Errata

Title & Document Type: 1740A Oscilloscope Operator’s Guide

Manual Part Number: 01740-90911

Revision Date: August 1976

HP References in this Manual

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, semiconductor products and chemical analysis businesses are now part of Agilent Technologies. We have made no changes to this manual copy. The HP XXXX referred to in this document is now the Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A.

About this Manual

We’ve added this manual to the Agilent website in an effort to help you support your product. This manual provides the best information we could find. It may be incomplete or contain dated information, and the scan quality may not be ideal. If we find a better copy in the future, we will add it to the Agilent website.

Support for Your Product

Agilent no longer sells or supports this product. You will find any other available product information on the Agilent Test & Measurement website:

www.tm.agilent.com

Search for the model number of this product, and the resulting product page will guide you to any available information. Our service centers may be able to perform calibration if no repair parts are needed, but no other support from Agilent is available.
SAFETY SUMMARY

The following general safety precautions must be observed during operation of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements.

GROUND THE INSTRUMENT.
To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The instrument is equipped with a three-conductor ac power cable. The power cable must either be plugged into an approved three-contact outlet or used with a three-contact to two-contact adapter with the grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet. The power jack and mating plug of the power cable meet International Electrotechnical Commission (IEC) safety standards.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE.
Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

DO NOT REMOVE INSTRUMENT COVERS.
Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Service instructions for this instrument are provided in a separate Operating and Service Manual.

DANGEROUS PROCEDURE WARNINGS.
Warnings such as the example below, precede potentially dangerous procedures throughout this manual! Instructions contained in the warnings must be followed.

WARNING

Dangerous voltages, capable of causing death, are present in this instrument.
Use extreme caution when handling, installing or operating.
<table>
<thead>
<tr>
<th>Table of Contents</th>
<th>Model 1740A</th>
</tr>
</thead>
</table>

**TABLE OF CONTENTS (Cont'd)**

<table>
<thead>
<tr>
<th>Measuring Phase Difference by Time Delay</th>
<th>38</th>
</tr>
</thead>
<tbody>
<tr>
<td>A VS B Phase Measurements</td>
<td>39</td>
</tr>
<tr>
<td>Triggering</td>
<td>41</td>
</tr>
<tr>
<td>Trigger View</td>
<td>41</td>
</tr>
<tr>
<td>Eliminating Multiple Triggering on</td>
<td></td>
</tr>
<tr>
<td>Complex Waveforms</td>
<td>42</td>
</tr>
<tr>
<td>Option 101 - Logic State Display</td>
<td>42</td>
</tr>
</tbody>
</table>
ACCESSORIES FINISHED.

ACCESSORIES FINISHED.

DESCRIPTION.

DESCRIPTION.

GENERAL INFORMATION.

OPERATING INSTRUCTIONS

MODEL 1740A OPERATORS GUIDE

1

Accessories Finished.

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<table>
<thead>
<tr>
<th>Specification</th>
<th>Value/Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maximum Input Voltage</strong> (Two Channels)</td>
<td>AC and DC: 250 V (dc + peak ac) or 500 V p-p ac at 1.5 kHz or less. 50 Ohms: 5 V rms.</td>
</tr>
<tr>
<td><strong>A-B Operation</strong></td>
<td>Differential (A-B) Common Mode: CMRR 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.</td>
</tr>
<tr>
<td><strong>Deflection Factor</strong></td>
<td>Vertical Magnification (X5)</td>
</tr>
<tr>
<td></td>
<td>Bandwidth: 3 dB down from 8-division reference signal</td>
</tr>
<tr>
<td></td>
<td>Dc-coupled: dc to 40 MHz (ac-coupled: -10 Hz)</td>
</tr>
<tr>
<td></td>
<td>Rise Time: &lt;9 ns (measured from 10% to 90% of 50 MHz)</td>
</tr>
<tr>
<td></td>
<td>Input RC (selectable)</td>
</tr>
<tr>
<td></td>
<td>AC and DC: 1 megohm ±2% shunted by approximately 20 pF</td>
</tr>
<tr>
<td></td>
<td>50 Ohm: 50 ohms ±3%, VSWR &lt;1.4:1 at 100 MHz</td>
</tr>
<tr>
<td><strong>Rise Time</strong></td>
<td>&lt;5.5 ns (measured from 10% to 90% of 50 MHz)</td>
</tr>
<tr>
<td></td>
<td>Bandwidth: dc to 100 MHz</td>
</tr>
<tr>
<td></td>
<td>Measured 3-dB down from 8-division reference bandwidth may be limited to approximately 20 MHz by DW LIMIT switch. Lower 3-dB Limit, ac Coupling: -10 Hz.**</td>
</tr>
<tr>
<td><strong>Deflection</strong></td>
<td>3 mV/div to 20 V/div in 12 calibrated positions: 1, 2, 5 sequence: accurate within 3%. With vernier and calibrated continuously variable between ranges and to at least 50 V/div.</td>
</tr>
</tbody>
</table>

**Table 1: Specifications**

Model 1740A
**TRIGGERING**

Division: 0.25 MHz

Delay jitter: 0.002% (1 part in 5000)

Delay Jitter: 0.002% (1 part in 5000)

**Sweep Monitor (Main Only):** Continuously variable

**Sweepable Monitor:**

<table>
<thead>
<tr>
<th>Temperature Range</th>
<th>Divided Time</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>VI0°C to 55°C</td>
<td>50 ms/div</td>
<td>X10</td>
</tr>
<tr>
<td>VI0°C to 15°C</td>
<td>100 ms/div</td>
<td>X10</td>
</tr>
<tr>
<td>VI0°C to 55°C</td>
<td>500 ms/div</td>
<td>X10</td>
</tr>
</tbody>
</table>

**Accuracy**

1°, 2°, 5° sequence

Delay: 50 ms/div to 20 ms/div (16 ranges) in sequence

Main: 50 ms/div to 20 ms/div (5 ranges) in 1°, 2°, 5° sequence

**Ranges**

**CALIBRATED SWEEP DELAY**

Delivered: 100 ns to 2 ns (minimum delay)

Delay Time Range: 0.5 to 10 x MAIN TIME

**Model I740A**
to 1 division of vertical deflection at 100 MHz in all display modes.
Increase signal level by 2 when in CHOP and by 5 when MAG X5 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.
Increase signal level by 2 when in CHOP.

