## Errata

**Title & Document Type:** **1700B Option 300 Oscilloscope Operating and Service Manual**

**Manual Part Number:** **01700-90907**

**Revision Date:** **March 1973**

### About this Manual

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

### HP References in this Manual

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

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

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Table 1-1. Specifications (Cont'd)

button arms sweep and lights indicator; in auto mode, sweep occurs once each time RESET pushbutton is pressed.

**TRIGGERING**

**Internal:** dc to 35 MHz on signals causing 0.5 div or more vertical deflection, increasing to 1.5 div at 75 MHz in all display modes except chop; dc to 100 kHz in chop mode.

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

**External Input RC:** approx 1 megohm shunted by approx 27 pF.

**Line:** triggers on line frequency.

**LEVEL AND SLOPE**

**INTERNAL:** at any point on vertical waveform displayed.

**EXTERNAL:** continuously variable from +3V to —3V on either slope of trigger signal. Maximum input, ±100V. +30V to —30V in ÷10.

**Coupling:** AC, DC, LFAC, or HFAC.

AC: attenuates signals below approx 20 Hz.
HFAC: attenuates signals below approx 5 kHz.
LFAC: attenuates signals above approx 30 kHz.

**TRIGGER HOLDOFF:** time between sweeps continuously variable.

## EXTERNAL HORIZONTAL INPUT

**BANDWIDTH:** dc to 1 MHz.

**COUPLING:** dc.

**DEFLECTION FACTOR:** X1, 1 V/div; X10, 0.1 V/div.

**VERNIER:** 10:1 vernier provides continuous adjustment between ranges.

**INPUT RC:** 1 megohm shunted by approximately 30 pF.

## CATHODE-RAY TUBE AND CONTROLS

**TYPE:** post-accelerator, +15 kV accelerating potential; aluminized P31 phosphor.

**GRATICULE:** 6 X 10 div internal graticule; 0.2-division subdivisions on major horizontal and vertical axes. 1 div = 1 cm. Front panel adjustment aligns trace with graticule.

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

## GENERAL

**CALIBRATOR**

**Type:** 1 kHz, ±10%, square wave.

**Voltage:** 1V p-p, ±1%.

**POWER REQUIREMENTS**

**AC Line:** 115 or 230V ±20%, 48 to 440 Hz, 30 VA max.

**DC Line:** 11.5 to 36V, 18 watts max.

**Battery (Option C12):** 26 1/4V, 18 watts max.

**BATTERY PACK PARAMETERS IN 1700B OPT C12**

**Operating Time:** up to 6 hours.

**Recharge Time:** 14 hours maximum, with power switch off, if not operated after power light flashes.

**Low Battery Indicator:** power light flashes to indicate that batteries are discharged.

**Recharging:** batteries are recharging whenever power mode switch is set to AC with power applied. With power switch off, full charge is applied. With power switch on, trickle charge is applied.

**WEIGHT**

**Without Panel Cover:** net, 27 lb (12,3 kg).

**With Panel Cover and Accessories:** net, 35 lb (16 kg).

**With Panel Cover, Accessories, and Battery Pack:** net, 42 lb (19,05 kg).

## ENVIRONMENTAL SPECIFICATIONS

Meets all environmental requirements of the AN/USM-339 described in MIL-O-83226 (USAF).

**TEMPERATURE-ALTITUDE:** nonoperating —62 to +85°C, 50,000 feet, operating —40 to +55°C, 20 minutes at 71°C, 10,000 feet.

**HUMIDITY:** nonoperating +28°C to +71°C at 95% relative humidity, ten 24-hour cycles for total of 240 hours.

**VIBRATION:** nonoperating; 5 to 15 Hz, 0.06, 15 to 25 Hz, 0.04 in.; 25 to 55 Hz, 0.02 in.

**SHOCK:** 15G for 11 ±1 ms sawtooth for total of 18 shocks.

**SALT FOG:** nonoperating per Method 509, Procedure 1 of MIL-STD-810.

**EXPLOSIVE ATMOSPHERE:** per Method 511, Procedure 1 of MIL-STD-810.

**DUST:** non-operating per Method 510 Procedure of MIL-STD-810.

**DRIP PROOF:** per MIL-STD-810, except front panel cover shall be removed.

**DROP TEST AND WATERTIGHTNESS:** per MIL-T-2100.

**ELECTROMAGNETIC INTERFERENCE:** per MIL-STD-462 performed by MIL-STD-461 as shown below:

| Requirement | Limit Modifications |
|---|---|
| CE03 | relax 10 dB |
| CS01, CS02 | none |
| CS06 | none |
| RE02 | relax 10 dB, upper frequency 1 GHz |
| RS02, RS04 | none |

**Accessories Furnished:** Model 10163A Option 030 Cover with accessories and Model 10006B, Option 030 with accessories.

Note

See Figures 1-2 and 1-3.

Table 1-1. Specifications (Cont'd)

**DIMENSIONS:** Refer to outline drawing.

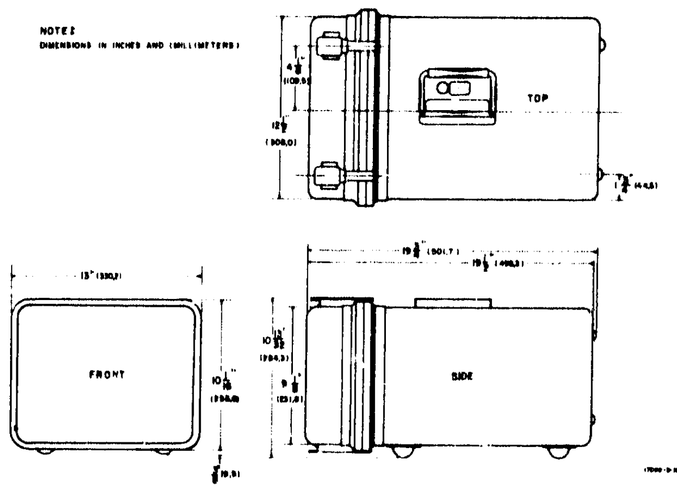



Table 1-2. Option 300 Accessories Available

| Accessory No. | Description |
|---|---|
| HP Model 10104A | Viewing Hood (collapsible) |
| HP Model 10106A | Camera Adapter |
| HP 01701-68701 | Service Kit; contains three extender boards and one board puller. |
| HP Model 10036A | Probe Adapter Kit; probe tips contained in this kit are designed for use with the probes supplied with 1700-series oscilloscopes. |

1-3. This section contains a description of the Option 300. The instrument specifications are listed in table 1-1. Table 1-2 contains a list of the accessories available for the Option 300. Figure 1-2 shows the Model 10006B Option 030 with accessories. Figure 1-3 shows the Accessory Kit.

## 1-4. DESCRIPTION.

## 1-5. INTRODUCTION.

1-6. The Option 300 is an environment resistant oscilloscope designed for use in uncontrolled environments. This ruggedized instrument meets military specifications for environmental operations.

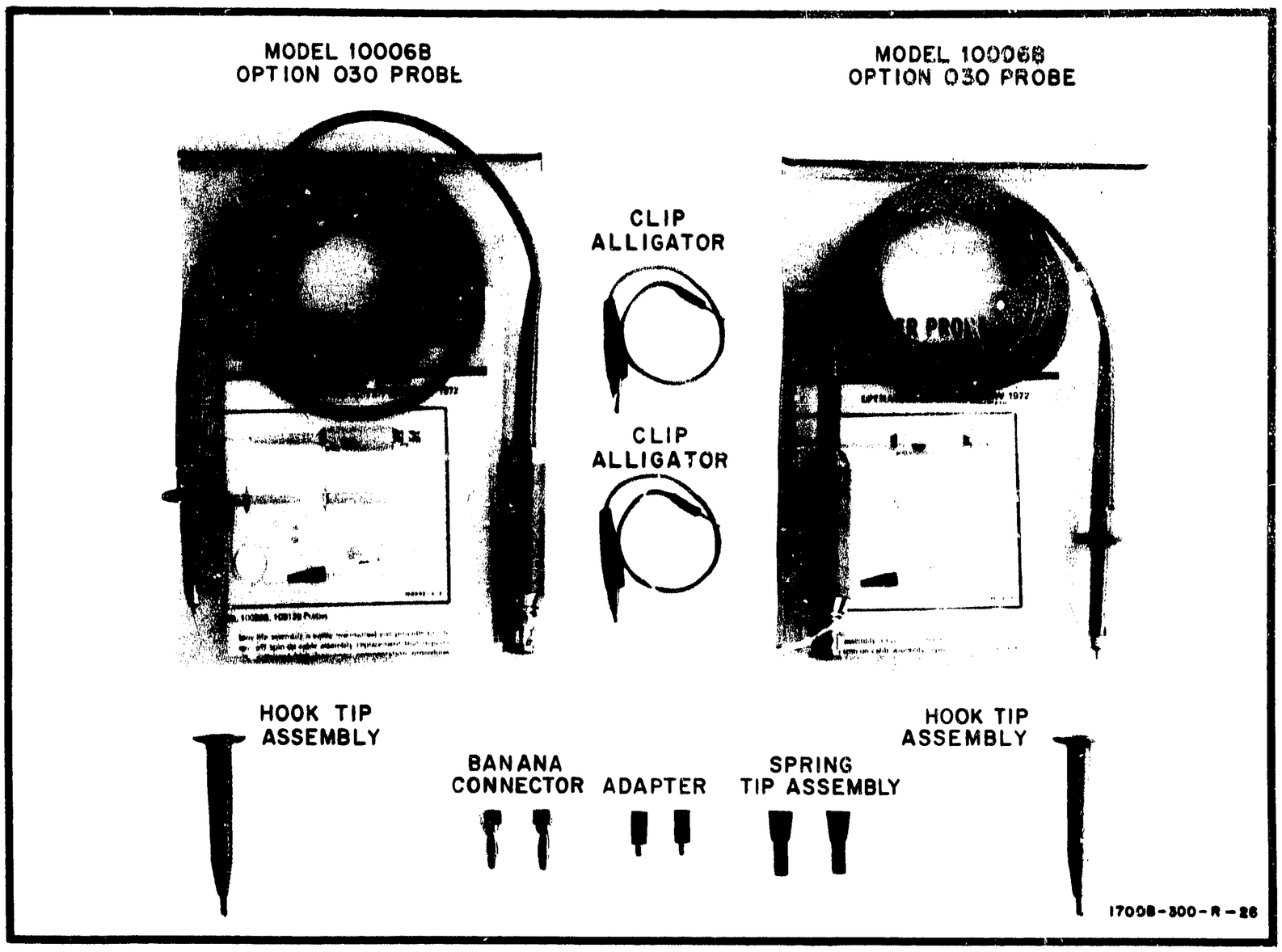



Figure 1-2. Model 10006B Option 030 with Accessories

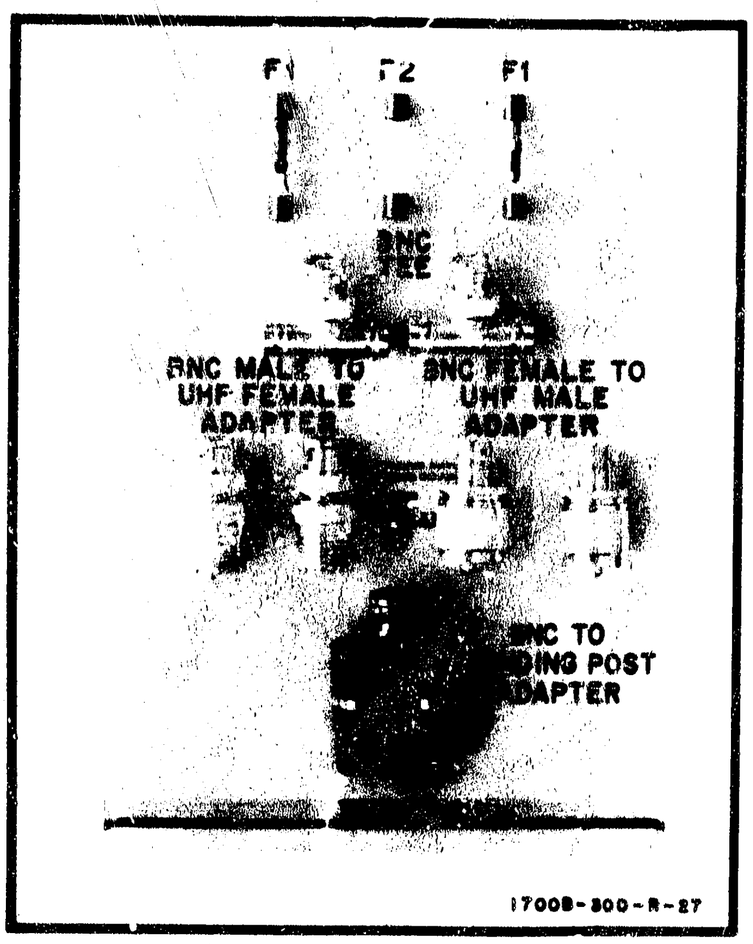



Figure 1-3. Accessory Kit

### 1-7. VERTICAL CIRCUITS.

1-8. The Option 300 contains two identical vertical amplifiers for single or dual channel operation. The vertical bandwidth is 35 MHz with a risetime less than 10 ns. Each channel offers a choice of ac or dc coupling. Common mode rejection is at least 40 dB at 10 mV/div, and 20 dB for the rest of the deflection ranges for frequencies up to 1 MHz.

1-9. Eleven calibrated switch settings provide a deflection factor range from 10 mV/div to 20 V/div in a 1, 2, 5 sequence. The vertical verniers permit continuous adjustment between calibrated steps and extend the least sensitive deflection factor (20 V/div) to 50 V/div.

1-10. With the dual trace feature (channel A, channel B), displays can be obtained on either channel A or B, channels A and B together, channels A + B and channels A — B. Simultaneous display of two signals is possible in either chop or alternate mode of operation. During chop operation, channels are switched at approximately 100-kHz rate during each sweep. In the alternate mode of operation, the signal applied to each channel is displayed on alternate sweeps. Triggering is selectable from either A TRIG or COMPOSITE TRIG position. In the COMPOSITE TRIG position, the instrument triggers on the displayed signal. In the A TRIG position, the instrument triggers on the signal applied to channel A.

### 1-11. HORIZONTAL CIRCUITS.

1-12. The horizontal circuits provide sweep speed settings from 0.1 usec/div to 2 sec/div in a 1, 2, 5 sequence. The vernier controls allow adjustment between steps and extend the slowest sweep to 5 sec/div. Using the MAG X10 function, the fastest sweep speed can be expanded to 10 ns/div.

1-13. The trigger circuit has provisions for either internal, external or line operation. Choice of trigger coupling is provided; choices are ac/dc, high frequency reject and low frequency reject.

### 1-14. CATHODE-RAY TUBE.

1-15. The Option 300 uses a post-accelerator CRT with a nonglare rectangular faceplate. An internal graticule is located on the same plane as the display to eliminate parallax errors. The tube has a 15-kV accelerating potential, and 6 vertical by 10 horizontal divisions. A type P31 phosphor is used in the standard CRT.

### 1-16. WARRANTY.

1-17. The instrument (except the CRT) is certified and warranted as stated in the front of this manual. The CRT is covered by a separate warranty. The CRT warranty and warranty claim forms are located in the rear of this manual. Should the CRT fail within the time specified on the CRT warranty page, complete the warranty claim form and return it with the defective CRT. The procedure for returning a defective CRT is described on the CRT warranty page.

CAUTION

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

### 1-18. ACCESSORIES FURNISHED.

1-19. Accessories furnished are listed in table 1-1 and shown in figures 1-2 and 1-3.

### 1-20. ACCESSORIES AVAILABLE.

1-21. Table 1-2 lists the accessories available for the Option 300. The service kit (figure 1-5) is recommended to maintain the Option 300.

### 1-22. INSTRUMENT AND MANUAL IDENTIFICATION.

1-23. This manual applies directly to the Option 300 instruments with a serial prefix number as listed on the manual title page. The serial prefix number is the first group of digits in the instru-

ment serial number (figure 1-4). The instrument serial number is on a tag located on the front panel.

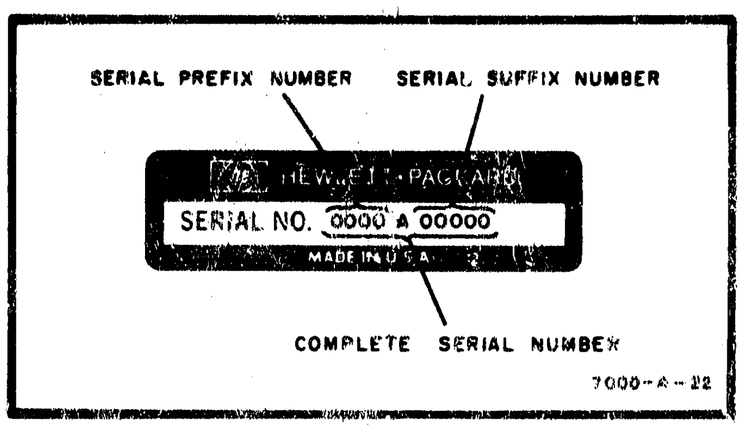



Figure 1-4. Instrument Serial Number

1-24. Check the serial prefix number of the instrument. If the serial prefix number is different from that listed on the title page of this manual, refer to Section VII for instructions to adapt this manual for proper instrument coverage.

1-25. Technical corrections (if any) are contained in the replacement pages in the front of this manual.

## 1-26. INQUIRIES.

1-27. Refer any questions regarding the manual, the replacement pages or the instrument to the nearest HP Sales/Service Office. Always identify the instrument by model number, complete name and complete serial number in all correspondence. Refer to the rear of the manual for a world-wide listing of HP Sales/Service Offices.

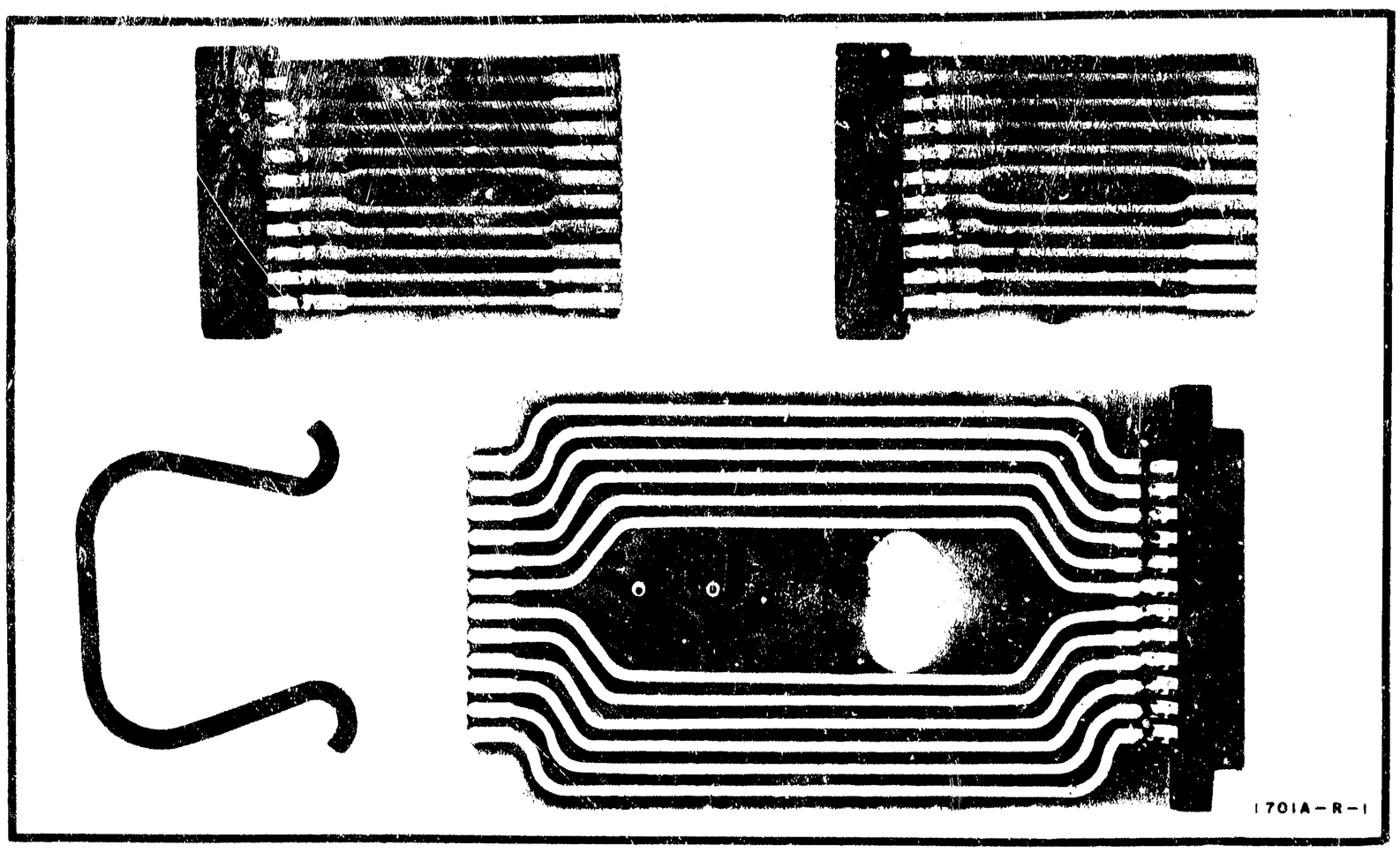



Figure 1-5. Service Kit for 1700-series Oscilloscopes

# SECTION II

# INSTALLATION

## 2-1. INTRODUCTION.

2-2. This section contains instructions for performing an initial inspection of the Option 300. Installation procedures and precautions are presented in step-by-step order. The procedures for making a claim for warranty repairs and for repacking the instrument for shipment are also described in this section.

## 2-3. INITIAL INSPECTION.

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

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

**WARNING**

Line voltages are present inside the instrument when the power cord is connected.

## 2-6. PREPARATION FOR USE.

### 2-7. UNPACKING.

2-8. The Option 300 is installed in a carrying case that provides adequate protection during transit or storage. To unpack the Option 300, proceed as follows:

a. Place carrying case on clean, flat working area.

b. Turn PRESSURE EQUALIZER valve (figure 2-1) in ccw direction.

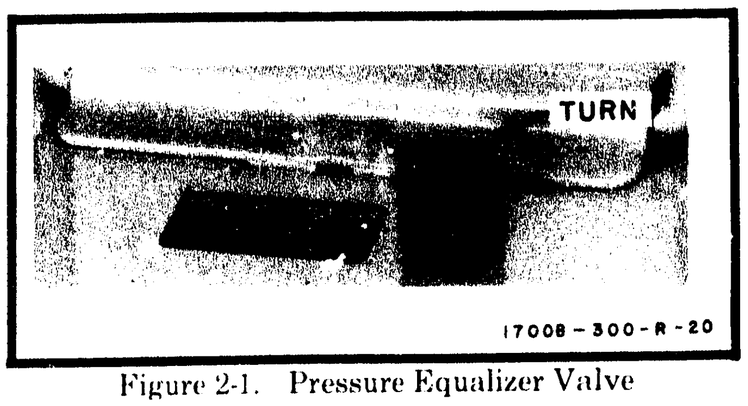



Figure 2-1. Pressure Equalizer Valve

Note

The carrying case is airtight. The PRESSURE EQUALIZER valve must be opened to equalize the carrying case internal pressure to local atmospheric pressure.

c. Remove any tags or seals that may be attached to carrying case.

d. Unfasten latches (figure 2-2) and remove storage cover from carrying case.

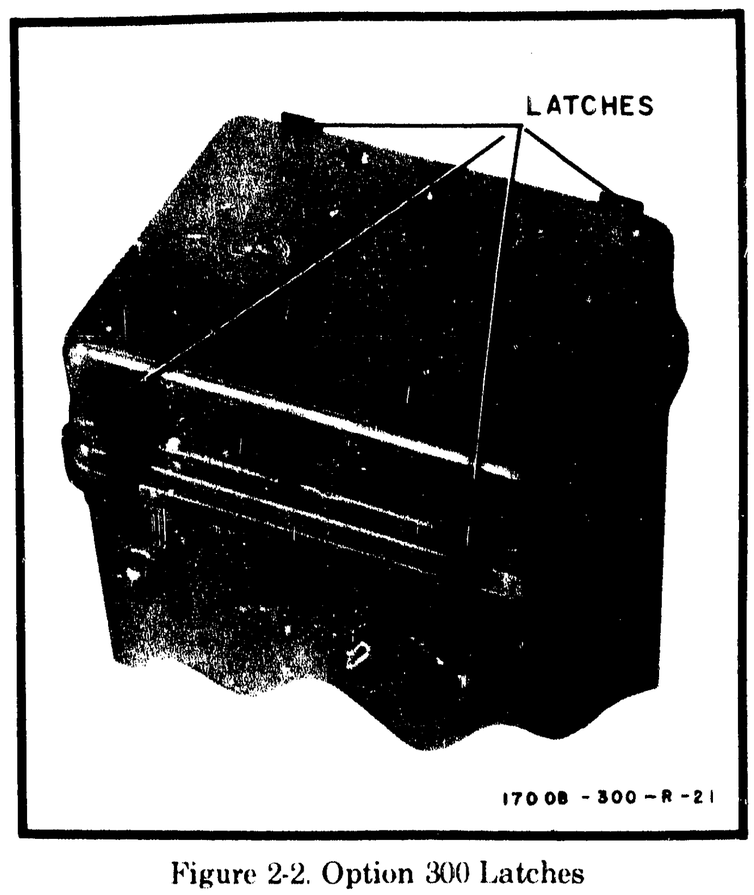



Figure 2-2. Option 300 Latches

e. Open hinged lid of storage compartment.

f. Remove cables and probes from storage cover.

g. Connect probes to channel A and channel B INPUT connectors.

Note

Refer to Probe operating note for correct methods to change probe tips.

h. Connect ac power cord to AC LINE connector. If dc operation is desired, connect dc power cord to DC LINE connector.

### 2-9. POWER REQUIREMENTS.

2-10. The Option 300 can operate either from an ac or dc power source. For ac operation, the Option 300 requires 115- or 230-volt ±20%, single phase, 48- to 440-Hz source that can deliver 30 volt-amperes.

2-11. The front panel POWER MODE switch can be set for 115V AC, 230V AC or DC LINE operation. To operate from an ac line, proceed as follows:

a. Remove any attached power cords.

b. Using small screwdriver, set POWER MODE switch to 115V AC or 230V AC.

c. For 115V ac operation, verify that AC LINE fuse is rated at 0.6A slow-blow. For 230V ac operation, verify that AC LINE fuse is rated at 0.3A slow-blow.

d. Connect ac power cord to AC LINE connector.

2-12. For dc operation, the Option 300 requires from 11.5 to 36 volts, 18 watts maximum. To operate from a dc line, proceed as follows:

a. Remove any attached power cords.

b. Using small screwdriver, set POWER MODE switch to DC LINE.

c. Connect dc power cord to DC LINE connector.

### 2-13. THREE-CONDUCTOR AC POWER CABLE.

2-14. For the protection of operating personnel, Hewlett-Packard Company recommends that the instrument panel and cabinet be grounded. This instrument is equipped with a three-conductor, ac power cable that, when connected to an appropriate receptacle, grounds the instrument through the offset pin. The power jack and mating plug of the power cord meet International Electro-technical Commission (IEC) safety standards. To preserve this protection feature when operating from a two-contact outlet, use a three-conductor to two-conductor adapter, and connect the adapter wire to ground at the power outlet.

## 2-15. STORAGE.

2-16. To prepare the Option 300 for storage, proceed as follows:

a. Inspect Option 300 as specified in initial inspection paragraph in this section.

b. Store all power cables and probes in storage cover.

c. Secure storage cover to carrying case by securing latches.

d. Turn PRESSURE EQUALIZER valve fully cw.

2-17. The Option 300, must be stored in a place that meets the environmental requirements specified in table 1-1.

## 2-18. CLAIMS.

2-19. The warranty statement applicable to this instrument is printed in the front of this manual. Refer to the front of this manual for the CRT warranty statement. If physical damage is found or if operation is not as specified when the instrument is received notify the carrier and the nearest Hewlett-Packard Sales/Service Office immediately (refer to the list in back of this manual for addresses). The HP Sales/Service Office will arrange for repair or replacement without waiting for settlement with the carrier.

## 2-20. REPACKING FOR SHIPMENT.

2-21. If the Option 300 is to be shipped to a Hewlett-Packard Sales/Service Office for service or repair, attach a tag showing owner (with address), complete instrument serial number, and a description of the service required.

2-22. Use the original shipping carton and packing material. If the original packing material is not available, the HP Sales/Service Office will provide information and recommendations on materials to be used. Material used for shipping an instrument normally include the following:

a. A doubled-walled carton; refer to table 2-1 for test strength required.

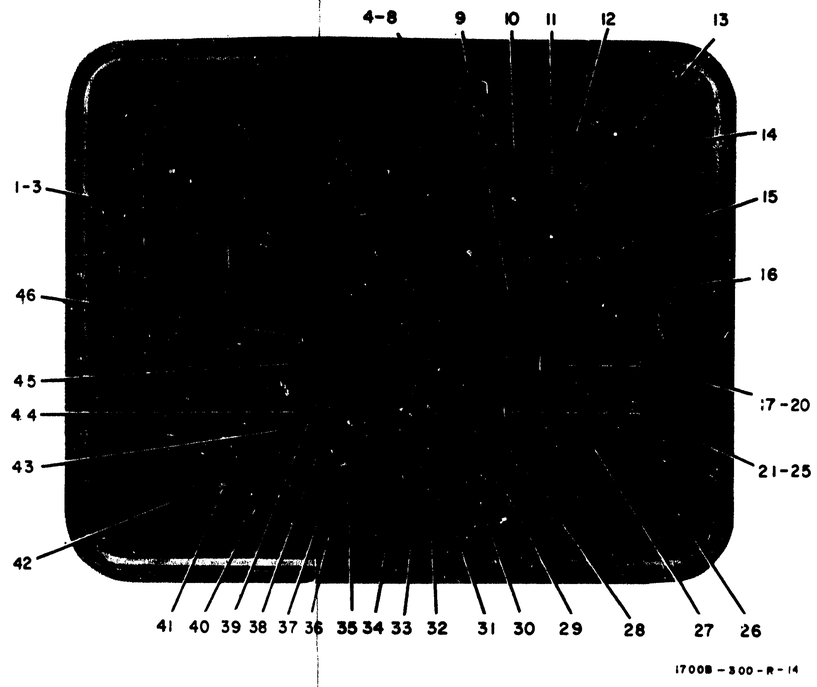
b. Heavy paper or sheets of cardboard to protect all instrument surfaces; use a nonabrasive material such as polyurethane or cushioned paper such as Kimpak around projecting parts.

c. At least 4 inches of tightly-packed, industry-approved, shock-absorbing material such as extra-firm polyurethane foam.

d. Heavy-duty shipping tape for securing outside of carton.

Table 2-1. Shipping Carton Test Strength

| Gross Weight (lb) | Carton Test Strength (lb) |
|---|---|
| up to 10 | 200 |
| 10 to 30 | 275 |
| 30 to 120 | 350 |
| 120 to 140 | 500 |
| 140 to 160 | 600 |




1. INTENSITY. Controls brightness of display.

2. BEAM FINDER. Returns display to viewing area.

3. POWER-ON. Toggle switch with indicator light for turning oscilloscope on and off.

4. FOCUS. Adjusts writing beam for sharpest trace.

5. SCALE ILLUMINATION. Controls brightness of scale illumination.

6. TRACE ALIGN. Adjust to align trace with horizontal graticule line.

7. CAL 1 VOLT. Provides 1-kHz square wave at 1 volt ±1%.

8. ASTIGMATISM. Adjusts roundness of writing spot.

9. TRIGGER HOLDOFF (MIN). Provides continuous control of time between sweeps.

10. VERNIER. Provides continuous control of sweep time between calibrated positions of TIME/DIV control.

11. TIME/DIV. Controls sweep time.

12. X10 MAG. Lamp lights when MAG is set to X10.

13. sweep display. Selects SWEEP or EXT HORIZ INPUT operation.

14. horizontal POSITION. Controls coarse and fine horizontal position of display.

15. VERNIER UNCAL. Lights when VERNIER is not in CAL position.

16. TRIGGER LEVEL. Selects amplitude point on trigger signal that starts sweep.

17. SINGLE. Selects single sweep operation.

18. RESET. Resets sweep in SINGLE sweep mode.

19. AUTO/NORM.

    a. AUTO. Automatic sweep in absence of trigger signal, or triggered sweep by applying trigger signal above 40 Hz.

    b. NORM. Sweep is triggered only by applying trigger signal.

20. MAG. In X10 position, sweep is magnified 10 times.

21. INT/EXT. Selects trigger internal or external sweep triggering.

22. LINE. Instrument triggers internally on line frequency.

23. AC/DC. Selects trigger signal coupling.

24. HFAC. Attenuates trigger signals below 5 kHz.

25. LFAC. Attenuates trigger signals above 30 kHz.

26. SLOPE. Selects slope of trigger signal that starts sweep.

27. EXT TRIG INPUT. External trigger input.

28. ÷1/÷10. Attenuates external trigger signals by factor of 10; increasing external trigger range to ±30V.

29. EXT HORIZ INPUT. Input to external horizontal amplifier.

30. EXT HORIZ VERNIER. Permits 10:1 horizontal gain ratio.

31. AC LINE FUSE. Ac line fuse (0.6 AT fuse for 115V ac; 0.3 AT fuse for 230V ac).

32. channel B DC BAL. Adjust to minimize vertical shift of trace when channel B vernier is rotated.

33. channel B POSITION. Controls vertical position of display.

34. channel B GAIN. Adjust to calibrate amplifier with CHANNEL B VOLTS/DIV settings.

35. DC LINE FUSE. 2 AT fuse in circuit for all modes of operation.

36. channel B INPUT. BNC input connector.

37. channel B coupling (AC-GND-DC). Selects capacitive (AC) or direct (DC) coupling of input signal, or grounds input amplifier stage while disconnecting input.

38. channel B vernier (VERN CAL). Provides continuous adjustment of VOLTS/DIV between calibrated positions of channel B VOLTS/DIV control.

39. channel B VOLTS/DIV. Selects vertical deflection factor necessary for calibrated measurements.

40. DC LINE. Power input for dc line operation.

41. POWER MODE. Selects 115V ac, 230V ac or dc line operation.

42. AC LINE. Power input for ac line operation.

43. MODE. Selects type of display; either single channel, dual channel, ALT or CHOP mode.

44. trig. Selects internal triggering mode.

    a. A TRIG. Instrument triggers on signal applied to channel A.

    b. COMPOSITE TRIG. Instrument triggers on displayed signal.

45. CHAN B POLARITY. Selects polarity of channel B display (NORM/INVT).

46. VERNIER UNCAL. Lights when either channel A or channel B vernier is not in CAL position.

Figure 3-1.
Controls and Connectors

OPERATING AND SERVICE MANUAL

# MODEL 1700B
# OPTION 300
# OSCILLOSCOPE

**SERIALS PREFIXED: 1233A**

Refer to Section VII for instruments with the following standard options: **001, C12.**

## IMPORTANT NOTICE

Occasionally, portions of this manual will be revised due to engineering changes, specification changes, or to correct errors in the manual. These changes will be printed on replacement pages and will be located in the front of this manual. A serials prefixed number or revision letter will be printed at the bottom of each replacement page that has been changed. The serials prefixed number on the bottom of the replacement page will indicate that an engineering change has been incorporated on that page for instruments having that particular serials prefixed number or higher. A revision letter on the bottom of any page indicates that errata corrections have been incorporated that apply to all instruments.

REPLACE ALL APPLICABLE PAGES IN THIS MANUAL WITH THE APPROPRIATE REPLACEMENT PAGES LOCATED IN THE FRONT OF THIS MANUAL.

HEWLETT-PACKARD COMPANY/COLORADO SPRINGS DIVISION
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Microfiche Part No. 01700-90807.

**PRINTED: MAR 1973**

# SECTION III

# OPERATION

## 3-1. INTRODUCTION.

3-2. This section provides general operating instructions and applications information for the Option 300. Front panel controls and connectors are identified and briefly described in figure 3-1. General operating instructions are shown in figures 3-2 through 3-6.

## 3-3. CONTROLS AND CONNECTORS.

### 3-4. CRT AND AUXILIARY CONTROLS AND CONNECTORS.

*3-5. Focus and Astigmatism.* Together, these controls enable the operator to adjust the beam for uniform focus over the entire CRT screen.

*3-6. Beam Finder.* Pushing the BEAM FINDER pushbutton reduces the amplifier gain enough to return an off-screen deflection to the CRT viewing area. This control enables the operator to locate the beam and determine the necessary action to center the display. For example: the operator can reduce input signal amplitude, change coupling, adjust deflection factor, adjust trigger level, adjust dc balance, or adjust position controls. When the corrective action has been taken, the beam remains on screen when the BEAM FINDER is released. The beam finder function is independent of the INTENSITY control. It also defocuses the beam, preventing CRT phosphor burns due to high intensity settings.

*3-7. Calibrator.* The CAL 1 VOLT connector is the 1-volt, 1-kHz square-wave output that can be used for vertical sensitivity calibration and for divider probe compensation. Amplitude accuracy is ±1% while frequency is ±10%.

*3-8. Intensity.* The INTENSITY control allows the operator to control trace brightness and should be set to the lowest trace brightness compatible with good viewing.

*3-9. Trace Align.* The TRACE ALIGN adjustment compensates for external magnetic fields that affect alignment of the horizontal trace with the graticule. The alignment should be checked when the instrument is moved to a new location and adjustment made whenever necessary.

### 3-10. VERTICAL CONTROLS AND CONNECTORS.

*3-11. Mode.* The MODE switch selects the type of vertical display. Input signals can be displayed either singly or simultaneously as follows:

3-12. Position A displays channel A input signal.

3-13. Position B displays channel B input signal.

3-14. Position A + B displays the algebraic sum of channel A and channel B input signals. The term becomes A — B when CHAN B POLARITY switch is set to INVT.

3-15. Position CHOP presents a separate display of each input. Both channels are displayed during the same sweep by switching between each channel at a 100-kHz rate. This mode should be used to display low frequency signals.

3-16. Position ALT displays each channel on alternate sweeps. This mode should be used to display higher frequency signals.

*3-17. Channel B Polarity.* The CHAN B POLARITY control permits the channel B display to be inverted 180 degrees. This allows the MODE A + B function to become A — B.

*3-18. Vertical Sensitivity.* The CHANNEL A (or B) VOLTS/DIV switch permits selection of vertical deflection from 0.01 volt/div to 20 volts/div in 11 calibrated ranges when the vertical vernier is in the CAL position. The vertical vernier control is mounted concentrically with the volts/div control. When rotated out of the CAL detent position, the vernier permits adjustment of the deflection factor between calibrated ranges.

*3-19. Position.* The channel A or B POSITION control sets the vertical adjustment of the display. With no input, the trace should be approximately in the center of the CRT with the POSITION control set to midrange.

*3-20. Coupling.* The channel A and channel B coupling switches select either capacitive coupling (AC) or direct coupling (DC) of the input signal to the input of the vertical preamplifier. In the GND position, the coupling switch disconnects the input signal and grounds the vertical preamplifier input. Direct coupling should be used when viewing events of long duration or monitoring the dc levels of

waveforms. Capacitive coupling should be selected when viewing ac waveforms having large dc levels. The GND position can be used to establish a reference.

*3-21. Vertical Calibration.* The front panel channel A or B GAIN adjustments permit the operator to maintain vertical amplifier calibration.

*3-22. Vertical Dc Balance.* The front panel DC BAL (channel A or B) adjustments permit the operator to minimize dc shift when changing the vertical amplifier deflection factor. This feature is especially useful to overcome the results of long-term drift when using the more sensitive ranges of the volts/div switches.

## 3-23. HORIZONTAL CONTROLS AND CONNECTORS.

*3-24. Sweep Display.* The sweep display control assembly consists of two controls mounted concentrically. The outer knob is the TIME/DIV control that selects the sweep speed of the integrator. The inner knob is the sweep display switch that selects EXTERNAL HORIZ INPUT or SWEEP. In the SWEEP position, the sweep output sets a time base reference for the vertical signal. In the EXT HORIZ INPUT position, an external signal source must be applied to the EXT HORIZ INPUT connector to drive the horizontal circuits.

*3-25. Horizontal Position.* The horizontal POSITION control consists of two concentrically positioned knobs. The outer knob is a coarse adjustment and the inner knob is a fine adjustment.

*3-26. Vernier Sweep Speed.* The VERNIER knob permits continuous control of the sweep speeds between calibrated positions of the TIME/DIV control. The VERNIER UNCAL lamp lights when the VERNIER is not in the CAL position to warn the operator that the sweep is uncalibrated.

*3-27. Sweep Magnification.* The MAG pushbutton enables the operator to magnify the sweep by a factor of 10. In the X1 position, the sweep speed is as read on the TIME/DIV control. In the X10 position, the reading of the TIME/DIV control must be divided by 10. To alert the operator of the X10 function, the X10 MAG lamp lights.

## 3-28. TRIGGERING CONTROLS AND CONNECTORS.

3-29. Trigger signal requirements are shown in table 3-1.

*3-30. Trigger Level.* The TRIGGER LEVEL control selects the amplitude point on the trigger signal that initiates the sweep. With an internal trigger, the TRIGGER LEVEL control can select any point on the displayed signal as the sweep starting point. With an external trigger, the TRIGGER LEVEL control can select any point between —3 volts and +3 volts as the starting point. With the +1/+10 control set to +10, the external starting point can be selected on any point between —30 volts and +30 volts.

*3-31. Trigger Holdoff.* The TRIGGER HOLDOFF control is a dual purpose, log-tapered potentiometer. When the control is rotated out of detent position (MIN), it acts as a high frequency stability control. This prevents double triggering on high frequency signals. As the control is rotated further out of detent, it functions as a trigger holdoff and allows the instrument to synchronize on complex waveforms.

*3-32. Single Sweep.* The SINGLE pushbutton selects single sweep or normal sweep operation. In the single sweep mode, the sweep is generated only one time after being triggered. To rearm the sweep, the RESET pushbutton must be pushed and released. The RESET lamp lights to indicate that the sweep is armed. When the AUTO/NORM control is set to AUTO, a sweep will occur once each time the RESET pushbutton is pressed. In NORM, a sweep will occur once the first time a trigger signal is applied after pressing RESET.

*3-33. Automatic Triggering.* When the AUTO/NORM switch is set to AUTO the sweep free-runs in the absence of a trigger signal. If a trigger signal of 40 Hz or greater is applied, it overides free-run operation and triggers the sweep. Use NORM if the trigger signal is erratic or less than 40 Hz.

*3-34. Low Frequency AC.* The LFAC pushbutton, when engaged, rejects trigger signals above 30 kHz. This feature is useful, for instance, if high frequency noise on the trigger signal is causing erratic triggering.

*3-35. High Frequency AC.* The HFAC pushbutton, when engaged, rejects trigger signals below approximately 5 kHz. This feature is useful, for instance, if line frequencies are causing erratic triggering.

*3-36. Trigger Coupling.* The AC/DC pushbutton selects direct or capacitive coupling. Direct coupling can be used from dc to 35 MHz. Capacitive coupling blocks the dc component of a trigger signal and passes the ac component. Capacitive coupling, however, attenuates signals below approximately 20 Hz.

*3-37. Trigger Source.* The INT/EXT pushbutton determines whether the instrument triggers on the internal sync signal from the vertical preamplifier or on an external signal (applied to EXT TRIG INPUT).

Table 3-1. Trigger Signal Requirements

| Trigger Mode | Trigger Coupling | Trigger Source | Minimum Trigger Amplitude | Trigger Level | Trigger Slope |
|---|---|---|---|---|---|
| NORM | | LINE | FIXED | | SELECTABLE + or − |
| | DC: dc to 35 MHz | INT | dc – 35 MHz, ≥0.5 div increasing to 1.5 div at 75 MHz | Adjustable to any point on displayed waveform | |
| | AC: 20 Hz to 35 MHz | EXT | dc – 35 MHz, 50 mV p-p increasing to 100 mV p-p at 75 MHz | −3V to +3V | |
| AUTO | | LINE | FIXED | | |
| | DC: dc to 35 MHz | INT | dc – 35 MHz, ≥0.5 div increasing to 1.5 div at 75 MHz | Adjustable to any point on displayed waveform | |
| | AC: 20 Hz to 35 MHZ | EXT | dc – 35 MHz, 50 mV p-p increasing to 100 mV p-p at 75 MHz | −3V to +3V | |
| SINGLE | Single may be selected after setting up any display | | | | |

*3-38. Trigger Slope.* The SLOPE pushbutton determines whether the sweep triggers on the positive-going or negative-going slope of the trigger signal.

*3-39. Line Triggering.* The LINE pushbutton, when engaged, synchronizes the sweep circuits to the line frequency. This control cannot be used when the instrument is operated in the dc line mode.

## 3-40. PREOPERATIONAL ADJUSTMENTS.

### 3-41. INITIAL TURN-ON.

3-42. To place the Option 300 into operation, proceed as follows:

a. Set INTENSITY fully ccw.

b. Set channel A and channel B POSITION controls to midrange.

c. Set MODE to desired position.

d. Set CHANNEL A VOLTS/DIV and CHANNEL B VOLTS/DIV to 20.

e. Set channel A and channel B verniers to CAL.

f. Set CHAN B POLARITY to NORM.

g. Set channel A and channel B coupling to GND.

h. Set horizontal POSITION to midrange.

i. Set TIME/DIV to 1 mSEC.

j. Set sweep display to SWEEP.

k. Set VERNIER to CAL.

l. Set AUTO/NORM to AUTO.

m. Set INT/EXT to INT.

CAUTION

Verify proper position of POWER MODE switch.

n. Apply operating power and allow 15-minute warm-up time.

o. Adjust INTENSITY so trace is visible.

### 3-43. FOCUS AND ASTIGMATISM ADJUST.

a. Set all pushbuttons out.

b. Set Option 300 sweep display to EXT HORIZ INPUT.





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d. for best

e. of grat ASTIGM

**3-44. D**

3-45. T channel channel

a.

b. while a minimiz

c.

d.

**3-46. T**

3-47. T magneti follows:

a.

b. POSITIO

c. A with X-a

**3-48. V**

3-49. Th and cha channel

a. S

c. Center beam with channel A POSITION and horizontal POSITION controls.

d. Adjust FOCUS and ASTIGMATISM controls for best defined dot.

e. Check definition of dot near four corners of graticule; make compromise adjustment of ASTIGMATISM if necessary.

### 3-44. DC BALANCE ADJUST.

3-45. This adjustment is identical for both channels A and B. To adjust dc balance for channel A, proceed as follows:

a. Set channel A controls as follows:

MODE ..... A
channel A coupling ..... GND
TIME/DIV ..... .2 mSEC

b. Turn channel A vernier back and forth while adjusting channel A DC BAL control to minimize vertical movement of trace.

c. Set MODE to B.

d. Repeat step b for channel B.

### 3-46. TRACE ALIGN ADJUST.

3-47. To compensate for the effect of external magnetic fields on trace orientation, proceed as follows:

a. Set controls as follows:

MODE ..... A
channel A coupling ..... GND
TIME/DIV ..... 5 uSEC

b. Center trace on CRT using channel A POSITION and horizontal POSITION controls.

c. Adjust TRACE ALIGN until trace is aligned with X-axis of graticule.

### 3-48. VERTICAL AMPLITUDE CALIBRATION.

3-49. This adjustment is identical for channel A and channel B. To make the adjustment for channel A, proceed as follows:

a. Set controls as follows:

MODE ..... A
VOLTS/DIV ..... .2
channel A coupling ..... DC
TIME/DIV ..... 1 mSEC
AUTO/NORM ..... AUTO

b. Connect CAL 1 VOLT output to channel A INPUT with test lead.

c. Adjust channel A POSITION control until waveform is aligned with bottom graticule.

d. Adjust channel A GAIN until display is exactly 5 div.

e. Repeat steps a through d for channel B.

## 3-50. OPERATOR'S PERFORMANCE CHECK.

3-51. The operation of the instrument can be checked without the use of additional test equipment by using the CAL 1 VOLT output as a signal source. These operating checks will functionally check each of the display modes and the front panel controls. To check the specifications listed in Section I, refer to Section V for performance checks. The operator's checks must be performed in the order given. Do not attempt to start a procedure in midsequence, as succeeding steps depend on control settings and results of previous steps. If any of the results are unobtainable, refer to Section V, performance checks and adjustment procedures, or Section VIII, schematics and troubleshooting.

3-52. To check instrument operation, proceed as follows:

a. Set instrument controls as follows:

Channel A

CHANNEL A VOLTS/DIV ..... .2
channel A coupling ..... AC
channel A vernier ..... CAL
channel A POSITION ..... as required
MODE ..... A
trig ..... A TRIG

Channel B

CHANNEL B VOLTS/DIV ..... any
channel B coupling ..... any
channel B vernier ..... CAL
CHANNEL B POSITION ..... as required
CHAN B POLARITY ..... NORM
horizontal POSITION ..... as required
VERNIER ..... CAL
sweep display ..... SWEEP
TIME/DIV ..... .5 mSEC
MAG ..... X1
AUTO/NORM ..... AUTO
INT/EXT ..... INT
AC/DC ..... DC
SLOPE ..... +
TRIGGER HOLDOFF ..... MIN
TRIGGER LEVEL ..... as required

b. Set INTENSITY, FOCUS and POSITION controls for desired display.

c. Connect CAL 1 VOLT output to BNC tee.

d. Using two 8-inch BNC cables, connect one end of BNC tee to channel A INPUT and other end of BNC tee to EXT HORIZ INPUT.

e. Adjust TRIGGER LEVEL for stable display. Observe approximately five positive-going pulses

f. Rotate VERNIER fully ccw. Observe 15 or more pulses between first and eleventh graticule lines.

g. Turn VERNIER to CAL position.

h. Set sweep display to EXT HORIZ INPUT. Observe 1 div of horizontal display.

i. Disconnect BNC cables.

j. Set TIME/DIV to .1 SEC.

k. Turn TRIGGER LEVEL fully cw.

l. Set AUTO/NORM to NORM.

m. Engage SINGLE pushbutton.

n. Press RESET pushbutton. Observe RESET lamp is on and no sweep.

o. Rotate TRIGGER LEVEL fully ccw. Observe one sweep and RESET lamp goes off.

p. Set AUTO/NORM to AUTO.

q. Press RESET pushbutton. Observe one sweep.

## 3-53. OPERATING PROCEDURES.

3-54. Figures 3-2 through 3-6 contain step-by-step operating procedures. The index numbers on the photographs correspond to step numbers in the procedure.

## 3-55. OPERATING INFORMATION.

3-56. The following paragraphs provide additional information concerning the use of one specific function over another.

### 3-57. AUTO VERSUS NORM.

3-58. In auto operation, there will always be a baseline. A trigger signal of 40 Hz or higher overrides auto operation and produces a stable presentation. Adjustment of TRIGGER LEVEL may be necessary for a stable display. If the trigger is 40 Hz or less NORM operation should be used. A trigger signal is always needed in NORM operation to generate a sweep.

### 3-59. AC VERSUS DC.

3-60. Ac coupling removes the dc level of trigger signals. Use of the HFAC control prevents low frequency noise from triggering the sweep.


**AUTO OPERATION**

1. Adjust vertical controls for desired display, and connect vertical input signal.
2. Set AUTO/NORM to AUTO.
3. Set MAG to X1.
4. Set INT/EXT to desired trigger source. If EXT trigger is selected, connect trigger signal to EXT TRIG INPUT jack.
5. Set AC/DC to desired position.
6. Set SLOPE to desired position.
7. Turn TIME/DIV to desired sweep speed.
8. Adjust TRIGGER LEVEL for stable display.

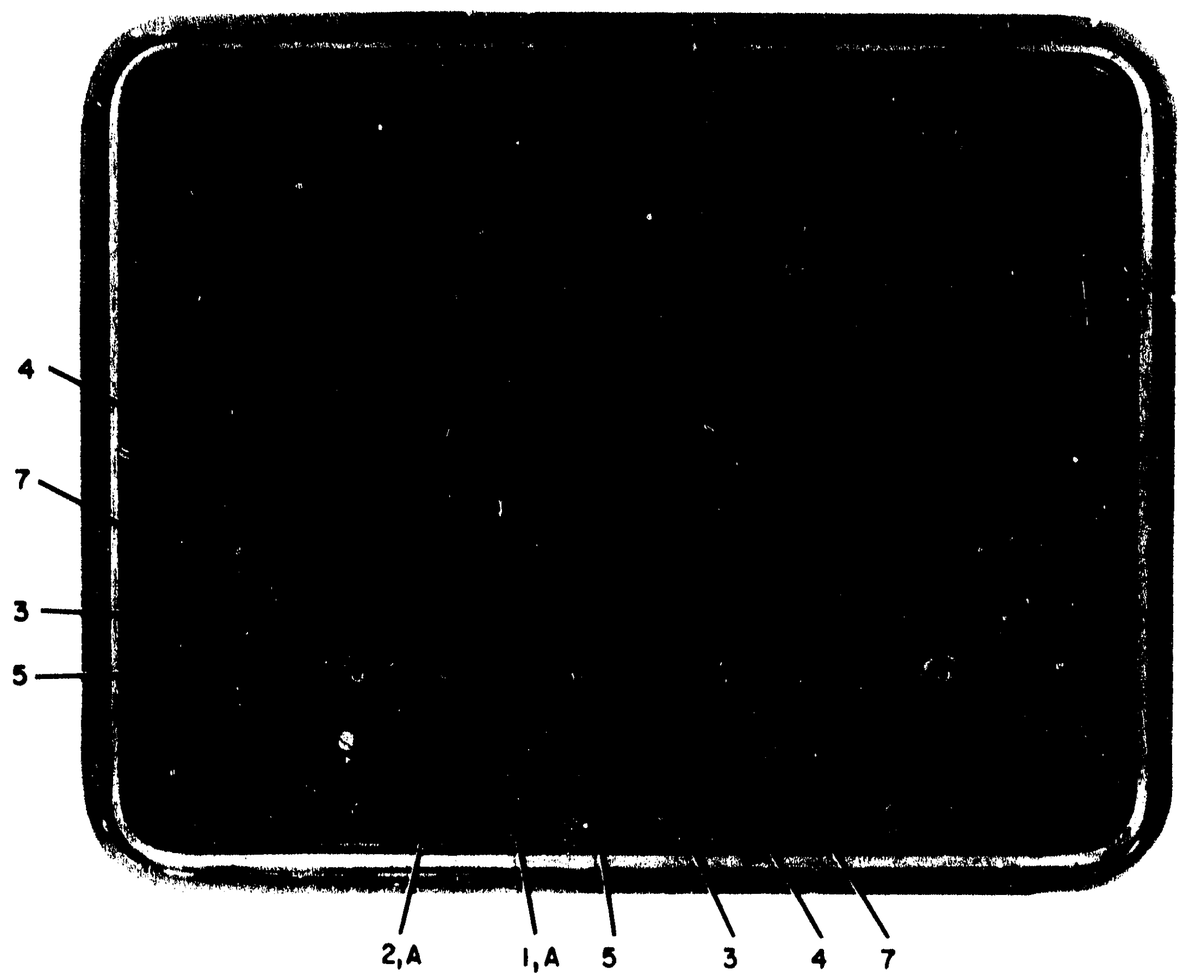
**NORM OPERATION**

A. Set AUTO/NORM to NORM.

B. Perform steps 3 through 8 for AUTO OPERATION.

17008-500-R-16

Figure 3-2. Auto and Norm Operation




### A or B SINGLE CHANNEL OPERATION

1. Set MODE to A or B, and perform following steps for selected channel.
2. Set trig to COMPOSITE TRIG.
3. Set channel A or channel B coupling to AC or DC.
4. Set CHANNEL A VOLTS/DIV or CHANNEL B VOLTS/DIV to desired range.
5. Connect input signal to channel A or channel B INPUT connector.
6. Obtain baseline on CRT (figure 3-2).
7. Adjust channel A POSITION or channel B POSITION for desired vertical position of display.

### CHOPPED OR ALTERNATE, DUAL CHANNEL

A. Set MODE to CHOP or ALT position.

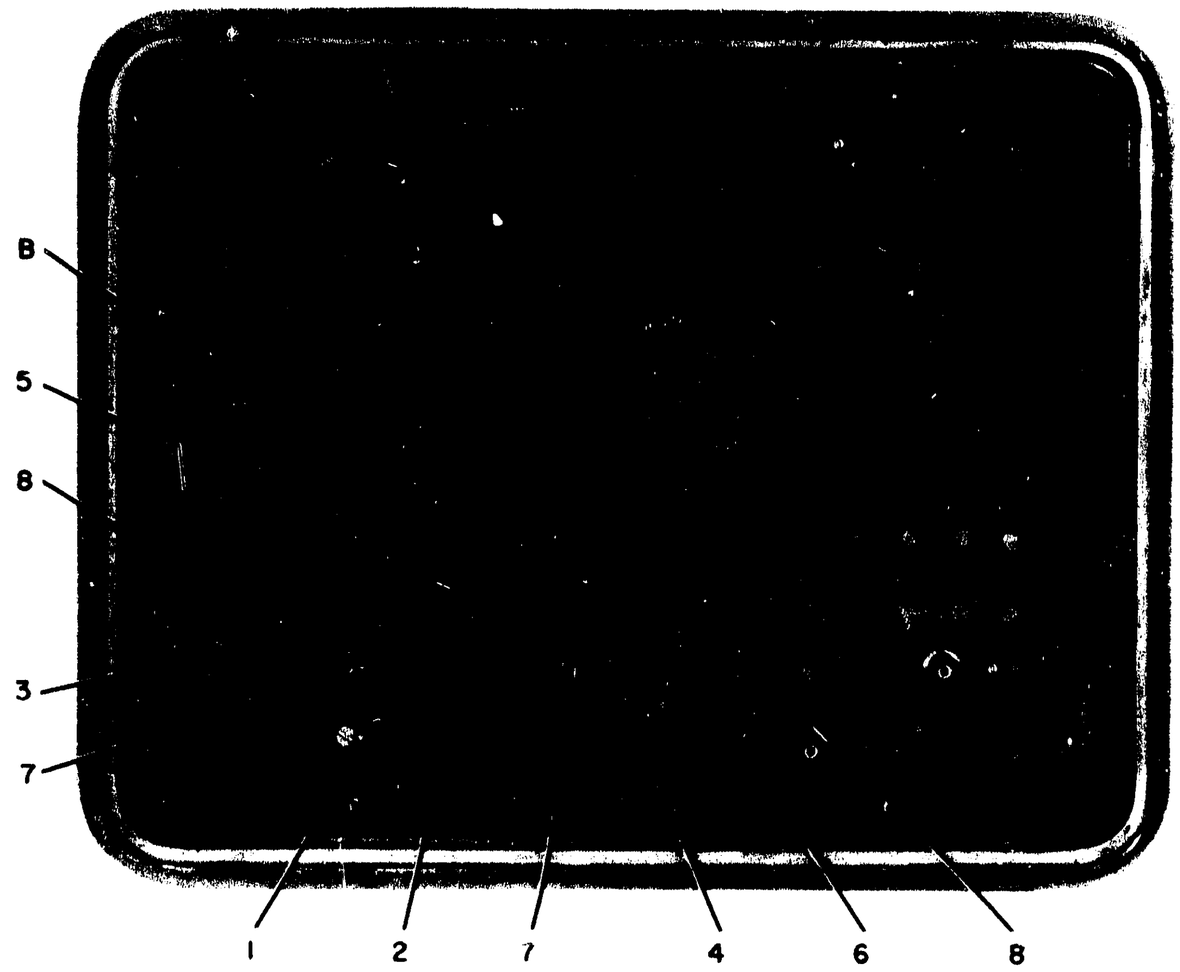
**Note**

In CHOP operation, use A TRIG. The COMPOSITE TRIG position is undefined in CHOP mode.

B. Perform steps 2 through 7 (A or B, single channel) for both vertical channels.

1700B-300-R-17

Figure 3-3. Single and Dual Channel Operation




### A + B OPERATION

1. Set MODE to A + B.
2. Set trig to A TRIG or COMPOSITE TRIG as desired.
3. Set channel A coupling to AC or DC.
4. Set channel B coupling to AC or DC.
5. Set CHANNEL A VOLTS/DIV to desired range.
6. Set CHANNEL B VOLTS/DIV to desired range.
7. Connect desired vertical signals to channel A and channel B INPUT connectors.
8. Adjust channel A POSITION and channel B POSITION controls for desired display on screen.

**Note**

In the A + B mode, only one trace is observed. This trace is the sum of A + B and either channel POSITION control will vary the vertical position display.

### A — B OPERATION

A. Repeat steps 1 and 2 of A + B operation.

B. Set CHAN B POLARITY pushbutton to INVT.

C. Repeat steps 3 through 8 of A + B operation.

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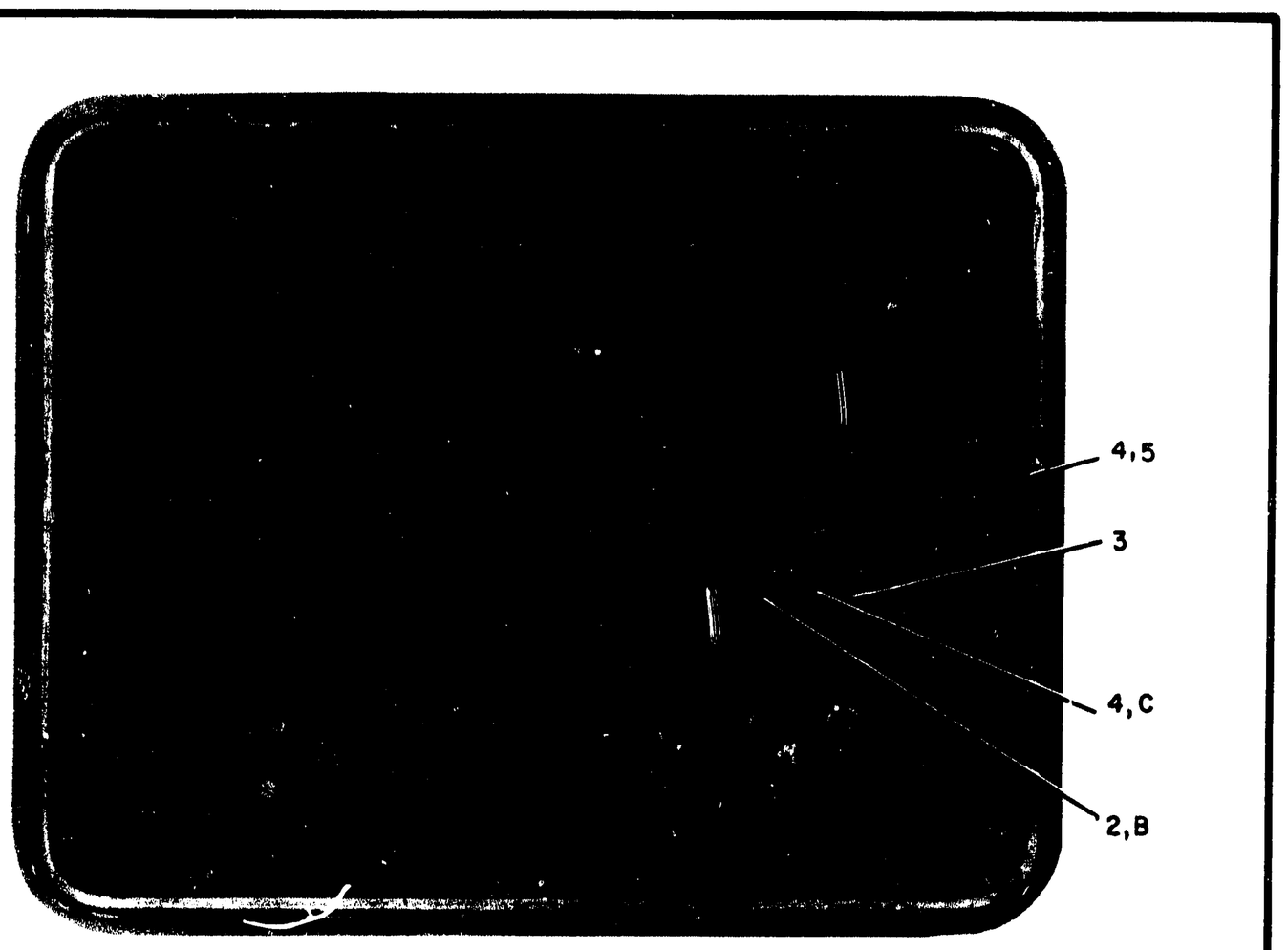
Figure 3-4. A + B and A — B Operation




**SINGLE (RESET) NORM OPERATION**

1. Obtain baseline (figure 3-2).
2. Engage SINGLE pushbutton.
3. Set AUTO/NORM to NORM.
4. Press and release RESET pushbutton. RESET indicator lamp will light to indicate sweep circuit is armed.
5. When sweep is armed, first trigger input will initiate sweep cycle. RESET lamp will go out at completion of cycle, and circuit must be rearmed for next cycle.

**SINGLE (RESET) AUTO OPERATION**

A. Obtain baseline (figure 3-2).

B. Engage SINGLE pushbutton.

C. Press and release RESET pushbutton. Sweep immediately starts due to auto circuit inside oscilloscope. These two modes of operation are ideal for use in photographing waveforms.

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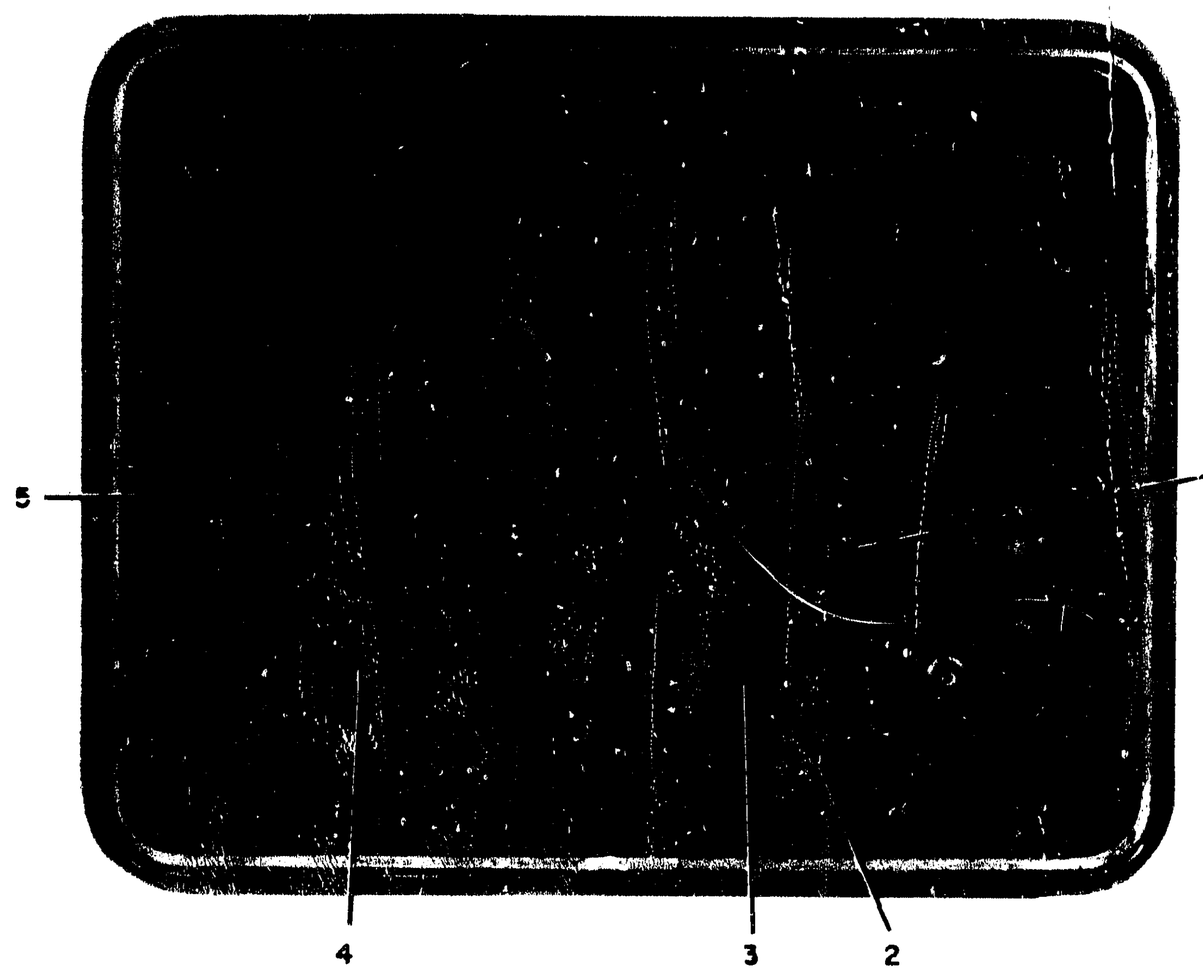
Figure 3-5. Single Sweep Operation




**EXT HORIZ OPERATION**

1. Engage SINGLE pushbutton.

Note

When the SINGLE pushbutton is engaged the internal sweep circuits are deactivated. This prevents ramp coupling into the horizontal circuits.

2. Connect horizontal drive signal to EXT HORIZ INPUT.

3. Adjust EXT HORIZ VERNIER for desired horizontal deflection factor.

4. Connect display to channel A INPUT.

5. Set CHANNEL A VOLTS/DIV to desired range.

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Figure 3-6. Ext Horiz Operation

## 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. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facility.*

## WARRANTY AND ASSISTANCE

This Hewlett-Packard product is warranted against defects in materials and workmanship. This warranty applies for one year from the date of delivery, or, in the case of certain major components listed in the operating manual, for the specified period. We will repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard. No other warranty is expressed or implied. We are not liable for consequential damages.

Service contracts or customer assistance agreements are available for Hewlett-Packard products that require maintenance and repair on-site.

# SECTION IV

# PRINCIPLES OF OPERATION

## 4-1. INTRODUCTION.

4-2. This section contains functional descriptions keyed to two overall block diagrams of the instrument. Refer to Section VIII for block diagrams.

## 4-3. GENERAL THEORY.

4-4. An overall explanation of circuit operation based on block diagrams (schematics 1 and 2) is presented to generate a basic understanding of the instrument. For simplicity, the block diagrams are drawn for function and do not show all circuit details.

Note

For circuit theory, a logic high (1) is a more positive voltage and logic low (0) is less positive voltage.

4-5. This instrument consists of a CRT, line rectifier, gate assembly, and three modules. The modules are as follows: (1) vertical amplifier module containing attenuators, vertical preamplifier, delay line and vertical output amplifier; (2) a horizontal amplifier module containing trigger assembly, horizontal mother board, integrator, sweep time assembly, holdoff assembly, horizontal mode assembly, horizontal preamplifier, and horizontal output amplifier, and (3) power supply module containing low voltage mother board, low voltage converter, line rectifier and filter, high voltage oscillator, and high voltage multiplier.

### 4-6. INPUT ATTENUATOR. (See schematic 1.)

4-7. The attenuators are compensated voltage-divider types. They provide division ratios of 1, 2, 5, 10, 100, and 1000, giving eleven separate sensitivities. Each decade input sensitivity range has an input capacitance adjustment and an attenuator compensation adjustment. Coupling (AC, GND, and DC) is also controlled in the attenuator stages.

### 4-8. VERTICAL PREAMPLIFIER.

4-9. The vertical preamplifier provides amplification to the input signals for drive to the vertical output amplifier. Channel A sync and composite sync signals originate in the vertical preamplifier. The sync signals are applied to the trigger assembly for internal triggering. Channel switching, chop operation, and display mode are also accomplished in the vertical preamplifier (schematic 7).

### 4-10. DELAY LINE.

4-11. The delay line provides approximately 160-ns delay to the vertical signal, allowing the horizontal circuits sufficient time to react to the trigger signal so that the event caused by the trigger can be observed on the fastest sweep.

### 4-12. VERTICAL OUTPUT AMPLIFIER.

4-13. The vertical output amplifier provides drive to the CRT vertical deflection plates.

### 4-14. TRIGGER CIRCUITS.

4-15. The trigger assembly provides the trigger signal to the integrator. Trigger modes are selectable in this assembly. The trigger circuit provides two outputs to the integrator (schematic 1). One output is the trigger that is generated by the current switch. The output of the current switch is controlled by the inputs to the set-trigger gates. One input to the set-trigger gate is the trigger signal and other input is the reset signal from the integrator. When the reset signal is high, the set-trigger gates are inoperative and no trigger signal is generated. When the reset signal is low, the set-trigger gates are operational and a trigger signal will be generated if there is an internal or external trigger input. The other output is the bright-line auto level which is provided only in the auto mode.

4-16. The trigger assembly also contains the external horizontal amplifier. In the ext horiz input mode of operation, an external signal must be applied to the EXT HORIZ INPUT connector. This signal is processed through the external horizontal amplifier and applied to the horizontal mode assembly.

### 4-17. INTEGRATOR.

4-18. The integrator initiates a horizontal sweep from the trigger input. When the trigger signal is applied to the input amplifier, the Miller integrator activates and produces the horizontal sweep ramp. The Miller integrator is connected to the sweep timing components (schematic 11). The TIME/DIV switch controls the ramp output from the Miller integrator. The output of the Miller integrator is

amplified and applied to the horizontal amplifier circuits.

4-19. The horizontal sweep is also compared to a 12-volt reference by the ramp comparator which drives the integrator set-reset multivibrator. The set-reset multivibrator, in conjunction with the holdoff circuit, controls the amplitude and timing sequence of the sweep ramp. When the sweep ramp reaches +12 volts, the ramp comparator turns on and resets the trigger set-trigger gates to a logic high (1). The signal from the holdoff amplifier determines the holdoff time of the circuits and sets the trigger set-trigger gates to a logic low (0) for a new sweep.

4-20. When the bright-line auto circuit is used, the set-reset multivibrator provides a ground for the bright-line auto level and terminates the sweep. This allows the sweep signal to return to its starting point.

4-21. At the same time that the main ramp is generated, the alt amplifier provides on output to the vertical preamplifier J-K flip-flop for alt operation.

## 4-22. HOLDOFF.

4-23. The holdoff establishes the time interval between trigger points. The time interval is adjusted by the TRIGGER HOLDOFF control. A signal from the integrator set-reset multivibrator activates the holdoff circuit. When the holdoff is activated, a ramp, determined by the holdoff amplifier RC circuits and the TRIGGER HOLDOFF control, is generated. When this ramp reaches a predetermined level, it activates the main integrator set-reset multivibrator. The set-reset multivibrator then sets the trigger set-trigger gates low for new sweep.

## 4-24. TIMING SEQUENCE.

4-25. Figure 4-1 is an illustration representating the time relationship between the trigger and sweep timing circuits. Waveform A represents the input signal to the vertical circuits and the internal sync signal. Waveform B represents the integrator set-reset multivibrator output. Waveform C represents the input to the trigger set-trigger gates and waveform D represents the output. Waveform F represents the input to the holdoff amplifier.

4-26. At $T_0$, the multivibrator output is high, holding the set-trigger gates high, preventing a sweep signal. At $T_1$, the holdoff time is completed and the multivibrator output goes low, activating the set-trigger gates. At $T_2$, the trigger signal goes positive and the set-trigger gates output goes low, activating the integrator which produces a horizontal sweep signal.

4-27. At $T_3$, the sweep is terminated and the set-reset multivibrator output goes high. When the set-reset multivibrator goes high, the holdoff time signal starts and the set-trigger gates are locked high, preventing a sweep. At the completion of holdoff time, the sequence is repeated.

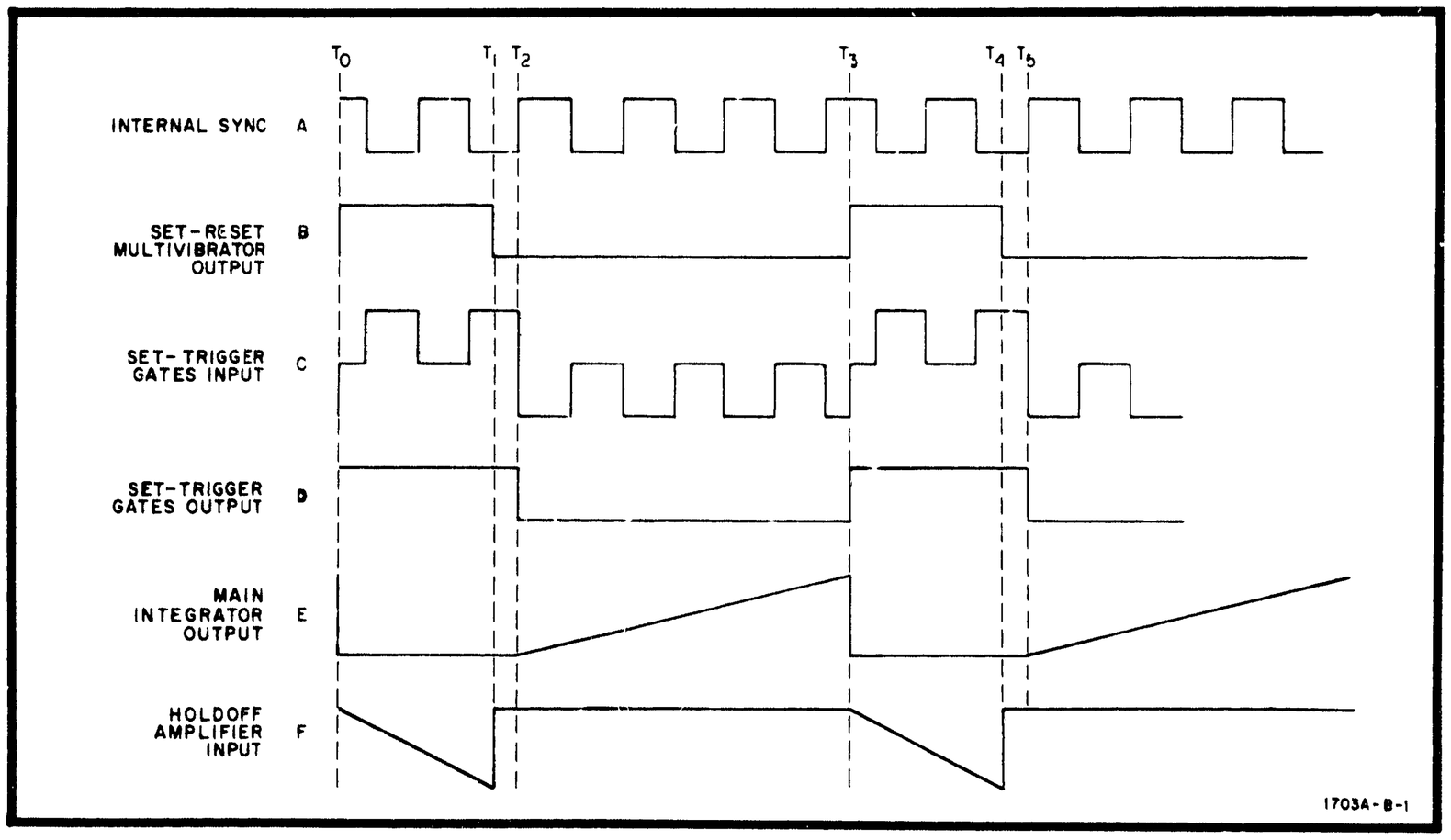


Figure 4-1. Timing Sequence

### 4-28. HORIZONTAL MODE ASSEMBLY.

4-29. The ext horizontal assembly consists of a switching network that selects either the internal ramp or the external horizontal input signal. In the EXT HORIZ INPUT position, the blanking signal from the integrator is grounded.

