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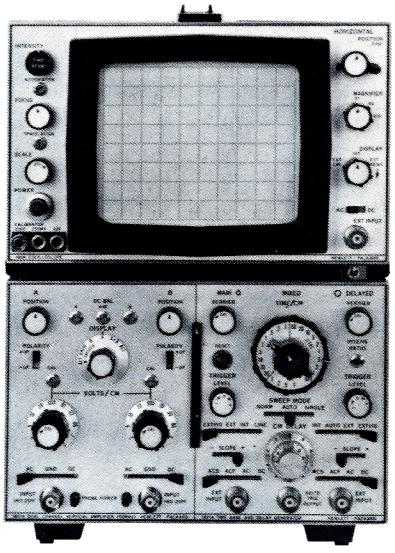
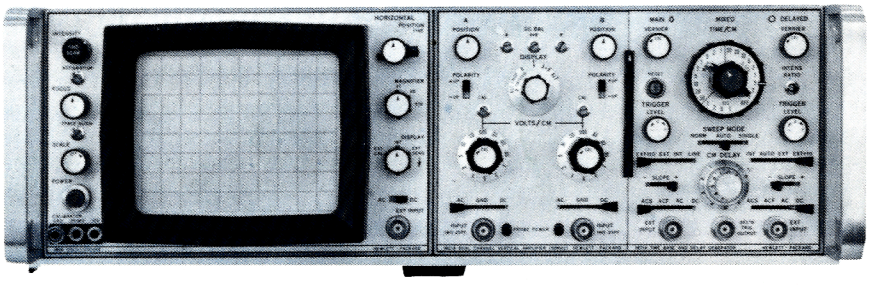
In the village of Blunham, Bedfordshire, UK.

OPERATING AND SERVICE MANUAL

OSCILLOSCOPE

180A/AR





HEWLETT hp PACKARD

HP 180A/AR

CERTIFICATION

The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facility.

WARRANTY AND ASSISTANCE

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

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

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

OPERATING AND SERVICE MANUAL

MODEL
180A/AR OSCILLOSCOPE

Serials Prefixed: 822–

See Section I for instruments with other serial prefixes.

See Section VII for Instruments with Options.

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

02589-5

PRINTED: MAY 1969

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Table 1-1. Specifications

CATHODE-RAY TUBE AND CONTROLS

TYPE:

Post accelerator,12 kV accelerating potential; aluminized P31 phosphor (other phosphors available, see Modifications); safety glass faceplate.

GRATICULE:

8 x 10 div parallaxfree internal graticule. 0.2-div subdivisions on major axes. 1 div = 1 cm. Front panel recessed screwdriver adjust TRACE ALIGN aligns trace with graticule. Internal Y-align aligns Y-trace with X-trace. Scale control illuminates CRT phosphor for viewing with hood or taking photographs.

BEAM FINDER:

Pressing Find Beam control brings trace on CRT screen regardless of setting of horizontal, vertical, or intensity controls.

INTENSITY MODULATION:

Approximately +2 V, dc to 15 MHz, will blank trace of normal intensity. Input R, 5100 ohms.

CALIBRATOR

TYPE:

Approximately 1 kHz square wave, 3 us risetime.

VOLTAGE:

Two outputs, 250 mV pkpk and 10 V pk-pk; accuracy, ±1%.

HORIZONTAL AMPLIFIER

BANDWIDTH:

DC to 5 MHz when dccoupled; 5 Hz to 5 MHz when ac-coupled.

DEFLECTION FACTOR:

1 V/div, X1; 0.2 V/div, X5; 0.1 V/div, X10. Vernier provides continuous adjustment between ranges. Dynamic range, ±5 V.

MAXIMUM INPUT:

600 Vdc (ac-coupled input).

INPUT RC:

1 megohm shunted by approximately 30 pF.

SWEEP MAGNIFIER

X1, X5, X10; magnified sweep accuracy, ±5% (for ±3% accuracy time base plug-ins).

OUTPUTS

Four emitter follower outputs on rear for main and delayed gates, main and delayed sweeps; maximum current available, ±3 mA; outputs will drive impedances down to 1000 ohms without distortion.

GENERAL

WEIGHT:

(Without plug-ins) Model 180A, net, 22 lb (9,9 kg); shipping, 30 lb (13,5 kg). Model 180AR (rack), net, 25 lb (11,3 kg); shipping 33 lb (14,9 kg).

ENVIRONMENT:

Operates within specifications over the following ranges:

Temperature: −28 ° C to +65 ° C.

Humidity: To 95% relative humidity at 40 ° C.

Altitude: To 15,000 ft.

Vibration: Vibrated in three planes for 15 minutes each with 0.010-inch excursion, 10 to 55 Hz.

ACTIVE COMPONENTS:

All solid-state (except CRT).

POWER:

115 or 230 V ±10%, 50 to 400 Hz, less than 110 watts with plug-ins at normal line, convection cooled.

Option 003: 100 or 200 V operation.

Option 004: 110 or 220 V operation.

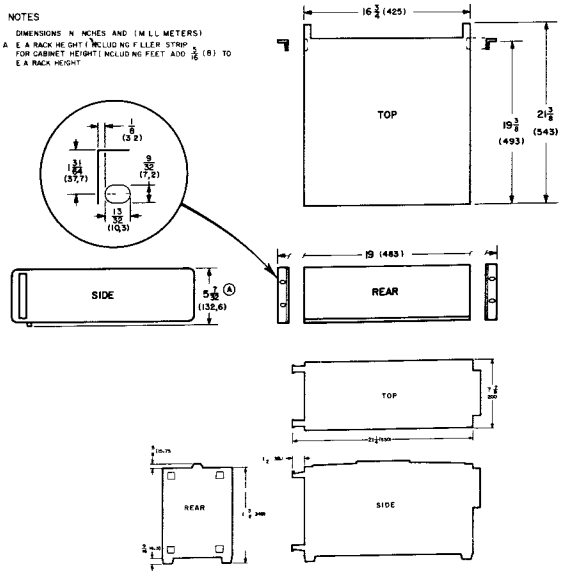
ACCESSORIES FURNISHED:

Mesh contrast filter; power cord; rack mounting hardware (180AR only).

MODIFICATIONS:

CRT phosphor (specify by phosphor number); P31 standard; P2, P7, P11 available.

DIMENSIONS:



SECTION I

GENERAL INFORMATION

1-1. DESCRIPTION.

1-2. The Model 180A/AR, Figure 1-1, is a light weight, general purpose oscilloscope with plug-in capabilities. Both the Model 180A and Model 180AR, as shipped from the factory, are intended for bench use. The Model 180AR however, may be rack mounted as described in Section II.

1-3. All active components in the Model 180A/AR are solid state devices (no vacuum tubes except the CRT). The Model 180A/AR is convection cooled and operates within specifications from -28°C to $+65^{\circ}$C.

1-4. The horizontal amplifier bandwidth is dc to 5 MHz with direct coupling and 5 Hz to 5 MHz with capacitive coupling. A BNC connector is provided to attach an external deflection signal. The amplifier's dynamic range is ±5 V. The deflection factor is adjustable between 0.1 V/div to 1 V/div.

1-5. A BNC connector is provided to connect an external intensity modulation signal. The input resistance is 5100 ohms. Approximately +2 Vdc to 15 MHz blanks a beam of normal intensity.

1-6. Four other BNC connectors are provided to couple signals from the plug-ins to external equipment. Since these outputs are dependent upon the specific plug-ins, refer to applicable plug-in manuals for identification. The outputs can supply 3 mA and will drive impedances as low as 1 k ohm without distortion.

1-7. A 1 kHz square wave signal at two amplitudes, 250 mV and 10 V, is available at the front panel. Its amplitude is accurate to 1% and its risetime is 3 usec. The signal may be used to adjust horizontal and vertical deflection factors and to compensate divider probes.

1-8. CATHODE-RAY TUBE.

1-9. The Model 180A/AR uses an internal graticule CRT which eliminates display parallax. The CRT is furnished with P31 aluminized phosphor and is equipped with a safety faceplate. P2, P7, and P11 phosphors are also available.

1-10. WARRANTY.

1-11. This instrument is certified and warranted as stated on the inside front cover of this manual. The CRT however, is covered by a warranty separate from the rest of the instrument. The CRT warranty and warranty claim forms are located at the rear of this manual. Should the CRT fail within the time specified on the warranty, return the CRT with the warranty form completed.

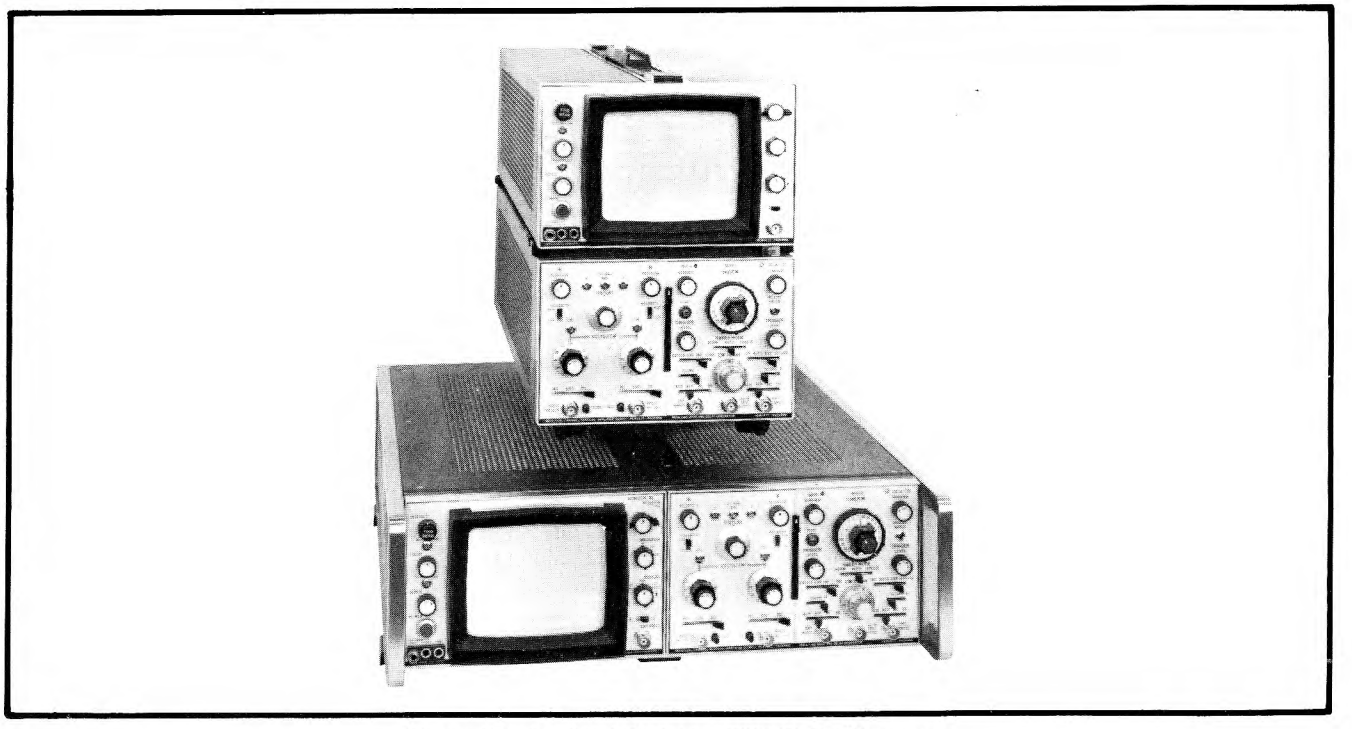


Figure 1-1. Models 180A and 180AR Oscilloscopes

1-12. INSTRUMENT IDENTIFICATION.

1-13. Hewlett-Packard uses a two-section eight-digit serial number to identify instruments. The first three digits (preceding the dash) are the serial prefix which identifies a series of instruments; the last five digits identify a particular instrument in the series. The serial number appears on a plate located on the rear panel. All correspondence with a Hewlett-Packard Sales/Service Office in regard to an instrument should reference the complete serial number.

1-14. MANUAL CHANGES.

1-15. This manual provides operating and service information for the HP Model 180A/AR Oscilloscope. Information in this manual applies directly to instruments (as manufactured) with serial numbers prefixed by the three digits indicated on the title page. If the serial prefix of the instrument is different from that on the title page, a MANUAL CHANGES sheet supplied, or Section VII of this manual, will describe changes which will adapt this manual to provide correct coverage. Technical corrections (if any) to this manual, due to known errors in print, are called Errata and are shown on the change sheet. For information on manual coverage of any HP instrument, contact the nearest HP Sales/Service Office (addresses are listed at the rear of this manual).

1-16. ACCESSORIES FURNISHED.

1-17. The Model 180A/AR Oscilloscope is equipped with a mesh contrast filter, and a detachable power cord. Also included with the Model 180AR is a rack mounting kit.

1-18. The mesh contrast filter snaps into place under the light shield and provides increased display visiblity. All parts and hardware required to convert the Model 180AR for rack mounting are provided in the kit supplied.

1-19. AVAILABLE ACCESSORIES.

1-20. A series of mobile test stands are available for both the Model 180A and Model 180AR. The Model 1118A is a tripod testmobile intended for use with the cabinet Model 180A, and provides adjustable height, tilt, and rotation. It is also equipped with locking wheels and is readily collapsible for transport. The Model 1119A/B Testmobiles are intended for use with rack model instruments such as the Model 180AR, while the Model 1119C/D Testmobiles are intended for use with cabinet model instruments such as the Model 180A. The Model 1119-series Testmobiles are general purpose test stands designed for maximum utility while requiring a minimum of floor space. These testmobiles allow the instrument to be tilted at least 40 degrees above and below horizontal in 10 degree steps.

1-21. A front-panel cover of fiberglass material, HP Model 10166A, can be used to provide front-panel protection for the cabinet Model 180A, and a cover for the rack Model 180AR is available as HP Part No. 5060-0437.

1-22. For ease of calibration and maintenance an HP Model 10407A Plug-in Extender can be obtained. It provides for removal of the plug-ins from the frame and exposes components and adjustments for servicing.

1-23. Cameras, probes, viewing hoods, terminations, and other accessory items are available for specialized requirements. Information on these and the above described accessories may be obtained from HP Sales/Service Offices listed in the rear of this manual.

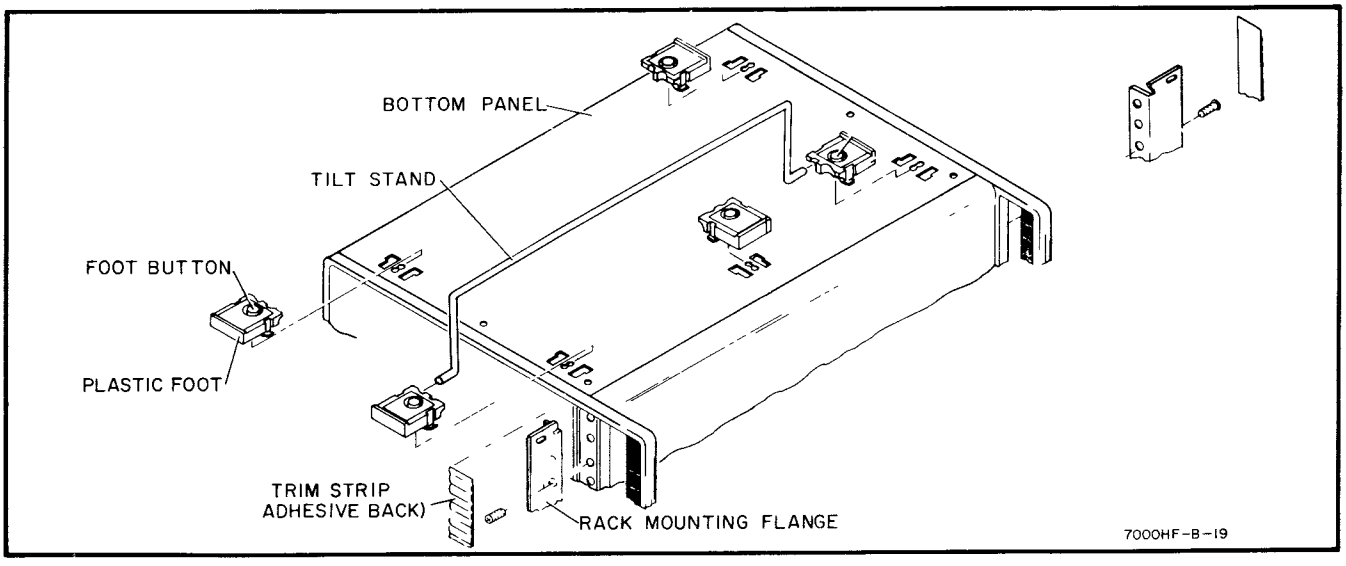


Figure 2-1. Rack Mount Procedure

SECTION II

INSTALLATION

2-1. INITIAL INSPECTION.

2-2. MECHANICAL CHECK. Check the shipping carton for damage immediately after receipt. If it is damaged, ask the carrier's agent to be present when the instrument is unpacked. Inspect the Model 180A/AR for physical damage such as bent or broken parts and dents or scratches. If damage is found, refer to Paragraph 2-4 for recommended claim procedure. If the Model 180A/AR appears undamaged, perform the electrical check (Paragraph 2-3). Retain the packaging material for possible future use.

2-3. ELECTRICAL CHECK. The performance check is given in Paragraphs 5-5 through 5-14. This check will determine whether or not the instrument is operating within its specifications as listed in Table 1-1. The initial performance and accuracy of this instrument are certified as stated on the inside front cover of this manual. If the Model 180A/AR does not operate as specified, refer to Paragraph 2-4 for the recommended claim procedure.

2-4. CLAIMS.

2-5. If physical damage is found or if the instrument is not within specifications when received, notify the carrier and the nearest Hewlett-Packard Sales/Service Office immediately. The Sales/Service Office will arrange for repair or replacement of the instrument without waiting for a claim to be settled with the carrier.

2-6. The warranty statement for all Hewlett-Packard products is on the inside front cover of this manual. Contact the nearest Sales/Service Office for information about warranty claims.

2-7. REPACKAGING FOR SHIPMENT.

2-8. If the instrument is to be shipped to a Hewlett-Packard Sales/Service Office, attach a tag to it showing owner's name and address, instrument's model number and eight-digit serial number, and a description of service required.

2-9. The original shipping carton and packaging materials should be used for reshipment. If they are not available or reusable, the instrument should be repackaged with the following materials:

a. A double-walled carton (refer to Table 2-1 for test strength required).

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

Table 2-1. Shipping Carton Test Strength

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

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

d. Heavy duty shipping tape to secure outside of carton.

2-10. PREPARATION FOR USE.

2-11. POWER REQUIREMENTS.

2-12. The standard Model 180A/AR requires either a 115 or 230 V ±10%, single phase, 50 to 400 Hz power source that can deliver 110 watts. Options 003 and 004 provide for 100/200 V or 110/220 V operation respectively (see Section VII).

a. 115 V OPERATION. This instrument, as shipped, is ready for operation on 115 Vac. Refer to the following paragraph for 230 Vac operation.

CAUTION

Before applying power, check the rear-panel slide switch for proper position (115 or 230).

b. 230 V OPERATION. If the instrument is to be operated on 230 Vac, set the rear-panel switch to 230. It is not necessary to replace the 115 V fuse. Positioning the 115/230 switch selects the proper fuse for the desired voltage.

2-13. THREE-CONDUCTOR POWER CABLE.

2-14. The National Electrical Manufacturers' Association (NEMA) recommends that the instrument panel and cabinet be grounded to protect the operating personnel. The Model 180A/AR is equipped with a detachable three-conductor power cord which, when plugged into an appropriate outlet, grounds the instrument through the

round offset pin. When operating the Model 180A/AR from a two-contact outlet, use a three-conductor to two-conductor adapter. Preserve the safety feature by grounding the adapter lead.

2-15. INSTRUMENT MOUNTING.

2-16. BENCH USE. Both the Model 180A and the Model 180AR, as shipped from the factory, are intended for bench use. The Model 180AR however, may be rack mounted as described below.

2-17. RACK MOUNTING. A kit for converting the Model 180AR to a rack mount configuration is supplied with each instrument. Instructions for making the conversion are given below. Refer to Figure 2-1 for parts identification.

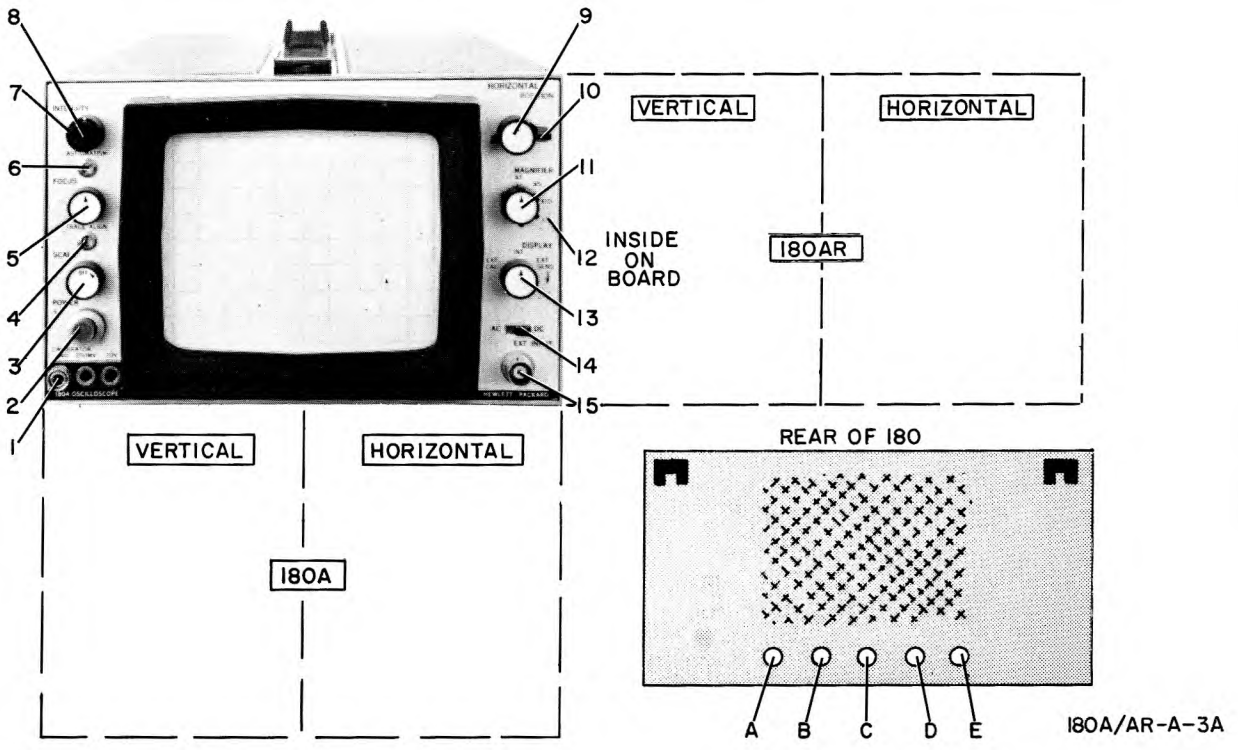
a. Detach tilt stand by pressing it away from the front feet. Remove all plastic feet by depressing metal button and sliding feet free.

b. Remove aluminum trim strip from each side of instrument with a thin blade tool.

c. Attach rack mounting flange in space where trim strip was removed (use screws provided with kit). Large notch of flange should be positioned at bottom of instrument.

2-18. INSTRUMENT COOLING.

2-19. The Model 180A/AR does not require forced-air cooling when operated in an ambient temperature of −28 to +65 degrees centigrade. Normal air circulation will maintain a reasonable temperature within the instrument.



1. CALIBRATOR. Provides a 1-kHz square wave at two amplitudes; 250 mV and 10 V pk-pk.

2. POWER. Pushbutton switch with indicator light for turning oscilloscope on and off.

3. SCALE. Controls overall brightness of CRT face.

4. TRACE ALIGN. Rotates trace around center of CRT face.

5. FOCUS. Controls sharpness of writing beam.

6. ASTIGMATISM. Adjusts roundness of writing spot.

7. INTENSITY. Controls brightness of display.

8. FIND BEAM. Returns display to CRT.

9. POSITION. Coarse adjustment of display's horizontal position.

10. FINE. Fine adjustment of display's horizontal position.

11. MAGNIFIER. Magnifies horizontal display.

12. PHASE/BANDWIDTH. Selects between normal operation (BANDWIDTH) and X-Y operation (PHASE).

13. DISPLAY. Selects source of horizontal input signal.

14. AC/DC. Selects AC or DC coupling for the external horizontal input signal.

15. EXT INPUT. BNC connector for applying an external horizontal input signal to the oscilloscope.

REAR PANEL

A. MAIN GATE OUTPUT. BNC for connecting main gate signal to external equipment.

B. DELAYED GATE OUTPUT. BNC for connecting delayed gate signal to external equipment.

C. DELAYED SWEEP OUTPUT. BNC for connecting delayed sweep signal to external equipment.

D. MAIN SWEEP OUTPUT. BNC for connecting main sweep signal to external equipment.

E. Z-AXIS INPUT. BNC for applying an external intensification or blanking signal to the oscilloscope.

Figure 3-1. Controls and Connectors

SECTION III

OPERATION

3-1. INTRODUCTION.