**LEVEL AND SLOPE**

**Internal:** at any point on the positive or negative slope of the displayed waveform.

**External:** continuously variable through ±1.5 V on either slope of the trigger signal; ±15 V in +10.

**MAXIMUM INPUT VOLTAGE**

**AC and DC:** 250 V (dc + peak ac) or 500 V p-p ac at 1 kHz or less.

**TRIGGER VIEW**

Displays the internal or external trigger signal. In alternate or Chop mode (dual channel) channel A, channel B, and the trigger signal are displayed. In channel A or B mode (single channel), trigger view overrides that channel and displays the trigger signal. Displayed amplitude of the internal trigger signal is approximately the same as the on-screen vertical signal. Deflection factor of the external trigger signal is 100 mV/div or 1 V/div in EXT+ mode. Trigger point of the main sweep is approximately at the point that the displayed trigger signal crosses center screen. With identically timed signals applied to a vertical channel and the external trigger input, the trigger signal is delayed by 2.5 ns ± 1 ns.

**A VS B OPERATION**

**BANDWIDTH**

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

**DEFLECTION FACTOR:** 5 mV/div to 20 V/div (12 calibrated positions) in 1, 2, 5 sequence.

**PHASE DIFFERENCE BETWEEN CHANNELS:** <3° dc to 100 kHz.
TRIGGERING

Main sweep

External trigger is inferred by internal or

with no advanced triggering.

The input signal is maintained at the baseline displaced in absence of input signal. External trigger is inferred by internal or

Normal sweep.

AUTOMATIC: Input signals are delayed such that
the leading edge of input pulse is aligned to view baseline.

Input coupling: Selectable for AC or DC, 60

Input impedance: 1 MΩ, 1 pF, and 50 Ω.

DISPLAY MODES: channel A, channel B (not

TWO CHANNELS)

HORIZONTAL DEFLECTION

VERTICAL DEFLECTION

Table 2. General Characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1A PANEL OUTPUTS: Main and delayed gate, 1Ω</td>
<td>50 ohms</td>
</tr>
<tr>
<td>R1B PANEL OUTPUTS: Main and delayed gate, 1Ω</td>
<td>50 ohms</td>
</tr>
<tr>
<td>Type: Approximate f-kHz square wave, r-Ω</td>
<td>0°C to 4°C</td>
</tr>
<tr>
<td>Transformer: 1kΩ, 1 pF, and 50 Ω</td>
<td>60°C</td>
</tr>
<tr>
<td>Maximum input: +20 V (dc + peak ac)</td>
<td>10%</td>
</tr>
</tbody>
</table>

Table 1, Specifications (Cont'd)

CATHODE-RAY TUBE AND CONTROLS

Z-AXIS INPUT: +4 V, 50 ns with pulse duration for

Model 1740A
**Table 2. General Characteristics (Cont'd)**

| **Single:** sweep occurs once with same triggering as normal; reset pushbutton arms sweep and lights indicator. |
| **DELAYED SWEEP** |
| **Auto:** delayed sweep automatically starts at end of delay period. |
| **Trig:** delayed sweep is armed and triggerable at end of delay period from selected sources. |

| **TRIGGER SOURCE** |
| Selectable from channel A, channel B, composite, or line frequency (composite triggering on displayed signal except in chop; in chop, channel A is trigger source). |

| **External Input RC:** approximately 1 megohm shunted by approximately 20 pF. |

| **Coupling:** AC, DC, LF REJ, or HF REJ. |
| **AC:** attenuates signals below approximately 20 Hz. |
| **LF REJ:** (main sweep only) attenuates signals below approximately 4 kHz. |
| **HF REJ:** (main sweep only) attenuates signals above approximately 4 kHz. |
| **TRIGGER HOLDOFF:** (main sweep only) increases sweep holdoff time in all ranges. |

**CATHODE-RAY TUBE AND CONTROLS**

| **TYPE:** post accelerator, approximately 15 kV accelerating potential; aluminized P31 phosphor. |

| **GRATICULE:** 8- by 10-div internal graticule; 0.2-div subdivisions on major horizontal and vertical axes. 1 div = 1 cm. Internal flood gun graticule illumination. |

| **BEAM FINDER:** returns trace to CRT screen regardless of setting on horizontal, vertical, or intensity controls. |

| **REAR PANEL CONTROLS:** astigmatism and trace align. |
Table 2. General Characteristics (Cont'd)

1. Dimensions are for general information only. If dimensions are required for building, contact your HP field engineer. Special instructions are on the reverse side.

NOTES:

Model 1740A
pouch, and two Model 10006D 10:1 divider probes approximately 2 m (6 ft) long.

**ACCESSORIES AND OPTIONS AVAILABLE.**

Several divider probes are available with various voltage division ratios and lengths.

- **Model 10002A**: 50:1, approximately 1.5 m (5 ft) long.
- **Model 10004D**: 10:1, approximately 1.1 m (3.5 ft) long.
- **Model 10007B**: 1:1, approximately 1.1 m (3.5 ft) long.
- **Model 10020A** resistive divider probe kit has a probe length of approximately 1.2 m (4 ft) and division ratios of 1:1, 5:1, 10:1, 20:1, 50:1, and 100:1.

Option 090 deletes the two Model 10006D divider probes normally supplied. You may specify other probes listed that are more suited to your requirements.

A metal mesh contrast screen (HP Part Number 01741-07101) improves display contrast and serves as an RFI filter.

Model 10140A collapsible viewing hood aids in viewing low duty-cycle signals that are hard to see in high ambient light. With a Model 10376A adapter, the Model 197A camera can be utilized.

Models 1001A, 1002A, and 1114A testmobiles all accept the Model 1740A and provide convenient, mobile stands for the oscilloscope.

Option 101 is designed for optimum performance with the HP Model 1607A Logic State Analyzer to provide...
Switcheed set for 120-V operation.

1. Disconnect the power cable from the power source; proceed as follows:
   - To operate the instrument from any other ac power source, disconnect the power cord equipped with the appropriate mains plug for that location. If the instrument is to be used in a location that satisfies the applicable mains plug standards, the appropriate mains plug is shown above each receptacle. The receptacles shown in the figure above are standard power receptacles. The power cord required depends on the ac input operation. The oscilloscope requires a power source of either 110. 120 220 or 240 volts ac 10% above, 10% below.

**CAUTION**

Figure 1. Power Receptacles

- Option 066
- Option 096
- Option 109
- Option 199
- Option 299

**POWER REQUIREMENTS**

The power cord will be provided.

**PREPARATION FOR USE**

Model I740A

Bothlez and signal leaves are displayed. The X-Y mode of operation is selected. Read the Safety Summary at the front of the Operations Guide.
Figure 2. Line Voltage Selection Switch Settings

3. For 220-V or 240-V inputs, replace fuse F1 with the 0.5 ampere slow-blow fuse supplied with your instrument (see figure 3).

4. Connect the input power cable to the power source.

CONTROLS AND CONNECTORS.

Front- and rear-panel photographs (see figures 27 and 28) are located at the rear of this guide on a fold-out page for easy reference while you are reading any section. Control and connector descriptions have
at 250 KHz rate. Simultaneous display of switching between channels A and B is interpreted as channel B display only. If the channel displays the difference between the two signals, then channel B display is inverted (cross). Channel A and B signals are displayed when channel A is selected. Switch to display A and B by pressing both channel A and B buttons.

