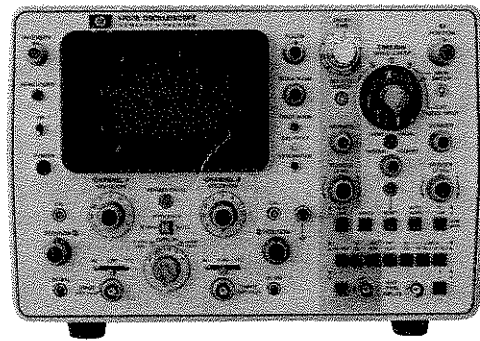


OSCILLOSCOPE

1707B



HEWLETT  PACKARD



OPERATING AND SERVICE MANUAL

**MODEL 1707B
OSCILLOSCOPE**

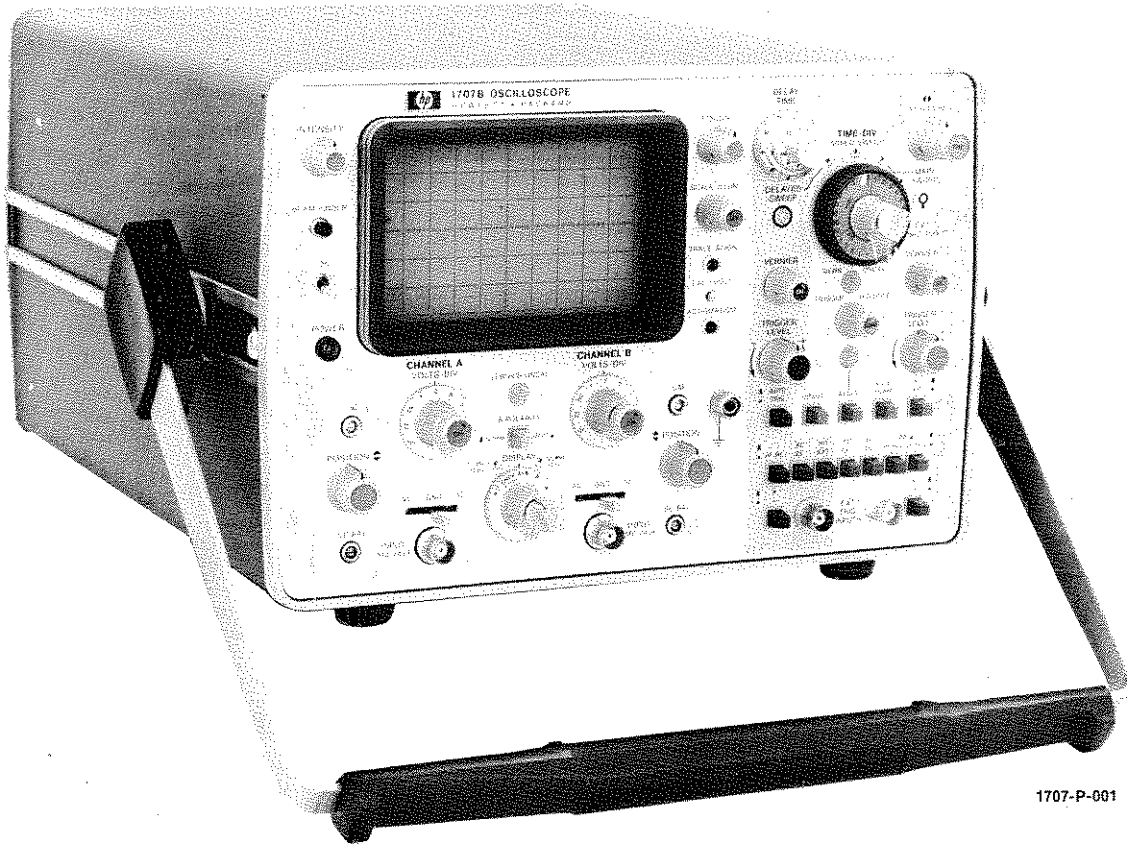
SERIALS PREFIXED: 1410A

Refer to Section VII for instruments with the following standard options: **002, 007, 011, 012, 015, 602, 607, 611** and **631**.

HEWLETT-PACKARD COMPANY/COLORADO SPRINGS DIVISION
1900 GARDEN OF THE GODS ROAD, COLORADO SPRINGS, COLORADO, U.S.A.

Manual Part Number 01707-90916
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1707-P-001

Figure 1-1. Model 1707B Oscilloscope

SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. This manual provides operating and service information for the Hewlett-Packard Model 1707B Oscilloscope (figure 1-1). This manual is divided into eight sections, each covering a specific topic or aspect of the instrument. All schematics are located at the rear of the manual. Also located at the rear of the manual are instruction cards located in an envelope attached to the inside back cover. These cards explain the function of each instrument control. The card is designed to fit the inside lid of the front panel storage cover.

1-3. This section contains a description of Model 1707B. Instrument specifications are listed in table 1-1. Table 7-2 lists the options available for Model 1707B.

1-4. DESCRIPTION.

1-5. INTRODUCTION.

1-6. The Model 1707B is a general-purpose, wide-band oscilloscope designed for bench or field service. The Model 1707B operates from an ac line, dc line or optional battery pack. The optional rechargeable nickel cadmium batteries provide up to 4½ hours of operation and require a recharge time of approximately 14 hours. A carrying handle provides ease of transportation and is adjustable, allowing the Model 1707B to be placed at an angle for viewing the CRT.

1-7. VERTICAL CIRCUITS.

1-8. Vertical bandwidth is 75 MHz with a rise time less than 4.7 ns. Maximum vertical deflection factor is 10 mV/div. The Model 1707B contains two identical vertical amplifiers for single or dual channel operation. Each channel offers a choice of ac or dc coupling. Common mode rejection is at least 40 dB at 10 mV/div, and 20 dB for the rest of the deflection ranges.

1-9. Nine calibrated switch settings provide a deflection factor range from 10 mV/div to 5 V/div in a 1, 2, 5 sequence. The vertical verniers permit continuous adjustment between calibrated steps and extend the least sensitive deflection factor (5 V/div) to at least 12.5 V/div.

1-10. With the dual-trace feature, displays can be obtained on either channel A or B, channels A and B together, channels A + B, and channels A — B. Simultaneous display of two signals is possible in either chop or alternate mode of operation. During chop operation, channels are switched at an approximate rate of 400-kHz during each sweep. In the alternate mode of operation, the signal applied to each channel is displayed on alternate sweeps. Triggering is selectable from either A ONLY TRIG or NORM TRIG position. In the NORM TRIG position, the instrument triggers on the displayed signal. In the A ONLY TRIG position, the instrument triggers on the signal applied to channel A.

1-11. HORIZONTAL CIRCUITS.

1-12. The horizontal circuits provide four types of sweep displays. The displays are main sweep, mixed sweep, delayed sweep and external horizontal input.

1-13. Operation of the delayed sweep while in the main sweep mode provides trace intensification. The amount of intensification width depends on the delayed front panel settings. In the delayed mode, the intensified portion is displayed across the entire CRT.

1-14. Sweep speed settings from 0.1 usec/div to 2 sec/div (main sweep) and 0.1 usec/div to 0.2 sec/div (delayed sweep) are available in a 1, 2, 5 sequence. Vernier controls allow continuous adjustment between steps and extend the slowest sweep to 5 sec/div (main sweep) and 0.5 sec/div (delayed sweep). Using the magnifier function, the fastest sweep speed can be expanded to 10 ns/div. The mixed sweep function provides for simultaneous display of an input waveform and an expanded portion of the waveform. The delayed circuits are calibrated, permitting accurate time difference measurements to be made.

1-15. The main and delayed trigger circuits have provisions for either internal or external operation. Choice of trigger coupling is provided; ac/dc, high frequency reject, and low frequency reject. The delayed trigger circuit does not have low frequency reject trigger coupling.

1-16. An external horizontal input allows the use of an external signal to drive the horizontal deflection plates of the CRT.

VERTICAL AMPLIFIERS

MODES OF OPERATION: channel A; channel B; channels A and B displayed alternately on successive sweeps (alt); channels A and B displayed by switching between channels at approximately 400-kHz rate with blanking during switching (chop); channel A + channel B (algebraic addition).

EACH CHANNEL (2)

Bandwidth: (Direct or with Model 10006B probe, 3-dB down from 50-kHz, 6-div reference signal from terminated 50-ohm source.)

DC-COUPLED: dc to 75 MHz.

AC-COUPLED: lower limit is approximately 10 Hz.

Risetime: <4.7 ns direct or with Model 10006B probe, 10% to 90% points with 6 div input step from terminated 50-ohm source.

DEFLECTION FACTOR

Ranges: from 10 mV/div to 5 V/div (9 ranges) in 1, 2, 5 sequence; $\pm 3\%$ accuracy with vernier in calibrated position.

Vernier: continuously variable between all ranges, extends maximum deflection factor to at least 12.5 V/div.

Polarity: NORM or INVT selectable on channel B.

Signal Delay: input signals are delayed sufficiently to view leading edge of input signals without advanced external trigger.

Input RC: 1 megohm $\pm 2\%$, shunted by approximately 24 pF.

Input Coupling: AC, DC or GND selectable. GND position disconnects signal input and grounds amplifier input.

MAXIMUM INPUT

AC-coupled: $\pm 600\text{V}$ (dc + pk ac); rms ac $< 350\text{V}$, 5 V/div to 20 mV/div; $< 150\text{V}$ at 10 mV/div (10 kHz or less).

DC-coupled: $< 350\text{V}$ (rms) 5 V/div to 20 mV/div; $< 150\text{V}$ at 10 mV/div (10 kHz or less).