3-2. The Model 180A/AR is a light-weight, general-purpose oscilloscope with plug-in capabilities. The plug-in compartment is located below the CRT in the Model 180A and to the right of the CRT in the Model 180AR. In either configuration, the horizontal plug-in goes into the right side of the compartment and the vertical into the left. The plug-ins must be locked together before being inserted into the compartment (see plug-in manuals).

3-3. CONTROLS AND CONNECTORS.

3-4. Location of controls and connectors is shown in Figure 3-1 along with a brief description of their functions. The following paragraphs explain some functions in more detail.

3-5. FRONT PANEL.

3-6. CALIBRATOR. The 10 V and 250 mV, 1-kHz square-wave outputs of the CALIBRATOR may be used for vertical and horizontal sensitivity calibration, and for divider probe compensation. The amplitude is accurate to ±1% from −28°C to +65°C (−18°F to 149°F). Risetime of the signal is 3 usec.

3-7. SCALE. This control adjusts the over-all brightness of the CRT face. It should be adjusted for good contrast between the background and the graticule. The SCALE control is especially useful when using a hood to view the display or when photographing waveforms. Rotate SCALE to OFF when scale illumination is not needed.

3-8. TRACE ALIGN. The TRACE ALIGN adjustment compensates for external magnetic fields that may affect the alignment of the horizontal trace with the graticule. The alignment should be checked when the instrument is moved to a new location and adjustment made whenever necessary.

3-9. FOCUS AND ASTIGMATISM. Both of these controls are used to obtain the sharpest display. Normally, once set, ASTIGMATISM will not need to be readjusted. It may need readjustment however, when the vertical plug-in is changed.

3-10. FIND BEAM. Occasionally the CRT beam may be driven off screen by large dc input levels or by improper control settings. The beam may be brought back on screen by depressing the FIND BEAM control and adjusting the horizontal and vertical (see vertical plug-in manual) position controls to center the beam. If INTENSITY is properly set, the beam will remain visible when FIND BEAM is released.

3-11. MAGNIFIER. This control varies the gain of the horizontal amplifier. When switched from X1 to X5 or X10 the gain increases five or ten times respectively. For example, one volt into the vertical amplifier plug-in Ext Input jack produces 1 div of deflection in X1, 5 div of deflection in X5, and 10 div of deflection in X10.

3-12. DISPLAY. This control determines the origin of the input signal applied to the horizontal amplifier. With the DISPLAY control positioned to EXT CAL, the external horizontal input signal is coupled directly to the horizontal amplifier. As DISPLAY is rotated ccw, the external signal is increasingly attenuated. When DISPLAY is fully ccw (INT), the external input signal is disconnected and the internal sweep is coupled directly to the horizontal amplifier.

3-13. REAR PANEL.

3-14. OUTPUTS. Four BNC connectors on the rear panel of the Model 180A/AR are provided to supply signals from the plug-ins to external equipment. Refer to the plug-in manuals for signal identification. These outputs can supply 3 mA and will drive impedances as low as 1000 ohms without distortion.

3-15. Z-AXIS INPUT. This BNC connector allows application of an external intensity modulation signal directly to the gate amplifier. Approximately +2 V, dc to 15 MHz, blanks a beam of normal intensity. Conversely, a negative signal will intensify the beam.

3-16. INTERNAL.

3-17. Positioning the PHASE/BANDWIDTH switch to PHASE causes the horizontal input signal to be delayed the same amount of time as the vertical input signal. This delay allows the Model 180A/AR to be used for phase measurements. Channel A of multi-channel vertical plug-ins should be used when making phase measurements. Refer to Paragraph 5-29e for calibration procedures when a different channel (other than A) is to be used, or when changing from one vertical plug-in to another.

Note

Make certain that the switch is placed to BANDWIDTH after making phase measurements. This will allow normal operation.

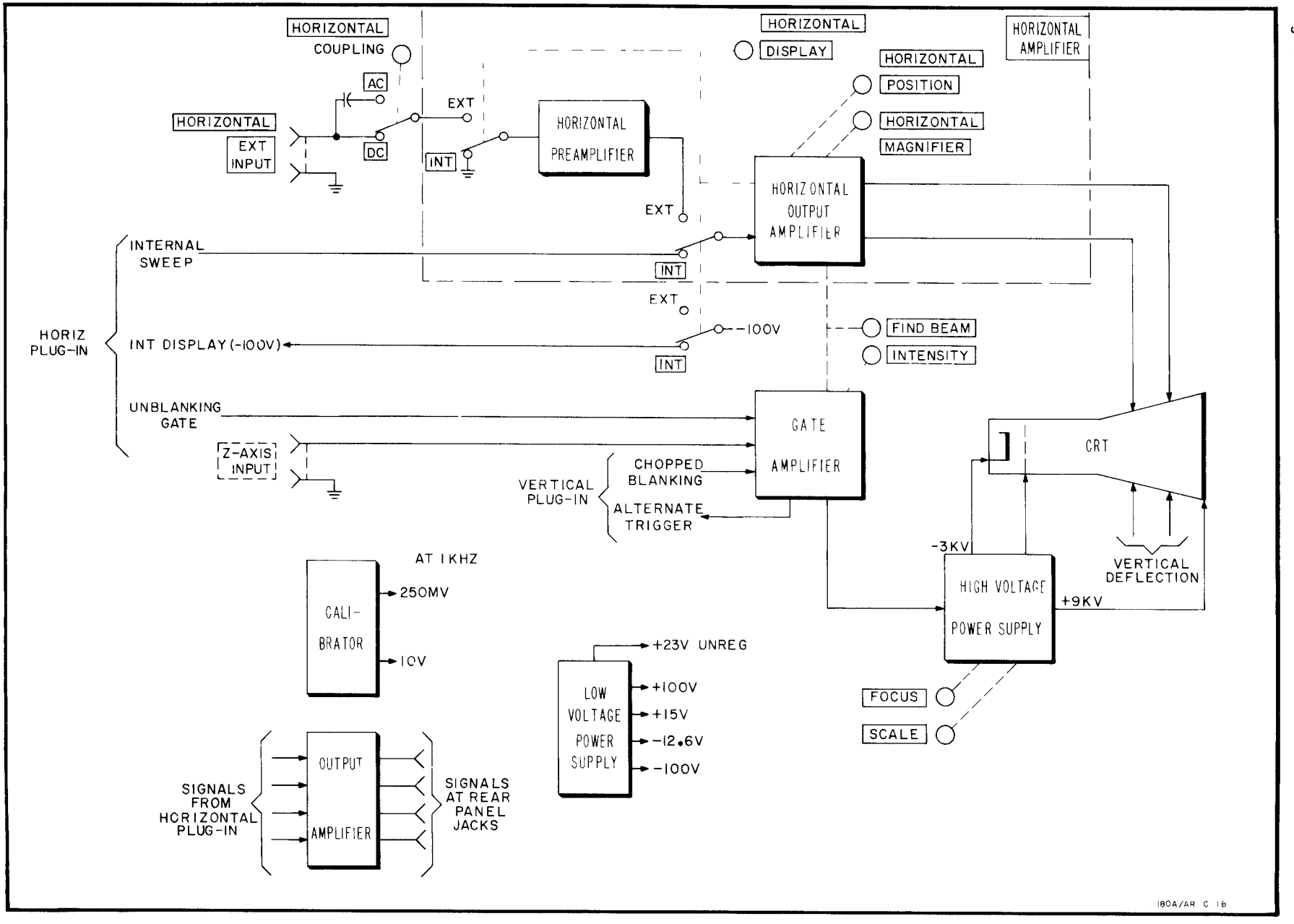


Figure 4-1. Model 180A/AR Overall Block Diagram

SECTION IV

PRINCIPLES OF OPERATION

4-1. INTRODUCTION.

4-2. The Model 180A/AR Oscilloscope is comprised of four basic circuits. These are: a gate amplifier, a horizontal amplifier, a high-voltage power supply, and a low-voltage power supply. Two associated circuits, also contained, are a calibrator and an output amplifier. Figure 4-1 shows the interrelationship of these circuits.

4-3. FUNCTIONAL DESCRIPTION.

4-4. Three input signals; intensity, horizontal deflection, and vertical deflection; are necessary to obtain a usable display on the CRT. The circuitry for the intensity and horizontal deflection signals is explained in the following paragraphs which are referenced to Figure 4-1. The vertical deflection signal is coupled directly to the CRT from the Vertical Plug-in.

4-5. INTERNAL. Positioning the HORIZONTAL DISPLAY switch to INT applies −100 volts to the Horizontal Plug-in. This voltage allows the plug-in to operate normally and to produce the unblanking gate and the internal sweep signal.

4-6. The unblanking gate is coupled from the Horizontal Plug-in to the gate amplifier where it is summed with the Z-axis input and chopped blanking signals (if they are applied). The resulting signal is amplified, and coupled through the high voltage power supply to the control grid of the CRT to control the intensity of the display.

4-7. The alternate trigger signal is a negative pulse produced by the gate amplifier at the end of each unblanking gate. It is coupled directly to the Vertical Plug-in (refer to Vertical Plug-in manual for signal function).

4-8. The internal sweep signal from the Horizontal Plug-in is coupled through the HORIZONTAL DISPLAY switch to the output amplifier. Here it is converted to a differential signal, amplified, and applied to the CRT horizontal deflection plates.

4-9. EXTERNAL. Positioning the HORIZONTAL DISPLAY switch to EXT removes the internal display voltage from the Horizontal Plug-in, eliminating both the unblanking gate and the internal sweep signal.

4-10. The gate amplifier operates as it did when INT was selected. There are; however, only two inputs to the gate amplifier: an externally applied intensity modulation signal (Z-axis input) and the chopped blanking signal from the Vertical Plug-in. The alternate trigger signal will be produced only if the externally applied signal is similar to the normal unblanking gate.

4-11. The externally applied deflection signal is coupled through the horizontal preamplifier to the output amplifier where it is amplified and converted to a differential signal and then applied to the CRT horizontal deflection plates.

4-12. CIRCUIT DETAILS.

4-13. The following paragraphs contain a detailed explanation of each circuit in the Model 180A/AR.

4-14. GATE AMPLIFIER.

4-15. The inputs to the gate amplifier (refer to Figure 4-2) are the unblanking gate, the chopped blanking signal, and the Z-axis input signal. These three signals may be present either singly or simultaneously, depending upon control

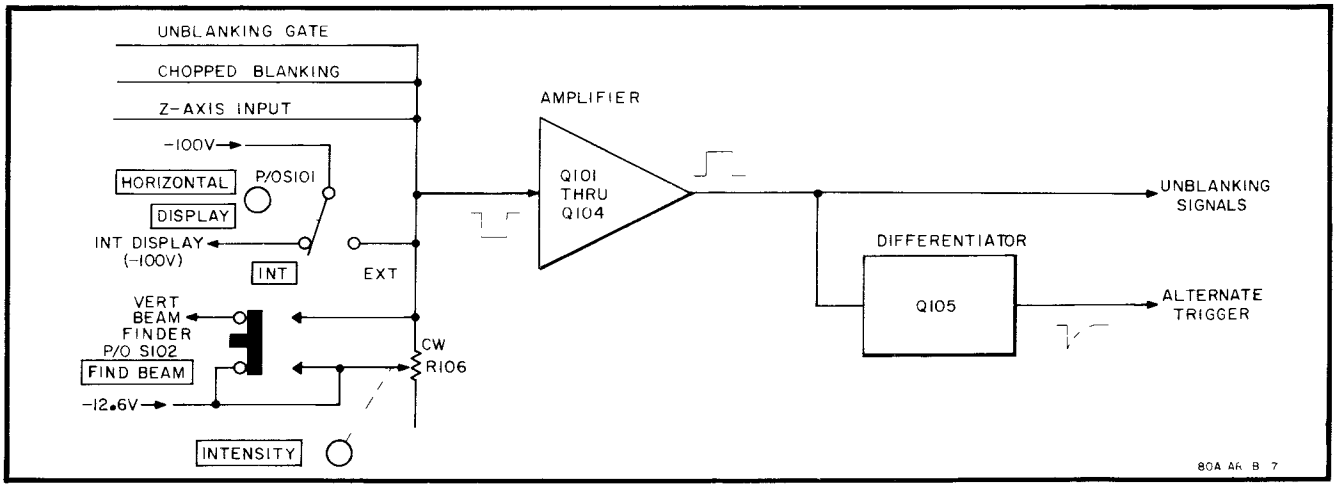


Figure 4-2. Gate Amplifier Block Diagram

settings. These inputs are combined with a current established by three front-panel controls: FIND BEAM, INTENSITY, and HORIZONTAL DISPLAY. Depressing FIND BEAM shunts the normally adjustable INTENSITY potentiometer and supplies maximum current from this source. Setting HORIZONTAL DISPLAY to EXT supplies additional current to brighten the beam.

4-16. The input current to amplifier Q101 through Q104 is converted to a voltage, amplified, and coupled to the control grid of the CRT. The output signal is also differentiated, clipped, and coupled to the Vertical Plug-in.

4-17. The input currents to the gate amplifier (refer to Figure 8-3, schematic) are summed in the low impedance emitter circuit of Q101. The resulting current is coupled to the complementary feedback amplifier (a current-fed operational amplifier) Q102/Q103/Q104, where it is converted to a voltage, and coupled to the control grid circuit of the CRT. The output voltage is approximately:

$$\Delta E_{Q104\ COLLECTOR} \cong (\Delta I_{CR101})(R_{R119\ \&\ R121})$$

The large negative feedback from the collectors of Q103 and Q104 to the base of Q102 provides the complementary feedback amplifier with a very stable gain. C110 and C113 adjust the high-frequency feedback. CR108 provides temperature compensation for Q103. CR109 and CR110 protect Q103 and Q104 from voltage breakdown. CR112 and CR113 isolate Q103 and Q104 from the high voltage in the control grid circuit of the CRT in the event of a grid or cathode short. The output from Q103 and Q104 is differentiated by C116, R128, and R130, and coupled through Q105 to the Vertical Plug-in. CR111 is a positive clipper.

4-18. HORIZONTAL AMPLIFIER.

4-19. The inputs to the horizontal amplifier (refer to Figure 4-3) are the internal sweep signal and an external signal applied to the HORIZONTAL EXT INPUT jack Positioning HORIZONTAL DISPLAY to INT disconnects the external signal and grounds the input of the preamplifier. The internal sweep signal is connected through the HORIZONTAL DISPLAY switch to the output amplifier.

4-20. Selecting either EXT SENS or EXT CAL disconnects the internal sweep signal and connects the external signal through the preamplifier to the output amplifier. With EXT SENS selected, the amplitude of the signal from the preamplifier is adjustable by rotating HORIZONTAL DISPLAY between the extreme positions. In EXT CAL, R211 is shorted and the output amplitude is determined only by the input amplitude.

4-21. The selected signal is applied to the output amplifier and summed with a current extablished by the HORIZONTAL POSITION control. The resulting current is converted to a differential signal, amplified, and applied to the horizontal deflection plates of the CRT.

4-22. The external signal applied to the preamplifier (refer to Figure 8-4, schematic) is coupled through Q201 and Q202 to the HORIZONTAL DISPLAY switch, S101. The high input impedance of Q201 prevents loading the external circuit. Q202 provides the low impedance necessary to drive Q203. CR201 protects Q201 from voltage breakdown. C203 and C204, when switched in, decrease the bandwidth of the preamplifier. The decreased bandwidth compensates for the signal delay in the Vertical Plug-in and allows more accurate X-Y phase measurements to be made. R207 is adjusted for 0 Vdc across R211, eliminating horizontal dc shift as HORIZONTAL DISPLAY is rotated.

4-23. The input signal to Q203 is summed in the low impedance emitter circuit with a current established by the POSITION controls. The resulting signal is coupled from the emitter of Q206 through emitter follower Q204 to differential amplifier Q206/Q207. Q204 provides the low impedance necessary to drive Q206. The input signal to Q206 is coupled through the MAGNIFIER switch, S203, to Q207. S203 selects the amount of emitter degeneration between Q206 and Q207, and therefore controls the gain; as degeneration decreases, gain increases. R250, R248, and R246 adjust the gain in the X1, X5, and X10 positions, respectively, of S203. R253 adjusts the emitter potentials of Q206 and Q207 to be equal, preventing horizontal dc shift as the MAGNIFIER control is switched. Q205 provides a low impedance voltage source for the base of Q207. The differential signal at the collectors of Q206 and Q207 is applied to complementary feedback amplifiers (current fed operational amplifiers)

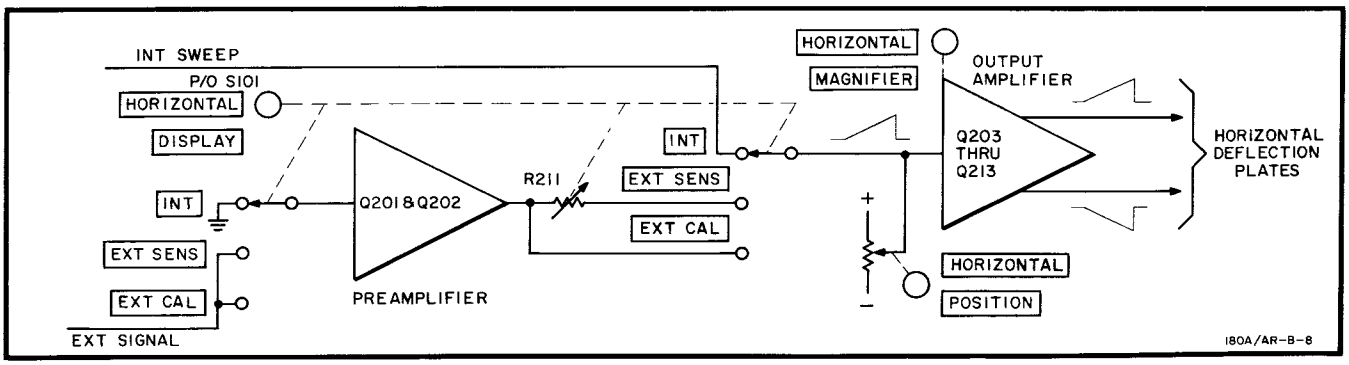


Figure 4-3. Horizontal Amplifier Block Diagram

Q208/Q209/Q210 and Q211/Q212/Q213, converted to a voltage, and coupled to the horizontal deflection plates of the CRT. CR203 and CR206 prevent Q206 and Q207, respectively, from saturating. Diodes CR202/CR204 and CR207/CR208 limit the output to the deflection plates between +6 and +94 volts regardless of the input amplitude. Depressing the FIND BEAM control disables limiter CR207/CR208 and blocks the signal to Q211. The differential gain is effectively cut in half and the electron beam is confined to the horizontal limit of the CRT screen. The gain of the complementary feedback amplifier is very stable because of the large negative feedback from the collectors of Q209/Q210 and Q212/Q213 to the bases of Q208 and Q211, respectively. C210 and C229 adjust the high frequency feedback of each amplifier individually while C213 adjusts the feedback for both. CR205 and CR209 provide temperature compensation for Q210 and Q213.

4-24. HIGH-VOLTAGE POWER SUPPLY (HVPS).

4-25. The high voltage power supply (refer to Figure 4-4) produces three regulated voltages: −2950 V, ≈+9 kV, and a control grid bias voltage. All three voltages are regulated by sampling the −2950 volt supply.

4-26. The 50 kHz output from oscillator Q304/T301 (refer to Figure 8-5, schematic) is coupled to two half-wave rectifiers, CR302 and CR307, and to a voltage tripler circuit. The pulsating dc from CR302 is filtered and applied to the control grid of the CRT. R326 adjusts the dc potential on the grid. The pulsating dc from CR307 is filtered and applied to the cathode of the CRT. V301 and V302 limit the potential difference between the cathode and the control grid to 140 volts in the event of a grid or cathode short. The ac voltage applied to CR307 is also coupled to a voltage tripler, CR308-CR310 and C318-C321. The +9 kV output from the tripler is applied to the post-accelerator of the CRT.

4-27. Changes in the cathode voltage are coupled through the regulator Q301-Q303 to the oscillator Q304/T301. Assume the cathode voltage decreases (goes positive); a positive-going signal is applied through the regulator to the base of Q304; Q304 conducts for a greater protion of the input cycle and causes a greater voltage change across the primary of T301, thus increasing the voltage across the secondary. R302 adjusts the quiescent dc on the base of Q304 and controls the CRT cathode potential. L301 prevents the oscillator from running at 1 MHz. C308 provides an ac ground so that the oscillator's feedback is felt on the base of Q304.

4-28. LOW-VOLTAGE POWER SUPPLY (LVPS).

4-29. The low-voltage power supply produces five dc voltages. The −100, −12.6, +15, and +100 volt supplies are regulated and used throughout the Model 180A/AR and plug-ins. The unregulated +23 V supply is used only by the HVPS and the pilot lamp. A regulated +105-volt supply is also produced, however, it is used only within the LVPS.

4-30. Figure 4-5 shows a basic regulated power supply. It is like a voltage divider in that the entire applied voltage must be dropped across the series regulator and the parallel combination of the load and the sensing device. If the voltage across the load were to change, the sensing device would detect the change and cause the resistance of the series regulator to change and correct the output.

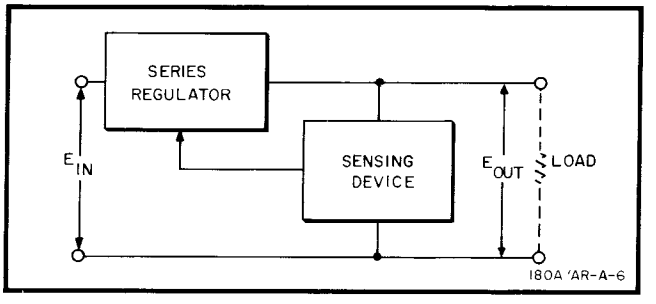


Figure 4-5. Basic Regulated Power Supply

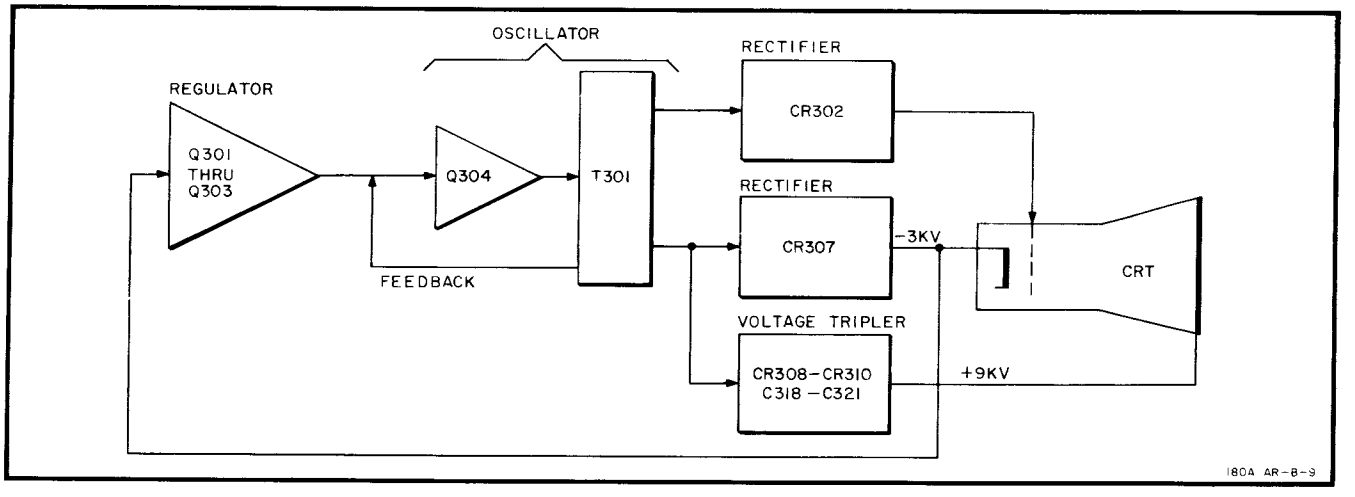


Figure 4-4. HVPS Block Diagram

4-31. Refer to the LVPS schematic diagram, Figure 8-6. Closing S401 supplies power through rear-panel switch S402 to the primary of T401. S402 connects the primary windings in either series or parallel for 230-volt or 115-volt operation, respectively.