---

**CHANNEL B**
- Displays the channel B input signal.

**CHANNEL A**
- Displays the channel A input signal.

**ALERT**
- Channel A and B signals are displayed alternatively on consecutive sweeps.

**SCALE**
- Adjusts the CRT background illumination, a control designed specifically for darkroom photography. It cannot be used in normal photography. When viewing a darkroom background and the background is lit, the background illumination for good contrast between the background and the illuminated subject is necessary. The following practices provide desired results:

---

**FOCUS**
- Adjusts the writing beam for the CRT display.

**BEAM INTENSITY**
- Controls the brightness of the CRT display. Choose intensity of the beam in relation to position controls for increase or decrease as necessary to center a display (for example). Be careful to locate the beam and determine the action to take within the viewing area. This enables you to observe the intensity and compensate the display instrument power is on.

---

**LIME INDICATOR**
- Indicates height when the line is selected. This line is also used when you are making measurements. See the Application Section for information on using with the Model 1140.
**Operators Guide**

**TRIG VIEW** - Displays the selected internal or external trigger signal at a fixed sensitivity of approximately 100 mV/div or 1 V/div with EXT -10 . TRIGGER LEVEL positions the display vertically. Center screen indicates the trigger threshold level with respect to the trigger signal. If ALT or CHOP is selected, three signals are displayed: channel A, the selected trigger signal (at center screen), and channel B. If an external trigger signal is selected, you can correlate the time between the trigger signal and the channel and channel B signals. If you select a single channel, trigger view overrides that channel to display the selected trigger signal.

**MAG X5** - Magnifies the vertical presentation five times, and increases the maximum sensitivity to 1 mV/div. The bandwidth is decreased to 40 MHz. Recommended on 5 mV/div and 10 mV/div ranges only.

**BW LIMIT** - Reduces the bandwidth of channel A and channel B to approximately 20 MHz.

**CH B INVT** - Inverts the polarity of the channel B signal. In A + B & mode, pressing

**CH B INVT** results in an A minus B display.

**TRIGGER A** - Selects a sample of the channel A signal as the trigger signal when INT/EXT is in INT.

**TRIGGER B** - When in INT, a sample of the channel B signal is selected as the trigger signal.

**& COMP** - When the display mode is set to channel A, channel B, ALT, or A + B, the sweep is triggered by the displayed signal. When in CHOP, the sweep is triggered by the channel A signal only.

**NOTE**

In the following descriptions for controls through , only channel A controls and connectors are discussed. Channel B controls and connectors are identical in function.

**AC** - Selects the input coupling and impedance for the vertical amplifiers. In the AC position
DIY Range: 25°C to 1°C

Vert Almost Range: 25°C to 1°C
detection factor between calibrated VOLTS/DIV VOLTS/DIV - Provides continuous control of the vertical detection factor in a 1.25 sequence from 0.005 V/DIV to 20 V/DIV, accurate within 3% with vertical range in the CAL position.

VOLTS/DIV - Selects the vertical detection factor.

CAL 1 - Provides a 1-V peak-to-peak (within display) vertical position of the ground post - Controls the vertical position of the ground post - Controls the vertical position of the ground post.

1 Hz or less. (de + peak ac) or more than 500 V peak-to-peak; enable by DC - All dc components of the input signal are passed. Grounded - The input signal is disconnected. Grounded - The input signal is disconnected. The lower cutoff limit is approximately 10 Hz. When the vertical control is out of the ON position to indicate VOLTS/DIV.

UNCAL - Lights when the vertical control is out of the ON position to indicate VOLTS/DIV.

Operate Guide
AUTO/NORM - AUTO sweep mode (pushbutton out). A free-running sweep provides a bright display in the absence of a trigger signal. A trigger signal input (internal or external) of 40 Hz or more overrides AUTO operation and sweep triggering is the same as in the NORM mode.

NORM sweep mode (pushbutton in) requires an internal or external signal to generate a sweep and must be used if the input frequency is less than 40 Hz.

SINGLE - Sweep occurs once with the same triggering as in NORM. After each sweep, the trigger circuit must be manually RESET.

RESET - Momentary pushbutton that arms the trigger circuit in the single-sweep mode. After RESET, the sweep can be triggered by an internal or external trigger signal or by rotating the TRIGGER LEVEL control through zero.

Reset Lamp - When lit, indicates the trigger circuit is armed. Lamp goes off at the end of the sweep and remains off until the trigger circuit is again armed by pressing the reset button.

MAIN - Selects main sweep for horizontal display. Sweep rate and triggering are selected by the main-sweep controls, and horizontal positioning is adjusted by channel A POSN, and horizontal positioning is adjusted by POSITION and FINE.

A VS B - Selects an X-Y mode of operation with channel A input (Y-axis) plotted versus channel B input (X-axis). Vertical positioning is adjusted by channel A POSN, and horizontal positioning is adjusted by POSITION and FINE.

OPTION 101 - Deletes the A VS B function and adds logic state display. When the Model 1740A is connected to a HP Model 1607A Logic State Analyzer, pressing STATE DSPL displays a 16-word table of 16-bit words. See the Applications Section for details.

MAG X10 - Magnifies the horizontal display 10 times, and expands the fastest sweep time to 5 ns/div, maintaining a sweep accuracy within 3% at room temperature.
Start the sweep.

The interferer waveform displayed vertical waveform if triggered signal used to then the interferer level selects any point on the sweep. Interferer level is continuously variable when the interferer level is constant. The interferer level is displayed on the interferer level. When the interferer level is displayed, the sweep is displayed on the interferer level. When the interferer level is displayed, the sweep is displayed on the interferer level.

Interferer level - Selects the voltage level the interferer level is displayed on the interferer level. When the interferer level is displayed, the sweep is displayed on the interferer level.

Trigger level - Selects the voltage level the interferer level is displayed on the interferer level. When the interferer level is displayed, the sweep is displayed on the interferer level.

Trigger holdoff - Increases the time base of the interferer level.

Operations Guide

Model 170A
HF REJ - Attenuates internal or external trigger signals above approximately 4 kHz. This is useful to condition low-frequency signals for best synchronization by eliminating unwanted high-frequency signals such as RF.

LINE - Selecting both LF REJ and HF REJ removes all EXT input or INT displayed signals from the trigger circuit and applies a power-line frequency signal for triggering.

AC/DC - Selects ac or dc coupling of the input (EXT or INT) or displayed signal to the trigger circuit. The DC position must be selected for signals below approximately 20 Hz.

