HEWLETT-PACKARD COMPANY / OPERATING AND SERVICE MANUAL

1750A

DUAL TRACE VERTICAL AMPLIFIER

1750A

CERTIFICATION

THE HEWLETT-PACKARD COMPANY CERTIFIES THAT THIS INSTRUMENT WAS THOROUGHLY TESTED AND INSPECTED AND FOUND TO MEET ITS PUBLISHED SPECIFICATIONS WHEN IT WAS SHIPPED FROM THE FACTORY.

HP FURTHER CERTIFIES THAT ITS CALIBRATION MEASUREMENTS ARE TRACEABLE TO THE NATIONAL BUREAU OF STANDARDS TO THE EXTENT ALLOWED BY THE BUREAU'S CALIBRATION FACILITY.

OPERATING AND SERVICE MANUAL

MODEL 1750A

SERIALS PREFIXED: 321-

DUAL TRACE VERTICAL AMPLIFIER

HEWLETT-PACKARD COMPANY

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TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

Table 1-1. Specifications

MODE OF OPERATION	1. Channel A alone 2. Channel B alone 3. Channels A and B displayed on alternate sweeps 4. Channels A and B displayed by switching at 200 kc rate, with blanking during switching 5. Channel A minus Channel B (differential input)
EACH CHANNEL	
Sensitivity Range:	0.05 v/cm to 20 v/cm. Nine calibrated ranges in 1, 2, 5, 10 sequence. Vernier extends minimum sensitivity to at least 50 v/cm, and provides continuous control between ranges. A sensitivity calibration adjustment for each channel is provided on the instrument front panel.
Attenuator Accuracy:	±3%
Pass Band:	DC-coupled, dc to 40 mc; AC-coupled 2 cps to 40 mc
Rise Time:	Less than 9 ns
Dynamic Range:	Input amplifiers can be overloaded by 18 cm signal without causing noticeable signal distortion.
Vertical Position Control Range:	±9 cm
Input Impedance:	1 megohm shunted by approximately 28 pf
Input capacitor rating:	600 vdc (ac-coupled input)
Polarity of presentation:	+up or -up, selectable for each channel
DIFFERENTIAL INPUT	Both inputs, with their associated attenuators, may be switched to one channel to give differential input. The input attenuators may be set separately to allow mixing signals of different levels.
Amplifier:	Channel A; amplifier input: A minus B
Common Mode Rejection:	At least 40 db at maximum sensitivity or 30 db when using attenuators at frequencies to 1 mc
GENERAL	
Weight:	Net 5 lb
Power:	Supplied by Model 175A Oscilloscope
Accessories Available:	10002A (AC-21C) Probe, 50:1 Divider, 30 mc frequency response 10003A (AC-21M) Probe (two supplied with Model 175A Oscilloscope) 10110A (AC-76A) Adapter, terminal post to male BNC

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SECTION I
GENERAL INFORMATION

1-1. DESCRIPTION AND PURPOSE.

1-2. The Hewlett-Packard Model 1750A Dual Trace Vertical Amplifier is a wide-band vertical amplifier designed to be used with the Ⓗ Model 175A Oscilloscope. It provides calibrated sensitivity with 40 megacycle bandwidth and provides the capability of viewing two traces simultaneously. The two channels may also be combined in differential operation, with the difference signal displayed.

1-3. INSTRUMENT IDENTIFICATION.

1-4. Hewlett-Packard instruments use an eight-digit, two-section serial number. The first three digits form the serial prefix, which remains the same until a change is made in the instrument. If the serial prefix on your instrument does not agree with that shown on the title page of this manual, change sheets will describe differences between your instrument and this manual.

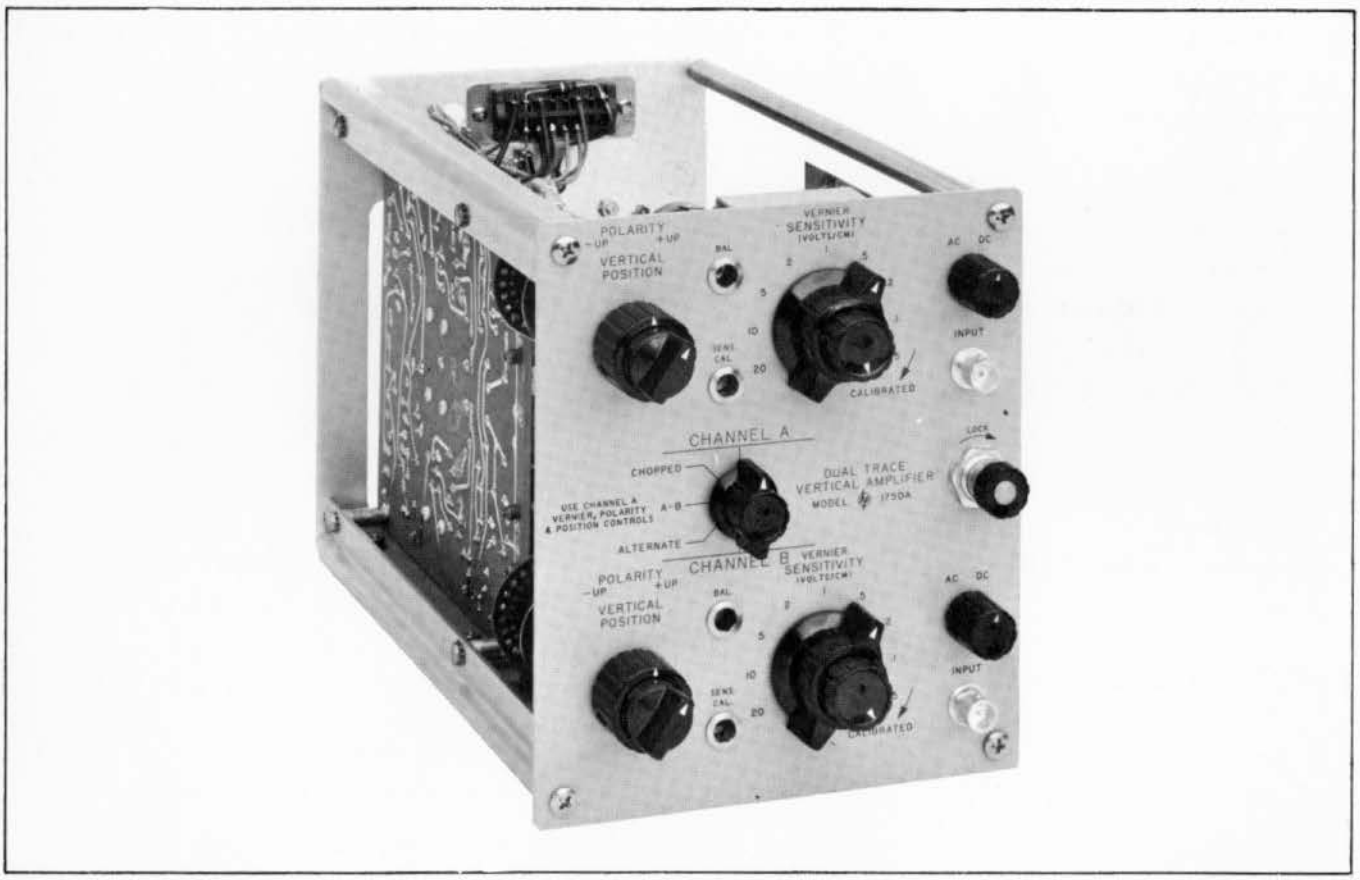


Figure 1-1. Model 1750A Dual Trace Vertical Amplifier

SECTION II
INSTALLATION

2-1. INCOMING QUALITY CONTROL INSPECTION.

2-2. MECHANICAL INSPECTION. Upon receipt of your Ⓗ Model 1750A, unpack it, check the contents against the packing slip and inspect the instrument for mechanical damage. If the instrument is damaged in any way, notify the carrier immediately (refer to the warranty on the inside back cover of this manual). Your local Hewlett-Packard Engineering representative is prepared to give you assistance with any problem involving this instrument and its application.

2-3. PERFORMANCE CHECK. Make the performance check as outlined in paragraph 5-3 of this manual.

2-4. STORAGE AND RESHIPMENT.

2-5. Following is a general guide for repackaging an instrument for storage or reshipment. If there are any questions involving the packaging materials to be used, contact an authorized Hewlett-Packard Engineering representative.

a. Wrap the instrument in heavy paper or plastic before placing it in the shipping container.

b. Use plenty of packing material around all sides of the instrument and protect panel faces with cardboard strips.

c. Use a heavy cardboard carton or wooden box to house the instrument and use heavy tape or metal straps to seal the container.

d. Mark the packing box, "FRAGILE-DELICATE INSTRUMENT".

2-6. INSTALLATION.

2-7. The Ⓗ Model 1750A is designed to be plugged into the vertical amplifier compartment of the Model 175A Oscilloscope. To install the Model 1750A, slide it into the vertical amplifier compartment and lock it into place with the LOCK knob on the front panel. All necessary connections between the Model 1750A and the Model 175A are automatically completed.

SECTION III
OPERATING INSTRUCTIONS

3-1. INTRODUCTION.

3-2. The Model 1750A may be used in five modes, selectable by a front panel control. The five modes, are: Channel A only, Channel B only, Channels A and B on alternate sweeps, Channels A and B chopped on the same sweep, and Channel A minus Channel B (differential mode). Each channel has a polarity switch, position control, and attenuator with continuous vernier.

3-3. CONTROLS.

3-4. The front panel controls locations are shown in figure 3-1. The controls for each channel have identical locations, therefore only the controls for Channel A are identified.

3-5. AC-DC. The AC-DC switch selects either direct or capacitive coupling of the input signal. The AC position is useful for observing small ac signals superimposed on a high dc level, such as power supply ripple. In the DC position the amplifier direct-coupled, allowing accurate measurements of dc or low-frequency ac signals. The lower -3 db frequency in the AC position is 2 cps; if square waves or pulses of long duration are to be observed without sag, the DC position should be used. Table 3-1 shows the percentage of sag for various pulse widths.

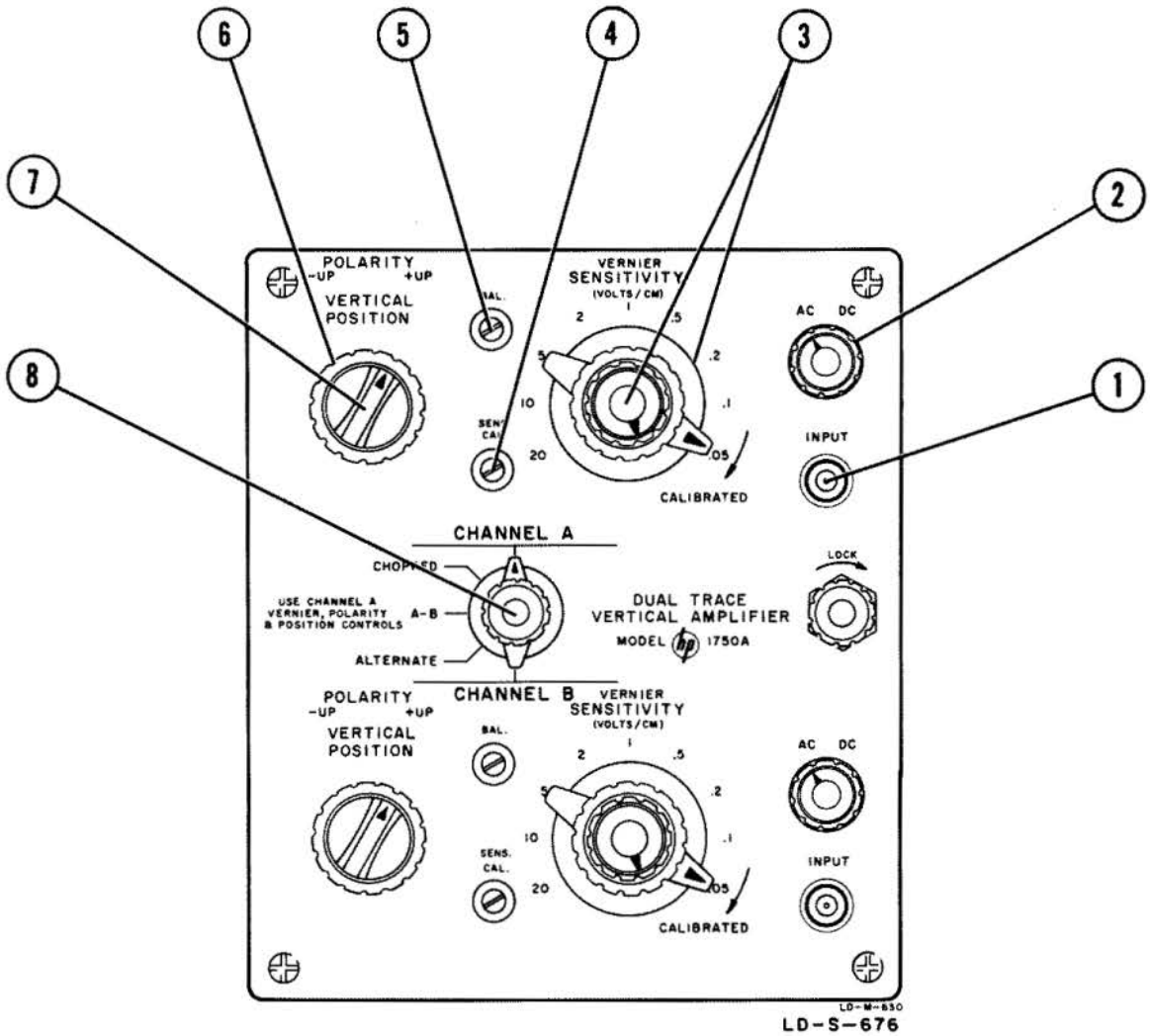
Table 3-1. Pulse Width vs Sag

Width (sec.)	.001	.002	.005	.01	.02	.05	.1
% SAG	1	2	5	9	18	39	63

Note

In the AC position the attenuator accuracy as specified in table 1-1 is retained to approximately 20 cps.

3-6. SENSITIVITY. The SENSITIVITY control is calibrated in volts/cm; if the VERNIER control is in the CALIBRATED position, the trace height may be read directly in volts.



1. INPUT. BNC connector accepts input signal.
2. AC-DC. Selects direct or capacitive coupling of the input signal.
3. SENSITIVITY and VERNIER. Set the deflection sensitivity of the trace. SENSITIVITY is calibrated when VERNIER is rotated completely clockwise into its detented position.
4. SENS. CAL. Sets the calibration of SENSITIVITY.
5. BAL. Compensates for trace shift when VERNIER is operated.
6. VERTICAL POSITION. Positions the trace vertically.
7. POLARITY. Selects the more positive (+UP) or more negative (-UP) voltage for upward deflection.
8. Vertical Presentation. Selects mode of operation.

Figure 3-1. Control Location

3-7. VERNIER. The VERNIER control provides continuous adjustment of the deflection sensitivity, and allows the display to be set to any arbitrary height. Minimum sensitivity can be set to at least 50 v/cm.

3-8. SENS. CAL. This front panel screwdriver adjustment allows the calibration of the Model 1750A to be set using an external voltage standard or the calibrator of the Model 175A. A step-by-step procedure for this adjustment is outlined in figure 3-2.

3-9. BAL. The BAL. control balances the amplifier so that no vertical shift of the trace occurs when the VERNIER control is operated. A step-by-step procedure for BAL. is outlined in figure 3-2.

3-10. VERTICAL POSITION. The VERTICAL POSITION control has a range of ±9 cm., so that off-screen portions of the trace may be brought into view.

3-11. POLARITY. The POLARITY switch reverses the polarity of the trace on the screen. Thus, in the -UP position, a negative voltage causes an upward deflection.

3-12. SINGLE TRACE OPERATION.

3-13. The vertical presentation switch allows selection of either Channel A or Channel B for presentation on the screen. For step-by-step operating procedure, refer to figure 3-3.

3-14. DUAL TRACE OPERATION.

3-15. The vertical presentation switch also selects either of two modes of dual trace operation. CHOPPED or ALTERNATE. For step-by-step operating procedure, refer to figure 3-4.

3-16. CHOPPED. In this mode of operation the two channels are electronically switched at approximately 200 kc on a single sweep. Accurate time difference or phase comparisons may be made in this mode, since both signals occur on the same sweep. However, this mode is intended to be used where the input frequency is much lower than the rate at which the channels are switched.

3-17. ALTERNATE. In this mode the two channels are presented on alternate sweeps. For accurate time or phase comparisons, use an external triggering signal.

3-18. DIFFERENTIAL OPERATION.

3-19. Since both inputs are fed to the channel A amplifier in this mode of operation, only the difference between the two inputs will be displayed on the screen. Therefore any signal on both channels which is equal in phase and amplitude (common mode signal) will be rejected. Use differential mode where measurements are made in the presence of hum or other unwanted pickup. A step-by-step operating procedure for A-B is outlined in figure 3-5.

Note

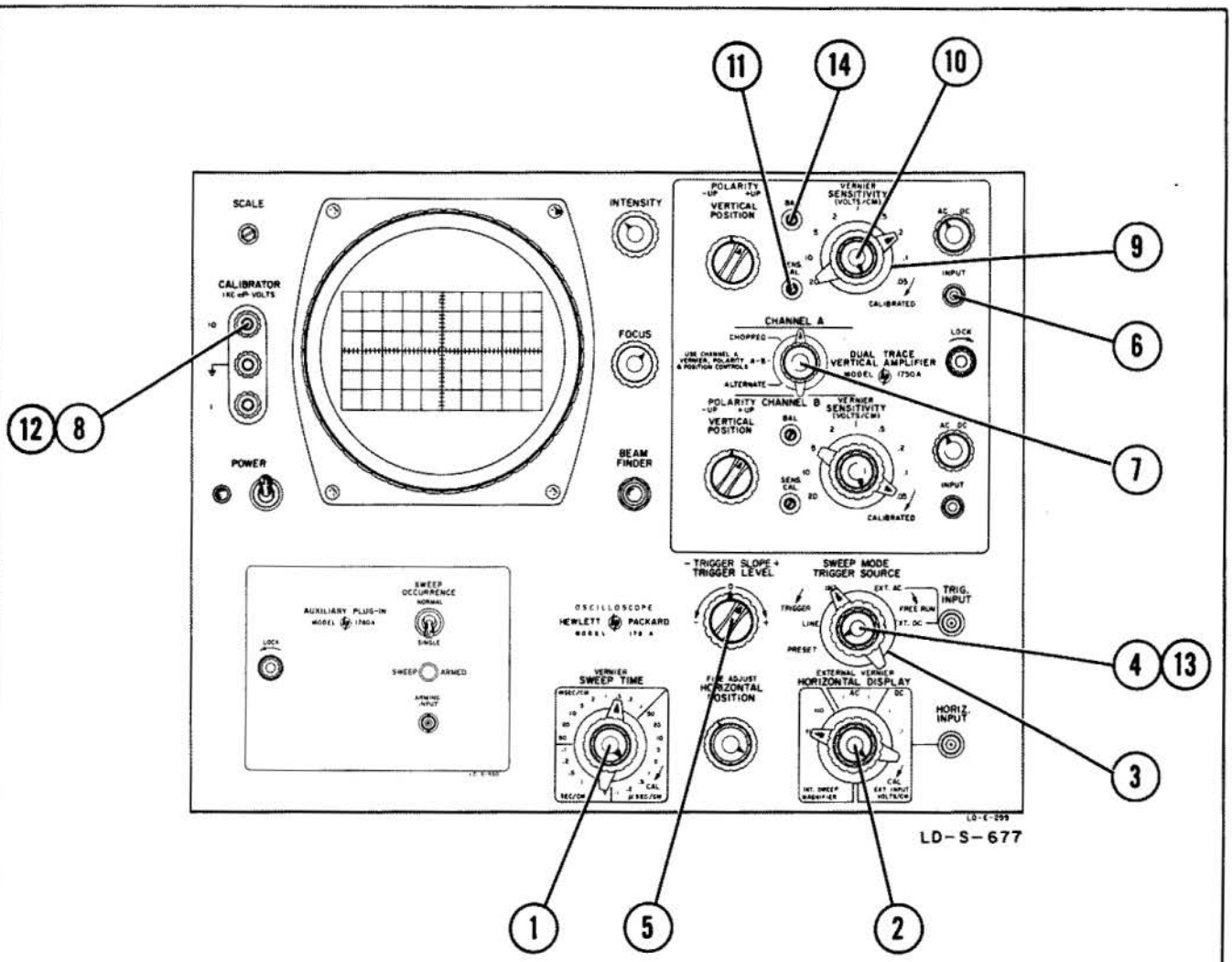
For greatest rejection of common-mode signals, set both channels to the same sensitivity.

3-20. INPUT CONSIDERATIONS.

3-21. ACCESSORY PROBES. In order to preserve the bandwidth capabilities of the Model 1750A, certain precautions must be observed to avoid circuit loading and resultant waveform distortion. The input of the Model 1750A is 1 megohm shunted by 28 pf; however, accessory probes may be used to increase the input impedance and decrease circuit loading. The 10003A (AC-21M) Probe supplied with the Model 175A Oscilloscope presents an input of 10 megohms shunted by 10 pf and may be used over the 40 megacycle bandwidth of the Model 1750A. When using the probe multiply the SENSITIVITY setting by 10.

3-22. When using the 10003A (AC-21M) or other accessory probes, it is necessary to compensate the probe for the input impedance of the amplifier. Without compensation, the probe will not divide accurately at high frequencies and waveforms will be distorted. For compensation adjustment refer to the Model 175A manual or the 10003A operating note.

3-23. AMPLIFIER OVERLOAD CAPABILITY. In certain situations it may be desired to observe with increased sensitivity a small part of a waveform. A signal as large as 18 cm (3 vertical screen diameters) may be applied to the input without causing noticeable distortion.



