OPERATING AND SERVICE MANUAL

H/P Part No. 162B-901

MODEL 162B
AND
SPECIFICATION HO2-162B

SERIAL PREFIXED: 251-

DUAL TRACE
VERTICAL AMPLIFIER

HEWLETT-PACKARD COMPANY

01558-1

Printed: MAR 1963

MANUAL CHANGES

MODEL 162B &
Specif. H02-162B

DUAL-TRACE VERTICAL AMPLIFIER

Manual Serial Prefixed: 251-
Manual Printed: MAR 1963

Make all changes in this manual according to the Errata below. Also check the following table for your instrument serial prefix (3 digits) and/or serial number (8 digits) and make any listed change(s) in the manual:

Serial Prefix or Number	Make Manual Changes	Serial Prefix or Number	Make Manual Changes
228-00126 to 00150	1 & Errata		
228-00101 to 00125	Errata only		

ERRATA

Page 5-6, Figure 5-5,
C101 should be -UP; C102 should be +UP.
Page 5-7, Paragraph 5-34,
Step h. should read
"Channel A POLARITY. . . . . -UP"
Step j. should read
"Channel A POLARITY. . . . . +UP"
Page 5-10, Figure 5-9,
C126, C226: Change value to 3.3 PF.
Section VI, Replaceable Parts
C126, C226: Change ⓗ Stock No. to 0150-0059.

CHANGE 1

Page 5-11/5-12, Figure 5-10,
Change both VERNIER circuits as shown below in Figure 1.
Section VI, Replaceable Parts,
H02-162B only:
V101-103, 201-203, 301-303: Change to tube type 7308, ⓗ Stock No. 1932-0032.
162B and H02-162B:
Add S104, NSR, part of R123.
Add S204, NSR, part of R223.

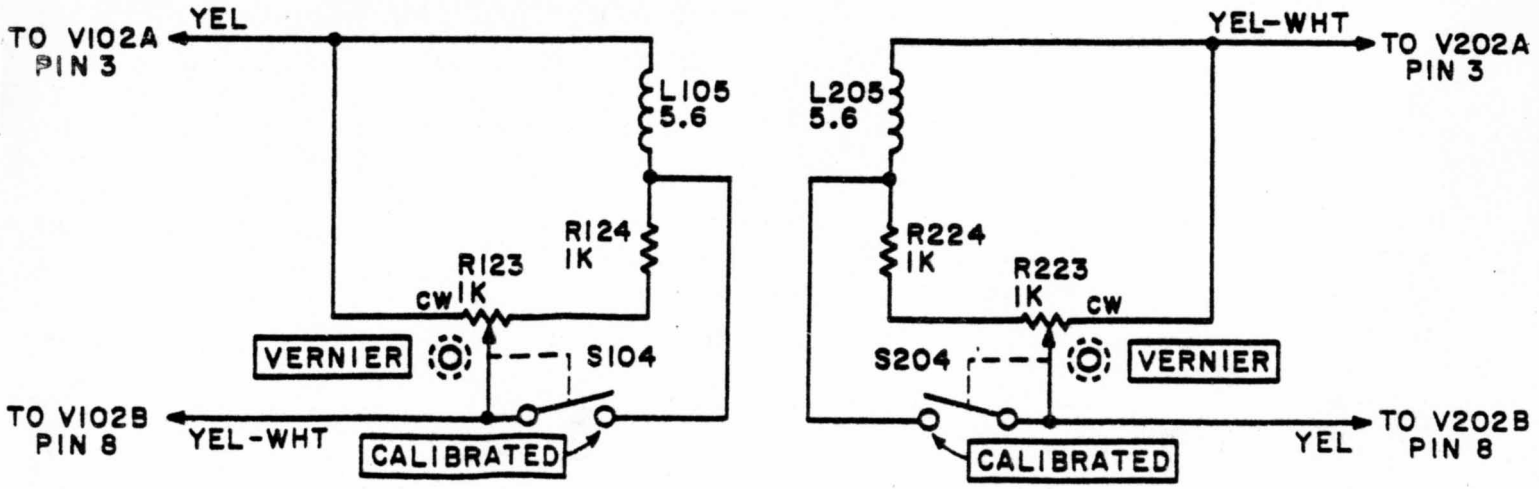

FIGURE 1.

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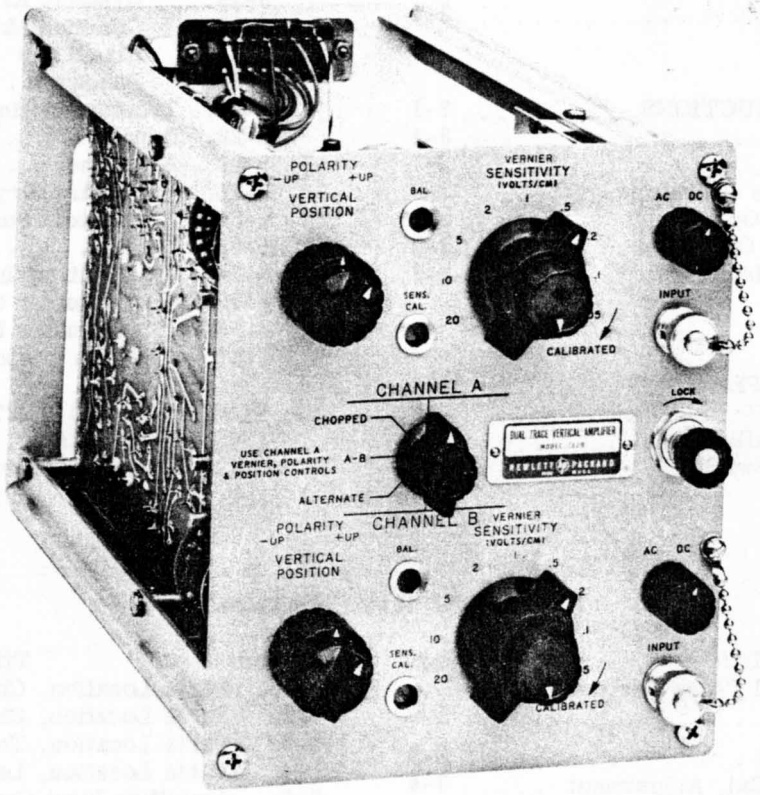


Figure 1-1. Model 162B Dual Trace Vertical Amplifier

SECTION I
GENERAL INFORMATION

1-1. DESCRIPTION AND PURPOSE.

1-2. The Hewlett-Packard Model 162B Dual Trace Vertical Amplifier is a wide-band vertical amplifier designed to be used with the hp Models 160B and 170A Oscilloscopes. It provides calibrated sensitivity with 30 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. The information in this manual also applies to the Specification HO2-162B, which is identical to the Model 162B except that all tubes and semiconductors are MIL approved types. Both units meet the environmental requirements of MIL-E-16400.

1-4. INSTRUMENT IDENTIFICATION.

1-5. 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.

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 electronic 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 adjustment between ranges. A sensitivity calibration adjustment for each channel is provided on the instrument front panel.

Attenuator Accuracy: ±3%.

Pass Band:
In 170A—DC coupled: dc to 30 mc. AC coupled: 2 cps to 30 mc.
In 160B—DC coupled: dc to 15 mc. AC coupled: 2 cps to 15 mc.

Rise Time: Less than 12 nsec in 170A, and 23 nsec in 160B.

Dynamic Range: Input amplifiers may be overloaded by 18 cm signal without causing noticeable signal distortion.

Vertical Position Control Range: ±9 cm.

Input Impedance: 1 megohm (nominal) shunted by 28 pf.

Input Capacitor Rating: 600 vdc

Polarity of Presentation: + up or - up, selectable.

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.

Common Mode Rejection: At least 40 db at maximum sensitivity up to 1 mc, or 30 db when using attenuators.

GENERAL

Weight: Net 5 lb.

Power: Supplied by Model 160B/170A Oscilloscopes.

Accessories Available:
10001A Probe, 10:1 divider (2 supplied with 160B/170A Oscilloscope).

10001B Probe, 10:1 divider, 10 feet (3.05m) long cable.

10002A Probe, 50:1 divider.

10002B Probe, 50:1 divider, 10 feet (3.05m) long cable.

10110A Adaptor, binding post to male BNC

SECTION II
INSTALLATION

2-1. INCOMING QUALITY CONTROL INSPECTION.

2-2. MECHANICAL INSPECTION. Upon receipt of your Model 162B, 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 162B is designed to be plugged into the vertical amplifier compartment of the Models 160B or 170A Oscilloscope. To install the Model 162B, 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 162B and the Model 160B/170A are automatically completed.

SECTION III
OPERATING INSTRUCTIONS

3-1. INTRODUCTION.

3-2. The Model 162B 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 control 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 is 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.

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 162B to be set using an external voltage standard or the calibrator of the Model 160B/170A. 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 offscreen 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

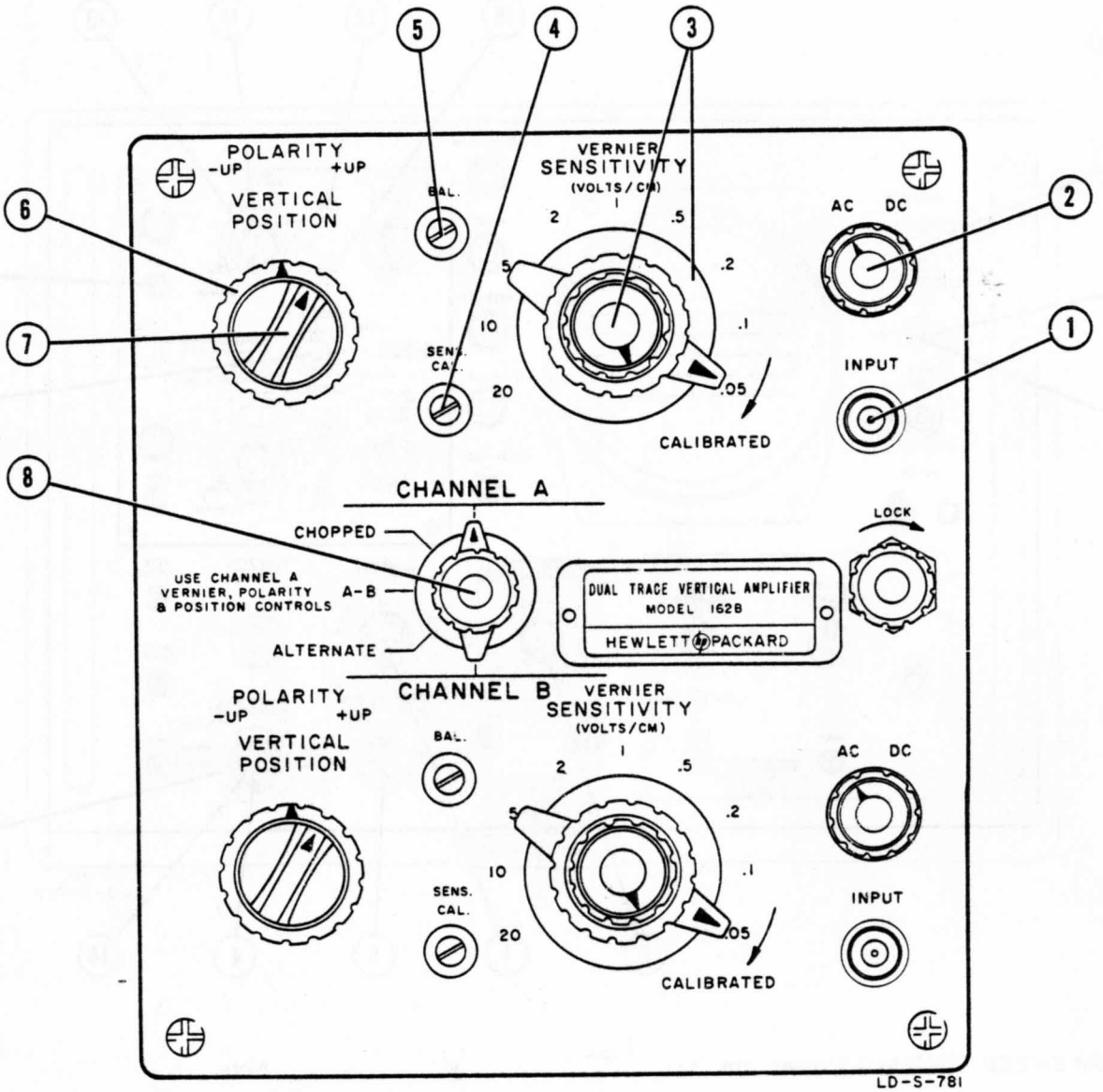
For greatest rejection of common-mode signals, set both channels to the same sensitivity.

3-20. INPUT CONSIDERATIONS.

3-21. ACCESSORY PROBES. To preserve the bandwidth capabilities of the Model 162B, certain precautions must be observed. To avoid circuit loading and resultant waveform distortion, accessory probes may be used to increase the input impedance. The 10001A Probe supplied with the Model 160B/170A Oscilloscope presents an input of 10 megohms shunted by 10 pf and may be used over the 30 megacycle bandwidth of the Model 162B. When using the probe multiply the SENSITIVITY setting by 10.