INT/EXT - INT Selects a sample of the internal vertical signal chosen by the TRIGGER source, while EXT selects the signal at the EXT TRIGGER input for application to the main trigger circuit. Internal signals from dc to 25 MHz displaying 0.3-div amplitude or more are sufficient for stable triggering, increasing to 1 div of amplitude at 100 MHz. Externally applied signals 50 mV p-p from dc to 50 MHz, increasing to 100 mV p-p at 100 MHz are sufficient for stable triggering.

EXT +10 - Attenuates EXT TRIGGER input signal by a factor of 10.

EXT TRIGGER - BNC connector for external trigger input. Input impedance is approximately one megohm shunted by approximately 20 pF. Do not apply more than 250 V (dc + peak ac) or 500 V p-p ac at 1 kHz or less.

DELAY - The DELAY control provides a variable delay time from 0.5 to 10 X the MAIN TIME/DIV settings of 100 ns to 2 s. See the Applications Section for more information.

DLY'D - Selects delayed sweep for horizontal display.

MIXED - Selects main and delayed sweeps for the horizontal display. The first portion of the sweep is at the main-sweep rate, and the second portion of the sweep (starting point chosen by DELAY) is at the delayed-sweep rate. See Mixed Sweep Display under Obtaining Basic Displays for more information.

SWEEP AFTER DELAY AUTO/TRIG - Selects the method of starting the delayed-sweep when in main intensified, delayed, or mixed mode operation. In AUTO, delayed sweep
TURN-ON PROCEDURE:

1. **240 V operation.**
   - Operation 0/90° 240 V slow blow for 120° 1/2 V fuse - 14/220° 240 V slow blow for 120°
2. **Z-Axis - Intensity input from HP Model 1671A.**
3. **Vert. - X-Axis input from HP Model 1671A.**
4. **Horizontal - X-Axis input from HP Model 1671A.**
5. **1671A INPUTS - Option 101 only.**

With the delayed gate option of approximately +25° A coincident with the main gate. Operation of approximately +25° A coincident with the main gate.

**LINE INPUT - Connector for the power cord.**

**MAIN GATE OUTPUT - Provides a rectangular wave.**

**TRACE ALIGNS - Sequential alignment used in conjunction with FOCUS shortening to focus in the Y-direction.**

**ASTigmatism -** Sequential alignment used in conjunction with FOCUS shortening to focus in the Y-direction.

**Z-Axis Input -** Sequential alignment used in conjunction with FOCUS shortening to focus in the Y-direction.

**1671A INPUTS - Option 101 only.**

**Operations Guide**

**Model 1740A**

**Steps:**

To turn on the Model 1740A, perform the following:

1. Insert 22 and 32 at the back of this guide.
2. The controls and connectors section and by referring to the illustrations and other information provided in this guide.
3. Familiarize yourself with the controls and their functions by reading the requirement paragraphs. You should also become familiar with the illustrations in the summary at the front of this guide.
4. Follow the instructions in this guide carefully.
5. Before turning on the oscilloscope, please read and understand the operating guide.
Operators Guide

1. Turn all control knobs to the 12 o'clock position except verniers 10 and SWEEP VERNIER 18 which should be in the CAL position; TRIGGER HOLDOFF 19 should be on MIN. The MAIN TIME/DIV 20 control should be fully clockwise.

2. All pushbuttons should be out except A 13, A 15, and MAIN 17.

3. Press the LINE switch 11; the LINE indicator 12 should light. After CRT warm up, a free-running trace should be observed near the center of the screen.

4. Increase (or decrease) BEAM INTENSITY 4 to a comfortable viewing level, and adjust FOCUS 5 as necessary for the sharpest trace.

OPERATORS CALIBRATION.

A few checks and adjustments will ensure that Model 1740A is operating properly. If the oscilloscope is moved from one electromagnetic environment to another, the trace alignment control may need adjustment to align the horizontal trace with the graticule. Astigmatism and focus controls may need adjustment to obtain the sharpest display. Probe compensation may be required because the total input resistance and capacitance varies slightly from one oscilloscope to another.

TRACE ALIGNMENT.

1. Obtain a display as described in the turn-on procedure.

2. With the vertical POSN control 22, align the trace with the center graticule line.

3. With a screwdriver, adjust TRACE ALIGN 43 (on rear panel) for best trace alignment with the graticule line.

ASTIGMATISM AND FOCUS.

1. Select A VS B 32 and lower BEAM INTENSITY 4 to a low level.

2. Position the spot near the center of the CRT with POSN 27 and POSITION 25 controls.

3. Adjust FOCUS 5 and ASTIGMATISM 33 (on rear panel) for the smallest round spot.
1. Apply an accurate calibration signal (such as an HP Model 2264A Time Mark Generator) to the channel A INP. Apply a test lead with a nullifier chip.

2. Connect the CAL A V lead to the CH A signal. Apply the CAL A V lead to the CH B signal.

3. Adjust the channel A VOLTS/DIV con. A

4. Adjust the CAL A V level.

5. Set the controls to the positions indicated in the Turn-on Procedure.

VERTICAL ACCURACY CHECK

If overshoot or undershoot is present, turn the probe for a 100% square wave output. Make sure the probe is properly inserted into the BNC (see Figure 4).

If overshoot or undershoot is present, turn the probe for a 100% square wave output. Make sure the probe is properly inserted into the BNC (see Figure 4).

Probes Compensation.

Model 1740A
2. Set the controls to the positions indicated in the turn-on procedure except for MAIN TIME/DIV which you should adjust to 0.5 μSEC/div.

3. Set a marker on the graticule line at the far left with the horizontal position control. Markers should line up approximately with each graticule line across the CRT. The marker on the far right-hand side should be within 2 mm of the graticule line.

**TRIGGER SELECTION TABLE.**

Table 3 will help you in determining whether a trigger mode is unusable, usable, good, or the best mode for various signal conditions.

**OBTAINING BASIC DISPLAYS.**

These procedures will help you become familiar with the operation of the Model 1740A so you can obtain commonly used displays. Before performing the procedures, complete the turn-on procedure and adjust the following controls:

- **Channel A TRIGGER**
- **Channel A coupling**
- **Channel A VOLTS/DIV**
- **MAIN TIME/DIV**
- **DELAY**

NORMAL SWEEP DISPLAY.

1. Connect your Model 10006D probe to the channel A INPUT connector, the CAL 1 V output, and the ground post.

2. Adjust the POSN control to align the base of the square wave on the center graticule line and the TRIGGER LEVEL control for a stable display. You will see a square wave with an amplitude of two divisions and approximately five to nine positive-going pulses.

MAGNIFIED SWEEP DISPLAY.

1. Follow steps 1 and 2 to obtain a Normal Sweep Display.

2. Adjust the horizontal POSITION control to place the waveform portion you want to magnify on the CRT center graticule (see figure 5a).