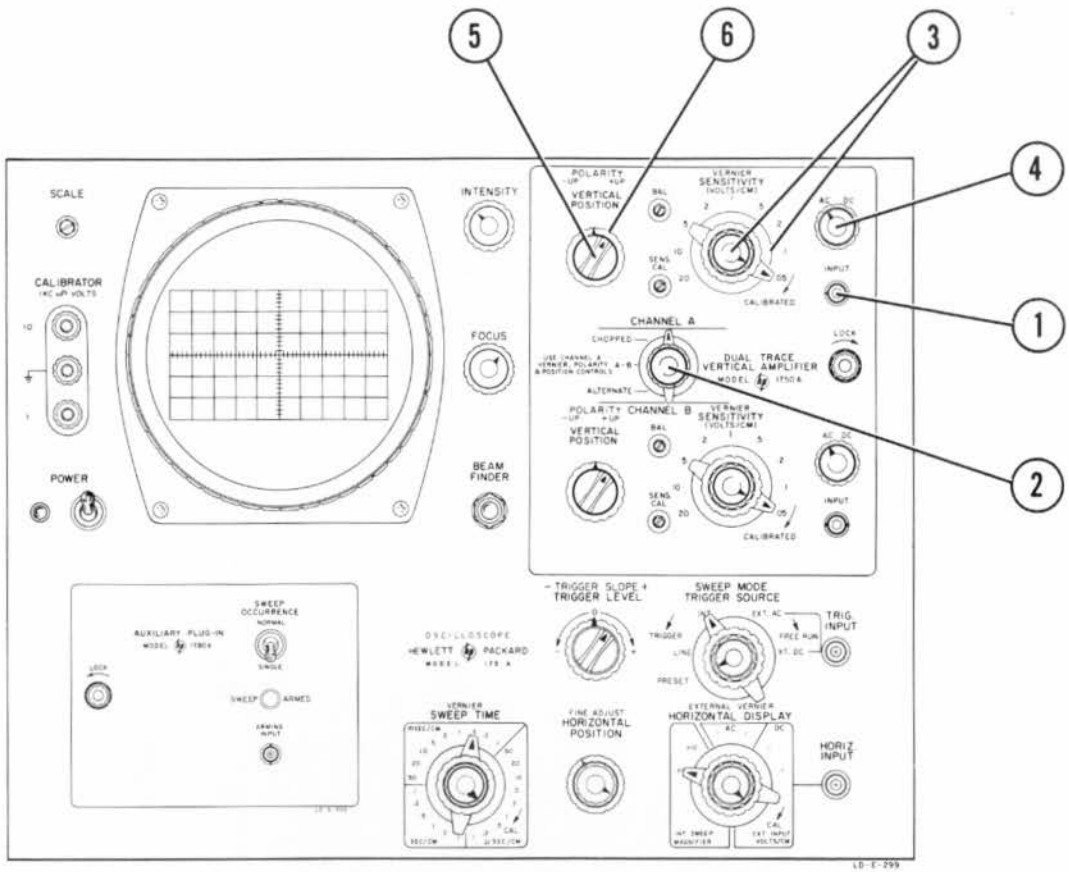
1. Set SWEEP TIME to 0.5 msec/cm.
2. Set HORIZONTAL DISPLAY to INT. SWEEP X1.
3. Set TRIGGER SOURCE to INT.
4. Set SWEEP MODE to PRESET.
5. Set TRIGGER LEVEL to 0.
6. Connect probe or cable to channel A INPUT.
7. Select CHANNEL A.
8. Connect probe or cable to 10 volt CALIBRATOR output.
9. Set SENSITIVITY to 2 volts/cm.

   Note

   If using 10003A (AC-21M) Probe set SENSITIVITY to 0.2 volts/cm.

10. Set VERNIER to CALIBRATED.
11. Adjust SENS. CAL. for a display exactly 5 cm high.
12. Disconnect calibrator.
13. Set SWEEP MODE to FREE RUN.
14. Adjust BAL. for no vertical movement of trace as VERNIER is rotated.
15. Repeat steps 6 through 14 for channel B.

Figure 3-2. BAL. and SENS. CAL Adjustment



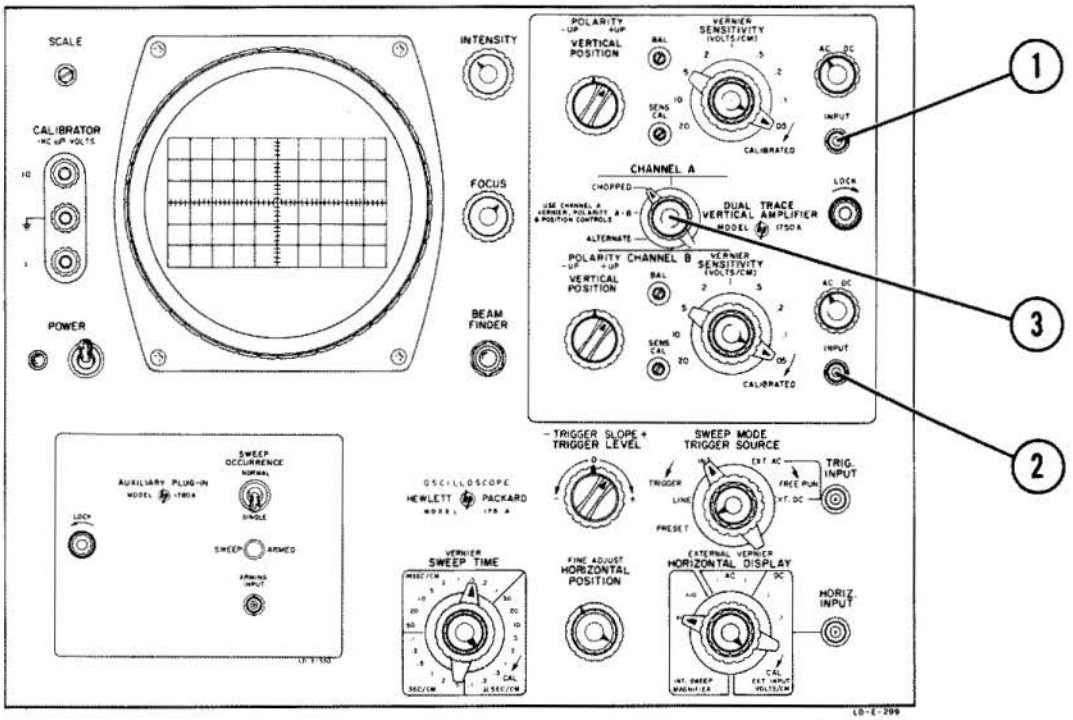
LD-S-678

1. Connect signal to channel A INPUT.
2. Select CHANNEL A.
3. Set SENSITIVITY as desired. For calibrated sensitivity set VERNIER to CALIBRATED.
4. Select AC or DC coupling as desired.
5. Set POLARITY to +UP or -UP as desired.
6. Adjust VERTICAL POSITION as desired.

Note

Corresponding steps are the same for channel B operation.

Figure 3-3. Single Trace Operation

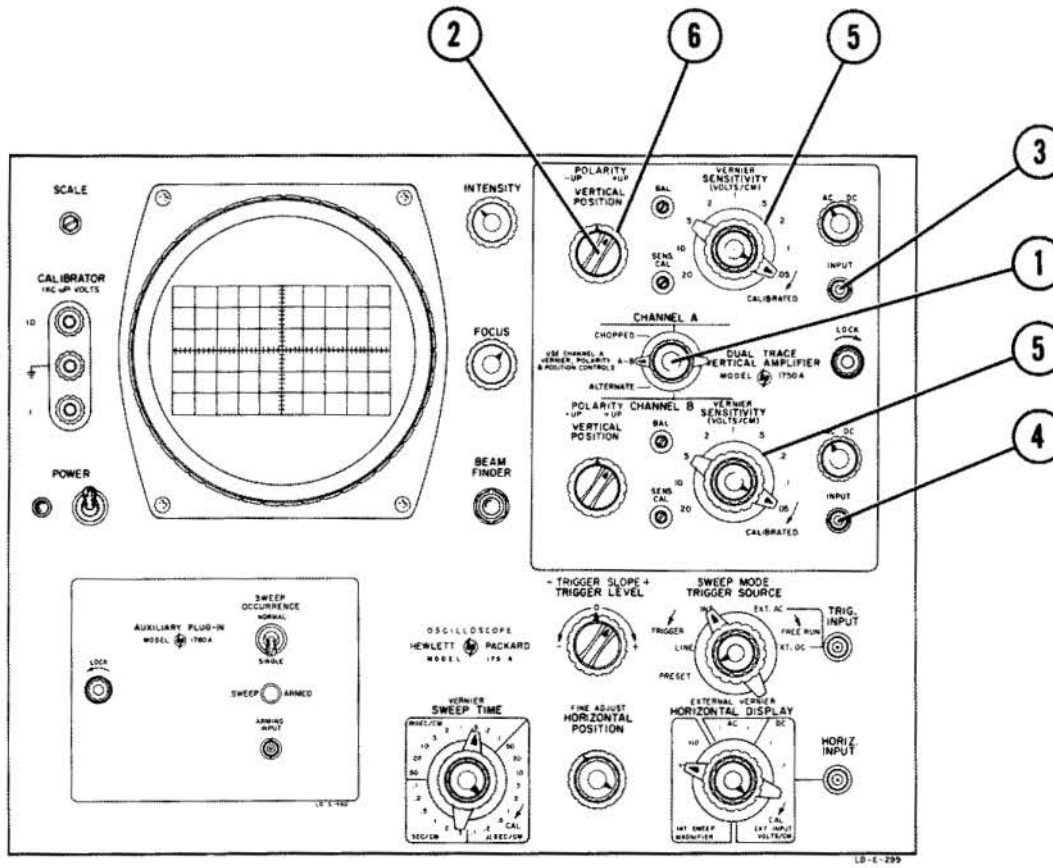


1. Connect one signal to channel A INPUT, and set channel A controls as desired (procedure shown in figure 3-4).
2. Connect the second signal to channel B INPUT, and set channel B controls as desired.
3. Select CHOPPED for display of both signals during the same sweep, or ALTERNATE for display of signals on alternate sweeps. (CHOPPED is suitable for slower sweep rates, ALTERNATE for fast sweep rates.)

Note

For accurate time or phase difference measurements use external triggering.

Figure 3-4. Dual Trace Operation



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1. Select A-B.
2. Set channel A POLARITY to +UP for A-B or -UP for B-A presentation.
3. Connect one signal to channel A INPUT.
4. Connect second signal to channel B INPUT.
5. Set SENSITIVITY as desired. For greatest rejection of common mode signals set both channels to the same sensitivity.
6. Adjust VERTICAL POSITION as desired.

Note

Channel B VERTICAL POSITION, POLARITY, and VERNIER are inoperative in A-B mode.

Figure 3-5. A-B Operation

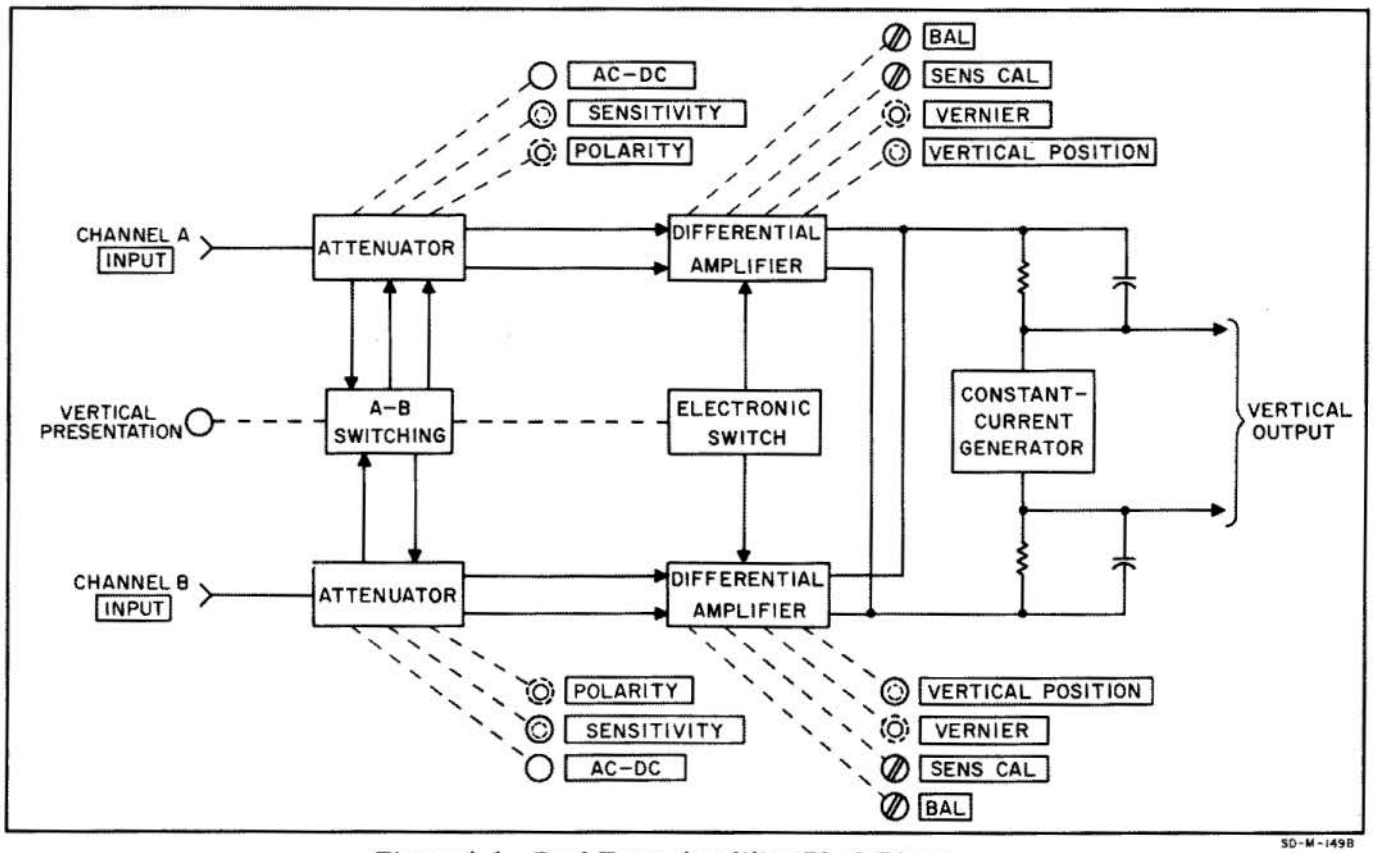


Figure 4-1. Dual Trace Amplifier Block Diagram

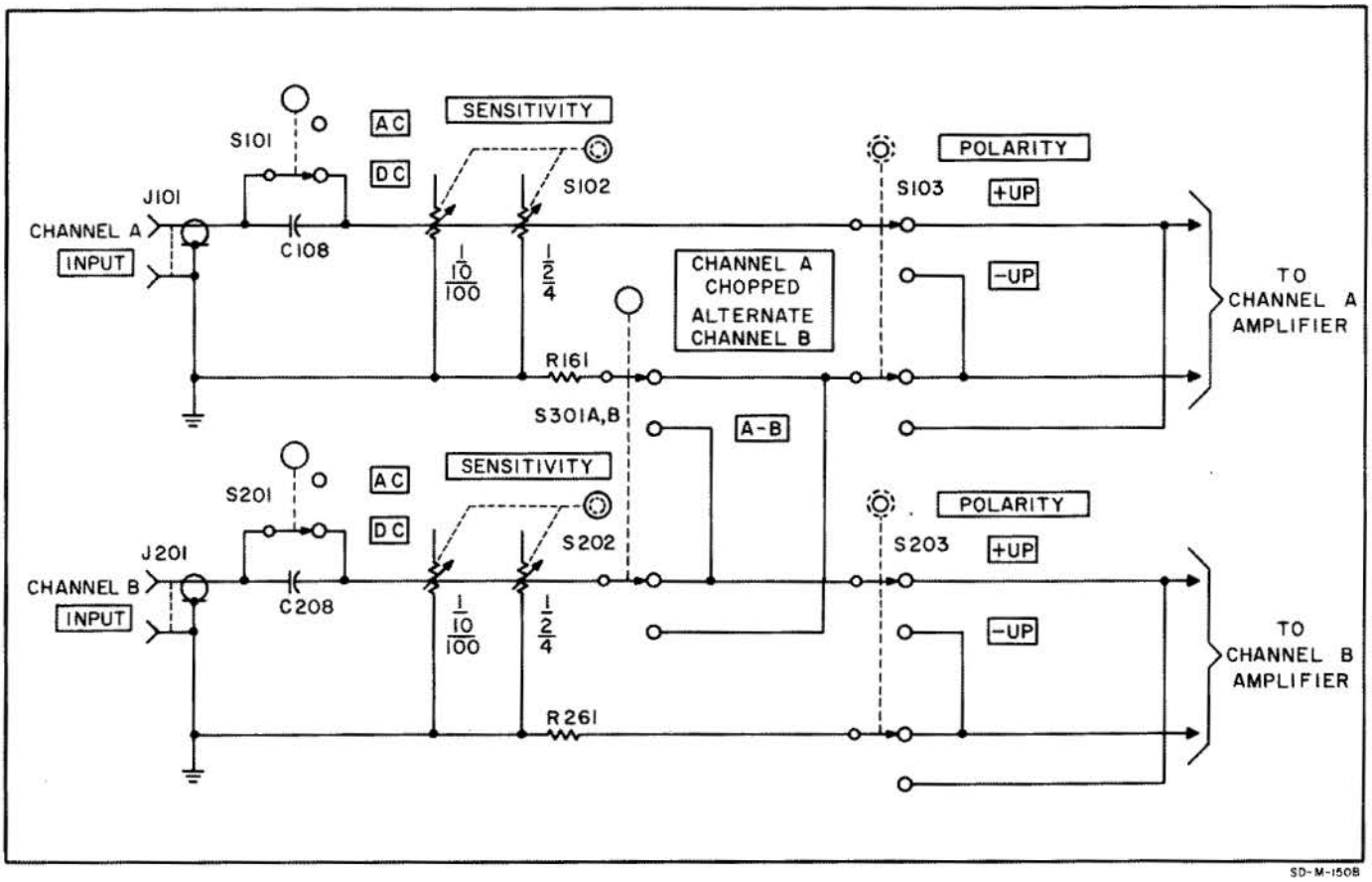


Figure 4-2. Attenuator Simplified Schematic

SECTION IV
PRINCIPLES OF OPERATION

4-1. INTRODUCTION.

4-2. The Model 1750A is a wide-band, calibrated vertical amplifier consisting of two independent channels which may be selected for separate or combined viewing. As shown in figure 4-1 the Model 1750A basically consists of a frequency-compensated attenuator and a differential amplifier in each channel. The output of each channel is combined in the output to the main oscilloscope vertical amplifier. The channels are turned on or off by a switching multivibrator whose function is controlled by the Vertical Presentation switch.

4-3. CIRCUIT DETAILS.

4-4. The two channels in the Model 1750A are identical in function, so only channel A will be discussed in detail.

4-5. INPUT ATTENUATOR. The input attenuator consists of two cascaded voltage dividers which are compensated by shunt capacitors so that their division ratio is constant over the entire frequency range of the instrument. A simplified schematic of the attenuator is shown in figure 4-2. The first section has division ratios of 1, 1/10, and 1/100, while the following section has division ratios of 1, 1/2, and 1/4. This combination of ratios divides the input signal to the most sensitive range (0.05 v/cm). The output of the channel A attenuator is fed through channel A POLARITY switch S103 to input cathode follower V101. The output of the channel B attenuator is fed through Vertical Presentation switch S301 ahead of channel B POLARITY switch S203 to allow A-B presentation.

4-6. INPUT CATHODE FOLLOWER. As shown in figure 4-3, the output of the attenuator is fed to the cathode follower V101 which serves as an impedance transformer and isolates the attenuator and input from the rest of the amplifier. In all modes of operation except A-B, V101A carries the signal from the attenuator to the grid of differential amplifier V102A, while V101B sets the dc bias for the grid of V102B. In A-B both V101A and V101B carry the signal to V102A/B. The BAL. control R104 adjusts the plate current distribution of V101A and V101B and also the dc level of the grids of V102. Further discussion of the use of this control is found in paragraph 4-8.

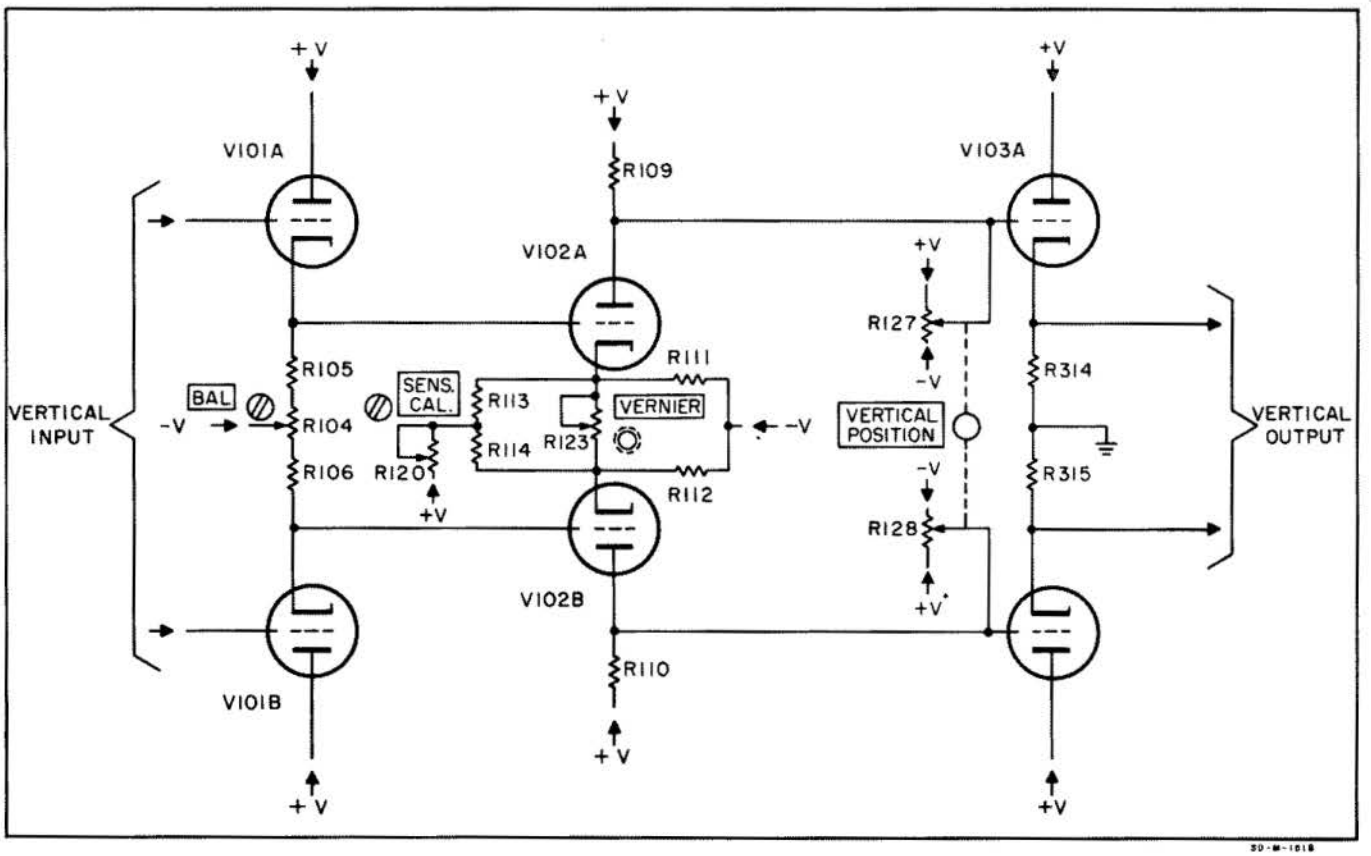


Figure 4-3. Amplifier Simplified Schematic

4-7. DIFFERENTIAL AMPLIFIER. Differential amplifier V102A/B amplifies the signal from cathode follower V101A/B and converts it from a single-ended signal to the balanced signal necessary for the main vertical amplifier. In any operating mode other than A-B, the grid of V102B is fixed at a dc level set by cathode follower V101B. When a signal appears at the grid of V102A it is amplified and appears as a signal at the plate. At the same time a signal appears at the cathode of V102A. Since the cathodes of the two halves of V102 are tied together this signal appears between the cathode and grid of V102B. This differential signal is also amplified and appears at the plate of V102B as a signal opposite in polarity to the signal on the plate of V102A. In the A-B mode, the signal from the channel A attenuator is switched to V102A and the signal from the channel B attenuator is switched to V102B. The operation of the differential amplifier in this mode is similar to that described above: a signal appears at the grid of V102A and is amplified; the same signal appears at the cathode, but since another signal now appears at the grid of V102B only the difference signal between channel A and channel B is amplified. Therefore, any signal which appears at both grids with the same phase and amplitude (common mode) will not appear in the output.

