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hp 175A



HEWLETT-PACKARD COMPANY / OPERATING AND SERVICE MANUAL

**175A**

**OSCILLOSCOPE**

hp 175A



OPERATING AND SERVICE MANUAL

MODEL 175A

SERIALS PREFIXED: 235 -

OSCILLOSCOPE

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1501 PAGE MILL ROAD, PALO ALTO, CALIFORNIA, U.S.A.



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Figure 1-1. Model 175A Oscilloscope with Model 1750A and Model 1780A Plug-In Units

## SECTION I

### GENERAL INFORMATION

#### 1-1. DESCRIPTION.

1-2. The  $\Phi$  Model 175A Oscilloscope is a calibrated general-purpose test instrument with a vertical bandwidth of 50 megacycles and a 6 x 10 cm display. Optional plug-in units and accessories are available to increase the versatility of this instrument. Specifications are listed in table 1-1.

#### 1-3. AUXILIARY EQUIPMENT.

1-4. Available associated equipment and accessories are listed in table 1-2.

a. Plug-Ins. Plug-in units for the Model 175A include dual-trace and single-trace vertical amplifiers which collectively cover 5 mv/cm to 20 v/cm sensitivities and dc to 50-mc bandwidth. Horizontal units include single sweep, sweep delay, a time-mark generator, and a display scanner.

b. Accessories. Each oscilloscope is supplied with two Model 10003A (AC-21M) high-impedance probes and a detachable power cable.

#### 1-5. INSTRUMENT IDENTIFICATION.

1-6. Hewlett-Packard uses a two-section eight-digit serial number (000-00000). If the first three digits of the serial number on your instrument do not agree with those on the title page of this manual, change sheets supplied with the manual will define differences between your instrument and the Model 175A described in this manual.

#### 1-7. WARRANTY.


1-8. Both the cathode-ray tube (crt) and Model 175A carry Hewlett-Packard warranties. The crt warranty is illustrated in figure 1-2, and a copy is included at the back of this manual for your use in the event of tube failure within the warranty period. The Model 175A warranty is also at the back of this manual.

Table 1-1. Specifications

<p><u><b>SWEEP GENERATOR</b></u></p> <p>Internal Sweep: 24 ranges, 0.1 <math>\mu</math>sec/cm to 5 sec/cm <math>\pm</math>3%. Vernier provides continuous adjustment between ranges and extends slowest sweep to at least 12.5 sec/cm.</p> <p>Magnification: X10 (<math>\pm</math>5%)</p> <p>Triggering: Internal - Vertical input signal (from 2 mm below 1 mc to approximately 2 cm at 50 mc). External - Either capacitive- or direct-coupled, from any signal 0.5 volt peak-to-peak or more.</p> <p>Triggering Point: Internal - Any level of positive- or negative-going signal displayed on the crt graticule. External - Any level between +5 and -5 volts on either the positive- or negative-going portion of the vertical signal.</p> <p><u><b>HORIZONTAL AMPLIFIER</b></u></p> <p>Bandwidth: DC to 500 kc</p> <p>Sensitivity: 2 ranges, 0.1 volt/cm and 1 volt/cm. Vernier provides continuous adjustment between ranges and extends minimum sensitivity to 10 volts per centimeter.</p> <p>Input Impedance: 1 megohm shunted by approximately 30 pf</p>	<p><u><b>VERTICAL AMPLIFIER</b></u></p> <p>Bandwidth: DC to greater than 50 mc</p> <p><u><b>CALIBRATOR</b></u></p> <p>Type: Approximately 1000-cycle square wave, approximately 3 <math>\mu</math>sec rise time</p> <p>Voltage: 2 ranges, 1 volt and 10 volts peak-to-peak, <math>\pm</math>1%, 15°C to 35°C</p> <p><u><b>CATHODE-RAY TUBE</b></u></p> <p>Type: <math>\Phi</math> post accelerator, 12-kv accelerating potential. Type P31-AL phosphor standard. For other phosphors, see OPTIONS.</p> <p>Graticule: Internal, 6 x 10 cm, marked in centimeter squares. Major horizontal and vertical axes have 2-millimeter subdivisions.</p> <p>Intensity Modulation: Approximately +20-volt pulse will blank trace of normal intensity</p> <p><u><b>GENERAL</b></u></p> <p>Power Requirements: 115 or 230 volts ac <math>\pm</math>10%, 50 to 60 cps, approximately 425 watts maximum (depends on plug-ins used).</p>
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Table 1-1. Specifications (Cont'd)

<p><b>GENERAL</b> (cont'd)</p> <p><b>Dimensions:</b> 16-3/4 inches wide, 12-1/4 inches high, 24-3/8 inches deep overall; hardware furnished for quick conversion to 12-1/4-inch x 19-inch rack mount, 22 inches deep behind panel.</p> <p><b>Weight:</b> Net approximately 70 lb maximum (depends on plug-ins used)</p> <p><b>Plug-In Vertical Amplifiers:</b></p> <ul style="list-style-type: none"> <li>Ⓜ Model 1750A Dual Trace Vertical Amplifier, dc to 40 mc</li> <li>Ⓜ Model 1751A Single Channel Vertical Amplifier, dc to 50 mc</li> <li>Ⓜ Model 1752A High Gain Vertical Amplifier, dc to 18 mc</li> <li>Ⓜ Model 1753A Single Channel Vertical Amplifier, dc to 40 mc</li> </ul>	<p><b>Plug-In Horizontal Time Base Units:</b></p> <ul style="list-style-type: none"> <li>Ⓜ Model 1780A Auxiliary Unit</li> <li>Ⓜ Model 1781A Sweep Delay Unit</li> <li>Ⓜ Model 1782A Display Scanner</li> <li>Ⓜ Model 1783A Time-Mark Generator</li> </ul> <p><b>Accessories Furnished;</b> Two probes, 10003A (AC-21M), 10:1 voltage division, one power cable</p> <p><b>Accessories Available:</b></p> <ul style="list-style-type: none"> <li>Ⓜ 1075A, 1075B (AC-83A) Viewing Hood</li> <li>Ⓜ Model 1115A Testmobile</li> <li>Ⓜ Model 196B Oscilloscope Camera, includes ultraviolet light source for illuminating the graticule and pre-sensitizing film</li> </ul> <p><b>OPTIONS</b></p> <ul style="list-style-type: none"> <li>02. Supplied with P2 phosphor</li> <li>07. Supplied with P7 phosphor</li> <li>11. Supplied with P11 phosphor</li> <li>08. Sawtooth Output (approximately -2.5 volts to +2.5 volts) and Gate Output (+5-volt pulse nominal, riding on a -2.5 volt level).</li> </ul>
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**CATHODE RAY TUBE WARRANTY**

The cathode ray tube supplied in your Hewlett-Packard Oscilloscope and replacement cathode ray tubes purchased from Ⓜ, are guaranteed against electrical failure for one year from the date of sale by the Hewlett-Packard Company. Broken tubes or tubes with burned phosphor are not included in this guarantee.

Your local Hewlett-Packard representative maintains a stock of replacement tubes and will be glad to process your warranty claim for you. Please consult him.

Whenever a tube is returned for a warranty claim, the reverse side of this sheet must be filled out in full and returned with the tube. Follow shipping instructions carefully to insure safe arrival, since no credit can be allowed on broken tubes.

SHIPPING INSTRUCTIONS

- 1) Carefully wrap the tube in 1/4" thick cotton batting or other soft padding material.
- 2) Wrap the above in heavy kraft paper.
- 3) Pack in a rigid container which is at least 4 inches larger than the tube in each dimension.
- 4) Surround the tube with at least four inches of packed excelsior or similar shock absorbing material. Be certain that the packing is tight all around the tube.
- 5) Tubes returned from outside the continental United States should be packed in a wooden box.
- 6) Ship prepaid preferably by AIR FREIGHT or RAILWAY EXPRESS. We do not recommend parcel post or air parcel post shipment.

**CRT WARRANTY CLAIM**

FROM: \_\_\_\_\_ DATE: \_\_\_\_\_

NAME: \_\_\_\_\_

COMPANY: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

Person to contact for further information:

NAME: \_\_\_\_\_

TITLE: \_\_\_\_\_

COMPANY: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

To process your claim quickly please enter the information indicated below:

- 1) Ⓜ INSTRUMENT MODEL \_\_\_\_\_ SERIAL \_\_\_\_\_
- 2) TUBE TYPE \_\_\_\_\_ SERIAL \_\_\_\_\_
- 3) ORIGINAL TUBE \_\_\_\_\_ REPLACEMENT TUBE \_\_\_\_\_
- 4) YOUR PURCHASE ORDER NO. \_\_\_\_\_
- 5) DATE PURCHASED \_\_\_\_\_
- 6) PURCHASED FROM \_\_\_\_\_
- 7) COMPLAINT: (Please describe nature of trouble) \_\_\_\_\_
- 8) OPERATING CONDITIONS: (Please describe conditions prior to and at time of failure) \_\_\_\_\_

SIGNATURE \_\_\_\_\_

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Figure 1-2. Cathode-Ray Tube Warranty




Table 1-2. Associated Equipment and Accessories

Model	Name	Description
1750A	Dual Trace Vertical Amplifier	Dual-trace and differential display, 0.05 v/cm to 20 v/cm sensitivity, 9 nsec rise time (dc to 40 mc bandwidth).
1751A	Fast Rise Plug-In	7-nsec rise time, (dc to 50 mc bandwidth), 0.05 v/cm to 20 v/cm sensitivity.
1752A	High Gain Vertical Amplifier	0.005 v/cm to 20 v/cm sensitivity, dc to 18 mc bandwidth. Dual-input differential display, single channel.
1753A	Single Channel Vertical Amplifier	Single channel, single input, 0.05 v/cm to 20 v/cm sensitivity, 9-nsec rise time (dc to 40 mc bandwidth).
1780A	Auxiliary Plug-In	Single or normal sweep, manual or external arming.
1781A	Sweep Delay Generator	0 to 10 cm of sweep delay. Will either trigger or arm main sweep. Horizontal display controlled by either main sweep or delaying sweep for all or part of trace. Delaying sweep rate $2\mu\text{sec/cm}$ to $1\text{ sec/cm}$ .
1782A	Display Scanner	Provides output to operate conventional X-Y recorder. Includes pen stabilizer for nearly constant writing rate. Approximately 30-mc bandwidth with 40-mc plug-in unit.
1783A	Time-Mark Generator	Provides intensity modulating time markers synchronized with sweep. Marker intervals 0.1, 1, or 10 $\mu\text{sec}$ .
196B	Oscilloscope Camera	Makes permanent record of oscilloscope trace on quick-developing Polaroid-Land film. Clamps quickly to oscilloscope bezel. Oscillo-Raptar fully corrected f/1.9 lens. Alphax #3 shutter, 1/100 to 1 second. Includes ultraviolet light to silhouette internal graticule of crt. Model 10351A Carrying Case available.
1075A or 1075B (AC-83A)	Viewing Hood	Shades crt screen from surrounding light sources.
1115A	Testmobile	Holds oscilloscope in convenient position for viewing. Rolls on 4-inch rubber-tired wheels. Tilts instrument from $10^\circ$ below to $20^\circ$ above horizontal in $5^\circ$ increments. Chrome plate. Folds compactly for shipment or storage.
10003A (AC-21M)	Voltage Probe (2 supplied with Model 175A Oscilloscope)	High-impedance test probe with flange-operated jaws and approximately 4 feet of shielded cable matched to oscilloscope input. Division ratio 10:1, input impedance approximately 10 megohms shunted by 10 pf. Maximum voltage rating 600 volts peak.
10002A or 10002B (AC-21C)	Voltage Probe	High-impedance test probe with flange-operated jaws and approximately 5 feet of shielded cable matched to oscilloscope input. Division ratio 50:1, input impedance approximately 9 megohms shunted by 2.5 pf. Maximum voltage rating 1000 volts peak.
10025A (AC-21J)	Low Frequency Probe	Provides straight-through connection to oscilloscope from circuit test points. Pushbutton operated jaws. Shunt capacity approximately 150 pf. Cable approximately 5 feet long. Requires BNC to binding post adapter Model 10110A or equivalent.
10035A	Tip Assortment	One each of the 10010 tips for 10002A/B or 10003A Probes
10010A 10010B  10010D	Alligator jaw Pincer jaw  Banana	10010E Pin tip 10010F Hook tip 10010G Spring tip

**1-9. SPECIAL FEATURES.**

1-10. Special features of the Model 175A include the Hewlett-Packard internal-graticule crt, PRESET triggering, BEAM FINDER, and a cabinet which serves both bench- and rack-mount requirements. Optional plug-in units are provided for both the vertical and the time axis. The main vertical amplifier rise time is less than 7 nanoseconds which provides maximum versatility for present and future plug-ins.

**1-11. CATHODE-RAY TUBE.**

1-12. The crt used in the Model 175A is a multi-grid 12-kv post-accelerator type with the  internal graticule which eliminates parallax, and an aluminized

phosphor. The gun structure provides a large 6 x 10 cm distortionless viewing area as well as extremely high deflection-plate sensitivity. No front-panel astigmatism control is required.

**1-13. SPECIAL CONTROLS.**

1-14. Special panel controls make the Model 175A easy to operate. With SWEEP MODE in PRESET, the sweep will synchronize internally on nearly all signals. BEAM FINDER enables the operator to locate the beam when it is off screen. SWEEP MAGNIFIER increases the maximum sweep rate to 10 nsec/cm, calibrated in all positions.

## SECTION II

### INSTALLATION

#### 2-1. INCOMING INSPECTION.

#### 2-2. MECHANICAL INSPECTION.

2-3. Upon receipt of your Model 175A, check the contents of the shipment against the packing list and inspect the instrument for any obvious damage received in transit. See warranty sheet at the back of this manual. Keep the packing material until performance check has been successfully completed.

#### 2-4. PERFORMANCE CHECK.

2-5. Check the performance of the Model 175A by making the tests outlined in paragraph 5-5 of this manual. Use this check to verify all listed specifications and also as part of an incoming quality-control inspection. Instructions for the plug-in units will be found in the individual manuals for these instruments.

#### 2-6. INSTALLATION.

2-7. The Model 175A is packaged in the new Hewlett-Packard cabinet, suitable for bench or rack mount. Top and bottom covers may be removed for easy accessibility to internal parts and adjustments.

#### 2-8. RACK MOUNTING.

2-9. Parts necessary for rack mounting are packaged with the instrument. Proceed as follows:

- a. Remove tilt stand.
- b. Remove feet (press foot-release button).
- c. Remove adhesive-backed trim strip from sides.
- d. Attach filler strip along bottom edge of front panel.
- e. Attach mounting flanges to sides with larger notch toward bottom of instrument.
- f. Mount in standard 19-inch rack (mounting screws not supplied).

#### Note

Rear support must be supplied to the rack-mounted instrument if it is to be subjected to mechanical vibrations.

#### 2-10. COOLING.

2-11. The air filter in this instrument must receive an oil coat before the instrument is placed in normal use to prevent excessive dirt from entering instrument case. Recommended is Research Products Company No. 3 Filter Coat. This adhesive is available in "Handi-Koter" sprayer cans at most heating-supply stores or through your Hewlett-Packard field sales engineer.

2-12. The cooling fan and air filter are located at the rear of the Model 175A. Leave at least two inches of clearance behind the instrument for the free movement of air. In rack installations be sure that the recirculation of warm air within the rack cabinet does not result in high ambient temperature. Inspect the air filter periodically and clean it as soon as it appears to be reducing the flow of cooling air. See section V for cleaning instructions.

#### 2-13. POWER REQUIREMENT.

2-14. The Model 175A operates on 115 or 230 volts  $\pm 10\%$ , 50 to 60 cps. Power required depends upon the plug-ins used, but will not exceed approximately 425 watts. Before connecting the instrument to the power source, be sure that the 115-230 switch on the rear panel is in the correct position, and that the proper fuse is installed (see section VI).

#### CAUTION

Connecting to a 230-volt source with the switch in the 115-volt position can result in damage to the instrument.

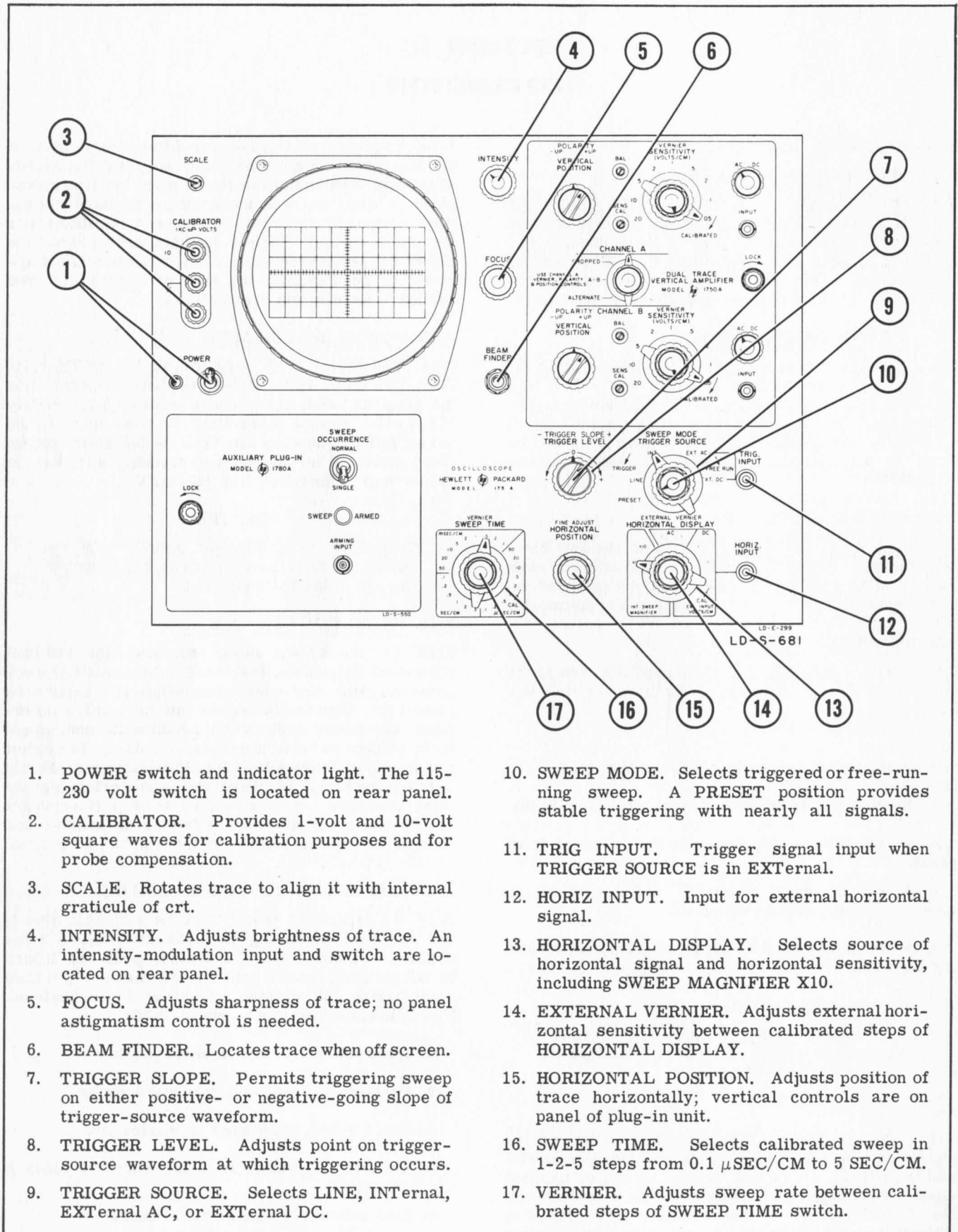
#### 2-15. SAFETY POWER CABLE.

2-16. To protect operating personnel the National Electrical Manufacturers' Association (NEMA) recommends that the instrument panel and cabinet be grounded. This instrument is equipped with a three-conductor power cable which grounds the instrument when plugged into an appropriate outlet. The offset round pin on the power-cable three-prong connector is the ground pin. To preserve the protection feature when operating the instrument from a two-contact outlet, use a three-prong to two-prong adapter and connect the green pigtail on the adapter to ground.

#### 2-17. REPACKAGING FOR SHIPMENT.

2-18. To repack the Model 175A for shipment, always use the best packaging methods available. If the original container with its packing pads and fillers is not on hand, consult your nearest Hewlett-Packard sales office for packing materials or instructions. The following steps are a general guide:

- a. Wrap the instrument in heavy paper.
- b. Protect the panel with cardboard strips.
- c. Use a strong cardboard or wooden box.
- d. Use ample packing material around all sides of the instrument.
- e. Seal with heavy tape or metal bands.
- f. Mark the container "Fragile - Delicate Instrument".



1. POWER switch and indicator light. The 115-230 volt switch is located on rear panel.
2. CALIBRATOR. Provides 1-volt and 10-volt square waves for calibration purposes and for probe compensation.
3. SCALE. Rotates trace to align it with internal graticule of crt.
4. INTENSITY. Adjusts brightness of trace. An intensity-modulation input and switch are located on rear panel.
5. FOCUS. Adjusts sharpness of trace; no panel astigmatism control is needed.
6. BEAM FINDER. Locates trace when off screen.
7. TRIGGER SLOPE. Permits triggering sweep on either positive- or negative-going slope of trigger-source waveform.
8. TRIGGER LEVEL. Adjusts point on trigger-source waveform at which triggering occurs.
9. TRIGGER SOURCE. Selects LINE, INTERNAL, EXTERNAL AC, or EXTERNAL DC.
10. SWEEP MODE. Selects triggered or free-running sweep. A PRESET position provides stable triggering with nearly all signals.
11. TRIG INPUT. Trigger signal input when TRIGGER SOURCE is in EXTERNAL.
12. HORIZ INPUT. Input for external horizontal signal.
13. HORIZONTAL DISPLAY. Selects source of horizontal signal and horizontal sensitivity, including SWEEP MAGNIFIER X10.
14. EXTERNAL VERNIER. Adjusts external horizontal sensitivity between calibrated steps of HORIZONTAL DISPLAY.
15. HORIZONTAL POSITION. Adjusts position of trace horizontally; vertical controls are on panel of plug-in unit.
16. SWEEP TIME. Selects calibrated sweep in 1-2-5 steps from 0.1 μSEC/CM to 5 SEC/CM.
17. VERNIER. Adjusts sweep rate between calibrated steps of SWEEP TIME switch.

Figure 3-1. Model 175A Controls and Terminals

## SECTION III OPERATION

### 3-1. GENERAL.

3-2. The front panel labeling of the Model 175A closely describes the function of each control. The instrument has a rise time of less than 7 nanoseconds, and compatible test probes are provided. Vertical controls are on the panel of the vertical plug-in unit. Their operation is described in the manual for that instrument.

### 3-3. BEAM FINDER.

3-4. BEAM FINDER locates the trace when it might otherwise be off the screen. Depressing this button brings the trace on the screen, defocused and intensified. The POSITION controls can then be adjusted to bring the trace to the center of the screen.

### 3-5. CALIBRATION.

3-6. The CALIBRATOR amplitude is accurate to 1% from 15°C to 35°C (50°F to 95°F). Square-wave outputs are provided at an amplitude of 1 and 10 volts and a frequency of approximately 1 kc.

### 3-7. TRIGGERING.

3-8. Four front-panel controls affect the start of the normal sweep. They are the TRIGGER SOURCE switch, TRIGGER LEVEL control, TRIGGER SLOPE switch, and SWEEP MODE control.

### 3-9. TRIGGER SOURCE.

3-10. The TRIGGER SOURCE switch selects the source of the sweep trigger: the power line (LINE), the signal applied to the vertical amplifier (INT), or an external signal applied to TRIG INPUT (EXT AC or EXT DC). With INT or EXT AC triggering selected, the trigger signal is ac-coupled to the sweep generator. With EXT DC selected, the trigger signal is dc-coupled to the sweep generator.

### 3-11. TRIGGER LEVEL.

3-12. The TRIGGER LEVEL control selects the voltage level on the trigger signal at which the sweep starts. The control provides continuous adjustment of the trigger level from about -5 volts to about +5 volts on external trigger signals and over a range equivalent to 6 centimeters of vertical deflection on internal trigger signals.

### 3-13. TRIGGER SLOPE.

3-14. TRIGGER SLOPE determines whether the sweep starts on the positive-slope or negative-slope portion of the trigger signal.

### 3-15. SWEEP MODE.

3-16. The SWEEP MODE control determines whether the sweep requires a trigger or free runs. The control is continuously adjustable with a switched position

(PRESET) at its counterclockwise extreme. The PRESET triggering condition is best for nearly all triggered functions. At some discrete frequencies it may be desirable to move the control out of PRESET.

### 3-17. SWEEP CONTROLS.

#### 3-18. SWEEP TIME.

3-19. There are 24 positions of the SWEEP TIME control, from 5 SEC/CM to 0.1  $\mu$ SEC/CM, accurate to  $\pm 3\%$ . Intermediate (uncalibrated) sweep times may be obtained by adjusting sweep time VERNIER.

#### 3-20. SWEEP MAGNIFIER.

3-21. In the INT SWEEP X1 position of HORIZONTAL DISPLAY the basic sweep time is that indicated by the setting of the SWEEP TIME switch. In the X10 magnified position the displayed sweep is 10 times faster, accurate to  $\pm 5\%$ . Divide the SWEEP TIME scale by 10 to obtain the actual sweep time. The magnified signal is actually 10 screen diameters across; however, HORIZONTAL POSITION has enough range to permit any portion of the presentation to be positioned on screen.

3-22. On the fastest sweep time, 0.1  $\mu$ SEC/CM X10 (10 nsec/cm) do not use the first 5 cm of trace for time-scale measurements since small non-linearities may exist. Due to the delay in the vertical amplifier, this portion of the trace precedes the actual triggering point of the waveform. As long as the first 5 cm of trace is positioned off screen in the 10  $\mu$ SEC/CM X10 position of SWEEP TIME, the full 10-cm display may be used.

### 3-23. HORIZONTAL FUNCTIONS.

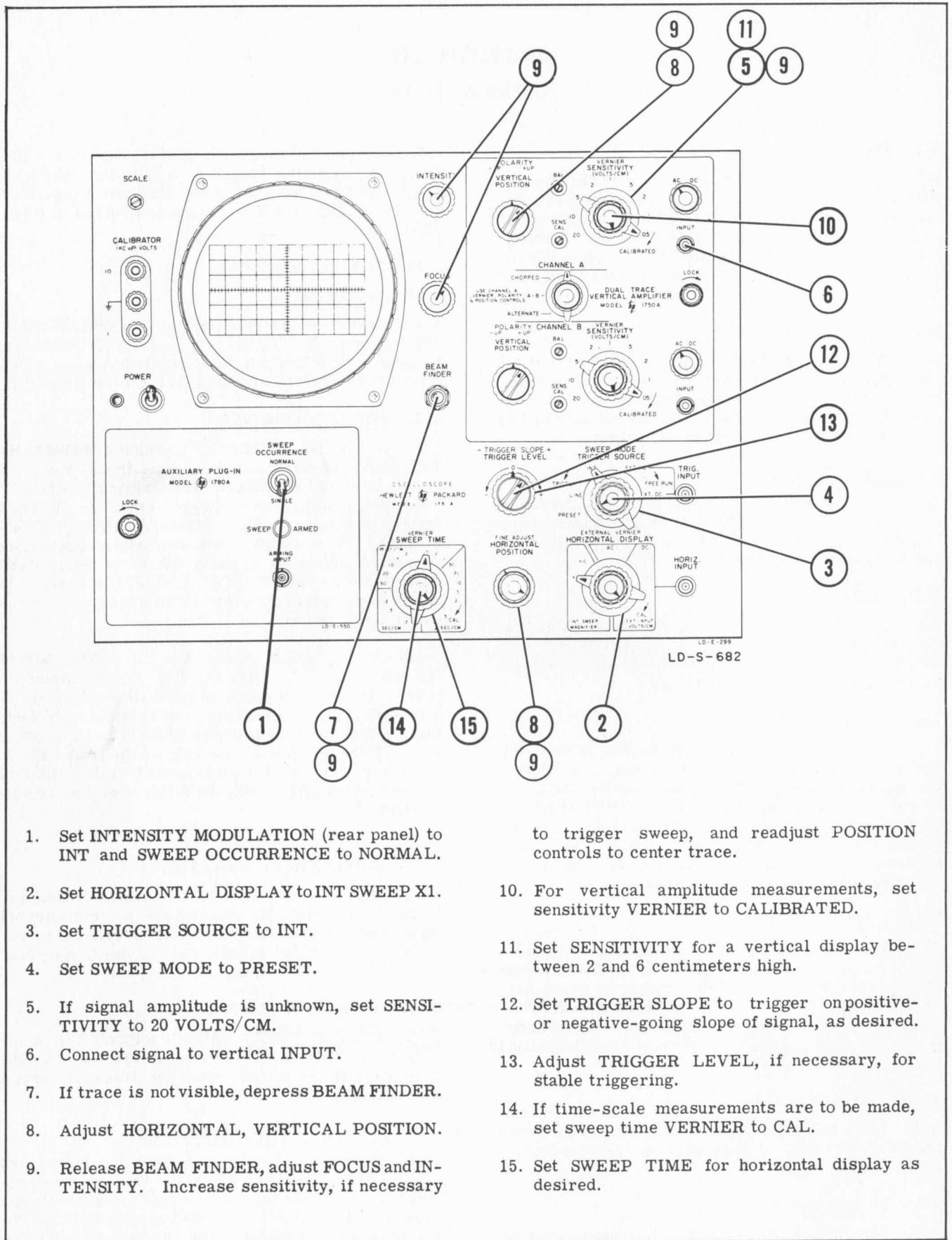
3-24. HORIZONTAL DISPLAY performs three external horizontal input functions: it selects external input, sets the sensitivity to 0.1 v/cm or 1 v/cm, and arranges the input circuit for ac or dc coupling.

### 3-25. INTENSITY MODULATION.

3-26. INTENSITY MODULATION controls are on the rear panel of the Model 175A (see figure 3-5). A positive 20-volt pulse will blank the trace at normal intensities.

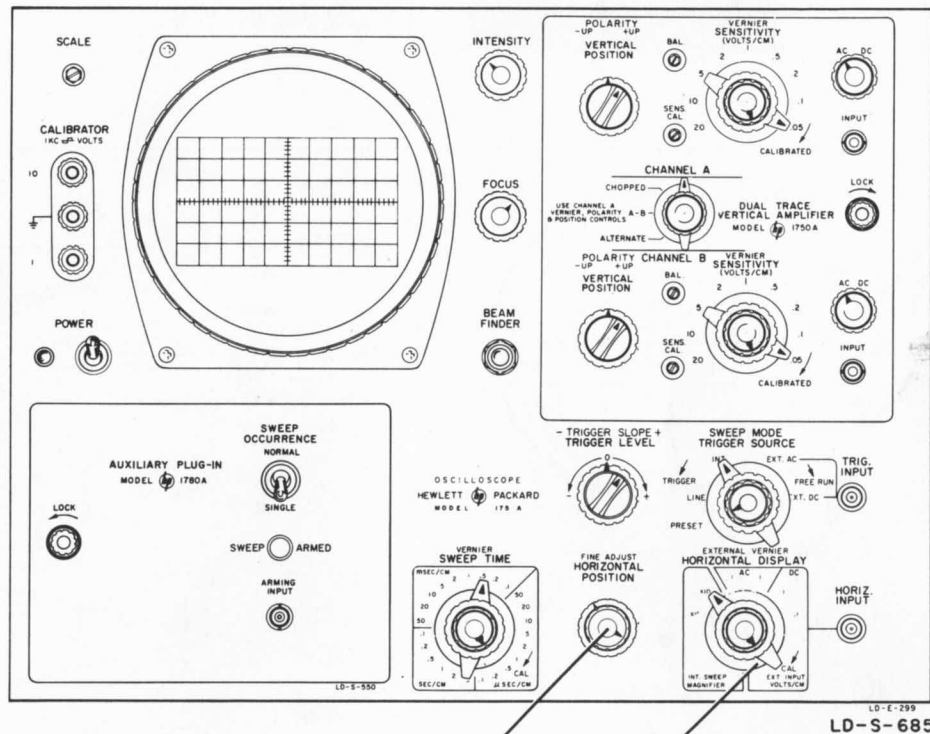
### 3-27. STEP-BY-STEP PROCEDURES.

3-28. Figure 3-1 briefly describes the function of each of the Model 175A controls. Step-by-step procedures for a few basic operations are given in figures 3-2 through 3-5. Included are instructions for compensating the probes. The numbers on each control refer to the corresponding step in the text below the illustration.



1. Set INTENSITY MODULATION (rear panel) to INT and SWEEP OCCURRENCE to NORMAL.
2. Set HORIZONTAL DISPLAY to INT SWEEP X1.
3. Set TRIGGER SOURCE to INT.
4. Set SWEEP MODE to PRESET.
5. If signal amplitude is unknown, set SENSITIVITY to 20 VOLTS/CM.
6. Connect signal to vertical INPUT.
7. If trace is not visible, depress BEAM FINDER.
8. Adjust HORIZONTAL, VERTICAL POSITION.
9. Release BEAM FINDER, adjust FOCUS and INTENSITY. Increase sensitivity, if necessary to trigger sweep, and readjust POSITION controls to center trace.
10. For vertical amplitude measurements, set sensitivity VERNIER to CALIBRATED.
11. Set SENSITIVITY for a vertical display between 2 and 6 centimeters high.
12. Set TRIGGER SLOPE to trigger on positive- or negative-going slope of signal, as desired.
13. Adjust TRIGGER LEVEL, if necessary, for stable triggering.
14. If time-scale measurements are to be made, set sweep time VERNIER to CAL.
15. Set SWEEP TIME for horizontal display as desired.

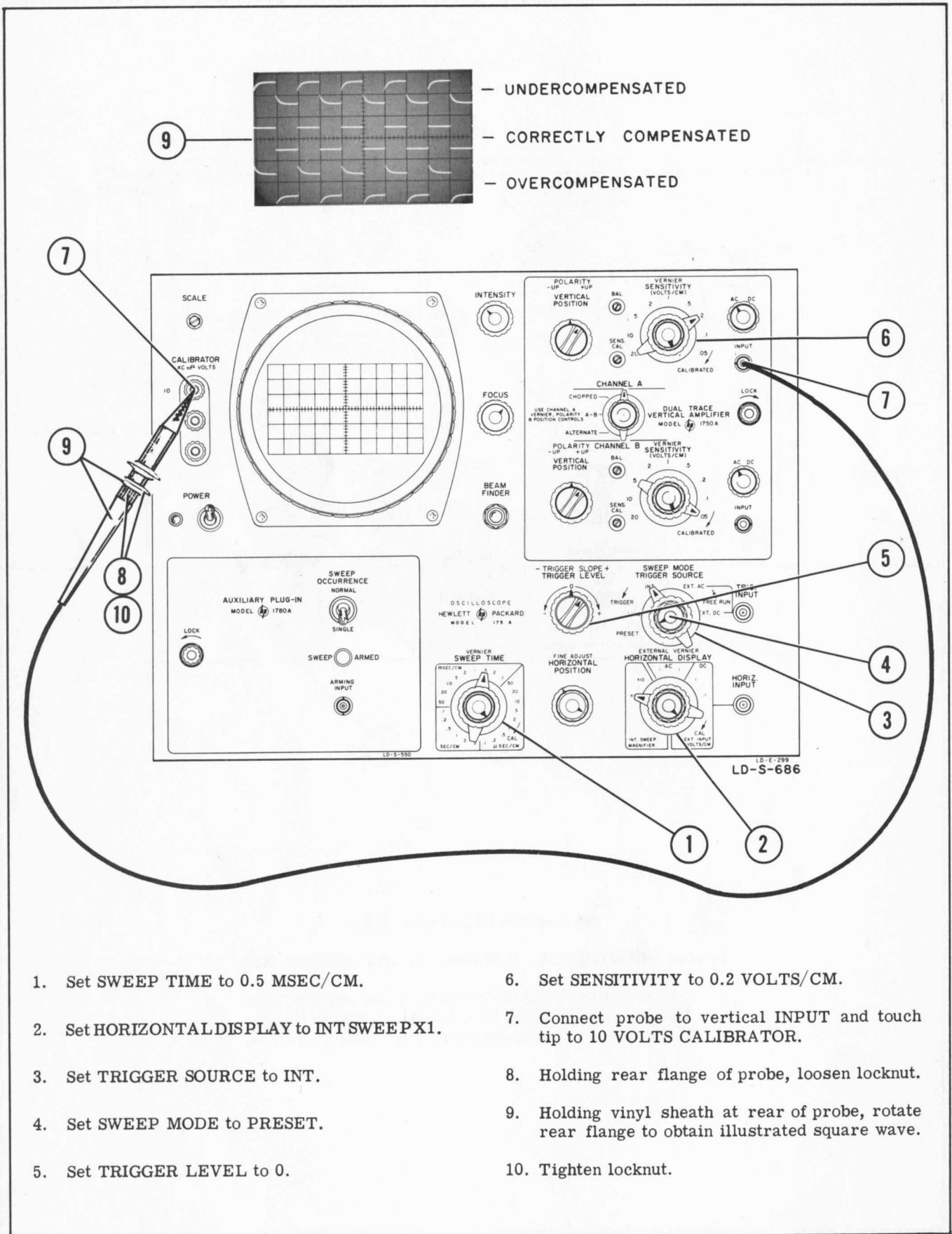
Figure 3-2. Internal Sweep



Set controls as in figure 3-2.

1. Set HORIZONTAL DISPLAY to INT SWEEP X10.
2. Adjust HORIZONTAL POSITION to view any part of the display. Do not make time measurements in the first 5 cm of fastest magnified sweep ( $0.1 \mu\text{SEC}/\text{CM} \times 10$ ).

Figure 3-3. Magnified Sweep



1. Set SWEEP TIME to 0.5 MSEC/CM.
2. Set HORIZONTAL DISPLAY to INT SWEEP X1.
3. Set TRIGGER SOURCE to INT.
4. Set SWEEP MODE to PRESET.
5. Set TRIGGER LEVEL to 0.
6. Set SENSITIVITY to 0.2 VOLTS/CM.
7. Connect probe to vertical INPUT and touch tip to 10 VOLTS CALIBRATOR.
8. Holding rear flange of probe, loosen locknut.
9. Holding vinyl sheath at rear of probe, rotate rear flange to obtain illustrated square wave.
10. Tighten locknut.

Figure 3-4. Probe Compensation



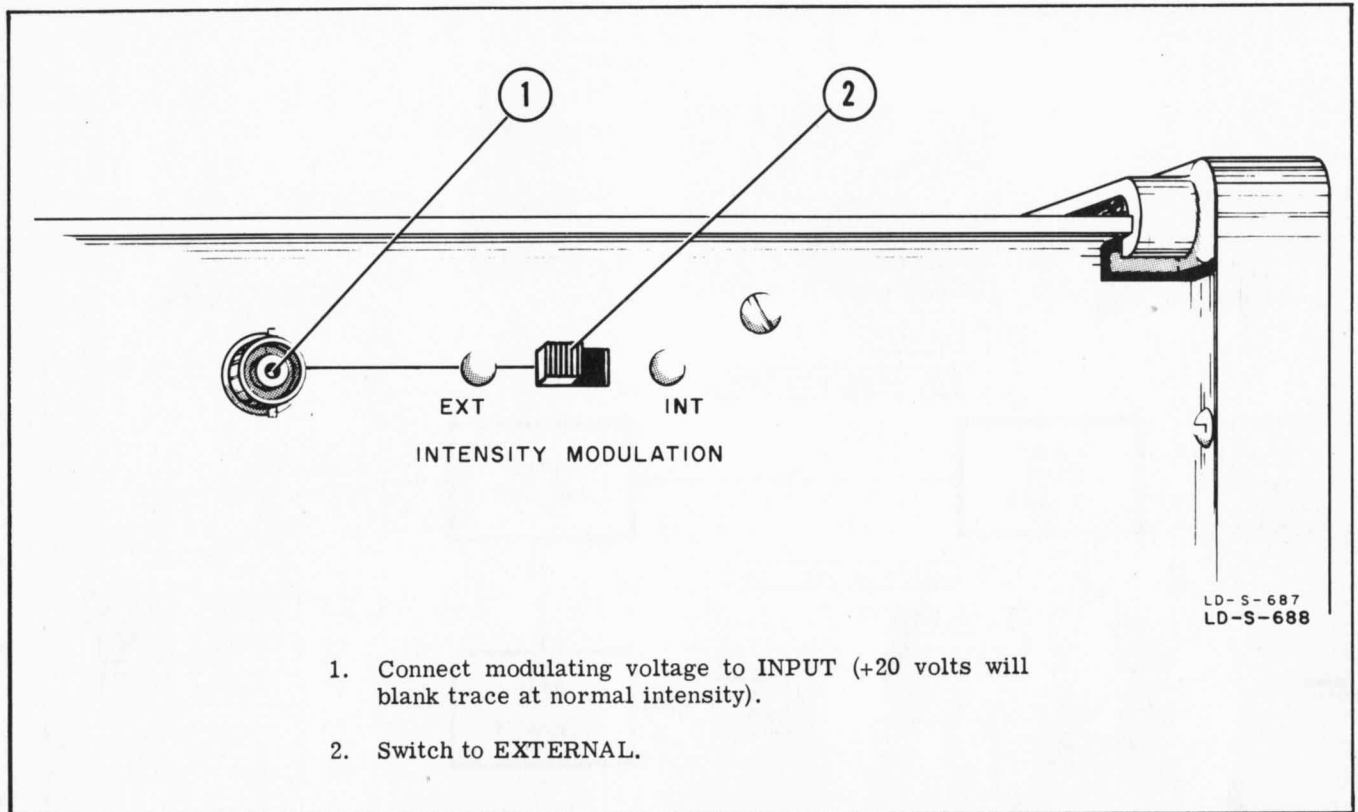


Figure 3-5. Intensity Modulation

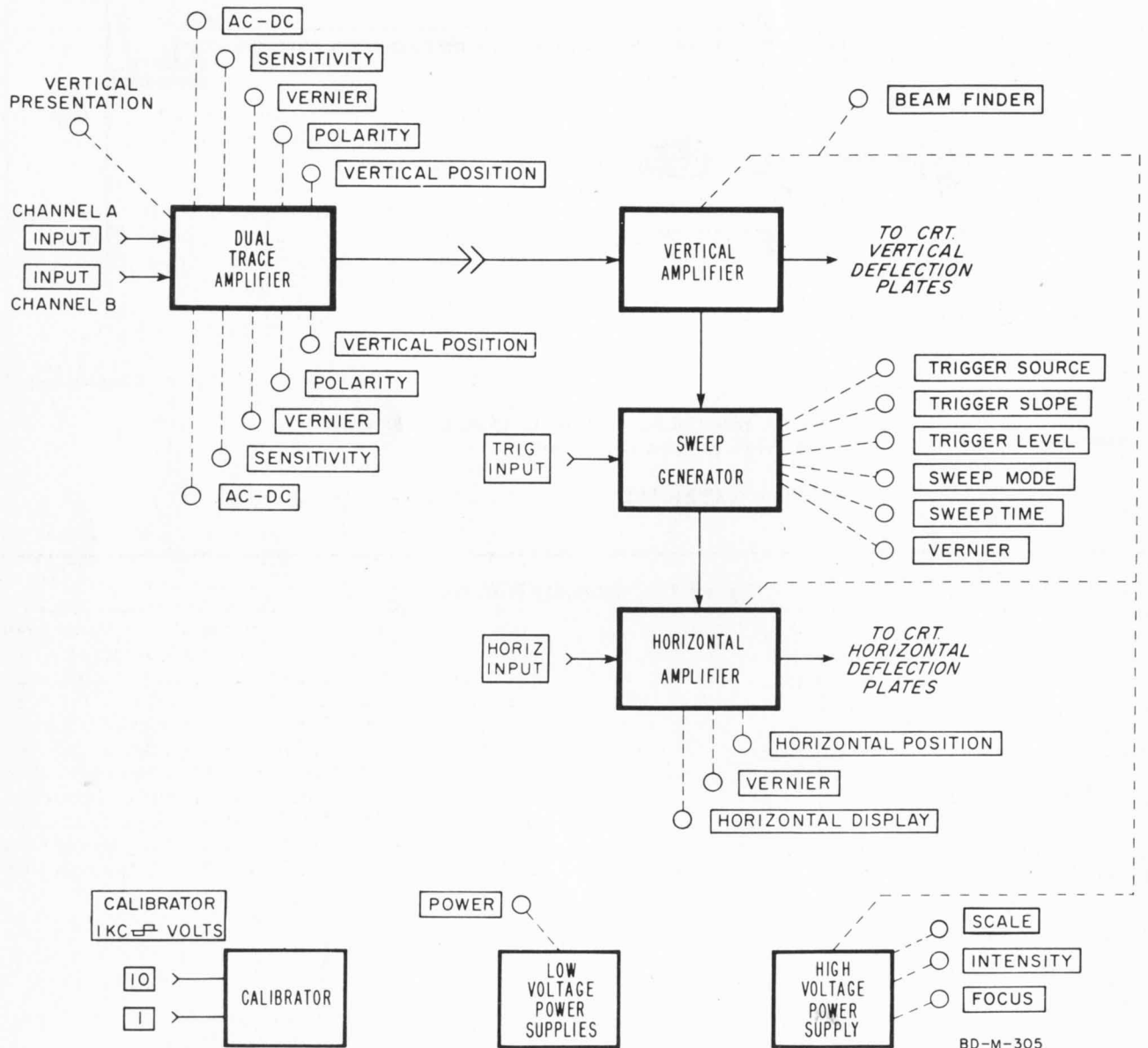


Figure 4-1. Overall Block Diagram of Model 175A with Model 1750A Plug-In Unit

## SECTION IV

### PRINCIPLES OF OPERATION

#### 4-1. OVERALL FUNCTIONAL DESCRIPTION.

4-2. The Model 175A consists of a high- and a low-voltage supply, a vertical and a horizontal amplifier, a sweep generator and a calibrator. Both power supplies are regulated, as is the dc heater supply. Options include a gate- and sweep-output circuit not included in the standard instrument. Figure 4-1 shows a block diagram of the instrument illustrating the main functional units and controls. For clarity, a dual-trace plug-in amplifier has been shown as part of the diagram. The circuits of the plug-in units are described in the manuals for those instruments. Circuit diagrams of the Model 175A are shown in figures 5-19 to 5-38.

4-3. **VERTICAL AMPLIFIER.** The vertical amplifier delays the signal received from the dual-trace amplifier and applies the amplified signal to the vertical deflection plates of the crt. Before the signal is delayed, the vertical amplifier applies part of the signal to the sweep generator for internal triggering of the sweep.

4-4. **SWEEP GENERATOR.** The sweep generator accepts a trigger signal from an internal or external source and generates a fast-rising trigger which is synchronized with the trigger signal. The trigger starts the linearly rising sweep voltage which drives the beam horizontally across the crt screen. The sweep generator thus provides a linear time base on which to measure the vertical signal. The sweep generator also provides an unblanking pulse to turn on the crt beam during the sweep.