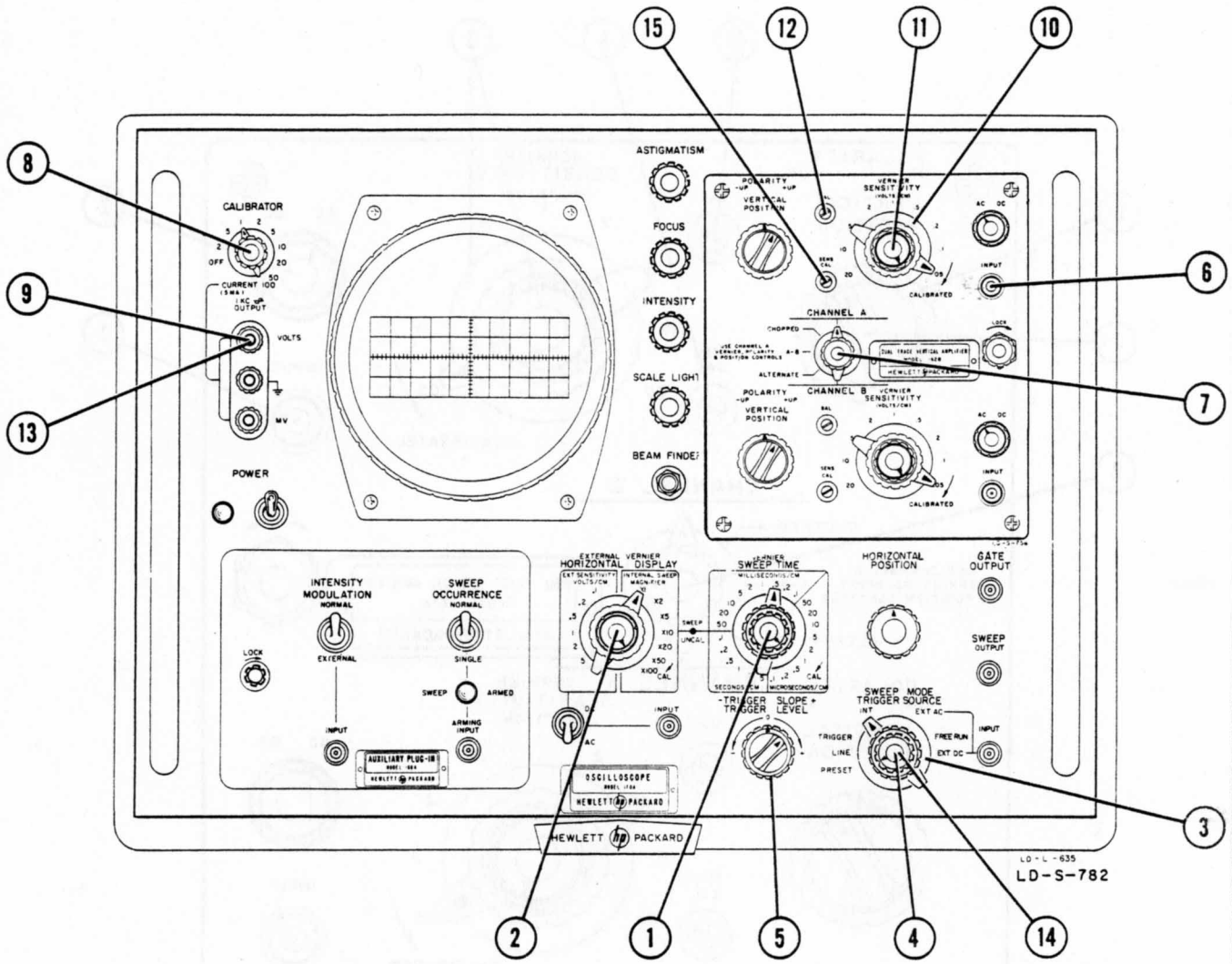
3-22. When using the 10001A (AC-21A) or other accessory probes, it is necessary to compensate the probe for the input impedance of the amplifier. Without compensation, the probe will not divide accurately at high frequencies and waveforms will be distorted. For compensation adjustment refer to the 10001A (AC-21A) 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. 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 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



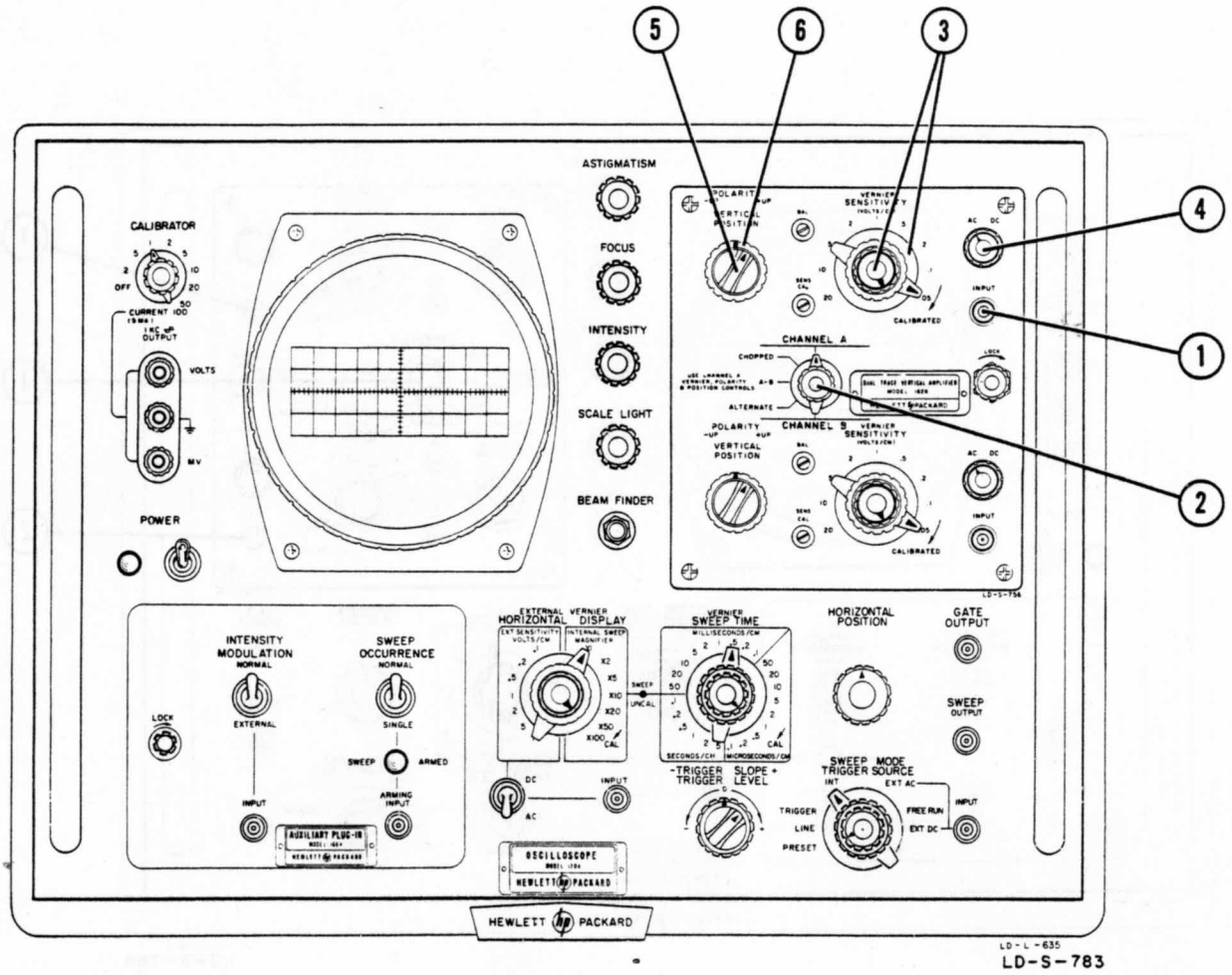
1. Set SWEEP TIME to 0.5 msec/cm.
2. Set HORIZONTAL DISPLAY to INTERNAL SWEEP X1.
3. Set TRIGGER SOURCE to INT.
4. Set SWEEP MODE to PRESET.
5. Set TRIGGER LEVEL to 0.
6. Connect probe or cable to Channel A INPUT.
7. Select CHANNEL A.
8. In Model 160B set CALIBRATOR to 10.
   In Model 170A set CALIBRATOR to 20.
9. Connect probe or cable to calibrator VOLTS connector.
10. In Model 160B set SENSITIVITY to 2 volts/cm.
    In Model 170A set SENSITIVITY to 5 volts/cm.

Note

If using 10:1 divider probe, divide SENSITIVITY settings by 10.

11. Set VERNIER to CALIBRATED.
12. In Model 160B adjust SENS. CAL. for a display exactly 5 cm. high.
    In Model 170A adjust SENS. CAL. for a display exactly 4 cm. high.
13. Disconnect calibrator.
14. Set SWEEP MODE to FREE RUN.
15. Adjust BAL. for no vertical movement of trace as VERNIER is rotated.
16. Repeat steps 6 through 15 for Channel B.

Figure 3-2. Bal. and Sens. Cal. Adjustment



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.

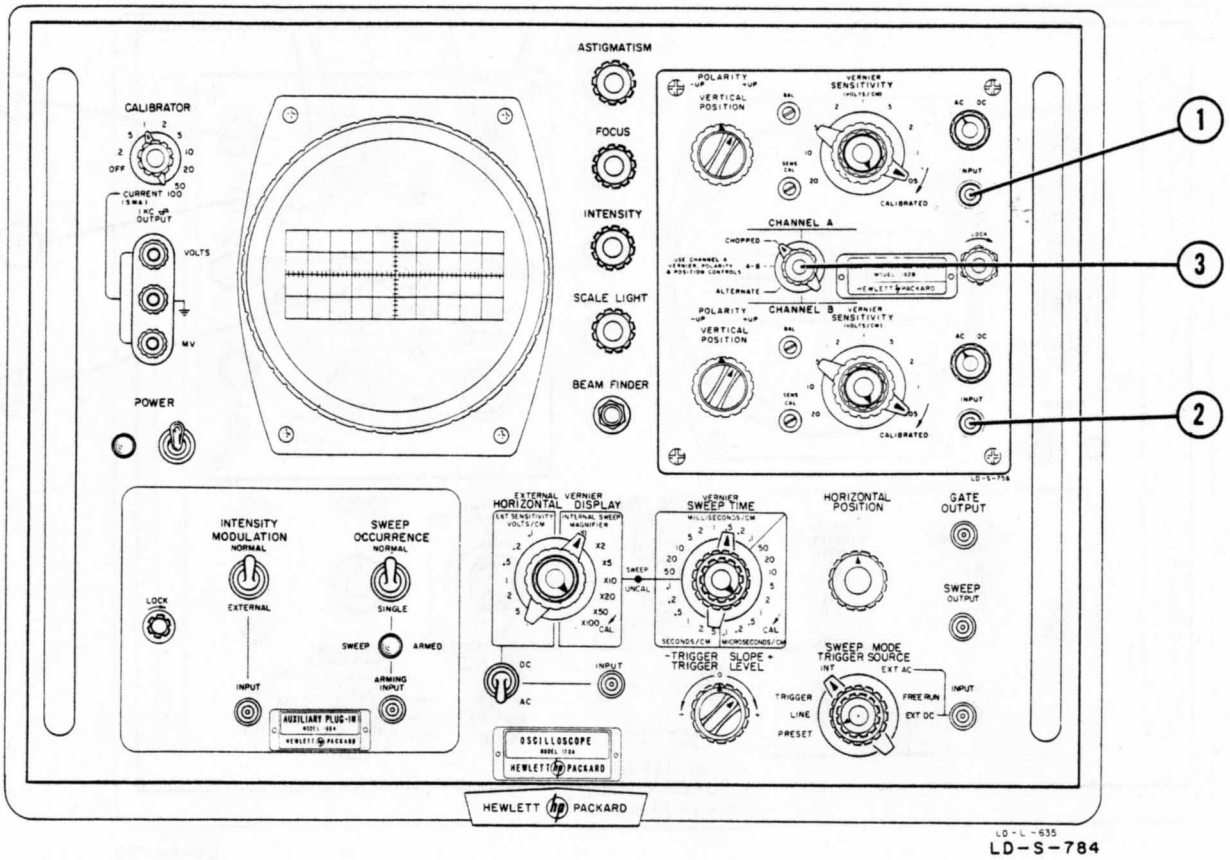
5. Set POLARITY to +UP or -UP as desired.

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).