4-8. With VERNIER control R123 in CALIBRATED the cathodes of V102A and V102B are tied together. When R123 is rotated out of the CALIBRATED position resistance is inserted between the cathodes. This resistance acts as regenerative feedback and lowers the gain of the stage, giving the desired control of the deflection sensitivity. If the two halves of the tube were identical and R111 and R112 has exactly the same value, then R123 would have no effect on the dc balance of the differential amplifier. However, since these components are not identical, BAL. control R104 adjusts the operating point of the differential amplifier stages so that the two cathode voltages are equal and no current flows through R123 to change the balance of the stage and move the vertical position of the trace. A means of bringing the SENSITIVITY scales into calibration is provided by SENS. CAL. control R120. This control acts as a voltage divider with R113 and R114, changing the operating point of V102 toward lower plate current, lowering the transconductance and the gain. In this manner the entire vertical amplifier may be brought into calibration.

4-9. OUTPUT CATHODE FOLLOWER. The output of differential amplifier V102 is connected through coupling networks R121-L103 and R122-L104 to the grids of output cathode follower V103. These networks are necessary to compensate for differences in the frequency response of the two channels due to switch and wiring capacitance. These networks are not used in the channel B amplifier.

4-10. To achieve control over the vertical trace position, VERTICAL POSITION control R127-128 varies the dc bias in the grid circuit of V103. This in turn varies the cathode voltage of V103, and thus the vertical position of the trace.

4-11. CONSTANT CURRENT GENERATOR. The ac signal is coupled to the output through C307 and C308, but the dc signal is reduced in level from +75 volts at the cathode of V103A to approximately zero volts at the output. Referring to figure 4-4, the grid of V303A is biased by voltage divider R320-321 to -32 volts. This fixed bias, along with cathode bias resistor R318, regulates the tube at a constant plate current. Since V303A draws constant current through R310, an increase in dc level will not change the drop across R310 and the dc signal will appear at the output unattenuated. Positive feedback from the input through R312 compensates for the voltage division by R308 and the 1 megohm resistor in the input of the main vertical amplifier. R308 isolates the output from the capacitance of V303A.

4-12. Vert. Pos. Adj. R319 acts as a coarse vertical position control and allows centering of the range of VERTICAL POSITION control R127-128. Potentiometer R19 adjust the cathode voltage of V303A and thereby adjusts the dc level at the plate of V303A, resulting in the same effect as adjustment of R127-128.

4-13. ELECTRONIC SWITCH.

4-14. The output of each channel is controlled by switching multivibrator V302, shown in figure 4-5. When V302A conducts, its plate voltage is approximately +45 volts, forward-biasing diode CR301. The conduction of CR301 pulls the plates of V102 (and therefore the grids of V103) to approximately +60 volts, cutting off V103. With V103 in a cutoff

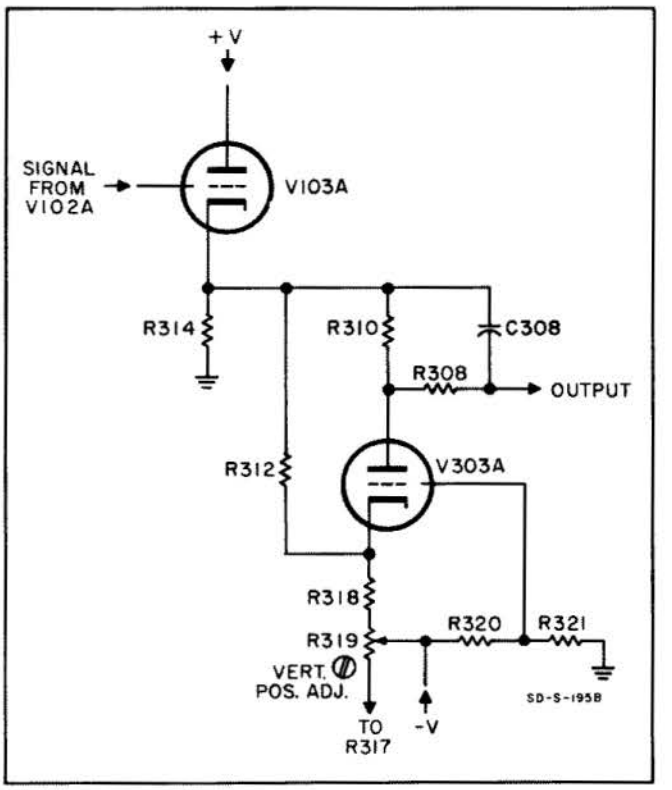


Figure 4-4. Constant Current Generator

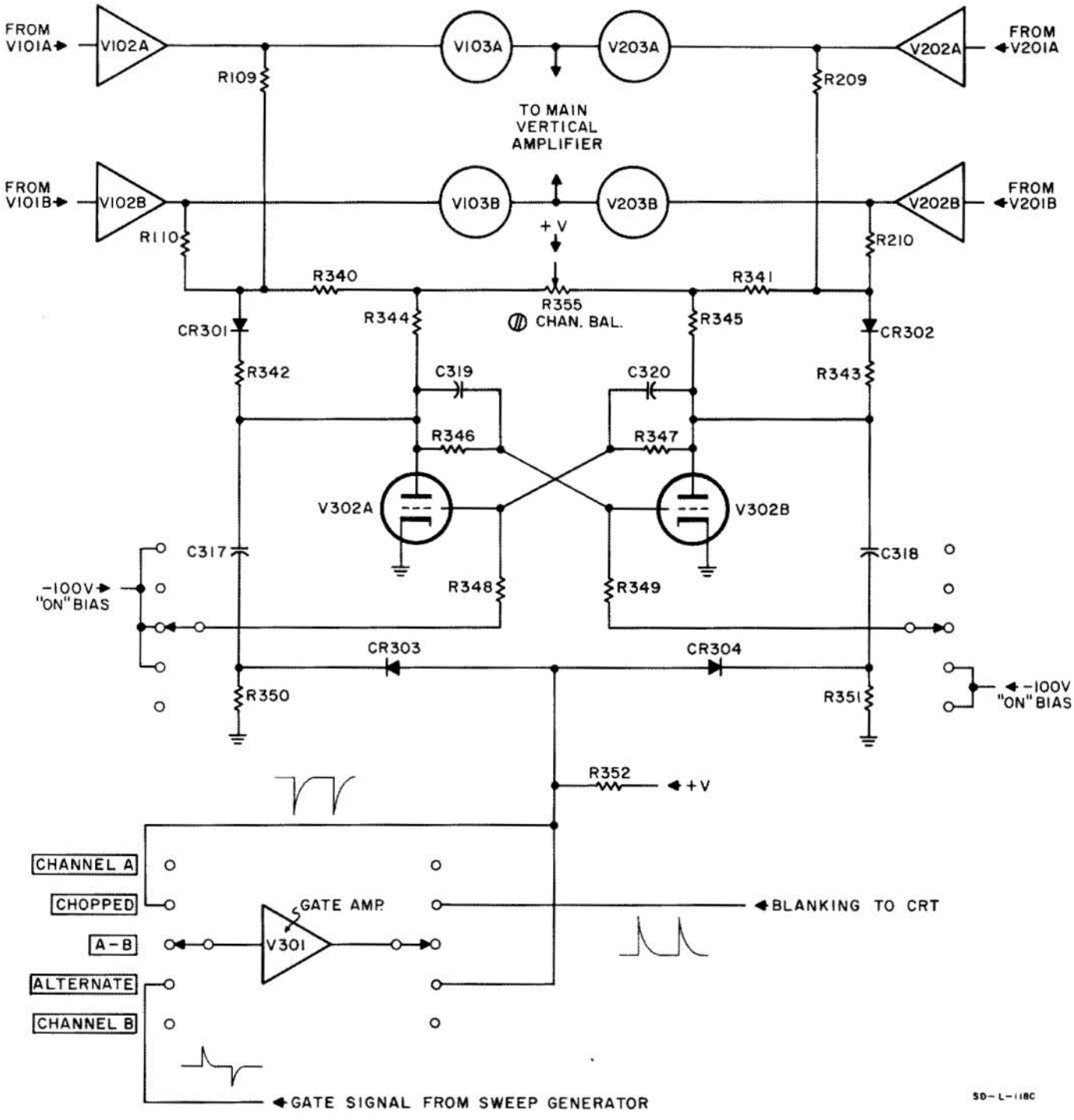


Figure 4-5. Electronic Switch

condition, no signal from channel A appears in the output. Conversely, when V302B is not conducting, its plate voltage is approximately +100 volts, which reverse-biases diode CR302 and channel B operates normally. The conducting or non-conducting states of V302 are controlled by Vertical Presentation switch S301.

4-15. With S301 at CHANNEL A, negative bias is applied to the grid of V302A, diode CR301 is reverse biased, and channel A operates normally. Set to CHANNEL B, S301 applies negative bias to the grid of V302B.

4-16. With S301 at CHOPPED, the multivibrator free runs at approximately 200 kc, alternately switching each channel on and off. The waveform at each plate of V302 is differentiated, and the positive spike

is clipped. For V302A, the differentiation is by C317-R350 and the clipping by CR303. For V302B, the differentiating-clipping network is C318-R351-CR304. The negative spike from V302 is amplified and inverted by gate amplifier V301, and applied to the CRT as a blanking signal to blank the trace during the transition period when V302 is switching. Resistor R355 adjusts the balance of the two channels for minimum trace slope during chopped operation.

4-17. With S301 at ALTERNATE, negative bias is applied to both V302 grids, and V302 acts as a binary triggered by signals from the oscilloscope sweep circuit. With this arrangement, each channel is presented on alternate sweeps.

4-18. With S301 at A-B, negative bias is applied to the grid of V302A, channel A operates normally, and channel B is turned off.

SECTION V
MAINTENANCE

5-1. INTRODUCTION.

5-2. This section contains information for the adjustment and repair of the Model 1750A along with step-by-step procedures for checking performance and making necessary adjustments.

5-3. PERFORMANCE CHECK.

5-4. The performance check indicated in this section may be used as a routine maintenance procedure or as an incoming inspection to verify the performance of the instrument against its specifications.

5-5. REQUIRED TEST EQUIPMENT. The instruments required for the performance check are items 1 through 4 listed in table 5-1. If the recommended equipment is not available, equipment with similar characteristics may be substituted.

5-6. PRELIMINARY PROCEDURE.

a. On Model 175A set controls as follows:

Set: Intensity Modulation (rear panel) . INT
SWEEP TIME VERNIER . . . . . CAL
HORIZONTAL DISPLAY . . . INT SWEEP X1
TRIGGER SOURCE . . . . . INT
SWEEP MODE . . . . . FREE RUN
TRIGGER SLOPE . . . . . +
TRIGGER LEVEL 0

b. Set horizontal plug-in controls:

Model 1780A:
SWEEP OCCURRENCE . . . . . NORMAL

Model 1781A/B:
SWEEP SELECTOR . . . . . MAIN SWEEP

Model 1782A:
FUNCTION . . . . . OFF

Model 1783A:
TIME MARKER . . . . . OFF

Table 5-1. Recommended Test Equipment

Item	Instrument Type	Required Characteristics	Measurement/ Adjustment	Ref Paragraph	Recommended Instrument
1	Signal Generator	Frequency: 50 kc to 40 mc Output: 0.3 to 5 v p-p into 50 ohms, constant with frequency	Common Mode Rejection Bandwidth	5-13 5-15	hp Model 606A
2	Voltmeter Calibrator	Output: 0.2 to 100 v p-p, + and - 0.5 vdc Accuracy: ±0.5%	Sensitivity Calibration Vertical Position Range SENS. CAL.	5-10 5-11 5-31	hp Model 738AR
3	Pulse Generator	Output: 0.25 volts into 50 ohms Rise Time: 3 nsec or less	Rise Time Pulse Response	5-14 5-38	Tektronix Type 107 Square Wave Generator
4	Coaxial Termination	Impedance: 50 ohms VSWR: 1.05 max.	Rise Time Bandwidth Pulse Response	5-14 5-15 5-38	hp Model 908A
5	Square Wave Generator	Output: 0.25 to 60 V Frequency: 1 kc and 10 kc	Frequency Compensation	5-35 5-36 5-37	hp Model 211A
6	Alignment Attenuator		Input Capacitance	5-35 5-37	hp 10403A (1750A-95A)
7	Extender		Extends plug-in outside oscilloscope		hp 10400A (160B-39A)

c. On Model 1750A set controls as follows:

Set: AC-DC . . . . . AC
SENSITIVITY . . . . . 20 volts/cm
VERNIER . . . . . CALIBRATED
POLARITY . . . . . +UP
Vertical Presentation . . . . . CHANNEL A

5-7. SINGLE CHANNEL OPERATION.

a. Position the trace at the top of the graticule with channel A VERTICAL POSITION.

b. Channel B controls should move the trace less than 0.2 cm.

c. Set Vertical Presentation to CHANNEL B.

d. Position the trace at the bottom of the graticule with channel B VERTICAL POSITION.

e. Channel A controls should move the trace less than 0.2 cm.

5-8. ALTERNATE OPERATION.

a. Set Vertical Presentation to ALTERNATE.

b. Set SWEEP TIME to 0.1 sec/cm.

c. Channel A and channel B traces should be displayed on alternate sweeps.

5-9. CHOPPED OPERATION.

a. Set:
Vertical Presentation . . . . . CHOPPED
SWEEP TIME . . . . . 5 μsec/cm
INTENSITY . . . . . fully clockwise
SWEEP MODE. . . . . PRESET

b. A square wave with a frequency of approximately 200 kc should be displayed.

c. Return INTENSITY to normal level.

5-10. SENSITIVITY CALIBRATION.

a. Apply a 400 cycle, 0.3 volt peak-to-peak signal from the Voltmeter Calibrator to the channel A INPUT.

b. Set:
Vertical Presentation . . . . . CHANNEL A
SENSITIVITY . . . . . 0.05 volts/cm
SWEEP TIME . . . . . 2 msec/cm

c. Set SENS. CAL. for display exactly 6 cm high.

d. Check the accuracy of all remaining SENSTIVITY ranges as shown in table 5-2.

e. Set:
SENSITIVITY . . . . . 20 volts/cm
VERNIER . . . . . fully counterclockwise

f. Set the Voltmeter Calibrator output to 100 volts peak-to-peak.

g. Display height should be less than 2 cm.

h. Repeat steps a through g for channel B.

5-11. VERTICAL POSITION RANGE.

a. Connect the Voltmeter Calibrator output to the channel A INPUT.

b. Set the Voltmeter Calibrator output to 0 volts.

c. Set:
Vertical Presentation . . . . . CHANNEL A
SWEEP MODE . . . . . FREE RUN
SENSITIVITY . . . . . 0.05 volts/cm
VERNIER . . . . . CALIBRATED
AC-DC . . . . . DC

d. Center the trace with VERTICAL POSITION control.

e. Set the output of the Voltmeter Calibrator to +0.5 volts dc.

f. The VERTICAL POSITION control should bring the trace back to at least the first graticule line above center.

g. Set the output of the Voltmeter Calibrator to -0.5 volts dc.

h. The VERTICAL POSITION control should bring the trace back to at least the first graticule line above center.

i. Repeat steps a through h for channel B.

5-12. DYNAMIC RANGE.

a. Apply a 400 cycle, 0.9 volt peak-to-peak signal from the Voltmeter Calibrator to the channel A INPUT.

Table 5-2. Sensitivity Calibration

Sensitivity (volts/cm)	Voltmeter Calibrator Output (volts p-p)	Display Height (cm)
.1	0.5	4.85 to 5.15
.2	1	4.85 to 5.15
.5	3	5.82 to 6.18
1	5	4.85 to 5.15
2	10	4.85 to 5.15
5	30	5.82 to 6.18
10	50	4.85 to 5.15
20	100	4.85 to 5.15

b. Set:
SENSITIVITY . . . . . 0.05 volts/cm
VERNIER . . . . . CALIBRATED
Vertical Presentation . . . . . CHANNEL A

c. No distortion should be evident on any part of the waveform.

d. Repeat steps a through c for channel B.

e. Disconnect the Voltmeter Calibrator.

5-13. COMMON MODE REJECTION.

a. Apply a 1 mc signal from the Signal Generator to both channel A and channel B INPUT connectors.

b. Set:
Vertical Presentation . . . . . ALTERNATE
Channels A and B SENSITIVITY . 5 volts/cm
Channels A and B VERNIER . . CALIBRATED

c. Adjust Signal Generator output for 1 cm display on both traces.

d. Set:
Vertical Presentation . . . . . A-B
Channels A and B SENSITIVITY . . 0.5 volts/cm

e. Display height should not be greater than 0.32 cm.

f. Set both SENSITIVITY controls to 0.05 volts/cm.

g. Display height should not be greater than 1 cm.

h. Disconnect the Signal Generator.

5-14. RISE TIME.

a. Apply a signal from the Pulse Generator to the channel A INPUT, terminating the connecting cable with the Coaxial Termination.

b. Set:
Vertical Presentation . . . . . CHANNEL A
SENSITIVITY . . . . . 0.05 volts/cm
VERNIER . . . . . CALIBRATED
SWEEP TIME . . . . . 0.1 μ sec/cm
HORIZONTAL DISPLAY . . . INT SWEEP X10
TRIGGER SLOPE . . . . . +

c. Adjust the Pulse Generator output for 5 cm display height.

d. The rise time between the 10% and 90% points should be less than 9 nanoseconds.

e. Repeat steps a through d for channel B.

f. Disconnect the Pulse Generator.

5-15. BANDWIDTH.

a. Apply a 50 kc signal from the Signal Generator to the channel A INPUT, terminating the connecting cable with the Coaxial Termination.

b. Set:
Vertical Presentation . . . . . CHANNEL A
SENSITIVITY . . . . . 0.05 volts/cm
VERNIER . . . . . CALIBRATED

c. Adjust the Signal Generator output for a display 6 cm high.

d. Change the Signal Generator output frequency to 40 mc.

e. The display height should not be less than 4.2 cm.

f. Repeat steps a through e for Channel B.

g. Disconnect the Signal Generator.

5-16. TROUBLESHOOTING.

5-17. The following paragraphs outline procedures for the localization and clearance of troubles. Be sure that the trouble cannot be cleared by making an adjustment. Waveforms and dc voltage levels are shown on the amplifier schematic, figure 5-10.

5-18. TROUBLE LOCALIZATION. The initial action in locating the source of improper operation is to determine which part of the circuit is at fault. Table 5-3 lists operational faults and the circuits which may be the cause.

Table 5-3. Trouble Localization

Symptom	Cause
Trace off screen; VERTICAL POSITION will not bring it into view.	Unbalance (ref. paragraph 5-19.)
Calibration low; SENS. CAL. will not bring amplifier into calibration	Low gain; V101 (201), V102 (202), V103 (203)(ref. para. 5-20)
Improper CHOPPED or ALTERNATE operation	V301, (302) (ref. para. 5-21)

5-19. UNBALANCE. If the amplifier is operating properly, both halves of each stage will have equal grid, cathode, and plate voltages. Any component failure will affect this balance, usually causing the trace to be off-screen. Table 5-4 gives a systematic method of forcing balance in each stage by shorting grid-to-grid, cathode-to-cathode, etc. in each stage thereby pinpointing the source of the unbalance.

5-20. LOW GAIN. The gain of the amplifier with VERNIER in CALIBRATED is normally four. If the gain falls much below this value it will not be possible to calibrate the amplifier with the SENS. CAL. control. The table of waveforms on the amplifier schematic, figure 5-10, shows the voltage gain of each stage for a 10 volt calibrator input. To locate the trouble, trace the calibrator signal from the input through each successive stage until the faulty stage is found.

Table 5-4. Unbalance

Short Together	Effect	Fault
Pins 1 and 9 of P301	trace centers	Model 1750A
	trace does not center	Model 175A
Pins 3 and 8 of V103	trace centers	input and differential amplifier
	trace does not center	R319 or V303
Pins 2 and 7 of V103	trace centers	V101, 102
	trace does not center	V103
Pins 2 and 7 of V102	trace centers	V101
	trace does not center	V102
Pins 2 and 7 of V101	trace does not center	V101 or R104
Note: Same procedure may be used for channel B.		

5-21. IMPROPER DUAL-TRACE OPERATION. Any trouble involving CHOPPED or ALTERNATE operation can be traced to V301, V302 and associated circuitry. The amplifier schematic, figure 5-6, shows the waveforms for both modes of operation.