A + B OPERATION

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

Common Mode (A — B)

FREQUENCY: dc to 1 MHz.

REJECTION RATIO: at least 40 dB on 10 mV/div; at least 20 dB on all other ranges with verniers set for optimum rejection. Common-mode signal amplitude equivalent to 30 div.

TRIGGERING

Normal Trigger: on displayed signal.

A only trigger: on signal from channel A.

MAIN TIME BASE**SWEEP**

Ranges: from 0.1 usec/div to 2 sec/div (23 ranges) in 1, 2, 5 sequence; $\pm 3\%$ accuracy with vernier in calibrated position.

Vernier: continuously variable between all ranges, extends slowest sweep to at least 5 sec/div; vernier uncalibrated light indicates when vernier is not in CAL position.

Magnifier: expands all sweep by factor of 10 and extends fastest sweep to 10 ns/div; accuracy $\pm 5\%$ (including 3% accuracy of time base).

SWEEP MODE

Normal: sweep is triggered by internal or external signal.

Automatic: bright baseline displayed in absence of input signal; triggering is same as normal above 40 Hz.

Single: in normal mode, sweep occurs once with same triggering as normal; reset pushbutton arms sweep and lights indicator; in auto mode, sweep occurs once each time RESET pushbutton is pressed.

TRIGGERING

Internal: dc to 35 MHz on signals causing 0.5 div or more vertical deflection, increasing to 1 div at 75 MHz in all display modes except chop; dc to 400 kHz in chop mode.

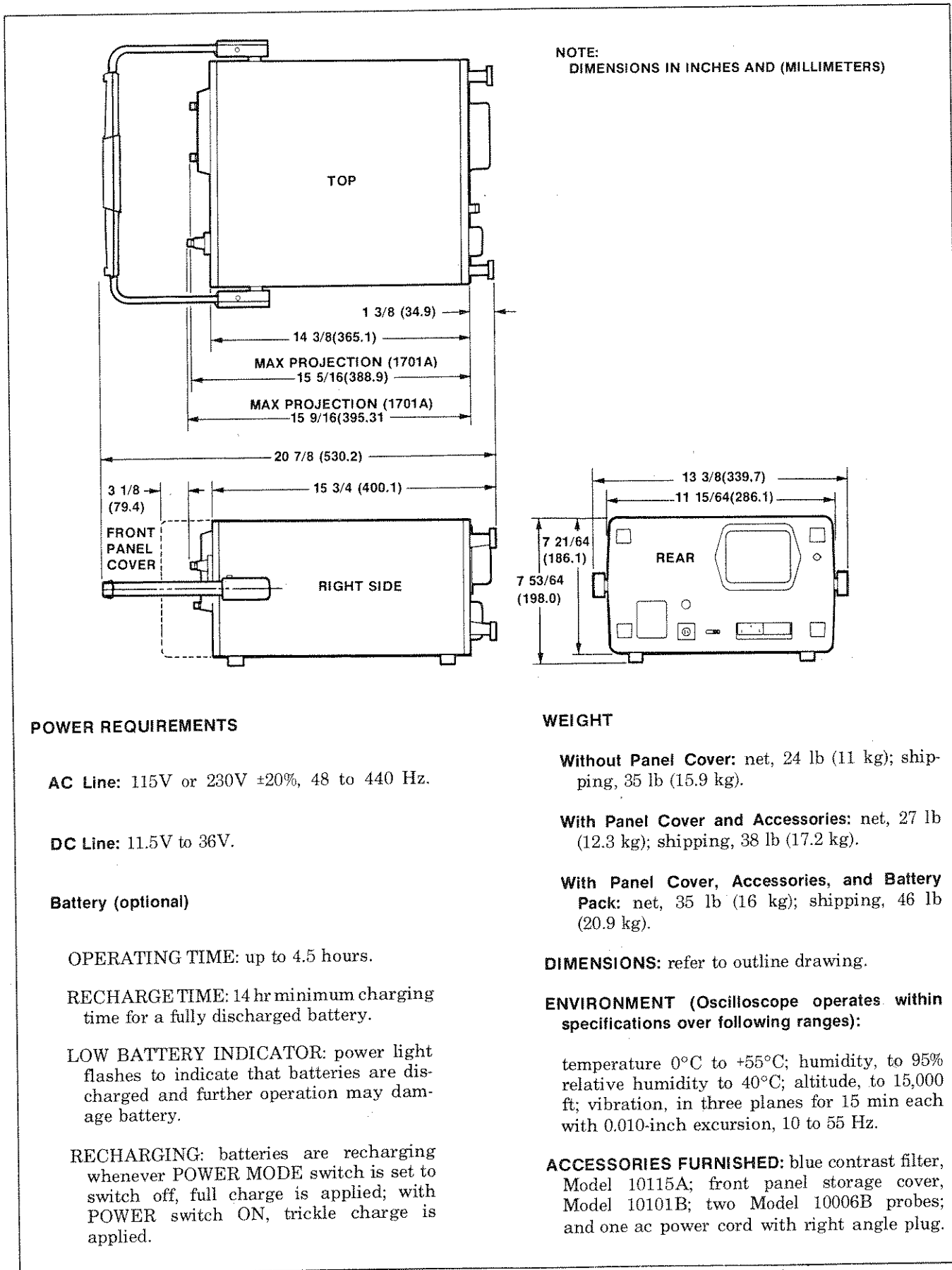
External: dc to 35 MHz on signals 50 mV p-p or more, increasing to 100 mV p-p at 75 MHz.

External Input RC: approximately 1 megohm shunted by approximately 27 pF.

Table 1-1. Specifications (Cont'd)

Level and Slope	Coupling: selectable, AC, DC, or HF REJ. AC attenuates signals below approximately 20 Hz. HF REJ attenuates signals above approximately 30 kHz.
INTERNAL: at any point on vertical waveform displayed. EXTERNAL: continuously variable from +1.2V to -1.2V on either slope of trigger signal. Maximum input, $\pm 100V$.	DELAY (Before start of delayed sweep.)
Coupling: AC, DC, LF REJ, or HF REJ.	Time: continuously variable from 0.1 usec to 2 sec.
AC: attenuates signals below approximately 20 Hz.	Time Jitter: <0.005% (1 part in 20,000) of maximum delay in each sweep.
LF REJ: attenuates signals below approximately 15 kHz.	Calibrated delay Accuracy: $\pm 1\%$; linearity, $\pm 0.2\%$.
HF REJ: attenuates signals above approximately 30 kHz.	MIXED SWEEP
TRIGGER HOLDOFF: time between sweeps continuously variable.	Combines main and delayed sweeps into one display. Sweep is started by main time base and is completed by faster delayed time base.
DELAYED TIME BASE	EXTERNAL HORIZONTAL INPUT
TRACE INTENSIFICATION: intensifies that part of main time base to be expanded to full screen in delayed time base mode. Rotating time base switch from OFF position activates intensified mode.	BANDWIDTH: dc to 1 MHz.
SWEEP	COUPLING: dc.
Ranges: 0.1 usec/div to 0.2 sec/div (20 ranges) in 1, 2, 5 sequence; $\pm 3\%$ with vernier in calibrated position.	DEFLECTION FACTOR: X1; 1 V/div.
Vernier: continuously variable between all ranges, extends slowest sweep to 0.5 sec/div.	X10; 0.1 V/div.
Magnifier: expands all sweeps by a factor of 10 and extends fastest sweep to 10 ns/div; accuracy $\pm 5\%$ (including 3% accuracy of time base).	VERNIER: 10:1 vernier provides continuous adjustment between ranges.
SWEEP MODE	DYNAMIC RANGE: beam may be positioned to left edge of CRT with 0 to -5V input.
Trigger: delayed sweep is armed at end of delay period.	MAXIMUM INPUT: $\pm 100V$.
Auto: delayed sweep is automatically triggered at end of delay period.	INPUT RC: 1 megohm shunted by approximately 30 pF.
TRIGGERING	CATHODE-RAY TUBE AND CONTROLS
Internal: same as main time base.	TYPE: post-accelerator, 22.2-kV accelerating potential; aluminized P31 phosphor (other phosphors available, refer to options).
External: same as main time base. Input RC is approximately 1 megohm shunted by approximately 27 pF.	GRATICULE: 6 X 10 div internal graticule; each major division consists of 5 subdivisions on major axes; 1 div = 1 cm.
Level and Slope	TRACE ALIGN: aligns trace with horizontal graticule line.
INTERNAL: at any point on vertical waveform displayed.	BEAM FINDER: returns trace to CRT regardless of settings of vertical, horizontal, or intensity controls.
EXTERNAL: continuously variable from +1.2V to -1.2V on either slope of trigger signal.	INTENSITY MODULATION: +4V, dc to 1 MHz, blanks trace of any intensity. Input R equals 1000 ohms $\pm 10\%$. Maximum Input: 10V (dc plus pk ac).
	GENERAL
	CALIBRATOR
	Type: 1 kHz $\pm 10\%$ square wave.
	Voltage: 1V p-p $\pm 1\%$.

Table 1-1. Specifications (Cont'd)



1-17. CATHODE-RAY TUBE.

1-18. The Model 1707B uses a post-accelerator CRT with a nonglare, rectangular faceplate. An internal graticule is located on the same plane as the display to eliminate parallax errors. The CRT has approximately 22-kV accelerating potential, and 6 vertical by 10 horizontal divisions. Each division is a square centimeter.

1-19. A type P31 phosphor is used in the standard CRT. Other types of phosphors are available by special order. Refer to Section VII for further information about optional and special-order modifications.

NOTE

Due to phosphor burn sensitivity, instruments with a P-11 phosphor do not have the intensified function of the beam finder.

1-20. WARRANTY.



