the dual marker mode, time interval measurements can be made from Channel A to Channel B or from Channel B to Channel A when the alternate display mode is selected. A convenient switch lets you select whether the start marker is on Channel A or B.

In the three channel trigger view mode, the start marker is displayed on the trigger channel with time coincident stop markers on each of the other two channels. This allows direct readings of time intervals between events on either channel and the external trigger input signal.

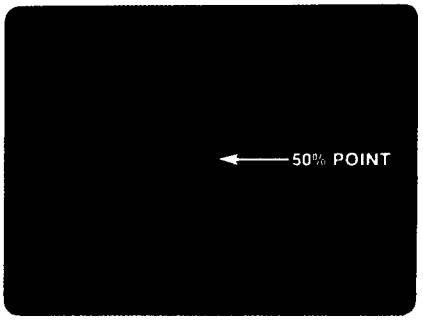


Figure 8

OPTIONAL MEASUREMENT CAPABILITY

TV SYNC OPTION

With this option you can trigger on composite video for analysis of fields, test signals, timing relationships, lines, or segments of lines. This capability is provided through a TV sync separator circuit that triggers the main sweep on the vertical interval of a composite video waveform and triggers the delayed sweep on individual horizontal lines.

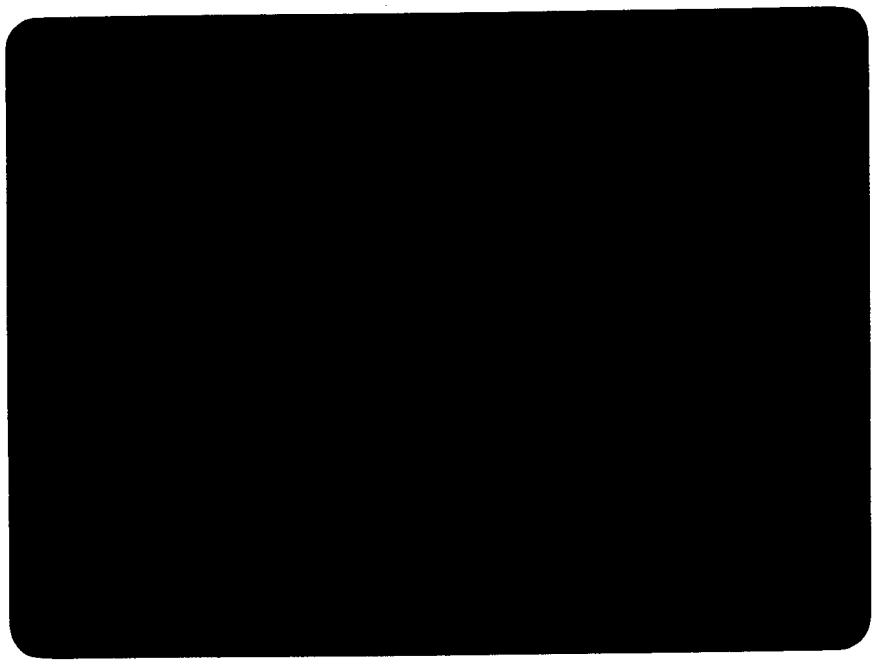


Figure 9 — *the modulated stairstep test signal is easily displayed with the TV/Video Sync option. For detailed analysis, single line scan can be used to examine expanded portions of this waveform.*

VIDEO WAVEFORM DISPLAY

To aid in viewing specific portions of composite video waveforms, the TV sync option includes field select, TV line scan, and single line scan capabilities. Field selection is easily accomplished by pressing the Field Select button which automatically displays the alternate field in the frame. The TV Line Scan (1740A/1742A) or Delay Time Control (1745A/1746A) allows you to position the intensified marker to the desired location for expansion. When switched to delayed sweep, individual lines are easily inspected and measured. For precise control of highly expanded line segments, single line scan lets you examine one line in detail. With the 1740A/1742A the TV/video sync option is installed internally, and the channel B 50 Ω input is changed to 75 Ω to match most video signals. Channel B is provided with a TV clamp.

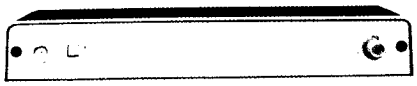


Figure 10a - *in the 1745A/1746A the TV/video sync option is installed on the top cover and provides its own signal input with a 75 Ω termination to match most video systems. The input also provides a TV clamp which eliminates position shift due to varying levels of video information.*

Figure 10b - *three signal outputs on the back panel of the TV/video sync option provide access to the video signal, the main trigger signal and the delayed trigger signal. These signals are routed to a vertical channel, the main trigger input, and the delayed trigger input to view video signals.*

OPTIONAL DIGITAL MULTIMETER

Adding an optional 3-1/2 digit autoranging DMM improves the convenience of your basic measurement capabilities. With the optional DMM, you can make the five most common measurements: ac/dc voltage, ac/dc current, and resistance. The DMM has autoranging so that readings always have the same multiplier: voltage in volts, current in amperes, and resistance in kilohms. In addition, the DMM has auto-zero which eliminates the need to zero the instrument prior to a test and auto-polarity for measuring either positive or negative voltages without reversing test leads.