5-22. REPAIR.

5-23. If replacement of components on the etched circuit boards proves necessary, follow the general procedure outlined below:

a. To remove components from the board use a low-wattage soldering iron such as Ungar #1235 heating unit with #776 handle and #PL 333 tip. Apply just enough heat to melt the solder and remove the component.

b. After the component has been removed, clear the hole by melting the solder and inserting a wooden toothpick in the hole.

Note

Using a metal tool may damage the plating in the hole.

c. Bend the leads of the new component to the proper spacing and insert in the board. Apply solder from the side of the board opposite the component.

Note

Excessive heat may lift an isolated conductor pad from the board. If this occurs, solder the connection from the component side of the board.

d. Use pliers as a heat sink when soldering semiconductor diodes. Grip the leads close to the diode body.

e. To remove components with multiple connections such as potentiometers or tube sockets clip the pins with pliers and remove each pin separately, or use a de-soldering tip such as Ungar #855 on the soldering iron.

5-24. Table 5-5 lists the adjustments recommended after replacement of tubes or diodes.

5-25. LOCATION OF PARTS. Figures 5-1 through 5-4 show the location of components not part of an assembly. These components are listed by reference designator and cross-referenced in table 6-1. Table 6-1 lists all components included in each assembly, and these components are for the most part identified by silkscreening or by panel engraving.

5-26. ADJUSTMENTS.

5-27. The following paragraphs outline procedures for adjusting the calibration, balance, and frequency compensation of the Model 1750A.

5-28. In all of the adjustments except pulse response the instrument may be mounted on the hp 10400A (160B-39A) Extender. This allows easy access to all the adjustments. If the extender is not available, the top and right side covers of the Model 175A Oscilloscope must be removed. For pulse response adjustments the instrument must be installed in the Model 175A and the right side cover must be removed.

Note

In order to make the adjustments properly in the Model 1750A, the Model 175A in which it is installed must have been previously adjusted for optimum performance.

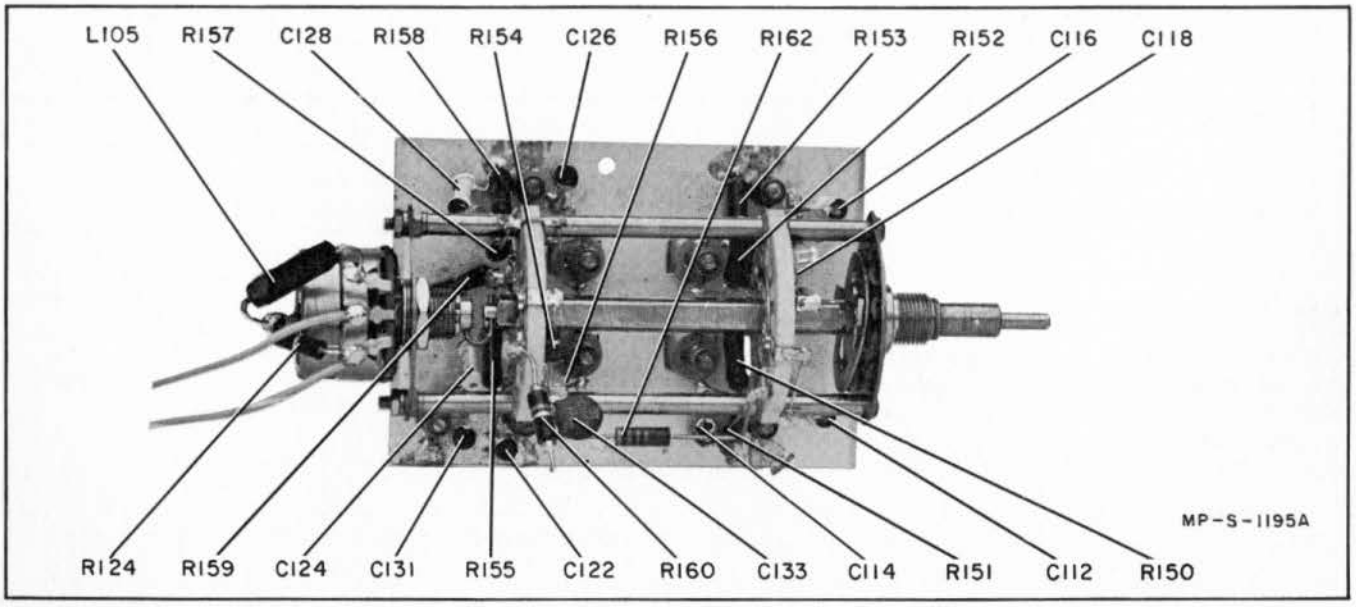


Figure 5-1. Parts Location, Channel A Attenuator

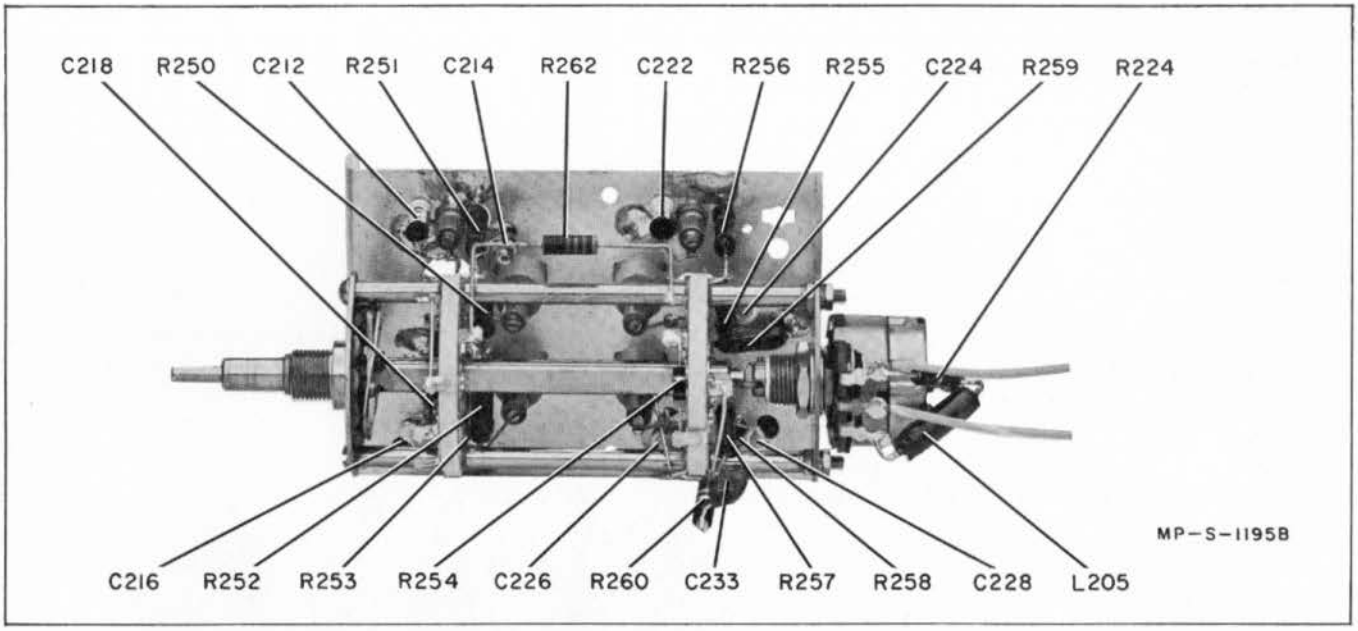


Figure 5-2. Parts Location, Channel B Attenuator

Table 5-5. Recommended Adjustments Following Tube or Diode Replacement

Tube or Diode	Function	Adjustment	Ref. Paragraph
	AMPLIFIER		
CR101, 102, 201, 202	Isolation Diode	None	
V101, 201	Input Cathode Follower	Bal.	5-31
V102, 202	Differential Amplifier	Bal. Gain Vert. Pos. Adj. Pulse Resp.	5-31 5-34 5-32 5-38
V103, 203	Output Cathode Follower	Chan. Bal.	5-33
V303	Constant-Current Generator	Vert. Pos. Adj.	5-32
	ELECTRONIC SWITCH		
CR301, 302	Switch Diode	None	
CR303, 304	Clipper Diode	None	
V301	Gate Amplifier	None	
V302	Switching Multivibrator	None	

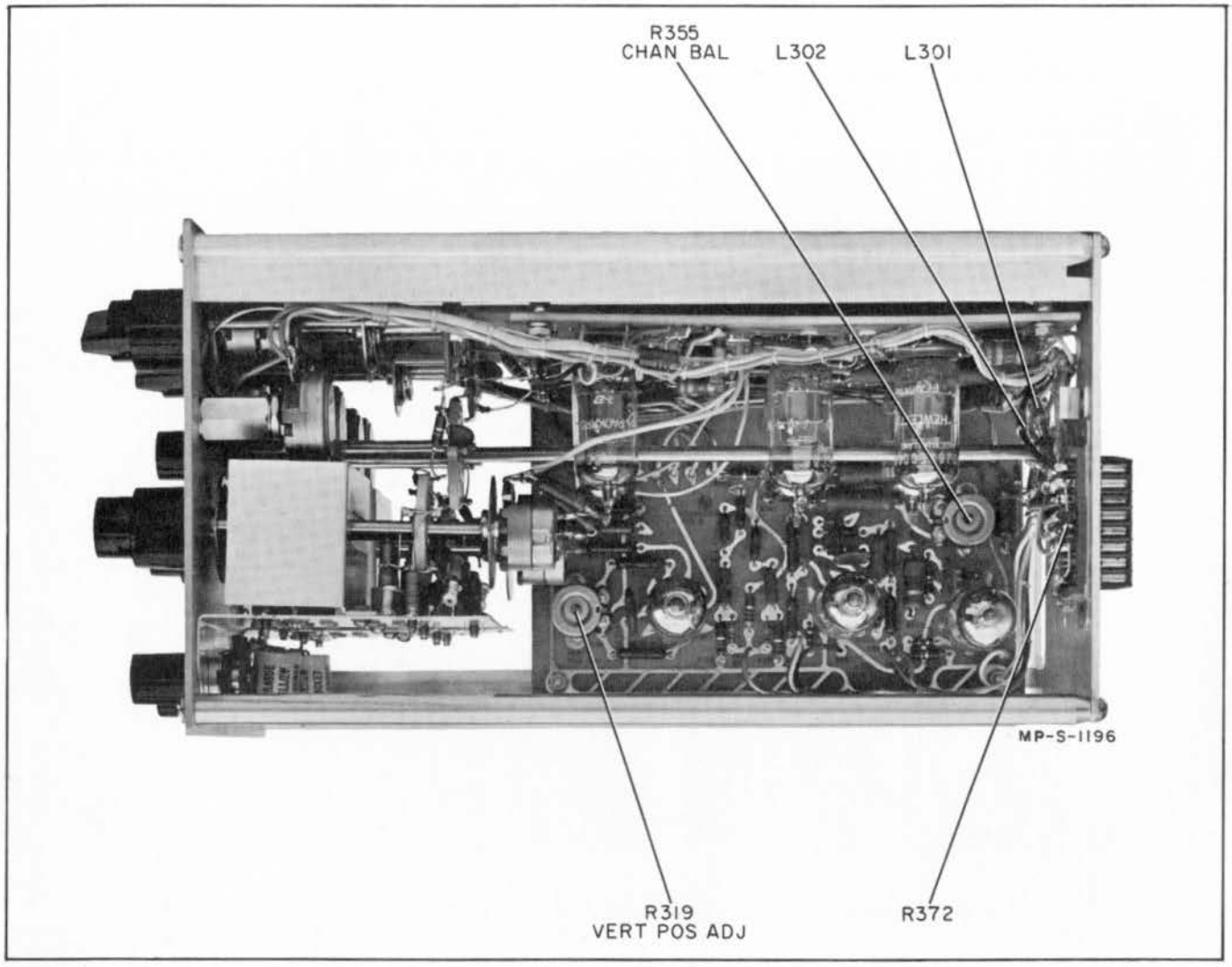


Figure 5-3. Parts Location, Top

5-29. REQUIRED TEST EQUIPMENT. The instruments required to make the adjustments in the following paragraphs are items 2 through 6 listed in table 5-1.

5-30. PRELIMINARY SETTINGS.

a. On the Model 175A make the following settings:

Set: HORIZONTAL DISPLAY . . INT. SWEEP X1
TRIGGER SOURCE . . . . . INT
TRIGGER LEVEL 0
SWEEP MODE . . . . . FREE RUN
SWEEP TIME . . . . . 1 msec/cm
VERNIER . . . . . CAL.

b. On horizontal plug-ins make the following settings:

Model 1780A: SWEEP OCCURRENCE . . . . . NORMAL
Model 1781A/B: SWEEP SELECTOR . . . . . MAIN SWEEP
Model 1782B: FUNCTION . . . . . OFF
Model 1783A: TIME MARKER . . . . . OFF

5-31. BAL. ADJUSTMENT. For BAL. adjustments, refer to figure 3-2.

5-32. VERTICAL POSITION.

a. Set Vertical Presentation to ALTERNATE.

b. Mechanically center channel A and channel B VERTICAL POSITION controls.

c. Adjust R319, Vert Pos Adj, so that both traces are centered or symmetrical about the center of the graticule.

5-33. CHANNEL BALANCE.

a. Set Vertical Presentation to CHOPPED.

b. Separate traces by 5 cm with vertical position controls.

c. Adjust R355, Chan. Bal. for minimum trace widths.

5-34. GAIN.

a. Apply a .3 volt peak-to-peak signal from the Voltmeter Calibrator to the channel A INPUT.

b. Set:

Vertical Presentation	CHANNEL A
SENSITIVITY	0.05 volts/cm
VERNIER	CALIBRATED
VERTICAL POSITION	centered

c. Adjust SENS. CAL. for a display exactly 6 cm high.

d. Repeat steps a through c for channel B.

e. Disconnect the Voltmeter Calibrator.

5-35. AMPLIFIER INPUT CAPACITANCE.

a. Apply a 1 kc signal from the Square Wave Generator through the Alignment Attenuator to the channel B INPUT.

b. Set:

SWEEP TIME	0.5 msec/cm
SWEEP MODE	PRESET
Channel A SENSITIVITY	5 volts/cm
VERNIER	CALIBRATED
Channel B SENSITIVITY	0.05 volts/cm
VERNIER	CALIBRATED

c. Adjust the output of the Square Wave Generator for 5 to 6 cm display height.

d. Set:

Vertical Presentation	CHANNEL B
Channel B POLARITY	+UP

e. Adjust C201 for best square wave (figure 5-5).

f. Set:

Channel B POLARITY	-UP

g. Adjust C202 for best square wave.

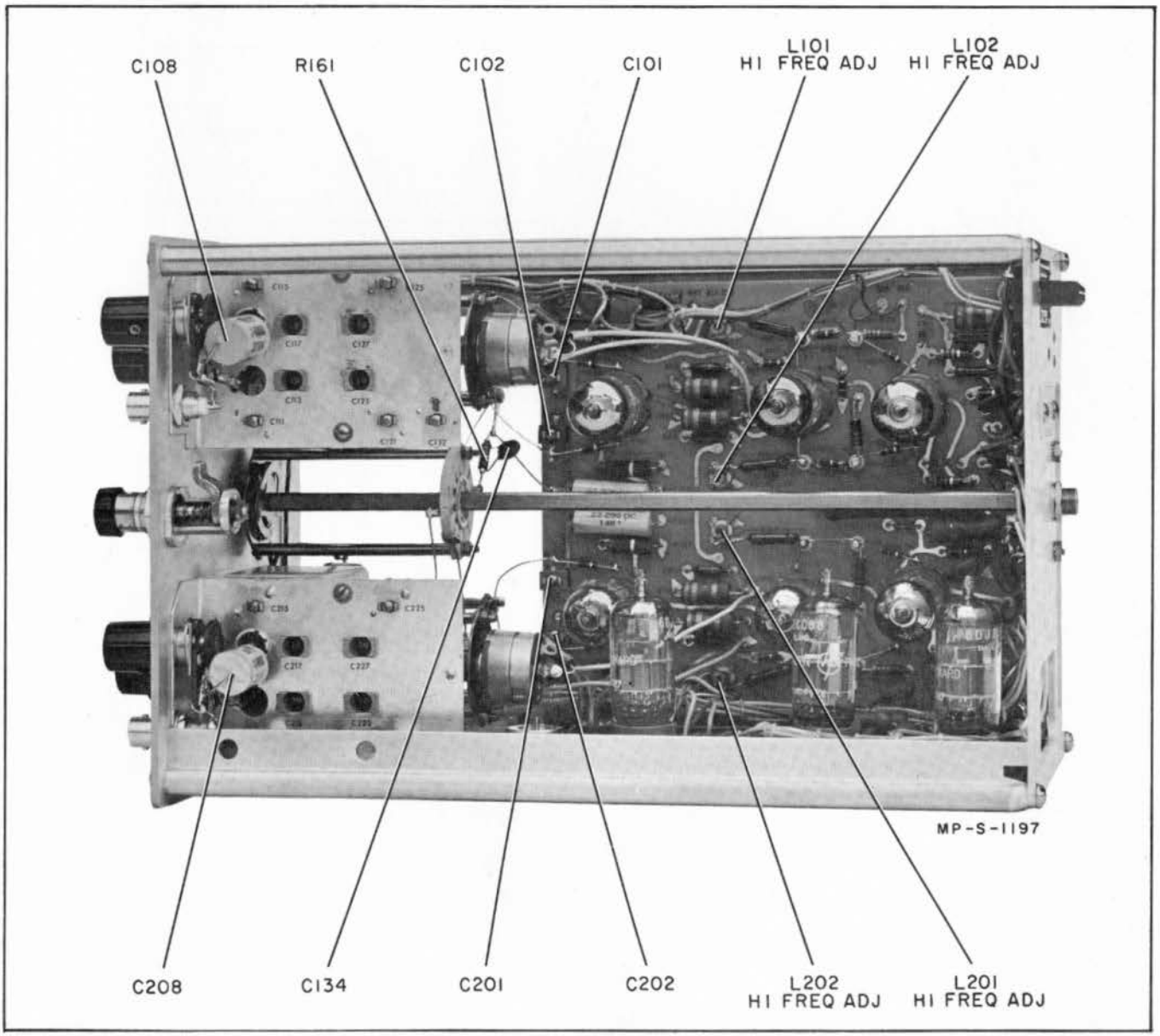


Figure 5-4. Parts Location, Right Side

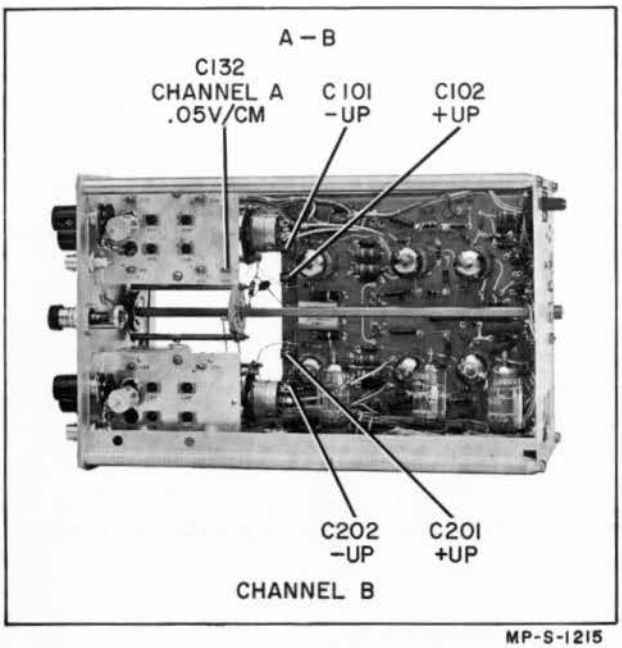


Figure 5-5. Amplifier Input Capacitance Adjustment Location

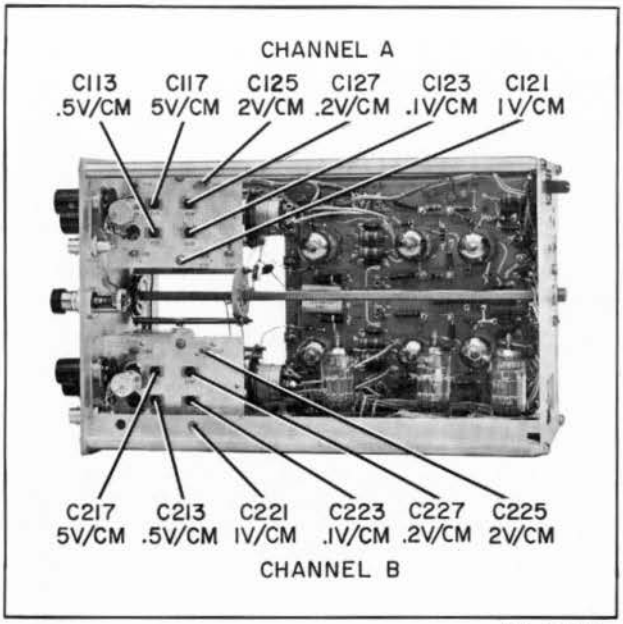


Figure 5-6. Attenuator Compensation Adjustment Location

h. Set:
Vertical Presentation . . . . . A-B
Channel A POLARITY . . . . . –UP

i. Adjust C101 for best square wave.

j. Set:
Channel A POLARITY . . . . . +UP

k. Adjust C102 for best square wave.

m. Disconnect Alignment Attenuator and Square Wave Generator from channel B INPUT and connect them to channel A INPUT.

n. Set:
Vertical Presentation . . . . . CHANNEL A
SENSITIVITY . . . . . 0.05 volts/cm

p. Adjust C132 for the best square wave.

q. Disconnect Alignment Attenuator and Square Wave Generator.

5-36. ATTENUATOR COMPENSATION.

a. Apply a 10 kc signal from the Square Wave Generator to the Channel A INPUT.

b. Set:
Vertical Presentation . . . . . CHANNEL A
SENSITIVITY . . . . . 0.1 volts/cm
VERNIER . . . . . CALIBRATED
SWEEP TIME . . . . . 50 μsec/cm

c. Adjust the Square Wave Generator output for 5 to 6 cm trace height.

d. Adjust capacitors as shown in table 5-6 for best square wave (figure 5-6).

e. Repeat steps a through d for channel B.

f. Disconnect Square Wave Generator.