The warranty may be void for instruments having a mutilated serial number tag.

1-21. The instrument is certified and warranted as stated in the front of this manual. The CRT is covered by a separate warranty. The CRT warranty and warranty claim form is located at the rear of this manual. Should the CRT fail within the time specified on the CRT warranty page, complete the warranty claim form and return it with the defective CRT. The procedure for returning a defective CRT is described on CRT warranty page.

1-22. ACCESSORIES FURNISHED.

1-23. Accessories furnished are listed in table 1-1.

1-24. ACCESSORIES AVAILABLE.

1-25. Table 1-2 lists accessories available for the Model 1707B. The service kit (figure 1-3) is recommended to maintain the Model 1707B.

1-26. INSTRUMENT AND MANUAL IDENTIFICATION.

1-27. This manual applies directly to Model 1707B instruments with a serial prefix number as listed on the manual title page. The serial prefix number is the first group of digits in the instrument serial number (figure 1-2). The instrument serial number is on a tag located on the rear panel.

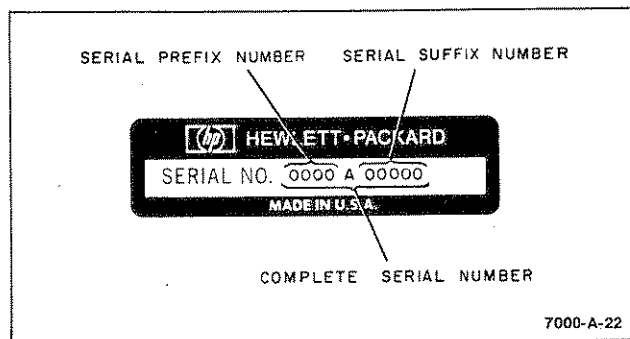


Figure 1-2. Instrument Serial Number

1-28. Check the serial prefix number of the instrument. If the serial prefix number is different from that listed on the title page of this manual, refer to Section VII for instructions to adapt this manual for proper instrument coverage.

1-29. Technical corrections to the manual are listed under errata on an enclosed MANUAL CHANGES sheet (if any).

1-30. INQUIRIES.

1-31. Refer any questions regarding the manual, the change sheet or the instrument to the nearest HP Sales/Service Office. Always identify the instrument by model number, complete name and complete serial number in all correspondence. Refer to the rear of the manual for a world-wide listing of HP Sales/Service Offices.

Table 1-2. Model 1707B Accessories Available

Accessory No.	Description
HP Model 10102A	RFI Contrast Screen
HP Model 10103B	Battery Pack
HP Model 10104A	Viewing Hood (collapsible)
HP Model 10105A	Testmobile Adapter
HP Model 10106A	Camera Adapter
HP 01701-68701	Service Kit; contains three extender boards and one board puller.
HP Model 10036A	Probe Adapter Kit: probe tips contained in kit are designed for use with probes supplied with 1700-series oscilloscopes.

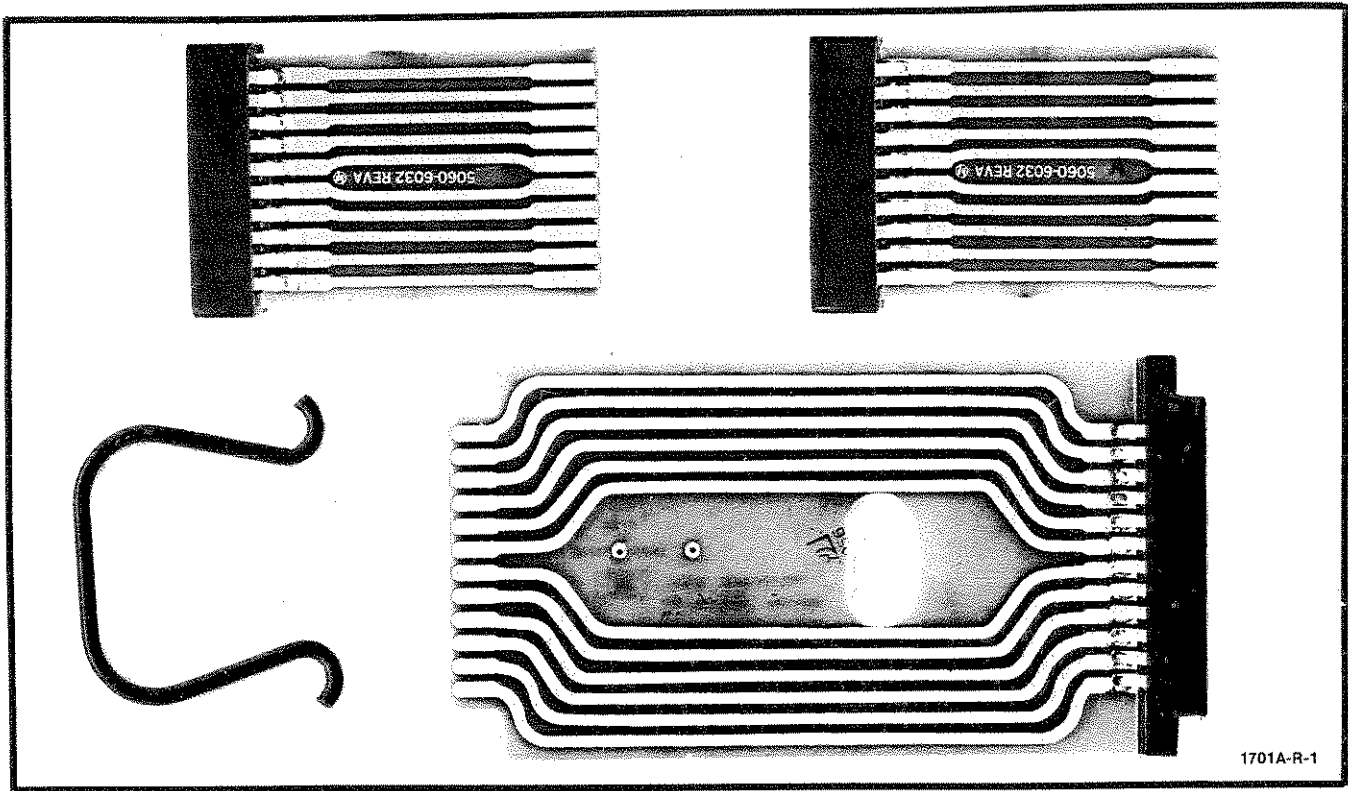


Figure 1-3. Service Kit for HP 1700-series Oscilloscopes

SECTION II

INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains instructions for performing an initial inspection of the Model 1707B. Installation procedures and precautions are presented in step-by-step order. The procedures for making a claim for warranty repairs and for repacking the instrument for shipment are also described in this section.

2-3. INITIAL INSPECTION.

2-4. The instrument was inspected mechanically and electrically before shipment. Upon receipt, inspect it for damage that may have occurred in transit. Check for broken knobs, bent or broken connectors, and dents or scratches. If damage is found, refer to the claims paragraph in this section. Retain the packing material for possible future use.

WARNING

Voltages are present inside instrument when power switch is off and ac power cord connected.

2-5. Check the electrical performance of the instrument immediately after receipt. Refer to Section V for the performance check procedure. The performance check will determine whether or not the instrument is operating within the specifications listed in table 1-1. Initial performance and accuracy of the instrument are certified as stated in the front of this manual. If the instrument does not operate as specified, refer to the claims paragraph in this section.

2-6. PREPARATION FOR USE.

2-7. POWER REQUIREMENTS.

2-8. The Model 1707B can operate from either an ac or dc power source. For ac operation, the Model 1707B requires 115- or 230-volt $\pm 20\%$, single phase, 48- to 440-Hz source that can deliver 50 volt-amperes.

2-9. A slide switch inside the rear panel power module (figure 2-1), on the rear panel, determines 115- or 230-volt operation. To check or change the position of this slide switch, proceed as follows:

- a. Turn instrument off and remove power cord from rear panel.
- b. Move plastic cover to left (figure 2-1).

c. Pull out lever under fuse. This removes fuse (0.5 AT for 115V operation) from instrument.

d. Check to see that slide switch (figure 2-1) is to right for 115V operation.

e. For 230V operation, move slide switch to left and install 0.25 AT fuse.

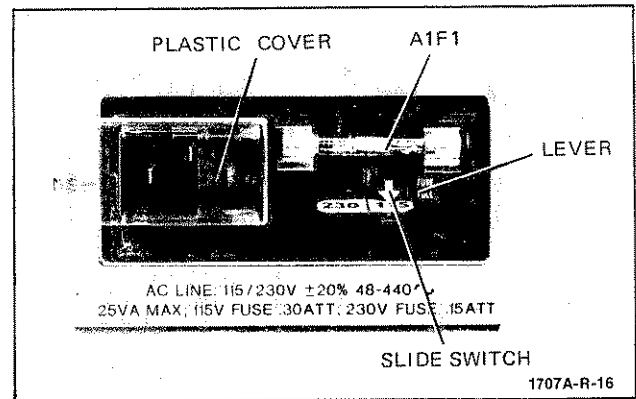


Figure 2-1. Rear Panel Power Module

2-10. For dc operation, the Model 1707B requires from 11.5 to 36 volts, 25 watts maximum. The 2 amp dc line fuse (F1) must be replaced with a 3 amp fuse for DC LINE operation. The instrument can also be operated from a battery pack. Depending on the power mode of operation, the POWER MODE switch (on rear panel) should be set to one of three positions: DC LINE, INTERNAL BATTERY, or AC LINE.

CAUTION

Do not change the POWER MODE switch setting with the instrument on or with ac or dc power applied to the rear panel.