4-32. AC voltages from the secondary windings of T401 are full-wave rectified by bridge circuits. The resulting dc voltages are filtered and applied to the regulating circuits described in the following paragraphs.

4-33. The −100 V supply output is used as a reference for the other regulating circuits. It must be adjusted first since its amplitude will effect the other outputs.

4-34. −100-VOLT SUPPLY. The level of the −100 V supply output voltage is controlled by a series regulator, Q414, in the supply ground path. Any change in output voltage is sensed by Q415 and Q416 which are connected in a differential amplifier configuration. The adjustable tap of R449 provides a sample of the supply output voltage which is used to control the conduction of Q416. Voltage regulator V402 maintains a constant voltage drop of 82 volts, and in conjunction with R444 divides the supply output voltage so that the total variation in output voltage will be sensed by Q415. If an increase in the load current requirement occurs, a decrease in output voltage will be observed, resulting in a positive-going (less negative) signal on the base of Q416, with a larger change being sensed by Q415. This causes Q415 to conduct more positive. Thus, the variation in output voltage is sensed and amplified. The positive-going change is coupled from the single-ended output of Q416 to the base of Q413. Driver Q413 controls the base bias level of Q414. The series regulator will therefore compensate for the change in output voltage by decreasing its series resistance to return the supply output voltage to the desired level. Temperature compensation for Q416 is provided by Q415. High-frequency variations in the driver input signal are filtered by C425 and R442 to prevent oscillation. Transistors Q415 and Q416 are protected by CR433 and CR434, while CR432 prevents voltage breakdown from the base of Q413 to the emitter of Q414. Overload current protection is furnished by F406, and CR430 protects against possible reverse charging of C427 in the event F406 opens.

4-35. +100-VOLT SUPPLY. The operation of the +100 V supply is similar to the −100 V supply. Q403 and Q404 operate as a differential amplifier, with Q404 sensing any variation in output or change in relation to the regulated −100 V supply. Voltage regulator V401 and R407 divide the supply output voltage, and Q403 senses the total variation in output voltage. Protection against excessive current is provided by F403, and CR412 prevents the output filter capacitor, C408, from reverse charging if the fuse opens. Temperature compensation for Q404 is provided by Q403.

4-36. +105-VOLT SUPPLY. A dc voltage from rectifier CR401-CR404 is applied across R401 and breakdown diode VR401. Zener action keeps the top of VR401 five volts more positive than the bottom, which is at +100 V. This +105-volt potential at the top of VR401 provides bias current for Q402 and Q404.

4-37. −12.6-VOLT SUPPLY. Part of the voltage from the −12.6 V rectifier filter is dropped across the series regulator and R430, the rest is dropped across the load. Any variation in the output will be coupled through Q412 and Q409 to the base of the series regulator. Q412 provides a voltage gain, while Q409 provides a current gain. C419 and R428 shunt high frequencies to prevent oscillation. CR425 provides temperature compensation for Q412. CR420 protects Q412 from base to emitter voltage breakdown.

4-38. Current limiter, Q411, and R430 form a protective circuit for the series regulator. If the output is shorted, the voltage drop across R430 turns Q411 on. The resulting negative signal from the collector of Q411 is coupled through the driver to the series regulator, turning it off. The output current is limited to the current necessary to keep Q411 turned on.

4-39. +15-VOLT SUPPLY. The +15 V supply is similar to the −12.6 V supply. Changes in output voltage are applied to the base of Q408, amplified, and coupled through Q405 to series regulator Q406. Current limiting action is provided by R419 and Q407.

4-40. SUPPLY CURRENT AVAILABLE. Table 4-1 lists the current available from each power supply. There is no minimum current requirement for any supply.

Table 4-1. LVPS Current Capabilities

Power Supply	Maximum Safe Current Available
+100 VDC	160 mA
+15 VDC	420 mA
−12.6 VDC	725 mA
−100 VDC	80 mA

4-41. CALIBRATOR.

4-42. The schematic diagram of the calibrator is in Figure 8-3. Q106 and Q107 comprise a free-running multivibrator whose output is a 1 kHz square wave at two amplitudes, 250 mV and 10 V. CR116 and CR117 protect Q106 and Q107 from voltage breakdown. CR115 disconnects the collector of Q107 from C122 as Q107 turns off, providing a faster risetime. The two outputs are supplied to front-panel connectors and may be used for probe compensation and sensitivity calibration.

4-43. OUTPUT AMPLIFIERS.

4-44. The output amplifiers (refer to Figure 8-3, schematic) are four emitter followers (Q108-Q111) that couple signals from the Horizontal plug-in to rear-panel connectors. Check the specific plug-in manual to determine what signals are actually applied to the rear panel connectors.

SECTION V

PERFORMANCE CHECK AND ADJUSTMENTS

5-1. INTRODUCTION.

5-2. This section provides the performance check (Paragraph 5-5) and the adjustment procedure (Paragraph 5-17) for the Model 180A/AR. Troubleshooting information, schematic diagrams, and component identification are located in Section VIII.

5-3. TEST EQUIPMENT.

5-4. Test equipment required for maintaining and checking the performance of the Model 180A/AR is listed in Table 5-1. Test equipment having characteristics similar to those listed in the table may be used for the performance check and adjustments.

5-5. PERFORMANCE CHECK.

5-6. The performance check verifies whether or not the Model 180A/AR is operating within the specifications as stated in Table 1-1. This check may be used as part of an incoming quality control inspection, as a periodic operational check, or after repair and/or adjustments have been made. Recently calibrated test equipment should be used when performing the check.

5-7. A Performance Check Record form is included in this manual on Page 5-5/5-6. As the initial performance check is accomplished, the actual readings should be entered on the form. The form should then be removed

Table 5-1. Required Test Equipment

Recommended Test Equipment		Required Characteristics	Reference Paragraph
Type	Model		
Voltmeter Calibrator	HP Model 738AR, 6920B, or E02-738BR	1, 2, and 10 V pk-pk ±0.2%	5-11, step b; 5-12, steps b and d
Monitor Oscilloscope	HP Model 180A/AR w/1801A and 1820A plug-ins	Sensitivity 1 V/div sweep speed 1 usec/div risetime <3 usec sweep output	5-11, step g; 5-28, step b 5-29, step d, 1
10:1 Divider Probe	HP Model 10001A	±3%	5-28, step c
Constant Amplitude Signal Generator	Tektronix Type 190B/191	50 kHz – 50 MHz @ 10 V pk-pk	5-13, step a; 5-29, step d, 7
Digital Voltmeter	HP Model 3440A w/3441A or 3444A plug-in	±100 Vdc ±.05%	5-22, step a; 5-23, step a
100:1 Divider Probe	HP Model 11044A	3000 Vdc	5-23,step a
Ammeter	HP Model 3440A w/3444A Plug-in	0.20 mA – 2.5 mA ±0.2%	5-29, step c, 3
DC Power Supply	HP Model 6204B	2.5 mA ±0.3%	5-29, step c, 3
Square Wave Generator	HP Model 211A/B	200 kHz 1 V pk-pk risetime ≤30 nsec	5-29, step d, 3
Oscillator	HP Model 200CD	100 kHz @ 10 V pk-pk	5-29, step e, 2

from the manual and filed in a safe place so that readings taken at a later date can be compared with the original readings.

5-8. The performance check must be done in the sequence given below. Do not attempt to start the procedure in mid-sequence, as succeeding steps are dependent upon control settings and results of previous steps.

5-9. PRELIMINARY SET-UP.

5-10. Apply power to the Model 180A/AR and allow a fifteen minute warm-up. Do not install plug-ins.

5-11. CALIBRATOR.

a. Set controls as follows:

MAGNIFIER X5
HORIZONTAL DISPLAY ..... EXT CAL
HORIZONTAL Coupling ..... AC

b. Connect a 10 V pk-pk signal from Voltmeter Calibrator output to HORIZONTAL EXT INPUT.

c. Obtain a horizontal trace by adjusting INTENSITY and POSITION controls.

d. Adjust HORIZONTAL DISPLAY for 10 div of deflection.

e. Disconnect Voltmeter Calibrator and connect CALIBRATOR 10 V output to HORIZONTAL EXT INPUT.

f. Trace is 10 div ±1 minor div long.

g. Observe CALIBRATOR 10 V output using the Monitor Oscilloscope.

h. Risetime of calibrator waveform should be less than 3 usec.

5-12. MAGNIFIER.

a. Set MAGNIFIER to X1 and HORIZONTAL DISPLAY to EXT CAL.

b. Connect a 10 V pk-pk signal from Voltmeter Calibrator output to HORIZONTAL EXT INPUT.

c. Deflection is 10 div ±5 minor div.

d. Repeat above procedure setting MAGNIFIER to X5 with 2 V pk-pk signal, and X10 with a 1 V pk-pk signal. Deflection is 10 div ±5 minor div in each case.

5-13. BANDWIDTH.

a. Connect a 50 kHz signal from Constant Amplitude Signal Generator to HORIZONTAL EXT INPUT.

b. Set MAGNIFIER to X1. Adjust Signal Generator amplitude for 10 div of deflection.

c. Increase frequency to 5 MHz. Deflection is greater than 7.1 div. (If deflection is less than 2 div check that Phase/Bandwidth switch is in Bandwidth.)

5-14. BEAM FINDER.

a. Rotate INTENSITY and HORIZONTAL POSITION fully ccw.

b. Depress FIND BEAM.

c. Intensified beam appears on screen.

5-15. COVER REMOVAL.

5-16. There are four separate instrument covers on both the Model 180A and the Model 180AR. The covers of the Model 180AR may be removed by removing the appropriate screws and lifting the cover free. Covers of the Model 180A are "L-shaped", each covering part of the side as well as part of the top or bottom of the instrument. To remove the covers from the Model 180A, proceed as follows: lower tilt stand and set instrument on end; locate the plastic slide locks at the front and back along the side of the instrument (where the panels meet); push the front slide forward and the rear back; lift the cover along the side of the instrument and rotate toward top or bottom.

5-17. ADJUSTMENTS.

5-18 Procedures for adjusting the Model 180A and the Model 180AR are given in Paragraphs 5-19 through 5-29. Required test equipment is listed in Table 5-1. Test equipment with similar characteristics may be substituted if necessary. Figure 5-1 shows the location of adjustments in the Model 180A and 180AR.

5-19. The adjustment procedure must be done in the sequence given below. Do not attempt to start the procedure in mid-sequence, as succeeding steps are dependent upon control settings of previous steps.

5-20. PRELIMINARY SET-UP.

5-21. Install plug-ins in Model 180A/AR. Turn power on and allow a fifteen minute warm-up. Make certain that Phase/Bandwidth switch is in Bandwidth position.

5-22. LOW-VOLTAGE POWER SUPPLY.

a. Connect the Digital Voltmeter to each test point in Table 5-2.

b. Make the proper adjustment to obtain the indicated voltage.

Table 5-2. Low Voltage Adjustments

Test Point	Measure	Adjust
TP404	−100 V ±0.1 V	R449
TP401	+100 V ±0.1 V	R412
TP403	−12.6 V ±0.01 V	R434
TP402	+15 V ±0.01 V	R423

5-23. HIGH-VOLTAGE POWER SUPPLY.

a. Monitor the −100 Vdc at TP404 with the Digital Voltmeter using a 100:1 Divider Probe.

b. Observe and note the voltage reading, which will be approximately −1.000 volt. Accuracy in noting the obtained voltage is essential for proper adjustment.

c. Multiply the reading obtained in step b by 29.50.

d. Monitor the High Voltage at TP301 with the Digital Voltmeter using a 100:1 Divider Probe.

WARNING

This voltage is dangerous to life.

e. Adjust R302 to obtain a voltage reading exactly equivalent to the result obtained in step c, (approximately −29.500 V).

f. The required high-voltage output of the supply is −2950 V ±0.5%.

5-24. ASTIGMATISM.

a. Set HORIZONTAL DISPLAY to EXT CAL and Vertical Display to A.

b. Center spot with Horizontal and Vertical POSITION controls.

c. Adjust FOCUS and ASTIGMATISM for the smallest round spot.

5-25. INTENSITY LIMIT.

a. Set Sweep Display switch on Horizontal Plug-in to MAIN (if applicable) and rotate INTENSITY to 10 o'clock position.

b. Adjust R326 until spot disappears.

5-26. FLOOD GUN.

a. Rotate INTENSITY fully ccw and SCALE fully cw.

b. Rotate R348 fully cw and then slowly ccw until entire screen is at a uniform intensity.

c. Rotate SCALE fully ccw.

5-27. TRACE ALIGNMENT.

a. Set HORIZONTAL MAGNIFIER to X1 and HORIZONTAL Coupling to AC.

b. Connect CALIBRATOR 10 V output to HORIZONTAL EXT INPUT.

c. Rotate INTENSITY cw to view trace.

d. Adjust TRACE ALIGN to make trace parallel with center graticule line.

e. Connect CALIBRATOR 10 V output to Channel A Input.

f. Set Vertical Plug-in controls as follows:

Channel A Polarity ..... +UP
Channel A Volts/div 1
Channel A Vernier ..... CAL
Channel A Coupling ..... AC

g. Adjust R336 to align trace parallel with center graticule line.

h. Disconnect CALIBRATOR from Vertical INPUT.

5-28. GATE AMPLIFIER RESPONSE.

a. Set following controls as applicable:

HORIZONTAL DISPLAY ..... INT
Main Time/div ..... 0.1 uSEC
Main Vernier ..... CAL
Sweep Mode ..... AUTO
Sweep Display ..... MAIN
Delayed Time/div ..... OFF

b. Set Monitor Oscilloscope controls as follows:

Volts/div 1
Time/div ..... 0.1 uSEC
Trigger Source ..... INT
Slope ..... +
Coupling ..... DC

c. Observe signal on collector of Q103 using a 10:1 Divider Probe. Adjust INTENSITY control to cause observed signal to increase by 2 minor div.

d. Adjust C110 and C113 for a fast risetime and a flat response.

5-29. HORIZONTAL AMPLIFIER.

a. DC BALANCE.

1. Set MAGNIFIER to X10 and HORIZONTAL DISPLAY to EXT CAL. Center spot with HORIZONTAL POSITION.

2. Set MAGNIFIER to X1 and recenter spot with R253.

3. Repeat steps 1 and 2 until spot does not shift position when MAGNIFIER is switched from X10 to X1.

b. VERNIER BALANCE.

1. Set MAGNIFIER to X10.

2. Rotate HORIZONTAL DISPLAY fully ccw (not into INT) and center spot with HORIZONTAL POSITION.

3 Rotate HORIZONTAL DISPLAY to EXT CAL and adjust R207 to recenter spot.

4. Repeat Steps 2 and 3 until spot does not shift when HORIZONTAL DISPLAY is rotated from fully ccw (not in INT) to EXT CAL.

c. GAIN.

1. Set HORIZONTAL MAGNIFIER to X1 and HORIZONTAL DISPLAY to EXT CAL.

2. Adjust Horizontal and Vertical POSITION to center spot on left edge of graticule.

Note

Table 5-3 lists the currents necessary to calibrate the horizontal gain. They should be accurate to 0.3% if plug-in interchangeability is desired.

3. Inject the current specified in Table 5-3 into the emitter of Q203. Spot should be at right edge of graticule.

Table 5-3 Gain Adjust

MAGNIFIER	INJECT	ADJUST
X1	2.5 mA	R250
X5	0.5 mA	R248
X10	0 25 mA	R246

4. Perform the adjustment specified in Table 5-3 to take up half of the difference between the spot and the right edge of the graticule.

Note

If 10 div of deflection can not be obtained by adjusting R250 and the CRT has been replaced, it may be necessary to select a new value for R251.

5. Repeat steps 2 through 4 until spot deflects 10 div.

6. Set HORIZONTAL MAGNIFIER to X5 and repeat steps 2 through 5 using applicable information in Table 5-3.

7. Set HORIZONTAL MAGNIFIER to X10 and repeat steps 2 through 5 using applicable information in Table 5-3.

d. TRANSIENT RESPONSE.

1. Connect a 1 usec/div sweep signal from the Monitor Oscilloscope to the Channel A Input of the Vertical Plug-in.

2. Adjust Channel A Volts/div and Vernier controls for an 8 div display.

3. Connect a 200 kHz 1 V pk-pk, square wave from the Square Wave Generator to the Model 180A/AR HORIZONTAL EXT INPUT.

4. Synchronize the Monitor Oscilloscope with the 200 kHz signal.

5. Observe the waveform on the Model 180A/AR and adjust C210, C213, and C229 for best response on lower right-hand corner of the waveform.

Note

C210 and C229 should be adjusted so their slugs are almost equally extended.

6. Set controls as follows:

HORIZONTAL DISPLAY . . . . . INT
Channel A Volts/div 1
Channel A Vernier . . . . . CAL

7. Connect a 50 MHz sine wave at approximately 4 V pk-pk from the Constant Amplitude Signal Generator to Channel A Input.

8. Select the fastest sweep speed and obtain a display.

9. Readjust C213 to display one cycle in 20 nanoseconds.

e. PHASE.

1. Set controls as follows:

Phase/Bandwidth . . . . . Phase
HORIZONTAL MAGNIFIER X1
HORIZONTAL DISPLAY . . . . . EXT CAL

Serial Number: _____

PERFORMANCE CHECK RECORD

Paragraph	Check	Minimum	Reading	Maximum
5-11	Calibrator			
step f	amplitude	9.9 div		10.1 div
step h	risetime	none		3 usec
5-12	Magnifier			
step c	X1	9.5 div		10.5 div
step d	X5	9.5 div		10.5 div
	X10	9.5 div		10.5 div
5-13	Bandwidth			
step c	AC coupling	7.1 div		none
5-14				
step c	Beam Finder	Intensified beam		yes or no

PERFORMANCE CHECK RECORD

Paragraph	Check	Minimum	Reading	Maximum
5-11	Calibrator			
step f	amplitude	9.9 div		10.1 div
step h	risetime	none		3 usec
5-12	Magnifier			
step c	X1	9.5 div		10.5 div
step d	X5	9.5 div		10.5 div
	X10	9.5 div		10.5 div
5-13	Bandwidth			
step c	AC coupling	7.1 div		none
5-14				
step c	Beam Finder	Intensified beam		yes or no

2. Connect a 100 kHz sine wave from the Oscillator to HORIZONTAL EXT INPUT and to Channel A Input.

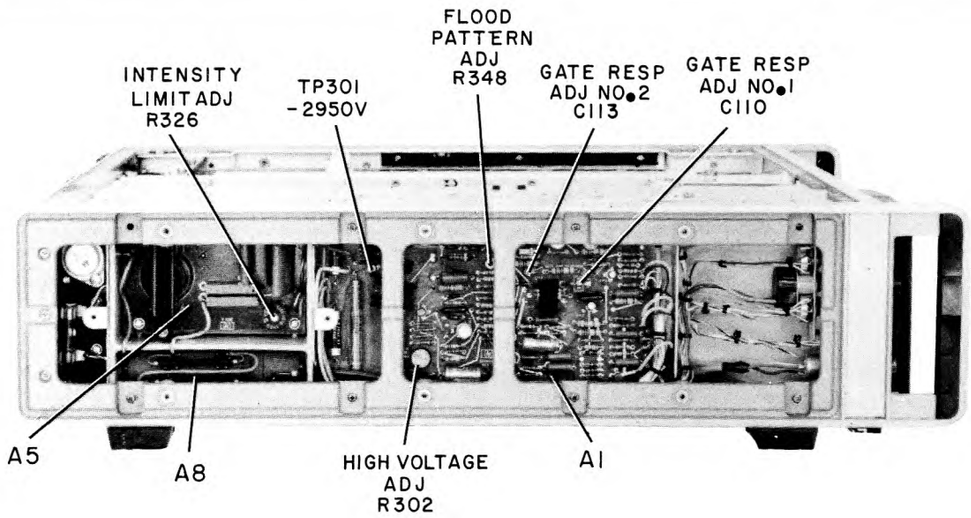
Note

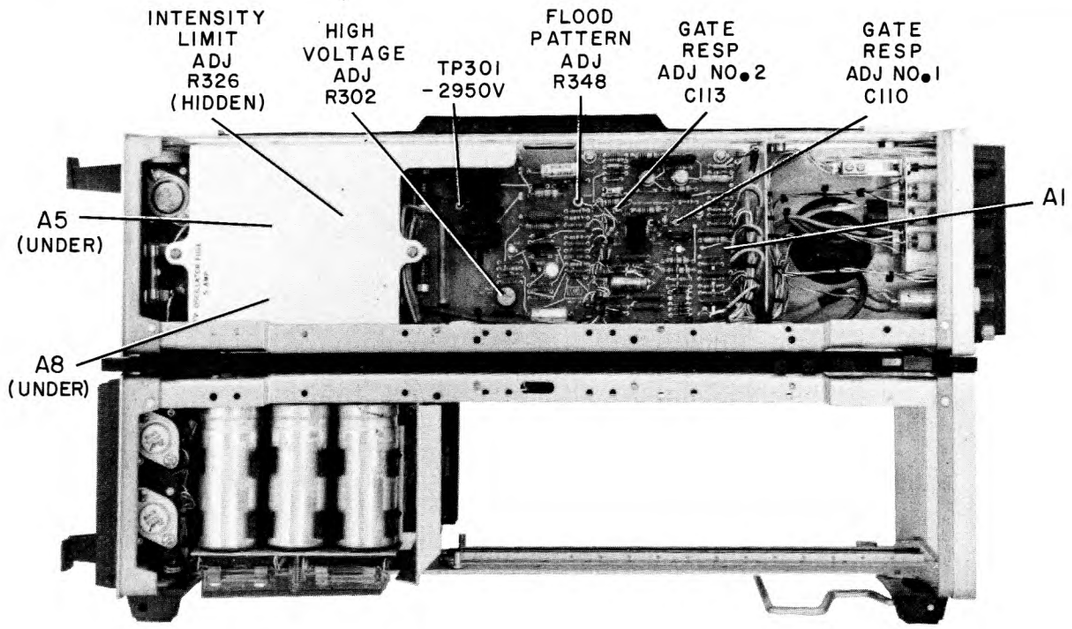
Under normal conditions, only Channel A should be used (when using a multi-channel Vertical Plug-in). If another channel must be used, perform this procedure for that channel instead of A.

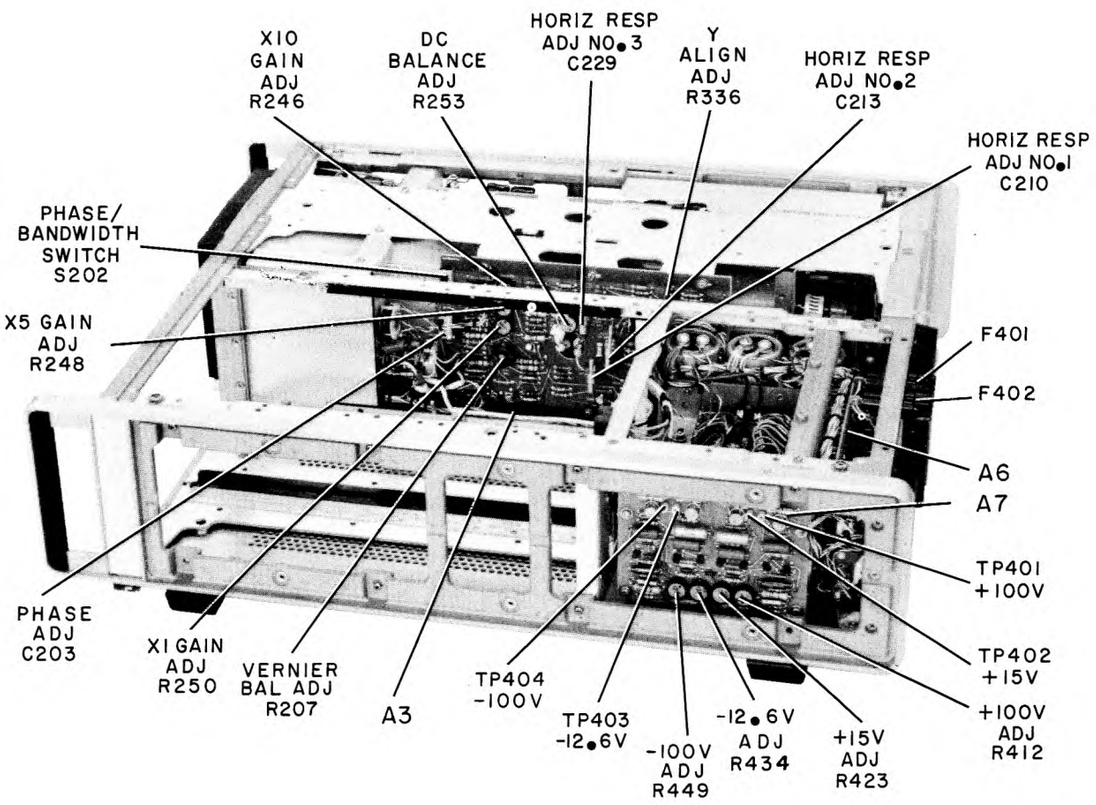
3. Adjust Oscillator amplitude for an 8 div display.