In the 1742A/1746A, the optional DMM improves the accuracy and convenience of delta time measurements. A switch on the 1742A/1746A lets you select DMM operation or direct delta time readout.

Figure 11 — *the optional DMM provides measurements of ac/dc voltage, ac/dc current, and resistance and improves the accuracy and convenience of time interval measurements on the 1742A/1746A.*

TEMPERATURE MEASUREMENTS

By adding an HP Model 10023A Temperature Probe to the optional built-in DMM, you can make fast, accurate temperature measurements by simply pressing a button, touching the surface to be measured, and reading the temperature in degrees Celsius directly on the DMM. The probe's temperature sensor has a very low thermal mass so that measurements can be made quickly and heating and cooling changes are closely tracked.

PROBING — COMPLETING THE MEASUREMENT SOLUTION

The HP 1740-series oscilloscopes' selectable 1 MΩ or 50 Ω impedance inputs coupled with HP's full line of probes allow you to select the optimum input impedance for maximum pulse fidelity and minimum circuit disturbance.

MINIATURE PROBES

HP's miniature oscilloscope probes easily access test points in densely populated circuits. These small, lightweight probes fit in the hand much like a pencil and simplify difficult measurements where the possibility of shorting adjacent leads is a problem.

Two HP 10041A, 2 metre, 1 MΩ/12 pF, 10:1 resistive divider miniature probes are standard with the 1740 series. Also available are 1 metre (10026A) and 2 metre (10027A) 50 Ω 1:1 miniature probes which are used with optimal pulse response in 50Ω systems.

Grounding can be an elusive problem in probing high frequency signals. The length and inductance of a six inch grounded lead can induce ringing and disturb the pulse response of the probing system. To eliminate this, HP's miniature probes have a spring tip ground lead which equalizes the length of the ground path and signal path, maintaining pulse fidelity.

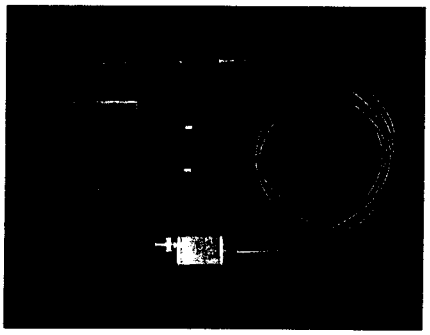


Figure 12 — *HP Miniature probes are small, lightweight, and easily access components on crowded, printed circuit boards. They also provide a variety of probe tips and ground leads to meet your probing requirements.*

DIP PROBING

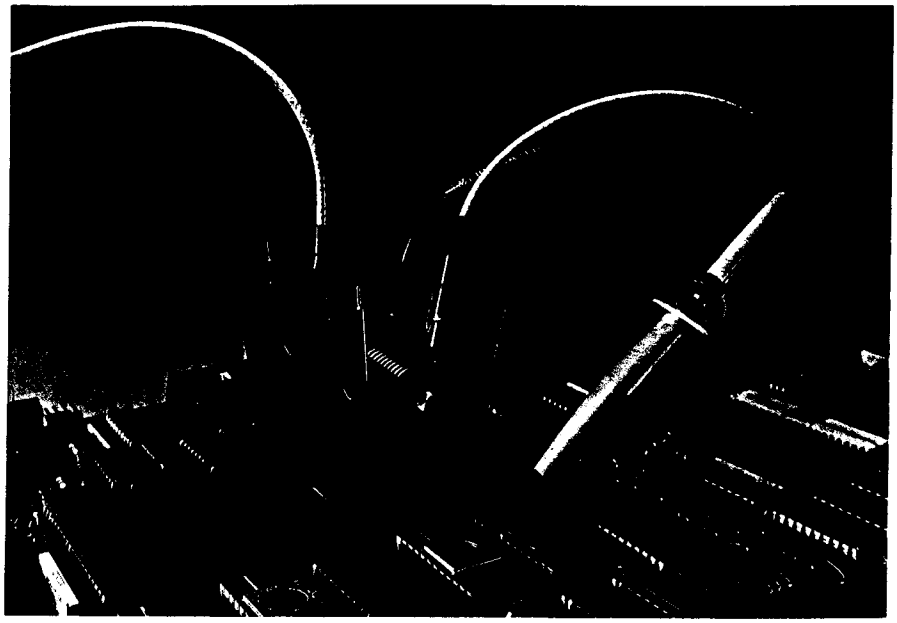


Figure 13 — *the 10211A DIP clip accesses pins on DIPs without the worry of shorting adjacent pins. The 10211A accesses 24-pin DIPs, but two or more can be used to probe DIPs with greater than 24 pins.*

By removing the miniature probe's insulating sleeve and using the 10024A or 10211A IC clip, you can monitor points on DIPs with improved pulse fidelity and without the worry of shorting adjacent pins. The 10024A probes 14 or 16 pin DIPs while the 10211A probes DIPs with 24 or more pins. Both the 10024A and 10211A contain a reference ground plane that equalizes the length of signal and ground paths, maintaining pulse fidelity. Also, the 10028A jumper cable allows signals to be inserted in the IC clip from other parts of the circuit.