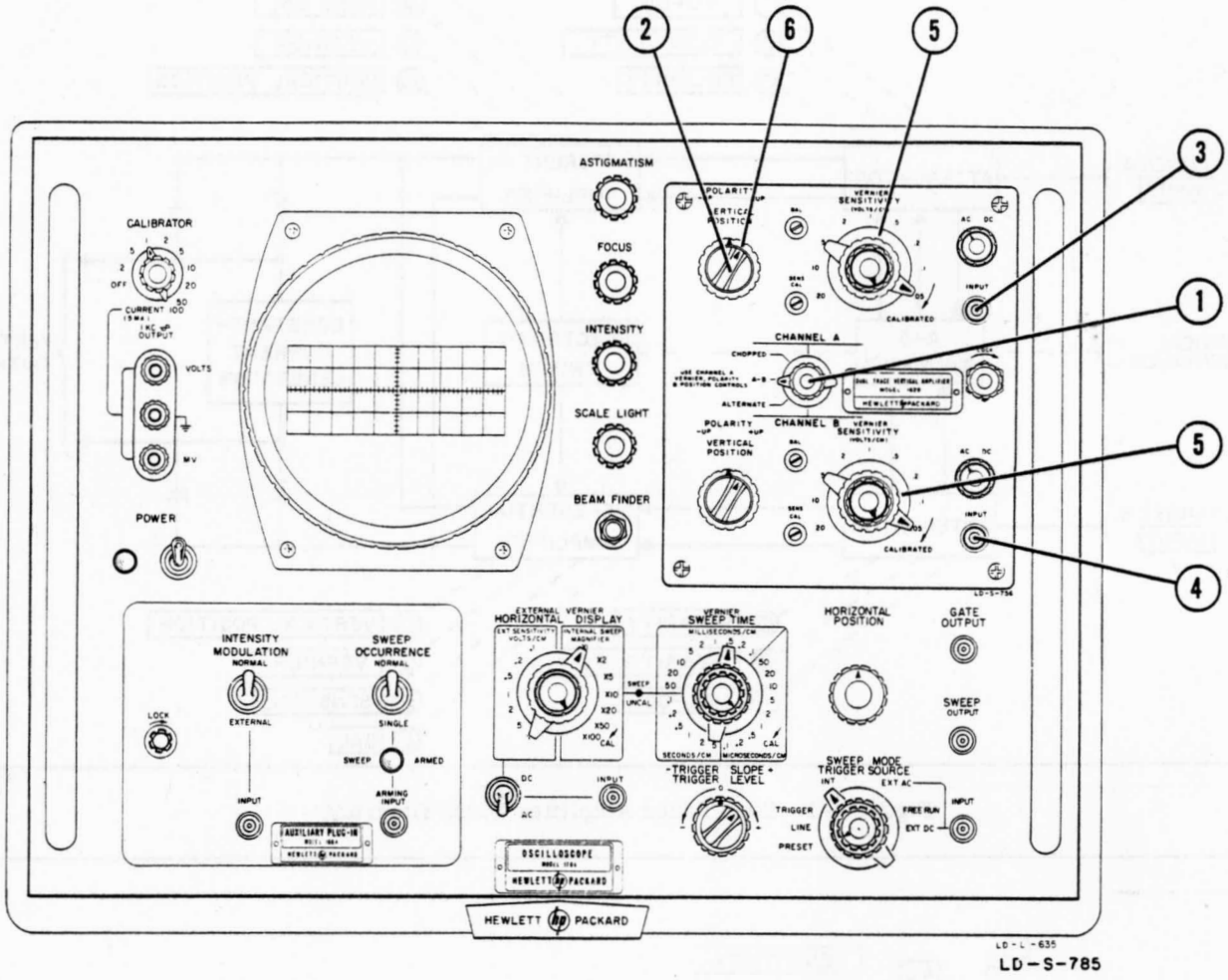
2. Connect the second signal to channel B INPUT and set channel B controls as desired.

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



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

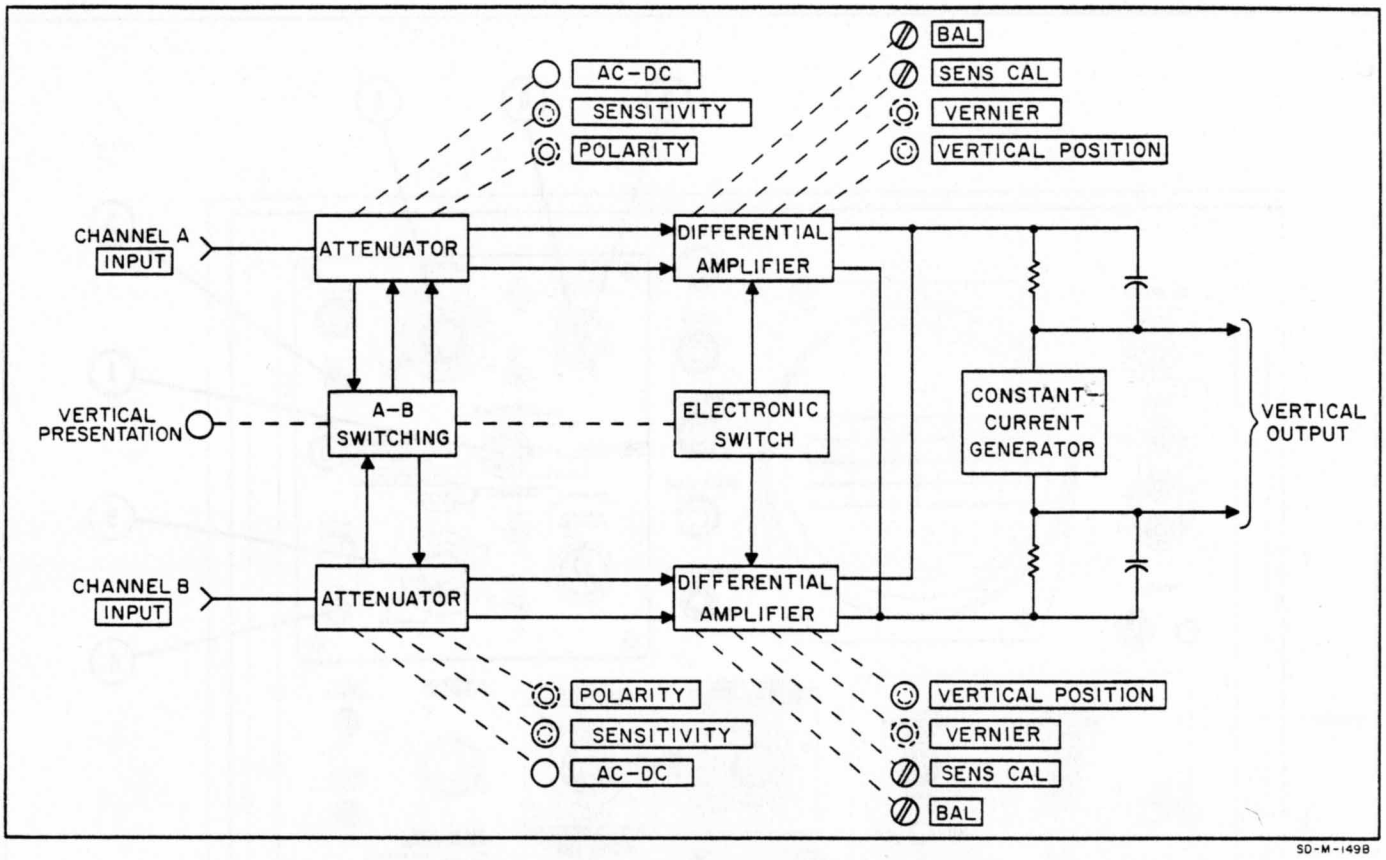


Figure 4-1. Dual Trace Amplifier Block Diagram

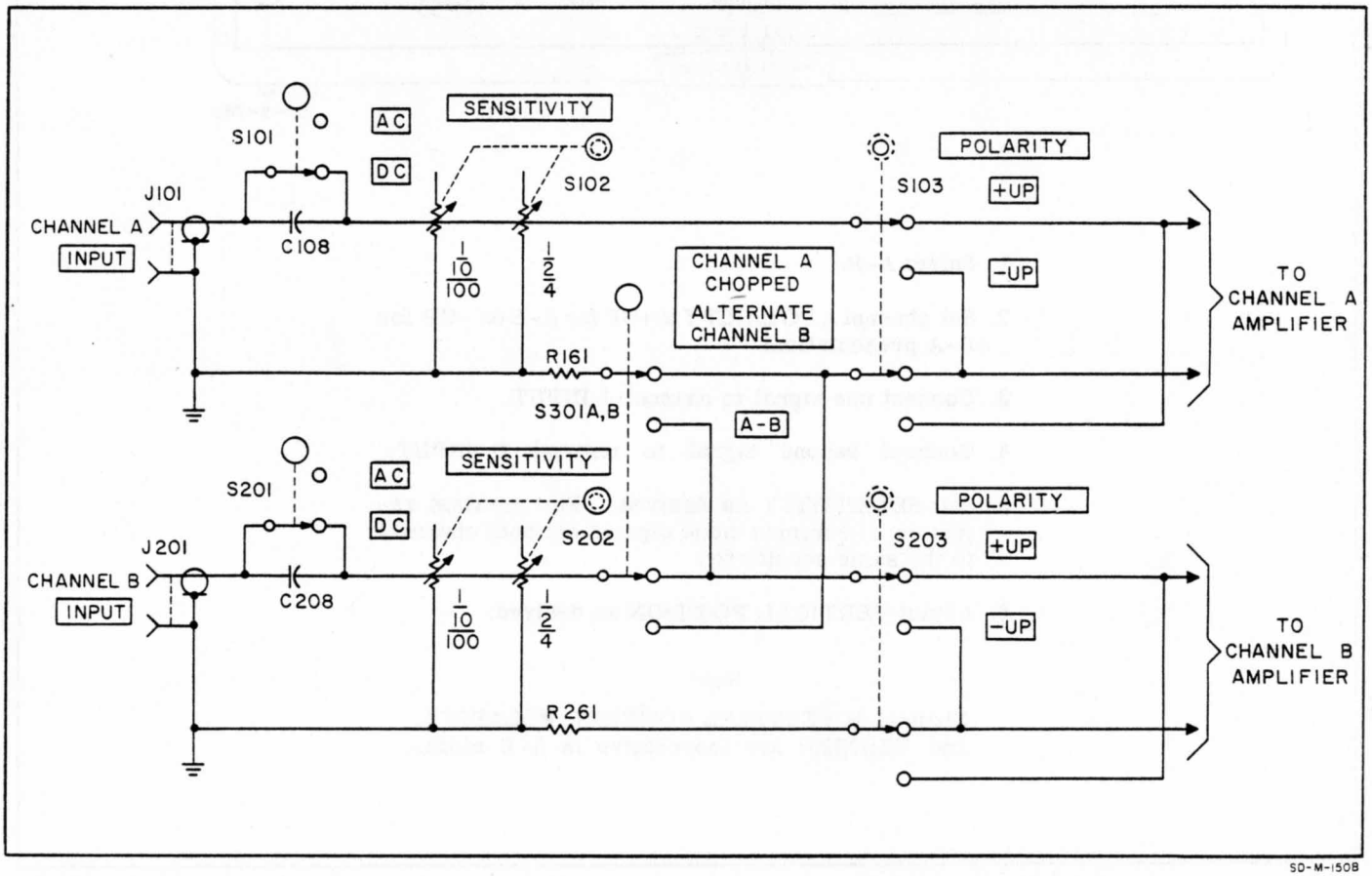


Figure 4-2. Attenuator Simplified Schematic

SECTION IV
PRINCIPLES OF OPERATION

4-1. INTRODUCTION.

4-2. The Model 162B 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 162B 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 162B 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.

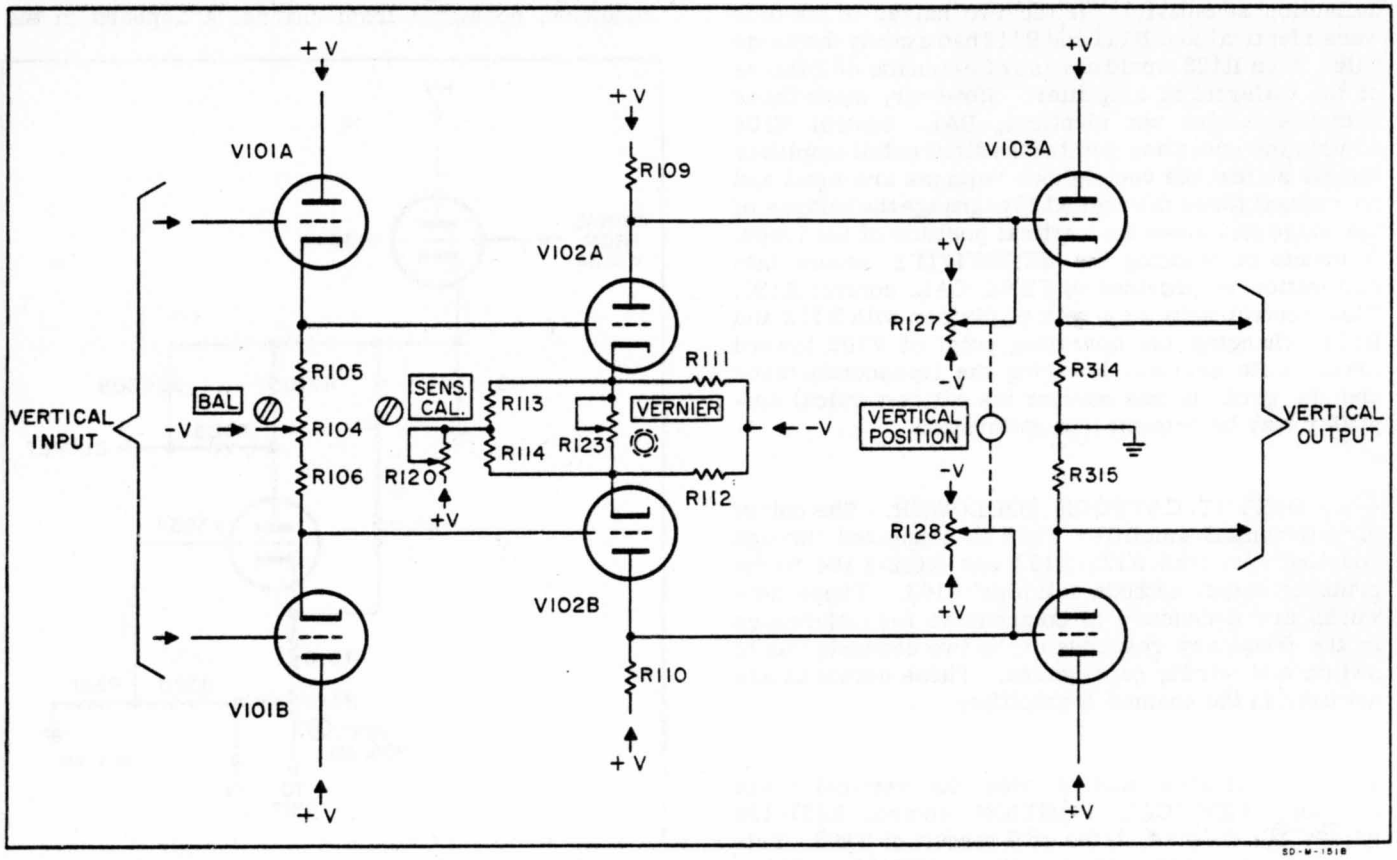


Figure 4-3. Amplifier Simplified Schematic

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 cathode 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 degenerative 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 had 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 adjusts 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 condition, no signal from channel A appears in the