Table 5-6. Attenuator Compensation

SENSITIVITY	ADJUST	
(volts/cm)	Channel A	Channel B
.1	C123	C223
.2	C127	C227
.5	C113	C213
1	C121	C221
2	C125	C225
5	C117	C217

5-37. ATTENUATOR INPUT CAPACITANCE.

a. Apply a 1 kc signal from the Square Wave Generator through the Alignment Attenuator to the channel A INPUT.

a. Set:
Vertical Presentation . . . . . CHANNEL A
SENSITIVITY . . . . . 0.5 volts/cm
SWEEP TIME . . . . . 0.5 msec/cm

c. Adjust the output of the Square Wave Generator for 5 to 6 cm trace height.

d. Adjust capacitors as shown in table 5-7 for best square wave (figure 5-7).

e. Repeat steps a through d for channel B.

f. Disconnect Alignment Attenuator and Square Wave Generator.

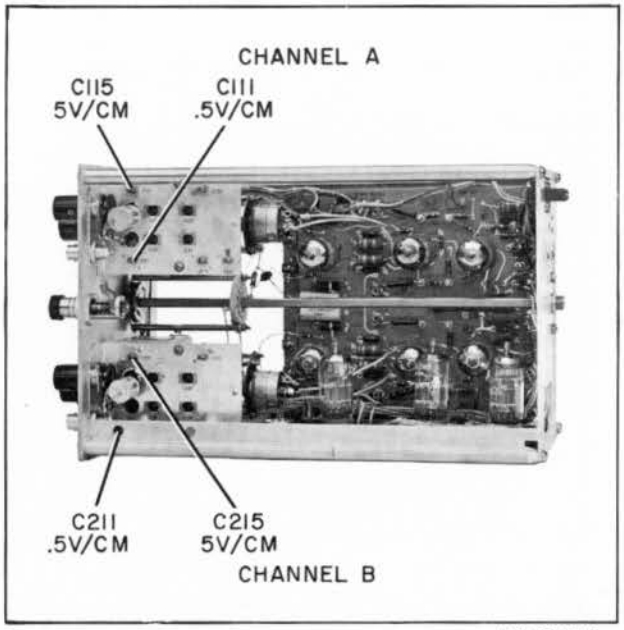


Figure 5-7. Attenuator Input Capacitance Adjustment Location

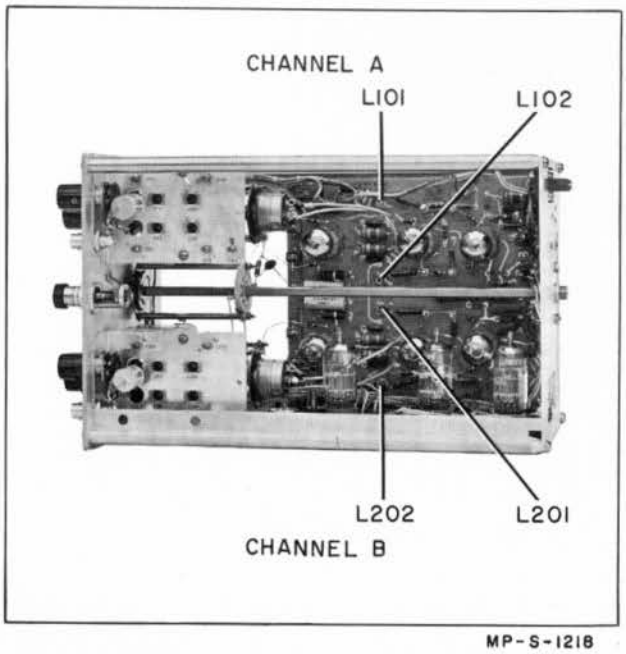


Figure 5-8. Pulse Response Adjustment Location

Table 5-7. Attenuator Input Capacitance

SENSITIVITY	ADJUST	
(volts/cm)	Channel A	Channel B
.5	C111	C211
5	C115	C215

5-38. PULSE RESPONSE.

a. Apply a signal from the Pulse Generator to the channel A INPUT, terminating the connecting cable with the Coaxial Termination.

b. Set:

Vertical Presentation	CHANNEL A
SENSITIVITY	0.05 volts/cm
SWEEP TIME	0.1 μsec/cm

c. Adjust the output of the Pulse Generator for a trace height approximately 5 cm high.

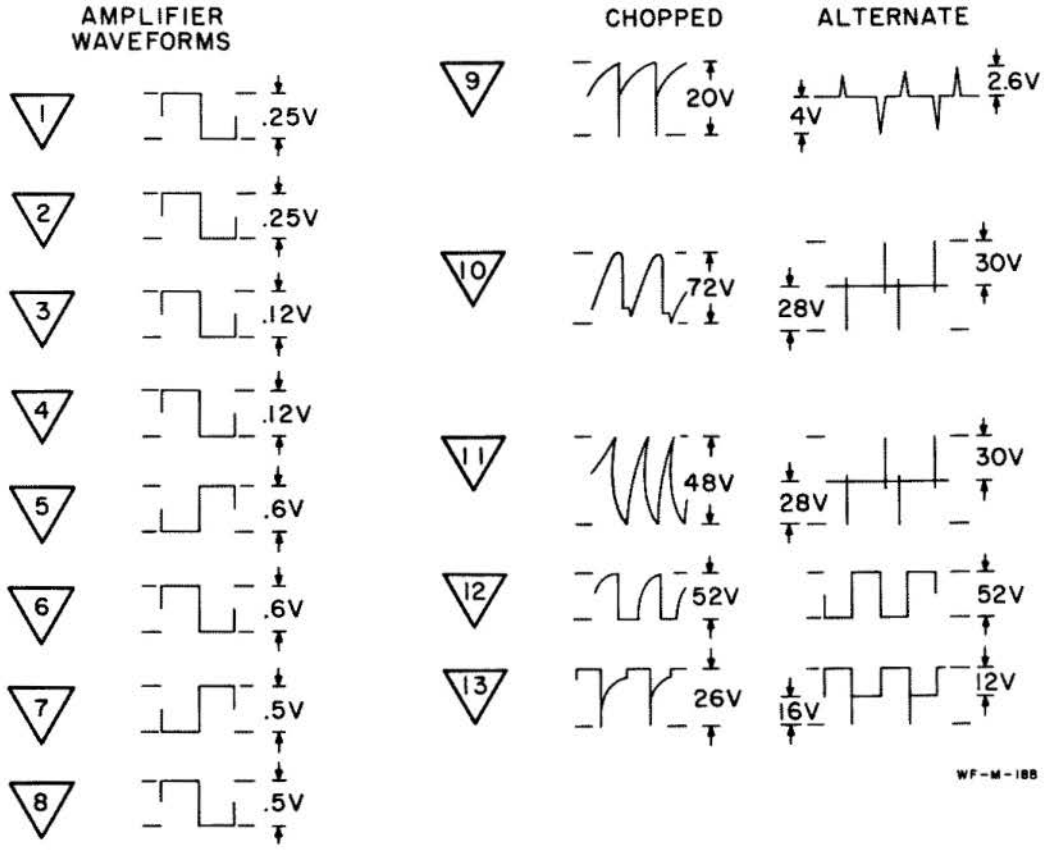
d. Adjust L101 and L102, Hi Freq Adj for a pulse response with a rise time of 9 nanoseconds or less and less than 1% overshoot (figure 5-8).

e. Repeat steps a through d for channel B. Adjust L201 and L202.

f. Disconnect Pulse Generator.

Schematic Diagram Notes

1. All values in ohms, microhenries, and picofarads unless otherwise noted.
2. Titles enclosed in boxes indicate front-panel engraving.
3. Conditions of measurement for dc voltages as follows:
   a. Vertical Presentation - CHANNEL A.
   b. VERTICAL POSITION - center of range.
   c. POLARITY - +UP.
   d. SENSITIVITY - 0.1 v/cm.
   e. VERNIER-CALIBRATED.
   f. AC-DC - DC.
   g. No signal input.



Conditions of measurement for amplifier waveforms:

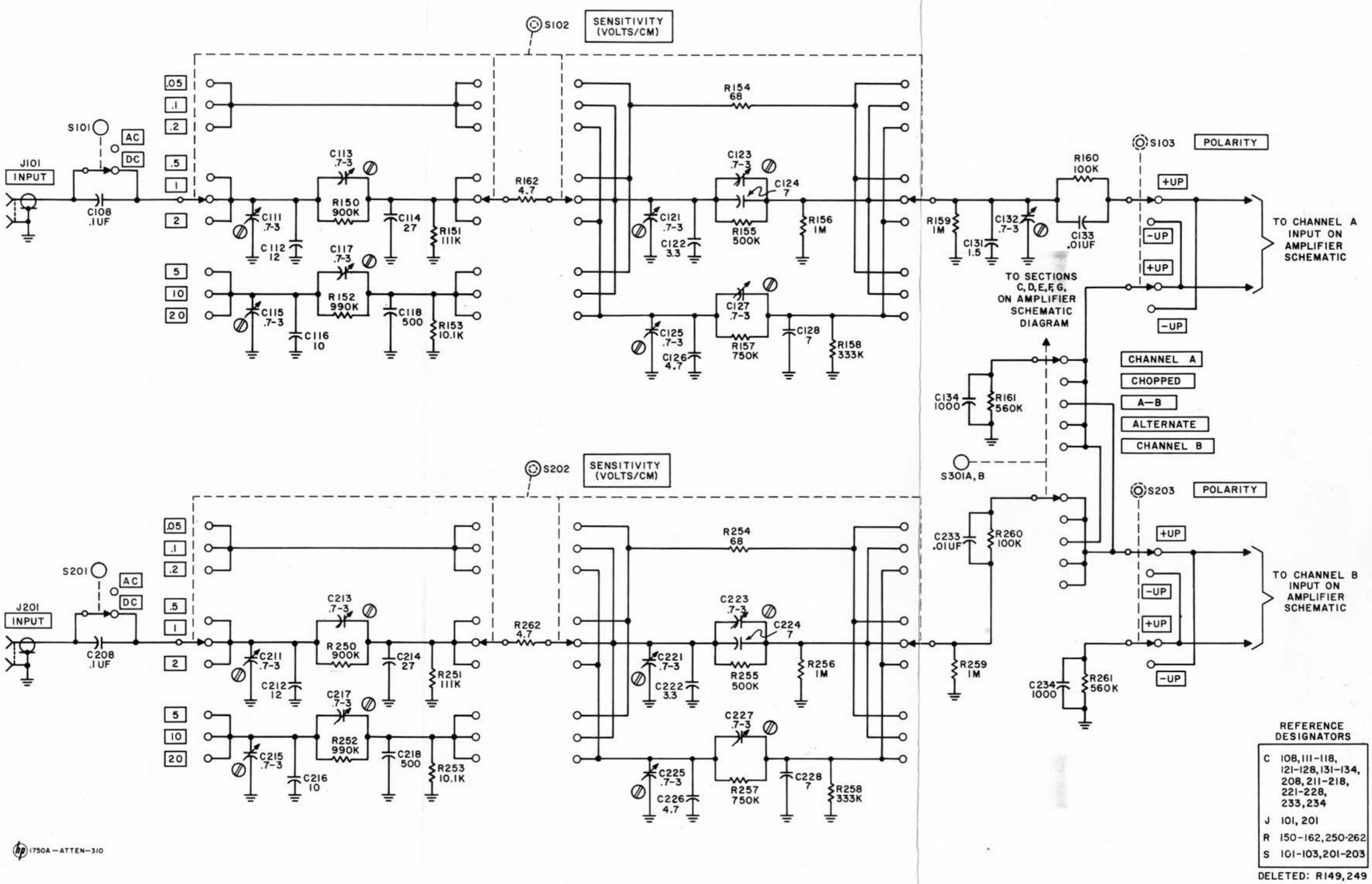
Vertical Presentation: CHANNEL A

SENSITIVITY: 2 volts/cm

VERNIER: CALIBRATED

POLARITY: +UP

10 Volt Calibrator input

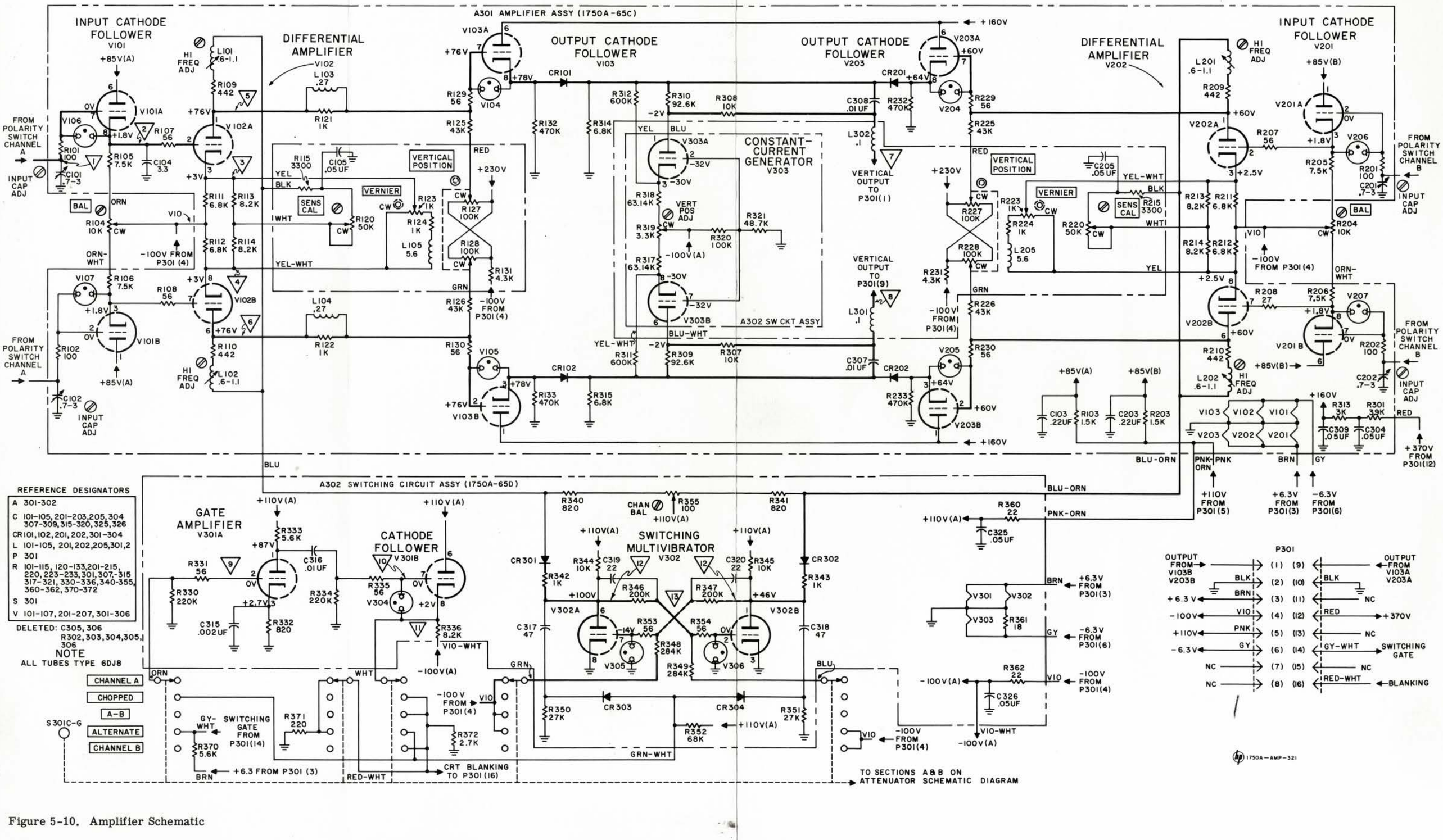


REFERENCE DESIGNATORS

C	108, 111-118, 121-128, 131-134, 208, 211-218, 221-228, 233, 234
J	101, 201
R	150-162, 250-262
S	101-103, 201-203

DELETED: R149, 249

Figure 5-9. Attenuator Schematic



REFERENCE DESIGNATORS

A 301-302

C 101-105, 201-203, 205, 304 307-309, 315-320, 325, 326

CR 101, 102, 201, 202, 301-304

L 101-105, 201, 202, 205, 301, 2

P 301

R 101-115, 120-133, 201-215, 220, 223-233, 301, 307, 315 317-321, 330-336, 340-355, 360-362, 370-372

S 301

V 101-107, 201-207, 301-306

DELETED: C305, 306 R302, 303, 304, 305, 306

NOTE
ALL TUBES TYPE 6DJ8

Figure 5-10. Amplifier Schematic

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section contains information for ordering replacement parts. Table 6-1 lists parts in alpha-numerical order of their reference designators and indicates the description and hp stock number of each part, together with any applicable notes. Table 6-2 lists parts in alpha-numerical order of their hp stock numbers and provides the following information on each part:

a. Description of the part (see list of abbreviations below).

b. Typical manufacturer of the part in a five-digit code; see list of manufacturers in appendix.

c. Manufacturer's stock number.

d. Total quantity used in the instrument (TQ column).

e. Recommended spare part quantity for complete maintenance during one year of isolated service (RS column).

6-3. Miscellaneous parts not indexed in table 6-1 are listed at the end of table 6-2.

6-4. ORDERING INFORMATION.

6-5. To order a replacement part, address order or inquiry either to your authorized Hewlett-Packard sales representative or to

CUSTOMER SERVICE
Hewlett-Packard Company
395 Page Mill Road
Palo Alto, California

or, in Western Europe, to

Hewlett-Packard S.A.
54-54bis Route des Acacias
Geneva, Switzerland

6-6. Specify the following information for each part:

a. Model and complete serial number of instrument.

b. Hewlett-Packard stock number.

c. Circuit reference designator.

d. Description.

6-7. To order a part not listed in tables 6-1 and 6-2, give a complete description of the part and include its function and location.

REFERENCE DESIGNATORS

A	= assembly	F	= fuse	P	= plug	V	= vacuum tube, neon bulb, photocell, etc.
B	= motor	FL	= filter	Q	= transistor	W	= cable
C	= capacitor	J	= jack	R	= resistor	X	= socket
CR	= diode	K	= relay	RT	= thermistor	Y	= crystal
DL	= delay line	L	= inductor	S	= switch	Z	= network
DS	= device signaling (lamp)	M	= meter	T	= transformer		
E	= misc electronic part	MP	= mechanical part				

ABBREVIATIONS

A	= amperes	F	= farads	NC	= normally closed
BP	= bandpass	FXD	= fixed	NE	= neon
BWO	= backward wave oscillator	GE	= germanium	NO	= normally open
CER	= ceramic	GL	= glass	NPO	= negative positive zero (zero temperature coefficient)
CMO	= cabinet mount only	GRD	= ground(ed)	NSR	= not separately replaceable
COEF	= coefficient	H	= henries	OBD	= order by description
COM	= common	HG	= mercury	OX	= oxide
COMP	= composition	HR	= hour(s)	P	= peak
CONN	= connection	IMPG	= impregnated	PC	= printed circuit board
CRT	= cathode-ray tube	INCD	= incandescent	PF	= picofarads = 10^{-12} farads
DEPC	= deposited carbon	INS	= insulation(ed)	PP	= peak-to-peak
EIA	= Tubes or transistors meeting Electronic Industires' Association standards will normally result in instrument operating within specifications; tubes and transistors selected for best performance will be supplied if ordered by hp stock numbers.	K	= kilo = 1000	PIV	= peak inverse voltage
		LIN	= linear taper	POR	= porcelain
		LOG	= logarithmic taper	POS	= position(s)
		MEG	= meg $=10^6$	POLY	= polystyrene
		M	= milli $=10^{-3}$	POT	= potentiometer
		MINAT	= minature	RECT	= rectifier
		METFLM	= metal film	ROT	= rotary
		MFR	= manufacturer	RMS	= root-mean-square
		MOM	= momentary	RMO	= rack mount only
		MTG	= mounting	S-B	= slow-blow
		MY	= mylar	SE	= selenium
				SECT	= section(s)
				SI	= silicon
				SIL	= silver
				SL	= slide
				SPL	= special
				TA	= tantalum
				TD	= time delay
				TI	= titanium dioxide
				TOG	= toggle
				TOL	= tolerance
				TRIM	= trimmer
				TWT	= traveling wave tube
				U	= micro $=10^{-6}$
				VAC	= vacuum
				VAR	= variable
				W/	= with
				W	= watts
				WW	= wirewound
				W/O	= without
				*	= optimum value selected at factory, average value shown (part may be omitted)

01194-6

ELECT = electrolytic
ENCAP = encapsulated

Table 6-1. Reference Designation Index

Circuit Reference		Stock No.	Description	Note
A101		1750A-34A	ASSY:ATTENUATOR	
A102		0BD#	ASSEMBLY:VERTICAL PRESENTATION	
A102			CONSISTS OF S301A-B AND S301C-G	
A103	THRU			
A200			NOT ASSIGNED	
A201		1750A-34B	ASSY:ATTENUATOR	
A202	THRU			
A300			NOT ASSIGNED	
A301		1750A-65C	ASSY:AMPLIFIER	
A302		1750A-65D	ASSY:SWITCHING CIRCUIT	
A303		~~3100-0308~~	ASSY:POLARITY SWITCH INCLUDES R127,R128	
A304		~~3100-0308~~ 3100-0725	ASSY:POLARITY SWITCH INCLUDES R227,R228	
C101		0132-0004	C:FXD VAR 0.7-3.0PF	
C102		0132-0004	C:FXD VAR 0.7-3.0PF	
C103		0170-0038	C:FXD MY 0.22UF 10% 200VDC#	
C104		0150-0059	C:FXD CER 3.3 PF +/- NP0 600 VDC#	
C105		0150-0052	C:FXD C.05 UF 20% 400 VDC#	
C106	THRU			
C107			NOT ASSIGNED	
C108		0170-0022	C:FXD MY 0.1UF 20% 600VDC#	
C109	THRU			
C110			NOT ASSIGNED	
C111		0132-0004	C:FXD VAR 0.7-3.0PF	
C112		0160-0132	C:FXD CER 12PF 5% 500VDC#	
C113		0132-0004	C:FXD VAR 0.7-3.0PF	
C114		0150-0115	C:FXD CER 27PF 10% 500VDC#	
C115		0132-0004	C:FXD VAR 0.7-3.0PF	
C116		0150-0063	C:FXD 10PF 500VDC#	
C117		0132-0004	C:FXD VAR 0.7-3.0PF	
C118		0160-0133	C:FXD MICA 500PF 10% 500VDC#	
C119	THRU			
C120			NOT ASSIGNED	
C121		0132-0004	C:FXD VAR 0.7-3.0PF	
C122		0150-0059	C:FXD CER 3.3 PF +/- NP0 600 VDC#	
C123		0132-0004	C:FXD VAR 0.7-3.0PF	
C124		0150-0074	C:FXD CER 7 PF +/-.5PF 500 VDC#	
C125		0132-0004	C:FXD VAR 0.7-3.0PF	
C126		0150-0089	C:FXD CER 4.7 PF +/-0.25 PF 500 VDC#	
C127		0132-0004	C:FXD VAR 0.7-3.0PF	
C128		0150-0074	C:FXD CER 7 PF +/-.5PF 500 VDC#	
C129	THRU			
C130			NOT ASSIGNED	
C131		0150-0091	C:FXD CER 1.5 PF +/-0.25 PF 500 VDC#	
C132		0132-0004	C:FXD VAR 0.7-3.0PF	
C133		0150-0012	C:FXD .01UF	
C134		0150-0069	C:FXD .001UF 500VDC#	
C135	THRU			
C200			NOT ASSIGNED	
C201		0132-0004	C:FXD VAR 0.7-3.0PF	
C202		0132-0004	C:FXD VAR 0.7-3.0PF	
C203		0170-0038	C:FXD MY 0.22UF 10% 200VDC#	

See introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

Circuit Reference	Stock No.	Description	Note
C204		NOT ASSIGNED	
C205	0150-0052	C:FXD C.05 UF 20% 400 VDCW	
C206 THRU			
C207		NOT ASSIGNED	
C208	0170-0022	C:FXD MY 0.1UF 20% 600VDCW	
C209 THRU			
C210		NOT ASSIGNED	
C211	0132-0004	C:FXD VAR 0.7-3.0PF	
C212	0160-0132	C:FXD CER 12PF 5% 500VDCW	
C213	0132-0004	C:FXD VAR 0.7-3.0PF	
C214	0150-0115	C:FXD CER 27PF 10% 500VDCW	
C215	0132-0004	C:FXD VAR 0.7-3.0PF	
C216	0150-0063	C:FXD 10PF 500VDCW	
C217	0132-0004	C:FXD VAR 0.7-3.0PF	
C218	0160-0133	C:FXD MICA 500PF 10% 500VDCW	
C219 THRU			
C220		NOT ASSIGNED	
C221	0132-0004	C:FXD VAR 0.7-3.0PF	
C222	0150-0059	C:FXD CER 3.3 PF +/- NPO 600 VDCW	
C223	0132-0004	C:FXD VAR 0.7-3.0PF	
C224	0150-0074	C:FXD CER 7 PF +/-.5PF 500 VDCW	
C225	0132-0004	C:FXD VAR 0.7-3.0PF	
C226	0150-0089	C:FXD CER 4.7 PF +/-0.25 PF 500 VDCW	
C227	0132-0004	C:FXD VAR 0.7-3.0PF	
C228	0150-0074	C:FXD CER 7 PF +/-.5PF 500 VDCW	
C229 THRU			
C232		NOT ASSIGNED	
C233	0150-0012	C:FXD .01UF 500VDCW	
C234	0150-0069	C:FXD .001UF 500VDCW	
C235 THRU			
C303		NOT ASSIGNED	
C304	0150-0052	C:FXD 0.05 UF 20% 400 VDCW	
C305 THRU			
C306		NOT ASSIGNED	
C307	0150-0012	C:FXD CER 0.01UF 20% 1000VDCW	
C308	0150-0012	C:FXD CER 0.01UF 20% 1000VDCW	
C309	0150-0052	C:FXD C.05 UF 20% 400 VDCW	
C310 THRU			
C314		NOT ASSIGNED	
C315	0150-0023	C:FXD CER 2000PF 20% 1000VDCW	
C316	0150-0012	C:FXD CER 0.01UF 20% 1000VDCW	
C317	0140-0039	C:FXD MICA 47PF 5% 300VDCW	
C318	0140-0039	C:FXD MICA 47PF 5% 300VDCW	
C319	0140-0034	C:FXD MICA 22 PF 5% 500 VDCW	
C320	0140-0034	C:FXD MICA 22 PF 5% 500 VDCW	
C321 THRU			
C324		NOT ASSIGNED	
C325	0150-0052	C:FXD C.05 UF 20% 400 VDCW	
C326	0150-0052	C:FXD C.05 UF 20% 400 VDCW	
CR101	1910-0016	SEMICON DEVICE DIODE GERMANIUM	
CR102	1910-0016	SEMICON DEVICE DIODE GERMANIUM	

See introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

Circuit Reference	Stock No.	Description	Note
CR103 THRU			
CR200		NOT ASSIGNED	
CR201	1910-0016	SEMICON DEVICE DIODE GERMANIUM	
CR202	1910-0016	SEMICON DEVICE DIODE GERMANIUM	
CR203 THRU			
CR300		NOT ASSIGNED	
CR301	1910-0016	SEMICON DEVICE DIODE GERMANIUM	
CR302	1910-0016	SEMICON DEVICE DIODE GERMANIUM	
CR303	1910-0016	SEMICON DEVICE DIODE GERMANIUM	
CR304	1910-0016	SEMICON DEVICE DIODE GERMANIUM	
J101	1250-0118	CONNECTOR:BNC	
J102 THRU			
J200		NOT ASSIGNED	
J201	1250-0118	CONNECTOR:BNC	
L101	1750A-60A	COIL:VAR	
L102	1750A-60A	COIL:VAR	
L103	9140-0095	COIL FXD RF: 0.27UHY	
L104	9140-0095	COIL FXD RF: 0.27UHY	
L105	9140-0135	COIL FXD RF 5.6 UHY	
L106 THRU			
L200		NOT ASSIGNED	
L201	1750A-60A	COIL:VAR	
L202	1750A-60A	COIL:VAR	
L203 THRU			
L204		NOT ASSIGNED	
L205	9140-0135	COIL FXD RF 5.6 UHY	
L206 THRU			
L300		NOT ASSIGNED	
L301	9140-0120	COIL FXD 0.1 UHY	
L302	9140-0120	COIL FXD 0.1 UHY	
P301	1251-0006	CONNECTOR:MALE 16-CONTACT	
R101	0684-1011	R:FXD COMP 100 OHMS 10% 1/4W	
R102	0684-1011	R:FXD COMP 100 OHMS 10% 1/4W	
R103	0690-1521	R:FXD COMP 1500 OHMS 10% 1W	
R104	2100-0234	R:VAR COMP 10K OHM 10% LIN 2W	
R105	0761-0016	R:FXD MET FLM 7500 OHM 5% 1W	
R106	0761-0016	R:FXD MET FLM 7500 OHM 5% 1W	
R107	0684-5601	R:FXD COMP 56 OHMS 10% 1/4W	
R108	0684-5601	R:FXD COMP 56 OHMS 10% 1/4W	
R109	0727-0387	R:FXD DEP C 442 OHMS 1% 1/2W	
R110	0727-0387	R:FXD DEP C 442 OHMS 1% 1/2W	
R111	0764-0012	R:FXD MET FLM 6800 OHM 5% 2W	
R112	0764-0012	R:FXD MET FLM 6800 OHM 5% 2W	
R113	0758-0048	R:FXD MET FLM 8.2K OHMS 5% 1/2W	
R114	0758-0048	R:FXD MET FLM 8.2K OHMS 5% 1/2W	
R115	0758-0010	R:FXD METALLIC OXIDE 3.3K OHMS 5% 1/2W	
R116 THRU			
R119		NOT ASSIGNED	
R120	2100-0044	R:VAR COMP 50K OHMS 10% 2W	
R121	0684-1021	R:FXD COMP 1000 OHMS 10% 1/4W	

See introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

Circuit Reference		Stock No.	Description	Note
R122		0684-1021	R:FXD COMP 1000 OHMS 10% 1/4W	
R123		2100-0316	R:VAR COMP 1000 OHM 20% 90 CCWLOG 1/2W	
R124		0687-1021	R:FXD COMP 1000 OHMS 10% 1/2W	
R125		0686-4335	R:FXD COMP 43K OHMS 5% 1/2W	
R126		0686-4335	R:FXD COMP 43K OHMS 5% 1/2W	
R127			NOT SEPARATELY REPLACEABLE PARTOF A303	
R128			NOT SEPARATELY REPLACEABLE PARTOF A303	
R129		0684-5601	R:FXD COMP 56 OHMS 10% 1/4W	
R130		0684-5601	R:FXD COMP 56 OHMS 10% 1/4W	
R131		0686-4325	R:FXD COMP 4300 OHMS 5% 1/2W	
R132		0687-4741	R:FXD COMP 470K OHMS 10% 1/2W	
R133		0687-4741	R:FXD COMP 470K OHMS 10% 1/2W	
R134	THRU			
R149			NOT ASSIGNED	
R150		0727-0261	R:FXD 900K 1% 1/2W	
R151		0727-0212	R:FXD DEPC 111K OHM 1% 1/2W	
R152		0727-0271	R:FXD DEPC 990K OHM 1% 1/2W	
R153		0727-0158	R:FXD 10.1K OHM 1/2W	
R154		0684-6801	R:FXD COMP 68 OHMS 10% 1/4W	
R155		0727-0245	R:FXD DEPC 500K OHM 1% 1/2W	
R156		0727-0276	R:FXD DEPC 1M OHM 1% 1/2W	
R157		0727-0254	R:FXD DEPC 750K OHM 1% 1/2W	
R158		0727-0234	R:FXD DEPC 333K OHM 1% 1/2W	
R159		0727-0276	R:FXD DEPC 1M OHM 1% 1/2W	
R160		0687-1041	R:FXD COMP 100K OHM 10% 1/2W	
R161		0687-5641	R:FXD COMP 560K OHMS 10% 1/2W	
R162		0698-0001	R:FXD COMP 4.7 OHM 5% 1/2W	
R163	THRU			
R200			NOT ASSIGNED	
R201		0684-1011	R:FXD COMP 100 OHMS 10% 1/4W	
R202		0684-1011	R:FXD COMP 100 OHMS 10% 1/4W	
R203		0690-1521	R:FXD COMP 1500 OHMS 10% 1W	
R204		2100-0234	R:VAR COMP 10K OHM 10% LIN 2W	
R205		0761-0016	R:FXD MET FLM 7500 OHM 5% 1W	
R206		0761-0016	R:FXD MET FLM 7500 OHM 5% 1W	
R207		0684-5601	R:FXD COMP 56 OHMS 10% 1/4W	
R208		0684-2701	R:FXD COMP 27 OHMS 10% 1/4W	
R209		0727-0387	R:FXD DEP C 442 OHMS 1% 1/2W	
R210		0727-0387	R:FXD DEP C 442 OHMS 1% 1/2W	
R211		0764-0012	R:FXD MET FLM 6800 OHM 5% 2W	
R212		0764-0012	R:FXD MET FLM 6800 OHM 5% 2W	
R213		0758-0048	R:FXD MET FLM 8.2K OHMS 5% 1/2W	
R214		0758-0048	R:FXD MET FLM 8.2K OHMS 5% 1/2W	
R215		0758-0010	R:FXD METALLIC OXIDE 3.3K OHMS 5% 1/2W	
R216	THRU			
R219			NOT ASSIGNED	
R220		2100-0044	R:VAR COMP 50K OHMS 10% 2W	
R221	THRU			
R222			NOT ASSIGNED	
R223		2100-0316	R:VAR COMP 1000 OHM 20% 90 CCWLOG 1/2W	
R224		0687-1021	R:FXD COMP 1000 OHMS 10% 1/2W	

See introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

Circuit Reference		Stock No.	Description	Note
R225		0686-4335	R:FXD COMP 43K OHMS 5% 1/2W	
R226		0686-4335	R:FXD COMP 43K OHMS 5% 1/2W	
R227			NOT SEPARATELY REPLACEABLE PARTOF A304	
R228			NOT SEPARATELY REPLACEABLE PARTOF A304	
R229		0684-5601	R:FXD COMP 56 OHMS 10% 1/4W	
R230		0684-5601	R:FXD COMP 56 OHMS 10% 1/4W	
R231		0686-4325	R:FXD COMP 4300 OHMS 5% 1/2W	
R232		0687-4741	R:FXD COMP 470K OHMS 10% 1/2W	
R233		0687-4741	R:FXD COMP 470K OHMS 10% 1/2W	
R234	THRU			
R249			NOT ASSIGNED	
R250		0727-0261	R:FXD 900K 1% 1/2W	
R251		0727-0212	R:FXD DEPC 111K OHM 1% 1/2W	
R252		0727-0271	R:FXD DEPC 990K OHM 1% 1/2W	
R253		0727-0158	R:FXD 10.1K OHM 1/2W	
R254		0684-6801	R:FXD COMP 68 OHMS 10% 1/4W	
R255		0727-0245	R:FXD DEPC 500K OHM 1% 1/2W	
R256		0727-0276	R:FXD DEPC 1M OHM 1% 1/2W	
R257		0727-0254	R:FXD DEPC 750K OHM 1% 1/2W	
R258		0727-0234	R:FXD DEPC 333K OHM 1% 1/2W	
R259		0727-0276	R:FXD DEPC 1M OHM 1% 1/2W	
R260		0687-1041	R:FXD COMP 100K OHM 10% 1/2W	
R261		0687-5641	R:FXD COMP 560K OHMS 10% 1/2W	
R262		0698-0001	R:FXD COMP 4.7 OHM 5% 1/2W	
R263	THRU			
R300			NOT ASSIGNED	
R301		0776-0008	R:FXD MET FLM 3900 OHMS 5% 7W	
R302	THRU			
R306			NOT ASSIGNED	
R307		0687-1031	R:FXD COMP 10K OHMS 10% 1/2W	
R308		0687-1031	R:FXD COMP 10K OHMS 10% 1/2W	
R309		0727-0205	R:FXD DEPC 92.6K OHM 1% 1/2W	
R310		0727-0205	R:FXD DEPC 92.6K OHM 1% 1/2W	
R311		0727-0246	R:FXD DEPC 600K OHM 1% 1/2W	
R312		0727-0246	R:FXD DEPC 600K OHM 1% 1/2W	
R313		0767-0016	R:FXD MET FLM 3000 OHMS 5% 3W	
R314		0764-0012	R:FXD MET FLM 6800 OHM 5% 2W	
R315		0764-0012	R:FXD MET FLM 6800 OHM 5% 2W	
R316			NOT ASSIGNED	
R317		0727-0346	R:FXD DEP C 63.14K OHMS 1/2% 1/2W	
R318		0727-0346	R:FXD DEP C 63.14K OHMS 1/2% 1/2W	
R319		2100-0182	R:VAR COMP 3300 OHM 10% LIN 0.3W	
R320		0727-0208	R:FXD 100K OHMS 1% 1/2W	
R321		0727-0193	R:FXD DEPC 48.7K OHMS 1% 1/2W	
R322	THRU			
R329			NOT ASSIGNED	
R330		0687-2241	R:FXD COMP 220K OHMS 10% 1/2W	
R331		0684-5601	R:FXD COMP 56 OHMS 10% 1/4W	
R332		0687-8211	R:FXD COMP 820 OHMS 10% 1/2W	
R333		0765-0009	R:FXD MET FLM 5600 OHMS 10% 2W	
R334		0687-2241	R:FXD COMP 220K OHMS 10% 1/2W	

See introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

Circuit Reference	Stock No.	Description	Note
R335	0684-5601	R:FXD COMP 56 OHMS 10% 1/4W	
R336	0765-0005	R:FXD MET FLM 8200 OHMS 10% 2W	
R337 THRU			
R339		NOT ASSIGNED	
R340	0767-0018	R:FXD MET FLM 820 OHMS 5% 3W	
R341	0767-0018	R:FXD MET FLM 820 OHMS 5% 3W	
R342	0758-0003	R:FXD MET FLM 1000 OHMS 5% 1/2W	
R343	0758-0003	R:FXD MET FLM 1000 OHMS 5% 1/2W	
R344	0758-0006	R:FXD MET FLM 10K OHMS 5% 0.5W	
R345	0758-0006	R:FXD MET FLM 10K OHMS 5% 0.5W	
R346	0727-0221	R:FXD DEPC 200K OHM 1% 1/2W	
R347	0727-0221	R:FXD DEPC 200K OHM 1% 1/2W	
R348	0727-0230	R:FXD DEPC 284K OHM 1% 1/2W	
R349	0727-0230	R:FXD DEPC 284K OHM 1% 1/2W	
R350	0687-2731	R:FXD COMP 27K OHMS 10% 1/2W	
R351	0687-2731	R:FXD COMP 27K OHMS 10% 1/2W	
R352	0687-6831	R:FXD COMP 68K OHMS 10% 1/2W	
R353	0684-5601	R:FXD COMP 56 OHMS 10% 1/4W	
R354	0684-5601	R:FXD COMP 56 OHMS 10% 1/4W	
R355	2100-0108	R:VAR COMP 100 OHMS 30% LIN 1/3W	
R356 THRU			
R359		NOT ASSIGNED	
R360	0687-2201	R:FXD COMP 22 OHMS 10% 1/2W	
R361	0812-0012	R:FXD WW 18 OHMS 5% 3W	
R362	0687-2201	R:FXD COMP 22 OHMS 10% 1/2W	
R363 THRU			
R369		NOT ASSIGNED	
R370	0684-5621	R:FXD COMP 5600 OHMS 10% 1/4W	
R371	0684-2211	R:FXD COMP 220 OHMS 10% 1/4W	
R372	0687-2721	R:FXD COMP 2700 OHMS 10% 1/2W	
S101	3100-0211	SWITCH ROTARY 1 SECT 2 POS	
S102	3100-0307	SWITCH:ROTARY 2 SECT 9 POS NOT RECOMMENDED FOR FIELD REPLACEMENT	
S103	3100-0308	SWITCH:ROTARY 1SECT 2POS.	
S104 THRU			
S200		NOT ASSIGNED	
S201	3100-0211	SWITCH ROTARY 1 SECT 2 POS	
S202	3100-0307	SWITCH:ROTARY 2 SECT 9 POS NOT RECOMMENDED FOR FIELD REPLACEMENT	
S203	3100-0308	SWITCH:ROTARY 1 SECT 2 POS	
S204 THRU			
S300		NOT ASSIGNED	
S301	3100-0351	SWITCH:ROTARY 1SECT 5 POS WAFERS A AND B ONLY	
S301	3100-0352	SWITCH:ROTARY 1SECT 5 POS WAFERS C THROUGH G ONLY	
V101	1932-0022	ELECTRON TUBE: DUAL TRIODE	
V102	1932-0022	ELECTRON TUBE: DUAL TRIODE	
V103	1932-0022	ELECTRON TUBE: DUAL TRIODE	
V104	2140-0008	LAMP:NEON	
V105	2140-0008	LAMP:NEON	
V106	2140-0008	LAMP:NEON	

See introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

Circuit Reference	Stock No.	Description	Note
V107	2140-0008	LAMP:NEON	
V108 THRU			
V200		NOT ASSIGNED	
V201	1932-0022	ELECTRON TUBE: DUAL TRIODE	
V202	1932-0022	ELECTRON TUBE: DUAL TRIODE	
V203	1932-0022	ELECTRON TUBE: DUAL TRIODE	
V204	2140-0006	LAMP:NEON	
V205	2140-0008	LAMP:NEON	
V206	2140-0006	LAMP:NEON	
V207	2140-0008	LAMP:NEON	
V208 THRU			
V300		NOT ASSIGNED	
V301	1932-0022	ELECTRON TUBE: DUAL TRIODE	
V302	1932-0022	ELECTRON TUBE: DUAL TRIODE	
V303	1932-0022	ELECTRON TUBE: DUAL TRIODE	
V304	2140-0008	LAMP:NEON	
V305	2140-0006	LAMP:NEON	
V306	2140-0008	LAMP:NEON	
XV101	1200-0058	SOCKET:TUBE 9PIN MINAT.	
XV102	1200-0058	SOCKET:TUBE 9PIN MINAT.	
XV103	1200-0058	SOCKET:TUBE 9PIN MINAT.	
XV104 THRU			
XV200		NOT ASSIGNED	
XV201	1200-0058	SOCKET:TUBE 9PIN MINAT.	
XV202	1200-0058	SOCKET:TUBE 9PIN MINAT.	
XV203	1200-0058	SOCKET:TUBE 9PIN MINAT.	
XV204 THRU			
XV300		NOT ASSIGNED	
XV301	1200-0062	SOCKET:TUBE 9 PIN MINIATURE	
XV302	1200-0062	SOCKET:TUBE 9 PIN MINIATURE	
XV303	1200-0062	SOCKET:TUBE 9 PIN MINIATURE	
		MISCELLANEOUS	
	G-74AT	KNOB:POLARITY	
	G-74AU	KNOB:EXTERNAL VERNIER.	
	G-74AU	KNOB:VERNIER	
	G-74BE	KNOB:VERTICAL POSITION	
	G-74BS	KNOB:VERTICAL PRESENTATION	
	G-74CA	KNOB:AC-DC	
	G-74CE	KNOB:LOCK	
	G-74Q	KNOB:SENSITIVITY	