### 4-30. LOW VOLTAGE POWER SUPPLY. (See schematic 2.)

4-31. The low voltage power supply operates from two different power sources. The sources are ac line or external dc line. The ac line is applied to the input power module which is selectable for 115- or 230-volt operation and has an ac line protection fuse. The ac input is applied to a step-down power transformer.

4-32. The line rectifier rectifies and filters the power transformer ac output of approximately 36 volts. This voltage is applied to the voltage regulator and a ripple filter which filters out the ripple.

4-33. The voltage regulator output is applied to the low voltage converter. This stage converts the input dc power to usable output dc of different voltage levels. The low voltage converter oscillates between 10 kHz and 45 kHz depending upon the input voltage and the output power.

4-34. The voltage coupled from the converter to the low voltage rectifier is filtered and applied to the low voltage mother board which provides low voltage distribution to the power supply module. A portion of the +15 and – 15 volts is fed back to the low voltage regulator which determines the frequency and duty cycle of the converter for output voltage regulation.

4-35. The filtered voltages from the low voltage mother board are coupled to the gate board. The gate board provides filtering, fuse protection and distribution of the low voltage supplies to the rest of the Option 300 circuits.

### 4-36. HIGH VOLTAGE POWER SUPPLY.

4-37. The high voltage power supply consists of the high voltage oscillator, power transformer, rectifying networks, and high voltage multiplier. When the instrument is turned on the high voltage oscillator activates, coupling voltages from pins 1 and 2 into the secondary pins 6 and 7, 5, 8, and 9. Pins 11 and 10 are connected to filaments of the CRT. The secondary voltage at pin 7 is connected through a rectifying diode to the control grid of the CRT . Pin 8 of the secondary is connected through a rectifying diode to the cathode. A correction voltage is coupled from this diode back through a resistive divider network, controlling the current source. The current source controls the oscillator amplitude and thus the high voltage oscillator output. The CRT voltages are negative, except for the post-accelerator voltage.

4-38. The CRT cathode voltage is fed back to the current source. If the cathode voltage becomes more negative, less current is supplied to the high voltage (hv) oscillator. With less current supplied, the amplitude of the hv oscillator output is reduced and the cathode voltage will return to its normal operating value. If the cathode voltage becomes less negative, more current is supplied to the hv oscillator. The output amplitude now increases and the cathode voltage again returns to its normal operating value. A 5-kV peak-to-peak voltage is present at pin 9 of the high voltage transformer. This voltage is applied to the high voltage multiplier circuit where it is multiplied by 3. The 15-kV output is applied to the post-accelerator on the CRT.

### 4-39. GATE AMPLIFIER.

4-40. The gate amplifier has four inputs: one input is from the INTENSITY control, another input is the horizontal mode blanking input, a third input is the vertical preamplifier chop blanking input and fourth input is from the BEAM FINDER switch. All of these inputs control the intensity or Z-axis of the CRT. The output from the gate amplifier to the CRT grid increases or decreases the intensity of the display.

## 4-41. DETAILED CIRCUIT THEORY.

4-42. The detailed circuit theory is keyed to schematics located at the rear of this manual. A reference is made to the appropriate schematic at the applicable point in each discussion. The indicated schematic may then be folded out for reference while reading the text.

### 4-43. INPUT ATTENUATORS.

4-44. The 35-MHz attenuators (schematic 3) provide selectable attenuation, attenuator compensation, and adjustment of input capacitance. The attenuators are compensated voltage-divider types divided into two cascaded sections. The front section provides division ratios of 1, 10, 100, and 1000. The rear section provides division ratios of 1, 2, and 5.

4-45. Because A5A1 (channel A attenuator) and A5A2 (channel B attenuator) are identical, only A5A1 will be discussed.

4-46. Switch A5A1S1 provides a choice of coupling: capacitive (AC), direct (DC), or grounded input (GND). In AC position, coupling capacitor A5A1C1 causes a low frequency cutoff of approximately 10 Hz.

4-47. Variable capacitors A5A1C2, A5A1C5, and A5A1C19 are adjusted to compensate the front section of the attenuator. Range equalization of input capacitance is accomplished by adjusting A5A1C3, A5A1C6, and A5A1C9. Rear-section attenuator compensation is provided by A5A1C15 and A5A1C18. Range equalization of the rear section input capacitance is accomplished by adjustment of A5A1C12 and A5A1C16. RC network A5C1/A5R1 protects the field effect transistor (A5A4Q1 on schematic 4) in case a high voltage is applied to the input when the attenuator is set to a high sensitivity range.

## 4-48. VERTICAL PREAMPLIFIER.

4-49. The vertical preamplifier is diagrammed on schematics 4, 5, 6, and 7. Amplification and control functions are shown on schematics 4, 5, and 6. The display function and sync selection are shown on schematic 7.

*4-50. SCHEMATIC 4.* Separate preamplification for channel A and channel B takes place in the circuits shown on schematic 4. The channel A and channel B circuits are nearly identical, so only the channel A circuits will be discussed.

4-51. In describing the preamplifier stages, only basic reference designators will be used. When referring to table 6-2 (Section VI), prefix all basic reference designators (except front-panel controls and components located on assembly A5) with A5A4.

4-52. Negative voltage limiter CR1/CR2 and positive voltage limiter CR5/CR6 are over-voltage protection circuits for Q1. If the input voltage exceeds approximately 1.2 volts, either CR1 or CR5 will conduct and limit the input voltage.

4-53. Field effect transistors (FET) Q1 and Q2 provide the high impedance required to prevent loading circuits under test. Amplifier dc balance is also accomplished in this stage. DC BAL adjustment A5R3 permits the dc voltage on the base of Q2 to be varied, consequently varying the static dc level at the output of the amplifier.

4-54. Emitter-follower stage Q5/Q6 provides low impedance drive to the rest of the amplifier.

4-55. Amplification, position centering, vernier gain control, gain calibration, and dc balance calibration are accomplished in differential amplifier stage Q9/Q10. Amplifier gain is a function of the resistance between the emitters of Q9 and Q10. GAIN adjust A5R12 is varied to obtain the precise amount of gain needed in the amplifier. The channel A VERN potentiometer A5R5 permits the gain to be varied between approximately 33% and 100% of the calibrated amplifier gain.

4-56. Position centering adjustment, R40, is used to balance the input from channel A POSITION potentiometer A5R17A/B.

4-57. Part of the output of Q5/Q6 is applied to the channel A sync amplifier shown on schematic 5.

4-58. Channel A VERN CAL switch (part of A5R5) is connected in series with the channel B VERN CAL switch (part of A5R7). When either A5R5 or A5R7 is rotated out of detent, the ground circuit to A5DS1 is opened and +50 volts is applied to A5DS1. Lamp A5DS1 lights to indicate that the vernier is not in the calibrated position.

*4-59. SCHEMATIC 5.* The circuits shown on schematic 5 accomplish channel A and channel B summing, A + B balance, channel B polarity control, and channel A sync signal amplification.

4-60. Summing is accomplished by the channel switches. The channel A switch consists of differential amplifier Q18/Q19 and transistor switch Q16. Whenever Q16 is turned on (by a voltage from schematic 7), its emitter goes to approximately 6.7 volts causing the emitters of CR10/CR11 to turn on. This clamps the emitters of Q18/Q19 to approximately +6 volts, turning them off. When Q16 is turned off, its emitter approaches 0 volt and the diodes turn off. This permits the emitters of Q18/Q19 to fall to approximately +3.9 volts, turning the transistors on.

4-61. The channel B switch consists of normal output amplifier Q21/Q22, inverted output amplifier Q20/Q23, and transistor switch Q17. Transistor switch Q17 functions exactly as explained in paragraph 4-60 for Q16. Depending on the position of CHAN B POLARITY switch A5S1, the normal output amplifier or the inverted output amplifier will turn on, only the channel A signal appears at the output of the channel switches. When Q16 is turned on and Q17 is turned off, only the channel B signal appears at the output. When both Q16 and Q17 are turned off, the algebraic sum of the channel A and channel B signals appears at the output. If the normal channel B amplifier is on, the output of the channel switches is the sum of the signals. If the inverted channel B output amplifier is on, the output of the channel switches is the difference between the two signals.

4-62. Feedback amplifier Q24/Q25 amplifies the composite signal and drives the delay line driver. The feedback circuits improve frequency response by compensating for collector-to-base capacitance.

4-63. The channel A sync amplifier consists of Q13, Q14, and Q15. Its inputs are from the channel A amplifier on schematic 4 and its output is to the sync selection circuits on schematic 7.

*4-64. SCHEMATIC 6.* The vertical preamplifier circuits Q30/Q31 amplify the composite signal and drive the delay line. Sync take off amplifier Q26/Q27 selects and applies the composite sync signal to sync amplifier Q28/Q29. The composite sync signal drives the sync selection circuits (schematic 7).

*4-65. SCHEMATIC 7.* The circuits shown on schematic 7 control the channel switches (schematic 5), generate chop blanking, and select the internal sync signal.

4-66. The steering logic circuits control the channel gates and generate chop blanking. Astable multivibrator Q32/Q33 is activated when the base of Q32 is logic high (>+2.4V). It free-runs at a 200-kHz rate. When the base is logic low (0V), it is prohibited from running. Transistor Q34 controls the channel A gate (schematic 5) and Q35 controls the channel B gate. Integrated circuit, U1, is a four-section IC consisting of four NAND gates. Three of the four sections operate conventionally but, because its two inputs are tied together, U1B functions simply as an inverter. Clocked flip-flop U2 has two outputs and three inputs. When T and C inputs are high and S input is low, the Q output is high. When T and S inputs are high and C input is low, the Q output is high. When T input is high and both S and C inputs are low, both Q and $\overline{Q}$ are high. When both S and C inputs are high, a negative-going transition on T input will cause the flip-flop to change states.

4-67. The astable multivibrator is driven by U1A and U1B. In all positions of the MODE switch, except CHOP, the astable multivibrator is disabled because pin 2 of U1A is grounded (held low) by the front section of A5S2A. In the CHOP position, the ground is removed and pin 2 goes high. During sweep time, the alternate trigger signal (from schematic 10) is also high. Because both inputs are now high, the output of pin 3 is low. Pin 6 of U1B is high and the astable multivibrator is running.

4-68. The clocked flip-flop is driven by U1C and U1D. In the A, B, or A + B position of the MODE switch, the T input to the clocked flip-flop is held high because pin 9 of U1D is grounded by the rear section of A5S2A. In position A, the S input of U2 is grounded by the front section of A5S2C and Q34 is turned on. In position B, the C input is grounded by the rear section of A5S2C and Q35 is turned on. In position A + B, both S and C are grounded and both Q34 and Q35 are turned on.

4-69. In the CHOP and ALT position of the MODE switch, the S and C inputs of U2 are ungrounded and go high. Pin 9 of U1D is also ungrounded and goes high. In these positions, changes at pin 10 of U1D control the state of the flip-flop.

4-70. In the CHOP position of A5S2, the astable multivibrator is permitted to free-run, its output being routed to pin 12 of U1C. During the time when the alt trigger signal is present, the output of the astable multivibrator will cause the clocked flip-flop to change states at each negative transition. The net result being that the channel switches (schematic 5) change between channel A and channel B at a 100-kHz rate.

4-71. In the ALT position of A5S2, the astable multivibrator is again disabled and pin 12 of U1C is held high. Each negative-going transition of the alt trigger signal causes the clocked flip-flop to change states. The net result being that the channel switches (schematic 5) alternate, at the sweep rate, between channel A and channel B.

4-72. The chop blanking output of the astable multivibrator is routed through the circuits on schematic 14 to the CRT blanking circuits to blank the CRT during the channel switching transitions.

4-73. The COMPOSITE trig/A TRIG switch selects either channel A trigger from schematic 5 or the composite trigger from schematic 6.

4-74. In the A + B position of the MODE switch, the B section of the switch connects +15 volts (schematic 4) to the A+B balance adjustment potentiometer R60 (schematic 5). This permits correction of any dc unbalance caused by turning both the channel A and channel B switches on together.

### 4-75. DELAY LINE.

4-76. The delay line (schematic 6) provides 160 nanoseconds delay to the vertical signal. This offsets the delay time in the trigger and gating circuitry and assures that a portion of the vertical signal is not lost before these circuits react and start the sweep.

### 4-77. VERTICAL OUTPUT AMPLIFIER.

4-78. In describing the vertical output amplifier stages, only basic reference designators will be used. When referring to table 6-2 (Section VI), prefix all basic reference designators (except front-panel controls and components located on assembly A5) with A5A5.

4-79. The vertical output amplifier (schematic 6) consists of differential amplifier Q1/Q2, feedback amplifier Q3/Q4, and cascode differential amplifier Q7 through Q10. The amplifier receives the composite signal from the delay line and drives the vertical deflection plates of the CRT. Transistors Q5 and Q6 form a constant current source to the cascode amplifier.

4-80. Optimum high frequency response is obtained from the amplifier by adjusting high frequency compensating capacitors C4 and C10.

4-81. The feedback circuits of Q3 and Q4 improve frequency response by compensating for collector-to-base capacitance.

4-82. The BEAM FINDER switch S3 (when pressed) limits the current available to the cascode amplifier. This reduces the overall gain and assures that the beam will not be deflected off screen.

**4-83. TRIGGER CIRCUITS.**

4-84. Inputs to the trigger assembly (schematics 8 and 9) are selected from the internal sync circuits in the vertical preamplifier, from the EXT TRIG INPUT connector, or from the LINE SYNC. Two outputs, the trigger signal and the bright line auto signal, are provided to the integrator.

4-85. In describing the trigger assembly, only basic reference designators will be used. When referring to able 6-2 (Section VI), prefix all basic reference designators (except front-panel controls and components located on assembly A6) with A6A2.

*4-86. SCHEMATIC 8.* The INT/EXT switch selects a signal from the circuits on schematic 7 or from the EXT TRIG INPUT connector. If EXT trigger is selected, a divide by 1 attenuation network (R41/R42/C11) or a divide by 10 attenuation network (R43/R44/C12) is provided.

4-87. The AC/DC switch connects C1 in series for capacitive coupling or bypasses it for direct coupling.

4-88. The HFAC switch either bypasses the frequency limiting network (C2/R1) or connects it to reject trigger frequency components above 15 kHz.

4-89. The LFAC switch bypasses the frequency limiting circuit (R2/stray capacitance) or activates it to reject trigger frequency components below 15 kHz.

4-90. The SLOPE switch reverses the inputs to Q1 and Q2. This permits triggering on either slope of the trigger waveform.

4-91. The TRIGGER LEVEL control A6R1 permits selection of the point on the trigger slope that initiates the sweep. It accomplishes this by shifting the static dc level on the trigger amplifiers.

4-92. Source followers Q1/Q2 provide the high impedance required to prevent loading of the trigger source. Network C3/R3 and R4 protects Q1/Q2 from being overdriven. Diode array CR1 through CR4 protects Q1/Q2 from over voltage application. These diodes turn on at approximately 1.5 volts, clamping the input signal.

4-93. Emitter followers Q3/Q4 provide the required low impedance drive to the differential amplifiers. Differential amplifiers Q5 through Q8 drive the current steering switches (schematic 9).

*4-94. SCHEMATIC 9.* The current steering switches, Q9 and Q10, are a differential amplifier designed so one side turns off while the other side turns on whenever a square wave signal is applied differentially to their bases. With no input, both sides are turned off.

4-95. Set-trigger gates U1A and U1B consists of two OR circuits with biasing and feedback to cause them to function as a Schmitt trigger. The set-trigger Schmitt has two functions: to generate a signal to initiate the sweep upon receipt of a trigger, and to prohibit further triggering during sweep and holdoff. A trigger signal from the current steering switches causes the set-trigger Schmitt to change states. The resultant output is used to initiate the sweep. A signal from the set-reset multivibrator (schematic 10) disables the set-trigger Schmitt during sweep and holdoff.

4-96. The threshold voltage for the Schmitt trigger is set by the trigger sensitivity adjustment potentiometer R40.

4-97. The trigger switch, Q11/Q12 functions exactly like the current steering switch (paragraph 4-94). When pin 8 of U1B goes low and Q11 turns on, pin 9 goes high and Q12 turns off. Transistor Q13 turns on and saturates. Because the collector of Q13 is coupled to the base of Q14, Q13 remains on and Q14 remains off even though Q12 turns back on. If no trigger signal is applied, the base voltage of Q14 decays through an RC network consisting of R28, C16, and R29. When the voltage decays to approximately 16 volts, CR8 turns on. Transistors Q15 and Q16 turn on and Schmitt trigger Q17/Q18 activates, supplying current to the integrator (schematic 10) through R34. In this manner, the sweep is initiated in the absence of trigger pulses.

**4-98. INTEGRATOR.**

4-99. The integrator circuit consists of a Miller integrator (schematic 10), the set-reset multivibrator (schematic 10), and the sweep time assembly (schematic 11). The integrator, in conjunction with the sweep time assembly, generates the sweep ramp, provides blanking to the horizontal assembly (schematic 13), and alternate triggering to the vertical preamplifier (schematic 7). The set-reset multivibrator terminates the sweep and sets the set-trigger Schmitt (schematic 9) low to initiate a new trigger.

4-100. In describing the integrator only basic reference designators will be used. When referring to table 6-2 (Section VI), prefix all basic reference designators (except components on assemblies A6 and A6A1) with A6A3.

*4-101. SCHEMATIC 10.* Gate amplifier Q1, when in the quiescent state, is turned off. A positive pulse on either of its two inputs, trigger or

bright line auto, turns it on. When Q1 turns on, its collector approaches 0 volt and CR5, CR6, and CR9 turn on. This initiates blanking, alternate trigger, sweep, and reset and holdoff.

4-102. When CR5 turns on, it furnishes a ground to the horizontal blanking circuit (schematic 13). This turns the CRT on and allows the trace to be seen. When Q1 is off, the blanking circuit is on, blanking the CRT.

4-103. When CR9 turns on, it causes CR13 and ramp control transistor Q6 to turn off, activating the comparator.

4-104. The Miller integrator consists of the components associated with Q7/Q8 and, according to the position of the TIME/DIV switch, certain of the sweep time assembly components (schematic 11). Basically, the function of the TIME/DIV switch is to connect a selected integrating capacitor between the collector of Q8 and the base of Q9. The switch also connects a selected integrating resistor between the gate of Q7 and a calibrated charging voltage (schematic 11). In the quiescent state, Q6 is turned on clamping the gate of Q7 to a fixed voltage. When Q6 turns off, a charging current through the integrating resistor causes the integrating capacitor to start charging negatively. This change is integrated and appears at the output of Q8 as a linear positive-going ramp. Output amplifier Q9 drives the horizontal circuits (schematic 14 by way of schematic 13). The ramp also drives the comparator.

4-105. In the quiescent state, CR12 is turned on, clamping the emitter of Q5 and holding the transistor on. When CR12 turns off, the emitter of Q5 is permitted to follow its base. As the ramp (from Q8) rises on the base of Q5, the emitter follows. When the ramp voltage equals the voltage on the base of Q2 (+12 volts), the comparator changes states. The resultant current through R6 causes common-emitter transistor Q3 to turn on.

4-106. The set-reset multivibrator (U1) is a R-S type flip-flop composed of two negated output AND (NAND) gates. The set-reset multivibrator performs a number of functions. First, it permits the formation of a gate any time a trigger pulse arrives during quiescent periods. It does this by providing a low (from its pin 6 output) to pin 1 of the set-trigger Schmitt (schematic 9). Second, it initiates holdoff. It does this by changing states at the end of sweep time and applying a high (from pin 6) to turn on A6A7Q1 (schematic 12). Third, it prevents the formation of a new gate during holdoff. It does this by applying the high on pin 6 to pin 1 of the set-trigger Schmitt (schematic 9), disabling it. Finally, it terminates the sweep during operation of bright line auto. It does this as follows: when pin 6 goes high at the end of sweep time, pin 12 goes low. This turns CR3 on, grounding the bright line auto signal and turning Q1 off.

4-107. In NORM position, the AUTO/NORM switch (A6A1S4) grounds the bright line auto input, preventing this circuit from initiating a sweep.

4-108. The SINGLE switch (A6A1S2) disconnects the enable line. In this condition the last sweep cycle proceeds to the end of the sweep but, because the enable line is disconnected, cannot proceed further. The RESET switch (A6A1S3) connects A6A1C1 and, during initial surge of its charging curve, pin 1 of U1 is drawn low forcing its output (pin 12) high.

4-109. Lamp driver A6A1Q1 turns on whenever the reset and holdoff line goes high, causing the RESET lamp A6DS2 to light.

*4-110. SCHEMATIC 11.* In describing the sweep time assembly only basic reference designators will be used. When referring to table 6-2 (Section VI), prefix all basic reference designators (except assemblies A6 and A6A3) with A6A5.

4-111. The sweep time assembly provides selection of an integrating resistor, and integrating capacitor, and a calibrated charging voltage for the integrator (schematic 10).

4-112. Section A of the TIME/DIV switch S1 selects the integrating resistors for all sweep speeds except the five fastest speeds. The resistor for the five fastest speeds are selected by section B of the switch.

4-113. A separate capacitor is provided for each decade of the TIME/DIV switch. The B and C sections of the switch select all except the fastest decade. The integrating capacitor for the fastest decade (A6A3C8) is permanently wired into the integrator circuitry (schematic 10). On all other decades A6A3C8 is in parallel with the selected capacitor.

4-114. Operational amplifier Q1, Q2, and Q3 provides a fixed charging voltage at the collector of Q2. The charging voltage is separately calibrated for each decade of the TIME/DIV switch. Section D of the switch selects the calibrating potentiometers.

### 4-115. HOLDOFF.

4-116. The circuits on the holdoff assembly (schematic 12) determine the time between the end of one sweep and the beginning of the next (holdoff).

4-117. In describing the holdoff assembly, only basic reference designators will be used. When referring to table 6-2 (Section VI), prefix all basic reference designators (except components located on assembly A6) with A6A7.

4-118. In the quiescent state, Q1 is turned off and Q2 is turned on. The capacitor selected by TIME/DIV switch S1 is charged to about +16 volts. When the

reset and holdoff voltage (from schematic 10) goes high at the end of sweep time, Q1 turns on and Q2 turns off. The selected capacitor starts discharging exponentially through R5 and TRIGGER HOLDOFF potentiometer A6R3. The rate of discharge (and holdoff time) is determined by the setting of A6R3. When the charge on the selected capacitor has fallen to approximately 0 volt, Q3 turns on. Diode CR4 turns on and applies a low to the set-reset multivibrator (schematic 10), enabling it. When the reset and holdoff voltage goes low, Q1 turns off and Q2 turns on. The charge on the selected capacitor quickly rises to +16 volts and Q3 turns off.

**4-119. GATE ASSEMBLY.**

4-120. In describing the gate assembly and calibrator (paragraph 4-127), only the basic reference designators will be used. When referring to table 6-2 (Section VI), prefix all basic reference designators (except front-panel controls) with A4.

4-121. The gate assembly (schematic 14) combines (sums) the inputs from four different sources and controls the brightness of the CRT. The basic input is the current sink consisting of R2, front-panel INTENSITY potentiometer R1, and the —15-volt power supply. The current sink draws current from one or more sources. The basic source is Q1. The amount of current drawn from Q1 depends on the setting of the INTENSITY potentiometer. The amount of current drawn from Q1, in turn controls the brightness of the CRT.

4-122. When the BEAM FINDER switch S3 is pressed, CR8 and R32 are connected in parallel with the current sink causing it to demand more current. This causes the CRT to turn on with maximum intensity.

4-123. The sweep blanking input (from schematic 13) functions as another current source. Because the current sink, under a given condition, draws a fixed amount of current, varying the current in one current source will cause the current in another source to vary. If the sweep blanking input supplies more current, Q1 will supply less. Conversely, if the sweep blanking input supplies less current, Q1 will supply more.

4-124. The chop blanking input (from schematic 7) is also a current source. The chop blanking input supplies either enough current to cause blanking of the CRT trace or none.

4-125. Transistor Q1 draws current from the bases of Q3 and Q4. Transistor Q3 drives Q5 and transistor Q4 drives Q6. Transistors Q5 and Q6 are connected in the complementary configuration in order to provide the required dynamic range to drive the intensity grid of the CRT between cutoff and saturation.

4-126. The feedback circuit, consisting of gate response adjustment C12, is adjusted to optimize the frequency response of the amplifier.

**4-127. CALIBRATOR.**

4-128. The calibrator consists of emitter-coupled multivibrator Q7/Q8, output amplifier Q9, and avalanche diode VR2 (schematic 14). The multivibrator free-runs at approximately 1 kHz. turning Q9 on and off with each cycle. Diode VR2 causes a 6.2-volt square wave at the collector of Q9 as it turns on and off. The calibrator amplifier adjustment potentiometer R29 is adjusted to produce a square wave with 1 volt amplitude at the CAL 1 VOLT output.

**4-129. HORIZONTAL PREAMPLIFIER AND OUTPUT ASSEMBLIES.**

4-130. The horizontal preamplifier assembly (schematic 13) amplifies the sweep signal and controls the horizontal position of the trace. It also provides sweep length adjustment, trace magnification (X10), and trace centering. The horizontal output amplifier (also schematic 13) provides class B drive to the horizontal plates of the CRT.

*4-131. SCHEMATIC 13.* The sweep signal is applied to the input of A6A4Q1. Transistor A6A4Q1 is balanced by temperature compensated amplifier A6A4Q2. Differential amplifier A6A4Q3/A6A4Q4 provides differential drive to the horizontal output amplifier. When the MAG switch is set to X10 position, the gain of the differential amplifier is increased by a factor of approximately 10. X10 gain adjustment A6A4R21 is adjusted to set the gain increase to exactly 10. When the BEAM FINDER switch is pressed, less current is supplied to the differential amplifier, reducing its gain and assuring that the beam is not deflected off screen.

4-132. The output stage of the horizontal output amplifier A6A6 is a class B differential amplifier. Each side consists of a pair of transistors connected in the complementary configuration. Each output transistor has a separate driver. Feedback circuits on both sides improve the linearity of the amplifier.

*4-133. SCHEMATIC 8.* The external horizontal input amplifier is physically located on Trigger Assembly A6A2. The amplifier consists of a source follower, a cascade amplifier, a single-ended emitter follower output stage, and a current source.

4-134. The input to FET differential amplifier A6A2Q19/A6A2Q20 is driven single-ended from the output of a compensated voltage divider consisting of A6A2C14/A6A2R45, A6A2R46, and A6A2C15. The input circuit provides the required high impedance and voltage step-down functions. Voltage clamps A6A2CR9 and A6A2CR10 limits the voltage on the gate of A6A2Q19 to approximately ±15 volts.

4-135. Cascade amplifier A6A2Q21/A6A2Q22 amplify the input signal from A6A2Q19 and apply it to emitter-follower output stage A6A2Q23. Current source A6A2Q24 provides temperature compensation for the amplifier by supplying a constant current to the emitter circuit of A6A2Q21.

4-136. The output of emitter follower A6A2Q23 is applied to the horizontal preamplifier through sweep selector switch A6A6S1 (schematic 13).

**4-137. INDICATOR DRIVERS.**

4-138. The POWER indicator lamp lights when +50V and —50V is applied from the low voltage power supplies.

4-139. Scale lamp driver A4Q10 (schematic 16) is a linear amplifier that drives the scale illumination lamps A7DS1 and A7DS2. The brightness of the lamps is dependent on the setting of SCALE ILLUMINATION potentiometer R3.

**4-140. LOW VOLTAGE POWER SUPPLY.**

4-141. The Option 300 can be operated from a 115-volt ac line, a 230-volt ac line, or 11.5-volt to 36-volt dc line. Circuits and controls for converting these inputs to the required dc voltages are shown on schematics 16, 17, and 18.

*4-142. SCHEMATIC 16.* Schematic 16 diagrams the POWER MODE switch S2 and the circuitry for operating from an ac power line. The input power section contains the ac line input fuse F1, capacitors C3 and C4, the 115/230 input selector switch S2, and a 3:1 step-down transformer T1. Assembly Z1 provides full-wave rectification for the line voltage. Capacitors A2C1 and A2C2 are ripple filters. Transistors A3Q2 and A3A1Q1 function as a coarse series regulator. Current through A3A1R1 and A3A1VR1 establish a fixed voltage for the base of A3A1Q1. Diode A3A1VR4 provides a high dynamic impedance to the power supply ripple voltage. Diode A3A1CR1 is a protective diode for A3Q2 and A3A1Q1.

4-143. The POWER MODE switch S2 selects the output from the ac power supply or the DC LINE J5. Fuse F2 remains in the circuit in the two power modes.

*4-144. SCHEMATIC 17.* Schematic 17 diagrams the low voltage converter protection circuits, the low voltage converter assembly, and the low voltage regulator. The protection circuit protects the instrument in case of regulator failure, inadvertent application of more than 40 volts on the dc line, or inadvertent reversal of the dc line polarity. The low voltage converter assembly, regulated by the low voltage regulator, converts the dc input to a regulated pulsating dc to operate the low voltage transformer (schematic 18).

4-145. If a dc voltage is inadvertently connected with reverse polarity, A3A1CR3 conducts, causing the line fuse F1 (schematic 16) to open. If a dc voltage over 40 volts is connected, A3A1VR3 conducts, causing A3A1SCR1 to conduct, and the line fuse opens. If the regulated +15-volt supply (schematic 18) goes above approximately 20 volts, bidirectional diode A3A1CR5 conducts. Network A3A1CR5, A3A1C2, and A3A1R9 form a relaxation oscillator whose output is coupled across A3A1T1, rectified by A3A1CR4, and filtered by A3A1C3. The rectified voltage causes A3ASCR1 to conduct and the line fuse opens.

4-146. When the instrument is first turned on, A3A2Q1 and A3A2Q2 are both turned off. Current through A3A2R2 and A3A2VR2 establishes the operating potentials for A3A2Q1. Capacitor A3A2C7 starts charging through A3A2R6. When the voltage across A3A2C7 reaches the peak-point emitter voltage of unijunction transistor A3A2Q1, the transistor turns on causing A3A2Q2 to turn on. When A3A2Q2 turns on, A3A2Q1 turns off and does not turn on again (unless, of course, the instrument is turned off and then back on) because A3A2CR5 keeps A3A2C7 discharged below the peak-point emitter voltage of A3A2Q1.

4-147. Operation of the low voltage converter is as follows. When A3A2Q2 turns on, current flows in the primary windings of A3A2T1 and A3A3T1 (schematic 18). As the current increases, the primary winding (pins 1 and 2) of A3A2T1 induces a voltage into the secondary winding (pins 3 and 4) in such a direction as to turn A3A2Q2 on harder. The primary current continues to increase until the core of A3A2T1 saturates. At this time, there is no magnetic coupling in A3A2T1 and Q2 turns off. Current ceases to flow in the primaries of A3A2T1 and A3A3T1. The magnetic field in the core of A3A3T1 collapses and induces a flyback voltage into the secondaries. A flyback voltage is also induced into the secondary of A3A2T1. This voltage keeps A3A2Q2 turned off, turns A3A2CR4 on, and charges A3A2C8. When all the energy has left the core, A3A2CR4 turns off and the stored charge on A3A2C8 turns A3A2Q2 on to repeat the cycle. Diode A3A2CR3 protects A3A2Q2 from reversed junction breakdown.

4-148. The low voltage converter is regulated by varying the amplitude of a dc current in the tertiary winding (pins 5 and 6) of A3AT1. This varies the permeance of the core and, in turn, varies the duty cycle of the converter thus controlling the output voltage. The —15-volt power supply output (schematic 18) is applied to A3A2R1 and A3A2VR1 (schematic 17) to establish a reference voltage. A sample of the output of the +15-volt supply (through A3A2R3 and A3A2R4) is compared with the reference voltage. Any difference voltage is amplified and inverted by operational amplifier A3A2U1. The output of A3A2U1 drives the inputs of complementary amplifier A3A2-

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Q3/A3A2Q4 whose current path is through the tertiary winding of A3A2T1. In this manner, a change in the output of the +15-volt supply causes a change in the current through the tertiary winding. The change will be in such a direction as to correct the original change in the output of the power supply.

*4-149. SCHEMATIC 18.* When the flyback voltage is induced into the secondaries of A3A3T1, the voltage is rectified and filtered by the diodes, inductors, and capacitors on low voltage rectifier and filter assembly A3A3. The outputs are connected to low voltage mother board A3A1 where further filtering takes place. The low voltage power supply control voltages and the high voltage power supply operating voltages are connected to circuits on schematics 15 and 17 respectively. The remainder of the outputs are connected to components on gate assembly A4 where fusing, additional filtering, and distribution is accomplished.

## 4-150. HIGH VOLTAGE POWER SUPPLY.

4-151. The high voltage power supply (schematic 15) generates the high voltage operating potentials for the CRT. When the instrument is turned on, A3Q1 starts to conduct through the primary winding (pins 1 and 2) of high voltage transformer A3A4A1T1. Positive feedback to the base of A3Q1 occurs from the tertiary winding (pins 3 and 4) of the transformer and the circuit oscillates at a rate determined by the distributed inductance and capacitance of the circuit. The magnitude of the oscillations, and consequently the output of the power supply, is controlled by the voltage on the collector of A3A4Q3. A sample of the +15-volt power supply (through A3A4R1 and A3A4R2) establishes a reference at the base of A3A4Q1. A sample of the —2150-volt output of the power supply is fed back to the base of A3A4Q1 and compared with the reference voltage. Any difference is amplified and inverted by Darlington amplifier A3A4Q1/A3A4Q2. The output of the Darlington pair drives the base of A3A4Q3 causing its collector voltage to change. This change is reflected through the tertiary winding of the transformer to the base of A3Q1 and causes the amplitude of its oscillations to change. The change is in such a direction as to correct the original change in the output voltage of the power supply.

4-152. The output of the gate assembly (schematic 14) is connected to the positive side of the —2220-volt output. Any variation in the gate voltage, varies the total voltage on the intensity grid of the CRT and controls the brightness (or blanking) of the trace.

4-153. High voltage multiplier A3A4A2 quadruples the output from pin 8 of the high voltage transformer and supplies a potential of -15 kilovolts for the post accelerator of the CRT.

Table 5-1. Recommended Test Equipment

| Instrument Type | Recommended Model | Required Characteristics | Required For |
|---|---|---|---|
| Voltmeter Calibrator | HP Model H01-738BR | Voltage: 5 mV to 100V<br>Accuracy: to 0.1% | P, A |
| Oscillator | HP Model 204C | Frequency: 100 kHz<br>Voltage Output: 15 mV | A |
| Time-mark Generator | HP Model 226A | Time Marks: 0.1 usec to 2 sec in 1, 2, 5 sequence | P, A |
| Square-wave Generator | HP Model 211B | Frequency: 100 kHz<br>Risetime: <5 ns | P |
| Multifunction Digital Voltmeter | HP Model 3439A with 3444A | Voltage Range: 1000V<br>Accuracy: ±0.1%<br>Resistance Range: 10 megohms<br>Accuracy: ±0.1% | P, A, T |
| VHF Signal Generator | HP Model 608E | Frequency: 50 kHz to 75 MHz<br>Voltage Output: 50 mV to 5V p-p | P |
| LCR Meter | HP Model 4332A | Range: 30 pF | A |
| 50-ohm Feed-through Termination | HP Model 10100C | Resistance: 50 ohms | P, A |
| RG 213 | 50-ohm BNC Cable (1) | 50-ohms | P, A |
| BNC Cable (2) 44 in. | HP Model 10501A Cable Assembly | 44 in. | P, A |
| BNC Cable (2) 9 in. | HP Model 10502A Cable Assembly | 9 in. | P, A |
| Banana Jack to BNC Adapter | HP Model 10110A | Banana Jack to BNC | P, A |
| BNC to Binding Post Adapter | HP Model 10111A | BNC to Binding Post | P, A |
| Test Leads | HP Model 11002A | Test Leads | P, A, T |
| RF Millivoltmeter | HP Model 411A | Range: 35 mV<br>Accuracy: ±3% | P |
| 10:1 Divider Probe | HP Model 10006B Option 030 | Divide Ratio: 10:1 | A |
| 1000:1 Divider Probe | HP Model K05-3440A | Divide Ratio: 1000:1 | A |
| Monitor Oscilloscope | HP Model 180A, 1801A and 1820A | Bandwidth: 50 MHz | A, T |
| Screwdriver | HP Part No. 8710-0900 | Pozidrive | A, T |
| Service Kit | HP Part No. 01701-68701 | Extender Boards and Board Puller | P, A, T |

7000-A-19A

Note 1. P = Performance Check, A = Adjustment Procedure, T = Troubleshooting

# SECTION V

# PERFORMANCE CHECK AND ADJUSTMENTS

## 5-1. INTRODUCTION.

5-2. This section contains step-by-step procedures for checking the instrument specifications as given in table 1-1 of this manual. The performance check procedure gives troubleshooting suggestions in case the instrument fails to meet any specification tested. A table (performance check record) is provided at the end of the performance check for recording the measurements obtained in the first running of the procedure. This record may be used to compare measurements taken at later dates with the original. The procedures for making all internal adjustments are covered in paragraph 5-73 through 5-163. Photographs showing the locations of all internal adjustments are presented in figure 5-13.

## 5-3. TEST EQUIPMENT.

5-4. Test equipment required for procedures in this section is located in table 5-1. Test equipment equivalent to that recommended may be substituted, provided it meets the required characteristics listed in the table. For best results, use recently calibrated test equipment.

## 5-5. PERFORMANCE CHECK.

5-6. The following subparagraphs describe the procedures to determine whether or not the instrument is operating within the specifications of table 1-1. This check can be used as part of an incoming inspection, as a periodic operational test, or to check calibration after repairs or adjustments have been made. Any one of the following checks can be made separately, if desired.

5-7. The first time the performance check is made, enter the results on the performance check record at the end of the procedure. Remove the record from the manual and file it for future reference. Be sure to include the instrument serial number on the record for identification.

## 5-8. FRONT PANEL ADJUSTMENTS.

5-9. Set the instrument up and perform the initial adjustments outlined in Section III before proceeding with the performance checks or adjustment procedures.

## 5-10. FRONT PANEL SETTINGS.

5-11. Begin each performance test and adjustment procedure with the control settings listed below. If a control is to be set to another position, it will be listed in the procedure. After completion of each performance check or adjustment procedure, the controls should be set back to the original front panel settings.

POWER MODE ..... 115V AC
POWER-ON ..... ON
INTENSITY .. as required for visible display
FOCUS .... ..... as required
SCALE ILLUMINATION ..... OFF
CHANNEL A VOLTS/DIV ..... .01
channel A vernier ..... CAL
channel A POSITION ..... as required
channel A coupling ..... AC
MODE ..... A
trig ..... A TRIG
CHAN B POLARITY ..... NORM
CHANNEL B VOLTS/DIV ..... .01
channel B vernier ..... CAL
channel B POSITION ..... as required
channel B coupling ..... AC
VERNIER ..... CAL
horizontal POSITION ..... as required
TIME/DIV ..... 5 uSEC
sweep display ..... SWEEP
TRIGGER HOLDOFF ..... MIN
TRIGGER LEVEL ..... as required
AUTO/NORM ..... AUTO
MAG ..... X1
INT/EXT ..... INT
AC/DC ..... AC
SLOPE ..... +
EXT HORIZ VERNIER ..... CAL

## 5-12. PERFORMANCE TESTS.

### 5-13. DEFLECTION FACTOR.

5-14. *Specification.* Ranges: from 10 mV/div to 20 V/div (11 ranges) in 1, 2, 5 sequence. Accuracy: ±3% with vernier in CAL position. Vernier: continuously variable between all ranges, extends maximum deflection factor to at least 50 V/div. VERNIER UNCAL light indicates when vernier is not in CAL position.

5-15. *Description.* The deflection factor is checked by applying a 400-Hz, voltage-calibrated signal to the input. The displayed signal is compared against the voltage standard.

*5-16. Equipment.*

a. voltmeter calibrator.
b. banana jack to BNC adapter.
c. BNC cable, 44 in.

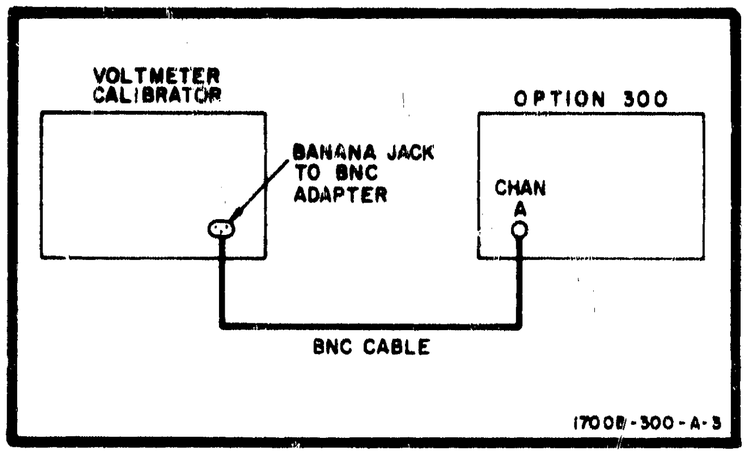



Figure 5-1. Deflection Factor Test Setup

*5-17. Procedure.*

a. Connect instrumonts as shown in figure 5-1.

b. Set Option 300 TIME/DIV to .5 mSEC.

c. Set voltmeter calibrator controls for 50-mV p-p output signal. Display should be 5 vertical div ±3%.

d. Observe vertical deflection factors specified in table 5-2.

e. Adjust voltmeter calibrator and CHANNEL A VOLTS/DIV for 5 div of vertical deflection.

f. Rotate channel A vernier fully ccw. VERNIER UNCAL light should be on. Vertical deflection should be equal to or less than 2.4 div.

g. Rotate channel A vernier control fully cw into CAL detent.

h. Connect voltmeter calibrator output to channel B INPUT.

i. Set MODE to B.

j. Repeat steps b through f for channel B.

k. Remove test equipment.

l. To return to initial settings, set Option 300 controls as follows:

MODE ..... A

CHANNEL A VOLTS/DIV ..... .01

CHANNEL B VOLTS/DIV ..... .01

TIME/DIV ..... 5uSEC

channel A vernier ..... CAL

channel B vernier ..... CAL

m. Refer to schematics 3 through 7 if any deflection factor is not within specifications.

**5-18. RISETIME.**

*5-19. Specification.* Risetime is less than 10 ns; direct or with Model 10006B Option 030 Probe. Risetime is measured from 10% to 90% with 6-div input step from a terminated 50-ohm source.

*5-20. Description.* A 100-kHz signal with a risetime of less than 5 ns is applied to the vertical input of the instrument. The risetime displayed on the CRT is then checked to see that it is less than 10 ns. This measurement is made direct but may be made with Model 10006B Option 030 Probe.

*5-21. Equipment.*

a. Square-wave generator.

b. 50-ohm feedthrough termination.

c. BNC cable, 44 in.

Table 5-2. Deflection Factor Accuracy

| Voltmeter Calibrator Settings (Volts p-p) | VOLTS/DIV Settings | Vertical Display (div) |
|---|---|---|
| 0.05 | .01 | 5 ±0.15 |
| 0.1 | .02 | 5 ±0.15 |
| 0.3 | .05 | 6 ±0.18 |
| 0.5 | .1 | 5 ±0.15 |
| 1 | .2 | 5 ±0.15 |
| 3 | .5 | 6 ±0.18 |
| 5 | 1 | 5 ±0.15 |
| 10 | 2 | 5 ±0.15 |
| 30 | 5 | 6 ±0.18 |
| 50 | 10 | 5 ±0.15 |
| 100 | 20 | 5 ±0.15 |

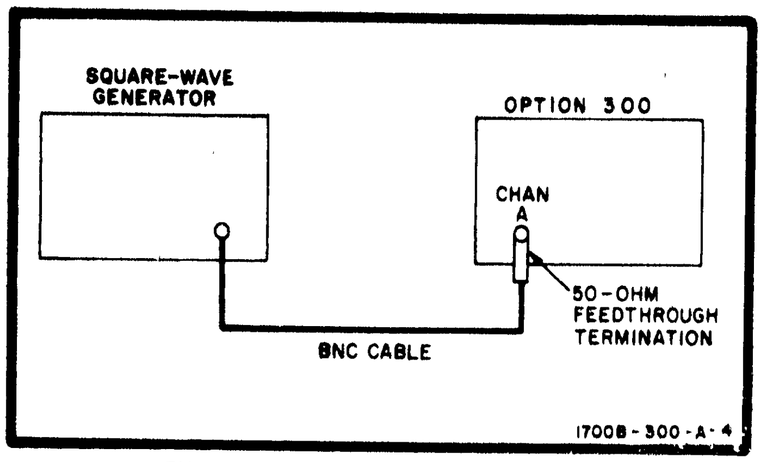



Figure 5-2. Risetime Test Setup

*5-22. Procedure.*

a. Connect instruments as shown in figure 5-2.

b. Set Option 300 TIME/DIV to .1 uSEC.

c. Set square-wave generator controls for 60-mV, 100-kHz output signal.

d. Adjust horizontal POSITION control so risetime portion of signal is in center of CRT.

e. Set MAG to X10.

f. Measure pulse risetime between 10% and 90% points (dotted lines on CRT). Risetime should be less than 10 ns.

g. Connect square-wave generator output to channel B INPUT.

h. Set MODE to B.

i. Repeat steps b through f for channel B.

j. Remove test equipment.

k. To return to initial settings, set Option 300 controls as follows:

| | |
|---|---|
| MODE | A |
| TIME/DIV | 5 uSEC |
| MAG | X1 |

l. Refer to schematics 3 through 7 if risetime specification is not met.

## 5-23. BANDWIDTH.

*5-24. Specification.* (Direct or with Model 10006B Option 030 Probe, 3-dB down from 50-kHz, 6-div reference signal from a terminated 50-ohm source). Dc coupled: dc to 35 MHz, ac coupled: 2 Hz to 35 MHz.

*5-25 Description.* To check bandwidth, a vhf signal generator is used to apply a 6-division, 50-kHz signal to the Option 300 input. The vhf signal generator frequency is increased to 35 MHz. The signal amplitude displayed on the CRT must always be equal to or greater than 4.3 div to meet bandwidth specifications. This measurement is made direct but may be made with Model 10006B Option 030 Probe.

*5-26. Equipment.*

a. VHF signal generator.

b. RG 213 cable.

c. 50-ohm feedthrough termination.

*5-27. Procedure.*

a. Connect instruments as shown in figure 5-3.

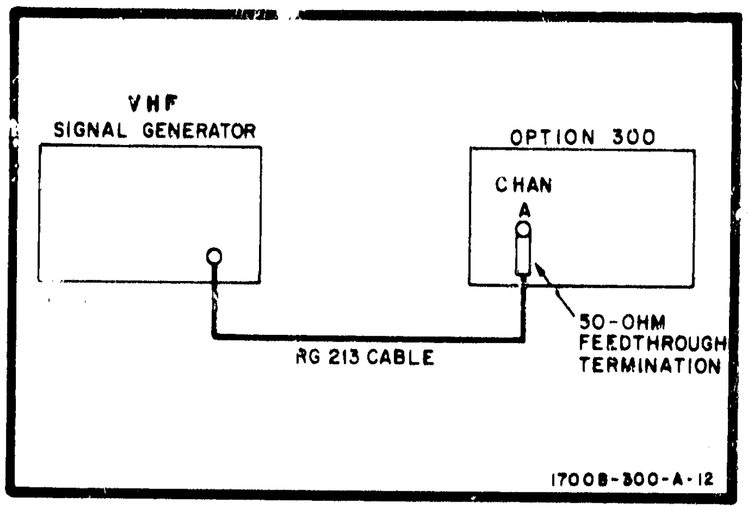



Figure 5-3. Bandwidth Test Setup

b. Set vhf signal generator controls for 60-mV, 50-kHz output signal.

c. Adjust TRIGGER LEVEL for stable display.

d. Adjust vhf signal generator voltage vernier for 6-div vertical display.

e. Set vhf signal generator controls for frequency output of 35 MHz. Vertical display of CRT should be equal to or greater than 4.3 div.

f. Connect vhf signal generator to channel B.

g. Set MODE to B.

h. Repeat steps b through e for channel B.

i. Remove test equipment.

j. To return to initial settings, set MODE to A.

k. Refer to schematics 3 through 7 if either channel does not meet bandwidth specification.





**5-28. INP**

*5-29. Spec* shunted by

*5-30. Desc* ured with

*5-31. Equ*

a. mu

b. BN

c. ban

*5-32. Proc*

a. Co


Fig

b. Se to DC.

c. Se measure 1

Use havi If m inpu

d. Co Multifuncti megohm ±2

e. Ch per table 5-

f. Mo B. Multifu 1 megohm

g. Ch per table 5-

## 5-28. INPUT RESISTANCE.

*5-29. Specification.* The input is 1 megohm ±2% shunted by approximately 35 pF.

*5-30. Description.* The input resistance is measured with an ohmmeter to verify resistance.

*5-31. Equipment.*

a. multifunction digital voltmeter.

b. BNC cable, 44 in.

c. banana jack to BNC adapter.

*5-32. Procedure.*

a. Connect instruments as shown in figure 5-4.

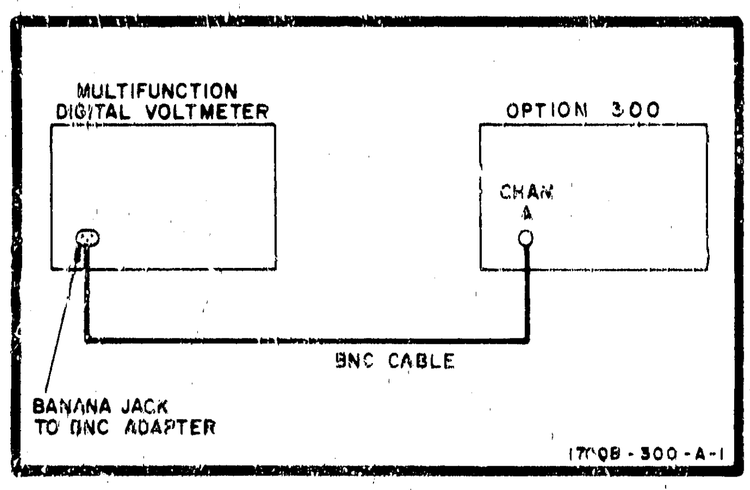



Figure 5-4. Input Resistance Test Setup

b. Set Option 300 channel A and B coupling to DC.

c. Set multifunction digital voltmeter controls to measure 10 megohms.

Note

Use a range on the digital voltmeter having an output voltage less than 0.6V. If more than 0.6V is applied, erroneous input resistance readings may result.

d. Connect BNC cable to channel A INPUT. Multifunction digital voltmeter should indicate 1 megohm ±2%.

e. Check all CHANNEL A VOLTS/DIVranges per table 5-3.

f. Move BNC cable from channel A to channel B. Multifunction digital voltmeter should indicate 1 megohm ±2%.

g. Check all CHANNEL B VOLTS/DIV ranges per table 5-3.

Table 5-3. Input Resistance

| VOLTS/DIV Setting | Resistance | | |
|---|---|---|---|
| | Min | Actual | Max |
| .02 | 0.98 megohm | _____ | 1.02 megohm |
| .05 | 0.98 megohm | _____ | 1.02 megohm |
| .1 | 0.98 megohm | _____ | 1.02 megohm |
| .2 | 0.98 megohm | _____ | 1.02 megohm |
| .5 | 0.98 megohm | _____ | 1.02 megohm |
| 1 | 0.98 megohm | _____ | 1.02 megohm |
| 2 | 0.98 megohm | _____ | 1.02 megohm |
| 5 | 0.98 megohm | _____ | 1.02 megohm |
| 10 | 0.98 megohm | _____ | 1.02 megohm |
| 20 | 0.98 megohm | _____ | 1.02 megohm |

h. Remove test equipment.

i. To return to initial settings, set Option 300 controls as follows:

CHANNEL A VOLTS/DIV ..... .01
CHANNEL B VOLTS/DIV ..... .01
channel A coupling ..... AC
channel B coupling ..... AC

j. Refer to schematic 3 if input resistance specification is not met.

## 5-33. COMMON MODE REJECTION RATIO (CMRR).

*5-34. Specification.* Frequency: dc to 1 MHz. CMRR: at least 40 dB on 10 mV/div range; at least 20 dB on all other ranges with verniers set for optimum rejection.

*5-35. Description.* This measurement is made by applying identical signals to channel A and channel B and operating in the A+B (CHAN B POLARITY INVT) mode. The signal display on the CRT will be the common mode signal.

*5-36. Equipment.*

a. VHF signal generator.

b. BNC cable, 9 in.

c. BNC tee.

d. RG 213 cable.

e. 50-ohm feedthrough termination.

*5-37. Procedure.*

a. Connect instruments as shown in figure 5-5.

b. Set Option 300 CHANNEL A VOLTS/DIV to .05.

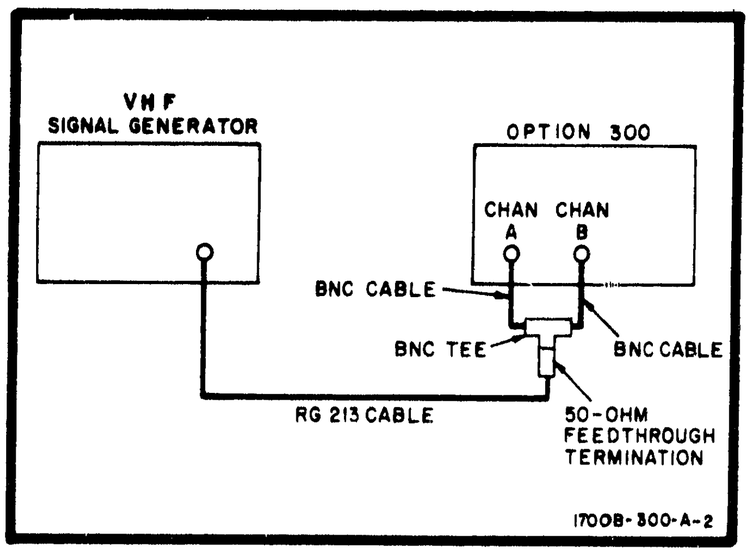



Figure 5-5. CMRR Test Setup

c. Set vhf signal generator controls for 50-kHz, 0.3V p-p signal as viewed on Option 300 CRT.

d. Set MODE switch to A+B.

e. Set CHANNEL A and B VOLTS/DIV to .01.

f. Set CHAN B POLARITY switch to INVT. Display should be less than 0.3 div.

g. Increase vhf signal generator frequency to 1 MHz. Display should be less than 0.3 division.

h. For all other vertical sensitivity ranges (VOLTS/DIV), 30 div of signal at 1 MHz applied to channel A and B INPUT will result in deflection factor equal to or less than 3 div. This deflection factor is with channel A and channel B vernier adjusted for maximum CMRR.

i. Remove test equipment.

j. To return to initial settings, set Option 300 controls as follows:

MODE ..... A
CHAN B POLARITY ..... NORM
CHANNEL A and CHANNEL B VOLTS/DIV ..... .01
channel A and B verniers ..... CAL

k. Refer to schematics 3 through 7 if CMRR specification is not met.

**5-38. SWEEP TIME.**

*5-39. Specification.* Range: from 0.1 usec/div to 2 sec/div (23 ranges) and 1, 2, 5 sequence. Accuracy is ±3% with VERNIER in CAL position. VERNIER: continuously variable between all ranges; extends slowest sweep to at least 5 sec/div. VERNIER UNCAL light indicates when VERNIER is not in CAL position. Magnifier: expands all sweeps by a factor of 10 and extends the fastest sweep speed to 10 ns/div. Accuracy is ±5%, includes ±3% accuracy of time base.

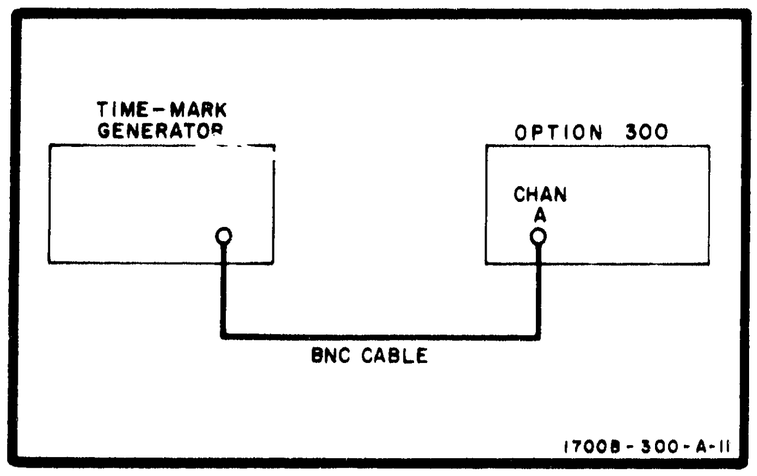



Figure 5-6. Sweep Time Test Setup

*5-40. Description.* The instrument time base is compared against a time-mark generator to verify specifications.

*5-41. Equipment.*

a. time-mark generator.

b. BNC cable, 44 in.

*5-42. Procedure.*

a. Connect instruments as shown in figure 5-6.

b. Set Option 300 controls as follows:

CHANNEL A VOLTS/DIV ... approx 5 div
TIME/DIV ..... .1 uSEC

c. Set time-mark generator controls for 0.1-usec time-mark output.

d. Adjust horizontal POSITION control so first marker is aligned with first, left-hand vertical graticule. Eleven markers should be present on CRT.

e. Check rest of TIME/DIV settings using table 5-4.

f. Set TIME/DIV switch to 1 uSEC.

g. Set time-mark generator for 5-usec time-mark output.

h. Adjust horizontal POSITION control so three time marks appear on CRT.

i. Rotate VERNIER fully ccw. VERNIER UNCAL light should be on. Time period between time marks should be less than 2 div.

Table 5-4. Sweep Performance Check

| Time-mark Generator | TIME/DIV | Time Marks To Check |
|---|---|---|
| 0.1 usec | .1 uSEC | |
| 0.2 usec | .2 uSEC | |
| 0.5 usec | .5 uSEC | |
| 1 usec | 1 uSEC | |
| 2 usec | 2 uSEC | |
| 5 usec | 5 uSEC | |
| 10 usec | 10 uSEC | |
| 20 usec | 20 uSEC | |
| 50 usec | 50 uSEC | |
| 0.1 ms | .1 mSEC | |
| 0.2 ms | .2 mSEC | |
| 0.5 ms | .5 mSEC | 11 in 10 div ±0.3 div |
| 1 ms | 1 mSEC | |
| 2 ms | 2 mSEC | |
| 5 ms | 5 mSEC | |
| 10 ms | 10 mSEC | |
| 20 ms | 20 mSEC | |
| 50 ms | 50 mSEC | |
| 0.1 sec | .1 SEC | |
| 0.2 sec | .2 SEC | |
| 0.5 sec | .5 SEC | |
| 1 sec | 1 SEC | |
| 2 sec | 2 SEC | |

j. Return VERNIER to CAL position.

k. Set time-mark generator for 1-usec time-mark output. Eleven time marks should appear on CRT.

l. Set MAG to X10.

m. Adjust horizontal POSITION control until two time marks appear. Time-marks should be 10 div apart ±0.5 div.

n. Remove test equipment.

o. To return to initial settings, set Option 300 controls as follows:

CHANNEL A VOLTS/DIV ..... .01
TIME/DIV ..... 5 uSEC
MAG ..... X1

p. Refer to following paragraphs and schematics if any of these test fail:

(1). Sweep ranges: paragraph 5-120 and schematic 11.

(2). VERNIER check: schematic 11.

(3). MAG (X10) check: paragraph 5-125 and schematic 13.

**5-43. TRIGGERING.**

*5-44. Specification.* Dc to 35 MHz on signals causing 0.5 div of vertical deflection, increasing to 1.5 div at 75 MHz in all display modes except CHOP; dc to 100 kHz in CHOP mode. External: dc to 35 MHz on signals 50 mV p-p or more, increasing to 100 mV p-p at 75 MHz. LINE: instrument triggers on ac line frequency..

*5-45. Description.* The triggering is checked with known input signals to ensure proper triggering.

*5-46. Equipment.*

a. VHF signal generator.

b. RF millivoltmeter.

c. BNC tee (2).

d. BNC cable, 9 in (2).

e. RG 213 cable.

f. 50-ohm feedthrough termination.

g. 10:1 divider probe.

*5-47. Procedure.*

a. Connect instruments as shown in figure 5-7.

b. Set Option 300 controls as follows:

TIME/DIV ..... .1 uSEC
MAG ..... X10
CHANNEL A VOLTS/DIV ..... .1
trig ..... COMPOSITE TRIG

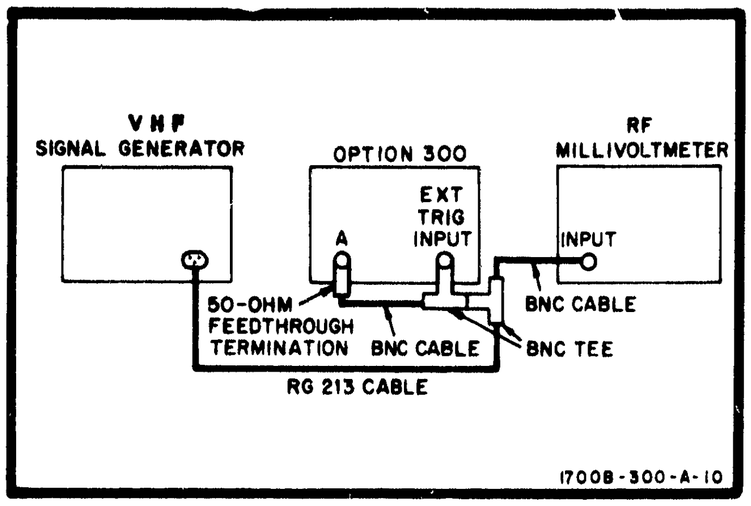



Figure 5-7. Triggering Test Setup

c. Set vhf signal generator controls for 35-MHz, 0.5-div display.

d. Adjust TRIGGER LEVEL for stable display. If stable display is obtained, instrument is triggering properly.

e. Set vhf signal generator controls for 75-MHz, 1.5 div display.

f. Adjust TRIGGER LEVEL for stable display. If stable display is obtained, instrument is triggering properly.

g. Change trig to A TRIG and repeat steps b through f.

h. Set INT/EXT to EXT.

i. Set vhf signal generator controls for 75-MHz, 35-mV rms (100-mV p-p) signal as read on RF millivoltmeter.

j. Adjust TRIGGER LEVEL for stable display. If stable display is obtained, instrument is triggering properly.

k. Set vhf signal generator controls for 35-MHz, 17.5-mV rms (50-mV p-p) signal as read on RF millivoltmeter.

l. Adjust TRIGGER LEVEL for stable display. If stable display is obtained, instrument is triggering properly.

m. Set INT/EXT to INT.

n. Set MAG to X1.

o. Set MODE to CHOP.

p. Set TIME/DIV control to 2 uSEC.

q. Set vhf signal generator controls for 400-kHz, 0.5-div display.

r. Adjust TRIGGER LEVEL for stable display. Segmented display should be observed. This is normal display.

s. Remove test equipment.

t. Connect 10:1 divider probe from channel A INPUT to ac line voltage source.

u. Set Option 300 controls as follows:

LINE ..... engaged
CHANNEL A VOLTS/DIV ..... 5
channel A vernier ..... ccw
TIME/DIV ..... 2 mSEC

v. Adjust TRIGGER LEVEL to obtain stable display. If stable display is obtained, instrument is triggering properly.

w. To return to initial settings, set Option 300 controls as follows:

CHANNEL A VOLTS/DIV ..... .01
TIME/DIV ..... 5 uSEC
LINE ..... disengaged
channel A vernier ..... CAL

x. Refer to paragraph 5-107 and schematics 8 and 9 if any triggering specifications are not met.

## 5-48. TRIGGER LEVEL RANGE AND POLARITY.

*5-49. Specification.* The trigger level should adjust smoothly at any point on the vertical waveform for both the negative and positive portions of the signal. In EXT mode, stable triggering should occur from −3V to +3V of trigger signal amplitude.

*5-50. Description.* The trigger level range and polarity are checked against calibrated inputs to ensure that the instrument triggers on both negative and positive slopes of the input signal.

*5-51. Equipment.*

a. voltmeter calibrator.

b. BNC cable, 44 in.

c. BNC cable, 9 in. (2).

d. BNC tee.

e. banana jack to BNC adapter.

*5-52. Procedure.*

a. Connect instruments as shown in figure 5-8.

b. Set Option 300 controls as follows:

CHANNEL A VOLTS/DIV ..... 1.0
TIME/DIV ..... .5 mSEC
LFAC ..... engaged

## TABLE OF CONTENTS (Cont'd)



## LIST OF ILLUSTRATIONS

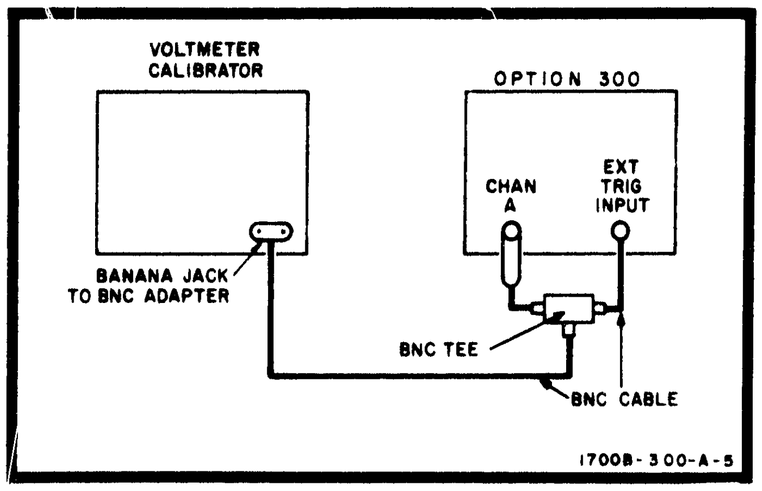



Figure 5-8. Trigger Level Range and Polarity Test Setup

c. Set voltmeter calibrator controls for 10V output signal.

d. Rotate TRIGGER LEVEL to both extremes. Triggering point should adjust smoothly across positive slope of waveform displayed on CRT.

e. Set SLOPE to (—).

f. Rotate TRIGGER LEVEL to both extremes. Triggering point should adjust smoothly across negative slope of waveform displayed on CRT.

g. Set INT/EXT to EXT.

h. Repeat steps a through f in EXT position. Triggering in EXT for both positive and negative slope should operate smoothly from +3V to —3V.

i. Remove test equipment.

j. To return to initial settings, set Option 300 controls as follows:

CHANNEL A VOLTS/DIV ..... .01
TIME/DIV ..... 5 uSEC
INT/EXT ..... INT
SLOPE ..... +
LFAC ..... disengaged

k. Refer to paragraph 5-102 and schematics 8 if any specifications are not met.

## 5-53. CALIBRATOR.

*5-54. Specification.* Type 1-kHz ±10% square wave. Voltage: 1V p-p ±1%.

*5-55. Description.* The frequency is checked by the Option 300. The calibrator amplitude is checked by comparing the calibrator amplitude against a known 0.1%, 1V p-p signal.

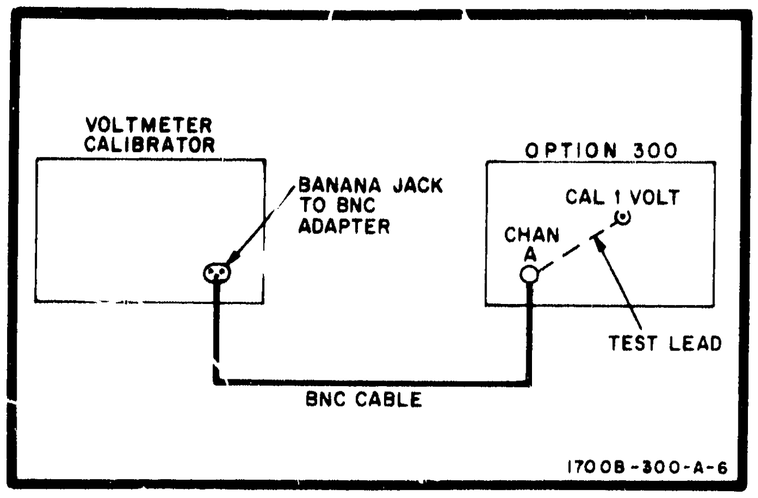



Figure 5-9. Calibrator Test Setup

*5-56. Equipment.*

a. voltmeter calibrator.

b. banana jack to BNC adapter.

c. BNC Cable, 44 in.

d. test lead.

*5-57. Procedure.*

a. Connect instruments as shown in figure 5-9.

b. Set Option 300 controls as follows:

CHANNEL A VOLTS/DIV ..... .1
channel A coupling ..... DC
TIME/DIV ..... .2 mSEC

c. Set voltmeter calibrator controls for 1V p-p output signal.

d. Adjust channel A vernier so display is exactly 6 div of vertical amplitude.

e. Disconnect voltmeter calibrator.

f. Connect CAL 1 VOLT output to channel A INPUT. Display should be 6 div of vertical amplitude ±0.06 div and 1 kHz ±10%.

g. Remove test lead.

h. To return to initial settings, set Option 300 controls as follows:

channel A coupling ..... AC
CHANNEL A VOLTS/DIV ..... .01
channel A vernier ..... CAL
TIME/DIV ..... 5 uSEC

i. Refer to paragraph 5-135 and schematic 14 if test limits are not met.

## 5-58. EXT HORIZ BANDWIDTH.

*5-59. Specification.* dc to 1 MHz.

*5-60. Description.* Bandwidth is checked by applying 50-kHz and 1-MHz signals to the EXT HORIZ INPUT and measuring the difference in trace deflection.

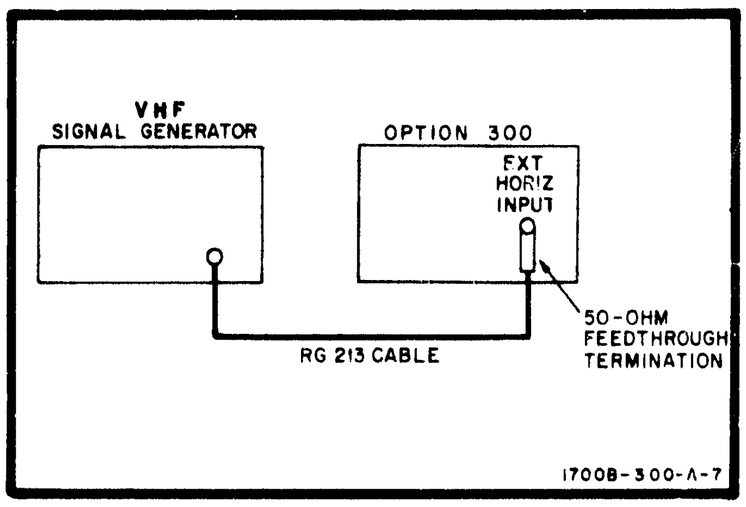



Figure 5-10. Ext Horiz Bandwidth Test Setup

*5-61. Equipment.*

a. VHF signal generator.

b. RG 213 cable.

c. 50-ohm feedthrough termination.

*5-62. Procedure.*

a. Set instruments up as shown in figure 5-10.

b. Set Option 300 controls as follows:

sweep display ..... EXT HORIZ INPUT
MAG ..... X10
SINGLE ..... engaged

c. Set vhf signal generator controls for 1V, 50-kHz output signal.

d. Adjust vhf signal generator controls to obtain exactly 10 div of horizontal deflection.

e. Adjust vhf signal generator frequency to obtain 1-Mhz output signal. Horizontal deflection shall be equal to or greater than 7.2 div.

f. Disconnect test equipment.

g. To return to initial settings, set Option 300 controls as follows:

sweep display ..... SWEEP
MAG ..... X1
SINGLE ..... disengaged

h. Refer to paragraph 5-159 and schematic 8 if specification is not met.

## 5-63. EXT HORIZ DEFLECTION FACTOR.

*5-64. Specification.* MAG (X1), 1V/div; MAG (X10), 0.1 V/div. Accuracy: ±5%.

*5-65. Description.* A voltmeter calibrator signal (1V or 10V at 400 Hz) is applied to the EXT HORIZ INPUT and the horizontal deflection measured to verify deflection factor.

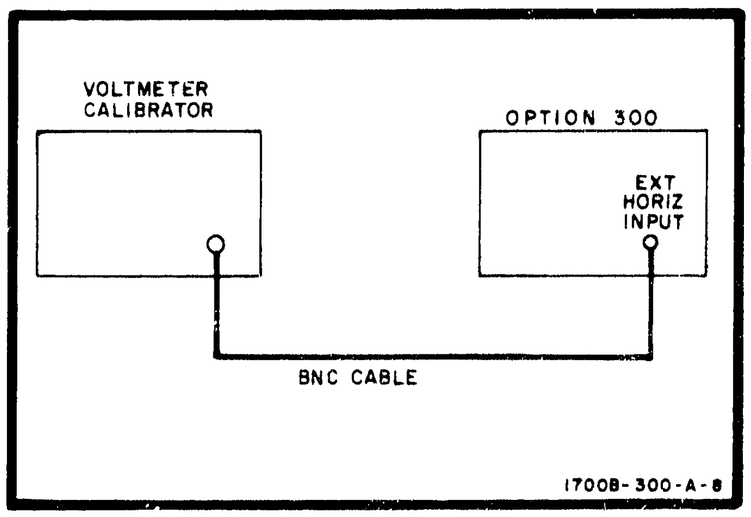



Figure 5-11. Ext Horiz Deflection Factor Test Setup

*5-66. Equipment.*

a. voltmeter calibrator.

b. BNC cable, 44 in.

*5-67. Procedure.*

a. Set instruments up as shown in figure 5-11.

b. Set Option 300 controls as follows:

sweep display ..... EXT HORIZ INPUT
SINGLE ..... engaged

c. Set voltmeter calibrator controls for 10V output signal.

d. In MAG (X1) position, horizontal deflection should be 10 div ±0.5 div.

e. Set voltmeter calibrator controls for 1V output.

f. Set MAG to X10. Deflection should be 10 div ±0.5 div.

g. Rotate EXT HORIZ VERNIER out of CAL detent fully ccw. Horizontal deflection factor should decrease to less than 1 div.

h. Disconnect test equipment.

i. To return to initial settings, set Option 300 controls as follows:

EXT HORIZ VERNIER ..... CAL
MAG ..... X1
SINGLE ..... disengaged
sweep display ..... SWEEP

j. Refer to paragraphs 5-150 through 5-158 and schematic 8 if specification is not met.

## 5-68. EXT HORIZ INPUT RESISTANCE.

*5-69. Specification.* 1 megohm ±2% shunted by approx 30 pF.

*5-70. Description.* The EXT HORIZ INPUT resistance is measured with an ohmmeter to verify resistance.

*5-71. Equipment.*

a. multifunction digital voltmeter.

b. BNC cable, 44 in.

c. banana jack to BNC adapter.

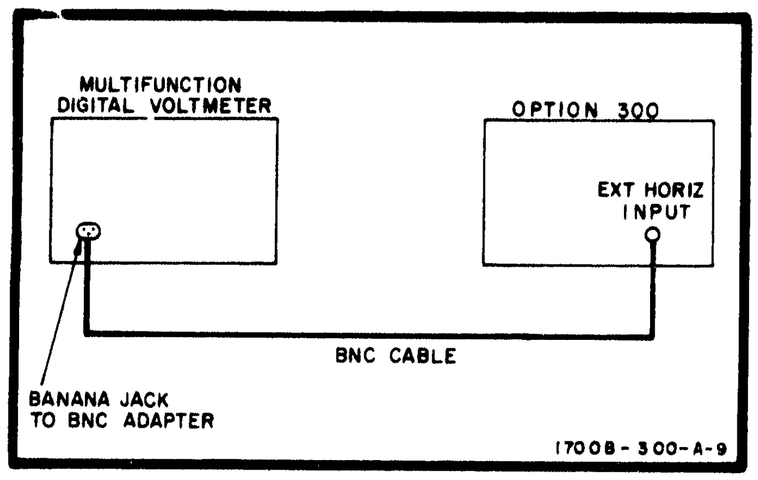



Figure 5-12. Ext Horiz Input Resistance Test Setup

*5-72. Procedure.*

a. Connect instruments as shown in figure 5-12.

b. Set multifunction digital voltmeter to measure 1 megohm. Multifunction digital voltmeter should be 1 megohm ±2%.

c. Disconnect test equipment.

d. Refer to schematic 8 if resistance measurement does not meet specification.