3. Press MAG X10 and adjust the horizontal FINE control for precise placement of the magnified display (see figure 5b).
### Signal Conditions

<table>
<thead>
<tr>
<th>Trigger Selection</th>
<th>Display Mode</th>
<th>Signal Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>OK or OK</td>
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<td>A or B</td>
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<td>OK or OK</td>
<td>OK or OK</td>
<td>A or B</td>
</tr>
</tbody>
</table>

#### Table 3: Display and Trigger Selection Table

- **Model 1740A**
- **Operators Guide**
DELAYED SWEEP DISPLAY.

1. Follow steps 1 and 2 to obtain a Normal Sweep Display.

2. Adjust the delayed TIME/DIV control for 50 μSEC/DIV, and observe the portion of the square wave that is intensified. Set the BEAM INTENSITY control to a comfortable viewing level.

3. Set SWEEP AFTER DELAY to AUTO and turn the DELAY control clockwise until the intensified portion of the trace is over the trace area you wish to investigate. This is demonstrated in figure 6a.

4. Press DLY/D and note the intensified portion of the trace is now displayed across the entire CRT (see figure 6b).

5. You may turn the DELAY control to view other pulses in the pulse train.

For a more complete description of delayed sweep, including TRIG operation, refer to the Applications Section.

MIXED SWEEP DISPLAY.

1. Follow steps 1 and 2 to obtain a Normal Sweep Display.

2. Adjust the delayed TIME/DIV control for 50 μSEC and note the portion of the square wave that is intensified. Set the BEAM INTENSITY control to a comfortable viewing level.

3. Turn the DELAY clockwise until part of the waveform in the second half of the CRT is intensified (see figure 7a).

4. Press MIXED and notice the first portion of the display is at the main TIME/DIV sweep rate and the second portion is at the delayed TIME/DIV sweep rate (see figure 7b). You can vary the transition point from main sweep to delayed sweep by adjusting the DELAY control.

X-Y DISPLAY.

1. Press A VS B. BEAM INTENSITY may need to be decreased. Apply the vertical (Y-axis) signal to the channel A INPUT connector and
the horizontal (X-axis) signal to the channel B INPUT connector. The channel A POSN 27 control will adjust vertical positioning, and the horizontal POSITION 26 control will adjust horizontal positioning. Adjust channel A and B VOLTS/DIV 10 controls as required.

2. If the display is not visible, press BEAM FIND 3 and adjust the channel A and B VOLTS/DIV controls until the display is compressed vertically. Next, center the compressed display with POSN 27 and POSITION 26 controls. Release BEAM FIND, and adjust FOCUS 5 for a sharp display.

APPLICATIONS

INTRODUCTION.

This section will assist you in using the Model 1740A oscilloscope for various measurement applications. In many cases, illustrations and examples are provided for clarity. We do not attempt to cover every possible application. If you have difficulty with any procedures or you have questions about an application not described here, please feel free to call on your HP Sales/Service representative for assistance. A list of HP Sales/Service Offices is included at the back of this guide. When measurements are made by scaling or interpolating on the CRT graticule, you should use five or more major divisions of display between measurement points. Most observers will agree, when adequate care is used, that most measurements can be kept within ±1/20 of a major division. This amounts to a scaling error of ±1% for five divisions of separation.

VOLTAGE MEASUREMENTS.

Voltage measurements can be made between a point on a waveform and a zero-volt reference (absolute voltage, see figure 8) or between any two points on a waveform (voltage difference, see figure 8).
Figure 3 shows the absolute voltage measurement setup.

1. MAIN TIME/DIV control as required.
2. TRIGGER LEVEL for a stable display. Adjust the trigger level to DC, and adjust the trigger reference level. Don't move the POSN control after the reference level is set.
3. SET the input components to GND and AUTO/NORM.
4. Set the appropriate POSN control, see the table on a fortunate line to establish a zero-volts reference on a fortunate line to establish a zero-volts reference.

Example: Assume the vertical distance is 7 div. the VOLTS/DIV setting is 1 (see Fig. 9).

- If you are using a probe, the VOLTS/DIV setting includes the attenuation factor.
- Multiply the number of divisions by 6 to find the number of divisions by 6.

The following procedure is used to make absolute voltage measurements, which are made with respect to a zero-volts reference.

Absolute Voltage Measurements.

The Model 7414A vertical deflection system has 12

Model 7414A.
Operators Guide

Voltage = 7 X 1 = +7 volts.

The waveform is above the reference line and so the voltage is positive.

VOLTAGE DIFFERENCE MEASUREMENTS.

The procedure used in making voltage difference measurements is similar to the absolute voltage procedure. However, the vertical distance is measured between two points on the waveform, not between a zero-volt reference line and the waveform. An example of a voltage difference measurement is peak-to-peak voltage, which is shown in figure 10.

![Figure 10. Peak-to-peak Voltage](image)

**AMOUNT OF VOLTAGE MEASUREMENTS.**

To measure average voltage, a zero-volt reference line is determined by setting the input coupling to GND. Next, switch the input coupling to DC and measure the absolute voltage to the point of interest on the waveform (see figure 11a). Switch input coupling to AC and measure the absolute voltage to the same point on the waveform (see figure 11b). The difference between the first and second voltage is the average voltage.

AMPLITUDE COMPARISON MEASUREMENTS.

When you are comparing an unknown signal to a known (reference) amplitude, it may be helpful to use deflection factors not calibrated on the VOLTS/DIV control. With this method, a particular amplitude can be displayed by an exact number of divisions of deflection. This would be desirable when you are calibrating an instrument. You can also increase the accuracy of your measurements with the comparison method; the accuracy of your measurement depends on the reference signal accuracy, not on the oscilloscope accuracy.

1. Apply the reference voltage to the channel A INPUT connector, and set DISPLAY and TRIGGER to channel A.
X display amplitude in HV (Step 5)

Amplitude = VOLTMS/DIV Setting (Step 5) x (Step 4)

6. Use the following formula to calculate the amplitude of the signal being measured:

\[
\text{Amplitude} = \frac{\text{Display Amplitude in HV} \times \text{VOLTS/DIV}}{\text{Reference Signal Amplitude (Vols)}}
\]

7. Disconnect the reference signal and connect the DIV Select.

8. Display Amplitude in HV (Step 2) x VOLTS/DIV

4. You should now calculate a scale factor (SF) to adjust the upper and lower limits of the signal on the display.

3. Set the appropriate VOLTMS/DIV, voltage, and reference signal levels for exactly six, seven, or eight divisions of amplitude. Don't exceed the vertical after Trigger level for a stable display.

2. Adjust MAIN TIME/DIV control for several cycles of display and TRIGGER LEVEL for a stable display.

4. Use the following formula, mind:

So, if the amplitude of an unknown signal can be detected, the amplitude of a known signal can be verified or measured.