50 Ω RESISTIVE DIVIDER PROBE

When probing high speed Schottky TTL or ECL gates, the HP 10020A 50Ω resistive divider probe provides optimal pulse response when used with the 1740-series 50Ω inputs. The 10020A provides division ratios of up to 100:1 to obtain input impedances of 5 kΩ with less than 0.7 pF. The 10020A includes the Spanner ground tip for equal length ground and signal paths to maintain pulse fidelity.

PROBE RELIABILITY

The same standards of quality and reliability are maintained in HP probes as in HP instruments. This reliability is backed by a probe replacement program. If a passive resistive divider or 50 Ω probe fails due to materials or workmanship within the one year warranty period, it is replaced free of charge. If a passive resistive divider or 50 Ω probe fails after the warranty period, it can be replaced at approximately half the purchase price. This program not only backs up HP quality but also assures you of the lowest possible cost of ownership over the long term.

HP QUALITY - A COMPLETE APPROACH

To Hewlett-Packard, providing a quality measurement solution means more than providing reliable, high performance instruments. It also means providing the service and technical support required to satisfy your measurement needs completely.

BUILT-IN RELIABILITY AND SERVICEABILITY

The reputation of the 1740 series for reliability has been the result of designed-in reliability and serviceability as well as an aggressive manufacturing program that builds in quality early in the manufacturing process.

An uncluttered interior is revealed when the convenient lift-off covers of the 1740A, 1742A, 1745A, or 1746A are removed. The low density arrangement of printed circuit boards and components facilitates access for calibration and maintenance. Test and adjustment points, as well as most transistor and IC locations, are clearly labeled to expedite servicing.

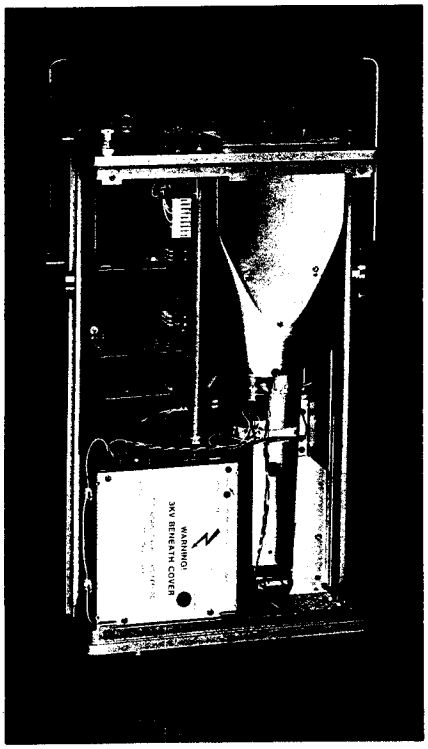


Figure 14 — *service and calibration time is reduced with few adjustments (approximately 44) and with an interface board that reduces interconnecting cables (1740A shown).*

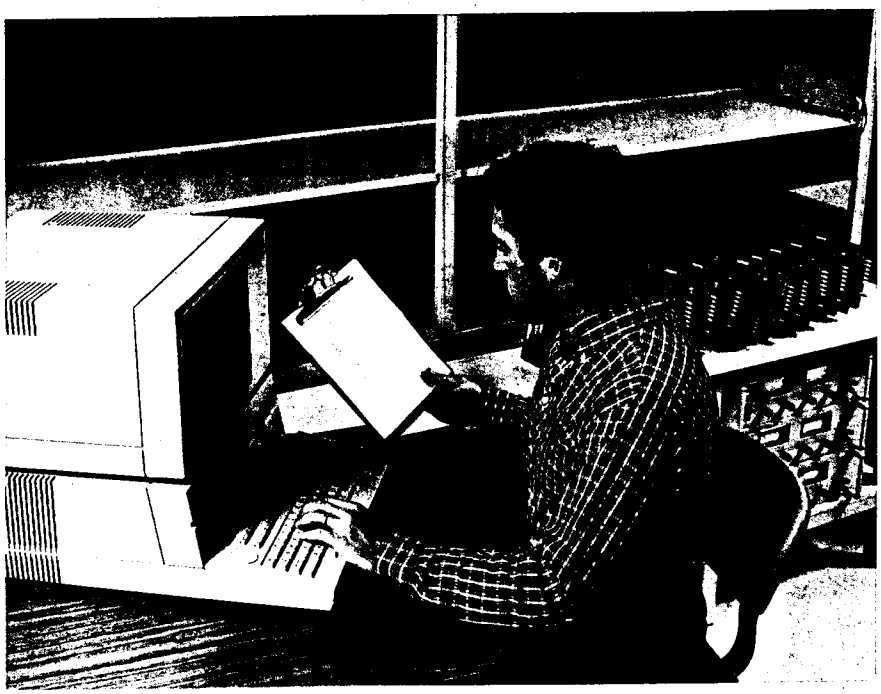


Figure 15 — *board reliability is emphasized early in the production process with functional and parametric board tests as well as power cycling. This has resulted in a board turn-on rate of 99.1% and has increased overall board reliability.*

Innovations in circuit design, along with custom integrated hybrid circuits minimize the number of calibration adjustments to be made. This results in calibration times that for a trained technician are typically 30% less than for competitive units.