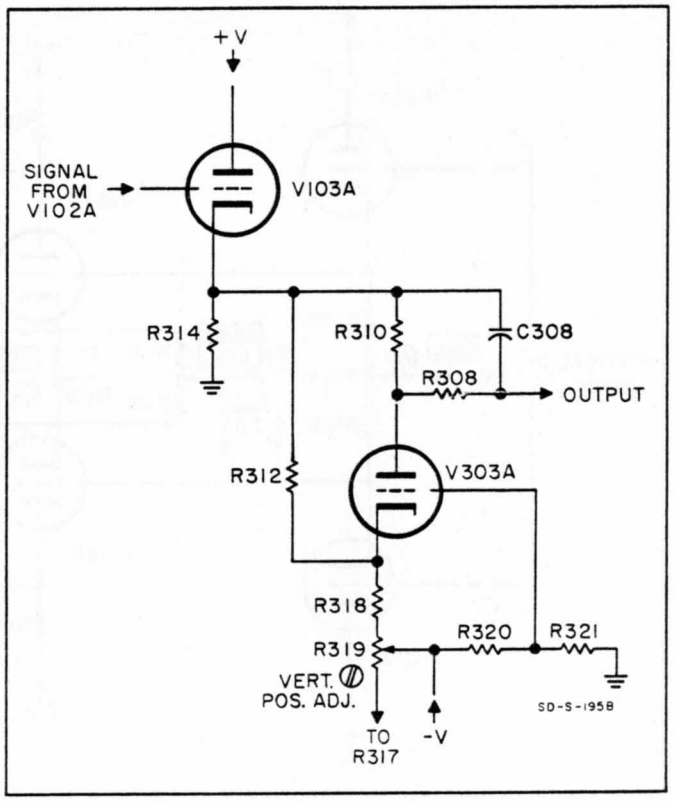


Figure 4-4. Constant Current Generator

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

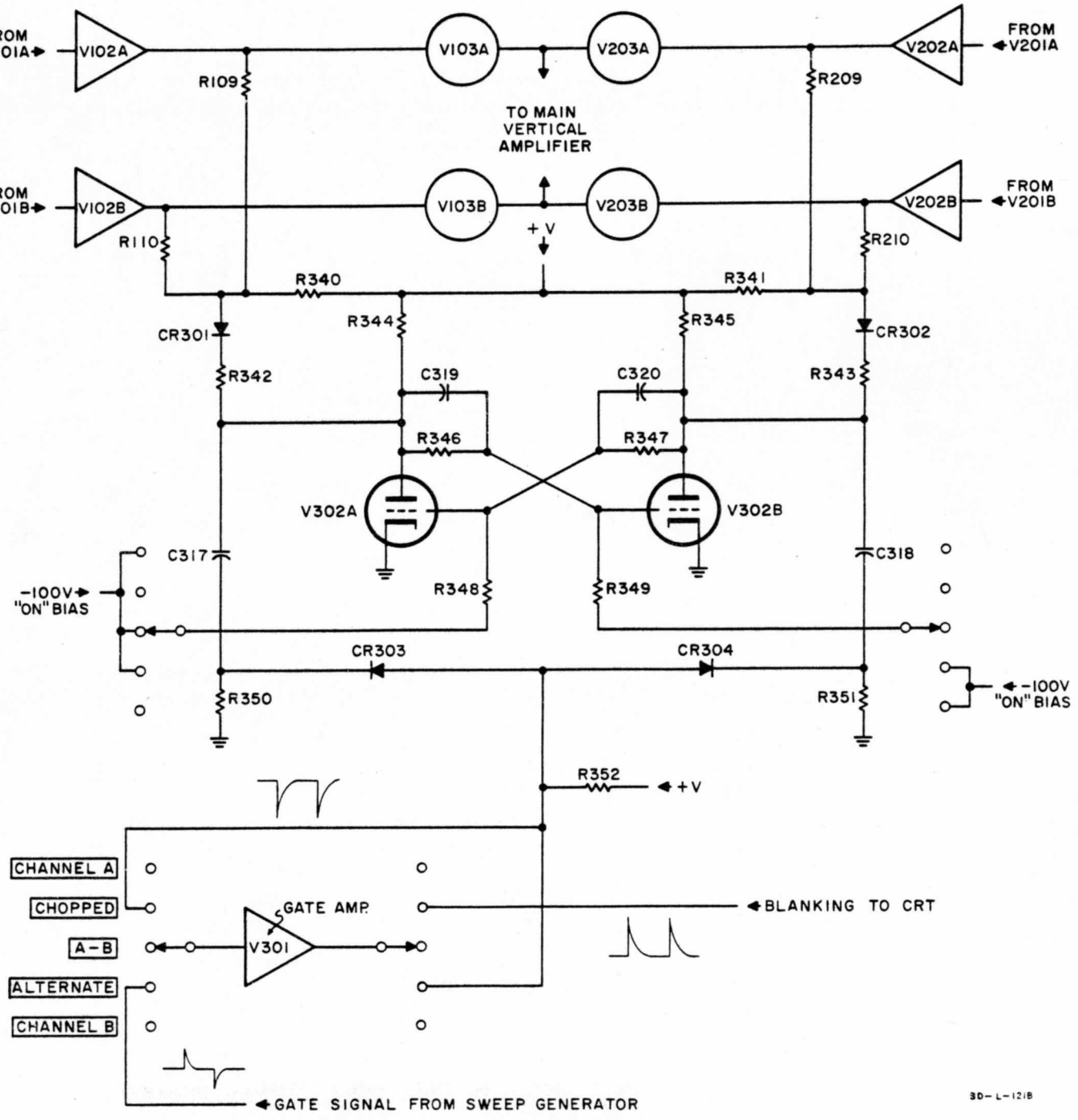


Figure 4-5. Electronic Switch

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.

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 162B 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 160B/170A set controls as follows:

Set: SWEEP TIME VERNIER . . . . . CAL
HORIZONTAL DISPLAY . . INTERNAL SWEEP X1
TRIGGER SOURCE . . . . . INT
SWEEP MODE . . . . . FREE RUN
TRIGGER SLOPE . . . . . +
TRIGGER LEVEL 0

b. Set horizontal plug-in controls:

Model 166A: SWEEP OCCURRENCE . . . NORMAL

Model 166D: SWEEP SELECTOR . . MAIN SWEEP

Model 166C: FUNCTION . . . . . OFF

Model 166B: 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 30 mc Output: 0.3 to 5 v p-p into 50 ohms, constant with frequency	Common Mode Rejection Bandwidth	5-13 5-15	℗ 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	℗ Model 738AR
3	Pulse Generator	Output: 0.25 volts into 50 ohms Rise Time: 3 nsec or less	Rise Time Pulse Response	5-14 5-37	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 5-37	℗ Model 908A
5	Square Wave Generator	Output: 0.25 to 60 V Frequency: 1 kc and 10 kc	Frequency Compensation	5-34 5-36 5-37	℗ Model 211A
6	Alignment Attenuator		Input Capacitance	5-34 5-36	℗ Model 10403A
7	Extender		Extends plug-in outside oscilloscope		℗ Model 10400A

c. On Model 162B 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, 0.2 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 4 cm high.

d. Check the accuracy of all remaining SENSITIVITY 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.

Table 5-2. Sensitivity Calibration

Sensitivity (Volts/cm)	Voltmeter Calibrator Output (Volts pk-pk)		Display Height (cm)	
	Model 160B	Model 170A	Model 160B	Model 170A
.1	0.5	0.3	4.85 to 5.15	2.91 to 3.09
.2	1.0	0.5	4.85 to 5.15	2.42 to 2.58
.5	3.0	2.0	5.82 to 6.18	3.88 to 4.12
1	5.0	3.0	4.85 to 5.15	2.91 to 3.09
2	10.0	5.0	4.85 to 5.15	2.42 to 2.58
5	30.0	20.0	5.82 to 6.18	3.88 to 4.12
10	50.0	30.0	4.85 to 5.15	2.91 to 3.09
20	100.0	50.0	4.85 to 5.15	2.42 to 2.58

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)

5-12. DYNAMIC RANGE.

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

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
Channel A and B SENSITIVITY. . 5 volts/cm
Channel A and B VERNIER . . CALIBRATED

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

d. Set:
Vertical Presentation. . . . . ALTERNATE
Channel 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 μsec/cm
HORIZONTAL DISPLAY . . . INT SWEEP X10
TRIGGER SLOPE . . . . . +

c. Adjust the Pulse Generator output for 5 cm display height (4 cm in Model 170A).

d. The rise time between the 10% and 90% points should be less than 23 nanoseconds (12 nanoseconds in Model 170A).

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 (4 cm in Model 170A).

d. Change the Signal Generator output frequency to 15 mc (30 mc in Model 170A).

e. The display height should not be less than 4.2 cm (2.8 cm in Model 170A).

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.

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.

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 5-10, shows the waveforms for both modes of operation.

Table 5-4. Unbalance

Short Together	Effect	Fault
Pins 1 and 9 of P301	trace centers trace does not center	Model 162B Model 160B/170A
Pins 3 and 8 of V103	trace centers trace does not center	input and differential amplifier R319 or V303
Pins 2 and 7 of V103	trace centers trace does not center	V101, 102 V103
Pins 2 and 7 of V102	trace centers trace does not center	V101 V102
Pins 2 and 7 of V101	trace does not center	V101 or R104
Note: Same procedure may be used for channel B.		

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 #PL333 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 re-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.