4-5. **HORIZONTAL AMPLIFIER.** The horizontal amplifier converts the internal sweep or external

signal from unbalanced to balanced, and amplifies the signal to the level required to drive the horizontal deflection plates of the crt.

4-6. **CALIBRATOR.** The calibrator multivibrator generates a square wave of about 1 kc with 1-volt and 10-volt outputs.

4-7. **HIGH-VOLTAGE POWER SUPPLY.** The high-voltage power supply is an rf oscillator-rectifier circuit which generates the three regulated dc voltages required for operation of the crt.

4-8. **LOW-VOLTAGE POWER SUPPLIES.** Operating voltages for all the oscilloscope circuits, including the high-voltage supply, are provided by the low-voltage power supplies. All dc voltages are regulated.

#### 4-9. VERTICAL AMPLIFIER.

4-10. The vertical amplifier is a conventional balanced differential amplifier. The block diagram is shown in figure 4-2. The amplifier receives the balanced signal from the plug-in vertical amplifier, amplifies the signal, and drives the vertical deflection plates of the crt. The circuit includes a delay line which delays the vertical signal 0.2  $\mu$ sec before applying it to the vertical plates of the crt. Prior to the delay line, the signal from one side of the amplifier is sampled, amplified and applied to the sweep generator for internal triggering of the sweep. This starts the sweep in advance of arrival of the vertical signal at the crt deflection plates. The delayed signal is also applied to horizontal plug-in connector J105 for use in the Model 1782A Display Scanner.

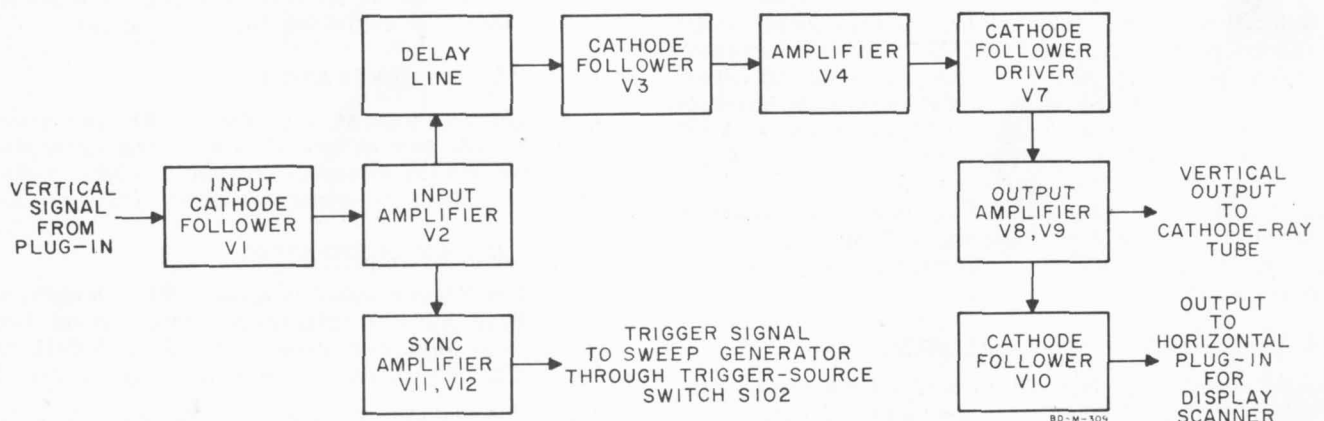


Figure 4-2. Vertical Amplifier Block Diagram

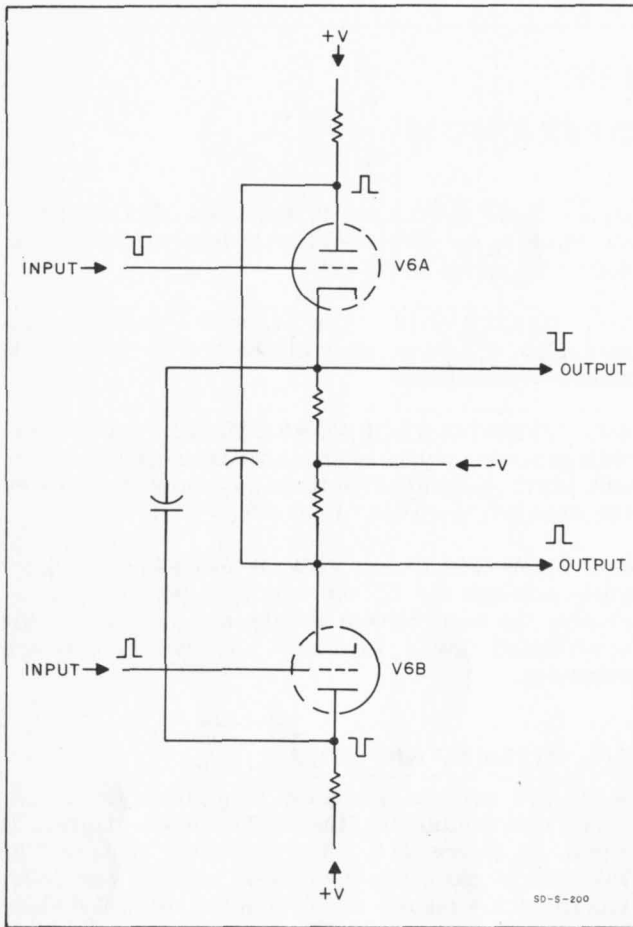


Figure 4-3. Cross-Coupled Cathode Follower Simplified Schematic Diagram

4-11. CROSS-COUPLED CATHODE FOLLOWER.

4-12. Input stage V1, as well as V3 and V7, are cross-coupled cathode followers. The simplified schematic is shown in figure 4-3. The cross-coupled cathode follower circuit provides a low impedance driving source for the following stage. At low frequencies, the stage acts as a simple cathode follower. High frequency signals appearing at the plate circuits readily pass through coupling capacitors to the opposite cathode. Since these high-frequency signals are in phase with the signals at the opposite cathode, they add to the current available to the load. The decrease in load impedance at high frequencies is partly compensated by the increase in high-frequency current offered by the cross-coupled cathode follower. The plate and cathode resistors are the same value, therefore voltages at the plates and cathodes are equal in amplitude and the signals are effectively added in parallel. Since the plate and cathode signals are added at high frequencies, the effective output impedance is reduced.

4-13. DIFFERENTIAL AMPLIFIER.

4-14. Input amplifier V2 as well as V4 and V7 are differential amplifiers. An unbalanced signal applied to one grid will appear at both plates balanced and amplified. Common-mode signals, such as hum, at

the grids are reduced in magnitude at the plates. In the circuit of amplifier V4, cathode degeneration is introduced by Gain control R45, reducing the gain of the stage.

4-15. PEAKING.

4-16. Series and shunt peaking are provided throughout the amplifier to extend the bandwidth while maintaining optimum transient response. Coils L7 and L8 adjust high-frequency response. Capacitors C22 and C35, which remove cathode degeneration in the circuits of V4 and V7 as signal frequency increases, provide a means of adjusting mid-frequency and low-frequency response.

4-17. SYNC AMPLIFIER.

4-18. The sync amplifier is composed of two cathode followers (input and output) and two amplifiers. The sync amplifier samples the signal prior to the vertical amplifier delay line and delivers this amplified signal to the trigger generator to start the sweep. Since the signal in the vertical amplifier is delayed 0.2  $\mu$ sec after the sync amplifier pick-off point, the sweep is able to start before the vertical signal reaches the crt deflection plates.

4-19. DELAY LINE.

4-20. The delay line is constructed to provide a 0.2  $\mu$ sec delay. The internal impedance of input amplifier V2 in parallel with plate load resistors R23 and R24 is designed to match the impedance of the delay line in order to minimize reflections. The delay line is peaked with L13 and L14 for optimum transient response.

4-21. CIRCUIT PROTECTION.

4-22. Diodes CR1, 2, 3, and 4 prevent the grid-cathode voltage of V3 and V7 from becoming excessive during turn-on time.

4-23. SCAN OUTPUT.

4-24. Cathode follower V10 provides low-impedance output to the horizontal plug-in connector for use with the Model 1782A Display Scanner. A balanced divider, R71-R73 and R74-R72, reduces the dc level at the plates of V7 to approximately zero volts; C36 and C37 compensate the divider at high frequencies. C33 balances the high-frequency scan output.

4-25. SWEEP GENERATOR.

4-26. The sweep generator consists of sweep-generating circuits plus an amplifier and trigger generator which actuate the sweep-generating circuits. A block diagram of the sweep generator is shown in figure 4-4.

4-27. TRIGGER GENERATOR.

4-28. The trigger signal is applied through differential driver V101 to trigger-generator tunnel diode CR102 and amplifier Q103. TRIGGER SLOPE and TRIGGER LEVEL controls are in the driver circuit.

4-29. The trigger generator is a tunnel diode acting as a bistable device to convert an input signal of any wave shape to a rectangular wave with very fast

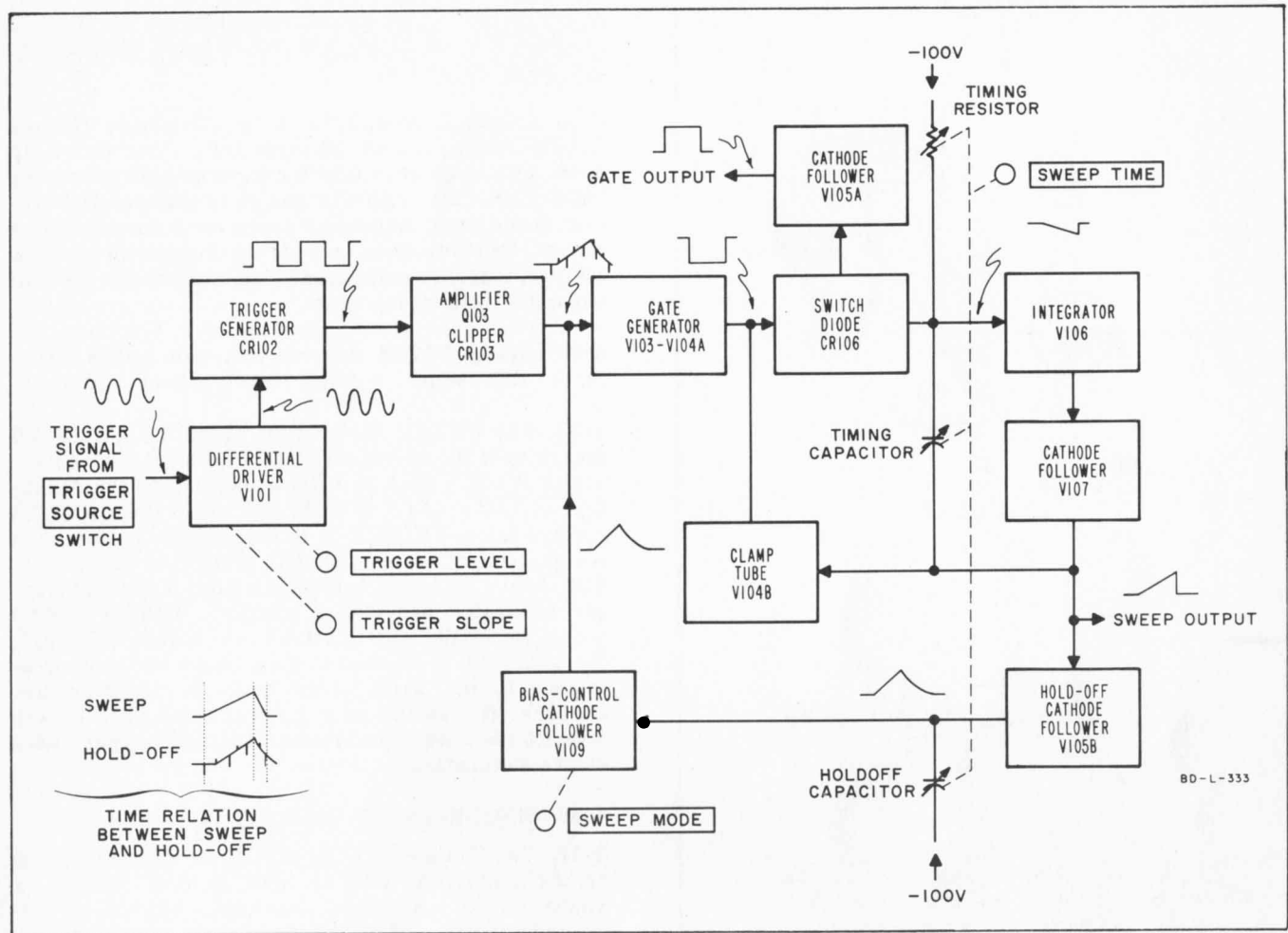


Figure 4-4. Sweep Generator Block Diagram

switching times. A simplified circuit is shown in figure 4-5A, and the composite characteristic of this circuit is illustrated in figure 4-5B. The composite characteristic is the sum of the currents through the tunnel diode and through the Sensitivity control. Because the tunnel diode is a non-linear device with a negative resistance region while the Sensitivity control is a linear device, Sensitivity can be adjusted to alter the shape of the curve in figure 4-5B, achieving narrow switching limits between points D and E. The Symmetry control adjusts the total current to the circuit, establishing bias line CF, halfway between switching points D and E. As the trigger signal varies through its cycle, current and voltage follow the path CDGFEB, producing the rectangular trigger output. The inductor sharpens the rise and fall times of the square wave by preventing fast current changes through the Sensitivity control. Points A and H represent the signal limits when the trigger signal is larger than necessary. The output of the trigger generator is differentiated by transformer T103, and the resulting sharp pulses actuate the gate generator.

#### 4-30. SWEEP GENERATING CIRCUITS.

4-31. Gate generator V103/V104A is a Schmitt circuit with wide hysteresis limits. Between sweeps,

the A section of bias control cathode follower V109 holds the bias at the input of the gate generator close to the lower hysteresis limit. The trigger generator applies both positive and negative triggers. The positive triggers are reduced in amplitude by clipper diode CR103 and have no effect, but a negative pulse drives the input to the gate generator below the lower hysteresis limit and causes the gate generator to switch (see paragraph 4-40).

4-32. When gate generator V103/V104A switches, it provides positive and negative gates. The positive gate is applied to the high-voltage power supply through the horizontal plug-in to turn on the crt beam. The negative gate applies reverse bias to switch diode CR106. Prior to the gate, the switch diode is forward biased and holds the input to integrator V106 at about -4 volts. The negative gate opens the diode switch and frees the input to the integrator.

4-33. Once freed, the input to integrator V106 starts going negative since it is connected to -100 volts through the sweep-time resistor (figure 5-23). The integrator amplifies and inverts its input to produce a large, positive-going output which is applied back to the input through cathode follower V107 and the sweep capacitor (figure 5-23). As a result, the

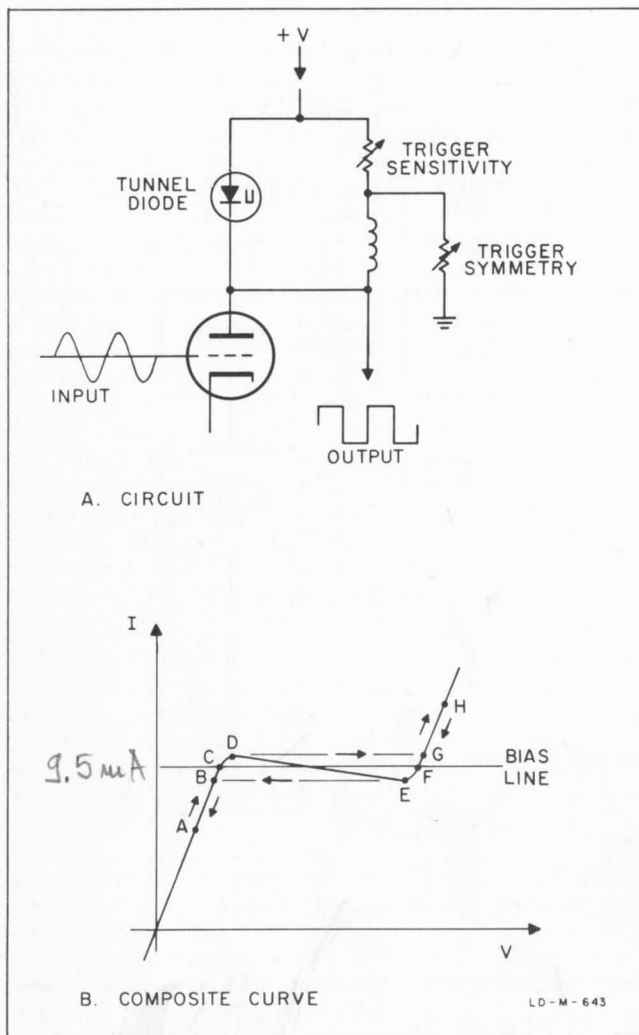


Figure 4-5. Trigger Generator Simplified Circuit and Composite Characteristic

change in voltage at the input to integrator V106 during the sweep time is only about one volt. Voltage across the sweep resistor, then, changes by about 1%, and the current through the resistor changes by the same amount. The current through the sweep resistor is the charging current for the sweep capacitor; therefore, the voltage across the sweep capacitor changes quite linearly with time, and the sweep signal is a nearly linear voltage ramp. The SWEEP TIME switch changes the value of sweep resistor or capacitor to change the sweep time. The sweep output is applied to the horizontal amplifier through the horizontal plug-in.

4-34. An attenuated sweep signal is applied to the input of gate generator V103/V104A through hold-off cathode follower V105B and section B of bias control cathode follower V109. This signal drives the input of the gate generator up to the upper hysteresis limit and causes the gate generator to switch back to its pre-sweep state. The gate generator then ends the gates, blanking the crt and forward biasing switch

diode CR106. The switch diode returns the input of integrator V106 to its pre-sweep level, discharging the sweep capacitor.

4-35. During a sweep time, hold-off cathode follower V105B charges a hold-off capacitor. After the sweep ends, this capacitor lets the input to gate generator V103/V104A down slowly enough to prevent that circuit from being triggered again until the remaining sweep circuits have recovered completely. The SWEEP TIME switch changes the size of the hold-off capacitor with sweep time.

4-36. Clamp V104B ensures that each sweep starts from the same voltage level, about -50 volts.

4-37. The SWEEP MODE control R172 (figure 5-23) determines the no-signal bias at the input to gate generator V103/V104A by setting the bias on the A section of bias control cathode follower V109. With the control set to PRESET or in the TRIGGER portion of its adjustable range, the gate generator bias cannot drop below its lower hysteresis limit unless the trigger generator provides a trigger. With the control set in the FREE RUN portion of its adjustable range, the gate bias is allowed to drop below its lower hysteresis limit. Thus as the hold-off capacitor discharges, it lets the gate generator bias all the way down to the lower hysteresis limit, and another sweep starts automatically.

#### 4-38. SINGLE-SWEEP OPERATION.

4-39. The SWEEP OCCURRENCE switch (on the panel of the horizontal plug-in unit) selects normal or single-sweep operation. Normal operation is discussed above. For single-sweep operation, the SWEEP OCCURRENCE switch converts V109 into a Schmitt circuit. As the sweep signal from hold-off cathode follower V105B rises to end the gate from the gate generator, the sweep signal also switches the Schmitt circuit of V109 so that V109B conducts and V109A is cut off. The B section of V109 then holds the input to gate generator V103/V104A high enough so that triggers from the trigger generator cannot actuate the gate generator, and the sweep generating circuits are effectively disabled. A positive signal applied to V109A switches the Schmitt circuit of V109 so that V109A conducts and V109B is cut off. The A section of V109 then sets the input to the gate generator according to the setting of the SWEEP MODE control, and the sweep generating circuits are effectively armed. The switching signal for V109A can be an external signal applied to the ARMING INPUT connector or an internal signal obtained by switching SWEEP MODE control out of its PRESET position.

#### 4-40. SCHMITT TRIGGER CIRCUIT.

4-41. The Schmitt trigger circuit is a form of bi-stable multivibrator used where fast-rising signals are required. Figure 4-6 shows a simplified Schmitt trigger circuit and input and output waveforms. If initially the input voltage is such that V1 is cut off, V2 conducts. As the input voltage becomes more positive, it will eventually reach a predetermined level (a) at which the circuit changes state; V1 conducts

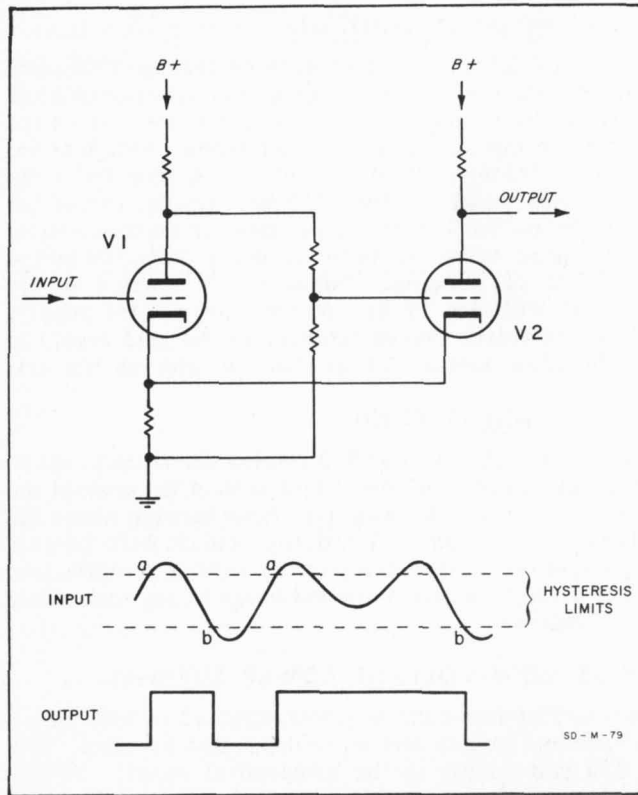


Figure 4-6. Simplified Schmitt Trigger Circuit

and V2 is cut off. If the input voltage then goes negative, the common cathode potential decreases and V2 grid goes positive. When the input reaches a second predetermined level (b), V2 conducts and the circuit switches back to its initial state. The output of the circuit is a voltage step, either positive or negative depending upon the slope of the input.

4-42. The input voltage levels at which a Schmitt trigger switches are the hysteresis limits. Note that the circuit does not switch unless the input crosses both limits.

4-43. HORIZONTAL AMPLIFIER.

4-44. The horizontal amplifier amplifies the internal sweep or an external signal applied to the horizontal INPUT connector and drives the horizontal deflection plates of the crt. Figure 4-7 is a simplified block diagram of the horizontal amplifier. The internal sweep signal is applied through the HORIZONTAL DISPLAY switch to cathode follower V203A. From V203A the signal passes through cathode follower V203B to one input of differential amplifier V204-V205. The other grid of the differential amplifier is returned to ground through a resistance. The differential amplifier amplifies the difference between its two input signals (one of which is ground) and provides a balanced output signal which is applied to output cathode followers V208A and V208B. These cathode followers drive the crt deflection plates. The cathode followers also drive capacitance driver V209 which acts as the cathode resistance for the output cathode followers. When high-speed signals such as the faster sweeps drive the crt beam from left to right, the capacitance driver discharges the capacitance of the crt deflection plates.

4-45. External horizontal signals applied to the INPUT connector pass through an attenuator, amplifier V201A-B, and the HORIZONTAL DISPLAY switch to cathode follower V203A. Otherwise the operation is the same as described above for the internal sweep signal.

4-46. The HORIZONTAL DISPLAY switch selects the signal to be applied to the horizontal deflection plates. The switch also controls the input attenuator and the sweep magnifier. The sweep magnifier attenuator between V203A and V203B provides a means of sweep expansion. The EXTERNAL VERNIER control varies the series resistance between V201A and V201B and thereby varies the output of V201B. The range of the EXTERNAL VERNIER is sufficient to provide continuous adjustment of external horizontal sensitivity between the calibrated settings of the HORIZONTAL DISPLAY switch. A section of the BEAM FINDER switch is in the common cathode circuit of V204 and

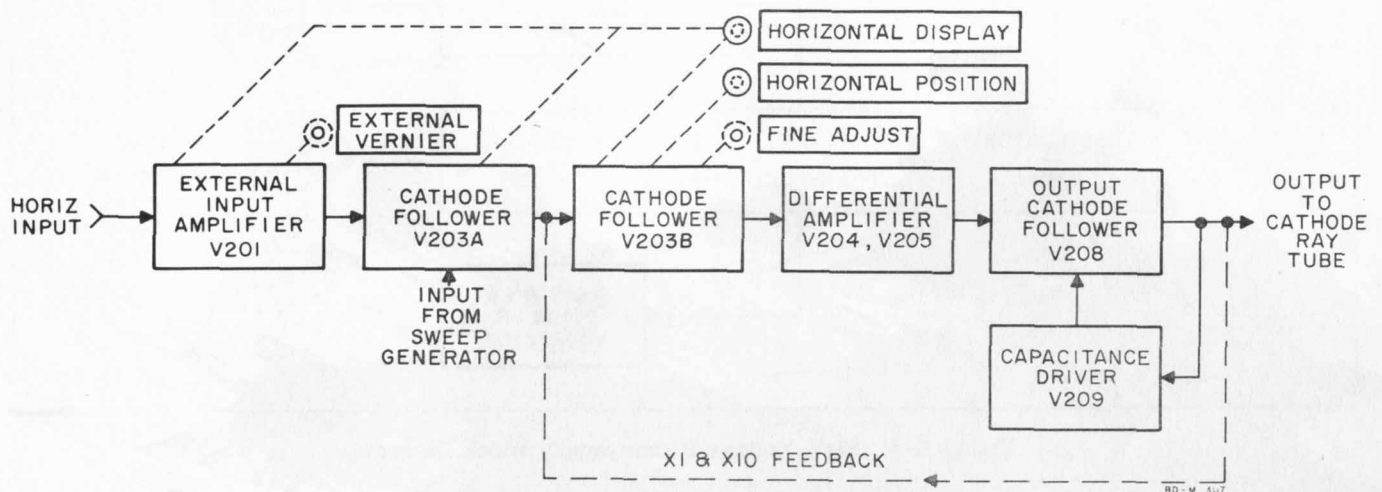


Figure 4-7. Horizontal Amplifier Block Diagram

V205. When pressed, the switch reduces the gain so that an unbalance prior to V204 and V205 cannot deflect the crt beam off the screen.

#### 4-47. HIGH-VOLTAGE POWER SUPPLY.

4-48. The high-voltage supply provides the operating voltages for the crt. A block diagram of the high-voltage power supply is shown in figure 4-8. The 50-kc output of rf oscillator V301 is applied to high voltage transformer T301. The transformer steps up the oscillator output to high ac voltages which rectifiers V304, V305, and doubler stage V302 and V303 convert to dc. The dc voltages are then supplied to the crt.

4-49. Control of the high-voltage supply is accomplished by comparing the -2700 volts supplied to the crt cathode with +370 volts from the regulated low-voltage power supply. Changes in the -2700 volt supply produce an error voltage which is amplified by the dc control amplifier V306A-B and is applied to the oscillator as a control voltage. The control voltage changes the output amplitude of the oscillator, and hence corrects for the change in the -2700 volt supply.

4-50. The crt is normally biased off. The positive unblanking gate from the sweep generator, applied to the crt control grid, overrides the bias and unblanks the crt. The gating pulse time is identical to the sweep time so that the crt remains on during sweep time and external horizontal operation.

#### 4-51. INTENSITY CONTROL.

4-52. INTENSITY control R319 varies the -2700 volts supplied to the crt control grid. FOCUS control R334 varies the voltage supplied to focus element of the crt to produce a sharply defined trace. Astigmatism control R340, part of the voltage divider from the +370 volt supply to the +110 volt supply, varies the voltage on the crt to compensate for electron-beam defocusing when the beam is being deflected by the vertical or horizontal signals. A section of the BEAM FINDER is in the crt control-grid supply. When pressed, the switch returns the grid supply to +370 volts instead of ground, turning on the crt.

#### 4-53. SCALE CONTROL.

4-54. SCALE control R350 rotates the trace by varying the current through a coil around the neck of the crt, and hence the magnetic field through which the beam must pass. Rotation of the SCALE control changes the voltage and polarity across the deflection coil enough to give a control range of approximately  $\pm 10$  degrees.

#### 4-55. LOW-VOLTAGE POWER SUPPLIES.

4-56. The low-voltage power supplies include an independent supply and three dependent supplies. The -100 volt supply is the independent supply. It is a reference for the +370 and +110 volt supplies and provides operating voltage to the differential amplifier of the +110 volt supply and to the sensor amplifier of the +6.3 volt supply.

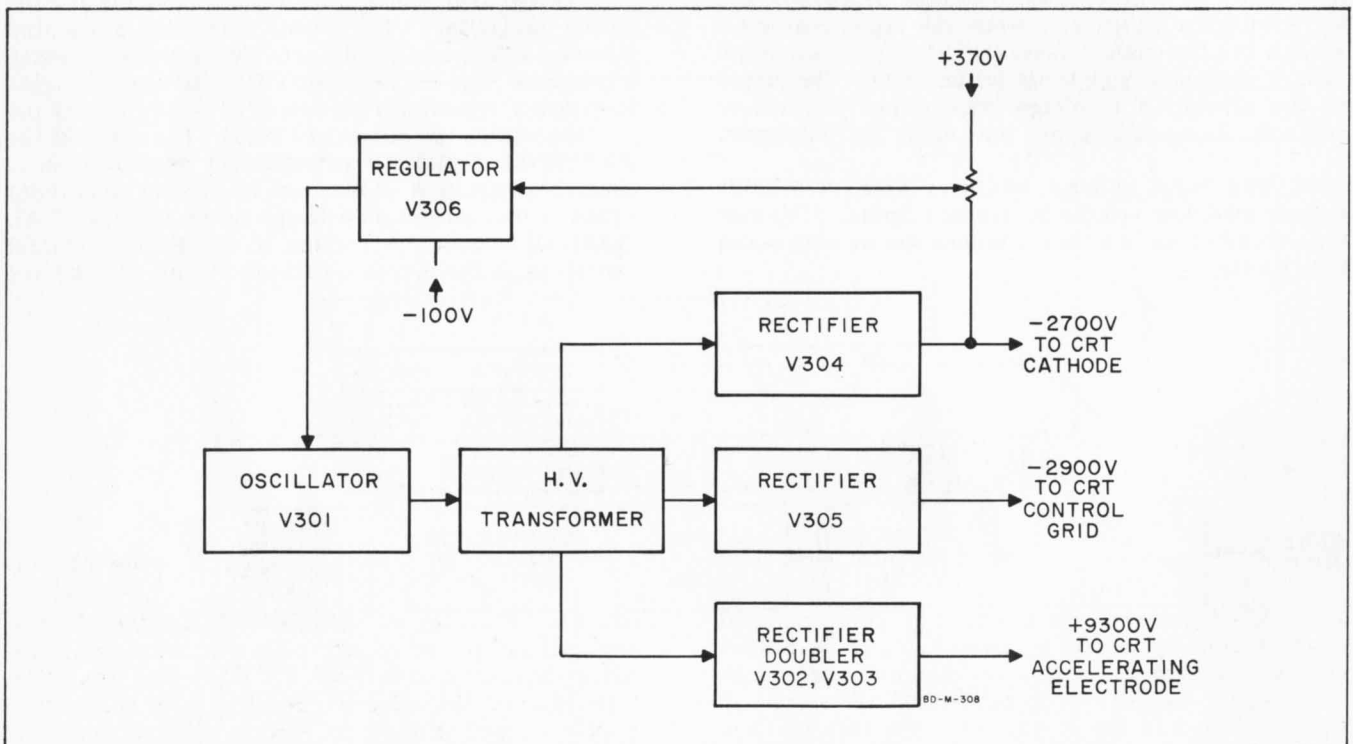


Figure 4-8. High-Voltage Power Supply Block Diagram



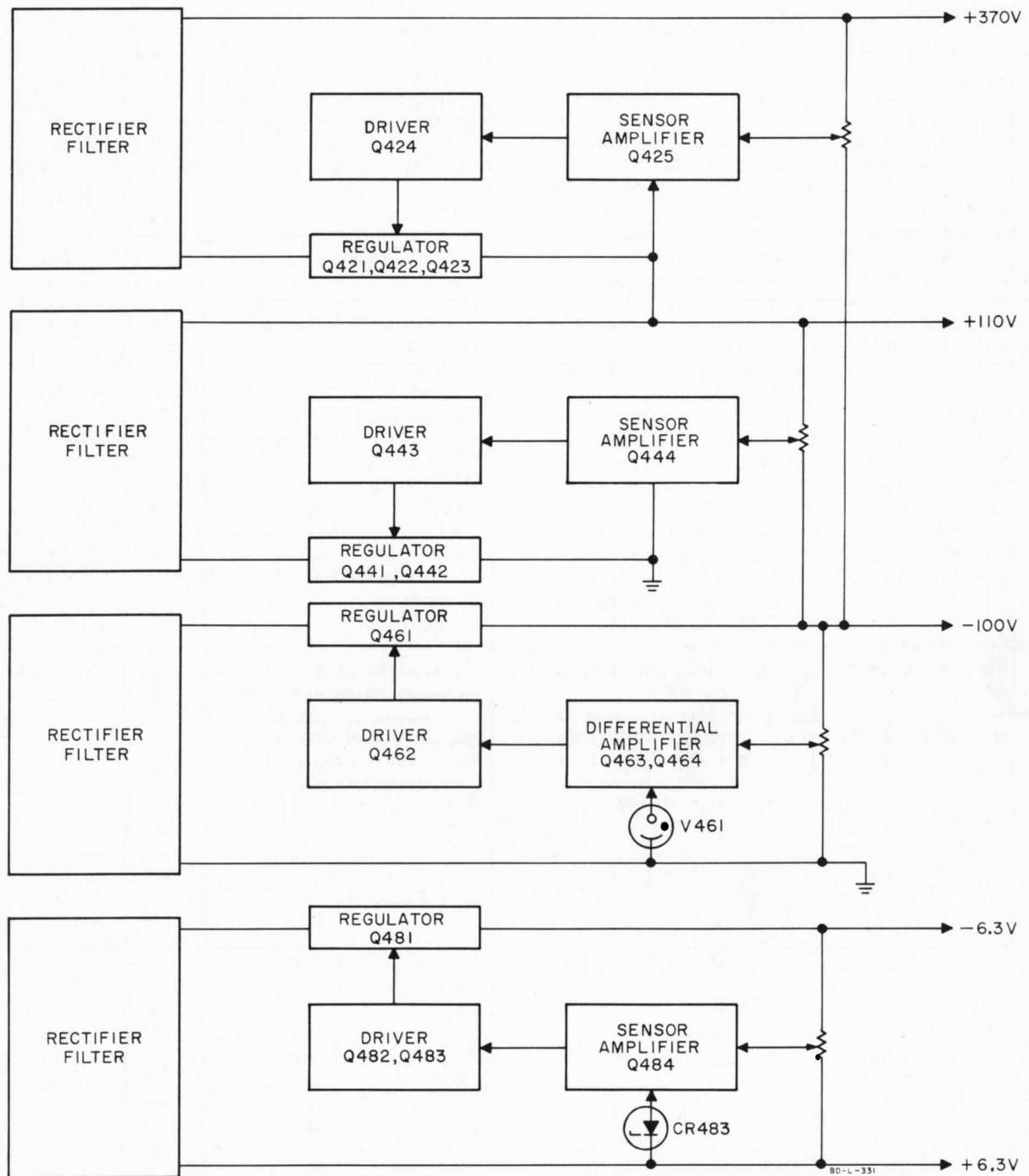


Figure 4-9. Low-Voltage Power-Supply Block Diagram

4-57. A simplified block diagram of the regulated power supplies is shown in figure 4-9. Each series regulator acts as a variable resistance in series with each supply output (even if the series regulator is in the return leg of the supply, as in the +110 volt and +370 volt returns, the regulator is in series with the

output). A sensor or differential amplifier senses any change in the output voltage by comparing the output against a reference voltage. The amplifier then changes the effective resistance of the series regulator, and thereby the voltage drop across it, to oppose the change in output voltage.

Table 5-1. Test Equipment for Checks and Adjustments

Item	Instrument	Instrument Characteristics	Required to Test	Ref Para	Model
1	Signal Generator	50 kc, 500 kc, 1 mc, 50 mc, 1.5 volt output; output amplitude constant with frequency	Horizontal Bandwidth Trigger Sensitivity	5-13 5-17	Tektronix Type 190A
2	Oscillator	Frequency: 1 kc Amplitude: 10 volts	Trigger Point	5-16	hp 200CD
3	Calibration Generator	Output: 0.3 to 50 volts peak-to peak, 0.03 to 0.2 volts rms ( $\pm 0.35\%$ ), 0 to 300 volts dc	Horizontal Sensitivity Calibrator High-Voltage Power Supply Sweep Gain Trigger Sensitivity and Symmetry Vertical Gain Calibrator	5-12 5-21 5-37 5-42 5-50 5-55 5-58	hp 738 AR
4	Time-Mark Generator	Marker intervals from 0.1 $\mu$ sec to 5 sec in 1-2-5 steps; output amplitude greater than 50 mv	Sweep Calibration Sweep Magnifier Pattern Sweep Time	5-18 5-19 5-39 5-52	Tektronix Type 180A
5	Vertical Response Tester	Mercury-pulser vertical plug-in unit	Vertical Bandwidth Vertical Pulse Response	5-20 5-57	hp 10405A
6	Square-Wave Generator	Frequency: 4 kc to 1 mc Output (open circuit): 600 ohm: 50 volts 75 ohm: 7 volts	Intensity Modulation Horizontal-Amplifier Frequency Compensation Sweep Length Scan Response	5-22 5-46 5-51 5-56	hp 211A
7	Test Oscilloscope	10-mc passband, external sync, 0.1 $\mu$ sec/cm to 5 sec/cm sweep time	Sweep and Gate Output Scan Response	5-23 5-56	hp 160B hp 170A hp 175A w/08*
8	DC Voltmeter	Range: 0 - 400 vdc, 1%	Low-Voltage Power Supplies Preset	5-33 5-49	hp 412A
9	High-Voltage Vacuum-Tube Voltmeter	Range: 0 - 3000 vdc, 8%	High-Voltage Power Supply	5-35	hp 410B hp 459A
10	AC Voltmeter	Range: 1 mv to 0.1 volt full scale Input Impedance: 1 megohm	Low-Voltage Power Supplies	5-33	hp 400D/H/L
11	Test Plug	To be constructed (see figure 5-1)	Scan Response	5-56	none
12	Vertical Test Adapter	Test plug to allow signals to be applied directly to vertical amplifier	Vertical Gain	5-55	hp 10404A
13	Variable Transformer	To vary line voltage from 102 to 128 (204 to 256) volts for power-supply measurement (para 5-33) To hold line voltage at 115 volts for waveform and voltage measurements during adjustment			

\* Model 175A Oscilloscope with option 08, Sweep and Gate Output

## SECTION V MAINTENANCE

### 5-1. INTRODUCTION.

5-2. This section covers routine maintenance, troubleshooting, and adjustment of the Model 175A Oscilloscope. A performance check is included which may be used to verify proper operation of the instrument at incoming inspection or after adjustments have been made.

### 5-3. SERVICING THE AIR FILTER.

5-4. Inspect the air filter at the rear of the instrument and clean it before it becomes clogged enough to restrict the flow of cooling air. To clean, remove the filter from the instrument and wash it thoroughly in warm water and detergent. Dry thoroughly and coat with a filter adhesive such as Filter Coat No. 3 from Research Products Company, Inc. This adhesive is available from heating supply stores or from your Hewlett-Packard sales representative.

### 5-5. PERFORMANCE CHECK.

5-6. The performance check is intended to determine whether or not the instrument is operating within its specifications. Should adjustment be required, refer to paragraph 5-25. To check the vertical and horizontal plug-in units, refer to the individual manuals covering these instruments.

### 5-7. TEST EQUIPMENT.

5-8. Test equipment recommended for the performance check is listed in table 5-1, items 1 through 7. Similar instruments having the listed characteristics may be substituted.

### 5-9. PRELIMINARY SETTINGS.

5-10. Vertical and horizontal plug-in units must be in place to make the performance check. Set the 115-230 volt switch to the line voltage being used.

a. If the vertical plug-in unit has more than one channel, select CHANNEL A and use channel A controls. Make the following settings on the panel of the vertical plug-in unit:

AC-DC . . . . . AC  
SENSITIVITY . . . . . 2 VOLTS/CM  
VERNIER . . . . . CAL

b. Depending on model number, make the following settings on the panel of the horizontal plug-in unit:

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

c. Make the following settings on the Model 175A:

POWER . . . . . ON  
INTENSITY MODULATION . . . . . INTERNAL  
SWEEP TIME . . . . . 1 MSEC/CM  
Sweep VERNIER . . . . . CAL  
HORIZONTAL DISPLAY . . . . . X1  
EXTERNAL VERNIER . . . . . CAL  
TRIGGER SOURCE . . . . . INT  
SWEEP MODE . . . . . FREE RUN  
TRIGGER LEVEL . . . . . 0  
TRIGGER SLOPE . . . . . (+)

d. Depress BEAM FINDER to locate trace. With BEAM FINDER depressed, center display with horizontal and vertical position controls.

e. Release BEAM FINDER and turn INTENSITY control clockwise, if necessary. A trace should appear on screen.

f. The INTENSITY control should vary the intensity of the display from extinguished to brighter than normal intensity. Adjust INTENSITY for normal viewing level.

g. The FOCUS control should defocus the display at each extreme of the control and focus the display at approximately midrange. Adjust FOCUS for sharpest display.

h. Adjust SCALE control to align the trace parallel to the horizontal graticule lines.

### 5-11. HORIZONTAL AMPLIFIER.

#### 5-12. SENSITIVITY.

a. Connect the Calibration Generator to HORIZ INPUT.

b. Set Calibration Generator output for 10 volts peak-to-peak.

c. Set:  
HORIZONTAL DISPLAY . . . . . 1 VOLT/CM AC  
EXTERNAL VERNIER . . . . . fully counterclockwise

d. Horizontal deflection should be 1 cm or less.

e. Set:  
EXTERNAL VERNIER . . . . . CAL

f. Horizontal deflection should be 10 cm ±0.5 cm.

g. Set Calibration Generator output for 1 volt peak-to-peak.

h. Set:  
HORIZONTAL DISPLAY . . . . . 0.1 VOLT/CM AC

- i. Horizontal deflection should be 10 cm  $\pm$ 0.5 cm.
- j. Check the two dc positions of HORIZONTAL DISPLAY in the same manner.
- k. Disconnect Calibration Generator.

5-13. BANDWIDTH.

- a. Connect Signal Generator to HORIZ INPUT.
- b. Set:  
HORIZONTAL DISPLAY . . . 0.1 VOLT/CM DC
- c. Set Signal Generator for 50 kc and adjust output amplitude for a horizontal deflection of 10 cm.
- d. Set frequency of Signal Generator to 500 kc.
- e. Horizontal deflection should be at least 7 cm.
- f. Disconnect Signal Generator.

5-14. SWEEP GENERATOR.

5-15. PRESET.

- a. Set:  
HORIZONTAL DISPLAY . . . . . X1  
SWEEP MODE . . . . . PRESET
- b. No sweep should be present.
- c. Connect CALIBRATOR 10 VOLT output to the vertical INPUT.
- d. A stable synchronized display should be present.
- e. Disconnect CALIBRATOR.

5-16. TRIGGER POINT.

- a. Connect Oscillator to vertical INPUT.
- b. Adjust Oscillator output for 5 cm deflection, and frequency to 1 kc.
- c. Rotate TRIGGER LEVEL to both extremes. The starting point of the sweep should be adjustable to any point on the positive slope of the signal.
- d. Set:  
TRIGGER SLOPE . . . . . (-)
- e. Rotate TRIGGER LEVEL to both extremes. The starting point of the sweep should be adjustable to any point on the negative slope of the signal.
- f. Disconnect Oscillator. Return TRIGGER LEVEL to 0 and TRIGGER SLOPE to +.

5-17. TRIGGER SENSITIVITY.

- a. Connect Signal Generator to the vertical INPUT and TRIG INPUT.
- b. Set:  
SWEEP TIME . . . . . 1  $\mu$ SEC/CM  
Vertical SENSITIVITY . . . . . 0.5 VOLT/CM

- c. Set Signal Generator frequency to 1 mc and output amplitude for 1 cm of vertical deflection.

- d. Adjust TRIGGER LEVEL, if necessary, for a synchronized display and reduce the Signal Generator output amplitude until the sweep stops. The sweep should continue to trigger at signal amplitudes 0.2 cm or greater.

- e. Set:  
TRIGGER SOURCE . . . . . EXT AC

- f. Repeat steps c and d. The sweep should continue to trigger at signal amplitudes of approximately 0.5 cm or greater.

- g. Set:  
TRIGGER SOURCE . . . . . EXT DC

- h. Repeat steps c and d. The sweep should continue to trigger at signal amplitudes of approximately 0.5 cm or greater.

- i. Set frequency of Signal Generator to 50 mc and output amplitude for 3 cm of deflection.

- j. Set:  
SWEEP TIME . . . . . 0.1  $\mu$ SEC/CM  
HORIZONTAL DISPLAY . . . . . X10

- k. Repeat step d. The sweep should continue to trigger at signal amplitudes of approximately 1 cm or greater.

- m. Set:  
TRIGGER SOURCE . . . . . EXT AC

- n. Repeat step d. The sweep should continue to trigger at signal amplitudes of approximately 1 cm or greater.

- p. Set:  
TRIGGER SOURCE . . . . . INT

- q. Set Signal Generator output amplitude for 3 cm of deflection.

- r. Repeat step d. The sweep should continue to trigger at signal amplitudes of approximately 2 cm or greater.

- s. Disconnect Signal Generator.

- t. Connect a Model 10003A (AC-21M) Probe to vertical INPUT.

- u. Set:  
TRIGGER SOURCE . . . . . LINE  
Vertical SENSITIVITY . . . . . 5 VOLTS/CM  
SWEEP TIME . . . . . 5 MSEC/CM  
HORIZONTAL DISPLAY . . . . . X1  
TRIGGER LEVEL . . . . . 0

- v. Connect probe tip to power line. Do not connect probe ground lead.

Table 5-2. Sweep Calibration

SWEEP TIME	Markers	Interval	SWEEP TIME	Markers	Interval
.1 μSEC/CM	10 mc	1 cycle/cm	1 MSEC/CM	1 msec	1 marker/cm
.2 μSEC/CM	5 mc	1 cycle/cm	2 MSEC/CM	1 msec	2 markers/cm
.5 μSEC/CM	1 μsec	1 marker/2-cm	5 MSEC/CM	5 msec	1 marker/cm
1 μSEC/CM	1 μsec	1 marker/cm	10 MSEC/CM	10 msec	1 marker/cm
2 μSEC/CM	1 μsec	2 markers/cm	20 MSEC/CM	10 msec	2 markers/cm
5 μSEC/CM	5 μsec	1 marker/cm	50 MSEC/CM	50 msec	1 marker/cm
10 μSEC/CM	10 μsec	1 marker/cm	.1 SEC/CM	100 msec	1 marker/cm
20 μSEC/CM	10 μsec	2 markers/cm	.2 SEC/CM	100 msec	2 markers/cm
50 μSEC/CM	50 μsec	1 marker/cm	.5 SEC/CM	500 msec	1 marker/cm
.1 MSEC/CM	100 μsec	1 marker/cm	1 SEC/CM	1 sec	1 marker/cm
.2 MSEC/CM	100 μsec	2 markers/cm	2 SEC/CM	1 sec	2 markers/cm
.5 MSEC/CM	500 μsec	1 marker/cm	5 SEC/CM	5 sec	1 marker/cm

- w. A stable synchronized pattern should be obtained.
- x. Disconnect probe from power line and vertical INPUT.