- a. Turn instrument power off.
- b. Disconnect ac or dc power cord from rear panel.
- c. Set POWER MODE switch to desired position.
- d. Connect ac or dc power cord if desired.
- e. Turn instrument power on.

2-11. THREE-CONDUCTOR AC POWER CABLE.

2-12. For the protection of operating personnel, Hewlett-Packard Company recommends that the instrument panel and cabinet be grounded. This in-

strument is equipped with a three-conductor ac power cable that, when connected to an appropriate receptacle, grounds the instrument through the offset pin. The power jack and mating plug of the power cord meet International Electro-technical Commission (IEC) safety standards. To preserve this protection feature when operating from a two-contact outlet, use a three-conductor to two-conductor adapter, and connect the adapter wire to ground at the power outlet.

2-13. DC PLUG.

2-14. A dc jack is provided for operating from a dc line. The cable used for the dc power cord should be 2 wire (grounded) and must be able to carry 2.5A of current with a voltage loss of less than 1 volt.

2-15. BATTERY INSTALLATION.

2-16. To install the battery pack in the Model 1707B, proceed as follows:

CAUTION

Read operating note on battery pack before installation.

- a. Turn instrument off and remove power cord from rear of instrument.
- b. Move POWER MODE switch to INTERNAL BATTERY position.
- c. Turn instrument on its top and loosen fasteners holding bottom cover.
- d. Remove bottom cover.
- e. Place battery pack in instrument as shown in figure 2-2.

NOTE

Use only HP Model 10103B Battery Pack with the Model 1707B.

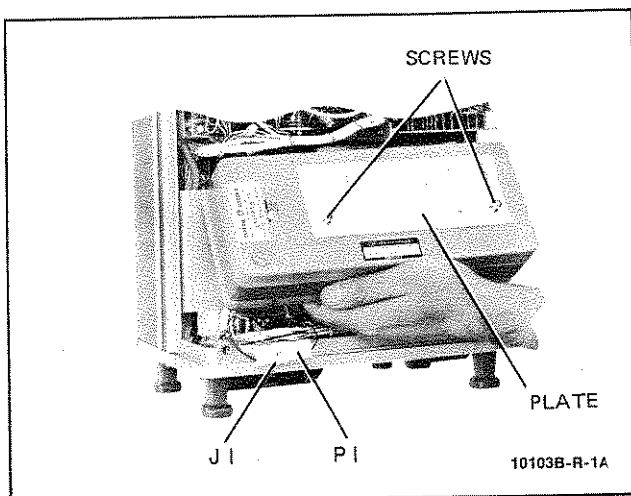


Figure 2-2. Battery Pack Installation

- f. Install two battery screws (figure 2-2).
- g. Connect P1 to J1 (figure 2-2).
- h. Replace bottom cover and tighten fasteners.
- i. Turn instrument right side up.

CAUTION

If power light is flashing, battery is discharged. Damage to the battery may occur if operated in this condition. Refer to Section III for battery recharging operation.

- j. Turn instrument on and observe power light. If power light is on, resume normal operation.

2-17. CLAIMS

2-18. The warranty statement applicable to this instrument is printed in the front of this manual. Refer to the front of this manual for the CRT warranty statement also. If physical damage is found or if operation is not as specified when the instrument is received, notify the carrier and the nearest Hewlett-Packard Sales/Service Office immediately (refer to the list in back of this manual for addresses). The HP Sales/Service Office will arrange for repair or replacement without waiting for settlement of the claim with the carrier.

2-19. REPACKING FOR SHIPMENT.

2-20. If the Model 1707B is to be shipped to a Hewlett-Packard Sales/Service Office for service or repair, attach a tag showing owner (with address), complete instrument serial number, and a description of the service required.

2-21. Use the original shipping carton and packing material. If the original packing material is not available, the HP Sales/Service Office will provide information and recommendations on materials to be used. Materials used for shipping an instrument normally include the following:

- a. A double-walled carton with a test strength of about 300 lb.
- b. Heavy paper or sheets of cardboard to protect all instrument surfaces; use a nonabrasive material such as polyurethane or cushioned paper such as Kimpak around projecting parts.
- c. At least 4 inches of tightly-packed, industry-approved, shock-absorbing material such as extra-firm polyurethane foam.
- d. Heavy-duty shipping tape for securing outside of carton.

SECTION III

OPERATION

3-1. INTRODUCTION.

3-2. This section provides general operating instructions and applications information for the Model 1707B. Front-and rear-panel controls and connectors are identified and briefly described in figure 3-1. Operational adjustments are shown in figures 3-3 and 3-4 and general operating instructions are shown in figures 3-5 through 3-7.

3-3. CONTROLS AND CONNECTORS.

3-4. The following paragraphs explain some of the controls and connectors in detail.

3-5. BEAM FINDER.

3-6. Pressing this pushbutton increases intensity and reduces amplifier gain enough to return beam to viewing area. This enables the operator to locate beam and determine the action necessary to center a display (examples: reduce input signal amplitude, change coupling, adjust deflection factor, trigger level, dc balance, position controls, or intensity). When centered properly, the beam remains on the CRT when the pushbutton is released.

NOTE

Due to phosphor burn sensitivity, instruments with a P11 phosphor do not have the intensified function of the beam finder.

3-7. SCALE ILLUMINATION.

3-8. This control adjusts the overall brightness of the CRT graticule. It should be adjusted for good contrast between the background and graticule. The SCALE ILLUM control is especially useful when using a hood to view the display or when photographing waveforms. Rotate the control to OFF when scale illumination is not needed.

3-9. TRACE ALIGN.

3-10. The TRACE ALIGN adjustment compensates for external magnetic fields that may affect the alignment of the horizontal trace with the graticule. The alignment should be checked when the instrument is moved to a new location and adjustment made whenever necessary.

3-11. CALIBRATOR.

3-12. The 1-volt, 1-kHz square wave output of the calibrator can be used for vertical sensitivity calibration and for divider probe compensation. The amplitude accuracy is $\pm 1\%$ and the frequency accuracy is $\pm 10\%$.

3-13. FOCUS AND ASTIGMATISM.

3-14. Both of these controls are used to obtain a sharp display. Normally, the ASTIGMATISM control need not be readjusted once it is set.

3-15. COUPLING.

3-16. This lever switch selects either capacitive (AC) or direct (DC) coupling of the input signal to the amplifier, or it grounds (GND) the amplifier input stage while disconnecting the input signal. The switch should be positioned to DC when viewing long duration pulses or dc levels of waveforms. AC should be selected when viewing ac waveforms having large dc levels. GND position is used to disconnect the signal source from the input of the amplifier and at the same time grounds the input of the amplifier. It is useful to use GND position to establish a zero volt reference.

3-17. DISPLAY.

3-18. This switch selects the type of display. Input signals may be displayed either singly or simultaneously as explained below.

3-19. Position A displays channel A input signals.

3-20. Position B displays channel B input signals.

3-21. Position A+B displays the algebraic sum of the channel A and channel B input signals.

3-22. CHOP position presents a separate display of each input. Both inputs are displayed during the same sweep by switching between each channel at a rate of 400 kHz. This mode should be used to display low frequency signals. A ONLY TRIG should be used in the CHOP mode for stable triggering.

3-23. ALT position presents each channel on alternate sweeps. This mode should be used to display high frequency signals. If the channel A and B signals are time related, A ONLY TRIG will provide