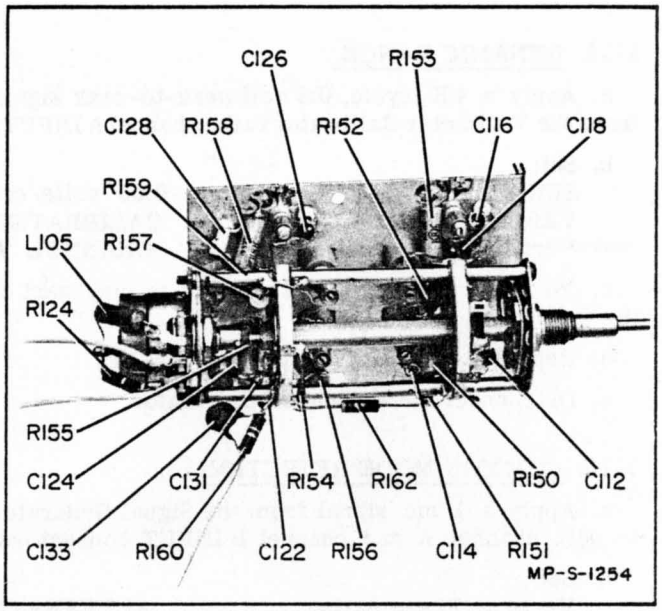


Figure 5-1. Parts Location, Channel A Attenuator

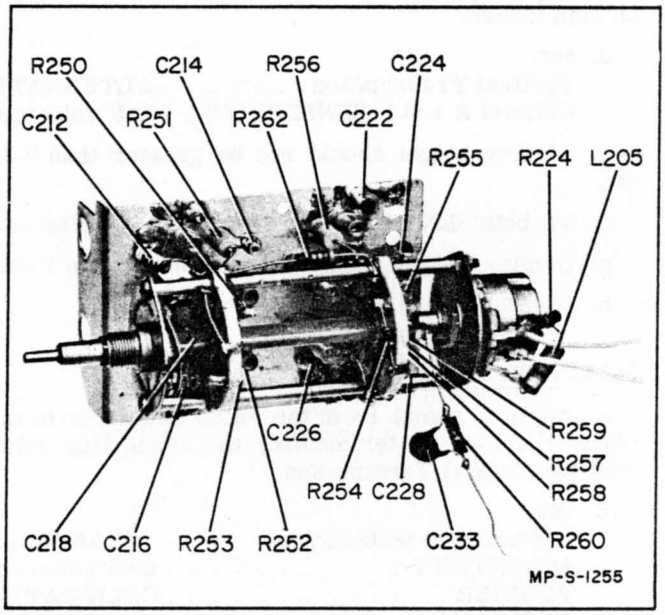


Figure 5-2. Parts Location, Channel B Attenuator

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	

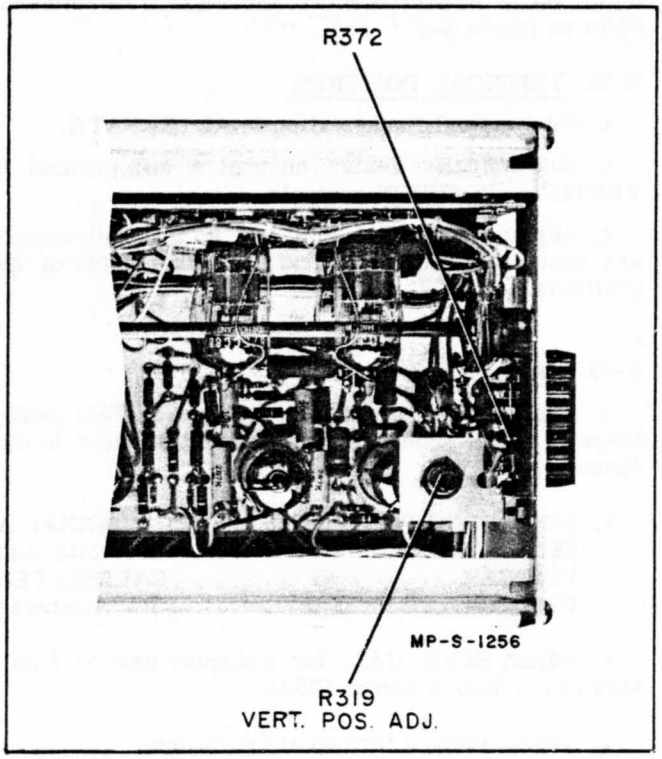


Figure 5-3. Parts Location, Top

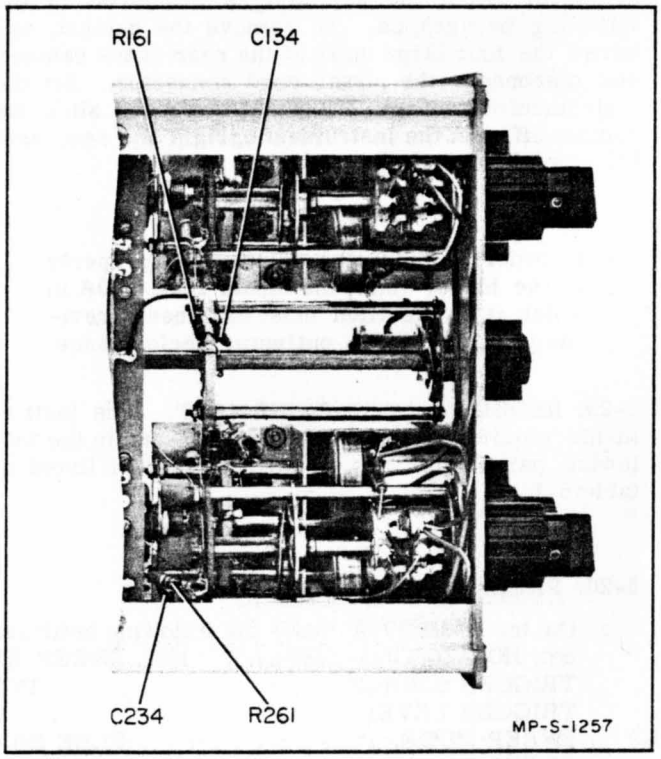


Figure 5-4. Part, Location, Left Side

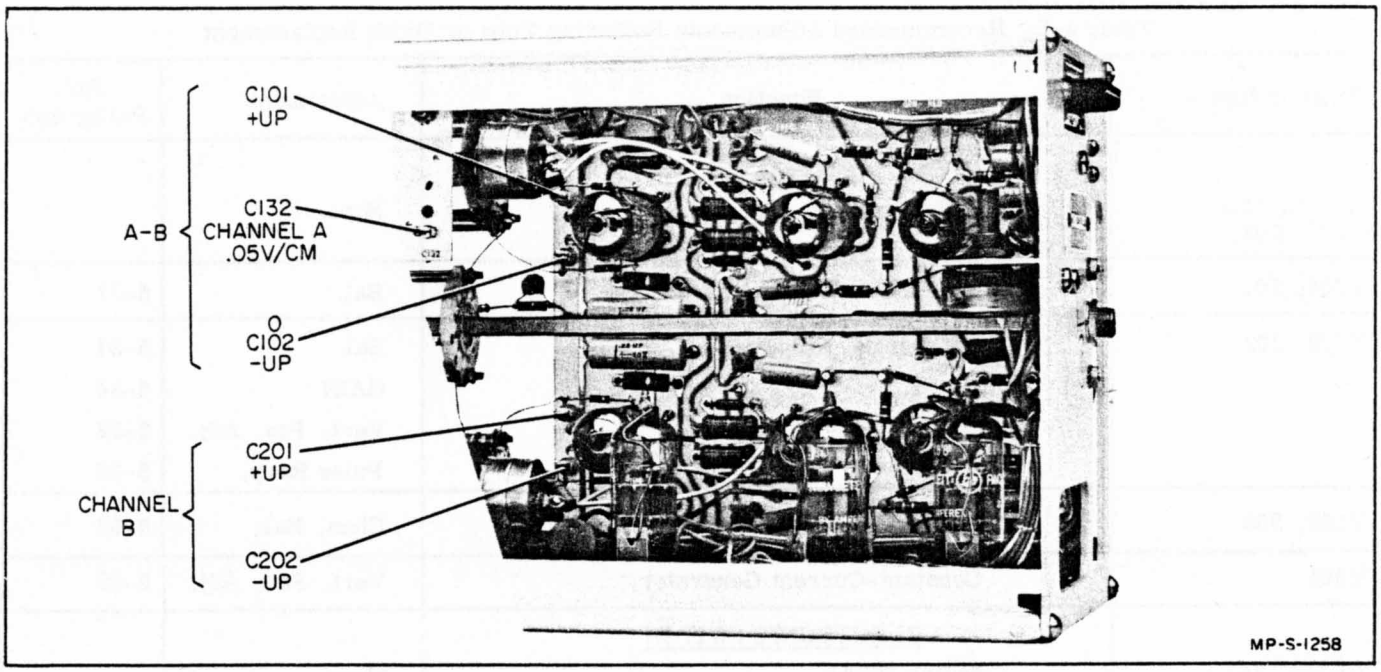


Figure 5-5. Amplifier Input Capacitance Adjustment Location

5-26. ADJUSTMENTS.

5-27. The following paragraphs outline procedures for adjusting the calibration, balance, and frequency compensation of the Model 162B.

5-28. The oscilloscope cabinet must be removed in order to reach the adjustments described in the following paragraphs. To remove the cabinet, unscrew the four large bolts at the rear of the cabinet, and disconnect the power cord connector. Set the instrument down with the panel down and slide the cabinet off. Set the instrument upright and reconnect the power cord.

Note

In order to make the adjustments properly in the Model 162B, the Model 160B/170A in which it is installed must have been previously adjusted for optimum performance.

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.

5-20. PRELIMINARY SETTINGS.

a. On the 160B/170A 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 166A: SWEEP OCCURRENCE . . . NORMAL
Model 166B: SWEEP SELECTOR . MAIN SWEEP
Model 166C: FUNCTION. . . . . OFF
Model 166B: TIME MARKER . . . . . OFF

5-31. BAL. ADJUSTMENT. For BAL. adjustment, 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. GAIN.

a. Apply a .3 volt (.2 volt in Model 170A) 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 (4 cm high in Model 170A).

d. Repeat steps a through d for channel B.

e. Disconnect the Voltmeter Calibrator.

5-34. 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 (4 cm in Model 170A).

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.

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.

5-35. 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 (4 cm in Model 170A).

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.

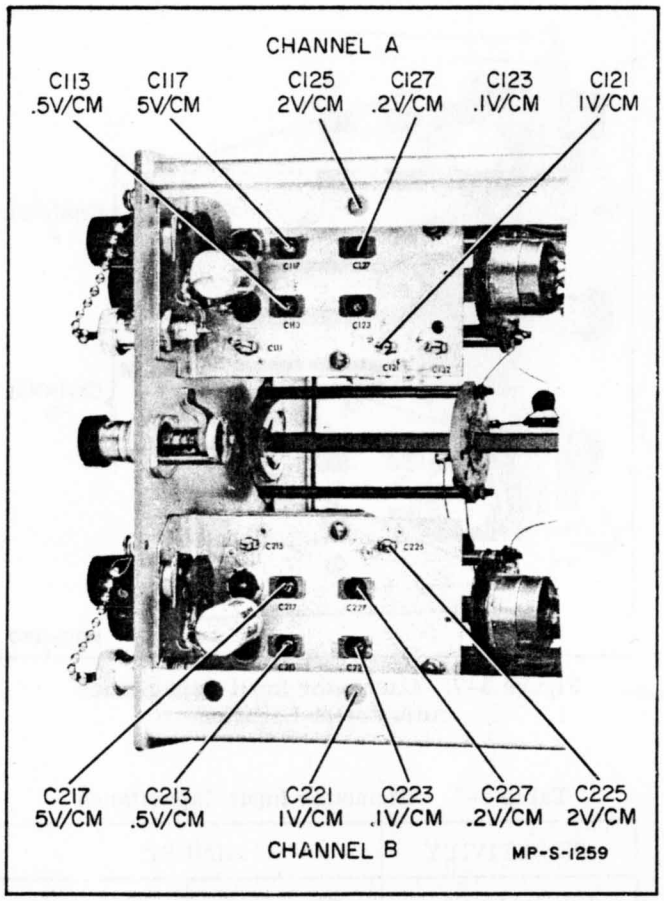


Figure 5-6. Attenuator Compensation Adjustment Location

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

5-36. ATTENUATOR INPUT CAPACITANCE.

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

b. 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 from 5 to 6 cm trace height (4 cm in Model 170A).

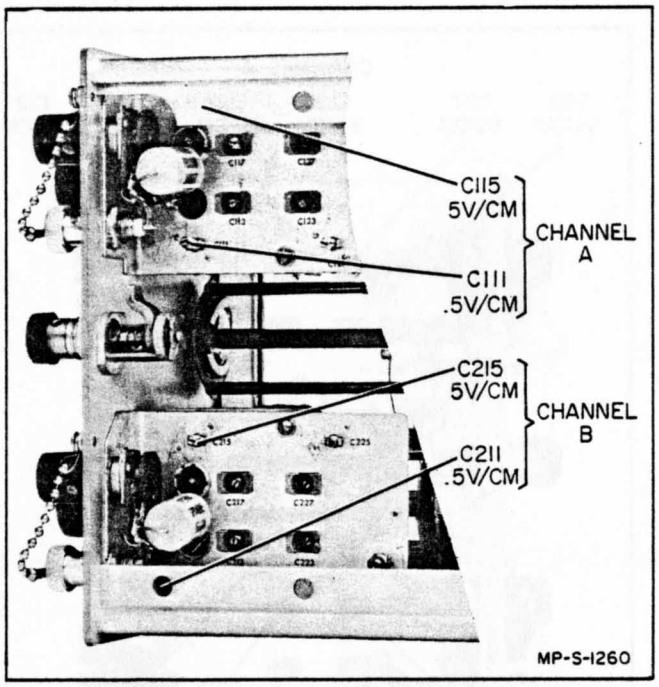


Figure 5-7. Attenuator Input Capacitance Adjustment Location

Table 5-7. Attenuator Input Capacitance

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

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.

5-37. 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 (4 cm in Model 170A).

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.