5-18. SWEEP CALIBRATION.

- a. Set:  
TRIGGER SOURCE . . . . . INT  
SWEEP TIME . . . . . 5 SEC/CM  
Sweep VERNIER . . . fully counterclockwise  
SWEEP MODE . . . . . FREE RUN
- b. It should take at least 125 seconds for the spot to travel 10 cm.
- c. Set:  
SWEEP MODE . . . . . PRESET  
Sweep VERNIER . . . . . CAL
- d. Connect the Time-Mark Generator to vertical INPUT. Set Time-Mark Generator output and SWEEP TIME as shown in table 5-2.
- e. Adjust TRIGGER LEVEL and vertical SENSITIVITY, if necessary, for a stable, usable display.
- f. In each case adjust HORIZONTAL POSITION to make the first marker coincide with the left graticule edge. The 10-cm marker should be within ±0.3 cm of the right graticule edge.

5-19. SWEEP MAGNIFIER.

- a. Set:  
SWEEP TIME . . . . . 0.1 MSEC/CM  
HORIZONTAL DISPLAY . . . . . X10
- b. Set Time-Mark Generator output for 100 μsec markers.
- c. With HORIZONTAL POSITION, set one marker to coincide with left graticule edge.

- d. The next marker should be within ±0.5 cm of right graticule edge.

e. Set:

SWEEP TIME . . . . . 0.1 μSEC/CM

f. Set Time-Mark Generator output for 10 mc.

g. Set one cycle of the sine wave to cross the left graticule edge.

h. Except for the first cycle of the expanded display, the corresponding point on the waveform one cycle later should cross within ±0.5 cm of the right graticule edge.

i. Disconnect Time-Mark Generator.

5-20. VERTICAL AMPLIFIER BANDWIDTH.

- a. Install Vertical Response Tester in place of vertical plug-in unit.
- b. Set:  
SWEEP TIME . . . . . 0.1 μSEC/CM
- c. Adjust HORIZONTAL POSITION and TRIGGER LEVEL, if necessary, for a stable display.
- d. Set Test Plug-In for a positive 5-cm pulse.
- e. Center trace with VERTICAL POSITION. The 10% and 90% points on the pulse rise time are now 2 cm below and 2 cm above the main horizontal axis of the crt.
- f. Set HORIZONTAL POSITION to place the 10% point on any vertical line of the graticule. The 90% point should be no more than 7 mm to the right of the 10% point.
- g. Remove Test Plug-In and replace vertical plug-in unit.

5-21. CALIBRATOR.

a. Connect the Calibration Generator to vertical INPUT and set output for 10 volts peak-to-peak.

b. Set:

SWEEP TIME . . . . . 2 MSEC/CM  
HORIZONTAL DISPLAY . . . . . X1  
Vertical SENSITIVITY . . . . . 1 VOLT/CM  
Vertical Sensitivity  
VERNIER . . . . . counterclockwise

c. Rotate vertical sensitivity VERNIER clockwise for exactly 5 cm of vertical deflection.

d. Disconnect Calibration Generator and connect CALIBRATOR 10 VOLT output to vertical INPUT. Vertical deflection should be 5 cm  $\pm$ 0.05 cm if ambient temperature is between 15°C and 35°C (50°F and 95°F). Vertical deflection should be 5 cm  $\pm$ 0.15 cm if ambient temperature is between 0°C and 15°C or 35°C and 55°C (32°F and 50°F or 95°F and 130°F).

5-22. INTENSITY MODULATION.

a. Connect the 600-ohm output of the Square Wave Generator to vertical INPUT and INTENSITY MODULATION INPUT.

b. Set 600-ohm output to maximum and frequency to 10 kc.

c. Set:

SWEEP TIME . . . . . 20  $\mu$ SEC/CM  
Vertical SENSITIVITY . . . . . 10 VOLTS/CM  
INTENSITY MODULATION . . . . . EXT  
Vertical POLARITY . . . . . +UP

d. The top of the square wave should be intensified with respect to the bottom.

e. Disconnect Square Wave Generator. Return INTENSITY MODULATION to INT.

5-23. SWEEP AND GATE OUTPUT (OPTIONAL FEATURE).

a. Set SWEEP MODE to FREE RUN.

b. Trigger Test Oscilloscope with gate output signal from Model 175A.

c. Observe SWEEP OUTPUT signal on Test Oscilloscope. Signal should be a linear ramp of approximately -2.5 to +2.5 volts on all SWEEP TIME settings.

d. Observe GATE OUTPUT signal on Test Oscilloscope. Signal should be approximately 4 volts for the duration of sweep on all SWEEP TIME settings.

e. Disconnect Test Oscilloscope.

5-24. ACCESSORY PROBES.

a. Set:

SWEEP TIME . . . . . 0.5 MSEC/CM  
Vertical SENSITIVITY . . . . . 0.2 VOLTS/CM

b. Connect the Model 10003A (AC-21M) Probe from vertical INPUT to CALIBRATOR 10 VOLT output.

c. Loosen locknut at rear of probe and rotate rear plastic flange with respect to cable. The waveform should change from one with overshoot to one with undershoot.

d. Adjust probe for best square wave and tighten locknut. Note vertical amplitude of display.

e. Disconnect probe from vertical INPUT and CALIBRATOR.

f. Connect CALIBRATOR 1 VOLT output directly to vertical INPUT. The vertical amplitude of the display should be equal to that noted in step d.

g. Disconnect CALIBRATOR from vertical INPUT.

5-25. ADJUSTMENTS.

5-26. This section covers internal adjustments of the Model 175A. If difficulty is encountered in making any adjustment, refer to paragraph 5-67 for troubleshooting procedures.

5-27. EQUIPMENT NEEDED FOR ADJUSTMENTS.

5-28. In table 5-1, items 3 through 13 are the test instruments recommended to make the adjustments outlined in this section. Equipment with equivalent characteristics may be substituted. The special horizontal Test Plug shown in figure 5-1 is required to test the main vertical amplifier scanner outputs.

5-29. LOCATION OF ADJUSTMENTS.

5-30. Figures 5-2 and 5-3 show the location of tubes and adjustments in the Model 175A. These diagrams are screened on the inside of the top and bottom covers of the instrument.

5-31. PRELIMINARY SETTINGS.

5-32. Install vertical and horizontal plug-in units in their compartments in the Model 175A. If the vertical plug-in unit has more than one channel, select CHANNEL A and use channel A controls.

a. Make the following settings on the panel of the vertical plug-in unit.

AC-DC . . . . . AC  
VERNIER . . . . . CAL

b. Depending on model number, make the following settings on the panel of horizontal plug-in unit:

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

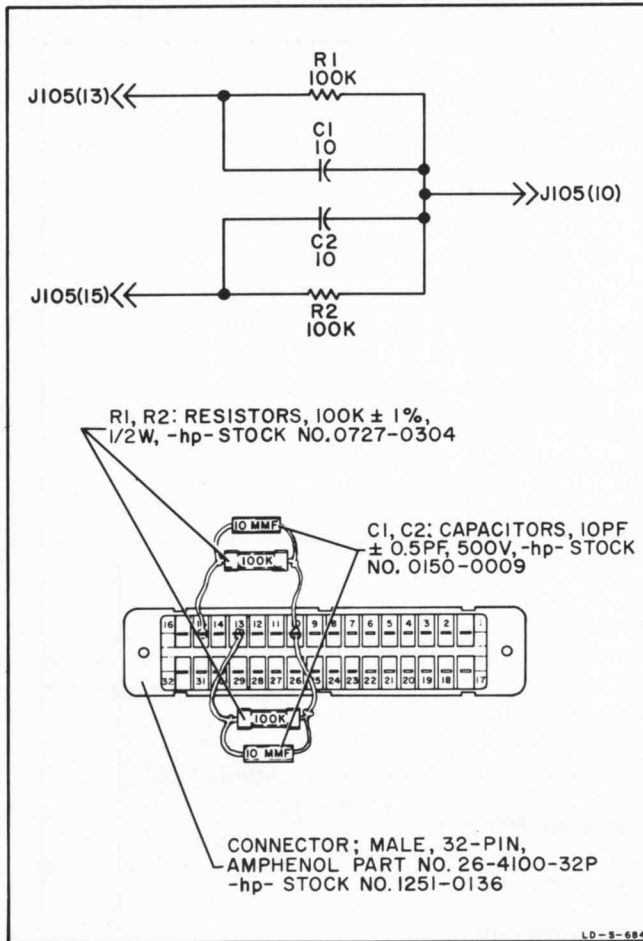


Figure 5-1. Test Plug

c. Connect Model 175A to power source through Variable Transformer and set line voltage to 115 (230) volts. Make the following settings on the panel of the Model 175A:

POWER . . . . . ON  
 HORIZONTAL DISPLAY . . . 1 VOLT/CM AC  
 EXTERNAL VERNIER . . . . . CAL  
 TRIGGER SOURCE . . . . . INT  
 TRIGGER SLOPE . . . . . (+)  
 TRIGGER LEVEL . . . . . 0  
 SWEEP MODE . . . . . PRESET  
 SWEEP TIME . . . . . 1 MSEC/CM  
 Sweep VERNIER . . . . . CAL

5-33. LOW-VOLTAGE POWER SUPPLIES.

5-34. Refer to figure 5-3 for location of adjustments.

a. Set line voltage to 115 volts (230 volts if the 115-230 volt switch is in 230-volt position).

b. Measure output of each supply connecting the DC Voltmeter to the terminals on the printed circuit board mounted adjacent and at right angles to the supply fuses (see figure 5-3).

c. The voltages will normally be within the limits given in table 5-3. If adjustment is required, make the adjustments in the order given in table 5-3.

d. Check regulation of each supply as the line voltage is varied between 102 and 128 volts. All regulated voltages should remain within 1% of the values noted in step b or c.

e. Measure ac ripple on each supply using the AC Voltmeter. The ripple should be within the values given in table 5-3.

Table 5-3. Power Supply Tolerances

Supply (volts)	Tolerance (volts)	Ripple (rms)	Wire Color Code	Adjustment
-100	±3	3 mv	violet	R472
+110	±3	3 mv	pink	R451
+370	±10	4 mv	red	R433
+6.3	±.2	2 mv	brown	R486
-6.3	±.2	2 mv	gray	R486

5-35. HIGH-VOLTAGE POWER SUPPLY.

5-36. Refer to figure 5-2 for location of adjustments.

5-37. DC OUTPUT.

a. Set line voltage to 115 volts.

b. Calibrate the High-Voltage Vacuum-Tube Voltmeter by setting the Calibration Generator to 300 volts, connecting the voltmeter 100:1 high-voltage divider probe to the generator output, and setting the Voltmeter to read 3 volts.

c. Set Voltmeter range to 30 volts and measure the voltage at pin 1 of the low-voltage power transformer T401 (see figure 5-3).

d. The measured voltage should be -2700 volts ±100 volts.

e. Adjust HV Adj R328, if necessary, for a reading of -2700 volts.

f. Vary line voltage from 102 to 128 volts. The -2700 volt supply output should remain within ±25 volts of the reading obtained in step d or e.

5-38. ASTIGMATISM.

a. Center a low intensity spot on the crt.

b. Adjust FOCUS and Astigmatism Adj R340 to obtain the smallest round and sharply focused spot.

5-39. PATTERN.

a. Connect the Time-Mark Generator to vertical INPUT.

b. Set:

HORIZONTAL DISPLAY . . . . . X1

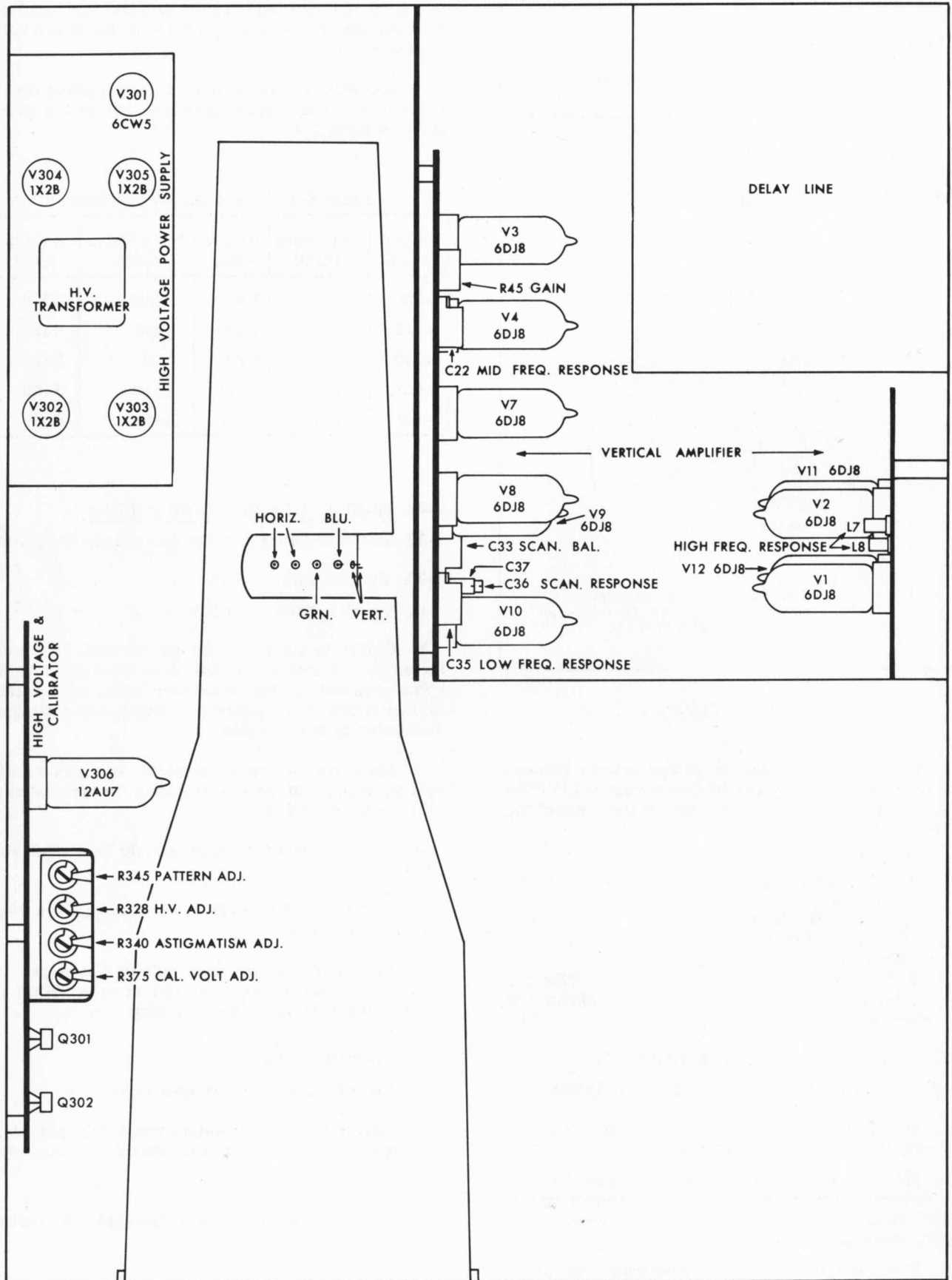


Figure 5-2. Adjustment and Component Locations, Top View



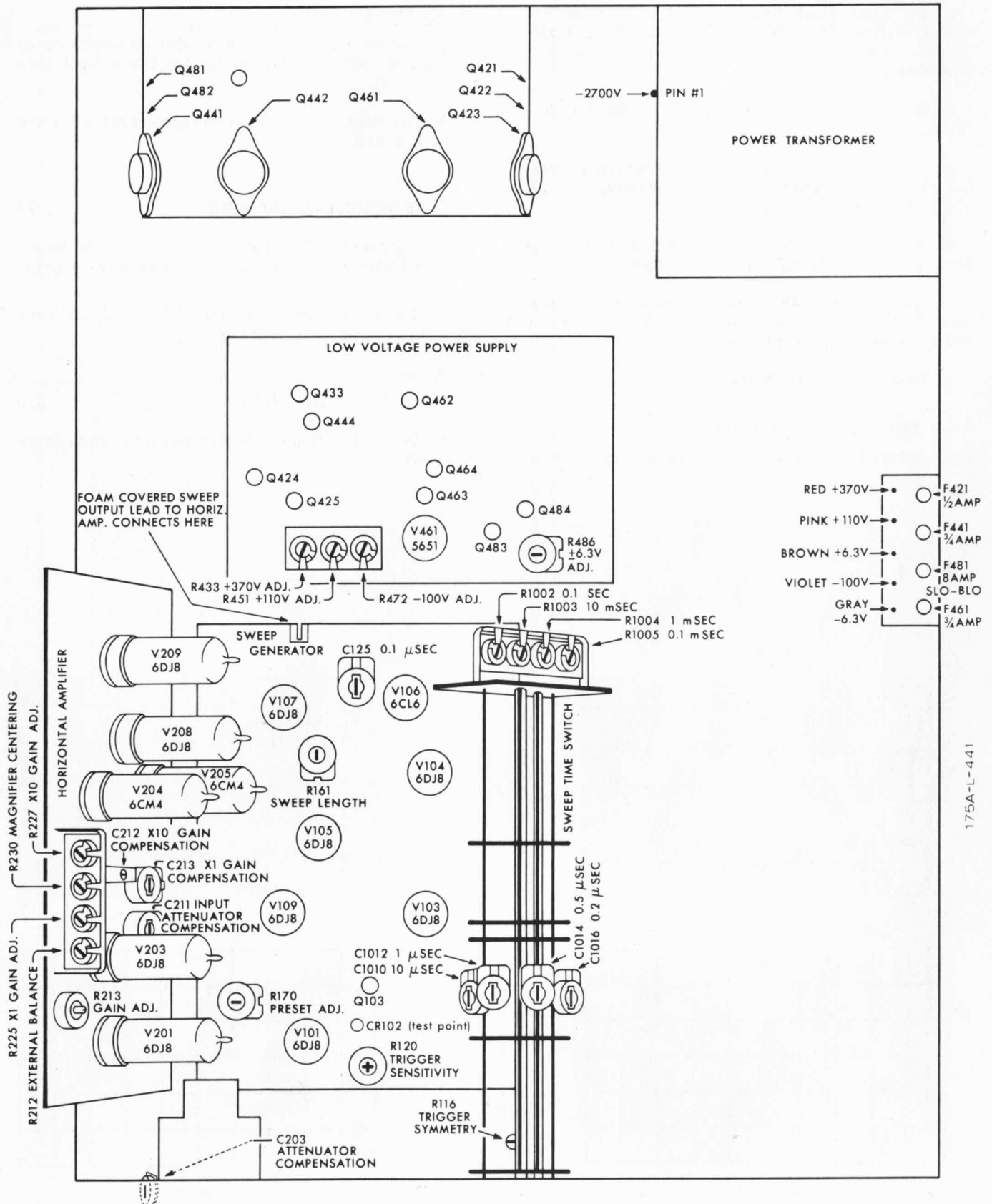


Figure 5-3. Adjustment and Component Locations, Bottom View

c. Set Time-Mark Generator output to 5 mc and adjust vertical SENSITIVITY and VERTICAL POSITION for a 6-cm display coinciding with top and bottom lines of graticule.

d. Set HORIZONTAL POSITION to align left side of display with left graticule edge.

e. Adjust Pattern Adj R345 for minimum barreling or pin-cushioning around top, bottom, and left sides of display (see figure 5-4).

f. Adjust HORIZONTAL POSITION to align right side of display with right graticule edge.

g. Trim Pattern Adj R345, if necessary, for minimum barreling or pin-cushioning. Repeat steps d and e for squarest overall pattern.

h. Disconnect Time-Mark Generator.

5-40. HORIZONTAL AMPLIFIER.

5-41. Refer to figure 5-3 for location of adjustments.

5-42. SWEEP GAIN.

a. Locate foam-covered wire which connects sweep generator output to horizontal amplifier input (see figure 5-3).

b. Disconnect wire from sweep generator printed circuit board.

c. Set:

HORIZONTAL DISPLAY . . . . . X1

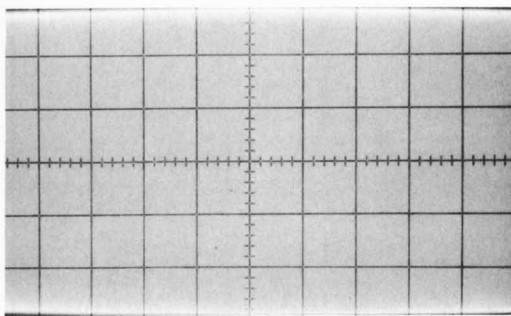
d. Connect the Calibration Generator to the foam-covered wire and set output to 50 volts peak-to-peak.

e. Center display and adjust X1 Gain Adj R225 for 5.5 cm of horizontal deflection.

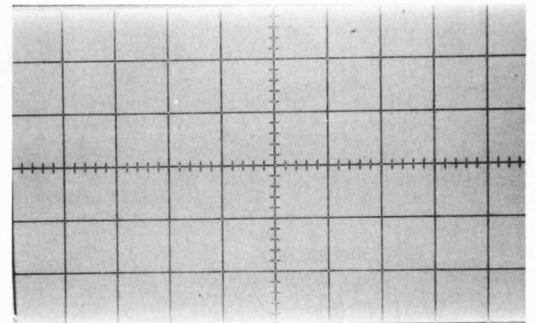
f. Set:

HORIZONTAL DISPLAY . . . . . X10

g. Set Calibration Generator output to 5 volts peak-to-peak.



BARRELING



PIN-CUSHIONING

WF - S-368

Figure 5-4. Pattern Adjustment

h. Center display and adjust X10 Gain Adj R227 for 5.5 cm of horizontal deflection.

i. Disconnect Calibration Generator from foam-covered wire.

5-43. INTERNAL BALANCE.

a. Set:

HORIZONTAL DISPLAY . . . . . X10  
SWEEP MODE . . . . . just out of PRESET

b. Center the spot on crt with HORIZONTAL POSITION control.

c. Set:

HORIZONTAL DISPLAY . . . . . X1

d. Adjust Magnifier Centering R230 to center spot.

e. Repeat steps a through d until spot does not move when switching HORIZONTAL DISPLAY from X1 to X10.

5-44. EXTERNAL BALANCE.

a. Set:

HORIZONTAL DISPLAY 0.1 VOLT/CM DC  
EXTERNAL VERNIER fully counterclockwise

b. Center the spot on crt with HORIZONTAL POSITION control.

c. Set:

EXTERNAL VERNIER . . . . . CAL

d. Adjust External Balance R212 to center spot.

e. Repeat steps a through d until spot does not move when EXTERNAL VERNIER is rotated.

5-45. EXTERNAL GAIN.

a. Connect Calibration Generator to HORIZ INPUT.

b. Set:

HORIZONTAL DISPLAY . 0.1 VOLT/CM DC

c. Set Calibration Generator output to 1 volt peak-to-peak.

d. Adjust Gain Adj R213 for 10 cm of horizontal deflection.

e. Disconnect Calibration Generator.

5-46. FREQUENCY COMPENSATION.

a. Connect Square Wave Generator 600-ohm output to foam-covered wire disconnected in paragraph 5-42.

b. Connect 75-ohm output to TRIG INPUT.

c. Connect, with a jumper, the vertical INPUT to the point (sweep output) on sweep-generator printed-circuit board from which the foam-covered wire was disconnected.

d. Set:

Vertical SENSITIVITY . . . . . 10 VOLTS/CM  
Vertical Sensitivity VERNIER . . . . . CAL  
Vertical AC-DC . . . . . AC  
HORIZONTAL DISPLAY . . . . . X1  
TRIGGER SOURCE . . . . . EXT AC  
SWEEP MODE . . . . . PRESET  
SWEEP TIME . . . . . 0.1 MSEC/CM

e. Set 600-ohm and 75-ohm Square-Wave Generator outputs to maximum and frequency to 4 kc.

f. Center display and adjust TRIGGER LEVEL, if necessary, for a stable display (see figure 5-5).

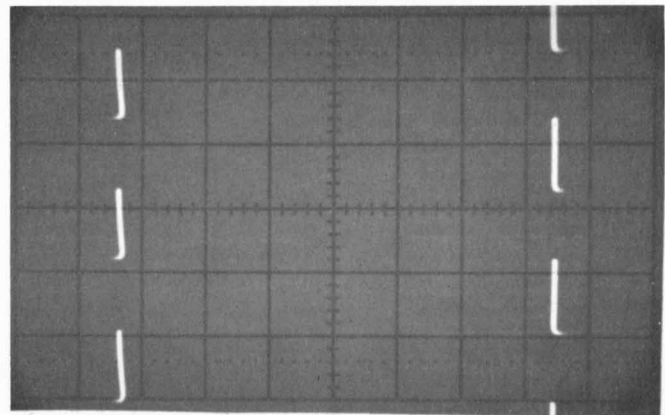


Figure 5-5. Frequency Compensation

g. Adjust Input Attenuator Compensation C211 for best square wave.

h. Set:

HORIZONTAL DISPLAY . . . . . X10

i. Adjust 600-ohm Square Wave Generator output for 8 cm of deflection. Trim C211, if necessary, for best square wave with HORIZONTAL DISPLAY in X1 and X10 positions.

j. Set:

HORIZONTAL DISPLAY . . . . . X1  
SWEEP TIME . . . . . 10 μSEC/CM

k. Set 600-ohm Square Wave Generator output to maximum and frequency to 40 kc.

m. Adjust X1 Gain Compensation C213 for best square wave.

n. Set:

HORIZONTAL DISPLAY . . . . . X10

p. Set 600-ohm Square Wave Generator output for 8 cm of deflection.

q. Adjust X10 Gain Compensation C212 for best square wave.

r. Set:

HORIZONTAL DISPLAY . . . 1 VOLT/CM DC

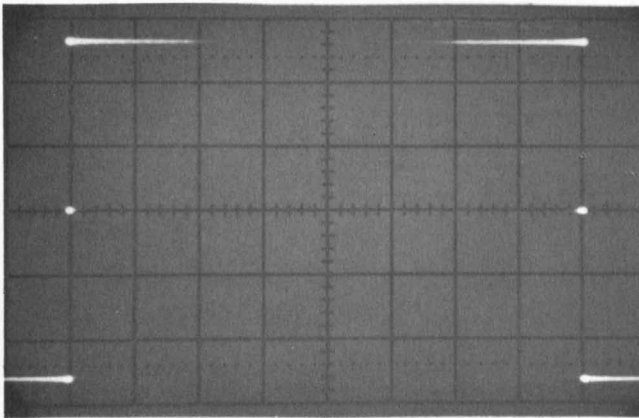


Figure 5-6. Attenuator Compensation  
 (Top: undercompensated, Middle: compensated,  
 Bottom: overcompensated)

s. Disconnect 600-ohm Square-Wave Generator output from foam-covered wire and connect Generator to HORIZ INPUT. Adjust output amplitude for 8 cm deflection and frequency to 4 kc.

t. Adjust Attenuator Compensation C203 for round dots with no tails (see figure 5-6).

u. Disconnect Square-Wave Generator and jumper from vertical INPUT and sweep-generator printed-circuit board. Connect foam-covered wire to sweep-generator printed-circuit board.

5-47. SWEEP GENERATOR.

5-48. Refer to figure 5-3 for location of adjustments.

5-49. PRESET.

a. Set:

HORIZONTAL DISPLAY . . . . . X1  
 SWEEP TIME . . . . . 10  $\mu$ SEC/CM

b. Connect DC Voltmeter to pin 3 of V109. This voltage will be approximately -40 volts.

c. Rotate SWEEP MODE slowly clockwise while watching Voltmeter. Meter pointer will jump when sweep generator free runs.

d. Note voltage at which sweep generator free runs (maximum negative reading obtained on Voltmeter).

e. Set:

SWEEP MODE . . . . . PRESET

f. Adjust Preset Adj R170 for meter reading of 2.5 volts less negative than voltage noted in step d.

g. Disconnect Voltmeter.

5-50. TRIGGER SENSITIVITY AND SYMMETRY.

a. Set:

SWEEP MODE . . . . . PRESET  
 TRIGGER SLOPE . . . . . (-)  
 TRIGGER SOURCE . . . . . EXT AC  
 HORIZONTAL DISPLAY . . . . . X1  
 SWEEP TIME . . . . . 1 MSEC/CM  
 Vertical SENSITIVITY . . . . . 0.05 VOLT/CM  
 Vertical AC-DC . . . . . AC

b. Connect Model 10003A (AC-21M) Probe from vertical INPUT to case of tunnel diode CR102 on sweep-generator circuit board (see figure 5-3). CAUTION: +110 VOLTS present at this point.

c. Connect Calibration Generator to TRIG INPUT and adjust output for 0.05 volt rms.

d. Mechanically center Trigger Symmetry R116, and turn Trigger Sensitivity R120 fully clockwise.

e. Rotate TRIGGER LEVEL to obtain a free running display approximately 0.5 volt in amplitude (see figure 5-7).

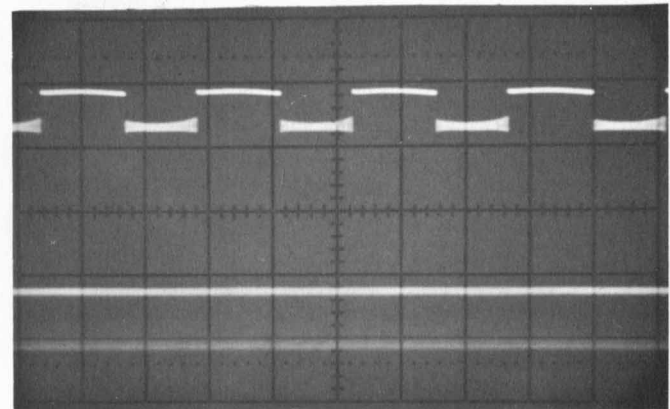


Figure 5-7. Trigger Sensitivity  
 (Top: Synchronized, Bottom: Free Running)

f. Using TRIGGER LEVEL to maintain a presentation adjust Trigger Sensitivity R120 counterclockwise until a stable, synchronized, symmetrical square wave approximately 0.35 volt in amplitude is obtained (see figure 5-7).

g. Set Calibration Generator output to 0.03 volt rms.

h. The trigger circuit should not trigger solidly. Counterclockwise adjustment of Trigger Sensitivity R120 may be necessary to prevent solid triggering. Rotate TRIGGER LEVEL when checking for solid triggering.

i. Set Calibration Generator output to 0.05 volt rms.

j. The trigger circuit should again trigger solidly. Adjust TRIGGER LEVEL if necessary. Repeat steps f, g, h, and i until circuit triggers solidly with a 0.05-volt rms input and does not trigger solidly with a 0.03-volt rms input.

k. Set:  
TRIGGER SLOPE (+)

m. Ground green/orange wire which is connected to TRIGGER SLOPE switch.

n. Adjust Trigger Symmetry R116 for a symmetrical square wave display.

p. Unground green/orange wire. Disconnect probe from CR102 and vertical INPUT. Disconnect Calibration Generator.

5-51. SWEEP LENGTH.

a. Connect Square-Wave Generator 75-ohm output to vertical INPUT, and set frequency to 1 mc.

b. Set:  
HORIZONTAL DISPLAY . . . . . X1  
TRIGGER SOURCE . . . . . INT  
TRIGGER LEVEL . . . . . 0  
SWEEP MODE . . . . . PRESET  
SWEEP TIME . . . . . 1 MSEC/CM

c. Set Square Wave Generator output and vertical SENSITIVITY for approximately 3 cm of deflection.

d. Adjust Sweep Length R161 for 11 cm of sweep.

e. Disconnect Square-Wave Generator.

5-52. SWEEP TIME.

a. Connect Time-Mark Generator to vertical INPUT.

b. Set:  
HORIZONTAL DISPLAY . . . . . X1  
SWEEP MODE . . . . . PRESET  
TRIGGER SOURCE . . . . . INT

c. Set vertical SENSITIVITY and TRIGGER LEVEL for a suitable display, and set SWEEP TIME and marker interval as shown in table 5-4. Make the corresponding adjustment for the indicated markers per centimeter if necessary.

d. Disconnect Time-Mark Generator.

5-53. VERTICAL AMPLIFIER.

5-54. Refer to figure 5-2 for location of adjustments.

5-55. GAIN.

a. Install Vertical Test Adapter in vertical plug-in connector J1 in place of vertical plug-in unit.

b. Connect 1.0 volt peak-to-peak from Calibration Generator to Test Adapter and adjust position control on adapter for on-scale trace.

c. Adjust Gain R45 for 5 cm deflection.

d. Remove Test Adapter and install vertical plug-in unit.

5-56. SCAN RESPONSE.

a. Connect Square-Wave Generator 75-ohm output to vertical INPUT and set frequency to 50 kc.

b. Set Square-Wave Generator 75-ohm output and vertical SENSITIVITY for 6 cm of deflection.

c. Trigger Test Oscilloscope with 600-ohm output of Square-Wave Generator.

d. Remove horizontal plug-in unit from Model 175A and install Test Plug described in paragraph 5-28.

e. Observe signal on pin 15 of horizontal plug-in connector J105. Use probe on Test Oscilloscope to minimize loading.

f. Adjust Scan Response C36 for best square wave as viewed on Test Oscilloscope.

g. Observe signal on pin 13 of horizontal plug-in connector J105.

h. Adjust Scan Response C37 for best square wave as viewed on Test Oscilloscope.

i. Set frequency of Square-Wave Generator to 1 mc.

j. Observe signal on pin 10 of Test Plug.

k. Adjust Scan Balance C33 for best balance as viewed on Test Oscilloscope (see figure 5-8).

Table 5-4. Sweep Time

SWEEP TIME	Markers	Adjust	Set for
.1 μSEC/CM	10 mc	C125	1 cycle/cm
.2 μSEC/CM	5 mc	C1016	1 cycle/cm
.5 μSEC/CM	1 μsec	C1014	1 marker/2 cm
1 μSEC/CM	1 μsec	C1012	1 marker/cm
10 μSEC/CM	10 μsec	C1010	1 marker/cm
.1 MSEC/CM	100 μsec	R1005	1 marker/cm
1 MSEC/CM	1 msec	R1004	1 marker/cm
10 MSEC/CM	10 msec	R1003	1 marker/cm
.1 SEC/CM	100 msec	R1002	1 marker/cm

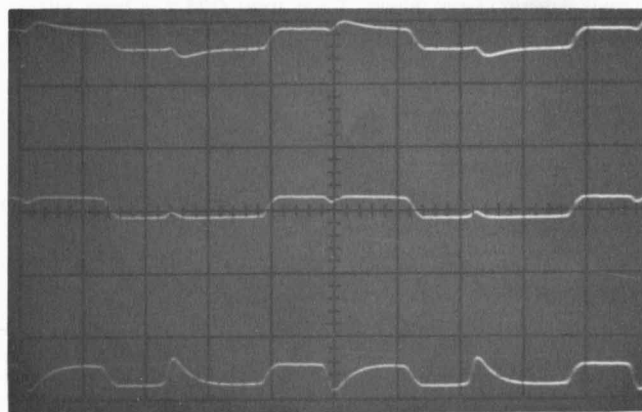


Figure 5-8. Scan Balance (Top: Unbalanced Middle: Balanced, Bottom: Unbalanced)

m. Disconnect Test Oscilloscope and Square-Wave Generator.

n. Remove Test Plug and install horizontal plug-in unit.

5-57. PULSE RESPONSE.

a. Remove vertical plug-in unit and install Test Plug-In Unit.

b. Set Test Plug-In Unit for a positive pulse output 5 cm in amplitude.

c. Set:

SWEEP TIME . . . . . 0.5  $\mu$ SEC/CM  
TRIGGER SOURCE . . . . . INT  
TRIGGER SLOPE . . . . . (+)  
SWEEP MODE . . . . . PRESET  
HORIZONTAL DISPLAY . . . . . X1

d. Set TRIGGER LEVEL for stable display and adjust Mid Freq. Response C22 to drop leading corner of pulse about 0.2 cm (see figure 5-9).

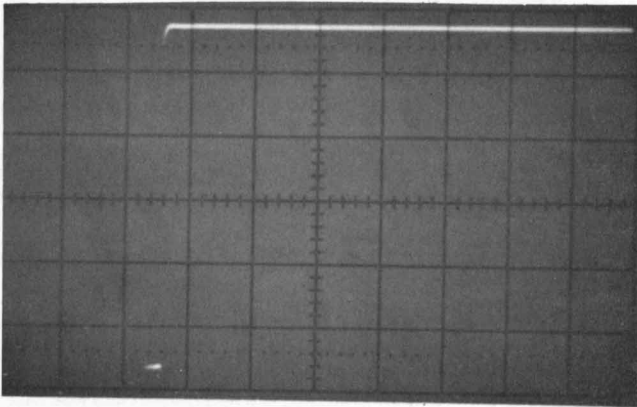


Figure 5-9. Mid-Frequency Response Preliminary Adjustment

e. Adjust Low Freq Response C35 for best pulse flat top.

f. Readjust Mid Freq Response C22 for best pulse response (see figure 5-10).

g. Set:

SWEEP TIME . . . . . 0.1  $\mu$ SEC/CM

h. Adjust Hi Freq Response L7 and L8 for best high frequency corner (see figure 5-11).

i. Remove Test Plug-In and install vertical plug-in.

5-58. CALIBRATOR.

a. Connect Calibration Generator to vertical INPUT and set output to 10 volts peak-to-peak.

b. Set:

HORIZONTAL DISPLAY. . . . . X1  
SWEEP TIME . . . . . 0.5 MSEC/CM  
TRIGGER SOURCE . . . . . INT  
TRIGGER LEVEL . . . . . 0  
SWEEP MODE. . . . . PRESET  
Vertical SENSITIVITY . . . . . 1 VOLT/CM

c. Set vertical sensitivity VERNIER for exactly 6 cm of deflection.

d. Disconnect Calibration Generator and connect vertical INPUT to CALIBRATOR 10 VOLT output.

e. Adjust Cal Volt Adj R375 for exactly 6 cm of deflection.

f. Disconnect CALIBRATOR from vertical INPUT.

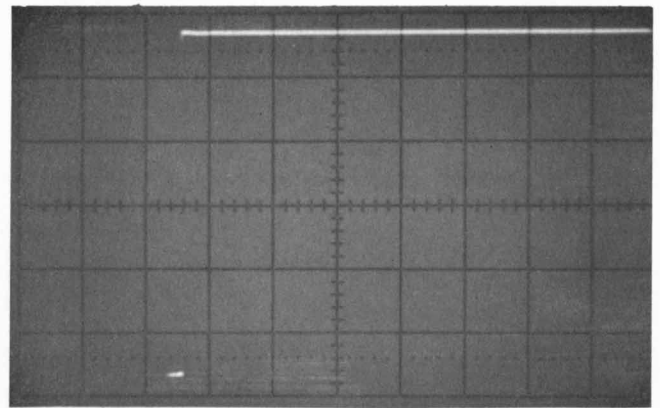


Figure 5-10. Mid-Frequency Response Final Adjustment

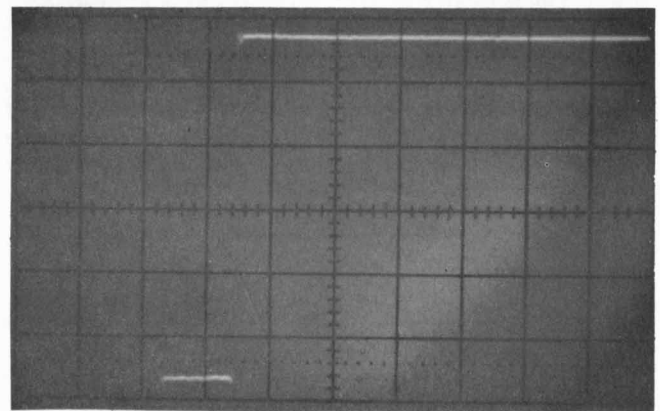


Figure 5-11. High-Frequency Response

5-59. REPAIRS.

5-60. The Model 175A uses edge-on connectors for most connections to the boards. The assembly may be removed in a few moments for access to otherwise hidden components. When removing or replacing edge-on connectors be careful to align the connector properly with its guide slot. Applying force with the connector improperly aligned may spring the contacts and result in a poor connection.

5-61. EQUIPMENT REQUIRED.

5-62. In general, miniaturized equipment calls for miniature tools. The following are particularly important:

- a. Low-heat soldering iron (25 to 50 watts). Idling temperature must be no more than 800°F.
- b. Small soldering iron tip (1/16 to 3/32 inch).
- c. Small-diameter rosin-core solder.
- d. Wooden toothpick.

5-63. The low-heat iron is required in order to protect solid-state devices from too high a temperature, and to avoid causing conductors to lift from the printed circuit boards. The small tip will transfer less heat to the component, yet will be adequate to melt the solder. Small-diameter solder melts more quickly, reducing the length of time that heat must be applied. The toothpick is essential for cleaning out mounting holes after removing a component. Do not attempt repairs on the Model 175A unless the above equipment is on hand.

5-64. PROCEDURE.

5-65. The Model 175A has plated-through circuit boards. Each component mounting hole is plated through in order to provide electrical conduction from one side of the board to the other and to provide a better solder bond between the circuit and the component. The plating is easily damaged by reaming the hole with a metal tool, or by forcing component leads into the hole. The use of the wooden toothpick for cleaning out solder, and ordinary care in replacing the component, will result in a satisfactory job.

5-66. REPLACING TRANSISTORS. Solid-state diodes and transistors require special handling, in that they are sensitive to both heat and electrical overload. Use long-nose pliers between the iron and the device as a heat sink. Hold the pliers for a moment after the iron is removed to allow the joint to cool. Be sure there is no electrical leakage from iron to work. Such leakage can damage transistors.

5-67. TROUBLESHOOTING.

5-68. ISOLATING TROUBLES TO A MAJOR SECTION.

5-69. The following check may be performed whenever instrument malfunction is suspected.

a. Set:

HORIZONTAL DISPLAY . . . 1 VOLT/CM AC  
 EXTERNAL VERNIER . . . . . CAL  
 Vertical SENSITIVITY . . . 2 VOLTS/CM  
 Vertical Sensitivity VERNIER . . . . . CAL

b. Depending on the model number of the horizontal plug-in unit, set controls as follows:

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

- c. Depress BEAM FINDER.
- d. A defocused spot should appear on the crt.
- e. If proper display is obtained, it is likely that the power supplies are operating properly. If no spot appears, troubleshoot the power supplies (paragraphs 5-70 and 5-77) and the amplifiers (paragraphs 5-81 and 5-93).
- f. Connect CALIBRATOR 10 VOLT output to vertical INPUT and HORIZ INPUT.
- g. A tilted straight line pattern with a 10-cm horizontal deflection and 5-cm vertical deflection should be obtained.
- h. If proper display is obtained, it is likely that the horizontal amplifier, vertical amplifier, and calibrator are operating properly.

i. Set:

HORIZONTAL DISPLAY . . . . . X1  
 SWEEP MODE . . . . . PRESET  
 SWEEP TIME . . . . . 1 MSEC/CM  
 Sweep VERNIER . . . . . CAL  
 TRIGGER LEVEL . . . . . 0  
 TRIGGER SOURCE . . . . . INT

- j. A synchronized square wave pattern 5 cm high should be obtained.
- k. If proper display is obtained, it is likely that the sweep generator is operating properly.

5-70. LOW-VOLTAGE POWER SUPPLIES.

5-71. The transistors used in the power supply are located on the power-supply printed-circuit board and fan-shroud assembly. The series-regulator transistors are power transistors mounted on heat sinks on the fan-shroud assembly. The amplifier and other transistors are mounted on the printed circuit board (figure 5-33).

5-72. If maintenance on the fan-shroud assembly is required, it may easily be removed from the instrument by removing the mounting screws on rear gusset. However, power supply malfunctions can generally quickly be isolated to components either on the printed circuit board or on the fan-shroud assembly, thus eliminating unnecessary removal of the fan-shroud assembly.

5-73. Nominal voltages at key points in the supply are given on the Low-Voltage Power-Supply schematic diagram, figure 5-34.

5-74. The cause of excessive output ripple on any of the supplies can be isolated in the following manner. Measure the ripple at the output of the rectifiers of the supply in question. Compare the measurement with the value given on the schematic diagram, figure 5-34. If the ripple is excessive, check the input filter capacitors and bleeder resistors. If the input ripple is normal, the cause is most likely low gain in the amplifier transistors.

5-75. Table 5-5 gives troubleshooting aids for locating causes of loss of regulation in each supply.

5-76. The balance between the +6.3 volt and -6.3 volt supply outputs and ground is determined by the supply load. The load is a series-parallel arrangement of tube heaters, diagrammed in figure 5-35. An unbalanced output voltage can usually be traced to an open or shorted tube heater or a wrong type tube.