Fans or ventilating holes for convection cooling are not required, reducing the internal accumulation of dust and dirt. There are no fan filters to clean and none of the noise associated with fan cooling. This results in lower maintenance costs as well as a more pleasant working environment.

SEMINARS

Seminars are an excellent vehicle to help engineers and technicians learn more about their Hewlett-Packard oscilloscope, whether the information concerns applications, operation, or maintenance.

Maintenance training classes are offered several times each year at the Colorado Springs Division. These seminars, directed towards calibration and repair technicians, teach operation, circuit theory, calibration, and troubleshooting to the component level. A nominal fee is charged to cover study materials and manuals. Contact your HP field engineer for information about a seminar for a specific instrument.

Operation/application seminars are also arranged on an individual basis by field engineers. These seminars inform engineers and technicians about special considerations for such areas as variable persistence storage, probing, time base errors, bandwidth, modes of operation, and specific applications.

SPECIFICATIONS

	1740A	1745A	1742A/1746A
VERTICAL DISPLAY MODES	Channel A; Channel B; ALT (Channels A and B displayed on successive sweeps); CHOP (A and B displayed by switching between channels at a rate of approximately 250 kHz); A + B (algebraic addition); X-Y (A vs. B); A - B (Channel B inverted).		
TRIGGER VIEW	Displays internal or external trigger signal. In a one-channel display, Trigger View overrides the selected channel. In ALT or CHOP, Channels A, B, and the trigger signal are presented in a three-channel display.		
VERTICAL AMPLIFIERS	Bandwidth and rise time at all deflection factors, from 0° to 55° C, 3 dB down from a 6 div reference signal.		
BANDWIDTH - DC Coupled	dc to 100 MHz in both 50Ω and 1 MΩ input modes.		
BANDWIDTH - AC Coupled	Approximately 10 Hz to 100 MHz.		
BANDWIDTH LIMIT	Limits upper bandwidth to approximately 20 MHz.		
RISE TIME	≤3.5 ns, measured from 10% to 90% points of a 6 div input step.	≤3.5 ns, measured from 10% to 90% points of a 5 div input step.	
DEFLECTION FACTOR - Ranges	5 mV/div to 20 V/div (12 calibrated positions) in 1, 2, 5 sequence. Accurate to within 3%.		
DEFLECTION FACTOR - Vernier	Continuously variable between all ranges, extends maximum deflection factor to at least 50 V/div. UNCAL light indicator.		
DEFLECTION FACTOR - Trigger View	Internal trigger signal amplitude approximates vertical signal amplitude. External trigger signal deflection factor is approximately 100 mV/div or 1 V/div for EXT ÷ 10. Trigger point is approximately center screen.		
POLARITY	Channel B may be inverted with front panel pushbutton.		
DELAY LINE	Input signals are delayed sufficiently to view leading edge of input pulse without advanced trigger.		
DELAY LINE - Trigger View Signal Delay	With identically timed signals to a vertical input and the external trigger input, trigger view signal delay is ≤3.5 ns.		
INPUT COUPLING - AC or DC	1 MΩ ±2% shunted by approximately 20 pF; maximum input ±250 V (dc + pk ac) or 500 V p-p at 1 kHz or less.		
INPUT COUPLING - 50Ω	50Ω ±3%. Maximum input 5 V rms.		
INPUT COUPLING - GND	Ground position disconnects input connector and grounds amplifier input.		
A + B OPERATION - Amplifier	Bandwidth and deflection factors are unchanged; Channel B may be inverted for A - B operation.		
A - B DIFFERENTIAL - Common Mode	CMR is at least 20 dB from dc to 20 MHz. Common mode signal amplitude equivalent to 8 div with one vernier adjusted for optimum rejection.		
VERTICAL MAGNIFICATION (X5) - Bandwidth	3 dB down from 6 div reference.		
BANDWIDTH - DC Coupled	dc to approximately 40 MHz.		
BANDWIDTH - AC Coupled	Approximately 10 Hz to 40 MHz.		
RISE TIME	≤9 ns - measured from 10% to 90% points on a 6 div input step.	≤9 ns - measured from 10% to 90% points of a 5 div input step.	
DEFLECTION FACTOR	Increases sensitivity of the 5 mV and 10 mV/div deflection factor settings by a factor of 5 with a maximum sensitivity of 1 mV/div on Channels A and B.		
TRIGGERING - Trigger Source	Channel A, Channel B, Composite or Line. All display modes triggered by displayed signal except in CHOP and Line. In CHOP mode, trigger signal is derived from Channel A. In Line, trigger signal derived from power line frequency.		
MAIN SWEEP MODES - Normal	Sweep is triggered by internal or external signal.		
MAIN SWEEP MODES - Automatic	Baseline displayed in absence of input signal. With input signals above approximately 40 Hz, triggering is same as normal. Note: for stable triggering on signals with repetition rates less than 40 Hz, use Normal mode.		
MAIN SWEEP MODES - Single	Selects Normal triggering and permits only one sweep. RESET rearms sweep and lights indicator.		
DELAYED SWEEP MODES - Automatic	Delayed Sweep automatically starts at the end of delay time.		
DELAYED SWEEP MODES - Trig	Delayed Sweep is armed and triggerable at the end of delay time.		
MAIN, DELAYED INTERNAL TRIGGERING	dc to 25 MHz on signals causing ≥0.3 div vertical deflection, increasing to ≥1 div at 100 MHz - in CHOP, 2 div to 100 MHz and 5 div with X5 vertical engaged. Line triggering available.		
MAIN, DELAYED EXTERNAL TRIGGERING	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 increased by 2 in CHOP mode.		
EXTERNAL TRIGGER INPUT	Approximately 1 MΩ shunted by 20 pF. Maximum input 250 V (dc + pk ac) or 500 V p-p at 1 kHz or less.		
TRIGGER LEVEL and SLOPE - Internal	At any point on the displayed vertical waveform.		