## PERFORMANCE CHECK RECORD
MODEL 1700B Option 300

**Instrument Serial Number** _____ **Date** _____

| Check | Specification | Measured Chan A | Measured Chan B |
|---|---|---|---|
| **DEFLECTION FACTOR** | | | |
| .01 VOLTS/DIV | 5 div ±0.15 div | | |
| .02 VOLTS/DIV | 5 div ±0.15 div | | |
| .05 VOLTS/DIV | 6 div ±0.18 div | | |
| .1 VOLTS/DIV | 5 div ±0.15 div | | |
| .2 VOLTS/DIV | 5 div ±0.15 div | | |
| .5 VOLTS/DIV | 6 div ±0.18 div | | |
| 1 VOLTS/DIV | 5 div ±0.15 div | | |
| 2 VOLTS/DIV | 5 div ±0.15 div | | |
| 5 VOLTS/DIV | 6 div ±0.18 div | | |
| 10 VOLTS/DIV | 5 div ±0.15 div | | |
| 20 VOLTS/DIV | 5 div ±0.15 div | | |
| Channel A Vernier | ≤2.4 div | | |
| Channel B Vernier | ≤2.4 div | | |
| **RISETIME** | | | |
| Channel A Risetime | <10 ns | | |
| Channel B Risetime | <10 ns | | |
| **BANDWIDTH** | | | |
| Channel A Bandwidth | ≥4.3 div | | |
| Channel B Bandwidth | ≥4.3 div | | |
| **INPUT RESISTANCE** | | | |
| Channel A Resistance | | | |
| .01 VOLTS/DIV | 1 ±0.02 megohm | | |
| .02 VOLTS/DIV | 1 ±0.02 megohm | | |
| .05 VOLTS/DIV | 1 ±0.02 megohm | | |
| .1 VOLTS/DIV | 1 ±0.02 megohm | | |
| .2 VOLTS/DIV | 1 ±0.02 megohm | | |
| .5 VOLTS/DIV | 1 ±0.02 megohm | | |
| 1 VOLTS/DIV | 1 ±0.02 megohm | | |
| 2 VOLTS/DIV | 1 ±0.02 megohm | | |
| 5 VOLTS/DIV | 1 ±0.02 megohm | | |
| 10 VOLTS/DIV | 1 ±0.02 megohm | | |
| 20 VOLTS/DIV | 1 ±0.02 megohm | | |
| Channel B Resistance | | | |
| .01 VOLTS/DIV | 1 ±0.02 megohm | | |
| .02 VOLTS/DIV | 1 ±0.02 megohm | | |
| .05 VOLTS/DIV | 1 ±0.02 megohm | | |
| .1 VOLTS/DIV | 1 ±0.02 megohm | | |

## PERFORMANCE CHECK RECORD (Cont'd)

MODEL 1700B Option 300

**Instrument Serial Number** _____ **Date** _____

| Check | Specification | Measured |
|---|---|---|
| Channel B Resistance (Cont'd) | | |
| .2 VOLTS/DIV | 1 ±0.02 megohm | |
| .5 VOLTS/DIV | 1 ±0.02 megohm | |
| 1 VOLTS/DIV | 1 ±0.02 megohm | |
| 2 VOLTS/DIV | 1 ±0.02 megohm | |
| 5 VOLTS/DIV | 1 ±0.02 megohm | |
| 10 VOLTS/DIV | 1 ±0.02 megohm | |
| 20 VOLTS/DIV | 1 ±0.02 megohm | |
| COMMON MODE REJECTION RATIO (CMRR) | | |
| CMRR (50 kHz/0.01 volts/div) | <0.3 div | |
| CMRR (1 MHz/0.01 volts/div) | <0.3 div | |
| MAIN SWEEP TIME | | |
| .1 uSEC | 11 in 10 div ±0.3 div | |
| .2 uSEC | 11 in 10 div ±0.3 div | |
| .5 uSEC | 11 in 10 div ±0.3 div | |
| 1 uSEC | 11 in 10 div ±0.3 div | |
| 2 uSEC | 11 in 10 div ±0.3 div | |
| 5 uSEC | 11 in 10 div ±0.3 div | |
| 10 uSEC | 11 in 10 div ±0.3 div | |
| 20 uSEC | 11 in 10 div ±0.3 div | |
| 50 uSEC | 11 in 10 div ±0.3 div | |
| .1 mSEC | 11 in 10 div ±0.3 div | |
| .2 mSEC | 11 in 10 div ±0.3 div | |
| .5 mSEC | 11 in 10 div ±0.3 div | |
| 1 mSEC | 11 in 10 div ±0.3 div | |
| 2 mSEC | 11 in 10 div ±0.3 div | |
| 5 mSEC | 11 in 10 div ±0.3 div | |
| 10 mSEC | 11 in 10 div ±0.3 div | |
| 20 mSEC | 11 in 10 div ±0.3 div | |
| 50 mSEC | 11 in 10 div ±0.3 div | |
| .1 SEC | 11 in 10 div ±0.3 div | |
| .2 SEC | 11 in 10 div ±0.3 div | |
| .5 SEC | 11 in 10 div ±0.3 div | |
| 1 SEC | 11 in 10 div ±0.3 div | |
| 2 SEC | 11 in 10 div ±0.3 div | |
| Main Vernier Check | <2 div | |
| MAG (X10) Check | 10 div ±0.5 div | |

**PERFORMANCE CHECK RECORD (Cont'd)**

**MODEL 1700B Option 300**

**Instrument Serial Number** _____ **Date** _____

| Check | Specification | Measured |
|---|---|---|
| **TRIGGERING** | | |
| Internal Triggering (35 MHz) | √ | _____ |
| Internal Triggering (75 MHz) | √ | _____ |
| External Triggering (75 MHz) | √ | _____ |
| External Triggering (35 MHz) | √ | _____ |
| Chop Triggering (400 kHz) | √ | _____ |
| Line Triggering | √ | _____ |
| **TRIGGER LEVEL RANGE AND POLARITY** | | |
| Int Trigger Level (+) | √ | _____ |
| Int Trigger Level (–) | √ | _____ |
| Ext Trigger Level (+) | –3V to +3V | _____ |
| Ext Trigger Level (–) | –3V to +3V | _____ |
| **CALIBRATOR** | | |
| Amplitude | 6 div ±0.06 div | _____ |
| Frequency | 1 kHz ±10% | _____ |
| **EXT HORIZ BANDWIDTH** | | |
| Ext Horiz Bandwidth | ≥7.2 div | _____ |
| **EXT HORIZ DEFLECTION FACTOR** | | |
| Mag (X1) | 10 div ±0.5 div | _____ |
| Mag (X10) | 10 div ±0.5 div | _____ |
| Ext Horiz Vernier ccw | <1 div | |
| **EXT HORIZ INPUT RESISTANCE** | | |
| Resistance | 1 ±0.02 megohm | _____ |

## 5-73. ADJUSTMENTS.

5-74. The following paragraphs describe procedures to calibrate the instrument so that it will perform as specified in table 1-1. The entire adjustment procedure can be done in sequence, or any separate adjustments can be calibrated by following the steps outlined in the appropriate paragraphs. The locations of adjustment controls are shown in figure 5-13, a photograph included at the end of the section on a foldout page.

5-75. Use a nonmetallic screwdriver and recently calibrated test equipment with characteristics as specified in table 5-1. After adjustments are complete, check instrument performance by doing the performance check at the beginning of this section.

5-76. Set Option 300 front-panel controls to those positions given in paragraph 5-10.

## 5-77. ADJUSTMENT PROCEDURES.

### 5-78. LOW VOLTAGE POWER SUPPLY ADJUSTMENT.

*5-79. Reference.* Schematics 16, 17, 18 and figure 5-13.

*5-80. Description.* The +15V is the only regulated voltage in this instrument. The rest of the voltages in this instrument are referenced to +15V. The voltage accuracy is set by a multifunction digital voltmeter to monitor the +15V.

*5-81. Equipment.*

a. multifunction digital voltmeter.

b. test lead.

*5-82. Procedure.*

a. Remove top and bottom covers.

b. Connect multifunction digital voltmeter to XA4 pin 6.

c. Turn instrument ON.

d. Adjust A3A2R3, LOW VOLTAGE ADJUST, for meter indication of +15V ±10 mV.

e. Check rest of low voltage power supply output voltages as shown in table 5-5.

f. Turn instrument off.

g. If any voltage measurement is inaccurate, refer to schematics 16, 17, and 18.

Table 5-5. Power Supply Voltage Limits

| Supply | Test Point | Limits | |
|---|---|---|---|
| +15V | A4 Wire (92) | +15.01V | +14.99V |
| −15V | A4 Wire (97) | −15.75V | −14.5V |
| +5V | A4 Wire (93) | +5.5V | +5.1V |
| +50V | A4 Wire (2) | +52V | +47V |
| −50V | A4 Wire (7) | −52V | −47V |
| +80V | A4 Wire (926) | +90V | +80V |

### 5-83. HIGH VOLTAGE POWER SUPPLY ADJUSTMENT.

*5-84. Reference.* Schematic 15 and figure 5-13.

*5-85. Description.* The high voltage is adjusted to −2150V by comparing it against a known, calibrated voltage standard.

*5-86. Equipment.*

a. multifunction digital voltmeter.

b. voltmeter calibrator.

c. 1000:1 divider probe.

*5-87. Procedure.*

a. Turn power off.

b. Remove A3 Power Supply Module cover.

c. Turn POWER-ON switch ON.

d. Connect multifunction digital voltmeter through 1000:1 divider probe to voltmeter calibrator.

e. Set voltmeter calibrator to −100-volt output.

f. Note multifunction digital voltmeter indication.

g. Multiply indication in step f by 21.5.

h. Monitor high voltage on red wire (2) from A3A4 using 1000:1 divider probe and multifunction digital voltmeter.

i. Adjust A3A4R1, HIGH VOLTAGE ADJUST, for value calculated in step g.

j. Turn instrument off.

k. Disconnect test equipment and replace A3 Power Supply Module cover.

l. Check high voltage power supply circuits on schematic 15 if adjustment cannot be made.

**5-88. INTENSITY LIMIT ADJUSTMENT.**

*5-89. Reference.* Schematic 15 and figure 5-13.

*5-90. Description.* The intensity limit adjustment is set so the front-panel INTENSITY control has complete range. This range is from extinguished to complete brightness.

*5-91. Procedure.*

a. Turn POWER-ON switch ON.

b. Set Option 300 TIME/DIV to 1 mSEC.

c. Obtain free-running trace.

d. Set INTENSITY control to 9 o'clock position.

e. Adjust A3A4R15, INTENSITY LIMIT, until trace is just extinguished.

f. Set INTENSITY control to 10 o'clock position and verify trace is visible.

g. Check high voltage power supply circuit on schematic 15 if adjustment cannot be made.

**5-92. Y-AXIS ALIGNMENT.**

*5-93. Reference.* Schematics 14 and 15; figure 5-13.

*5-94. Description.* The internal ortho adjust is set to align the trace on the Y-axis.

*5-95. Equipment.*

a. test leads.

*5-96. Procedure.*

a. Set POWER-OFF switch to off.

b. Disconnect coax wire (6) on A4 Gate Assembly.

c. Connect CAL 1 VOLT output to channel A INPUT.

d. Set Channel A coupling switch to DC.

e. Set CHANNEL A VOLTS/DIV switch to 2.

f. Center channel A POSITION control.

g. Set POWER-ON switch to ON.

h. Engage SINGLE pushbutton.

i. Adjust horizontal POSITION until two dots are centered on CRT screen.

j. Adjust A4R35, ortho adj, until dots are on major Y-axis graticule.

k. Set POWER-ON switch to off.

l. Reconnect coax. wire (6) on A4 Gate Assembly.

m. Set POWER-ON switch to ON.

n. Release SINGLE pushbutton.

o. Disconnect CAL 1 VOLT from channel A INPUT.

p. To return to initial settings, set Option 300 controls as follows:

channel A coupling ..... AC
CHANNEL A VOLTS/DIV ..... .01

q. Refer to schematics 14 and 15 if adjustments cannot be made.

**5-97. GATE AMPLIFIER RESPONSE ADJUSTMENT.**

*5-98. Reference.* Schematic 14 and figure 5-13.

*5-99. Description.* The gate amplifier is adjusted for optimum response.

*5-100. Equipment.*

a. monitor oscilloscope.

b. 10:1 divider probe.

*5-101. Procedure.*

a. Set Option 300 TIME/DIV to 1 uSEC.

b. Connect 10:1 divider probe from monitor oscilloscope to wire (1) on A4 gate amplifier assembly.

c. Set monitor oscilloscope controls as follows:

coupling ..... DC
all others ..... normal display

d. Adjust INTENSITY control for 20V amplitude pulse as displayed on oscilloscope.

e. Adjust A4C12, gate response adj, for fastest risetime and flatest pulse of positive-going signal.

f. Disconnect test equipment.

g. To return to initial settings, set Option 300 TIME/DIV to 5 uSEC.

h. Refer to schematic 14 if adjustment cannot be made.

## 5-102. TRIGGER AMPLIFIER BALANCE AND DC LEVEL ADJUSTMENT.

*5-103. Reference.* Schematics 5 and 6; figure 8-14.

*5-104. Description.* The composite sync adj, and channel A sync zero adj, are set so the instrument triggers at the same point on all signals.

*5-105. Equipment.*

a. oscillator.

b. BNC cable, 44 in.

*5-106. Procedure.*

a. Connect oscillator to channel A INPUT.

b. Set CHANNEL A VOLTS/DIV to .1.

c. Set oscillator to 50-kHz, 6-div output.

d. Adjust channel A POSITION to center display.

e. Adjust TRIGGER LEVEL until sweep triggers at center graticule.

f. Set channel A coupling to DC.

g. Adjust A5A4R80, composite sync adj, until sweep triggers at same point as in step e.

h. Set MODE to ALT.

i. Adjust A5A4R50, chan A sync zero, until sweep triggers at same point as in step e.

j. Disconnect test equipment.

k. To return to initial settings, set Option 300 controls as follows:

MODE ..... A
CHANNEL A VOLTS/DIV ..... .01
channel A coupling ..... AC

l. Refer to schematics 5 and 6 if adjustment cannot be made.

## 5-107. TRIGGER SENSITIVITY ADJUSTMENT.

*5-108. Reference.* Schematics 8 and 9, and figure 5-13.



*5-109. Description.* Trigger sensitivity is adjusted with a calibrated input to optimize triggering across the entire specified frequency range.

*5-110. Equipment.*

a. oscillator.

b. BNC cable, 44 in.

*5-111. Procedure.*

a. Set Option 300 controls as follows:

CHANNEL A VOLTS/DIV ..... 0.2
TIME/DIV ..... .5 mSEC
LFAC ..... engaged

b. Connect oscillator output to channel A INPUT.

c. Set oscillator controls for 500-Hz, 4-div display, output signal as viewed on Option 300 CRT.

d. Adjust main TRIGGER LEVEL and A6A2R40 trigger sensitivity adj, until instrument triggers on entire range of positive slope without double triggering.

Note

There is a small allowable range of rotation for A6A2R40 where step d is satisfied. If optimum high frequency trigger sensitivity is desired, rotate A6A2R40 to the most counterclockwise position within the allowable range. If optimum low frequency trigger stability is desired, rotate A6A2R40 to the most clockwise position within the allowable range. The trigger sensitivity is set at the factory for optimum high frequency trigger sensitivity (farthest counterclockwise within the allowable range).

e. Recheck performance in accordance with paragraph 5-43. Readjust A6A2R40 if necessary.

f. Disconnect test equipment.

g. To return to initial settings, set Option 300 controls as follows:

TIME/DIV ..... 5 uSEC
CHANNEL A VOLTS/DIV ..... .01
LFAC ..... disengaged

h. Refer to schematics 8 and 9 if adjustment cannot be made.

## 5-112. POSITION CENTERING ADJUSTMENT.

*5-113. Reference.* Schematics 4 through 7 and figure 8-12.

*5-114. Description.* Internal controls are adjusted to center the display. This adjustment varies the amplifier dc reference, thus establishing position.

Note

Be sure channel A and channel B DC BAL are properly adjusted (paragraph 3-44).

*5-115. Procedure.*

a. Set MODE to B.

b. Center channel B POSITION control.

c. Adjust A5A4R43, B pos centering adj, for no vertical shift as CHAN B POLARITY switch is changed from NORM to INVT.

d. Adjust A5A4R108, B pol bal adj, to center trace vertically.

e. Set MODE to A.

f. Center channel A POSITION control.

g. Adjust A5A4R40, pos centering adj, to center trace vertically.

h. Set MODE to A + B.

i. Adjust A5A4R60, A + B bal, to center trace.

j. To return to initial settings, set MODE to A.

k. Refer to schematics 4, 5, 6 and 7 if adjustment cannot be made.

## 5-116. SWEEP LENGTH ADJUSTMENT.

*5-117. Reference.* Schematic 13, figure 5-13.

*5-118. Description.* The horizontal preamplifier X1 gain adjust is set for a sweep length of 11 divisions.

*5-119. Procedure.*

a. Adjust A6A4R1, X1 gain adjust, for display length of 11 divisions. This is accomplished by positioning right end of display 1 division to left and readjusting A6A4R1 to increase display length by 1 division.

b. Refer to schematic 13 if adjustment cannot be made.

## 5-120. SWEEP TIMING ADJUSTMENT.

*5-121. Reference.* Schematics 10 and 11, and figure 5-13.

*5-122. Description.* The sweep time adjustments are made with a known time reference input to provide a calibrated sweep.

*5-123. Equipment.*

a. time-mark generator.

b. BNC cable, 44 in.

*5-124. Procedure.*

a. Connect time-mark generator output to channel A INPUT with BNC cable.

b. Set Option 300 controls as follows:

CHANNEL A VOLTS/DIV . as required for comfortable display
TIME/DIV ..... .1 uSEC

c. Set time-mark generator controls for 0.1 usec time-mark output.

d. Adjust A6A5R16, cal adj 0.1 usec-2 usec, for 11 time marks in 10 div.

e. Make rest of sweep timing adjustments per table 5-6.

f. Disconnect test equipment.

g. To return to initial settings, set Option 300 controls as follows:

CHANNEL A VOLTS/DIV ..... .01
TIME/DIV ..... 5 uSEC

h. Refer to schematic 10 and 11 if adjustments cannot be made.

## 5-125. X10 GAIN ADJUSTMENT.

*5-126. Reference.* Schematic 13 and figure 5-13.

*5-127. Description.* The horizontal preamplifier circuit X10 gain adjust is adjusted in the expand mode for X10 magnification.

*5-128. Equipment.*

a. time-mark generator.

b. BNC cable, 44 in.

## LIST OF ILLUSTRATIONS (Cont'd)

Table 5-6. Sweep Time Adjustment

| Time-mark Generator | TIME/DIV | Adjustment | Time mark |
|---|---|---|---|
| 10 usec | 10 uSEC | A6A5R15 | |
| 1 ms | 1 mSEC | A6A5R14 | 11 in 10 div |
| 0.1 sec | .1 SEC | A6A5R13 | |

*5-129. Procedure.*

a. Connect time-mark generator to channel A INPUT.

b. Set Option 300 controls as follows:

TIME/DIV ..... 1 mSEC
CHANNEL A VOLTS/DIV ... approx 5 div of deflection

c. Set time-mark generator controls for 0.1-ms time marks.

d. Set MAG to X10.

e. Adjust A6A4R21, X10 gain adj, for 1 div between time marks.

f. Disconnect test equipment.

g. To return to initial settings, set Option 300 controls as follows:

MAG ..... X1
CHANNEL A VOLTS/DIV ..... .01
TIME/DIV ..... 5 uSEC

h. Refer to schematic 13 if adjustment cannot be made.

**5-130. MAG CENTERING ADJUSTMENT.**

*5-131. Reference.* Schematic 13 and figure 5-13.

*5-132. Description.* The mag centering adj is set so the display is expanded around center screen.

*5-133. Equipment.*

a. time-mark generator.

b. BNC cable, 44 in.

*5-134. Procedure.*

a. Connect time-mark generator to channel A INPUT.

b. Set Option 300 controls as follows:

TIME/DIV ..... .2 mSEC
CHANNEL A VOLTS/DIV ... approx 5 div of deflection

c. Set time-mark generator controls for 1-ms time-mark output.

d. Adjust horizontal POSITION so middle time mark is on center graticule.

e. Set MAG to X10.

f. Adjust A6A4R2, mag centering adj, to re-center middle time-mark.

g. Disconnect test equipment.

h. To return to initial settings, set Option 300 controls as follows:

CHANNEL A VOLTS/DIV ..... .01
TIME/DIV ..... 5 uSEC
MAG ..... X1

i. Refer to schematic 13 if adjustment cannot be made.

**5-135. CALIBRATOR ADJUSTMENT.**

*5-136. Reference.* Schematic 14 and figure 5-13.

*5-137. Description.* The calibrator output is compared against a voltmeter calibrator standard to accurately set the calibrator amplitude.

*5-138. Equipment.*

a. voltmeter calibrator.

b. test leads.

*5-139. Procedure.*

a. Set CHANNEL A VOLTS/DIV to .1.

b. Set channel A coupling to DC.

c. Connect voltmeter calibrator to channel A INPUT.

d. Set voltmeter calibrator to 1V p-p output.

e. Adjust channel A vernier for display of 6 div.

f. Disconnect voltmeter calibrator.

g. Connect CAL 1 VOLT output to channel A INPUT.

h. Adjust A4R29, cal ampl adj, for 6-div display.

i. Disconnect CAL 1 VOLT output from channel A.

j. To return to initial settings, set Option 300 controls as follows:

CHANNEL A VOLTS/DIV ..... .01
channel A vernier ..... CAL
channel A coupling ..... AC

k. Refer to schematic 14 if adjustment cannot be made.

## 5-140. INPUT CAPACITANCE AND ATTENUATOR COMPENSATION ADJUSTMENT.

*5-141. Reference.* Schematic 3; and figures 8-10 and 8-12.

*5-142. Description.* The input capacitance is adjusted to 35 pF using an LCR meter. The attenuator compensation adjustment is made with a square-wave input to provide optimum pulse response.

*5-143. Equipment.*

a. LCR meter.

b. square-wave generator.

c. BNC cable, 44 in.

*5-144. Procedure.*

a. Connect LCR meter to channel A INPUT.

b. Set Option 300 controls as follows:

MODE ..... ALT
TIME/DIV ..... 20 uSEC
channel A coupling ..... DC
channel B coupling ..... DC

c. Adjust A5A4C1 for 35-pF indication on LCR meter.

d. Connect LCR meter to channel B INPUT.

e. Adjust A5A4C2 for 35-pF indication on LCR meter.

f. Disconnect LCR meter.

g. Connect 600-ohm output from square-wave generator to both channels A and B INPUT.

h. Set square-wave generator for 10-kHz output.

**Table 5-7. Square-wave Adjustment**

| VOLTS/DIV | Channel A | Channel B |
|---|---|---|
| 0.02 | A5A1C15 | A5A2C15 |
| 0.05 | A5A1C18 | A5A2C18 |
| 0.1 | A5A1C2 | A5A2C2 |
| 1.0 | A5A1C5 | A5A2C5 |
| 10 | A5A1C19 | A5A2C19 |

i. Adjust square-wave generator amplitude control for 4-division display.

j. Perform adjustments in table 5-7 for best square-wave response.

k. Disconnect square-wave generator.

l. Connect LCR meter to appropriate channel as listed in table 5-8 and adjust appropriate component for 35-pF indication.

**Table 5-8. Capacitance Adjustment**

| VOLTS/DIV | Channel A | Channel B |
|---|---|---|
| 0.02 | A5A1C12 | A5A2C12 |
| 0.05 | A5A1C16 | A5A2C16 |
| 0.1 | A5A1C3 | A5A2C3 |
| 1.0 | A5A1C6 | A5A2C6 |
| 10 | A5A1C9 | A5A2C9 |

m. Disconnect test equipment.

n. To return to initial settings, set controls as follows:

CHANNEL A VOLTS/DIV ..... .01
CHANNEL B VOLTS/DIV ..... .01
MODE ..... A
TIME/DIV ..... 5 uSEC
channel A coupling ..... AC
channel B coupling ..... AC

## 5-145. PULSE RESPONSE ADJUSTMENT.

*5-146. Reference.* Schematic 6 and figure 5-13.

*5-147. Description.* The high frequency compensation capacitors in the vertical output amplifier are adjusted for optimum pulse response.

*5-148. Equipment.*

a. square-wave generator.

b. 50-ohm feedthrough termination.

*5-149. Procedure.*

a. Connect square-wave generator output through 50-ohm termination to channel A INPUT.

b. Set Option 300 controls as follows:

CHANNEL A VOLTS/DIV ..... .01
TIME/DIV ..... .1 uSEC
MAG ..... X10

c. Adjust output of square-wave generator for 6-division, 100-kHz display.

d. Adjust A5A5C4, HF comp adj, and A5A5C10, HF comp adj, for best pulse response with risetime of less than 10 ns.

e. Connect square-wave generator to channel B INPUT.

f. Set MODE to B.

g. Observe pulse response of channel B in NORM and INVT positions.

h. Readjust A5A5C4 and A5A5C10, if necessary, to obtain optimum pulse response for both positions with risetime of less than 10 ns.

i. Set MODE to A.

j. Readjust A5A5C4 and A5A5C10 as necessary to optimize pulse response.

k. Repeat steps e through i until A5A5C4 and A5A5C10 are adjusted for optimum pulse response on both channels.

l. Disconnect test equipment.

m. Set MAG to X1.

n. Refer to schematic 6 if adjustment cannot be made.

**5-150. EXTERNAL HORIZONTAL DC BALANCE ADJUSTMENT.**

*5-151. Reference.* Schematic 8 and figure 5-13.

*5-152. Description.* External horizontal dc balance is adjusted for minimum horizontal shift when rotating EXT HORIZ VERNIER from CAL to maximum attenuation.

*5-153. Procedure.*

a. Set sweep display to EXT HORIZ INPUT.

b. Set beam to center screen with horizontal POSITION control.

c. Adjust A6A2R48, dc bal adj, for minimum horizontal shift as EXT HORIZONTAL VERNIER is rotated from CAL to maximum attenuation.

d. To return to initial settings, set Option 300 sweep display to SWEEP.

e. Refer to schematic 8 if adjustment cannot be made.

**5-154. EXTERNAL HORIZONTAL GAIN ADJUSTMENT.**

*5-155. Reference.* Schematic 8 and figure 5-13.

*5-156. Description.* The external horizontal gain adjust is set to deflection sensitivity of 10 V/div.

*5-157. Equipment.*

a. voltmeter calibrator.

b. BNC cable, 44 in.

*5-158. Procedure.*

a. Set sweep display to EXT HORIZ INPUT.

b. Connect voltmeter calibrator to EXT HORIZ INPUT.

c. Set voltmeter calibrator for 100V p-p output.

d. Adjust A6A2R53, cal adj, for 10-div display.

e. Disconnect test equipment.

f. To return to initial settings, set Option 300 sweep display to SWEEP.

g. Refer to schematic 8 if adjustment cannot be made.

**5-159. EXTERNAL HORIZONTAL INPUT COMPENSATION ADJUSTMENT.**

*5-160. Reference.* Schematic 8 and figure 5-13.

*5-161. Description.* The external horizontal attenuator compensation is adjusted to provide optimum pulse adjustment.

*5-162. Equipment.*

a. square-wave generator.

b. BNC cable, 44 in.

*5-163. Procedure.*

a. Set sweep display to EXT HORIZ INPUT.

b. Connect square-wave generator to EXT HORIZ INPUT.

c. Set square-wave generator for 10-kHz, 8-div display.

d. Adjust A6A2C14, input cap, for small round dots with no tails.

e. Remove test equipment.

f. To return to initial settings, set Option 300 sweep display to SWEEP.

g. Refer to schematic 8 if adjustment cannot be made.

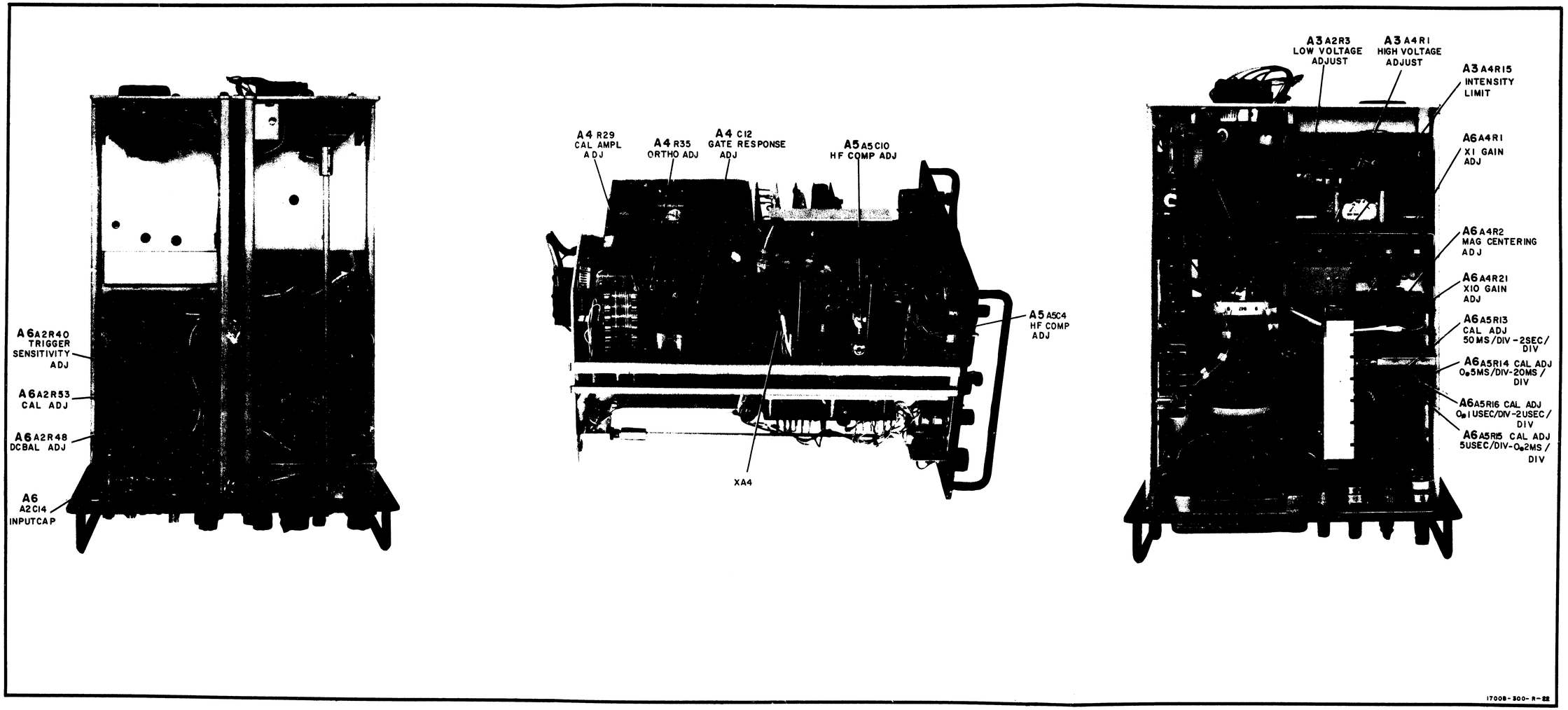



Figure 5-13.
Adjustment Locations

## LIST OF TABLES

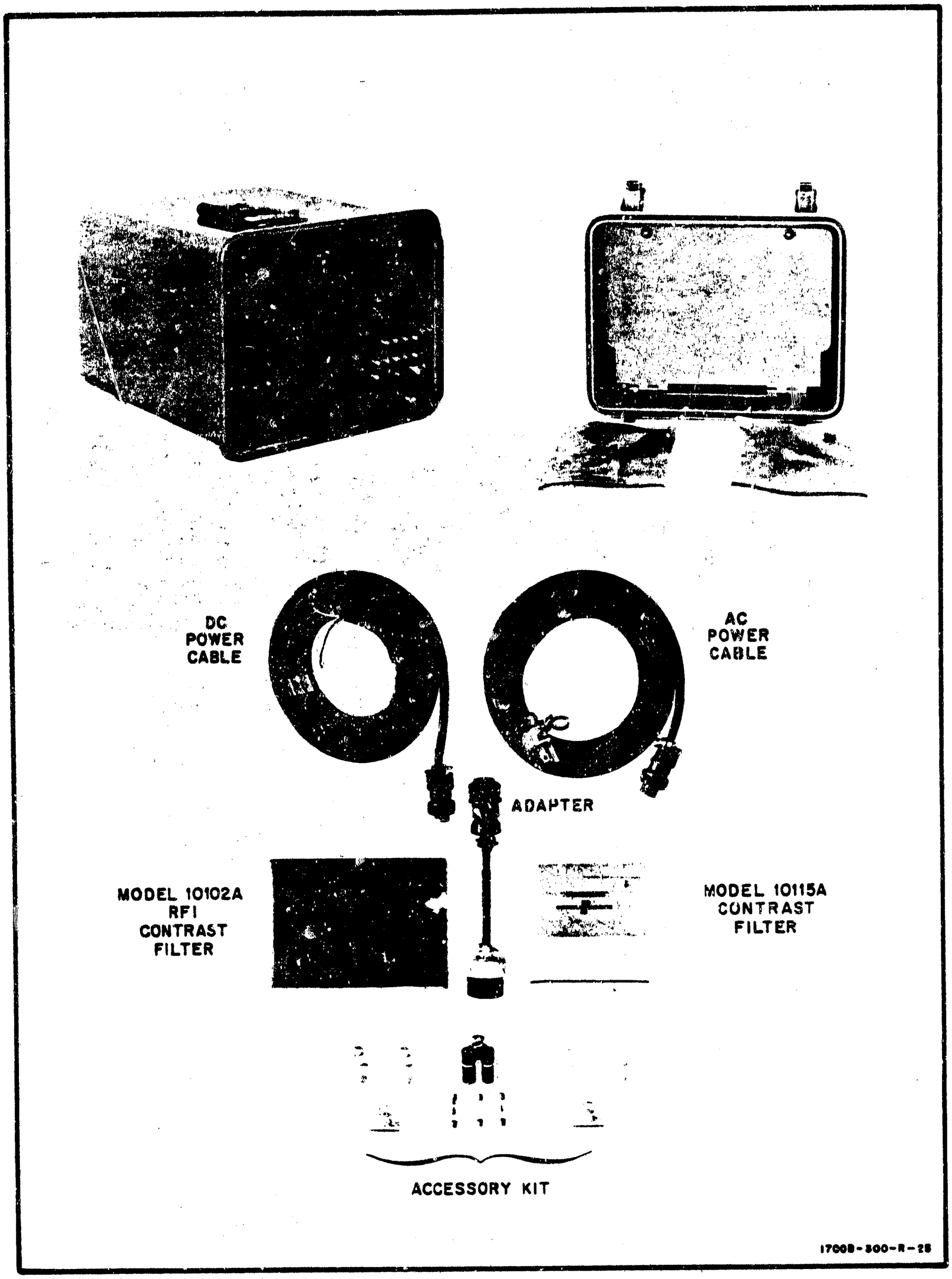



Figure 1-1. Model 1700B Option 300 and Accessories

# SECTION I
# GENERAL INFORMATION

## 1-1. INTRODUCTION.

1-2. This manual provides operating and service information for the Hewlett-Packard Model 1700B Option 300 Oscilloscope (figure 1-1). The manual is divided into eight sections, each covering a specific topic or aspect of the instrument. All schematics are located at the rear of the manual and can be unfolded and used for reference while reading any part of the manual.

Note

Throughout the text of this manual, the Hewlett-Packard Model 1700B Option 300 Oscilloscope shall be called the Option 300.

Table 1-1. Specifications

### VERTICAL AMPLIFIERS

**MODES OF OPERATION:** channel A; channel B; channels A and B displayed alternately on successive sweeps (alt); channels A and B displayed by switching between channels at approx 100-kHz rate with blanking during switching (chop); channel A + channel B (algebraic addition).

**EACH CHANNEL** (2)

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

DC-COUPLED: dc to 35 MHz.
AC-COUPLED: lower limit is approx 2 Hz.

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

**DEFLECTION FACTOR**

**Ranges:** from 10 mV/div to 20 V/div (11 ranges) in 1, 2, 5 sequence. ±3% accuracy with vernier in calibrated position.

**Vernier:** continuously variable between all ranges, extends maximum deflection factor to at least 50 V/div.

**Polarity:** NORM or INVT selectable on channel B.

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

**Input RC:** 1 megohm ±2%, shunted by approx 35 pF.

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

**MAXIMUM INPUT**

**AC-coupled:** ±600V (dc + pk ac); rms ac <350V, 5 V/div to 20 mV/div; <150V at 10 mV/div (10 kHz or less).

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

### A+B OPERATION

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

**Common Mode (A—B)**

FREQUENCY: dc to 1 MHz.
REJECTION RATIO: at least 40 dB on 10 mV/div; at least 20 dB on all other ranges with verniers set for optimum rejection. Common mode signal amplitude equivalent to 30 div.

**TRIGGERING**

Source (applies for all five modes of operation).
A TRIG: on signal from channel A.
COMPOSITE TRIG: on displayed signal.

### TIME BASE

**SWEEP**

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

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

**Magnifier:** expands all sweeps by factor of 10 and extends fastest sweep to 10 ns/div. Accuracy ±5% (including 3% accuracy of time base).

**SWEEP MODE**

**NORMAL:** sweep is triggered by internal or external signal.

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

**Single:** in normal mode, sweep occurs once with same triggering as normal; reset push-



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

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A5R1 | 0757-0476 | 2 | R:FXD MET FLM 301K OHM 1% 1/8W | 28480 | 0757-0476 |
| A5R2 | 0757-0476 | | R:FXD MET FLM 301K OHM 1% 1/8W | 28480 | 0757-0476 |
| A5R3 | 2100-3007 | 2 | R:VAR COMP 50K OHM 20% LIN 1/4W | 28480 | 2100-3007 |
| A5R4 | 2100-3007 | | R:VAR COMP 50K OHM 20% LIN 1/4W | 28480 | 2100-3007 |
| A5R5 | 2100-3008 | 2 | R:VAR COMP 100 OHM 20% LIN | 28480 | 2100-3008 |
| A5R6 | 0757-0391 | 2 | R: FXD MET FLM 38.2 OHM 1% 1/8W | 28480 | 0757-0391 |
| A5R7 | 2100-3008 | | R:VAR COMP 100 OHM 20% LIN | 28480 | 2100-3009 |
| A5R8 | 0757-0391 | | R: FXD MET FLM 38.2 OHM 1% 1/8W | 28480 | 0757-0391 |
| A5R9 | 0684-3901 | 52 | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A5R10 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A5R11 | 0757-0398 | 4 | R:FXD MET FLM 75 OHM 1% 1/8W | 28480 | 0757-0398 |
| A5R12 | 2100-2762 | 2 | R:VAR CERMET 100 OHM 20% LIN 2W | 28480 | 2100-2762 |
| A5R13 | 0757-0398 | | R:FXD MET FLM 75 OHM 1% 1/8W | 28480 | 0757-0398 |
| A5R14 | 0757-0398 | | R:FXD MET FLM 75 OHM 1% 1/8W | 28480 | 0757-0398 |
| A5R15 | 2100-2762 | | R:VAR CERMET 100 OHM 20% LIN 2W | 28480 | 2100-2762 |
| A5R16 | 0757-0398 | | R:FXD MET FLM 75 OHM 1% 1/8W | 28480 | 0757-0398 |
| A5R17 | 2100-3016 | 2 | R:VAR CERMET 50K OHM 20% LIN | 28480 | 2100-3016 |
| A5R18 | 2100-3016 | | R:VAR CERMET 50K OHM 20% LIN | 28480 | 2100-3016 |
| A5S1 | 3101-0940 | 1 | SWITCH:TOGGLE DPDT | 28480 | 3101-0940 |
| A5S2 | 3100-2568 | 1 | SWITCH:ROTARY | 28480 | 3100-2568 |
| A5W1 | 01701-61603 | 1 | CABLE:VERTICAL | 28480 | 01701-61603 |
| A5W2 | 01701-61614 | 1 | CABLE:VERTICAL SUB | 28480 | 01701-61614 |
| A5A1 | 01700-63401 | | ATTENUATOR ASSY | 28480 | 01700-63401 |
| A5A1C1 | 0160-2449 | 2 | C: FXD My 0.1 UF 20% 600 VDCW | 84411 | TYPE 24 |
| A5A1C2 | 0121-0407 | 16 | C:VAR TRIMMER 0.7-3.0 PF | 72982 | 536-016 |
| A5A1C3 | 0121-0407 | | C:VAR TRIMMER 0.7-3.0 PF | 72982 | 536-016 |
| A5A1C4 | 0160-2261 | 6 | C:FXD CER 15 PF 5% 500VDCW | 72982 | 301-NP0-15 PF |
| A5A1C5 | 0121-0168 | | C:VAR TEFLON 0.25-1.50 PF 600VDCW | 28480 | 0121-0168 |
| A5A1C6 | 0121-0407 | | C:VAR TRIMMER 0.7-3.0 PF | 72982 | 536-016 |
| A5A1C7 | 0160-2261 | | C:FXD CER 15 PF 5% 500VDCW | 72982 | 301-NP0-15 PF |
| A5A1C8 | 0160-3130 | 2 | C:FXD MICA 100 PF 10% 250VDCW | 72982 | 2933-003-18A0 101K |
| A5A1C9 | 0121-0407 | | C:VAR TRIMMER 0.7-3.0 PF | 72982 | 536-016 |
| A5A1C10 | 0160-2261 | | C:FXD CER 15 PF 5% 500VDCW | 72982 | 301-NP0-15 PF |
| A5A1C11 | 0160-3463 | 2 | C:FXD MICA 1000 PF 10% 250VDCW | 72982 | 2933-003 18A0 103K |
| A5A1C12 | 0121-0407 | | C:VAR TRIMMER 0.7-3.0 PF | 72982 | 536-016 |
| A5A1C13 | 0160-2249 | 2 | C:FXD CER 4.7 PF 500VDCW | 72982 | 301-NP0-4.7 PF |
| A5A1C14 | 0160-2259 | 2 | C:FXD CER 12 PF 5% 500VDCW | 72982 | 301-000-C0G0-120J |
| A5A1C15 | 0121-0407 | | C:VAR TRIMMER 0.7-3.0 PF | 72982 | 536-016 |
| A5A1C16 | 0121-0407 | | C:VAR TRIMMER 0.7-3.0 PF | 72982 | 536-016 |
| A5A1C17 | 0160-2256 | 2 | C:FXD CER 9.1 PF 500VDCW | 72982 | 301-000-C0K0-919C |
| A5A1C18 | 0121-0407 | | C:VAR TRIMMER 0.7-3.0 PF | 72982 | 536-016 |
| A5A1C19 | 0121-0168 | | C:VAR TEFLON 0.25-1.50 PF 600VDCW | 28480 | 0121-0168 |
| A5A1R1 | 0684-1001 | | R:FXD COMP 10 OHM 10% 1/4W | 01121 | CB 1001 |
| A5A1R2 | 0698-6400 | 3 | R:FXD FLM 900K OHM 1.0% 1/4W | 28480 | 0698-6400 |
| A5A1R3 | 0698-7096 | 2 | R:FXD COMP 10 OHM 10% 1/8W | 01121 | BB 1001 |
| A5A1R4 | 0698-5470 | 2 | R:FXD FLM 111K OHM 1% 1/8W | 28480 | 0698-5470 |
| A5A1R5 | 0698-6634 | 2 | R:FXD FLM 990K OHM 1.0% 1/4W | 28480 | 0698-6634 |
| A5A1R6 | 0698-3109 | 2 | R:FXD MET FLM 10.1K OHM 1% 1/8W | 28480 | 0698-3109 |
| A5A1R7 | 0684-2201 | | R:FXD COMP 22 OHM 10% 1/4W | 01121 | CB 2201 |
| A5A1R8 | 0684-2201 | | R:FXD COMP 22 OHM 10% 1/4W | 01121 | CB 2201 |
| A5A1R9 | 0757-0344 | 3 | R: FXD MET FLM 1.00 MEGOHM 1% 1/4W | 28480 | 0757-0344 6 |
| A5A1R10 | 0757-0280 | 4 | R:FXD MET FLM 1K OHM 1% 1/8W | 28480 | 0757-0280 |
| A5A1R11 | 0686-1011 | 2 | R:FXD COMP 100 OHM 10% 1/8W | 01121 | BB-1011 |
| A5A1R12 | 0684-1001 | | R:FXD COMP 10 OHM 10% 1/4W | 01121 | CB 1001 |
| A5A1R13 | 0684-1001 | | R:FXD COMP 10 OHM 10% 1/4W | 01121 | CB 1001 |
| A5A1R14 | 0698-3263 | 2 | R:FXD MET FLM 500K OHM 1% 1/8W | 28480 | 0698-3263 |
| A5A1R15 | 0757-0344 | 4 | R:FXD MET FLM 1.00 MEGOHM 1% 1/4W | 28480 | 0757-0344 |
| A5A1R16 | 0698-6654 | 2 | R:FXD MET FLM 800K OHM 1% 1/4W | 28480 | 0698-6654 |
| A5A1R17 | 0698-4011 | 2 | R:FXD FLM 250K OHM 1% 1/8W | 28480 | 0698-4011 |
| A5A1R18 | 0757-0344 | | R:FXD MET FLM 1.00 MEGOHM 1% 1/4W | 28480 | 0757-0344 |
| A5A1R19 | 0684-5611 | 2 | R:FXD COMP 560 OHM 10% 1/4W | 01121 | CB 5611 |
| A5A1S1 | 3100-2570 | 2 | SWITCH:ROTARY 3 SECTION 11 POSITION | 28480 | 3100-2570 |
| A5A1S2 | 3101-1759 | 2 | SWITCH:TOGGLE DPDT | 28480 | 3101-1759 |
| A5A2 | | | SAME AS A5A1. USE PREFIX A5A2. | | |
| A5A3 | 01701-61616 | | DELAY LINE | 28480 | 01701-61616 |
| A5A3MP1 | 01701-01208 | 1 | BRACKET: DELAY LINE (LOWER) | 28480 | 01701-01208 |
| A5A3MP2 | 01701-01209 | 1 | BRACKET, DELAY LINE (UPPER) | 28480 | 01701-01209 |
| A5A4 | 01700-66518 | | BOARD ASSY:VERTICAL PL AMP | 28480 | 01700-66518 |
| A5A4C1 | 0121-0138 | 2 | C:VAR TRIMMER 1.3-6.7 PF | 74970 | 189-502-5 |
| A5A4C2 | 0121-0138 | | C:VAR TRIMMER 1.3-6.7 PF | 74970 | 189-502-5 |
| A5A4C3 | 0160-3453 | | C:FXD CER 0.05 UF +80-20% 100VDCW | 56289 | C023A101L503Z525-CDH |
| A5A4C4 | 0150-0084 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 72982 | 8131-100-651-104Z |
| A5A4C5 | 0160-3453 | | C:FXD CER 0.05 UF +80-20% 100VDCW | 56289 | C023A101L503Z525-CDH |
| A5A4C6 | 0160-3453 | | C:FXD CER 0.05 UF +80-20% 100VDCW | 56289 | C023A101L503Z525-CDH |
| A5A4C7 | 0150-0084 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 72982 | 8131-100-651-104Z |
| A5A4C8 | 0160-3451 | | C:FXD CER 0.01 UF +80-20% 100VDCW | 56289 | C023B101F103Z525-CDH |
| A5A4C9 | 0160-3453 | | C:FXD CER 0.05 UF +80-20% 100VDCW | 56289 | C023A101L503Z525-CDH |
| A5A4C10 | 0160-3451 | | C:FXD CER 0.01 UF +80-20% 100VDCW | 56289 | C023B101F103Z525-CDH |
| A5A4C11 | 0180-0230 | | C:FXD ELECT 1.0 UF 20% 50VDCW | 56289 | 150D105X0050A2-DYS |
| A5A4C12 | 0160-3453 | | C:FXD CER 0.05 UF +80-20% 100VDCW | 56289 | C023A101L503Z525-CDH |
| A5A4C13 | 0160-3451 | | C:FXD CER 0.01 UF +80-20% 100VDCW | 56289 | C023B101F103Z525-CDH |
| A5A4C14 | 0160-3451 | | C:FXD CER 0.01 UF +80-20% 100VDCW | 56289 | C023B101F103Z525-CDH |
| A5A4C15 | 0160-2246 | 2 | C:FXD CER 3.6+/-0.25 PF 500VDCW | 72982 | 301-000-C0J0-369C |

See introduction to this section for ordering information

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

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A5A4C16 | 0160-2246 | | C:FXD CER 3.6+/-0.25 PF 500VDCW | 72982 | 301-000-COJ0-369C |
| A5A4C17 | 0160-3453 | | C:FXD CER 0.05 UF +80-20% 100VDCW | 56289 | C023A101L503ZS25-CDH |
| A5A4C18 | 0180-0229 | | C:FXD ELECT 33 UF 10% 10VDCW | 28480 | 0180-0229 |
| A5A4C19 | 0150-0084 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 72982 | 8131-100-651-104Z |
| A5A4C20 | 0180-0229 | | C:FXD ELECT 33 UF 10% 10VDCW | 28480 | 0180-0229 |
| A5A4C21 | 0160-3453 | | C:FXD CER 0.05 UF +80-20% 100VDCW | 56289 | C023A101L503ZS25-CDH |
| A5A4C22 | 0160-3453 | | C:FXD CER 0.05 UF +80-20% 100VDCW | 56289 | C023A101L503ZS25-CDH |
| A5A4C23 | 0140-0206 | 1 | C:FXD MICA 270 PF 5% | 72136 | RDM15E271J 500V |
| A5A4C24 | 0160-3451 | | C:FXD CER 0.01 UF +80-20% 100VDCW | 56289 | C023B101F103ZS25-CDH |
| A5A4C25 | 0160-2220 | 1 | C:FXD MICA 1200 PF 5% 300 V | 28480 | 0160-2220 |
| A5A4C26 | 0160-3451 | | C:FXD CER 0.01 UF +80-20% 100VDCW | 56289 | C023B101F103ZS25-CDH |
| A5A4C27 | 0160-2201 | 1 | C:FXD MICA 51 PF 5% | 72136 | RDM15E510JIC |
| A5A4C28 | 0160-2205 | 1 | C:FXD MICA 120 PF 5% | 28480 | 0160-2205 |
| A5A4C29 | 0180-0197 | 3 | C:FXD ELECT 2.2 UF 10% 20VDCW | 56289 | 150D225X9020A2-DYS |
| A5A4CR1 | 1901-0376 | 6 | DIODE:SILICON 35V | 28480 | 1901-0376 |
| A5A4CR2 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A5A4CR3 | 1901-0376 | | DIODE:SILICON 35V | 26480 | 1901-0376 |
| A5A4CR4 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A5A4CR5 | 1901-0376 | | DIODE:SILICON 35V | 28480 | 1901-0376 |
| A5A4CR6 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A5A4CR7 | 1901-0376 | | DIODE:SILICON 35V | 28480 | 1901-0376 |
| A5A4CR8 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A5A4CR9 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A5A4CR10 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A5A4CR11 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A5A4CR12 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A5A4CR13 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A5A4CR14 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A5A4CR15 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A5A401 | 1855-0085 | 8 | TSTR:FET (MATCHED PAIR) | 28480 | 1855-0085 |
| A5A402 | 1855-0085 | | TSTR:FET (MATCHED PAIR) | 28480 | 1855-0085 |
| A5A403 | 1855-0085 | | TSTR:FET (MATCHED PAIR) | 28480 | 1855-0085 |
| A5A404 | 1855-0085 | | TSTR:FET (MATCHED PAIR) | 28480 | 1855-0085 |
| A5A405 | 1854-0296 | 14 | TSTR:SI NPN | 28480 | 1854-0296 |
| A5A406 | 1854-0296 | | TSTR:SI NPN | 28480 | 1854-0296 |
| A5A407 | 1854-0296 | | TSTR:SI NPN | 28480 | 1854-0296 |
| A5A408 | 1854-0296 | | TSTR:SI NPN | 28480 | 1854-0296 |
| A5A409 | 1854-0296 | | TSTR:SI NPN | 28480 | 1854-0296 |
| A5A4010 | 1854-0296 | | TSTR:SI NPN | 28480 | 1854-0296 |
| A5A4011 | 1854-0296 | | TSTR:SI NPN | 28480 | 1854-0296 |
| A5A4012 | 1854-0296 | | TSTR:SI NPN | 28480 | 1854-0296 |
| A5A4013 | 1853-0203 | 5 | TSTR:SI PNP | 28480 | 1853-0203 |
| A5A4014 | 1853-0015 | 8 | TSTR:SI PNP | 80131 | 2N3640 |
| A5A4015 | 1854-0215 | | TSTR:SI NPN | 80131 | 2N3904 |
| A5A4016 | 1854-0215 | | TSTR:SI NPN | 80131 | 2N3904 |
| A5A4017 | 1854-0215 | | TSTR:SI NPN | 80131 | 2N3904 |
| A5A4018 | 1854-0009 | 6 | TSTR:SI NPN | 80131 | 2N709 |
| A5A4019 | 1854-0009 | | TSTR:SI NPN | 80131 | 2N709 |
| A5A4020 | 1854-0009 | | TSTR:SI NPN | 80131 | 2N709 |
| A5A4021 | 1854-0009 | | TSTR:SI NPN | 80131 | 2N709 |
| A5A4022 | 1854-0009 | | TSTR:SI NPN | 80131 | 2N709 |
| A5A4023 | 1854-0009 | | TSTR:SI NPN | 80131 | 2N709 |
| A5A4024 | 1854-0019 | 6 | TSTR:SI NPN | 28480 | 1854-0019 |
| A5A4025 | 1854-0019 | | TSTR:SI NPN | 28480 | 1854-0019 |
| A5A4026 | 1853-0015 | | TSTR:SI PNP | 80131 | 2N3640 |
| A5A4027 | 1853-0015 | | TSTR:SI PNP | 80131 | 2N3640 |
| A5A4028 | 1853-0015 | | TSTR:SI PNP | 80131 | 2N3640 |
| A5A4029 | 1854-0215 | | TSTR:SI NPN | 80131 | 2N3904 |
| A5A4030 | 1853-0203 | | TSTR:SI PNP | 28480 | 1853-0203 |
| A5A4031 | 1853-0203 | | TSTR:SI PNP | 28480 | 1853-0203 |
| A5A4032 | 1854-0215 | | TSTR:SI NPN | 80131 | 2N3904 |
| A5A4033 | 1854-0215 | | TSTR:SI NPN | 80131 | 2N3904 |
| A5A4034 | 1854-0215 | | TSTR:SI NPN | 80131 | 2N3904 |
| A5A4035 | 1854-0215 | | TSTR:SI NPN | 80131 | 2N3904 |
| A5A4R1 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A5A4R2 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A5A4R3 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A5A4R4 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A5A4R5 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A5A4R6 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A5A4R7 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A5A4R8 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A5A4R9 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A5A4R10 | 0757-0469 | 2 | R:FXD FLM 150K OHM 1% 1/8W | 28480 | 0757-0469 |
| A5A4R11 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |

See introduction to this section for ordering information

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

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A5A4R12 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A5A4R13 | 0757-0469 | | R:FXD FLM 150K OHM 1% 1/8W | 28480 | 0757-0469 |
| A5A4R14 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A5A4R15 | 0684-1521 | | R:FXD COMP 1500 OHM 10% 1/4W | 01121 | CB 1521 |
| A5A4R16 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A5A4R17 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A5A4R18 | 0757-0274 | 2 | R:FXD MET FLM 1.21K OHM 1% 1/8W | 28480 | 0757-0274 |
| A5A4R19 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A5A4R20 | 0684-1521 | | R:FXD COMP 1500 OHM 10% 1/4W | 01121 | CB 1521 |
| A5A4R21 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A5A4R22 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A5A4R23 | 0757-0274 | | R:FXD MET FLM 1.21K OHM 1% 1/8W | 28480 | 0757-0274 |
| A5A4R24 | 0757-0442 | | R:FXD MET FLM 10.0K OHM 1% 1/8W | 28480 | 0757-0442 |
| A5A4R25 | 0757-0442 | | R:FXD MET FLM 10.0K OHM 1% 1/8W | 28480 | 0757-0442 |
| A5A4R26 | 0757-0442 | | R:FXD MET FLM 10.0K OHM 1% 1/8W | 28480 | 0757-0442 |
| A5A4R27 | 0757-0442 | | R:FXD MET FLM 10.0K OHM 1% 1/8W | 28480 | 0757-0442 |
| A5A4R28 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A5A4R29 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A5A4R30 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A5A4R31 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A5A4R32 | 0757-0273 | | R:FXD MET FLM 3.01K OHM 1% 1/8W | 28480 | 0757-0273 |
| A5A4R33 | 0757-0273 | | R:FXD MET FLM 3.01K OHM 1% 1/8W | 28480 | 0757-0273 |
| A5A4R34 | 0684-1001 | | R:FXD COMP 10 OHM 10% 1/4W | 01121 | CB 1001 |
| A5A4R35 | 0757-0273 | | R:FXD MET FLM 3.01K OHM 1% 1/8W | 28480 | 0757-0273 |
| A5A4R36 | 0757-0273 | | R:FXD MET FLM 3.01K OHM 1% 1/8W | 28480 | 0757-0273 |
| A5A4R37 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A5A4R38 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A5A4R39 | 0757-0290 | 7 | R:FXD MET FLM 6.19K OHM 1% 1/8W | 28480 | 0757-0290 |
| A5A4R40 | 2100-2497 | 3 | R:VAR FLM 2000 OHM 10% LIN 1/2W | 28480 | 2100-2497 |
| A5A4R41 | 0757-0290 | | R:FXD MET FLM 6.19K OHM 1% 1/8W | 28480 | 0757-0290 |
| A5A4R42 | 0757-0290 | | R:FXD MET FLM 6.19K OHM 1% 1/8W | 28480 | 0757-0290 |
| A5A4R43 | 2100-2497 | | R:VAR FLM 2000 OHM 10% LIN 1/2W | 28480 | 2100-2497 |
| A5A4R44 | 0757-0290 | | R:FXD MET FLM 6.19K OHM 1% 1/8W | 28480 | 0757-0290 |
| A5A4R45 | 0757-0124 | 4 | R:FXD MET FLM 39.2K OHM 1% 1/8W | 28480 | 0757-0124 |
| A5A4R46 | 0757-0124 | | R:FXD MET FLM 39.2K OHM 1% 1/8W | 28480 | 0757-0124 |
| A5A4R47 | 0757-0124 | | R:FXD MET FLM 39.2K OHM 1% 1/8W | 28480 | 0757-0124 |
| A5A4R48 | 0757-0124 | | R:FXD MET FLM 39.2K OHM 1% 1/8W | 28480 | 0757-0124 |
| A5A4R50 | 2100-1773 | 1 | R:VAR WW 1K OHM 5% TYPE M 1W | 28480 | 2100-1773 |
| A5A4R51 | 0757-0280 | | R:FXD MET FLM 1K OHM 1% 1/8W | 28480 | 0757-0280 |
| A5A4R52 | 0684-2211 | | R:FXD COMP 220 OHM 10% 1/4W | 01121 | CB 2211 |
| A5A4R53 | 0684-2211 | | R:FXD COMP 220 OHM 10% 1/4W | 01121 | CB 2211 |
| A5A4R54 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A5A4R55 | 0684-1021 | | R:FXD COMP 1000 OHM 10% 1/4W | 01121 | CB 1021 |
| A5A4R56 | 0757-0283 | 5 | R:FXD MET FLM 2.00K OHM 1% 1/8W | 28480 | 0757-0283 |
| A5A4R57 | 0757-0273 | | R:FXD MET FLM 3.01K OHM 1% 1/8W | 28480 | 0757-0273 |
| A5A4R58 | 0684-3321 | 7 | R:FXD COMP 3300 OHM 10% 1/4W | 01121 | CB 3321 |
| A5A4R59 | 0757-0437 | 3 | R:FXD MET FLM 4750 OHM 1% 1/8W | 28480 | 0757-0437 |
| A5A4R60 | 2100-2497 | | R:VAR FLM 2000 OHM 10% LIN 1/2W | 28480 | 2100-2497 |
| A5A4R61 | 0757-0437 | | R:FXD MET FLM 4750 OHM 1% 1/8W | 28480 | 0757-0437 |
| A5A4R62 | 0684-1021 | | R:FXD COMP 1000 OHM 10% 1/4W | 01121 | CB 1021 |
| A5A4R63 | 0684-1021 | | R:FXD COMP 1000 OHM 10% 1/4W | 01121 | CB 1021 |
| A5A4R64 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A5A4R65 | 0757-1094 | 2 | R:FXD MET FLM 1.47K OHM 1% 1/8W | 28480 | 0757-1094 |
| A5A4R66 | 0757-0410 | 3 | R:FXD MET FLM 301 OHM 1% 1/8W | 28480 | 0757-0410 |
| A5A4R67 | 0757-0410 | | R:FXD MET FLM 301 OHM 1% 1/8W | 28480 | 0757-0410 |
| A5A4R68 | 0757-1094 | | R:FXD MET FLM 1.47K OHM 1% 1/8W | 28480 | 0757-1094 |
| A5A4R69 | 0757-0282 | 1 | R:FXD MET FLM 221 OHM 1% 1/8W | 28480 | 0757-0282 |
| A5A4R70 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A5A4R71 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A5A4R72 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A5A4R73 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A5A4R74 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A5A4R75 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A5A4R76 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A5A4R77 | 0757-0283 | | R:FXD MET FLM 2.00K OHM 1% 1/8W | 28480 | 0757-0283 |
| A5A4R78 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A5A4R79 | 0698-3136 | 1 | R:FXD MET FLM 17.8K OHM 1% 1/8W | 28480 | 0698-3136 |
| A5A4R80 | 2100-2030 | | R:VAR FLM 20K OHM 10% LIN 1/2W | 28480 | 2100-2030 |
| A5A4R81 | 0757-0413 | 2 | R:FXD MET FLM 392 OHM 1% 1/8W | 28480 | 0757-0413 |
| A5A4R82 | 0757-0452 | 1 | R:FXD MET FLM 27.4K OHM 1% 1/8W | 28480 | 0757-0452 |
| A5A4R83 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A5A4R84 | 0757-0273 | | R:FXD MET FLM 3.01K OHM 1% 1/8W | 28480 | 0757-0273 |
| A5A4R85 | 0684-3321 | | R:FXD COMP 3300 OHM 10% 1/4W | 01121 | CB 3321 |
| A5A4R86 | 0757-0417 | 1 | R:FXD MET FLM 562 OHM 1% 1/8W | 28480 | 0757-0417 |
| A5A4R87 | 0757-0419 | 1 | R:FXD MET FLM 681 OHM 1% 1/8W | 28480 | 0757-0419 |

See introduction to this section for ordering information

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

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A5A4R88 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A5A4R89 | 0684-2211 | | R:FXD COMP 220 OHM 10% 1/4W | 01121 | CB 2211 |
| A5A4R90 | 0757-0434 | 1 | R:FXD MET FLM 3.65K OHM 1% 1/8W | 28480 | 0757-0434 |
| A5A4R91 | 0757-0402 | 1 | R:FXD MET FLM 110 OHM 1% 1/8W | 28480 | 0757-0402 |
| A5A4R92 | 0684-2211 | | R:FXD COMP 220 OHM 10% 1/4W | 01121 | CB 2211 |
| A5A4R93 | 0757-0442 | | R:FXD MET FLM 10.0K OHM 1% 1/8W | 28480 | 0757-0442 |
| A5A4R94 | 0757-0400 | 4 | R:FXD MET FLM 90.9 OHM 1% 1/8W | 28480 | 0757-0400 |
| A5A4R95 | 0758-0049 | 2 | R: FXD FLM 33K OHM 10% 1/4W | 28480 | 0758-0049 |
| A5A4R96 | 0684-2221 | | R:FXD COMP 2200 OHM 10% 1/4W | 01121 | CB 2221 |
| A5A4R97 | 0758-0049 | | R: FXD FLM 33K OHM 10% 1/4W | 28480 | 0758-0049 |
| A5A4R98 | 0684-3321 | | R:FXD COMP 3300 OHM 10% 1/4W | 01121 | CB 3321 |
| A5A4R99 | 0684-3321 | | R:FXD COMP 3300 OHM 10% 1/4W | 01121 | CB 3321 |
| A5A4R100 | 0684-1021 | | R:FXD COMP 1000 OHM 10% 1/4W | 01121 | CB 1021 |
| A5A4R100 | 0684-2221 | | R:FXD COMP 2200 OHM 10% 1/4W | 01121 | CB 2221 |
| A5A4R101 | 0684-1021 | | R:FXD COMP 1000 OHM 10% 1/4W | 01121 | CB 1021 |
| A5A4R102 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A5A4R103 | 0684-1021 | | R:FXD COMP 1000 OHM 10% 1/4W | 01121 | CB 1021 |
| A5A4R104 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A5A4R105 | 0757-0437 | | R:FXD MET FLM 4750 OHM 1% 1/8W | 28480 | 0757-0437 |
| A5A4R106 | 0684-5621 | 2 | R:FXD COMP 5.6K OHM 10% 1/4W | 01121 | CB 5621 |
| A5A4R107 | 0684-5621 | | R:FXD COMP 5.6K OHM 10% 1/4W | 01121 | CB 5621 |
| A5A4R108 | 2100-2061 | 1 | R:VAR FLM 200 OHM 10% LIN 1/2W | 28480 | 2100-2061 |
| A5A4R109 | 0757-0400 | | R:FXD MET FLM 90.9 OHM 1% 1/8W | 28480 | 0757-0400 |
| A5A4R110 | 0884-1021 | | R: FXD COMP 1000 OHM 10% 1/4W | 01121 | CB 1021 |
| A5A4U1 | 1820-0094 | 1 | IC:DTL QUAD 2-INPUT GATE | 04713 | SC6903PK |
| A5A4U2 | 1820-0308 | 1 | IC:DTL CLOCKED FF RL:6K | 07263 | U6A994559X |
| A5A4VR1 | 1902-3048 | 1 | DIODE BREAKDOWN:SILICON 3.48V 5% | 28480 | 1902-3048 |
| A5A4XU1 | 1200-0768 | 3 | SOCKET:INTEGRATED CIRCUIT 14 CONTACT | 91506 | 314-AG5D-3R |
| A5A4XU2 | 1200-0768 | | SOCKET:INTEGRATED CIRCUIT 14 CONTACT | 91506 | 314-AG5D-3R |
| A5A5 | 01700-66519 | | BOARD ASSY:VERTICAL OUTPUT AMPL | 28480 | 01700-66519 |
| A5A5C1 | 0160-3453 | | C:FXD CER 0.05 UF +80-20% 100VDCW | 56289 | C023A101L503Z525-CDH |
| A5A5C2 | 0160-3453 | | C:FXD CER 0.05 UF +80-20% 100VDCW | 56289 | C023A101L503Z525-CDH |
| A5A5C3 | 0160-0166 | 1 | C:FXD MY 0.068 UF 10% 200VDCW | 56289 | 192P68392-PTS |
| A5A5C4 | 0121-0166 | 2 | C:VAR AIR 2.4-24.5 PF 650VDCW | 28480 | 0121-0166 |
| A5A5C5 | 0140-0205 | 1 | C:FXD MICA 62 PF 5% 300VDCW | 00853 | RDM15E620J3C |
| A5A5C6 | 0150-0059 | 2 | C:FXD CER 3.3-0.25 PF 500VDCW | 72982 | 301-000-COJO-339C |
| A5A5C7 | 0150-0059 | | C:FXD CER 3.3-0.25 PF 500VDCW | 72982 | 301-000-COJO-339C |
| A5A5C8 | 0160-3453 | | C:FXD CER 0.05 UF +80-20% 100VDCW | 56289 | C023A101L503Z525-CDH |
| A5A5C9 | 0160-2202 | 1 | C:FXD MICA 75 PF 5% | 28480 | 0160-2202 |
| A5A5C10 | 0121-0166 | | C:VAR AIR 2.4-24.5 PF 650VDCW | 28480 | 0121-0166 |
| A5A5C11 | 0150-0084 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 72982 | 8131-100-651-104Z |
| A5A5Q1 | 1853-0203 | | TSTR:SI PNP | 28480 | 1853-0203 |
| A5A5Q2 | 1853-0203 | | TSTR:SI PNP | 28480 | 1853-0203 |
| A5A5Q3 | 1853-0015 | | TSTR:SI PNP | 80131 | 2N3640 |
| A5A5Q4 | 1853-0015 | | TSTR:SI PNP | 80131 | 2N3640 |
| A5A5Q5 | 1853-0036 | | TSTR:SI PNP | 80131 | 2N3906 |
| A5A5Q6 | 1854-0039 | | TSTR:SI NPN | 80131 | 2N3053 |
| A5A5Q7 | 1854-0233 | 2 | TSTR:SI NPN | 80131 | 2N3866 |
| A5A5Q8 | 1854-0233 | | TSTR:SI NPN | 80131 | 2N3866 |
| A5A5Q9 | 1854-0019 | | TSTR:SI NPN | 28480 | 1854-0019 |
| A5A5Q10 | 1854-0019 | | TSTR:SI NPN | 28480 | 1854-0019 |
| A5A5R1 | 0684-1001 | | R:FXD COMP 10 OHM 10% 1/4W | 01121 | CB 1001 |
| A5A5R2 | 0684-1001 | | R:FXD COMP 10 OHM 10% 1/4W | 01121 | CB 1001 |
| A5A5R3 | 0757-0400 | | R:FXD MET FLM 90.9 OHM 1% 1/8W | 28480 | 0757-0400 |
| A5A5R4 | 0757-0400 | | R:FXD MET FLM 90.9 OHM 1% 1/8W | 28480 | 0757-0400 |
| A5A5R5 | 0757-0402 | 1 | R: FXD MET FLM 110 OHM 1% 1/8W | 28480 | 0757-0402 |
| A5A5R6 | 0757-0444 | 2 | R:FXD MET FLM 12.1K OHM 1% 1/8W | 28480 | 0757-0444 |
| A5A5R7 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A5A5R8 | 0757-0280 | | R:FXD MET FLM 1K OHM 1% 1/8W | 28480 | 0757-0280 |
| A5A5R9 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A5A5R10 | 0757-0418 | 3 | R:FXD MET FLM 619 OHM 1% 1/8W | 28480 | 0757-0418 |
| A5A5R11 | 0757-0418 | | R:FXD MET FLM 619 OHM 1% 1/8W | 28480 | 0757-0418 |
| A5A5R12 | 0757-0290 | | R:FXD MET FLM 6.19K OHM 1% 1/8W | 28480 | 0757-0290 |
| A5A5R13 | 0757-0290 | | R:FXD MET FLM 6.19K OHM 1% 1/8W | 28480 | 0757-0290 |
| A5A5R14 | 0684-1001 | | R:FXD COMP 10 OHM 10% 1/4W | 01121 | CB 1001 |
| A5A5R15 | 0684-1001 | | R:FXD COMP 10 OHM 10% 1/4W | 01121 | CB 1001 |
| A5A5R16 | 0757-0734 | 2 | R:FXD MET FLM 1.21K OHM 1%/1/4W | 28480 | 0757-0734 |
| A5A5R17 | 0757-0734 | | R:FXD MET FLM 1.21K OHM 1%/1/4W | 28480 | 0757-0734 |
| A5A5R18 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A5A5R19 | 0684-1001 | | R:FXD COMP 10 OHM 10% 1/4W | 01121 | CB 1001 |
| A5A5R20 | 0757-0411 | 1 | R:FXD MET FLM 332 OHM 1% 1/8W | 28480 | 0757-0411 |
| A5A5R21 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A5A5R22 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A5A5R23 | 0757-0431 | 1 | R:FXD MET FLM 2.43K OHM 1% 1/8W | 28480 | 0757-0431 |
| A5A5R24 | 0757-0069 | 1 | R:FXD MET FLM 121 OHM 1% 1/4W | 28480 | 0757-0069 |
| A5A5R25 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |

See introduction to this section for ordering information

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

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A5A5R26 | 0684-2211 | | R:FXD COMP 220 OHM 10% 1/4W | 01121 | CB 2211 |
| A5A5R27 | 0684-2721 | | R:FXD COMP 2700 OHM 10% 1/4W | 01121 | CB 2721 |
| A5A5R28 | 0757-0438 | | R:FXD MET FLM 5.11K OHM 1% 1/8W | 28480 | 0757-0438 |
| A5A5R29 | 0757-0388 | 2 | R:FXD FLM 30.1 OHM 1% 1/8W | 28480 | 0757-0388 |
| A5A5R30 | 0757-0388 | | R:FXD FLM 30.1 OHM 1% 1/8W | 28480 | 0757-0388 |
| A5A5R31 | 0757-0394 | | R:FXD MET FLM 51.1 OHM 1% 1/8W | 28480 | 0757-0394 |
| A5A5R32 | 0757-0817 | 4 | R:FXD MET FLM 750 OHM 1% 1/2W | 28480 | 0757-0817 |
| A5A5R33 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A5A5R34 | 0757-0817 | | R:FXD MET FLM 750 OHM 1% 1/2W | 28480 | 0757-0817 |
| A5A5R35 | 0757-0817 | | R:FXD MET FLM 750 OHM 1% 1/2W | 28480 | 0757-0817 |
| A5A5R36 | 0757-0817 | | R:FXD MET FLM 750 OHM 1% 1/2W | 28480 | 0757-0817 |
| A6 | 01700-65804 | | HORIZONTAL AMPLIFIER MODULE ASSY | 28480 | 01700-65804 |
| A6DS1 | 1450-0709 | | LIGHT:INDICATOR 90 VDC | 72765 | 6140-000-603 |
| A6DS2 | 1450-0709 | | LIGHT:INDICATOR 90 VDC | 72765 | 6140-000-603 |
| A6DS3 | 1450-0709 | | LIGHT:INDICATOR 90 VDC | 72765 | 6140-000-603 |
| A6MP1 | 0510-0087 | | RETAINER: PUSH-ON | | |
| A6MP2 | 01700-23706 | 1 | SHAFT; SWITCH EXTENSION | 28480 | 01700-23706 |
| A6MP3 | 01700-60601 | 1 | SHIELD ASSY: HORIZONTAL | 28480 | 01700-60601 |
| A6MP4 | 01701-00609 | 1 | SHIELD: HOLDOFF | 28480 | 01701-00609 |
| A6MP5 | 01701-63703 | 2 | SHAFT ASS: PUSHBUTTON EXTENSION | 28480 | 01701-63703 |
| A6MP6 | 01830-23201 | 1 | COUPLER: SWITCH EXTENSION | 28480 | 01830-23201 |
| A6R1 | 2100-3278 | 1 | R:VAR COMP 100K OHM 20% 1/3W | 28480 | 2100-3278 |
| A6R2 | 2100-3009 | 1 | R:VAR COMP 20K OHM 20% LIN | 28480 | 2100-3009 |
| A6R3 | 2100-3279 | 1 | R:VAR CERMET 200K OHM | 28480 | 2100-3279 |
| A6R4 | 2100-3014 | 1 | R:VAR COMP DUAL 20K OHM 20% LIN | 28480 | 2100-3014 |
| A6R5 | 0757-0273 | 2 | R: FXD MET FLM 3.01K OHM 1% 1/8W | 28480 | 0757-0273 |
| A6R6 | 0757-0273 | | R: FXD MET FLM 3.01K OHM 1% 1/8W | 28480 | 0757-0273 |
| A6A1 | 01700-66520 | | BOARD ASSY:HORIZONTAL MOTHER | 28480 | 01700-66520 |
| A6A1C1 | 0160-2204 | 2 | C:FXD MICA 100PF 5% | 72136 | RDM15F101J3C |
| A6A1J1 | 1251-1626 | 4 | CONNECTOR:PC (2 X 12) 24 CONTACT | 71785 | 252-12-30-300 |
| A6A1J2 | 1251-1626 | | CONNECTOR:PC (2 X 12) 24 CONTACT | 71785 | 252-12-30-300 |
| A6A1J3 | 1251-1626 | | CONNECTOR:PC (2 X 12) 24 CONTACT | 71785 | 252-12-30-300 |
| A6A1J4 | 1251-1626 | | CONNECTOR:PC (2 X 12) 24 CONTACT | 71785 | 252-12-30-300 |
| A6A1Q1 | 1354-0087 | 1 | TSTR:SI NPN | 80131 | 2N3417 |
| A6A1R1 | 0757-0433 | 1 | R:FXD MET FLM 3.32K OHM 1% 1/8W | 28480 | 0757-0433 |
| A6A1R2 | 0684-3331 | 1 | R: FXD COMP 33K OHM 10% 1/4W | 01121 | CB 3331 |
| A6A1R3 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A6A1R4 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A6A1R5 | 0757-0418 | | R:FXD MET FLM 619 OHM 1% 1/8W | 28480 | 0757-0418 |
| A6A1R6 | 0757-0283 | | R:FXD MET FLM 2.00K OHM 1% 1/8W | 28480 | 0757-0283 |
| A6A1R7 | 0757-0413 | | R:FXD MET FLM 392 OHM 1% 1/8W | 28480 | 0757-0413 |
| A6A1R8 | 0684-2221 | | R:FXD COMP 2200 OHM 10% 1/4W | 01121 | CB 2221 |
| A6A1R9 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A6A1R10 | 0684-1031 | | R: FXD COMP 10K OHM 10% 1/4W | 01121 | CB 1031 |
| A6A1S1 | 3101-1241 | 1 | SWITCH:PUSHBUTTON 4POT | 71590 | PB 1 |
| A6A1S2 | 3101-1397 | 3 | SWITCH:PUSHBUTTON 2 POLE 3 STATION | 28480 | 3101-1397 |
| A6A1S3 | 3101-1397 | | SWITCH:PUSHBUTTON 2 POLE 3 STATION | 28480 | 3101-1397 |
| A6A1S4 | 3101-1397 | | SWITCH:PUSHBUTTON 2 POLE 3 STATION | 28480 | 3101-1397 |
| A6A2 | 01700-66521 | | BOARD ASSY:TRIGGER | 28480 | 01700-66521 |
| A6A2C1 | 0160-2228 | | C:FXD MICA 2700 PF 5% | 28480 | 0160-2228 |
| A6A2C2 | 0160-2207 | 1 | C:FXD MICA 300 PF 5% | 28480 | 0160-2207 |
| A6A2C3 | 0140-0203 | 1 | C:FXD MICA 30 PF 5% | 28480 | 0140-0203 |
| A6A2C4 | 0160-3453 | 3 | C:FXD CER 0.05 UF +80-20% 100VDCW | 56289 | C023A101L503Z525-CDH |
| A6A2C5 | 0160-3453 | | C:FXD CER 0.05 UF +80-20% 100VDCW | 56289 | C023A101L503Z525-CDH |
| A6A2C6 | 0160-3453 | | C:FXD CER 0.05 UF +80-20% 100VDCW | 56289 | C023A101L503Z525-CDH |
| A6A2C7 | 0160-3453 | | C:FXD CER 0.05 UF +80-20% 100VDCW | 56289 | C023A101L503Z525-CDH |
| A6A2C8 | 0150-0084 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 72982 | 8131-100-651-104Z |
| A6A2C9 | 0160-3453 | | C:FXD CER 0.05 UF +80-20% 100VDCW | 56289 | C023A101L503Z525-CDH |
| A6A2C10 | 0160-3451 | | C:FXD CER 0.01 UF +80-20% 100VDCW | 56289 | C023B101F103Z525-CDH |
| A6A2C11 | 0160-2198 | 1 | C:FXD MICA 20 PF 5% | 72136 | RDM15C200J3C |
| A6A2C12 | 0160-2197 | 1 | C:FXD MICA 10 PF 5% | 72136 | RDM15C100J3C |
| A6A2C13 | 0140-0198 | 1 | C:FXD MICA 200 PF 5% | 72136 | RDM15F201J3C |
| A6A2C14 | 0121-0131 | 9 | C:VAR AIR 1.2-4.2 PF | 28480 | 0121-0131 |
| A6A2C15 | 0140-0203 | | C:FXD MICA 30 PF 5% | 28480 | 0140-0203 |
| A6A2C16 | 0180-0197 | | C:FXD ELECT 2.2 UF 10% 20VDCW | 56289 | 150D225X9020A2-DYS |
| A6A2C17 | 0150-0084 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 72982 | 8131-100-651-104Z |
| A6A2CR1 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A6A2CR2 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A6A2CR3 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A6A2CR4 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A6A2CR5 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A6A2CR6 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A6A2CR7 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A6A2CR8 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A6A2CR9 | 1901-0376 | | DIODE:SILICON 35V | 28480 | 1901-0376 |
| A6A2CR10 | 1901-0376 | | DIODE:SILICON 35V | 28480 | 1901-0376 |
| A6A2CR11 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A6A2CR12 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A6A2CR13 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A6A2Q1 | 1855-0085 | | TSTR:FET (MATCHED PAIR) | 28480 | 1855-0085 |
| A6A2Q2 | 1855-0085 | | TSTR:FET (MATCHED PAIR) | 28480 | 1855-0085 |
| A6A2Q3 | 1854-0296 | | TSTR:SI NPN | 28480 | 1854-0296 |
| A6A2Q4 | 1854-0296 | | TSTR:SI NPN | 28480 | 1854-0296 |
| A6A2Q5 | 1854-0296 | | TSTR:SI NPN | 28480 | 1854-0296 |