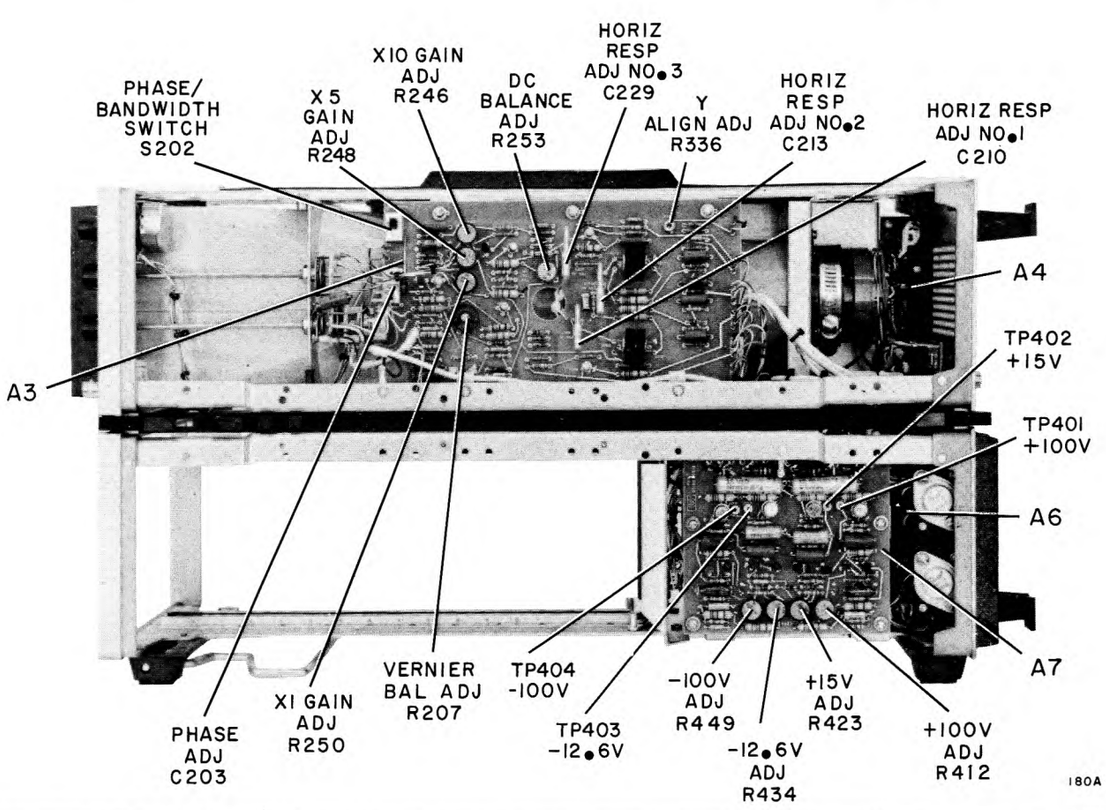
4. Adjust C203 for a single diagonal line on the CRT (no phase shift).

5. Return Phase/Bandwidth switch to Bandwidth position before replacing covers.









180A-8-13

Figure 5-1. Adjustment Locations

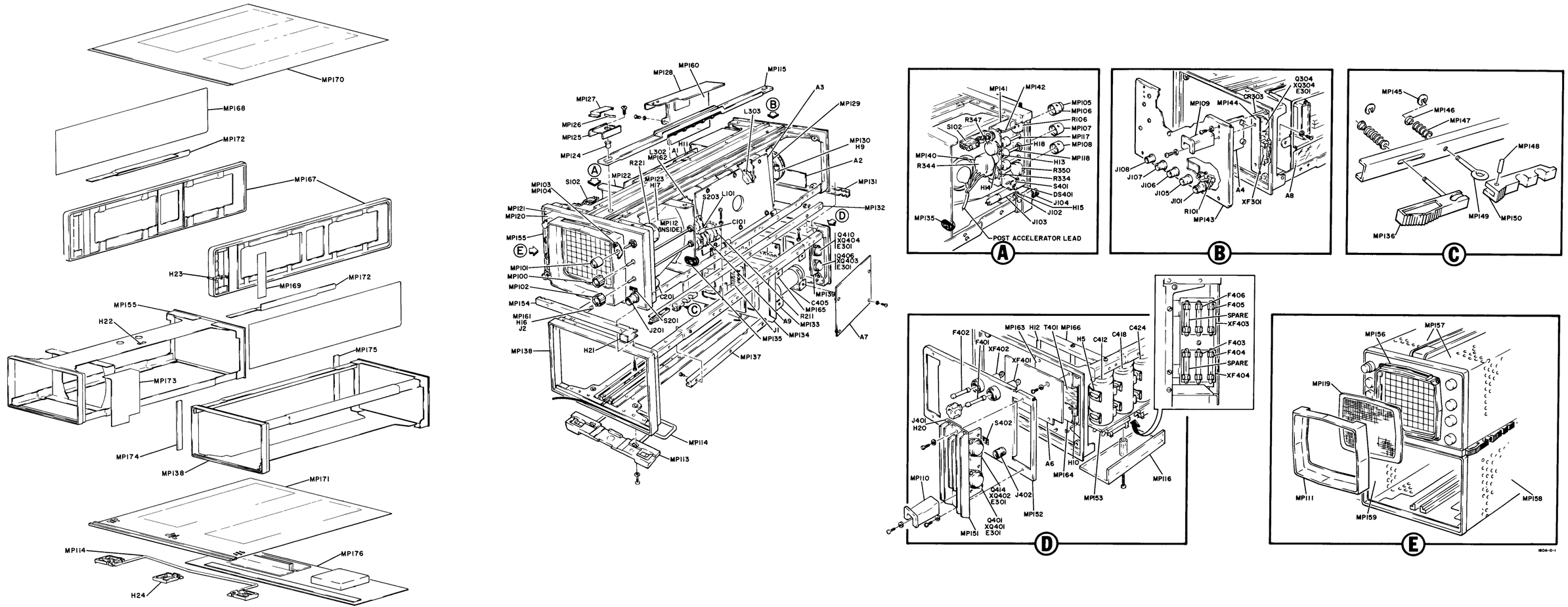


Figure 6-1. Model 180A/AR Mechanical Parts Identification

SECTION VI

REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section contains information for ordering replaceable parts for the instrument. Table 6-2 lists the parts in alpha-numerical order of their reference designations and provides the following information for each item:

a. HP Part Number.

b. Total quantity (TQ) used in instrument; given only first time a part number is listed.

c. Description of part; see Table 6-1 for list of reference designators and abbreviations.

6-3. Mechanical parts are listed by reference designation in Table 6-2, and identified in Figure 6-1.

6-4. ORDERING INFORMATION.

6-5. To order a replacement part from the Hewlett-Packard Company, address the order or inquiry to the nearest Hewlett-Packard Sales/Service Office (list in rear of manual) and supply the following information:

a. HP Part Number of item(s).

b. Model number and eight-digit serial number of instrument.

c. Quantity of parts desired.

6-6. To order a part not listed in Table 6-2, provide the following information:

a. Model number and eight-digit serial number of the instrument.

b. Description of part including function and location.

6-7. Component descriptions given in Table 6-2 are as complete as possible to assist in obtaining replacement parts from manufacturers other than HP. However, many parts are manufacturered only by HP, or are produced by other manufacturers to HP proprietary specifications, and are therefore available only from HP. Actual manufacturer and manufacturers part number for non-HP parts will be supplied upon request. Contact the nearest HP Sales/Service Office.

Table 6-1. Reference Designators And Abbreviations

REFERENCE DESIGNATORS

A	= assembly	E	= misc. electronic part	M	= meter	TB	= terminal board
AT	= attenuator, resistive termination	F	= fuse	MP	= mechanical part	TP	= test point
B	= motor, fan	FL	= filter	P	= plug	U	= microcircuit(non-repairable)
C	= capacitor	H	= hardware	PS	= power supply	V	= vacuum tube, neon bulb, photocell, etc.
CP	= coupling	IC	= integrated circuit	Q	= transistor	VR	= voltage regulator (diode)
CR	= diode	J	= jack	R	= resistor	W	= cable
DL	= delay line	K	= relay	RT	= thermistor	X	= socket
DS	= device signaling (lamp)	L	= inductor	S	= switch	Y	= crystal
		LS	= speaker	T	= transformer		

ABBREVIATIONS

A	= ampere(s)	Ge	= germanium	minat	= miniature	s-b	= slow-blow
ampl	= amplifier(s)	G	= giga (10^9)	mom.	= momentary	Se	= selenium
assy	= assembly	gl	= glass	mtg	= mounting	sect	= section(s)
		grd	= ground(ed)	my.	= mylar	semicon	= semiconductor(s)
bd	= board(s)					Si	= silicon
bp	= bandpass	H	= henry(ies)	n	= nano (10^{-9})	sil	= silver
		Hg	= mercury	n/c	= normally closed	sl	= slide
c	= centi (10^{-2})	hr	= hour(s)	Ne	= neon	sp	= single pole
car.	= carbon	HP	= Hewlett-Packard	n/o	= normally open	spl	= special
ccw	= counterclockwise	Hz	= hertz	npo	= negative positive zero (zero temperature coefficient)	st	= single throw
cer	= ceramic					std	= standard
coax.	= coaxial	if.	= intermediate freq				
coef	= coefficient	impg	= impregnated	nsr	= not separately replaceable	Ta	= tantalum
com	= common	incd	= incandescent			td	= time delay
comp	= composition	incl	= include(s)			TD	= tunnel diode(s)
conn	= connector(s)	ins	= insulation(ed)	obd	= order by description	tgl	= toggle
CRT	= cathode-ray tube	int	= internal	ox	= oxide	Ti	= titanium
cw	= clockwise					tol	= tolerance
d	= deci (10^{-1})	k	= kilo (10^3)	p	= pico (10^{-12})	trim.	= trimmer
depc	= deposited carbon			pc	= printed (etched) circuit(s)		
dp	= double pole	lb	= pound(s)	PGM	= program	u	= micro (10^{-6})
dt	= double throw	lev	= lever	piv	= peak inverse voltage(s)		
		lin	= linear taper	p/o	= part of	V	= volt(s)
elect.	= electrolytic	log.	= logarithmic taper	poly	= polystyrene	var	= variable
encap	= encapsulated	lpf	= low-pass filter(s)	porc	= porcelain		
ext	= external			pos	= position(s)	W	= watt(s)
		m	= milli (10^{-3})	pot.	= potentiometer(s)	w/	= with
F	= farad(s)	M	= mega (10^6)	pk-pk	= peak-to-peak	w/o	= without
fet	= field-effect transistor(s)	metflm	= metal film	rect	= rectifier(s)	wVdc	= dc working volt(s)
fxd	= fixed	metox	= metal oxide	rf	= radio frequency	ww	= wirewound

Table 6-2 Replaceable Parts

Ref Desig	HP Part No	TQ	Description (See Table 6-1)
A1	00180-66524	1	A: gate amplifier and high voltage regulator
A2	00180-66521	1	A: output amplifier
A3	00180-66517	1	A: horizontal amplifier
A4	00180-66523	1	A: high voltage oscillator
A5	00180-66522	1	A: high voltage rectifier
A6	00180-66520	1	A: low voltage rectifier
A7	00180-66519	1	A: low voltage supply
A8	00180-61101	1	A: high voltage supply (180A)
A8	00180-61102	1	A: high voltage supply (180AR)
A9	00180-61903	1	A: switch display
C101	0160-0168	5	C: fxd my 0.1 uF 10% 200 wVdc
C102	0160-0207	1	C: fxd my .01 uF 5% 200 wVdc
C103	0160-0162	12	C: fxd my .022 uF 10% 200 wVdc
C104	0160-0162		C: fxd my .022 uF 10% 200 wVdc
C105	0160-0162		C: fxd my .022 uF 10% 200 wVdc
C106	0160-0162		C: fxd my .022 uF 10% 200 wVdc
C110	0132-0004	1	C: var polystyrene 0.7 - 3 pF 300 wVdc
C111	0150-0059	1	C: fxd cer 3.3 pF ±0.25 pF 500 wVdc
C112	0140-0180	1	C: fxd mica 2000 pF 2% 300 wVdc
C113	0121 0168	1	C: var teflon 0.2 - 1.5 pF 600 wVdc
C114	0160-0162		C: fxd my .022 uF 10% 200 wVdc
C115	0180-0039	1	C: fxd Al elect 100 uF −10+75% 12 wVdc
C116	0150-0061	1	C: fxd cer 20 pF 10% 100 wVdc
C120	0180-0155	3	C: fxd Ta 2.2 uF 20% 20 wVdc
C121	0160-2961	2	C: fxd mica 5825 pF 2% 300 wVdc
C122	0160-2961		C: fxd mica 5825 pF 2% 300 wVdc
C123	0180-0089	1	C: fxd elect 10 uF −10+100% 150 wVdc
C127	0180-0155		C: fxd Ta 2.2 uF 20% 20 wVdc
C128	0180-0155		C: fxd Ta 2.2 uF 20% 20 wVdc
C201	0170 0022	1	C: fxd my 0.1 uF 20% 600 wVdc
C202	0150-0075	1	C: fxd cer 4700 pF −20+100% 500 wVdc
C203	0131 0004	1	C: var mica 16 - 150 pF 175 wVdc
C204	0140 0231	1	C: fxd mica 440 pF 1% 300 wVdc
C205	0160-0162		C: fxd my .022 uF 10% 200 wVdc
C206	0160 0162		C: fxd my .022 uF 10% 200 wVdc
C210	0132-0007	3	C. var rexolite 0.7 3 pF 350 wVdc
C211	0160-0162		C: fxd my .022 uF 10% 200 wVdc
C212	0170-0040	2	C: fxd my .047 uF 10% 200 wVdc
C213	0132-0007		C: var rexolite 0.7 - 3 pF 350 wVdc
C214	0160-2235	1	C: fxd cer 0.75 pF ±0.25 pF 500 wVdc

Table 6-2 Replaceable Parts (Cont'd)

Ref Desig	HP Part No	TQ	Description (See Table 6-1)
C218	0160-0162		C: fxd my .022 uF 10% 200 wVdc
C219	0160-0162		C: fxd my .022 uF 10% 200 wVdc
C220	0180-0197	4	C fxd Ta elect 2.2 uF 10% 20 wVdc
C221	0180-0197		C: fxd Ta elect 2.2 uF 10% 20 wVdc
C222	0160-0162		C. fxd my .022 uF 10% 200 wVdc
C226	0180-0197		C: fxd Ta elect 2.2 uF 10% 20 wVdc
C227	0180-0197		C: fxd Ta elect 2.2 uF 10% 20 wVdc
C228	0180-0218	1	C: fxd Ta elect 0 15 uF 10% 35 wVdc
C229	0132-0007		C: var rexolite 0.7 3 pF 350 wVdc
C230	0160-0162		C: fxd my .022 uF 10% 200 wVdc
C231	0170-0040		C: fxd my .047 uF 10% 200 wVdc
C301	0180-0076	1	C: fxd elect 20 uF 25 wVdc
C302	0160-3007	3	C fxd cer .0047 uF 20% 4000 wVdc
C303	0170-0019	1	C: fxd my 0.1 uF 5% 200 wVdc
C307	0180-0097	3	C: fxd elect 47 uF 10% 35 wVdc
C308	0160-0380	1	C: fxd my 0.22 uF 10% 200 wVdc
C309	0160-0907	1	C: fxd cer .01 uF 5000 wVdc
C310	0160-3008	4	C: fxd cer .0047 uF 20% 4000 wVdc
C311	0160-3007		C: fxd cer .0047 uF 20% 4000 wVdc
C312	0160-3008		C: fxd cer .0047 uF 20% 4000 wVdc
C314	0160-3008		C: fxd cer .0047 uF 20% 4000 wVdc
C315	0160-2320		C: fxd cer .01 uF 5000 wVdc
C316	0160-3007		C. fxd cer .0047 uF 20% 4000 wVdc
C317	0160-3008		C: fxd cer .0047 uF 20% 4000 wVdc
C318			NSR: p/o A8
C319			NSR: p/o A8
C320			NSR: p/o A8
C321			NSR: p/o A8
C401	0180-1811	1	C: fxd elect 100 uF 20 wVdc
C405	0180-1808	1	C: fxd elect 430 uF −10+50% 200 wVdc
C406	0160-0168	4	C: fxd my 0 1 uF 10% 200 wVdc
C407	0180-0100	2	C. fxd Ta elect 4.7 uF 10% 35 wVdc
C408	0180-1810	2	C: fxd Al elect 18 uF −10+50% 150 wVdc
C412	0180-1865	1	C. fxd elect 2100 uF −10+75% 40 wVdc
C413	0160-0168	1	C. fxd my 0.1 uF 10% 200 wVdc
C414	0180-0097		C: fxd elect 47 uF 10% 35 wVdc
C418	0180-1809	1	C: fxd elect 3400 uF −10+75% 25 wVdc
C419	0160-0168		C: fxd my 0 1 uF 10% 200 wVdc
C420	0180-0097		C: fxd elect 47 uF 10% 35 wVdc
C424	0180-1807	1	C: fxd elect 290 uF −10+50% 200 wVdc

Table 6-2 Replaceable Parts (Cont'd)

Ref Desig	HP Part No	TQ	Description (See Table 6-1)
C425	0160-0168		C: fxd my 0.1 uF 10% 200 wVdc
C426	0180-0100		C: fxd Ta elect 4.7 uF 10% 35 wVdc
C427	0180-1810		C fxd Al elect 18 uF −10+50% 150 wVdc
CR101	1901-0179	1	CR: Si (special)
CR102	1901-0040	17	CR: Si (special)
CR103	1901-0040		CR Si (special)
CR104	1901-0040		CR: Si (special)
CR108	1901-0040		CR: Si (special)
CR109	1901-0029	2	CR Si (special)
CR110	1901-0029		CR: Si (special)
CR111	1901-0040		CR. Si (special)
CR112	1901-0436	2	CR: Si (special)
CR113	1901-0436		CR: Si (special)
CR115	1901-0096	4	CR: Si (special)
CR116	1901-0096		CR Si (special)
CR117	1901-0096		CR: Si (special)
CR201	1901-0096		CR: Si (special)
CR202	5080-0464	4	CR: Si (special)
CR203	1901-0040		CR: Si (special)
CR204	5080-0464		CR: Si (special)
CR205	1901-0040		CR: Si (special)
CR206	1901-0040		CR: Si (special)
CR207	5080-0464		CR: Si (special)
CR208	5080-0464		CR: Si (special)
CR209	1901-0040		CR Si (special)
CR301	1901-0049	5	CR: Si (special)
CR302	1901 0341	2	CR: Si (special)
CR303	1901-0040		CR Si (special)
CR307	1901-0341		CR: Si (special)
CR308			NSR: p/o A8
CR309			NSR p/o A8
CR310			NSR: p/o A8
CR401	1901-0049		CR: Si (special)
CR402	1901-0049		CR: Si (special)
CR403	1901-0049		CR: Si (special)
CR404	1901-0049		CR Si (special)
CR405	1901-0040		CR: Si (special)
CR406	1901-0040		CR: Si (special)

Table 6-2 Replaceable Parts (Cont'd)

Ref Desig	HP Part No	TQ	Description (See Table 6-1)
CR407	1901-0040		CR: Si (special)
CR408	1901-0028	8	CR: Si (special)
CR409	1901-0028		CR: Si (special)
CR410	1901-0028		CR: Si (special)
CR411	1901-0028		CR: Si (special)
CR412	1901-0026	2	CR: Si (special)
CR413	1901-0415	8	CR: Si (special)
CR414	1901-0415		CR: Si (special)
CR415	1901-0415		CR: Si (special)
CR416	1901-0415		CR: Si (special)
CR417	1901-0040		CR: Si (special)
CR419	1901-0040		CR: Si (special)
CR420	1901-0040		CR: Si (special)
CR421	1901-0415		CR: Si (special)
CR422	1901-0415		CR: Si (special)
CR423	1901-0415		CR: Si (special)
CR424	1901-0415		CR: Si (special)
CR425	1901-0040		CR: Si (special)
CR426	1901-0028		CR: Si (special)
CR427	1901-0028		CR: Si (special)
CR428	1901 0028		CR: Si (special)
CR429	1901-0028		CR: Si (special)
CR430	1901-0026		CR: Si (special)
CR432	1901-0040		CR: Si (special)
CR433	1901-0040		CR: Si (special)
CR434	1901-0040		CR: Si (special)
DS401	2140-0245	1	DS: incandescent midget 28 V 40 mA
E301	1200-0043	5	Insulator: transistor
F301	2110-0012	1	F: 0.5 A 250 V cartridge
F401	2110-0005	1	F: 1.6 A s-b 125 V cartridge
F402	2110-0020	1	F: 0.8 A s-b 125 V cartridge
F403	2110-0065	1	F: 0.375 A 250 V cartridge
F404	2110-0002	2	F: 2 A 250 V cartridge
F405	2110-0002		F: 2 A 250 V cartridge
F406	2110-0067	1	F: 0.30 A 250 V cartridge

Table 6-2 Replaceable Parts (Cont'd)

Ref Desig	HP Part No	TQ	Description (See Table 6-1)
H1	0362-0063	40	Clip: square pin
H2	5020-0495	109	Pin: interconnection square
H3	3100-1580	8	Spacer: ceramic
H4	1205-0063	3	Heat sink: 2-transistor
H5	1400-0091	6	Clip: component 1-3/8 in. dia black
H6	0340-0039	2	Bushing: teflon (on A5)
H7	5040-0402	1	Mount: T301 7/8 in (on A5)
H8	5040-0430	1	Mount: T301 21/32 in. (on A5)
H9	1400-0026	1	Clamp: hose (CRT neck)
H10	00180-24701	4	Standoff: octogonal T401 mount
H11	00180-24702	1	Standoff: black insulating for A1
H12	0380-0724	2	Spacer: T401 support
H13	00180-45402	1	Bushing. insulator focus control
H14	00180-45404	1	Insulator: focus control
H15	00180-45403	3	Bushing: insulator calibrator jacks
H16	00180-09104	1	Clip: ground plug-in
H17	00180-09105	1	Clip: ground dag
H18	0510-0053	1	Retaining ring: focus shaft
H20	7200-0293	1	Spacer: power input connector
H21	00180-44701	1	Spacer: trademark (180A)
H22	00180-41208	1	Clip: twin lead horiz (180AR)
H23	5040-0464	2	Hanger: probe clip-on (180AR)
H24	5060-0767	5	Foot: assy plastic (180AR)
J1	1251-0137	1	J: female 32 pin
J2	00180-69501	1	J: 2 pin (left guide w/2 contacts)
	0363-0006	2	Spring contact only
J101	1250-0083	6	J: BNC female
J102	00180-21702	2	J: banana female
J103	00180-21702		J: banana female
J104	00180-61001	1	J: ground post assy (incl insulator block)
J105	1250-0083		J: BNC female
J106	1250-0083		J: BNC female
J107	1250-0083		J: BNC female
J108	1250-0083		J: BNC female
J201	1250-0083		J: BNC female
J401	1251-0148	1	J: power 3 pin
J402	1510-0038	1	J: binding post

Table 6-2 Replaceable Parts (Cont'd)