SPECIFICATIONS (continued)

	1740A	1745A	1742/1746A
TRIGGER LEVEL and SLOPE - External	Continuously variable from +1 V to −1 V on either slope of the trigger signal; +10 V to −10 V in divide by 10 mode (÷10).		
TRIGGER COUPLING - AC	Attenuates signals below approximately 20 Hz.		
TRIGGER COUPLING - LF Reject	Attenuates signals below approximately 4 kHz.		
TRIGGER COUPLING - HF Reject	Attenuates signals above approximately 4 kHz.		
TRIGGER HOLDOFF (Main Sweep)	Increases sweep holdoff time in all ranges.		
HORIZONTAL - Display Modes	Main, Delayed, Mixed, Mag X10, A vs. B, Main Intensified; Main Intensified is activated by rotating delayed time base control from the off position.		Main, Delayed, Mag X10, A vs. B, Main Intensified, Delta Time: Channel A or B may be selected for the start event in Delta Time mode.
MAIN SWEEP - Ranges	50 ns to 2 s/div (24 ranges) in a 1, 2, 5 sequence.		
DELAYED SWEEP - Ranges	50 ns to 20 ms/div (18 ranges) in a 1, 2, 5 sequence.		
ACCURACY - Main and Delayed	*50 ns to 20 ms/div 0°C to +15°C: X1 ±3%, X10 ±4% +15°C to +35°C: X1 ±2%, X10 ±3% +35°C to +55°C: X1 ±3%, X10 ±4% *Add 1% for the 50 ms to 2 s range		
MAIN SWEEP VERNIER	Continuously variable between all ranges; extends slowest sweep to at least 5 s/div. UNCAL light indicator.		
MAGNIFIER (X10)	Expands all sweeps by a factor of 10; extends fastest sweep range to 5 ns/div.		
CALIBRATED SWEEP DELAY - Range	0.5 to 10X Main Time/div settings of 100 ns to 2 s (minimum, delay 150 ns).		
DIFFERENTIAL TIME MEASUREMENT ACCURACY - Helidial Readout	Main Time Base Setting: 100 ns/div to 20 ms/div; 50 ms/div to 2 s/div *Accuracy (+15°C to +35°C): ±(0.5% + 0.1% of full-scale); ±(1% + 0.1% of full-scale) *Add 1% from 0°C to +15°C and from +35°C to +55°C		
DELAY JITTER	<0.002% (1 part in 50,000) of maximum delay in each step from +15°C to +35°C; <0.005% (1 part in 20,000) from 0°C to +15°C and from +35°C to +55°C.		
MAIN INTENSIFIED - Delayed Sweep	Intensifies the portion of main time base to be expanded to full screen in Delayed Time Base mode. STOP control adjusts position of intensified marker in the 1742A/1746A.		
Δ TIME MODE			(See pg. 11 for time interval specifications)
MIXED TIME BASE	Dual time base in which the main time base displays the first portion of sweep and the delayed time base completes the sweep at a faster rate. Also operates in Single Sweep mode. Accuracy, add 2% to main time base setting.		
A vs. B OPERATION - Bandwidth	Channel A (Y-axis), dc to 100 MHz; Channel B (X-axis), dc to 5 MHz.		
PHASE DIFFERENCE	<3° dc to 100 kHz.		
CATHODE RAY TUBE AND CONTROLS -Type	Hewlett-Packard, 12.8 cm (5 in.) rectangular CRT, post accelerator, approximately 15 kV accelerating potential, aluminized P31 phosphor.	Hewlett-Packard, 15.3 cm (6 in.) rectangular CRT, post accelerator, approximately 21 kV accelerating potential, aluminized P31 phosphor. The 1742A has same CRT as the 1740A.	
GRATICULE	8 x 10 div; 1 div = 1 cm; internal non-parallax graticule with 0.2 subdivision markings on major horizontal and vertical axes, markings for rise time measurements. Internal flood gun graticule illumination.	10 x 10 div; 1 vertical div = 0.95 cm, 1 horizontal div = 1.2 cm; internal nonparallax graticule with 0.2 subdivision markings on major horizontal and vertical axes, markings for rise time measurements. Internal flood gun graticule illumination. The 1742A has same graticule as the 1740A.	
BEAM FINDER	Returns trace to CRT regardless of horizontal, vertical, or intensity settings.		
Z-AXIS INPUT (Intensity Modulation)	+4 V, >50 ns width pulse blanks trace of any intensity, usable to ≤10 MHz for normal intensity. Input R, 1 kΩ ±10%. Maximum input ±20 V (dc + peak ac), ≤1 kHz.		
REAR PANEL CONTROLS	Astigmatism and trace align.		