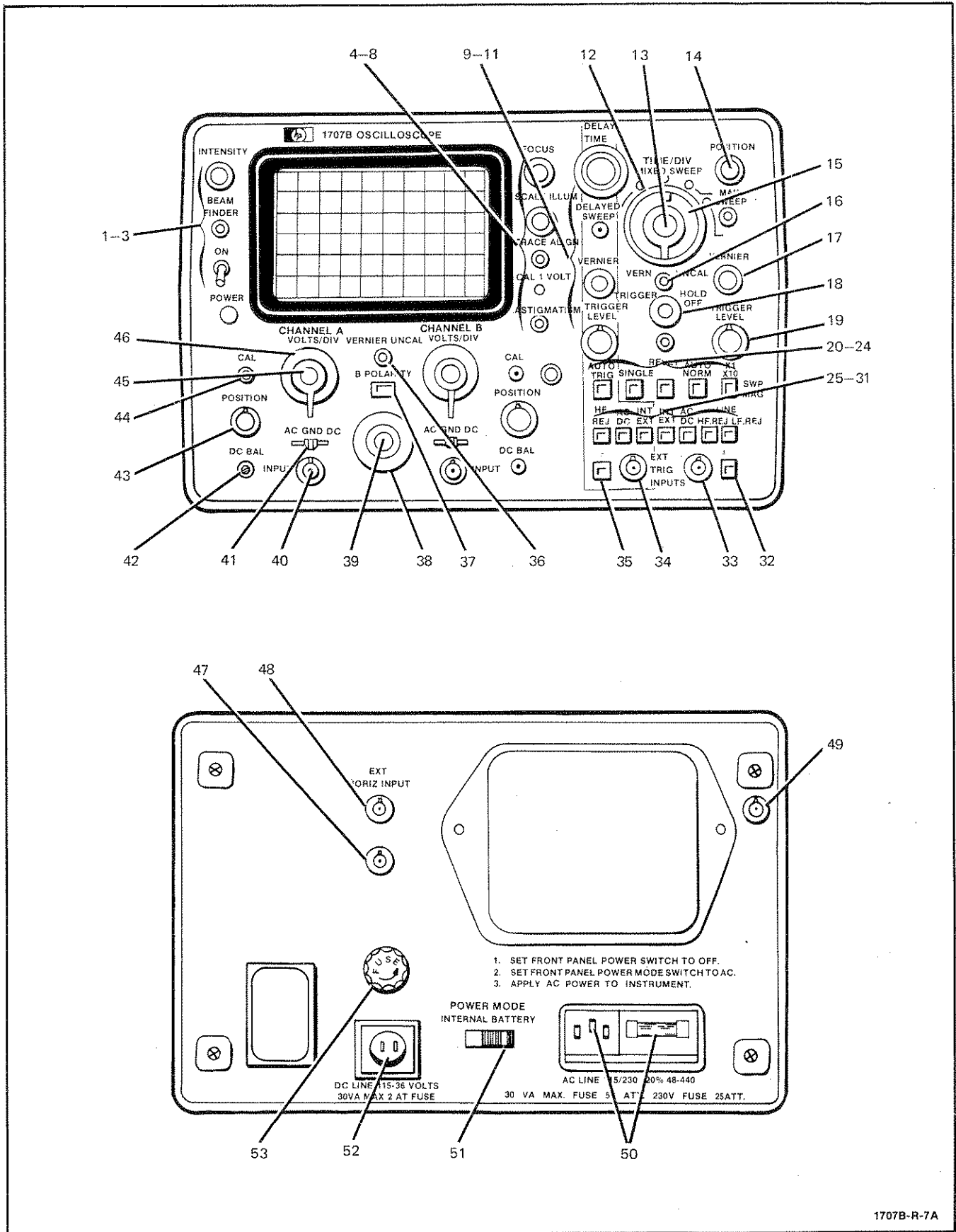


Figure 3-1. Controls and Connectors

1. INTENSITY. Controls brightness of display.
 2. BEAM FINDER. Returns display to viewing area.
 3. POWER-ON. Toggle switch for turning oscilloscope on and off. Light illuminates when power is on. Light flashes when optional battery is discharged.
 4. FOCUS. Adjusts writing beam for sharpest trace.
 5. SCALE ILLUM. Controls brightness of scale illumination.
 6. TRACE ALIGN. Adjust to align trace with horizontal graticule line.
 7. CAL 1 VOLT. provides 1-kHz square wave at 1 volt $\pm 1\%$.
 8. ASTIGMATISM. Adjusts roundness of writing spot.
 9. DELAY TIME. Selects time delay between start of main sweep and start of delayed sweep.
 10. delayed VERNIER. Provides continuous control of sweep time between calibrated positions of delayed TIME/DIV switch.
 11. delayed TRIGGER LEVEL. Selects amplitude point on trigger signal that starts delayed sweep.
 12. delayed TIME/DIV. Controls sweep time in DELAYED mode. Controls intensified portion of sweep in MAIN mode.
 13. sweep display. Selects MAIN, DELAYED or MIXED SWEEP, or EXT HORIZ INPUT.
 14. HORIZONTAL POSITION. Controls coarse and fine horizontal position of display.
 15. main TIME/DIV. Controls sweep time in MAIN SWEEP mode.
 16. VERNIER UNCAL. Lights when either main or delayed VERNIER is not in CAL position.
 17. main VERNIER. Provides continuous control of sweep between calibrated positions of main TIME/DIV switch.
 18. TRIGGER HOLDOFF. Provides continuous control of time between sweeps. NORM holdoff time is minimum.
 19. main TRIGGER LEVEL. Selects amplitude point on trigger signal that starts main sweep.
 20. AUTO/TRIG.
 - a. AUTO. Delayed sweep starts automatically at end of delay time.
 - b. TRIG. Delayed sweep arms at end of delay time and is ready to be triggered either internally or externally.
 21. SINGLE. Selects single or normal sweep operation.
 22. RESET. Resets sweep in SINGLE sweep mode; reset light indicates when sweep is armed.
 23. AUTO/NORM.
 - a. AUTO. Automatic sweep in absence of trigger signal or triggered sweep by applying trigger signal above 40 Hz rate.
 - b. NORM. Main sweep is triggered only by applying trigger signal.
 24. SWP MAG. In X10 position, sweep is magnified ten times.
 25. HF REJ. Attenuates delayed sweep trigger signals above 30 kHz.
 26. AC/DC. Selects delayed sweep trigger signal coupling.
 27. INT/EXT. Selects internal or external sweep triggering for delayed sweeps.
 28. INT/EXT. Selects internal or external sweep triggering for main sweep.
 29. AC/DC. Selects main sweep trigger signal coupling.
 30. HF REJ. Attenuates main sweep trigger signals above 30 kHz.
 31. LF REJ. Attenuates main sweep trigger signals below 15 kHz.
- NOTE**
- Depressing both HF REJ and LF REJ selects a LINESYNC mode of triggering.
32. main slope. Selects slope of main trigger signal that starts sweep.
 33. EXT TRIG INPUTS. Main sweep external trigger input.
 34. EXT TRIG INPUTS. Delayed sweep external trigger input.
 35. delayed slope. Selects slope of delayed sweep trigger signal.
 36. VERNIER UNCAL. Lights when either vernier control is out of full clockwise CAL detent position.
 37. B POLARITY. Controls channel B polarity.
 38. DISPLAY. Selects display mode of channel A, B, A+B, CHOP or ALT.
 39. trig.
 - a. A ONLY TRIG. Internal trigger signal is derived from channel A.
 40. INPUT. Input signal connects to BNC connector.
 41. coupling. Selects capacitive (AC) or direct (DC) coupling of input signal, or grounds (GND) amplifier stage.
 42. DC BAL. Adjust to minimize vertical shift of trace when vernier is rotated.
 43. POSITION. Varies vertical position of display.
 44. CAL. Adjust to calibrate amplifier with setting of VOLTS/DIV switch.
 45. vernier. Provides continuous adjustments of volts/div between calibrated positions of VOLTS/DIV switch.
 46. VOLTS/DIV. Selects vertical deflection factor necessary for calibrated measurements
 47. ext horiz VERNIER. Permits 10:1 horizontal amplifier gain.
 48. EXT HORIZ INPUT. Input to external amplifier.
 49. Z AXIS INPUT. Z-axis input connector.
 50. AC LINE. Power input from ac line. Power module contains ac line fuse (0.50 amp slow-blow for 125V, 0.25 amp slow-blow for 230V) and line selector switch.
 51. POWER MODE. Selects dc line, ac line or internal battery operation.
 52. DC LINE. Power input for dc line operation.
 53. FUSE. 2 amp slow-blow fuse for all modes of operation except DC LINE (3 amp used in DC LINE).

the most stable triggering. If the two signals are not time related, then NORM TRIG should be used.

3-24. TRIG.

3-25. This switch selects the signal to be used as the internal trigger signal. In A ONLY TRIG position, the signal on channel A is used as the internal trigger signal. In NORM TRIG position, the instrument triggers on the signal being displayed, except in ALT mode. In ALT mode, the instrument triggers on the composite sync signal and LF REJ trigger coupling should be used to maintain stable triggering.

3-26. B POLARITY.

3-27. This switch inverts the channel B display 180 degrees. This switch can also be used to present an A-B display. Set DISPLAY to A+B mode. Put B POLARITY switch in INVT position. Display observed is A-B.

3-28. SWEEP DISPLAY.

3-29. This switch, mounted concentric to the main and delayed TIME/DIV controls, determines the horizontal sweep display modes. Modes are EXT HORIZ INPUT, MAIN SWEEP, MIXED SWEEP and DELAYED SWEEP. The function of each mode is as follows:

3-30. EXT HORIZ INPUT.

3-31. In this mode, the CRT horizontal plates are driven by an external source.

3-32. MAIN SWEEP.

3-33. In this mode, the main sweep sets a time base reference for the vertical signal. Main sweep controls are mounted on the right side of the front panel, and sweep speed is selected by main TIME/DIV. If delayed TIME/DIV is set to OFF, sweep intensity is uniform. However, any other setting of delayed TIME/DIV causes the sweep to intensify during the time that the delayed sweep is generated. This feature makes it possible to select a point of interest on the main sweep time base before viewing in the delayed sweep mode.

3-34. MIXED SWEEP.

3-35. In this mode, the first portion of signal is referenced to the main time base and the expanded portion is referenced to the delayed time base. Turning the DELAY TIME control varies the amount of display controlled by the delayed time base.

3-36. DELAYED SWEEP.

3-37. Main sweep is not displayed in this mode. The sweep speed is controlled by delayed TIME/DIV.

3-38. TIME/DIV.

3-39. Main and delayed TIME/DIV switches determine the amount of time to sweep horizontally one graticule division. Both switches are concentric and interlocked so the delayed sweep is always faster than the main sweep. Main sweep speeds are selectable by main TIME/DIV in 23 ranges from 0.1 usec/div to 2 sec/div. Twenty ranges of delayed sweep speeds from 0.1 usec/div to 0.2 sec/div are provided by delayed TIME/DIV. By using the SWP MAG switch, a display can be expanded 10 times, increasing the fastest sweep to 10 ns/div.

3-40. VERNIER.

3-41. Sweep speeds are calibrated to the TIME/DIV switch when both the main and delayed VERNIER controls are set fully clockwise to the CAL detent position. As the VERNIER controls are turned counterclockwise, the VERNIER UNCAL indicator lights and sweep speeds decrease. The main VERNIER control extends the slowest sweep to at least 5 sec/div. The vernier controls are useful for making continuous adjustments of sweep speed, however, TIME/DIV readings are uncalibrated.

3-42. TRIGGER LEVEL.

3-43. These controls select the point on the sync signal that starts the sweep. Triggering point is adjustable at any level on the displayed signal in INT position. In the EXT position, the triggering point is adjustable from +1.2V to -1.2V along the sync signal. Delayed TRIGGER LEVEL has no function when AUTO/TRIG is set to AUTO.

3-44. TRIGGER HOLDOFF.