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

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A6A2Q6 | 1854-0296 | | TSTR:SI NPN | 28480 | 1854-0296 |
| A6A2Q7 | 1853-0015 | | TSTR:SI PNP | 80131 | 2N3640 |
| A6A2Q8 | 1853-0015 | | TSTR:SI PNP | 80131 | 2N3640 |
| A6A2Q9 | 1854-0296 | | TSTR:SI NPN | 28480 | 1854-0296 |
| A6A2Q10 | 1854-0296 | | TSTR:SI NPN | 28480 | 1854-0296 |
| A6A2Q11 | 1853-0036 | | TSTR:SI PNP | 80131 | 906 |
| A6A2Q12 | 1853-0036 | | TSTR:SI PNP | 80131 | 906 |
| A6A2Q13 | 1853-0036 | | TSTR:SI PNP | 80131 | 906 |
| A6A2Q14 | 1853-0036 | | TSTR:SI PNP | 80131 | 906 |
| A6A2Q15 | 1854-0215 | | TSTR:SI NPN | 80131 | 2N3904 |
| A6A2Q16 | 1853-0036 | | TSTR:SI PNP | 80131 | 2N3906 |
| A6A2Q17 | 1853-0036 | | TSTR:SI PNP | 80131 | 2N3906 |
| A6A2Q18 | 1853-0036 | | TSTR:SI PNP | 80131 | 2N3906 |
| A6A2Q19 | 1855-0085 | | TSTR:FET (MATCHED PAIR) | 28480 | 1855-0085 |
| A6A2Q20 | 1855-0085 | | TSTR:FET (MATCHED PAIR) | 28480 | 1855-0085 |
| A6A2Q21 | 1854-0215 | | TSTR:SI NPN | 80131 | 2N3904 |
| A6A2Q22 | 1853-0036 | | TSTR:SI PNP | 80131 | 2N3906 |
| A6A2Q23 | 1853-0036 | | TSTR:SI PNP | 80131 | 2N3906 |
| A6A2Q24 | 1854-0215 | | TSTR:SI NPN | 80131 | 2N3904 |
| A6A2R1 | 0757-0465 | 6 | R:FXD MET FLM 100K OHM 1% 1/8W | 28480 | 0757-0465 |
| A6A2R2 | 0757-0465 | | R:FXD MET FLM 100K OHM 1% 1/8W | 28480 | 0757-0465 |
| A6A2R3 | 0757-0367 | 1 | R:FXD MET FLM 100K OHM 1% 1/2W | 28480 | 0757-0367 |
| A6A2R4 | 0757-0488 | 2 | R:FXD MET FLM 909K OHM 1% 1/8W | 28480 | 0757-0488 |
| A6A2R5 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A6A2R6 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A6A2R7 | 0757-0442 | | R:FXD MET FLM 10.0K OHM 1% 1/8W | 28480 | 0757-0442 |
| A6A2R8 | 0757-0442 | | R:FXD MET FLM 10.0K OHM 1% 1/8W | 28480 | 0757-0442 |
| A6A2R9 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A6A2R10 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A6A2R11 | 0684-1031 | | R:FXD COMP 10K OHM 10% 1/4W | 01121 | CB 1031 |
| A6A2R12 | 0684-1031 | | R:FXD COMP 10K OHM 10% 1/4W | 01121 | CB 1031 |
| A6A2R13 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A6A2R14 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A6A2R15 | 0684-3321 | | R:FXD COMP 3300 OHM 10% 1/4W | 01121 | CB 3321 |
| A6A2R16 | 0757-0401 | | R:FXD MET FLM 100 OHM 1% 1/8W | 28480 | 0757-0401 |
| A6A2R17 | 0757-0401 | | R:FXD MET FLM 100 OHM 1% 1/8W | 28480 | 0757-0401 |
| A6A2R18 | 0684-2221 | | R:FXD COMP 2200 OHM 10% 1/4W | 01121 | CB 2221 |
| A6A2R19 | 0757-0401 | | R:FXD MET FLM 100 OHM 1% 1/8W | 28480 | 0757-0401 |
| A6A2R20 | 0757-0401 | | R:FXD MET FLM 100 OHM 1% 1/8W | 28480 | 0757-0401 |
| A6A2R21 | 0757-0429 | 1 | R:FXD MET FLM 1.82K OHM 1% 1/8W | 28480 | 0757-0429 |
| A6A2R22 | 0684-2221 | | R:FXD COMP 2200 OHM 10% 1/4W | 01121 | CB 2221 |
| A6A2R23 | 0757-0401 | | R:FXD MET FLM 100 OHM 1% 1/8W | 28480 | 0757-0401 |
| A6A2R24 | 0757-0401 | | R:FXD MET FLM 100 OHM 1% 1/8W | 28480 | 0757-0401 |
| A6A2R25 | 0757-0438 | | R:FXD MET FLM 5.11K OHM 1% 1/8W | 28480 | 0757-0438 |
| A6A2R26 | 0684-2231 | 4 | R:FXD COMP 22K OHM 10% 1/4W | 01121 | CB 2231 |
| A6A2R27 | 0684-1531 | | R:FXD COMP 15K OHM 10% 1/4W | 01121 | CB 1531 |
| A6A2R28 | 0684-3341 | 1 | R:FXD COMP 330K OHM 10% 1/4W | 01121 | CB 3341 |
| A6A2R29 | 0684-2221 | | R:FXD COMP 2200 OHM 10% 1/4W | 01121 | CB 2221 |
| A6A2R30 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A6A2R31 | 0684-1031 | | R:FXD COMP 10K OHM 10% 1/4W | 01121 | CB 1031 |
| A6A2R32 | 0684-1031 | | R:FXD COMP 10K OHM 10% 1/4W | 01121 | CB 1031 |
| A6A2R33 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A6A2R34 | 0684-3321 | | R:FXD COMP 3300 OHM 10% 1/4W | 01121 | CB 3321 |
| A6A2R35 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A6A2R36 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A6A2R37 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A6A2R38 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A6A2R39 | 0684-1001 | | R:FXD COMP 10 OHM 10% 1/4W | 01121 | CB 1001 |
| A6A2R40 | 2100-2216 | 1 | R:VAR FLM 5K OHM 10% LIN 1/2W | 28480 | 2100-2216 |
| A6A2R41 | 0757-0482 | 2 | R:FXD MET FLM 511K OHM 1% 1/8W | 28480 | 0757-0482 |
| A6A2R42 | 0757-0482 | | R:FXD MET FLM 511K OHM 1% 1/8W | 28480 | 0757-0482 |
| A6A2R43 | 0757-0451 | 1 | R:FXD MET FLM 24.3K OHM 1% 1/8W | 28480 | 0757-0451 |
| A6A2R44 | 0757-0488 | | R:FXD MET FLM 909K OHM 1% 1/8W | 28480 | 0757-0488 |
| A6A2R45 | 0698-6400 | | R:FXD FLM 900K OHM 1.0% 1/4W | 28480 | 0698-6400 |
| A6A2R46 | 0757-0465 | | R:FXD MET FLM 100K OHM 1% 1/8W | 28480 | 0757-0465 |
| A6A2R47 | 0757-0407 | | R:FXD MET FLM 200 OHM 1% 1/8W | 28480 | 0757-0407 |
| A6A2R48 | 2100-1788 | | R:VAR FLM 500 OHM 10% LIN 1/2W | 28480 | 2100-1788 |
| A6A2R49 | 0757-0288 | 1 | R:FXD MET FLM 9.09K OHM 1% 1/8W | 28480 | 0757-0288 |
| A6A2R50 | 0757-0290 | | R:FXD MET FLM 6.19K OHM 1% 1/8W | 28480 | 0757-0290 |
| A6A2R51 | 0757-0454 | | R:FXD MET FLM 33.2K OHM 1% 1/8W | 28480 | 0757-0454 |
| A6A2R52 | 0757-0410 | | R:FXD MET FLM 301 OHM 1% 1/8W | 28480 | 0757-0410 |
| A6A2R53 | 2100-1788 | | R:VAR FLM 500 OHM 10% LIN 1/2W | 28480 | 2100-1788 |
| A6A2R54 | 0684-3321 | | R:FXD COMP 3300 OHM 10% 1/4W | 01121 | CB 3321 |
| A6A2R55 | 0757-0449 | | R:FXD FLM 20K OHM 1% 1/8W | 28480 | 0757-0449 |
| A6A2R56 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |

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

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A6A2R57 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A6A2R58 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A6A2R59 | 0757-0454 | | R:FXD MET FLM 33.2K OHM 1% 1/8W | 28480 | 0757-0454 |
| A6A2R60 | 0757-0412 | 1 | R:FXD MET FLM 365 OHM 1% 1/8W | 28480 | 0757-0412 |
| A6A2R61 | 0757-0273 | | R:FXD MET FLM 3.01K OHM 1% 1/8W | 28480 | 0757-0273 |
| A6A2R62 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A6A2S1 | 3101-1398 | 5 | SWITCH:PUSHBUTTON 2 POLE 5 STATION | 28480 | 3101-1398 |
| A6A2S2 | 3101-1398 | | SWITCH:PUSHBUTTON 2 POLE 5 STATION | 28480 | 3101-1398 |
| A6A2S3 | 3101-1398 | | SWITCH:PUSHBUTTON 2 POLE 5 STATION | 28480 | 3101-1398 |
| A6A2S4 | 3101-1398 | | SWITCH:PUSHBUTTON 2 POLE 5 STATION | 28480 | 3101-1398 |
| A6A2S5 | 3101-1398 | | SWITCH:PUSHBUTTON 2 POLE 5 STATION | 28480 | 3101-1398 |
| A6A2S6 | 3101-1400 | 2 | SWITCH:PUSHBUTTON DPDT | 71590 | PB-1 |
| A6A2S7 | 3101-1400 | | SWITCH:PUSHBUTTON DPDT | 71590 | PB-1 |
| A6A2U1 | 1820-0142 | 1 | INTEGRATED CIRCUIT:4INPUT,2-OR/NOR | 04713 | MC1004P |
| A6A2VR1 | 1902-0041 | 2 | DIODE:BREAKDOWN 5.11V 5% | 04713 | SZ10939-98 |
| A6A2XU1 | 1200-0441 | 1 | SOCKET:IC 14 PIN MINIATURE | 28480 | 1200-0441 |
| A6A3 | 01700-66522 | | BOARD ASSY:INTEGRATOR | 28480 | 01700-66522 |
| A6A3C1 | 0180-0230 | | C:FXD ELECT 1.0 UF 20% 50VDCW | 56289 | 150D105X0050A2-DYS |
| A6A3C2 | 0180-0230 | | C:FXD ELECT 1.0 UF 20% 50VDCW | 56289 | 150D105X0050A2-DYS |
| A6A3C3 | 0180-0230 | | C:FXD ELECT 1.0 UF 20% 50VDCW | 56289 | 150D105X0050A2-DYS |
| A6A3C4 | 0180-0230 | | C:FXD ELECT 1.0 UF 20% 50VDCW | 56289 | 150D105X0050A2-DYS |
| A6A3C5 | 0160-3451 | | C:FXD CER 0.01 UF +80-20% 100VDCW | 56289 | C023B101F103Z525-CDH |
| A6A3C6 | 0160-3451 | | C:FXD CER 0.01 UF +80-20% 100VDCW | 56289 | C023B101F103Z525-CDH |
| A6A3C7 | 0160-3448 | 1 | C:FXD CER 1000 PF 10% 1000VDCW | 56289 | C067B251F102K525-CDH |
| A6A3C8 | 0160-2264 | 1 | C:FXD CER 20 PF 5% 500VDCW | 72982 | 301-000-C0G0-200J |
| A6A3C9 | 0160-3451 | | C:FXD CER 0.01 UF +80-20% 100VDCW | 56289 | C023B101F103Z525-CDH |
| A6A3C10 | 0160-2257 | 2 | C:FXD CER 10 PF 5% 500VDCW | 72982 | 301-000-C0H0-100J |
| A6A3C11 | 0160-2257 | | C:FXD CER 10 PF 5% 500VDCW | 72982 | 301-000-C0H0-100J |
| A6A3CR1 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A6A3CR2 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A6A3CR3 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A6A3CR4 | 1901-0535 | 3 | DIODE:HYBRID HOT CARRIER | 28480 | 1901-0535 |
| A6A3CR5 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A6A3CR6 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A6A3CR7 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A6A3CR8 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A6A3CR9 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A6A3CR10 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A6A3CR11 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A6A3CR12 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A6A3CR13 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A6A3CR14 | 1901-0040 | | DIODE SILICON 30 MA 30 WV | 07263 | FDG1088 |
| A6A3Q1 | 1854-0092 | 3 | TSTR:SI NPN | 80131 | 2N3563 |
| A6A3Q2 | 1853-0036 | | TSTR:SI PNP | 80131 | 2N3906 |
| A6A3Q3 | 1854-0092 | | TSTR:SI NPN | 80131 | 2N3563 |
| A6A3Q4 | 1854-0092 | | TSTR:SI NPN | 80131 | 2N3563 |
| A6A3Q5 | 1853-0036 | | TSTR:SI PNP | 80131 | 2N3906 |
| A6A3Q6 | 1853-0276 | 1 | TSTR:SI PNP | 28480 | 1853-0276 |
| A6A3Q7 | 1855-0057 | 1 | TSTR:SI FET N-CHANNEL | 28480 | 1855-0057 |
| A6A3Q8 | 1854-0215 | | TSTR:SI NPN | 80131 | 2N3904 |
| A6A3Q9 | 1854-0215 | | TSTR:SI NPN | 80131 | 2N3904 |
| A6A3R1 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A6A3R2 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A6A3R3 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A6A3R4 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A6A3R5 | 0684-1221 | | R:FXD COMP 1.2K OHM 10% 1/4W | 01121 | CB 1221 |
| A6A3R6 | 0684-1221 | | R:FXD COMP 1.2K OHM 10% 1/4W | 01121 | CB 1221 |
| A6A3R7 | 0684-1031 | | R:FXD COMP 10K OHM 10% 1/4W | 01121 | CB 1031 |
| A6A3R8 | 0684-2231 | | R:FXD COMP 22K OHM 10% 1/4W | 01121 | CB 2231 |
| A6A3R9 | 0757-0446 | 4 | R:FXD MET FLM 15.0K OHM 1% 1/8W | 28480 | 0757-0446 |
| A6A3R10 | 0684-1021 | | R:FXD COMP 1000 OHM 10% 1/4W | 01121 | CB 1021 |
| A6A3R11 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A6A3R12 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A6A3R13 | 0684-2231 | | R:FXD COMP 22K OHM 10% 1/4W | 01121 | CB 2231 |
| A6A3R14 | 0684-1021 | | R: FXD COMP 1000 OHM 10% 1/4W | 01121 | CB 1021 |
| A6A3R15 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A6A3R16 | 0684-1031 | | R:FXD COMP 10K OHM 10% 1/4W | 01121 | CB 1031 |
| A6A3R17 | 0684-2211 | | R:FXD COMP 220 OHM 10% 1/4W | 01121 | CB 2211 |
| A6A3R18 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A6A3R19 | 0684-1031 | | R:FXD COMP 10K OHM 10% 1/4W | 01121 | CB 1031 |
| A6A3R20 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A6A3U1 | 1820-0068 | 1 | IC:TTL TRIPLE 3-INPUT PCS NAND GATE | 12040 | SN7410N |
| A6A3XU1 | 1200-0768 | | SOCKET:INTEGRATED CIRCUIT 14 CONTACT | 91506 | 314-AG5D-3R |
| A6A4 | 01700-66526 | | BOARD ASSY:HORIZONTAL PREAMP | 28480 | 01700-66526 |
| A6A4C1 | 0160-3453 | | C:FXD CER 0.05 UF +80-20% 100VDCW | 56289 | C023A101L503Z525-CDH |
| A6A4C2 | 0160-3453 | | C:FXD CER 0.05 UF +80-20% 100VDCW | 56289 | C023A101L503Z525-CDH |

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

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A6A4C3 | 0160-3453 | | C:FXD CER 0.05 UF +80-20% 100VDCW | 56289 | C023A101L503Z525-CDH |
| A6A4C4 | 0160-3453 | | C:FXD CER 0.05 UF +80-20% 100VDCW | 56289 | C023A101L503Z525-CDH |
| A6A4C5 | 0160-3453 | | C:FXD CER 0.05 UF +80-20% 100VDCW | 56289 | C023A101L503Z525-CDH |
| A6A4C6 | 0180-0230 | | C:FXD ELECT 1.0 UF 20% 50VDCW | 56289 | 150D105X0050A2-DYS |
| A6A4C7 | 0180-0230 | | C:FXD ELECT 1.0 UF 20% 50VDCW | 56289 | 150D105X0050A2-DYS |
| A6A4C8 | 0160-3451 | | C:FXD CER 0.01 UF +80-20% 100VDCW | 56289 | C023B101F103Z525-CDH |
| A6A4C9 | 0160-3451 | | C:FXD CER 0.01 UF +80-20% 100VDCW | 56289 | C023B101F103Z525-CDH |
| A6A4CR1 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A6A4CR2 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A6A4CR3 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A6A4CR4 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A6A4CR5 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A6A4CR6 | 1901-0535 | | DIODE:HYBRID HOT CARRIER | 28480 | 1901-0535 |
| A6A4CR7 | 1901-0535 | | DIODE:HYBRID HOT CARRIER | 28480 | 1901-0535 |
| A6A4J1 | 1251-1604 | 2 | CONNECTOR:PC EDGE 1 ROW 22 CONTACT | 71785 | 252-22-30-310 |
| A6A4J2 | 1251-1604 | | CONNECTOR:PC EDGE 1 ROW 22 CONTACT | 71785 | 252-22-30-310 |
| A6A4Q1 | 1854-0019 | | TSTR:SI NPN | 28480 | 1854-0019 |
| A6A4Q2 | 1854-0019 | | TSTR:SI NPN | 28480 | 1854-0019 |
| A6A4Q3 | 1853-0036 | | TSTR:SI PNP | 80131 | 2N3906 |
| A6A4Q4 | 1853-0036 | | TSTR:SI PNP | 80131 | 2N3906 |
| A6A4R1 | 2100-1760 | | R:VAR WW 5K OHM 5% TYPE V 1W | 28480 | 2100-1760 |
| A6A4R2 | 2100-1762 | 5 | R:VAR WW 20K 5% 1W | 75042 | CT-106-4 |
| A6A4R3 | 0757-0438 | | R:FXD MET FLM 5.11K OHM 1% 1/8W | 28480 | 0757-0438 |
| A6A4R4 | 0757-0446 | | R:FXD MET FLM 15.0K OHM 1% 1/8W | 28480 | 0757-0446 |
| A6A4R5 | 0757-0441 | 1 | R:FXD MET FLM 8.25K OHM 1% 1/8W | 28480 | 0757-0441 |
| A6A4R6 | 0757-0465 | | R:FXD MET FLM 100K OHM 1% 1/8W | 28480 | 0757-0465 |
| A6A4R7 | 0757-0472 | 1 | R:FXD MET FLM 200K OHM 1% 1/8W | 28480 | 0757-0472 |
| A6A4R8 | 0757-0444 | | R:FXD MET FLM 12.1K OHM 1% 1/8W | 28480 | 0757-0444 |
| A6A4R9 | 0757-0273 | | R:FXD MET FLM 3.01K OHM 1% 1/8W | 28480 | 0757-0273 |
| A6A4R10 | 0757-0273 | | R:FXD MET FLM 3.01K OHM 1% 1/8W | 28480 | 0757-0273 |
| A6A4R11 | 0757-0458 | 3 | R:FXD MET FLM 51.1K OHM 1% 1/8W | 28480 | 0757-0458 |
| A6A4R12 | 0757-0283 | | R:FXD MET FLM 2.00K OHM 1% 1/8W | 28480 | 0757-0283 |
| A6A4R13 | 0757-0283 | | R:FXD MET FLM 2.00K OHM 1% 1/8W | 28480 | 0757-0283 |
| A6A4R14 | 0757-0446 | | R:FXD MET FLM 15.0K OHM 1% 1/8W | 28480 | 0757-0446 |
| A6A4R15 | 0757-0446 | | R:FXD MET FLM 15.0K OHM 1% 1/8W | 28480 | 0757-0446 |
| A6A4R16 | 0757-0273 | | R:FXD MET FLM 3.01K OHM 1% 1/8W | 28480 | 0757-0273 |
| A6A4R17 | 0757-0753 | 2 | R:FXD MET FLM 9.09K OHM 1% 1/4W | 28480 | 0757-0753 |
| A6A4R18 | | | DELETED | | |
| A6A4R19 | | | DELETED | | |
| A6A4R20 | 0757-0753 | | R:FXD MET FLM 9.09K OHM 1% 1/4W | 28480 | 0757-0753 |
| A6A4R21 | 2100-1755 | 1 | R:VAR WW 100 OHM 5% TYPE V 1W | 28480 | 2100-1755 |
| A6A4R22 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A6A4R23 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A6A4R24 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A6A4R25 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A6A4R26 | 0757-0408 | 1 | R:FXD MET FLM 243 OHM 1% 1/8W | 28480 | 0757-0408 |
| A6A4R27 | 0684-5611 | | R: FXD COMP 560 OHM 10% 1/4W | 01121 | CB 5611 |
| A6A5 | 01700-66523 | 1 | BOARD ASSY:SWEEP TIME | 28480 | 01700-66523 |
| A6A5C1 | 0160-3354 | | C:FXD POLY 10 UF +5-15% 100VDCW | 84411 | MEW 247 |
| A6A5C2 | 0160-2432 | | C:FXD POLY 0.1 UF 5% 100VDCWW | 84411 | 863T |
| A6A5C3 | 0160-2218 | 2 | C:FXD MICA 1000 PF 5% | 28480 | 0160-2218 |
| A6A5C4 | 0160-3451 | | C:FXD CER 0.01 UF +80-20% 100VDCW | 56289 | C023B101F103Z525-CDH |
| A6A5C5 | 0160-3451 | | C:FXD CER 0.01 UF +80-20% 100VDCW | 56289 | C023B101F103Z525-CDH |
| A6A5C6 | 0160-3443 | 2 | C:FXD CER 0.1 UF +80-20% 50VDCW | 72982 | 8131-050-651-104Z |
| A6A5C7 | 0160-3443 | | C:FXD CER 0.1 UF +80-20% 50VDCW | 28480 | 8131-050-651-104Z |
| A6A5MP1 | 0510-1101 | 2 | SPRING: RETAINER (PC SWITCH) | 28480 | 0510-1101 |
| A6A5MP2 | 1460-1148 | 2 | SPRING: TORSION | 28480 | 1460-1148 |
| A6A5MP3 | 01840-22502 | 2 | ROLLER: DETENT | 28480 | 01840-22502 |
| A6A5Q1 | 1854-0221 | 1 | TSTR:SI NPN(MFPL.BY 2N4044) | 72982 | 1854-0221 |
| A6A5Q2 | 1853-0086 | 1 | TSTR:SI PNP | 80131 | 2N5087 |
| A6A5Q3 | 1853-0049 | 1 | TSTR:SI PNP | 28480 | 1853-0049 |
| A6A5R1 | 0757-0779 | | R:FXD MET FLM 150K OHM 1% 1/4W | 28480 | 0757-0779 |
| A6A5R2 | 0757-0156 | 3 | R:FXD MET FLM 1.5 MEGOHM 1% 1/2W | 28480 | 0757-0156 |
| A6A5R3 | 0757-0779 | 4 | R:FXD MET FLM 150K OHM 1% 1/4W | 28480 | 0757-0779 |
| A6A5R4 | 0757-0156 | | R:FXD MET FLM 1.5 MEGOHM 1% 1/2W | 28480 | 0757-0156 |
| A6A5R5 | 0698-8131 | | R:FXD FLM 150K OHM 0.1% 1/4W | 28480 | 0698-8131 |
| A6A5R6 | 0757-0156 | 2 | R:FXD MET FLM 1.5 MEGOHM 1% 1/2W | 28480 | 0757-0156 |
| A6A5R7 | 0687-1231 | | R:FXD COMP 12K OHM 10% 1/2W | 01121 | EB 1231 |
| A6A5R8 | 0698-8131 | 1 | R:FXD FLM 150K OHM 0.1% 1/4W | 28480 | 0698-8131 |
| A6A5R9 | 0757-0156 | | R:FXD MET FLM 1.5 MEGOHM 1% 1/2W | 28480 | 0757-0156 |
| A6A5R10 | 0757-0465 | | R:FXD MET FLM 100K OHM 1% 1/8W | 28480 | 0757-0465 |
| A6A5R11 | 0757-0460 | 1 | R:FXD MET FLM 61.9K OHM 1% 1/8W | 28480 | 0757-0460 |
| A6A5R12 | 0757-0462 | 1 | R:FXD MET FLM 75.0K OHM 1% 1/8W | 28480 | 0757-0462 |
| A6A5R13 | 2100-1762 | | R:VAR WW 20K 5% 1W | 75042 | CT-106-4 |
| A6A5R14 | 2100-1762 | | R:VAR WW 20K 5% 1W | 75042 | CT-106-4 |
| A6A5R15 | 2100-1762 | | R:VAR WW 20K 5% 1W | 75042 | CT-106-4 |
| A6A5R16 | 2100-1762 | | R:VAR WW 20K 5% 1W | 75042 | CT-106-4 |
| A6A5R17 | 0684-1541 | 1 | R:FXD COMP 150K OHM 10% 1/4W | 01121 | CB 1541 |
| A6A5R18 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A6A5R19 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A6A5R20 | 0757-0779 | | R:FXD MET FLM 150K OHM 1% 1/4W | 28480 | 0757-0779 |

See introduction to this section for ordering information

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

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A6A5S1MP1 | 3130-0354 | 2 | ROTOR ASSY:MALE | 28480 | 3130-0354 |
| A6A5S1MP2 | 3130-0355 | 2 | ROTOR ASSY:FEMALE | 28480 | 3130-0355 |
| A6A6 | 01700-66527 | | BOARD ASSY:HORIZONTAL OUT , AMPL | 28480 | 01700-66527 |
| A6A6C1 | 0160-2235 | 2 | C:FXD CER 0.75 PF 500VC | 72982 | 301-000-COK0-758C |
| A6A6C2 | 0160-3453 | | C:FXD CER 0.05 UF +80- , 100VDCW | 56289 | C023A101L503ZS25-COH |
| A6A6C3 | 0160-3453 | | C:FXD CER 0.05 UF 20% 100VDCW | 56289 | C023A101L503ZS25-COH |
| A6A6C4 | 0160-2235 | | C:FXD CER 0.75 PF 500VDCW | 72982 | 301-000-COK0-758C |
| A6A6C5 | 0160-3451 | | C:FXD CER 0.01 UF +80-20% 100VDCW | 56289 | C023B101F103ZS25-COH |
| A6A6C6 | 0160-3451 | | C:FXD CER 0.01 UF +80-20% 100VDCW | 56289 | C023B101F103ZS25-COH |
| A6A6C7 | 0160-3451 | | C:FXD CER 0.01 UF +80-20% 100VDCW | 56289 | C023B101F103ZS25-COH |
| A6A6C8 | 0160-3451 | | C:FXD CER 0.01 UF +80-20% 100VDCW | 56289 | C023B101F103ZS25-COH |
| A6A6C9 | 0160-3622 | 2 | C:FXD CER 0.1 UF +80-20% 100VDCW | 72982 | 8131-100-651-104Z |
| A6A6C10 | 0160-3622 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 72982 | 8131-100-651-104Z |
| A6A6Q1 | 1853-0036 | | TSTR:SI PNP | 80131 | 2N3906 |
| A6A6Q2 | 1853-0036 | | TSTR:SI PNP | 80131 | 2N3906 |
| A6A6Q3 | 1854-0215 | | TSTR:SI NPN | 80131 | 2N3904 |
| A6A6Q4 | 1854-0215 | | TSTR:SI NPN | 80131 | 2N3904 |
| A6A6Q5 | 1854-0271 | 2 | TSTR:SI NPN | 28480 | 1854-0271 |
| A6A6Q6 | 1854-0271 | | TSTR:SI NPN | 28480 | 1854-0271 |
| A6A6Q7 | 1853-0037 | 2 | TSTR:SI PNP | 04713 | SS 2109 |
| A6A6Q8 | 1853-0037 | | TSTR:SI PNP | 04713 | SS 2109 |
| A6A6R1 | 0757-0449 | | R:FXD FLM 20K OHM 1% 1/8W | 28480 | 0757-0449 |
| A6A6R2 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A6A6R3 | 0684-3901 | | R:FXD COMP 39 OHM 10% 1/4W | 01121 | CB 3901 |
| A6A6R4 | 0757-0449 | | R:FXD FLM 20K OHM 1% 1/8W | 28480 | 0757-0449 |
| A6A6R5 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A6A6R6 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A6A6R7 | 0757-0458 | | R:FXD MET FLM 51.1K OHM 1% 1/8W | 28480 | 0757-0458 |
| A6A6R8 | 0757-0458 | | R:FXD MET FLM 51.1K OHM 1% 1/8W | 28480 | 0757-0458 |
| A6A6R9 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A6A6R10 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A6A6R11 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A6A6R12 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A6A6R13 | 0757-0273 | | R:FXD MET FLM 3.01K OHM 1% 1/8W | 28480 | 0757-0273 |
| A6A6R14 | 0757-0273 | | R:FXD MET FLM 3.01K OHM 1% 1/8W | 28480 | 0757-0273 |
| A6A6R15 | 0757-0416 | | R:FXD MET FLM 511 OHM 1% 1/8W | 28480 | 0757-0416 |
| A6A6R16 | 0757-0416 | | R:FXD MET FLM 511 OHM 1% 1/8W | 28480 | 0757-0416 |
| A6A6VR1 | 1902-0041 | | DIODE:BREAKDOWN 5.11V 5% | 04713 | SZ10939-98 |
| A6A7 | 01700-66524 | | BOARD ASSY:HOLDOFF | 28480 | 01700-66524 |
| A6A7C1 | 0180-0374 | 1 | C:FXD TANT, 10 UF 10% 20VDCW | 56289 | 150D106X9020B2-DYS |
| A6A7C2 | 0180-1743 | 1 | C:FXD ELECT 0.1 UF 10% 35VDCW | 56289 | 150D104X9035A2-DYS |
| A6A7C3 | 0160-2218 | | C:FXD MICA 1000 PF 5% | 28480 | 0160-2218 |
| A6A7C4 | 0140-0203 | | C:FXD MICA 30 PF 5% | 28480 | 0140-0203 |
| A6A7C5 | 0180-0197 | | C:FXD ELECT 2.2 UF 10% 20VDCW | 56289 | 150D225X9020A2-DYS |
| A6A7C6 | 0180-0210 | | C:FXD ELECT 1.0 UF 20% 50VDCW | 56289 | 150D105X0050A2-DYS |
| A6A7C7 | 0160-0161 | 1 | C:FXD MY 0.01 UF 10% 200VDCW | 56289 | 192P10392-PTS |
| A6A7C8 | 0160-2204 | | C:FXD MICA 100PF 5% | 72136 | RDM15F101J3C |
| A6A7CR1 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A6A7CR2 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A6A7CR3 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A6A7CR4 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A6A7MP1 | 0510-1101 | | SPRING: RETAINER (PC SWITCH) | 28480 | 0510-1101 |
| A6A7MP2 | 1460-1148 | | SPRING: TORSION | 28480 | 1460-1148 |
| A6A7MP3 | 01840-22502 | | ROLLER: DETENT | 28480 | 01840-22502 |
| A6A7Q1 | 1854-0215 | | TSTR:SI NPN | 80131 | 2N3904 |
| A6A7Q2 | 1853-0036 | | TSTR:SI PNP | 80131 | 2N3906 |
| A6A7Q3 | 1853-0036 | | TSTR:SI PNP | 80131 | 2N3906 |
| A6A7R1 | 0684-2231 | | R:FXD COMP 22K OHM 10% 1/4W | 01121 | CB 2231 |
| A6A7R2 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A6A7R3 | 0684-1021 | | R:FXD COMP 1000 OHM 10% 1/4W | 01121 | CB 1021 |
| A6A7R4 | 0684-2211 | | R:FXD COMP 220 OHM 10% 1/4W | 01121 | CB 2211 |
| A6A7R5 | 0757-0465 | | R:FXD MET FLM 100K OHM 1% 1/8W | 28480 | 0757-0465 |
| A6A7R6 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A6A7R7 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A6A7S1MP1 | 3130-0354 | 1 | ROTOR ASSY:FEMALE | 28480 | 3130-0352 |
| A6A7S1MP2 | 3130-0355 | 1 | ROTOR ASSY:MALE | 28480 | 3130-0353 |
| A6A8 | 01700-66525 | | BOARD ASSY:EXT HORIZONTAL | 28480 | 01700-66525 |
| A6A8MP1 | 0510-1101 | | SPRING: RETAINER (PC SWITCH) | 28480 | 0510-1101 |
| A6A8MP2 | 1460-1148 | | SPRING: TORSION | 28480 | 1460-1148 |
| A6A8MP3 | 01840-22502 | | ROLLER: DETENT | 28480 | 01840-22502 |
| A6A8S1MP1 | 3130-0350 | | ROTOR ASSY: FEMALE | 28480 | 3130-0350 |
| A6A8S1MP2 | 3130-0351 | | ROTOR ASSY: MALE | 28480 | 3130-0351 |
| A7 | 01701-26520 | | BOARD ASSY: SCALE ILLUM | 28480 | 01701-26520 |
| A8 | 10163A 030 | 1 | COVER:WITH ALL ACCESSORIES | 28480 | 10163A 030 |
| A8MP1 | 5060-0542 | 1 | COVER ASSY | 28480 | 5060-0542 |
| A8W1 | 01700-61606 | 1 | CABLE ASSY:AC POWER | 28480 | 01700-61606 |
| A8W2 | 01700-61607 | 1 | CABLE ASSY:ADAPTER | 28480 | 01700-61607 |
| A8W3 | 01700-61610 | 1 | CABLE ASSY:DC POWER | 28480 | 01700-61610 |
| A8A1 | 10006B C30 | | PROBE 10:1 DIVIDER | 28480 | 10006B030 |
| A8A1MP1 | 10004-61301 | 2 | LEAD ASSY:GROUND | 28480 | 10004-61301 |

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

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A8A1MP2 | 10004-67701 | 2 | BODY ASSY | 28480 | 10004-67701 |
| A8A1MP3 | 10006-62101 | 2 | PROBE ASSY | 28480 | 10006-62101 |
| A8A1MP4 | 10006-69502 | 2 | ATTEN ASSY | 28480 | 10006-69501 |
| A8A1MP5 | 5060-0468 | 2 | CUP:ALLIGATOR | 28480 | 5060-0468 |
| A8A1MP6 | 10004-67604 | 2 | ASSY:HOOK TIP | 28480 | 10004-67604 |
| A8A1MP7 | 1251-0013 | 2 | CONNECTOR:BANANA, SINGLE MALE CONTACT | 74970 | 108-753 |
| A8A1MP8 | 5060-0449 | 2 | ADAPTER | 28480 | 5060-0449 |
| A8A1MP9 | 5060-0420 | 2 | SPRING TIP ASSY | 28480 | 5060-0420 |
| A8A1W1 | 10006-61601 | 2 | CABLE ASSY:PROBE | 28480 | 10006-61601 |
| A8A2 | 10163-69501 | 1 | ACCESSORY KIT | 28480 | 10163-69501 |
| A8A2F1 | 2110-0303 ? | 1 | FUSE: CARTRIDGE 2A 250V SLOW-BLOW (DC LINE SPARE) | 71400 | MDX-2A |
| A8A2F2 | 2110-0016 | 2 | FUSE:0.6A 250V SLOW-BLOW (115V SPARE) | 75915 | 313-600S |
| A8A2F2 | 2110-0044 | 1 | FUSE:0.30A 250V SLOW-BLOW (230V OPERATION) | 28480 | 2110-0044 |
| A8A2MP1 | 10110-60002 | 1 | ADAPTER:BNC TO BINDING POST | 28480 | 10110-60002 |
| A8A2MP2 | 1250-0069-9 | 2 | ADAPTER:UHF FEMALE TO BNC MALE | 28480 | 1250-0069-9 |
| A8A2MP3 | 1250-0071-9 | 2 | ADAPTER:BNC FEMALE TO UHF MALE | 28480 | 1250-0071-9 |
| A8A2MP4 | 1250-0072-9 | 2 | ADAPTER | 28480 | 1250-0072-9 |

Table 6-3. List of Manufacturers' Codes

| MFR NO. | MANUFACTURER NAME | ADDRESS | ZIP CODE |
|---|---|---|---|
| 00000 | U.S.A. COMMON | ANY SUPPLIER OF U.S.A. | |
| 00853 | SANGAMO ELECTRIC CO.PICKENS DIV. | PICKENS, S.C. | 29671 |
| 01121 | ALLEN BRADLEY CO. | MILWAUKEE, WIS. | 53204 |
| 01538 | SMALL PARTS INC. | COSTA MESA, CALIF. | 92626 |
| 02660 | AMPHENOL CORP. | BROADVIEW, ILL. | 60153 |
| 02735 | RCA SOLID STATE & RECEIVING TUBE DIV. | SOMERVILLE, N.J. | 08876 |
| 04009 | ARROW, HART & HEGEMAN ELECT. CO. | HARTFORD, CONN. | 06106 |
| 04713 | MOTOROLA SEMICONDUCTOR PROD.INC. | PHOENIX, ARIZ. | 85008 |
| 07263 | FAIRCHILD CAMERA & INST. CORP. SEMICONDUCTOR DIV. | MOUNTAIN VIEW, CALIF. | 94040 |
| 08806 | G.E. CO. MINIATURE LAMP DEPT. | CLEVELAND, OHIO | 44112 |
| 09134 | TEXAS CAPACITOR CO. INC. | HOUSTON, TEX. | 77042 |
| 12040 | NATIONAL SEMICONDUCTOR CORP. | DANBURY, CONN. | 06810 |
| 13103 | THERMALLOY CO. | DALLAS, TEX. | 75247 |
| 16037 | SPRUCE PINE MICA CO. | SPRUCE PINE, N.C. | 28777 |
| 24931 | SPECIALTY CONNECTOR CO. INC. | INDIANAPOLIS, IND. | 46227 |
| 27264 | MOLEX PROD. CO. | DOWNERS GROVE, ILL. | 60515 |
| 28480 | HEWLETT-PACKARD CO. CORPORATE HQ | YOUR NEAREST HP OFFICE | |
| 50439 | HEWLETT-PACKARD CO. COLORADO SPRINGS DIV. | COLORADO SPRINGS, COLO | 80907 |
| 56289 | SPRAGUE ELECTRIC CO. | N. ADAMS, MASS. | 01247 |
| 66295 | WITTEK MFG. CO. | CHICAGO, ILL. | 60623 |
| 71590 | GLOBE UNION INC. CENTRALAB DIV. | MILWAUKEE, WISC. | 53201 |
| 71785 | CINCH MFG. CO. DIV TRW INC. | ELK GROVE VILLAGE, ILL. | |
| 72136 | ELECTRO MOTIVE MFG. CO. INC. | WILLIMANTIC, CONN. | 06226 |
| 72765 | DRAKE MFG. CO. | HARWOOD HEIGHTS, ILL. | 60656 |
| 72825 | FRY HUGH H. INC. | PHILADELPHIA, PA. | 19144 |
| 72982 | ERIE TECHNOLOGICAL PROD. INC. | ERIE, PA. | 16512 |
| 74970 | JOHNSON E.F. CO. | WASECA, MINN. | 56093 |
| 75042 | INTERNATIONAL RESISTANCE CO. INC. | PHILADELPHIA, PA. | 19108 |
| 75915 | LITTELFUSE INC. | DES PLAINES, ILL. | 60016 |
| 78553 | TINNERMAN PROD. INC. | CLEVELAND, OHIO | 44129 |
| 80131 | ELECTRONIC INDUSTRIES ASSOCIATION | WASHINGTON D.C. | 20006 |
| 82142 | AIRCO SPEER ELECT. COMP. | DU BOIS, PA. | 15801 |
| 83298 | BENDIX CORP. ELECTRIC POWER DIV. | EATONTOWN, N.J. | 07724 |
| 84411 | TRW CAPACITOR DIV. | OGALLALA, NEBR. | 69153 |
| 91418 | RADIO MATERIALS CO. | CHICAGO, ILL. | 60646 |
| 91506 | AUGAT INC. | ATTLEBORO, MASS. | 02703 |
| 95146 | ALCO ELECT. PROD. INC. | LAWRENCE, MASS. | 01843 |
| 97534 | A.P.M. HEXSEAL CORP. | ENGLEWOOD N.J. | 07631 |

See introduction to this section for ordering information

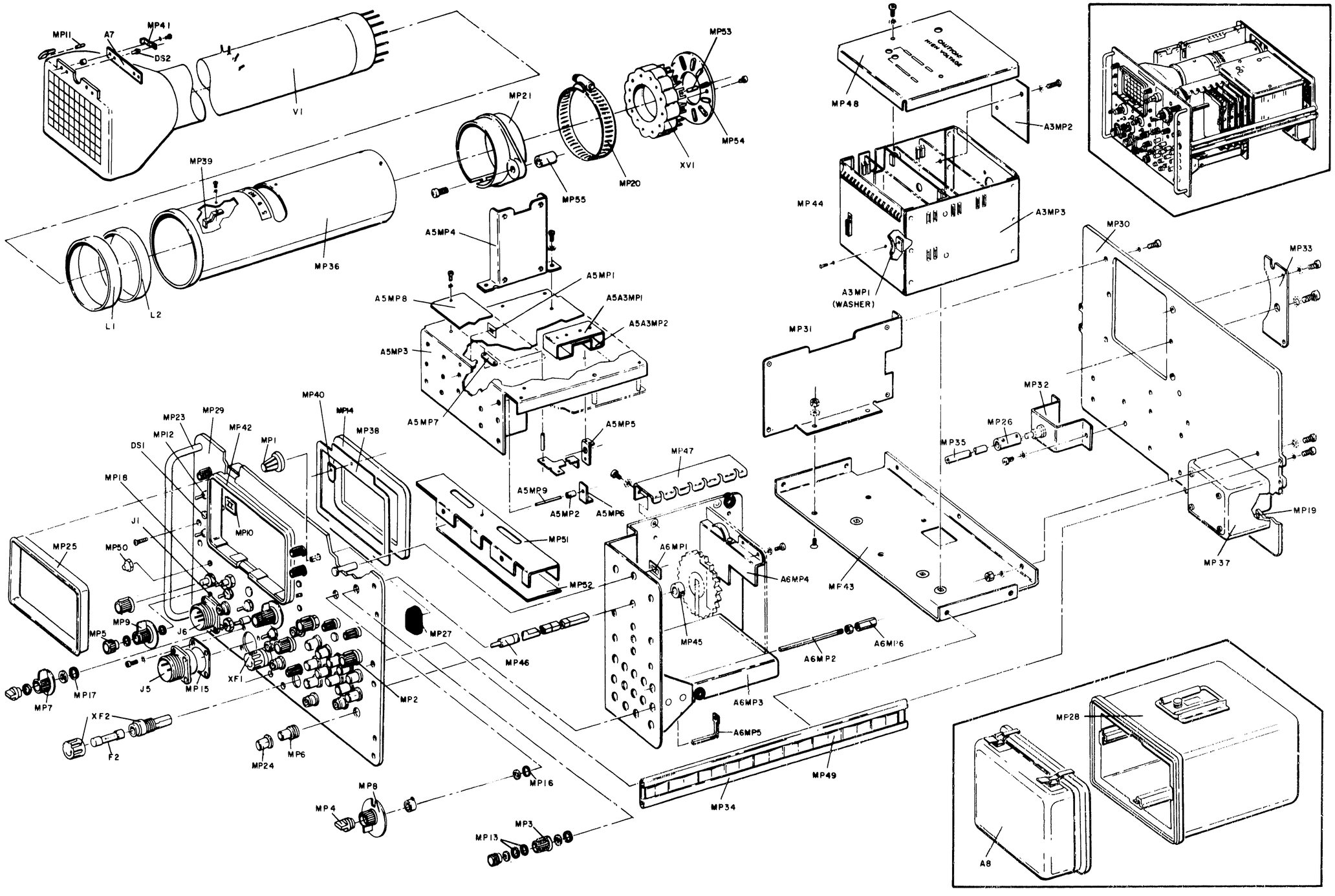



Figure 6-1. Parts Identifications

# SECTION VII

# MANUAL CHANGES AND OPTIONS

## 7-1. INTRODUCTION.

7-2. This section contains information required to backdate or update this manual for a specific instrument. Descriptions of special options and standard options are also in this section.

## 7-3. MANUAL CHANGES.

7-4. This manual applies directly to the instrument having the same serial prefix shown on the title page. If the serial prefix of the instrument is not the same as the one on the title page, refer to the manual replacement pages in the front of this manual. Replace the pages in the manual with new pages.

## 7-5. SPECIAL OPTIONS.

7-6. Most customer special application requirements and/or specifications can be met by factory modification of a standard instrument. A standard instrument modified in this way will carry a special option number, such as Model 0000A/Option C01.

7-7. An operating and service manual and a manual insert are provided with each special option instrument. The operating and service manual contains information about the standard instrument. The manual insert for the special option describes the factory modifications required to produce the special option instrument. Amend the operating and service manual by changing it to include all manual insert information. When these changes are made, the operating and service manual will apply to the special option instrument.

7-8. If you have ordered a special option instrument and the manual insert is missing, notify the nearest Hewlett-Packard Sales/Service Office. Be sure to give a full description of the instrument, including the complete serial number and special option number.

## 7-9. STANDARD OPTIONS

7-10. Standard options are modifications installed on HP instruments at the factory and are available on request. Table 7-1 lists the Option 300 standard options.

Table 7-1. Option 300 Standard Options

| Option | Description | HP Part No. |
|---|---|---|
| 001 | Instrument set at factory for 230V operation:<br>Fuse, .25 ASB for 230-volt operation. | Fuse: 2110-0018 |
| C12 | Standard Option 300 with Model 10103B Battery Pack. | Model 10103B<br>Battery Pack |

# SECTION VIII

# SCHEMATICS AND TROUBLESHOOTING

## 8-1. INTRODUCTION.

8-2. This section contains schematics, repair and replacement information, component-identification illustrations, waveforms, and test conditions. Table 8-9 defines symbols and conventions used on the schematics. A disassembly procedure for removing the CRT and instrument modules for repair and replacement is also contained in this section.

## 8-3. SCHEMATICS.

8-4. Schematics are printed on foldout pages for easy reference to the text and figures in other sections. The schematics are drawn to show the electronic function of the circuits. Any one schematic may include all or part of several different physical assemblies. Non MIL-standard symbols and conventions used in the schematics are defined in table 8-9.

8-5. The schematics are numbered in sequence with a bold number in a box at the lower right-hand corner of each page. These numbers are used to cross reference signal connections between the schematics. At each circuit breaking point, a number in a circle is shown, followed by another number in bold type. The circled number indicates the signal or circuit and the bold number indicates the associated schematic that contains the source or destination of the signal. To find the source or destination of the signal, turn to the indicated schematic and find the circled number in question.

8-6. A table on each schematic lists all components shown on the schematic by reference designation. Component reference designators that have been deleted from the schematic are listed below the table.

8-7. All components within the bordered areas on the schematic are physically located on etched circuit boards. Components not physically located on an etched circuit board are shown in the unbordered areas of the schematic.

## 8-8. REFERENCE DESIGNATIONS.

8-9. The unit system of reference designations used in this manual is in accordance with the provisions of USA Standard Y32. 16-1968, Reference designations for Electrical and Electronics Parts and Equipments, dated March 1, 1968. Minor variations from the standard, due to design and manufacturing practices, may be noted.

8-10. Each electrical component is assigned a class letter and a number. This letter-number combination is the basic reference designation. Components which are part of an assembly have, in addition to the basic designation, a prefix designation indicating the assembly of which the component is a part. For instance, resistor R23 on assembly A1 is called A1R23.

8-11. Assemblies are numbered consecutively. If an assembly reference designation is assigned and later deleted, that number is not reused.

## 8-12. COMPONENT LOCATIONS.

8-13. Locations of components on assemblies and subassemblies are illustrated on photographs adjacent to the schematics. Since the schematics are drawn to show function, portions of a particular assembly may appear on several different schematics. The component-location photograph is printed next to the schematic that shows most of the circuitry on the assembly. In some cases, a particular component-location photograph may appear adjacent to more than one schematic.

8-14. Components located on the chassis are identified in figures 8-4 and 8-5. The locations of adjustments are shown in Section V.

## 8-15. PREVENTIVE MAINTENANCE.

8-16. Preventive maintenance consists of periodic performance checks, calibration, mechanical inspection, lubrication, and other services designed to prevent breakdown and failure. Performance checks and calibration are covered in Section V of this manual. The other preventive maintenance services are covered in the following paragraphs.

### 8-17. MECHANICAL INSPECTION.

8-18. Inspect the Option 300 in accordance with table 8-1, and the following inspection procedures:

a. Check case exterior for dents or cracks.

b. Check latches and carring handle for damage.

c. Check rubber seal between front panel and carrying case for tears, cracks or other damage.

d. Check front panel for following items:

(1). Hardware is secure.

(2). All controls operate freely.

(3). Connectors are not bent, loose or pins are not corroded.

e. Verify that all accessories are available in storage cover.

f. Check accessory probes and cables for bent pins, broken wires, cracks, foreign matter in connectors and other damage.

g. Check adapters for bent pins, broken wires, cracks, foreign matter in connectors and other damage.

Table 8-1. Inspection Requirements

| INSPECT | CHECK FOR | REMEDIAL ACTION |
|---|---|---|
| Chassis | Dents, scratches, deformation corrosion, damaged hardware, illegible silkscreening. | Straighten, touch up paint, remove corrosion, replace damaged hardware, touch up silkscreening. |
| Connectors | Broken shells, cracked insulation, deformed contacts, corrosion, faulty solder. | Replace shells, insulation and contacts; remove corrosion, resolder as necessary. |
| Resistors | Cracked, broken, blistered, or charred bodies; poor connections. | Replace faulty resistors, resolder as necessary. |
| Transformers | Overheating, case damage, poor terminal connections, damaged hardware. | Replace defective transformers, resolder terminals as required, replace damaged or missing hardware. |
| Soldered Connections | Cold solder or resin joints, as indicated by rough, dull appearance; excess solder, solder particles adhering to insulation and components. | Resolder faulty connections, remove excess solder and traces of corrosion. |
| Wiring | Charring and physical damage, lead dress in relation to chassis and wiring. | Replace damaged wires, insulate bare wire that may contact chassis or other metal parts. |
| Storage cover | Dents, scratches, corrosion, damaged fasteners. | Straighten, touch up paint, remove corrosion, replace damaged fasteners. |
| Gaskets | Tears, creases, folds, rough surface, elongation. | Replace damaged gaskets. |
| Capacitors | Case damage. Loose, broken, or corroded terminal studs, lugs, or leads. Poor solder. | Replace capacitor if case is damaged. Clean corrosion, repair solder joints. |
| Printed Circuit Boards | Loose, broken, corroded, or poorly soldered terminal connections. Inspect printed circuits for any evidence of damage, such as burned, broken, cracked, or corroded plating. Inspect for loose mounting. | Resolder terminals, repair cracks, or other damage. Tighten loose mountings. |
| Semi-Conductors | Mechanical damage. Loose, broken, poorly soldered or corroded terminals. | Replace or repair. Clean and resolder terminals where indicated. |

### 8-19. SWITCH MAINTENANCE.

8-20. The pushbutton switches used in this instrument have been designed for long, trouble-free service. In the event that one of these switches becomes defective, replacement rather than repair is recommended.

8-21. The rotary switches in this instrument can easily be serviced after removal of the assembly on which the switch is mounted. In the case of the TIME/DIV switch, the TIME/DIV switch shaft must be removed. Refer to the paragraphs on repair and replacement in this section for instructions on disassembly of the modules in the instrument.

8-22. Conventional rotary switches are serviced by cleaning the contacts with a degreaser such as MS-180 FREON TF DEGREASER produced by Miller-Stevenson Chemical Company. The contact surfaces are then lubricated with a lubricant comparable to LUBRIPLATE FML produced by the Fiske Brothers Refining Company. LUBRIPLATE FML is available from the Hewlett-Packard Company. Order HP Part No. 6040-0305.

8-23. The switches on the sweep time assembly, horizontal mode assembly and holdoff assembly can be serviced as follows:

a. Remove TIME/DIV knob and shaft (paragraph 8-36).

b. Remove printed circuit board keeper from top of assemblies.

c. Remove assembly or assemblies to be serviced. See figure 8-5 for assembly locations.

d. Note orientation of open part of rotor section.

Note

The following steps use the main sweep time assembly (figure 8-28) as an example.

e. Remove retainer ring MP1.

f. Separate two rotor sections, S1MP1 and S1MP2, from etched circuit board.

g. Check contact area of etched circuit board. If contact area shows excessive wear, replace etched circuit board.

h. Check contacts on two rotor sections. If contacts show excessive wear, replace rotor.

i. Clean and lubricate contacts on etched circuit board and rotors as described in paragraph 8-22.

j. Place rotor sections on etched circuit board and reinstall retainer ring MP1.

k. Position open part of rotor section as noted in step d.

l. Reinstall TIME/DIV shaft and knob assembly.

## 8-24. REPAIR AND REPLACEMENT.

8-25. The following paragraphs provide procedures for removal and replacement of assemblies, subassemblies, and components. Special servicing instructions for the etched circuit boards are provided in paragraph 8-51. Section VI provides a detailed parts list for use in ordering replacement parts. Refer to table 8-8 for the location of a particular assembly.

### 8-26. CRT REMOVAL AND REPLACEMENT.

**WARNING**

To prevent personal injury, wear a face mask or goggles when handling the CRT. Wear protective gloves and handle the CRT carefully.

8-27. To remove and replace the CRT, proceed as follows:

a. Remove top and bottom covers from instrument.

b. Remove rear panel CRT socket cover.

c. Remove front panel CRT bezel by squeezing at midpoint on bottom and rotating outward and upward.

d. Remove filter if in use.

e. Remove two screws holding vertical amplifier shield and tilt to side of instrument.

f. Remove five wires from neck of CRT.

g. Remove two scale illumination wires from front of CRT.

**WARNING**

Failure to discharge high voltage can result in severe electrical shock and damage to instrument.

h. Unplug post-accelerator connector, and immediately discharge lead to ground.

i. Remove CRT shock mounting screws on rear panel.

j. Remove two screws from rear of CRT shield.

k. Loosen CRT clamp.

l. Carefully remove CRT socket.

m. Rotate shield and shock mount 45 degrees until shock mount flanges are in corners of square access opening of rear panel.

n. Pull shield back.

o. Place one hand on CRT face and use other hand to slide CRT toward rear of instrument until CRT can be raised upward and out of instrument.

p. To reinstall CRT, reverse removal procedure.

### 8-28. VERTICAL AMPLIFIER MODULE REMOVAL AND REPLACEMENT.

8-29. To remove the vertical amplifier module, proceed as follows:

a. Using allen wrench, loosen allen screws in POSITION, VOLTS/DIV, and MODE control knobs.

b. Remove control knobs.

c. Pull plastic covers from coupling switches.

d. Remove top and bottom covers from instrument.

e. Disconnect main harness wires from vertical preamplifier assembly.

f. Disconnect two wires from delay line to vertical output amplifier.

g. Remove two screws holding vertical output amplifier to vertical amplifier module.

h. Remove vertical output amplifier assembly.

i. Hold vertical preamplifier assembly.

j. Remove nuts on VOLTS/DIV and POSITION controls.

k. Gently lift vertical module assembly out.

l. To reinstall vertical amplifier module, reverse removal procedure.

### 8-30. DELAY LINE REMOVAL AND REPLACEMENT.

8-31. To remove the delay line from the vertical amplifier module, proceed as follows:

a. Remove vertical amplifier module as described in paragraph 8-28.

b. Unsolder two wires (red, blue) from end of delay line to vertical preamplifier assembly. Mark locations of wires to facilitate correct reassembly.

c. Remove two center screws from bottom side of vertical module (C, figure 8-1).

d. Rotate delay line slightly and remove.

Note

The two wires to the vertical output amplifier assembly go through a rubber grommet. These two wires must be carefully brought through the grommet during removal of the delay line.

e. To reinstall delay line, reverse removal procedure.

### 8-32. ATTENUATOR REMOVAL AND REPLACEMENT.

8-33. To remove the attenuator assemblies from the vertical amplifier module, proceed as follows:

a. Remove vertical amplifier module as described in paragraph 8-28.

b. Remove locking nuts (A, figure 8-1).

c. Remove six screws on bottom side of vertical amplifier module (B and C, figure 8-1).

d. Remove delay line as described in paragraph 8-30.

e. Unsolder C1 from BNC input connectors (figure 8-2).

f. Remove nuts holding BNC connectors to shield.

g. Remove BNC connectors.

h. Slide vertical preamplifier back from shield.

i. Raise vertical preamplifier up and unsolder components connected between attenuators and vertical preamplifier board.

j. Remove two screws for each attenuator from top side of preamplifier board.

k. Lift attenuators from board.

l. To reinstall attenuators, reverse removal procedure.

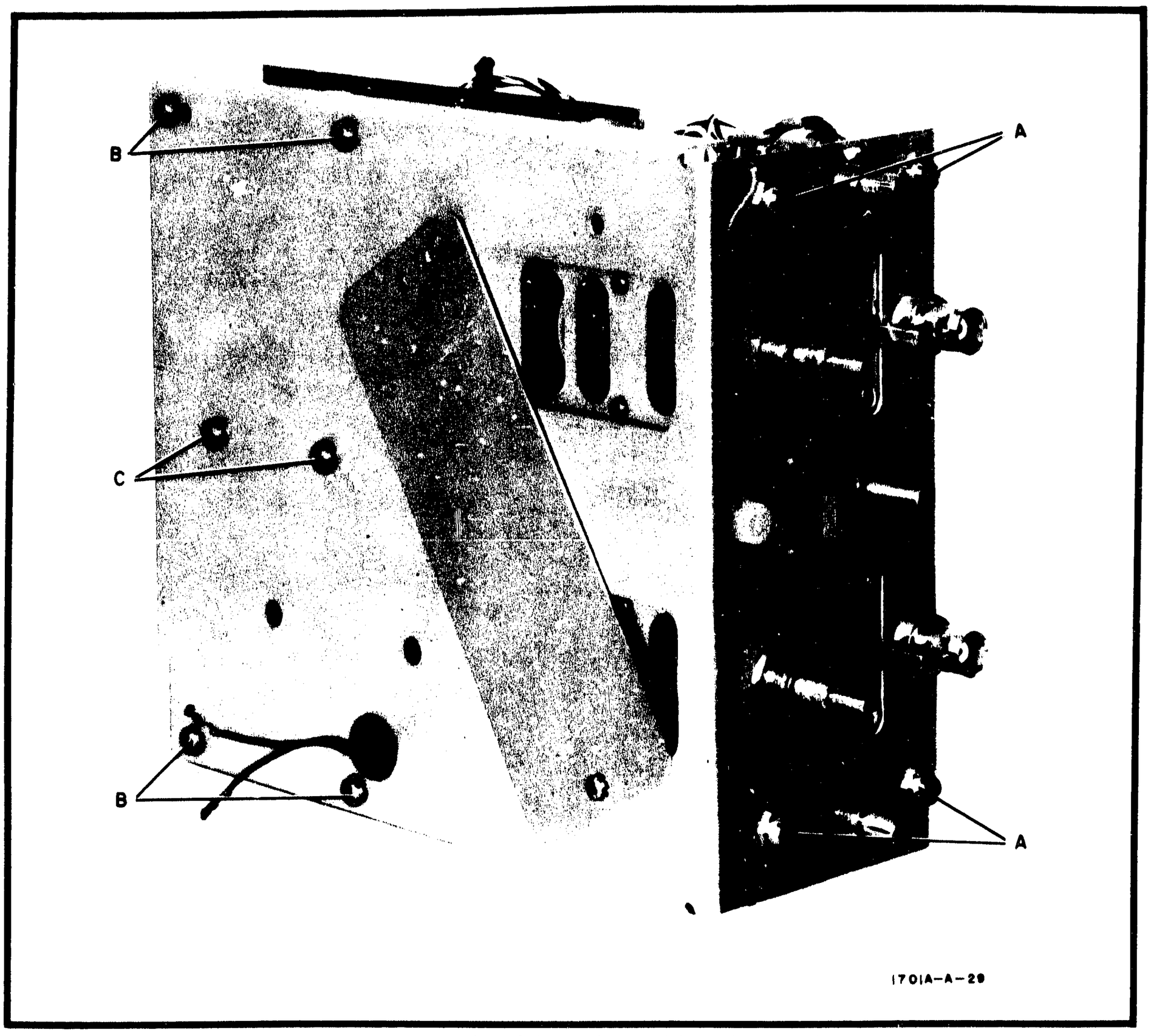



Figure 8-1. Vertical Module Mechanical Parts Removal

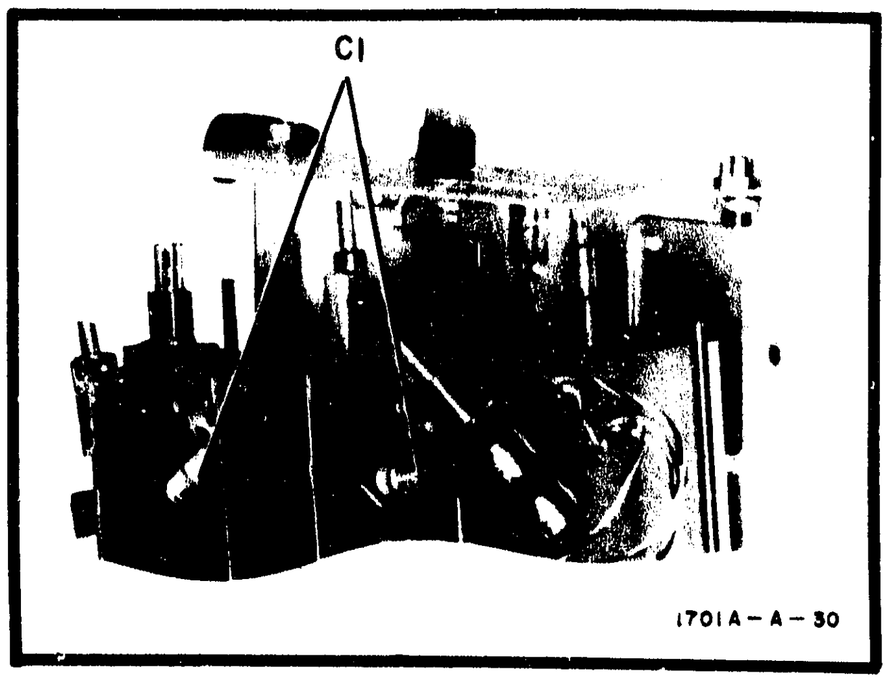



Figure 8-2. Attenuator Removal

## 8-34. REMOVAL AND REPLACEMENT OF ASSEMBLIES IN HORIZONTAL AMPLIFIER MODULE.

8-35. The following paragraphs provide information required to remove and replace the various assemblies in the horizontal amplifier module.

*8-36. TIME/DIV Switch Removal and Replacement.* To remove the TIME/DIV switch, proceed as follows:

a. Set TIME/DIV to .2 SEC.

b. Loosen locking collar setscrew on inside front panel of instrument.

c. Pull TIME/DIV shaft out.

d. To reinstall TIME/DIV shaft, reverse removal procedure.

*8-37. Plug-in Assemblies Removal and Replacement.* After removal of the TIME/DIV shaft, the five plug-in assemblies in the horizontal amplifier module can be removed as follows:

a. Remove etched circuit board keeper from top of assemblies.

b. Gently rock assemblies from side to side while pulling upward to remove from sockets.

c. To reinstall assemblies, reverse removal procedure.

*8-38. Trigger Assembly and Horizontal Mother Board Removal and Replacement.* To remove the trigger assembly and horizontal mother board,proceed as follows:

a. Remove TIME/DIV shaft as described in paragraph 8-36.

b. Remove assemblies as described in paragraph 8-37.

c. Disconnect wires (top and bottom) to horizontal preamplifier board.

d. Remove two screws from horizontal preamplifier board.

e. Disconnect wires to trigger assembly.

f. Separate horizontal amplifier from trigger assembly and horizontal mother board.

g. Remove horizontal preamplifier board.

h. Hold trigger assembly and remove four screws that hold assembly.

i. Carefully remove trigger assembly.

j. Horizontal mother board can be removed by disconnecting wires connected to it.

k. To reinstall, reverse removal procedure.

**8-39. POWER SUPPLY MODULE REMOVAL AND REPLACEMENT.**

8-40. To remove power supply module from instrument, proceed as follows:

a. Turn instrument off and remove power cord.

b. Remove top and bottom covers.

Note

Do not attempt to remove lead from CRT glass.

c. Unplug CRT post-accelerator lead.

d. Turn instrument on its side.

e. Remove battery if instrument is Option C12.

f. Unplug A3J1 connecting power supply to main cable.

g. Using #1 Pozidrive screwdriver, remove two flathead screws directly in front of power transformer T1.

h. To reinstall power supply module, reverse removal procedure.

**8-41. POWER SUPPLY MODULE DISASSEMBLY AND REASSEMBLY.**

8-42. To disassemble power supply module, proceed as follows:

a. Remove power box cover.

b. Using board puller furnished with service kit, hook on inside of standoffs between two low voltage boards and pull straight out.

c. Disconnect Q2 from low voltage mother board.

d. Disconnect both ends of wires from low voltage mother board to high voltage oscillator.

e. Remove four screws holding low voltage mother board.

f. Carefully compress sides of A3J1 to release it from power box.

g. Lift low voltage mother board from power box.

WARNING

Failure to discharge high voltage can result in severe electrical shock.

h. Discharge (to ground) high voltage points where high voltage wires are connected.

i. Disconnect wires from high voltage transistor.

j. Pull high voltage oscillator from power box.

k. To reinstall, reverse removal procedure.

**8-43. SEMICONDUCTOR REMOVAL AND REPLACEMENT.**

8-44. Figure 8-3 is included to help identify the leads on the common shapes and sizes of semiconductor

devices. When removing a semiconductor, use long-nosed pliers as a heat sink between the device and the soldering iron. When replacing a semiconductor, ensure sufficient lead length to dissipate the soldering heat by using the same length of exposed lead as used for the original part.

### 8-45. ATTENUATOR SERVICING.

8-46. A metal plate provides access to the attenuators. The plate is located under the front of the CRT. Service for the attenuators is accomplished by removing the CRT (paragraph 8-26) and metal plate. After the attenuators have been serviced, replace the metal plate and CRT.

### 8-47. CIRCUIT BOARDS.

8-48. The following paragraphs provide information regarding servicing procedures for etched circuit boards, use of heat sinks, and special soldering considerations.

### 8-49. BOARD CONNECTIONS.

8-50. Square-pin connectors are identified on circuit boards by the color code of the connecting wire. Connector pins on plugs and jacks are identified by either a numeral or a letter. The letters G, I, O, and Q have been omitted. Table 8-8 shows the types of board connections used in the instrument.

### 8-51. SERVICING ETCHED CIRCUIT BOARDS.

8-52. This instrument uses etched circuit boards with plated-through component holes. This allows components to be removed or replaced by unsoldering or soldering from either side of the board. When removing large components, such as potentiometers, rotate the soldering iron tip from lead to lead while applying pressure to the part to lift it from the board. HP Service Note M-20E contains additional information on repair of etched circuit boards.

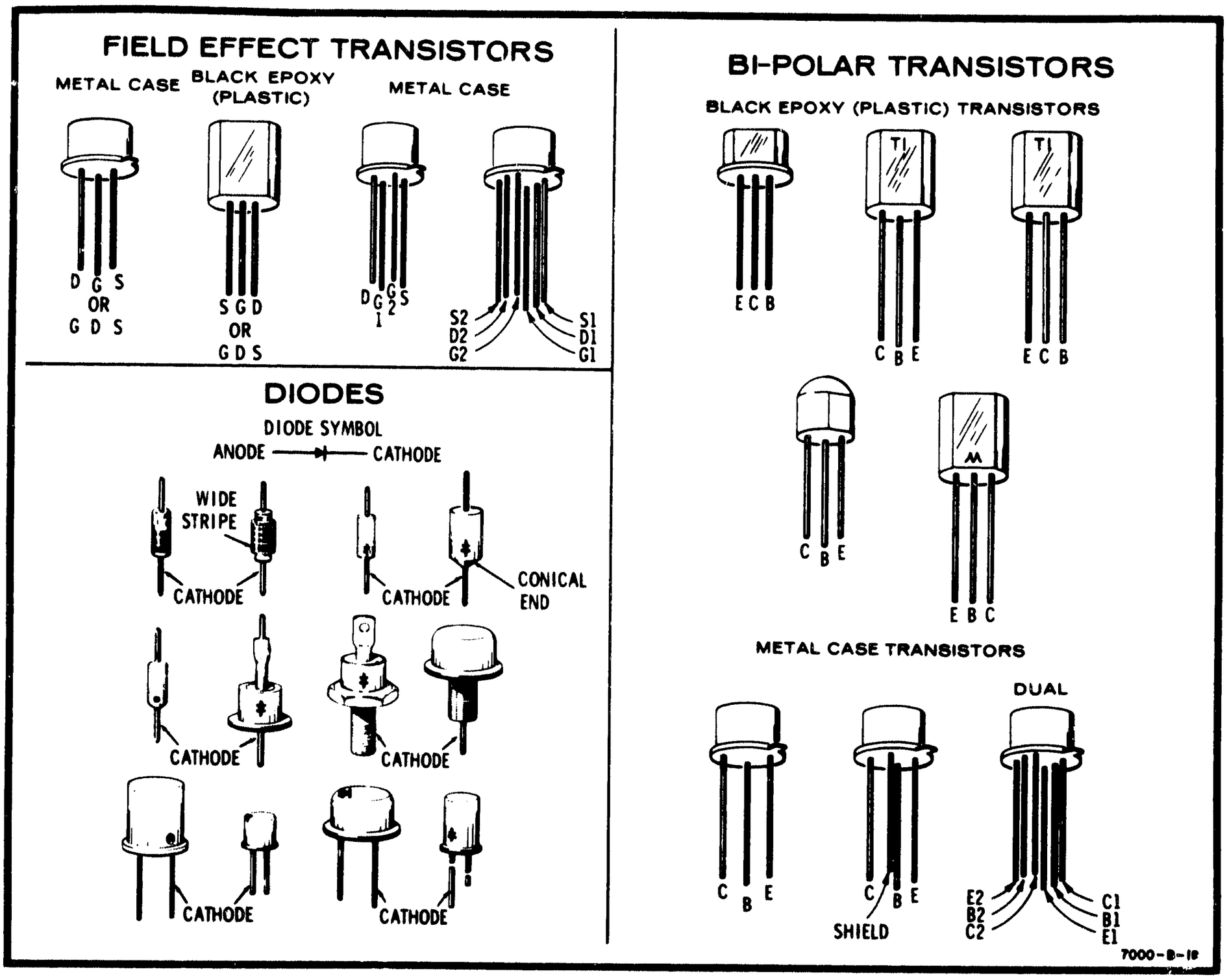



Figure 8-3. Examples of Diode and Transistor Markings

# SECTION VI

# REPLACEABLE PARTS

## 6-1. INTRODUCTION.

6-2. This section contains information for ordering replacement parts. The abbreviations used in the parts list are described in table 6-1. Table 6-2 lists the parts in alphanumeric order by reference designator and includes the manufacturer and manufacturer's part number. Table 6-3 contains the list of manufacturers' codes. Figure 6-1 identifies most of the mechanical parts.

## 6-3. ORDERING INFORMATION.

6-4. To obtain replacement parts from Hewlett-Packard, address order or inquiry to the nearest Hewlett-Packard Sales/Service Office and supply the following information:

a. Instrument model and serial number.

b. HP part number of items(s).

c. Quanity of part(s) desired.

d. Reference designator of part(s).

6-5. To order a part not listed in the table, provide the following information:

a. Instrument model and serial number.

b. Description of the part, including function and location in the instrument.

c. Quanity desired.

Table 6-1. Abbreviations for Replaceable Parts List

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| A | = ampere(s) | GRD | = ground(ed) | NPO | = negative positive zero (zero temperature coefficient) | RWV | = reverse working voltage |
| ASSY | = assembly | H | = henry(ies) | NPN | = negative-positive-negative | S-B | = slow-blow |
| BD | = board(s) | HG | = mercury | NSR | = not separately replaceable | SCR | = silicon controlled rectifier |
| BH | = binder head | HP | = Hewlett-Packard | | | SE | = selenium |
| BP | = bandpass | HZ | = hertz | OBD | = order by description | SEC | = second(s) |
| C | = centi ($10^{-2}$) | IF | = intermediate freq. | OH | = oval head | SECT | = section(s) |
| CAR | = carbon | IMPG | = impregnated | OX | = oxide | SI | = silicon |
| CCW | = counterclockwise | INCD | = incandescent | P | = peak | SIL | = silver |
| CER | = ceramic | INCL | = include(s) | PC | = printed (etched) circuit(s) | SL | = slide |
| CMO | = cabinet mount only | INS | = insulation(ed) | PF | = picofarads | SP | = single pole |
| COAX | = coaxial | INT | = internal | PHL | = Phillips | SPL | = special |
| COEF | = coefficient | K | = kilo ($10^{3}$) | PIV | = peak inverse voltage(s) | ST | = single throw |
| COMP | = composition | KG | = kilogram | PNP | = positive-negative-positive | STD | = standard |
| CONN | = connector(s) | LB | = pound(s) | P/O | = part of | TA | = tantalum |
| CRT | = cathode-ray tube | LH | = left hand | PORC | = porcelain | TD | = time delay |
| CW | = clockwise | LIN | = linear taper | POS | = position(s) | TFL | = teflon |
| D | = deci ($10^{-1}$) | LOG | = logarithmic taper | POT | = potentiometer(s) | TGL | = toggle |
| DEPC | = deposited carbon | LPF | = low-pass filter(s) | P-P | = peak-to-peak | THYR | = thyristor |
| DP | = double pole | LVR | = lever | PRGM | = program | TI | = titanium |
| DT | = double throw | M | = milli ($10^{-3}$) | PS | = polystyrene | TNLDIO | = tunnel diode(s) |
| ELECT | = electrolytic | MEG | = mega ($10^{6}$) | PWV | = peak working voltage | TOL | = tolerance |
| ENCAP | = encapsulated | MET FILM | = metal film | | | TRIM | = trimmer |
| EXT | = external | MET OX | = metal oxide | RECT | = rectifier(s) | U | = micro ($10^{-6}$) |
| F | = farad(s) | MFR | = manufacturer | RF | = radio frequency | V | = volts |
| FET | = field-effect transistor(s) | MINAT | = miniature | RFI | = radio frequency interference | VAR | = variable |
| FH | = flat head | MOM | = momentary | RH | = round head or right hand | VDCW | = dc working volt(s) |
| FIL H | = fillister head | MTG | = mounting | RMO | = rack mount only | W | = watt(s) |
| FXD | = fixed | MY | = mylar | RMS | = root mean square | W/ | = with |
| G | = giga ($10^{9}$) | N | = nano ($10^{-9}$) | | | WIV | = working inverse voltage |
| GE | = germanium | N/C | = normally closed | | | W/O | = without |
| GL | = glass | NE | = neon | | | WW | = wirewound |
| | | N/O | = normally open | | | | |

### 8-53. INTEGRATED CIRCUIT REPLACEMENT.

CAUTION

Unless an integrated circuit has definitely failed, be careful to prevent damage when removing or replacing it.