See introduction to this section

Table 6-2. Replaceable Parts

Stock No.	Description #	Mfr.	Mfr. Part No.	TQ	RS
0132-0004	C:FXD VAR 0.7-3.0PF	28480	0132-0004	21	5
0140-0034	C:FXD MICA 22 PF 5% 500 VDCW	76433	RCM15E220J	2	1
0140-0039	C:FXD MICA 47PF 5% 300VDCW	76433		2	1
0150-0012	C:FXD .01UF	56289	H 1036	5	1
0150-0023	C:FXD CER 2000PF 20% 1000VDCW	91418	TYPE JF .002 20%	1	1
0150-0052	C:FXD C.05 UF 20% 400 VDCW	05729	20X503MC4	6	2
0150-0059	C:FXD CER 3.3 PF +/- NPO 600 VDCW	72982	301 000 C0J0 339C	3	1
0150-0063	C:FXD 10PF 500VDCW	72982	CC20CG100D	2	1
0150-0069	C:FXD .001UF 500VDCW	72982	801-010X5	2	1
0150-0074	C:FXD CER 7 PF +/-.5PF 500 VDCW	72982	301 000 C0H0 709D	4	1
0150-0089	C:FXD CER 4.7 PF +/-0.25 PF 500 VDCW	72982	301 011 C0H0 479C	2	1
0150-0091	C:FXD CER 1.5 PF +/-0.25 PF 500 VDCW	72982	301 011 C0K0 159C	1	1
0150-0115	C:FXD CER 27PF 10% 500VDCW	71590	CC20 TCN 27	2	1
0160-0132	C:FXD CER 12PF 5% 500VDCW	72982	TYPE 301	2	1
0160-0133	C:FXD MICA 500PF 10% 500VDCW	72982	666 003	2	1
0170-0022	C:FXD MY 0.1UF 20% 600VDCW	09134	TYPE 27	2	1
0170-0038	C:FXD MY 0.22UF 10% 200VDCW	56289	TYPE 148P 148P22492	2	1
0684-1011	R:FXD COMP 100 OHMS 10% 1/4W	01121	CB 1011	4	1
0684-1021	R:FXD COMP 1000 OHMS 10% 1/4W	01121	CB 1021	2	1
0684-2211	R:FXD COMP 220 OHMS 10% 1/4W	01121	CB 2211	1	1
0684-2701	R:FXD COMP 27 OHMS 10% 1/4W	01121	CB 2701	1	1
0684-5601	R:FXD COMP 56 OHMS 10% 1/4W	01121	CB 5601	11	3
0684-5621	R:FXD COMP 5600 OHMS 10% 1/4W	01121	CB 5621	1	1
0684-6801	R:FXD COMP 68 OHMS 10% 1/4W	01121	CB 6801	2	1
0686-4325	R:FXD COMP 4300 OHMS 5% 1/2W	01121	EB 4325	2	1
0686-4335	R:FXD COMP 43K OHMS 5% 1/2W	01121	EB 4335	4	1
0687-1021	R:FXD COMP 1000 OHMS 10% 1/2W	01121	EB 1021	2	1
0687-1031	R:FXD COMP 10K OHMS 10% 1/2W	01121	EB 1031	2	1
0687-1041	R:FXD COMP 100K OHM 10% 1/2W	01121	EB 1041	2	1
0687-2201	R:FXD COMP 22 OHMS 10% 1/2W	01121	EB 2201	2	1
0687-2241	R:FXD COMP 220K OHMS 10% 1/2W	01121	EB 2241	2	1
0687-2721	R:FXD COMP 2700 OHMS 10% 1/2W	01121	EB 2721	1	1
0687-2731	R:FXD COMP 27K OHMS 10% 1/2W	01121	EB 2731	2	1
0687-4741	R:FXD COMP 470K OHMS 10% 1/2W	01121	EB 4741	4	1
0687-5641	R:FXD COMP 560K OHMS 10% 1/2W	01121	EB 5641	2	1
0687-6831	R:FXD COMP 68K OHMS 10% 1/2W	01121	EB 6831	1	1
0687-8211	R:FXD COMP 820 OHMS 10% 1/2W	01121	EB 8211	1	1
0690-1521	R:FXD COMP 1500 OHMS 10% 1W	01121	GB 1521	2	1
0698-0001	R:FXD COMP 4.7 OHM 5% 1/2W	01121	EB 4705	2	1
0727-0158	R:FXD 10.1K OHM 1/2W	19701	DC12CR5	2	1
0727-0193	R:FXD DEPC 48.7K OHMS 1% 1/2W	19701	DC 1/2AR5	1	1
0727-0205	R:FXD DEPC 92.6K OHM 1% 1/2W	19701	DC 1/2C R5	2	1
0727-0208	R:FXD 100K OHMS 1% 1/2W	19701	DC1/2CR5	1	1
0727-0212	R:FXD DEPC 111K OHM 1% 1/2W	19701	DC 1/2C R5	2	1
0727-0221	R:FXD DEPC 200K OHM 1% 1/2W	19701	DC 1/2A R5	2	1
0727-0230	R:FXD DEPC 284K OHM 1% 1/2W	19701	DC1/2CR5-2843 F	2	1
0727-0234	R:FXD DEPC 333K OHM 1% 1/2W	19701	DC 1/2C R5	2	1
0727-0245	R:FXD DEPC 500K OHM 1% 1/2W	19701	DC 1/2C R5	2	1
0727-0246	R:FXD DEPC 600K OHM 1% 1/2W	19701	DC 1/2C R5	2	1
0727-0254	R:FXD DEPC 750K OHM 1% 1/2W	19701	DC 1/2C R5	2	1

See introduction to this section

Table 6-2. Replaceable Parts (Cont'd)

Stock No.	Description #	Mfr.	Mfr. Part No.	TQ	RS
0727-0261	R:FXD 900K 1% 1/2W	19701	DC12CR5	2	1
0727-0271	R:FXD DEPC 990K OHM 1% 1/2W	19701	DC 1/2C R5	2	1
0727-0276	R:FXD DEPC 1M OHM 1% 1/2W	19701	DC 1/2C R5	4	1
0727-0346	R:FXD DEP C 63.14K OHMS 1/2% 1/2W	19701	DC 1/2A R5	2	1
0727-0367	R:FXD DEP C 442 OHMS 1% 1/2W	19701	DC 1/2A R5	4	1
0758-0003	R:FXD MET FLM 1000 OHMS 5% 1/2W	07115	C 20/1K-5%-1/2W	2	1
0758-0006	R:FXD MET FLM 10K OHMS 5% 0.5W	07115	C 20	2	1
0758-0010	R:FXD METALLIC OXIDE 3.3K OHMS 5% 1/2W	07115	C20	2	1
0758-0048	R:FXD MET FLM 8.2K OHMS 5% 1/2W	07115	C20	4	1
0761-0016	R:FXD MET FLM 7500 OHM 5% 1W	07115	C 32	4	1
0764-0012	R:FXD MET FLM 6800 OHM 5% 2W	07115	C 42	6	2
0765-0005	R:FXD MET FLM 8200 OHMS 10% 2W	07115	C42S	1	1
0765-0009	R:FXD MET FLM 5600 OHMS 10% 2W	07115	C 42	1	1
0767-0016	R:FXD MET FLM 3000 OHMS 5% 3W	07115	LPI 3	1	1
0767-0018	R:FXD MET FLM 820 OHMS 5% 3W	07115	LPI 3	2	1
0776-0008	R:FXD MET FLM 3900 OHMS 5% 7W	07115	LPI 7	1	1
0812-0012	R:FXD WW 18 OHMS 5% 3W	94310		1	1
1200-0058	SOCKET:TUBE 9PIN MINAT.	91662	3901PHSPTD	6	2
1200-0062	SOCKET:TUBE 9 PIN MINIATURE	71785	1215111060	3	1
1250-0118	CONNECTOR:BNC	91737	8427	2	1
1251-0006	CONNECTOR:MALE 16-CONTACT	02660	26-4100-16P	1	1
1910-0016	SEMICON DEVICE DIODE GERMANIUM	93332	D2361	8	8
1932-0022	ELECTRON TUBE: DUAL TRIODE	73445	6DJ8/ECC 88	9	9
2100-0044	R:VAR COMP 50K OHMS 10% 2W	28480	2100 0044	2	1
2100-0108	R:VAR COMP 100 OHMS 30% LIN 1/3W	28480	2100 0108	1	1
2100-0182	R:VAR COMP 3500 OHM 10% LIN 0.3W	28480	2100 0182	1	1
2100-0234	R:VAR COMP 10K OHM 10% LIN 2W	01121	JA1NU56S103MA	2	1
2100-0316	R:VAR COMP 1000 OHM 20% 90 CCWLOG 1/2W	28480	2100 0316	2	1
2140-0008	LAMP:NEON	24455	NE2	11	11
3100-0211	SWITCH ROTARY 1 SECT 2 POS	28480	3100 0211	2	1
3100-0307	SWITCH:ROTARY 2 SECT 9 POS	28480	3100 0307	2	1
3100-0308	ASSY:POLARITY SWITCH INCLUDES R127:R128			3	1
3100-0351	SWITCH:ROTARY 1SECT 5 POS	28480	3100-0351	1	1
3100-0352	SWITCH:ROTARY 1SECT 5 POS	28480	3100-0352	1	1
9140-0095	COIL FXD RF: 0.27UHY	28480	9140 0095	2	1
9140-0120	COIL FXD 0.1 UHY	28480	9140 0120	2	1
9140-0135	COIL FXD RF 5.6 UHY	28480	9140 0135	2	1
1750A-34A	ASSY:ATTENUATOR	28480	1750A-34A	1	1
1750A-34B	ASSY:ATTENUATOR	28480	1750A-34B	1	1
1750A-60A	COIL:VAR	28480	1750A-60A	4	1
1750A-65C	ASSY:AMPLIFIER			1	1
1750A-65D	ASSY:SWITCHING CIRCUIT			1	1
G-74AT	KNOB:POLARITY	28480	G74AT	2	1
G-74AU	KNOB:VERNIER	28480	G74AU	4	1
G-74BE	KNOB:VERTICAL POSITION	28480	G74BE	2	1
G-74BS	KNOB:VERTICAL PRESENTATION	28480	G74BS	1	1
G-74CA	KNOB:AC-DC	28480	G74CA	2	1
G-74CE	KNOB:LOCK	28480	G74CE	1	1
OBD#	ASSEMBLY:VERTICAL PRESENTATION			1	1
G74Q	KNOB:SENSITIVITY	28480	G74Q	2	1

See introduction to this section

APPENDIX
CODE LIST OF MANUFACTURERS (Sheet 1 of 2)

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) and their latest supplements. The date of revision and the date of the supplements used appear at the bottom of each page. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 handbooks.

CODE NO.	MANUFACTURER	ADDRESS
00136	McCoy Electronics	Mount Holly Springs, Pa.
00334	Humidial Co.	Colton, Calif.
00335	Westrex Corp.	New York, N.Y.
00373	Garlock Packing Co., Electronic Products Div.	Camden, N.J.
00656	Aerovox Corp.	New Bedford, Mass.
00779	Amp, Inc.	Harrisburg, Pa.
00781	Aircraft Radio Corp.	Boonton, N.J.
00815	Northern Engineering Laboratories, Inc.	Burlington, Wis.
00853	Sangamo Electric Company, Ordill Division (Capacitors)	Marion, Ill.
00866	Goe Engineering Co.	Los Angeles, Calif.
00891	Carl E. Holmes Corp.	Los Angeles, Calif.
01121	Allen Bradley Co.	Milwaukee, Wis.
01255	Litton Industries, Inc.	Beverly Hills, Calif.
01281	Pacific Semiconductors, Inc.	Culver City, Calif.
01295	Texas Instruments, Inc. Transistor Products Div.	Dallas, Texas
01349	The Alliance Mfg. Co.	Alliance, Ohio
01561	Chassi-Trak Corp.	Indianapolis, Ind.
01589	Pacific Relays, Inc.	Van Nuys, Calif.
01930	Amerock Corp.	Rockford, Ill.
01961	Pulse Engineering Co.	Santa Clara, Calif.
02114	Ferroxcube Corp. of America	Saugerties, N.Y.
02286	Cole Mfg. Co.	Palo Alto, Calif.
02660	Amphenol-Borg Electronics Corp.	Chicago, Ill.
02735	Radio Corp. of America Semiconductor and Materials Div.	Somerville, N.J.
02771	Vocaline Co. of America, Inc.	Old Saybrook, Conn.
02777	Hopkins Engineering Co.	San Fernando, Calif.
03508	G.E. Semiconductor Products Dept.	Syracuse, N.Y.
03705	Apex Machine & Tool Co.	Dayton, Ohio
03797	Eldema Corp.	El Monte, Calif.
03877	Transitron Electronic Corp.	Wakefield, Mass.
03888	Pyrofilm Resistor Co.	Morristown, N.J.
03954	Air Marine Motors, Inc.	Los Angeles, Calif.
04009	Arrow, Hart and Hegeman Elect. Co.	Hartford, Conn.
04062	Elmenco Products Co.	New York, N.Y.
04222	Hi-Q Division of Aerovox	Myrtle Beach, S.C.
04298	Elgin National Watch Co., Electronics Division	Burbank, Calif.
04404	Dymec Division of Hewlett-Packard Co.	Palo Alto, Calif.
04651	Sylvania Electric Prods., Inc. Electronic Tube Div.	Mountain View, Calif.
04713	Motorola, Inc., Semiconductor Prod. Div.	Phoenix, Arizona
04732	Filtron Co., Inc. Western Division	Culver City, Calif.
04773	Automatic Electric Co.	Northlake, Ill.
04796	Sequoia Wire & Cable Company	Redwood City, Calif.
04870	P. M. Motor Co.	Chicago 44, Ill.
05006	Twentieth Century Plastics, Inc.	Los Angeles, Calif.
05277	Westinghouse Electric Corp., Semi-Conductor Dept.	Youngwood, Pa.
05347	Ultronix, Inc.	San Mateo, Calif.
05593	Illumitronic Engineering Co.	Sunnyvale, Calif.
05624	Barber Colman Co.	Rockford, Ill.
05729	Metropolitan Telecommunications Corp., Metro Cap. Div.	Brooklyn, N.Y.
05783	Stewart Engineering Co.	Santa Cruz, Calif.
06004	The Bassick Co.	Bridgeport, Conn.
06136	Ward Leonard Electric	Los Angeles, Calif.
06175	Bausch and Lomb Optical Co.	Rochester, N.Y.
06555	Beede Electrical Instrument Co., Inc.	Penacook, N.H.
06751	U.S. Semcor Div. of Nuclear Corp. of Am.	Phoenix, Ariz.
06812	Torrington Mfg. Co., West Div.	Van Nuys, Calif.
07115	Corning Glass Works Electronic Components Dept.	Bradford, Pa.
07126	Digitran Co.	Pasadena, Calif.
07137	Transistor Electronics Corp.	Minneapolis, Minn.
07138	Westinghouse Electric Corp. Electronic Tube Div.	Elmira, N.Y.
07261	Avnet Corp.	Los Angeles, Calif.
07263	Fairchild Semiconductor Corp.	Mountain View, Calif.
07910	Continental Device Corp.	Hawthorne, Calif.
07933	Rheem Semiconductor Corp.	Mountain View, Calif.
07966	Shockley Semi-Conductor Laboratories	Palo Alto, Calif.
07980	Boonton Radio Corp.	Boonton, N.J.
08145	U.S. Engineering Co.	Los Angeles, Calif.
08358	Burgess Battery Co.	Niagara Falls, Ontario, Canada
08717	Sloan Company	Burbank, Calif.
08718	Cannon Electric Co. Phoenix Div.	Phoenix, Ariz.
08792	CBS Electronics Semiconductor Operations, Div. of C.B.S. Inc.	Lowell, Mass.
08984	Mel-Rain	Indianapolis, Ind.
09026	Babcock Relays, Inc.	Costa Mesa, Calif.
09134	Texas Capacitor Co.	Houston, Texas
09250	Electro Assemblies, Inc.	Chicago, Ill.
09569	Mallory Battery Co. of Canada, Ltd.	Toronto, Ontario, Canada
10214	General Transistor Western Corp.	Los Angeles, Calif.
10411	Ti-Tal, Inc.	Berkeley, Calif.
10646	Carborundum Co.	Niagara Falls, N.Y.
11236	CTS of Berne, Inc.	Berne, Ind.
11237	Chicago Telephone of California, Inc.	So. Pasadena, Calif.
11312	Microwave Electronics Corp.	Palo Alto, Calif.
11534	Duncan Electronics, Inc.	Santa Ana, Calif.
11711	General Instrument Corporation Semiconductor Division	Newark, N.J.
11717	Imperial Electronics, Inc.	Buena Park; Calif.
11870	Melabs, Inc.	Palo Alto, Calif.
12697	Clarostat Mfg. Co.	Dover, N.H.
12859	Nippon Electric Co., Ltd.	Tokyo, Japan
14298	American Components, Inc.	Conshocken, Pa.
14655	Cornell Dubilier Elec. Corp.	So. Plainfield, N.J.
15909	The Daven Co.	Livingston, N.J.
16688	De Jur-Amsco Corporation	Long Island City 1, N.Y.
16758	Delco Radio Div. of G. M. Corp.	Kokomo, Ind.
18873	E. I. DuPont and Co., Inc.	Wilmington, Del.
19315	Eclipse Pioneer, Div. of Bendix Aviation Corp.	Teterboro, N.J.
19500	Thomas A. Edison Industries, Div. of McGraw-Edison Co.	West Orange, N.J.
19701	Electra Manufacturing Co.	Kansas City, Mo.
20183	Electronic Tube Corp.	Philadelphia, Pa.
21226	Executive, Inc.	New York, N.Y.
21520	Fansteel Metallurgical Corp.	No. Chicago, Ill.
21335	The Fafnir Bearing Co.	New Britain, Conn.
21964	Fed. Telephone and Radio Corp.	Clifton, N.J.
24446	General Electric Co.	Schenectady, N.Y.
24455	G.E., Lamp Division	Nela Park, Cleveland, Ohio
24655	General Radio Co.	West Concord, Mass.
26462	Grobet File Co. of America, Inc.	Carlstadt, N.J.
26992	Hamilton Watch Co.	Lancaster, Pa.
28480	Hewlett-Packard Co.	Palo Alto, Calif.
33173	G.E. Receiving Tube Dept.	Owensboro, Ky.
35434	Lectrohm Inc.	Chicago, Ill.
37942	P. R. Mallory & Co., Inc.	Indianapolis, Ind.
39543	Mechanical Industries Prod. Co.	Akron, Ohio
40920	Miniature Precision Bearings, Inc.	Keene, N.H.
42190	Muter Co.	Chicago, Ill.
43990	C. A. Norgren Co.	Englewood, Colo.
44655	Ohmite Mfg. Co.	Skokie, Ill.
47904	Polaroid Corp.	Cambridge, Mass.
48620	Precision Thermometer and Inst. Co.	Philadelphia, Pa.
49956	Raytheon Company	Lexington, Mass.
54294	Shallcross Mfg. Co.	Selma, N.C.
55026	Simpson Electric Co.	Chicago, Ill.
55933	Sonotone Corp.	Elmsford, N.Y.
55938	Sorenson & Co., Inc.	So. Norwalk, Conn.
56137	Spaulding Fibre Co., Inc.	Tonawanda, N.Y.
56289	Sprague Electric Co.	North Adams, Mass.
59446	Telex, Inc.	St. Paul, Minn.
61775	Union Switch and Signal, Div. of Westinghouse Air Brake Co.	Swissvale, Pa.
62119	Universal Electric Co.	Owosso, Mich.
64959	Western Electric Co., Inc.	New York, N.Y.
65092	Weston Inst. Div. of Daystrom, Inc.	Newark, N.J.
66295	Wittek Manufacturing Co.	Chicago 23, Ill.
66346	Wollensak Optical Co.	Rochester, N.Y.
70276	Allen Mfg. Co.	Hartford, Conn.
70309	Allied Control Co., Inc.	New York, N.Y.
70485	Atlantic India Rubber Works, Inc.	Chicago, Ill.
70563	Amperite Co., Inc.	New York, N.Y.
70903	Belden Mfg. Co.	Chicago, Ill.
70998	Bird Electronic Corp.	Cleveland, Ohio
71002	Birnbach Radio Co.	New York, N.Y.
71041	Boston Gear Works Div. of Murray Co. of Texas	Quincy, Mass.
71218	Bud Radio Inc.	Cleveland, Ohio
71286	Camloc Fastener Corp.	Paramus, N.J.
71313	Allen D. Cardwell Electronic Prod. Corp.	Plainville, Conn.
71400	Bussmann Fuse Div. of McGraw-Edison Co.	St. Louis, Mo.
71450	CTS Corp.	Elkhart, Ind.
71468	Cannon Electric Co.	Los Angeles, Calif.
71471	Cinema Engineering Co.	Burbank, Calif.
71482	C. P. Clare & Co.	Chicago, Ill.
71528	Standard-Thomson Corp., Clifford Mfg. Co. Div.	Waltham, Mass.
71590	Centralab Div. of Globe Union Inc.	Milwaukee, Wis.
71700	The Cornish Wire Co.	New York, N.Y.
71744	Chicago Miniature Lamp Works	Chicago, Ill.
71753	A. O. Smith Corp., Crowley Div.	West Orange, N.J.
71785	Cinch Mfg. Corp.	Chicago, Ill.
71984	Dow Corning Corp.	Midland, Mich.
72136	Electro Motive Mfg. Co., Inc.	Willimantic, Conn.
72354	John E. Fast & Co.	Chicago, Ill.
72619	Dialight Corp.	Brooklyn, N.Y.
72656	General Ceramics Corp.	Keasbey, N.J.
72758	Girard-Hopkins	Oakland, Calif.
72765	Drake Mfg. Co.	Chicago, Ill.
72825	Hugh H. Eby Inc.	Philadelphia, Pa.
72928	Gudeman Co.	Chicago, Ill.
72964	Robert M. Hadley Co.	Los Angeles, Calif.
72982	Erie Resistor Corp.	Erie, Pa.
73061	Hansen Mfg. Co., Inc.	Princeton, Ind.
73138	Helipot Div. of Beckman Instruments, Inc.	Fullerton, Calif.
73293	Hughes Products Division of Hughes Aircraft Co.	Newport Beach, Calif.
73445	Amperex Electronic Co., Div. of North American Phillips Co., Inc.	Hicksville, N.Y.
73506	Bradley Semiconductor Corp.	Hamden, Conn.
73559	Carling Electric, Inc.	Hartford, Conn.
73682	George K. Garrett Co., Inc.	Philadelphia, Pa.