3-45. This adjustment is a dual purpose control. When the control is rotated out of detent position, the first portion of the control acts as a high frequency stability control. This prevents double triggering on high frequency waveforms. As the control is rotated further out of detent position, it functions as a trigger holdoff and allows the instrument to synchronize on complex waveforms.

3-46. SLOPE.

3-47. These switches determine whether the sweep triggers on the positive-going (+) or negative-going (-) portion of the sync signal. When the AUTO/TRIG is set to AUTO, the delayed slope control has no function.

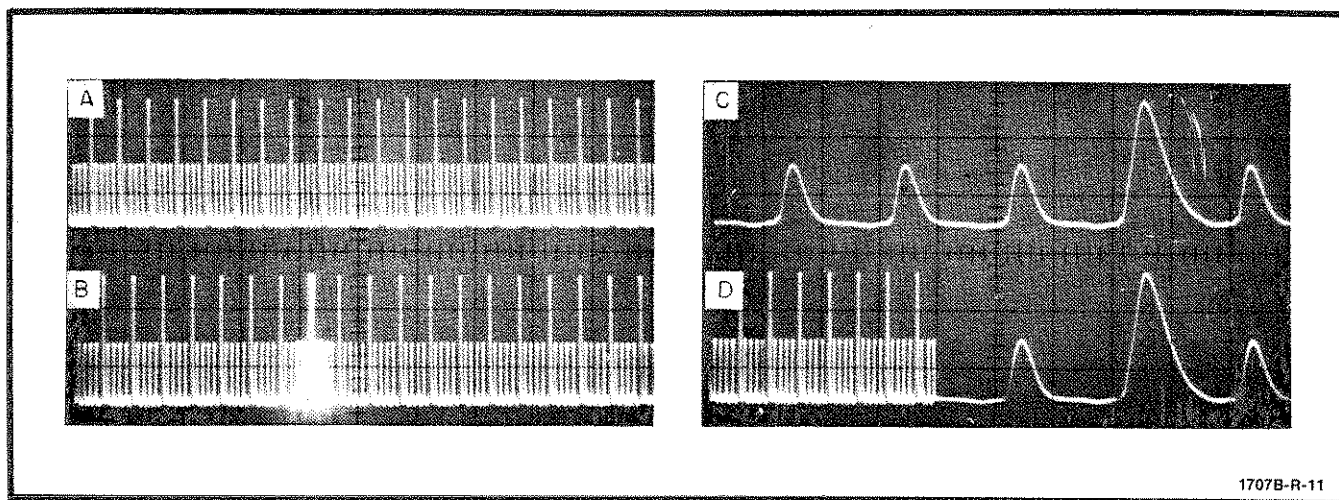


Figure 3-2. Sweep Combinations

3-48. SWEEP MODE.

3-49. This group of switches selects the type of main and delayed sweep triggering. Main sweep free runs in AUTO, giving a bright base line in the absence of a sync signal. However, if a sync signal of 40 Hz or greater is applied, it overrides free-run operation and triggers the sweep. Due to the presence of a base line, the auto sweep mode can be used for most applications. Use NORM if the sync signal is erratic or is less than 40 Hz. The sync input signal is always needed in NORM to generate a sweep. When the SINGLE pushbutton is engaged, the sweep is generated only once. To sweep again, push RESET pushbutton and release. This arms the sweep circuit. This feature is particularly useful for viewing or photographing single transient waveforms.

3-50. When AUTO/TRIG is set to AUTO, the delayed sweep starts at the end of the delay time. When AUTO/TRIG is set to TRIG, the delayed sweep is started by the first sync signal after the delay time.

3-51. TRIGGER SELECTION.

3-52. Main and delayed trigger source is selected by this group of switches. In the INT position, sweep is synchronized to the vertical deflection signal. When EXT is selected, the sweep is triggered by sync signals applied to the EXT TRIG INPUTS connector.

3-53. The trigger coupling switches determine the type of main and delayed sync coupling. Direct coupling (DC) is normally used for sync signals from dc to less than 20 Hz. Capacitive coupling (AC) blocks the dc component of a sync signal and passes only the ac component. AC coupling does, however, attenuate signals below 20 Hz. The LF REJ switch attenuates signals below approximately 15 kHz and is used, for example, to prevent power line or other low frequency signals from triggering the sweep. The delayed trigger circuits do not have a LF REJ switch.

The HF REJ switch attenuates signals above approximately 30 kHz and can be used to prevent high frequency noise from triggering the sweep.

3-54. MAGNETIC INTERFERENCE.

3-55. The CRT is provided with a mu-metal shield for protection against magnetic fields. Due to the sensitivity of the CRT, it is possible that strong magnetic fields from nearby motors, ac line transformers, etc., may still result in noticeable beam deflection. In this event, reorient or relocate the instrument with respect to the interfering device.

3-56. BATTERY RECHARGE OPERATION.**NOTE**

Use only the HP Model 10103B Battery Pack with the Model 1707B.

3-57. To recharge Model 10103B Battery Pack, proceed as follows:

- a. Set front panel POWER switch to off.
- b. Set rear panel POWER MODE switch to AC LINE.
- c. Connect ac power to the instrument. This sends 400 milliamperes of charge current to the battery. Recharge time is approximately 14 hours. (With the ac POWER switch set to ON, a trickle charge of approximately 40 mA is applied to the battery.)

3-58. PREOPERATIONAL ADJUSTMENTS.**3-59. INITIAL TURN-ON.**

3-60. To place the Model 1707B into operation, perform the following steps:

- a. Set INTENSITY to full counterclockwise.

- b. Set vertical POSITION A and B to midrange.
- c. Set DISPLAY to desired mode of operation.
- d. Set VOLTS/DIV to 5V.
- e. Set channel A and B verniers to CAL detent.
- f. Place B POLARITY to NORM.
- g. Set vertical coupling channel A and B to GND.
- h. Set HORIZONTAL POSITION to midrange.
- i. Set main TIME/DIV to 1 mSEC.
- j. Set delayed TIME/DIV to OFF.
- k. Set main and delayed VERNIER to CAL detent.
- l. Set main AUTO/NORM to AUTO.
- m. Set main INT/EXT to INT.
- n. Set sweep display to MAIN sweep.



Verify proper position of POWER MODE switch located on rear panel.

- o. Apply operating power and allow 15 minutes warmup time.
- p. Set INTENSITY so that trace is just visible.
- q. Connect signal(s) and proceed with measurements.

3-61. FOCUS AND ASTIGMATISM ADJUST.

3-62. To adjust FOCUS and ASTIGMATISM proceed as follows:

- a. Set all pushbuttons out.
- b. Set Model 1707B channel A controls as follows:
 - VOLTS/DIV01
 - DISPLAY A
 - POSITION center trace on CRT
- c. Set main TIME/DIV to .2 SEC.
- d. Turn main vernier full ccw.
- e. Set INTENSITY to observe dot.
- f. Adjust FOCUS and ASTIGMATISM controls for best defined dot, as dot moves slowly across CRT.

3-63. OPERATING PROCEDURES.

3-64. Figure 3-5 through 3-7 are operating plates containing step-by-step operating procedures indexed to photographs.

3-65. OPERATORS PERFORMANCE CHECK.

3-66. The operation of the Model 1707B may be checked without use of additional test equipment by using the CAL 1 VOLT output as a signal source. These operating tests will functionally check each of the display modes and the front-panel controls. To check specifications listed in table 1-1, refer to Section V for performance checks. The operation check must be performed in the sequence given. Do not attempt to start a procedure in mid-sequence, as succeeding steps depend on control settings and results of previous steps. If any of the results are unobtainable, refer to Section V, Performance Checks and Adjustment Procedure, or Section VIII, Schematics and Troubleshooting.

a. Set Model 1707B controls as follows:

channel A VOLTS/DIV02
channel A coupling	A
channel A vernier	CAL
DISPLAY	A
trig	A ONLY TRIG
B POLARITY	NORM
main VERNIER	CAL
delayed VERNIER	CAL
sweep display	MAIN SWEEP
main TIME/DIV5 mSEC
delayed TIME/DIV	OFF
DELAY TIME	3.00
AUTO/NORM	AUTO
AUTO/TRIG	AUTO
main INT/EXT	INT
delayed INT/EXT	INT
delayed slope	+
main slope	+
main TRIGGER LEVEL	as required
	for stable triggering
TRIGGER HOLDOFF	NORM
SWP MAG	X1

- b. Set INTENSITY, FOCUS and POSITION controls for desired display in center of screen.
- c. Connect CAL 1 VOLT output to channel A INPUT using the X10 probe.
- d. Adjust main TRIGGER LEVEL for stable display. Observe approximately 5 positive-going pulses with an amplitude of 5 div.
- e. Set delayed TIME/DIV to .2 mSEC. Observe intensified portion of sweep.

NOTE

Intensified portion should cover 4 to 5 divisions.

f. Adjust DELAY TIME until intensified portion is centered on CRT.

g. Set sweep display switch to DELAYED SWEEP. Observe that intensified portion is expanded to full 10 divisions.

h. Set sweep display switch to MAIN SWEEP.

i. Vary DELAY TIME control. Observe that intensified portion moves smoothly along display.

j. Set delayed AUTO/TRIG control to TRIG.

k. Adjust delayed TRIGGER LEVEL for stable intensified portion of the trace.

l. Vary DELAY TIME control. Observe that leading edge of intensified portion jumps from one positive slope leading edge to next.

m. Set delayed TIME/DIV to OFF.

n. Rotate main VERNIER counterclockwise to stop. Observe 15 or more pulses between first and eleventh graticule lines.

o. Disconnect calibrator signal from vertical amplifier.

p. Set main TIME/DIV to .1 SEC.

q. Set main TRIGGER LEVEL to full clockwise position.

r. Set main AUTO/NORM to NORM.

s. Select SINGLE operation.

t. Press RESET pushbutton. Reset indicator should go on. Observe no sweep.

u. Rotate main TRIGGER LEVEL to full counterclockwise position. Observe one sweep and reset indicator goes off after sweep.

v. Set AUTO/NORM to AUTO.

w. Press RESET pushbutton. Observe one sweep.