Figure 11: Average Voltage

\[
\text{AVERAGE VOLTAGE} = \frac{0.5V - 0.3V}{1.5V} = 1V
\]
Operators Guide

**Example:** Assume a reference signal amplitude of 40 Volts, a VOLTS/DIV setting of 5, and a display amplitude of six divisions.

Substituting in the formula from Step 4:

\[ sf = \frac{40}{6 \times 5} = 1.3 \]

Now, if the signal to be measured has a display amplitude of five divisions with a VOLTS/DIV setting of 2, determine the amplitude from the formula in Step 6.

Amplitude = 2 VOLTS/DIV X 1.3 X 5 DIV = 13 volts.

You can also calculate an unknown signal as a percentage of a known signal.

**Example:** Assume the reference signal has a deflection of eight divisions. Therefore, each division represents 12.5%. If the unknown signal has a deflection of 6.2 divisions, the amplitude of the unknown signal is:

UNKNOWN SIGNAL AMPLITUDE = 6.2 DIV X 12.5% / DIV = 77.5% of the reference signal amplitude.

**COMMON MODE REJECTION.**

Frequently, signals of interest are modulated by an undesired dc or low-frequency ac component that prevents you from using a vertical range sensitive enough to make adequate measurements. You can often cancel the unwanted signal components by applying a signal similar to the unwanted components on the opposite channel and selecting A + B display mode and pressing the CH B INV'T switch. The result is A minus B and only the desired signal is displayed. With this procedure, you can subtract unwanted components that are much larger in amplitude than the desired signal.

1. Apply the desired signal with unwanted components to the channel A INPUT connector and a signal similar to the unwanted components to the channel B INPUT connector.

2. Set input coupling as required, and select ALT. Adjust the VOLTS/DIV and vernier controls so the unwanted components on the channel A and B signals are approximately equal in amplitude.

3. Select TRIGGER A, CH B INV'T, and DISPLAY A + B. With either channel A or channel B vernier control, adjust for minimum deflection of the common mode signal.
The following procedures illustrate period and time measurement.

**Time Measurement.**

**Example:** In Figure 12a and 12b the common mode mode signal.

1. The signal display will either be indicated at
2. Channel A.
3. The desired signal is illustrated.
4. The common display will either be indicated at
5. Channel B.

**Time Measurement.**

**Example:** In Figure 12a and 12b the common mode mode signal.

1. The signal display will either be indicated at
2. Channel A.
3. The desired signal is illustrated.
4. The common display will either be indicated at
5. Channel B.
Operators Guide

Figure 13. Examples of Time Duration Measurements

edge. If these points are not well defined, use the 10% rise and fall points. In time difference measurements, both channels of the oscilloscope are used and the horizontal distance measured is from the start of a reference waveform to the start of the waveform being compared to the reference.

The time base accuracy is within 2% at room temperature. Refer to table 1 for complete specifications.

Period Measurements.

1. Apply your signal to the channel A or B INPUT connector, and select A or B DISPLAY and TRIGGER.

2. Adjust the appropriate VOLTS/DIV control for six to seven divisions of display, if possible, and set the MAIN TIME/DIV control to the fastest sweep speed that will display at least one cycle within the 10 available divisions on the CRT.

3. Using the appropriate POSN control and the horizontal POSITION control center the display.

4. Measure the horizontal distance for one cycle in divisions. The SWEEP VERNIER should be in CAL detent.

5. Multiply the horizontal distance in step 4 times the MAIN TIME/DIV setting. If you are using the MAG X10 switch divide the product by 10.

Use the following formula:

\[
\text{Period} = \frac{\text{Horizontal Distance For One Cycle in Div (Step 4) X MAIN TIME/DIV Setting (Step 2)}}{\text{Magnifier}}
\]
Apply the pulse to the channel A or B INPUT.

To measure the rise time, connect the ZERO VOLTAGE reference point to the output of the circuit under test.

The rise time is measured from the 10% to 90% points of the waveform.

\[
\text{Rise Time} = \frac{0.1 \text{ to } 0.9 \text{ ms}}{1 \text{ cycle}} \times 10^3 \text{ ms} \text{ per} \text{ cycle}
\]

Example: Using the previous formula, calculate the rise time for a 10% to 90% measurement.

\[
\text{Rise Time} = \frac{0.8 \text{ ms}}{1 \text{ cycle}} \times 10^3 \text{ ms} \text{ per} \text{ cycle} = 800 \text{ ms per} \text{ cycle}
\]

1. **Replication Rate of Frequency Measurements**

   \[
   \frac{8 \times 10^8 \text{ cycles}}{1 \text{ cycle}} = \frac{125 \times 10^8 \text{ cycles}}{1 \text{ cycle}}
   \]

   Example: Using this formula, calculate the replication rate of frequency.

   \[
   \frac{8 \times 10^8 \text{ cycles}}{1 \text{ cycle}} = \frac{125 \times 10^8 \text{ cycles}}{1 \text{ cycle}}
   \]

   Example: Using the previous formula, calculate the replication rate of frequency.

   \[
   \frac{8 \times 10^8 \text{ cycles}}{1 \text{ cycle}} = \frac{125 \times 10^8 \text{ cycles}}{1 \text{ cycle}}
   \]

   Example: Using the previous formula, calculate the replication rate of frequency.

   \[
   \frac{8 \times 10^8 \text{ cycles}}{1 \text{ cycle}} = \frac{125 \times 10^8 \text{ cycles}}{1 \text{ cycle}}
   \]

   Example: Using the previous formula, calculate the replication rate of frequency.
2. Adjust the appropriate VOLTS/DIV control and vernier for six or eight divisions of amplitude and the MAIN TIME/DIV control to display enough pulse top and baseline for measurement. Spread the 10% and 90% points as far apart as possible.

3. Turn the horizontal POSITION control until the 10% point on the waveform intersects a 10% marking and a vertical graticule line. The display should be centered in the viewing area.

4. Count the number of divisions until the pulse rise crosses the 90% markings. The SWEEP VERNIER should be in CAL detent.

5. Multiply the number of divisions in step 4 times the MAIN TIME/DIV setting. This is the rise time (R\text{\scriptsize T}) you use the MAG X10 switch, divide the product by 10.

**Example:** Assume the number of divisions between the 10% and 90% points is four and the MAIN TIME/DIV setting is 2 \( \mu\text{SEC} \) (see figure 15).

\[ R\text{\scriptsize T} = 4 \times 2 \, \mu\text{SEC} = 8 \, \mu\text{SEC} \]

If you use the oscilloscope to measure a rise time near the Model 1740A rise time (<3.5 ns), error correction may be required. For accurate results, error correction should be used when the pulse rise time is four times the oscilloscope rise time or faster.