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Revised: 20 December 1962

APPENDIX
CODE LIST OF MANUFACTURERS (Sheet 2 of 2)

CODE NO.	MANUFACTURER	ADDRESS
73734	Federal Screw Products Co.	Chicago, Ill.
73743	Fischer Special Mfg. Co.	Cincinnati, Ohio
73793	The General Industries Co.	Elyria, Ohio
73905	Jennings Radio Mfg. Co.	San Jose, Calif.
74455	J. H. Winns, and Sons	Winchester, Mass.
74861	Industrial Condenser Corp.	Chicago, Ill.
74868	R.F. Products Division of Amphenol-Borg Electronics Corp.	Danbury, Conn.
74970	E. F. Johnson Co.	Waseca, Minn.
75042	International Resistance Co.	Philadelphia, Pa.
75173	Jones, Howard B., Division of Cinch Mfg. Corp.	Chicago, Ill.
75378	James Knights Co.	Sandwich, Ill.
75382	Kulka Electric Corporation	Mt. Vernon, N.Y.
75818	Lenz Electric Mfg. Co.	Chicago, Ill.
75915	Littelfuse Inc.	Des Plaines, Ill.
76005	Lord Mfg. Co.	Erie, Pa.
76210	C. W. Marwedel	San Francisco, Calif.
76433	Micamold Electronic Mfg. Corp.	Brooklyn, N.Y.
76487	James Millen Mfg. Co., Inc.	Malden, Mass.
76493	J. W. Miller Co.	Los Angeles, Calif.
76530	Monadnock Mills	San Leandro, Calif.
76545	Mueller Electric Co.	Cleveland, Ohio
76854	Oak Manufacturing Co.	Crystal Lake, Ill.
77068	Bendix Pacific Division of Bendix Corp.	No. Hollywood, Calif.
77221	Phaostron Instrument and Electronic Co.	South Pasadena, Calif.
77252	Philadelphia Steel and Wire Corp.	Philadelphia, Pa.
77342	Potter and Brumfield, Div. of American Machine and Foundry	Princeton, Ind.
77630	Radio Condenser Co.	Camden, N.J.
77638	Radio Receptor Co., Inc.	Brooklyn, N.Y.
77764	Resistance Products Co.	Harrisburg, Pa.
78189	Shakeproof Division of Illinois Tool Works	Elgin, Ill.
78283	Signal Indicator Corp.	New York, N.Y.
78471	Tilley Mfg. Co.	San Francisco, Calif.
78488	Stackpole Carbon Co.	St. Marys, Pa.
78553	Tinnerman Products, Inc.	Cleveland, Ohio
78790	Transformer Engineers	Pasadena, Calif.
78947	Ucinite Co.	Newtonville, Mass.
79142	Veeder Root, Inc.	Hartford, Conn.
79251	Wenco Mfg. Co.	Chicago, Ill.
79727	Continental-Wirt Electronics Corp.	Philadelphia, Pa.
79963	Zierick Mfg. Corp.	New Rochelle, N.Y.
80031	Mepco Division of Sessions Clock Co.	Morristown, N.J.
80120	Schnitzer Alloy Products	Elizabeth, N.J.
80130	Times Facsimile Corp.	New York, N.Y.
80131	Electronic Industries Association Any brand tube meeting EIA standards	Washington, D.C.
80207	Unimax Switch, Div. of W. L. Maxson Corp.	Wallingford, Conn.
80248	Oxford Electric Corp.	Chicago, Ill.
80294	Bourns Laboratories, Inc.	Riverside, Calif.
80411	Acro Div. of Robertshaw Fulton Controls Co.	Columbus 16, Ohio
80486	All Star Products Inc.	Defiance, Ohio
80583	Hammerlund Co., Inc.	New York, N.Y.
80640	Stevens, Arnold, Co., Inc.	Boston, Mass.
81030	International Instruments, Inc.	New Haven, Conn.
81073	Grayhill Co.	LaGrange, Ill.
81312	Winchester Electronics Co., Inc.	Norwalk, Conn.
81415	Wilkor Products, Inc.	Cleveland, Ohio
81453	Raytheon Mfg. Co., Industrial Components Div., Industr. Tube Operations	Newton, Mass.
81483	International Rectifier Corp.	El Segundo, Calif.
81860	Barry Controls, Inc.	Watertown, Mass.
82042	Carter Parts Co.	Skokie, Ill.
82142	Jeffers Electronics Division of Speer Carbon Co.	Du Bois, Pa.
82170	Allen B. DuMont Labs., Inc.	Clifton, N.J.
82209	Maguire Industries, Inc.	Greenwich, Conn.
82219	Sylvania Electric Prod. Inc., Electronic Tube Div.	Emporium, Pa.
82376	Astron Co.	East Newark, N.J.
82389	Switchcraft, Inc.	Chicago, Ill.
82647	Metals and Controls, Inc., Div. of Texas Instruments, Inc., Spencer Prods.	Attleboro, Mass.
82866	Research Products Corp.	Madison, Wis.
82877	Rotron Manufacturing Co., Inc.	Woodstock, N.Y.
82893	Vector Electronic Co.	Glendale, Calif.
83053	Western Washer Mfr. Co.	Los Angeles, Calif.
83058	Carr Fastener Co.	Cambridge, Mass.
83086	New Hampshire Ball Bearing, Inc.	Peterborough, N.H.
83125	Pyramid Electric Co.	Darlington, S.C.
83148	Electro Cords Co.	Los Angeles, Calif.
83186	Victory Engineering Corp.	Union, N.J.
83298	Bendix Corp., Red Bank Div.	Red Bank, N.J.
83330	Smith, Herman H., Inc.	Brooklyn, N.Y.
83501	Gavitt Wire and Cable Co., Div. of Amerace Corp.	Brookfield, Mass.
83594	Burroughs Corp., Electronic Tube Div.	Plainfield, N.J.
83777	Model Eng. and Mfg., Inc.	Huntington, Ind.
83821	Loyd Scruggs Co.	Festus, Mo.
84171	Arco Electronics, Inc.	New York, N.Y.
84396	A. J. Glesener Co., Inc.	San Francisco, Calif.
84411	Good All Electric Mfg. Co.	Ogallala, Neb.
84970	Sarkes Tarzian, Inc.	Bloomington, Ind.
85454	Boonton Molding Company	Boonton, N.J.
85471	A. B. Boyd Co.	San Francisco, Calif.
85474	R. M. Bracamonte & Co.	San Francisco, Calif.
85660	Koiled Kords, Inc.	New Haven, Conn.
85911	Seamless Rubber Co.	Chicago, Ill.
86197	Clifton Precision Products	Clifton Heights, Pa.
86684	Radio Corp. of America, RCA Electron Tube Div.	Harrison, N.J.
87216	Philco Corp. (Lansdale Division)	Lansdale, Pa.
87473	Western Fibrous Glass Products Co.	San Francisco, Calif.
88140	Cutler-Hammer, Inc.	Lincoln, Ill.
88220	Gould-National Batteries, Inc.	St. Paul, Minn.
89473	General Electric Distributing Corp.	Schenectady, N.Y.
89636	Carter Parts Div. of Economy Baler Co.	Chicago, Ill.
89665	United Transformer Co.	Chicago, Ill.
90179	U.S. Rubber Co., Mechanical Goods Div.	Passaic, N.J.
90970	Bearing Engineering Co.	San Francisco, Calif.
91260	Connor Spring Mfg. Co.	San Francisco, Calif.
91345	Miller Dial & Nameplate Co.	El Monte, Calif.
91418	Radio Materials Co.	Chicago, Ill.
91506	Augat Brothers, Inc.	Attleboro, Mass.
91637	Dale Electronics, Inc.	Columbus, Nebr.
91662	Elco Corp.	Philadelphia, Pa.
91737	Gremar Mfg. Co., Inc.	Wakefield, Mass.
91827	K F Development Co.	Redwood City, Calif.
91921	Minneapolis-Honeywell Regulator Co., Micro-Switch Division	Freeport, Ill.
92196	Universal Metal Products, Inc.	Bassett Puente, Calif.
93332	Sylvania Electric Prod. Inc., Semiconductor Div.	Woburn, Mass.
93369	Robbins and Myers, Inc.	New York, N.Y.
93410	Stevens Mfg. Co., Inc.	Mansfield, Ohio
93983	Insuline-Van Norman Ind., Inc. Electronic Division	Manchester, N.H.
94144	Raytheon Mfg. Co., Industrial Components Div., Receiving Tube Operation	Quincy, Mass.
94145	Raytheon Mfg. Co., Semiconductor Div., California Street Plant	Newton, Mass.
94148	Scientific Radio Products, Inc.	Loveland, Colo.
94154	Tung-Sol Electric, Inc.	Newark, N.J.
94197	Curtiss-Wright Corp., Electronics Div.	East Paterson, N.J.
94310	Tru Ohm Prod. Div. of Model Engineering and Mfg. Co.	Chicago, Ill.
94682	Worcester Pressed Aluminum Corp.	Worcester, Mass.
94928	Telefunken	Berlin, W. Germany
95236	Allies Products Corp.	Miami, Fla.
95238	Continental Connector Corp.	Woodside, N.Y.
95263	Leecraft Mfg. Co., Inc.	New York, N.Y.
95264	Lerco Electronics, Inc.	Burbank, Calif.
95265	National Coil Co.	Sheridan, Wyo.
95275	Vitramon, Inc.	Bridgeport, Conn.
95354	Methode Mfg. Co.	Chicago, Ill.
95987	Weckesser Co	Chicago, Ill.
96067	Hugqins Laboratories	Sunnyvale, Calif.
96095	Hi-Q Division of Aerovox	Olean, N.Y.
96256	Thordarson-Meissner Div. of Maguire Industries, Inc.	Mt. Carmel, Ill.
96296	Solar Manufacturing Co.	Los Angeles, Calif.
96330	Carlton Screw Co.	Chicago, Ill.
96341	Microwave Associates, Inc.	Burlington, Mass.
96501	Excel Transformer Co.	Oakland, Calif.
97464	Industrial Retaining Ring Co.	Irvington, N.J.
97539	Automatic and Precision Mfg. Co.	Yonkers, N.Y.
97966	CBS Electronics, Div. of C.B.S., Inc.	Danvers, Mass.
97979	Reon Resistor Corp.	Yonkers, N.Y.
98141	Axel Brothers Inc.	Jamaica, N.Y.
98220	Francis L. Mosley	Pasadena, Calif.
98278	Microdot, Inc.	So. Pasadena, Calif.
98291	Sealectro Corp.	Mamaroneck, N.Y.
98405	Carad Corp.	Redwood City, Calif.
98734	Palo Alto Engineering Co., Inc.	Palo Alto, Calif.
98821	North Hills Electric Co.	Mineola, N.Y.
98925	Clevite Transistor Prod. Div. of Clevite Corp.	Waltham, Mass.
98978	International Electronic Research Corp.	Burbank, Calif.
99109	Columbia Technical Corp.	New York, N.Y.
99313	Varian Associates	Palo Alto, Calif.
99515	Marshall Industries, Electron Products Division	Pasadena, Calif.
99707	Control Switch Division, Controls Co. of America	El Segundo, Calif.
99800	Delevan Electronics Corp.	East Aurora, N.Y.
99848	Wilco Corporation	Indianapolis, Ind.
99934	Renbrandt, Inc.	Boston, Mass.
99942	Hoffman Semiconductor Div. of Hoffman Electronics Corp.	Evanston, Ill.
99957	Technology Instrument Corp. of Calif.	Newbury Park, Calif.

THE FOLLOWING H-P VENDORS HAVE NO NUMBER ASSIGNED IN THE LATEST SUPPLEMENT TO THE FEDERAL SUPPLY CODE FOR MANUFACTURERS HANDBOOK.

0000F	Malco Tool and Die	Los Angeles, Calif.
0000I	Telefunken (c/o American Elite)	New York, N.Y.
0000M	Western Coil Div. of Automatic Ind., Inc.	Redwood City, Calif.
0000N	Nahm-Bros. Spring Co.	San Leandro, Calif.
0000P	Ty-Car Mfg. Co., Inc.	Holliston, Mass.
0000T	Texas Instruments, Inc. Metals and Controls Div.	Versailles, Ky.
0000U	Tower Mfg. Corp.	Providence, R.I.
0000W	Webster Electronics Co. Inc.	New York, N.Y.
0000X	Spruce Pine Mica Co.	Spruce Pine, N.C.
0000Y	Midland Mfg. Co. Inc.	Kansas City, Kans.
0000Z	Willow Leather Products Corp.	Newark, N.J.
000AA	British Radio Electronics Ltd.	Washington, D.C.
000BB	Precision Instrument Components Co.	Van Nuys, Calif.
000CC	Computer Diode Corp.	Lodi, N.J.
000EE	A. Williams Manufacturing Co.	San Jose, Calif.
000FF	Carmichael Corrugated Specialties	Richmond, Calif.
000GG	Goshen Die Cutting Service	Goshen, Ind.
000HH	Rubbercraft Corp.	Torrance, Calif.
000II	Birtcher Corporation, Industrial Division	Monterey Park, Calif.
000KK	Amatom	New Rochelle, N.Y.
000LL	Avery Label	Monrovia, Calif.
000MM	Rubber Eng. & Development	Hayward, Calif.
000NNA	"N" D Manufacturing Co.	San Jose 27, Calif.
000PP	Atohm Electronics,	Sun Valley, Calif.
000QQ	Cooltron	Oakland, Calif.
000RR	Radio Industries	Des Plaines, Ill.
000SS	Control of Elgin Watch Co.	Burbank, Calif.
000TT	Thomas & Betts Co., The	Elizabeth 1, N.J.
000WW	California Eastern Lab.	Burlingame, Calif.
000XX	Methode Electronics, Inc.	Chicago 31, Ill.
000YY	S. K. Smith Co.	Los Angeles 45, Calif.

From: F.S.C. Handbook Supplements
H4-1 Dated: December 1962
H4-2 Dated: April 1962

00015-29
Revised: 20 December 1962

MANUAL CHANGES

MODEL 1750A

DUAL TRACE VERTICAL AMPLIFIER

Manual Serial Prefixed: 321-
Manual Printed: 4/63

To adapt this manual to instruments with other serial prefixes check for errata below, and make changes shown in tables.

Instrument Serial Prefix	Make Manual Changes
ALL SERIALS	ERRATA

Instrument Serial Prefix	Make Manual Changes

ERRATA: Page 5-9,
Add Table 5-8. See attached sheet.

Table 5-8. Condensed Adjustment Procedure

Test	Ext. Equip. Required	Procedure	Adjust
1. BAL.	None	a. Set SWEEP MODE to FREE RUN. b. Vertical Presentation CHANNEL A. c. Rotate channel A VERNIER.	Channel A BAL. for no shift of trace.
		d. Vertical Presentation CHANNEL B. e. Rotate channel B VERNIER.	Channel B BAL. for no shift of trace.
2. Vertical Position	None	a. Vertical Presentation ALTERnate. b. Channel A and B VERTICAL POSITION mechanically centered.	Vert. Pos. Adj. R319 for traces centered.
3. Channel Balance	None	a. Vertical Presentation CHOPPED b. Traces separated 5 cm.	Chan. Bal. R355 for minimum trace widths.
4. Gain	Voltmeter Calibrator	a. Apply 0.3 volt pk-pk to channel A INPUT. b. Channel A SENSITIVITY to 0.05 v/cm.	Channel A SENS. CAL. for exactly 6 cm deflection.
		c. Apply 0.3 volt pk-pk to channel B INPUT. d. Channel B SENSITIVITY to 0.05 v/cm.	Channel B SENS. CAL. for exactly 6 cm deflection.
5. Amplifier Input Capacitance	Square Wave Generator Alignment Attenuator	a. Apply 1 KC through Alignment Attenuator to channel B INPUT. b. Set: SWEEP TIME . . 0.5 msec/cm SWEEP MODE . . FREE RUN Ch. A SENSITIVITY . . 5v/cm Ch. B SENSITIVITY. 0.05v/cm Vertical Presentation . . . . . CHANNEL B	
		Set: Channel B POLARITY . . . . +UP Channel B POLARITY . . . . -UP	C201 for best square wave. C202 for best square wave.
		Set: Vertical Presentation . . . . A-B Channel A POLARITY . . . . -UP Channel A POLARITY . . . . +UP	C101 for best square wave. C102 for best square wave.
		c. Apply 1 KC through Alignment Attenuator to Channel A INPUT. d. Set: Ch. A SENSITIVITY. 0.05 v/cm VERTICAL PRESENTATION . . . . . CHANNEL A	C132 for best square wave.

Table 5-8. Condensed Adjustment Procedure (Cont'd)

Test	Ext. Equip. Required	Procedure	Adjust
6. Attenuator Compensation	Square Wave Generator	a. Apply 10 KC to channel A INPUT	
		Channel A / SENSITIVITY / Adjust for best Square Wave	
		.1 v/cm	C123
		.2 v/cm	C127
		.5 v/cm	C113
		1 v/cm	C121
		2 v/cm	C125
		5 v/cm	C117
		b. Apply 10 KC to channel B INPUT	
		Channel B / SENSITIVITY / Adjust for best Square Wave	
		.1 v/cm	C223
		.2 v/cm	C227
		.5 v/cm	C213
		1 v/cm	C221
		2 v/cm	C225
		5 v/cm	C217
7. Attenuator Input Capacitance	Square Wave Generator Alignment Attenuator	a. Apply 1 KC through Alignment Attenuator to channel A INPUT. b. Set: Channel A SENSITIVITY . . . . . 0.5 v/cm c. Set: Channel A SENSITIVITY . . . . . 5 v/cm	C111 for best square wave. C115 for best square wave.
		d. Apply 1 KC through Alignment Attenuator to channel B INPUT. e. Set: Channel B SENSITIVITY . . . . . 0.5 v/cm f. Set: Channel B SENSITIVITY . . . . . 5 v/cm	C211 for best square wave. C215 for best square wave.
8. Pulse Response	Pulse Generator Coaxial Termination	a. Set: SWEEP TIME . . 0.1 μsec/cm; HORIZONTAL DISPLAY . X1; Channel A SENSITIVITY . . . . . 0.05 v/cm b. Apply 6 cm signal to channel A INPUT, terminating cable with Coaxial Termination.	L101, 102 for best pulse response.
		c. Set: Channel B SENSITIVITY . . . . . 0.05 v/cm d. Apply 6 cm signal to channel B INPUT, terminating cable with Coaxial Termination.	L201, 202 for best pulse response.

MANUAL CHANGES

MODEL 1750A

DUAL TRACE VERTICAL AMPLIFIER

Manual Serial Prefixed: 321-
Manual Printed: 4/63

To adapt this manual to instruments with other serial prefixes check for errata on Supplement A and make changes shown in tables.

Instrument Serial Prefix	Make Manual Changes
314-	1
310-	1
242-	1, 2
229-	1, 2, 3

Instrument Serial Prefix	Make Manual Changes
225-	1, 2, 3, 4
216-	1, 2, 3, 4, 5

CHANGE 1

Figure 5-10 and Table 6-1,
A301: Change hp Stock No. to 1750A-65A
A302: Change hp Stock No. to 1750A-65B
C105, 205: Delete
R113, 114, 213, 214: Change to 15K, hp Stock No. 0758-0018
R115, 215: Delete
V104, 105, 106, 107, 204, 205, 206, 207, 304, 305, 306: Delete

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CHANGE 2

Table 6-1,
R104, 204: Change hp Stock No. to 2100-0027.

CHANGE 3

Figure 5-9 and Table 6-1,
C113, 233: Change to 1000 pf, hp Stock No. 0150-0069.
C126, 226: Change to 3.3 pf, hp Stock No. 0150-0059.

CHANGE 4

Figure 5-10 and Table 6-1,
L301, 302: Delete

CHANGE 5

Figure 5-10 and Table 6-1,
L101, 102, 201, 202: Change to inductor, variable, 0.6-1.1 μh; hp Stock No. 162F-60A.
L103, 104: Change to inductor, fixed, 0.47 μh; hp Stock No. 9140-0134.
C104, 309: Delete
CR101, 102, 201, 202: Delete
R132, 133, 162, 232, 233, 262, 313, 314, 315: Delete
R208: Change to resistor, fixed composition, 56 ohms ±10%, 1/4W; hp Stock No. 0684-5601.
R355: Change to resistor, variable, composition, 100 ohms ±20%, 0.3W, linear taper; hp Stock No. 2100-0118.
Add the following components,
R149: Resistor, fixed, composition, 22 ohms ±10%, 1/4W. Connect between J101 and junction of C108 and S101.
R249: Resistor, fixed, composition, 22 ohms ±10%, 1/4W. Connect between J201 and junction of C208 and S201.

Instrument Serial Prefix	Make Manual Changes
314-	1
310-	1
242-	1, 2
229-	1, 2, 3

Instrument Serial Prefix	Make Manual Changes
225-	1, 2, 3, 4
216-	1, 2, 3, 4, 5

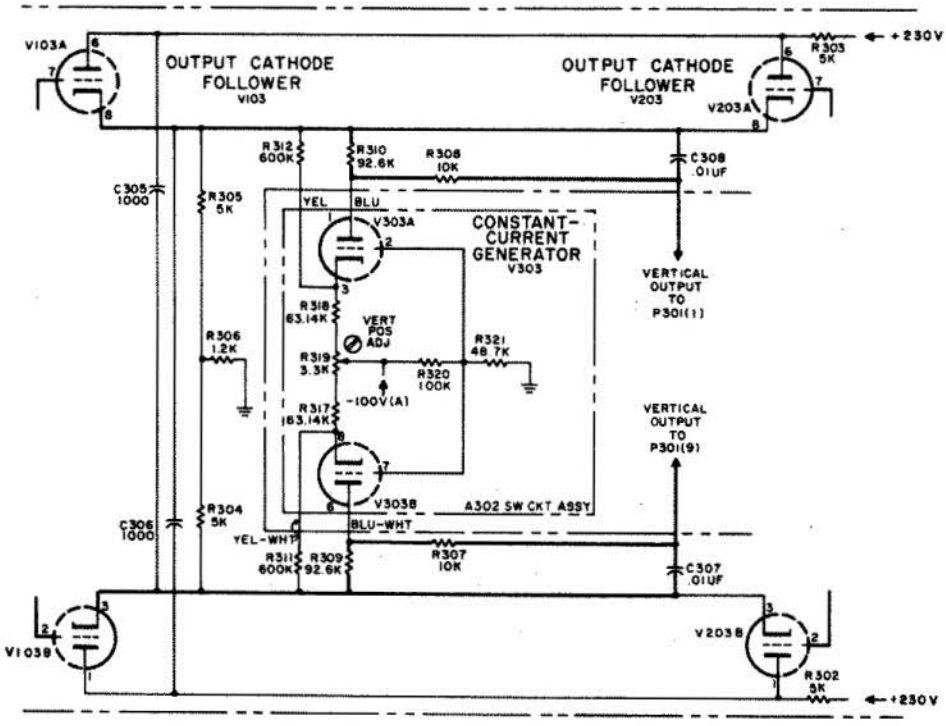
CHANGE 5 (Cont'd)

Add the following components as shown in the partial schematic below:

C305, 306: Capacitor, fixed, ceramic, 1000 pf, 600 vdcw ℗ Stock No. 0150-0050.

R302, 303, 304, 305: Resistor, fixed, dep. carbon, 5K ohms ±1%, 1W; ℗ Stock No. 0730-0022.

R306: Resistor, fixed, composition, 1200 ohms ±10%, 1W; ℗ Stock No. 0690-1221.



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