3-67. OPERATING INFORMATION.

3-68. The following paragraphs provide additional information concerning the use of some specific functions.

3-69. AUTO VERSUS NORM.

3-70. In AUTO operation, there will always be a base line. A trigger signal of 40 Hz or higher overrides AUTO operation and produces a stable presentation. Adjustment of main TRIGGER LEVEL may be necessary for a stable display. If the trigger is less than 40 Hz, or if it is unstable, NORM operation should be used. A trigger signal is always needed in NORM operation to generate a sweep.

3-71. AUTO VERSUS TRIG.

3-72. Auto delayed sweep operation is achieved when AUTO/TRIG pushbutton is out. This causes the delayed sweep to start at the end of delayed time as set by the DELAY TIME control.

3-73. AC VERSUS DC.

3-74. Ac coupling removes the dc level of trigger signals operations. Use of the LF REJ control prevents low frequency noise from triggering the sweep.

3-75. MIXED SWEEP.

3-76. In this mode, the first part of the presentation is displayed on a time base set by the main TIME/DIV switch. The last part of the presentation is displayed on a time base set by the delayed TIME/DIV switch. The delay between the start of the main sweep and the start of the delayed sweep is determined in part by the DELAY TIME control.

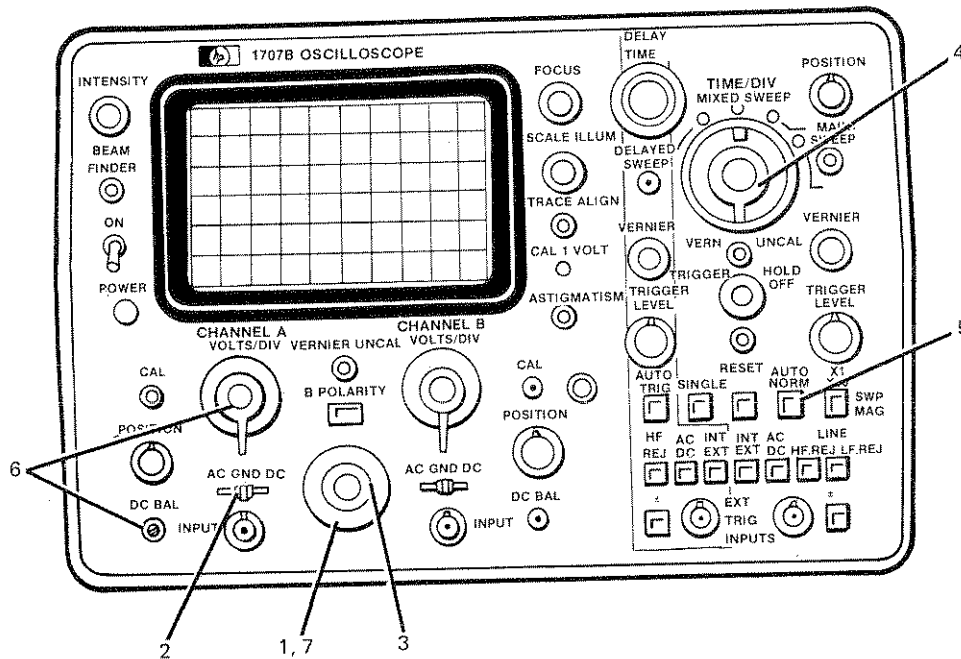
3-77. DELAYED SWEEP.

3-78. Signals can be displayed at 100 ns/div with 3% accuracy. Displays can also be expanded up to 10 ns/div (X10 magnification) with 5% accuracy. This expansion permits viewing critical rise time or signal shapes with increased resolution. The portion to be expanded is selectable by the DELAY TIME control in main sweep operation. It is then expanded to the sweep speed selected by the delayed TIME/DIV switch after delayed sweep operation is selected. Because the sweeps are independent, the main VERNIER may be out of CAL position while the delayed sweep is still calibrated.

3-79. Sweep jitter can be reduced by use of the delayed operation. By using TRIG mode instead of AUTO in delayed sweep operation, the delayed sweep starts on a new trigger. This reduces the jitter that has accumulated since start of the main sweep.

3-80. LINE SYNC.

3-81. Line sync is selected by depressing both main HF REJ and LF REJ pushbutton. This method of time base synchronization is useful when observing waveforms that are time-related to the line frequency.

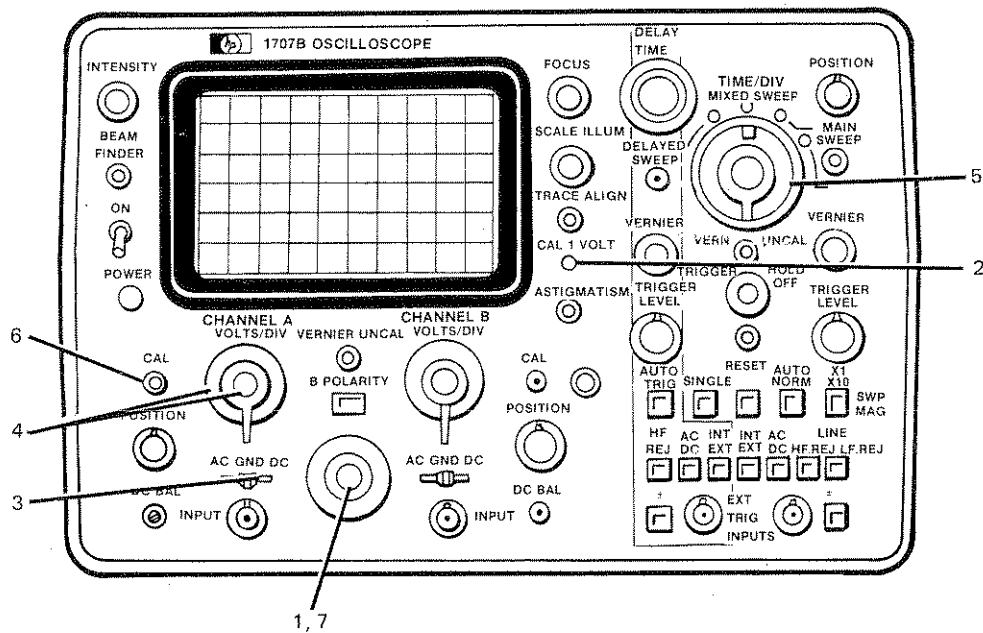


1. Set DISPLAY to A.
2. Set channel A coupling to GND.
3. Set trig to NORM TRIG.
4. Set sweep display to MAIN SWEEP.
5. Set AUTO/NORM to AUTO.
6. Adjust channel A DC BAL for minimum vertical shift while rotating channel vernier between CAL and maximum attenuation.
7. Set DISPLAY to B.
8. Repeat steps 2 through 6 for channel B.

NOTE

If trace is not on CRT, press BEAM FINDER and adjust DC BAL until trace remains on screen

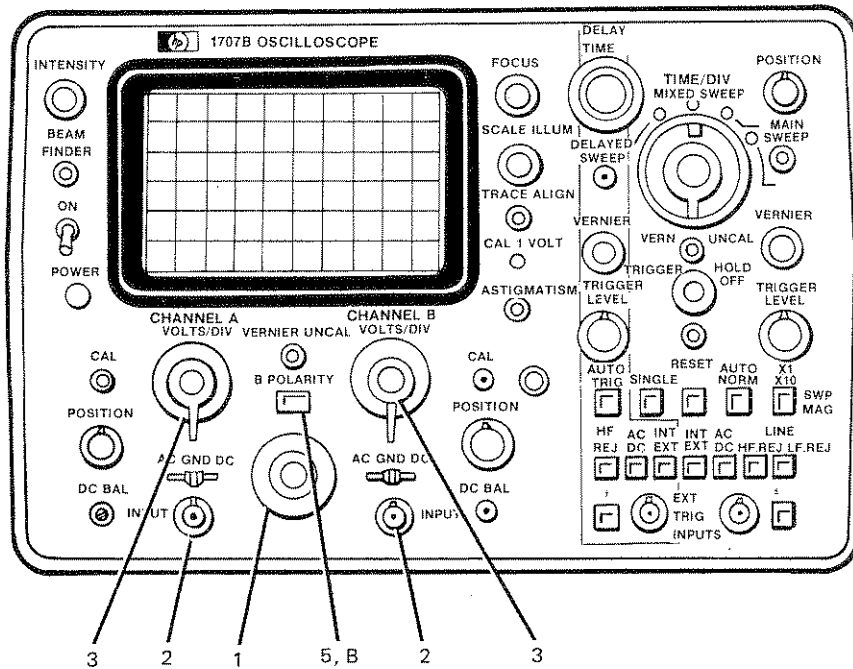
Figure 3-3. DC BAL Adjust



1. Set DISPLAY to A.
2. Connect CAL 1 VOLT output to channel A INPUT, using the Model 10006B 10:1 probe.
3. Set channel A coupling to DC.
4. Set channel A VOLTS/DIV to .02 and vernier to CAL (detent).
5. Set main TIME/DIV to .5 mSEC.
6. Adjust channel A CAL for exactly 5 div of vertical deflection.
7. Set DISPLAY to B.
8. Repeat steps 2 through 6 for channel B.