Ref Desig	HP Part No	TQ	Description (See Table 6-1)
L101	9140-0179	7	L: fxd 22 uH 10%
L102	9140-0179		L: fxd 22 uH 10%
L105	9140-0179		L: fxd 22 uH 10%
L107	9140-0179		L: fxd 22 uH 10%
L108	9140-0179		L: fxd 22 uH 10%
L200	9140-0179		L: fxd 22 uH 10%
L202	9140-0179		L: fxd 22 uH 10%
L203	9170-0029	1	L: bead
L301	9140-0071	1	L: fxd 22 uH 10%
L302	5060-0435	1	L: trace align
L303	00180-65601	1	L: y align
MP100	00180-67404	2	Knob: assy bar w/black arrow
MP101	00180-67402	1	Knob: assy w/black arrow
MP102	00180-67404		Knob: assy bar w/black arrow
MP103	00180-05002	1	Lever: control fine horiz position
MP104	0370-0432	1	Knob: control lever
MP105	0370-0350	1	Button: push find beam
MP106	0370-0348	1	Knob: round hollow shaft intensity
MP107	00180-67401	1	Knob: assy w/black arrow
MP108	00180-67403	1	Knob: assy w/black arrow and off
MP109	5040-0447	2	Foot: rear long (180A)
MP110	5040-0446	2	Foot: rear short (180A)
MP111	5040-0444	1	Shield: light plastic bezel
MP112	0905-0016	1	Gasket: CRT mount
MP113	5040-0445	2	Foot: bottom (180A)
MP114	1490-0710	1	Stand: tilt (180A)
MP114	1490-0030	1	Stand: tilt (180AR)
MP115	5040-0459	1	Handle: carring (180A)
MP116	00180-44105	1	Cover: fuse block
MP117	00180-23202	2	Coupler: control screwdriver adjust
MP118	00180-23201	1	Coupler: control knob
MP119	10179-60501	1	Filter: mesh contrast
MP120	00180-00201	1	Panel: front (incl J104)
MP121	00180-00202	1	Panel: front sub
MP122	00180-01201	1	Bracket: horiz control mtg (p/o MP155)
MP123	00180-00602	1	Shield: assy CRT
MP124	00180-24704	2	Spacer: handle carrying (180A)
MP125	00180-22301	2	Keeper: handle carrying (180A)
MP126	00180-09103	2	Spring: insert (180A)
MP127	00180-07201	2	Keeper: insert (180A)
MP128	00180-04103	1	Cover: high voltage supply
MP129	00180-01202	1	Bracket: CRT clamp (p/o MP155)

Table 6-2 Replaceable Parts (Cont'd)

Ref Desig	HP Part No	TQ	Description (See Table 6-1)
MP129	00180-01202	1	Bracket: CRT clamp (p/o MP155)
MP130	00180-41207	2	Clamp: CRT neck plastic
MP131	5020-0502	1	Spacer: rear frame (180A)
MP132	5020-0480	2	Spacer: side frame (180A)
MP133	00180-01210	1	Bracket: xfmr mount bottom front
MP134	00180-01209	1	Bracket: connector plug-in
MP135	0400-0010	2	Grommet: 250 I.D.
MP136	5040-0448	4	Latch: slide cover (180A)
MP137	00180-43102	1	Guide: right plug in
MP138	00180-60102	1	Chassis assy power section (180A)
MP138	00180-60104	1	Chassis: assy power section (180AR)
MP139	00180-61103	1	Heat Sink: right (incl XQ403, XQ404)
MP140	5040-0453	1	Insulator: high voltage
MP141	00180-01208	1	Bracket: CRT control
MP142	00180-23701	1	Shaft: find beam control
MP143	00180-00205	1	Panel: rear display section
MP144	00180-01206	1	Bracket: pwr transistor (incl XF301, XQ301)
MP145	0510-0952	6	Ring: retaining (180A)
MP146	3050-0441	10	Washer: shoulder (180A)
MP147	1460-0706	6	Spring: compression (180A)
MP148	0510-0705	2	Pin: spring hinge (180A)
MP149	5020-0499	2	Hinge: probe hanger (180A)
MP150	5040-0463	2	Hanger. probe (180A)
MP151	00180-61104	1	Heat Sink: left (incl XQ401, XQ402)
MP152	00181-00203	1	Panel: rear power section
MP153	00180-01212	1	Bracket: capacitor (incl XF403, XF404, H5)
MP154	5020-0481	1	Spacer: front frame (180A)
MP155	00180-60101	1	Chassis: assy display section (180A)
MP155	00180-60103	1	Chassis: assy display section (180AR)
MP156	5020-0476	1	Bezel: front panel
MP157	5000-0447	2	Cover: top (180A)
MP158	5000-0448	1	Cover: bottom right (180A)
MP159	5000-0539	1	Cover bottom left (180A)
MP160	00180-25401	1	Insulator plexiglass high voltage cover
MP161	00180-43101	1	Guide: left plug-in
MP162	00180-01218	2	Bracket: mount L302
MP163	00180-01211	1	Bracket: T401 mount top rear
MP164	00180-01215	1	Bracket T401 mount bottom rear
MP165	00180-01214	1	Bracket: T401 mount top front
MP166	00180-04703	1	Bracket: T401 support
MP167	5060-0431	2	Frame: assy side (180AR)

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

Ref Desig	HP Part No	TQ	Description (See Table 6-1)
MP168	5000-0444	2	Cover: side (180AR)
MP169	5000-0051	2	Plate: fluted aluminum (180AR)
MP170	5000-0446	1	Cover: top (180AR)
MP171	5000-0445	1	Cover: bottom (180AR)
MP172	00180-01217	2	Bracket: cover (180AR)
MP173	00180-00601	1	Shield: post accelerator (180AR)
MP174	5000-0449	1	Spacer: frame front (180AR)
MP175	5000-0469	1	Spacer: frame rear (180AR)
MP176	5060-0775	1	Kit: rack mount (180AR)
Q101	1854-0019	5	Q: Si npn (special)
Q102	1854-0019		Q: Si npn (special)
Q103	1853-0038	3	Q: Si pnp (special)
Q104	1854-0271	1	Q: Si npn (special)
Q105	1853-0009	3	Q: Si pnp (special)
Q106	1854-0234	2	Q: Si npn 2N3440
Q107	1845-0234		Q: Si npn 2N3440
Q108	1854-0071	12	Q: Si npn (special)
Q109	1854-0071		Q: Si npn (special)
Q110	1853-0016	2	Q: Si pnp 2N3638
Q111	1853-0016		Q: Si pnp 2N3638
Q201	1855-0020	1	Q: Si FET n-channel (special)
Q202	1854-0083	1	Q: Si npn (special)
Q203	1850-0158	1	Q: Ge pnp 2N2635
Q204	1854-0019		Q: Si npn (special)
Q205	1854-0071		Q: Si npn (special)
Q206	1854-0019		Q: Si npn (special)
Q207	1854-0019		Q: Si npn (special)
Q208	1853-0009		Q: Si pnp (special)
Q209	1854-0056	2	Q: Si npn 2N3119
Q210	1853-0038		Q: Si pnp (special)
Q211	1853-0009		Q: Si pnp (special)
Q212	1854 0056		Q: Si npn 2N3119
Q213	1853-0038		Q: Si pnp (special)
Q301	1854-0023	1	Q: Si npn (special)
Q302	1854-0071		Q: Si npn (special)
Q303	1854-0039	3	Q: Si npn 2N3053
Q304	1854-0291	1	Q: Si npn (special)
Q401	1854-0063	4	Q: Si npn 2N3055
Q402	1854-0090	2	Q: Si npn (special)

Table 6-2 Replaceable Parts (Cont'd)

Ref Desg	HP Part No	TQ	Description (See Table 6-1)
Q403	1854-0087		Q: Si npn (special)
Q404	1854-0071		Q Si npn (special)
Q405	1854-0039		Q: Si npn 2N3053
Q406	1854-0063		Q Si npn 2N3055
Q407	1854-0071		Q: Si npn (special)
Q408	1854-0071		Q: Si npn (special)
Q409	1854-0039		Q: Si npn 2N3053
Q410	1854-0063		Q Si npn 2N3055
Q411	1854-0071		Q Si npn (special)
Q412	1854-0071		Q Si npn (special)
Q413	1854 0090		Q: Si npn (special)
Q414	1854-0063		Q: Si npn 2N3055
Q415	1854-0087		Q Si npn (special)
Q416	1854-0071		Q Si npn (special)
R101	0757-0438	8	R: fxd metflm 5.11 k ohms 1% 1/8 W
R102	0757-0407	7	R: fxd metflm 200 ohms 1% 1/8 W
R103	0757 0407		R: fxd metflm 200 ohms 1% 1/8 W
R104	0757-0401	9	R: fxd metflm 100 ohms 1% 1/8 W
R105	0757-0458	1	R: fxd metflm 51.1 k ohms 1% 1/8 W
R106	2100 1904	1	R: var comp 10 k ohms 20% 1/4 W
R107	0757-0281	3	R: fxd metflm 2 74 k ohms 1% 1/8 W
R111	0757-0401		R: fxd metflm 100 ohms 1% 1/8 W
R112	0757-0401		R: fxd metflm 100 ohms 1% 1/8 W
R113	0757-0401		R: fxd metflm 100 ohms 1% 1/8 W
R114	0757 0290	1	R: fxd metflm 6.19 k ohms 1% 1/8 W
R115	0757-0724	1	R: fxd metflm 392 ohms 1% 1/4 W
R116	0757-0461	1	R: fxd metflm 68 1 k ohms 1% 1/8 W
R117	0757-0727	1	R: fxd metflm 562 ohms 1% 1/4 W
R118	0757-0407		R fxd metflm 200 ohms 1% 1/8 W
R119	0757-0756	1	R: fxd metflm 13 k ohms 1% 1/4 W
R120	0757-0469	1	R: fxd metflm 150 k ohms 1% 1/8 W
R121	0757-0756		R fxd metflm 13 k ohms 1% 1/4 W
R122	0687-1011	1	R fxd comp 100 ohms 10% 1/2 W
R125	0757-0280	10	R fxd metflm 1 k ohm 1% 1/8 W
R126	0757 0760	3	R: fxd metflm 20 k ohms 1% 1/4 W
R127	0757-0416	1	R fxd metflm 511 ohms 1% 1/8 W
R128	0757-0441	2	R fxd metflm 8 25 k ohms 1% 1/8 W
R129	0757-0438		R: fxd metflm 5 11 k ohms 1% 1/8 W
R130	0757-0434	5	R: fxd metflm 3 65 k ohms 1% 1/8 W
R131	0757 0283	6	R: fxd metflm 2 k ohms 1% 1/8 W
R132	0757-0421	1	R fxd metflm 825 ohms 1% 1/8 W
R133	0761 0083	1	R fxd met oxflm 68 k ohms 5% 1 W
R136	0757-0760		R fxd metflm 20 k ohms 1% 1/4 W
R137	0757-0468	3	R: fxd metflm 130 k ohms 1% 1/8 W
R138	0757-0468		R: fxd metflm 130 k ohms 1% 1/8 W
R139	0683-0275	5	R: fxd comp 2 7 ohms 5% 1/4 W
R140	0757-0283		R fxd metflm 2 k ohms 1% 1/8 W

Table 6-2 Replaceable Parts (Cont'd)

Ref Desig	HP Part No	TQ	Description (See Table 6-1)
R141	0757-0407		R: fxd metflm 200 ohms 1% 1/8 W
R142	0757-0760		R: fxd metflm 20 k ohms 1% 1/4 W
R143	0698-5418	1	R: fxd metflm 50 ohms 0.1% 1/8 W
R144	0698-5419	1	R: fxd metflm 1.95 k ohms 0.1% 1/8 W
R145	0698-5421	1	R: fxd metflm 17.82 k ohms 0.1% 1/2 W
R149	0757-0451	2	R: fxd metflm 24.3 k ohms 1% 1/8 W
R150	0757-0438		R: fxd metflm 5.11 k ohms 1% 1/8 W
R151	0757-0436	3	R: fxd metflm 4.32 k ohms 1% 1/8 W
R152	0757-0451		R: fxd metflm 24.3 k ohms 1% 1/8 W
R153	0757-0438		R: fxd metflm 5.11 k ohms 1% 1/8 W
R154	0757-0436		R: fxd metflm 4.32 k ohms 1% 1/8 W
R155	0757-0431	2	R: fxd metflm 2.43 k ohms 1% 1/8 W
R156	0757-0283		R: fxd metflm 2 k ohms 1% 1/8 W
R157	0757-0438		R: fxd metflm 5.11 k ohms 1% 1/8 W
R158	0757-0431		R: fxd metflm 2.43 k ohms 1% 1/8 W
R159	0757-0283		R: fxd metflm 2 k ohms 1% 1/8 W
R160	0757-0438		R: fxd metflm 5.11 k ohms 1% 1/8 W
R161	0683-0275		R: fxd comp 2.7 ohms 5% 1/4 W
R162	0683-0275		R: fxd comp 2.7 ohms 5% 1/4 W
R201	0757-0465	7	R: fxd metflm 100 k ohms 1% 1/8 W
R202	0757-0344	1	R: fxd metflm 1 megohm 1% 1/4 W
R203	0757 0401		R: fxd metflm 100 ohms 1% 1/8 W
R204	0761-0076	1	R: fxd metflm 18 k ohms 5% 1 W
R205	0757-0282	1	R: fxd metflm 221 ohms 1% 1/8 W
R206	0757-0847	1	R: fxd metflm 27.4 k ohms 1% 1/2 W
R207	2100 1418	1	R: var comp 50 k ohms 20% 1/5 W
R208	0757-0440	2	R: fxd metflm 7.5 k ohms 1% 1/8 W
R209	0698-5420	1	R: fxd metflm 3874 ohms 0.1% 1/8 W
R210	0757-0463	2	R: fxd metflm 82.5 k ohms 1% 1/8 W
R211	2100 2089		R: var comp 50 k ohms 30% 1/2 W (special slot)
R215	0757 0441		R: fxd metflm 8.25 k ohms 1% 1/8 W
R216	0757-0792	1	R: fxd metflm 681 k ohms 1% 1/4 W
R217	0757 0401		R: fxd metflm 100 ohms 1% 1/8 W
R218	2100 2076	1	R: var car comp dual 100 k ohms 20% (includes R221)
R219	0757 0460	4	R: fxd metflm 61.9 k ohms 1% 1/8 W
R220	0757-0401		R: fxd metflm 100 ohms 1% 1/8 W
R221			NSR: p/o R218
R222	0757-0283		R: fxd metflm 2 k ohms 1% 1/8 W
R223	0757-0764	3	R: fxd metflm 33.2 k ohms 1% 1/4 W
R225	0757 0741	2	R: fxd metflm 2.43 k ohms 1% 1/4 W
R226	0757-0401		R: fxd metflm 100 ohms 1% 1/8 W

Table 6-2 Replaceable Parts (Cont'd)

Ref Desig	HP Part No	TQ	Description (See Table 6-1)
R229	0757-0281		R: fxd metflm 2.74 k ohms 1% 1/8 W
R230	0757-0443	2	R: fxd metflm 11 k ohms 1% 1/8 W
R231	0757-0434		R: fxd metflm 3 65 k ohms 1% 1/8 W
R232	0757-0736	2	R fxd metflm 1.5 k ohms 1% 1/4 W
R234	0757-0846	2	R: fxd metflm 22.1 k ohms 1% 1/2 W
R235	0757-0413	2	R. fxd metflm 392 ohms 1% 1/8 W
R237	0757-0407		R: fxd metflm 200 ohms 1% 1/8 W
R238	0757-0841	2	R: fxd metflm 12.1 k ohms 1% 1/2 W
R239	0757-0448		R: fxd metflm 18.2 k ohms 1% 1/8 W
R244	0683-0275		R fxd comp 2 7 ohms 5% 1/4 W
R245	0757-0388	5	R: fxd metflm 30.1 ohms 1% 1/8 W
R246	2100-1770	1	R: var ww 100 ohms 10% 1/2 W
R247	0757-0284	1	R: fxd metflm 150 ohms 1% 1/8 W
R248	2100-1771	1	R var ww 200 ohms 10% 1/2 W
R249	0757-0411	1	R: fxd metflm 332 ohms 1% 1/8 W
R250	2100-1773	2	R var ww 1 k ohm 10% 1/2 W
R251	0757 0428	1	R: fxd metflm 1.62 k ohms 1% 1/8 W
R252	0698-3416	2	R: fxd metflm 21.5 k ohms 1% 1/2 W
R253	2100-0741	1	R: var ww 5 k ohms 5% 1 W
R254	0698-3416		R: fxd metflm 21.5 k ohms 1% 1/2 W
R257	0757-0468		R: fxd metflm 130 k ohms 1% 1/8 W
R258	0757-0440		R: fxd metflm 7 5 k ohms 1% 1/8 W
R259	0757-0427	1	R fxd metflm 1.5 k ohms 1% 1/8 W
R261	0757-0741		R: fxd metflm 2.43 k ohms 1% 1/4 W
R262	0757-0281		R. fxd metflm 2 74 k ohms 1% 1/8 W
R263	0757 0200	1	R: fxd metflm 5 62 k ohms 1% 1/8 W
R264	0757-0443		R: fxd metflm 11 k ohms 1% 1/8 W
R268	0757 0434		R: fxd metflm 3 65 k ohms 1% 1/8 W
R269	0757-0736		R: fxd metflm 1.5 k ohms 1% 1/4 W
R270	0757-0413		R: fxd metflm 392 ohms 1% 1/8 W
R271	0757-0846		R. fxd metflm 22 1 k ohms 1% 1/2 W
R273	0757-0407		R: fxd metflm 200 ohms 1% 1/8 W
R275	0757-0841		R: fxd metflm 12.1 k ohms 1% 1/2 W
R301	0683-0275		R. fxd comp 2 7 ohms 5% 1/4 W
R302	2100-0944	1	R var metflm 200 k ohms 20% 3/4 W
R303	0698-4984	1	R: fxd metflm 953 k ohms 1% 1/2 W
R304	0757-0442	2	R: fxd metflm 10 k ohms 1% 1/8 W
R305	0698-7182	1	R: fxd metflm 30 megohms 1% 2 W
R310	0757-0280		R: fxd metflm 1 k ohm 1% 1/8 W
R313	0757-0442		R: fxd metflm 10 k ohms 1% 1/8 W

Table 6-2 Replaceable Parts (Cont'd)

Ref Desig	HP Part No	TQ	Description (See Table 6-1)
R314	0757-0438		R: fxd metflm 10 k ohms 1% 1/8 W
R315	0698-3553	1	R: fxd car flm 2.49 megohms 1% 1/2 W
R316	0757-0283		R: fxd metflm 2 k ohms 1% 1/8 W
R317	0757-0280		R: fxd metflm 1 k ohm 1% 1/8 W
R318	0757-0465		R: fxd metflm 100 k ohms 1% 1/8 W
R319	0757-0401		R: fxd metflm 100 ohms 1% 1/8 W
R320	0757-0814	1	R: fxd metflm 511 ohms 1% 1/2 W
R321	0757 0465		R: fxd metflm 100 k ohms 1% 1/8 W
R325	0683-2235	1	R: fxd comp 22 k ohms 5% 1/4 W
R326	2100-0918	1	R: var comp 1 megohm 20% lin 1/5 W
R327	0836-0003	1	R: fxd depc 29 megohms 10% 1 W
R328	0683-1055	1	R: fxd comp 1 megohm 5% 1/4 W
R330	0757-0456	3	R: fxd metflm 43.2 k ohms 1% 1/8 W
R331	0757-0460		R: fxd metflm 61.9 k ohms 1% 1/8 W
R332	0757 0456		R: fxd metflm 43.2 k ohms 1% 1/8 W
R333	0757-0460		R: fxd metflm 61.9 k ohms 1% 1/8 W
R334	2100-1903	1	R: var ww 5 k ohms 10% 2 W
R335	0757-0280		R: fxd metflm 1 k ohm 1% 1/8 W
R336	2100-2030	1	R: var cer metflm 20 k ohms 30% 1/2 W
R337	0757-0280		R: fxd metflm 1 k ohm 1% 1/8 W
R341	0683-5125	1	R: fxd comp 5.1 k ohms 5% 1/4 W
R342			NSR: p/o A8
R343	0698-5677	1	R: fxd comp 8.25 megohms 5% 1 W
R344	2100 1906	1	R: var comp 5 megohms 10% 1/2 W
R345	0698-5678	1	R: fxd comp 16.25 megohms 5% 1 W
R346	0683-1045	1	R: fxd comp 100 k ohms 5% 1/4 W
R347	2100-1905	1	R: var comp 50 k ohms 20% 1/2 W
R348	2100-2031	1	R: var cer metflm 50 k ohms 30% 1/2 W
R349	0757 0454	1	R. fxd metflm 33.2 k ohms 1% 1/8 W
R350	2100-1901	1	R: var ww 100 ohms 10% 2 W
R351	0757-0280		R: fxd metflm 1 k ohm 1% 1/8 W
R352	0757 0280		R: fxd metflm 1 k ohm 1% 1/8 W
R353	0757 0460		R: fxd metflm 31.9 k ohms 1% 1/8 W
R354	0757-0456		R: fxd metflm 43.2 k ohms 1% 1/8 W
R401	0757-0280		R: fxd metflm 1 k ohm 1% 1/8 W
R402	0811-1788	1	R: fxd ww 15 ohms 5% 2 W
R403	0757-0465		R: fxd metflm 100 k ohms 1% 1/8 W
R404	0757-0280		R: fxd metflm 1 k ohm 1% 1/8 W
R405	0757-0399	2	R: fxd metflm 82.5 ohms 1% 1/8 W
R406	0757-0848	3	R: fxd metflm 30.1 k ohms 1% 1/2 W

Table 6-2 Replaceable Parts (Cont'd)

Ref Desig	HP Part No	TQ	Description (See Table 6-1)
R407	0757-0200	3	R: fxd metflm 5.62 k ohms 1% 1/8 W
R408	0757-0438		R fxd metflm 5 11 k ohms 1% 1/8 W
R409	0757-0764		R fxd metflm 33 2 k ohms 1% 1/4 W
R410	0757-0388		R: fxd metflm 30 1 ohms 1% 1/8 W
R411	0757-0200		R: fxd metflm 5.62 k ohms 1% 1/8 W
R412	2100-1774	1	R: var ww 2 k ohms 10% 1/2 W
R413	0757-0855	1	R fxd metflm 68.1 k ohms 1% 1/2 W
R417	0757-0388		R. fxd metflm 30.1 ohms 1% 1/8 W
R418	0757-0044	1	R: fxd metflm 33.2 k ohms 1% 1/2 W
R419	0811-1746	2	R fxd ww 0.36 ohms 5% 2 W
R420	0757-0463		R: fxd metflm 82 5 k ohms 1% 1/8 W
R421	0757-0480	1	R: fxd metflm 432 k ohms 1% 1/8 W
R422	0757-0434		R: fxd metflm 3.65 k ohms 1% 1/8 W
R423	2100-1772	2	R: var ww 500 ohms 10% 1/2 W
R424	0757-0060	2	R: fxd metflm 24 3 k ohms 1% 1/2 W
R428	0757-0388		R: fxd metflm 30 1 ohms 1% 1/8 W
R429	0757-0848		R: fxd metflm 30 1 k ohms 1% 1/2 W
R430	0811-1746		R: fxd ww 0.36 ohms 5% 2 W
R431	0757-0465		R: fxd metflm 100 k ohms 1% 1/8 W
R432	0757 0477	1	R: fxd metflm 332 k ohms 1% 1/8 W
R433	0757-0434		R: fxd metflm 3.65 k ohms 1% 1/8 W
R434	2100-1772		R: var ww 500 ohms 10% 1/2 W
R435	0757-0060		R: fxd metflm 24.3 k ohms 1% 1/2 W
R439	0811-1678	1	R: fxd ww 10 ohms 5% 2 W
R440	0757-0465		R: fxd metflm 100 k ohms 1% 1/8 W
R441	0757-0280		R: fxd metflm 1 k ohm 1% 1/8 W
R442	0757-0399		R: fxd metflm 82 5 ohms 1% 1/8 W
R443	0757-0848		R: fxd metflm 30.1 k ohms 1% 1/2 W
R444	0757-0200		R: fxd metflm 5.62 k ohms 1% 1/8 W
R445	0757-0465		R: fxd metflm 100 k ohms 1% 1/8 W
R446	0757-0764		R: fxd metflm 33.2 k ohms 1% 1/4 W
R447	0757-0388		R: fxd metflm 30.1 ohms 1% 1/8 W
R448	0757-0436		R: fxd metflm 4.32 k ohms 1% 1/8 W
R449	2100-1773		R: var ww 1 k ohm 10% 1/2 W
R450	0698-3416	1	R: fxd metflm 21.5 k ohms 1% 1/2 W
S101	3100-1344	1	S: rotary two-position (includes R211)
S102	3101-0977	1	S: pushbutton dpdt mom 30 Vac 250 mA
S201	3101-0070	1	S: slide dpdt minat 125 Vac-Vdc 0.5 A
S202	3101-0982	1	S: slide spdt minat 125 Vac-Vdc 0.5 A pc mount
S203	3100-1345	1	S: rotary three-position one-section