Table 5-5. Troubleshooting the Low-Voltage Supply

Supply	Symptom	Procedure	Effect	Trouble
-100V	High output	Disconnect base lead of Q461 from printed circuit board. This is the yellow lead which connects to rear edge of board adjacent to fan motor.	Output remains high	Q461 shorted
			Voltage drops	Q461 good
		Reconnect yellow wire to printed circuit board and short collector of Q464 to emitter.	Output remains high	Q462 shorted
			Voltage drops	Q464 open
	Low output	Short collector of Q462 to emitter	Output remains low	Q461 open
			Voltage rises	Q461 good
		Remove short from Q462 and measure voltage across CR465	0 volt	CR465 shorted
			6 volts	CR465 good
		Measure voltage across R470	Within 10 volts of output	Q463 open or C466 shorted
			Less than output	Q463 and C466 good
	Measure voltage from collector of Q464 to emitter	0 volt approx 10 volts	Q464 shorted Q464 good	
	+110V	High output	Check -100 volt supply output	Normal
Abnormal				Trouble in -100V supply
Disconnect base lead of Q442 from printed circuit board. This is the white lead which connects to rear edge of board adjacent to fan motor.			Output remains high	Q441 or Q442 shorted
			Voltage drops	Q441 and Q442 good
Reconnect white lead and measure voltage from collector of Q443 to emitter			0 volt	Q443 shorted
			Greater than 2 volts	Q443 good
Measure voltage from collector of Q444 to emitter			0 volt	Q444 shorted
			Greater than 2 volts	Q444 good
Low output		Check -100 volt supply output	Normal	Trouble in +110V supply
			Abnormal	Trouble in -110V supply
		Short collector of Q443 to emitter	Output remains low	Q441 or Q442 open
			Voltage rises	Q441 and Q442 good



Table 5-5. Troubleshooting the Low-Voltage Supply (Cont'd)

Supply	Symptom	Procedure	Effect	Trouble
+ 110V cont'd	Low output	Remove short from Q443 and short collector of Q444 to emitter	No change	Q443 open
			Voltage rises	Q444 open
		Remove short from Q444 and measure voltage at base of Q444	Positive	C445 shorted or leaky
+ 370V	High output	Check -100 volt supply output	Normal	Trouble in + 110V or + 370V supply
			Abnormal	Trouble in -100V supply
		Check + 110 volt supply output	Normal	Trouble in + 370V supply
			Abnormal	Trouble in + 110V supply
		Disconnect base lead of Q423 from printed circuit board. This is orange lead which connects rear edge of board adjacent to fan motor.	Output remains high	Q421, Q422, or Q423 shorted
			Output voltage drops below + 370 volts	Q421, Q422, and Q423 good
		Reconnect orange lead and measure voltage from collector Q424 to emitter	0 volt	Q424 shorted
			Greater than 2 volts	Q424 good
	Measure voltage from collector of Q425 to emitter	0 volt	Q425 shorted	
		Greater than 2 volts	Q425 good	
	Low output	Check -100 volt supply output	Normal	Trouble in + 110 or + 370V supply
			Abnormal	Trouble in -100V supply
		Check + 110 volt supply output	Normal	Trouble in + 370V supply
			Abnormal	Trouble in + 110V supply
		Short collector of Q424 to emitter	Output remains low	Q421, Q422, or Q423 open
			Output rises	Q421, Q422, or Q423 good
Remove short from Q424 and measure voltage across CR425		0 volt	CR425 shorted	
		6 volts	CR425 good	
Short collector of Q425 to emitter	Output remains low	Q424 open		
	Output rises	Q425 open		
± 6.3V	High output (Voltmeter from + 6.3V to -6.3V output)	Check -100 volt supply output	Normal	Trouble in ± 6.3V supply
			Abnormal	Trouble in -100V supply
		Disconnect base lead of Q482 from printed circuit board. This is the blue lead which connects to front edge of board adjacent to V461, the 5651 reference tube.	Output remains high	Q481 or Q482 shorted
			Output drops	Q481 and Q482 good

Table 5-5. Troubleshooting the Low-Voltage Supply (Cont'd)

Supply	Symptom	Procedure	Effect	Trouble
±6.3V cont'd		Reconnect blue wire and measure voltage from collector of Q483 to emitter	0 volt	Q483 shorted
			Greater than 2 volts	Q483 good
		Short collector of Q484 to emitter	Output drops	Q484 open
	Low output (Voltmeter from +6.3V to -6.3V output)	Check -100 volt supply output	Normal	Trouble in ±6.3V supply
			Abnormal	Trouble in -100V supply
		Short collector of Q483 to emitter	Output remains low	Q481 or Q482 open
			Output rises	Q481 and Q482 good
		Remove short from Q483 and measure voltage from collector of Q483 to emitter	Greater than 10 volts	Q483 open
			Approx 2.5 volts	Q483 good
		Measure voltage from collector of Q484 to emitter	0 volt	Q484 shorted
			Greater than 2 volts	Q484 good
		Measure voltage across CR483	0 volt	CR483 shorted
			6 volts	CR483 good

5-77. HIGH-VOLTAGE POWER SUPPLIES.

5-78. Waveforms and dc voltages are given as a troubleshooting aid on the high-voltage power-supply schematic diagram, figure 5-32.

5-79. The cause of an output voltage which is too high or too low can best be isolated by measuring dc voltages. Start with the resistor divider string composed of resistors R328 through R337. Then check voltages on regulator tube V306 and rf oscillator tube V301.

5-80. The cause of loss of regulation can also best be isolated by this method. A change in the crt cathode voltage in the positive direction should be sensed by V306 and appear as a positive change at the screen grid, pin 9, of V301. The plate voltage of V301 should then increase accordingly. Likewise, a negative change in crt cathode voltage should cause the plate voltage of V301 to decrease.

5-81. VERTICAL AMPLIFIER.

5-82. As a troubleshooting aid, nominal dc voltages and signal waveforms are given on the vertical-amplifier schematic diagram, figure 5-19.

5-83. UNBALANCE. Unbalance in direct-coupled differential amplifier V1-V4 and V7-V9 can be isolated by measuring the dc voltages on the various tube elements. In order to eliminate the effect of any unbalance in the vertical plug-in unit, short pins 2 and 7 of V1 together. Since a properly operating differential amplifier has equal voltages on each side of the amplifier, another method may be used to isolate an unbalanced stage. Proceed as outlined in table 5-6.

5-84. IMPROPER GAIN. Insure that the vertical plug-in unit gain is correct and that the gain of the amplifier cannot be set properly by adjusting Gain Control R45. If not, mechanically center R45, and set up the conditions of waveform measurements given in the vertical-amplifier schematic diagram notes, figure 5-19. To isolate the cause of abnormal gain, check the gain of each stage of the amplifier against the waveforms given in figure 5-19 starting from the input.

5-85. COMPRESSION. The compression of the vertical amplifier can be checked in the following manner:

- a. Connect a 1-kc sine wave signal to vertical INPUT.
- b. Connect a high-impedance ac voltmeter isolated from ground to the vertical crt deflection plates, D3 and D4. CAUTION: +300 VOLTS present on both terminals.
- c. Vertically center the trace on the crt, and adjust the sine wave amplitude and vertical SENSITIVITY for a reading of 1.0 volt on voltmeter.
- d. Position the trace to the top of graticule.
- e. The voltmeter reading should be 1.0 volt ±0.05 volt.
- f. Position the trace to the bottom of graticule.
- g. The voltmeter reading should be 1.0 volt ±0.05 volt.

Table 5-6. Vertical Amplifier Troubleshooting

Procedure	Effect	Trouble
Short pin 6 of V8 and pin 6 of V9 together	Trace does not center Trace centers	High- or low-voltage power supply, or crt Before crt
Remove short from V8 and V9 and short pins 3 and 8 of V7 together	Trace does not center Trace approx centers	V8, V9, V10 Before V8 and V9
Remove short from pins 3 and 8 and short pins 2 and 7 of V7 together	Trace does not center Trace approx centers	V7 Before V7
Remove short from V7 and short pins 2 and 7 of V4 together	Trace does not center Trace approx centers	V4 Before V4
Remove short from V4 and short pins 2 and 7 of V3 together	Trace does not center Trace approx centers	V3 Before V3
Remove short from V3 and short pins 2 and 7 of V2 together	Trace does not center Trace approx centers	V2 Before V2
Remove short from V2 and short pins 2 and 7 of V1 together	Trace does not center Trace approx centers	V1 Vertical plug-in unit

5-86. If the amplifier exhibits excessive compression, the cause can be isolated by moving the voltmeter to the grids of the preceding stage and repeating steps c through g. Move the voltmeter from the deflection plates to pin 2 of V8 and V9; then to pins 2 and 7 of V7; then to pins 2 and 7 of V4, etc. When a correct compression reading is obtained, the trouble is located between that particular measurement point and the preceding one.

5-87. SWEEP GENERATOR.

5-88. Nominal dc voltages and waveforms are given as a troubleshooting aid on the sweep-generator schematic diagram, figure 5-23.

5-89. If the sweep generator operates properly when the SWEEP MODE control is in FREE RUN but not in TRIGGER or PRESET, the problem is most likely associated with V101, CR102, Q103, or R170.

5-90. If the sweep generator does not operate properly with the SWEEP MODE control in FREE RUN, ensure that the problem is not in the horizontal amplifier by checking the horizontal amplifier for proper operations.

5-91. If the problem is in the sweep generator, it is most likely associated with V103 through V107 or V109. Since this circuit utilizes feedback, the problem can most easily be isolated by forcing the sweep generator to remain in one of its two states. One state is known as the sweep completed state. In this state the output remains at the peak level of the normally present sweep voltage. The other state is known as the reset state. In this state, the output remains at the starting level of the normally present sweep voltage.

5-92. To troubleshoot the sweep generator, put the sweep generator in each of these states as explained in table 5-7 and check the dc voltages against the values given in table 5-7. A 10% or 15% variation from the values given can be expected; however, larger variations indicate a source of trouble.

Table 5-7. Sweep Generator Troubleshooting Guide

Test Point	Sweep Completed*	Reset**
V103 Pin 7	-100	0
V103 Pin 6	+110	+6.5
V103 Pin 3	+52	-24
V103 Pin 3	+52	-20
V104 Pin 2	-16	-52
V104 Pin 3	-17	-2.1
V104 Pin 1	-6	-3.8
V104 Pin 7	-52	-51
V104 Pin 8	+80	-50
V106 Pin 9	-6.4	-4.4
V106 Pin 6	+310	+70
V107 Pin 2	+81	-56
V107 Pin 3	+81	-50
V105 Pin 7	-6.7	-74
V105 Pin 8	-1.1	-65
V109 Pin 8	-100	0
V109 Pin 3	-100	0

\* Sweep Completed: Remove V109 from socket.  
\*\* Reset: Remove V109 from socket and ground pin 7 of V103

Table 5-8. Horizontal Amplifier Troubleshooting

Procedure	Effect	Trouble
Connect DC Voltmeter to pin 2 of V204. Adjust HORIZONTAL POSITION for reading of 0 volt. <i>R262</i>	0 volt reading impossible Correct reading	R262 or V203 Input circuitry good
Measure voltages at pin 1 of V204 and pin 1 of V205	Voltages unequal Voltages approx equal	V204 or V205 V204 and V205 good
Measure voltages at pins 3 and 8 of V208	Voltages unequal Voltages approx equal	V208 or V209 V208 and V209 good

5-93. HORIZONTAL AMPLIFIER.

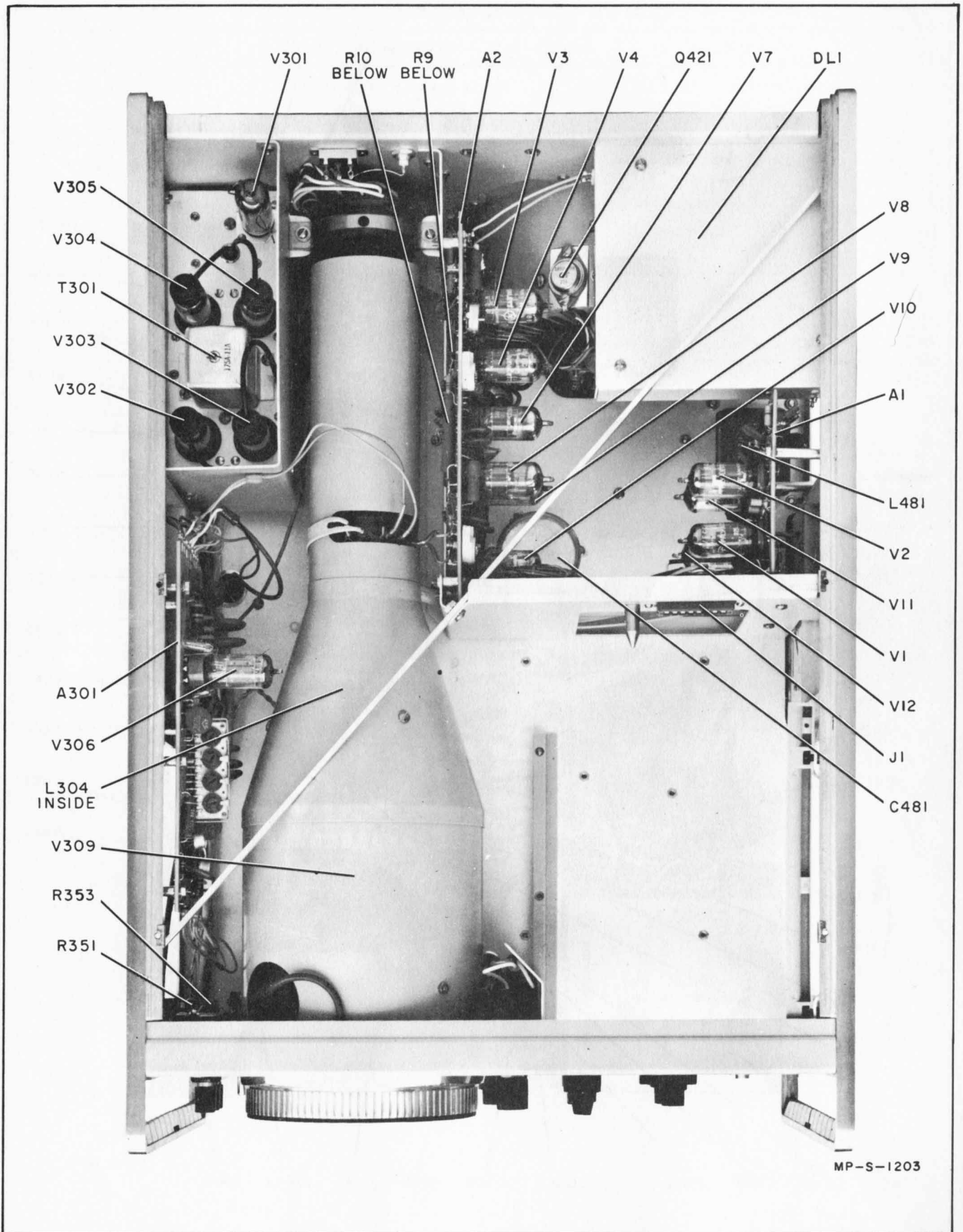
5-94. Signal waveforms and their associated dc levels are given as a troubleshooting aid on the horizontal-amplifier schematic diagram, figure 5-29.

5-95. If the horizontal amplifier appears to operate properly with the HORIZONTAL DISPLAY in any of the external input positions, but not in internal sweep positions, the trouble is most likely in the sweep generator.

5-96. If the horizontal amplifier appears to operate properly with the HORIZONTAL DISPLAY in the internal sweep positions, but not in any of the external input positions, the trouble is most likely associated with the horizontal input amplifier.

5-97. UNBALANCE. The cause of unbalance in the horizontal amplifier will most likely be associated with V204, V205, V208, or V209 since these are the only stages connected in the differential configuration. Measurement of dc voltages on each side of the amplifier is the best method to use to isolate the cause of unbalance because of the feedback used in the amplifier. Proceed as in table 5-8.

5-98. GAIN. If the amplifier has the wrong gain, ensure that it cannot be corrected by adjusting Gain Adj R213, X1 Gain Adj R225, or X10 Gain Adj R227. The waveforms given on the schematic diagram, figure 5-29, provide information on the gain of each stage. Start at the input and proceed toward the deflection plates.



MP-S-1203

Figure 5-12. Model 175A Component Locations, Top View

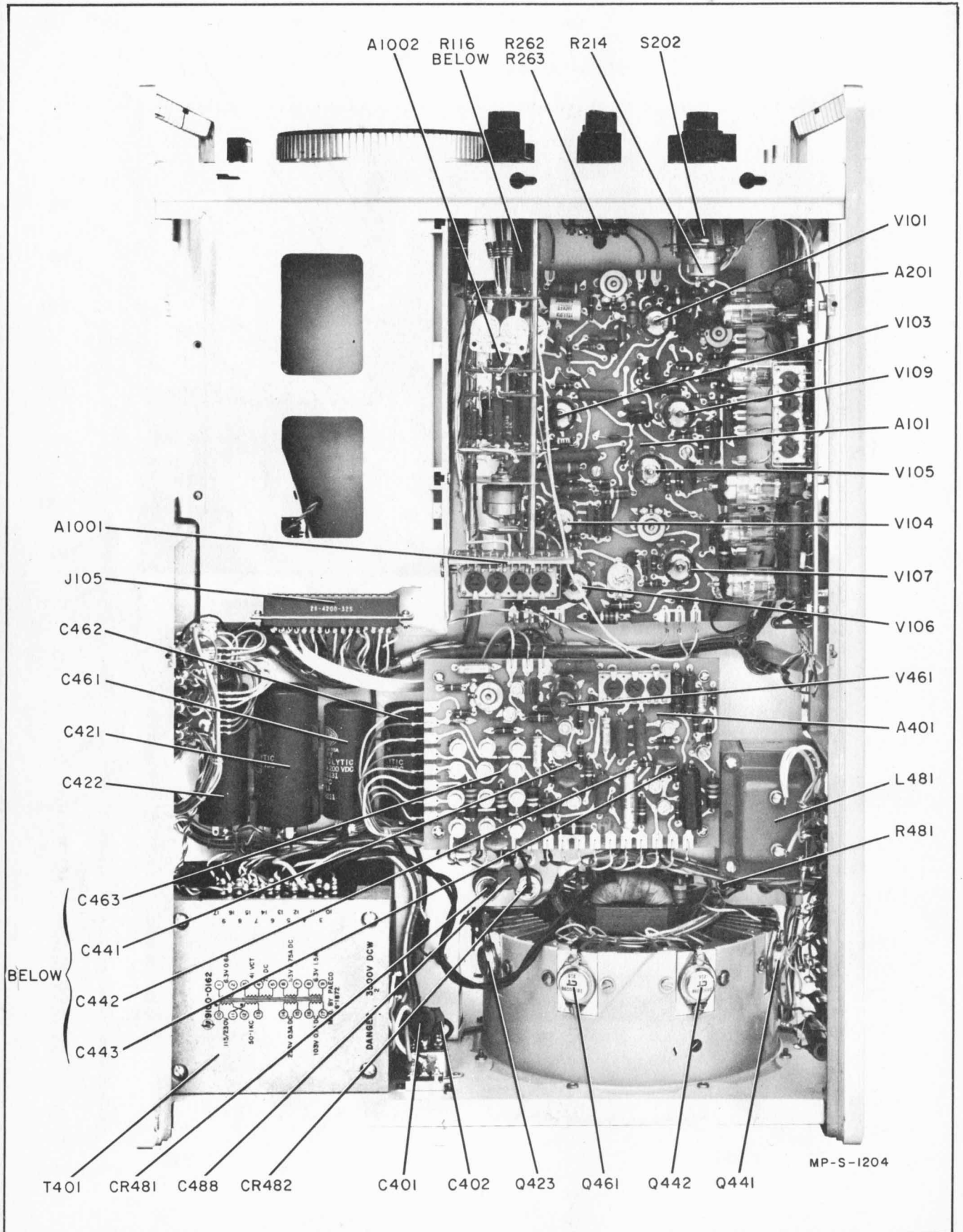


Figure 5-13. Model 175A Component Locations, Bottom View

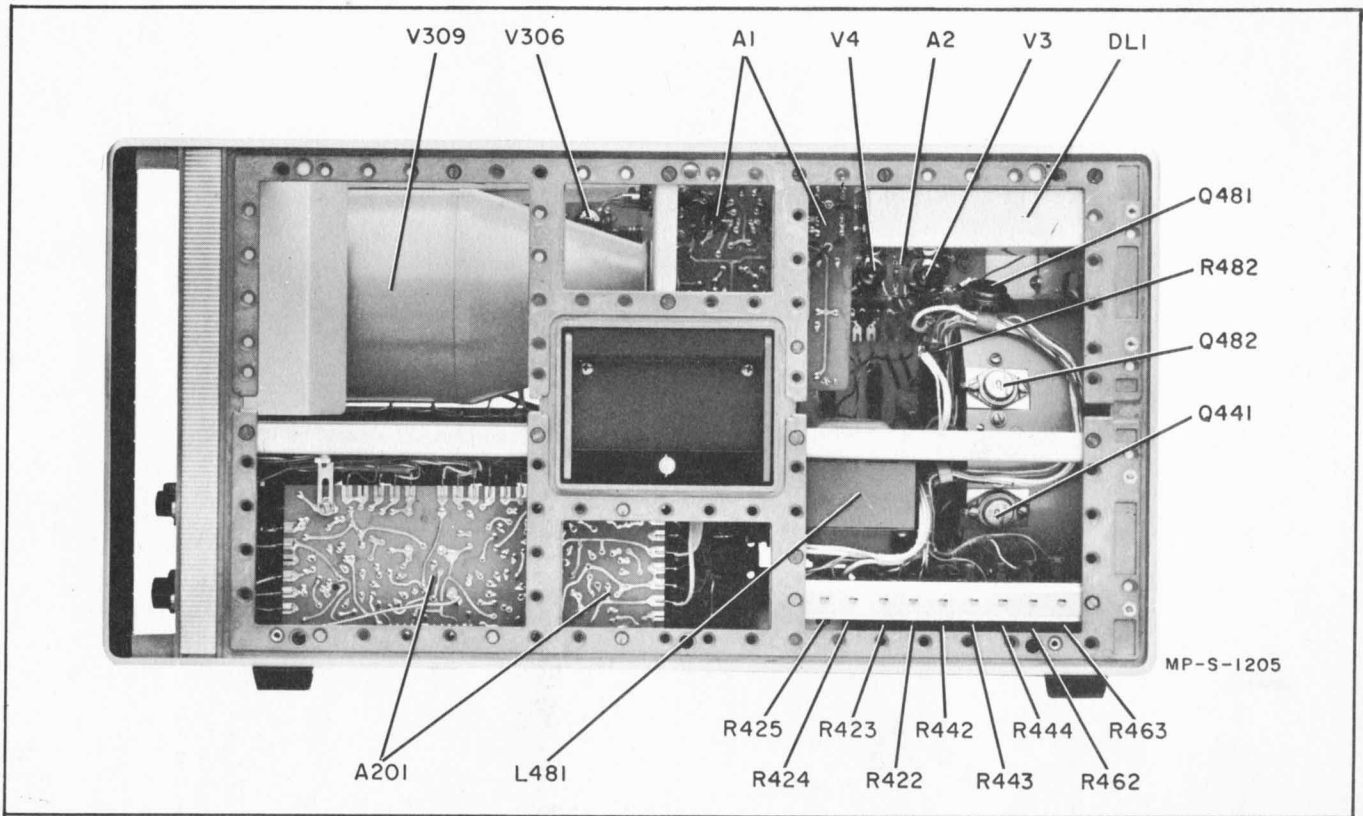


Figure 5-14. Model 175A Component Locations, Right Side View

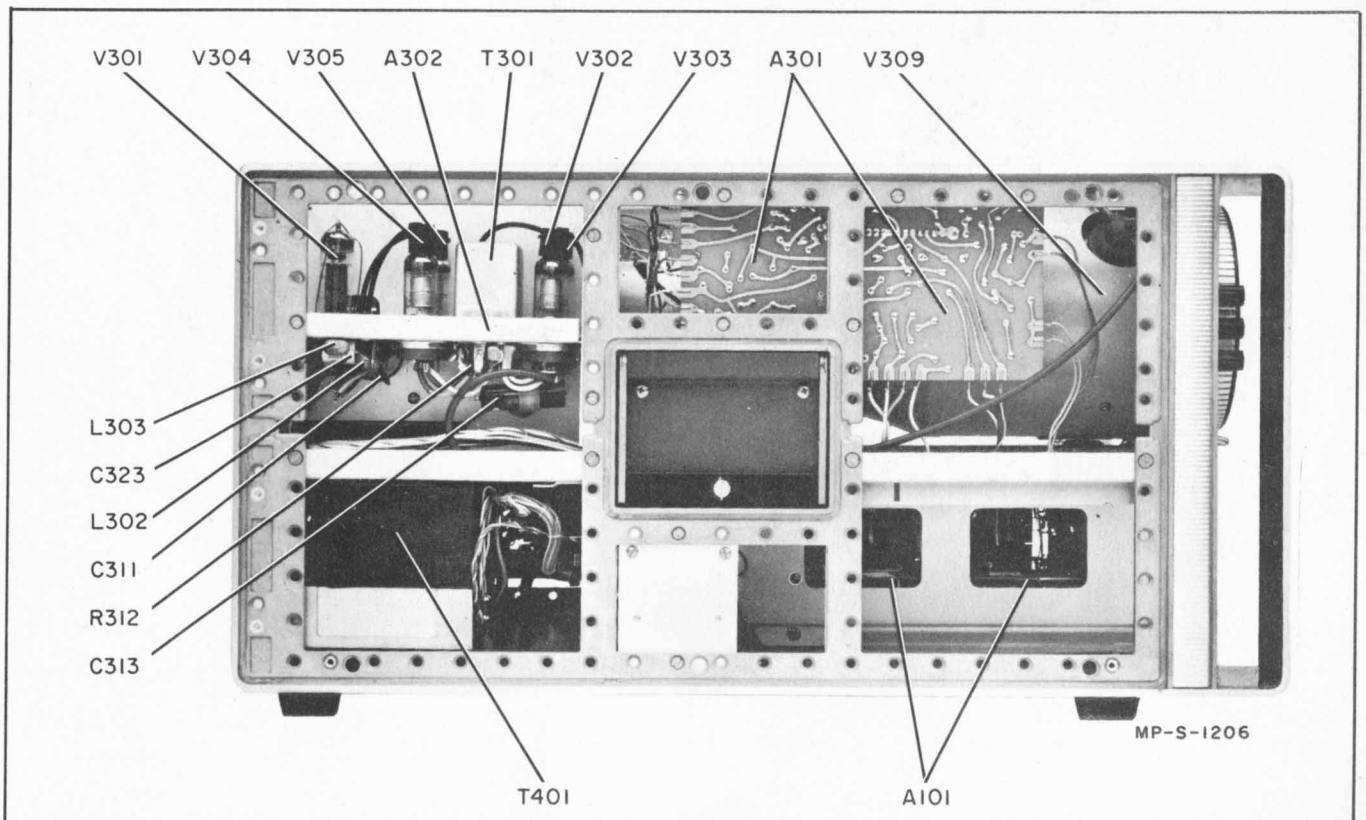


Figure 5-15. Model 175A Component Locations, Left Side View

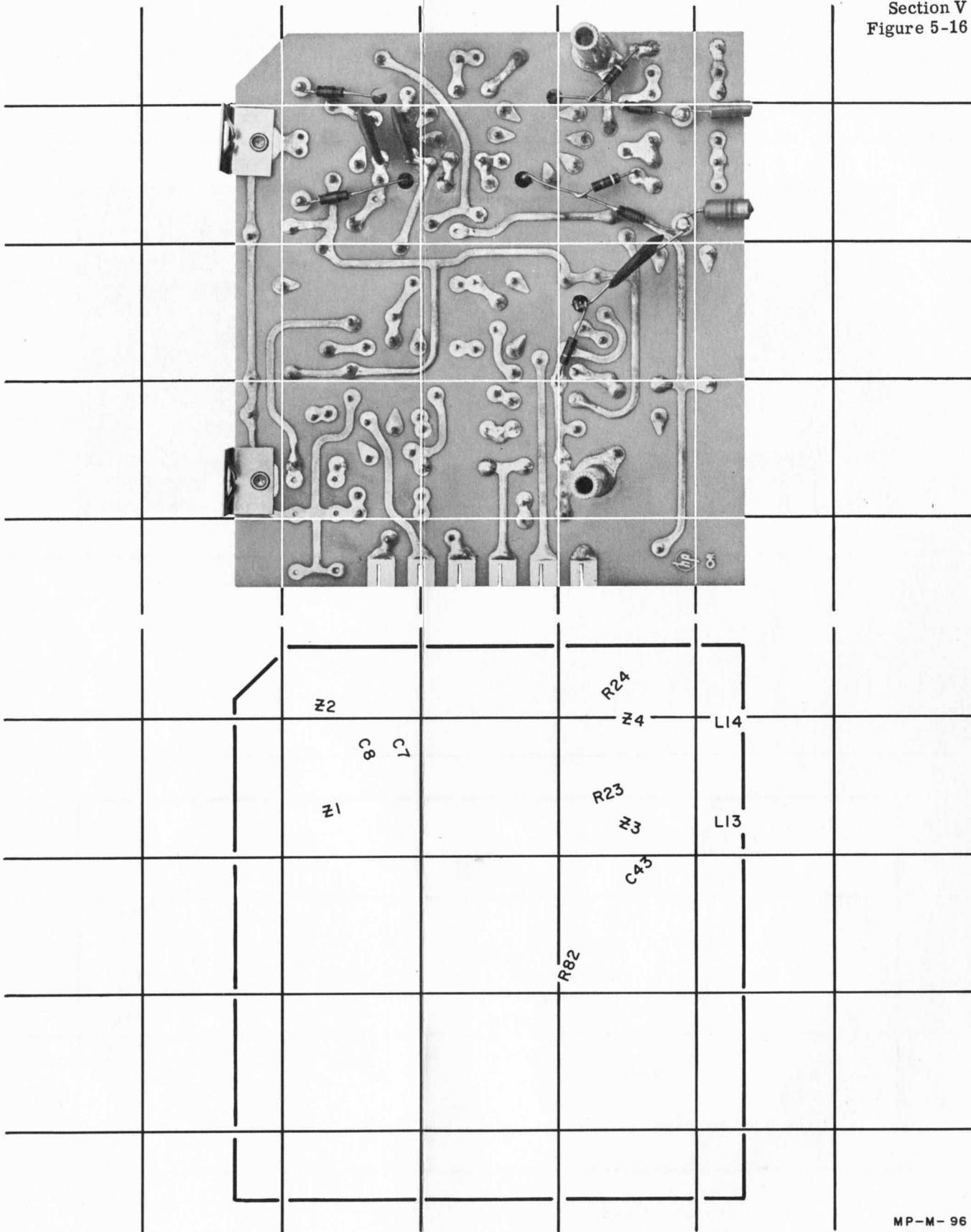
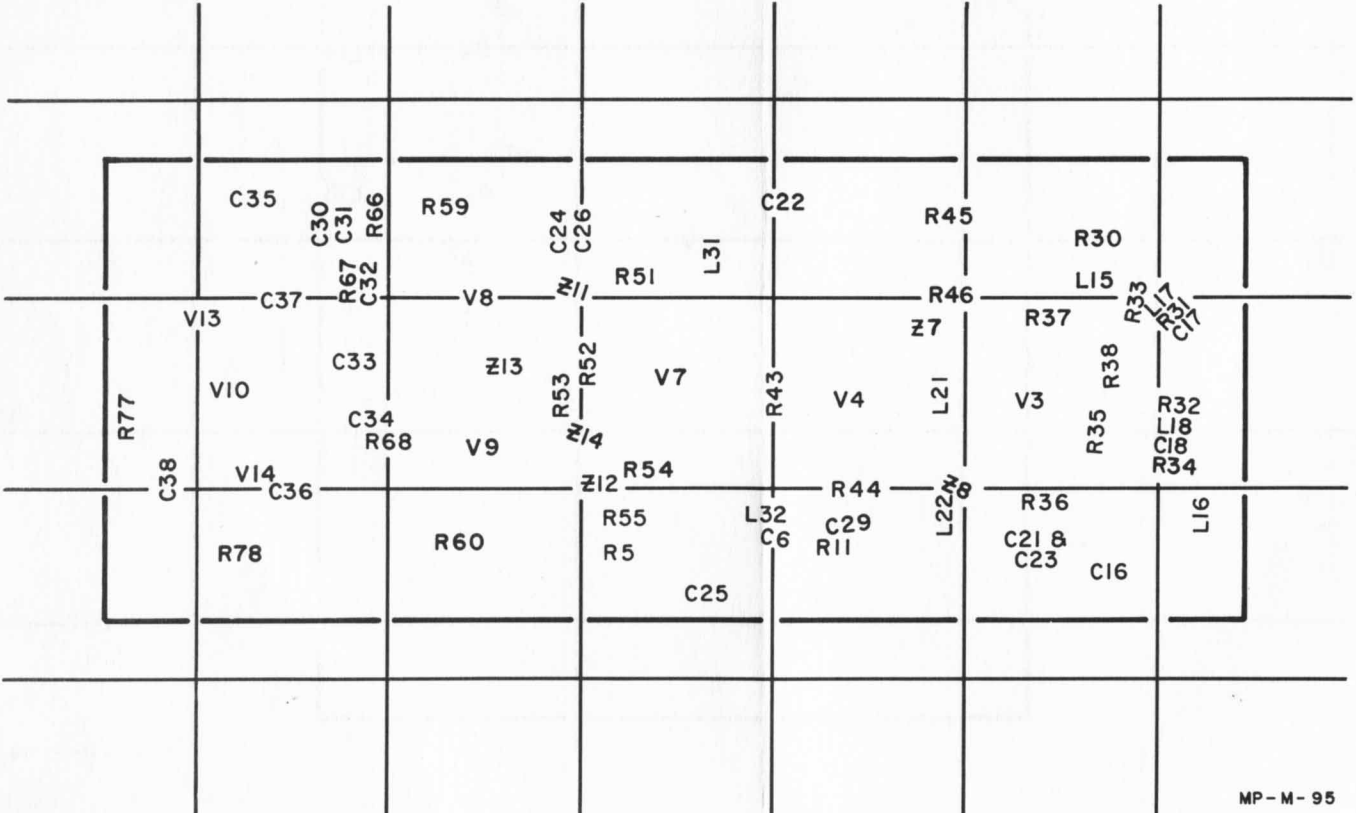
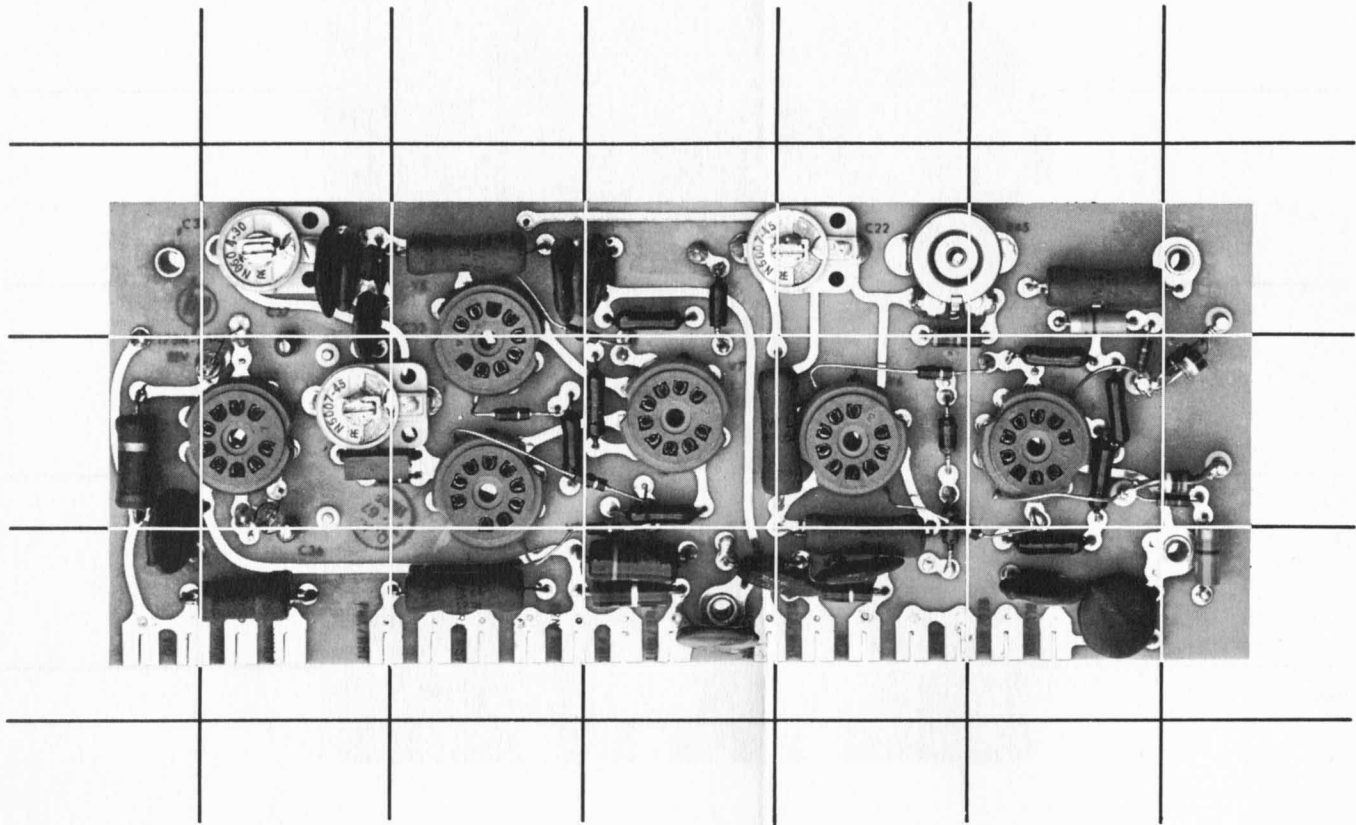


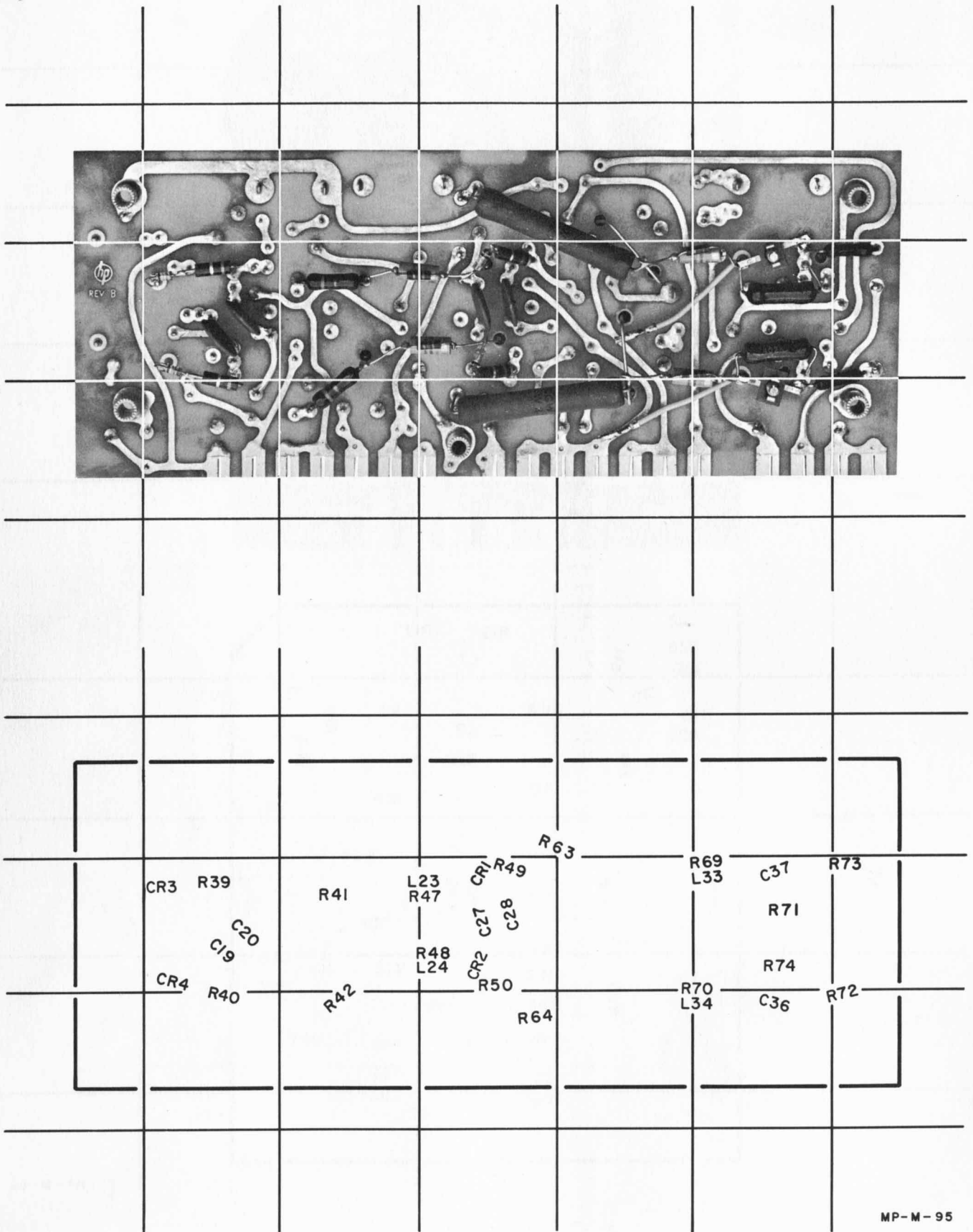
Figure 5-16. A1 Vertical-Input Assembly  
Component Locations  
(Left: Top, Right: Bottom)





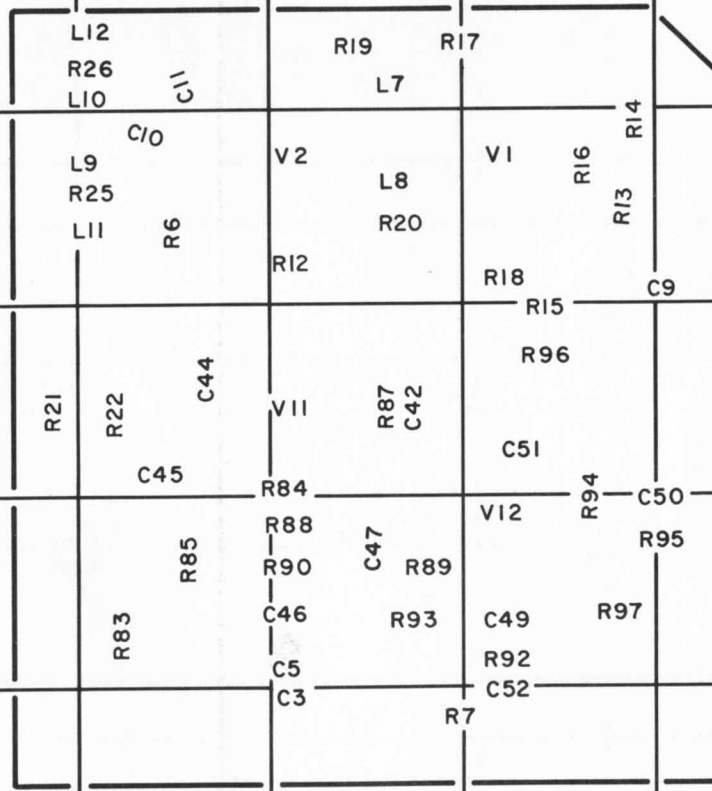
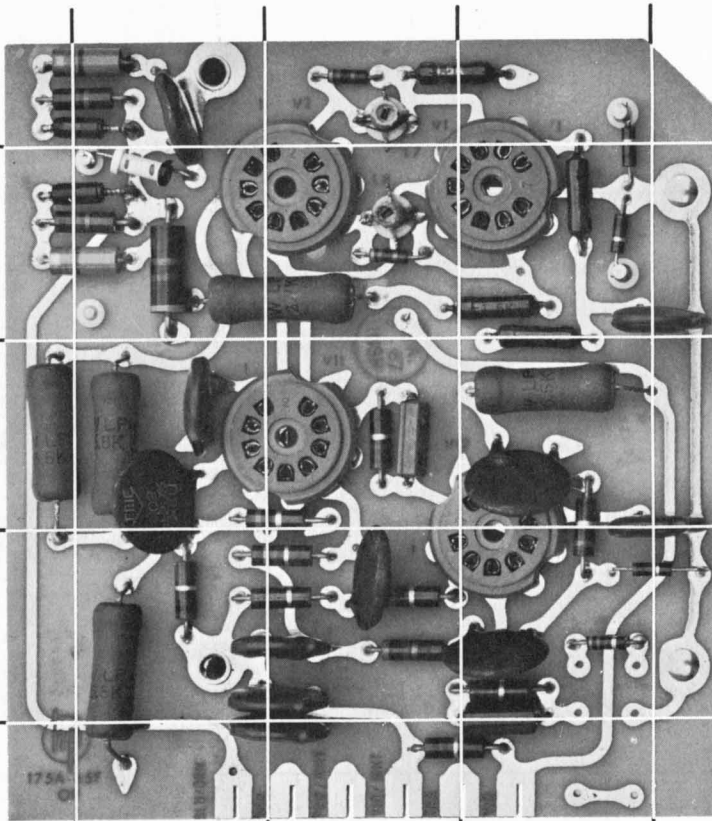
MP-M-95

Figure 5-17.