SPECIFICATIONS (continued)

	1740A	1745A	1742/1746A
GENERAL			
REAR PANEL OUTPUTS	Main and delayed gates; 0.8 V to >2.5 V capable of supplying approximately 5 mA.		
AMPLITUDE CALIBRATOR	1 V p-p into ≥1 MΩ; 0.1 V into 50Ω; accuracy ±1%; rise time ≤0.1 μs; frequency approximately 1.4 kHz.		
POWER	100, 120, 220, 250 Vac, ±10%; 48 to 440 Hz; 100 VA max.		
WEIGHT	Net 13 kg (28.6 lb); shipping 15.7 kg (34.6 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 .254 mm (0.01 in.) excursion, 10 to 55 Hz.		
ACCESSORIES FURNISHED	One blue light filter (HP P/N 01740-02701, 1740A); one green contrast filter/CRT shield (HP P/N 1000-0649, 1745/46A); one 2.3 m (7.5 ft.) power cord; one vinyl accessory storage pouch; one Operator's Guide and one Service Manual; two Model 10041A 10:1 divider probes approximately 2 m (6.6 ft.) long; with TV sync Option 005, two IRE graticule overlays 0 to 100 IRE units (HP P/N 01740-02801) and -40 to 100 IRE units (HP P/N 01740-02802).		
PRICES	**$2540**	**$2840**	**$2775/$3140**
OPTIONS	**001:** fixed line power cord		+ **$15.**
	005: TV sync (1740/42) ..... + **$215.**		+ **$330.**
	034: built-in DMM (60 Hz operation)		+ **$430.**
	035: built-in DMM (50 Hz operation)		+ **$430.**
	090: without probes		− **$150.**
	096: two 1.8 m (6 ft) 10006D 10:1 probes substituted for two miniature probes		**NC**
		534: combines option 005 and 034	+ **$730.**
		535: combines option 005 and 035	+ **$730.**

TIME INTERVAL (1742A/1746A)

Δ **TIME MODE:** intensifies two parts of main time base to be expanded to full screen in Delayed Time Base Mode.

FUNCTION: measures time interval between two events on Channel A (Channel A display), two events on Channel B (Channel B display), or between two events starting on Channel A or B and stopping on Channel A or B (alternate display).

ACCURACY - Opt. 034/035 or External DVM: (plus accuracy of external DVM.)

Main Time Base	Accuracy **+15° C to +35° C
*100 ns to 20 ms/div	±(0.5% of reading +0.05% of full-scale)
50 ms to 2 s/div	±(1% of reading +0.1% of full-scale)

*On 100 ns/div range, specification applies after first cm of sweep. On all other ranges, specification applies after first 8 mm of sweep.

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

TIME INTERVAL OUTPUT VOLTAGE: varies from 50 V to 100 mV full scale. Full-scale output voltage equals (Time/div X10 V) (e.g., 0.05 μs or 0.05 ms give 0.5 V out).

STABILITY - 0° C to 55° C: short term, 0.005%; temperature ±0.03%/° C deviation from calibration temperature range.

OPTION 034/035 DMM SPECIFICATIONS (1740A,1742A,1745A,1746A)

DC VOLTMETER

Ranges: ±0.110 V, 1.10 V, 11.0 V, 110 V, 1100 V (1000 V max).

Accuracy: (+20° C to +30° C).

Range	Accuracy
0.11 V	±(0.3% of reading + 2 digits)
1.1 V, 11 V	±(0.3% of reading + 1 digit)
110 V, 1100 V	±(0.4% of reading + 1 digit)

Common Mode Rejection: (1 kΩ unbalance) >100 dB at 50 Hz or 60 Hz selected internally.

Input Resistance: 10 MΩ ±5%.

Input Protection: 1100 V peak.

Temperature Coefficient: ±(0.05% of reading +0.2 digit)/° C.

AC VOLTMETER

Ranges: 0.110 V, 1.10 V, 11.0 V, 110 V, 1100 V (700 V rms max).

Accuracy: (+20° C to +30° C).