8-54. The integrated circuit in this instrument are of two general configurations, plug-in types and those soldered in place. Remove a plug-in integrated circuit with a straight pull away from the board. Soldered integrated circuits can be removed with soldering irons which simultaneously heat all connections. These irons are available from various manufacturers. Soldering irons with built-in desoldering tools also facilitate quick removal.

8-55. Use the following procedure for removing an integrated circuit with a standard soldering iron.

a. Heat lead solder joint. Use small tip such as on Weller No. PT-H7 iron.

b. When solder is fluid, remove with desoldering tool such as deluxe Model Soldapullt manufactured by Edsyn Company of California.

c. Repeat steps a and b for each lead until all leads are free.

d. Grasp each lead with long-nosed pliers and check that it is mechanically free from circuit board.

e. When all leads are free, carefully remove integrated circuit. Dual in-line type can be removed by gently gripping top and bottom with long-nosed pliers and rolling integrated circuit out.

f. Use desoldering tool or toothpick to remove all remaining solder from circuit board holes.

CAUTION

Be careful not to damage the integrated circuit with excessive heat. Work quckly.

g. Insert replacement integrated circuit into circuit board and solder in place.

8-56. When replacing an integrated circuit, note the mark or notch used for orientation. The component-identification photographs and the integrated circuit pin-location diagrams in this manual show the correct orientation.

### 8-57. SERVICE KIT.

8-58. The service kit (refer to Section I) consists of three extender boards and a board puller. The extenders can be used with the plug-in etched circuit boards. They permit a circuit board to remain connected to the instrument, yet raised to a convenient level for circuit checks and adjustments. The board puller is used to remove the low voltage converter assembly A3A2 and the low voltage rectifier and filter assembly A3A3. Connect the hook portion of the board puller around the metal standoffs that connect the two assemblies and pull the assemblies out.

### 8-59. SOLDERING TOOL, SOLDER, AND AIDS.

8-60. Table 8-2 contains a list of soldering tools, solder, and soldering aids. These items or equivalents should be used to obtain the very best results when repairing and replacing soldered-in components on etched circuit boards.

### 8-61. HEAT SINK REMOVAL.

8-62. There are two types of transistor heat sinks used in this instrument; the friction type and the screw-on type. The friction type can be removed by carefully pulling them off. To remove the screw-on type, proceed as follows:

a. Remove transistor from circuit board.

b. Grasp cooling fins with taped pliers.

c. Remove nut with ½-inch wrench.

CAUTION

When replacing heat sinks, especially friction type, support the bottom of the transistors to avoid lead damage caused by downward pressure.

## 8-63. TROUBLESHOOTING.

8-64. The most important prerequisite for successful troubleshooting is understanding how the instrument is designed to operate and correct use of front panel controls. Improper control settings or circuit connections can cause apparent malfunctions. Read Section III (operating procedures) for an explanation of controls and connectors and general operating considerations. Read Section IV (principles of Operation) for explanations of circuit theory.

8-65. To quickly troubleshoot on Option 300 malfunction, the various circuits must be checked in the order of their importance. The following tables are aids in troubleshooting the Option 300 and should be followed in numbered sequence.

a. Table 8-3. Low Voltage Power Supply (LVPS) Troubleshooting.

b. Table 8-4. High Voltage Power Supply (HVPS), CRT and Gate Troubleshooting.

Table 8-2. Etched Circuit Soldering Equipment

| Item | Use | Specification | Item Recommended |
|---|---|---|---|
| Soldering tool | Soldering<br>Unsoldering | Wattage rating: 37-5<br>Tip Temp: 750-800 degrees | Ungar #775 handle with<br>Ungar #1237 Heating Unit |
| Soldering Tip<br><br>De-soldering aid | Soldering<br><br>To remove molten solder from connection | Shape: chisel<br><br>Suction device | Ungar #PL 113<br><br>Soldapullt by Edsyn Co., Arleta, California |
| Resin (flux)<br>Solvent | Remove excess flux from soldered area before application of protective coating | Must not dissolve etched circuit base board material or conductor bonding agent | Freon<br>Acetone<br>Lacquer Thinner<br>Isopropyl Alcohol<br>(100% dry) |
| Solder | Component replacement<br>Circuit board repair<br>Wiring | Resin (flux) core, high tin content (60/40 tin/lead).<br>18 gauge (SWG) preferred | |
| Protective Coating | Contamination,<br>Corrosion protection | Good electrical insulation, corrosion-prevention properties | Silicone Resin such as<br>GE DRI-FILM *88 |

c. Table 8-5. Vertical Deflection Troubleshooting.

d. Table 8-6. Horizontal Deflection Troubleshooting.

e. Table 8-7. Time Base Troubleshooting.

8-66. The first few checks in each table use front panel indications to quickly isolate the problem area. The latter part of each table uses internal, as well as front panel indications to isolate the problem to an individual area. Note also, that the first or second check of each table, if correct indications are observed, assumes that the circuits are functioning correctly and directs the user to the next table. In most cases, no attempt is made to isolate a malfunction to a discrete component and only those malfunctions most encountered in oscilloscopes are covered. Test conditions for each table should remain unchanged unless directed by successive steps or notes.

8-67. If trouble is suspected, visually inspect the instrument. Look for loose or burned components that might suggest a source of trouble. Check to see that all circuit board connections are making good contact and are not shorting to an adjacent circuit. If no obvious trouble is found, check the power supply voltages in the instrument. Prior to any extensive troubleshooting, also check the external power sources.

## 8-68. DC VOLTAGES.

8-69. On some of the schematics, dc voltages are indicated for active components (transistors, etc). Conditions for making these voltage measurements are listed adjacent to the schematics. Since the conditions for making the measurements may differ from one circuit to another, always check the specific condition listed adjacent to the schematic.

## 8-70. WAVEFORMS.

8-71. Waveform measurement points ( ▽ with a numeral inclosed) are placed on the schematics along main signal paths. The numbers inside the measurement point symbols are keyed to corresponding waveforms adjacent to each schematic. Like the dc voltage measurement conditions, waveform measurement conditions may vary from one circuit to another.

## 8-72. TEST POINTS.

8-73. Test points are shown on schematics with this symbol ( ⊙ ). Test points correspond to pins protruding from etched circuit boards and do not necessarily correspond to waveform measurement points.

## 8-74. CIRCUIT CHECKING.

8-75. The block diagram (schematics 1 and 2) have been provided to enable rapid isolation of a malfunction to a particular circuit group. This is accomplished by observing the indicated waveforms and voltages shown on the block diagrams until a block is found whose inputs are normal but whose outputs are abnormal. Once this point is reached, the input and output to the block is located on the appropriate schematic and progressive troubleshooting techniques (waveform analysis, voltage measurement, resistance measurement, and substitution) are employed between the two points to isolate the malfunction to a particular component(s).

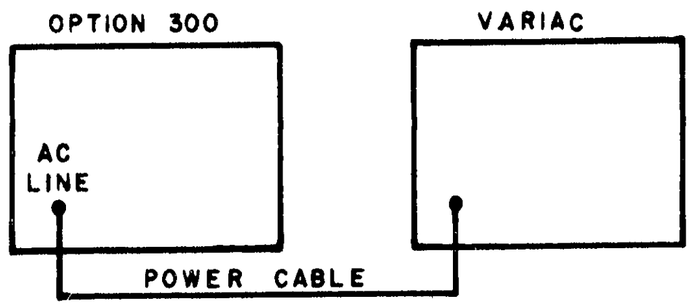
Table 8-3. Low Voltage Power Supply Troubleshooting

Troubleshooting Conditions

A. Front Panel Settings:

| | |
|---|---|
| INTENSITY | as required |
| FOCUS | as required |
| SCALE ILLUMINATION | fully cw |
| CHANNEL A VOLTS/DIV | 10 |
| channel A vernier | CAL |
| channel A coupling | AC |
| channel A POSITION | centered |
| MODE | A |
| CHAN B POLARITY | NORM |
| CHANNEL B VOLTS/DIV | 10 |
| channel B vernier | CAL |
| channel B coupling | AC |
| channel B POSITION | centered |
| POWER MODE | 115V AC |
| trig | A ONLY |
| VERNIER | CAL |
| horizontal POSITION | centered |
| sweep display | SWEEP |
| TIME/DIV | 5 uSEC |
| TRIGGER HOLDOFF | MIN |
| TRIGGER LEVEL | as required |
| AUTO/NORM | AUTO |
| INT/EXT | INT |
| AC/DC | DC |
| HFAC | disengaged |
| LFAC | disengaged |
| SLOPE | + |
| ÷1/÷10 | ÷1 |
| MAG | X1 |
| EXT HORIZ VERNIER | CAL |

B. Test Setup:




C. Set variac controls for 115 Vac output.

| Test | Conditions | Indications | Procedures, Checks, Probable Causes |
|---|---|---|---|
| 1. | See troubleshooting conditions | POWER light on.<br>Scale lamps on | Assume LVPS is working and proceed to table 8-4. |
| | Note<br>Check power supply voltages if desired | | |
| 2. | Same as test 1 | POWER light off<br>Scale lamps on | Assume T1, Z1, A3Q2 and associated circuits (schematic 16) ok. |
| | | | Check A3A2Q2, A3A3U1, A4F1, A4F4 and associated circuits (schematics 17 and 18). |
| 3. | Same as test 1 | POWER light on<br>Scale lamps off | Check A4Q10, A7DS1, A7DS2 and associated circuits (schematic 16). |

Table 8-3. Low Voltage Power Supply Troubleshooting (Cont'd)

| Test | Conditions | Indications | Procedures, Checks, Probable Causes |
|---|---|---|---|
| 4. | Same as test 1 | POWER light off<br>Scale lamps off | Check A1F1, S2 position and contacts, F1, A3Q2, A3A1Q1 and associated circuits (schematic 16). |
| | Note<br>At normal line voltage, there should be approximately 33 Vdc at S2. If line voltage abnormal, check ac input line voltage. | | |
| 5. | Same as test 1 | F1 (schematic 16) open | a. Disconnect power.<br>b. Remove A3A2.<br>c. Replace F1. |
| | | | If F1 does not open, check A3A2. If F1 opens, check A3A1CR5, A3A1CR6, A3A1VR3 and associated circuits (schematic 17). |
| 6. | Same as test 1 | All low voltage outputs out of tolerance. | All low voltage outputs should be within ±10% when input to A3A2 is 24 Vdc and A3A2U1 is inoperative. To deactivate A3A2U1, unsolder one end of A3A2R16 or A3A2L1 (schematic 17). |
| | | | a. Measure dc voltage at A3A2 input.<br>b. Set variac controls for 24 Vdc input to A3A2.<br>c. Proceed to test 6a. |
| 6a. | Same as test 1 and with A3A2U1 deactivated | All low voltage outputs within ±10% | Check A3A2U1 and associated circuits (schematic 17). |
| 6b. | Same as test 6a. | All low voltage outputs out of tolerance. | Check A3A2Q2 and associated circuits (schematic 17). |
| 6c. | Same as test 6a. | Only 1 low voltage output out of tolerance. | Check A3A3, A3A1 and A4 circuits (schematic 18) associated with bad voltage. |

Table 8-4. High Voltage Power Supply, CRT and Gate Troubleshooting

Troubleshooting Conditions

A. Front Panel Settings:

| | |
|---|---|
| INTENSITY | as required |
| FOCUS | as required |
| SCALE ILLUMINATION | fully cw |
| CHANNEL A VOLTS/DIV | 10 |
| channel A vernier | CAL |
| channel A coupling | AC |
| channel A POSITION | centered |
| MODE | A |
| CHAN B POLARITY | NORM |
| trig | A ONLY |
| VERNIER | CAL |
| horizontal POSITION | centered |
| sweep display | SWEEP |
| TIME/DIV | 5 uSEC |
| TRIGGER HOLDOFF | as required |
| TRIGGER LEVEL | as required |
| AUTO/NORM | AUTO |
| INT/EXT | INT |
| AC/DC | AC |
| HFAC | disengaged |

Table 8-4. High Voltage Power Supply, CRT and Gate Troubleshooting (Cont'd)

| | |
|---|---|
| CHANNEL B VOLTS/DIV ..... 10 | LFAC ..... disengaged |
| channel B vernier ..... CAL | SLOPE ..... + |
| channel B coupling ..... AC | ÷1/÷10 ..... ÷1 |
| channel B POSITION ..... centered | MAG ..... X1 |
| POWER MODE ..... 115V AC | EXT HORIZ VERNIER ..... CAL |

| Test | Conditions | Indications | Procedures, Checks, Probable Cause |
|---|---|---|---|
| 1. | See troubleshooting conditions | Beam displayed on CRT. Intensity is controllable. | Assume HVPS, CRT and Gate ampl ok. Proceed to test 2. |
| 2. | Check vertical and horizontal deflection sensitivities. | Both deflection sensitivities ok. | Assume vertical and horizontal ampl ok; proceed to table 8-7. |
| 3. | Same as test 2. | Both deflection sensitivities off. | Check HVPS output voltages (schematic 15). See note and test 7. |
| | Note<br>If HVPS output voltages are high, both deflections will be contracted. If HVPS output voltages are low, both deflections will be expanded (usually accompanied by poor focus). | | |
| 4. | Same as test 1. | No beam visible on CRT. | Press BEAM FINDER:<br><br>a. Beam near center horizontally but deflected up or down vertically; proceed to table 8-5, test 3. |
| | | | b. Beam near center vertically but deflected right or left horizontally; proceed to table 8-6, test 2. |
| | | | c. Beam near center both vertically and horizontally; check INTENSITY level and horizontal blanking input to gate ampl (schematics 14 and 15). |
| | | | d. No beam; check A3A4F1, A3Q1 CRT (open filament or cathode) and gate ampl (schematics 14 and 15). |
| 5. | Same as test 1. | Beam displayed on CRT. No intensity control. | Set FOCUS control fully cw to prevent damage to CRT. |
| | | | Remove brown (1) wire from A4 gate. Connect brown wire to ground. Vary A3A4R15: |
| | | | a. If intensity level is controllable from full on to full off, trouble is in A4 gate (schematic 14). |
| | | | b. If intensity level is uncontrollable, proceed to test 5a. |

Table 8-4. High Voltage Power Supply, CRT and Gate Troubleshooting (Cont'd)

| Test | Conditions | Indications | Procedures, Checks, Probable Cause |
|---|---|---|---|
| 5a. | Same as test 1. | Beam displayed on CRT. No intensity control (A4 gate ok). | Remove A3A4 High Voltage Oscillator from power module box. Do not disconnect any wires. Insulate A3A4 High Voltage Oscillator from power supply module. |
| | | | a. Measure voltage drop across A3A4R18 (use floating voltmeter). |
| | | | (1). If voltage drop is 0V, CRT grid circuit is open. Check CRT wires, connections, CRT and A3A4CR7 (schematic 15) for opens. |
| | | | (2) If voltage drop is greater than 2V, the CRT grid circuit is drawing excessive current. Check CRT (see note), A3A4DS1, A3A4DS2, and A3A4C21 (schematic 15). |
| Note<br>To check CRT for leakage, remove CRT socket. If voltage drop disappears, CRT is bad. If voltage remains, leave CRT socket off to protect CRT while troubleshooting. | | | |
| 6. | Press BEAM FINDER. | No beam. | Measure CRT cathode potential: |
| | | | a. Potential correct.<br>(1). Check grid potential; if potential ok, suspect bad CRT. |
| | | | (2). If grid potential wrong, check grid circuit and A4 gate ampl (schematic 15). |
| | | | b. No potential.<br>(1). Check A3A4F1 (schematic 15). |
| | | | (2). Check A3Q1 (schematic 13) output. |
| Note<br>All components listed in tests 7 and 8 are on schematic 15. | | | |
| 7. | Same as test 6. | Beam displayed on CRT. Some intensity control. Deflection sensitivities off. | Measure cathode voltage:<br>a. Voltage low and unable to adjust up with HIGH VOLTAGE ADJUST. |
| | | | (1). Check A3A4R2 through A3A4R5. |
| | | | (2). Remove CRT socket. If voltage remains low, check filter capacitors for leakage. |

Table 8-4. High Voltage Power, CRT and Gate Troubleshooting (Cont'd)

| Test | Conditions | Indications | Procedures, Checks, Probable Cause |
|---|---|---|---|
| | | | (3). Check A3A4Q1 - Q3. |
| | | | (4). Check ±15V supplies. |
| | | | (5). Check A3Q1 output. |
| | | | (6). If item 2 and 5 ok, suspect A3A4A1. |
| | | | b. Voltage high and unable to adjust down, with HIGH VOLTAGE ADJUST. |
| | | | (1). Check A3A2R2 through A3A4R5. |
| | | | (2). Check A3A4Q1 - Q3. |
| | | | c. Voltage high and unable to adjust with HIGH VOLTAGE ADJUST. |
| | | | (1). Suspect open A3A4R2, 3, 4 or 5. |
| 8. | Same as test 6. | Intermittent flicker. | a. Check for visible or audible arcing. |
| | | | b. Check for intermittent operation of A3A4Q1 - 3 or A3Q1. |
| | | | c. Suspect intermittent open. |
| | | | d. Suspect breakdown of A3A4A1, filter capacitors, CRT, or HV Multiplier A3A4A2. |

Table 8-5. Vertical Deflection Troubleshooting

Troubleshooting Conditions

A. Front Panel Settings:

| | |
|---|---|
| INTENSITY | as required |
| FOCUS | as required |
| SCALE ILLUMINATION | fully cw |
| CHANNEL A VOLTS/DIV | 10 |
| channel A vernier | CAL |
| channel A coupling | AC |
| channel A POSITION | centered |
| MODE | A |
| CHAN B POLARITY | NORM |
| CHANNEL B VOLTS/DIV | 10 |
| channel B vernier | CAL |
| channel B coupling | AC |
| channel B POSITION | centered |
| POWER MODE | 115V AC |
| trig | A ONLY |
| VERNIER | CAL |
| horizontal POSITION | centered |
| sweep display | SWEEP |
| TIME/DIV | 5 uSEC |
| TRIGGER HOLDOFF | MIN |
| TRIGGER LEVEL | as required |
| AUTO/NORM | AUTO |
| INT/EXT | INT |
| AC/DC | DC |
| HFAC | disengaged |
| LFAC | disengaged |
| SLOPE | + |
| ÷1/÷10 | ÷1 |
| MAG | X1 |
| EXT HORIZ VERNIER | CAL |

B. Test Setup:

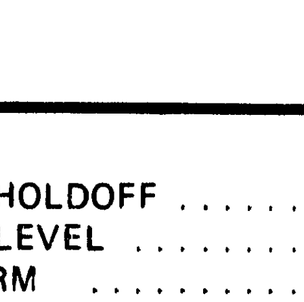


Table 8-5. Vertical Deflection Troubleshooting (Cont'd)

| Test | Conditions | Indications | Procedures, Checks, Probable Cause |
|---|---|---|---|
| 1. | See troubleshooting conditions. | Beam displayed on CRT. Positioning ok. Deflection sensitivities ok. | Assume channel A preampl and vertical output ampl ok. Proceed to test 2. |
| 2. | Same as test 1, except set MODE to B. | Same as test 1. | Assume channel B preampl ok. Proceed to table 8-6. |
| 3. | Same as test 1. | No beam on channel A. | Press BEAM FINDER. Beam deflected up or down and unable to position. |
| | | | a. Check channel A preampl and output ampl. |
| | | | b. Check channel B under same conditions. |
| Note 1<br>Do not discount the possibility that the channel has been overloaded, causing a preamplifier problem and that the same signal into the other channel has caused the same problem. | | | |
| 4. | Same as test 1. | Beam deflected up or down on both channels. | Short bases of A5A5Q1 and A5A5Q2 (schematic 6) together: |
| | | | a. Beam normal; assume output ampl ok. |
| | | | b. Beam deflected; problem in output ampl. |
| | | | Short bases of A5A4Q30 and A5A4Q31 (schematic 6) together: |
| | | | a. Beam normal; A5A4Q30 and Q31 ok. |
| | | | b. Beam deflected; problem in A5A4Q30 and Q31 or delay line. |
| 5. | Same as test 1. | Beam deflected up or down on one channel only. | Short bases of A5A4Q9 and A5A4Q10 (schematic 4) together: |
| | | | a. Beam normal and positioning ok; A5A4Q9, Q10, Q18 - Q25 ok. |
| | | | b. Beam deflected; problem in A5A4Q9, Q10, Q18 - 25. |
| Note 2<br>The methods used in test 3, 4 and 5 may also be used to locate problems of trace bounce or drift. | | | |
| Note 3<br>The following tests are dependent on proper horizontal and time base operation. Repair any horizontal or time base problems first. Refer to table 8-6 and 8-7. | | | |

Table 8-5. Vertical Deflection Troubleshooting (Cont'd)

| Test | Conditions | Indications | Procedures, Checks, Probable Cause |
|---|---|---|---|
| 6. | Same as test 1. | Gain or pulse response off on one channel only. | Check part of A5A4 for that channel. |
| 7. | Same as test 1. | Gain or pulse response off on both channels. | Assume problem in output of A5A4 or A5A5 (schematics 5 and 6). |
| 8. | Same as test 1, except set TIME/DIV to 1 mSEC and MODE to ALT. | No alternate trace on one channel | a. Check alt trigger signal to A5A4U1 (schematic 7). |
| | | | b. Check A5A4U1, U2, Q16, Q17 and Q32 through Q35 (schematics 5 or 7). |
| 9. | Same as test 8, except set MODE to CHOP. | No chop operation. | Check A5A4U1, U2, Q16, Q17 and Q32 (schematics 5 and 7). |
| 10. | Same as test 9. | No chop blanking. | Check A5A4U2, Q16, Q17, Q34 and Q35 (schematic 7). |
| 11. | Same as test 9, except set MODE to A + B. | No A + B operation on one channel. | Check A5A4U2, Q16, Q17, Q34 and Q35 (schematic 7). |
| 12. | Same as test 9, except set MODE to A. | No internal sync on channel A. | Check A5A4Q13 through Q15 (schematic 5). |
| 13. | Same as test 12. | No composite sync. | Check A5A4Q26 through Q29 (schematic 6). |
| 14. | Same as test 12. | No channel A or composite sync. | a. Check A5A4R50 and A5A4R80 (schematics 5 and 6). |
| | | | b. Check lead from A5S2 to A6A2 (schematic 7). |

Table 8-6. Horizontal Deflection Troubleshooting

Troubleshooting Conditions

A. Front Panel Settings:

| | |
|---|---|
| INTENSITY | as required |
| FOCUS | as required |
| SCALE ILLUMINATION | fully cw |
| CHANNEL A VOLTS/DIV | 10 |
| channel A vernier | CAL |
| channel A coupling | AC |
| channel A POSITION | centered |
| MODE | A |
| CHAN B POLARITY | NORM |
| CHANNEL B VOLTS/DIV | 10 |
| channel B vernier | CAL |
| channel B coupling | AC |
| channel B POSITION | centered |
| POWER MODE | 115V AC |
| trig | A ONLY |
| VERNIER | CAL |
| horizontal POSITION | cw |
| sweep display | EXT HORIZ INPUT |
| TIME/DIV | 5 uSEC |
| TRIGGER HOLDOFF | MIN |
| TRIGGER LEVEL | as required |
| AUTO/NORM | AUTO |
| INT/EXT | INT |
| AC/DC | DC |
| HFAC | disengaged |
| LFAC | disengaged |
| SLOPE | + |
| ÷1/÷10 | ÷1 |
| MAG | X1 |
| EXT HORIZ VERNIER | CAL |

B. Test Setup:

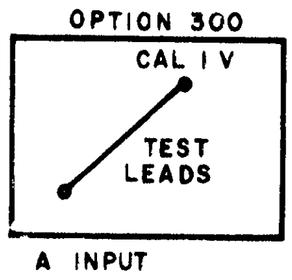


Table 8-6. Horizontal Deflection Troubleshooting (Cont'd)

| Test | Conditions | Indications | Procedures, Checks, Probable Cause |
|---|---|---|---|
| 1. | See troubleshooting conditions. | Beam displayed on CRT. Positioning ok. Deflection sensitivities ok. | Assume A6A4, A6A6 and ext horiz ampl portion of A6A2 ok. Proceed to table 8-7. |
| 2. | Same as test 1. | No beam | Press BEAM FINDER: |
| | | | a. Beam on and centered. Check horizontal blanking output from A6A4 (schematic 10). |
| | | | b. Beam deflected right or left: |
| | | | (1). Short bases of A6A6Q3 and A6A6Q4 (schematic 13) together: |
| | | | (a). Beam deflected off screen. Problem in A6A6. |
| | | | (b). Beam on screen. Problem in A6A4. |
| | | | (2). Remove input to A6A4R1 (gray wire on square pin). Vary horizontal POSITION control fully cw. |
| | | | (a). Beam centered on screen. Problem in A6A2 ext horiz ampl (schematic 8). |
| | | | (b). Beam not on screen. Problem in A6A4 (schematic 13). |

Table 8-7. Time Base Troubleshooting

Troubleshooting Conditions

A. Front Panel Settings:

| | |
|---|---|
| INTENSITY | as required |
| FOCUS | as required |
| SCALE ILLUMINATION | fully cw |
| CHANNEL A VOLTS/DIV | 10 |
| channel A vernier | CAL |
| channel A coupling | AC |
| channel A POSITION | centered |
| MODE | A |
| CHAN B POLARITY | NORM |
| CHANNEL B VOLTS/DIV | 10 |
| channel B vernier | CAL |
| channel B coupling | AC |
| channel B POSITION | centered |
| POWER MODE | 115V AC |
| trig | A ONLY |
| VERNIER | CAL |
| horizontal POSITION | centered |
| sweep display | SWEEP |
| TIME/DIV | 1 mSEC |
| TRIGGER HOLDOFF | MIN |
| TRIGGER LEVEL | as required |
| AUTO/NORM | AUTO |
| INT/EXT | INT |
| AC/DC | DC |
| HFAC | disengaged |
| LFAC | disengaged |
| SLOPE | + |
| ÷1/÷10 | ÷1 |
| MAG | X1 |
| EXT HORIZ VERNIER | CAL |

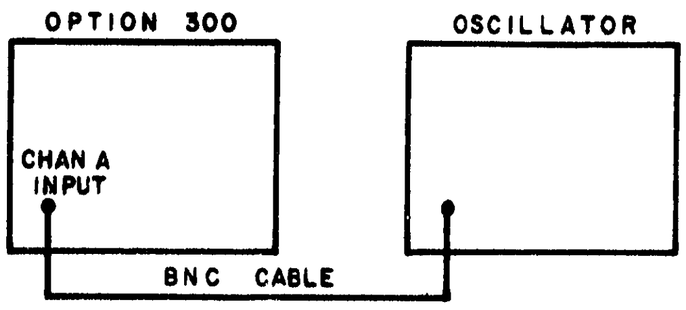
## Table 6-2. Replaceable Parts

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A1 | | | NOT ASSIGNED | | |
| A2 | 01700-66512 | 1 | BOARD ASSY: LINE RECTIFIER | 28480 | 01700-66512 |
| A3 | 01700-61101 | 1 | POWER SUPPLY ASSY | 28480 | 01700-61101 |
| A3A1 | 01700-66513 | 1 | BOARD ASSY: LOW VOLTAGE MOTHER | 28480 | 01700-66513 |
| A3A2 | 01700-66514 | 1 | BOARD ASSY: LOW VOLTAGE CONVERTER | 28480 | 01700-66514 |
| A3A3 | 01700-66515 | 1 | BOARD ASSY: RECTIFIER AND FILTER | 28480 | 01700-66515 |
| A3A4 | 01700-66516 | 1 | BOARD ASSY: HIGH VOLTAGE OSCILLATOR | 28480 | 01700-66516 |
| A4 | 01700-66511 | 1 | BOARD ASSY: GATE | 28480 | 01700-66511 |
| A5 | 01700-65803 | 1 | VERTICAL AMPLIFIER MODULE ASSY | 28480 | 01700-65803 |
| A5A1 | 01700-63401 | 2 | ATTENUATOR ASSY | 28480 | 01700-63401 |
| A5A2 | 01700-63401 | | ATTENUATOR ASSY | 28480 | 01700-63401 |
| A5A3 | 01701-61616 | 1 | DELAY LINE | 28480 | 01701-61616 |
| A5A4 | 01700-66518 | 1 | BOARD ASSY: VERTICAL PREAMPLIFIER | 28480 | 01700-66518 |
| A5A5 | 01700-66519 | 1 | BOARD ASSY: VERTICAL OUTPUT AMPLIFIER | 28480 | 01700-66519 |
| A6 | 01700-65804 | 1 | HORIZONTAL AMPLIFIER MODULE ASSY | 28480 | 01700-65804 |
| A6A1 | 01700-66520 | 1 | BOARD ASSY: HORIZONTAL MOTHER | 28480 | 01700-66520 |
| A6A2 | 01700-66521 | 1 | BOARD ASSY: TRIGGER | 28480 | 01700-66521 |
| A6A3 | 01700-66522 | 1 | BOARD ASSY: INTEGRATOR | 28480 | 01700-66522 |
| A6A4 | 01700-66526 | 1 | BOARD ASSY: HORIZONTAL PREAMPLIFIER | 28480 | 01700-66526 |
| A6A5 | 01700-66523 | 1 | BOARD ASSY: SWEEP TIME | 28480 | 01700-66523 |
| A6A6 | 01700-66527 | 1 | BOARD ASSY: HORIZ OUTPUT AMPLIFIER | 28480 | 01700-66527 |
| A6A7 | 01700-66524 | 1 | BOARD ASSY: HOLDOFF | 28480 | 01700-66524 |
| A6A8 | 01700-66525 | 1 | BOARD ASSY: EXT HORIZONTAL | 28480 | 01700-66525 |
| A7 | 01701-28520 | 1 | BOARD ASSY: SCALE ILLUM | 28480 | 01701-28520 |
| A8 | 10163A030 | 1 | COVER: WITH ALL ACCESSORIES | 28480 | 10163A030 |
| A8A1 | 10006B 030 | 2 | PROBE 10:1 DIVIDER | 28480 | 10006B 030 |
| A8A2 | 10163-69501 | 1 | ACCESSORY KIT | 28480 | 10163-69501 |
| C1 | 0160-3665 | 4 | C: FXD CER 0.01 UF +80--20% 500VDCW | 56289 | CO71A501K103ZS25-COH |
| C2 | 0160-3665 | | C: FXD CER 0.01 UF +80--20% 500VDCW | 56289 | CO71A501K103ZS25-COH |
| C3 | 0160-3665 | | C: FXD CER 0.01 UF +80--20% 500VDCW | 56289 | CO71A501K103ZS25-COH |
| C4 | 0160-3665 | | C: FXD CER 0.01 UF +80 20% 500VDCW | 56289 | CO71A501K193ZS25-COH |
| DS1 | 1450-0709 | 1 | LIGHT: INDICATOR 90 VDC | 72765 | 6140-000-603 |
| DS2 | 2140-0253 | 2 | LAMP: INCANDESCENT | 08717 | FB3B |
| DS3 | 2140-0253 | | LAMP: INCANDESCENT | 08717 | FB3B |
| F1 | 2110-0016 | 1 | FUSE: 0.6A 250V (115V OPERATION) | 75915 | 313-600S |
| F2 | 2110-0002 | 1 | FUSE: CARTRIDGE 2A 3AG (DC OPERATION) | 75915 | 312.002 |
| FL1 | 10102A | 1 | FILTER: RFI CONTRAST | 28480 | 10102A |
| FL2 | 10115A | 1 | FILTER: CONTRAST | 28480 | 10115A |
| J1 | 1250-0118 | 4 | CONNECTOR: BNC | 24931 | 28JR-128-1 |
| J2 | 1250-0118 | | CONNECTOR: BNC | 24931 | 28JR-128-1 |
| J3 | 1250-0118 | | CONNECTOR: BNC | 24931 | 28JR-128-1 |
| J4 | 1250-0118 | | CONNECTOR: BNC | 24931 | 28JR-128-1 |
| J5 | 1251-3295 | 1 | CONNECTOR: DC LINE | 28480 | 1251-3295 |
| J6 | 1250-0235 | 1 | CONNECTOR: AC LINE | 28480 | 1250-0235 |
| L1 | 01701-66001 | 2 | COIL ASSY: ALIGNMENT | 28480 | 01701-66001 |
| L2 | 01701-66001 | | COIL ASSY: ALIGNMENT | 28480 | 01701-66001 |
| MP1 | 0370-1007 | 6 | KNOB: POINTER (FOCUS, INTENSITY, VERNIER, TRIG HOLDOFF, SCALE ILLUM, EXT HORIZ VERNIER) | 28480 | 0370-1007 |
| MP2 | 0370-1103 | 3 | KNOB: RANGE (TRIG LEVEL, CH A AND CH B POSITION) | 28480 | 0370-1103 |
| MP3 | 0370-1104 | 1 | KNOB: HORIZ POSITION | 28480 | 0370-1104 |
| MP4 | 0370-1130 | 2 | KNOB: BAR (MODE, SWEEP DISPLAY) | 28480 | 0370-1130 |
| MP5 | 0370-2178 | 3 | KNOB: POINTER (VERN CAL) | 28480 | 0370-2178 |
| MP6 | 0370-2190 | 11 | KNOB: PUSHBUTTON | 28480 | 0370-2190 |
| MP7 | 0370-2366 | 1 | KNOB: SKIRT (MODE) | 28480 | 0370-2366 |
| MP8 | 0370-2364 | 1 | KNOB: SKIRT (TIME/DIV) | 28480 | 0370-2364 |
| MP9 | 01700-67405 | 2 | KNOB ASSY: BAR SKIRT (VOLTS/DIV) | 28480 | 01700-67405 |
| MP10 | 0510-0097 | 1 | RETAINER: PUSH-ON | 78553 | C185-014-240 |
| MP11 | 1520-0079 | 6 | SHOCK MOUNT (CRT) | 00000 | OBD |
| MP12 | 3101-1224 | 3 | SEAL: TOGGLE | 28480 | 3101-1224 |
| MP13 | 0905-0185 | 5 | SEAL "O" RING | 00000 | OBD |
| MP14 | 0905-0452 | 1 | GASKET: FOAM RUBBER (CRT) | 00000 | OBD |
| MP15 | 0905-0460 | 2 | GASKET: SEAL (POWER CONNECTORS) | 83298 | 10-40450-14 |
| MP16 | 0905-0476 | 2 | SEAL "O" RING | 00000 | OBD |
| MP17 | 0905-0477 | 4 | SEAL "O" RING | 00000 | OBD |
| MP18 | 3101-0563 | 2 | SEAL: TOGGLE | 28480 | 3101-0563 |
| MP19 | 1200-0081 | 8 | INSULATOR: BUSHING, NYLON | 28480 | 1200-0081 |
| MP20 | 1400-0026 | 1 | CLAMP: HOSE | 66295 | 36H |
| MP21 | 1400-0798 | 1 | CLAMP: CRT | 28480 | 1400-0798 |
| MP22 | 1410-0052 | 1 | BUSHING: POWER SWITCH | 28480 | 1410-0052 |
| MP23 | 1440-0100 | 2 | HANDLE: RAIL | 28480 | 1440-0100 |
| MP24 | 3131-0250 | 11 | BOOT: PUSHBUTTON SWITCH | 28480 | 3131-0250 |
| MP25 | 4040-0814 | 1 | BEZEL: OLIVE BLACK | 28480 | 4040-0814 |
| MP26 | 5020-0237 | 1 | COUPLER: SOLID | 28480 | 5020-0237 |
| MP27 | 5040-0421 | 1 | INSULATOR COVER: POTENTIOMETER | 28480 | 5040-0421 |
| MP28 | 5060-0537 | 1 | CASE: ASSEMBLY | 28480 | 5060-0537 |
| MP29 | 01700-00210 | 1 | PANEL: FRONT | 28480 | 01700-00210 |
| MP30 | 01700-00212 | 1 | PANEL: REAR | 28480 | 01700-00212 |
| MP31 | 01700-00604 | 1 | SHIELD: GATE | 28480 | 01700-00604 |
| MP32 | 01700-01202 | 1 | BRACKET: SWITCH | 28480 | 01700-01202 |
| MP33 | 01700-01203 | 1 | CLAMP: CRT CABLE | 28480 | 01700-01203 |
| MP34 | 01700-23704 | 3 | RAIL: SUPPORT | 28480 | 01700-23704 |

See introduction to this section for ordering information

Table 8-7. Time Base Troubleshooting (Cont'd)

B. Test Setup:




C. Set oscillator controls for 2-kHz, 2-div output signal.

| Test | Conditions | Indications | Procedures, Checks, Probable Cause |
|---|---|---|---|
| | Note<br>The two basic blocks of the time base, sweep and trigger, should be handled in a logical manner. First, get a sweep going; then get the sweep triggered. | | |
| 1. | See troubleshooting conditions. | Auto sweep present. | Assume sweep circuits working and proceed to test 3. |
| 2. | Same as test 1. | No auto sweep. | Measure voltage at A6A2Q18 (schematic 9). |
| | | | a. Voltage is +15V: |
| | | | (1). Problem in sweep circuits; see tests 3 through 8. |
| | | | b. Voltage is not +15V: |
| | | | (1). Lift collector lead of A6A2Q11 (schematic 9) which turns A6A2Q12 on. |
| | | | (a). Voltage is now +15V; check A6A2Q11 and A6A2U1. |
| | | | (b). Voltage is not +15V; check A6A2Q12 through A6A2Q18. |
| | Note<br>Three front panel indications are used to locate troubles in the sweep circuits. | | |
| 3. | Same as test 1, except press BEAM FINDER. | No auto sweep, reset lamp off, beam intensity off, beam positioned to left. | a. Check A6A7Q1 through Q3 and associated circuits (schematic 12). |
| | | | b. Check A6A3Q3, A6A3U1 and associated circuits (schematic 10). |
| 4. | Same as test 3. | No auto sweep, reset lamp off, beam intensity off, beam positioned to right. | Check A6A3Q6 through Q7 and associated circuits (schematic 10). |
| 5. | Same as test 1. | No auto sweep, reset lamp off, beam intensity normal. | Regardless of beam position, check A6A3Q1, A6A3CR1 through CR4 (schematic 11) and associated circuits. |

Table 8-7. Time Base Troubleshooting (Cont'd)

| Test | Conditions | Indications | Procedures, Checks, Probable Cause |
|---|---|---|---|
| 6. | Same as test 1. | No auto sweep, reset lamp on, beam intensity off. | Same as test 5. |
| 7. | Same as test 1. | No auto sweep, reset lamp on, beam intensity beam on, beam positioned to left. | Check A6A3Q6 through Q9 (schematic 11) and associated circuits. |
| 8. | Same as test 1. | No auto sweep, reset lamp on, beam intensity on, beam positioned to right. | Check A6A3Q2/Q5 (schematic 10) and associated circuits.<br>Check A6A3Q3/U1 (schematic 10) and associated circuits. |
| 9. | Same as test 1. | Display is triggered. | Assume trigger circuits ok. |
| 10. | Same as test 1. | Display not triggered. | Connect signal to EXT TRIG INPUT. Set INT/EXT to EXT. If instrument can be triggered in ext, check internal sync signal (table 8-5). If instrument does not trigger on internal or external trigger signals, check trigger input circuits on schematic 8. |

Table 8-8. Option 300 Assembly Locations

| Assembly | Description | Schematic Number | Photo Figure No. |
|---|---|---|---|
| A2 | Line Rectifier | 16 | 8-5, 8-40 |
| A3 | Power supply Assembly | 15, 16, 17, 18 | 8-5 |
| A3A1 | Low Voltage Mother Board | 16, 17, 18 | 8-5, 8-44 |
| A3A2 | Low Voltage Converter | 17 | 8-5, 8-45 |
| A3A3 | Line Rectifier and Filter | 18 | 8-5, 8-47 |
| A3A4 | High Voltage Oscillator | 15 | 8-5, 8-38 |
| A4 | Gate | 14, 15, 16, 18 | 8-5, 8-36 |
| A5 | Vertical Amplifier Module | 3, 4, 5, 6, 7 | 8-5 |
| A5A1 | Attenuator (channel A) | 3 | 8-5, 8-10 |
| A5A2 | Attenuator (channel B) | 3 | 8-5, 8-10 |
| A5A3 | Delay Line | 6 | 8-5 |
| A5A4 | Vertical Preamplifier | 4, 5, 6, 7 | 8-5, 8-12 |
| A5A5 | Vertical Output Amplifier | 6 | 8-5, 8-17 |
| A6 | Horizontal Amplifier Module | 8, 9, 10, 11, 12, 13 | 8-5 |
| A6A1 | Horizontal Mother Board | 8, 9, 10, 11, 12, 13 | 8-5, 8-26 |
| A6A2 | Trigger | 8, 9 | 8-5, 8-21 |
| A6A3 | Integrator | 10 | 8-5, 8-25 |
| A6A4 | Horizontal Preamplifier | 13 | 8-5, 8-33 |
| A6A5 | Sweep Time | 11 | 8-5, 8-28 |
| A6A6 | Horizontal Output Ampl | 13 | 8-5, 8-34 |
| A6A7 | Holdoff | 12 | 8-5, 8-30 |
| A6A8 | Horizontal Mode | 13 | 8-5, 8-32 |
| A7 | Scale Illumination Assembly | 10 | 8-5 |

## Table 8-9. Schematic Notes

Refer to MIL-STD -15-1A for schematic symbols not listed in this table.

= Etched circuit board

= Front-panel marking

= Rear-panel marking

= Front-panel control

= Screwdriver adjustment

P/O = Part of

CW = Clockwise end of variable resistor

NC = No connection

= Waveform test point (with number)

= Common electrical point (with letter) not necessarily ground

= Single-pin connector on board

= Pin of a plug-in board (with letter or number)

= Coaxial cable connected to snap-on jack

= Coaxial cable connected directly to board

= Wire connected to pressure-fit socket on board

= Main signal path

= Primary feedback path

= Secondary feedback path

= Field-effect transistor (P-type base)

= Field-effect transistor (N-type base)

= Breakdown diode (voltage regulator)

= Tunnel diode

= Step-recovery diode

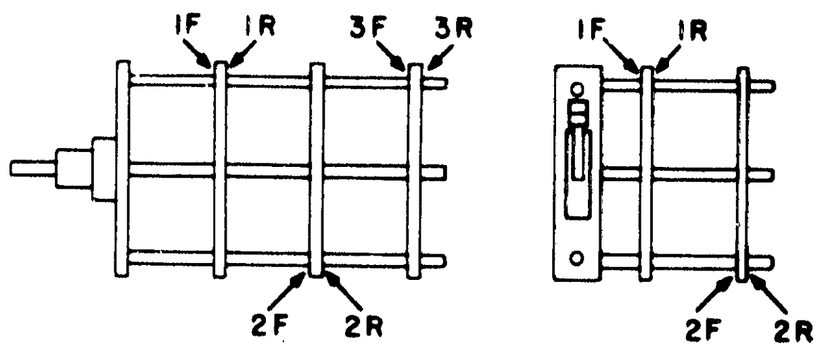
= Circuits or components drawn with dashed lines (phantom) show function only and are not intended to be complete. The circuit or component is shown in detail on another schematic.

(925) = Wire colors are given by numbers in parentheses using the resistor color code

[ (925) is wht-red-grn ]

| | |
|---|---|
| 0 - Black | 5 - Green |
| 1 - Brown | 6 - Blue |
| 2 - Red | 7 - Violet |
| 3 - Orange | 8 - Gray |
| 4 - Yellow | 9 - White |

Switch wafers are identified as follows:




* = Optimum value selected at factory, typical value shown; part may have been omitted.

Unless otherwise indicated:
resistance in ohms
capacitance in picofarads
inductance in microhenries

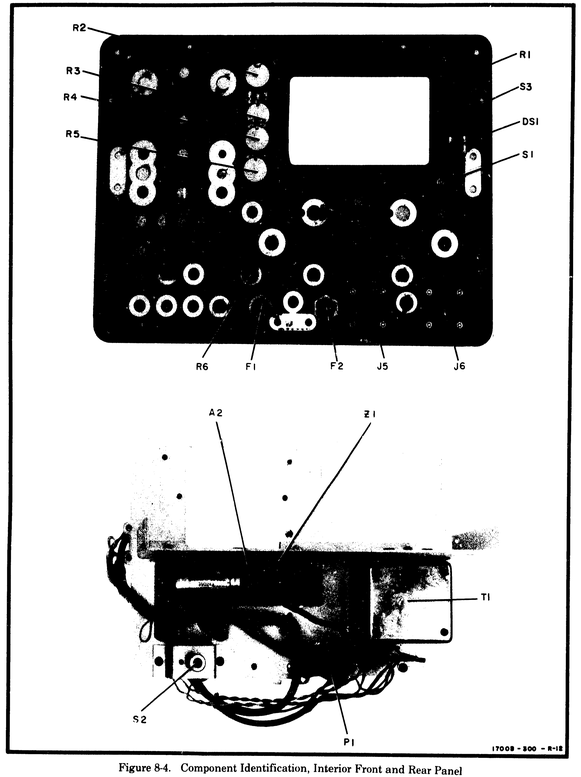



Figure 8-4. Component Identification, Interior Front and Rear Panel

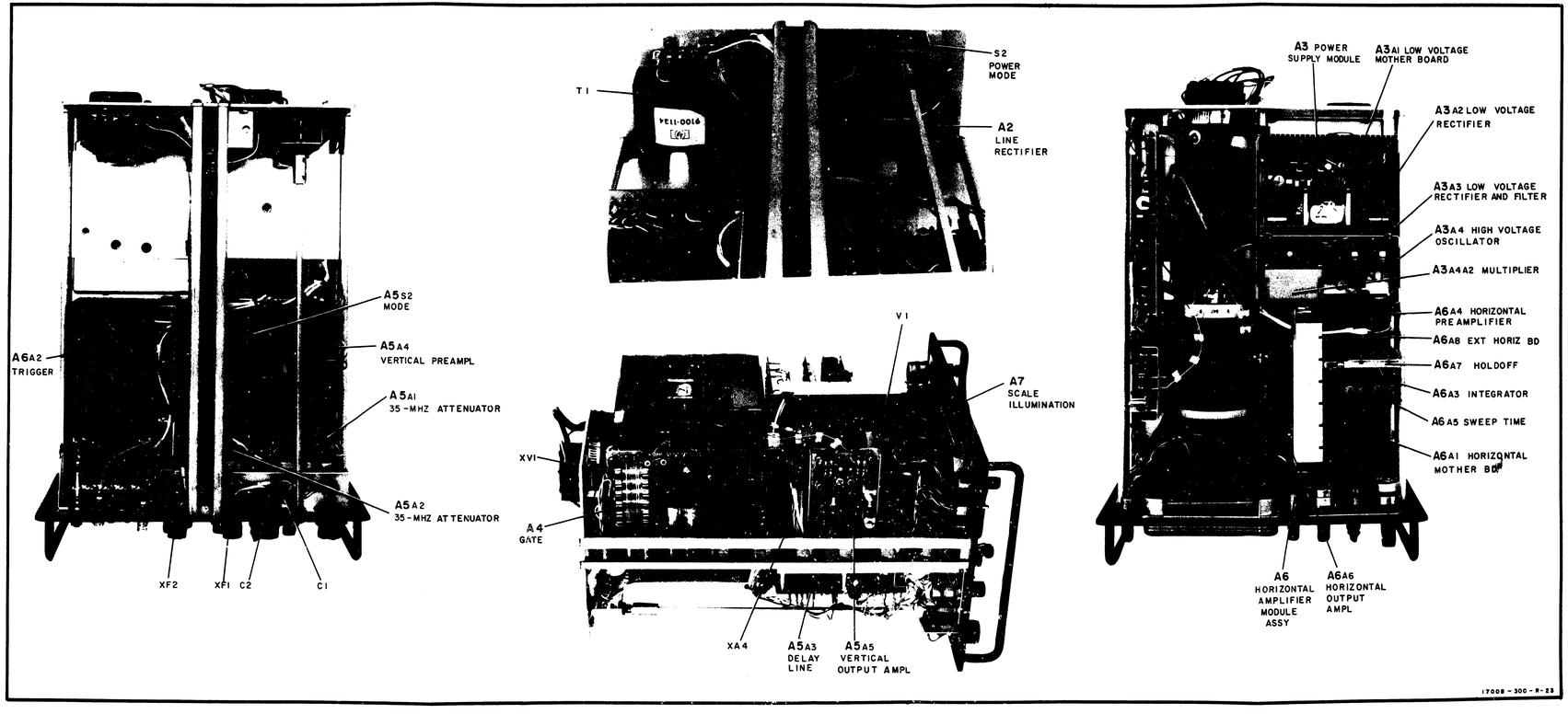



Figure 8-5. Component and Assembly Locations

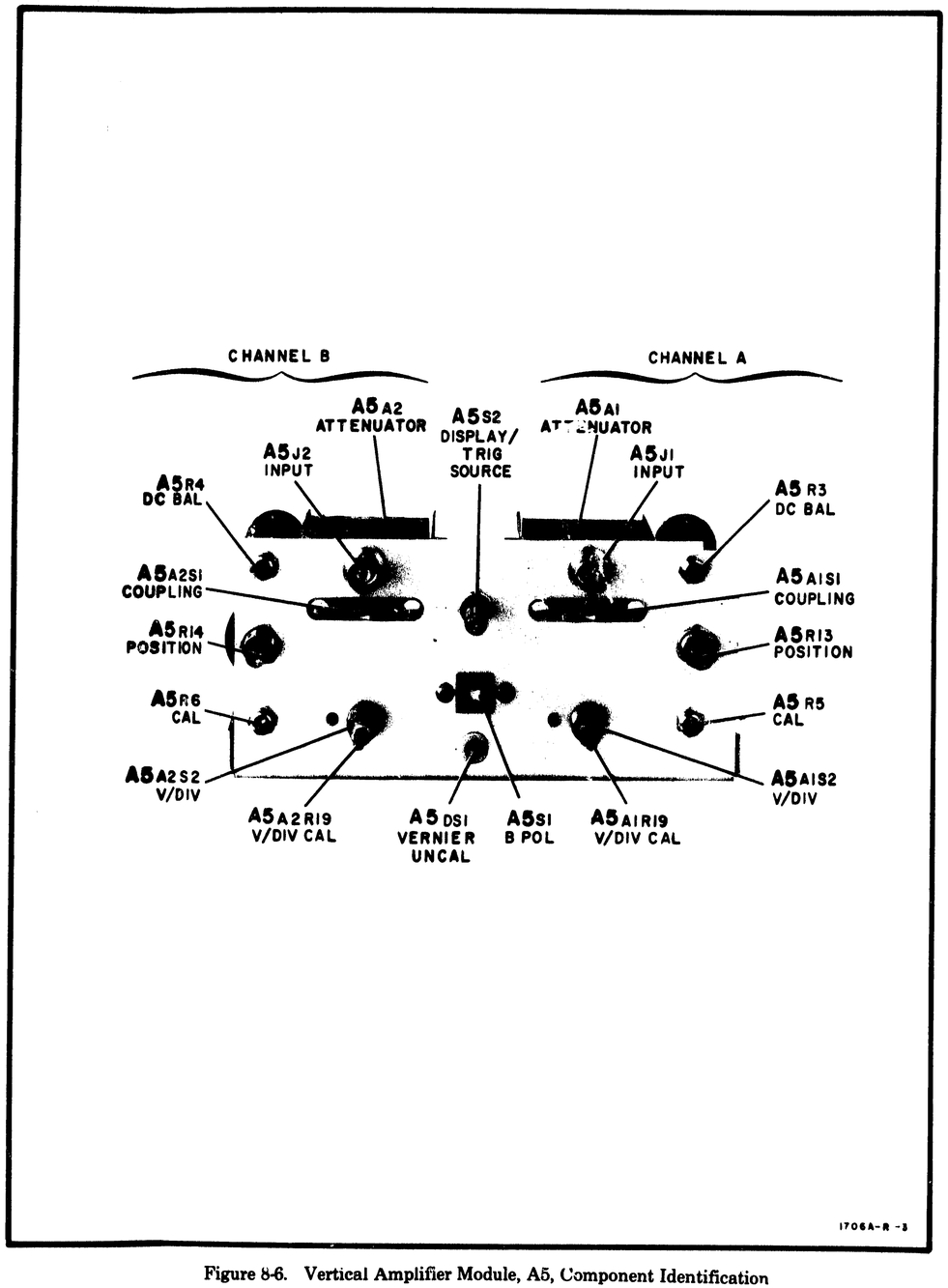



Figure 8-6. Vertical Amplifier Module, A5, Component Identification

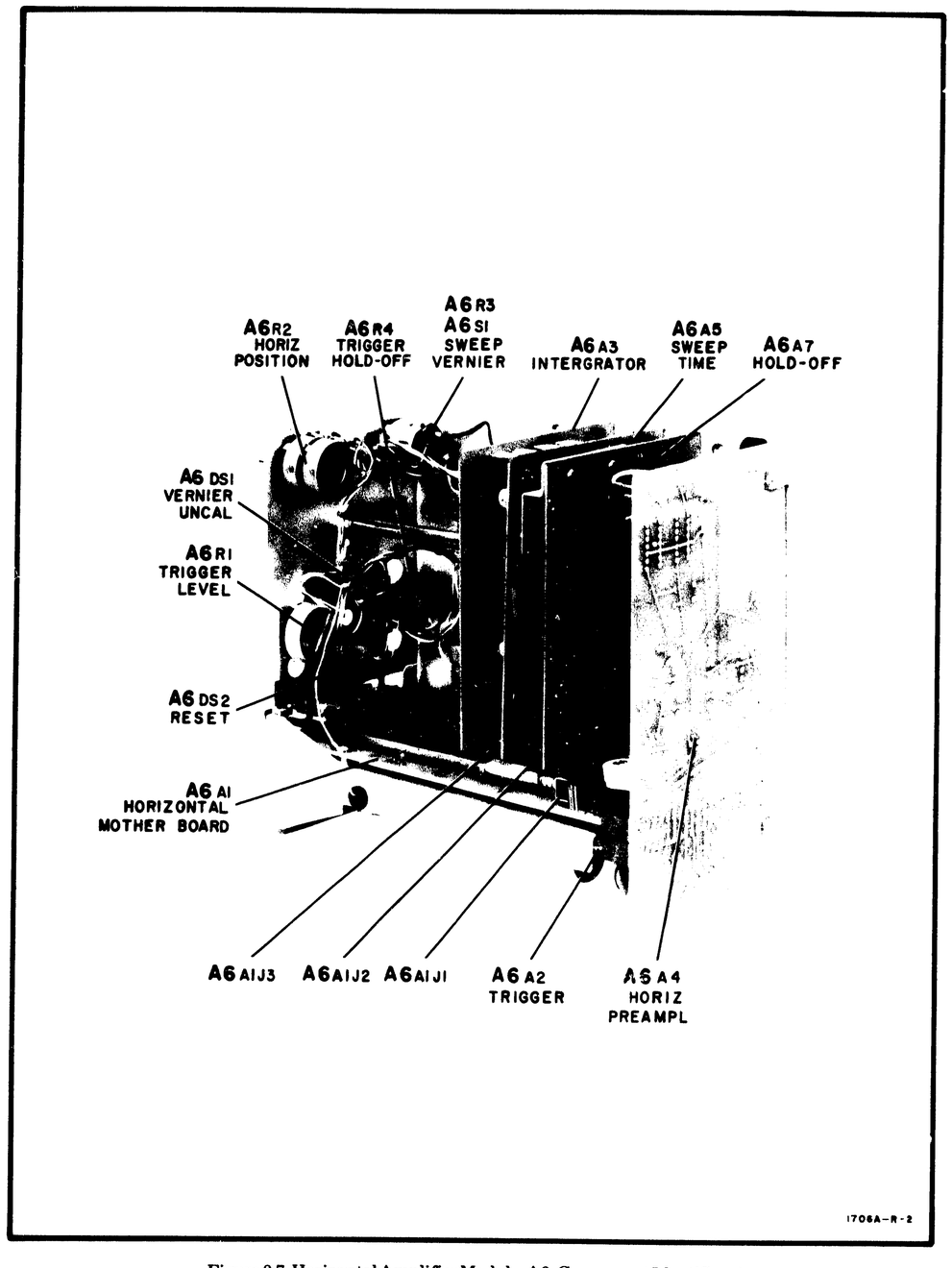



Figure 8-7. Horizontal Amplifier Module, A6, Component Identification

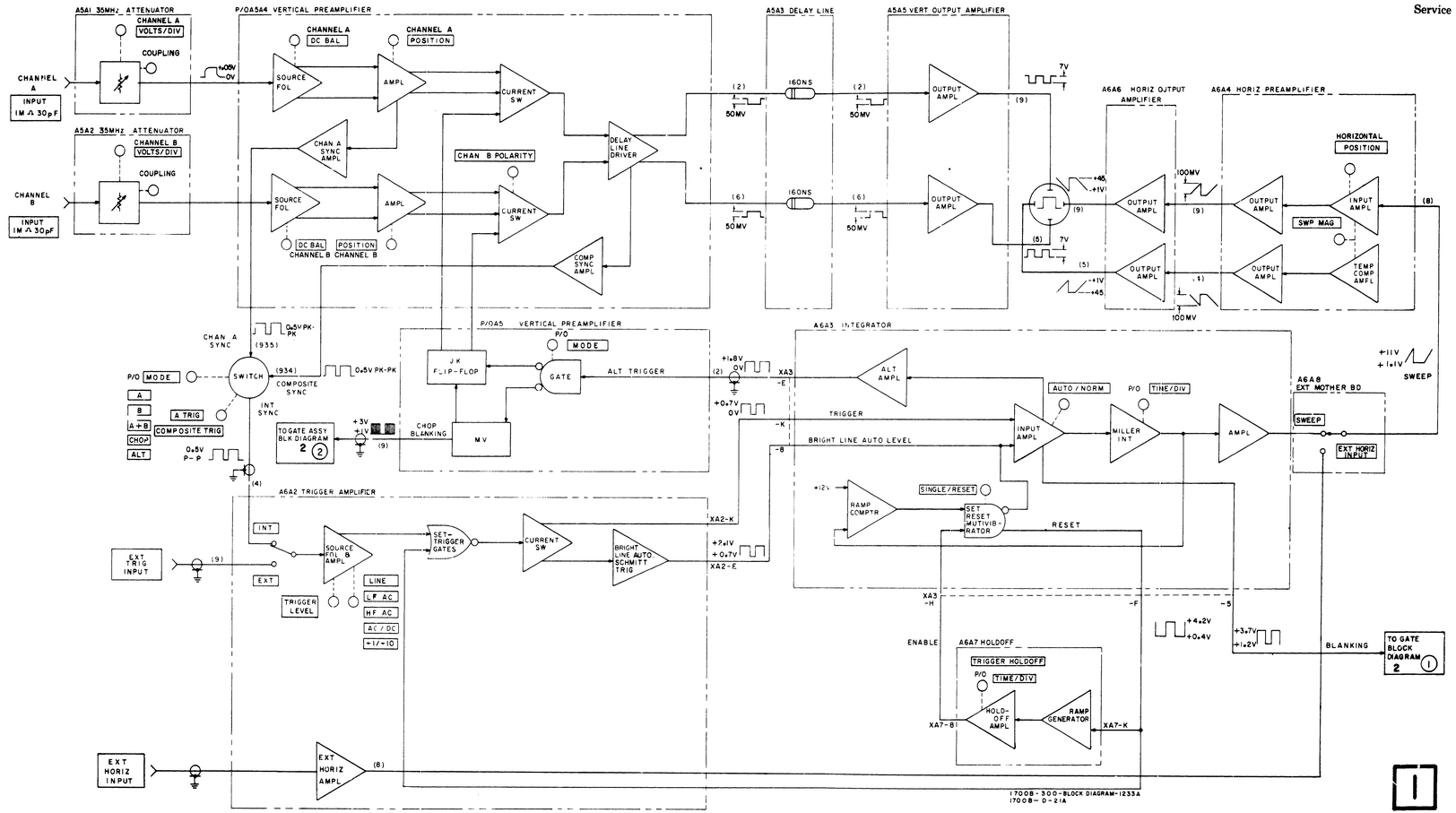
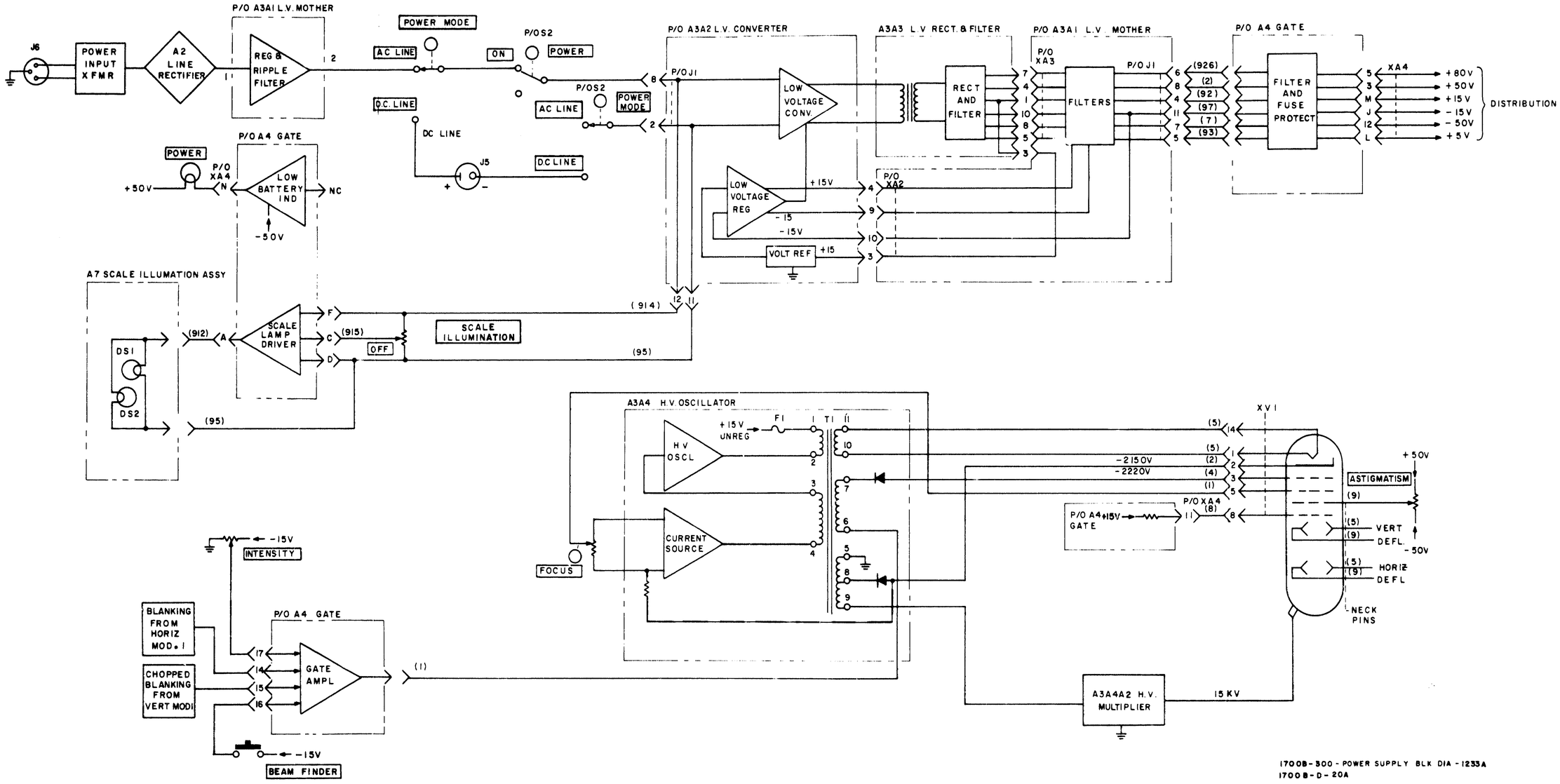



Figure 8-8.
Main Block Diagram
8-23/8-24




1700B-300-POWER SUPPLY BLK DIA-1233A
1700B-D-20A

2

Figure 8-9.
Power Supply Block Diagram

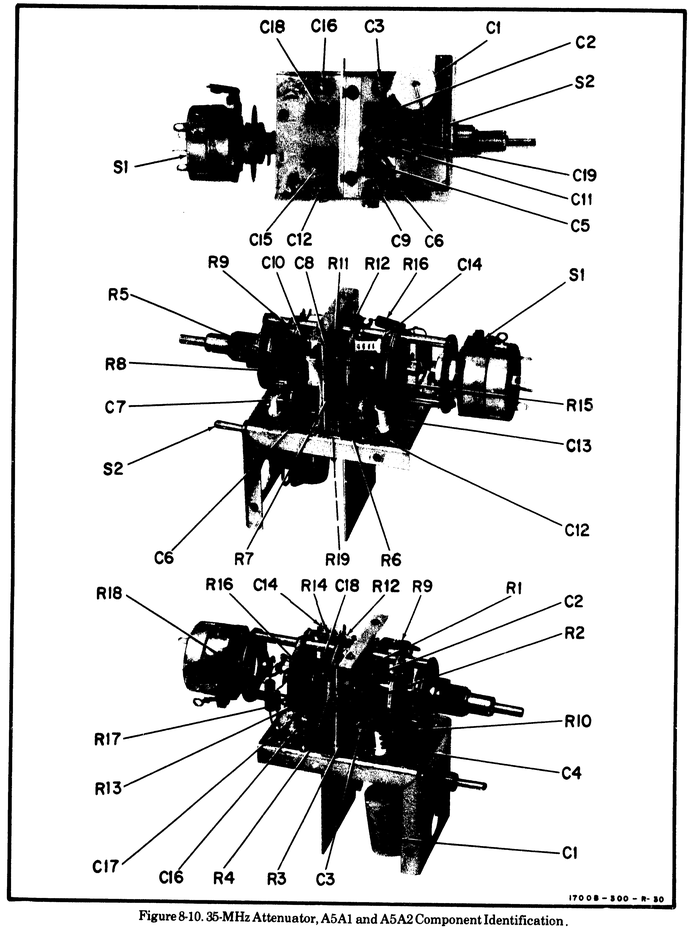



Figure 8-10. 35-MHz Attenuator, A5A1 and A5A2 Component Identification.

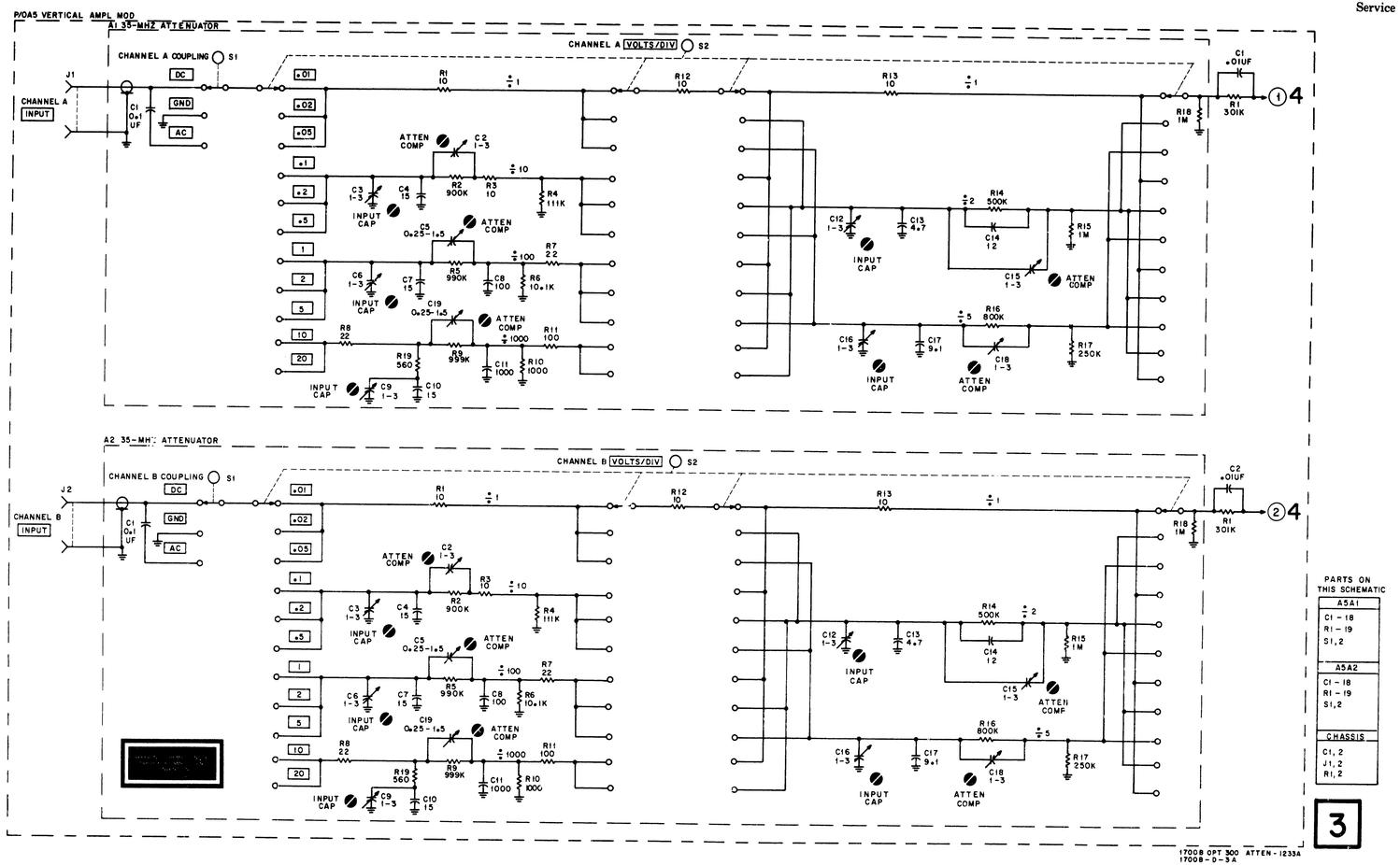
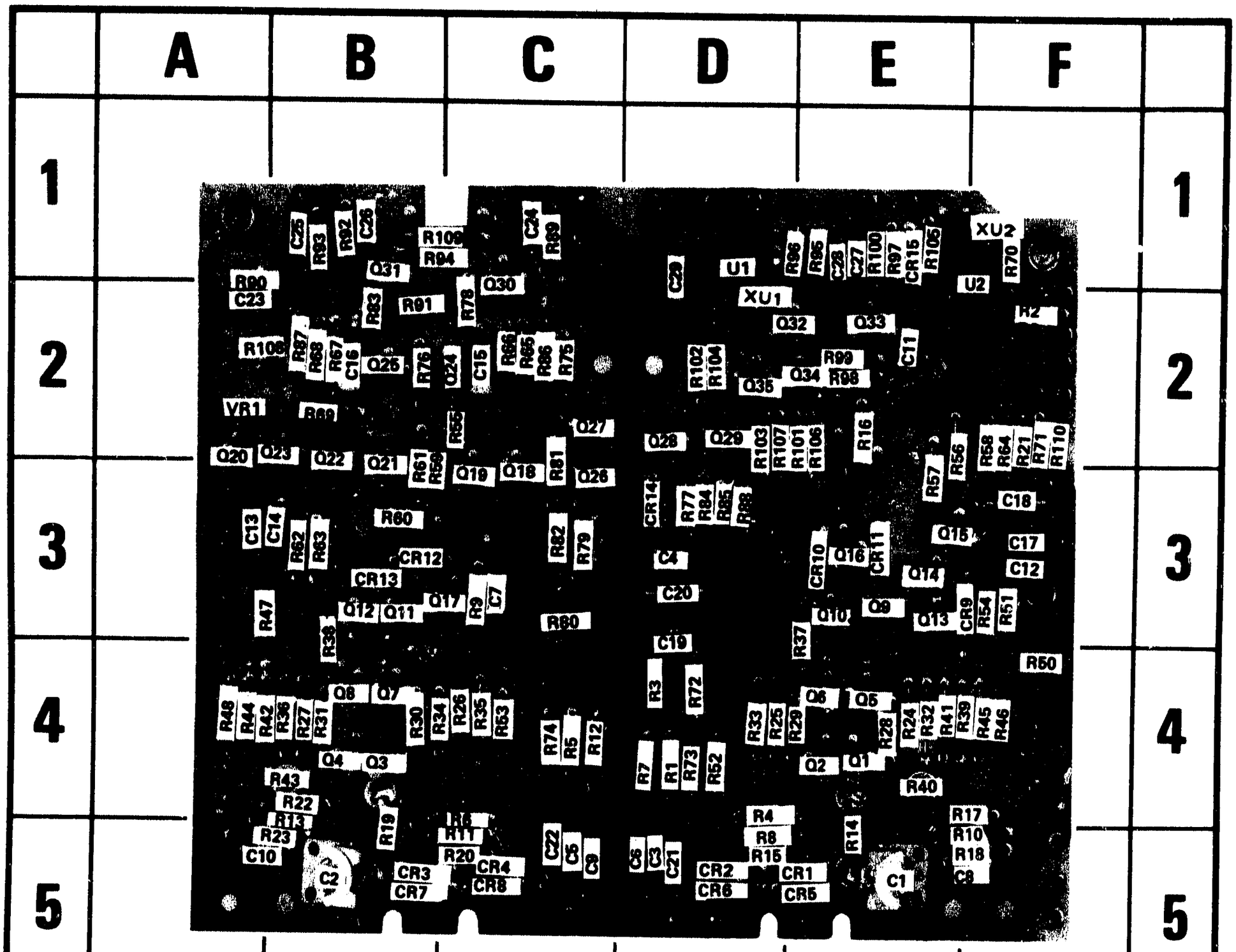



Figure 8-11.
35-MHz Attenuator,
A5A1 and A5A2, Schematic




Circuit boards have plated through component holes. This permits soldering from either side of the board.

## A5A4

| REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C1 | E 5 | C25 | B-1 | Q5 | E-4 | Q29 | D-2 | R18 | F-5 | R42 | A-4 | R67 | B-2 | R91 | B-2 |
| C2 | B-5 | C26 | B-1 | Q6 | E-4 | Q30 | C-1 | R19 | B-5 | R43 | B-4 | R68 | B-2 | R92 | B-1 |
| C3 | D-5 | C27 | E-1 | Q7 | B-4 | Q31 | B-1 | R20 | C-5 | R44 | A-4 | R69 | B-2 | R93 | B-1 |
| C4 | D-3 | C28 | E-1 | Q8 | B-4 | Q32 | D-1 | R21 | F-2 | R45 | F-4 | R70 | F-1 | R94 | B-1 |
| C5 | C-5 | C29 | D-1 | Q9 | E-3 | Q33 | E-2 | R22 | B-4 | R46 | F-4 | R71 | F-2 | R95 | E-1 |
| C6 | D-5 | CR1 | E-5 | Q10 | E-3 | Q34 | E-2 | R23 | B-5 | R47 | A-3 | R72 | D-4 | R96 | D-1 |
| C7 | C-3 | CR2 | D-5 | Q11 | B-3 | Q35 | D-2 | R24 | E-4 | R48 | A-4 | R73 | D-4 | R97 | E-1 |
| C8 | F-5 | CR3 | B-5 | Q12 | B-3 | R1 | D-4 | R25 | D-4 | R50 | F-4 | R74 | C-4 | R98 | E-2 |
| C9 | C-5 | CR4 | C-5 | Q13 | E-3 | R2 | F-2 | R26 | C-4 | R51 | F-3 | R75 | C-2 | R99 | E-2 |
| C10 | A-5 | CR5 | E-5 | Q14 | E-3 | R3 | D-4 | R27 | B-4 | R52 | D-4 | R76 | B-2 | R100 | E-1 |
| C11 | E-2 | CR6 | D-5 | Q15 | E-3 | R4 | D-4 | R28 | E-4 | R53 | C-4 | R77 | D-3 | R101 | E-2 |
| C12 | F-3 | CR7 | B-5 | Q16 | E-3 | R5 | C-4 | R29 | E-4 | R54 | F-3 | R78 | C-2 | R102 | D-2 |
| C13 | A-3 | CR8 | C-5 | Q17 | C-3 | R6 | C-4 | R30 | B-4 | R55 | C-2 | R79 | C-3 | R103 | D-2 |
| C14 | B-3 | CR9 | E-3 | Q18 | C-3 | R7 | D-4 | R31 | B-4 | R56 | E-2 | R80 | C-3 | R104 | D-2 |
| C15 | C-2 | CR10 | E-3 | Q19 | C-3 | R8 | D-5 | R32 | E-4 | R57 | E-3 | R81 | C-2 | R105 | E-1 |
| C16 | B-2 | CR11 | E-3 | Q20 | A-2 | R9 | C-3 | R33 | D-4 | R58 | F-2 | R82 | C-3 | R106 | E-2 |
| C17 | E-3 | CR12 | B-3 | Q21 | B-2 | R10 | F-5 | R34 | B-4 | R59 | B-3 | R83 | B-2 | R107 | D-2 |
| C18 | F-3 | CR13 | B-3 | Q22 | B-2 | R11 | C-5 | R35 | C-4 | R60 | B-3 | R84 | D-3 | R108 | A-2 |
| C19 | D-3 | CR14 | D-3 | Q23 | B-2 | R12 | C-4 | R36 | B-4 | R61 | B-3 | R85 | D-3 | R109 | B-1 |
| C20 | D-3 | CR15 | E-1 | Q24 | C-2 | R13 | B-5 | R37 | E-3 | R62 | B-3 | R86 | C-2 | R110 | F-2 |
| C21 | D-5 | Q1 | E-4 | Q25 | B-2 | R14 | E-5 | R38 | B-3 | R63 | B-3 | R87 | B-2 | U1 | D-1 |
| C22 | C-5 | Q2 | E-4 | Q26 | C-3 | R15 | D-5 | R39 | E-4 | R64 | F-2 | R88 | D-3 | U2 | F-1 |
| C23 | A-2 | Q3 | B-4 | Q27 | C-2 | R16 | E-2 | R40 | E-4 | R65 | C-2 | R89 | C-1 | VR1 | A-2 |
| C24 | C-1 | Q4 | B-4 | Q28 | D-2 | R17 | F-4 | R41 | E-4 | R66 | C-2 | R90 | A-2 | XU1 | D-1 |
| | | | | | | | | | | | | | | XU2 | F-1 |

17008-300-R-12

Figure 8-12. Vertical Preamplifier, A5A4, Component Identification

Table 8-10. Channel A Preamplifier Measurement Conditions and Waveforms

## WAVEFORM MEASUREMENT CONDITIONS

A. Set:

| | |
|---|---|
| MODE | A |
| Channel A POSITION | midrange |
| channel A vernier | VERN CAL |
| channel A VOLTS/DIV | .2 |
| channel A coupling | GND |

B. Connect CAL 1 VOLT signal to channel A INPUT.

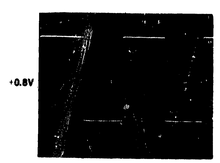
C. All waveforms are referenced to chassis ground. The monitor oscilloscope's vertical sensitivity(using a 1:1 probe) and sweep speed settings are shown below on each waveform photograph.