A2 Vertical-Output Assembly Component Locations  
(Left: Top, Right: Bottom)

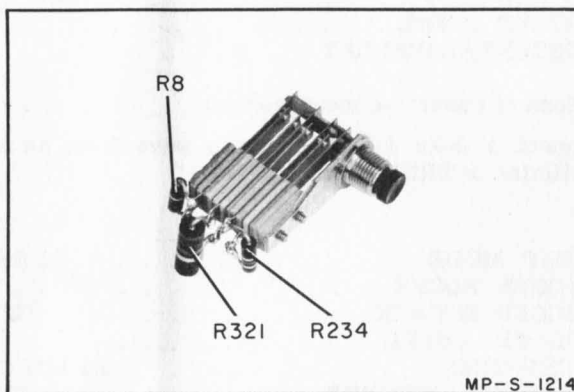
MP-M-95



SCHMATIC DIAGRAM NOTES

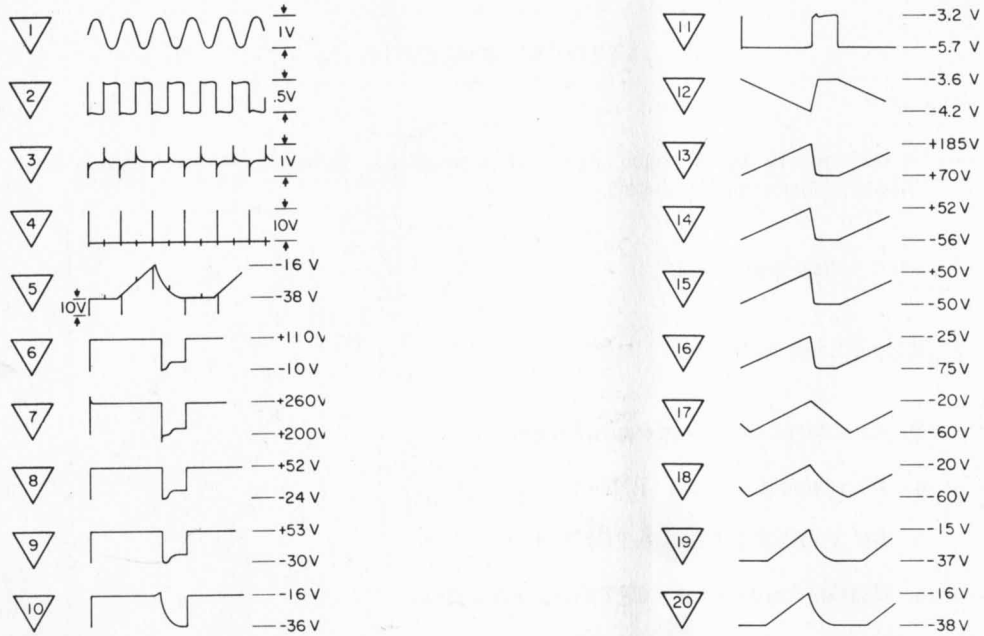
VERTICAL AMPLIFIER

1. Resistance in ohms, capacitance in picofarads, inductance in microhenries unless otherwise indicated.
2. All triodes type 6DJ8.
3. Signal lines weighted.
4. Conditions of dc voltage measurement:
  - a. Disconnect all signal inputs.
  - b. Set SWEEP MODE to FREE RUN.
  - c. Center trace with VERTICAL POSITION.
5. Conditions of waveform measurement:
  - a. Connect 10 VOLTS CALIBRATOR to vertical INPUT.
  - b. Set:  
VERTICAL SENSITIVITY . . . . . 2 VOLTS/CM  
TRIGGER SOURCE. . . . . INT.  
VERTICAL POSITION . . . . . to center trace



MP-S-1214

Figure 5-18. Beam-Finder Switch S1,  
Mounted Components



WF-M-202

**SCHEMATIC DIAGRAM NOTES**

**SWEEP GENERATOR**

1. Resistance in ohms, capacitance in picofarads, inductance in microhenries unless otherwise indicated.
2. All triodes type 6DJ8.
3. Signal lines weighted. Feedback lines weighted with dashes.
4. Conditions of dc voltage measurement:
  - a. Disconnect all signal inputs.
  - b. Set:
 

SWEEP MODE . . . . .	PRESET
TRIGGER SLOPE . . . . .	+
TRIGGER LEVEL . . . . .	0
HORIZONTAL DISPLAY . . . . .	X1
5. Conditions of waveform measurement:
  - a. Connect a 2-kc 1-volt p-p sine wave from an audio oscillator to TRIG INPUT.
  - b. Set
 

SWEEP MODE . . . . .	PRESET
TRIGGER SLOPE . . . . .	+
TRIGGER SOURCE . . . . .	EXT AC
TRIGGER LEVEL . . . . .	0
SWEEP TIME . . . . .	.01 MSEC/CM
SWEEP OCCURRENCE . . . . .	NORMAL
HORIZONTAL POSITION . . . . .	to center trace

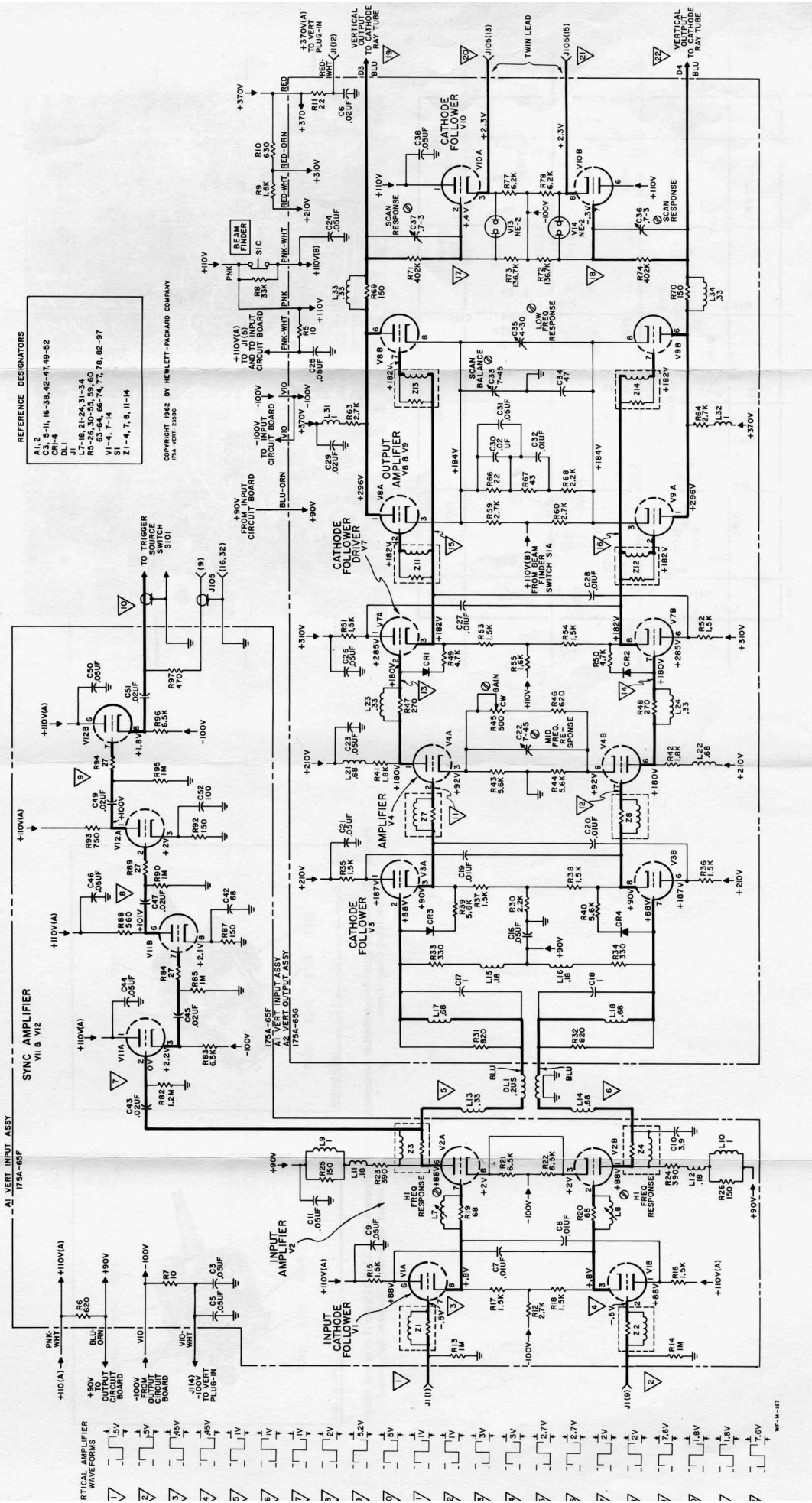
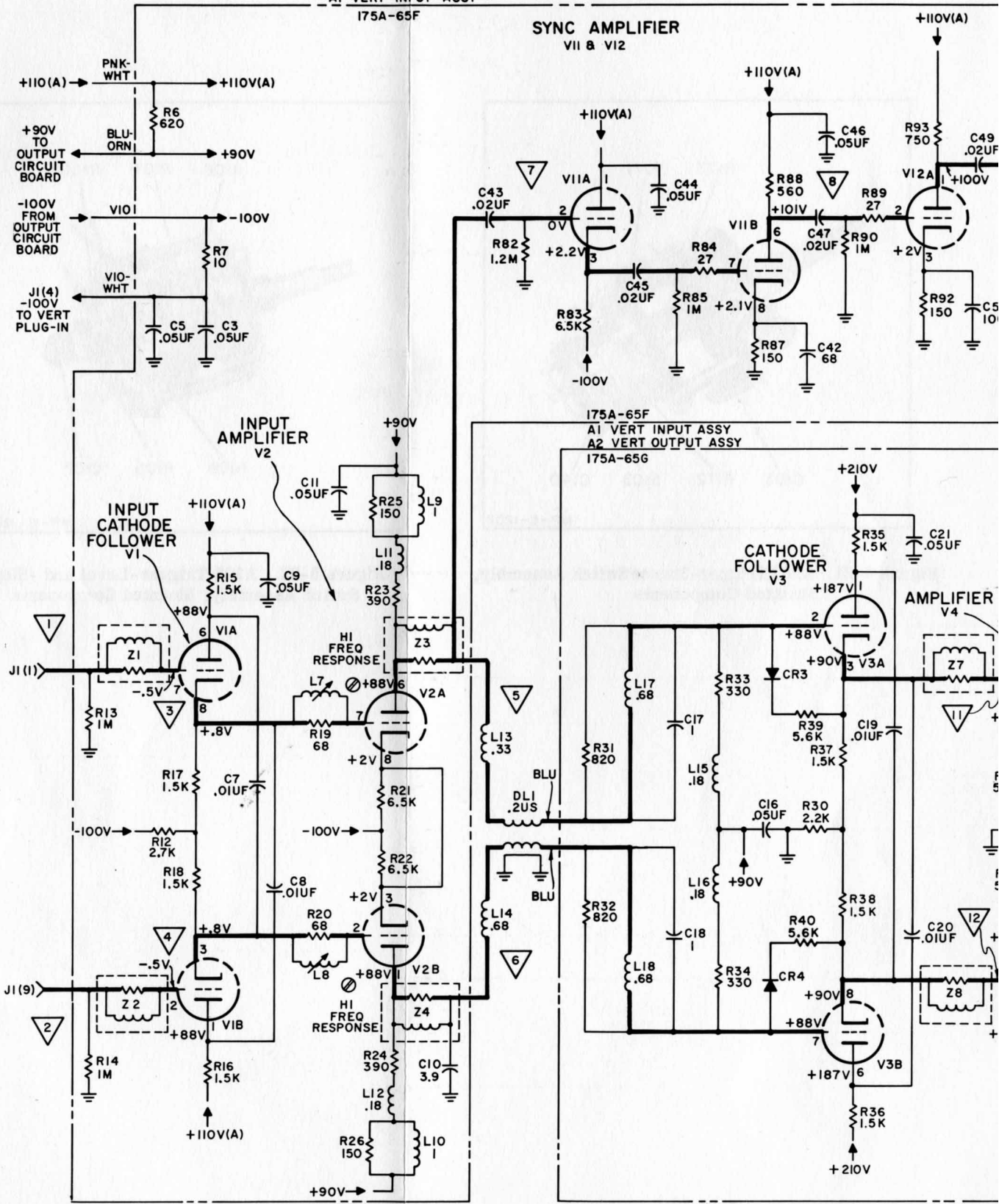
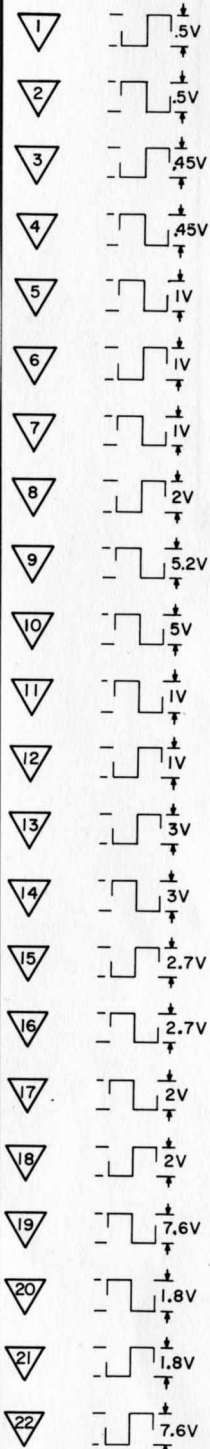


Figure 5-19. Vertical Amplifier

AI VERT INPUT ASSY  
175A-65F

SYNC AMPLIFIER  
VII & VI2

VERTICAL AMPLIFIER  
WAVEFORMS



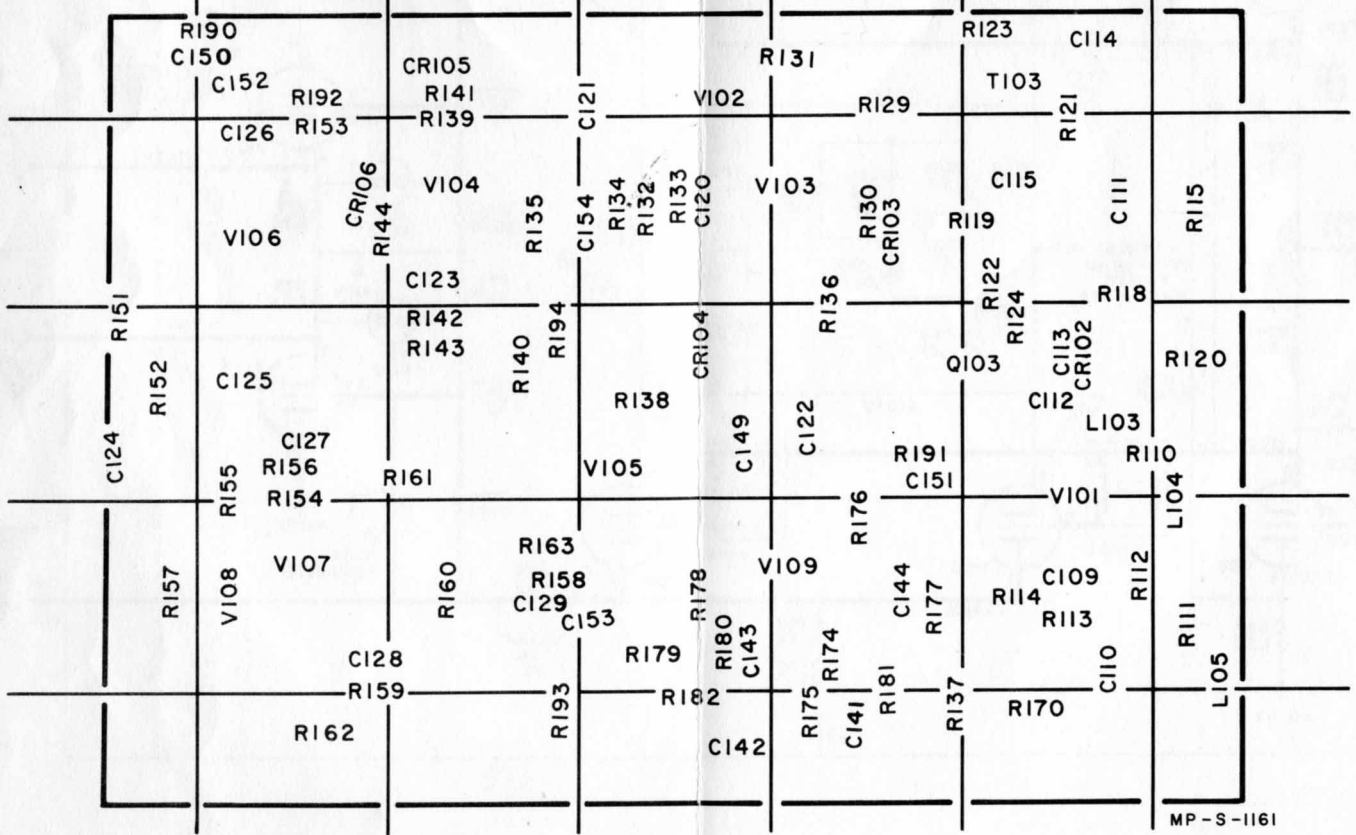
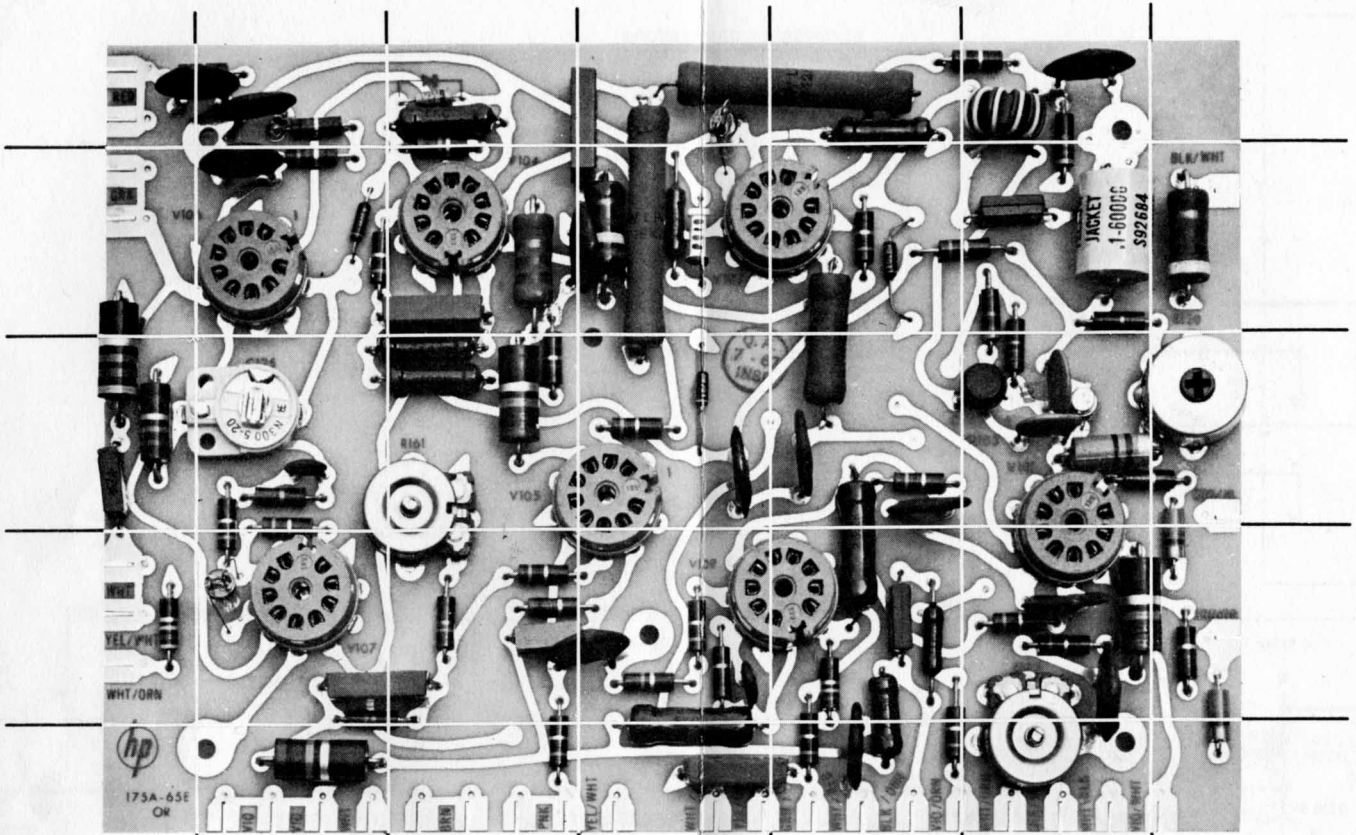


Figure 5-20. A101 Sweep-Generator Assembly Component Locations



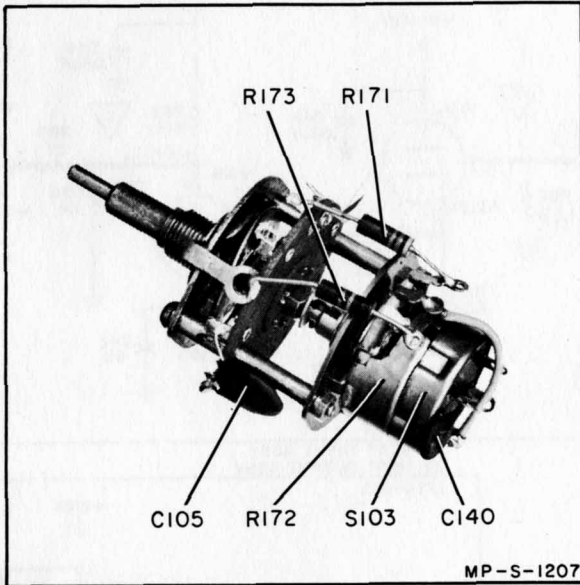


Figure 5-21. A102 Trigger-Source Switch Assembly, Mounted Components

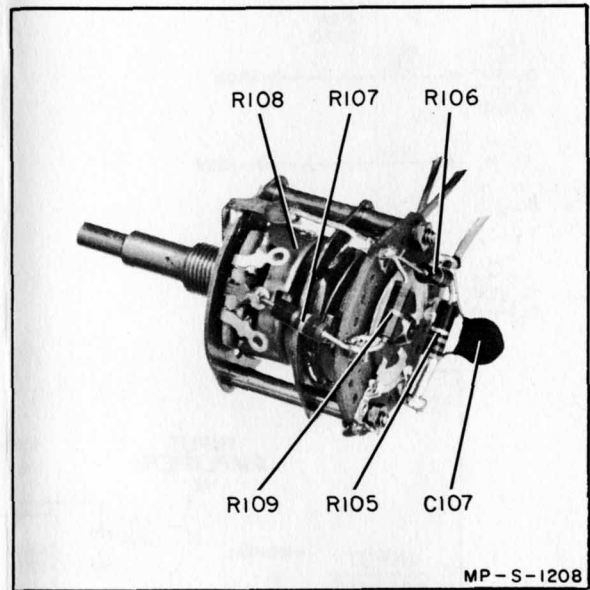
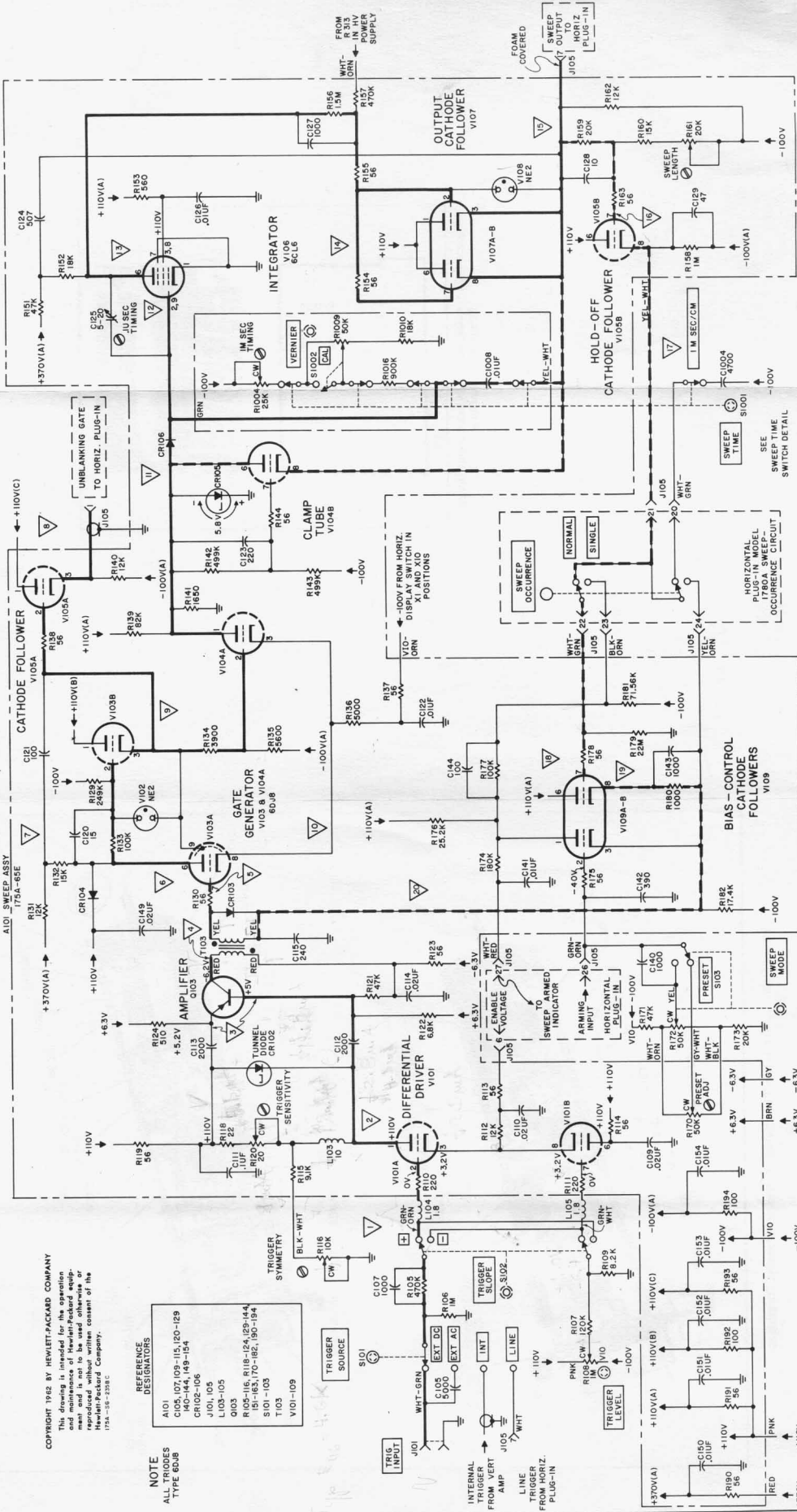


Figure 5-22. A103 Trigger-Level and -Slope Switch Assembly, Mounted Components



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175A-108-2558C

NOTE  
ALL TRIODES  
TYPE 6X8

REFERENCE DESIGNATORS
A101
C105, I07, I09-115, 20-129
I40-144, 149-154
CR102-106
J101, I05
L103-105
R105-116, R118-124, I29-144
I51-63, 70-82, 190-194
S101-103
T103
V101-109

Figure 5-23. Sweep Generator

Section V  
Figures 5-24 and 5-25

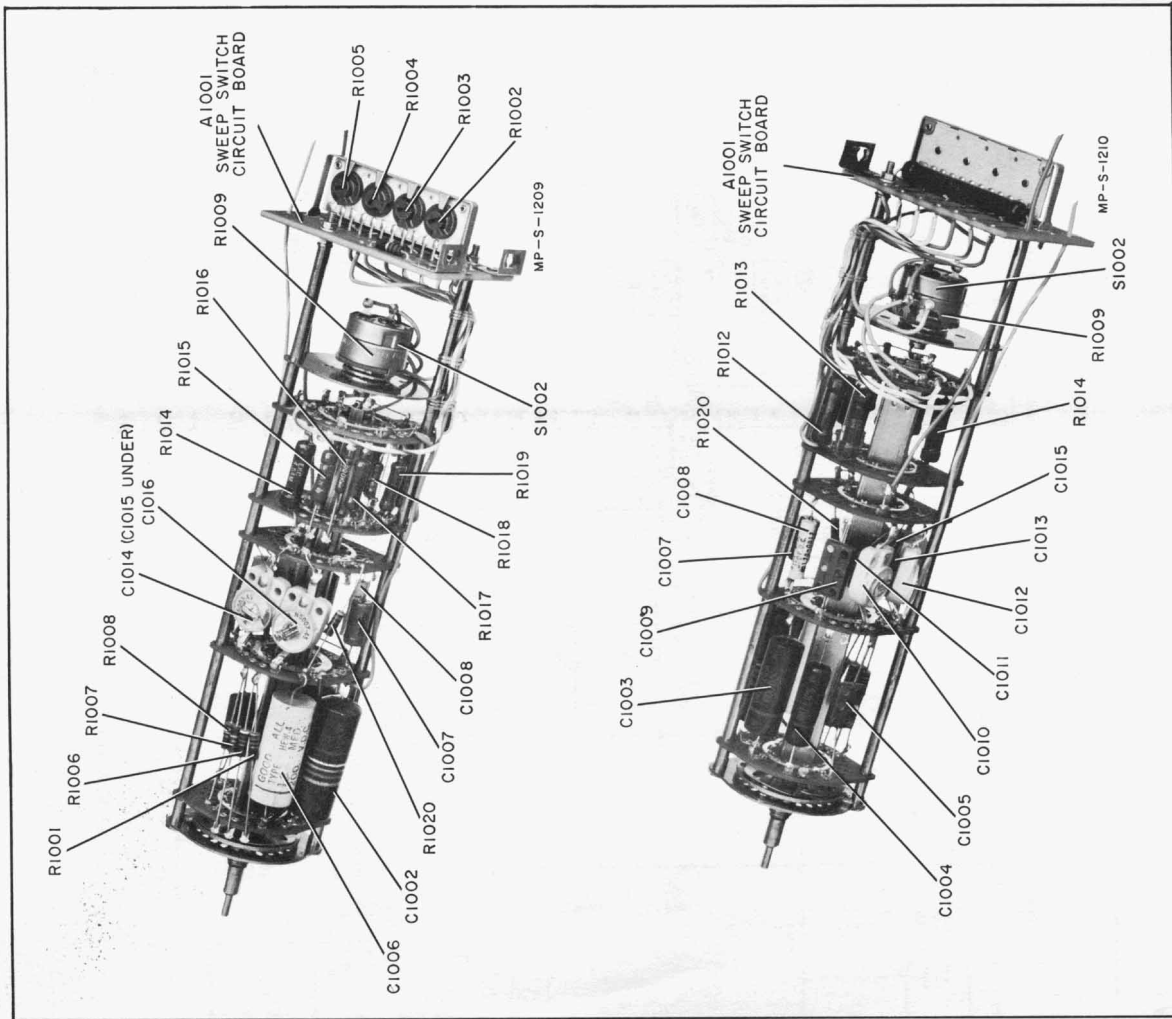


Figure 5-25. A1002 Sweep-Time Switch Assembly, Mounted Components

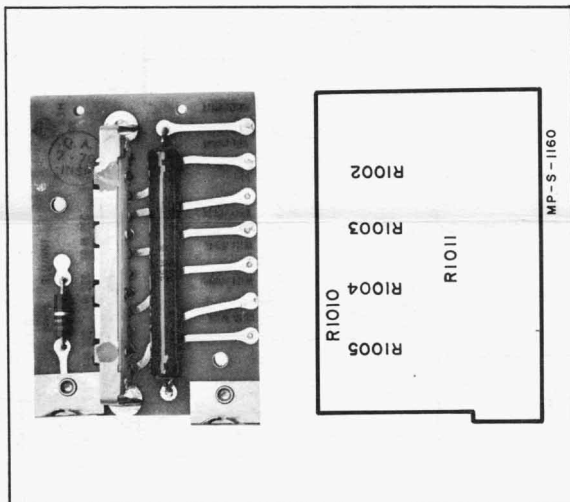
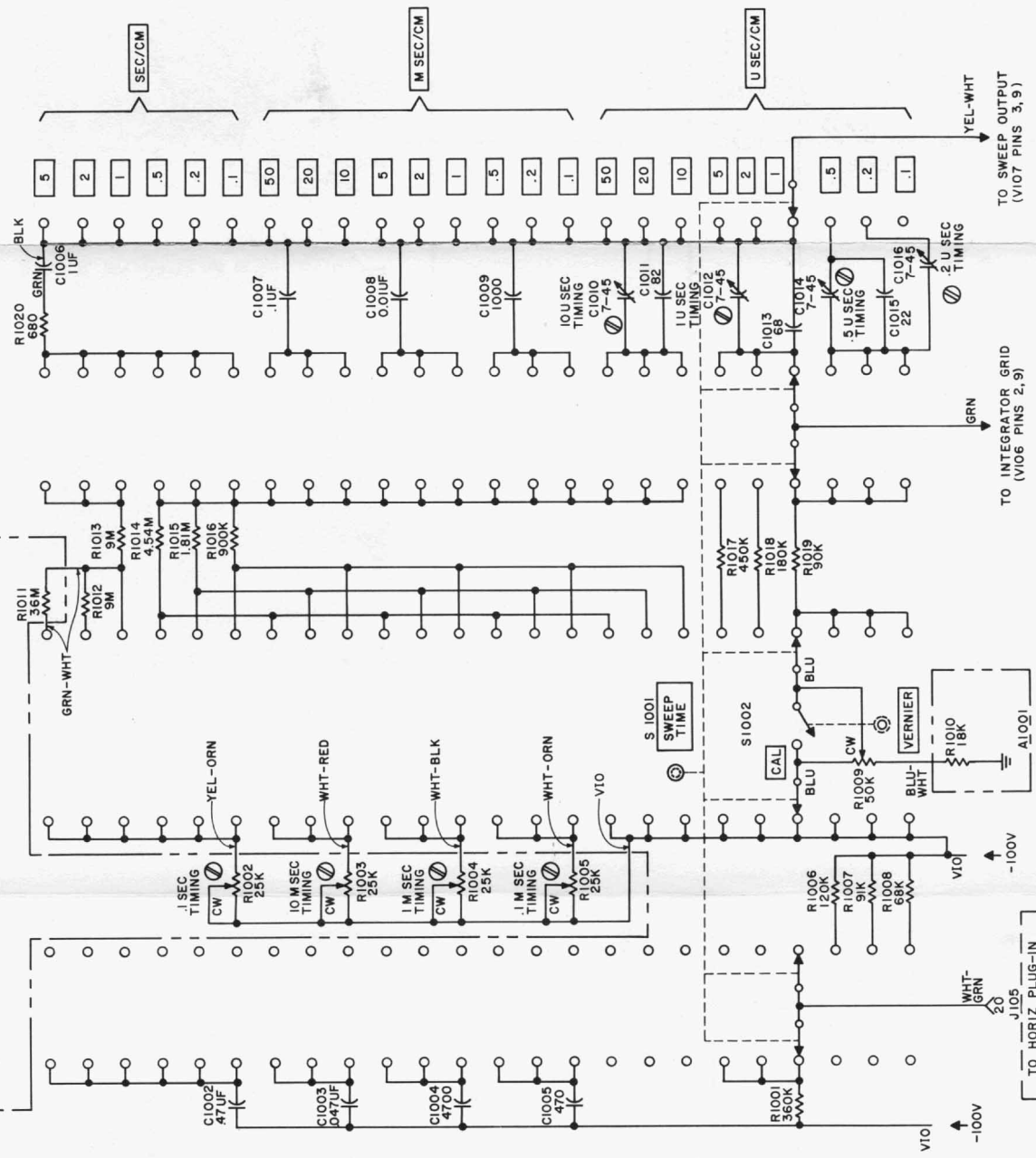


Figure 5-24. A1001 Sweep-Switch Circuit Board  
Component Locations

A1001 SWEEP-SWITCH CIRCUIT BOARD  
175A-65H

REFERENCE DESIGNATORS  
A - 1001  
C - 1002 - 1016  
R - 1001 - 1020  
S - 1001 - 1002

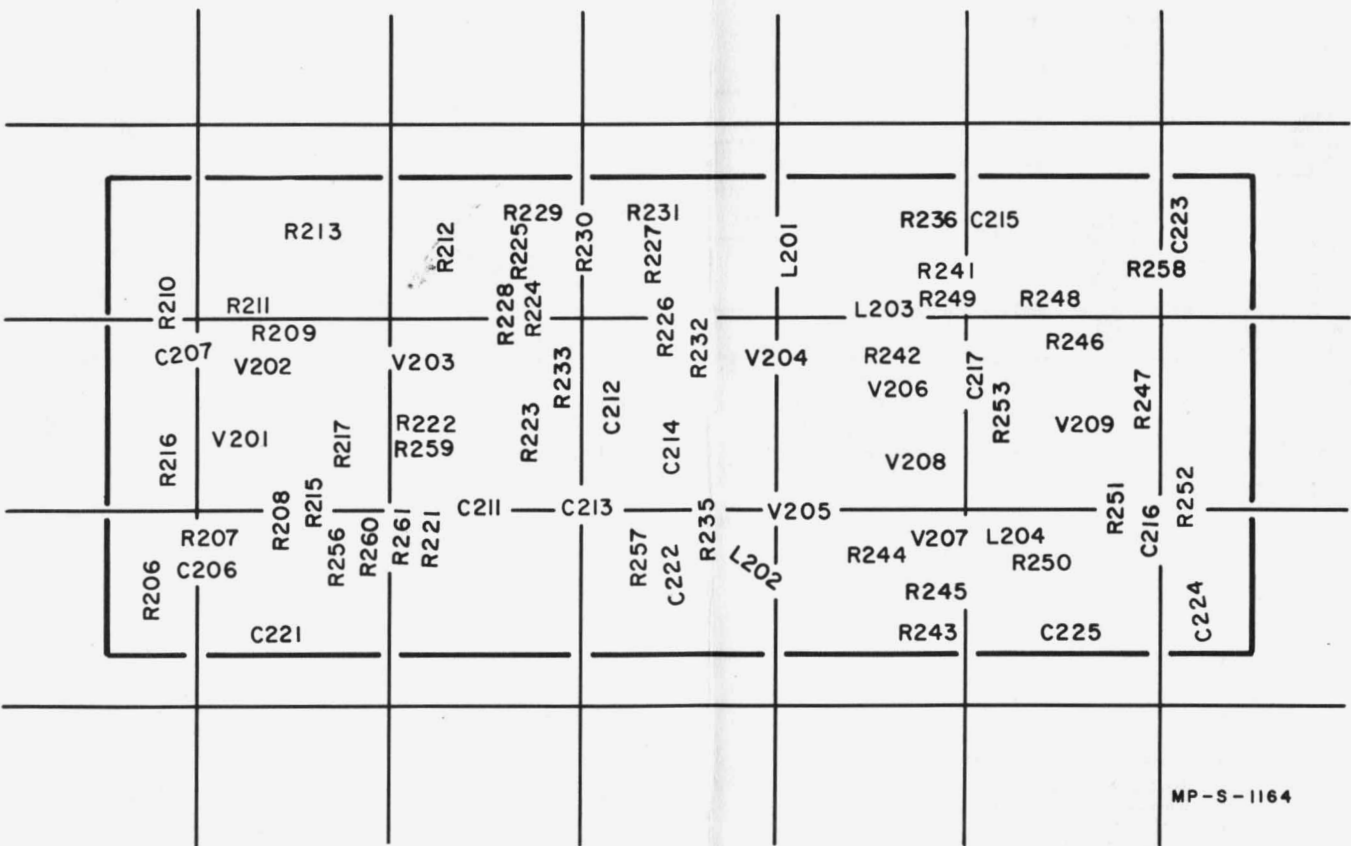
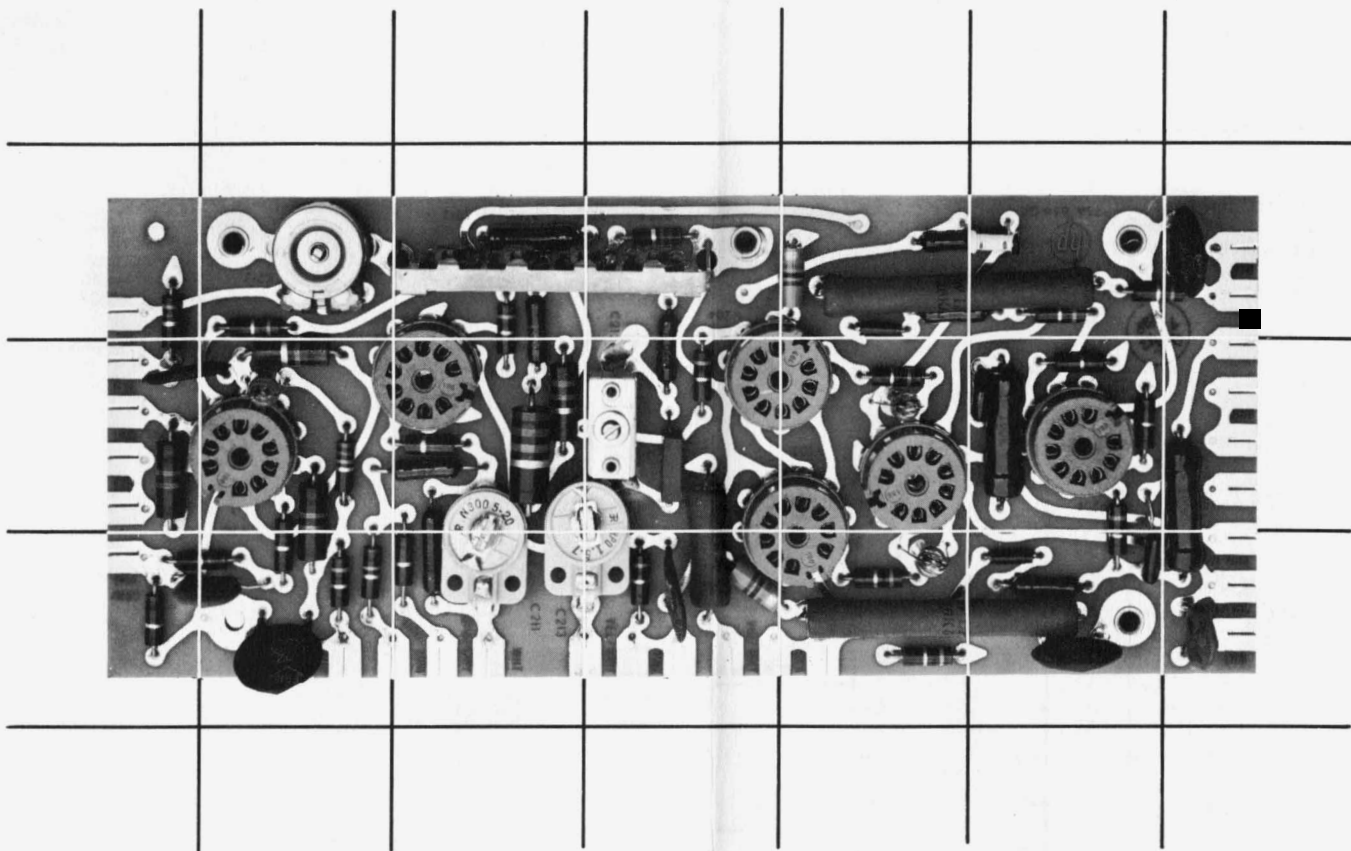


TO HORIZ PLUG-IN SWEEP OCCURRENCE CIRCUIT (SEE SWEEP GENERATOR SCHEMATIC)

NOTE  
1. RESISTANCE IN OHMS, CAPACITANCE IN PICOFARADS, UNLESS OTHERWISE NOTED

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175A-65H-2088

Figure 5-26. Sweep-Time Switch



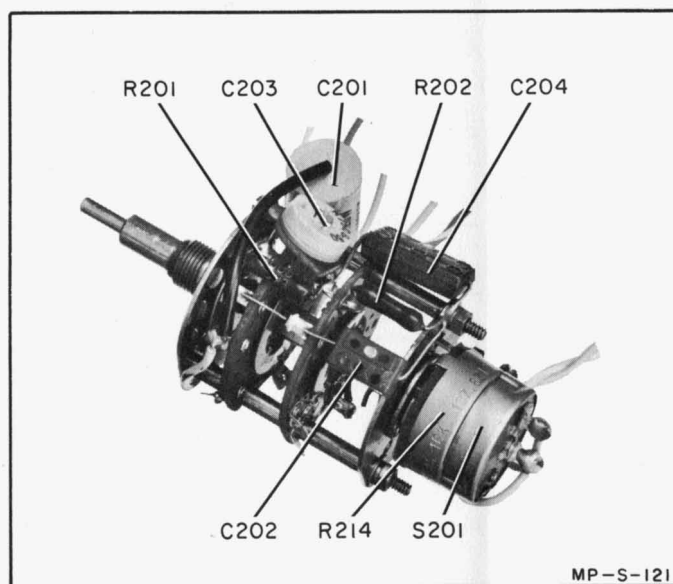
MP-S-1164

Figure 5-27. A201 Horizontal Amplifier Assembly Component Locations

**SCHEMATIC DIAGRAM NOTES**

**HORIZONTAL AMPLIFIER**

1. Resistance in ohms, capacitance in picofarads, inductance in microhenries unless otherwise indicated.
2. Signal lines weighted. Feedback lines weighted with dashes.
3. Conditions of sweep-voltage waveform measurements:
  - a. Waveforms are shown for X1 and X10 setting of HORIZONTAL DISPLAY.
  - b. Set:  
VERTICAL SENSITIVITY . . . . . 2 VOLTS/CM  
SWEEP TIME . . . . . 1 MSEC/CM  
TRIGGER SOURCE . . . . . INT.  
TRIGGER SLOPE . . . . . +  
TRIGGER LEVEL . . . . . 0  
SWEEP MODE . . . . . PRESET  
HORIZONTAL POSITION . . . . . to center trace
4. Conditions of HORIZ. INPUT waveform measurements:
  - a. Connect 10 VOLTS CALIBRATOR to HORIZ. INPUT.
  - b. Set:  
HORIZONTAL DISPLAY . . . . . 1 VOLT/CM AC  
EXTERNAL VERNIER . . . . . CAL.  
HORIZONTAL POSITION . . . . . to center trace

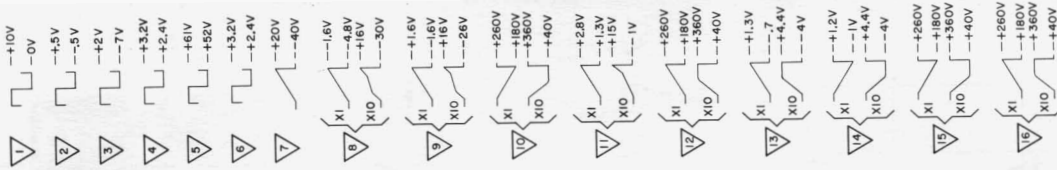


MP-S-1211

**Figure 5-28. A202 Horizontal Display Switch Assembly,  
Mounted Components**

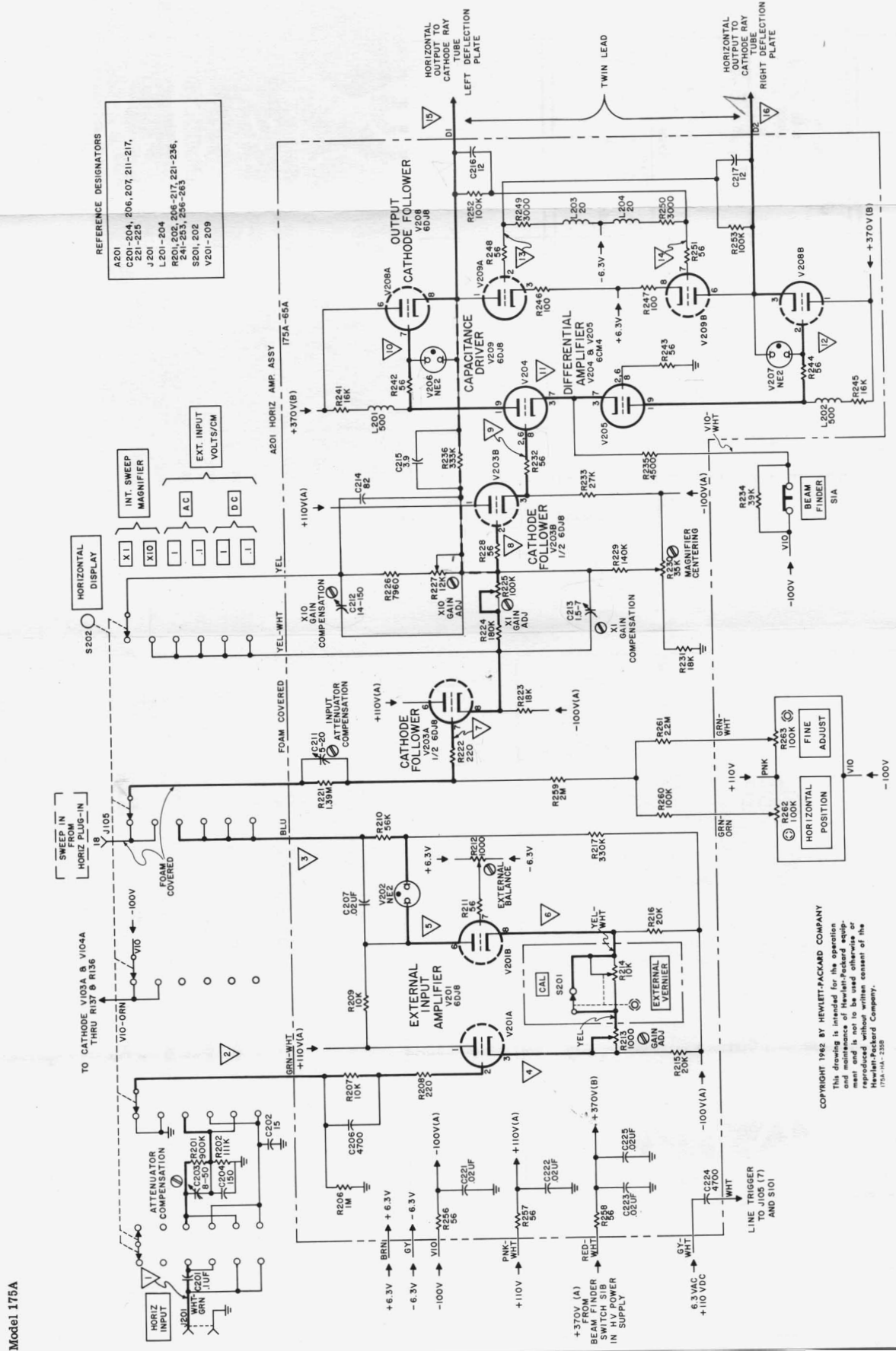
Section V  
Figure 5-29

WAVEFORMS



REFERENCE DESIGNATORS

A201	204, 206, 207, 211-217,
C201-204	201-205
J201	204
L201-204	206-217, 221-236,
R201-202	241-253, 256-263
S201, 202	209
V201-209	