Note - ac converter is average responding and calibrated in rms.

*Ranges	45 Hz to 2 kHz	2 kHz to 5 kHz	5 kHz to 10 kHz
1.1 V to 1100 V	±(1.5% of reading + 4 digits)	±(3% of reading + 6 digits)	±(8% of reading + 10 digits)

*Ranges usable from 0.03 of range to full range.

Common Mode Rejection: (1 kΩ unbalance) >80 dB at 50 Hz or 60 Hz selected internally.

Input Resistance: 10 MΩ ±5%.

Input Capacitance: <30 pF.

Input Protection: <1100 V peak.

Temperature Coefficient: ±(0.05% of reading +0.5 digit)/° C.

DC AMMETER

Ranges: +0.110 A, 1.10 A.

Accuracy: (+20° C to +30° C) ±(0.8% of reading +2 digits).

Impedance: 1-1.5Ω constant.

Current Protected: 1.5 A fuse.

Temperature Coefficient: ±(0.05% of reading +0.2 digit)/° C.

AC AMMETER

Ranges: 0.110 A, 1.10 A.

Accuracy: (+20° C to +30° C).

*Ranges 45 Hz to 2 kHz	2 kHz to 5 kHz
1.1A ±(2% of reading +4 digits)	±(3.5% of reading +6 digits)
0.11 A ±(2.5% of reading +6 digits)	±(5.5% of reading +6 digits)

*Ranges usable from 0.03 of range to full range.

Impedance: 1-1.5 Ω constant.

Current Protected: 1.5 A fuse.

Temperature Coefficient: ±(0.05% of reading +0.5 digit)/° C.

OHMMETER

Ranges: 1.10 kΩ, 11.0 kΩ, 110 kΩ, 1100 kΩ 11 000 kΩ.

Accuracy: (+20° C to +30° C).

Ranges	Accuracy
110 kΩ, 1100 kΩ	±(0.3% of reading + 1 digit)
11 000 kΩ, 1.1 kΩ, 11 kΩ	±(0.5% of reading + 1 digit)

Open Circuit Voltage: <4 V.

Input Voltage Protection: <30 V rms continuous fuse protected from 30 V.

Temperature Coefficient: ±(0.05% of reading +0.2 digit)/° C.

GENERAL

Ranging: Automatic Range Hold.

Common to Ground: <500 V peak.

Sample Rate: ≈3/second.

Overload Indication: horizontal bars.

Accessories Supplied: one operating and service manual and one kit (HP P/N 8120-2521) with two test leads.

Dimensions: See outline drawing page 12.

ACCESSORIES

MULTIMETER KIT

The Multimeter kit adapts standard Models 1740A, 1742A, 1745A and 1746A to Option 034/035 configuration. On Model 1746A, the kit also provides direct time interval readout. The kit includes a multimeter with two probes and operating manual, an oscilloscope top cover, a vinyl storage pouch, and mounting hardware. Order HP P/N 01740-69503 for 1740A and 1745A or P/N 01742-69501 for 1742A and 1746A . **$450**

TV/VIDEO SYNC RETROFIT KIT

Any 1700 series oscilloscope can easily display composite video waveforms with the addition of the 10029A retrofit kit module. No internal modifications are required to the oscilloscope except for a minor power requirement **$355**

TESTMOBILES

Models 1006A and 1007A Testmobiles offer efficient mobility for the Models 1740A, 1742A, 1745A or 1746A oscilloscopes. A power strip can be added to either testmobile, and Model 1007A can be modified for various applications with optional drawers and trays. Call your HP Field Engineer for the available configurations.

OSCILLOSCOPE CAMERA

Model 197B Camera fits directly on the 1740A and 197B Option 009 fits directly on the 1745A and 1746A. An ultraviolet light is included for graticule illumination.
Model 197B Camera (1740A) **$1495**
Model 197B Opt 009 (1745A, 1746A) .... **NC**
Model 197B Opt 001, without UV light ..... **— $50**
Camera Adapter: Model 10377A Camera Adapter fits Tektronix Inc C30 and C31 Cameras to the 1740A. Model 10379A fits HP Model 197B camera to the 1745A, 1746A **$230**

OPERATOR VIDEO TAPES

Three part video tapes series covering basic oscilloscope theory, front panel controls, and their use in various measurement applications. These tapes are titled "How to use an Oscilloscope" Part I (HP P/N 90742), Part II (HP P/N 90743), Part III (HP P/N 90744). Call your HP Field Engineer for ordering information.