## DC VOLTAGE MEASUREMENT CONDITIONS

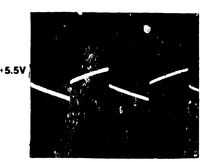
A. Set:

| | |
|---|---|
| MODE | A |
| channel A POSITION | midrange |
| channel A vernier | VERN CAL |
| channel A VOLTS/DIV | .2 |
| channel A coupling | GND |

B. All voltages are referenced to chassis ground. all indications are nominal and may vary slightly.




1 0.01 V/DIV
0.2 ms/div

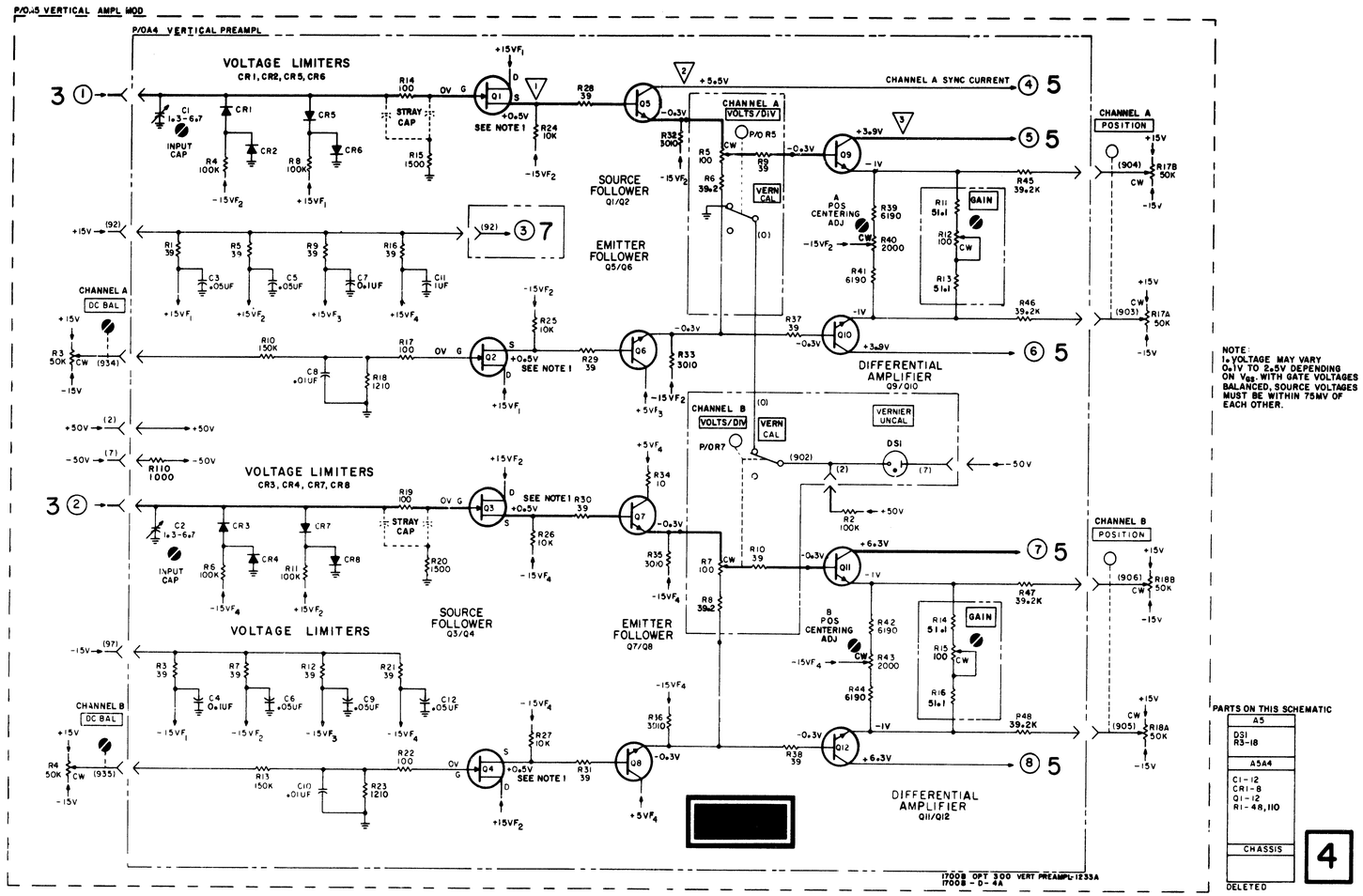



2 0.005 V/DIV
0.2 ms/DIV


3 0.005 V/DIV
0.2 ms/DIV

1700B-300-R-31






NOTE
1. VOLTAGE MAY VARY 0.1V TO 2.5V DEPENDING ON $V_{GS}$. WITH GATE VOLTAGES BALANCED, SOURCE VOLTAGES MUST BE WITHIN 75MV OF EACH OTHER.

PARTS ON THIS SCHEMATIC

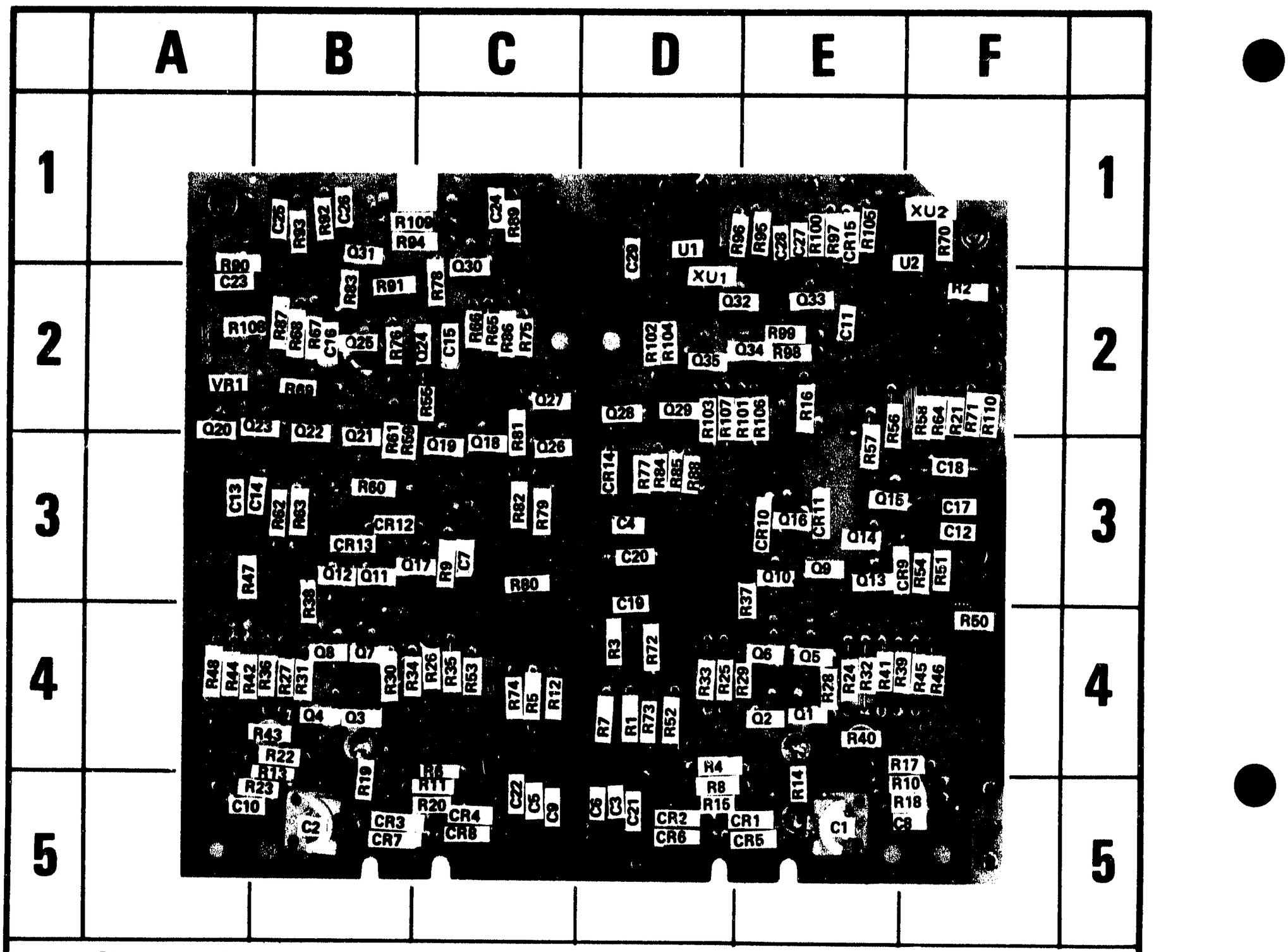
| |
|---|
| A5 |
| DS1 R3-18 |
| A5A4 |
| C1-12 CR1-8 Q1-12 R1-48, 110 |
| CHASSIS |
| DELETED |

4

Figure 8-13.
Vertical Preamplifier,
A5A4, Schematic 4

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

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| MP35 | 01700-23705 | 1 | SHAFT: EXTENSION | 28480 | 01700-23705 |
| MP36 | 01701-00601 | 1 | SHIELD: CRT | 28480 | 01701-00601 |
| MP37 | 01701-04109 | 1 | COVER: XFMR | 28480 | 01701-04109 |
| MP38 | 01701-07101 | 1 | MASK: CRT | 28480 | 01701-07101 |
| MP39 | 01701-09102 | 1 | SPRING: CRT CONTACT | 28480 | 01701-09102 |
| MP40 | 01701-09103 | 2 | SPRING: FLTR CONTACT | 28480 | 01701-09103 |
| MP41 | 01701-09104 | 2 | SPRING: CONTACT | 28480 | 01701-09104 |
| MP42 | 01701-24702 | 1 | SUPPORT: CRT CAMERA | 28480 | 01701-24702 |
| MP43 | 01707-00101 | 1 | DECK: BATTERY | 28480 | 01707-00101 |
| MP44 | 0363-0068 | 2 | CONTACT: GROUND | 28480 | 0363-0068 |
| MP45 | 1500-0364 | 1 | COLLAR: SHAFT | 28480 | 1500-0364 |
| MP46 | 01700-63704 | 1 | SHAFT: TIME/DIV SWITCH | 28480 | 01700-63704 |
| MP47 | 01701-02301 | 1 | KEEPER: PC BOARDS | 28480 | 01701-02301 |
| MP48 | 01701-04101 | 1 | COVER: POWER BOX | 28480 | 01701-04101 |
| MP49 | 1460-1305 | 3 | SPRING: LEAF | 28480 | 1460-1305 |
| MP50 | 3130-0055 | 6 | SCOT: BUSHING | 28480 | 3130-0055 |
| MP51 | 01700-00601 | 1 | SHIELD: INPUT | 28480 | 01700-00601 |
| MP52 | 01700-04102 | 1 | COVER: SHIELD INPUT | 28480 | 01700-04102 |
| MP53 | 1200-0050 | 7 | PIN: CRT SOCKET | 72825 | 9553-1 |
| MP54 | 1200-0408 | 1 | COVER: PLATE | 28480 | 1200-0408 |
| MP55 | 0380-1019 | 2 | SPACER | 28480 | 0380-1019 |
| P1 | 1251-2588 | 1 | BODY: R AND P CONN 12 MALE CONTACT | 27264 | 1625-12P-1 |
| R1 | 2100-3023 | 1 | R: VAR COMP 10K OHM 20% LIN 1/2W | 28480 | 2100-3023 |
| R2 | 2100-3017 | 1 | R: VAR CERMET 2.5 MEGOHM 20% LIN | 28480 | 2100-3017 |
| R3 | 2100-3022 | 1 | R: VAR COMP 10K OHM 20% LIN 1/5W | 28480 | 2100-3022 |
| R4 | 2100-0203 | 1 | R: VAR COMP 20K OHM 30% LIN 1/5W | 28480 | 2100-0203 |
| R5 | 2100-3021 | 1 | R: VAR COMP 100K OHM 20% LIN 1/5W | 28480 | 2100-3021 |
| R6 | 2100-3260 | 1 | R: VAR COMP 10K OHM 10% LIN 1/4W | 28480 | 2100-3260 |
| S1 | 3101-0163 | 1 | SWITCH: TOGGLE SPDT (POWER) | 04009 | MST-1050 |
| S2 | 3100-3094 | 1 | SWITCH: POWER MODE | 28480 | 3100-3094 |
| S3 | 3101-1175 | 1 | SWITCH: TOGGLE DPDT 115V 5A (BEAM FINDER) | 95146 | MST-205R |
| T1 | 01700-61103 | 1 | TRANSFORMER ASSY | 28480 | 01700-61103 |
| V1 | 5083-2752 | 1 | CRT: P31 ALUM. INT. GRATICULE | 28480 | 5083-2752 |
| W1 | 01700-61605 | 1 | CABLE ASSY: POWER | 28480 | 01700-61605 |
| W2 | 01701-61605 | 2 | CABLE ASSY: TWIN LEAD (VERT TO CRT) | 28480 | 01701-61605 |
| W3 | 01701-61605 | | CABLE ASSY: TWIN LEAD (HORIZ TO CRT) | 28480 | 01701-61605 |
| W4 | 01703-61603 | 1 | CABLE ASSY: VERT PREAMPL TO GATE (WHT CAP) | 28480 | 01703-61603 |
| W5 | 01703-61604 | 1 | CABLE ASSY: VERT PREAMPL TO GATE (BLU CAP) | 28480 | 01703-61604 |
| W6 | 01701-61609 | 1 | CABLE: COAX. (ALT TRIG) | 28480 | 01701-61609 |
| W7 | 01701-61624 | 1 | CABLE: COAX. (GATE TO 1V CAL-YEL CAP) | 28480 | 01701-61624 |
| W8 | 01701-61610 | 1 | CABLE ASSY: COAX. | 28480 | 01701-61610 |
| XF1 | 2110-0444 | 2 | HOLDER: FUSE | 28480 | 2110-0444 |
| XF2 | 2110-0444 | | HOLDER: FUSE | 28480 | 2110-0444 |
| XV1 | 1200-0037 | 1 | SOCKET: CRT | 72825 | 97097 |
| Z1 | 1901-0526 | 1 | BRIDGE: DIODE SI | 28480 | 1901-0526 |




Circuit boards have plated through component holes. This permits soldering from either side of the board.

## A5A4

| REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C1 | E-5 | C25 | B-1 | Q5 | E-4 | Q29 | D-2 | R18 | F-5 | R42 | A-4 | R67 | B-2 | R91 | B-2 |
| C2 | B-5 | C26 | B-1 | Q6 | E-4 | Q30 | C-1 | R19 | B-5 | R43 | B-4 | R68 | B-2 | R92 | B-1 |
| C3 | D-5 | C27 | E-1 | Q7 | B-4 | Q31 | B-1 | R20 | C-5 | R44 | A-4 | R69 | B-2 | R93 | B-1 |
| C4 | D-3 | C28 | E-1 | Q8 | B-4 | Q32 | D-1 | R21 | F-2 | R45 | F-4 | R70 | F-1 | R94 | B-1 |
| C5 | C-5 | C29 | D-1 | Q9 | E-3 | Q33 | E-2 | R22 | B-4 | R46 | F-4 | R71 | F-2 | R95 | E-1 |
| C6 | D-5 | CR1 | E-5 | Q10 | E-3 | Q34 | E-2 | R23 | B-5 | R47 | A-3 | R72 | D-4 | R96 | D-1 |
| C7 | C-3 | CR2 | D-5 | Q11 | B-3 | Q35 | D-2 | R24 | E-4 | R48 | A-4 | R73 | D-4 | R97 | E-1 |
| C8 | F-5 | CR3 | B-5 | Q12 | B-3 | R1 | D-4 | R25 | D-4 | R50 | F-4 | R74 | C-4 | R98 | E-2 |
| C9 | C-5 | CR4 | C-5 | Q13 | E-3 | R2 | F-2 | R26 | C-4 | R51 | F-3 | R75 | C-2 | R99 | E-2 |
| C10 | A-5 | CR5 | E-5 | Q14 | E-3 | R3 | D-4 | R27 | B-4 | R52 | D-4 | R76 | B-2 | R100 | E-1 |
| C11 | E-2 | CR6 | D-5 | Q15 | E-3 | R4 | D-4 | R28 | E-4 | R53 | C-4 | R77 | D-3 | R101 | E-2 |
| C12 | F-3 | CR7 | B-5 | Q16 | E-3 | R5 | C-4 | R29 | E-4 | R54 | F-3 | R78 | C-2 | R102 | D-2 |
| C13 | A-3 | CR8 | C-5 | Q17 | C-3 | R6 | C-4 | R30 | B-4 | R55 | C-2 | R79 | C-3 | R103 | D-2 |
| C14 | B-3 | CR9 | E-3 | Q18 | C-3 | R7 | D-4 | R31 | B-4 | R56 | E-2 | R80 | C-3 | R104 | D-2 |
| C15 | C-2 | CR10 | E-3 | Q19 | C-3 | R8 | D-5 | R32 | E-4 | R57 | E-3 | R81 | C-2 | R105 | E-1 |
| C16 | B-2 | CR11 | E-3 | Q20 | A-2 | R9 | C-3 | R33 | D-4 | R58 | F-2 | R82 | C-3 | R106 | E-2 |
| C17 | E-3 | CR12 | B-3 | Q21 | B-2 | R10 | F-5 | R34 | B-4 | R59 | B-3 | R83 | B-2 | R107 | D-2 |
| C18 | F-3 | CR13 | B-3 | Q22 | B-2 | R11 | C-5 | R35 | C-4 | R60 | B-3 | R84 | D-3 | R108 | A-2 |
| C19 | D-3 | CR14 | D-3 | Q23 | B-2 | R12 | C-4 | R36 | B-4 | R61 | B-3 | R85 | D-3 | R109 | B-1 |
| C20 | D-3 | CR15 | E-1 | Q24 | C-2 | R13 | B-5 | R37 | E-3 | R62 | B-3 | R86 | C-2 | R110 | F-2 |
| C21 | D-5 | Q1 | E-4 | Q25 | B-2 | R14 | E-5 | R38 | B-3 | R63 | B-3 | R87 | B-2 | U1 | D-1 |
| C22 | C-5 | Q2 | E-4 | Q26 | C-3 | R15 | D-5 | R39 | E-4 | R64 | F-2 | R88 | D-3 | U2 | F-1 |
| C23 | A-2 | Q3 | B-4 | Q27 | C-2 | R16 | E-2 | R40 | E-4 | R65 | C-2 | R89 | C-1 | VR1 | A-2 |
| C24 | C-1 | Q4 | B-4 | Q28 | D-2 | R17 | F-4 | R41 | E-4 | R66 | C-2 | R90 | A-2 | XU1 | D-1 |
| | | | | | | | | | | | | | | XU2 | F-1 |

1700B-300-R-12

Figure 8-14. Vertical Preamplifier, A5A4, Component Identification

Table 8-11. Channel A Preamplifier Measurement Conditions and Waveforms

## DC VOLTAGE MEASUREMENT CONDITIONS

A. Set:

| | |
|---|---|
| MODE | A |
| channel A POSITION | midrange |
| channel A vernier | VERN CAL |
| channel A VOLTS/DIV | .2 |
| channel A coupling | GND |

B. All voltages are referenced to chassis ground. All indications are nominal and may vary slightly.

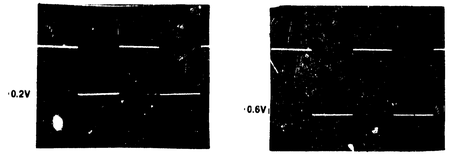
## WAVEFORM MEASUREMENT CONDITIONS

A. Set:

| | |
|---|---|
| MODE | A |
| channel A POSITION | midrange |
| channel A vernier | VERN CAL |
| channel A VOLTS/DIV | .2 |
| channel A coupling | AC |

B. Connect CAL ! VOLT to channel A INPUT.

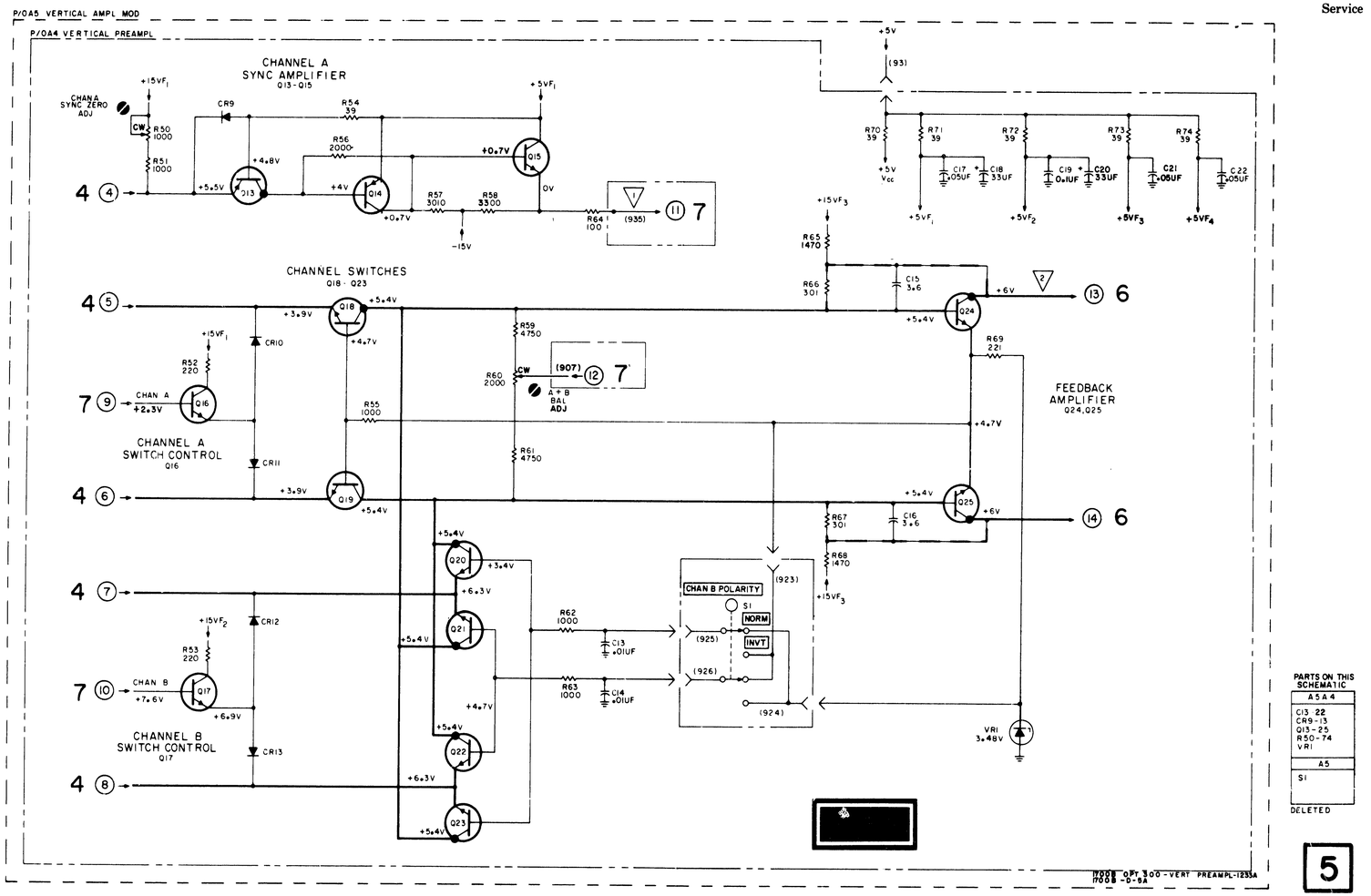
C. All waveforms are referenced to chassis ground. The monitor oscilloscope's vertical sensitivity (using a 1:1 probe) and sweep speed settings are shown below on each waveform photograph.




1 0.2 V/DIV 0.2 ms/DIV

2 0.02 V/DIV 0.2 ms/DIV

1700B-300-R-32



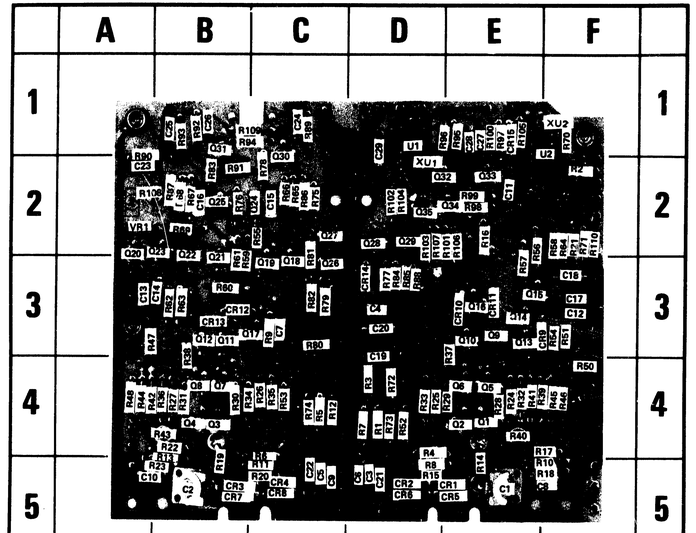

PARTS ON THIS SCHEMATIC

| A5A4 |
|---|
| C13 22<br>CR9-13<br>Q13-25<br>R50-74<br>VR1 |
| A5 |
| S1 |

DELETED

5

Figure 8-15. Vertical Preamplifier, A5A4, Schematic 5



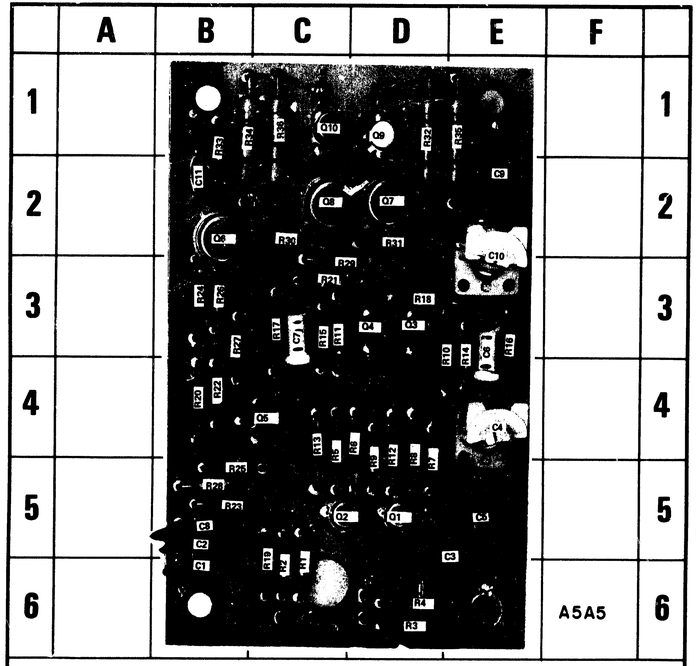

Circuit boards have plated through component holes. This permits soldering from either side of the board.

A5A4

| REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C1 | E-5 | C26 | B-1 | Q5 | E-4 | Q29 | D-2 | R18 | F-5 | R42 | A-4 | R67 | B-2 | R91 | B-2 |
| C2 | B-5 | C26 | B-1 | Q6 | E-4 | Q30 | C-1 | R19 | B-5 | R43 | B-4 | R68 | B-2 | R92 | B-1 |
| C3 | D-5 | C27 | E-1 | Q7 | B-4 | Q31 | B-1 | R20 | C-5 | R44 | A-4 | R69 | B-2 | R93 | B-1 |
| C4 | D-3 | C28 | E-1 | Q8 | B-4 | Q32 | D-1 | R21 | F-2 | R45 | F-4 | R70 | F-1 | R94 | B-1 |
| C5 | C-5 | C29 | D-1 | Q9 | E-3 | Q33 | E-2 | R22 | B-4 | R46 | F-4 | R71 | F-2 | R95 | E-1 |
| C6 | D-5 | CR1 | E-5 | Q10 | E-3 | Q34 | E-2 | R23 | B-5 | R47 | A-3 | R72 | D-4 | R96 | D-1 |
| C7 | C-3 | CR2 | D-5 | Q11 | B-3 | Q35 | D-2 | R24 | E-4 | R48 | A-4 | R73 | D-4 | R97 | E-1 |
| C8 | F-5 | CR3 | B-5 | Q12 | B-3 | R1 | D-4 | R25 | D-4 | R50 | F-4 | R74 | C-4 | R98 | E-2 |
| C9 | C-5 | CR4 | C-5 | Q13 | E-3 | R2 | F-2 | R26 | C-4 | R51 | F-3 | R75 | C-2 | R99 | E-2 |
| C10 | A-5 | CR5 | E-5 | Q14 | E-3 | R3 | D-4 | R27 | B-4 | R52 | D-4 | R76 | B-2 | R100 | E-1 |
| C11 | E-2 | CR6 | D-5 | Q15 | E-3 | R4 | D-4 | R28 | E-4 | R53 | C-4 | R77 | D-3 | R101 | E-2 |
| C12 | F-3 | CR7 | B-5 | Q16 | E-3 | R5 | E-4 | R29 | E-4 | R54 | F-3 | R78 | C-2 | R102 | D-2 |
| C13 | A-3 | CR8 | C-5 | Q17 | C-3 | R6 | C-4 | R30 | B-4 | R55 | C-2 | R79 | C-3 | R103 | D-2 |
| C14 | B-3 | CR9 | E-3 | Q18 | C-3 | R7 | D-4 | R31 | B-4 | R56 | E-2 | R80 | C-3 | R104 | D-2 |
| C15 | C-2 | CR10 | E-3 | Q19 | C-3 | R8 | D-5 | R32 | E-4 | R57 | E-3 | R81 | C-3 | R105 | E-1 |
| C16 | B-2 | CR11 | E-3 | Q20 | A-2 | R9 | C-3 | R33 | D-4 | R58 | F-2 | R82 | C-3 | R106 | E-2 |
| C17 | E-3 | CR12 | B-3 | Q21 | B-2 | R10 | F-5 | R34 | B-4 | R59 | B-3 | R83 | B-2 | R107 | D-2 |
| C18 | F-3 | CR13 | B-3 | Q22 | B-2 | R11 | C-5 | R35 | C-4 | R60 | B-3 | R84 | D-3 | R108 | A-2 |
| C19 | D-3 | CR14 | D-3 | Q23 | B-2 | R12 | C-4 | R36 | B-4 | R61 | B-3 | R85 | D-3 | R109 | B-1 |
| C20 | D-3 | CR15 | E-1 | Q24 | C-2 | R13 | B-5 | R37 | E-3 | R62 | B-3 | R86 | C-2 | R110 | F-2 |
| C21 | D-5 | Q1 | E-4 | Q25 | B-2 | R14 | E-5 | R38 | B-3 | R63 | B-3 | R87 | B-2 | U1 | D-1 |
| C22 | C-5 | Q2 | E-4 | Q26 | C-3 | R15 | D-5 | R39 | E-4 | R64 | F-2 | R88 | D-3 | U2 | F-1 |
| C23 | A-2 | Q3 | B-4 | Q27 | C-2 | R16 | E-2 | R40 | E-4 | R65 | C-2 | R89 | C-1 | VR1 | A-2 |
| C24 | C-1 | Q4 | B-4 | Q28 | D-2 | R17 | F-4 | R41 | E-4 | R66 | C-2 | R90 | A-2 | XU1 | D-1 |
| | | | | | | | | | | | | | | XU2 | F-1 |

17008-300-R-12

Figure 8-16. Vertical Preamplifier, A5A4, Component Identification




A5A5

| REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|---|---|---|---|---|---|---|---|---|---|
| C1 | B-5 | Q1 | D-5 | R2 | C-6 | R13 | C-4 | R25 | B-5 |
| C2 | B-5 | Q2 | C-5 | R3 | D-6 | R14 | E-3 | R26 | B-3 |
| C3 | E-5 | Q3 | D-3 | R4 | D-6 | R15 | C-3 | R27 | B-3 |
| C4 | E-4 | Q4 | D-3 | R5 | C-4 | R16 | E-3 | R28 | B-5 |
| C5 | E-5 | Q5 | C-4 | R6 | D-4 | R17 | C-3 | R29 | C-3 |
| C6 | E-3 | Q6 | B-2 | R7 | D-4 | R18 | D-3 | R30 | C-2 |
| C7 | C-3 | Q7 | D-2 | R8 | D-4 | R19 | C-6 | R31 | D-2 |
| C8 | B-5 | Q8 | C-2 | R9 | D-4 | R20 | B-4 | R32 | D-1 |
| C9 | E-2 | Q9 | D-1 | R10 | E-3 | R21 | C-3 | R33 | B-1 |
| C10 | E-2 | Q10 | C-1 | R11 | C-3 | R22 | B-4 | R34 | B-1 |
| C11 | B-2 | R1 | C-6 | R12 | D-4 | R23 | B-5 | R35 | E-1 |
| | | | | | | R24 | B-J | R36 | C-1 |

17008-300-R-6

Figure 8-17. Vertical Output Amplifier, A5A5, Component Identification

Table 8-12. Vertical Preamplifier and Output Amplifier Measurement Conditions and Waveforms

## DC VOLTAGE MEASUREMENT CONDITIONS

A. Set:

| | |
|---|---|
| MODE | A |
| channel A POSITION | midrange |
| channel A vernier | VERN CAL |
| channel A VOLTS/DIV | .2 |
| channel A coupling | GND |

B. All voltages are referenced to chassis ground. All indications are nominal and may vary slightly.

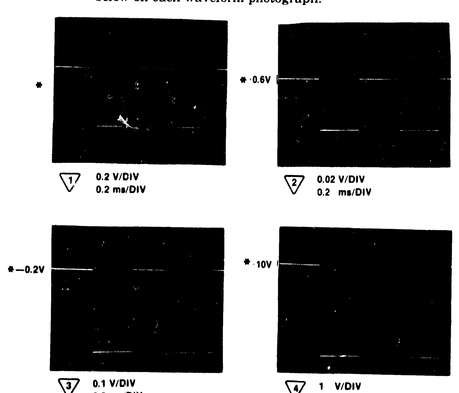
## WAVEFORM MEASUREMENT CONDITIONS

A. Set:

| | |
|---|---|
| MODE | A |
| channel A POSITION | midrange |
| channel A vernier | VERN CAL |
| channel A VOLTS/DIV | .2 |
| channel A coupling | AC |

B. Connect CAL 1 VOLT to channel A INPUT.

C. All waveforms are referenced to chassis ground. The monitor oscilloscope's vertical sensitivity (using a 1:1 probe) and sweep speed settings are shown below on each waveform photograph.




* Trace offset varies with position control and AC or DC coupling.

1700B-300-R-33

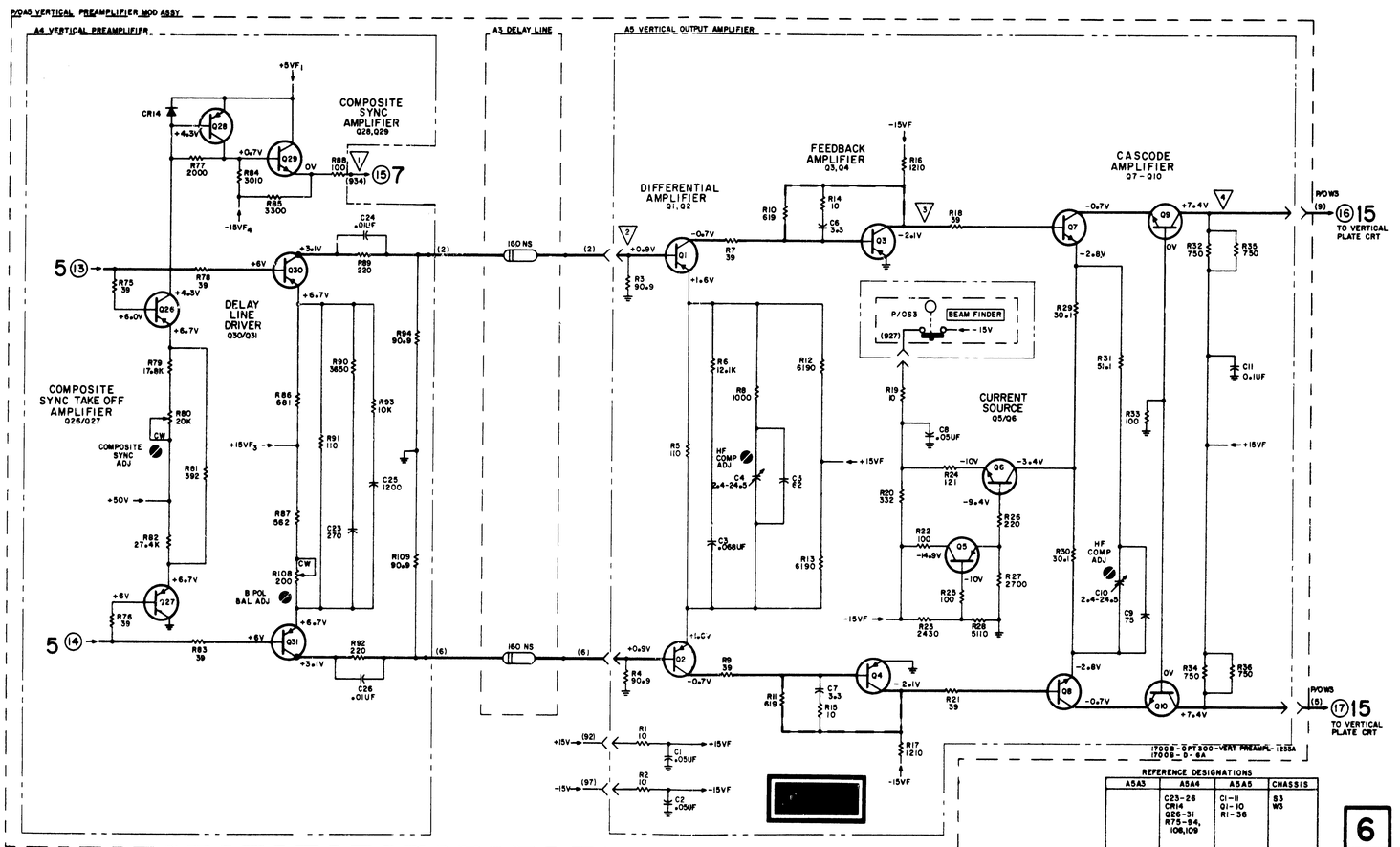
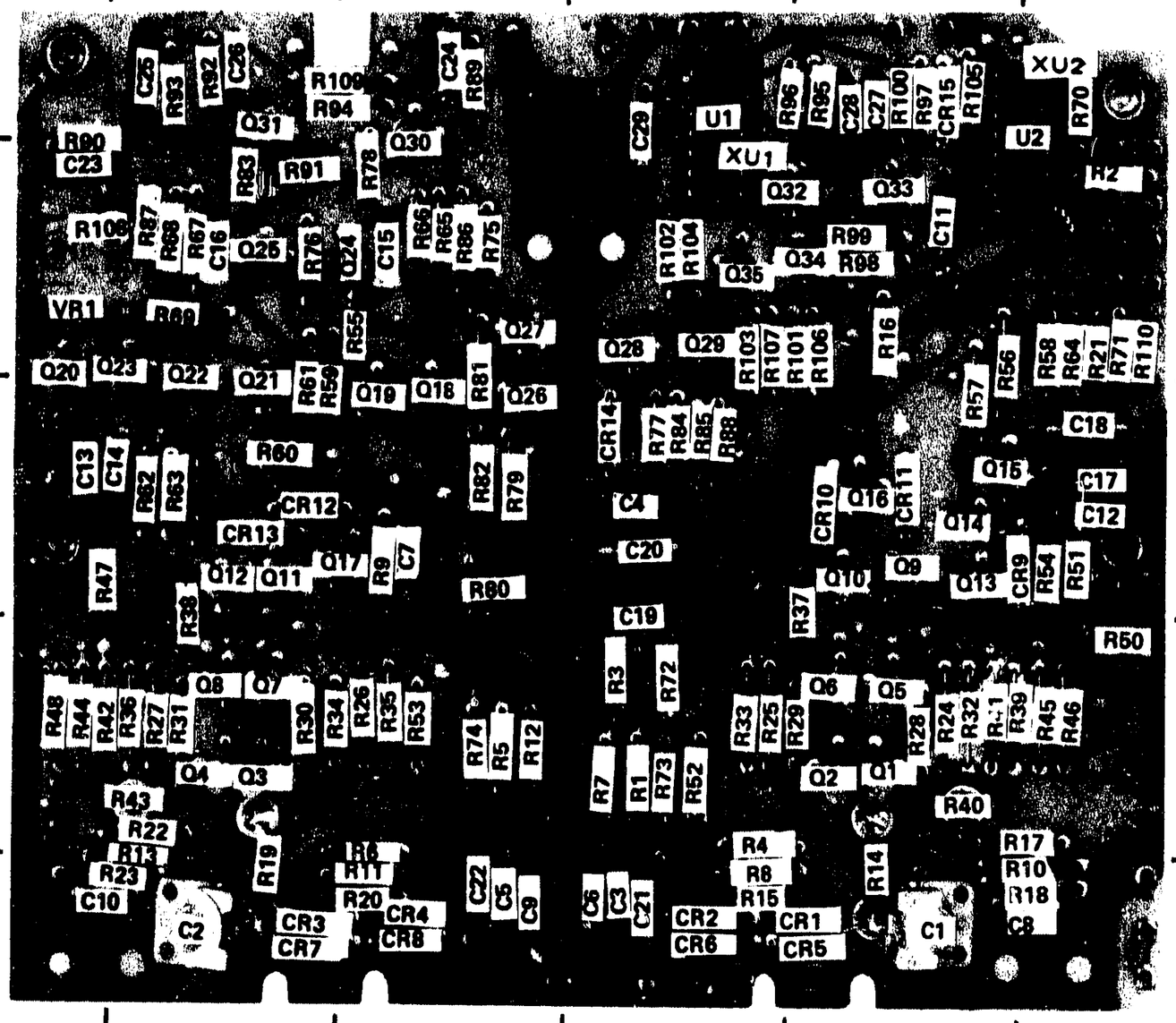



Figure 8-18. Vertical Preamplifier, A5A4, and Vertical Output Amplifier,




Circuit boards have plated through component holes. This permits soldering from either side of the board.

## A5A4

| REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C1 | E-5 | C25 | B-1 | Q5 | E-4 | Q29 | D-2 | R18 | F-5 | R42 | A-4 | R67 | B-2 | R91 | B-2 |
| C2 | B-5 | C26 | B-1 | Q6 | E-4 | Q30 | C-1 | R19 | B-5 | R43 | B-4 | R68 | B-2 | R92 | B-1 |
| C3 | D-5 | C27 | E-1 | Q7 | B-4 | Q31 | B-1 | R20 | C-5 | R44 | A-4 | R69 | B-2 | R93 | B-1 |
| C4 | D-3 | C28 | E-1 | Q8 | B-4 | Q32 | D-1 | R21 | F-2 | R45 | F-4 | R70 | F-1 | R94 | B-1 |
| C5 | C-5 | C29 | D-1 | Q9 | E-3 | Q33 | E-2 | R22 | B-4 | R46 | F-4 | R71 | F-2 | R95 | E-1 |
| C6 | D-5 | CR1 | E-5 | Q10 | E-3 | Q34 | E-2 | R23 | B-5 | R47 | A-3 | R72 | D-4 | R96 | D-1 |
| C7 | C-3 | CR2 | D-5 | Q11 | B-3 | Q35 | D-2 | R24 | E-4 | R48 | A-4 | R73 | D-4 | R97 | E-1 |
| C8 | F-5 | CR3 | B-5 | Q12 | B-3 | R1 | D-4 | R25 | D-4 | R50 | F-4 | R74 | C-4 | R98 | E-2 |
| C9 | C-5 | CR4 | C-5 | Q13 | E-3 | R2 | F-2 | R26 | C-4 | R51 | F-3 | R75 | C-2 | R99 | E-2 |
| C10 | A-5 | CR5 | E-5 | Q14 | E-3 | R3 | D-4 | R27 | B-4 | R52 | D-4 | R76 | B-2 | R100 | E-1 |
| C11 | E-2 | CR6 | D-5 | Q15 | E-3 | R4 | D-4 | R28 | E-4 | R53 | C-4 | R77 | D-3 | R101 | E-2 |
| C12 | F-3 | CR7 | B-5 | Q16 | E-3 | R5 | C-4 | R29 | E-4 | R54 | F-3 | R78 | C-2 | R102 | D-2 |
| C13 | A-3 | CR8 | C-5 | Q17 | C-3 | R6 | C-4 | R30 | B-4 | R55 | C-2 | R79 | C-3 | R103 | D-2 |
| C14 | B-3 | CR9 | E-3 | Q18 | C-3 | R7 | D-4 | R31 | B-4 | R56 | E-2 | R80 | C-3 | R104 | D-2 |
| C15 | C-2 | CR10 | E-3 | Q19 | C-3 | R8 | D-5 | R32 | E-4 | R57 | E-3 | R81 | C-2 | R105 | E-1 |
| C16 | B-2 | CR11 | E-3 | Q20 | A-2 | R9 | C-3 | R33 | D-4 | R58 | F-2 | R82 | C-3 | R106 | E-2 |
| C17 | E-3 | CR12 | B-3 | Q21 | B-2 | R10 | F-5 | R34 | B-4 | R59 | B-3 | R83 | B-2 | R107 | D-2 |
| C18 | F-3 | CR13 | B-3 | Q22 | B-2 | R11 | C-5 | R35 | C-4 | R60 | B-3 | R84 | D-3 | R108 | A-2 |
| C19 | D-3 | CR14 | D-3 | Q23 | B-2 | R12 | C-4 | R36 | B-4 | R61 | B-3 | R85 | D-3 | R109 | B-1 |
| C20 | D-3 | CR15 | E-1 | Q24 | C-2 | R13 | B-5 | R37 | E-3 | R62 | B-3 | R86 | C-2 | R110 | F-2 |
| C21 | D-5 | Q1 | E-4 | Q25 | B-2 | R14 | E-5 | R38 | B-3 | R63 | B-3 | R87 | B-2 | U1 | D-1 |
| C22 | C-5 | Q2 | E-4 | Q26 | C-3 | R15 | D-5 | R39 | E-4 | R64 | F-2 | R88 | D-3 | U2 | F-1 |
| C23 | A-2 | Q3 | B-4 | Q27 | C-2 | R16 | E-2 | R40 | E-4 | R65 | C-2 | R89 | C-1 | VR1 | A-2 |
| C24 | C-1 | Q4 | B-4 | Q28 | D-2 | R17 | F-4 | R41 | E-4 | R66 | C-2 | R90 | A-2 | XU1 | D-1 |
| | | | | | | | | | | | | | | XU2 | F-1 |

1700B - 300 - R - 12

Figure 8-19. Vertical Preamplifier, A5A4, Component Identification

Table 8-13. Vertical Preamplifier Measurement Conditions and Waveforms

## DC VOLTAGE MEASUREMENT CONDITIONS

A. Set:

| | |
|---|---|
| MODE | A |
| channel A (POSITION) | midrange |
| channel A vernier | VERN CAL |
| channel A VOLTS/DIV | .2 |
| channelA coupling | GND |

B. All voltages are referenced to chassis ground. All indications are nominal and may vary slightly.

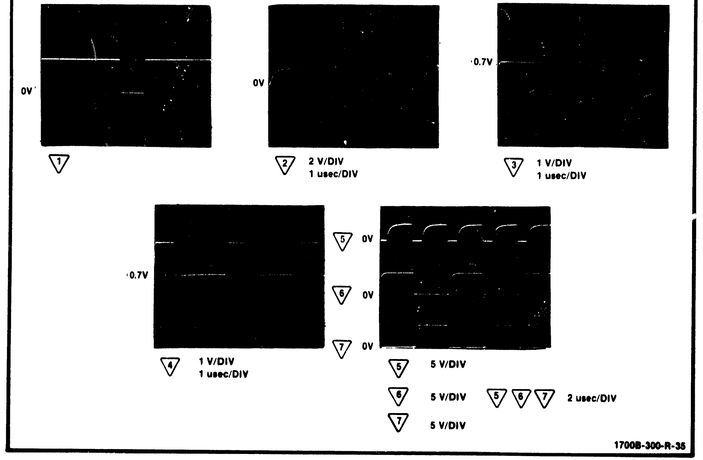
## WAVEFORM MEASUREMENT CONDITIONS

A. Set:

| | |
|---|---|
| MODE | CHOP |
| channel A POSITION | midrange |
| channel A vernier | VERN CAL |
| channel A VOLTS/DIV | .2 |
| channel A coupling | AC |
| INT/EXT | INT |
| main TIME/DIV | .2 mSEC |
| AUTO/NORM | AUTO |

b. Connect CAL 1 VOLT to channel A INPUT.

C. All waveforms are referenced to chassis ground. The monitor oscilloscope's vertical sensitivity (using a 1:1 probe) and sweep speed settings are shown below on each waveform photograph.



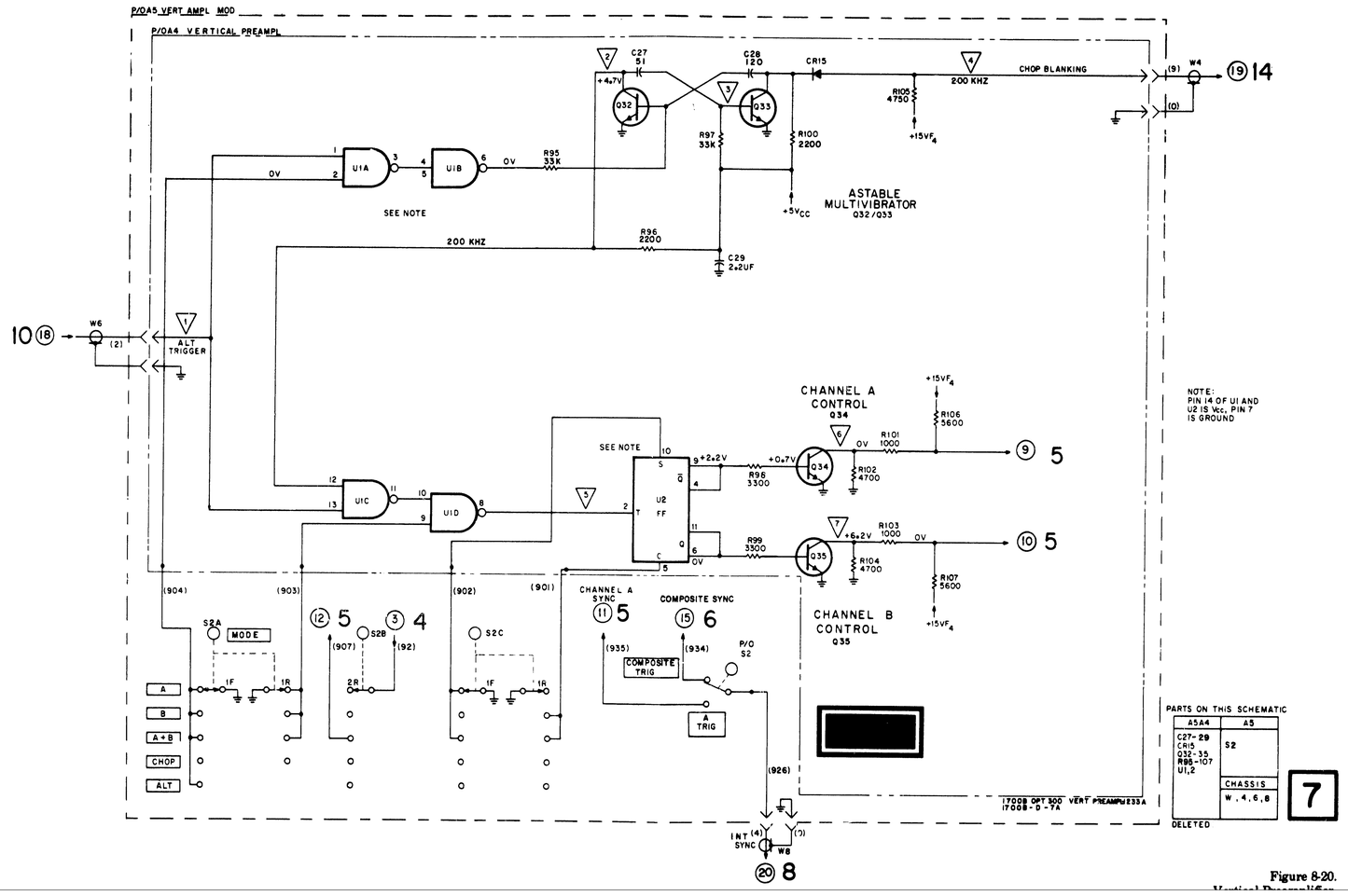




Figure 8-20.

| REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|---|---|---|---|
| C1 | B-6 | R9 | A-4 |
| C2 | B-5 | R10 | B-4 |
| C3 | B-5 | R11 | B-3 |
| C4 | C-5 | R12 | B-4 |
| C5 | B-4 | R13 | A-3 |
| C6 | C-5 | R14 | B-3 |
| C7 | B-4 | R15 | B-3 |
| C8 | A-1 | R16 | B-3 |
| C9 | B-4 | R17 | B-3 |
| C10 | B-5 | R18 | B-3 |
| C11 | D-5 | R19 | B-2 |
| C12 | C-4 | R20 | B-2 |
| C13 | C-5 | R21 | B-3 |
| C14 | D-4 | R22 | A-1 |
| C15 | C-4 | R23 | A-2 |
| C16 | C-2 | R24 | A-2 |
| C17 | C-6 | R25 | B-2 |
| CR1 | B-5 | R26 | B-2 |
| CR2 | B-5 | R27 | C-2 |
| CR3 | B-5 | R28 | B-1 |
| CR4 | B-5 | R29 | B-3 |
| CR5 | C-3 | R30 | C-2 |
| CR6 | C-3 | R31 | D-1 |
| CR7 | B-1 | R32 | D-1 |
| CR8 | C-1 | R33 | C-1 |
| CR9 | C-4 | R34 | C-1 |
| CR10 | D-4 | R35 | C-4 |
| CR11 | C-3 | R36 | B-4 |
| CR12 | C-3 | R37 | C-4 |
| CR13 | C-3 | R38 | B-4 |
| Q1 | A-4 | R39 | A-1 |
| Q2 | A-4 | R40 | B-3 |
| Q3 | A-4 | R41 | D-5 |
| Q4 | A-4 | R42 | D-5 |
| Q5 | A-3 | R43 | C-5 |
| Q6 | A-3 | R44 | C-5 |
| Q7 | A-3 | R45 | D-4 |
| Q8 | A-3 | R46 | C-4 |
| Q9 | A-2 | R47 | C-4 |
| Q10 | A-3 | R48 | D-4 |
| Q11 | B-2 | R49 | C-2 |
| Q12 | B-2 | R50 | C-2 |
| Q13 | C-2 | R51 | D-3 |
| Q14 | C-2 | R52 | D-3 |
| Q15 | C-1 | R53 | D-3 |
| Q16 | D-2 | R54 | D-3 |
| Q17 | D-1 | R55 | C-2 |
| Q18 | C-1 | R56 | D-2 |
| Q19 | C-4 | R57 | C-3 |
| Q20 | D-4 | R58 | D-3 |
| Q21 | C-3 | R59 | D-3 |
| Q22 | C-3 | R60 | B-5 |
| Q23 | C-3 | R61 | B-5 |
| Q24 | C-3 | R62 | B-4 |
| R1 | B-6 | S1 | C-6 |
| R2 | A-6 | S2 | C-6 |
| R3 | B-5 | S3 | B-6 |
| R4 | B-5 | S4 | B-6 |
| R5 | A-4 | S5 | A-6 |
| R6 | A-4 | S6 | C-4 |
| R7 | B-4 | S7 | A-4 |
| R8 | B-4 | U1 | A-2 |
| | | VR1 | D-2 |
| | | XU1 | A-2 |

Circuit boards have plated through component holes. This permits soldering from either side of the board.

1700B-300-R-11

Figure 8-21. Trigger, A6A2, Component Identification

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

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A1 | | | NOT ASSIGNED | | |
| A2 | 01700-66512 | | BOARD ASSY:LINE RECTIFIER | 28480 | 01700-66512 |
| A2C1 | 0150-0084 | 21 | C:FXD CER 0.1 UF +80-20% 100VDCW | 72982 | 8131-100-651-104Z |
| A2C2 | 0180-2351 | 1 | C:FXD ELECT 2000 UF +75-10% 50VDCW | 56289 | 390243 |
| A2C3 | 0150-0084 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 72982 | 8131-100-651-104Z |
| A2C4 | 0150-0084 | | C: FXD CER 0.1 UF +80—20% 100 VDCW | 72982 | 8131-100-651-104Z |
| A2CR1 | 1901-0045 | 6 | DIODE:SILICON 0.75A 100PIV | 04713 | SR1358-7 |
| A2R1 | 0811-1204 | 1 | R:FXD WW 200 OHM 5% 5W | 28480 | 0811-1204 |
| A2R2 | 0687-1031 | 1 | R:FXD COMP 10K OHM 10% 1/2W | 01121 | EB 1031 |
| A2R3 | 0684-1041 | 16 | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A2R4 | 0684-1521 | 4 | R:FXD COMP 1500 OHM 10% 1/4W | 01121 | CB 1521 |
| A3 | 01700-61101 | | POWER SUPPLY ASSY | 28480 | 01700-61101 |
| A3E1 | 1200-0077 | 1 | INSULATOR: TRANSISTOR, MICA | 16037 | #112 |
| A3MP1 | 0340-0460 | 1 | WASHER: INSULATOR | | |
| A3MP2 | 01700-00606 | 1 | SHIELD: XFMR | 28480 | 01700-00606 |
| A3MP3 | 01707-66501 | 1 | BOX ASSY: POWER | 28480 | 01707-66501 |
| A3Q1 | 5080-0476 | 1 | TRANSISTOR ASSY:SI NPN | 28480 | 5080-0476 |
| A3Q2 | 1P54-0063 | 1 | TSTR:SI NPN | 80131 | 2N3055 |
| A3XQ3 | 1200-0077 | 1 | INSULATOR:TRANSISTOR, MICA | 16037 | #112 |
| A3A1 | 01700-66513 | | BOARD ASSY:LV MOTHER | 28480 | 01700-66513 |
| A3A1C1 | 0180-1819 | 1 | C:FXD ELECT 100 UF +75-10% 50VDCW | 28480 | 0180-1819 |
| A3A1C2 | 0160-3451 | 20 | C:FXD CER 0.01 UF +80-20% 100VDCW | 56289 | C0238101F103Z525-CDH |
| A3A1C3 | 0180-0229 | 3 | C:FXD ELECT 33 UF 10% 10VDCW | 28480 | 0180-0229 |
| A3A1C4 | 0180-0230 | 9 | C:FXD ELECT 1.0 UF 20% 50VDCW | 56289 | 150D105X0050A2-DYS |
| A3A1C5 | 0180-0159 | 4 | C:FXD ELECT 220 UF 20% 10VDCW | 28480 | 0180-0159 |
| A3A1C6 | 0150-0084 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 72982 | 8131-100-651-104Z |
| A3A1C7 | 0150-0084 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 72982 | 8131-100-651-104Z |
| A3A1C8 | 0180-0159 | | C:FXD ELECT 220 UF 20% 10VDCW | 28480 | 0180-0159 |
| A3A1C9 | 0150-0084 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 72982 | 8131-100-651-104Z |
| A3A1C10 | 0150-0084 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 72982 | 8131-100-651-104Z |
| A3A1CR1 | 1901-0045 | | DIODE:SILICON 0.75A 100PIV | 04713 | SR1358-7 |
| A3A1CR2 | 1901-0045 | | DIODE:SILICON 0.75A 100PIV | 04713 | SR1358-7 |
| A3A1CR3 | 1901-0418 | 1 | DIODE:SI 3A 400PRRV | 04713 | SR1846-12 |
| A3A1CR4 | 1901-0040 | 60 | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A3A1CR5 | 1884-0094 | 1 | THYRISTOR:BILATERAL SWITCH | 04713 | SPT-12 |
| A3A1J1 | 01701-67601 | 1 | CONNECTOR ASSY | 28480 | 01701-67601 |
| A3A1J2 | 1251-1968 | 2 | CONNECTOR:PC 10 TUNING FORK TYPE CONT | 02660 | 143-010-07-1158 |
| A3A1J3 | 1251-1968 | | CONNECTOR:PC 10 TUNING FORK TYPE CONT | 02660 | 143-010-07-1156 |
| A3A1L1 | 9100-3139 | 11 | COIL:75 UH | 28480 | 9100-3139 |
| A3A1L2 | 9100-3139 | | COIL:75 UH | 28480 | 9100-3139 |
| A3A1L3 | 9100-3139 | | COIL:75 UH | 28480 | 9100-3139 |
| A3A1L4 | 9100-3139 | | COIL:75 UH | 28480 | 9100-3139 |
| A3A1L5 | 9100-3139 | | COIL:75 UH | 28480 | 9100-3139 |
| A3A1L6 | 9100-3139 | | COIL:75 UH | 28480 | 9100-3139 |
| A3A1L7 | 9140-0210 | | COIL/CHOKE 100 UH 5% | 82142 | 15-1315-12J |
| A3A1L8 | 9140-0210 | | COIL/CHOKE 100 UH 5% | 82142 | 15-1315-12J |
| A3A1L9 | 9140-0210 | | COIL/CHOKE 100 UH 5% | 82142 | 15-1315-12J |
| A3A1MP1 | 1400-0475 | 8 | BRACKET: COMPONENT CLIP | 03877 | 721-0004 |
| A3A1Q1 | 1854-0090 | 1 | TSTR:SI NPN(SIMILAR TO 2N3053) | 28480 | 1854-0090 |
| A3A1R1 | 0761-0015 | 1 | R:FXD MET OX 1500 OHM 5% 1W | 28480 | 0761-0015 |
| A3A1R2 | 0687-4711 | 2 | R:FXD COMP 470 OHM 10% 1/2W | 01121 | EB 4711 |
| A3A1R3 | 0684-1011 | 38 | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A3A1R4 | 0684-2201 | 5 | R:FXD COMP 22 OHM 10% 1/4W | 01121 | CB 2201 |
| A3A1R5 | 0811-1673 | 1 | R:FXD WW 3.9 OHM 5% 2W | 28480 | 0811-1673 |
| A3A1R6 | 0812-0086 | 1 | R:FXD WW 5 OHM 5% 3W | 28480 | 0812-0086 |
| A3A1R7 | 0684-4701 | 2 | R:FXD COMP 47 OHM 10% 1/4W | 01121 | CB 4701 |
| A3A1R8 | 0684-4711 | 1 | R:FXD COMP 470 OHM 10% 1/4W | 01121 | CB 4711 |
| A3A1R9 | 0687-4711 | | R:FXD COMP 470 OHM 10% 1/2W | 01121 | EB 4711 |
| A3A1R10 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A3A1R11 | 0684-2731 | 4 | R:FXD COMP 27K OHM 10% 1/4W | 01121 | CB 2731 |
| A3A1R12 | 0684-1031 | 11 | R:FXD COMP 10K OHM 10% 1/4W | 01121 | CB 1031 |
| A3A1R13 | 0684-2731 | | R:FXD COMP 27K OHM 10% 1/4W | 01121 | CB 2731 |
| A3A1R14 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A3A1R15 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A3A1R16 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A3A1R17 | 0684-2731 | | R:FXD COMP 27K OHM 10% 1/4W | 01121 | CB 2731 |
| A3A1R18 | 0684-2731 | | R:FXD COMP 27K OHM 10% 1/4W | 01121 | CB 2731 |
| A3A1SCR1 | 1884-0082 | 1 | THYRISTOR:SCR JEDEC TYPE 2N4441 | 04713 | 2N4441 |
| A3A1T1 | 01701-61104 | 1 | TOROID:FERRITE | 28480 | 01701-61104 |
| A3A1VR1 | 1902-3302 | 1 | DIODE BREAKDOWN:34.8V 2% 400 MW | 28480 | 1902-3302 |
| A3A1VR2 | 1902-3059 | 1 | DIODE BREAKDOWN:SILICON 3.83V 5% | 28480 | 1902-3059 |
| A3A1VR3 | 1902-3315 | 1 | DIODE BREAKDOWN:39.2V 2% 400 MW | 28480 | 1902-3315 |
| A3A1VR4 | 1902-3002 | 1 | DIODE BREAKDOWN:2.37V 5% | 28480 | 1902-3002 |
| A3A2 | 01700-66514 | | BOARD ASSY:LV CONVERTER | 28480 | 01700-66514 |

See introduction to this section for ordering information

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

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A3A2C1 | 0150-0084 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 72982 | 8131-100-651-104Z |
| A3A2C2 | 0150-0084 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 72982 | 8131-100-651-104Z |
| A3A2C3 | 0180-0098 | 4 | C:FXD ELECT 100 UF 20% 20VDCW | 56289 | 150D107X002052-DYS |
| A3A2C4 | 0180-1802 | 1 | C:FXD AL ELECT 150 UF +75-10% 40VDCW | 56289 | 39D157G040CJ4-DSR |
| A3A2C5 | 0180-0098 | | C:FXD ELECT 100 UF 20% 20VDCW | 56289 | 150D107X002052-DYS |
| A3A2C6 | 0180-1780 | 1 | C:FXD ELECT 500 UF +75-10% 10VDCW | 28480 | 0180-1780 |
| A3A2C7 | 0160-0168 | 4 | C:FXD MY 0.1 UF 10% 200VDCW | 56289 | 192P10492-PTS |
| A3A2C8 | 0160-0380 | 1 | C:FXD MY 0.22 UF 10% 200VDCW | 28480 | 0160-0380 |
| A3A2C9 | 0150-0084 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 72982 | 8131-100-651-104Z |
| A3A2C10 | 0160-3451 | | C:FXD CER 0.01 UF +80-20% 100VDCW | 56289 | C023B101E1032S25-CDH |
| A3A2C11 | 0150-0084 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 72982 | 8131-100-651-104Z |
| A3A2C12 | 0160-2141 | 1 | C:FXD CER 680 PF 80/20% 1000VDCW | 91418 | TYPE B |
| A3A2C13 | 0160-0168 | | C:FXD MY 0.1 UF 10% 200VDCW | 56289 | 192P10492-PTS |
| A3A2C14 | 0160-0168 | | C:FXD MY 0.1 UF 10% 200VDCW | 56289 | 192P10492-PTS |
| A3A2CR1 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A3A2CR2 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A3A2CR3 | 1901-0049 | 4 | DIODE:SILICON 50PIV | 28480 | 1901-0049 |
| A3A2CR4 | 1901-0049 | | DIODE:SILICON 50PIV | 28480 | 1901-0049 |
| A3A2CR5 | 1901-0045 | | DIODE:SILICON 0.75A 100PIV | 04713 | SR1358-7 |
| A3A2L1 | 9140-0128 | 1 | COIL:FXD RF 22 UH | 28480 | 9140-0128 |
| A3A2MP1 | 1205-0227 | | HEAT DISSIPATOR: SEMICONDUCTOR | 28480 | 1205-0227 |
| A3A2Q1 | 1855-0010 | 1 | TSTR:SI | 80131 | 2N2646 |
| A3A2Q2 | 1854-0476 | 1 | TSTR:SI NPN | 02735 | 2N3879 |
| A3A2Q3 | 1854-0039 | 2 | TSTR:SI NPN | 80131 | 2N3053 |
| A3A2Q4 | 1853-0027 | 1 | TSTR:SI PNP | 07263 | S15545 |
| A3A2R1 | 0684-1221 | 4 | R:FXD COMP 1.2K OHM 10% 1/4W | 01121 | CB 1221 |
| A3A2R2 | 0684-2721 | 3 | R:FXD COMP 2700 OHM 10% 1/4W | 01121 | CB 2721 |
| A3A2R3 | 2100-1760 | 2 | R:VAR WW 5K OHM 5% TYPE V 1W | 28480 | 2100-1760 |
| A3A2R4 | 0757-0199 | 1 | R:FXD MET FLM 21.5K OHM 1% 1/8W | 28480 | 0757-0199 |
| A3A2R5 | 0757-0442 | 9 | R:FXD MET FLM 10.0K OHM 1% 1/8W | 28480 | 0757-0442 |
| A3A2R6 | 0684-4721 | 9 | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A3A2R7 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A3A2R8 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A3A2R9 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A3A2R10 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A3A2R11 | 0698-3159 | 1 | R:FXD MET FLM 26.1K OHM 1% 1/8W | 28480 | 0698-3159 |
| A3A2R12 | 0757-0401 | 7 | R:FXD MET FLM 100 OHM 1% 1/8W | 28480 | 0757-0401 |
| A3A2R13 | 0684-1521 | | R:FXD COMP 1500 OHM 10% 1/4W | 01121 | CB 1521 |
| A3A2R14 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A3A2R15 | 0684-2211 | 6 | R:FXD COMP 220 OHM 10% 1/4W | 01121 | CB 2211 |
| A3A2R16 | 0813-0050 | 1 | R: FXD WW 100 OHM 5% 3W | 28480 | 0813-0050 |
| A3A2T1 | 9100-3152 | 1 | TRANSFORMER | 28480 | 9100-3152 |
| A3A2U1 | 1820-0058 | 2 | IC:LIN. OP. AMP. 15K MIN.(10-99) | 07263 | USF770939X |
| A3A2VR1 | 1902-0033 | 2 | DIODE:BREAKDOWN 6.2V | 04713 | 1N823 |
| A3A2VR2 | 1902-3256 | 1 | DIODE:BREAKDOWN SILICON 23.7V 5% | 28480 | 1902-3256 |
| A3A2VR3 | 1902-0197 | 1 | DIODE BREAKDOWN:SILICON 82.5V 5% | 28480 | 1902-0197 |
| A3A2XU1 | 1200-0763 | 1 | SOCKET:IC 8-PIN. FOR TO-5 CASE | 71785 | 133-98-92-061 |
| A3A3 | 01700-66515 | | BOARD ASSY:RECT AND FILTER | 28480 | 01700-66515 |
| A3A3C1 | 0180-0091 | 2 | C:FXD ELECT 10 UF +50-10% 100VDCW | 56289 | 30D106F100CC2-DSM |
| A3A3C2 | 0180-2344 | 4 | C:FXD AL ELECT 150 UF +75-10% 75VDCW | 56289 | 39D157G075FJ4-DSR |
| A3A3C3 | 0180-0094 | 6 | C:FXD ELECT 100 UF +75-10% 25VDCW | 56289 | 30D107G025DD2-DSM |
| A3A3C4 | 0180-0094 | | C:FXD ELECT 100 UF +75-10% 25VDCW | 56289 | 30D107G025DD2-DSM |
| A3A3C5 | 0180-2344 | | C:FXD AL ELECT 150 UF +75-10% 75VDCW | 56289 | 39D157G075FJ4-DSR |
| A3A3C6 | 0180-0159 | | C:FXD ELECT 220 UF 20% 10VDCW | 28480 | 0180-0159 |
| A3A3C7 | 0180-0094 | | C:FXD ELECT 100 UF +75-10% 25VDCW | 56289 | 30D107G025DD2-DSM |
| A3A3C8 | 0180-0094 | | C:FXD ELECT 100 UF +75-10% 25VDCW | 56289 | 30D107G025DD2-DSM |
| A3A3C9 | 0180-0094 | | C:FXD ELECT 100 UF +75-10% 25VDCW | 56289 | 30D107G025DD2-DSM |
| A3A3C10 | 0180-0094 | | C:FXD ELECT 100 UF +75-10% 25VDCW | 56289 | 30D107G025DD2-DSM |
| A3A3CR1 | 1901-0646 | 6 | DIODE:SI 200V 1A | 28480 | 1901-0646 |
| A3A3CR2 | 1901-0646 | | DIODE:SI 200V 1A | 28480 | 1901-0646 |
| A3A3CR3 | 1901-0646 | | DIODE:SI 200V 1A | 28480 | 1901-0646 |
| A3A3CR4 | 1901-0646 | | DIODE:SI 200V 1A | 28480 | 1901-0646 |
| A3A3CR5 | 1901-0646 | | DIODE:SI 200V 1A | 28480 | 1901-0646 |
| A3A3CR6 | 1901-0646 | | DIODE:SI 200V 1A | 28480 | 1901-0646 |
| A3A3CR7 | 1901-0646 | | DIODE:SI 200V 1A | 28480 | 1901-0646 |
| A3A3CR8 | 1901-0646 | | DIODE:SI 200V 1A | 28480 | 1901-0646 |
| A3A3L1 | 9100-3139 | | COIL:75 UH | 28480 | 9100-3139 |
| A3A3L2 | 9100-3139 | | COIL:75 UH | 28480 | 9100-3139 |
| A3A3MP1 | 0403-0175 | 1 | BUMPER: RUBBER 0.750 IN. DIA. | 77969 | 6557 |
| A3A3MP2 | 1400-0475 | | BRACKET: COMPONENT CLIP | 03877 | 721-0004 |
| A3A3T1 | 9100-3235 | 1 | TRANSFORMER:TOROID 8 SEC. | 28480 | 9100-3235 |
| A3A4 | 01700-66516 | | BOARD ASSY:HV OSCILLATOR | 28480 | 01700-66516 |
| A3A4A1 | 01700-61102 | 1 | HV TRANSFORMER ASSY | 28480 | 01700-61102 |
| A3A4C1 | 0160-0168 | | C:FXD MY 0.1 UF 10% 200VDCW | 56289 | 192P10492-PTS |
| A3A4C2 | 0160-2403 | 1 | C:FXD CER 1500 PF 20% 5K VDCW | 72982 | 828-025-X5R0-152M |
| A3A4C3 | 0160-3453 | 27 | C:FXD CER 0.05 UF +80-20% 100VDCW | 56289 | C023A101L503Z525-CDH |
| A3A4C4 | 0180-0291 | 1 | C:FXD ELECT 1.0 UF 10% 35VDCW | 56289 | 150D105X9035A2-DYS |
| A3A4C5 | 0180-1746 | 2 | C:FXD ELECT 15 UF 10% 20VDCW | 28480 | 0180-1746 |
| A3A4C6 | 0170-0040 | 1 | C:FXD MY 0.047 UF 10% 200VDCW | 56289 | 192P47392-PTS |
| A3A4C7 | 0160-3453 | | C:FXD CER 0.05 UF +80-20% 100VDCW | 56289 | C023A101L503Z525-CDH |
| A3A4C8 | 0160-3800 | 6 | C:FXD CER 5000 PF 20% 3K VDCW | 56289 | 44C148A2 |
| A3A4C9 | 0160-3801 | 7 | C:FXD CER 5000 PF 20% 3K VDCW | 56289 | 44C148A1 |