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175A-16-238

Figure 5-29. Horizontal Amplifier





**SCHEMATIC DIAGRAM NOTES**

**HIGH-VOLTAGE POWER SUPPLY**

1. Resistance in ohms, capacitance in picofarads, inductance in microhenries unless otherwise indicated.
2. DC voltage and calibrator output lines are weighted. Feedback lines are weighted with dashes.
3. Conditions of dc voltage and waveform measurements:
  - a. Connect 10 VOLTS CALIBRATOR to vertical INPUT.
  - b. Set:
 

VERTICAL SENSITIVITY . . . . .	2 VOLTS/CM
SWEEP MODE . . . . .	PRESET
TRIGGER SOURCE . . . . .	INT.
TRIGGER SLOPE . . . . .	+
TRIGGER LEVEL . . . . .	0
HORIZONTAL POSITION . . . . .	to center trace
VERTICAL POSITION . . . . .	to center trace

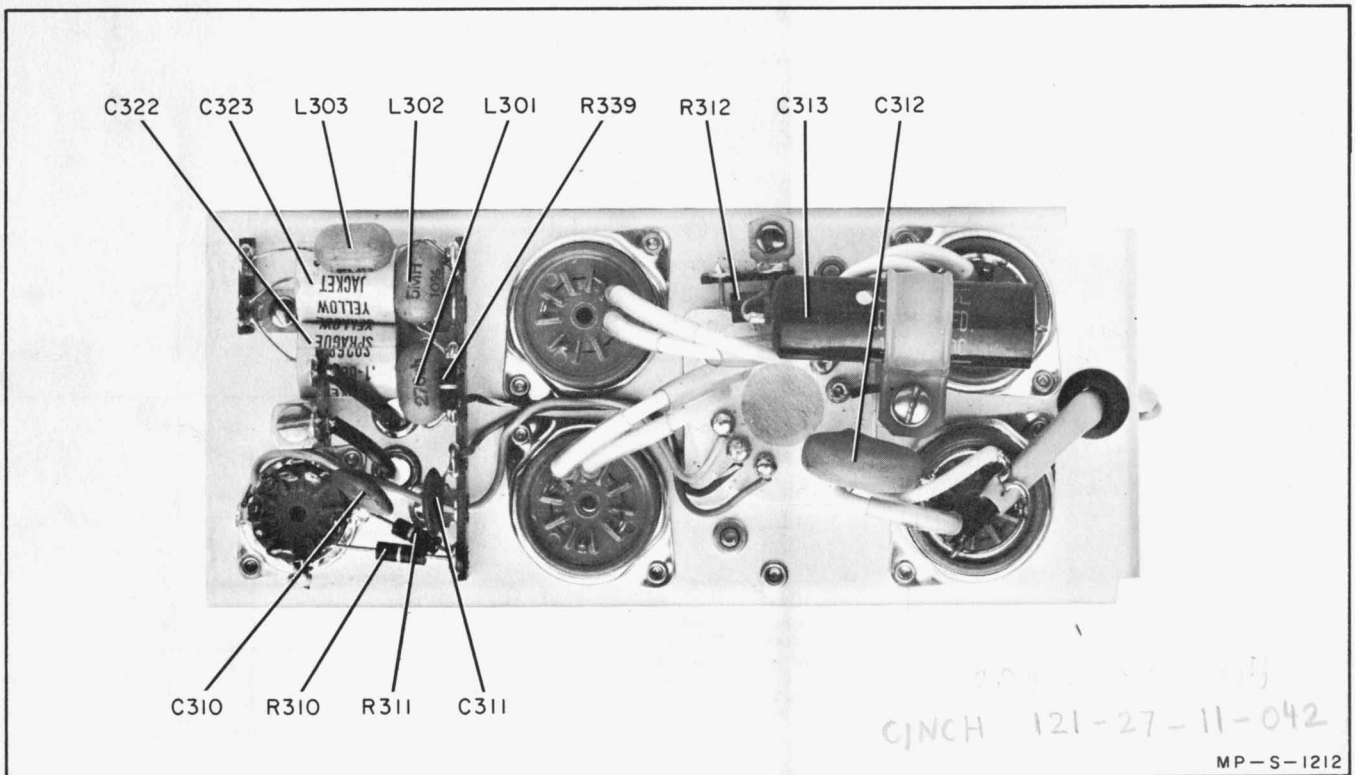


Figure 5-31. A302 High-Voltage Deck Assembly Component Locations

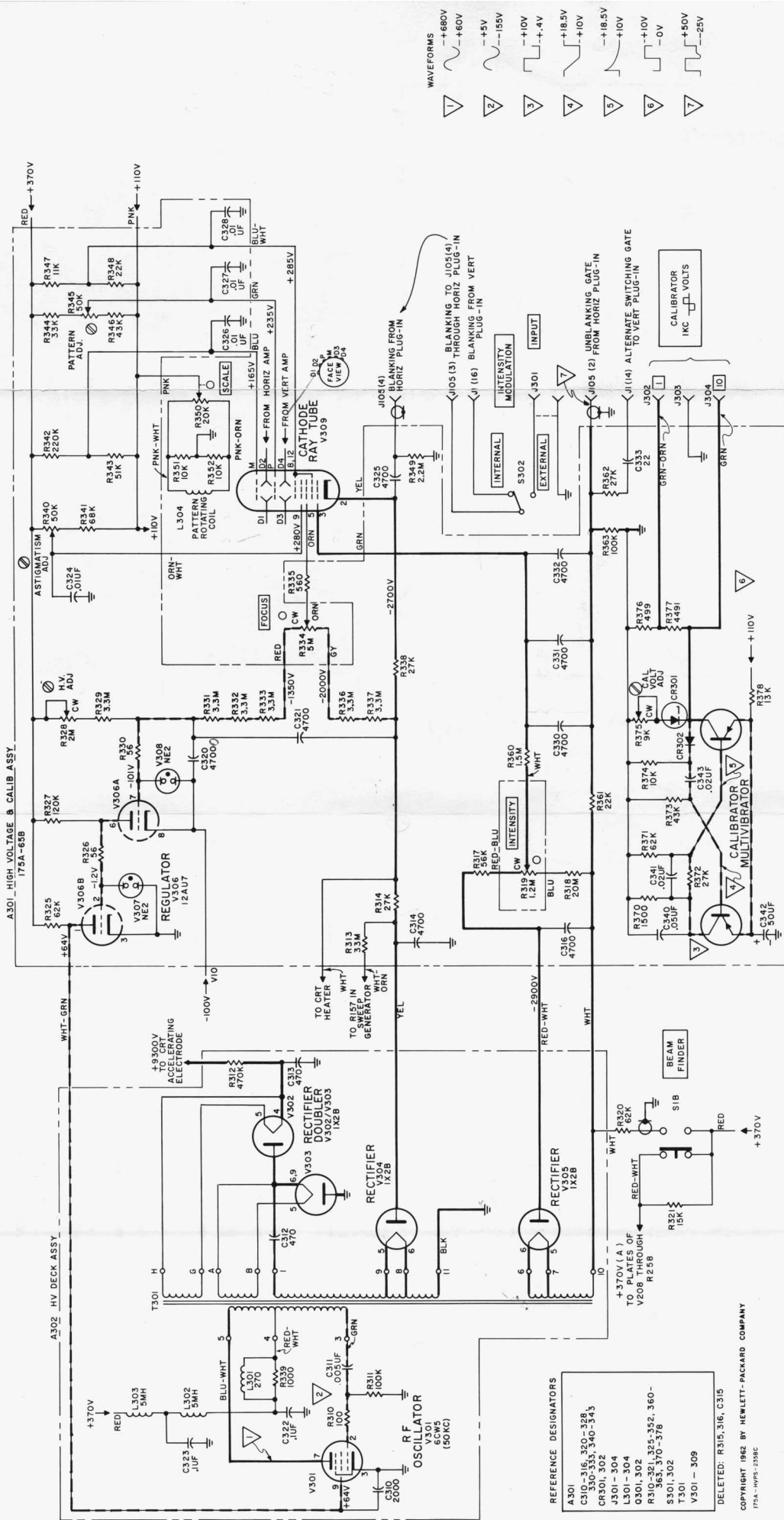


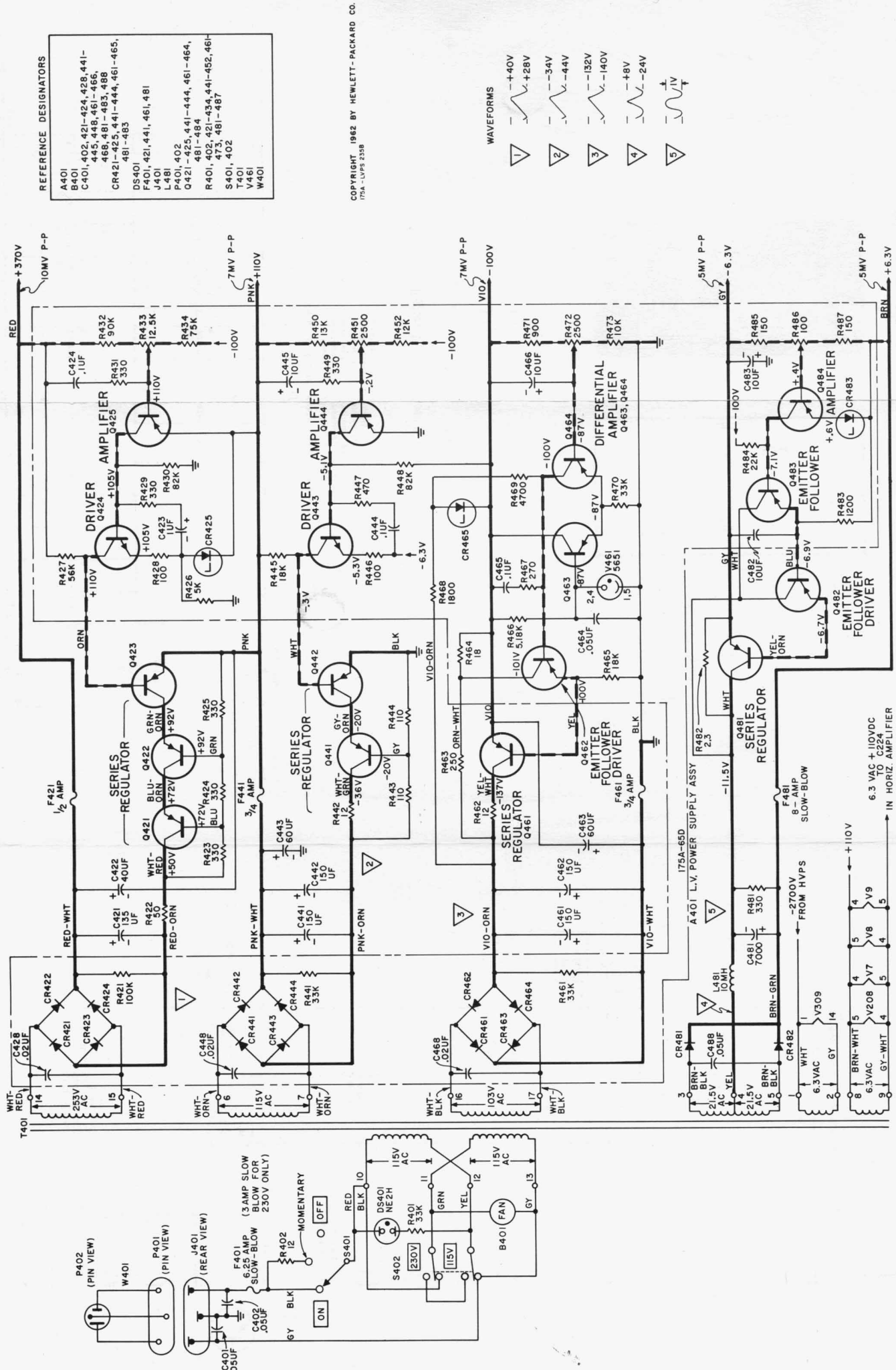
Figure 5-32. High-Voltage Power Supply and Calibrator



SCHMATIC DIAGRAM NOTES

LOW-VOLTAGE POWER SUPPLY

1. Resistance in ohms, capacitance in picofarads unless otherwise noted.
2. DC voltage lines are weighted. Feedback lines are weighted with dashes.
3. AC voltage values are rms.
4. Conditions of dc voltage and waveform measurement:
  - a. Line voltage 115 volts ac.
  - b. Set HORIZONTAL DISPLAY to 1 VOLT/CM AC.



REFERENCE DESIGNATORS

A401	402, 421-424, 428, 441-445, 448, 461-466, 468, 481-483, 488
B401	481-483
C401	421-425, 441-444, 461-465, 481-483
DS401	481-483
F401	421, 441, 461, 481
J401	
L481	
P401	402
Q421	425, 441-444, 461-464, 481-484
Q441	421-425, 441-444, 461-464, 481-487
Q461	402
S401	402
T401	
V481	
W401	

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175A-LVPS 238

WAVEFORMS

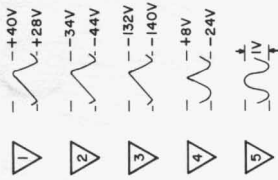
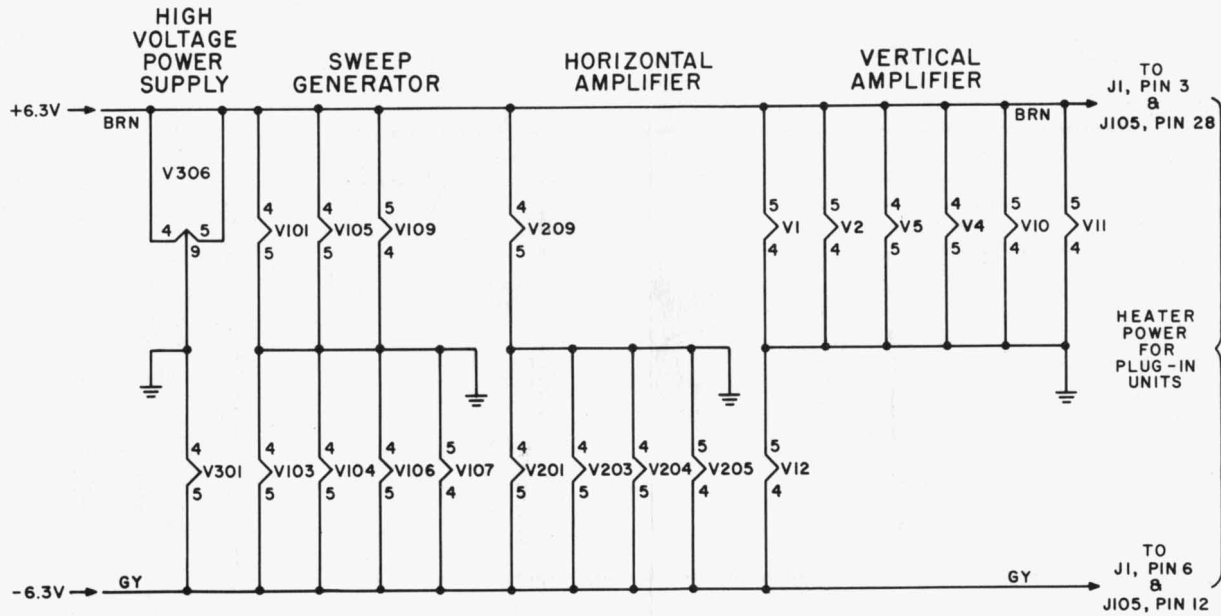


Figure 5-34. Low-Voltage Power Supply

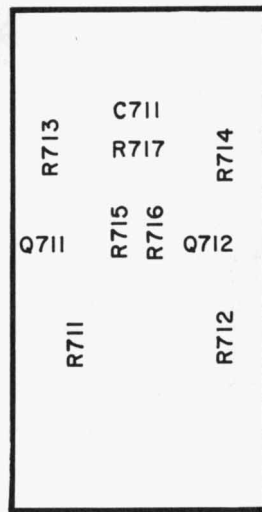
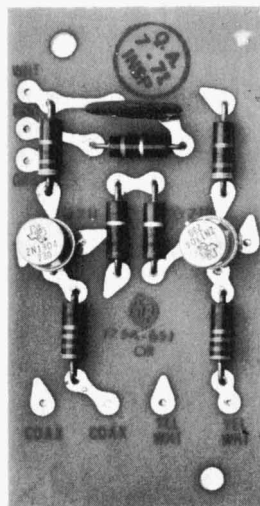


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175A HTR CKT-235B

Figure 5-35. Heater Circuit



MP-S-1167

Figure 5-36. A701 Gate- and Sweep-Output Assembly Component Locations

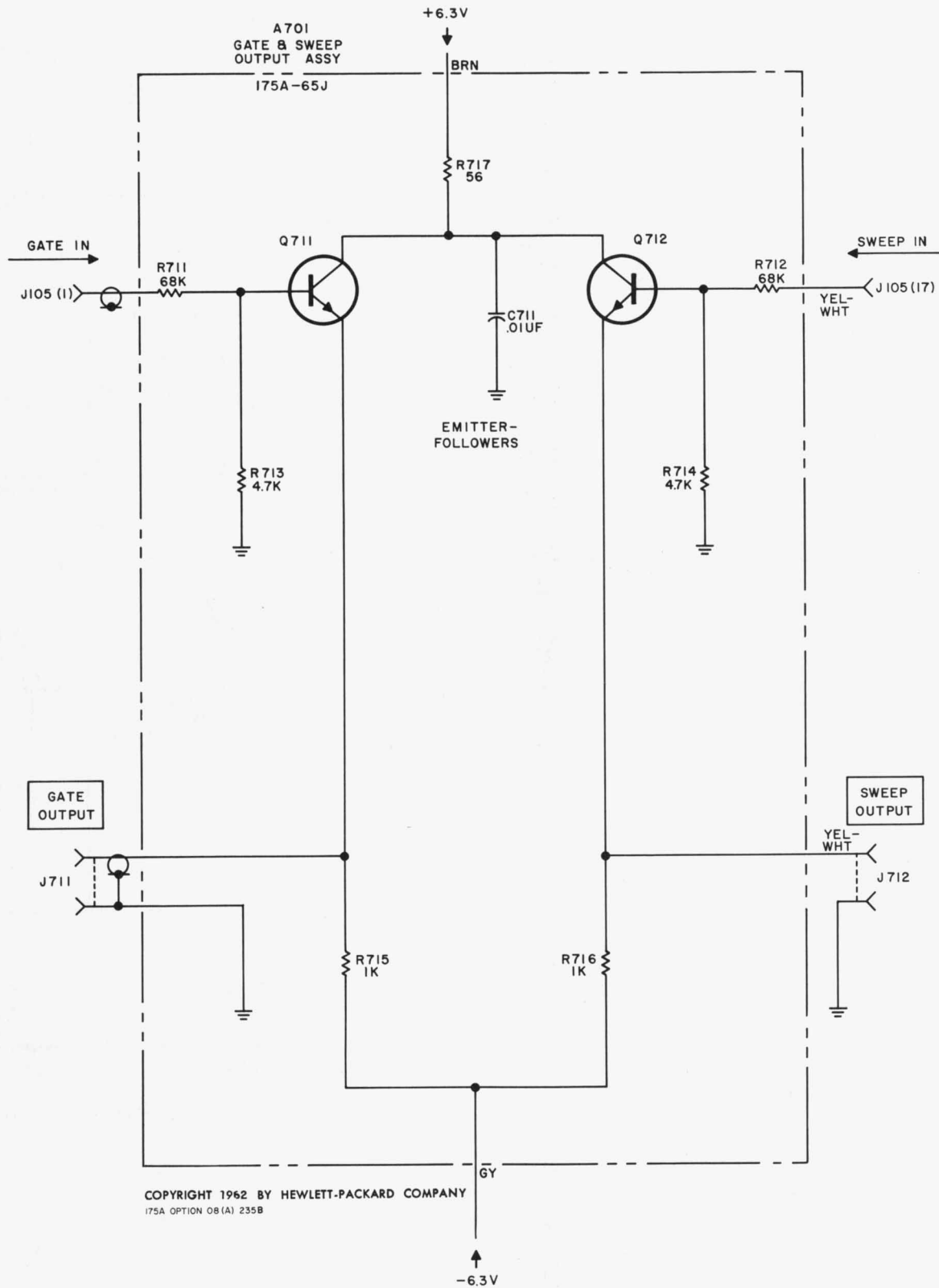


Figure 5-37. Gate and Sweep Output

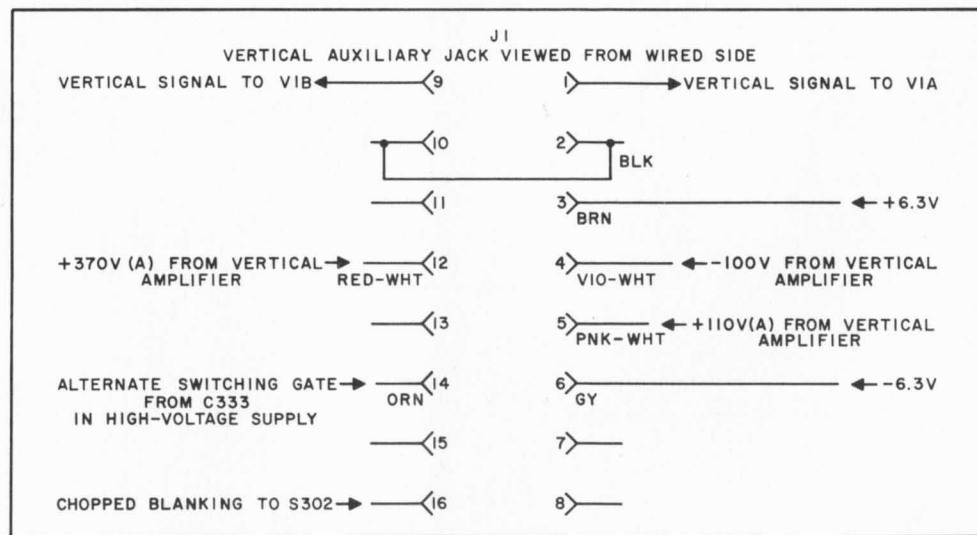
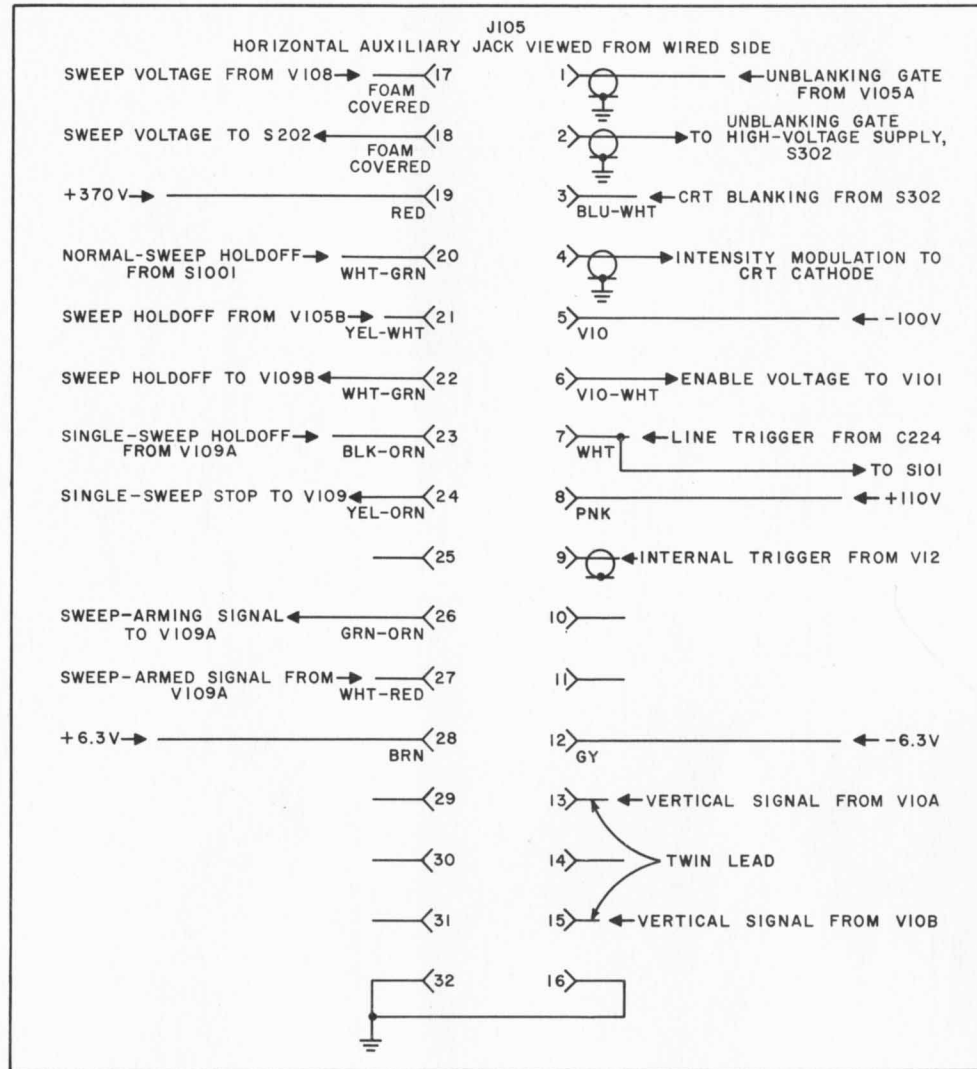


Figure 5-38. Connectors



## SECTION VI REPLACEABLE PARTS

### 6-1. INTRODUCTION.

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

- a. Description of the part (see list of abbreviations below).
- b. Typical manufacturer of the part in a five-digit code; see list of manufacturers in appendix.
- c. Manufacturer's stock number.
- d. Total quantity used in the instrument (TQ column).
- e. Recommended spare part quantity for complete maintenance during one year of isolated service (RS column).

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

### 6-4. ORDERING INFORMATION.

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

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

or, in Western Europe, to

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

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

- a. Model and complete serial number of instrument.
- b. Hewlett-Packard stock number.
- c. Circuit reference designator.
- d. Description.

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

#### REFERENCE DESIGNATORS

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

#### ABBREVIATIONS

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

01194-6

ELECT = electrolytic  
ENCAP = encapsulated

Table 6-1. Index by Reference Designator

Circuit Reference	Stock No.	Description #	Note	Circuit Reference	Stock No.	Description #	Note
A1	175A-65F	Assembly; Vertical Input		C21	0150-0052	C: fxd 0.05 $\mu$ f 20% 400 vdcw	
A2	175A-65G	Assembly; Vertical Output		C22	0130-0001	C: var cer 7-45 pf N500	
A3 thru A100		Not Assigned		C23	0150-0052	C: fxd 0.05 $\mu$ f 20% 400 vdcw	
A101	175A-65E	Assembly; Sweep		C24	0150-0052	C: fxd 0.05 $\mu$ f 20% 400 vdcw	
A102	175A-19C	Assembly; Trigger Source switch		C25	0150-0052	C: fxd 0.05 $\mu$ f 20% 400 vdcw	
A103	175A-19D	Assembly; Trigger Level & Slope switch		C26	0150-0052	C: fxd 0.05 $\mu$ f 20% 400 vdcw	
A104 thru A200		Not Assigned		C27	0150-0012	C: fxd cer 0.01 $\mu$ f 20% 1000 vdcw	
A201	175A-65A	Assembly; Horizontal Amplifier		C28	0150-0012	C: fxd cer 0.01 $\mu$ f 20% 1000 vdcw	
A202	175A-19B	Assembly; Horizontal Display switch		C29	0150-0070	C: fxd cer 0.02 $\mu$ f 20% 500 vdcw	
A203	2100-0345	R: var quad 12K/35K/100K/1K		C30	0150-0070	C: fxd cer 0.02 $\mu$ f 20% 500 vdcw	
A204	2100-0414	Assembly; Horizontal Position		C31	0150-0052	C: fxd 0.05 $\mu$ f 20% 400 vdcw	
A205 thru A300		Not Assigned		C32	0150-0012	C: fxd cer 0.01 $\mu$ f 20% 1000 vdcw	
A301	175A-65B	Assembly; HV & Calib		C33	0130-0001	C: var cer 7-45 pf N500	
A302	175A-4B	Assembly; HV Deck		C34	0140-0039	C: fxd mica 47 pf 5% 500 vdcw	
A303	2100-0349	R: var quad 50K/2M/50K/9K		C35	0130-0019	C: var cer 4-30 pf N650	
A304 thru A400		Not Assigned		C36	0132-0004	C: var poly 0.7-3 pf 350V	
A401	175A-65D	Assembly; LV Power Supply		C37	0132-0004	C: var poly 0.7-3 pf 350V	
A402	2100-0344	R: var triple 2.5K/2.5K/12.5K		C38	0150-0052	C: fxd 0.05 $\mu$ f 20% 400 vdcw	
A403 thru A700		Not Assigned		C39 thru C41		Not Assigned	
A701	175A-65J	Assembly; Gate & Sweep Output		C42	0140-0025	C: fxd mica 68 pf 10% 500 vdcw	
A702 thru A1000		Not Assigned		C43	0150-0070	C: fxd cer 0.02 $\mu$ f 20% 500 vdcw	
A1001	175A-65H	Circuit Board; Sweep Time switch		C44	0150-0052	C: fxd 0.05 $\mu$ f 20% 400 vdcw	
A1002	175A-19A	Assembly; Sweep Time switch		C45	0150-0070	C: fxd cer 0.02 $\mu$ f 20% 500 vdcw	
A1003	2100-0347	R: var quad 4x25K ohms		C46	0150-0052	C: fxd 0.05 $\mu$ f 20% 400 vdcw	
B401	3140-0020	Motor: fan 30W		C47	0150-0070	C: fxd cer 0.02 $\mu$ f 20% 500 vdcw	
C3	0150-0052	C: fxd 0.05 $\mu$ f 20% 400 vdcw		C48		Not Assigned	
C4		Not Assigned		C49	0150-0070	C: fxd cer 0.02 $\mu$ f 20% 500 vdcw	
C5	0150-0052	C: fxd 0.05 $\mu$ f 20% 400 vdcw		C50	0150-0052	C: fxd 0.05 $\mu$ f 20% 400 vdcw	
C6	0150-0070	C: fxd cer 0.02 $\mu$ f 20% 500 vdcw		C51	0150-0070	C: fxd cer 0.02 $\mu$ f 20% 500 vdcw	
C7	0150-0012	C: fxd cer 0.01 $\mu$ f 20% 1000 vdcw		C52	0140-0041	C: fxd mica 100 pf 5% 500 vdcw	
C8	0150-0012	C: fxd cer 0.01 $\mu$ f 20% 1000 vdcw		C53 thru C104		Not Assigned	
C9	0150-0052	C: fxd 0.05 $\mu$ f 20% 400 vdcw		C105	0150-0014	C: fxd cer 500 pf min 500 vdcw	
C10	0150-0088	C: fxd cer 3.9 pf / 0.25 pf 500 vdcw		C106		Not Assigned	
C11	0150-0052	C: fxd 0.05 $\mu$ f 20% 400 vdcw		C107	0150-0069	C: fxd cer .001 $\mu$ f +100%-20% 500 vdcw	
C12 thru C15		Not Assigned		C108		Not Assigned	
C16	0150-0052	C: fxd 0.05 $\mu$ f 20% 400 vdcw		C109	0150-0070	C: fxd cer 0.02 $\mu$ f 20% 500 vdcw	
C17	0150-0029	C: fxd ti 1pf 10% 500 vdcw		C110	0150-0070	C: fxd cer 0.02 $\mu$ f 20% 500 vdcw	
C18	0150-0029	C: fxd ti 1pf 10% 500 vdcw		C111	0170-0022	C: fxd my 0.1 $\mu$ f 20% 600 vdcw	
C19	0150-0012	C: fxd cer 0.01 $\mu$ f 20% 1000 vdcw		C112	0150-0023	C: fxd cer 2000 pf 20% 1000 vdcw	
C20	0150-0012	C: fxd cer 0.01 $\mu$ f 20% 1000 vdcw		C113	0150-0023	C: fxd cer 2000 pf 20% 1000 vdcw	

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Table 6-1. Index by Reference Designator

Circuit Reference	Stock No.	Description #	Note	Circuit Reference	Stock No.	Description #	Note
C114	0150-0070	C: fxd cer 0.02 $\mu$ f 20% 500 vdcw		C216	0140-0201	C: fxd mica 12 pf 5% 500 vdcw	
C115	0140-0092	C: fxd mica 240 pf 5% 500 vdcw		C217	0140-0201	C: fxd mica 12 pf 5% 500 vdcw	
C116 thru C119		Not Assigned		C218 thru C220		Not Assigned	
C120	0150-0064	C: fxd cer 15 pf 5% npo 500 vdcw		C221	0150-0070	C: fxd cer 0.02 $\mu$ f 20% 500 vdcw	
C121	0140-0054	C: fxd mica 100 pf 10% 500 vdcw		C222	0150-0070	C: fxd cer 0.02 $\mu$ f 20% 500 vdcw	
C122	0150-0081	C: fxd cer 0.01 $\mu$ f -20%+80% 500 vdcw		C223	0150-0070	C: fxd cer 0.02 $\mu$ f 20% 500 vdcw	
C123	0140-0031	C: fxd mica 220 pf 10% 500 vdcw		C224	0150-0086	C: fxd cer 4700 pf 20% 500 vdcw	
C124	0140-0107	C: fxd mica 507 pf 2% 500 vdcw		C225	0150-0070	C: fxd cer 0.02 $\mu$ f 20% 500 vdcw	
C125	0130-0006	C: var cer 5-20 pf N300		C226 thru C309		Not Assigned	
C126	0150-0081	C: fxd cer 0.01 $\mu$ f -20%+80% 500 vdcw		C310	0150-0085	C: fxd cer 2200 pf 20% 500 vdcw	
C127	0150-0069	C: fxd cer .001 $\mu$ f +100%-20% 500 vdcw		C311	0150-0014	C: fxd cer 5000 pf min 500 vdcw	
C128	0140-0002	C: fxd mica 10 pf 10% vdcw		C312	0150-0036	C: fxd cer 470 pf 20% 6kv	
C129	0140-0039	C: fxd mica 47 pf 5% 300 vdcw		C313	0160-0108	C: fxd paper 470 pf 20% 10000 vdcw	
C130 thru C139		Not Assigned		C314	0160-0151	C: fxd cer 4700 pf +80-20% 4000 vdcw	
C140	0150-0069	C: fxd cer .001 $\mu$ f +100%-20% 500 vdcw		C315		Not Assigned	
C141	0150-0081	C: fxd cer 0.01 $\mu$ f -20%+80% 500 vdcw		C316	0160-0151	C: fxd cer 4700 pf +80-20% 4000 vdcw	
C142	0140-0016	C: fxd mica 390 pf 5% 500 vdcw		C317 thru C319		Not Assigned	
C143	0150-0069	C: fxd cer .001 $\mu$ f +100%-20% 500 vdcw		C320	0170-0065	C: fxd my 0.047 $\mu$ f 10% 140 vdcw	
C144	0140-0041	C: fxd mica 100 pf 5% 500 vdcw		C321	0160-0151	C: fxd cer 4700 pf +80-20% 4000 vdcw	
C145 thru C148		Not Assigned		C322	0170-0022	C: fxd my 0.1 $\mu$ f 20% 600 vdcw	
C149	0150-0070	C: fxd cer 0.02 $\mu$ f 20% 500 vdcw		C323	0170-0022	C: fxd my 0.1 $\mu$ f 20% 600 vdcw	
C150	0150-0081	C: fxd cer 0.01 $\mu$ f -20%+80% 500 vdcw		C324	0150-0081	C: fxd cer 0.01 $\mu$ f -20%+80% 500 vdcw	
C151	0150-0081	C: fxd cer 0.01 $\mu$ f -20%+80% 500 vdcw		C325	0160-0151	C: fxd cer 4700 pf +80-20% 4000 vdcw	
C152	0150-0081	C: fxd cer 0.01 $\mu$ f -20%+80% 500 vdcw		C325	0160-0151	C: fxd cer 470 pf 80 20% 4000 vdcw	
C153	0150-0081	C: fxd cer 0.01 $\mu$ f -20%+80% 500 vdcw		C326	0150-0081	C: fxd cer 0.01 $\mu$ f -20%+80% 500 vdcw	
C154	0150-0081	C: fxd cer 0.01 $\mu$ f -20%+80% 500 vdcw		C327	0150-0081	C: fxd cer 0.01 $\mu$ f -20%+80% 500 vdcw	
C155 thru C200		Not Assigned		C328	0150-0081	C: fxd cer 0.01 $\mu$ f -20%+80% 500 vdcw	
C201	0170-0022	C: fxd my 0.1 $\mu$ f 20% 600 vdcw		C329		Not Assigned	
C202	0140-0004	C: fxd mica 15 pf 10% 500 vdcw		C330	0160-0151	C: fxd cer 4700 pf +80-20% 4000 vdcw	
C203	0130-0008	C: var cer 8-50 pf N750		C331	0160-0151	C: fxd cer 4700 pf +80-20% 4000 vdcw	
C204	0140-0055	C: fxd mica 150 pf 10% 500 vdcw		C332	0160-0151	C: fxd cer 4700 pf +80-20% 4000 vdcw	
C205		Not Assigned		C333	0140-0034	C: fxd mica 22 pf 5% 500 vdcw	
C206	0150-0086	C: fxd cer 4700 pf 20% 500 vdcw		C334 thru C339		Not Assigned	
C207	0150-0070	C: fxd cer 0.02 $\mu$ f 20% 500 vdcw		C340	0150-0052	C: fxd 0.05 $\mu$ f 20% 400 vdcw	
C208 thru C210		Not Assigned		C341	0170-0027	C: fxd my 0.02 $\mu$ f 5% 200 vdcw	
V211	0130-0006	C: var cer 5-20 pf N300		C342	0180-0058	C: fxd elect 50 $\mu$ f -10%+100% 25 vdcw	
C212	0131-0004	C: var mica 16-150 pf 175 vdcw		C343	0170-0027	C: fxd my 0.02 $\mu$ f 5% 200 vdcw	
C213	0130-0003	C: var C 1.5-7 pf 500 vdcw		C344 thru C400		Not Assigned	
C214	0140-0006	C: fxd mica 82 pf 10% 500 vdcw		C401	0150-0052	C: fxd 0.05 $\mu$ f 20% 400 vdcw	
C215	0150-0088	C: fxd cer 3.9 pf $\pm$ 0.25 pf 500 vdcw		C402	0150-0052	C: fxd 0.05 $\mu$ f 20% 400 vdcw	

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Table 6-1. Index by Reference Designator

Circuit Reference	Stock No.	Description #	Note	Circuit Reference	Stock No.	Description #	Note
C403 thru C420			Not Assigned	C1009	0140-0018	C: fxd mica 1000 pf 5% npo 500 vdcw	
C421	0180-0133	C: fxd elect 135 $\mu$ f -10+50% 400 vdcw		C1010	0130-0001	C: var cer 7-45 pf N500	
C422	0180-0024	C: fxd elect 40 $\mu$ f 450 vdcw		C1011	0140-0006	C: fxd mica 82 pf 10% 500 vdcw	
C423	0180-0032	C: fxd elect 10 $\mu$ f 10 vdcw		C1012	0130-0001	C: var cer 7-45 pf N500	
C424	0160-0013	C: fxd my 0.1 $\mu$ f 10% 400 vdcw		C1013	0140-0082	C: fxd mica 68 pf 5% 500 vdcw	
C425 thru C427			Not Assigned	C1014	0130-0001	C: var cer 7-45 pf N500	
C428	0150-0024	C: fxd cer 0.02 $\mu$ f +80%-20% 600 vdcw		C1015	0140-0034	C: fxd mica 22 pf 5% 500 vdcw	
C429 thru C440			Not Assigned	C1016	0130-0001	C: var cer 7-45 pf N500	
C441	0180-0131	C: fxd elect 150 pf -10+50% 200 vdcw		CR1	1910-0016	Semicon device diode germanium	
C442	0180-0131	C: fxd elect 150 pf -10+50% 200 vdcw		CR2	1910-0016	Semicon device diode germanium	
C443	0180-0132	C: fxd elect 60 $\mu$ f -10+100% 200 vdcw		CR3	1910-0016	Semicon device diode germanium	
C444	0150-0084	C: fxd 000 pf $\pm$ 300 pf 200 vdcw		CR4	1910-0016	Semicon device diode germanium	
C445	0180-0089	C: fxd elect 10 $\mu$ f -10%+100% 150 vdcw		CR5 thru CR101		Not Assigned	
C446 thru C447			Not Assigned	CR102	1912-0006	Semicon device diode ger tunnel	
C448	0150-0024	C: fxd cer 0.02 $\mu$ f +80%-20% 600 vdcw		CR103	1901-0034	Diode: silicon 5MA piv 120 cap-3 pf	
C449 thru C460			Not Assigned	CR104	1901-0034	Diode: silicon 5MA piv 120 cap-3 pf	
C461	0180-0131	C: fxd elect 150 pf -10+50% 200 vdcw		CR105	1902-0034	Semicon device diode	
C462	0180-0131	C: fxd elect 150 pf -10+50% 200 vdcw		CR106	1901-0044	Semicon device diode silicon	
C463	0180-0132	C: fxd elect 60 $\mu$ f -10+100% 200 vdcw		CR107 thru CR300		Not Assigned	
C464	0150-0052	C: fxd 0.05 $\mu$ f 20% 400 vdcw		CR301	1902-0009	Semicon device diode 1N755 250MW	
C465	0150-0084	C: fxd 000 pf $\pm$ 300 pf 200 vdcw		CR302	1901-0033	Semicon device diode 1N485B	
C466	0180-0059	C: fxd elect 10 $\mu$ f -10%+100% 25 vdcw		CR303 thru CR420		Not Assigned	
C467			Not Assigned	CR421	1901-0051	Semicon device: diode spl1N1566A	
C468	0150-0024	C: fxd cer 0.02 $\mu$ f +80%-20% 600 vdcw		CR422	1901-0051	Semicon device: diode spl1N1566A	
C469 thru C480			Not Assigned	CR422	1901-0051	Semicon device: diode spl1N1566A	
C481	0180-0134	C: fxd elect 7000 f -10+100% 25 vdcw		CR423	1901-0051	Semicon device: diode spl1N1566A	
C482	0180-0059	C: fxd elect 10 $\mu$ f -10%+100% 25 vdcw		CR424	1901-0051	Semicon device: diode spl1N1566A	
C483	0180-0059	C: fxd elect 10 $\mu$ f -10%+100% 25 vdcw		CR425	1902-0034	Semicon device: diode	
C484 thru C487			Not Assigned	CR426 thru CR440		Not Assigned	
C488	0150-0052	C: fxd 0.05 $\mu$ f 20% 400 vdcw		CR441	1901-0051	Semicon device: diode spl1N1566A	
C489 thru C710			Not Assigned	CR442	1901-0051	Semicon device: diode spl1N1566A	
C711	0150-0081	C: fxd cer 0.01 $\mu$ f -20%+80% 500 vdcw		CR443	1901-0051	Semicon device: diode spl1N1566A	
C712 thru C1001			Not Assigned	CR444	1901-0051	Semicon device: diode spl1N1566A	
C1002	0160-0015	C: fxd paper 0.47 $\mu$ f 10% 200 vdcw		CR445 thru CR460		Not Assigned	
C1003	0160-0005	C: fxd my 0.047 $\mu$ f 10% 600 vdcw		CR461	1901-0051	Semicon device: diode spl1N1566A	
C1004	0160-0010	C: fxd my 4700 pf 10% 600 vdcw		CR462	1901-0051	Semicon device: diode spl1N1566A	
C1005	0140-0085	C: fxd mica 470 pf 5% 500 vdcw		CR463	1901-0051	Semicon device: diode spl1N1566A	
C1006	0170-0018	C: fxd my 1 $\mu$ f 5% 200 vdcw		CR464	1901-0051	Semicon device: diode spl1N1566A	
C1007	0170-0019	C: fxd my 0.1 $\mu$ f 5% 200 vdcw		CR465	1902-0034	Semicon device: diode	
C1008	0170-0017	C: fxd my 0.01 $\mu$ f 5% 400 vdcw		CR466 thru CR480		Not Assigned	

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Table 6-1. Index by Reference Designator