Use the following formula:

\[ R\text{\scriptsize T} (\text{pulse}) = \sqrt{R\text{\scriptsize T}^2 (\text{observed}) - R\text{\scriptsize T}^2 (\text{oscilloscope})} \]

**Example:** Assume the 10% to 90% observed rise time is 7.5 ns and the oscilloscope rise time is 3.5 ns.

Substituting in the formula:

\[ R\text{\scriptsize T} (\text{pulse}) = \sqrt{7.5^2 - 3.5^2} = 6.6 \, \text{ns} \]
Substituting in the formula:

\[ t = \frac{6}{(\text{divisions between pulses}) \times \text{MAIN TIME/DIV}} \]

**Example:** Assume 6 divisions between pulses, and a MAIN TIME/DIV setting of 0.5 sec:

\[ t = \frac{6}{(\text{divisions between pulses}) \times 0.5} \]

To calculate the time interval (t), use the following formula:

6. Using horizontal position, place the second pulse (see figure 16), and count the number of divisions to the 50% point of the first pulse on a convenient grid. Place the 50% point of the first pulse to 100% horizontal position.

5. Using main trigger level, for a stable display, play six to eight divisions between pulses, and adjust VOLT/DIV control to display amplitude.

3. Select INT main trigger, and MAIN sweep.

1. Apply your signal to the channel A INPUT connector, and set TRIGGER and DISPLAY to channel B. Operate sweep.
Operators Guide

Figure 16. Time Interval Measurement Using Main Time Base

\[ t = (6.2 \text{ DIV} \times 0.5 \text{ ms}) \pm 2\% \text{ at room temperature} \]

\[ t = 3.1 \text{ ms} \pm 0.062 \text{ ms} \]

Now we will use delayed sweep to make the same measurement.

1. Perform steps 1 through 4 of the previous procedure and select AUTO SWEEP AFTER DELAY.

2. Set the DLY'D TIME/DIV control as required, and turn the DELAY control to place the intensified portion on the first pulse (see figure 17a).

3. Select DLY'D sweep and adjust the DELAY control so the 50% amplitude point of the first pulse is on the center vertical graticule line (see figure 17b). Note the DELAY control reading.

4. Rotate the DELAY control clockwise until the second pulse is positioned on the same point of the center vertical graticule line (see figure 17c). You can verify this is the correct pulse by returning to MAIN sweep and observing the intensified portion. Again note the DELAY control reading.

5. To calculate the time interval (t), use the following formula:
Example: Assume the first DElAY control reading is 7.5 ms and the second DElAY control reading is 1.31 ms. The DElAY control is set to 0.05 ms (see the DIVIDE TIME/DIV control set to 0.5 ms and the MAIN TIME/DIV control set to 0.05 ms). Convert to divide the DElAY reading by X MAIN TIME/DIV + error.

\[ \frac{\text{reading}}{\text{reading}} = \frac{7.5}{1.31 + 0.05} \]
Substituting in the formula:

\[ t = (7.58 - 1.31) \times \frac{0.5 \text{ ms} \pm \text{error}}{\text{DIV}} \]

\[ t = 3.14 \text{ ms} \pm \text{error} \]

The error is \(\pm [(0.5\% \times t) + (0.1\% \times \text{maximum delay period})]\). The maximum delay period is the main sweep rate times the total length of the display (10 div in the 1740A).

Therefore,

\[ \text{error} = \pm [(0.5\% \times 3.14) + (0.1\% \times 5)] = \pm 0.021 \text{ ms} \]

And,

\[ t = 3.14 \text{ ms} \pm 0.021 \text{ ms}, \text{ an accuracy of } <0.7\%. \text{ For greatest accuracy, use the fastest possible main sweep rate you can. This reduces the maximum delay period.} \]

**Pulse Jitter Measurements.**

Jitter is a time uncertainty in the waveform caused by random noise, or spurious or periodic signals. To measure jitter use the following procedure.

1. Apply the signal to the channel A or B INPUT connector, and select A or B DISPLAY and TRIGGER.

2. Adjust the appropriate VOLTS/DIV control for five or more divisions of vertical deflection, and set the MAIN TIME/DIV control to show the complete waveform.

3. Adjust TRIGGER LEVEL until the display is as stable as possible.

4. Set the DLY'D TIME/DIV control as required, and turn the DELAY control to place the intensified display on the portion of the pulse showing jitter. The SWEEP VERNIER control should be in the CAL detent position.

5. Select the DLY'D mode and AUTO SWEEP AFTER DELAY. The horizontal movement of the pulse is the pulse jitter. There is some inherent jitter in any delayed sweep time base and should be included in the measurement (jitter in Model 1740A 1:50,000, which is insignificant in most measurements). Using the horizontal POSITION control, place the leading edge of the pulse on the center vertical graticule line. With the POSN control center the display.

6. Measure the horizontal displacement on the center horizontal graticule line as shown in figure 18. This displacement times the DLY'D TIME/DIV setting is the pulse jitter in time.
When the time duration between the end of one pulse and the start of another pulse is variable, you can eliminate jitter from the display by using the TRIG SWEEP AFTER DELAY control. In this mode, the delayed sweep is triggered on the jitter after the delayed pulse. The integrated delay is displayed on the display. You can eliminate jitter from the display by using the TRIG SWEEP AFTER DELAY control.

Example: Assume the DIV×TIME/DIV setting is 0.2 ms/DIV and the horizontal displacement is 0.5 ms/DIV. The jitter on the display is eliminated, and you can measure the pulse width with a high degree of accuracy.

Operations Guide
MEASURING PHASE DIFFERENCE BY TIME DELAY.

The phase difference between two signals of the same frequency can be determined up to the frequency limitation of the vertical amplifier. Use the following procedure:

1. Select ALT, channel A TRIGGER, and main POS.

2. Apply the input signal to the channel A INPUT connector and the output signal to the channel B INPUT connector. The cables or probes used must either have the same electrical length or the delay differences must be accounted for to prevent measurement error.

3. Select AC input coupling for both channels, and adjust channels A and B VOLTS/DIV and vernier controls for an equal amplitude on both channels.

4. Adjust the MAIN TIME/DIV and SWEEP VERNIER controls so a complete cycle for each waveform is displayed within 10 horizontal divisions.

5. Using the POSN controls center both waveforms vertically.

6. Readjust SWEEP VERNIER for one complete cycle of the input signal in an exact number of major divisions. Six or eight divisions is suggested, which would equal 60°/Div and 45°/Div respectively. You can obtain additional resolution by using the MAG X10 switch. In this case, six divisions would equal 6°/Div and eight divisions would equal 4.5°/Div.

7. Count the number of major plus minor divisions between the reference signal and the output signal at the point where they both cross the center horizontal graticule line. Convert divisions to degrees and this is the phase difference.