See introduction to this section for ordering information

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

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A3A4C11 | 0160-3801 | | C:FXD CER 5000 PF 20% 3K VDCW | 56289 | 44C148A1 |
| A3A4C12 | 0160-3800 | | C:FXD CER 5000 PF 20% 3K VDCW | 56289 | 44C148A2 |
| A3A4C13 | 0160-3801 | | C:FXD CER 5000 PF 20% 3K VDCW | 56289 | 44C148A1 |
| A3A4C14 | 0160-3801 | | C:FXD CER 5000 PF 20% 3K VDCW | 56289 | 44C148A1 |
| A3A4C15 | 0160-3800 | | C:FXD CER 5000 PF 20% 3K VDCW | 56289 | 44C148A2 |
| A3A4C16 | 0160-3801 | | C:FXD CER 5000 PF 20% 3K VDCW | 56289 | 44C148A1 |
| A3A4C17 | 0160-3800 | | C:FXD CER 5000 PF 20% 3K VDCW | 56289 | 44C148A2 |
| A3A4C18 | 0160-3801 | | C:FXD CER 5000 PF 20% 3K VDCW | 56289 | 44C148A1 |
| A3A4C19 | 0160-3800 | | C:FXD CER 5000 PF 20% 3K VDCW | 56289 | 44C148A2 |
| A3A4C20 | 0160-3801 | | C:FXD CER 5000 PF 20% 3K VDCW | 56289 | 44C148A1 |
| A3A4C21 | 0160-3800 | | C:FXD CER 5000 PF 20% 3K VDCW | 56289 | 44C148A2 |
| A3A4C22 | 0180-1746 | | C:FXD ELECT 15 UF 10% 20VDCW | 28480 | 0180-1746 |
| A3A4CR1 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A3A4CR2 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A3A4CR3 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A3A4CR4 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A3A4CR5 | 1901-0049 | | DIODE:SILICON 50PIV | 28480 | 1901-0049 |
| A3A4CR6 | 1901-0049 | | DIODE:SILICON 50PIV | 28480 | 1901-0049 |
| A3A4CR7 | 1901-1022 | 2 | DIODE:SI RECTIFIER HV, 10 MA | 28480 | 1901-1022 |
| A3A4CR8 | 1901-1022 | | DIODE:SI RECTIFIER HV, 10 MA | 28480 | 1901-1022 |
| A3A4DS1 | 2140-0018 | 2 | LAMP:GLOW 1.0 MILLIAMPS 0.1W | 08806 | A9A-C(NE-2(1) |
| A3A4DS2 | 2140-0018 | | LAMP:GLOW 1.0 MILLIAMPS 0.1W | 08806 | A9A-C(NE-2(1) |
| A3A4E1 | 2110-0269 | 14 | CLIP: FUSE 0.250 IN. DIA. | 91506 | 6008-32CN |
| A3A4F1 | 2110-0043 | 1 | FUSE:0.75A 250V | 75915 | F02GR750A |
| A3A4F1 | 2110-0269 | 14 | CLIP:FUSE 0.250" DIA | 91506 | 6008-32CN |
| A3A4L1 | 9100-2268 | 1 | COIL:FXD 22.0 UH 10% | 82142 | 09-1316-4K |
| A3A4MP1 | 5040-0402 | 1 | MOUNT: XFMR | 28480 | 5040-0402 |
| A3A4MP2 | 5040-0430 | 1 | MOUNT: XFMR | 28480 | 5040-0430 |
| A3A4MP3 | 2200-0125 | 2 | SCREW: SST PAN | 00000 | OBD |
| A3A4MP4 | 2260-0001 | | NUT: HEX | 00120 | 000 |
| A3A4MP5 | 2260-0111 | | SCREW: PAN | 00000 | OBD |
| A3A4Q1 | 1854-0023 | 1 | TSTR:SI NPN(SELECTED FROM 2N2484) | 28480 | 1854-0023 |
| A3A4Q2 | 1854-0215 | 21 | TSTR:SI NPN | 80131 | 2N3904 |
| A3A4Q3 | 1853-0036 | | TSTR: SI PNP | 80131 | 2N3906 |
| A3A4R1 | 2100-2514 | 1 | R:VAR CERMET 20K OHM 10% LIN 1/2W | 28480 | 2100-2514 |
| A3A4R2 | 0757-0464 | 1 | R:FXD MET FLM 90.9K OHM 1% 1/8W | 28480 | 0757-0464 |
| A3A4R3 | 0698-7807 | 1 | R:FXD MET FLM 8.5 MEGOHM 1% 2.0W | 28480 | 0698-7807 |
| A3A4R4 | 0698-5922 | 2 | R:FXD MET FLM 1.8 MEGOHM 1.0% 1/2W | 28480 | 0698-5922 |
| A3A4R5 | 0698-5922 | | R:FXD MET FLM 1.8 MEGOHM 1.0% 1/2W | 28480 | 0698-5922 |
| A3A4R6 | 0684-1021 | 12 | R:FXD COMP 1000 OHM 10% 1/4W | 01121 | CB 1021 |
| A3A4R7 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A3A4R8 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A3A4R9 | 0684-4731 | 3 | R:FXD COMP 47K OHM 10% 1/4W | 01121 | CB 4731 |
| A3A4R10 | 0684-1021 | | R:FXD COMP 1000 OHM 10% 1/4W | 01121 | CB 1021 |
| A3A4R11 | 0684-1021 | | R:FXD COMP 1000 OHM 10% 1/4W | 01121 | CB 1021 |
| A3A4R12 | 0687-5611 | 1 | R:FXD COMP 560 OHM 10% 1/2W | 01121 | EB 5611 |
| A3A4R13 | 0684-1031 | | R:FXD COMP 10K OHM 10% 1/4W | 01121 | CB 1031 |
| A3A4R14 | 0684-1031 | | R:FXD COMP 10K OHM 10% 1/4W | 01121 | CB 1031 |
| A3A4R15 | 2100-2692 | 1 | R:VAR CERMET 1 MEGOHM 20% TYP( V 1/2W | 28480 | 2100-2692 |
| A3A4R16 | 0684-1031 | | R:FXD COMP 10K OHM 10%,1/4W | 01121 | CB 1031 |
| A3A4R17 | 0836-0003 | 1 | R:FXD COMP FLM 29 MEGOHM 10% 1% | 28480 | 0836-0003 |
| A3A4R18 | 0684-1051 | 2 | R:FXD COMP 1MEGOHM 5% 1/4W | 01121 | CB 1051 |
| A3A4R19 | 0684-4721 | 2 | R: FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A3A4R20 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A3A4R21 | | | DELETED | | |
| A3A4R22 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A4 | 01700-66511 | | BOARD ASSY:GATE | 28480 | 01700-66511 |
| A4C1 | 0140-2344 | | C:FXD AL ELECT 150 UF +75-10% 75VDCW | 56289 | 39D157G075FJ4-DSB |
| A4C2 | 0180-0098 | | C:FXD ELECT 100 UF 20% 20VDCW | 56289 | 150D107X0020S2-DYS |
| A4C3 | 0180-0098 | | C:FXD ELECT 100 UF 20% 20VDCW | 56289 | 150D107X0020S2-DYS |
| A4C4 | 0180-2344 | | C:FXD AL ELECT 150 UF +75-10% 75VDCW | 56289 | 39D157G075FJ4-DSB |
| A4C5 | 0180-0159 | | C:FXD ELECT 220 UF 20% 10VDCW | 28480 | 0180-0159 |
| A4C7 | 0160-3452 | 2 | C:FXD DISC CER 0.02 UF 20% 100VDCW | 56289 | C023B101H203MS25-CDH |
| A4C8 | 0160-3453 | | C:FXD CER 0.05 UF +80-20% 100VDCW | 56289 | C023A101L503ZS25-CDH |
| A4C9 | 0160-3453 | | C:FXD CER 0.05 UF +80-20% 100VDCW | 56289 | C023A101L503ZS25-CDH |
| A4C10 | 0160-2432 | 2 | C:FXD POLY 0.1 UF 5% 100VDCWW | 84411 | 863F |
| A4C11 | 0160-3452 | | C:FXD DISC CER 0.02 UF 20% 100VDCW | 56289 | C023B101H203MS25-CDH |
| A4C12 | 0121-0168 | 5 | C:VAR TEFLON 0.25-1.50 PF 600VDCW | 28480 | 0121-0168 |
| A4C13 | 0150-0084 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 72982 | 8131-100-651-104Z |
| A4C14 | 0150-0084 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 72982 | 8131-100-651-104Z |
| A4C15 | 0180-0104 | 1 | C:FXD ELECT 200 UF +75-10% 15VDCW | 56289 | 300207G015DF4-DSM |
| A4C16 | 0150-0084 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 72982 | 8131-100-651-104Z |
| A4C17 | 0150-0084 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 72982 | 8131-100-651-104Z |
| A4C18 | 0180-0091 | | C:FXD ELECT 10 UF +50-10% 100VDCW | 56289 | 300106F100DC2-DSM |
| A4CR1 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A4CR2 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A4CR3 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A4CR4 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A4CR5 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A4CR6 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A4CR7 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A4CR8 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A4CR9 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A4CR10 | 1901-0045 | | DIODE:SILICON 0.75A 100PIV | 04713 | SR1358-7 |
| A4CR11 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |

See introduction to this section for ordering information

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

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A4CR12 | 1901-0045 | | DIODE:SILICON 0.75A 100PIV | 04713 | SR1358-7 |
| A4CR13 | 1901-0040 | | DIODE: SILICON 30MA 30WV | 07263 | FDG1088 |
| A4CR14 | 1901-0040 | | DIODE: SILICON 30MA 30WV | 07263 | FDG1088 |
| A4E1 | 2110-0269 | | CLIP: FUSE 0.250 IN. DIA. | 91506 | 6008-32CN |
| A4F1 | 2110-0012 | 5 | FUSE: 0.5 AMP 250V | 75915 | 312.500 |
| A4F2 | 2110-0012 | 3 | FUSE:0.5 AMP 250V | 75915 | 312.500 |
| A4F3 | 2110-0012 | | FUSE:0.5 AMP 250V | 75915 | 312.500 |
| A4F4 | 2110-0012 | | FUSE: 0.5 AMP 250V | 75915 | 312.500 |
| A4F5 | 2110-0012 | | FUSE:0.5 AMP 250V | 75915 | 312.500 |
| A4F6 | 2110-0004 | | FUSE:CARTRIDGE 1/4 AMP 250V | 75915 | 3AG/CAT. 312.250 |
| A4L1 | 9100-3139 | | COIL:75 UH | 28480 | 9100-3139 |
| A4L2 | 9100-3139 | | COIL:75 UH | 28480 | 9100-3139 |
| A4L3 | 9100-3139 | | COIL:75 UH | 28480 | 9100-3139 |
| A4MP1 | 1205-0095 | 1 | HEAT SINK: TRANSISTOR | 13103 | 2225B |
| A4MP2 | 1400-0475 | | BRACKET: COMPONENT CLIP | 03877 | 721-0004 |
| A4Q1 | 1854-0215 | | TSTR:SI NPN | 80131 | 2N3904 |
| A4Q2 | 1853-0080 | 1 | TSTR:SI PNP | 80131 | 2N4808 |
| A4Q3 | 1853-0036 | 20 | TSTR:SI PNP | 80131 | 2N3906 |
| A4Q4 | 1854-0215 | | TSTR:SI NPN | 80131 | 2N3904 |
| A4Q5 | 1853-0232 | 1 | TSTR:SI PNP | 28480 | 1853-0232 |
| A4Q6 | 1854-0419 | 1 | TSTR:SI NPN | 04713 | SS657 |
| A4Q7 | 1854-0215 | | TSTR:SI NPN | 80131 | 2N3904 |
| A4Q8 | 1854-0215 | | TSTR:SI NPN | 80131 | 2N3904 |
| A4Q9 | 1853-0036 | | TSTR:SI PNP | 80131 | 2N3906 |
| A4Q10 | 1854-0072 | 1 | TSTR:SI NPN | 80131 | 2N3054 |
| A4R1 | 0811-1608 | 1 | R:FXD WW 24K OHM 3% 3W | 28480 | 0811-1608 |
| A4R2 | 0757-0435 | 1 | R:FXD FLM 3920 OHM 1% 1/8W | 28480 | 0757-0435 |
| A4R3 | 0757-0760 | 1 | R:FXD FLM 20K OHM 1% 1/4W | 28480 | 0757-0760 |
| A4R4 | 0757-0440 | 1 | R:FXD MET FLM 7.50K OHM 1% 1/8W | 28480 | 0757-0440 |
| A4R5 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A4R6 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A4R7 | | | DELETED | | |
| A4R8 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A4R9 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A4R10 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A4R11 | 0684-5631 | 1 | R:FXD COMP 56K OHM 10% 1/4W | 01121 | CB 5631 |
| A4R12 | 0757-0457 | 1 | R:FXD MET FLM 47.5K OHM 1% 1/8W | 28480 | 0757-0457 |
| A4R13 | 0684-1051 | | R:FXD COMP 1MEGOHM 1% 1/4W | 01121 | CB 1051 |
| A4R14 | 0757-0273 | 13 | R:FXD MET FLM 3.01K OHM 1% 1/8W | 28480 | 0757-0273 |
| A4R15 | 0757-0449 | 4 | R:FXD FLM 20K OHM 1% 1/8W | 28480 | 0757-0449 |
| A4R16 | 0757-0416 | 3 | R:FXD MET FLM 511 OHM 1% 1/8W | 28480 | 0757-0416 |
| A4R17 | 0698-3154 | 1 | R:FXD MET FLM 4.22K OHM 1% 1/8W | 28480 | 0698-3154 |
| A4R18 | 0684-2721 | | R:FXD COMP 2700 OHM 10% 1/4W | 01121 | CB 2721 |
| A4R19 | 0684-4701 | | R:FXD COMP 47 OHM 10% 1/4W | 01121 | CB 4701 |
| A4R20 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A4R21 | 0757-0453 | 1 | R:FXD MET FLM 30.1K OHM 1% 1/8W | 28480 | 0757-0453 |
| A4R22 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A4R23 | 0757-0442 | | R:FXD MET FLM 10.0K OHM 1% 1/8W | 28480 | 0757-0442 |
| A4R24 | 0757-0438 | 4 | R:FXD MET FLM 5.11K OHM 1% 1/8W | 28480 | 0757-0438 |
| A4R25 | 0757-0454 | 3 | R:FXD MET FLM 33.2K OHM 1% 1/8W | 28480 | 0757-0454 |
| A4R26 | 0684-6811 | 1 | R:FXD COMP 680 OHM 10% 1/4W | 01121 | CB 6811 |
| A4R27 | 0757-0421 | 1 | R:FXD MET FLM 825 OHM 1% 1/8W | 28480 | 0757-0421 |
| A4R28 | 0757-0407 | 2 | R:FXD MET FLM 200 OHM 1% 1/8W | 28480 | 0757-0407 |
| A4R29 | 2100-1788 | 3 | R:VAR FLM 500 OHM 10% LIN 1/2W | 28480 | 2100-1788 |
| A4R30 | 0684-1021 | | R:FXD COMP 1000 OHM 10% 1/4W | 01121 | CB 1021 |
| A4R31 | 0684-2221 | 8 | R:FXD COMP 2200 OHM 10% 1/4W | 01121 | CB 2221 |
| A4R32 | 0684-2221 | | R:FXD COMP 2200 OHM 10% 1/4W | 01121 | CB 2221 |
| A4R34 | 0684-1001 | 15 | R:FXD COMP 10 OHM 10% 1/4W | 01121 | CB 1001 |
| A4R35 | 2100-2030 | 2 | R:VAR FLM 20K OHM 10% LIN 1/2W | 28480 | 2100-2030 |
| A4R36 | 0684-1001 | | R:FXD COMP 10 OHM 10% 1/4W | 01121 | CB 1001 |
| A4VR1 | 1902-0052 | 1 | DIODE BREAKDOWN:6.81V | 28480 | 1902-0052 |
| A4VR2 | 1902-0033 | | DIODE:BREAKDOWN 6.2V | 04713 | 1N823 |
| A4VR3 | 1902-0244 | 1 | DIODE BREAKDOWN:30.1V | 28480 | 1902-0244 |
| A4XQ5 | 1205-0095 | 1 | HEAT SINK:TRANSISTOR | 13103 | 2225B |
| A5 | 01700-65803 | | VERTICAL AMPLIFIER MODULE ASSY | 28480 | 01700-65803 |
| A5C1 | 0160-2913 | 2 | C:FXD CER 0.01 UF +85-20% 500VDCW | 72982 | 811-014-Y5U0-103Z |
| A5C2 | 0160-2913 | | C:FXD CER 0.01 UF +85-20% 500VDCW | 72982 | 811-014-Y5U0-103Z |
| A5DS1 | 1450-0709 | 1 | INDICATOR LIGHT | 72765 | 6140-000-603 |
| A5MP1 | 0510-0097 | 4 | RETAINER: PUSH-ON | | |
| A5MP2 | 1490-0841 | 2 | COUPLER | | |
| A5MP3 | 01700-00602 | 1 | SHIELD: VERTICAL | 28480 | 01700-00602 |
| A5MP4 | 01700-00605 | 1 | SHIELD: VERT OUTPUT | 28480 | 01700-00605 |
| A5MP5 | 01701-01201 | 1 | BRACKET: SWP DISPLAY | 28480 | 01701-01201 |
| A5MP6 | 01701-01204 | 2 | BRACKET: POTENTIOMETER | 28480 | 01701-01204 |
| A5MP7 | 01701-04106 | 2 | PLATE: NUT | 28480 | 01701-04106 |
| A5MP8 | 01701-04107 | 1 | PLATE: ATTN COVER | 28480 | 01701-04107 |
| A5MP9 | 01701-23701 | 2 | SHAFT: POTENTIOMETER EXTN | 28480 | 01701-23701 |

See introduction to this section for ordering information

Table 8-18. Holdoff Amplifier Measurement Conditions and Waveforms

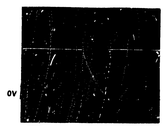
**DC VOLTAGE MEASUREMENT CONDITIONS**

A. Set:

| | |
|---|---|
| AUTO/NORM | AUTO |
| INT/EXT | INT |
| sweep display | SWEEP |
| SINGLE | engaged |
| main TIME/DIV | .2 mSEC |

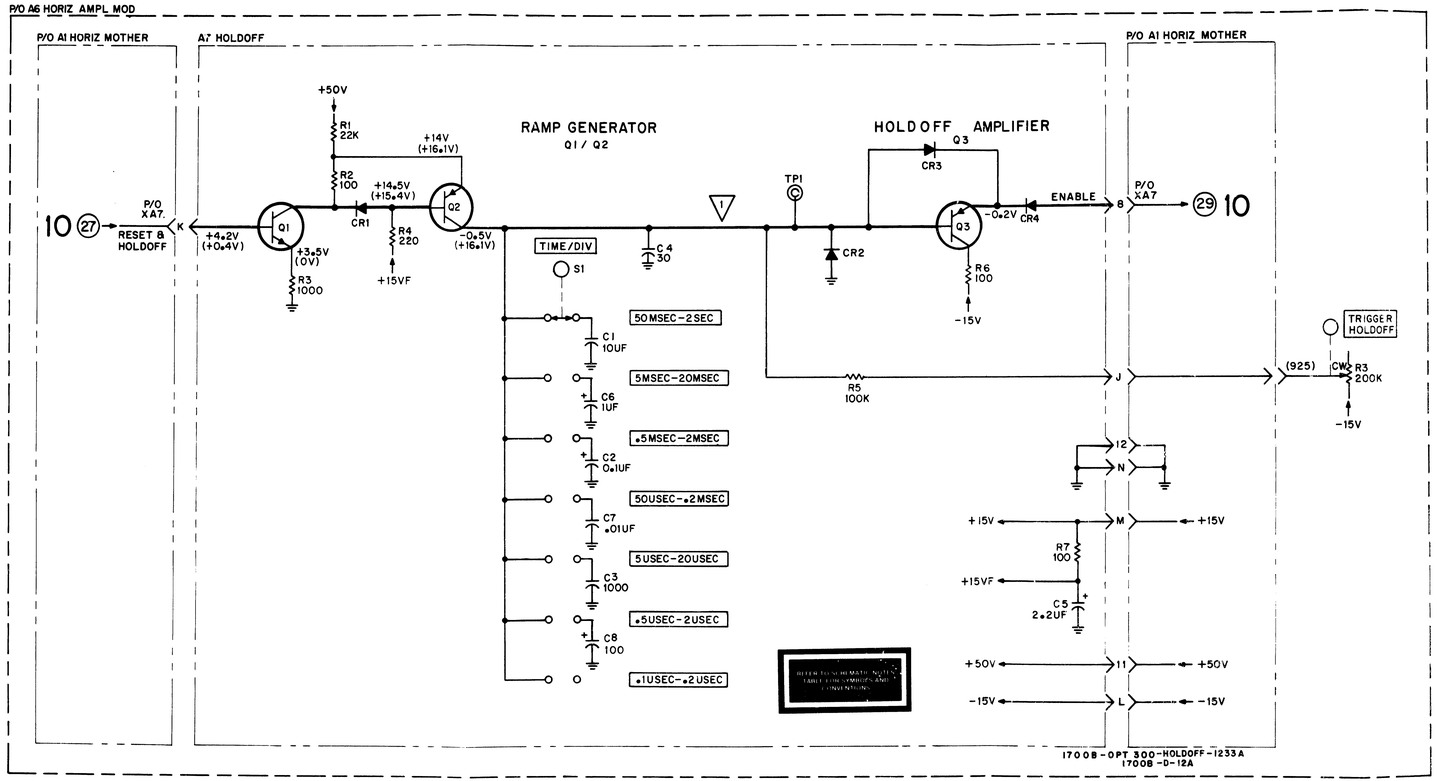
B. Voltages in ( ) are measured with AUTO/NORM set to NORM and SINGLE disengaged.

C. All waveforms are referenced to chassis ground. The monitor oscilloscope's vertical sensitivity (using a 1:1 probe) and sweep speed settings are shown below on each waveform photograph.




1700B-300-R-38





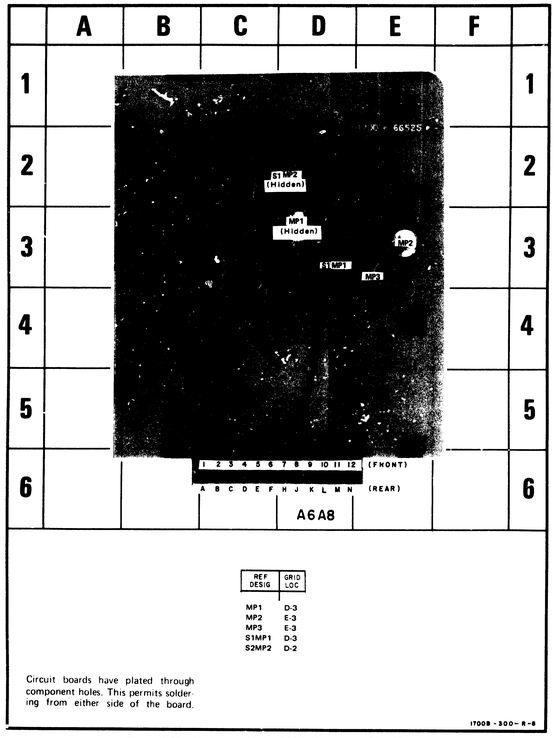

PARTS ON THIS SCHEMATIC

| A6 | A6A1 | A6A7 |
|---|---|---|
| R3 | XA7 | C1-8<br>CR1-4<br>Q1-3<br>R1-7<br>S1<br>TP1 |

DELETED:

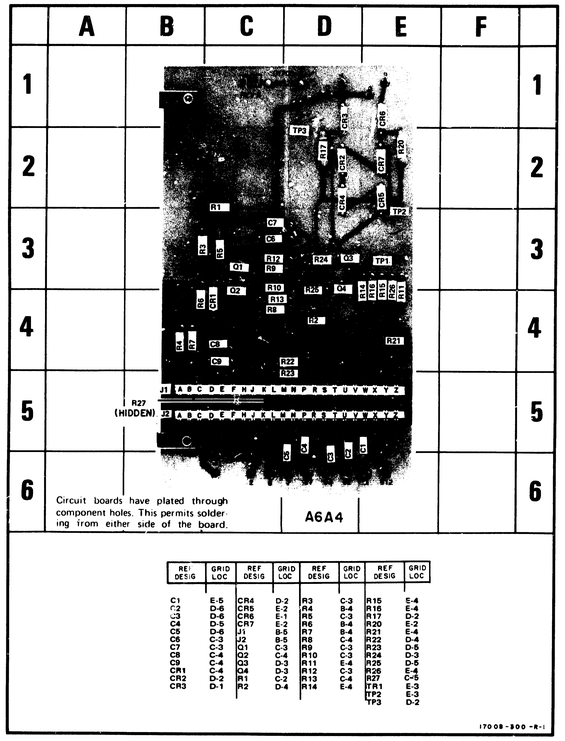
12

Figure 8-31. Holdoff Amplifier, A6A7, Schematic




| REF DESIG | GRID LOC |
|---|---|
| MP1 | D-3 |
| MP2 | E-3 |
| MP3 | E-3 |
| S1MP1 | D-3 |
| S2MP2 | D-2 |

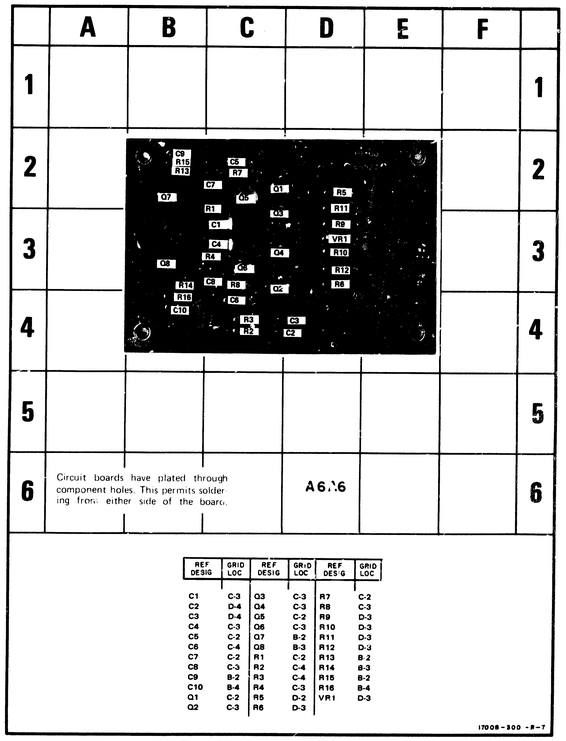
Figure 8-32. Horizontal Mode, A6A8, Component Identification




| REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|---|---|---|---|---|---|---|---|
| C1 | E-5 | CR4 | D-2 | R3 | C-3 | R15 | E-4 |
| C2 | D-6 | CR5 | E-2 | R4 | B-4 | R16 | E-4 |
| C3 | D-6 | CR6 | E-1 | R5 | C-3 | R17 | D-2 |
| C4 | D-5 | CR7 | E-2 | R6 | B-4 | R20 | E-2 |
| C5 | D-6 | J1 | B-5 | R7 | B-4 | R21 | E-4 |
| C6 | C-3 | J2 | B-5 | R8 | C-4 | R22 | D-4 |
| C7 | C-3 | Q1 | C-3 | R9 | C-3 | R23 | D-5 |
| C8 | C-4 | Q2 | C-4 | R10 | C-3 | R24 | D-3 |
| C9 | C-4 | Q3 | D-3 | R11 | E-4 | R25 | D-5 |
| C10 | C-4 | Q4 | D-3 | R12 | C-3 | R26 | E-4 |
| CR1 | D-2 | R1 | C-2 | R13 | C-4 | R27 | C-5 |
| CR2 | D-2 | R2 | D-4 | R14 | E-4 | TP1 | E-3 |
| CR3 | D-1 | | | | | TP2 | E-3 |
| | | | | | | TP3 | D-2 |

Figure 8-33. Horizontal Preamplifier, A6A4, Component Identification






| REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|---|---|---|---|---|---|
| C1 | C-3 | Q3 | C-3 | R7 | C-2 |
| C2 | D-4 | Q4 | C-3 | R8 | C-3 |
| C3 | D-4 | Q5 | C-2 | R9 | D-3 |
| C4 | C-3 | Q6 | C-3 | R10 | D-3 |
| C5 | C-2 | Q7 | B-2 | R11 | D-3 |
| C6 | C-4 | Q8 | B-3 | R12 | D-3 |
| C7 | C-2 | R1 | C-2 | R13 | B-2 |
| C8 | C-3 | R2 | C-4 | R14 | B-3 |
| C9 | B-2 | R3 | C-4 | R15 | B-2 |
| C10 | B-4 | R4 | C-3 | R16 | B-4 |
| Q1 | C-2 | R5 | D-2 | VR1 | D-3 |
| Q2 | C-3 | R6 | D-3 | | |

Figure 8-34. Horizontal Output Amplifier, A6A6, Component Identification

Table 8-19. Horiz Preampl and Output Ampl Measurement Conditions and Waveforms

## DC VOLTAGE MEASUREMENT CONDITIONS

A. Set:

| | |
|---|---|
| main AUTO/NORM | AUTO |
| INT/EXT | INT |
| sweep display | MAIN SWEEP |
| SINGLE | engaged |
| main TIME/DIV | .2 mSEC |
| horizontal POSITION | centered |

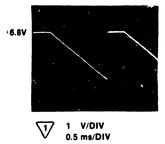
B. All voltages are referenced to chassis ground. All indications are nominal and may vary slightly.

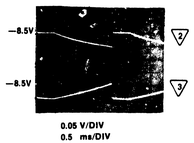
## WAVEFORM MEASUREMENT CONDITIONS

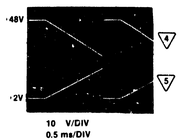
A. Set:

| | |
|---|---|
| main AUTO/NORM | AUTO |
| INT/EXT | INT |
| SWEEP DISPLAY | MAIN SWEEP |
| main slope | + |
| main TIME/DIV | .2 mSEC |

B. All waveforms are referenced to chassis ground. The monitor oscilloscope's vertical sensitivity (using a 1:1 probe) and sweep speed settings are shown below on each waveform photograph

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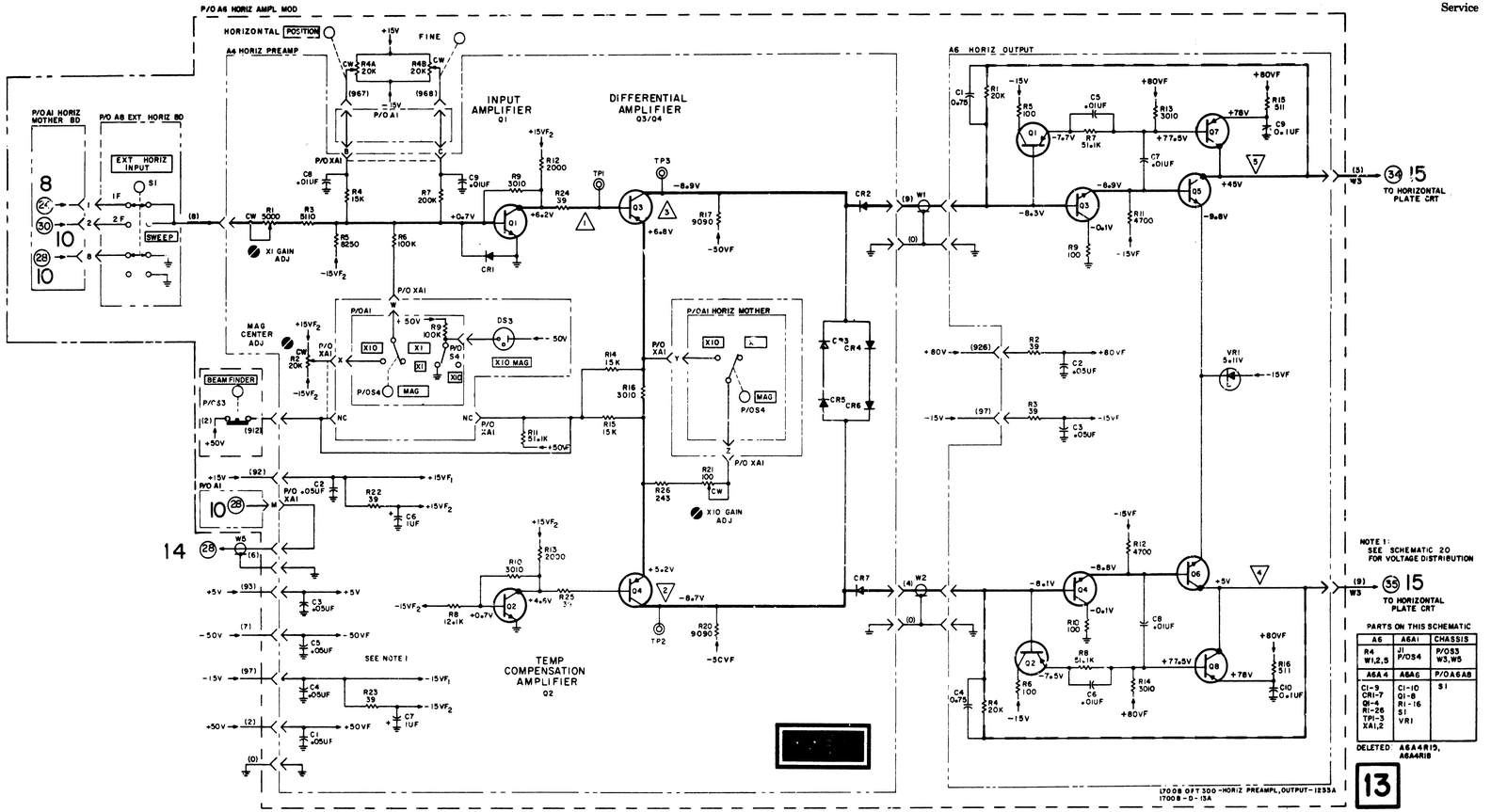
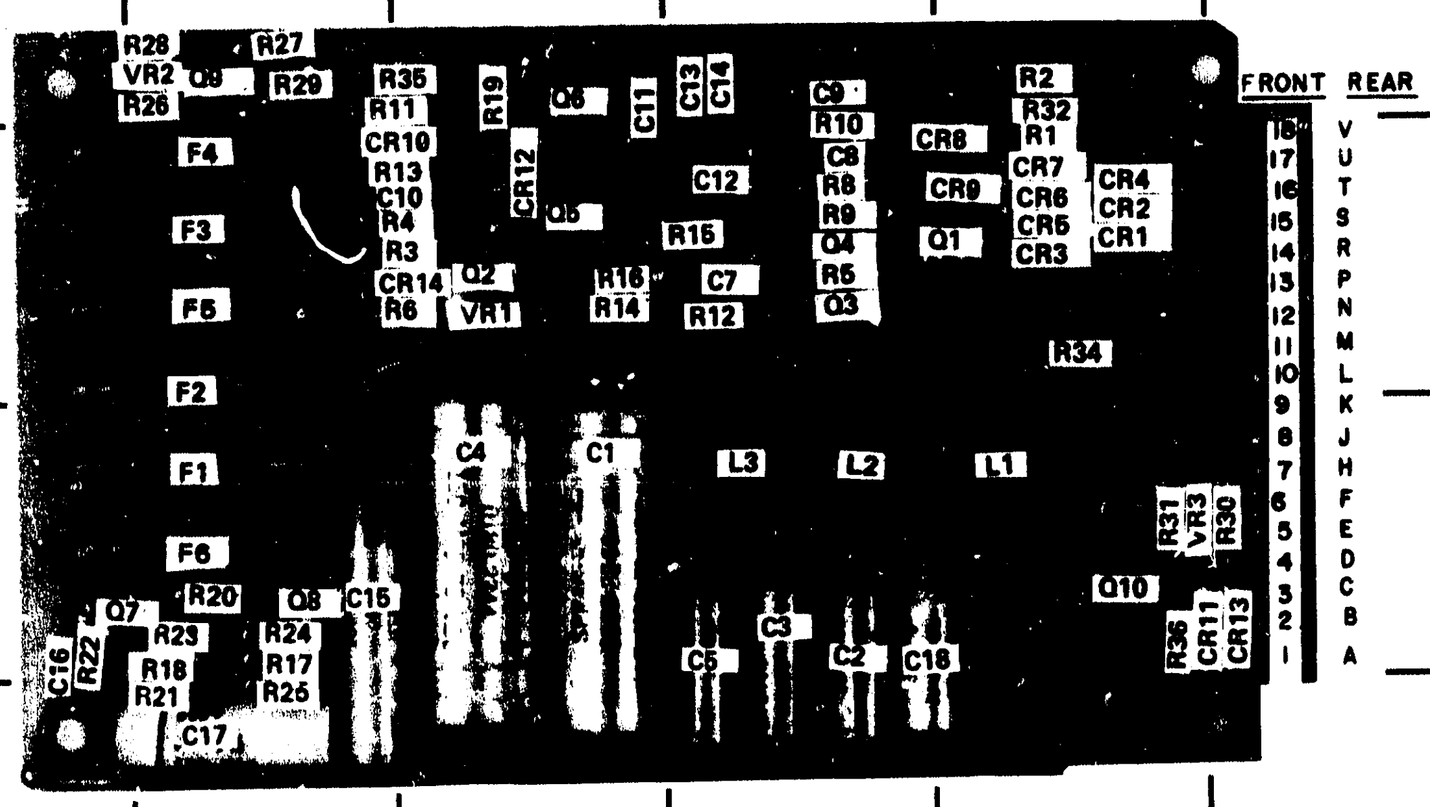



Figure 8-35. Horizontal Mode, A6A8, Horizontal Preamplifier, A6A4, and Horizontal Output Amplifier, A6A6, Schematic




Circuit boards have plated through component holes. This permits soldering from either side of the board.

A4

| REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C1 | C-4 | C14 | D-2 | CR8 | E-3 | F5 | B-3 | Q9 | B-2 | R13 | C-3 | R26 | B-2 |
| C2 | D-4 | C15 | B-4 | CR9 | E-3 | F6 | B-4 | Q10 | E-4 | R14 | C-3 | R27 | B-2 |
| C3 | D-4 | C16 | A-4 | CR10 | C-3 | L1 | E-4 | R1 | E-3 | R15 | D-3 | R28 | B-2 |
| C4 | C-4 | C17 | B-5 | CR11 | E-4 | L2 | D-4 | R2 | E-2 | R16 | C-3 | R29 | B-2 |
| C5 | D-4 | C18 | D-4 | CR12 | C-3 | L3 | D-4 | R3 | C-3 | R17 | B-4 | R30 | F-4 |
| C7 | D-3 | CR1 | E-3 | CR13 | F-4 | Q1 | E-3 | R4 | C-3 | R18 | B-4 | R31 | E-4 |
| C8 | D-3 | CR2 | E-3 | CR14 | C-3 | Q2 | C-3 | R5 | D-3 | R19 | C-2 | R32 | E-2 |
| C9 | D-2 | CR3 | E-3 | E1 | A-4 | Q3 | D-3 | R6 | C-3 | R20 | B-4 | R34 | E-3 |
| C10 | C-3 | CR4 | E-3 | F1 | B-4 | Q4 | D-3 | R8 | D-3 | R21 | B-5 | R35 | C-2 |
| C11 | C-2 | CR5 | E-3 | F2 | B-3 | Q5 | C-3 | R9 | D-3 | R22 | A-4 | R36 | E-4 |
| C12 | D-3 | CR6 | E-3 | F3 | B-3 | Q6 | C-2 | R10 | D-3 | R23 | B-4 | VR1 | C-3 |
| C13 | D-2 | CR7 | E-3 | F4 | B-3 | Q7 | B-4 | R11 | C-2 | R24 | B-4 | VR2 | B-2 |
| | | | | | | Q8 | B-4 | R12 | D-3 | R25 | B-5 | VR3 | E-4 |

1700B-300-R-4

Figure 8-36. Gate, A4, Component Identification

Table 8-20. Gate Measurement Conditions and Waveforms

## DC VOLTAGE MEASUREMENT CONDITIONS

A. Set:

| | |
|---|---|
| SINGLE | engaged |
| INTENSITY | normal |

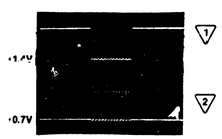
B. All voltages are referenced to chassis ground. All indications are nominal and may vary slightly.

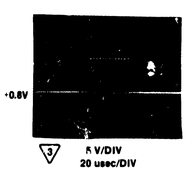
## WAVEFORM MEASUREMENT CONDITIONS

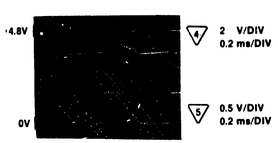
A. Set:

| | |
|---|---|
| MODE | CHOP |
| main AUTO/NORM | AUTO |
| INTENSITY | normal |
| main TIME/DIV | 5 uSEC |

B. All waveforms are referenced to chassis ground. The monitor oscilloscope's vertical sensitivity (using a 1:1 probe) and sweep speed settings are shown below on each waveform photograph.




1700B-300-R-40



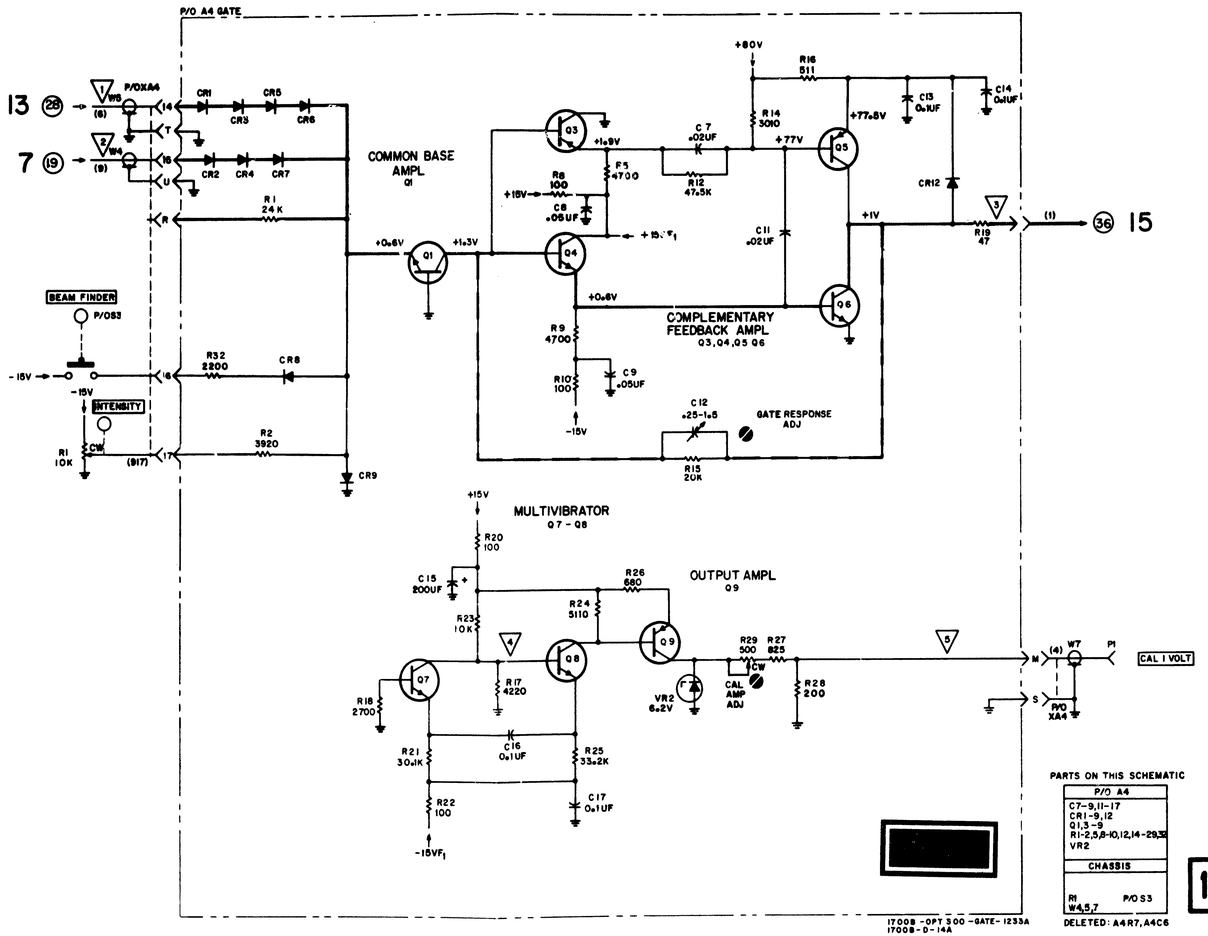



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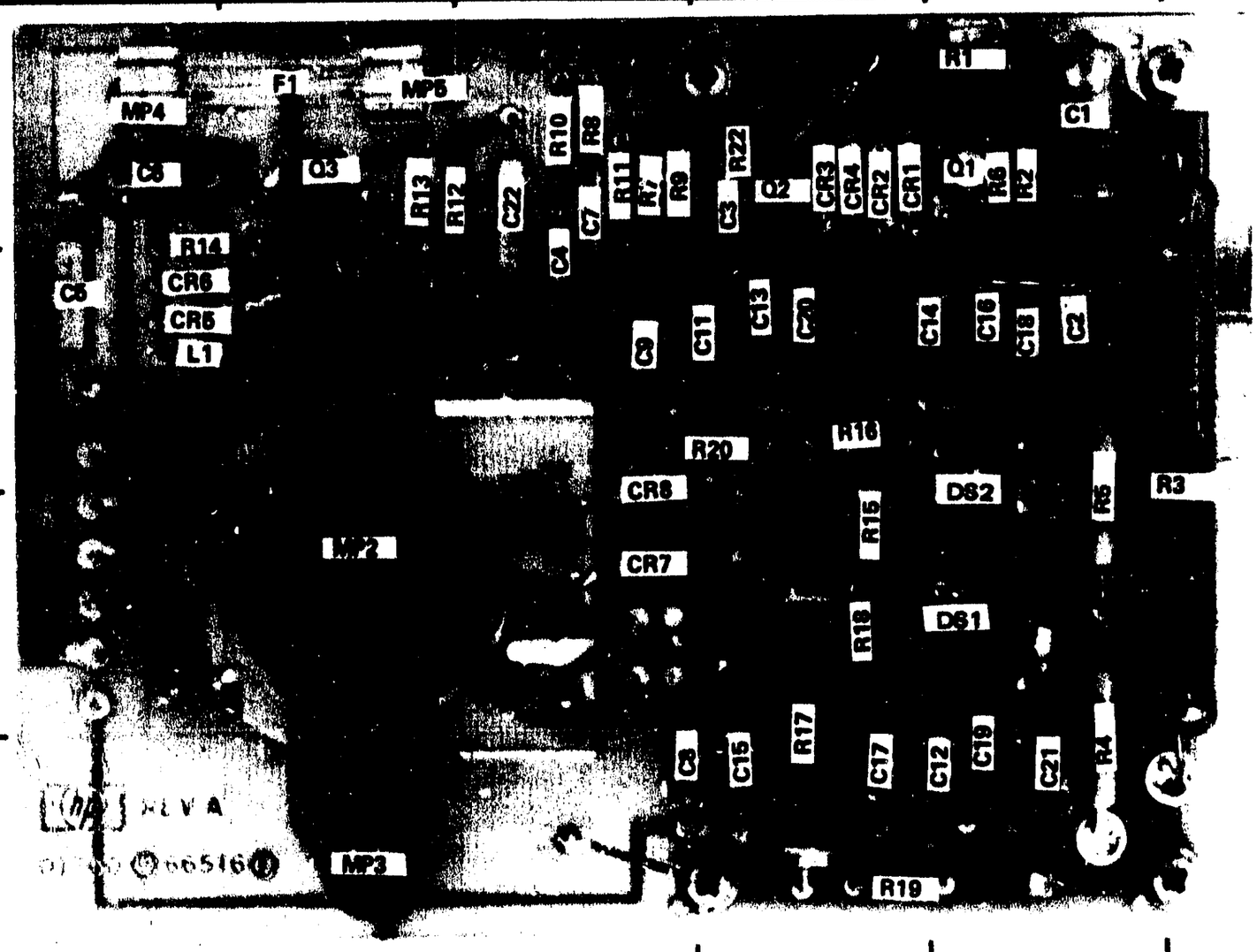
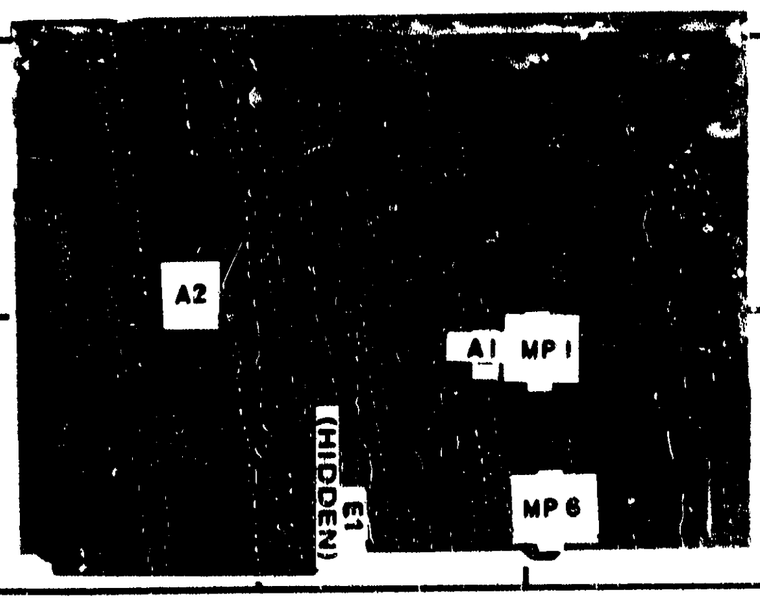
Figure 8-37.
Gate, A4, Schematic
8-49




A3A4

Circuit boards have plated through component holes. This permits soldering from either side of the board.

| REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|---|---|---|---|---|---|---|---|
| A1 | B-6 | C16 | E-2 | E-1 | B-6 | R-5 | E-3 |
| A2 | A-5 | C17 | D-4 | F-1 | B-1 | R6 | E-5 |
| C1 | E-1 | C18 | E-2 | L1 | A-2 | R7 | C-1 |
| C2 | E-2 | C19 | E-4 | MP1 | B-6 | R8 | C-1 |
| C3 | D-1 | C20 | D-2 | MP2 | B-3 | R9 | C-1 |
| C4 | C-2 | C21 | E-4 | MP3 | B-4 | R10 | C-1 |
| C5 | A-2 | C22 | C-1 | MP4 | A-1 | R11 | C-1 |
| C6 | A-1 | CR1 | D-1 | MP5 | B-1 | R12 | B-1 |
| C7 | C-1 | CR2 | D-1 | MP6 | C-6 | R13 | B-1 |
| C8 | C-4 | CR3 | D-1 | MP7 | F-1 | R14 | A-2 |
| C9 | C-2 | CR4 | D-1 | Q1 | E-1 | R15 | D-3 |
| C11 | D-2 | CR5 | A-2 | Q2 | D-1 | R16 | D-2 |
| C12 | E-4 | CR6 | A-2 | Q3 | B-1 | R17 | D-4 |
| C13 | D-2 | CR7 | C-3 | R1 | E-1 | R18 | D-3 |
| C14 | E-2 | CR8 | C-3 | R2 | E-1 | R19 | D-4 |
| C15 | D-4 | DS1 | E-3 | R3 | E-3 | R20 | D-2 |
| | | DS2 | E-2 | R4 | E-4 | R22 | D-1 |

17008-300-R-15

Figure 8-38. High Voltage Oscillator, A3A4, Component Identification

Table 8-21. High Voltage Oscillator Measurement Conditions and Waveforms

## DC VOLTAGE MEASUREMENT CONDITIONS

A. Set:

POWER ..... ON
INTENSITY ..... ccw

B. All voltages are referenced to chassis ground. All indications are nominal and may vary slightly.

## WAVEFORM MEASUREMENT CONDITIONS

A. Set:

POWER ..... ON
INTENSITY ..... ccw

B. All wave forms are referenced to chassis ground. The monitor oscilloscope's vertical sensitivity (using a 1:1 probe) and sweep speed settings are shown below on each waveform photograph.





1700B-300-R-41

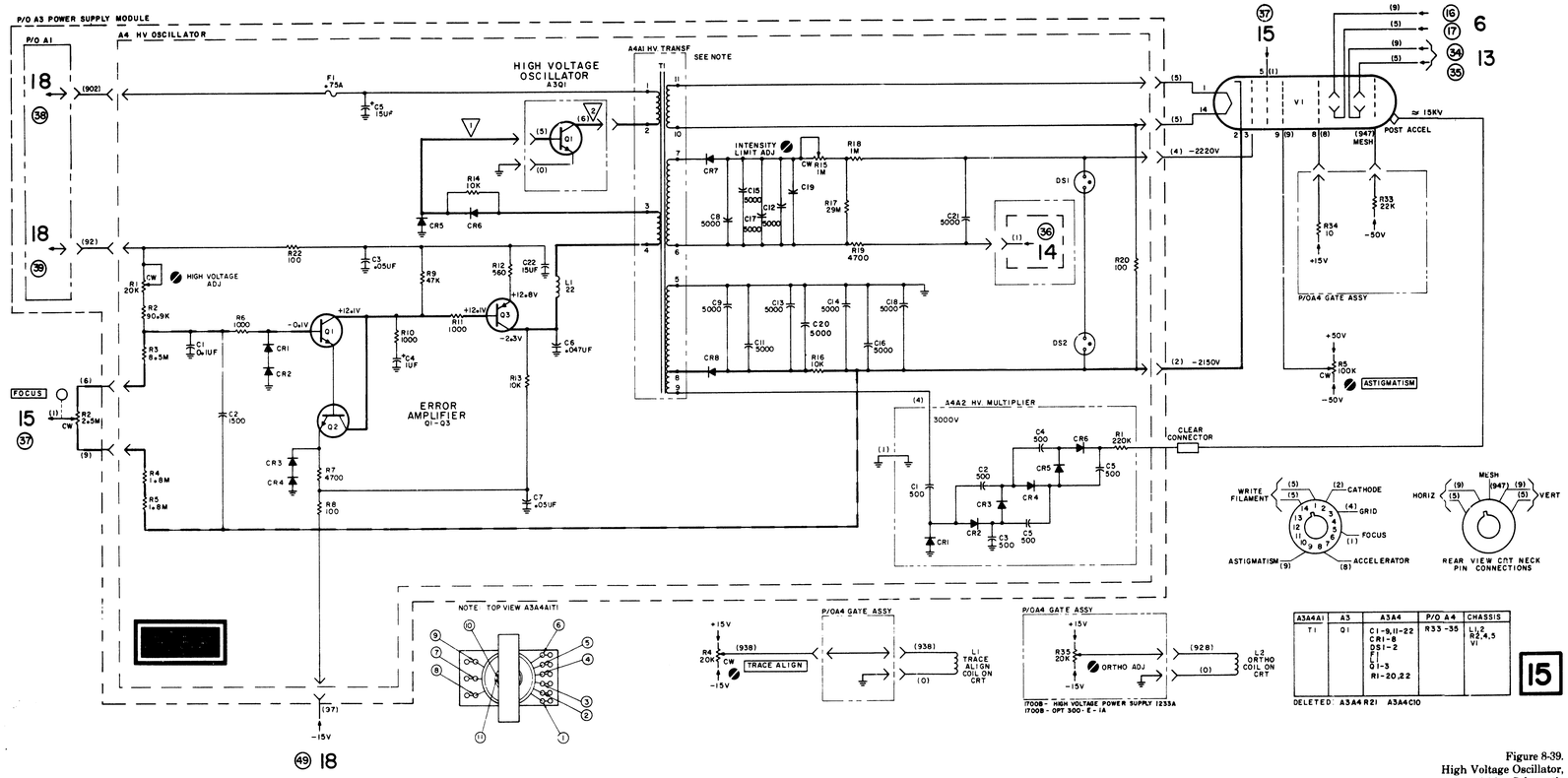
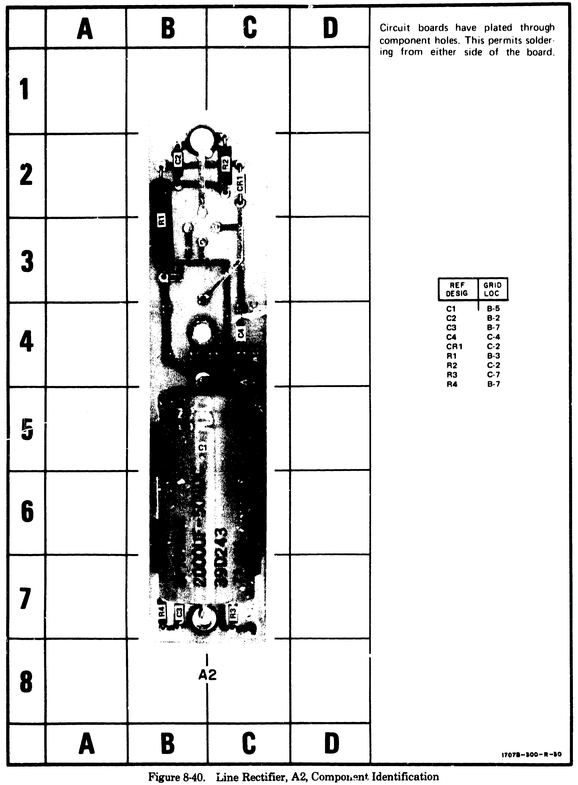
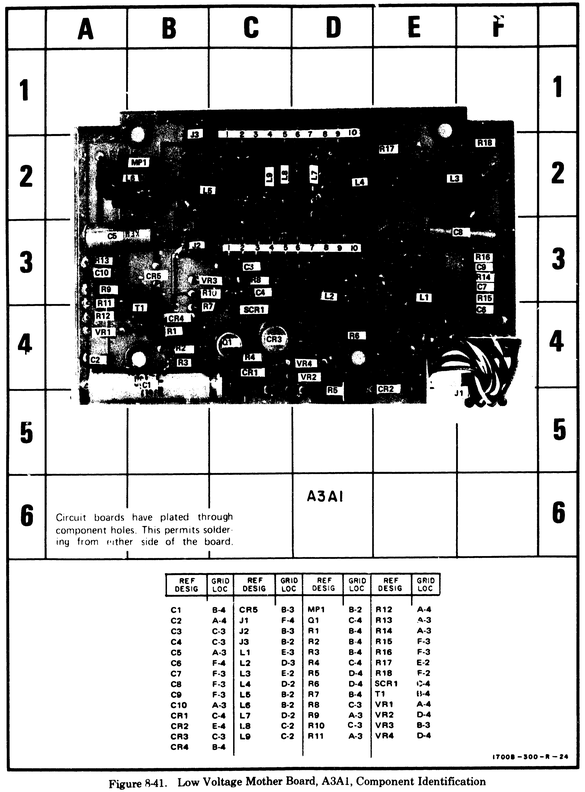



Figure 8-39.
High Voltage Oscillator,
A3A4, Schematic
8-51




| REF DESIG | GRID LOC |
|---|---|
| C1 | B-5 |
| C2 | B-2 |
| C3 | B-7 |
| C4 | C-4 |
| CR1 | C-2 |
| R1 | B-3 |
| R2 | C-2 |
| R3 | C-7 |
| R4 | B-7 |

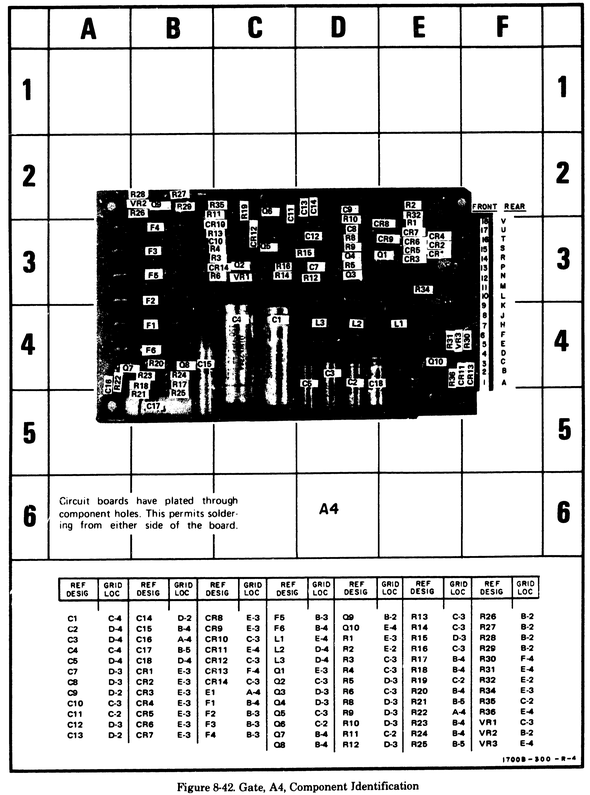
Figure 8-40. Line Rectifier, A2, Component Identification




| REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|---|---|---|---|---|---|---|---|
| C1 | B-4 | CR5 | B-3 | MP1 | B-2 | R12 | A-4 |
| C2 | A-4 | J1 | F-4 | Q1 | C-4 | R13 | A-3 |
| C3 | C-3 | J2 | B-3 | R1 | B-4 | R14 | A-3 |
| C4 | C-3 | J3 | B-2 | R2 | B-4 | R15 | F-3 |
| C5 | A-3 | L1 | E-3 | R3 | B-4 | R16 | F-3 |
| C6 | F-4 | L2 | D-3 | R4 | C-4 | R17 | E-2 |
| C7 | F-3 | L3 | E-2 | R5 | D-4 | R18 | F-2 |
| C8 | F-3 | L4 | D-2 | R6 | D-4 | SCR1 | D-4 |
| C9 | F-3 | L5 | B-2 | R7 | B-4 | T1 | H-4 |
| C10 | A-3 | L6 | B-2 | R8 | C-3 | VR1 | A-4 |
| CR1 | C-4 | L7 | D-2 | R9 | A-3 | VR2 | D-4 |
| CR2 | E-4 | L8 | C-2 | R10 | C-3 | VR3 | B-3 |
| CR3 | C-3 | L9 | C-2 | R11 | A-3 | VR4 | D-4 |
| CR4 | B-4 | | | | | | |

Figure 8-41. Low Voltage Mother Board, A3A1, Component Identification






| REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C1 | C-4 | C14 | D-2 | CR8 | E-3 | F5 | B-3 | Q9 | B-2 | R13 | C-3 | R26 | B-2 |
| C2 | D-4 | C15 | B-4 | CR9 | E-3 | F6 | B-4 | Q10 | E-4 | R14 | C-3 | R27 | B-2 |
| C3 | D-4 | C16 | A-4 | CR10 | C-3 | L1 | E-4 | R1 | E-3 | R15 | D-3 | R28 | B-2 |
| C4 | C-4 | C17 | B-5 | CR11 | E-4 | L2 | D-4 | R2 | E-2 | R16 | C-3 | R29 | B-2 |
| C5 | D-4 | C18 | D-4 | CR12 | C-3 | L3 | D-4 | R3 | C-3 | R17 | B-4 | R30 | F-4 |
| C6 | D-3 | CR1 | E-3 | CR13 | F-4 | Q1 | E-3 | R4 | C-3 | R18 | B-4 | R31 | E-4 |
| C7 | D-3 | CR2 | E-3 | CR14 | C-3 | Q2 | C-3 | R5 | D-3 | R19 | C-2 | R32 | E-2 |
| C8 | D-3 | CR3 | E-3 | E1 | A-4 | Q3 | D-3 | R6 | C-3 | R20 | B-4 | R34 | E-3 |
| C9 | D-2 | CR4 | E-3 | F1 | B-4 | Q4 | D-3 | R8 | D-3 | R21 | B-5 | R35 | C-2 |
| C10 | C-3 | CR5 | E-3 | F2 | B-3 | Q5 | C-3 | R9 | D-3 | R22 | A-4 | R36 | E-4 |
| C11 | C-2 | CR6 | E-3 | F3 | B-3 | Q6 | C-2 | R10 | D-3 | R23 | B-4 | VR1 | C-3 |
| C12 | D-3 | CR7 | E-3 | F4 | B-3 | Q7 | B-4 | R11 | C-2 | R24 | B-4 | VR2 | B-2 |
| C13 | D-2 | | | | | Q8 | B-4 | R12 | D-3 | R25 | B-5 | VR3 | E-4 |

Figure 8-42. Gate, A4, Component Identification

Table 8-22. Low Voltage Power Supply Measurement Conditions

**DC VOLTAGE MEASUREMENT CONDITIONS**

A. Set:

POWER MODE ..... 115V AC
POWER ..... ON

B. All voltages are referenced to chassis ground. All indications are nominal and may vary slightly.

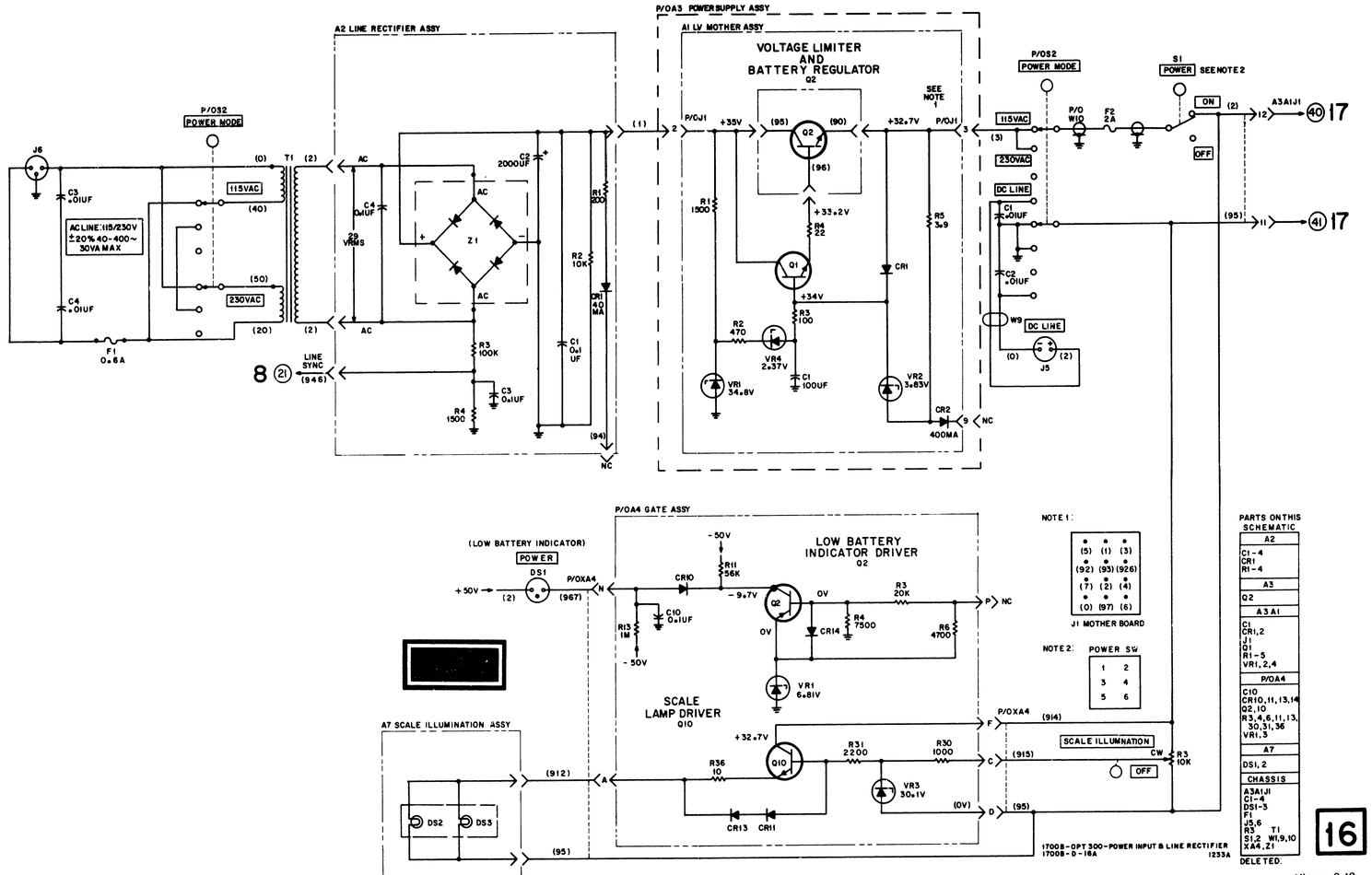
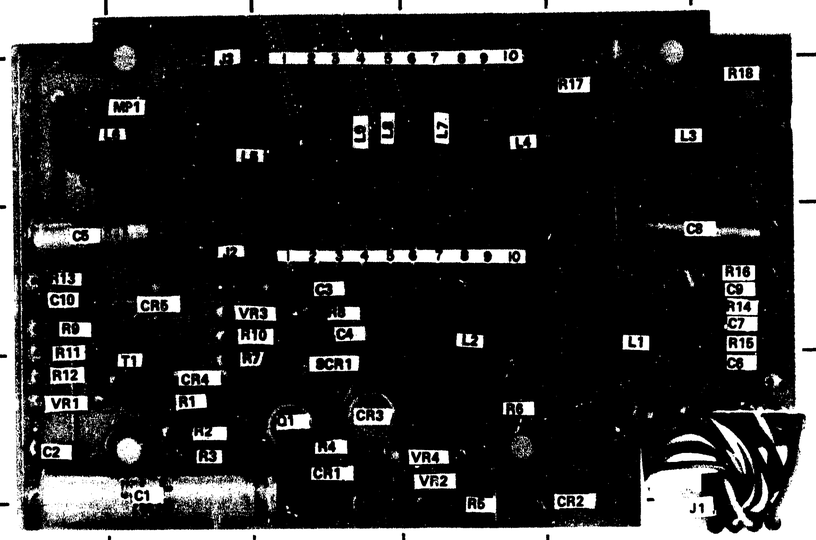



Figure 8-43.
Power Input Schematic



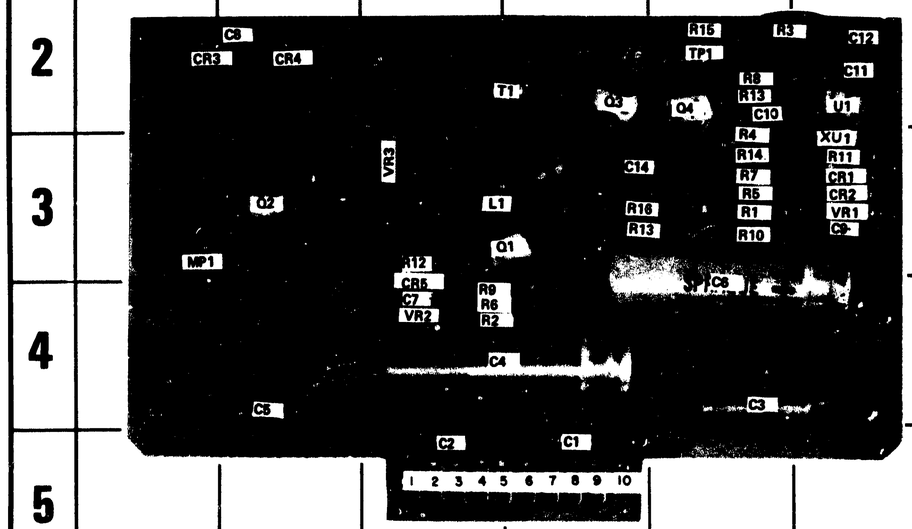

A3A1

Circuit boards have plated through component holes. This permits soldering from either side of the board.

| REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|---|---|---|---|---|---|---|---|
| C1 | B-4 | CR5 | B-3 | MP1 | B-2 | R12 | A-4 |
| C2 | A-4 | J1 | F-4 | Q1 | C-4 | R13 | A-3 |
| C3 | C-3 | J2 | B-3 | R1 | B-4 | R14 | A-3 |
| C4 | C-3 | J3 | B-2 | R2 | B-4 | R15 | F-3 |
| C5 | A-3 | L1 | E-3 | R3 | B-4 | R16 | F-3 |
| C6 | F-4 | L2 | D-3 | R4 | C-4 | R17 | E-2 |
| C7 | F-3 | L3 | E-2 | R5 | D-4 | R18 | F-2 |
| C8 | F-3 | L4 | D-2 | R6 | D-4 | SCR1 | C-4 |
| C9 | F-3 | L5 | B-2 | R7 | B-4 | T1 | B-4 |
| C10 | A-3 | L6 | B-2 | R8 | C-3 | VR1 | A-4 |
| CR1 | C-4 | L7 | D-2 | R9 | A-3 | VR2 | D-4 |
| CR2 | E-4 | L8 | C-2 | R10 | C-3 | VR3 | B-3 |
| CR3 | C-3 | L9 | C-2 | R11 | A-3 | VR4 | D-4 |
| CR4 | B-4 | | | | | | |

1700B-300-R-24

Figure 8-44. Low Voltage Mother Board, A3A1, Component Identification




A3A2

Circuit boards have plated through component holes. This permits soldering from either side of the board.

| REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|---|---|---|---|---|---|---|---|
| C1 | D-5 | C14 | D-3 | Q4 | E-2 | R12 | C-3 |
| C2 | C-5 | CR1 | F-3 | R1 | E-3 | R13 | E-3 |
| C3 | E-4 | CR2 | F-3 | R2 | C-4 | R14 | E-3 |
| C4 | C-4 | CR3 | A-2 | R3 | E-3 | R15 | E-2 |
| C5 | B-4 | CR4 | B-2 | R4 | E-3 | R16 | D-3 |
| C6 | E-4 | CR5 | C-4 | R5 | E-3 | T1 | D-2 |
| C7 | C-4 | | | R6 | C-4 | TP1 | E-2 |
| C8 | B-2 | L1 | C-3 | R7 | E-3 | U1 | F-2 |
| C9 | F-3 | MP1 | A-3 | R8 | E-2 | VR1 | F-3 |
| C10 | E-2 | Q1 | C-3 | R9 | C-4 | VR2 | C-4 |
| C11 | F-2 | Q2 | B-3 | R10 | E-3 | VR3 | C-3 |
| C12 | F-2 | Q3 | D-2 | R11 | F-3 | XU1 | F-3 |
| C13 | | | | | | | |

1700B-300-R-8

Figure 8-45. Low Voltage Converter, A3A2, Component Identification

Table 8-14. Trigger Measurement Conditions and Waveforms

## DC VOLTAGE MEASUREMENT CONDITIONS

A. Set:

| | |
|---|---|
| AUTO/NORM | AUTO |
| SINGLE | engaged |
| MAG | X1 |
| INT/EXT | INT |
| TRIGGER LEVEL | cw |
| slope | + |
| sweep display | SWEEP |

B. All voltages are referenced to chassis ground. All indications are nominal and may vary slightly.

## WAVEFORM MEASUREMENT CONDITIONS

A. Set:

| | |
|---|---|
| AUTO/NORM | AUTO |
| MAG | X1 |
| INT/EXT | EXT |
| sweep display | SWEEP |
| slope | + |
| TIME/DIV | .2 mSEC |
| TRIGGER LEVEL | 12 o'clock position |

B. Connect CAL 1 VOLT signal to +1 EXT TRIG INPUT.

C. All waveforms are referenced to chassis ground. The monitor oscilloscope's vertical sensitivity(using a 1:1 probe) and sweep speed settings are shown below on each waveform photograph.

## WAVEFORM MEASUREMENT CONDITIONS (EXT HORIZ INPUT AMPLIFIER)

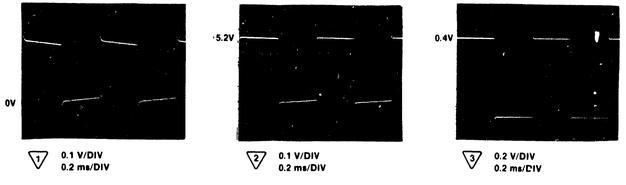
A. D.C. Voltage Measurements for EXT horiz input amp are same as above.

B. Set:

| | |
|---|---|
| SINGLE | engaged |
| sweep display | EXT HORIZ INPUT |

C. Connect CAL 1 VOLT to EXT HORIZ INPUT.

D. All waveforms are referenced to chassis ground. The monitor oscilloscope's vertical sensitivity(using a 1:1 probe) and sweep speed settings are shown below on each waveform photograph.