Circuit Reference	Stock No.	Description #	Note	Circuit Reference	Stock No.	Description #	Note
CR481	1901-0032	Semicon device: diode 1N3209	Junction	L16	9140-0080	Coil fxd rf: 0.18 uhy	
CR482	1901-0032	Semicon device: diode 1N3209	Junction	L17	9140-0024	Coil fxd rf: 0.68 uhy	
CR483	1902-0034	Semicon device: diode		L18	9140-0024	Coil fxd rf: 0.68 uhy	
DL1	8120-0092	Cable: Delay		L19 thru L20		Not Assigned	
DS401	1450-0048	Lamp: pilot NE2H power on indicator		L21	9140-0024	Coil fxd rf: 0.68 uhy	
F401	2110-0023	Fuse: Cartridge 6.25a 250v slow blow		L21	9140-0024	Coil fxd rf: 0.68 uhy	
F402 thru F420			Not Assigned	L22	9140-0024	Coil fxd rf: 0.68 uhy	
F421	2110-0012	Fuse: Cartridge 1/2a 250v		L23	9140-0088	Coil fxd rf: 0.33 uhy	
F422 thru F440			Not Assigned	L24	9140-0088	Coil fxd rf: 0.33 uhy	
F441	2110-0033	Fuse 0.75a 250v		L25 thru L30		Not Assigned	
F442 thru F460			Not Assigned	L31	9140-0018	Coil fxd rf: 1 uhy	
F461	2110-0033	Fuse 0.75a 250v		L32	9140-0018	Coil fxd rf: 1 uhy	
F462 thru F480			Not Assigned	L33	9140-0088	Coil fxd rf: 0.33 uhy	
F481	2110-0035	Fuse: Cartridge 8a slow blow		L34	9140-0088	Coil fxd rf: 0.33 uhy	
J1	1251-0007	Connector: Female 16-pin		L35 thru L102		Not Assigned	
J2 thru J100			Not Assigned	L103	9140-0074	Coil fxd rf: 10 uhy	
J101	1250-0118	Connector: BNC		L104	9140-0121	Coil fxd 1.8 uhy	
J102 thru J104			Not Assigned	L105	9140-0121	Coil fxd 1.8 uhy	
J105	1251-0137	Receptacle 32 contact		L106 thru L200		Not Assigned	
J106 thru J200			Not Assigned	L201	9140-0118	Coil fxd 500 uhy	
J201	1250-0083	Connector: BNC		L202	9140-0118	Coil fxd 500 uhy	
J202 thru J300			Not Assigned	L203	9140-0047	Coil fxd rf: 20 uhy	
J301	1250-0083	Connector: BNC		L204	9140-0047	Coil fxd rf: 20 uhy	
J302	G-10D	Binding post red 1v calibr-ator		L205 thru L300		Not Assigned	
J303	G-10C	Binding post: black		L301	9140-0075	Coil fxd rf: 270 uhy	
J304	G-10D	Binding post red 10v calibr-ator		L302	9140-0072	Coil fxd rf: 5000 uhy	
J305 thru J400			Not Assigned	L303	9140-0072	Coil fxd rf: 5000 uhy	
J401	1251-0148	Connector: power		L304	G-60B	Coil: alignment, pattern rotating coil	
J402 thru J710			Not Assigned	L305 thru L480		Not Assigned	
J711	1250-0083	Connector: BNC		L481	9110-0050	Inductor A.F.	
J712	1250-0083	Connector: BNC		P401-P402		Not separately replaceable part of W401	
L7	175A-60F	Coil: re, var. HI freq response		Q103	1850-0091	Transistor germanium 2N2048 PNP	
L8	175A-60F	Coil: re, var. HI freq response		Q104 thru Q300		Not Assigned	
L9	9140-0018	Coil fxd rf: 1 uhy		Q301	1850-0062	Transistor germanium	
L10	9140-0018	Coil fxd rf: 1 uhy		Q302	1850-0062	Transistor germanium	
L11	9140-0080	Coil fxd rf: 0.18 uhy		Q303 thru Q420		Not Assigned	
L12	9140-0080	Coil fxd rf: 0.18 uhy		Q421	1850-0098	Transistor germanium PNP selected	
L13	9140-0088	Coil fxd rf: 0.33 uhy		Q422	1850-0098	Transistor germanium PNP selected	
L14	9140-0094	Coil fxd rf: 0.68 uhy		Q423	1850-0098	Transistor germanium PNP selected	
L15	9140-0080	Coil fxd rf: 0.18 uhy		Q424	1851-0017	Transistor german tran 2N1304 NPN	

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Circuit Reference	Ⓢ Stock No.	Description #	Note	Circuit Reference	Ⓢ Stock No.	Description #	Note
Q425	1850-0062	Transistor germanium		R26	0686-1515	R: fxd comp 150 ohms 5% 1/2W	
Q426 thru Q440		Not Assigned		R27 thru R29		Not Assigned	
Q441	1850-0098	Transistor germanium PNP selected		R30	0767-0020	R: fxd met flm 2200 ohms 5% 3W	
Q442	1850-0098	Transistor germanium pnp selected		R31	0684-8211	R: fxd comp 820 ohms 10% 1/4W	
Q443	1851-0017	Transistor german tran 2N1304 npn		R32	0684-8211	R: fxd comp 820 ohms 10% 1/4W	
Q444	1850-0062	Transistor germanium		R33	0683-3315	R: fxd comp 330 ohms 5% 1/4W	
Q445 thru Q460		Not Assigned		R34	0683-3315	R: fxd comp 330 ohms 5% 1/4W	
Q461	1850-0098	Transistor germanium pnp selected		R35	0727-0110	R: fxd depc 1.5K ohms 1% 1/2W	
Q462	1850-0062	Transistor germanium		R36	0727-0110	R: fxd depc 1.5K ohms 1% 1/2W	
Q463	1850-0062	Transistor germanium		R37	0727-0110	R: fxd depc 1.5K ohms 1% 1/2W	
Q464	1850-0062	Transistor germanium		R38	0727-0110	R: fxd depc 1.5K ohms 1% 1/2W	
Q465 thru Q480		Not Assigned		R39	0687-6521	R: fxd comp 5600 ohms 10% 1/2W	
Q481	1850-0021	Transistor germanium 2N441 pnp		R40	0687-5621	R: fxd comp 5600 ohms 10% 1/2W	
Q482	1850-0098	Transistor germanium pnp selected		R41	0761-0010	R: fxd met flm 1800 ohms 5% 1W	
Q483	1850-0062	Transistor germanium		R42	0761-0010	R: fxd met flm 1800 ohms 5% 1W	
Q484	1850-0062	Transistor germanium		R43	0767-0005	R: fxd met flm 5600 ohms 5% 3W	
Q485 thru Q710		Not Assigned		R44	0767-0005	R: fxd 5600 ohms 5% 3W	
Q711	1851-0017	Transistor: 2N1304		R45	2100-0151	R: var 500 ohms 20% 2/10W lin	
Q712	1851-0017	Transistor: 2N1304		R46	0686-6215	R: fxd comp 620 ohms 5% 1/2W	
R5	0690-1001	R: fxd comp 10 ohms 10% 1W		R47	0683-2715	R: fxd comp 270 ohms 5% 1/4W	
R6	0689-6215	R: fxd comp 620 ohms 5% 1W		R48	0683-2715	R: fxd comp 270 ohms 5% 1/4W	
R7	0687-1001	R: fxd comp 10 ohms 10% 1/2W		R49	0687-4721	R: fxd comp 4700 ohms 10% 1/2W	
R8	0687-3331	R: fxd comp 33K ohms 10% 1/2W		R50	0687-4721	R: fxd comp 4700 ohms 10% 1/2W	
R9	0815-0022	R: fxd WW 1600 ohms 5% 10W		R51	0727-0110	R: fxd depc 1.5K ohms 1% 1/2W	
R10	0815-0011	R: fxd WW 630 ohms 5% 10W		R52	0727-0110	R: fxd depc 1.5K ohms 1% 1/2W	
R11	0687-2201	R: fxd comp 22 ohms 10% 1/2W		R53	0727-0110	R: fxd depc 1.5K ohms 1% 1/2W	
R12	0767-0021	R: fxd met flm 2700 ohms 5% 3W		R54	0727-0110	R: fxd depc 1.5K ohms 1% 1/2W	
R13	0684-1051	R: fxd comp 1M ohms 10% 1/4W		R55	0764-0017	R: fxd met flm 1600 ohms 5% 2W	
R14	0684-1051	R: fxd comp 1M ohms 10% 1/4W		R56 thru R58		Not Assigned	
R15	0727-0110	R: fxd depc 1.5K ohms 1% 1/2W		R59	0767-0021	R: fxd met flm 2700 ohms 5% 3W	
R16	0727-0110	R: fxd depc 1.5K ohms 1% 1/2W		R60	0767-0021	R: fxd met flm 2700 ohms 5% 3W	
R17	0727-0110	R: fxd depc 1.5K ohms 1% 1/2W		R61 thru R62		Not Assigned	
R18	0727-0110	R: fxd depc 1.5K ohms 1% 1/2W		R63	0773-0020	R: fxd met flm 2700 ohms 5% 5W	
R19	0683-6805	R: fxd comp 68 ohms 5% 1/4W		R64	0773-0020	R: fxd met flm 2700 ohms 5% 5W	
R20	0683-6805	R: fxd comp 68 ohms 5% 1/4W		R65		Not Assigned	
R21	0767-0006	R: fxd met flm 6500 ohms 5% 3W		R66	0683-2205	F: fxd comp 22 ohms 5% 1/4W	
R22	0767-0006	R: fxd met flm 6500 ohms 5% 3W		R67	0683-4305	R: fxd comp 43 ohms 5% 1/4W	
R23	0683-3915	R: fxd comp 390 ohms 5% 1/4W		R68	0684-2221	R: fxd comp 2200 ohms 10% 1/4W	
R24	0683-3915	R: fxd comp 390 ohms 5% 1/4W		R69	0683-1515	R: fxd comp 150 ohms 5% 1/4W	
R25	0686-1515	F: fxd comp 150 ohms 5% 1/2W		R70	0683-1515	R: fxd comp 150 ohms 5% 1/4W	

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Circuit Reference	Stock No.	Description #	Note	Circuit Reference	Stock No.	Description #	Note
R71	0727-0333	R: fxd depc 402K ohms 1% 1W		R120	2100-0388	R: var ww 20 ohms 20% lin 2W	
R72	0727-0216	R: fxd depc 136.7K ohms 1% 1/2W		R121	0686-4735	R: fxd comp 47K ohms 5% 1/2W	
R73	0727-0216	R: fxd depc 136.7K ohms 1% 1/2W		R122	0686-6825	R: fxd comp 6800 ohms 5% 1/2W	
R74	0727-0333	R: fxd depc 402K ohms 1% 1W		R123	0687-5601	R: fxd comp 56 ohms 10% 1/2W	
R75 thru R76		Not Assigned		R124	0686-5115	R: fxd comp 510 ohms 5% 1/2W	
R77	0764-0001	R: fxd met flm 6.2K ohms 5% 2W		R125 thru R128		Not Assigned	
R78	0764-0001	R: fxd met flm 6.2K ohms 5% 2W		R129	0727-0224	R: fxd depc 249K ohms 1% 1/2W	
R79 thru R81		Not Assigned		R130	0687-5601	R: fxd comp 56 ohms 10% 1/2W	
R82	0683-1255	R: fxd comp 1.2M ohms 5% 1/4W		R131	0773-0005	R: fxd met flm 12K ohms 5% 5W	
R83	0767-0006	R: fxd met flm 6500 ohms 5% 3W		R132	0773-0006	R: fxd met flm 15K ohms 5% 5W	
R84	0687-2701	R: fxd comp 27 ohms 10% 1/2W		R133	0727-0208	R: fxd depc 100K ohms 1% 1/2W	
R85	0687-1051	R: fxd comp 1M ohms 10% 1/2W		R134	0764-0019	R: fxd met flm 3900 ohms 5% 2W	
R86		Not Assigned		R135	0764-0020	R: fxd met flm 5600 ohms 5% 2W	
R87	0687-1511	R: fxd comp 150 ohms 10% 1/2W		R136	0767-0004	R: rxd met flm 5000 ohms 5% 3W	
R88	0687-5611	R: fxd comp 560 ohms 10% 1/2W		R137	0687-5601	R: fxd comp 56 ohms 10% 1/2W	
R89	0687-2701	R: fxd comp 27 ohms 10% 1/2W		R138	0687-5601	R: fxd comp 56 ohms 10% 1/2W	
R90	0687-1051	R: fxd comp 1M ohms 10% 1/2W		R139	0687-8231	R: fxd comp 82K ohms 10% 1/2W	
R91		Not Assigned		R140	0693-1231	R: fxd comp 12K ohms 10% 2 W	
R92	0687-1511	R: fxd comp 150 ohms 10% 1/2W		R141	0727-0307	R: fxd dep c cer 1.65K ohms 1% 1/2W	
R93	0686-7515	R: fxd comp 750 ohms 5% 1/2W		R142	0727-0243	R: fxd depc 499K ohms 1% 1/2W	
R94	0687-2701	R: fxd comp 27 ohms 10% 1/2W		R143	0727-0243	R: fxd depc 499K 1% 1/2W	
R95	0684-1051	F: fxd comp 1M ohms 10% 1/4W		R144	0687-5601	R: fxd comp 56 ohms 10% 1/2W	
R96	0767-0006	R: fxd met flm 6500 ohms 5% 3W		R145 thru R150		Not Assigned	
R97	0684-4711	R: fxd comp 470 ohms 10% 1/4W		R151	0693-4731	R: fxd comp 47K ohms 10% 2W	
R98 thru R104		Not Assigned		R152	0690-1831	R: fxd comp 18K ohms 10% 1W	
R105	0687-4741	R: fxd comp 470K ohms 10% 1/2W		R153	0687-5611	R: fxd comp 560 ohms 10% 1/2W	
R106	0687-1051	R: fxd comp 1M ohms 10% 1/2W		R154	0687-5601	R: fxd comp 56 ohms 10% 1/2W	
R107	0686-1245	R: fxd comp 120K ohms 5% 1/2W		R155	0687-5601	R: fxd comp 56 ohms 10% 1/2W	
R108		Not separately replaceable part of S102		R156	0686-1555	R: fxd comp 1.5M ohms 5% 1/2W	
R109	0686-8225	R: fxd comp 8200 ohms 5% 1/2W		R157	0687-4741	R: fxd comp 470K ohms 10% 1/2W	
R110	0687-2211	R: fxd 220 ohms 10% 1/2W		R158	0687-1051	R: fxd comp 1M ohms 10% 1/2W	
R111	0687-2211	R: fxd comp 220 ohms 10% 1/2W		R159	0686-2035	R: fxd comp 20K ohms 5% 1/2W	
R112	0693-1231	R: fxd comp 12K ohms 10% 2W		R160	0686-1535	R: fxd comp 15K ohms 5% 1/2W	
R113	0687-5601	R: fxd comp 56 ohms 10% 1/2W		R161	2100-0093	R: var 20K ohms 20% lin 1/5W	
R114	0687-5601	R: fxd comp 56 ohms 10% 1/2W		R162	0693-1231	R: fxd comp 12K ohms 10% 2W	
R115	0764-0021	R: fxd met flm 9100 ohms 5% 2W		R163	0687-5601	R: fxd comp 56 ohms 10% 1/2W	
R116	2100-0234	R: var comp 10K ohms 20% lin 2W		R164 thru R169		Not Assigned	
R117		Not Assigned		R170	2100-0094	R: var comp 50K ohms 30% lin 1/5W	
R118	0686-2205	R: fxd comp 22 ohms 5% 1/2W		R171	0686-4735	R: fxd comp 47K ohms 5% 1/2W	
R119	0687-5601	R: fxd comp 56 ohms 10% 1/2W		R172	2100-0348	R: var comp 50K ohms 20% lin 1W	

#See introduction to this section

Table 6-1. Index by Reference Designator

Circuit Reference	Stock No.	Description #	Note	Circuit Reference	Stock No.	Description #	Note
R173	0686-2035	R: fxd comp 20K ohms 5% 1/2W		R228	0687-5601	R: fxd comp 56 ohms 10% 1/2W	
R174	0687-1841	R: fxd comp 180K ohms 10% 1/2W		R229	0727-0217	R: fxd depc 140K ohms 1% 1/2W	
R175	0687-5601	R: fxd comp 56 ohms 10% 1/2W		R230		Not separately replaceable part of A203	
R176	0730-0041	R: fxd depc 25.2K ohms 1% 1W		R231	0687-1831	R: fxd comp 18K ohms 10% 1/2W	
R177	0727-0208	R: fxd depc 100K ohms 1% 1/2W		R232	0687-5601	R: fxd comp 56 ohms 10% 1/2W	
R178	0687-5601	R: fxd comp 56 ohms 10% 1/2W		R233	0690-2731	R: fxd comp 27K ohms 10% 1W	
R179	0687-2261	R: fxd comp 22M ohms 10% 1/2W		R234	0687-3931	R: fxd comp 39K ohms 10% 1/2W	
R180	0687-1021	R: fxd comp 1000 ohms 10% 1/2W		R235	0767-0022	R: fxd met flm 4500 ohms 5% 3W	
R181	0724-0038	R: fxd depc 71.5K ohms 1% 1/4W		R236	0727-0233	R: fxd depc 333K ohms 1% 1/2W	
R182	0730-0153	R: fxd depc 17.4K ohms 1% 1W		R237 thru R240		Not Assigned	
R183 thru R189		Not Assigned		R241	0776-0007	R: fxd met flm 16K ohms 5% 7W	
R190	0687-5601	R: fxd comp 56 ohms 10% 1/2W		R242	0687-5601	R: fxd comp 56 ohms 10% 1/2W	
R191	0687-5601	R: fxd comp 56 ohms 10% 1/2W		R243	0687-5601	R: fxd comp 56 ohms 10% 1/2W	
R192	0687-1011	R: fxd comp 100 ohms 10% 1/2W		R244	0687-5601	R: fxd comp 56 ohms 10% 1/2W	
R193	0687-5601	R: fxd comp 56 ohms 10% 1/2W		R245	0776-0007	R: fxd met flm 16K ohms 5% 7W	
R194	0687-1011	R: fxd comp 100 ohms 10% 1/2W		R246	0687-1011	R: fxd comp 100 ohms 10% 1/2W	
R195 thru R200		Not Assigned		R247	0687-1011	R: fxd comp 100 ohms 10% 1/2W	
R201	0727-0261	R: fxd depc 900K ohms 1% 1/2W		R248	0687-5601	R: fxd comp 56 ohms 10% 1/2W	
R202	0727-0212	R: fxd depc 111K ohms 1% 1/2W		R249	0727-0124	R: fxd carbon 3000 ohms 1% 1/2W	
R203 thru R205		Not Assigned		R250	0727-0124	R: fxd carbon 3000 ohms 1% 1/2W	
R206	0687-1051	R: fxd comp 1M ohms 10% 1/2W		R251	0687-5601	R: fxd comp 56 ohms 10% 1/2W	
R207	0687-1031	R: fxd comp 10K ohms 10% 1/2W		R252	0730-0069	R: fxd depc 100K ohms 1% 1W	
R208	0687-2211	R: fxd 220 ohms 10% 1/2W		R253	0730-0069	R: fxd depc 100K ohms 1% 1W	
R209	0690-1031	R: fxd comp 10K ohms 10% 1W		R254 thru R255		Not Assigned	
R210	0687-5631	R: fxd comp 56K ohms 10% 1/2W		R256	0687-5601	R: fxd comp 56 ohms 10% 1/2W	
R211	0687-5601	R: fxd comp 56 ohms 10% 1/2W		R257	0687-5601	R: fxd comp 56 ohms 10% 1/2W	
R212		Not separately replaceable part of A203		R258	0687-5601	R: fxd comp 56 ohms 10% 1/2W	
R213	2100-0154	R comp 1000 ohms 30% lin 3/10W		R259	0727-0287	R: fxd depc 2M ohms 1% 1/2W	
R214	2100-0346	R: var comp 10K ohms 20% lin 1W		R260	0687-1041	R: fxd comp 100K ohms 10% 1/2W	
R215	0689-2035	R: fxd comp 20K ohms 5% 1W		R261	0687-2251	R: fxd comp 2.2M ohms 10% 1/2W	
R216	0689-2035	R: fxd comp 20K ohms 5% 1W		R262		Not separately replaceable part of A203	
R217	0687-3341	R: fxd comp 330K ohms 10% 1/2W		R263		Not separately replaceable part of A203	
R218 thru R220		Not Assigned		R264 thru R309		Not Assigned	
R221	0727-0281	R: fxd depc 1.39M ohms 1% 1/2W		R310	0687-1011	R: fxd comp 100 ohms 10% 1/2W	
R222	0687-2211	R: fxd comp 220 ohms 10% 1/2W		R311	0687-1041	R: fxd comp 100K ohms 10% 1/2W	
R223	0693-1831	R: fxd comp 18K ohms 10% 2W		R312	0687-4741	R: fxd comp 470K ohms 10% 1/2W	
R224	0727-0218	R: fxd depc 180K ohms 1% 1/2W		R313	0836-0005	R: fxd depc 33M ohms 10% 1W	
R225		Not separately replaceable part of A203		R314	0687-2731	R: fxd comp 27K ohms 10% 1/2W	
R226	0727-0149	R: fxd depc 7.96K ohms 1% 1/2W		R315 thru R316		Not Assigned	
R227		Not separately replaceable part of A203		R317	0687-5631	R: fxd comp 56K ohms 10% 1/2W	



Table 6-1. Index by Reference Designator

Circuit Reference	Ⓢ Stock No.	Description #	Note	Circuit Reference	Ⓢ Stock No.	Description #	Note
R318	0836-0006	R: fxd depc 20M ohms 10% 1W		R370	0686-1525	R: fxd comp 1500 ohms 5% 1/2W	
R319	2100-0218	R: var comp 1.2M ohms 20% lin 2W		R371	0686-6235	R: fxd comp 62K ohms 5% 1/2W	
R320	0689-6235	R: fxd comp 62K ohms 5% 1W		R372	0686-2735	R: fxd comp 27K ohms 5% 1/2W	
R321	0690-1531	R: fxd comp 15K ohms 10% 1W		R373	0686-4335	R: fxd comp 43K ohms 5% 1/2W	
R322 thru R324		Not Assigned		R374	0686-1035	R: fxd comp 10K ohms 5% 1/2W	
R325	0692-6235	R: fxd comp 62K ohms 5% 2W		R375		Not separately replaceable part of A303	
R326	0687-5601	R: fxd comp 56 ohms 10% 1/2W		R376	0727-0394	R: fxd dep c 499 ohms 1/2% 1/2W	
R327	0690-1241	R: fxd comp 120K ohms 10% 1W		R377	0727-0393	R: fxd dep c 4.491K ohms 1/2% 1/2W	
R328		Not separately replaceable part of A303		R378	0689-1335	R: fxd 13K ohms +5% 1W	
R329	0693-3351	R: fxd comp 3.3M ohms 10% 2W		R379 thru R400		Not Assigned	
R330	0687-5601	R: fxd comp 56 ohms 10% 1/2W		R401	0687-3331	R: fxd comp 33K ohms 10% 1/2W	
R331	0693-3351	R: fxd comp 3.3M ohms 10% 2W		R402	0693-1201	R: fxd comp 12 ohms 10% 2W	
R332	0693-3351	R: fxd comp 3.3M ohms 10% 2W		R403 thru R420		Not Assigned	
R333	0693-3351	R: fxd comp 3.3M ohms 10% 2W		R421	0693-1041	R: fxd comp 100K ohms 10% 2W	
R334	2100-0112	R: var comp 5M ohms 30% 1/2W		R422	0816-0015	R: fxd ww 50 ohms 10% 10W	
R335	0687-5611	R: fxd comp 560 ohms 10% 1/2W		R423	0813-0011	R: fxd ww 330 ohms 5% 5W	
R336	0693-3351	R: fxd comp 3.3M ohms 10% 2W		R424	0813-0011	R: fxd ww 330 ohms 5% 5W	
R337	0693-3351	R: fxd comp 3.3M ohms 10% 2W		R425	0813-0011	R: fxd ww 330 ohms 5% 5W	
R338	0687-2731	R: fxd comp 27K ohms 10% 1/2W		R426	0727-0004	R: fxd met flm 5000 ohms 5% 3W	
R339	0687-1021	R: fxd comp 1000 ohms 10% 1/2W		R427	0693-5631	R: fxd comp 56K ohms 10% 2W	
R340	2100-0349	R: var comp 50K-2M-50K-9K ohms 30% lin 1/4 Not separately replaceable part of A303		R428	0687-1011	R: fxd comp 100 ohms 10% 1/2W	
R341	0687-6831	R: fxd comp 68K ohms 10% 1/2W		R429	0687-3311	R: fxd comp 330 ohms 10% 1/2W	
R342	0687-2241	R: fxd comp 220K ohms 10% 1/2W		R430	0687-8231	R: fxd comp 82K ohms 10% 1/2W	
R343	0686-5135	R: fxd comp 51K ohms 5% 1/2W		R431	0687-3311	R: fxd comp 330 ohms 10% 1/2W	
R344	0686-3335	R: fxd comp 33K ohms 5% 1/2W		R432	0730-0064	R: fxd depc 90. ohms 1% 1W	
R345		Not separately replaceable part of A303		R433	2100-0344	R: var comp dual 2500-12.5K Not separately replaceable part of A402	
R346	0686-4335	R: fxd comp 43K ohms 5% 1/2W		R434	0730-0058	R: fxd depc 75K ohms 1% 1W	
R347	0689-1135	R: fxd comp 11K ohms 5% 1W		R435 thru R440		Not Assigned	
R348	0693-2231	R: fxd comp 22K ohms 10% 2W		R441	0693-3331	R: fxd comp 33K ohms 10% 2W	
R349	0687-2251	R: fxd comp 2.2M ohms 10% 1/2W		R442	0816-0010	R: fxd ww 12 ohms 10% 10W	
R350	2100-0060	R: var 20K ohms 20% 2W lin		R443	0816-0020	R: fxd ww 110 ohms 10% 10W	
R351	0693-1031	R: fxd comp 10K ohms 10% 2W		R444	0816-0020	R: fxd ww 110 ohms 10% 10W	
R352	0693-1031	R: fxd comp 10K ohms 10% 2W		R445	0690-1831	R: fxd comp 18K ohms 10% 1W	
R353 thru R359		Not Assigned		R446	0687-1011	R: fxd comp 100 ohms 10% 1/2W	
R360	0687-1551	R: fxd comp 1.5M ohms 10% 1/2W		R447	0687-4711	R: fxd comp 470 ohms 10% 1/2W	
R361	0687-2231	R: fxd comp 22K ohms 10% 1/2W		R448	0687-8231	R: fxd comp 82K ohms 10% 1/2W	
R362	0687-2831	R: fxd comp 27K ohms 10% 1/2W		R449	0687-3311	R: fxd comp 330 ohms 10% 1/2W	
R363	0687-1041	R: fxd comp 100K ohms 10% 1/2W		R450	0767-0024	R: fxd met flm 13K ohms 5% 3W	
R364 thru R369		Not Assigned		R451		Not separately replaceable part of A402	

#See introduction to this section

Table 6-1. Index by Reference Designator

Circuit Reference	Stock No.	Description #	Note	Circuit Reference	Stock No.	Description #	Note
R452	0767-0009	R: fxd met flm		R1009	2100-0107	R: var comp 50K ohms 30% 1/3W	
R453 thru R460		Not Assigned		R1010	0687-1831	R: fxd comp 18K ohms 10% 1/2W	
R461	0693-3331	R: fxd comp 33K ohms 10% 2W		R1011	0733-0009	R: fxd depc 36M ohms 1% 2W	
R462	0816-0010	R: fxd ww 12 ohms 10% 10W		R1012	0730-0138	R: fxd depc 9M ohms 1% 1W	
R463	0818-0033	R: fxd ww 250 ohms 5% 20W		R1013	0730-0138	R: fxd depc 9M ohms 1% 1W	
R464	0693-1801	R: fxd comp 18 ohms 10% 2W		R1014	0730-0162	R: fxd depc 4.54M ohms 1% 1W	
R465	0690-1831	R: fxd comp 18K ohms 10% 1W		R1015	0727-0391	R: fxd dep c 1.81M ohms 1% 1/2W	
R466	0727-0137	R: fxd depc 5.18K ohms 1% 1/2W		R1016	0727-0261	R: fxd depc 900K ohms 1% 1/2W	
R467	0687-2711	R: fxd comp 270 ohms 10% 1/2W		R1017	0727-0392	R: fxd depc 450K ohms 1% 1/2W	
R468	0693-1821	R: fxd comp 1800 ohms 10% 2W		R1018	0727-0218	R: fxd depc 180K ohms 1% 1/2W	
R469	0687-4721	R: fxd comp 4700 ohms 10% 1/2W		R1019	0727-0204	R: fxd depc 90K ohms 1% 1/2W	
R470	0687-3331	R: fxd comp 33K ohms 10% 1/2W		R1020	0686-6815	R: fxd comp 680 ohms 5% 1/2W	
R471	0727-0095	R: fxd depc 900 ohms 1% 1/2W		S1	3100-0048	switch:push-button, beam finder	
R472		Not separately replaceable part of A402		S2 thru S100		Not Assigned	
R473	0767-0008	R: fxd met flm 10K ohms 5% 3W		S101		Not recommended for field replacement part of A102	
R474 thru R480		Not Assigned		S102	3100-0345	switch: rotary 1 sect 2 pos	
R481	0693-3311	R: fxd comp 330 ohms 10% 2W		S103		Not separately replaceable part os R172	
R482	0818-0034	R: fxd ww 2.3 ohms 5% 45W		S104 thru S200		Not Assigned	
R483	0687-1221	R: fxd comp 1200 ohms 10% 1/2W		S201		Not separately replaceable part of R214	
R484	0690-2231	R: fxd comp 22K ohms 10% 1W		S202		Not recommended for field replacement part of A202	
R485	0687-1511	R: fxd comp 150 ohms 10% 1/2W		S203		Not Assigned	
R486	2100-0108	R: var comp 100 ohms 30% lin 1/3W		S301		Not Assigned	
R487	0687-1511	R: fxd comp 150 ohms 10% 1/2W		S302	3101-0011	Switch: slide 0.5 a 125 vdc	
R488 thru R710		Not Assigned		S303 thru S400		Not Assigned	
R711	0686-6835	R: fxd comp 68K ohms 5% 1/2W		S401	3101-0050	Switch: toggle-power	
R712	0686-6835	R: vxd comp 68K ohms 5% 1/2W		S402	3101-0033	Switch: slide 115-23 ov	
R713	0686-4725	R: fxd comp 4700 ohms 5% 1/2W		S403 thru S1000		Not Assigned	
R714	0686-4725	R: fxd comp 4700 ohms 5% 1/2W		S1001		Not recommended for field replacement part of A1002	
R715	0687-1021	R: fxd comp 1000 ohms 10% 1/2W		S1002		Not separately replaceable part of R1009	
R716	0687-1021	R: fxd comp 1000 ohms 10% 1/2W		T103	175A-60A	Transformer: pulse	
R717	0687-5601	R: fxd comp 56 ohms 10% 1/2W		T104 thru T300		Not Assigned	
R718 thru R1000		Not Assigned		T301	175A-11A	Transformer: hv	
R1001	0686-3645	R: fxd comp 360K ohms 5% 1/2W		T302 thru T400		Not Assigned	
R1002		Not separately replaceable part of A1003		T401	9100-0162	T power	
R1003		Not separately replaceable part of A1003		V1	1932-0022	Electron tube: dual triode	
R1004		Not separately replaceable part of A1003		V2	1932-0022	Electron tube: dual triode	
R1005		Not separately replaceable part of A1003		V3	1932-0022	Electron tube: dual triode	
R1006	0686-1245	R: fxd comp 120K ohms 5% 1/2W		V4	1932-0022	Electron tube: dual triode	
R1007	0686-9135	R: fxd comp 91K ohms 5% 1/2W		V5 thru V6		Not Assigned	
R1008	0686-6835	R: fxd comp 68K ohms 5% 1/2W		V7	1932-0022	Electron tube: dual triode	

Table 6-1. Index by Reference Designator

Circuit Reference	Ⓢ Stock No.	Description #	Note	Circuit Reference	Ⓢ Stock No.	Description #	Note
V8	1932-0022	Electron tube: dual triode		XV1	1200-0058	Socket: 9-pin miniature tube	
V9	1932-0022	Electron tube: dual triode		XV2	1200-0058	Socket: 9-pin miniature tube	
V10	1932-0022	Electron tube: dual triode		XV3	1200-0058	Socket: 9-pin miniature tube	
V11	1932-0022	Electron tube: dual triode		XV4	1200-0058	Socket: 9-pin miniature tube	
V12	1932-0022	Electron tube: dual triode		XV5 thru XV6		Not Assigned	
V13	2140-0008	Lamp glow NE-2 neon		XV7	1200-0058	Socket: 9-pin miniature tube	
V14	2140-0008	Lamp glow NE-2 neon		XV8	1200-0058	Socket: 9-in miniature tube	
V15 thru V100		Not Assigned		XV9	1200-0058	Socket: 9-pin miniature tube	
V101	1932-0022	Electron tube: dual triode		XV10	1200-0058	Socket: 9-pin miniature tube	
V102	2140-0008	Lamp glow NE-2 neon		XV11	1200-0058	Socket: 9-pin miniature tube	
V103	1932-0022	Electron tube: dual triode		XV12	1200-0058	Socket: 9-pin miniature tube	
V104	1932-0022	Electron tube: dual triode		XV13 thru XV100		Not Assigned	
V105	1932-0022	Electron tube: dual triode		XV101	1200-0048	Socket: tube 9-pin miniature	
V106	1932-0030	Electron tube: 6CL6 noval pentode		XV102		Not Assigned	
V107	1932-0022	Electron tube: dual triode		XV103	1200-0048	Socket: tube 9-pin miniature	
V108	2140-0008	Lamp glow NE-2 neon		XV104	1200-0048	Socket: tube 9-pin miniature	
V109	1932-0022	Electron tube: dual triode		XV105	1200-0048	Socket: tube 9-pin miniature	
V110 thru V200		Not Assigned		XV106	1200-0048	Socket: tube 9-pin miniature	
V201	1932-0022	Electron tube: dual triode		XV107	1200-0048	Socket: tube 9-pin miniature	
V202	2140-0008	Lamp glow NE-2 neon		XV108		Not Assigned	
V203	1932-0022	Electron tube: dual triode		XV109	1200-0048	Socket: tube 9-pin miniature	
V204	1921-0018	Electron tube: triode 6CM4		XV110 thru XV200		Not Assigned	
V205	1921-0018	Electron tube: triode 6CM4		XV201	1200-0062	Socket: tube 9-pin miniature	
V206	2140-0008	Lamp glow NE-2 neon		XV202		Not Assigned	
V207	2140-0008	Lamp glow NE-2 neon		XV203	1200-0062	Socket: tube 9-pin miniature	
V208	1932-0022	Electron tube: dual triode		XV204	1200-0062	Socket: tube 9-pin miniature	
V209	1932-0022	Electron tube: dual triode		XV205	1200-0062	Socket: Tube 9 pin miniature	
V210 thru V300		Not Assigned		XV206 thru XV207		Not Assigned	
V301	1932-0044	Electron tube: 6CW5 (EL 86) pentode		XV208	1200-0062	Socket: tube 9-pin miniature	
V302	1920-0004	Electron tube: 1X2B diode		XV209	1200-0062	Socket: tube 9-pin miniature	
V303	1920-0004	Electron tube: 1X2B diode		XV210 thru XV300		Not Assigned	
V304	1920-0004	Electron tube: 1X2B diode		XV301	1200-0008	Socket: tube 9-pin	
V305	1920-0004	Electron tube: 1X2B diode		XV302 thru XV305		Not Assigned	
V306	1932-0029	Electron tube: 12AU7 dual triode		XV306	1200-0048	Socket: tube 9-pin miniature	
V307	2140-0008	Lamp glow NE-2 neon		XV307 thru XV308		Not Assigned	
V308	2140-0008	Lamp glow NE-2 neon		XV309	1200-0037	Socket: crt tube	
V309	G-205E-2	Crt: P31 aluminized internal graticule		XV310 thru XV460		Not Assigned	
V310 thru V460		Not Assigned		XV461	1200-0053	Socket: 7-pin tube	
V461	1940-0001	Electron tube: 5651 voltage reference		Z1	175A-60G	Coil and resistor network	
W401	8120-0078	Cable power svt-18-3 7.5 ft.		Z2	175A-60G	Coil and resistor network	

#See introduction to this section

Table 6-1. Index by Reference Designator

Circuit Reference	Ⓢ Stock No.	Description #	Note	Circuit Reference	Ⓢ Stock No.	Description #	Note
Z3	175A-60D	Coil and resistor network					
Z4	175A-60D	Coil: rf					
Z5 thru Z6		Not Assigned					
Z7	175A-60E	Coil: rf					
Z8	175A-60E	Coil: rf					
Z9 thru Z10		Not Assigned					
Z11	175A-60E	Coil: rf					
Z12	175A-60E	Coil: rf					
Z13	175A-60E	Coil: rf					
Z14	175A-60E	Coil: rf					

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Table 6-2. Replaceable Parts

Stock No.	Description#	Mfr.	Mfr. Part No.	TQ	RS
175A-4B	Assembly; HV Deck			1	1
175A-11A	Transformer: HV	28480	175A11A	1	1
175A-19A	Assembly; Sweep Time switch			1	1
175A-19B	Assembly; Horizontal Display switch			1	1
175A-19C	Assembly; Trigger Source switch			1	1
175A-19D	Assembly; Trigger Level & Slope switch			1	1
175A-60A	Transformer: pulse	28480	175A60A	1	1
175A-60D	Coil and resistor network	28480	175A60D	2	1
175A-60E	Coil: rf	28480	175A60E	5	1
175A-60F	Coil: re, var. hi freq response	8 28480	17560F	3	1
175A-60G	Coil and resistor network	28480	175A60G	2	1
175A-65A	Assembly; Horizontal Amplifier			1	1
175A-65B	Assembly; HV & Calib			1	1
175A-65D	Assembly; LV Power Supply			1	1
175A-65E	Assembly; Sweep			1	1
175A-65F	Assembly; Vertical Input			1	1
175A-65G	Assembly; Vertical Output			1	1
175A-65H	Circuit Board; Sweep Time switch			1	1
175A-65J	Assembly; Gate & Sweep Output			1	1
0130-0001	C: var cer 7-45 pf N500	72982	503-000-D2P0-33R	6	2
0130-0003	C: var C 1.5-7 pf 500 vdcw	72982	503-000C0P0-10R	1	1
0130-0006	C: var cer 5-20 pf N300	72982	503-000-B2P028R	2	1
0130-0008	C: var cer 8-50 pf N750	28480	0130-0008	1	1
0130-0019	C: var cer 4-30 pf N650	72982	Style 503-015-N650	1	1
0131-0004	C: var mica 16-150 pf 175 vdcw	28480	0131 0004	1	1
0132-0004	C: var poly 0.7-3 pf 350V	72982	535-009-4R	2	1
0140-0002	C: fxd mica 10 pf 10% vdcw	00853	Type KR B char.	1	1
0140-0004	C: fxd mica 15 pf 10% 500 vdcw	00853	Type DR DR1415 B10	1	1
0140-0006	C: fxd mica 82 pf 10% 500 vdcw	00853	Type DR DR1482 B10	2	1
0140-0016	C: fxd mica 390 pf 5% 500 vdcw	00853	Type KR KR1339 E5	1	1
0140-0018	C: fxd mica 100 pf 5% npo 500 vdcw	28480	0140 0018	1	1
0140-0025	C: fxd mica 68 pf 10% 500 vdcw	76433	RCM15B680K	1	1
0140-0031	C: fxd mica 220 pf 10% 500 vdcw	00853	Type K K1322 B10	1	1
0140-0034	C: fxd mica 22 pf 5% 500 vdcw	76433	RCM15E220J	2	1
0140-0039	C: fxd mica 47 pf 5% 500 vdcw	14655	CM15E470J	1	1
0140-0039	C: fxd mica 47 pf 5% 300 vdcw	76433		1	1
0140-0041	C: fxd mica 100 pf 5% 500 vdcw	00853	Type DR DR1310E5	2	1
0140-0054	C: fxd mica 100 pf 10% 500 vdcw	00853	Type K K1310 B10	1	1
0140-0055	C: fxd mica 150 pf 10% 500 vdcw	76433	RCM20B151K	1	1
0140-0082	C: fxd mica 68 pf 5% 500 vdcw	00853	Type DR DR1468 E5	1	1

#See introduction to this section

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

Stock No.	Description#	Mfr.	Mfr. Part No.	TQ	RS
0140-0085	C: fxd mica 470 pf 5% 500 vdcw	00853	Type KR KR1347 E5	1	1
0140-0092	C: fxd mica 240 pf 5% 500 vdcw	00853	Type DR DR1324 E5	1	1
0140-0092	C: fxd mica 240 pf 5% 500 vdcw	00853	Type DR DR1324E5	1	1
0140-0107	C: fxd mica 507 pf 2% 500 vdcw	14655	CM15E5070G	1	1
0140-0201	C: fxd mica 12 pf 5% 500 vdcw	04062	DM15C120J	2	1
0150-0012	C: fxd cer 0.01 $\mu$ f 20% 1000 vdcw	56289	H 1038	7	2
0150-0014	C: fxd cer 500 pf min 500 vdcw	04222	D1 4	2	1
0150-0023	C: fxd cer 200 pf 20% 1000 vdcw	91418	Type JF .002 20%	2	1
0150-0024	C: fxd cer 0.02 $\mu$ f +80%-20% 600 vdcw	71590	Type DD DD203	3	1
0150-0029	C: fxd ti 1pf 10% 500 vdcw	78488	Type GA 1.OPF 10%	2	1
0150-0036	C: fxd cer 470 pf 20% 6KV	91418	#6KV470 20%	1	1
0150-0052	C: fxd 0.05 $\mu$ f 20% 400 vdcw	05729	20x503MC4	20	4
0150-0064	C: fxd cer 15 pf 5% NPO 500 vdcw	72982	301 011 COG0 150J	1	1
0150-0069	C: fxd cer .001 $\mu$ f +100%-20% 500 vdcw	72982	#801 010X5G0102Z	4	1
0150-0070	C: fxd cer 0.02 $\mu$ f 20% 500 vdcw	72982	821 011X5U0203M	17	4
0150-0081	C: fxd cer 0.01 $\mu$ f -20%+80% 500 vdcw	5628	CK63AW103X	13	3
0150-0084	C: fxd 000 pf $\pm$ 300 pf 200 vdcw	96296	DD 310E 202 SD 1	2	1
0150-0085	C: fxd cer 2200 pf 20% 500 vdcw	56289	CK2AX222M	1	1
0150-0086	C: fxd cer 4700 pf 20% 500 vdcw	56289	CK2AW472M	2	1
0150-0088	C: fxd cer 3.9 pf $\pm$ 0.25 pf 500 vdcw	72982	CC20CH3R9C	2	1
0160-0005	C: fxd my 0.047 $\mu$ f 10% 600 vdcw	56289	160P47396	1	1
0160-0010	C: fxd my 4700 pf 10% 600 vdcw	56289	160P47296	1	1
0160-0013	C: fxd my 0.1 $\mu$ f 10% 400 vdcw	56289	160P10494	1	1
0160-0015	C: fxd paper 0.47 $\mu$ f 10% 200 vdcw	56289	109P47492	1	1
0160-0108	C: fxd paper 470 pf 20% 10000 vdcw	56289	184P4710100	1	1
0160-0151	C: fxd cer 4700 pf + 80 - 20% 4000 vdcw	71590	DA172 097CB	7	2
0170-0017	C: fxd my 0.01 $\mu$ f 5% 400 vdcw	84411	Type 620S/ .01	1	1
0170-0018	C: fxd my 1 $\mu$ f 5% 200 vdcw	84411	HEW 4	1	1
0170-0019	C: fxd my 0.1 $\mu$ f 5% 200 vdcw	28480	0170 0019	1	1
0170-0022	C: fxd my 0.1 $\mu$ f 20% 600 vdcw	09134	Type 27	4	1
0170-0027	C: fxd my 0.02 $\mu$ f 5% 200 vdcw	84411	Type 600 UE 20352	2	1
0170-0065	C: fxd my 0.047 $\mu$ f 10% 140 vdcw	56289	158P47391R4	1	1
0180-0024	C: fxd elect 40 $\mu$ f 450 vdcw	56289	D32441	1	1
0180-0032	C: fxd elect 10 $\mu$ f 10 vdcw	56289	30D147A1	1	1
0180-0058	C: fxd elect 50 $\mu$ f -10%+100% 25 vdcw	56289	Type 30D186A1	1	1
0180-0059	C: fxd elect 10 $\mu$ f -10%+100% 25 vdcw	56289	30D182A1	3	1
0180-0089	C: fxd elect 10 $\mu$ f -10%+100% 150 vdcw	56289	30D218A1	1	1
0180-0131	C: fxd elect 150pf -10+50% 200 vdcw	00853	PLI	4	1
0180-0132	C: fxd elect 60 $\mu$ f -10+100% 200 vdcw	00853	PLI	2	1
0180-0133	C: fxd elect 135 $\mu$ f -10+50% 400 vdcw	00853	PLI	1	1

#See introduction to this section

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

Stock No.	Description#	Mfr.	Mfr. Part No.	TQ	RS
0180-0134	C: fxd elect 700 $\mu$ f -10+100% 25 vdcw	56289	36D3070T	1	1
0683-1255	R: fxd comp 1.2M ohms 5% 1/4W	01121	CB 1255	1	1
0683-1515	R: fxd comp 150 ohms 5% 1/4W	01121	CB 1515	2	1
0683-2205	R: fxd comp 22 ohms 5% 1/4W	01121	CB 2205	1	1
0683-2715	R: fxd comp 270 ohms 5% 1/4W	01121	CB 2715	2	1
0683-3315	R: fxd comp 330 ohms 5% 1/4W	01121	CB 3315	2	1
0683-3915	R: fxd comp 390 ohms 5% 1/4W	01121	CB 3915	2	1
0683-4305	R: fxd comp 43 ohms 5% 1/4W	01121	CB 4305	1	1
0683-6805	R: fxd comp 68 ohms 5% 1/4W	01121	CB 6805	2	1
0684-1051	R: fxd comp 1M ohms 10% 1/4W	01121	CB 1051	3	1
0684-2221	R: fxd comp 2200 ohms 10% 1/4W	01121	CB 2221	1	1
0684-4711	R: fxd comp 470 ohms 10% 1/4W	01121	CB 4711	1	1
0684-8211	R: fxd comp 820 ohms 10% 1/4W	01121	CB 8211	2	1
0686-1035	R: fxd comp 10K ohms 5% 1/2W	01121	EB-1035	1	1
0686-1245	R: fxd comp 120K ohms 5% 1/2W	01121	EB-1245	2	1
0686-1515	R: fxd comp 150 ohms 5% 1/2W	01121	EB-1515	2	1
0686-1525	R: fxd comp 1500 ohms 5% 1/2W	01121	EB-1525	1	1
0686-1535	R: fxd comp 15K ohms 5% 1/2W	01121	EB-1535	1	1
0686-1555	R: fxd comp 1.5M ohms 5% 1/2W	01121	EB-1555	1	1
0686-2035	F: fxd comp 20K ohms 5% 1/2W	01121	EB-2035	2	1
0686-2205	R: fxd comp 22 ohms 5% 1/2W	01121	EB-2205	1	1
0686-2735	R: fxd comp 27K ohms 5% 1/2W	01121	EB-2735	1	1
0686-3335	R: fxd comp 33K ohms 5% 1/2W	01121	EB-3335	1	1
0686-3645	R: fxd comp 360K ohms 5% 1/2W	01121	EB-3645	1	1
0686-4335	R: fxd comp 43K ohms 5% 1/2W	01121	EB-4335	2	1
0686-4725	R: fxd comp 4700 ohms 5% 1/2W	01121	EB-4725	2	1
0686-4735	R: fxd comp 47K ohms 5% 1/2W	01121	EB-4735	2	1
0686-5115	R: fxd comp 510 ohms 5% 1/2W	01121	EB-5115	1	1
0686-5135	R: fxd comp 51K ohms 5% 1/2W	01121	EB-5135	1	1
0686-6215	R: fxd comp 620 ohms 5% 1/2W	01121	EB-6215	1	1
0686-6235	R: fxd comp 62K ohms 5% 1/2W	01121	EB-6235	1	1
0686-6815	R: fxd comp 680 ohms 5% 1/2W	01121	EB-6815	1	1
0686-6825	R: fxd comp 6800 ohms 5% 1/2W	01121	EB-6825	1	1
0686-6835	R: fxd comp 68K ohms 5% 1/2W	01121	EB-6835	3	1
0686-7515	R: fxd comp 750 ohms 5% 1/2W	01121	EB-7515	1	1
0686-8225	R: fxd comp 8200 ohms 5% 1/2W	01121	EB-8225	1	1
0686-9135	R: fxd comp 91K ohms 5% 1/2W	01121	EB-9135	1	1
0687-1001	R: fxd comp 10 ohms 10% 1/2W	01121	EB-1001	1	1
0687-1011	R: fxd comp 100 ohms 10% 1/2W	01121	EB-1011	7	2
0687-1021	R: fxd comp 1000 ohms 10% 1/2W	01121	EB-1021	4	1