Table 6-2 Replaceable Parts (Cont'd)

Ref Desig	HP Part No	TQ	Description (See Table 6-1)
S401	3101-0965	1	S: pushbutton spdt w/grn lite 125 Vac 5A (includes XDS401)
S402	3101-0109	1	S: slide dpdt slotted 125 V ac-dc 0.5 A
T301	00180-60801	1	T: high voltage
T401	9100-1129	1	T: power (standard)
T401	9100-1109	1	T: power (for Options 003 and 004)
TP301	1251-0206	5	TP: female
TP401	1251-0206		TP: female
TP402	1251-0206		TP: female
TP403	1251-0206		TP: female
TP404	1251-0206		TP: female
V301	2140-0018	2	V: neon glow A9A C (NE-2E1)
V302	2140-0018		V: neon glow A9A-C (NE-2E1)
V303	5083-0952	1	V: CRT internal graticule P31 phosphor
V401	1940-0013	2	V: voltage reference 82.0 V ±1.0 V
V402	1940-0013		V: voltage reference 82.0 V ±1.0 V
VR301	1902 0045	1	VR: avalanche 7.32 V 2%
VR302	1902-0025	1	VR: avalanche 10.0 V 5%
VR401	1902-3096	1	VR: avalanche 5.23 V 5%
VR402	1902 3354	2	VR: avalanche 54.9 V 5%
VR403	1902-3354		VR: avalanche 54.9 V 5%
W1	00180-61616	1	W: assy coax J1 to S101 (180A)
W1	00180-61607	1	W: assy coax J1 to S101 (180AR)
W2	00180 61625	1	W: assy vert deflection (180A)
W2	00180-61626	1	W: assy vert deflection (180AR)
W3	00180-61635	1	W: assy T401 primary
W4	00180-61650	1	W: assy sweep gate output
W5	00180-61651	1	W: assy horiz delfection (180A)
W5	00180-61656	1	W: assy horiz deflection (180AR)
W6	00180-61653	1	W: assy low voltage supply
W7	00180-61654	1	W: assy main harness (180A)
W7	00180-61655	1	W: assy main harness (180AR)
W8	00180-61657	1	W: assy horiz magnifier
W9	00180-61658	1	W: assy T401
W10	00180-61609	1	W: assy coax S101 to S201 (p/o W7)
W11	00180-61646	1	W: assy coax J1 to R158 (p/o W4)
W12	00180-61647	1	W: assy coax J1 to R155 (p/o W4)
W13	00180-61648	1	W: assy coax J1 to R152 (p/o W4)
W14	00180-61649	1	W: assy coax J1 to R149 (p/o W4)
W15	00180-61639	1	W: assy R101 to R103 (p/o W7)
W16	00180-61631	1	W: shielded power (p/o W7) (180A)

Table 6-2 Replaceable Parts (Cont'd)

Ref Desig	HP Part No	TQ	Description (See Table 6-1.)
W16	00180-61632	1	W: shielded power (p/o W7) (180AR)
W17	00180-61642	1	W: coax R132 to J1 (p/o W7) (180A)
W17	00180-61638	1	W: coax R132 to J1 (p/o W7) (180AR)
W18	00180-61643	1	W: coax J1 to Q101 (p/o W7) (180A)
W18	00180-61641	1	W: coax J1 to Q101 (p/o W7) (180AR)
W19	00180-61644	1	W: coax J1 to R102 (p/o W7) (180A)
W19	00180-61640	1	W: coax J1 to R102 (p/o W7) (180AR)
W20	00180-61645	1	W: shielded calibrator (p/o W7)
W101	00180-61652	1	W: assy coax display switch
W401	8120-0964	1	W: assy power 7.5 ft (180A)
W401	8120-0078	1	W: assy power 7.5 ft (180AR)
XF301	1400-0008	1	XF: block single
XF401	1400-0084	2	XF: cartridge single extractor-post type
XF402	1400-0084		XF: cartridge single extractor-post type
XF403	1400-0123	2	XF: block three-fuse
XF404	1400-0123		XF: block three-fuse
XQ304	1200-0041	5	XQ: insulated two-pin
XQ401	1200-0041		XQ: insulated two-pin
XQ402	1200-0041		XQ: insulated two-pin
XQ403	1200-0041		XQ: insulated two-pin
XQ404	1200-0041		XQ: insulated two-pin
XV303	- - -		Consists of:
	1200-0037	1	Socket: CRT
	1200-0050	7	Pin: CRT socket
	1200-0408	1	Cover: CRT socket

SECTION VII

MANUAL CHANGES AND OPTIONS

7-1. MANUAL CHANGES.

7-2. This manual applies directly to the Model 180A/AR Oscilloscope (as manufactured) with serials prefixed 822–. The following paragraphs explain how to adapt this manual to apply to later instruments (higher serial prefix), or earlier instruments (lower serial prefix). Technical corrections to this manual (if any) are called Errata and are listed on the separate MANUAL CHANGES sheet supplied with this manual.

7-3. LATER INSTRUMENTS. If the serial prefix of your Model 180A/AR is above 822–, refer to the separate MANUAL CHANGES sheet supplied with this manual. Locate the serial prefix of your instrument and make the indicated changes.

7-4. EARLIER INSTRUMENTS. If the serial prefix of your Model 180A/AR is below 822–, refer to Table 7-1 for the changes necessary to adapt this manual to your particular instrument. Locate the serial prefix of your instrument in the table and make the indicated changes.

Table 7-1. Manual Changes

Instrument Serial Prefix	Make Changes
611–	13 thru 1
636–	13 thru 2
638–	13 thru 3
639–	13 thru 4
646–	13 thru 5
647–	13 thru 6
709–	13 thru 7
721-02370 & below	13 thru 8
721-02371 & above	13 thru 9
747–	13 thru 10
750–	13 thru 11
752–	13 and 12
816–	13

7-5. OPTIONS.

7-6. Options are standard modifications performed on HP instruments at the factory. Two options for the Model 180A/AR are offered at the present time. Option 003 provides for operation with 100/200 V input power, and Option 004 provides for a 110/220 V input. For both Options 003 and 004, the standard power transformer (T401) is replaced with a special transformer (see Table 6-2, T401) which is wired at the factory for the specific input voltage.

7-7. SPECIAL INSTRUMENTS.

7-8. "Specials" are standard HP instruments that are modified at the factory according to customer specifications. A separate insert sheet is included with the manual for special instruments having electrical changes. Make the changes specified in addition to any other changes that are necessary per the MANUAL CHANGES sheet.

CHANGE 1

Table 6-2,
MP143: Change to HP Part No. 00180-00203.
MP116: Change to HP Part No. 00180-44102.
W6: Change to HP Part No. 00180-61601.
W9: Change to HP Part No. 00180-61604.
W3: Delete.
W7: Change to HP Part No. 00180-61602 (180A).
W7: Change to HP Part No. 00180-61603 (180AR).
Page 8-11, Figure 8-6, Schematic,
T401 (pin 14): Delete connection to J1 pin 31.
Page 8-12, Figure 8-7,
J1 (pin 31): Delete lead connecting to T401 pin 14.

CHANGE 2

Table 6-2,
C101: Delete.
L101: Delete.
Page 8-5, Figure 8-3, Schematic,
C101: Delete.
L101: Delete; connect J1 pin 3 to S101 INT.

CHANGE 3

Table 6-2,
R343: Change to HP Part No. 0698-5476; R: fxd car flm 7.5 megohms 5% 1 W.
R345: Change to HP Part No. 0698-5477; R: fxd car flm 17.5 megohms 5% 1 W.
H17: Delete.
Page 8-9, Figure 8-5, Schematic,
R343: Change value to 7.5 megohms.
R345: Change value to 17.5 megohms.

CHANGE 4

Page 5-3, Paragraph 5-29c, Step 4,
Delete the Note concerning R251.
Table 6-2,
L200: Delete.
Add: R224, R260; HP Part No. 0757-0448; R: fxd metflm 18.2 k ohms 1% 1/8 W.
Add: R233, R274; HP Part No. 0757-0847; R: fxd metflm 27.4 k ohms 1% 1/2 W.
R234, R271: Change to HP Part No. 0757-0847; R: fxd metflm 27.4 k ohms 1% 1/2 W.
Add: R236, R272; HP Part No. 0757-0280; R: fxd metflm 1 k ohm 1% 1/8 W.
R237, R273: Change to HP Part No. 0757-0401; R: fxd metflm 100 ohms 1% 1/8 W.
Add: R243; HP Part No. 0757-0388; R: fxd metflm 30.1 ohms 1% 1/8 W.
R247: Change to HP Part No. 0698-4416; R: fxd metflm 169 ohms 1% 1/8 W.
R249: Change to HP Part No. 0757-0412; R: fxd metflm 365 ohms 1% 1/8 W.
R251: Change to HP Part No. 0757-0429; R: fxd metflm 1.82 k ohms 1% 1/8 W.
Page 8-7, Figure 8-4, Schematic,
L200: Delete and replace with R243, 30.1 ohms.
Add: R224, R260; 18.2 k ohms, connect between base and collector of Q206 and Q207, respectively.
Add: R233, R274; 27.4 ohms, connect between base and collector of Q209 and Q212, respectively.
R234, R271: Change value to 27.4 k ohms.
Add: R236, 1000 ohms, connect between junctions of R234/CR205 and C211/Q210 base.
R237, R273: Change value to 100 ohms.
R247: Change value to 169 ohms.
R249: Change value to 365 ohms.
R251: Change value to 1820 ohms.
Add: R272, 1000 ohms, connect between junctions of CR209/R271 and C230/Q213 base.

CHANGE 5

Table 6-2,
C204: Change to HP Part No 0140-0225; C: fxd mica 300 pF 1% 300 wVdc.
Page 8-7, Figure 8-4, Schematic,
C204: Change value to 300 pF.
CR203: Invert; connect cathode to ground and anode to Q206 collector.

CHANGE 6

Table 6-2,
Add: S103; HP Part No. 3101-0976; S: pushbutton, DPST.
Page 8-5, Figure 8-3, Schematic,
Add: S103; S: pushbutton; connect as shown in Figure 7-1.

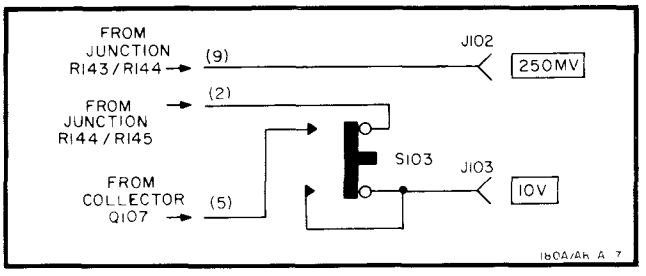


Figure 7-1. Calibrator Switch

CHANGE 7

Table 6-2,
MP158: Change TQ to 2.
MP159: Delete.

CHANGE 8

Table 6-2,
A1: Change to HP Part No. 00180-66503; A: gate amplifier and h. v. regulator.
A2: Change to HP Part No. 00180-66508; A: output amplifier.
A3: Change to HP Part No. 00180-66502; A: horizontal amplifier.
A4: Change to HP Part No. 00180-66507; A: high voltage oscillator.
A5: Change to HP Part No. 00180-66501; A: high voltage rectifier.
A6: Change to HP Part No. 00180-66506; A: low voltage rectifier.
A7: Change to HP Part No. 00180-66505; A: low voltage supply.
W4: Change to HP Part No. 00180-61624.
W5: Change to HP Part No. 00180-61626 (180A).
W5: Change to HP Part No. 00180-61633 (180AR).
W6: Change to HP Part No. 00180-61628.
W7: Change to HP Part No. 00180-61629(180A).
W7: Change to HP Part No. 00180-61630 (180AR).
W8: Change to HP Part No. 00180-61634.
W9: Change to HP Part No. 00180-61636.

CHANGE 9

Table 6-2,
C302, C311, C316: Change to HP Part No. 0160-2486; C: fxd cer .0045 uF 3500 wVdc.
C310, C317: Change to HP Part No. 0160-0907; C: fxd cer .01 uF 5000 wVdc.
C312, C314: Delete.
R305: Change to HP Part No. 0698-3588; R: fxd metflm 6 megohms 1% 1/2 W.
Add: R306, R307, R308, R309; HP Part No. 0698-3588, R: fxd metflm 6 megohms 1% 1/2 W.
Page 8-9, Figure 8-5, Schematic,
C302: Change value to 4500 pF.
C310, C311, C316, C317: Change value to .01 uF.

CHANGE 9 (Cont'd)

C312, C314: Delete.
R305: Change value to 5 megohms.
Add: R306, R307, R308, R309; 5 megohms, connect in series with R305.

CHANGE 10

Table 6-2,
C413: Change to HP Part No. 0170-0024, C: fxd my .022 uF 20% 200 wVdc.
CR405, CR406, CR407, CR419, CR420, CR432, CR433, CR434: Delete.
Add: CR418, CR431; HP Part No. 1901-0040, CR: Si.
F403: Change to HP Part No. 2110-0067, F: 0.3 A.
R417: Change to HP Part No. 0757-0407; R: fxd metflm 200 ohms 1% 1/8 W.
Page 8-11, Figure 8-6, Schematic,
C413: Change value to .022 uF.
CR405, CR406, CR407, CR419, CR420, CR432, CR433, CR434: Delete.
Add: CR418, connect cathode to base of Q403, anode to emitter junction of Q403 and Q404.
Add: CR431, connect cathode to base of Q415, anode to emitter junction of Q415 and Q416.
F403: Change value to 0.3 A.
R417: Change value to 200 ohms.

CHANGE 11

Table 6-2,
CR401-CR404, CR413-CR416, CR421-CR424: Change to HP Part No. 1901-0049.
R402: Change to HP Part No. 0811-1678, R: fxd ww 10 ohms 5% 2 W.
Page 8-11, Figure 8-6, Schematic,
R402: Change value to 10 ohms.

CHANGE 12

Table 6-2,
CR301: Change to HP Part No. 1901-0040.
CR303: Delete.
Page 8-9, Figure 8-5. Schematic,
CR303: Delete.

CHANGE 13

Table 6-2,
A1: Change to HP Part No. 00180-66518.
F401: Change to HP Part No. 2110-0021; F: 1.25 A slow-blow.
F402: Change to HP Part No. 2110-0020; F: 0.6 A slow-blow.
MP152: Change to HP Part No. 00180-00206.
Q104: Change to HP Part No. 1854-0056; Q: Si npn 2N3119.
R122: Delete.
R302: Change to HP Part No. 2100-0943; R: var metflm 100 k ohms 20% 3/4 W.
R303: Change to HP Part No. 0727-0263; R: fxd metflm 950 k ohms 1% 1/2 W.
R310: Delete
R341: Change to HP Part No. 0683-1535; R: fxd comp 15 k ohms 5% 1/4 W
Page 8-5, Figure 8-3, Schematic,
R122: Delete.
Page 8-9, Figure 8-5, Schematic,
R302: Change value to 100 k ohms.
R303: Change value to 950 k ohms.
R310: Delete.
R341: Change value to 15 k ohms.
Page 8-11, Figure 8-6, Schematic,
F401: Change value to 1.25 A.
F402: Change value to 0.6 A.

SECTION VIII

SCHEMATICS AND TROUBLESHOOTING

8-1. INTRODUCTION.

8-2. This section provides schematic diagrams, component identification, and troubleshooting and repair information for the Model 180A/AR.

8-3. SCHEMATIC DIAGRAMS.

8-4. Schematic diagrams appear on right-hand pages that unfold outside the right edge of the manual. These "throw-clear" pages allow viewing the schematics while referring to other sections.

8-5. Schematics are drawn primarily to show electronic function. A given schematic may include all or part of several assemblies. Information about symbols and conventions used in the schematics is provided by Table 8-1. Schematics also provide dc voltages and waveform test points. DC voltage measurement conditions, waveform measurement conditions, and waveforms applicable to each schematic are shown next to that schematic.

8-6. COMPONENT IDENTIFICATION.

8-7. Whenever possible, components appearing on a schematic are identified on the page opposite that schematic. When components on a given assembly appear on more than one schematic, all components on that assembly are identified opposite the first schematic showing that assembly. Adjustments, assemblies, and chassis mounted electrical components are identified in Figure 8-1. Mechanical components are identified in Figure 6-1.

8-8. TROUBLESHOOTING.

8-9. The first and most important prerequisite for successful troubleshooting is a through understanding of instrument operation and function. Often, suspected malfunctions are caused by improper control settings such as: intensity set too low, display selector or mode switch in wrong position, trigger level maladjusted, etc. Read Section III, Operation, and Section IV, Principles of Operation, for this information.

8-10. DC voltages for most active components (transistors, FET's, etc) are indicated on the schematics. Waveform test points (▽ with an enclosed number) are also placed on the schematic at various points along the main signal path. The numbers inside the test point symbols are keyed to the proper waveform adjacent to the schematic. These voltages and waveforms are invaluable for troubleshooting the instrument. Applications include: checking stage gain, locating unbalance in differential amplifiers, locating faulty transistors, etc. Always refer to the specific measurement conditions before using dc voltages or waveforms. Allow the level to stabilize before noting dc voltages. Small dots are etched on the circuit board assemblies next to the emitter lead of transistors, the source leads of FET's, the cathode end of diodes, and the positive end of electrolytic capacitors as an aid to locating test points.

CAUTION

When taking waveform or dc voltage measurements, use extreme care to avoid shorting supply voltages or components.

8-11. If a malfunction occurs, Figure 8-2 may help isolate the trouble to a particular circuit in the Model 180A/AR, or to a particular plug-in. Always begin troubleshooting with a visual inspection. Check for burned or loose components, loose wire connections, faulty switch contacts or any similar conditions suggesting a source of trouble.

8-12. REPAIR AND REPLACEMENT.

8-13. Almost all electrical components are accessible for replacement from the component side of the etched circuit boards. Section VI provides a detailed parts list to allow ordering replacement parts from either Hewlett-Packard or a typical manufacturer. If satisfactory operation or repair cannot be accomplished, contact the nearest Hewlett-Packard Sales/Service Office (addresses at rear of this manual). If shipment for repairs is required, see Section II for recommended packaging information.

8-14. HIGH-VOLTAGE SUPPLY REPAIR.

8-15. The following procedure should be used in replacing the high-voltage supply assembly (A8), the high voltage rectifier assembly (A5), or the high voltage transformer (T301):

a. Remove two screws and remove cover.

b. Remove rear instrument cover and unsolder five wires from small etched circuit board mounted to T301.

c. Remove four screws from corners of rectifier assembly, A5 Remove two screws from ends of T301.

d. Unsolder leads at cathode end of CR302 and CR307.

e. Unsolder lead at junction of C309 and R325.

f. Raise the rectifier assembly (including T301) from compartment in the HV supply assembly. T301 should be completely disconnected (small pc board is part of transformer).

WARNING

The post accelerator lead may hold a high-voltage charge. Use a screwdriver and carefully lift the insulator cap. Ground the screwdriver and the post accelerator lead as the lead is loosened and disconnected from the CRT.

8-16. CRT REMOVAL AND REPLACEMENT.

8-17. To remove the CRT, proceed as follows:

WARNING

To prevent possible injury, always wear a face mask or goggles, and gloves. Handle the CRT with extreme care.

a. Remove all four covers from the Model 180A or the top and bottom covers from the Model 180AR.

b. Remove the plug-ins. On the Model 180AR, remove the shield (two screws) next to the CRT post accelerator lead (shield is between CRT and plug-in compartment).

WARNING

The post accelerator lead may hold a high-voltage charge. Use a screwdriver and carefully lift the insulator cap. Ground the screwdriver and the post accelerator lead as the lead is loosened and disconnected from the CRT.

c. Remove post accelerator lead from CRT.

d. Remove the connections from the nine neck pins on the CRT (use long-nose pliers through access holes in CRT shield).

e. Squeeze plastic light shield at mid-point at top and bottom, and remove it.

f. Remove screws holding metal bezel on front panel.

g. Carefully pry the socket from the CRT base.

h. Loosen clamp at rear of CRT.

i. Place one hand on the CRT face and, with the other hand, slide the CRT forward and out of the instrument.

j. To replace the CRT, reverse the procedure.

k. After replacing the CRT, check the following adjustments: Intensity Limit, Paragraph 5-25; Flood Gun, Paragraph 5-26; Trace Alignment, Paragraph 5-27; and Horizontal Amplifier Gain, Paragraph 5-29, step c.

8-18. SERVICING ETCHED CIRCUIT BOARDS.

8-19. Etched circuit boards in this instrument have components mounted on one side of the board, conductive surfaces on both sides, and plated-through component mounting holes. Hewlett-Packard Service Note M-20E contains useful information on servicing etched circuit boards. Some important considerations are as follows:

a. Use a 37 to 47.5 watt chisel tip soldering iron with a tip diameter of 1/16 to 1/8 inch, and a small diameter rosin core solder.

b. Components may be removed by placing the soldering iron on the component leads on either side of the board and pulling the component straight away from the board. If heat is applied to the component side of the board, greater care is required to avoid damage to the components, especially semi-conductors. Heat damage may be minimized by gripping the lead with long nose pliers between the soldering iron and the component, thereby forming a heat sink.

c. If a component is obviously damaged or faulty, clip the leads close to the component and then unsolder the leads from the board.

d. Large components, such as potentiometers, may be removed by rotating the soldering iron from lead to lead and applying steady pressure to lift the part free. The alternative is to clip the leads of the damaged part and remove them individually.

e. Excessive heat or force will destroy the laminate bond between the metal plated surface (conductor) and the board. If this problem should occur, the lifted conductor may be cemented down with a small amount of quick-drying acetate-base cement having good insulating properties. Another method of repair is to solder a section of good conducting wire along the damaged area.

f. Before replacing a component, heat the remaining solder in the component hole and clean it out with a toothpick or "solder sucker". Sharp pointed metalic tools are not recommended since they may loosen eyelets in boards or remove plating from the inside of holes on plated-through etched circuit boards.

g. Tin and shape replacement component leads to fit existing holes.

h. Install the replacement component in the same position as the original.

Table 8-1. Schematic Diagram Notes

Refer to MIL-STD-15-1A for schematic symbols not listed in this table.

= Etched circuit board

= Front panel marking

= Rear panel marking

= Front panel control

= Screwdriver adjustment

P/O = Part of

CW = Clockwise end of variable resistor

N C = No connection

= Waveform test point (with number)

= Common electrical point (with letter) not necessarily ground

= Single pin connector on board

= Pin of a plug-in board (with letter or number)

= Main signal path

= Primary feedback path

= Secondary feedback path

* = Optimum value selected at factory, average value shown; part may have been omitted.

= Field effect transistor (N-channel)

= Breakdown diode

= Tunnel diode

= Step recovery diode

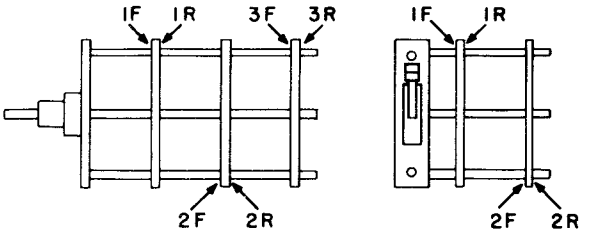
= Circuits or components drawn with dashed lines (phantom) show function only and are not intended to be complete. The circuit or component is shown in detail on another schematic.