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Figure 3-4. CAL Adjust



ALGEBRAIC ADDITION

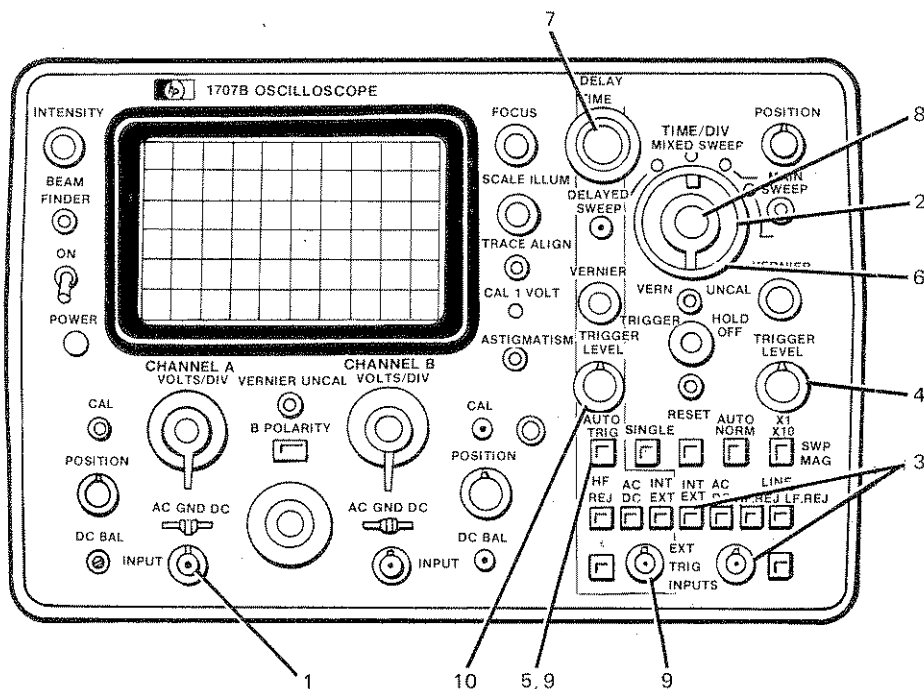
1. Set DISPLAY to A + B.
2. Connect signals to be added to the channel A and B INPUT connectors.
3. Set both VOLTS/DIV and verniers to similar settings.
4. Set time base controls as required to obtain desired display.
5. Set B POLARITY to NORM.
6. The resultant display represents the algebraic sum of channel A and B signals.

DIFFERENTIAL OPERATION

- A. Perform steps 1 through 4 of algebraic addition operation.
- B. Set B POLARITY to INVT.
- C. The resultant display represents the difference between channel A and B signals.

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Figure 3-5. Algebraic Addition and Differential Operation



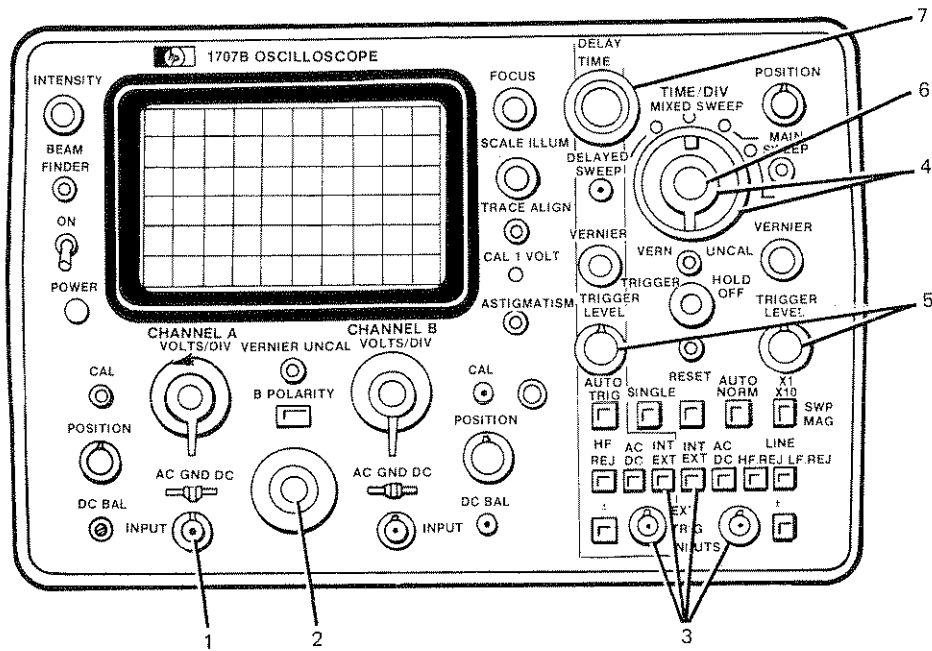
1. Apply signal to channel A INPUT.
2. Set main TIME/DIV to desired sweep speed.
3. Select INT or EXT as desired. If EXT is selected, connect trigger to main EXT TRIG INPUTS.
4. Adjust main TRIGGER LEVEL for stable triggering.
5. Set AUTO/TRIG to AUTO.
6. Set delayed TIME/DIV to desired sweep speed.
7. Adjust DELAY TIME so intensified portion of trace is over area of trace to be investigated.
8. Set sweep display switch to DELAYED SWEEP. Intensified portion of main sweep is now displayed across entire CRT.
9. If jitter is observed on delayed sweep, set AUTO/TRIG to TRIG. This allows the instrument to trigger on the signal of interest and reduces jitter.
10. Adjust delayed TRIGGER LEVEL for a stable display.

NOTE

If EXT triggering is selected, then trigger must be applied to delayed EXT TRIG INPUTS.

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Figure 3-6. Delayed Sweep



1. Connect the signal to channel A INPUT.
2. Set trig to A ONLY TRIG or NORM TRIG, as desired.
3. Set main and delayed INT/EXT as desired. If EXT is selected, connect trigger signals to main and delayed EXT TRIG INPUTS.
4. Set main and delayed TIME/DIV to desired sweep speeds.
5. Adjust main and delayed TRIGGER LEVEL for stable triggering.
6. Set sweep display to MIXED SWEEP.
7. Adjust DELAY TIME until desired waveform combination is displayed.

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Figure 3-7. Mixed Sweep



MANUAL CHANGES

MODEL 1707B

OSCILLOSCOPE

Manual Serials Prefixed: 1410A

Manual Printed: April 1974

Make all changes listed below as Errata. Check the following table for your instrument serial prefix and/or serial number and make listed change(s) to the manual:

Serial Prefix or Number	Make Changes	Serial Prefix or Number	Make Changes
1502A	1	1543A	1 thru 4
1507A	1, 2		
1508A	1, 2		
1528A	1 thru 3		

ERRATA

Page 1-0, figure 1-1,

Replace with figure 1-1 attached to this manual changes sheet.

Page 1-4, table 1-1,

POWER REQUIREMENTS: Change AC Line and DC Line as follows:

AC Line: 115V or 230V \pm 20%, 48 to 440 Hz, 60 VA max.

DC Line: 11.5V to 36V, 40 VA max.

Model 10006B: Change to Model 10006D in ACCESSORIES FURNISHED.

Page 1-5, table 1-2,

Add the following accessory to the table: HP Part No. 1251-2614, Dc power plug for connecting dc power source to Model 1707B.

Page 4-5, Paragraph 4-70,

Line 15: \bar{Q} should read Q.

Line 17: Q should read \bar{Q} .

Page 5-23, table 5-6,

Change: Adjustment column to read as follows: A6A5R16, A6A5R15, A6A5R14, A6A5R13.

Page 6-3, figure 6-2,

Replace the corresponding parts of figure 6-2 with figure 1 of this manual changes sheet.

Table 6-2,

Δ A1: Change HP Part No. and Mfr Part No. to read 0960-0444.

DS1: Change to HP Part No. 1450-0709, LIGHT, INC, NEON AMP TP LENS, Mfr Code 28480, Mfr Part No. 1450-0709.

MP7: Change Qty to 2.

MP8: Change Qty to 1, and change HP Part No. and Mfr Part No. to 0370-1129.

Table 6-2 (Cont'd),

MP9: Change Qty to 2.

MP10: Change Qty to 2.

MP21: Change HP Part No. and Mfr Part No. to 01701-67414.

MP24: Change Qty to 1.

MP35: Change to HP Part No. 0050-1757, GEAR: SUPPORT, Mfr Code 28480, Mfr Part No. 0050-1757.

MP36: Change to HP Part No. 01701-25002, HANDLE: ARM, RIGHT, Mfr Code 28480, Mfr Part No. 01701-25002.

MP37: Change to HP Part No. 01701-25001, HANDLE: ARM, LEFT, Mfr Code 28480, Mfr Part No. 01701-25001.

MP38: Change to HP Part No. 01701-64901, HANDLE ASSY, Mfr Code 28480, Mfr Part No. 01701-64901.

Delete: MP39.

Add: MP40, HP Part No. 7120-3043, NAMEPLATE, Mfr Code 28480, Mfr Part No. 7120-3043.

Add: MP41, HP Part No. 01701-07201, INSERT: HANDLE FRONT, Mfr Code 28480, Mfr Part No. 01701-07201.

Add: MP42, HP Part No. 01701-07202, INSERT: HANDLE REAR, Mfr Code 28480, Mfr Part No. 01701-07202.

Add: MP43, HP Part No. 01701-27401, BUTTON, Mfr Code 28480, Mfr Part No. 01701-27401.

Add: MP44, HP Part No. 01701-23707, SHAFT: PAWL, Mfr Code 28480, Mfr Part No. 01701-23707.

24 March 1976

Δ = Latest additions to this change sheet.

This change sheet supersedes all prior change sheets for this manual.

Supplement A for
01707-90916