**Example:** Assume one cycle of the input signal occurs in six divisions and there are three minor divisions between the input and output waveforms (see figure 21).
Phase measurement can be measured from the result of the input signal. With the channel B voltage selected on the y-axis, and the channel A voltage selected on the x-axis, the result yield a 100 kHz channel A input signal. The difference between two signals of the same frequency at a VS B mode will allow you to measure the phase difference.

**A VS B Phase Measurements**

Output is the input by 36°. Since one major division equals 60°, one minor division equals 12°. The phase difference is 8 X 12 = 36°.

**Figure 2.1 Phase Difference Measurement**

Connect one signal to the channel A and the other to the channel B INPUT connector. Select A VS B and adjust the channel A VOLT/S DIV control for six to seven divisions of vertical.

Connect the channel B to the zero level of the channel A and adjust the channel A DIV control for eight divisions of horizontal. Referring to the phase chart, center the display on the CRT for horizontal position, center the display on the CRT for vertical position, and adjust the channel B VOLT/S DIV control to the channel B INPUT connector. Select A VS B and adjust the channel A VOLT/S DIV control for six to seven divisions of vertical.
Operators Guide

5. The sine of the phase angle between the two signals is $A/B$. Figures 22b, 22c, and 22d show signals in phase, 90° out of phase, and 180° out of phase respectively. If the trace is rotating, the signals are not at the same frequency.

**Example:** In figure 22a, A equals five divisions and B equals eight divisions. Distance C is equal to distance D. The sine of the phase difference ($\theta$) is $A/B$, which is 0.625.

Therefore: (using HP 21 calculator).

Phase Angle ($\theta$) = arc sine of 0.625 = 38.7°.

---

**Figure 22b. Signals In Phase**

**Figure 22c. Signals 90° Out Of Phase**

**Figure 22d. Signals 180° Out Of Phase**
The trigger point is the trigger level location.

To set the trigger level, proceed as follows:
1. Connect the trigger signal to the main EXT TRIGGER input connector, and select main EXT.

The horizontal level location can be seen in the extended horizontal waveform. The horizontal level is controlled by using the channel A trigger level control. This is useful in setting both vertical and horizontal levels. This is achieved by using the horizontal level control.

It is recommended to observe the trigger level signal while observing the extended waveform.

Example 1: We will now use this trigger view to determine the trigger level.

Using the trigger level control, adjust the trigger level to a value of 10 mV/div.

Example 2: The selected trigger signal is displayed near center screen. The point where the trigger signal crosses the center horizontal reference is the trigger point location. The center point location is determined by adjusting the trigger level control.

Example 3: When the trigger signal crosses the center horizontal reference, the trigger point is determined by adjusting the trigger level control.

The trigger level control replaces the channel A or B trigger signal.
ELIMINATING MULTIPLE TRIGGERING ON COMPLEX WAVEFORMS.

Figure 24a shows an example of multiple triggering. To have a stable display, the period between sweeps must match the period of the waveform being displayed. In the example, the first sweep displays three bits of a four-bit word. The next sweep displays the remaining bit in the word. So on consecutive sweeps we see different portions of the same word causing the instability in figure 24a.

To eliminate the instability, the TRIGGER HOLDOFF control can be adjusted to vary the time between the end of one sweep and the beginning of the next. This is the holdoff period. In the example, if you increase the holdoff period long enough, the trigger from the fourth bit is held off, which eliminates the additional sweep that caused the display instability (see figure 24b).

![Figure 24a. Multiple Triggering With Display Instability](image)

![Figure 24b. Multiple Triggering Eliminated With Trigger Holdoff Control](image)

OPTION 101 – LOGIC STATE DISPLAY

This option allows you to use the Model 1740A with the HP Model 1607A Logic State Analyzer to aid in your analysis of digital systems that depend on sequences of logic states to control their operation.
NOTE

Model 1670A

The following adjustments apply to the

Sample Mode ...
OFF WORD
OFF

POWER

1. Press START/STOP on the Model 1740A

Procedure:

Connected to the Model 1670A for this

Check and data probes, don't have to be

NOTE

Model 1670A by the following procedure:

You may check Model 1740A operation with the

Initials:

Z-AXIS to the corresponding Model 1740 A rear-panel.

Model 1670 A rear-panel outputs, HORZ, VERIT, and

Model 1002A, connect the Model 1002A cable. Connect the

place the Model 1740A on top of the Model 1670A

To connect the Model 1740A to the Model 1670A

Manufacturers, Vertical and Z-axis signals from the

Horizontal, Vertical, and Z-axis signals from the

Operators Guide

All other specifications, Z-AXIS, COLUMN, BLANKING, OFF.

NOTICE
7. Rotate the COLUMN BLANKING control clockwise and observe that the vertical columns are blanked, starting with the most significant bit.

8. Rotate the COLUMN BLANKING control fully clockwise and note that the least significant bit column remains on the CRT.

9. Rotate the COLUMN BLANKING control fully counterclockwise.

10. Set trigger mode to START DSPL and observe that the first word is intensified.

11. Set trigger mode to END DSPL and note that the last word is intensified.

12. Set DELAY ON/OFF to ON. Setting the DELAY thumbwheels from 0 to 15 will move the intensified word on the display. For delays greater than 15, the intensified word will not be displayed.

In the following example, we will show how you can use Option 101 in logic state and electrical analysis to find the location of a fault in digital program flow.

Since a fault in an algorithmic state machine will cause an erroneous state to exist in the program flow, it is desirable to start troubleshooting using program flow. When you find the fault location, you can more easily find the specific cause using conventional time analysis techniques. With Option 101, the Model 1740A and Model 1607A provide logic state and timing analysis displays.

Assume our algorithmic state machine is a 60-second timer that is terminating its count prematurely. By observing the logic state flow with the Model 1740A and Model 1607A, the premature termination point can easily be found. In this example, the malfunction is at count 25 (see figure 25). In this case we triggered on word 20. Notice the timer proceeded normally until word 24, when it reset to zero.

The Model 1607A supplied an external trigger to the Model 1740A, triggering the time display on the word we selected (word 20). A probe was connected from channel A on the Model 1740A to the least significant bit channel on the timer. Another probe was connected from channel B to the reset line on the timer. By switching the Model 1740A STATE DSPL pushbutton to the off position, we obtained a time display starting with word 20 (see figure 26).

You will notice on channel A the pulses are normal until after word 24. The pulse at word 25 started to go high, but was not completed. Instead, the timer reset and started again at zero. Looking at the reset line on channel B, we see a "glitch" at word 25.
Figure 26. Glitch on Timer Reset Line Causing

Transistors and fuses, and interlocked inputs, outputs, and control lines for
delay to switch from logic stable to electrical unstable
In this example, you can see the advantage of behind

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Least Significant Bit

Model 1740A