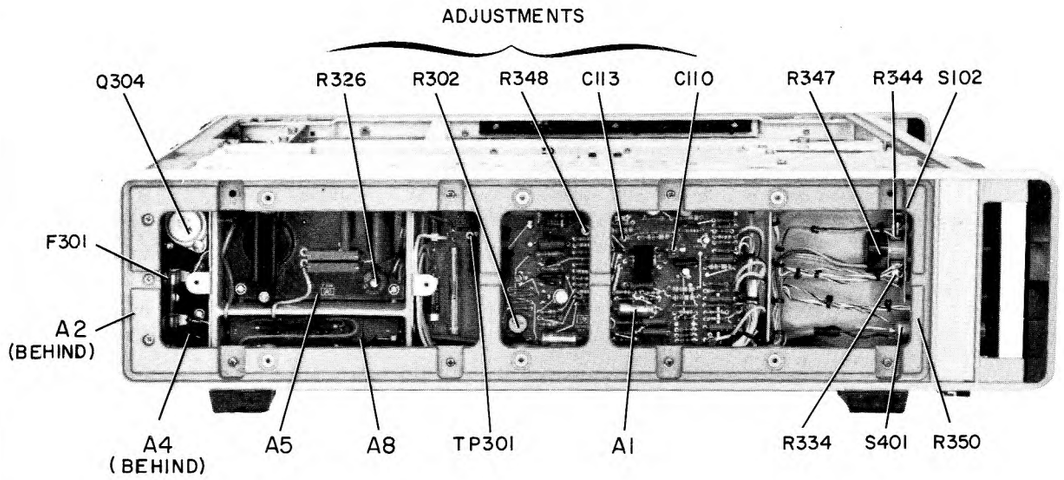
Unless otherwise indicated:
resistance in ohms
capacitance in picofarads
inductance in microhenries

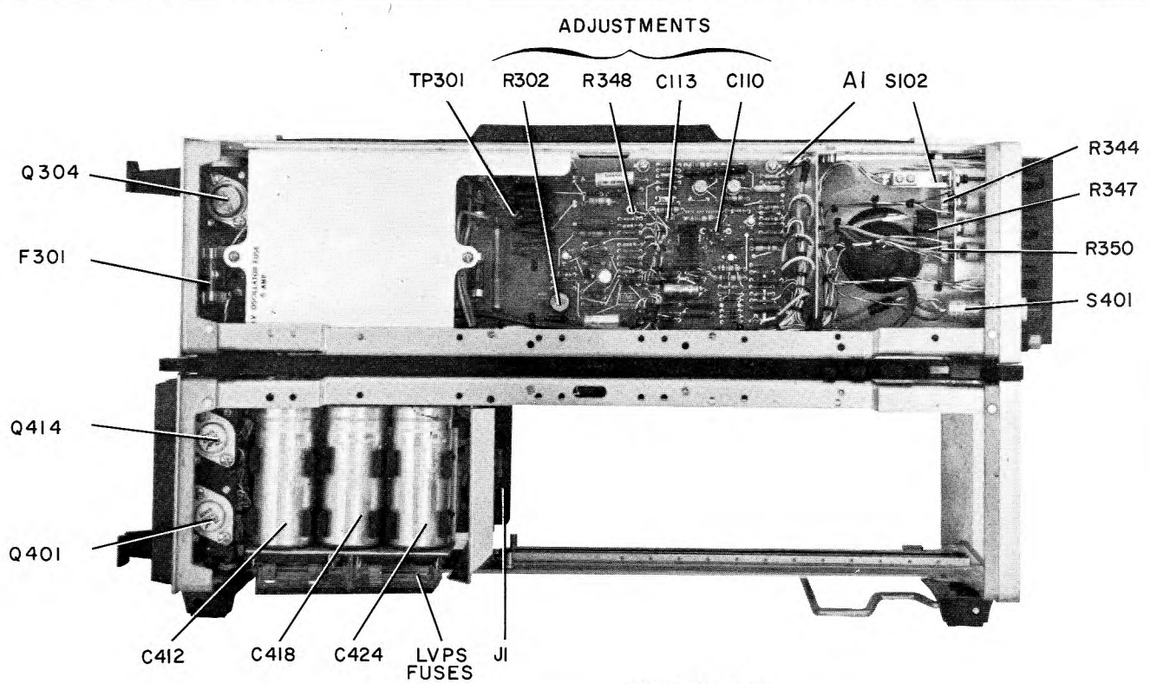
Wire colors are given by numbers in parentheses using the resistor color code [(925) is wht-red-grn].

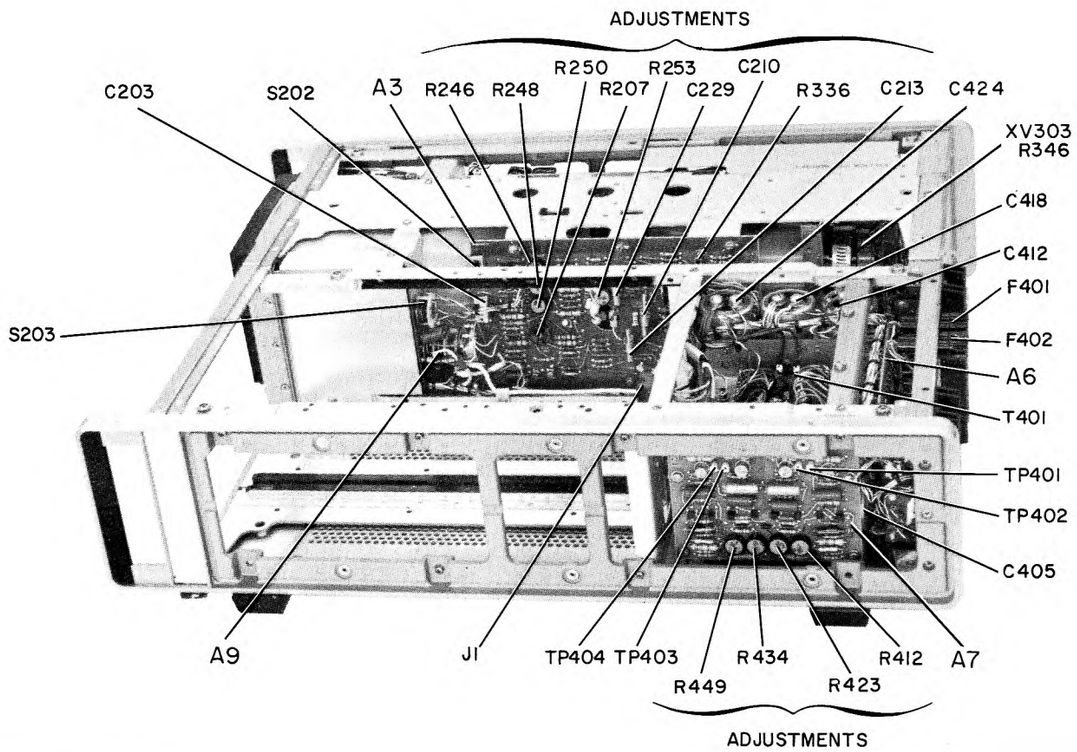
0 - Black	5 - Green
1 - Brown	6 - Blue
2 - Red	7 - Violet
3 - Orange	8 - Gray
4 - Yellow	9 - White

Switch wafers are identified as follows:









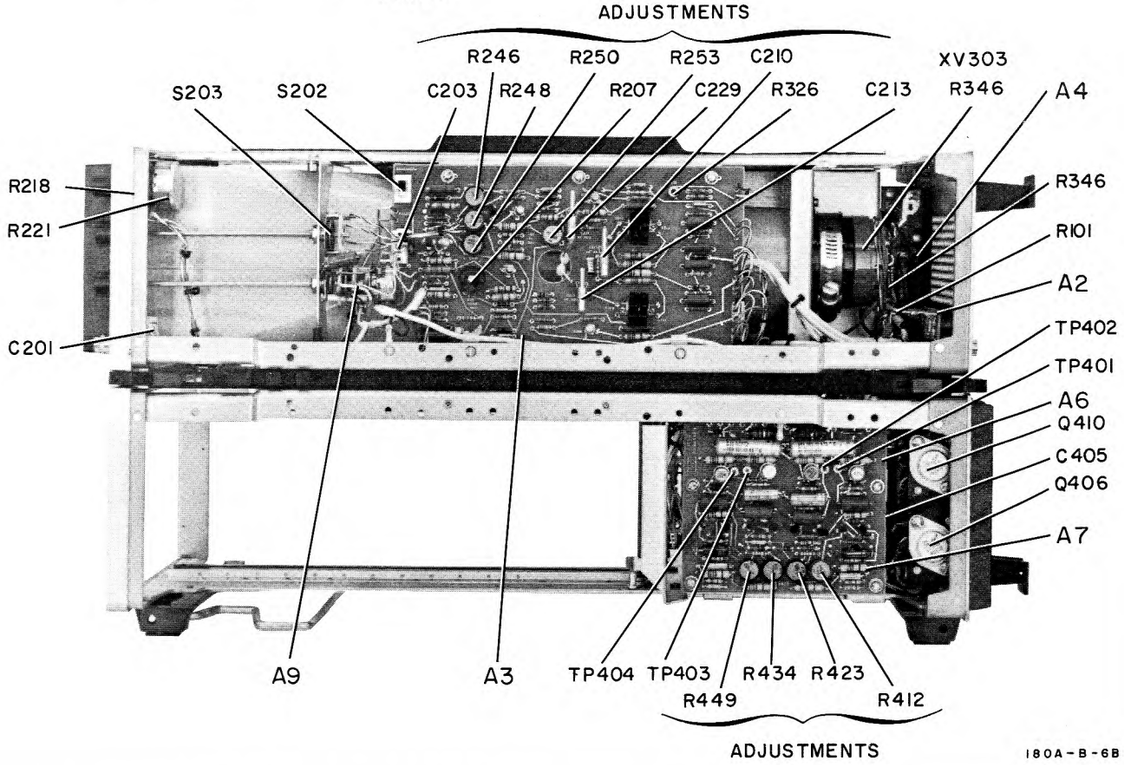
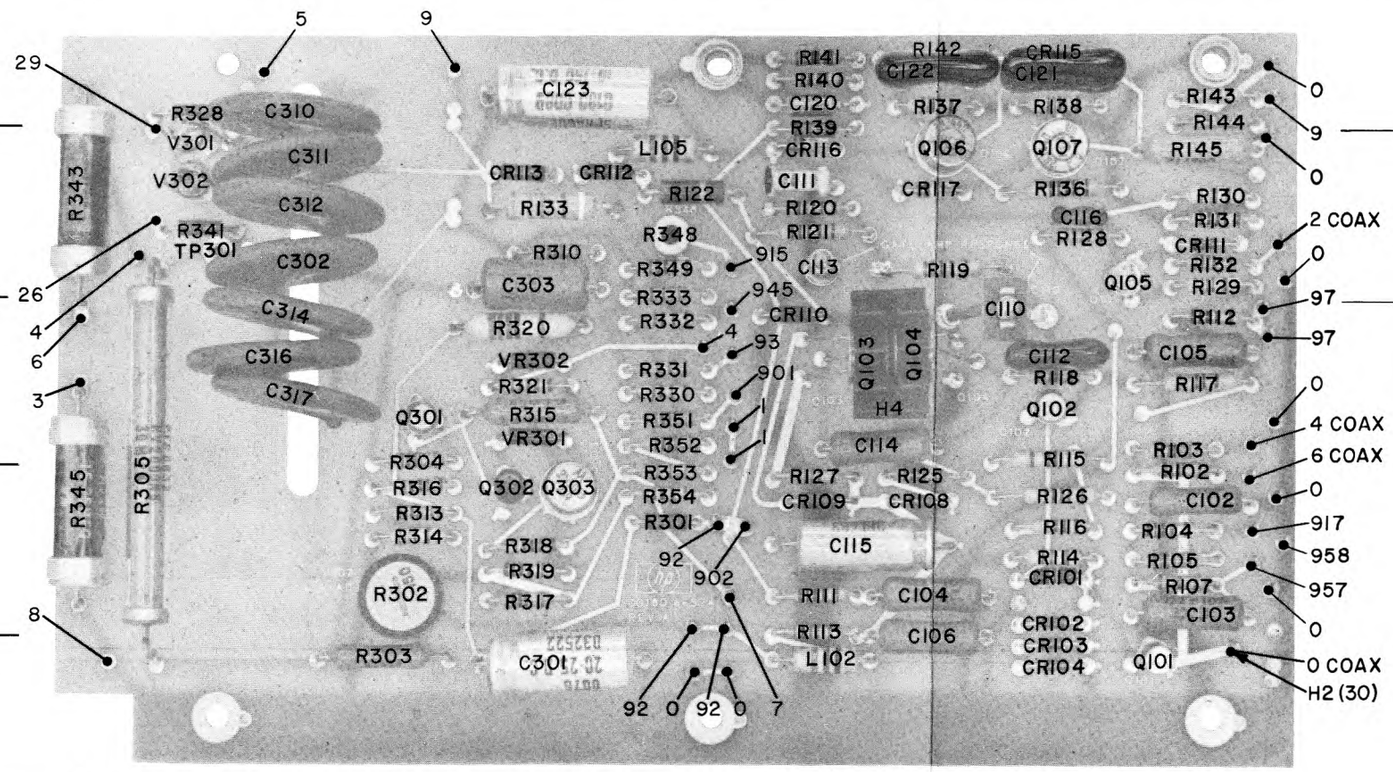


Figure 8-1. Component Identification



A1

REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C102	H-4	C121	G-1	CR101	G-4	CR117	F-2	Q302	D-4	R116	G-4	R130	H-2	R144	H-1	R317	D-4	R345	A-4
C103	H-4	C122	F-1	CR102	G-4	H4	F-3	Q303	D-4	R117	H-3	R131	H-2	R145	H-2	R318	D-4	R348	E-2
C104	F-4	C123	D-1	CR103	G-4	L102	F-5	R102	H-3	R118	G-3	R132	H-2	R301	E-4	R319	D-4	R349	E-2
C105	H-3	C301	D-5	CR104	G-5	L105	E-2	R103	H-3	R119	G-2	R133	D-2	R302	C-4	R320	D-3	R351	E-3
C106	F-4	C302	C-2	CR108	F-4	Q101	H-5	R104	H-4	R120	F-2	R136	G-2	R303	C-5	R321	D-3	R352	E-3
C110	G-2	C303	D-2	CR109	F-4	Q102	G-3	R105	H-4	R121	F-2	R137	F-1	R304	C-3	R328	B-1	R353	E-3
C111	F-2	C310	C-1	CR110	F-2	Q103	F-3	R107	H-4	R122	E-2	R138	G-1	R305	B-4	R330	E-3	R354	E-4
C112	G-3	C311	C-2	CR111	H-2	Q104	F-3	R111	F-4	R125	F-3	R139	F-1	R310	D-2	R331	E-3	TP301	B-2
C113	F-2	C312	C-2	CR112	D-2	Q105	H-2	R112	H-3	R126	G-4	R140	F-1	R313	C-4	R332	E-3	V301	B-1
C114	F-3	C314	C-2	CR113	D-2	Q106	F-2	R113	F-4	R127	F-3	R141	F-1	R314	C-4	R333	E-2	V302	B-2
C115	F-4	C316	C-3	CR115	G-1	Q107	G-2	R114	G-4	R128	G-2	R142	F-1	R315	D-3	R341	B-2	VR301	D-3
C116	G-2	C317	C-3	CR116	F-2	Q301	C-3	R115	G-3	R129	H-2	R143	H-1	R316	C-4	R343	A-2	VR302	D-3
C120	F-1																		

A2

REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C127	L-4	L108	J-4	R151	J-4	R157	L-4
C128	L-4	Q108	J-4	R152	K-4	R158	M-4
J105	J-4	Q109	K-4	R153	K-4	R159	M-4
J106	K-4	Q110	L-4	R154	K-4	R160	M-4
J107	L-4	Q111	M-4	R155	L-4	R161	K-4
J108	M-4	R149	J-4	R156	L-4	R162	J-4
L107	K-4	R150	J-4				

180A-B-IC

p/o Figure 8-3. Component Identification, A1 and A2

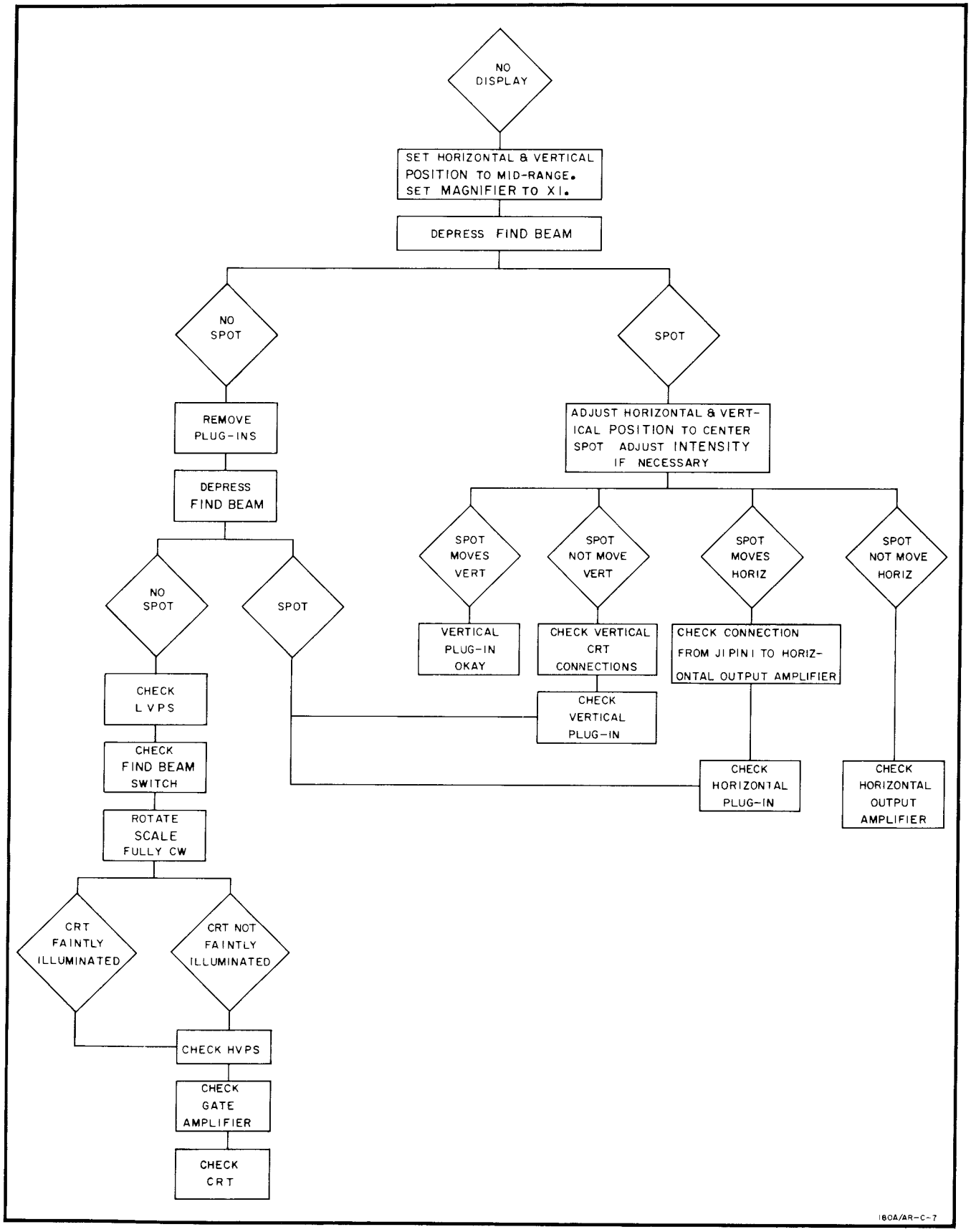
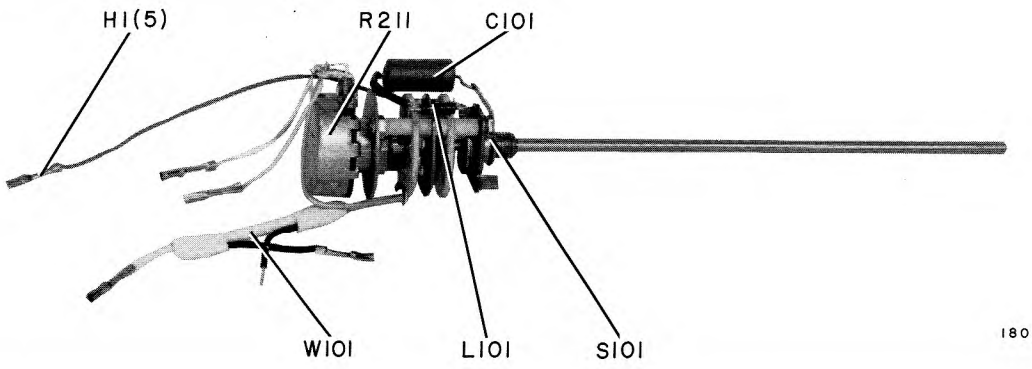


Figure 8-2. Over-all Troubleshooting Tree



p/o Figure 8-3. Component Identification, A9

DC VOLTAGE MEASUREMENT CONDITIONS

a. Set HORIZONTAL DISPLAY to EXT CAL.

b. Set Vertical Display to A.

c. Adjust INTENSITY for +57 Vdc on collectors of Q103 and Q104.

WAVEFORM MEASUREMENT CONDITIONS

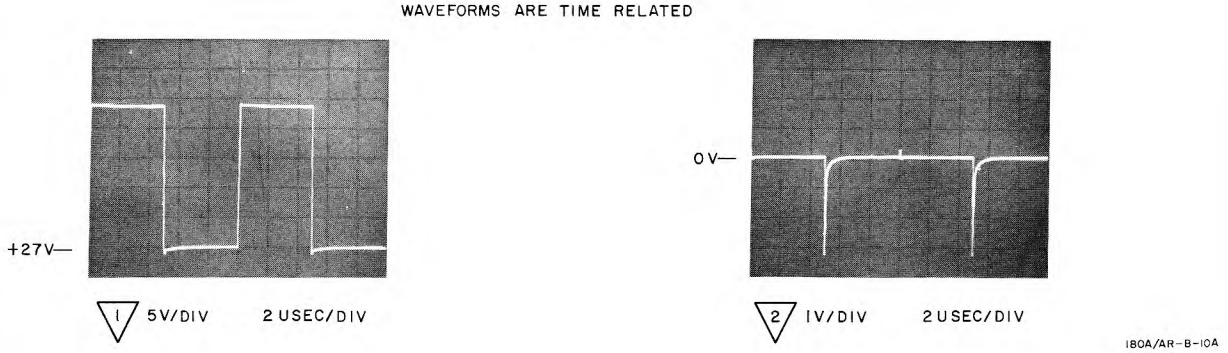
a. Set HORIZONTAL DISPLAY to EXT CAL.

b. Set Vertical Display to A.

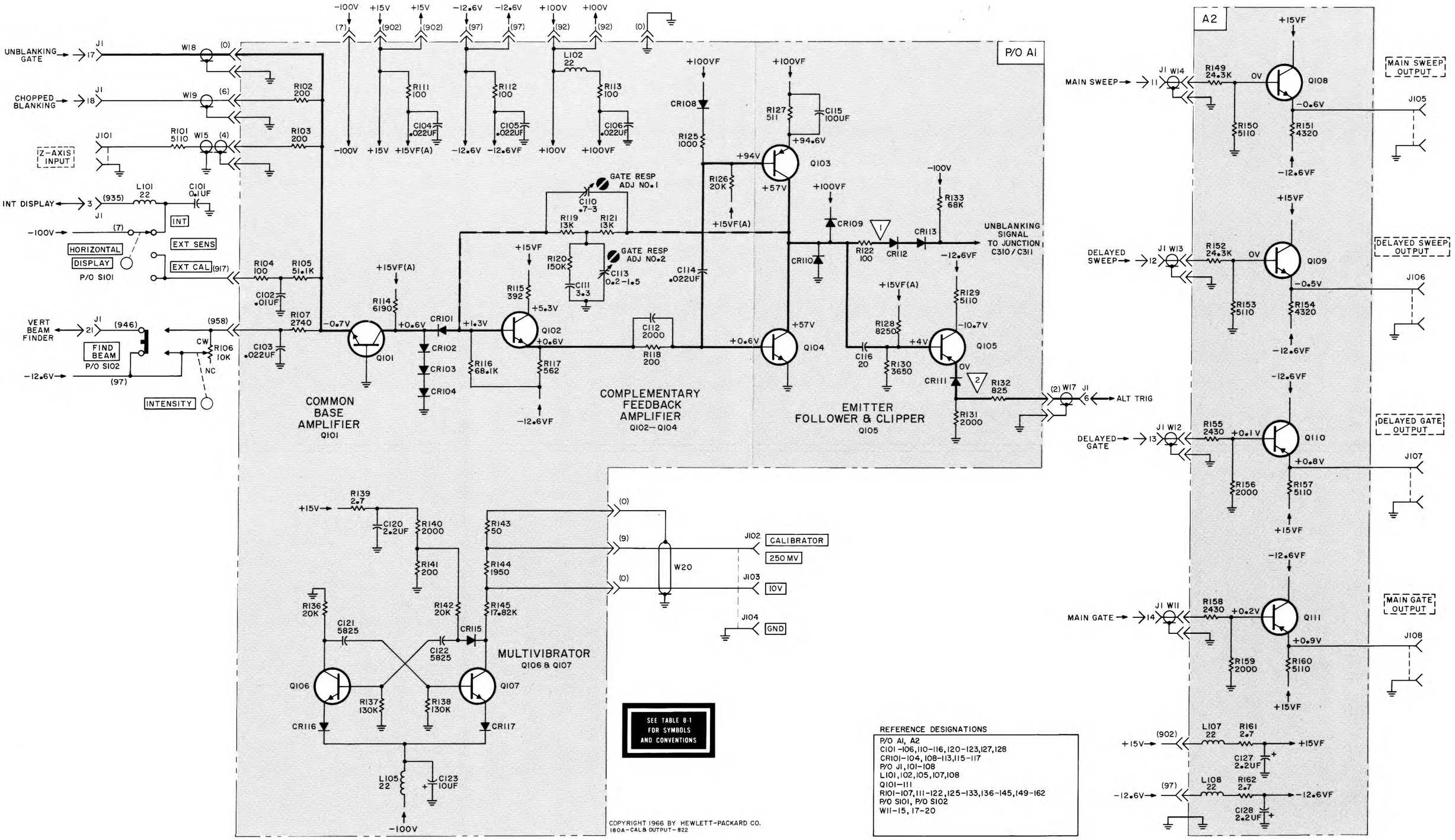
c. Rotate HORIZONTAL POSITION fully cw to move spot of screen.

d. Adjust INTENSITY for +30 Vdc on collector of Q103.

e. Connect a 100 kHz, 5 V pk-pk, negative, square wave with a risetime of less than 30 nsec to Z-axis Input.