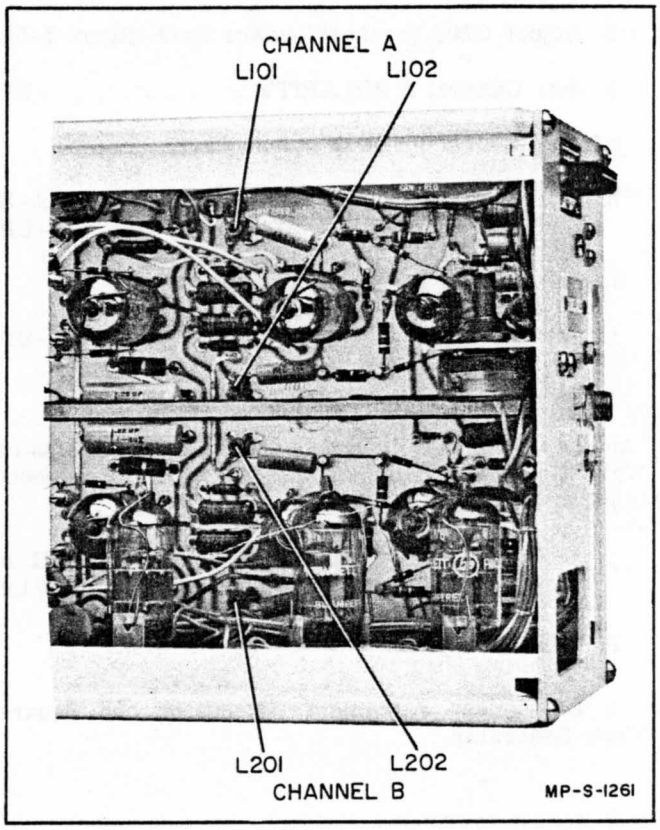
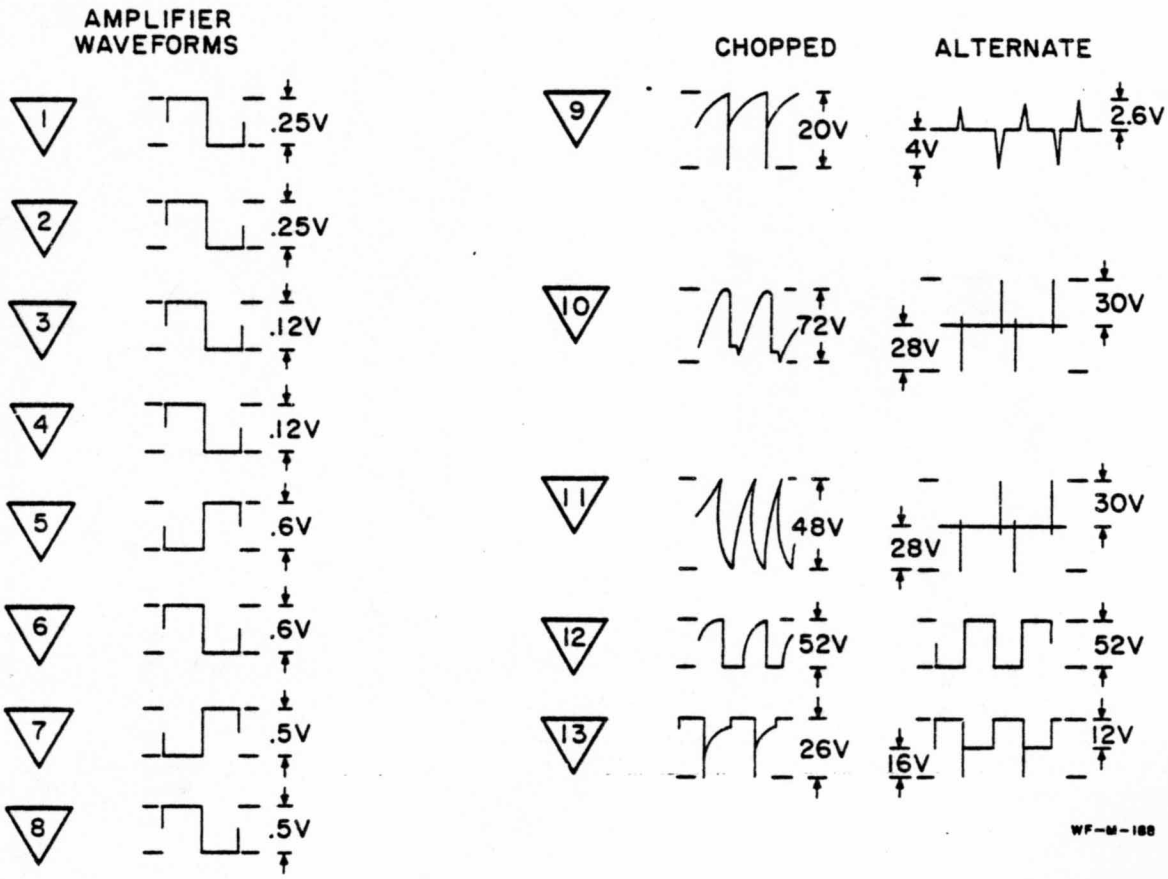


Figure 5-8. Pulse Response Adjustment Location

Notes for Schematics

1. All values in ohms, microhenries, and picofarads unless otherwise noted.
2. Titles enclosed in boxes indicated 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

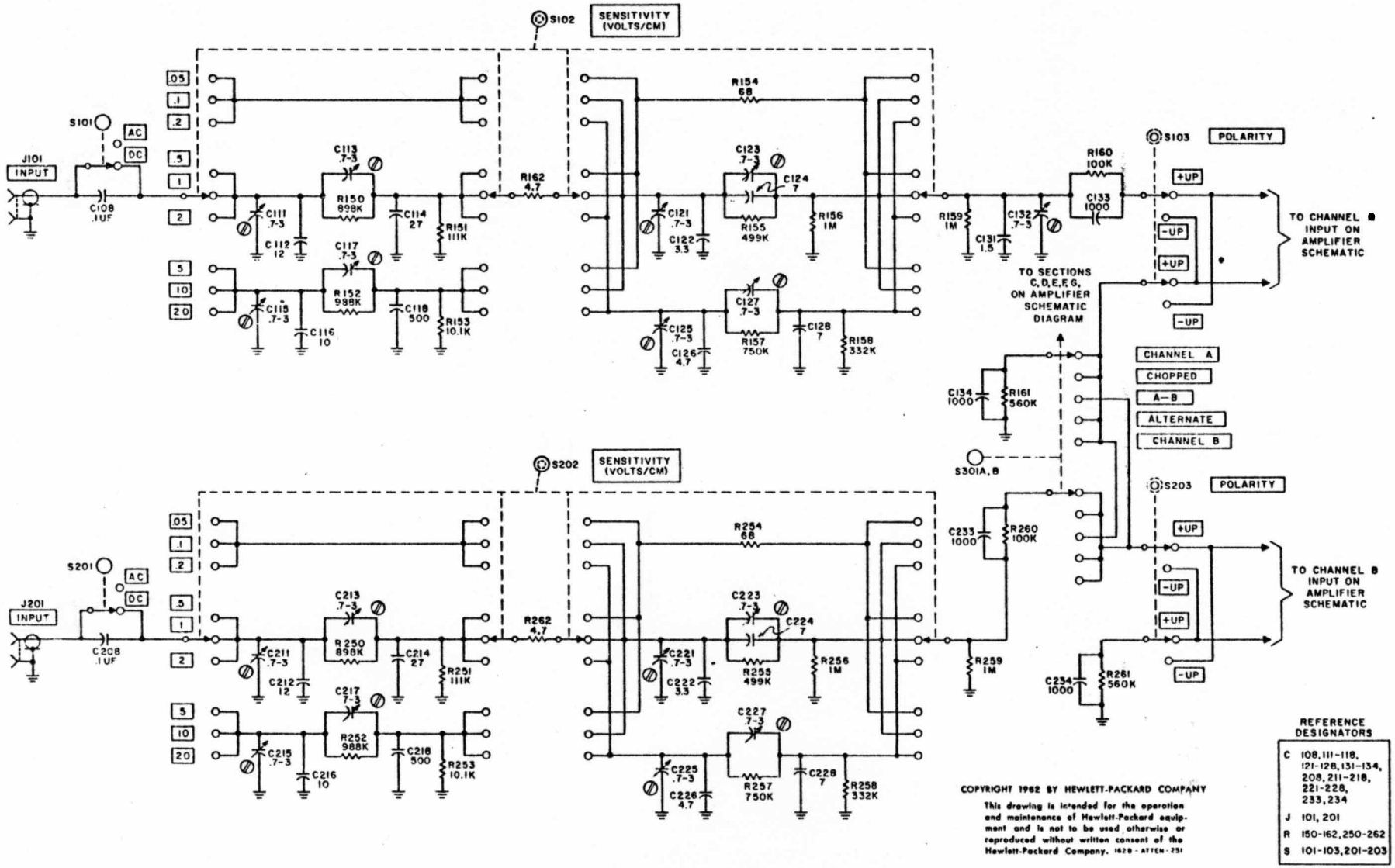


Figure 5-9. Attenuator Schematic

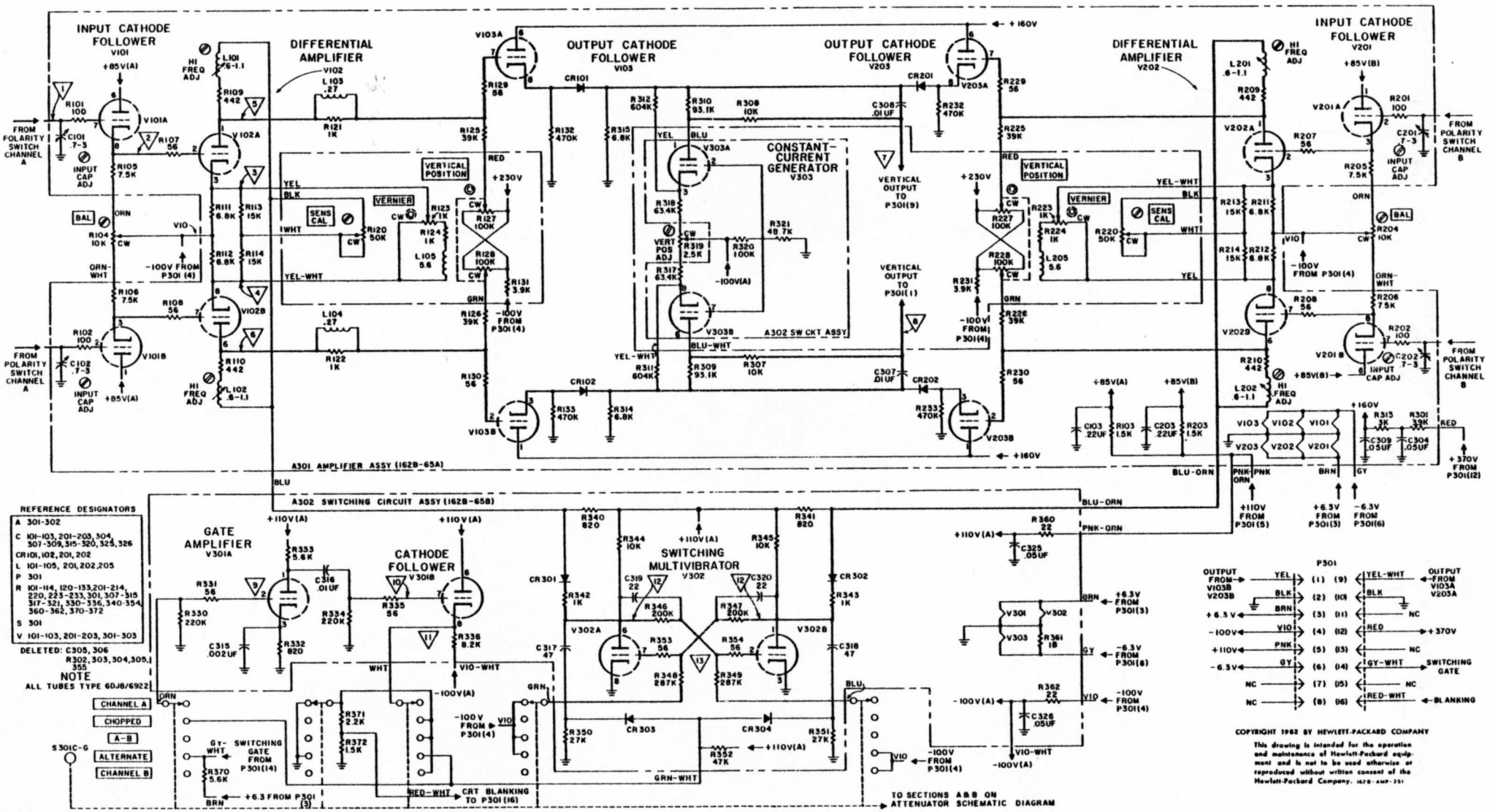


Figure 5-10. Amplifier Schematic

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 ℎ stock number of each part, together with any applicable notes. Table 6-2 lists parts in alpha-numerical order of their ℎ 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
B = motor
C = capacitor
CR = diode
DL = delay line
DS = device signaling (lamp)
E = misc electronic part
F = fuse
FL = filter
J = jack
K = relay
L = inductor
M = meter
MP = mechanical part
P = plug
Q = transistor
R = resistor
RT = thermistor
S = switch
T = transformer
V = vacuum tube, neon bulb, photocell, etc.
W = cable
X = socket
Y = crystal
Z = network

ABBREVIATIONS

A = amperes
BP = bandpass
BWO = backward wave oscillator
CER = ceramic
CMO = cabinet mount only
COEF = coefficient
COM = common
COMP = composition
CONN = connection
CRT = cathode-ray tube
DEPC = deposited carbon
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 ℎ stock numbers.
ELECT = electrolytic
ENCAP = encapsulated
F = farads
FXD = fixed
GE = germanium
GL = glass
GRD = ground(ed)
H = henries
HG = mercury
HR = hour(s)
IMPG = impregnated
INCD = incandescent
INS = insulation(ed)
K = kilo = 1000
LIN = linear taper
LOG = logarithmic taper
MEG = meg $=10^{6}$
M = milli $=10^{-3}$
MINAT = minature
METFLM = metal film
MFR = manufacturer
MOM = momentary
MTG = mounting
MY = mylar
NC = normally closed
NE = neon
NO = normally open
NPO = negative positive zero (zero temperature coefficient)
NSR = not separately replaceable
OBD = order by description
OX = oxide
P = peak
PC = printed circuit board
PF = picofarads = 10^{-12} farads
PP = peak-to-peak
PIV = peak inverse voltage
POR = porcelain
POS = position(s)
POLY = polystyrene
POT = potentiometer
RECT = rectifier
ROT = rotary
RMS = root-mean-square
RMO = rack mount only
S-B = slow-blow
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