#See introduction to this section

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

Stock No.	Description#	Mfr.	Mfr. Part No.	TQ	RS
0687-1031	R: fxd comp 10K ohms 10% 1/2W	01121	EB-1031	1	1
0687-1041	R: fxd comp 100K ohms 10% 1/2 W	01121	EB-1041	3	1
0687-1051	R: fxd comp 1M ohms 10% 1/2W	01121	EB-1051	5	1
0687-1221	R: fxd comp 1200 ohms 10% 1/2W	01121	EB-1221	1	1
0687-1511	R: fxd comp 150 ohms 10% 1/2W	01121	EB-1511	4	1
0687-1551	R: fxd comp 1.5M ohms 10% 1/2W	01121	EB-1551	1	1
0687-1831	R: fxd comp 18K ohms 10% 1/2W	01121	EB-1831	2	1
0687-1841	R: fxd comp 180K ohms 10% 1/2W	01121	EB-1841	1	1
0687-2201	R: fxd comp 22 ohms 10% 1/2W	01121	EB-2201	1	1
0687-2211	R: fxd comp 220 ohms 10% 1/2W	01121	EB-2211	4	1
0687-2231	R: fxd comp 22K ohms 10% 1/2W	01121	EB-2231	1	1
0687-2241	R: fxd comp 220K ohms 10% 1/2W	01121	EB-2241	1	1
0687-2251	R: fxd comp 2.2M ohms 10% 1/2W	01121	EB-2251	2	1
0687-2261	R: fxd comp 22M ohms 10% 1/2W	01121	EB-2261	1	1
0687-2701	R: fxd comp 27 ohms 10% 1/2W	01121	EB-2701	3	1
0687-2711	R: fxd comp 270 ohms 10% 1/2W	01121	EB-2711	1	1
0687-2731	R: fxd comp 27K ohms 10% 1/2W	01121	EB-2731	3	1
0687-3311	R: fxd comp 330 ohms 10% 1/2W	01121	EB-3311	3	1
0687-3331	R: fxd comp 33K ohms 10% 1/2W	01121	EB-3331	3	1
0687-3341	R: fxd comp 330K ohms 10% 1/2W	01121	EB-3341	1	1
0687-3931	R: fxd comp 39K ohms 10% 1/2W	01121	EB-3931	1	1
0687-4711	R: fxd comp 470 ohms 10% 1/2W	01121	EB-4711	1	1
0687-4721	R: fxd comp 4700 ohms 10% 1/2 W	01121	EB-4721	3	1
0687-4741	R: fxd comp 470K ohms 10% 1/2W	01121	EB-4741	3	1
0687-5601	R: fxd comp 56 ohms 10% 1/2W	01121	EB-5601	30	6
0687-5611	R: fxd comp 560 ohms 10% 1/2W	01121	EB-5611	3	1
0687-5621	R: fxd comp 5600 ohms 10% 1/2W	01121	EB-5621	2	1
0687-5631	R: fxd comp 56K ohms 10% 1/2W	01121	EB-5631	2	1
0687-6831	R: fxd comp 68K ohms 10% 1/2W	01121	EB-6831	1	1
0687-8231	R: fxd comp 82K ohms 10% 1/2W	01121	EB-8231	3	1
0689-1135	R: fxd comp 11K ohms 5% 1W	01121	GB-1135	1	1
0689-1335	R: fxd 13K ohms + 5% 1W	01121	GB-1335	1	1
0689-2035	R: fxd comp 20K ohms 5% 1W	01121	GB-2035	2	1
0689-6215	R: fxd comp 620 ohms 5% 1W	01121	GB-6215	1	1
0689-6235	R: fxd comp 62K ohms 5% 1W	01121	GB-6235	1	1
0690-1001	R: fxd comp 10 ohms 10% 1W	01121	GB-1001	1	1
0690-1031	R: fxd comp 10K ohms 10% 1W	01121	GB-1031	1	1
0690-1241	R: fxd comp 120K ohms 10% 1W	01121	GB-1241	1	1
0690-1531	R: fxd comp 15K ohms 10% 1W	01121	GB-1531	1	1
0690-1831	R: fxd comp 18K ohms 10% 1W	01121	GB-1831	3	1

#See introduction to this section



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

Stock No.	Description#	Mfr.	Mfr. Part No.	TQ	RS
0690-2231	R: fxd comp 22K ohms 10% 1W	01121	GB-2231	1	1
0690-2731	R: fxd comp 27K ohms 10% 1W	01121	GB-2731	1	1
0692-6235	R: fxd comp 62K ohms 5% 2W	01121	HB-6235	1	1
0693-1031	R: fxd comp 10K ohms 10% 2W	01121	HB-1031	2	1
0693-1041	R: fxd comp 100K ohms 10% 2W	01121	HB-1041	1	1
0693-1201	R: fxd comp 12 ohms 10% 2W	01121	HB-1201	1	1
0693-1231	R: fxd comp 12K ohms 10% 2W	01121	HB-1231	3	1
0693-1801	R: fxd comp 18 ohms 10% 2W	01121	HB-1801	1	1
0693-1821	R: fxd comp 1800 ohms 10% 2W	01121	HB-1821	1	1
0693-1831	R: fxd comp 18K ohms 10% 2W	01121	HB-1831	1	1
0693-2231	R: fxd comp 22K ohms 10% 2W	01121	HB-2231	1	1
0693-3311	R: fxd comp 330 ohms 10% 2W	01121	HB-3311	1	1
0693-3331	R: fxd comp 33K ohms 10% 2W	01121	HB-3331	2	1
0693-3351	R: fxd comp 3.3M ohms 10% 2W	01121	HB-3351	6	2
0693-4731	R: fxd comp 47K ohms 10% 2W	01121	HB-4731	1	1
0693-5631	R: fxd comp 56K ohms 10% 2W	01121	HB-5631	1	1
0724-0038	R: fxd depc 71.5K ohms 1% 1/4W	1901	CF-1/4	1	1
0727-0095	R: fxd depc 900 ohms 1% 1/2W	19701	DC-1/2 CR5	1	1
0727-0110	R: fxd depc 1.5K ohms 1% 1/2W	19701	DC-1/2 CR5	12	3
0727-0124	R: fxd carbon 3000 ohms 1% 1/2W	19701	DC-1/2 CR5	2	1
0727-0137	R: fxd depc 5.18K ohms 1% 1/2W	19701	DC-1/2 CR5	1	1
0727-0149	R: fxd depc 7.96K ohms 1% 1/2W	19701	DC-1/2 CR5	1	1
0727-0204	R: fxd depc 90K ohms 1% 1/2W	19701	CF-1/2	1	1
0727-0208	R: fxd depc 100K ohms 1% 1/2W	19701	DC-1/2 CR5	2	1
0727-0212	R: fxd depc 111K ohms 1% 1/2W	19701	DC-1/2 CR5	1	1
0727-0216	R: fxd depc 136.7K ohms 1% 1/2W	19701	DC-1/2 R5	2	1
0727-0217	R: fxd depc 140K ohms 1% 1/2W	19701	DC-1/2 BR5	1	1
0727-0218	R: fxd depc 180K ohms 1% 1/2W	19701	DC-1/2 CR5	2	1
0727-0224	R: fxd depc 249K ohms 1% 1/2W	19701	CF-1/2	1	1
0727-0233	R: fxd depc 333K ohms 1% 1/2W	19701	DC-1/2 AR5	1	1
0727-0243	R: fxd depc 499K ohms 1% 1/2W	19701	CF-1/2	2	1
0727-0261	R: fxd depc 900K ohms 1% 1/2W	19701	DC-1/2 CR5	2	1
0727-0281	R: fxd depc 1.39M ohms 1% 1/2W	19701	DC-1/2 AR5	1	1
0727-0287	R: fxd depc 2M ohms 1% 1/2W	19701	DC-1/2 CR5	1	1
0727-0307	R: fxd depc cer 1.65K ohms 1% 1/2W	19701	CF-1/2	1	1
0727-0333	R: fxd depc 402K ohms 1% 1W	19701	CF-1/2	2	1
0727-0391	R: fxd depc 1.81M ohms 1% 1/2W	19701	CF-1/2	1	1
0727-0392	R: fxd depc 450K ohms 1% 1/2W	19701	CF-1/2	1	1
0727-0393	R: fxd depc 4.491K ohms 1/2% 1/2W	19701	CF-1/2	1	1
0727-0394	R: fxd depc 499 ohms 1/2% 1/2W	19701	CF-1/2	1	1

#See introduction to this section

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

Stock No.	Description#	Mfr.	Mfr. Part No.	TQ	RS
0730-0041	R: fxd depc 25.2K ohms 1% 1W	19701	DC-1 R5	1	1
0730-0058	R: fxd depc 75K ohms 1% 1W	19701	DC-1 R5	1	1
0730-0064	R: fxd depc 90. ohms 1% 1W	19701	DC-1 R5	1	1
0730-0069	R: fxd depc 100K ohms 1% 1W	19701	DC-1 R5	2	1
0730-0138	R: fxd depc 9M ohms 1% 1W	19701	DC-1 R5	2	1
0730-0153	R: fxd depc 17.4K ohms 1% 1W	19701	DC-1 R5	1	1
0730-0162	R: fxd depc 4.54M ohms 1% 1W	19701	DC-1 R5	1	1
0733-0009	R: fxd depc 36M ohms 1% 2W	19701	DC-2 R5	1	1
0761-0010	R: fxd met flm 1800 ohms 5% 1W	07115	C-32	2	1
0764-0001	R: fxd met flm 6.2K ohms 5% 2W	07115	C-42	2	1
0764-0017	R: fxd met flm 1600 ohms 5% 2W	07115	C-42S	1	1
0764-0019	R: fxd met flm 3900 ohms 5% 2W	07115	C-42	1	1
0764-0020	R: fxd met flm 5600 ohms 5% 2W	07115	C-42	1	1
0764-0021	R: fxd met flm 9100 ohms 5% 2W	07115	C-42	1	1
0767-0004	R: fxd met flm 5000 ohms 5% 3W	07115	LPI-3	2	1
0767-0005	R: fxd met flm 5600 ohms 5% 3W	07115	LPI-3	2	1
0767-0006	R: fxd met flm 6500 ohms 5% 3W	07115	LPI-3	4	1
0767-0008	R: fxd met flm 10K ohms 5% 3W	07115	LPI-3	1	1
0767-0009	R: fxd met flm	07115	LPI-3	1	1
0767-0020	R: fxd met flm 2200 ohms 5% 3W	07115	LPI-3	1	1
0767-0021	R: fxd met flm 2700 ohms 5% 3W	07115	LPI-3	3	1
0767-0022	R: fxd met flm 4500 ohms 5% 3W	07115	LPI-3	1	1
0767-0024	R: fxd met flm 13K ohms 5% 3W	07115	LPI-3	1	1
0773-0005	R: fxd met flm 12K ohms 5% 5W	07115	LPI-5	1	1
0773-0006	R: fxd met flm 15K ohms 5% 5W	07115	LPI-5	1	1
0773-0020	R: fxd met flm 2700 ohms 5% 5W	07115	LPI-5	2	1
0776-0007	R: fxd met flm 16K ohms 5% 7W	07115	LPI-7	2	1
0813-0011	R: fxd ww 330 ohms 5% 5W	35434	C-5	3	1
0815-0011	R: fxd ww 630 ohms 5% 10W	94310	RW29V631	1	1
0815-0022	R: fxd ww 1600 ohms 5% 10W	94310	FR10	1	1
0816-0010	R: fxd ww 12 ohms 10% 10W	35434	Type GC10 12A	2	1
0816-0015	R: fxd ww 50 ohms 10% 10W	35434	GC10 50	1	1
0816-0020	R: fxd ww 110 ohms 10% 10W	35434	C10 110	2	1
0818-0033	F: fxd ww 250 ohms 5% 20W	94310	FR20	1	1
0818-0034	R: fxd ww 2.3 ohms 5% 45W	35434	ROE45 2.3T5	1	1
0836-0005	R: fxd depc 33M ohms 10% 1W	77764	BAKW	1	1
0836-0006	R: fxd depc 20M ohms 10% 1W	77764	BAKW	1	1
1200-0008	Socket: tube 9-pin	91662	377PHSPTD.125-3905	1	1
1200-0037	Socket: crt tube	72825	97094	1	1
1200-0048	Socket: tube 9 pin miniature	91662	390824	8	2

#See introduction to this section

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

Stock No.	Description#	Mfr.	Mfr. Part No.	TQ	RS
1200-0053	Socket: 7-pin tube	71785	1115111069	1	1
1200-0058	Socket: 9-pin miniature tube	91662	3901PHSPT0	10	2
1200-0062	Socket: tube 9 pin miniature	71785	1215111060	6	2
1250-0083	Connector: bnc	91737	UG-1094/U	4	1
1250-0118	Connector: bnc	91737	8427	1	1
1251-0007	Connector: female 16-pin	02660	264200-16S	1	1
1251-0137	Receptacle 32 contact	02660	26420032S	1	1
1251-0148	Connector: power			1	1
1450-0048	Lamp: pilot NE2H power on indicator	08717	858R	1	1
1850-0021	Transistor germanium 2N441 pnp	16758	2N441	1	1
1850-0062	Transistor germanium	28480	1850-0062	9	9
1850-0091	Transistor germanium 2N2048 pnp	87216	2N2048	1	1
1850-0098	Transistor germanium pnp selected	28480	1850-0098	7	7
1851-0017	Transistor german tran 2N1304 npn	01295	2N1304	4	4
1901-0032	Semicon device diode 1N3209 junction	04713	1N3209	2	2
1901-0033	Semicon device diode 1N485B	07910	1N485B	1	1
1901-0034	Diode: silicon 5MA piv 120 cap-3pf	28480	1901-0034	2	2
1901-0044	Semicon device diode silicon	28480	1901-0044	1	1
1901-0051	Semicon device: diode spln1566A	28480	1901-0051	12	12
1902-0009	Semicon device diode 1N755 250MW	01281	1N755	1	1
1902-0034	Semicon device diode	28480	1902-0034	4	4
1910-0016	Semicon device diode germanium	93332	D2361	4	4
1912-0006	Semicon device diode ger tunnel	28480	1912-0006	1	1
1920-0004	Electron tube: 1X2B diode	86684	1X2B	4	4
1921-0018	Electron tube: triode 6CM4	73445	6CM4/EC86	2	2
1923-0030	Electron tube: 6CL6 noval pentode	86684	6CL6	1	1
1923-0044	Electron tube: 6CW5 (el 86) pentode	73445	EL-86/6CW5	1	1
1932-0022	Electron tube: dual triode	73445	6DJ8/ECC 88	20	20
1932-0029	Electron tube: 12AU7 dual triode	12859	12AU7	1	1
1940-0001	Electron Tube: 5651 voltage reference	86684	5651	1	1
2100-0060	R: var 20K ohms 20% 2W lin	28480	2100-0060	1	1
2100-0093	R: var 20K ohms 20% lin 1/5W	28480	2100-0093	1	1
2100-0094	R: var comp 50K ohms 30% lin 1/5W	28480	2100-0094	1	1
2100-0107	R: var comp 50K ohms 30% 1/3W	28480	2100-0107	1	1
2100-0108	R: var comp 100 ohms 30% lin 1/3W	28480	2100-0108	1	1
2100-0112	R: var comp 5M ohms 30% 1/2W	28480	2100-0112	1	1
2100-0151	R: var 500 ohms 20% 2/10W lin	28480	2100-0151	1	1
2100-0154	R: comp 1000 ohms 30% lin 3/10W	28480	2100-0154	1	1
2100-0218	R: var comp 1.2M ohms 20% lin 2W	28480	2100-0218	1	1
2100-0234	R: var comp 10K ohms 20% lin 2W	28480	2100-0234	1	1

#See introduction to this section

MEL-RAY CO. 2100  
Inductor polar 3, 23  
NE

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

Stock No.	Description#	Mfr.	Mfr. Part No.	TQ	RS
2100-0344	R: var triple 2.5R/2.5R/12.5K				
2100-0345	R: var quad 12K/35K/100K/1K				
2100-0346	R: var comp 10K ohms 20% lin 1W	28480	2100-0346	1	1
2100-0347	R: var 4x25K ohms 30% lin 1/4W	28480	2100-0347	3	1
2100-0348	R: var comp 50K ohms 20% lin 1W	28480	2100-0348	1	1
2100-0349	R: var quad 50K-2M-50K-9K	28480	2100-0349	1	1
2100-0388	R: var WW 20 ohms 20% lin 2W	MEL-RAY CO.	2100-0388	1	1
2100-0414	Assembly: Horizontal Position				
2110-0012	Fuse: cartridge 1/2AMP 250V	75915	312.500	1	10
2110-0023	Fuse: cartridge 6.25 amp 250V slow blow	71400	MDF 6.25	1	10
2110-0033	Fuse: 0.75 amps 250 volts	75915	F02GR750A	2	20
2110-0035	Fuse: cartridge 8 amp slow blow	71400	MDL 8	1	10
2140-0008	Lamp glow NE-2 neon	24455	NE2	9	9
3100-0048	Switch: push-button, beam finder			1	1
3100-0345	Switch: rotary 1 sect 2 pos	28480	3100-0345	1	1
3101-0011	Switch: slide 0.5 amp 125 vdc	42190	4603	1	1
3101-0033	Switch: slide 115-230V			1	1
3101-0050	Switch: toggle-power			1	1
3140-0020	Motor: fan 30 watts	82821	1032453	1	1
8120-0078	Cable: power SVT-18-3 7.5 ft.	70903	KH4147	1	1
8120-0092	Cable: delay			1	1
9100-0162	T power	28480	9100-0162	1	1
9110-0050	Inductor A. F.	28480	9110-0050	1	1
9140-0018	Coil fxd rf 1 uhy	28480	9140-0018	4	1
9140-0024	Coil fxd rf 0.68 uhy	28480	9140-0024	4	1
9140-0047	Coil fxd rf 20 uhy	28480	9140-0047	2	1
9140-0072	Coil fxd rf: 5000 uhy	28480	9140-0072	2	1
9140-0074	Coil fxd rf: 10 uhy	28480	9140-0074	1	1
9140-0075	Coil fxd rf: 270 uhy	28480	9140-0075	1	1
9140-0080	Coil fxd rf: 0.18 uhy	28480	9140-0080	4	1
9140-0088	Coil fxd rf: 0.33 uhy	28480	9140-0088	5	1
9140-0094	Coil fxd rf: 0.68 uhy	99800	1537-08	1	1
9140-0118	Coil fxd 500 uhy	28480	9140-0118	2	1
9140-0121	Coil fxd 1.8 uhy	28480	9140-0121	2	1

#See introduction to this section

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

Stock No.	Description#	Mfr.	Mfr. Part No.	TQ	RS
MISCELLANEOUS					
AC-21M	Probe	28480	AC21M	1	1
C145B-73C	Cover: side	28480	C145B73C	1	1
C145H-02A	Assy: handle, side	28480	C145H02A	1	1
C145H-03A	Retainer: handle	28480	C145H93A	1	1
C145H-20	Assy: full module foot	28480	C145H20	1	1
C145H-44G	Kit: rack mount	28480	C145H44G	1	1
G-10C	Binding post: black	28480	G10C	1	1
G-10D	Binding post red 1 volt calibr-ator	28480	G10D	2	1
G-60B	Coil: alignment, pattern rotating coil	28480	G60B	1	1
G-74AT	Knob: trigger slope	28480	G74AT	1	1
G-74AU	Knob: horiz. position fine adjust	28480	G74AU	3	1
	Knob: sweep time vernier	28480	G74AU		
	Knob: external vernier	28480	G74AU		
G-74BE	Knob: trigger level horiz. position	28480	G74BE	1	1
G-74D	Knob: intensity, focus	28480	G74D	1	1
G-74DJ	Knob: trigger source	28480	G74DJ	1	1
G-74DK	Knob: sweep mode	28480	G74DK	1	1
G-74Q	Knob: sweep-time horizontal display.	28480	G74Q	1	1
G-205E-2	Crt: P31 aluminized internal graticule	28480	G-205E-2	1	1
120A-20A	Bezel	28480	120A20A	1	1
175A-1G	Cover: delay line	28480	175A1G	1	1
175A-2C	Panel: rear	28480	175A2C	1	1
175A-44A	Top cover	28480	175A44A	1	1
175A-44B	Bottom cover	28480	175A44B	1	1
1490-0030	Stand: tilt			1	1
3150-0023	Filter: air			1	1
6960-0001	Button: plug			1	1
6980-0006	Strip: trim			1	1

#See introduction to this section

## APPENDIX

### CODE LIST OF MANUFACTURERS (Sheet 1 of 2)

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

CODE NO.	MANUFACTURER	ADDRESS	CODE NO.	MANUFACTURER	ADDRESS	CODE NO.	MANUFACTURER	ADDRESS
00136	McCoy Electronics	Mount Holly Springs, Pa.	07115	Corning Glass Works	Bradford, Pa.	40920	Miniature Precision Bearings, Inc.	Keene, N.H.
00334	Humidial Co.	Colton, Calif.		Electronic Components Dept.		42190	Muter Co.	Chicago, Ill.
00335	Westrex Corp.	New York, N.Y.	07126	Digitran Co.	Pasadena, Calif.	43990	C. A. Norgren Co.	Englewood, Colo.
00373	Garlock Packing Co., Electronic Products Div.	Camden, N.J.	07137	Transistor Electronics Corp.	Minneapolis, Minn.	44655	Ohmite Mfg. Co.	Skokie, Ill.
00656	Aerovox Corp.	New Bedford, Mass.	07138	Westinghouse Electric Corp. Electronic Tube Div.	Elmira, N.Y.	47904	Polaroid Corp.	Cambridge, Mass.
00779	Amp, Inc.	Harrisburg, Pa.	07261	Avnet Corp.	Los Angeles, Calif.	48620	Precision Thermometer and Inst. Co.	Philadelphia, Pa.
00781	Aircraft Radio Corp.	Boonton, N.J.	07263	Fairchild Semiconductor Corp.	Mountain View, Calif.	49956	Raytheon Company	Lexington, Mass.
00815	Northern Engineering Laboratories, Inc.	Burlington, Wis.	07910	Continental Device Corp.	Hawthorne, Calif.	54294	Shallcross Mfg. Co.	Selma, N.C.
00853	Sangamo Electric Company, Ordill Division (Capacitors)	Marion, Ill.	07933	Rheem Semiconductor Corp.	Mountain View, Calif.	55026	Simpson Electric Co.	Chicago, Ill.
00866	Goe Engineering Co.	Los Angeles, Calif.	07966	Shockley Semi-Conductor Laboratories	Palo Alto, Calif.	55933	Sonotone Corp.	Elmsford, N.Y.
00891	Carl E. Holmes Corp.	Los Angeles, Calif.	07980	Boonton Radio Corp.	Boonton, N.J.	55938	Sorenson & Co., Inc.	So. Norwalk, Conn.
01121	Allen Bradley Co.	Milwaukee, Wis.	08145	U.S. Engineering Co.	Los Angeles, Calif.	56137	Spaulding Fibre Co., Inc.	Tonawanda, N.Y.
01255	Litton Industries, Inc.	Beverly Hills, Calif.	08358	Burgess Battery Co.	Niagara Falls, Ontario, Canada	56289	Sprague Electric Co.	North Adams, Mass.
01281	Pacific Semiconductors, Inc.	Culver City, Calif.	08717	Sloan Company	Burbank, Calif.	59446	Telex, Inc.	St. Paul, Minn.
01295	Texas Instruments, Inc. Transistor Products Div.	Dallas, Texas	08718	Cannon Electric Co. Phoenix Div.	Phoenix, Ariz.	61775	Union Switch and Signal, Div. of Westinghouse Air Brake Co.	Swissvale, Pa.
01349	The Alliance Mfg. Co.	Alliance, Ohio	08792	CBS Electronics Semiconductor Operations, Div. of C.B.S. Inc.	Lowell, Mass.	62119	Universal Electric Co.	Owosso, Mich.
01561	Chassi-Trak Corp.	Indianapolis, Ind.	08984	Mel-Rain	Indianapolis, Ind.	64959	Western Electric Co., Inc.	New York, N.Y.
01589	Pacific Relays, Inc.	Van Nuys, Calif.	09026	Babcock Relays, Inc.	Costa Mesa, Calif.	65092	Weston Inst. Div. of Daystrom, Inc.	Newark, N.J.
01930	Amerock Corp.	Rockford, Ill.	09134	Texas Capacitor Co.	Houston, Texas	66295	Wittek Manufacturing Co.	Chicago 23, Ill.
01961	Pulse Engineering Co.	Santa Clara, Calif.	09250	Electro Assemblies, Inc.	Chicago, Ill.	66346	Wollensak Optical Co.	Rochester, N.Y.
02114	Ferroxcube Corp. of America	Saugerties, N.Y.	09569	Mallory Battery Co. of Canada, Ltd.	Toronto, Ontario, Canada	70276	Allen Mfg. Co.	Hartford, Conn.
02286	Cole Mfg. Co.	Palo Alto, Calif.	10214	General Transistor Western Corp.	Los Angeles, Calif.	70309	Allied Control Co., Inc.	New York, N.Y.
02660	Amphenol-Borg Electronics Corp.	Chicago, Ill.	10411	Ti-Tal, Inc.	Berkeley, Calif.	70485	Atlantic India Rubber Works, Inc.	Chicago, Ill.
02735	Radio Corp. of America Semiconductor and Materials Div.	Somerville, N.J.	10646	Carborundum Co.	Niagara Falls, N.Y.	70563	Amperite Co., Inc.	New York, N.Y.
02771	Vocaline Co. of America, Inc.	Old Saybrook, Conn.	11236	CTS of Berne, Inc.	Berne, Ind.	70903	Belden Mfg. Co.	Chicago, Ill.
02777	Hopkins Engineering Co.	San Fernando, Calif.	11237	Chicago Telephone of California, Inc.	So. Pasadena, Calif.	70998	Bird Electronic Corp.	Cleveland, Ohio
03508	G.E. Semiconductor Products Dept.	Syracuse, N.Y.	11312	Microwave Electronics Corp.	Palo Alto, Calif.	71002	Birnbach Radio Co.	New York, N.Y.
03705	Apex Machine & Tool Co.	Dayton, Ohio	11534	Duncan Electronics, Inc.	Santa Ana, Calif.	71041	Boston Gear Works Div. of Murray Co. of Texas	Quincy, Mass.
03797	Eldema Corp.	El Monte, Calif.	11711	General Instrument Corporation Semiconductor Division	Newark, N.J.	71218	Bud Radio Inc.	Cleveland, Ohio
03877	Transitron Electronic Corp.	Wakefield, Mass.	11717	Imperial Electronics, Inc.	Buena Park, Calif.	71286	Camloc Fastener Corp.	Paramus, N.J.
03888	Pyrofilm Resistor Co.	Morristown, N.J.	11870	Melabs, Inc.	Palo Alto, Calif.	71313	Allen D. Cardwell Electronic Prod. Corp.	Plainville, Conn.
03954	Air Marina Motors, Inc.	Los Angeles, Calif.	12697	Claroat Mfg. Co.	Dover, N.H.	71400	Bussmann Fuse Div. of McGraw- Edison Co.	St. Louis, Mo.
04009	Arrow, Hart and Hegeman Elect. Co.	Hartford, Conn.	12859	Nippon Electric Co., Ltd.	Tokyo, Japan	71450	CTS Corp.	Elkhart, Ind.
04062	Elmenco Products Co.	New York, N.Y.	14298	American Components, Inc.	Conshocken, Pa.	71468	Cannon Electric Co.	Los Angeles, Calif.
04222	Hi-Q Division of Aerovox	Myrtle Beach, S.C.	14655	Cornell Duplicator Elec. Corp.	So. Plainfield, N.J.	71471	Cinema Engineering Co.	Burbank, Calif.
04298	Elgin National Watch Co., Electronics Division	Burbank, Calif.	15909	The Daven Co.	Livingston, N.J.	71482	C. P. Clare & Co.	Chicago, Ill.
04404	Dymec Division of Hewlett-Packard Co.	Palo Alto, Calif.	16688	De Jur-Amsco Corporation	Long Island City 1, N.Y.	71528	Standard-Thomson Corp., Clifford Mfg. Co. Div.	Waltham, Mass.
04651	Sylvania Electric Prods., Inc. Electronic Tube Div.	Mountain View, Calif.	16758	Delco Radio Div. of G. M. Corp.	Kokomo, Ind.	71590	Centralab Div. of Globe Union Inc.	Milwaukee, Wis.
04713	Motorola, Inc., Semiconductor Prod. Div.	Phoenix, Arizona	18873	E. I. DuPont and Co., Inc.	Wilmington, Del.	71700	The Cornish Wire Co.	New York, N.Y.
04732	Filtron Co., Inc. Western Division	Culver City, Calif.	19315	Eclipse Pioneer, Div. of Bendix Aviation Corp.	Teterboro, N.J.	71744	Chicago Miniature Lamp Works	Chicago, Ill.
04773	Automatic Electric Co.	Northlake, Ill.	19500	Thomas A. Edison Industries, Div. of McGraw-Edison Co.	West Orange, N.J.	71753	A. O. Smith Corp., Crowley Div.	West Orange, N.J.
04796	Sequoia Wire & Cable Company	Redwood City, Calif.	19701	Electra Manufacturing Co.	Kansas City, Mo.	71785	Cinch Mfg. Corp.	Chicago, Ill.
04870	P. M. Motor Co.	Chicago 44, Ill.	20183	Electronic Tube Corp.	Philadelphia, Pa.	71984	Dow Corning Corp.	Midland, Mich.
05006	Twentieth Century Plastics, Inc.	Los Angeles, Calif.	21226	Executive, Inc.	New York, N.Y.	72136	Electro Motive Mfg. Co., Inc.	Willimantic, Conn.
05277	Westinghouse Electric Corp., Semi-Conductor Dept.	Youngwood, Pa.	21520	Fansteel Metallurgical Corp.	No. Chicago, Ill.	72354	John E. Fast & Co.	Chicago, Ill.
05347	Ultronix, Inc.	San Mateo, Calif.	21335	The Fafnir Bearing Co.	New Britain, Conn.	72619	Dialight Corp.	Brooklyn, N.Y.
05593	Illumintronix Engineering Co.	Sunnyvale, Calif.	21964	Fed. Telephone and Radio Corp.	Clifton, N.J.	72656	General Ceramics Corp.	Keasbey, N.J.
05624	Barber Colman Co.	Rockford, Ill.	24446	General Electric Co.	Schenectady, N.Y.	72758	Girard-Hopkins	Oakland, Calif.
05729	Metropolitan Telecommunications Corp., Metro Cap. Div.	Brooklyn, N.Y.	24455	G.E., Lamp Division	Nela Park, Cleveland, Ohio	72765	Drake Mfg. Co.	Chicago, Ill.
05783	Stewart Engineering Co.	Santa Cruz, Calif.	24655	General Radio Co.	West Concord, Mass.	72825	Hugh H. Eby Inc.	Philadelphia, Pa.
06004	The Bassick Co.	Bridgeport, Conn.	24662	Grobet File Co. of America, Inc.	Carlstadt, N.J.	72928	Gudeman Co.	Chicago, Ill.
06136	Ward Leonard Electric	Los Angeles, Calif.	26992	Hamilton Watch Co.	Lancaster, Pa.	72964	Robert M. Hadley Co.	Los Angeles, Calif.
06175	Bausch and Lomb Optical Co.	Rochester, N.Y.	28480	Hewlett-Packard Co.	Palo Alto, Calif.	72982	Erie Resistor Corp.	Erie, Pa.
06555	Beede Electrical Instrument Co., Inc.	Penacook, N.H.	33173	G.E. Receiving Tube Dept.	Owensboro, Ky.	73061	Hansen Mfg. Co., Inc.	Princeton, Ind.
06751	U.S. Sencor Div. of Nuclear Corp. of Am.	Phoenix, Ariz.	35434	Lectrolum Inc.	Chicago, Ill.	73138	Helipot Div. of Beckman Instruments, Inc.	Fullerton, Calif.
06812	Torrington Mfg. Co., West Div.	Van Nuys, Calif.	37942	P. R. Mallory & Co., Inc.	Indianapolis, Ind.	73293	Hughes Products Division of Hughes Aircraft Co.	Newport Beach, Calif.
			39543	Mechanical Industries Prod. Co.	Akron, Ohio	73445	Amperex Electronic Co., Div. of North American Philips Co., Inc.	Hicksville, N.Y.
						73506	Bradley Semiconductor Corp.	Hamden, Conn.
						73559	Carling Electric, Inc.	Hartford, Conn.
						73682	George K. Garrett Co., Inc.	Philadelphia, Pa.

**APPENDIX**  
**CODE LIST OF MANUFACTURERS (Sheet 2 of 2)**

CODE NO.	MANUFACTURER	ADDRESS	CODE NO.	MANUFACTURER	ADDRESS	CODE NO.	MANUFACTURER	ADDRESS
73734	Federal Screw Products Co.	Chicago, Ill.	82647	Metals and Controls, Inc., Div. of Texas Instruments, Inc., Spencer Prods.	Attleboro, Mass.	95265	National Coil Co.	Sheridan, Wyo.
73743	Fischer Special Mfg. Co.	Cincinnati, Ohio				95275	Vitramon, Inc.	Bridgeport, Conn.
73793	The General Industries Co.	Elyria, Ohio	82866	Research Products Corp.	Madison, Wis.	95354	Methode Mfg. Co.	Chicago, Ill.
73905	Jennings Radio Mfg. Co.	San Jose, Calif.	82877	Rotron Manufacturing Co., Inc.	Woodstock, N.Y.	95987	Weckesser Co.	Chicago, Ill.
74455	J. H. Winns, and Sons	Winchester, Mass.				96067	Huggins Laboratories	Sunnyvale, Calif.
74861	Industrial Condenser Corp.	Chicago, Ill.	82893	Vector Electronic Co.	Glendale, Calif.	96095	Hi-Q Division of Aerovox	Olean, N.Y.
74868	R.F. Products Division of Amphel-Borg Electronics Corp.	Danbury, Conn.	83053	Western Washer Mfr. Co.	Los Angeles, Calif.	96256	Thordarson-Meissner Div. of Maguire Industries, Inc.	Mt. Carmel, Ill.
74970	E. F. Johnson Co.	Waseca, Minn.	83058	Carr Fastener Co.	Cambridge, Mass.			
75042	International Resistance Co.	Philadelphia, Pa.	83086	New Hampshire Ball Bearing, Inc.	Peterborough, N.H.	96296	Solar Manufacturing Co.	Los Angeles, Calif.
75173	Jones, Howard B., Division of Cinch Mfg. Corp.	Chicago, Ill.	83125	Pyramid Electric Co.	Darlington, S.C.	96330	Carlton Screw Co.	Chicago, Ill.
75378	James Knights Co.	Sandwich, Ill.	83148	Electro Cords Co.	Los Angeles, Calif.	96341	Microwave Associates, Inc.	Burlington, Mass.
75382	Kulka Electric Corporation	Mt. Vernon, N.Y.	83186	Victory Engineering Corp.	Union, N.J.	96501	Excel Transformer Co.	Oakland, Calif.
75818	Lenz Electric Mfg. Co.	Chicago, Ill.	83298	Bendix Corp., Red Bank Div.	Red Bank, N.J.	97464	Industrial Retaining Ring Co.	Irvington, N.J.
75915	Littelfuse Inc.	Des Plaines, Ill.	83330	Smith, Herman H., Inc.	Brooklyn, N.Y.	97539	Automatic and Precision Mfg. Co.	Yonkers, N.Y.
76005	Lord Mfg. Co.	Erie, Pa.	83501	Gavitt Wire and Cable Co., Div. of Amerace Corp.	Brookfield, Mass.	97966	CBS Electronics, Div. of C.B.S., Inc.	Danvers, Mass.
76210	C. W. Marwedel	San Francisco, Calif.	83594	Burroughs Corp., Electronic Tube Div.	Plainfield, N.J.	97979	Reon Resistor Corp.	Yonkers, N.Y.
76433	Micamold Electronic Mfg. Corp.	Brooklyn, N.Y.	83777	Model Eng. and Mfg., Inc.	Huntington, Ind.	98141	Axel Brothers Inc.	Jamaica, N.Y.
76487	James Millen Mfg. Co., Inc.	Malden, Mass.	83821	Loyd Scruggs Co.	Festus, Mo.	98220	Francis L. Mosley	Pasadena, Calif.
76493	J. W. Miller Co.	Los Angeles, Calif.	84171	Arco Electronics, Inc.	New York, N.Y.	98278	Microdot, Inc.	So. Pasadena, Calif.
76530	Monadnock Mills	San Leandro, Calif.	84396	A. J. Giesener Co., Inc.	San Francisco, Calif.	98291	Sealectro Corp.	Mamaroneck, N.Y.
76545	Mueller Electric Co.	Cleveland, Ohio				98405	Carad Corp.	Redwood City, Calif.
76854	Oak Manufacturing Co.	Crystal Lake, Ill.	84411	Good All Electric Mfg. Co.	Ogallala, Neb.	98734	Palo Alto Engineering Co., Inc.	Palo Alto, Calif.
77068	Bendix Pacific Division of Bendix Corp.	No. Hollywood, Calif.	84970	Sarkes Tarzian, Inc.	Bloomington, Ind.	98821	North Hills Electric Co.	Mineola, N.Y.
77221	Phaotron Instrument and Electronic Co.	South Pasadena, Calif.	84544	Boonton Molding Company	Boonton, N.J.	98925	Clevite Transistor Prod. Div. of Clevite Corp.	Waltham, Mass.
77252	Philadelphia Steel and Wire Corp.	Philadelphia, Pa.	85471	A. B. Boyd Co.	San Francisco, Calif.	98978	International Electronic Research Corp.	Burbank, Calif.
77342	Potter and Brumfield, Div. of American Machine and Foundry	Princeton, Ind.	85474	R. M. Bracamonte & Co.	San Francisco, Calif.	99109	Columbia Technical Corp.	New York, N.Y.
77630	Radio Condenser Co.	Camden, N.J.	85660	Koiled Kords, Inc.	New Haven, Conn.	99313	Varian Associates	Palo Alto, Calif.
77638	Radio Receptor Co., Inc.	Brooklyn, N.Y.	85911	Seamless Rubber Co.	Chicago, Ill.	99515	Marshall Industries, Electron Products Division	Pasadena, Calif.
77764	Resistance Products Co.	Harrisburg, Pa.	86197	Clifton Precision Products	Clifton Heights, Pa.	99707	Control Switch Division, Controls Co. of America	El Segundo, Calif.
78189	Shakeproof Division of Illinois Tool Works	Elgin, Ill.	86684	Radio Corp. of America, RCA Electron Tube Div.	Harrison, N.J.	99800	Delevan Electronics Corp.	East Aurora, N.Y.
78283	Signal Indicator Corp.	New York, N.Y.	87216	Philco Corp. (Lansdale Division)	Lansdale, Pa.	99848	Wilco Corporation	Indianapolis, Ind.
78471	Tilley Mfg. Co.	San Francisco, Calif.	87473	Western Fibrous Glass Products Co.	San Francisco, Calif.	99934	Renbrandt, Inc.	Boston, Mass.
78488	Stackpole Carbon Co.	St. Marys, Pa.				99942	Hoffman Semiconductor Div. of Hoffman Electronics Corp.	Evanston, Ill.
78553	Tinnerman Products, Inc.	Cleveland, Ohio	88140	Cutler-Hammer, Inc.	Lincoln, Ill.	99957	Technology Instrument Corp. of Calif.	Newbury Park, Calif.
78790	Transformer Engineers	Pasadena, Calif.	88220	Gould-National Batteries, Inc.	St. Paul, Minn.			
78947	Ucinite Co.	Newtonville, Mass.	89473	General Electric Distributing Corp.	Schenectady, N.Y.			
79142	Veeder Root, Inc.	Hartford, Conn.	89636	Carter Parts Div. of Economy	Baler Co. Chicago, Ill.			
79251	Wenco Mfg. Co.	Chicago, Ill.	89665	United Transformer Co.	Chicago, Ill.			
79727	Continental-Wirt Electronics Corp.	Philadelphia, Pa.	90179	U.S. Rubber Co., Mechanical Goods Div.	Passaic, N.J.			
79963	Zierick Mfg. Corp.	New Rochelle, N.Y.	90970	Bearing Engineering Co.	San Francisco, Calif.			
80031	Mepco Division of Sessions Clock Co.	Morristown, N.J.	91260	Connor Spring Mfg. Co.	San Francisco, Calif.			
80120	Schnitzer Alloy Products	Elizabeth, N.J.	91345	Miller Dial & Nameplate Co.	El Monte, Calif.			
80130	Times Facsimile Corp.	New York, N.Y.	91418	Radio Materials Co.	Chicago, Ill.			
80131	Electronic Industries Association Any brand tube meeting EIA standards	Washington, D.C.	91506	Augat Brothers, Inc.	Attleboro, Mass.			
80207	Unimax Switch, Div. of W. L. Maxson Corp.	Wallingford, Conn.	91637	Dale Electronics, Inc.	Columbus, Neb.			
80248	Oxford Electric Corp.	Chicago, Ill.	91662	Elco Corp.	Philadelphia, Pa.			
80294	Bourns Laboratories, Inc.	Riverside, Calif.	91737	Gremar Mfg. Co., Inc.	Wakefield, Mass.			
80411	Acro Div. of Robertshaw Fulton Controls Co.	Columbus 16, Ohio	91827	K F Development Co.	Redwood City, Calif.			
80486	All Star Products Inc.	Defiance, Ohio	91921	Minneapolis-Honeywell Regulator Co., Micro-Switch Division	Freeport, Ill.			
80583	Hammerlund Co., Inc.	New York, N.Y.	92196	Universal Metal Products, Inc.	Bassett Puente, Calif.			
80640	Stevens, Arnold, Co., Inc.	Boston, Mass.	93332	Sylvania Electric Prod. Inc., Semiconductor Div.	Woburn, Mass.			
81030	International Instruments, Inc.	New Haven, Conn.	93369	Robbins and Myers, Inc.	New York, N.Y.			
81073	Grayhill Co.	LaGrange, Ill.	93410	Stevens Mfg. Co., Inc.	Mansfield, Ohio			
81312	Winchester Electronics Co., Inc.	Norwalk, Conn.	93983	Insuline-Van Norman Ind., Inc. Electronic Division	Manchester, N.H.			
81415	Wilkor Products, Inc.	Cleveland, Ohio	94144	Raytheon Mfg. Co., Industrial Components Div., Receiving Tube Operation	Quincy, Mass.			
81453	Raytheon Mfg. Co., Industrial Components Div., Industr. Tube Operations	Newton, Mass.	94145	Raytheon Mfg. Co., Semiconductor Div., California Street Plant	Newton, Mass.			
81483	International Rectifier Corp.	El Segundo, Calif.	94148	Scientific Radio Products, Inc.	Loveland, Colo.			
81860	Barry Controls, Inc.	Watertown, Mass.	94154	Tung-Sol Electric, Inc.	Newark, N.J.			
82042	Carter Parts Co.	Skokie, Ill.	94197	Curtiss-Wright Corp., Electronics Div.	East Paterson, N.J.			
82142	Jeffers Electronics Division of Speer Carbon Co.	Du Bois, Pa.	94310	Tru Ohm Prod. Div. of Model Engineering and Mfg. Co.	Chicago, Ill.			
82170	Allen B. DuMont Labs., Inc.	Clifton, N.J.	94682	Worcester Pressed Aluminum Corp.	Worcester, Mass.			
82209	Maguire Industries, Inc.	Greenwich, Conn.	94928	Telefunken	Berlin, W. Germany			
82219	Sylvania Electric Prod. Inc., Electronic Tube Div.	Emporium, Pa.	95238	Allies Products Corp.	Miami, Fla.			
82376	Astron Co.	East Newark, N.J.	95238	Continental Connector Corp.	Woodside, N.Y.			
82389	Switchcraft, Inc.	Chicago, Ill.	95263	Leecraft Mfg. Co., Inc.	New York, N.Y.			
			95264	Lercro Electronics, Inc.	Burbank, Calif.			

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


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

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00015-29  
Revised: 20 December 1962



### **CATHODE RAY TUBE WARRANTY**

The cathode ray tube supplied in your Hewlett-Packard Oscilloscope and replacement cathode ray tubes purchased from , are guaranteed against electrical failure for one year from the date of sale by the Hewlett-Packard Company. Broken tubes or tubes with burned phosphor are not included in this guarantee.

Your local Hewlett-Packard representative maintains a stock of replacement tubes and will be glad to process your warranty claim for you. Please consult him.

Whenever a tube is returned for a warranty claim, the reverse side of this sheet must be filled out in full and returned with the tube. Follow shipping instructions carefully to insure safe arrival, since no credit can be allowed on broken tubes.

#### SHIPPING INSTRUCTIONS

- 1) Carefully wrap the tube in 1/4" thick cotton batting or other soft padding material.
- 2) Wrap the above in heavy kraft paper.
- 3) Pack in a rigid container which is at least 4 inches larger than the tube in each dimension.
- 4) Surround the tube with at least four inches of packed excelsior or similar shock absorbing material. Be certain that the packing is tight all around the tube.
- 5) Tubes returned from outside the continental United States should be packed in a wooden box.
- 6) Ship prepaid preferably by AIR FREIGHT or RAILWAY EXPRESS. We do not recommend parcel post or air parcel post shipment.



**CRT WARRANTY CLAIM**

FROM: \_\_\_\_\_ DATE: \_\_\_\_\_

NAME: \_\_\_\_\_

COMPANY: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Person to contact for further information:

NAME: \_\_\_\_\_

TITLE: \_\_\_\_\_

COMPANY: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

To process your claim quickly please enter the information indicated below:

1)  $\phi$  INSTRUMENT MODEL \_\_\_\_\_ SERIAL \_\_\_\_\_

2) TUBE TYPE \_\_\_\_\_ SERIAL \_\_\_\_\_

3) ORIGINAL TUBE \_\_\_\_\_ REPLACEMENT TUBE \_\_\_\_\_

4) YOUR PURCHASE ORDER NO. \_\_\_\_\_

5) DATE PURCHASED \_\_\_\_\_

6) PURCHASED FROM \_\_\_\_\_

7) COMPLAINT: (Please describe nature of trouble) \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

8) OPERATING CONDITIONS: (Please describe conditions prior to and at time of failure \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

SIGNATURE \_\_\_\_\_

\_\_\_\_\_