RACK MOUNT ADAPTER

Model 10491B rack mount adapter, 222 mm (8-3/4 in.) high, 540 mm (21-1/4 in.) wide, and 540 (21-1/4 in.) deep, adapts the 1740A, 1742A, 1745A or 1746A to a standard 483 mm (19 in.) rack (not compatible with Options 034/035) **$230**

INVERTER POWER SUPPLY

Model 1112A Inverter Power Supply is directly compatible with the 1740A, 1742A, 1745A, 1746A oscilloscopes and provides power from an internal battery or an external 11.5 V to 50 V dc source. For a convenient system, the 1112A is mounted on the oscilloscope with an easy-to-use mounting strap.
Model 1112A Inverter Power Supply (400 Hz) **$1525**
Model 1112A Option 060 Inverter (60 Hz) **$200**

MINIATURE PROBE ACCESSORIES

IC Test Clips: simplify probing dual in-line packages, reduce probe loading and shorting between IC pins.
16-Pin Dips 10024A **$20**
24-Pin Dips 10211A **$76**
Jumper Cable Model 10028A: model 10028A 50 ohm, 610 mm (24 in.) miniature probe/jumper cable, with a probe tip on each end, allows bypassing circuits or injecting signals in densely populated IC circuits **$56**
BNC Adapter Tip (HP P/N 1250-1454): the BNC Adapter Tip permits signal monitoring at BNC connectors with miniature probes **$21**

MINIATURE VOLTAGE PROBES

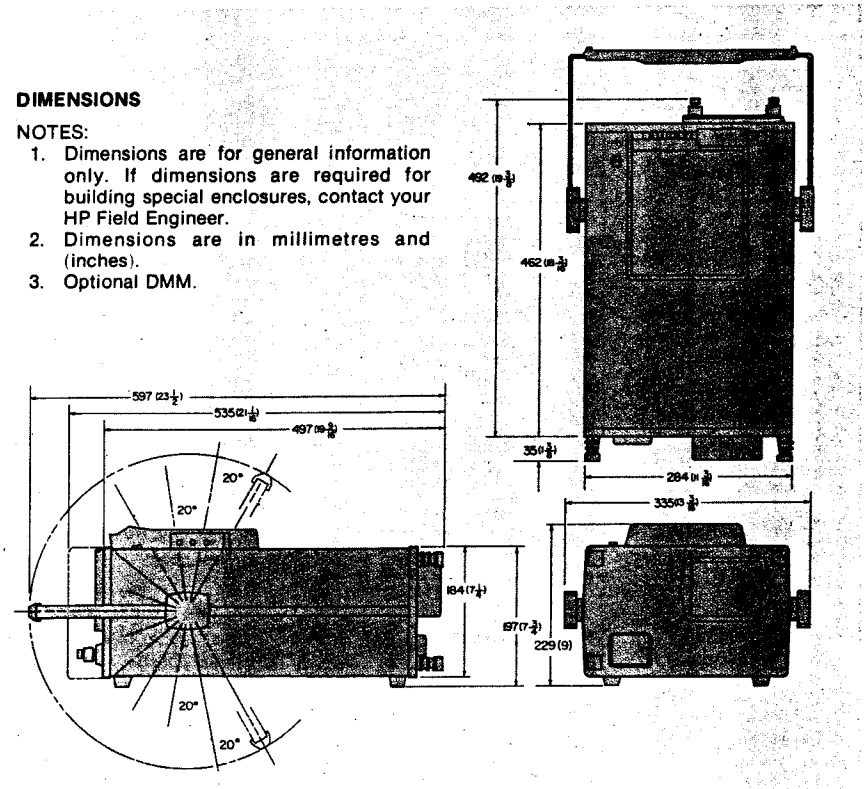
Model No.	Approx Length in Metres (ft)	Division Ratio	Input R	Shunt Capacitance	Max Peak Voltage	Compensates Scope Input C	Prices
10040A	1 (3.3)	10:1	1 MΩ	9 pF	300	20-30 pF	**$97**
10041A	2 (6.6)	10:1	1 MΩ	12 pF	300	20-26 pF	**$97**
10042A	3 (9.8)	10:1	1 MΩ	12 pF	300	20-24 pF	**$97**
10021A	1 (3.3)	1:1		36 pF	300		**$61**
10022A	2 (6.6)	1:1		62 pF	300		**$61**
10026A	1 (3.3)	1:1	50 Ω		100 (2A)		**$61**
10027A	2 (6.6)	1:1	50 Ω		100 (2A)		**$61**

TEMPERATURE PROBE

When combined with the Optional DMM (034/035), the Model 10023A Temperature Probe offers fast, accurate, direct readout of temperatures in degrees Celsius **$163**

DIMENSIONS

NOTES:
1. Dimensions are for general information only. If dimensions are required for building special enclosures, contact your HP Field Engineer.
2. Dimensions are in millimetres and (inches).
3. Optional DMM.



For more information, call your local HP Sales Office or nearest Regional Office: Eastern (301) 258-2000; Midwestern (312) 255-9800; Southern (404) 955-1500; Western (213) 877-1282; Canadian (416) 678-9430. Ask the operator for Instrument Sales. Or, Write: Hewlett-Packard, 1501 Page Mill Road, Palo Alto, CA 94304. In Europe: Hewlett-Packard S.A., 7, rue du Bois-du-Lan, P.O. Box CH-1217 Meyrin 2, Geneva, Switzerland. In Japan: Yokogawa-Hewlett-Packard Ltd., 29-21, Takaido-Higashi 3-chome, Suginami-ku, Tokyo, 168.

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