Table 6-1. Reference Designation Index

Circuit Reference	Stock No.	Description	Note
A1	162B-34A	ASSY:CHANNEL A ATTENUATOR	
A2	162B-34B	ASSY:CHANNEL B ATTENUATOR	
A3	162B-65A	ASSY:AMPLIFIER	
A4	162B-65B	ASSY:SWITCH CIRCUIT	
A5	OBD#	ASSY:VERTICAL PRESENTATION CONSISTS OF S301A-B AND S301C-G	
C101	0132-0006	C:VAR GL 0.7-3.0 PF 350 V	
C102	0132-0006	C:VAR GL 0.7-3.0 PF 350 V	
C103	0170-0087	C:FXD .22UF 20% 200VDCW	
C104 THRU C107		NOT ASSIGNED	
C108	0170-0022	C:FXD MY 0.1UF 20% 600VDCW	
C109 THRU C110		NOT ASSIGNED	
C111	0132-0006	C:VAR GL 0.7-3.0 PF 350 V	
C112	0160-0132	C:FXD CER 12PF 5% 500VDCW	
C113	0132-0006	C:VAR GL 0.7-3.0 PF 350 V	
C114	0150-0115	C:FXD CER 27PF 10% 500VDCW	
C115	0132-0006	C:VAR GL 0.7-3.0 PF 350 V	
C116	0150-0063	C:FXD 10 PF 5% 500VDCW	
C117	0132-0006	C:VAR GL 0.7-3.0 PF 350 V	
C118	0160-0133	C:FXD MICA 500PF 10% 500VDCW	
C119 THRU C120		NOT ASSIGNED	
C121	0132-0006	C:VAR GL 0.7-3.0 PF 350 V	
C122	0150-0059	C:FXD CER 3.3 PF +/- NPO 600 VDCW	
C123	0132-0006	C:VAR GL 0.7-3.0 PF 350 V	
C124	0150-0074	C:FXD CER 7 PF +/-.5PF 500 VDCW	
C125	0132-0006	C:VAR GL 0.7-3.0 PF 350 V	
C126	0150-0089	C:FXD CER 4.7 PF +/-0.25 PF 500 VDCW	
C127	0132-0006	C:VAR GL 0.7-3.0 PF 350 V	
C128	0150-0074	C:FXD CER 7 PF +/-.5PF 500 VDCW	
C129 THRU C130		NOT ASSIGNED	
C131	0150-0091	C:FXD CER 1.5 PF +/-0.25 PF 500 VDCW	
C132	0132-0006	C:VAR GL 0.7-3.0 PF 350 V	
C133	0150-0069	C:FXD 100PF 500VDCW	
C134	0150-0069	C:FXD 100PF 500VDCW	
C135 THRU C200		NOT ASSIGNED	
C201	0132-0006	C:VAR GL 0.7-3.0 PF 350 V	
C202	0132-0006	C:VAR GL 0.7-3.0 PF 350 V	
C203	0170-0087	C:FXD .22UF 20% 200VDCW	
C204 THRU C207		NOT ASSIGNED	
C208	0170-0022	C:FXD MY 0.1UF 20% 600VDCW	
C209 THRU C210		NOT ASSIGNED	
C211	0132-0006	C:VAR GL 0.7-3.0 PF 350 V	
C212	0160-0132	C:FXD CER 12PF 5% 500VDCW	
C213	0132-0006	C:VAR GL 0.7-3.0 PF 350 V	

See introduction to this section

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

Circuit Reference	Stock No.	Description	Note
C214	0150-0115	C:FXD CER 27PF 10% 500VDCW	
C215	0132-0006	C:VAR GL 0.7-3.0 PF 350 V	
C216	0150-0063	C:FXD 10 PF 5% 500VDCW	
C217	0132-0006	C:VAR GL 0.7-3.0 PF 350 V	
C218	0160-0133	C:FXD MICA 500PF 10% 500VDCW	
C219 THRU C220		NOT ASSIGNED	
C221	0132-0006	C:VAR GL 0.7-3.0 PF 350 V	
C222	0150-0059	C:FXD CER 3.3 PF +/- NPO 600 VDCW	
C223	0132-0006	C:VAR GL 0.7-3.0 PF 350 V	
C224	0150-0074	C:FXD CER 7 PF +/-.5PF 500 VDCW	
C225	0132-0006	C:VAR GL 0.7-3.0 PF 350 V	
C226	0150-0089	C:FXD CER 4.7 PF +/-0.25 PF 500 VDCW	
C227	0132-0006	C:VAR GL 0.7-3.0 PF 350 V	
C228	0150-0074	C:FXD CER 7 PF +/-.5PF 500 VDCW	
C229 THRU C232		NOT ASSIGNED	
C233	0150-0069	C:FXD 1000PF 500VDCW	
C234	0150-0069	C:FXD 1000PF 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 0.05 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 47PF 5% 500VDCW	
C318	0140-0039	C:FXD 47PF 5% 500VDCW	
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 0.05 UF 20% 400 VDCW	
C326	0150-0052	C:FXD 0.05 UF 20% 400 VDCW	
CR101	1910-0016	DIODE:SEMICON DEVICE FOR 162B ONLY.	
CR101	1910-0014	DIODE:SEMICON DEVICE FOR H02-162B ONLY	
CR102	1910-0016	DIODE:SEMICON DEVICE FOR 162B ONLY.	
CR102	1910-0014	DIODE:SEMICON DEVICE FOR H02-162B ONLY	
CR103 THRU CR200		NOT ASSIGNED	
CR201	1910-0016	DIODE:SEMICON DEVICE FOR 162B ONLY.	
CR201	1910-0014	DIODE:SEMICON DEVICE FOR H02-162B ONLY	
CR202	1910-0016	DIODE:SEMICON DEVICE FOR 162B ONLY.	
CR202	1910-0014	DIODE:SEMICON DEVICE FOR H02-162B ONLY	
CR203 THRU CR300		NOT ASSIGNED	
CR301	1910-0016	DIODE:SEMICON DEVICE FOR 162B ONLY.	

See introduction to this section

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

Circuit Reference	Stock No.	Description	Note
CR301	1910-0014	DIODE:SEMICON DEVICE FOR H02-162B ONLY	
CR302	1910-0016	DIODE:SEMICON DEVICE FOR 162B ONLY.	
CR302	1910-0014	DIODE:SEMICON DEVICE FOR H02-162B ONLY	
CR303	1910-0016	DIODE:SEMICON DEVICE FOR 162B ONLY.	
CR303	1910-0014	DIODE:SEMICON DEVICE FOR H02-162B ONLY	
CR304	1910-0016	DIODE:SEMICON DEVICE FOR 162B ONLY.	
CR304	1910-0014	DIODE:SEMICON DEVICE FOR H02-162B ONLY	
J101	1250-0118	CONNECTOR:BNC	
J102 THRU J200		NOT ASSIGNED	
J201	1250-0118	CONNECTOR:BNC	
L101	162F-60A	COIL:VAR .6-1.1	
L102	162F-60A	COIL:VAR .6-1.1	
L103	9140-0095	COIL FXD RF: 0.27UHY	
L104	9140-0095	COIL FXD RF: 0.27UHY	
L105	9140-0069	COIL FXD RF: 5.6UHY	
L106 THRU L200		NOT ASSIGNED	
L201	162F-60A	COIL:VAR .6-1.1	
L202	162F-60A	COIL:VAR .6-1.1	
L203 THRU L204		NOT ASSIGNED	
L205	9140-0069	COIL FXD RF: 5.6UHY	
P301	1251-0006	CONNECTOR:16 PIN	
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	2100-0027	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	0757-0149	R:FXD MET FLM 442 OHMS 1% 1/2W	
R110	0757-0149	R:FXD MET FLM 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	0758-0018	R:FXD MET FLM 15K OHMS 5% 1/2W	
R114	0758-0018	R:FXD MET FLM 15K OHMS 5% 1/2W	
R115 THRU R119		NOT ASSIGNED	
R120	2100-0044	R:VAR COMP 50K OHM 10% LIN 2W	
R121	0684-1021	R:FXD COMP 1000 OHMS 10% 1/4W	
R122	0684-1021	R:FXD COMP 1000 OHMS 10% 1/4W	
R123	2100-0271	R:VAR COMP 1000 OHMS 20% CCW 20% LOG 1W	
R124	0687-1021	R:FXD COMP 1000 OHMS 10% 1/2W	
R125	0687-3931	R:FXD COMP 39K OHMS 10% 1/2W	
R126	0687-3931	R:FXD COMP 39K OHMS 10% 1/2W	
R127		NOT SEPARATELY REPLACEABLE PART OF S103	
R128		NOT SEPARATELY REPLACEABLE PART OFS103	
R129	0684-5601	R:FXD COMP 56 OHMS 10% 1/4W	

See introduction to this section

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

Circuit Reference	Stock No.	Description	Note
R130	0684-5601	R:FXD COMP 56 OHMS 10% 1/4W	
R131	0687-3921	R:FXD COMP 3900 OHMS 10% 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	0757-0146	R:FXD MET FLM 89.8K OHMS 1% 1/4W	
R151	0757-0142	R:FXD MET FLM 111K OHMS 1% 1/4W	
R152	0757-0147	R:FXD MET FLM 98.8K OHMS 1% 1/4W	
R153	0757-0141	R:FXD MET FLM 10.1K OHMS 1% 1/4W	
R154	0684-6801	R:FXD COMP 68 OHMS 10% 1/4W	
R155	0757-0144	R:FXD MET FLM 499K OHMS 1% 1/4W	
R156	0757-0148	R:FXD MET FLM 1M OHMS 1% 1/4W	
R157	0757-0145	R:FXD MET FLM 750K OHMS 1% 1/4W	
R158	0757-0143	R:FXD MET FLM 332K OHMS 1% 1/4W	
R159	0757-0148	R:FXD MET FLM 1M OHMS 1% 1/4W	
R160	0687-1041	R:FXD COMP 100K OHMS 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	2100-0027	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	0684-5601	R:FXD COMP 56 OHMS 10% 1/4W	
R209	0757-0149	R:FXD MET FLM 442 OHMS 1% 1/2W	
R210	0757-0149	R:FXD MET FLM 442 OHMS 1% 1/2W	
R211	0764-0012	R:FXD MET FLM 6.800 OHM 5% 2W	
R212	0764-0012	R:FXD MET FLM 6.800 OHM 5% 2W	
R213	0758-0018	R:FXD MET FLM 15K OHMS 5% 1/2W	
R214	0758-0018	R:FXD MET FLM 15K OHMS 5% 1/2W	
R215 THRU R219		NOT ASSIGNED	
R220	2100-0044	R:VAR COMP 50K OHM 10% LIN 2W	
R221 THRU R222		NOT ASSIGNED	
R223	2100-0271	R:VAR COMP 1000 OHMS 20% CCW 20% LOG 1W	
R224	0687-1021	R:FXD COMP 1000 OHMS 10% 1/2W	
R225	0687-3931	R:FXD COMP 39K OHMS 10% 1/2W	
R226	0687-3931	R:FXD COMP 39K OHMS 10% 1/2W	
R227		NOT SEPARATELY REPLACEABLE PART OF S203	
R228		NOT SEPARATELY REPLACEABLE PART OF S203	
R229	0684-5601	R:FXD COMP 56 OHMS 10% 1/4W	
R230	0684-5601	R:FXD COMP 56 OHMS 10% 1/4W	
R231	0687-3921	R:FXD COMP 3900 OHMS 10% 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	

See introduction to this section

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

Circuit Reference	Stock No.	Description	Note
R250	0757-0146	R:FXD MET FLM 898K OHMS 1% 1/4W	
R251	0757-0142	R:FXD MET FLM 111K OHMS 1% 1/4W	
R252	0757-0147	R:FXD MET FLM 988K OHMS 1% 1/4W	
R253	0757-0141	R:FXD MET FLM 10.1K OHMS 1% 1/4W	
R254	0684-6801	R:FXD COMP 68 OHMS 10% 1/4W	
R255	0757-0144	R:FXD MET FLM 499K OHMS 1% 1/4W	
R256	0757-0148	R:FXD MET FLM 1M OHMS 1% 1/4W	
R257	0757-0145	R:FXD MET FLM 750K OHMS 1% 1/4W	
R258	0757-0143	R:FXD MET FLM 332K OHMS 1% 1/4W	
R259	0757-0148	R:FXD MET FLM 1M OHMS 1% 1/4W	
R260	0687-1041	R:FXD COMP 100K OHMS 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 3900 OHM 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	0757-0152	R:FXD MET FLM 93.1K OHMS 1% 0.5W	
R310	0757-0152	R:FXD MET FLM 93.1K OHMS 1% 0.5W	
R311	0757-0155	R:FXD MET FLM 604K OHMS 1% 0.5W	
R312	0757-0155	R:FXD MET FLM 604K OHMS 1% 0.5W	
R313	0767-0016	R:FXD 3.3K 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	0757-0151	R:FXD MET FLM 63.4K OHMS 1# 0.5W	
R318	0757-0151	R:FXD MET FLM 63.4K OHMS 1# 0.5W	
R319	2100-0207	R:VAR COMP 2500 OHMS 20% LIN 2W	
R320	0757-0153	R:FXD MET FLM 100K OHMS 1% 0.5W	
R321	0757-0150	R:FXD MET FLM 48.7K OHMS 1% 0.5W	
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 820 OHM 10% 1/2W	
R333	0765-0009	R:FXD 5.6K OHM 10% 2W	
R334	0687-2241	R:FXD COMP 220K OHMS 10% 1/2W	
R335	0684-5601	R:FXD COMP 56 OHMS 10% 1/4W	
R336	0765-0005	R:FXD 8.2K 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	0757-0050	R:FXD MET FLM 200K OHMS 1% 1/2W	