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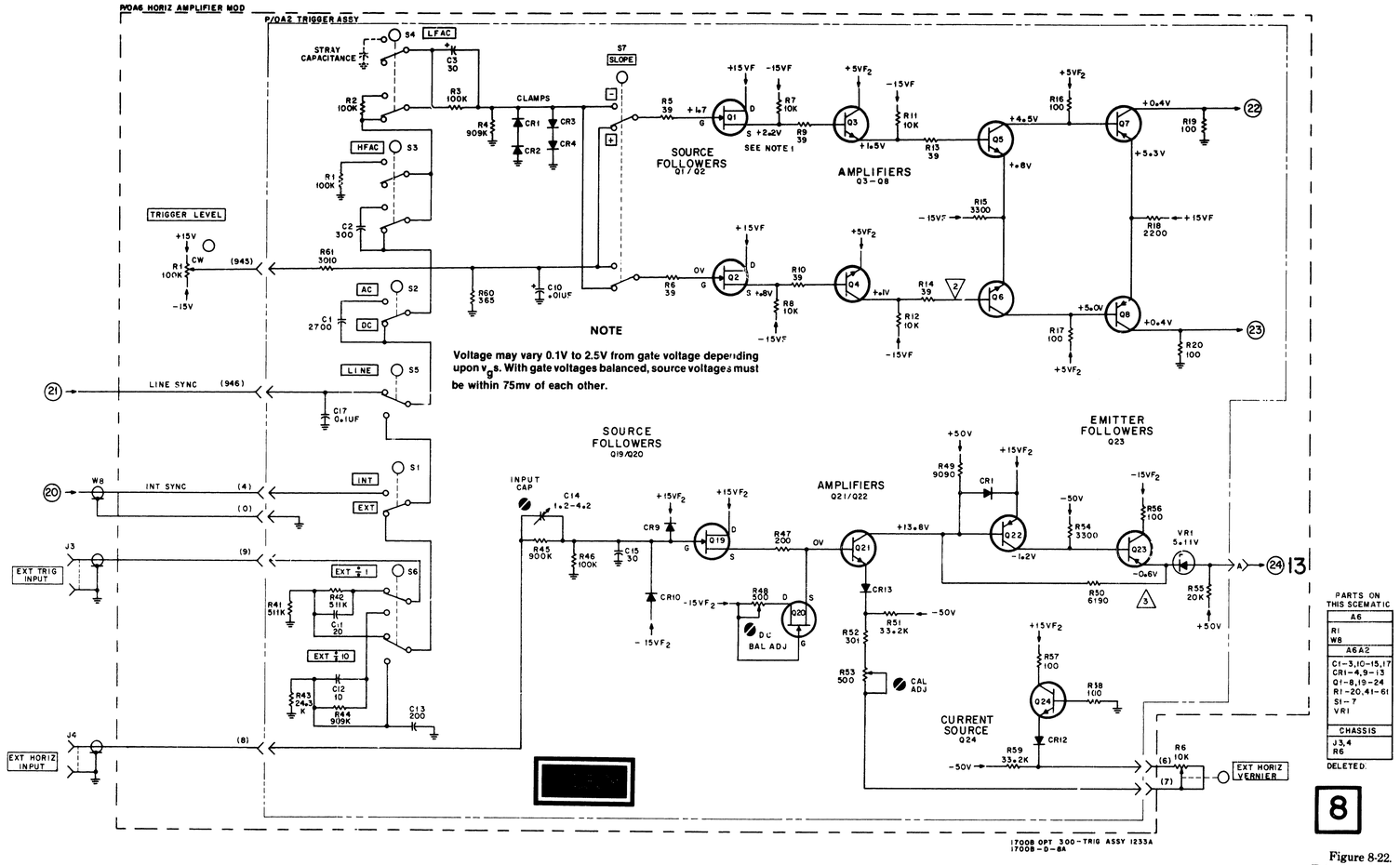



Figure 8-22. Trigger, A6A2, Schematic (1 of 2)

Table 8-23. Low Voltage Converter Measurement Conditions and Waveforms

## DC VOLTAGE MEASUREMENT CONDITIONS

A. Set:

POWER ..... ON
POWER MODE ..... DC LINE

B. Connect:

DC LINE ..... 36 Vdc

Measure (1)

c. Connect:

DC LINE ..... 24 Vdc

Measure (2)

D. Connect:

DC LINE ..... 11.5 Vdc

Measure (3)

E. All voltages are referenced to chassis ground. All indications are nominal and may vary slightly.

## WAVEFORM MEASUREMENT CONDITIONS

A. Set:

POWER ..... ON
POWER MODE ..... DC LINE

B. Connect:

DC LINE ..... 36 Vdc

Measure (1)

C. Connect:

DC LINE ..... 24 Vdc

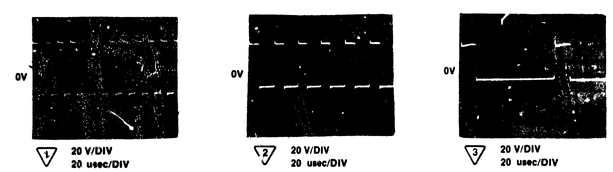
Measure (2)

D. Connect:

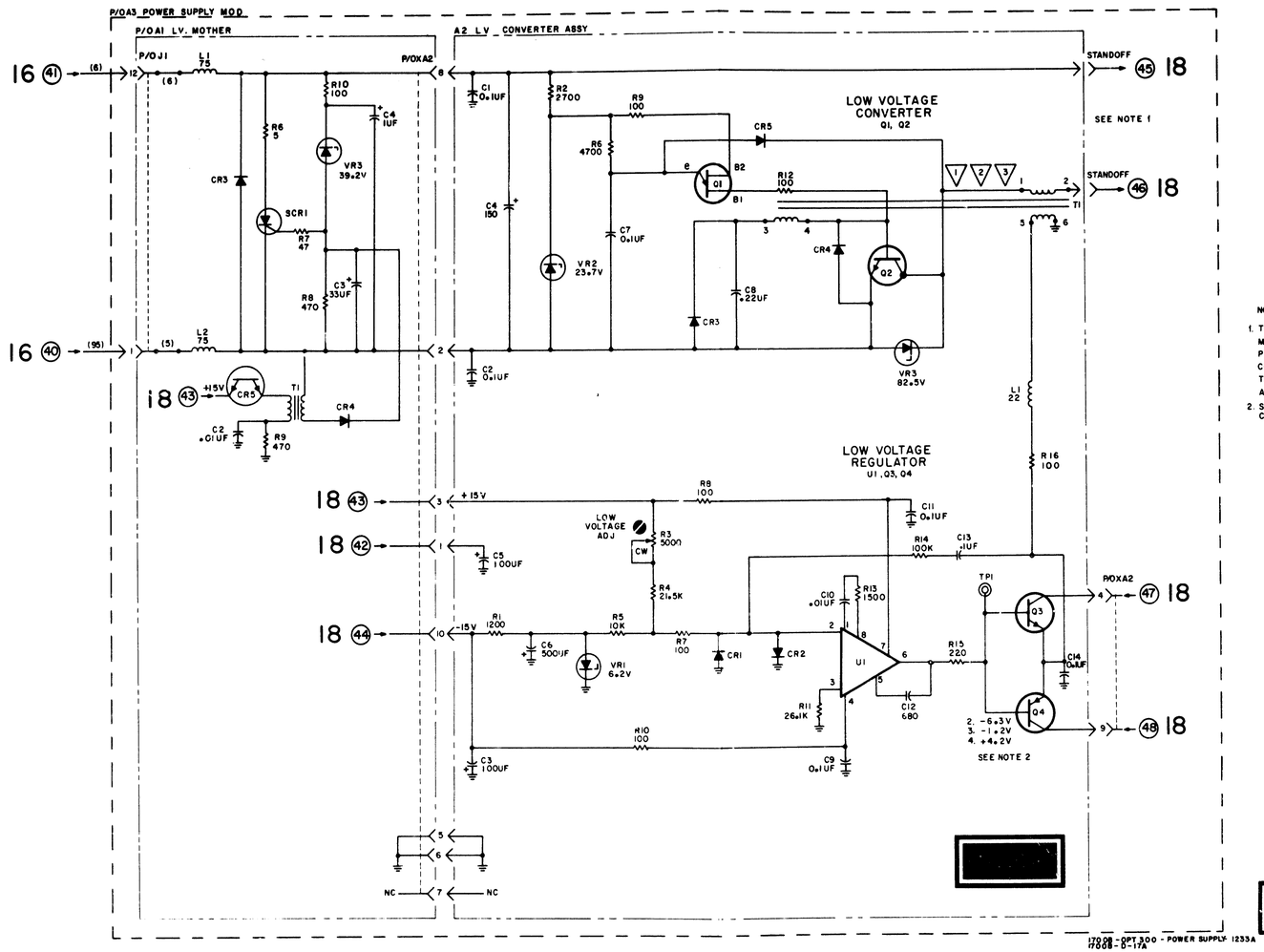
DC LINE ..... 11.5 Vdc

Measure (3)

E. All waveforms are referenced to chassis ground. The monitor oscilloscope's vertical sensitivity (using a 1:1 probe) and sweep speed settings are shown below on each waveform.




1700B-300-R-42




NOTE:

1. THE STANDOFFS ARE METAL CONDUCTORS PROVIDING ELECTRICAL CONNECTION BETWEEN THE A3A2 AND A3A3 ASSEMBLIES.
2. SEE VOLTAGE MEASUREMENT CONDITIONS

PARTS ON THIS SCHEMATIC

| A3A1 | A3A2 |
|---|---|
| C2,-4<br>CR3,4,5<br>J1,<br>L1,2<br>R6-10<br>SCR1<br>T1<br>VR3<br>XA2 | C1-14<br>CR1-5<br>L1<br>Q1-4<br>R1-16<br>T1<br>U1<br>VR1-3 |
| CHASSIS | |

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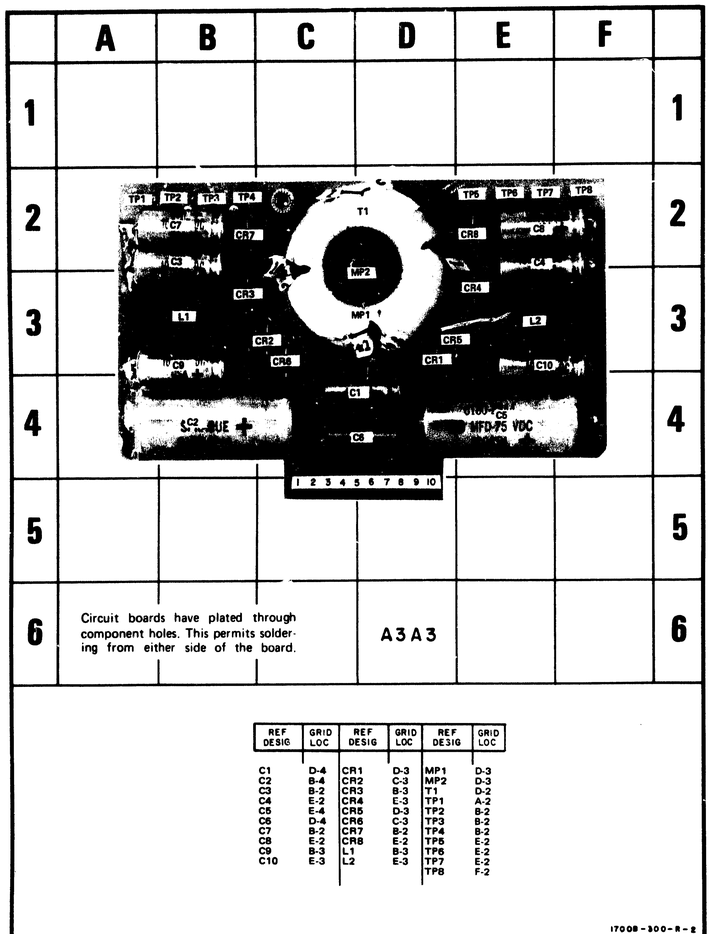
17

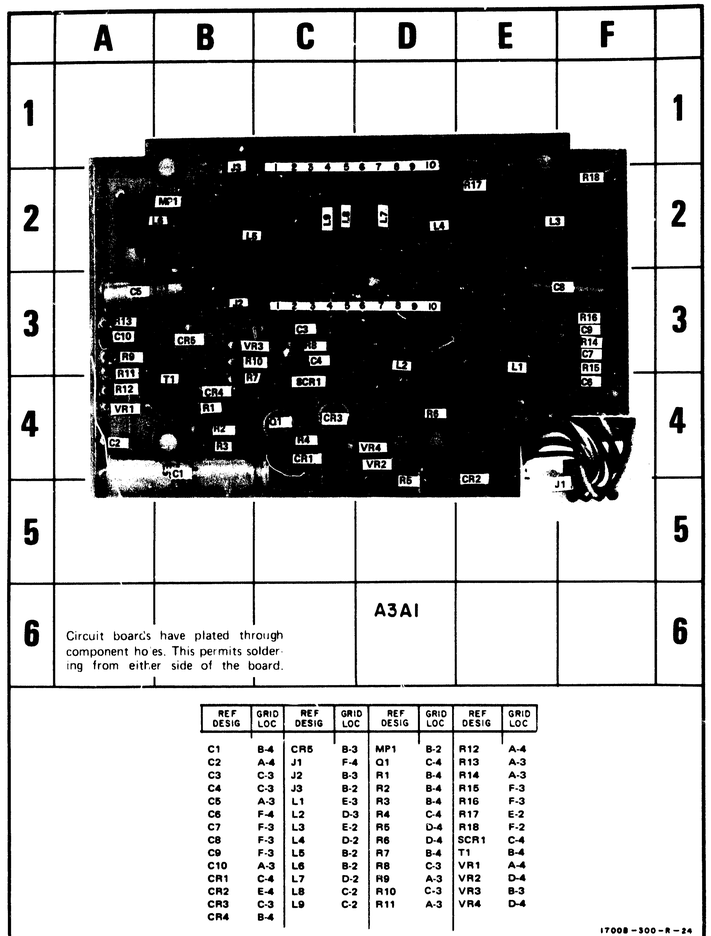
1700B-OPT.300 - POWER SUPPLY 1233A
1700B-D-17A

Figure 8-46.
Low Voltage Converter,
A3A2, Schematic



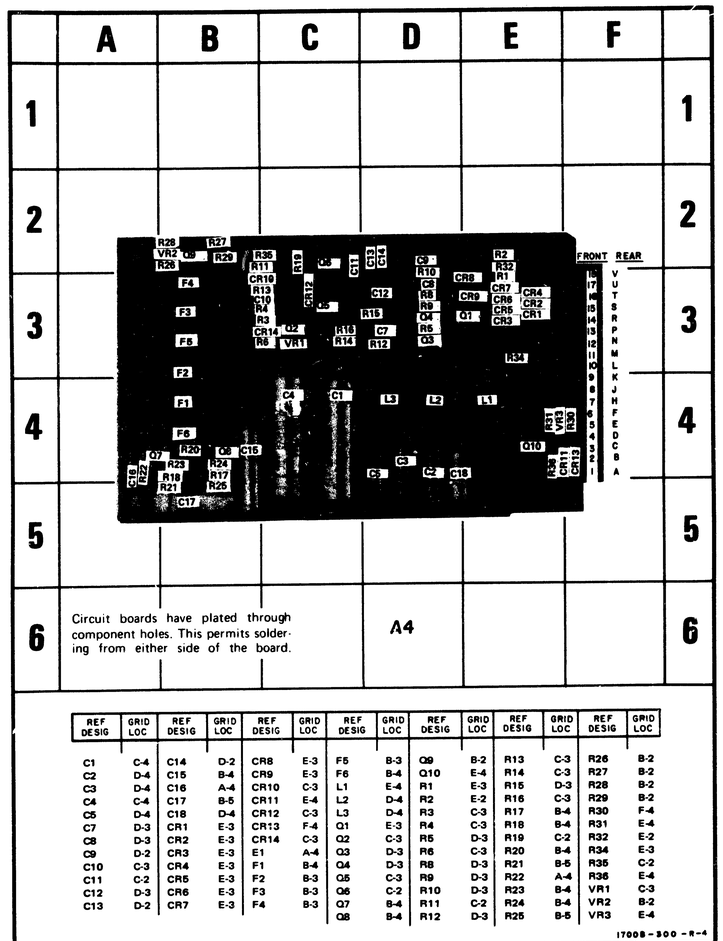

| REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|---|---|---|---|---|---|
| C1 | D-4 | CR1 | D-3 | MP1 | D-3 |
| C2 | B-4 | CR2 | C-3 | MP2 | D-3 |
| C3 | B-2 | CR3 | B-3 | T1 | D-2 |
| C4 | E-2 | CR4 | E-3 | TP1 | A-2 |
| C5 | E-4 | CR5 | D-3 | TP2 | B-2 |
| C6 | D-4 | CR6 | C-3 | TP3 | B-2 |
| C7 | B-2 | CR7 | B-2 | TP4 | B-2 |
| C8 | E-2 | CR8 | E-2 | TP5 | E-2 |
| C9 | B-3 | L1 | B-3 | TP6 | E-2 |
| C10 | E-3 | L2 | E-3 | TP7 | E-2 |
| | | | | TP8 | F-2 |

Figure 8-47. Line Rectifier and Filter, A3A3, Component Identification




| REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|---|---|---|---|---|---|---|---|
| C1 | B-4 | CR5 | B-3 | MP1 | B-2 | R12 | A-4 |
| C2 | A-4 | J1 | F-4 | Q1 | C-4 | R13 | A-3 |
| C3 | C-3 | J2 | B-3 | R1 | B-4 | R14 | A-3 |
| C4 | C-3 | J3 | B-2 | R2 | B-4 | R15 | F-3 |
| C5 | A-3 | L1 | E-3 | R3 | B-4 | R16 | F-3 |
| C6 | F-4 | L2 | D-3 | R4 | C-4 | R17 | E-2 |
| C7 | F-3 | L3 | E-2 | R5 | D-4 | R18 | F-2 |
| C8 | F-3 | L4 | D-2 | R6 | D-4 | SCR1 | C-4 |
| C9 | F-3 | L5 | B-2 | R7 | B-4 | T1 | B-4 |
| C10 | A-3 | L6 | B-2 | R8 | C-3 | VR1 | A-4 |
| CR1 | C-4 | L7 | D-2 | R9 | A-3 | VR2 | D-4 |
| CR2 | E-4 | L8 | C-2 | R10 | C-3 | VR3 | B-3 |
| CR3 | C-3 | L9 | C-2 | R11 | A-3 | VR4 | D-4 |
| CR4 | B-4 | | | | | | |

Figure 8-48. Low Voltage Mother Board, A3A1, Component Identification




| REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C1 | C-4 | C14 | D-2 | CR8 | E-3 | F5 | B-3 | Q9 | B-2 | R13 | C-3 | R26 | B-2 |
| C2 | D-4 | C15 | B-4 | CR9 | E-3 | F6 | B-4 | Q10 | E-4 | R14 | C-3 | R27 | B-2 |
| C3 | D-4 | C16 | A-4 | CR10 | C-3 | L1 | E-4 | R1 | E-3 | R15 | D-3 | R28 | B-2 |
| C4 | C-4 | C17 | B-5 | CR11 | E-4 | L2 | D-4 | R2 | E-2 | R16 | C-3 | R29 | B-2 |
| C5 | D-4 | C18 | D-4 | CR12 | C-3 | L3 | D-4 | R3 | C-3 | R17 | B-4 | R30 | F-4 |
| C7 | D-3 | CR1 | E-3 | CR13 | F-4 | Q1 | E-3 | R4 | C-3 | R18 | B-4 | R31 | E-4 |
| C8 | D-3 | CR2 | E-3 | CR14 | C-3 | Q2 | C-3 | R5 | D-3 | R19 | C-2 | R32 | E-2 |
| C9 | D-2 | CR3 | E-3 | E1 | A-4 | Q3 | D-3 | R6 | C-3 | R20 | B-4 | R34 | E-3 |
| C10 | C-3 | CR4 | E-3 | F1 | B-4 | Q4 | D-3 | R8 | D-3 | R21 | B-5 | R35 | C-2 |
| C11 | C-2 | CR5 | E-3 | F2 | B-3 | Q5 | C-3 | R9 | D-3 | R22 | A-4 | R36 | E-4 |
| C12 | D-3 | CR6 | E-3 | F3 | B-3 | Q6 | C-2 | R10 | D-3 | R23 | B-4 | VR1 | C-3 |
| C13 | D-2 | CR7 | E-3 | F4 | B-3 | Q7 | B-4 | R11 | C-2 | R24 | B-4 | VR2 | B-2 |
| | | | | | | Q8 | B-4 | R12 | D-3 | R25 | B-5 | VR3 | E-4 |

Figure 8-49. Gate, A4, Component Identification

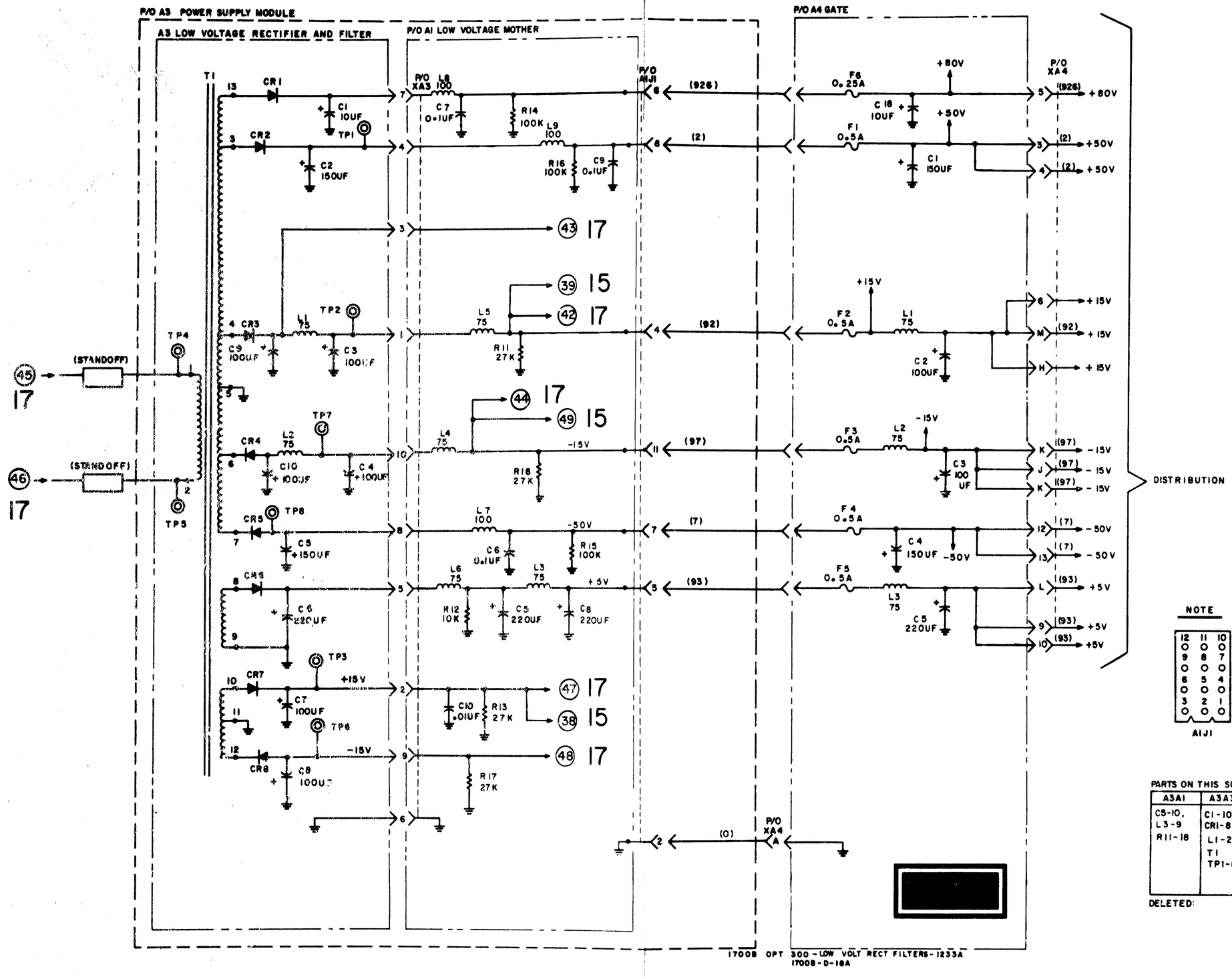



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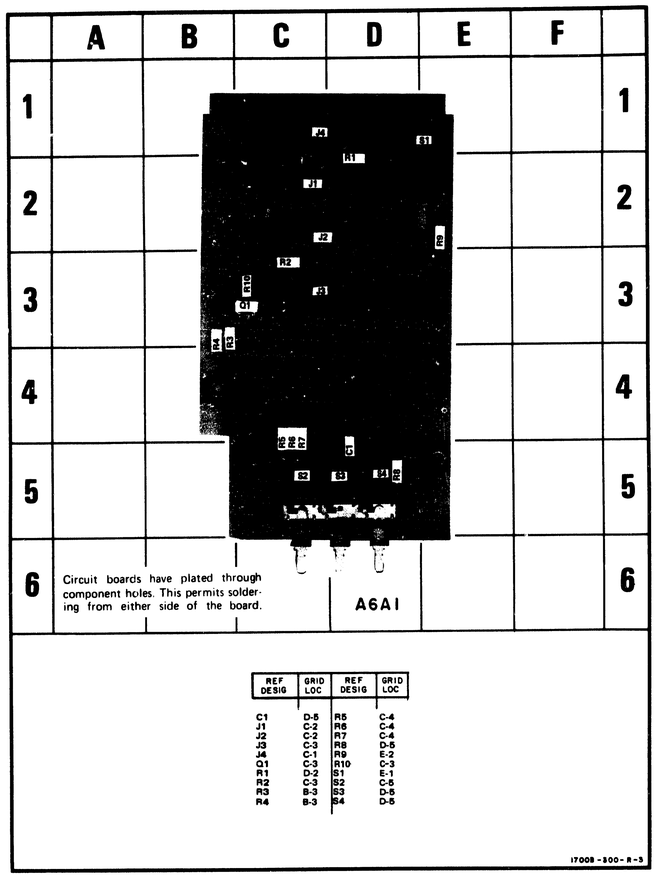
Figure 8-50.
Line Rectifier and
Filter, A3A3, Schematic
8-57/8-58

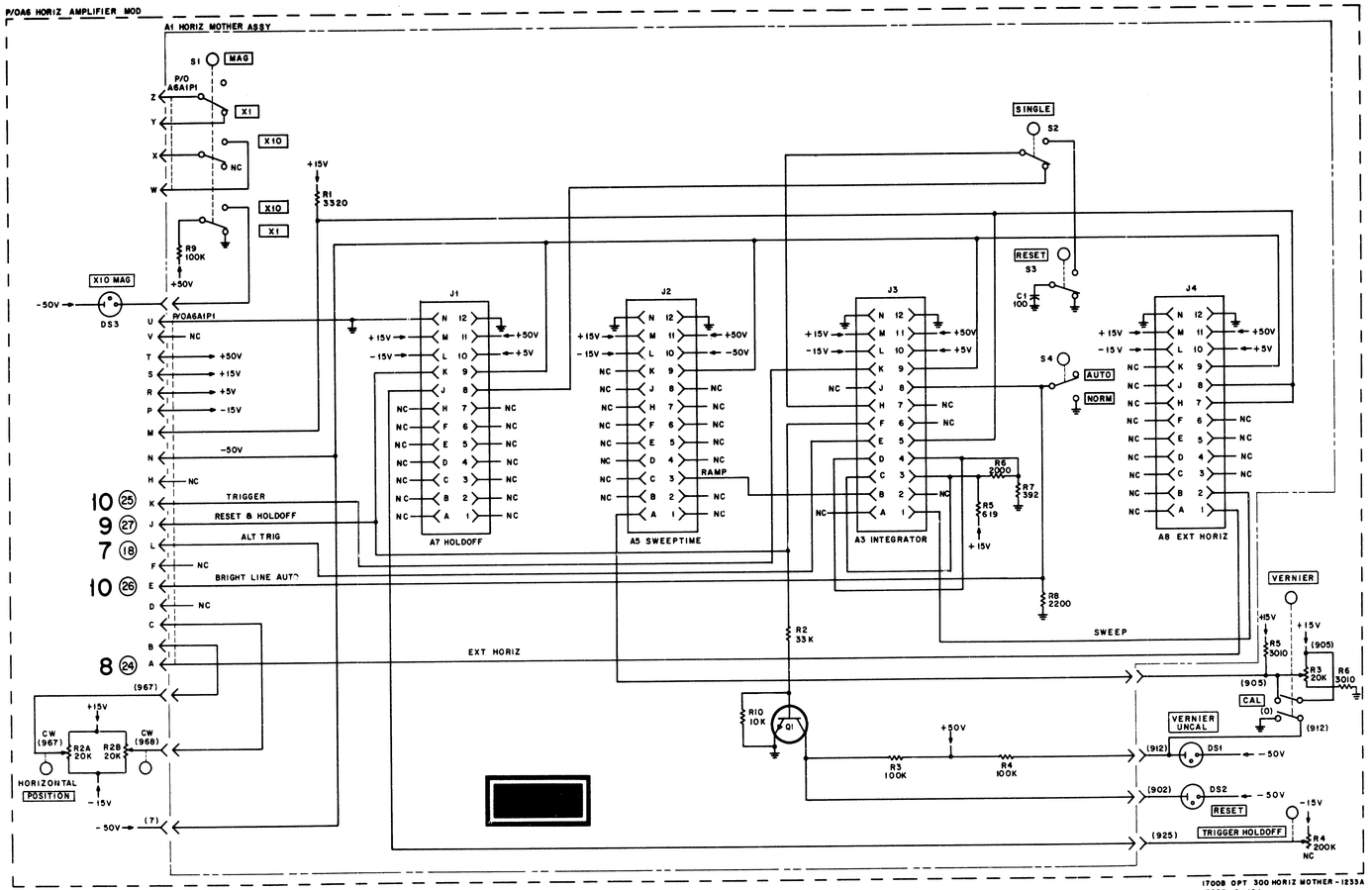



| REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|---|---|---|---|
| C1 | D-5 | R5 | C-4 |
| J1 | C-2 | R6 | C-4 |
| J2 | C-2 | R7 | C-4 |
| J3 | C-3 | R8 | D-5 |
| J4 | C-1 | R9 | E-2 |
| Q1 | C-3 | R10 | C-3 |
| R1 | D-2 | S1 | E-1 |
| R2 | C-3 | S2 | C-5 |
| R3 | B-3 | S3 | D-5 |
| R4 | B-3 | S4 | D-5 |

Figure 8-51. Horizontal Mother Board, A6A1, Component Identification








PARTS ON THIS SCHEMATIC

| A6A1 |
|---|
| C1<br>J1-J4<br>Q1<br>R1-10<br>S1-4 |
| **A6** |
| DS1-3<br>R2-6 |

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Figure 8-52. Horizontal Mother Board, A6A1, Interconnect Diagram

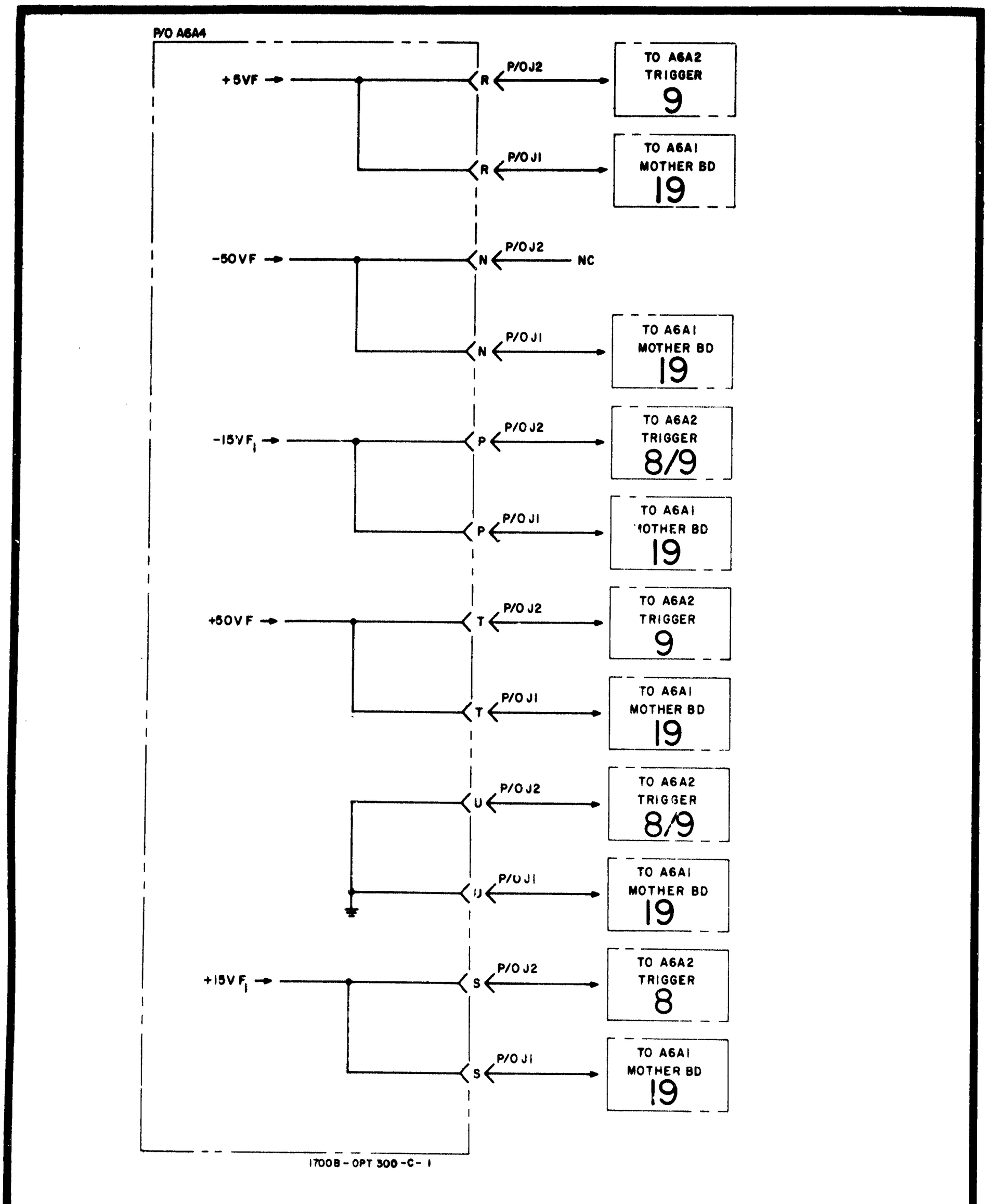



Figure 8-53. Horizontal Preamplifier, A6A4, Voltage Distribution Diagram

# MANUAL CHANGES

**MODEL 1700B OPTION 300**

**OSCILLOSCOPE**

**Manual Serials Prefixed: 1233A**
**Manual Printed: MAR 1973**

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

| Serial Prefix or Number | Make Changes | Serial Prefix or Number | Make Changes |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

## ERRATA

Δ Page 1-2, table 1-1,
TRIGGERING Internal: Change 75 MHz to read 50 MHz in third line.
POWER REQUIREMENTS: DC Line: Change 18 watts to read 25 watts. Battery (Option C12): Change 18 watts to read 25 watts.

Table 6-2,
Δ C3 and C4: Change to HP Part No. 0160-0302, C:FXD MY 0.01 UF 10% 1000 VDCW, Mfr Code 56289, Mfr Part No. 160P103910-PMD.
Δ Add: C5, HP Part No. 0160-3443, C:FXD CER 0.1 UF +80–20% 50 VDCW, Mfr Code 72982, Mfr Part No. 8131-050-651-104Z.
Δ Add: C6, HP Part No. 0180-1819, C:FXD ELECT 100 UF +75–10% 50 VDCW, Mfr Code 28480, Mfr Part No. 0180-1819.
Δ Add; C7, HP Part No. 0180-0049, C:FXD ELECT 20 UF +75–10% 50 VDCW, Mfr Code 56289, Mfr Part No. 30D206G050CC2-DSM.
Δ Add: C8, HP Part No. 0180-0049, C:FXD ELECT 20 UF +75–10% 50 VDCW, Mfr Code 56289, Mfr Part No. 30D206G050CC2-DSM.
Δ Add: L3, HP Part No. 9100-0597, COIL:RF 75 UH, Mfr Code 28480, Mfr Part No. 9100-0597.
Δ Add: L4, HP Part No. 9100-0597, COIL:RF 75 UH, Mfr Code 28480, Mfr Part No. 9100-0597.
Δ MP11: Change HP Part No. to 1520-0664, and Qty to 4.

Table 6-2 (Cont'd),
Δ MP28: Change HP Part No. and Mfr Part No. to 7101-0280.
Δ W8: Change HP Part No. and Mfr Part No. to 01703-61615.
Δ A3Q1: Change HP Part No. and Mfr Part No. to 5080-9690.
Add: A3W1, HP Part No. 01700-61609, CABLE: HIGH VOLTAGE, Mfr Code 28480, Mfr Part No. 01700-61609.
Δ Add: A3A4A2, HP Part No. 01701-61101, HIGH VOLTAGE MULTIPLIER ASSY, Mfr Code 28480, Mfr Part No. 01701-61101.
A3A4C1: Change to HP Part No. 0160-2290, C:FXD MY 0.15 UF 10% 80 VDCW, Mfr Code 56289, Mfr Part No. 292P1549R8-PTS.
Delete: A5R5 and A5R7.
A5R11, A5R13, A5R14, A5R16: Change to HP Part No. 0757-0394, R:FXD FLM 51.1 OHM 1% 1/8W, Mfr Code 28480, Mfr Part No. 0757-0394.
A5S2: Change HP and Mfr Part Nos. to 01700-61902.
Δ A5A1C2, A5A1C3, A5A1C6, A5A1C9, A5A1C12, A5A1C15, A5A1C16, A5A1C18: Change to HP Part No. 0121-0483, C:VAR CER 0.5-3.0 PF, Mfr Code 28480, Mfr Part No. 0121-0483.
Add: A5A1R20, HP Part No. 2100-3008, R:VAR COMP 100 OHM 20% LIN, Mfr Code 28480, Mfr Part No. 2100-3008.

2 January 1975
Δ = Latest additions to this change sheet.
This change sheet supersedes all prior change sheets for this manual.

Supplement A for
01700-90907

## ERRATA (Cont'd)

Table 6-2 (Cont'd),
A6MP4: Change HP and Mfr Part No. to 01701-00612.
Δ A6R5: Change to HP Part No. 0757-0435, R:FXD MET FLM 3920 OHM 1% 1/8W, Mfr Code 28480, Mfr Part No. 0757-0435.
Δ A6R6: Change to HP Part No. 0757-0283, R:FXD MET FLM 2000 OHM 1% 1/8W, Mfr Code 28480, Mfr Part No. 0757-0283.
A6A1C1: HP Part No. 0160-2202, C:FXD MICA 75 PF 5%, Mfr Code 28480, Mfr Part No. 0160-2202.
A6A7C3: Change to HP Part No. 0160-0153, C:FXD MY 0.001 UF 10% 200 VDCW, Mfr Code 56289, Mfr Part No. 192P10292-PTS.
A8MP1: Change HP and Mfr Part Nos. to 5060-0542.
Page 8-22, Figure 8-6,
A5R6: Change reference designator to A5A2R20.
A5R5: Change reference designator to A5A1R20.
Schematic 3,
Δ A5A1C2, A5A1C3, A5A1C6, A5A1C9, A5A1C12, A5A1C15, A5A1C16, A5A1C18: Change value to 0.5-3.0.
Δ A5A2C2, A5A2C3, A5A2C6, A5A2C9, A5A2C12, A5A2C15, A5A2C16, A5A2C18: Change value to 0.5-3.0.
Add: following note at bottom of page.

Note

On each range, unused switch positions may be grounded.

Schematic 4,
A5R5: Change reference designator to A5A1R20.
A5R7: Change reference designator to A5A2R20.
Δ Schematic 8,
A6A2VR1: Shown backwards. Cathode should be closest to A6A2R55.
Schematic 10,
A6A1C1: Change value to 75.
Δ Schematic 11,
A6R5: Change value to 3920.
A6R6: Change value to 2000.
Schematic 12,
A6A7C3: Change value to 0.001 UF.
Schematic 15,
A3A4C1: Change value to 0.15 UF.
Δ Page 8-52, figure 8-41,
CR1: Change to VR4.
VR4: Change to VR2.
VR2: Change to CR1.
Schematic 16,
Δ J6: Add pin designator C to terminal connected to C4 and F1. Show wire color (0).
Δ J6: Add pin designator A to terminal connected to C3. Show wire color (9).
Δ J6: Add pin designator B to terminal connected to ground.
Δ C3/C4 junction: Show connected to ground.
Δ Wire color (0) on T1: Change wire color to (20).
Δ Wire color (20) on T1: Change wire color to (0).
T1: Change wire color (2) to wire color (1) on the lead to A2R3.
Δ Change: DC input circuit per figure 1 of this change sheet.
Δ Schematic 19,
A6R5: Change value to 3920.
A6R6: Change value to 2000.

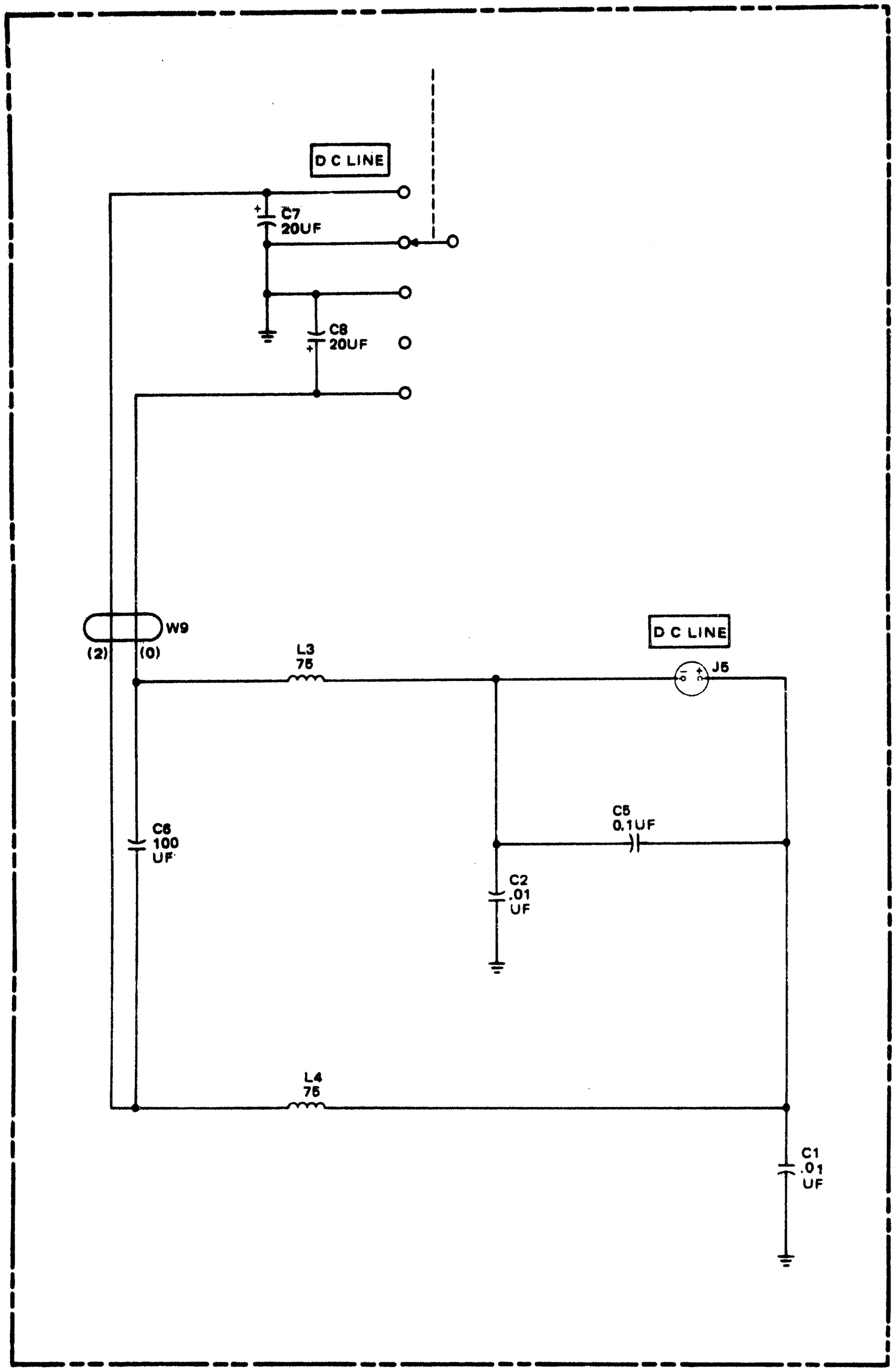
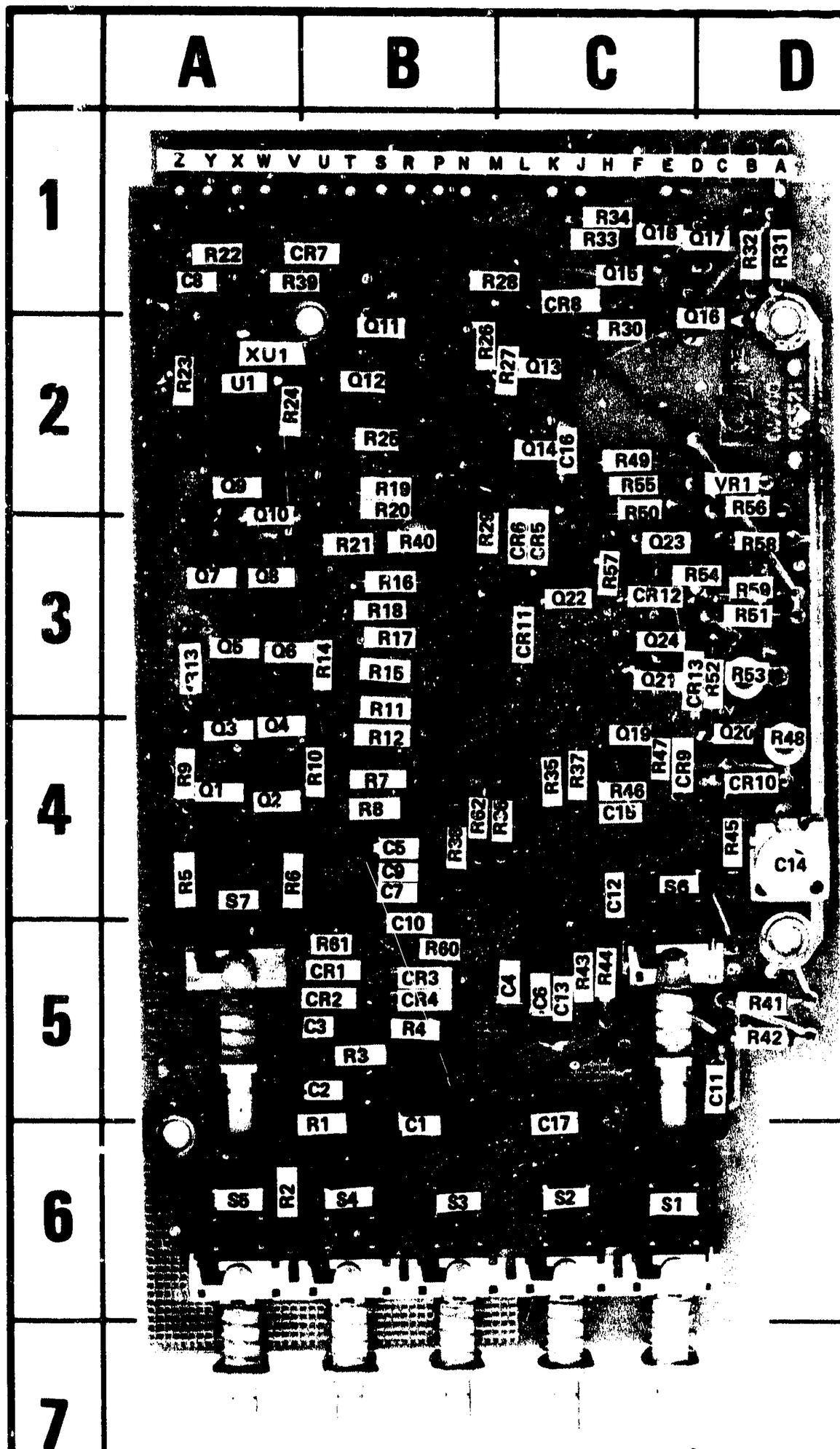



Figure 1. Change to Schematic 16

Revision A




| REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|---|---|---|---|
| C1 | B-6 | R9 | A-4 |
| C2 | B-5 | R10 | B-4 |
| C3 | B-5 | R11 | B-3 |
| C4 | C-5 | R12 | B-4 |
| C5 | B-4 | R13 | A-3 |
| C6 | C-5 | R14 | B-3 |
| C7 | B-4 | R15 | B-3 |
| C8 | A-1 | R16 | B-3 |
| C9 | B-4 | R17 | B-3 |
| C10 | B-5 | R18 | B-3 |
| C11 | D-5 | R19 | B-2 |
| C12 | C-4 | R20 | B-2 |
| C13 | C-5 | R21 | B-3 |
| C14 | D-4 | R22 | A-1 |
| C15 | C-4 | R23 | A-2 |
| C16 | C-2 | R24 | A-2 |
| C17 | C-6 | R25 | B-2 |
| CR1 | B-5 | R26 | B-2 |
| CR2 | B-5 | R27 | C-2 |
| CR3 | B-5 | R28 | B-1 |
| CR4 | B-5 | R29 | B-3 |
| CR5 | C-3 | R30 | C-2 |
| CR6 | C-3 | R31 | D-1 |
| CR7 | B-1 | R32 | D-1 |
| CR8 | C-1 | R33 | C-1 |
| CR9 | C-4 | R34 | C-1 |
| CR10 | D-4 | R35 | C-4 |
| CR11 | C-3 | R36 | B-4 |
| CR12 | C-3 | R37 | C-4 |
| CR13 | C-3 | R38 | B-4 |
| Q1 | A-4 | R39 | A-1 |
| Q2 | A-4 | R40 | B-3 |
| Q3 | A-4 | R41 | D-5 |
| Q4 | A-4 | R42 | D-5 |
| Q5 | A-3 | R43 | C-5 |
| Q6 | A-3 | R44 | C-5 |
| Q7 | A-3 | R45 | D-4 |
| Q8 | A-3 | R46 | C-4 |
| Q9 | A-2 | R47 | C-4 |
| Q10 | A-3 | R48 | D-4 |
| Q11 | B-2 | R49 | C-2 |
| Q12 | B-2 | R50 | C-2 |
| Q13 | C-2 | R51 | D-3 |
| Q14 | C-2 | R52 | D-3 |
| Q15 | C-1 | R53 | D-3 |
| Q16 | D-2 | R54 | D-3 |
| Q17 | D-1 | R55 | C-2 |
| Q18 | C-1 | R56 | D-2 |
| Q19 | C-4 | R57 | C-3 |
| Q20 | D-4 | R58 | D-3 |
| Q21 | C-3 | R59 | D-3 |
| Q22 | C-3 | R60 | B-5 |
| Q23 | C-3 | R61 | B-5 |
| Q24 | C-3 | R62 | B-4 |
| R1 | B-6 | S1 | C-6 |
| R2 | A-6 | S2 | C-6 |
| R3 | B-5 | S3 | B-6 |
| R4 | B-5 | S4 | B-6 |
| R5 | A-4 | S5 | A-6 |
| R6 | A-4 | S6 | C-4 |
| R7 | B-4 | S7 | A-4 |
| R8 | B-4 | U1 | A-2 |
| | | VR1 | D-2 |
| | | XU1 | A-2 |

Circuit boards have plated through component holes. This permits soldering from either side of the board.

1700B-300-R-II

Figure 8-23. Trigger, A6A2, Component Identification

Table 8-15. Comparator Measurement Conditions and Waveforms

## DC VOLTAGE MEASUREMENT CONDITIONS

A. Set:

| | |
|---|---|
| INT/EXT | INT |
| sweep display | MAIN SWEEP |
| main TRIGGER LEVEL | cw |
| delayed TRIGGER LEVEL | cw |
| AUTO/NORM | AUTO |
| SINGLE | engaged |
| slope | + |

B. Voltages in ( ) are measured with waveform measurement conditions below except AUTO/NORM set to NORM and disengage SINGLE pushbutton.

C. All voltages are referenced to chassis ground. All indications are nominal and may very slightly.

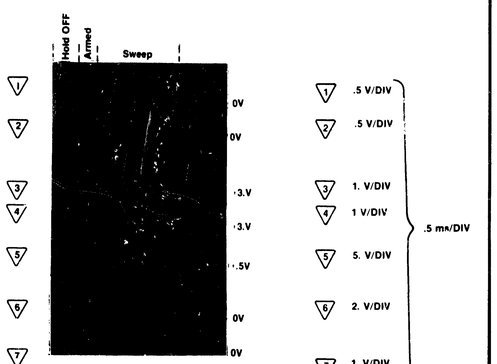
## WAVEFORM MEASUREMENT CONDITIONS

A. Set:

| | |
|---|---|
| AUTO/NORM | AUTO |
| INT/EXT | EXT |
| SWEEP DISPLAY | MAIN SWEEP |
| main slope | + |
| main TIME/DIV | .2 mSEC |
| main TRIGGER LEVEL | 12 o'clock position |

B. Connect CAL 1 VOLT to +1 EXT TRIG INPUT.

C. All wave forms are referenced to chassis ground. The monitor oscilloscope's vertical sensitivity(using a 1:1 probe) and sweep speed settings are shown below on each waveform photograph.




1700B-300-R-36



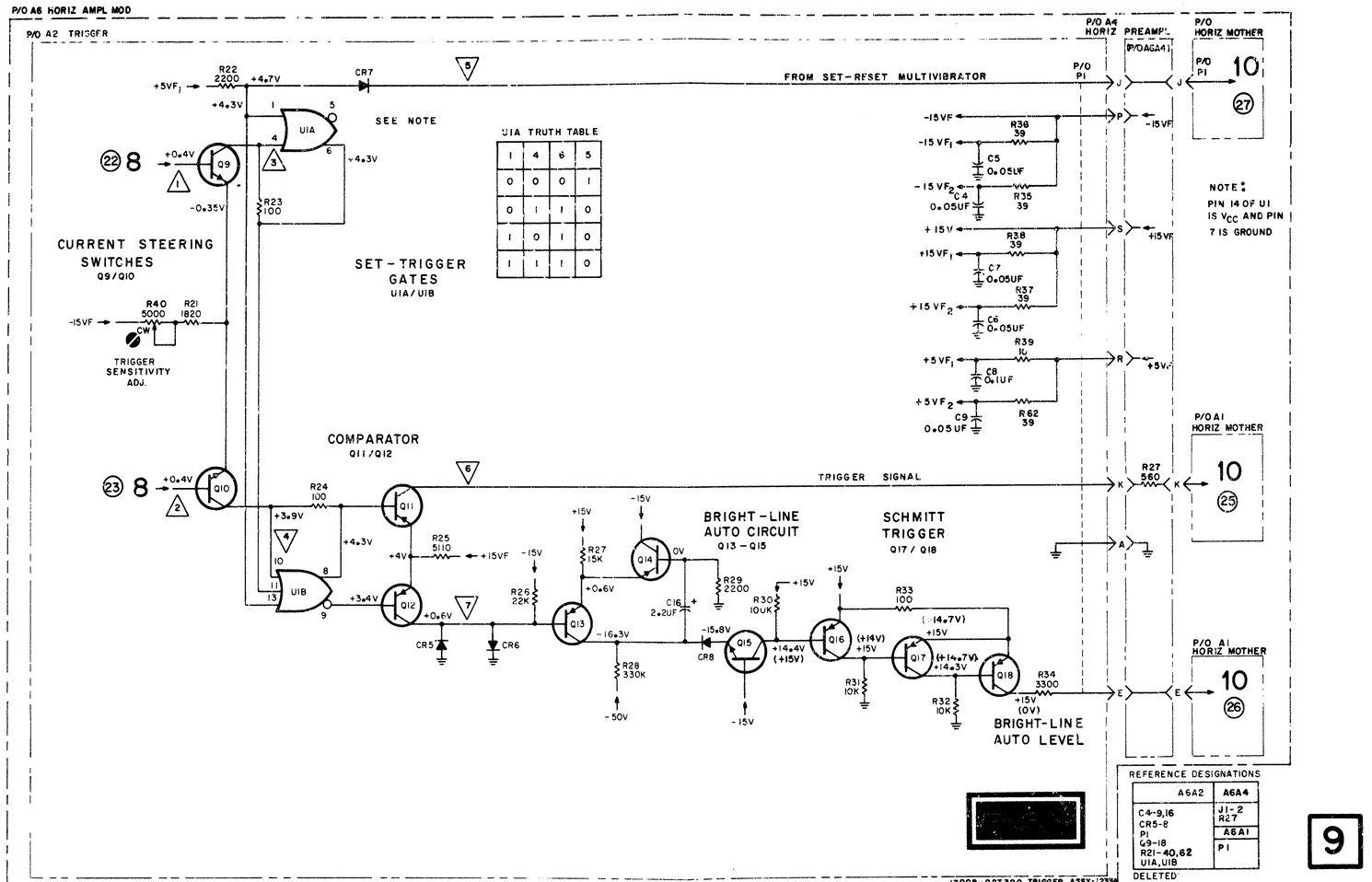
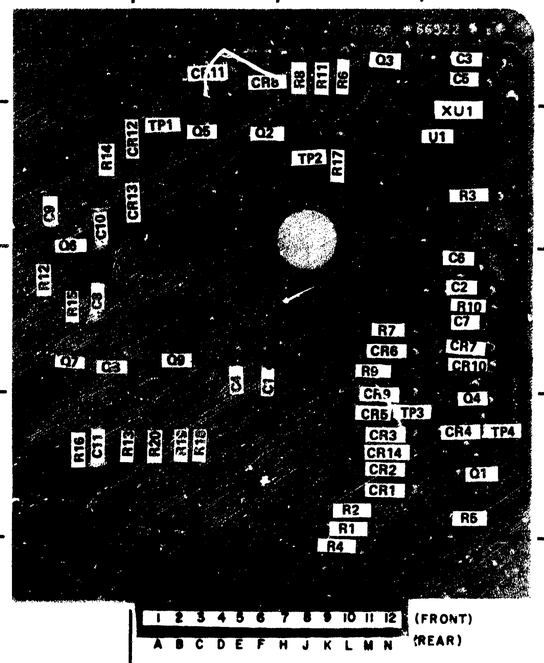



Figure 8-24. Trigger, A6A2, Schematic (2 of 2)




Circuit boards have plated through component holes. This permits soldering from either side of the board.

A6A3

| REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|---|---|---|---|---|---|---|---|---|---|
| C1 | C-3 | CR2 | D-4 | CR14 | D-4 | R3 | E-2 | R15 | B-3 |
| C2 | E-3 | CR3 | D-4 | Q1 | E-4 | R4 | D-5 | R16 | B-4 |
| C3 | E-1 | CR4 | E-4 | Q2 | C-2 | R5 | E-4 | R17 | D-2 |
| C4 | C-3 | CR5 | D-4 | Q3 | D-1 | R6 | D-1 | R18 | C-4 |
| C5 | E-1 | CR6 | D-3 | Q4 | E-4 | R7 | D-3 | R19 | C-4 |
| C6 | E-3 | CR7 | E-3 | Q5 | C-2 | R8 | D-1 | R20 | C-4 |
| C7 | E-3 | CR8 | C-1 | Q6 | B-2 | R9 | D-3 | TP1 | C-2 |
| C8 | B-3 | CR9 | D-4 | Q7 | B-3 | R10 | E-3 | TP2 | D-2 |
| C9 | B-2 | CR10 | E-3 | Q8 | B-3 | R11 | D-1 | TP3 | D-4 |
| C10 | B-2 | CR11 | C-1 | Q9 | C-3 | R12 | B-3 | TP4 | E-4 |
| C11 | B-4 | CR12 | C-2 | R1 | D-4 | R13 | B-4 | U1 | E-2 |
| CR1 | D-4 | CR13 | C-2 | R2 | D-4 | R14 | B-2 | XU1 | E-1 |

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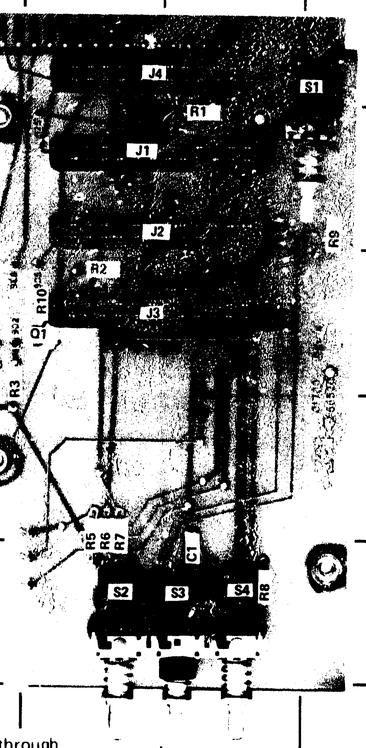
Figure 8-25. Integrator, A6A3, Component Identification




Circuit boards have plated through component holes. This permits soldering from either side of the board.

A6A1

| REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|---|---|---|---|
| C1 | D-5 | R5 | C-4 |
| J1 | C-2 | R6 | C-4 |
| J2 | C-2 | R7 | C-4 |
| J3 | C-3 | R8 | D-5 |
| J4 | C-1 | R9 | E-2 |
| Q1 | C-3 | R10 | C-3 |
| R1 | D-2 | S1 | E-1 |
| R2 | C-3 | S2 | C-5 |
| R3 | B-3 | S3 | D-5 |
| R4 | B-3 | S4 | D-5 |

17008-300-R-3

Figure 8-26. Horizontal Mother Board, A6A1, Component Identification

Table 8-16. Main Integrator Measurement Conditions and Waveforms

## DC VOLTAGE MEASUREMENT CONDITIONS

A. Set:

| | |
|---|---|
| AUTO/NORM | AUTO |
| INT/EXT | INT |
| sweep display | MAIN SWEEP |
| main TRIGGER LEVEL | cw |
| delayed TRIGGER LEVEL | cw |
| SINGLE | engaged |
| slope | + |

B. Voltages in ( ) are measured with AUTO/NORM set to NORM and SINGLE disengaged.

C. All voltages are referenced to chassis ground. All indications are nominal and may vary slightly.

## WAVEFORM MEASUREMENT CONDITIONS

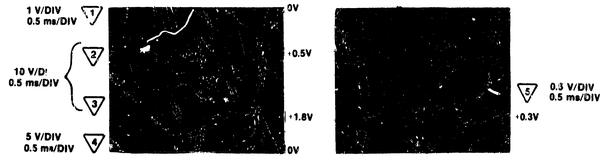
A. Set:

| | |
|---|---|
| AUTO/NORM | NORM |
| INT/EXT | EXT |
| sweep display | SWEEP |
| slope | + |
| TIME/DIV | .2 mSEC |

b. Connect CAL 1 VOLT to +1 EXT TRIG INPUT.

C. All wave forms are referenced to chassis ground. The monitor oscilloscope's vertical sensitivity(using a 1:1 probe) and sweep speed settings are shown below on each waveform photograph.

D. All waveforms are time related.

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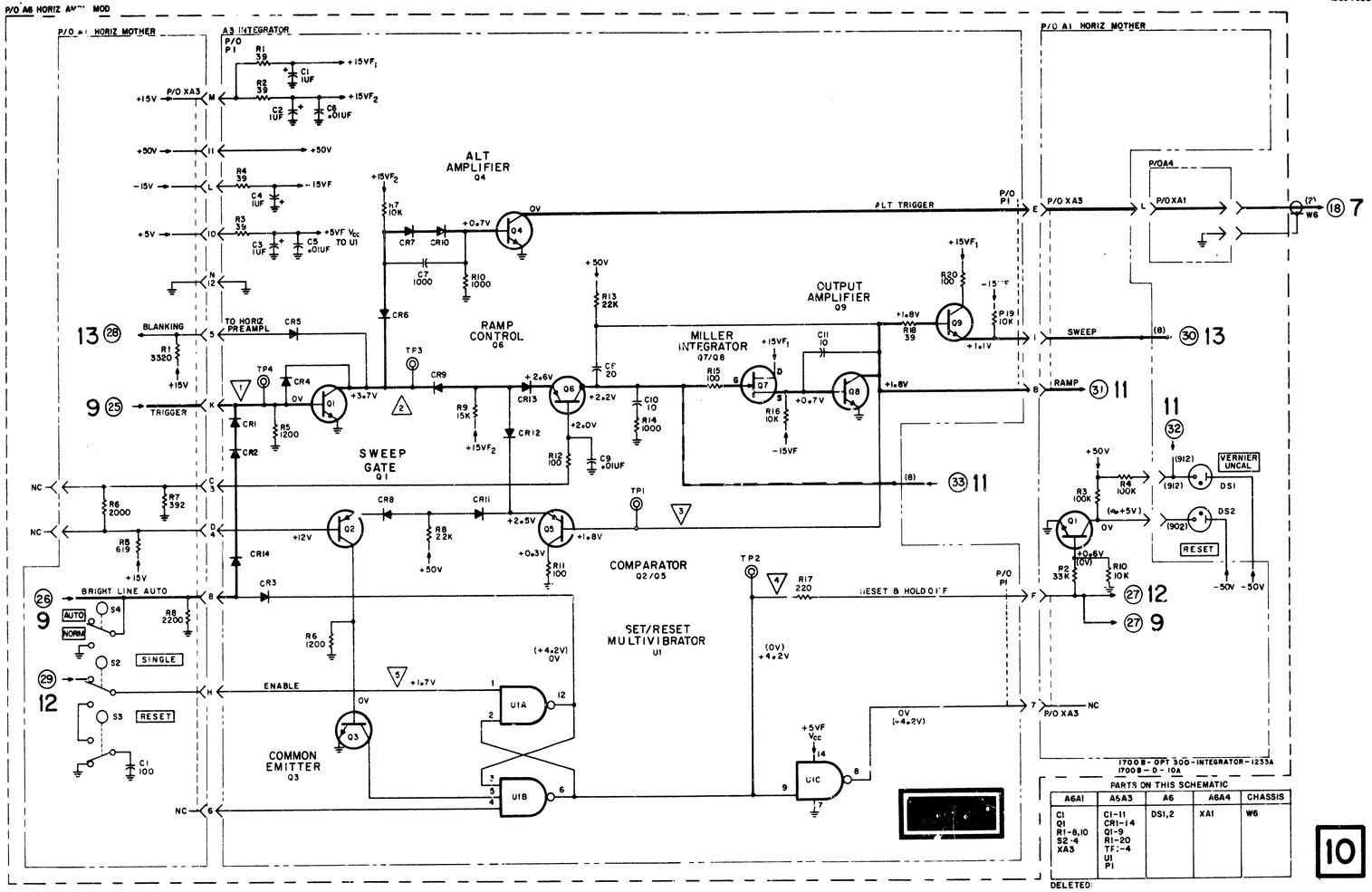
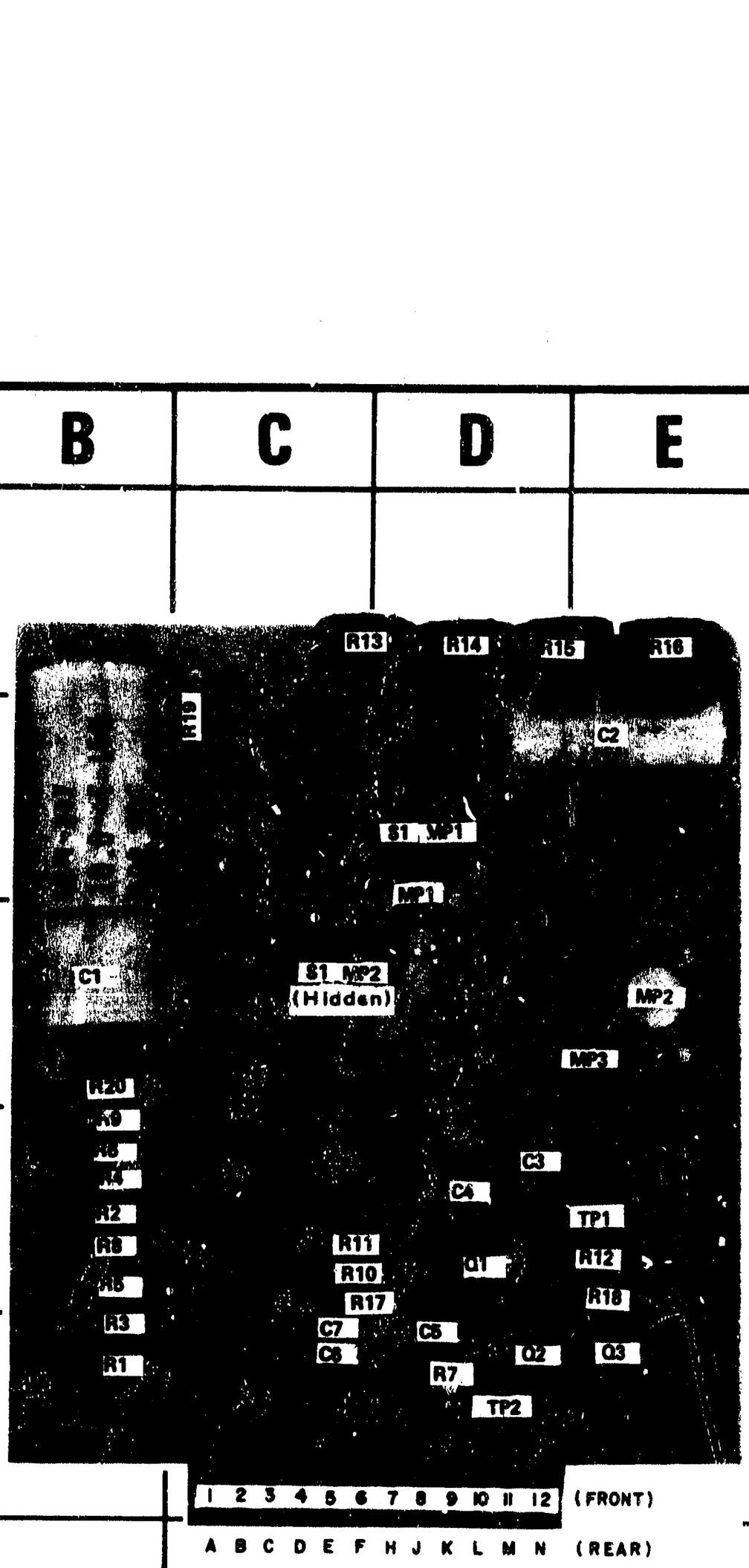



Figure 8-27. Integrator, A6A3, Schematic




Circuit boards have plated through component holes. This permits soldering from either side of the board.

**A6A5**

| REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|---|---|---|---|---|---|---|---|
| C1 | B-3 | Q1 | D-4 | R8 | B-4 | R18 | E-4 |
| C2 | E-2 | Q2 | D-5 | R9 | B-4 | R19 | C-2 |
| C3 | D-4 | Q3 | E-5 | R10 | C-4 | R20 | B-3 |
| C4 | D-4 | R1 | B-5 | R11 | C-4 | S1MP1 | D-2 |
| C5 | D-5 | R2 | B-4 | R12 | E-4 | S1MP2 | C-3 |
| C6 | C-5 | R3 | B-5 | R13 | C-1 | TP1 | E-4 |
| C7 | C-5 | R4 | B-4 | R14 | D-1 | TP2 | D-5 |
| MP1 | D-2 | R5 | B-4 | R15 | D-1 | | |
| MP2 | E-3 | R6 | B-4 | R16 | E-1 | | |
| MP3 | E-3 | R7 | D-5 | R17 | C-4 | | |

17008-500-28

Figure 8-28. Sweep Time, A6A5, Component Identification

Table 8-17. Main Sweep Time Measurement Conditions

**DC VOLTAGE MEASUREMENT CONDITIONS**

A. Set:

| | |
|---|---|
| AUTO/NORM | AUTO |
| INT/EXT | INT |
| sweep display | MAIN SWEEP |

B. All voltages are referenced to chassis ground. All indications are nominal and may vary slightly.

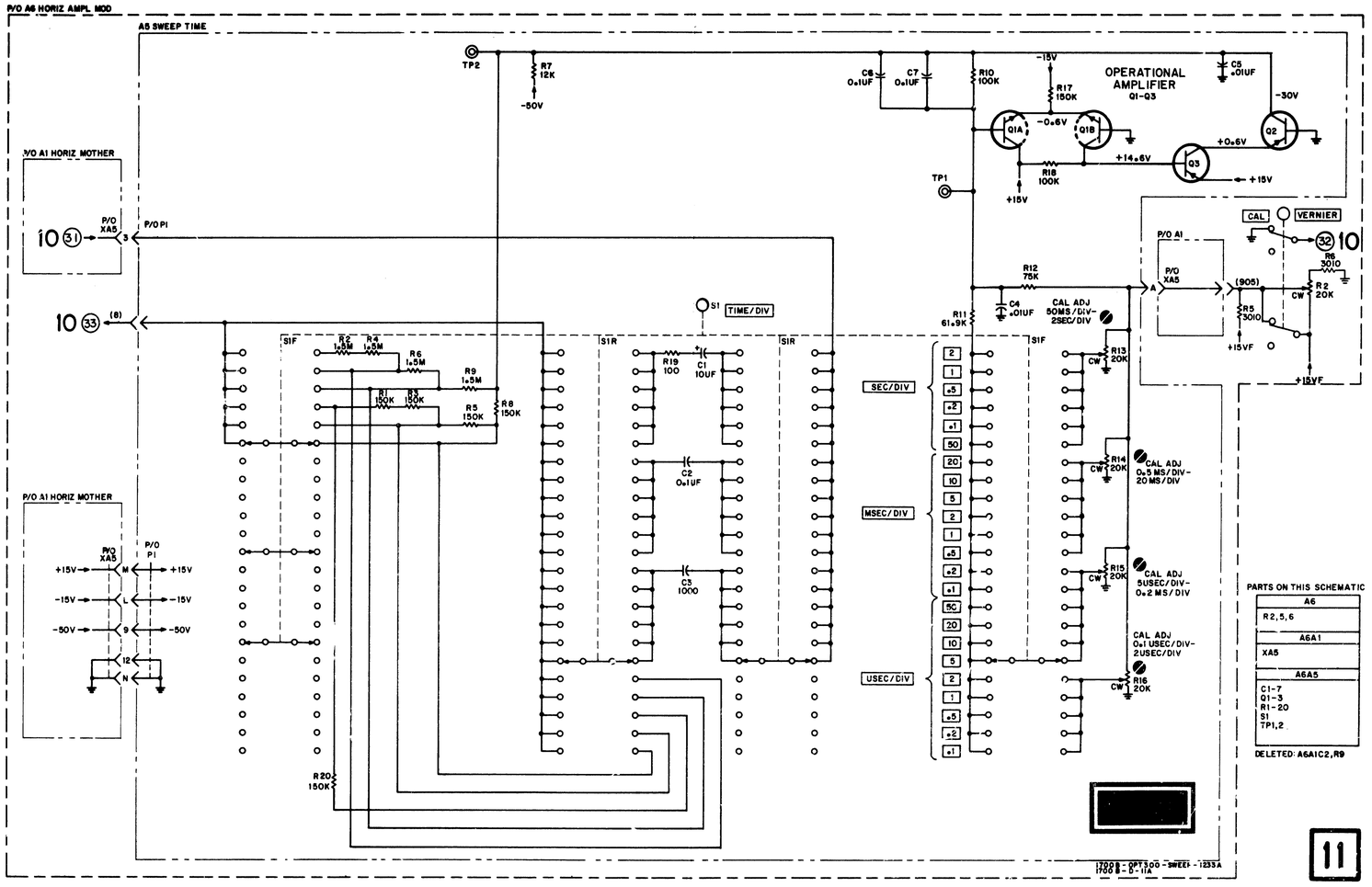
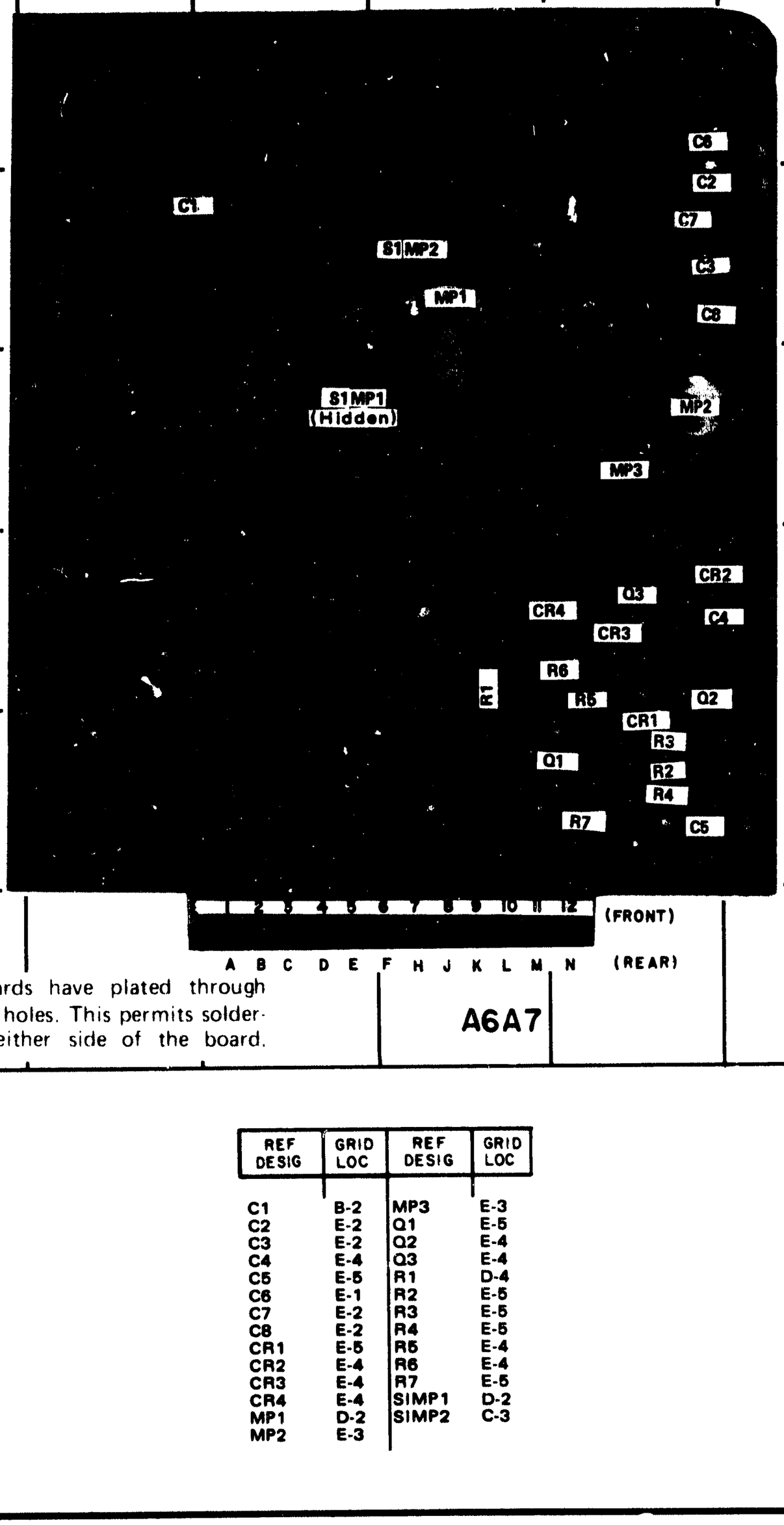



Figure 8-29. Sweep Time, A6A5, Schematic




Circuit boards have plated through component holes. This permits soldering from either side of the board.

**A6A7**

| REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|---|---|---|---|
| C1 | B-2 | MP3 | E-3 |
| C2 | E-2 | Q1 | E-5 |
| C3 | E-2 | Q2 | E-4 |
| C4 | E-4 | Q3 | E-4 |
| C5 | E-5 | R1 | D-4 |
| C6 | E-1 | R2 | E-5 |
| C7 | E-2 | R3 | E-5 |
| C8 | E-2 | R4 | E-5 |
| CR1 | E-5 | R5 | E-4 |
| CR2 | E-4 | R6 | E-4 |
| CR3 | E-4 | R7 | E-5 |
| CR4 | E-4 | SIMP1 | D-2 |
| MP1 | D-2 | SIMP2 | C-3 |
| MP2 | E-3 | | |

1700B-300-R-9

Figure 8-30. Holdoff Amplifier, A6A7, Component Identification