See introduction to this section

Table 6-1. Reference Designation Index

Circuit Reference		℗ Stock No.	Description	Note
R347		0757-0050	R:FXD MET FLM 200K OHMS 1% 1/2W	
R348		0757-0154	R:FXD MET FLM 287K OHMS 1%0.5W	
R349		0757-0154	R:FXD MET FLM 287K OHMS 1%0.5W	
R350		0687-2731	R:FXD COMP 27K OHMS 10% 1/2W	
R351		0687-2731	R:FXD COMP 27K OHMS 10% 1/2W	
R352		0687-4731	R:FXD COMP 47K 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	THRU			
R359			NOT ASSIGNED	
R360		0687-2201	R:FXD COMP 22 OHMS 10% 1/2W	
R361		0812-0012	R:FXD 18 OHM 5% 3W	
R362		0687-2201	R:FXD COMP 22 OHMS 10% 1/2W	
R363	THRU			
R369			NOT ASSIGNED	
R370		0684-5621	R:FXD 5600 OHM 10% 1/4W	
R371		0684-2221	R:FXD COMP 2200 OHMS 10% 1/4w	
R372		0687-1521	R:FXD COMP 1500 OHMS 10% 1/2W	
S101		3100-0211	SWITCH ROTARY 1 SECT 2 POS	
S102		3100-0349	SWITCH:ROTARY 2 SECT 9 POS NOT RECOMMENDED FOR FIELD REPLACEMENT	
S103		3100-0350	SWITCH:ROTARY 1 SECT 2 POS	
S104	THRU			
S200			NOT ASSIGNED	
S201		3100-0211	SWITCH ROTARY 1 SECT 2 POS	
S202		3100-0349	SWITCH:ROTARY 2 SECT 9 POS NOT RECOMMENDED FOR FIELD REPLACEMENT	
S203		3100-0350	SWITCH:ROTARY 1 SECT 2 POS	
S204	THRU			
S300			NOT ASSIGNED	
S301		3100-0351	SWITCH:ROTARY 1 SECT 5 POS S301A/B	
S301		3100-0352	SWITCH:ROTARY 1 SECT 5 POS S301C-G.	
V101		1932-0015	TUBE:ELECTRON 6922 FOR H02-162B ONLY	
V101		G-73Z	TUBE:ELECTRON SELECTED 162B ONLY.	
V102		1932-0015	TUBE:ELECTRON 6922 FOR H02-162B ONLY	
V102		G-73Z	TUBE:ELECTRON SELECTED 162B ONLY.	
V103		1932-0022	ELECTRON TUBE: DUAL TRIODE 162B ONLY	
V103		1932-0015	TUBE:ELECTRON 6922 FOR H02-162B ONLY	
V104	THRU			
V200			NOT ASSIGNED	
V201		1932-0015	TUBE:ELECTRON 6922 FOR H02-162B ONLY	
V201		G-73Z	TUBE:ELECTRON SELECTED 162B ONLY.	
V202		G-73Z	TUBE:ELECTRON SELECTED 162B ONLY.	
V202		1932-0015	TUBE:ELECTRON 6922 FOR H02-162B ONLY	
V203		1932-0022	ELECTRON TUBE: DUAL TRIODE 162B ONLY	
V203		1932-0015	TUBE:ELECTRON 6922 FOR H02-162B ONLY	
V204	THRU			
V300			NOT ASSIGNED	
V301		1932-0022	ELECTRON TUBE: DUAL TRIODE 162B ONLY	
V301		1932-0015	TUBE:ELECTRON 6922 FOR H02-162B ONLY	
V302		1932-0022	ELECTRON TUBE: DUAL TRIODE 162B ONLY	

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

Circuit Reference	Stock No.	Description	Note
V302	1932-0015	TUBE:ELECTRON 6922 FOR H02-162B ONLY	
V303	1932-0022	ELECTRON TUBE: DUAL TRIODE 162B ONLY	
V303	1932-0015	TUBE:ELECTRON 6922 FOR H02-162B ONLY	
XV101	1200-0058	SOCKET: TUBE	
XV102	1200-0058	SOCKET: TUBE	
XV103	1200-0058	SOCKET: TUBE	
XV104 THRU XV200		NOT ASSIGNED	
XV201	1200-0058	SOCKET: TUBE	
XV202	1200-0058	SOCKET: TUBE	
XV203	1200-0058	SOCKET: TUBE	
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-74CA	KNOB:AC-DC	
	G-74CE	KNOB:LOCK	
	G-74BE	KNOB: VERTICAL POSITION	
	G-74BS	KNOB: VERTICAL PRESENTATION	
	G-74Q	KNOB: SENSITIVITY	
	G-74AT	KNOB. POLARITY	
	G-74AU	KNOB: VERNIER	

See introduction to this section

Table 6-2. Replaceable Parts

℗ Stock No.	Description #	Mfr.	Mfr. Part No.	TQ	RS
OBD#	ASSY:VERTICAL PRESENTATION			1	1
G-73Z	TUBE:ELECTRON SELECTED 162B ONLY.			4	4
G-74AT	KNOB. POLARITY	28480	G-74AT	2	1
G-74AU	KNOB: VERNIER	28480	G-74AU	2	1
G-74BE	KNOB: VERTICAL POSITION	28480	G-74BE	2	1
G-74BS	KNOB: VERTICAL PRESENTATION	28480	G-74BS	2	1
G-74CA	KNOB:AC-DC	28480	G-74CA	1	1
G-74CA	KNOB:AC-DC	28480	G-74CA	1	1
G-74CE	KNOB:LOCK	28480	G-74CE	1	1
G-74Q	KNOB: SENSITIVITY	28480	G74Q	2	1
162B-34A	ASSY:CHANNEL A ATTENUATOR	28480	162B-34A	1	1
162B-34B	ASSY:CHANNEL B ATTENUATOR	28480	162B-34B	1	1
162F-60A	COIL:VAR .6-1.1	28480	162F-60A	4	1
162B-65A	ASSY:AMPLIFIER	28480	162B-65A	1	1
162B-65B	ASSY:SWITCH CIRCUIT	28480	162B-65B	1	1
0132-0006	C:VAR GL 0.7-3.0 PF 350 V	72982	535-034 34R	21	5
0140-0034	C:FXD MICA 22 PF 5% 500 VDCW	76433	RCM15E220J	2	1
0140-0039	C:FXD 47PF 5% 500VDCW	04062	RCM15E 470J	2	1
0150-0012	C:FXD CER 0.01UF 20% 1000VDCW	56289	H 1038	3	1
0150-0023	C:FXD CER 2000PF 20% 1000VDCW	91418	TYPE JF .002 20%	1	1
0150-0052	C:FXD 0.05 UF 20% 400 VDCW	05729	20X503MC4	4	1
0150-0059	C:FXD CER 3.3 PF +/- NPO 600 VDCW	72982	301 000 COJO 339C	2	1
0150-0063	C:FXD 10 PF 5% 500VDCW	72982	CC20G100D	2	1
0150-0069	C:FXD 1000PF 500VDCW	72982	801010X5	4	1
0150-0074	C:FXD CER 7 PF +/-.5PF 500 VDCW	72982	301 000 COH0 709D	4	1
0150-0089	C:FXD CER 4.7 PF +/-0.25 PF 500VDCW	72982	301 011 COH0 479C	2	1
0150-0091	C:FXD CER 1.5 PF +/-0.25 PF 500 VDCW	72982	301 011 COK0 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
0170-0087	C:EXD .22UF 20% 200VDCW	24446		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
0684-2221	R:FXD COMP 2200 OHMS 10% 1/4W	01121	CB 2221	1	1
0684-5601	R:FXD COMP 56 OHMS 10% 1/4W	01121	CB 5601	12	3
0684-5621	R:FXD 5600 OHM 10% 1/4W	01121	CB 5621	1	1
0684-6801	R:FXD COMP 68 OHMS 10% 1/4W	01121	CB 6801	2	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 OHMS 10% 1/2W	01121	EB 1041	2	1
0687-1521	R:FXD COMP 1500 OHMS 10% 1/2W	01121	EB 1521	1	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
0687-2731	R:FXD COMP 27K OHMS 10% 1/2W	01121	EB 2731	2	1
0687-3921	R:FXD COMP 3900 OHMS 10% 1/2W	01121	EB-3921	2	1
0687-3931	R:FXD COMP 39K OHMS 10% 1/2W	01121	EB 3931	4	1
0687-4731	R:FXD COMP 47K OHMS +/-10% 1/2W	01121	EB4731	1	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

See introduction to this section

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

℗ Stock No.	Description #	Mfr.	Mfr. Part No.	TQ	RS
0687-8211	R:FXD 820 OHM 10% 1/2W	01121	EB8211	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 47G5	2	1
0757-0050	R:FXD MET FLM 200K OHMS 1% 1/2W	19701	MF 1/2 T-0	2	1
0757-0141	R:FXD MET FLM 10.1K OHMS 1% 1/4W	75042	MEB-TO	2	1
0757-0142	R:FXD MET FLM 111K OHMS 1% 1/4W	75042	MEB-TO	2	1
0757-0143	R:FXD MET FLM 332K OHMS 1% 1/4W	75042	MEB-TO	2	1
0757-0144	R:FXD MET FLM 499K OHMS 1% 1/4W	75042	MEB-TO	2	1
0757-0145	R:FXD MET FLM 750K OHMS 1% 1/4W	75042	MEB-TO	2	1
0757-0146	R:FXD MET FLM 898K OHMS 1% 1/4W	75042	MEB-TO	2	1
0757-0147	R:FXD MET FLM 988K OHMS 1% 1/4W	75042	MEB-TO	2	1
0757-0148	R:FXD MET FLM 1M OHMS 1% 1/4W	75042	MEB-TO	4	1
0757-0149	R:FXD MET FLM 442 OHMS 1% 1/2W	75042	MEC-TO	4	1
0757-0150	R:FXD MET FLM 48.7K OHMS 1% 0.5W	75042	MEC-TO	1	1
0757-0151	R:FXD MET FLM 63.4K OHMS 1% 0.5W	75042	MEC-TO	2	1
0757-0152	R:FXD MET FLM 93.1K OHMS 1% 0.5W	75042	MEC-TO	2	1
0757-0153	R:FXD MET FLM 100K OHMS 1% 0.5W	75042	MEC-TO	1	1
0757-0154	R:FXD MET FLM 287K OHMS 1%0.5W	75042	MEC-TO	2	1
0757-0155	R:FXD MET FLM 604K OHMS 1% 0.5W	75042	MEC-TO	2	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
0758-0018	R:FXD MET FLM 15K OHMS 5% 1/2W	07115	C 20	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 8.2K 10% 2W	07115	C425	1	1
0765-0009	R:FXD 5.6K OHM 10% 2W	07115	C-42	1	1
0767-0016	R:FXD 3.3K 5% 3W	07115	LP1-3	1	1
0767-0018	R:FXD MET FLM 820 OHMS 5% 3W	07115	LPI 3	2	1
0776-0008	R:FXD 3900 OHM 5% 7W	07115	LP1-7	1	1
0812-0012	R:FXD 18 OHM 5% 3W	94310	RW59G 180	1	1
1200-0058	SOCKET: TUBE	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:16 PIN	02660	26-4100-16P	1	1
1910-0014	DIODE:SEMICON DEVICE FOR H02-162B ONLY	03877	1N27	8	8
1910-0016	DIODE:SEMICON DEVICE FOR 162B ONLY.	93332	D2361	8	8
1932-0015	TUBE:ELECTRON 6922 FOR H02-162B ONLY	73445	6922	9	9
1932-0022	ELECTRON TUBE: DUAL TRIODE 162B ONLY	73445	6DJ8/ECC 88	5	5
2100-0027	R:VAR COMP 10K OHM 10% LIN 2W	28480	2100 0027	2	1
2100-0044	R:VAR COMP 50K OHM 10% LIN 2W	28480	2100 0044	2	1
2100-0207	R:VAR COMP 2500 OHMS 20% LIN 2W	28480	2100 0207	1	1
2100-0271	R:VAR COMP 1000 OHMS 20% CCW 20% LOG 1W	28480	2100 0271	2	1
3100-0211	SWITCH ROTARY 1 SECT 2 POS	28480	3100 0211	2	1
3100-0349	SWITCH:ROTARY 2 SECT 9 POS	28480	3100 0349	2	1
3100-0350	SWITCH:ROTARY 1 SECT 2 POS	28480	3100 0350	2	1
3100-0351	SWITCH:ROTARY 1 SECT 5 POS S301A/B	28480	3100 0351	1	1
3100-0352	SWITCH:ROTARY 1 SECT 5 POS S301C-G.	28480	3100 0352	1	1
9140-0069	COIL FXD RF: 5.6UHY	95265	QA-5.6-P	2	1
9140-0095	COIL FXD RF: 0.27UHY	28480	9140 0095	2	1

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