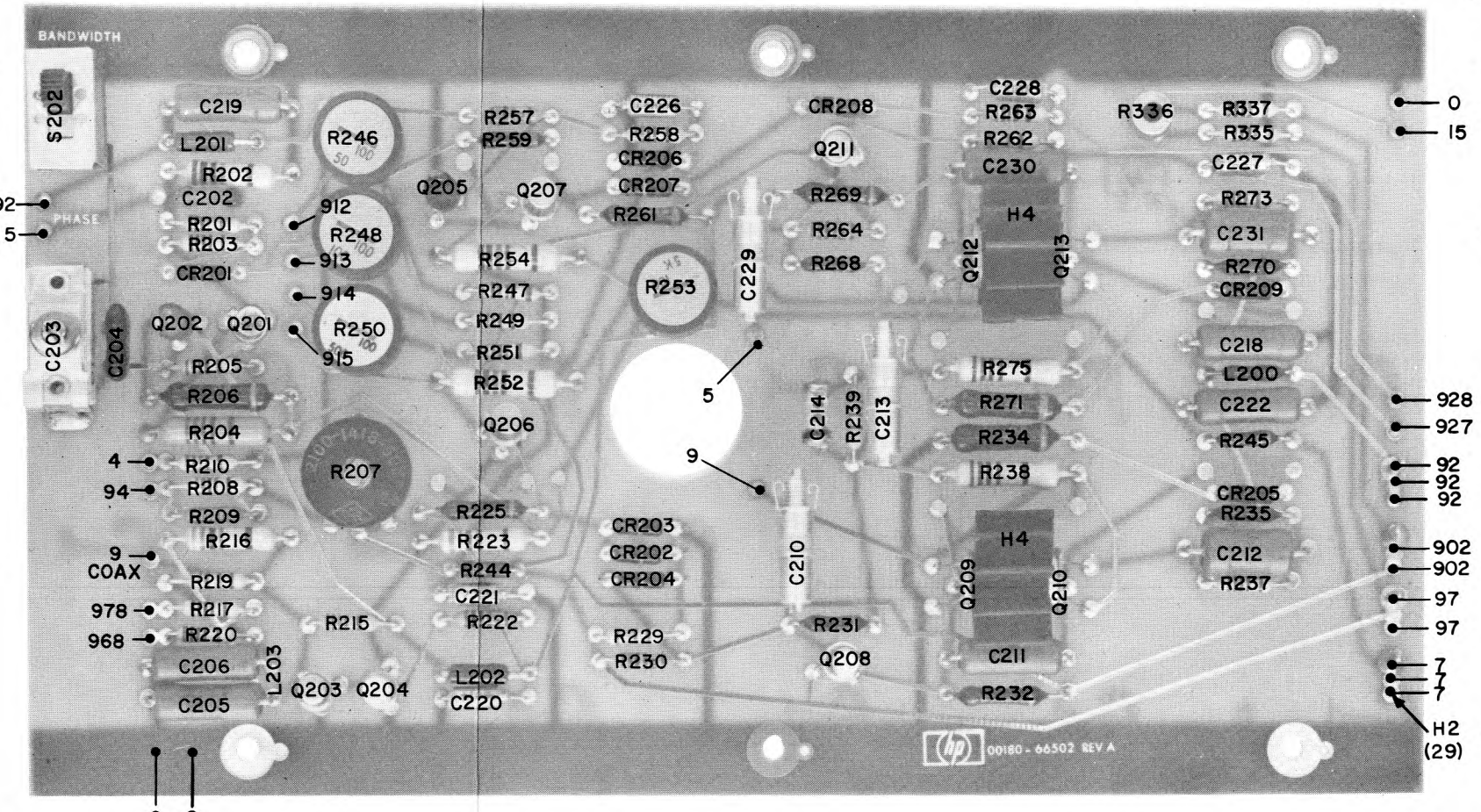
p/o Figure 8-3. Waveforms and Measurement Conditions



REFERENCE DESIGNATIONS

P/O A1, A2
C101-106,110-116,120-123,127,128
CR101-104, 108-113,115-117
P/O J1,101-108
L101,102,105,107,108
Q101-111
R101-107,111-122,125-133,136-145,149-162
P/O S101, P/O S102
W11-15, 17-20

p/o Figure 8-3. Gate Amplifier



A3

REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C202	C-2	C221	D-5	CR206	E-2	Q206	E-4	R206	C-3	R229	E-5	R248	D-3	R263	H-2
C203	B-3	C222	I-3	CR207	E-2	Q207	E-2	R207	D-4	R230	E-5	R249	E-3	R264	G-2
C204	B-3	C226	E-2	CR208	G-2	Q208	G-5	R208	C-4	R231	G-5	R250	D-3	R268	G-3
C205	C-5	C227	I-2	CR209	I-3	Q209	G-5	R209	C-4	R232	H-5	R251	E-3	R269	G-2
C206	C-5	C228	H-2	L200	I-3	Q210	H-5	R210	C-4	R234	H-4	R252	E-3	R270	I-3
C210	F-5	C229	F-3	L201	C-2	Q211	G-2	R215	D-5	R235	I-4	R253	F-3	R271	H-3
C211	H-5	C230	H-2	L202	D-5	Q212	G-3	R216	C-4	R237	I-4	R254	E-3	R273	I-2
C212	I-4	C231	I-2	L203	C-5	Q213	H-3	R217	C-5	R238	H-4	R257	E-2	R275	H-3
C213	G-4	CR201	C-3	Q201	C-3	R201	C-2	R219	C-5	R239	G-4	R258	E-2	R335	I-2
C214	G-4	CR202	E-4	Q202	C-3	R202	C-2	R220	C-5	R244	D-4	R259	E-2	R336	I-2
C218	I-3	CR203	E-4	Q203	C-5	R203	C-2	R222	D-5	R245	I-4	R261	E-2	R337	I-2
C219	C-2	CR204	E-5	Q204	D-5	R204	C-4	R223	D-4	R246	D-2	R262	H-2	S202	B-2
C220	D-5	CR205	I-4	Q205	D-2	R205	C-3	R225	D-4	R247	E-3				

180A-B-2B

p/o Figure 8-4. Component Identification, A3

INT SW

DC VOLTAGE MEASUREMENT CONDITIONS

a. Set HORIZONTAL DISPLAY to EXT CAL and HORIZONTAL MAGNIFIER to X1.

b. Adjust HORIZONTAL POSITION to center spot.

c. All voltages are referenced to ground.

WAVEFORM MEASUREMENT CONDITIONS

a. Set Model 180A/AR controls as follows:

HORIZONTAL MAGNIFIER X1
HORIZONTAL DISPLAY .....EXT CAL
HORIZONTAL EXT INPUT ..... AC

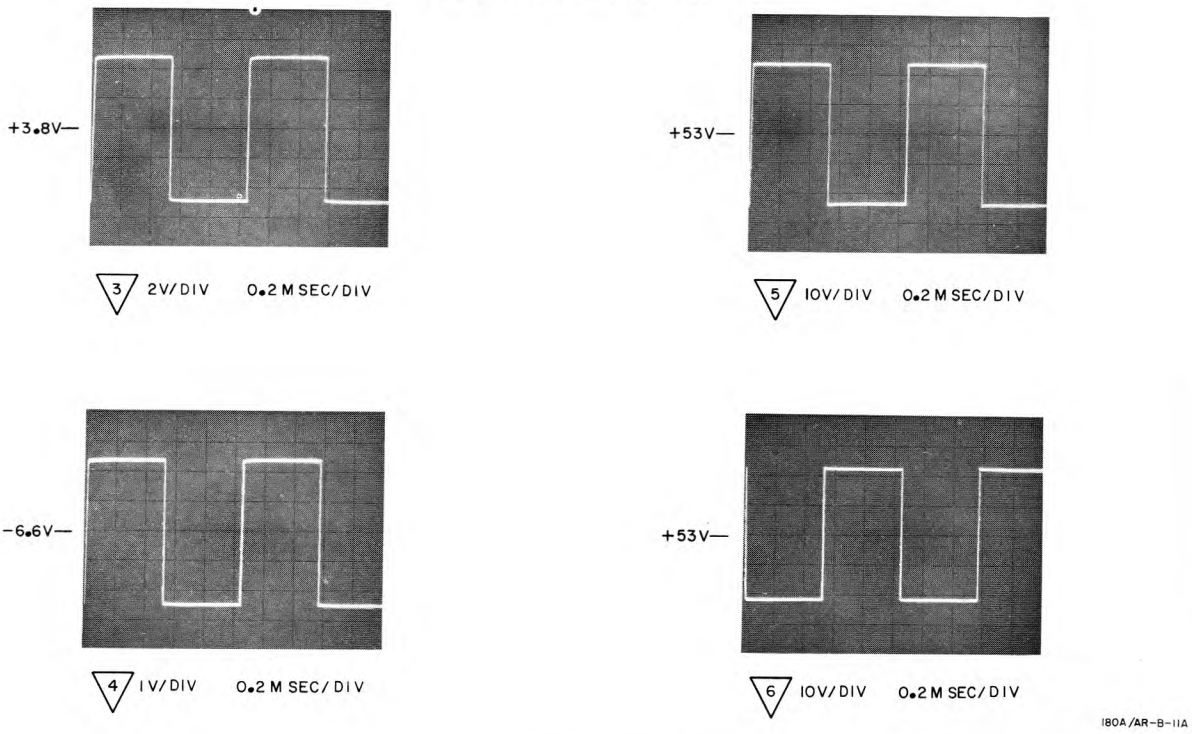
J201
HORIZ
EXT INPUT

b. Set Vertical Display to A.

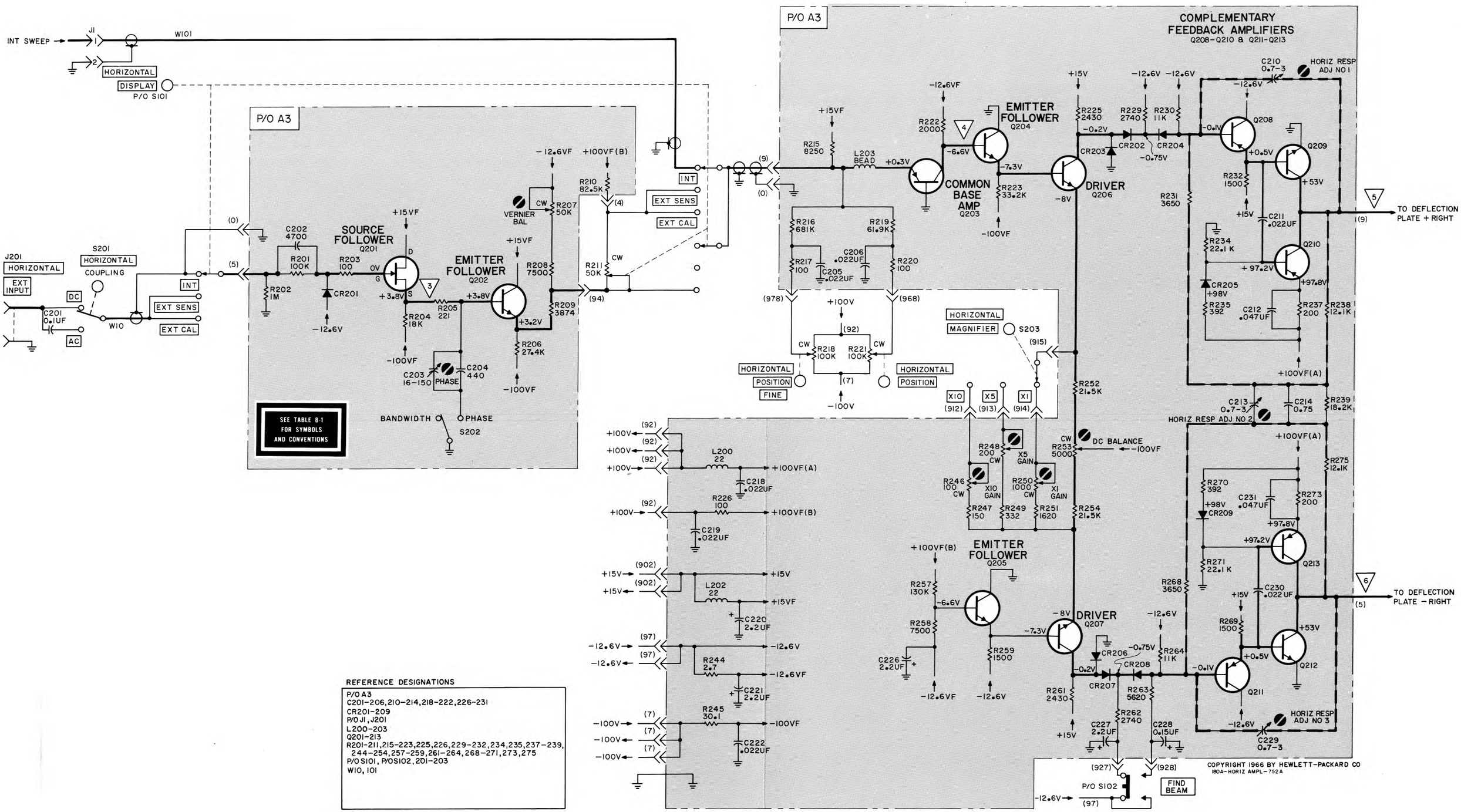
c. Connect CALIBRATOR 10 V output to HORIZONTAL EXT INPUT.

d. Adjust vertical and horizontal POSITION to center trace (increase INTENSITY if necessary).

WAVEFORMS ARE TIME-RELATED



p/o Figure 8-4. Waveforms and Measurement Conditions



REFERENCE DESIGNATIONS

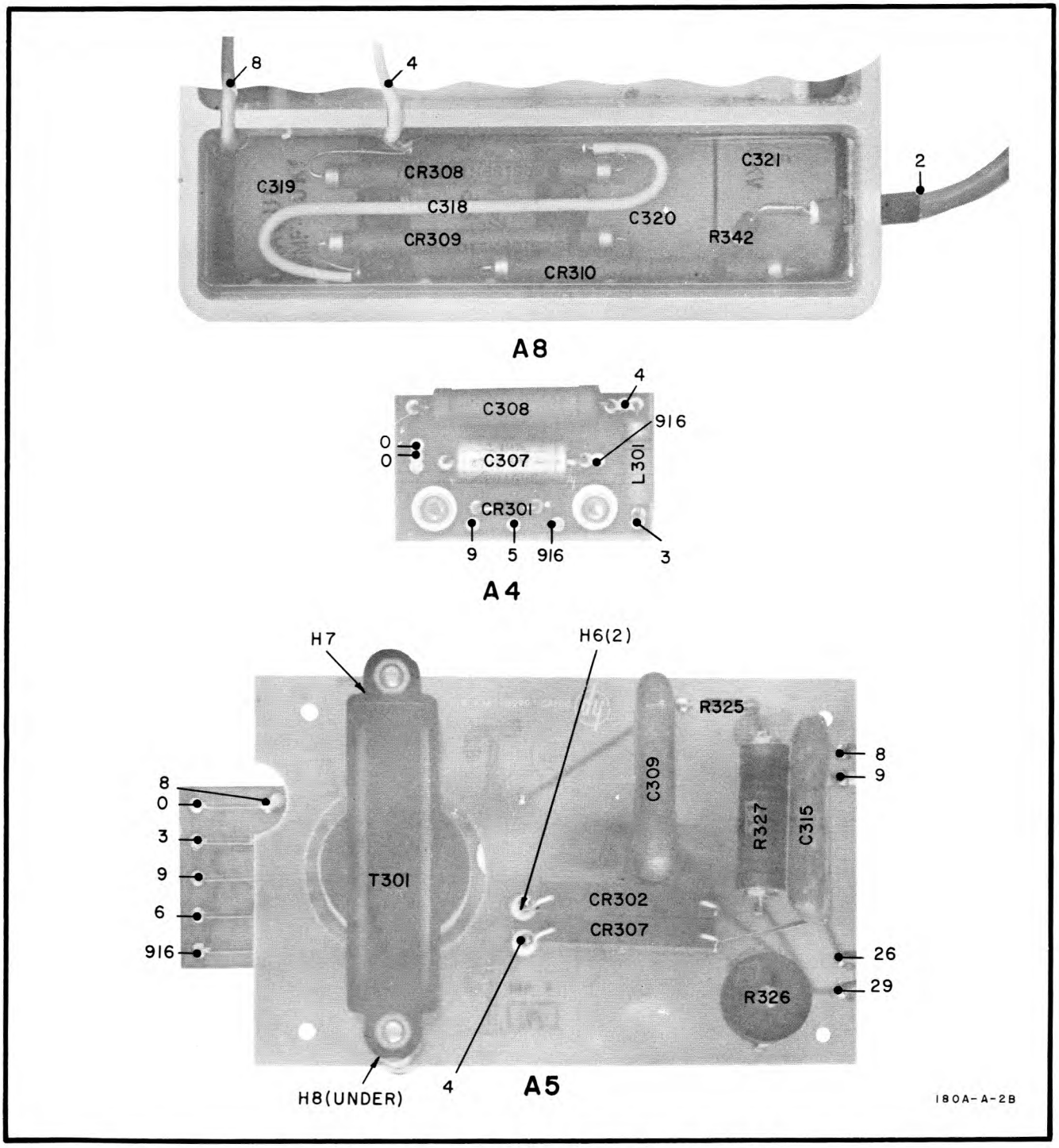
P/O A3
C201-206,210-214,218-222,226-231
CR201-209
P/O J1, J201
L200-203
Q201-213
R201-211,215-223,225,226,229-232,234,235,237-239, 244-254,257-259,261-264,268-271,273,275
P/O S101, P/O S102, 201-203
W10, 101

DELETED: L201

p/o Figure 8-4. Horizontal Amplifier

Component Identification for A1 on Figure 8-3.

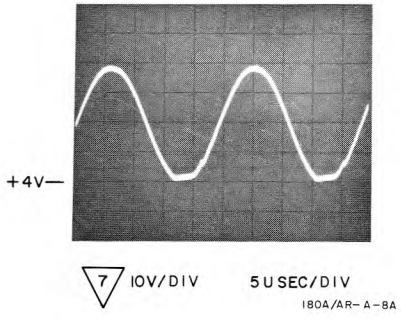
Component Identification for A3 on Figure 8-4.



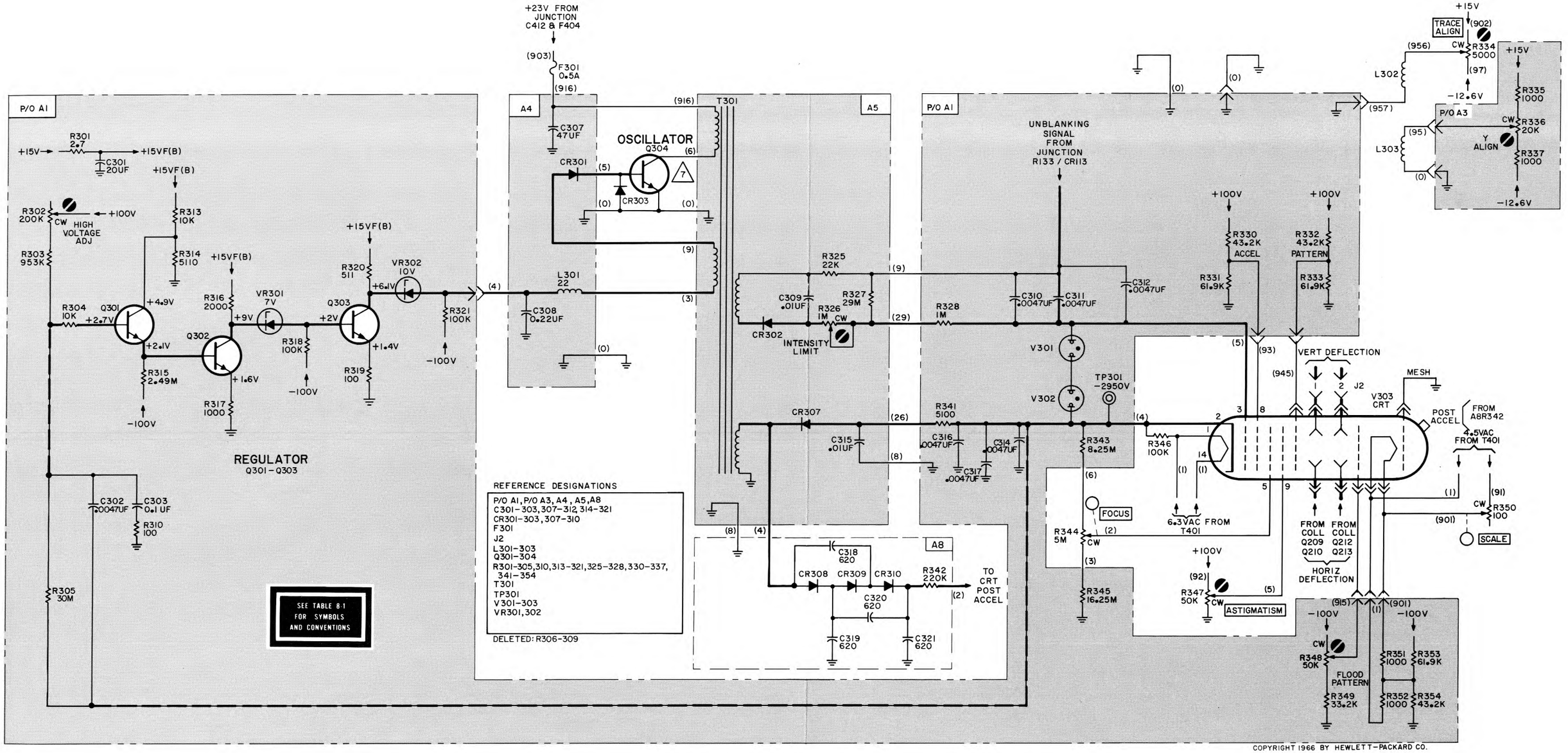
p/o Figure 8-5. Component Identification, A4, A5 and A8

WAVEFORM AND DC VOLTAGE MEASUREMENT CONDITIONS

Turn POWER on



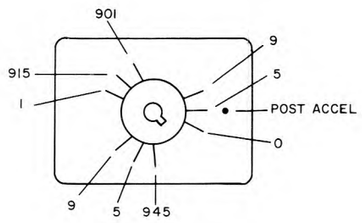
p/o Figure 8-5. Waveform and Measurement Conditions



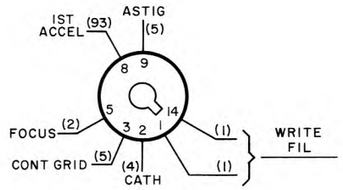
REFERENCE DESIGNATIONS

P/O A1, P/O A3, A4, A5, A8
C301-303, 307-312, 314-321
CR301-303, 307-310
F301
J2
L301-303
Q301-304
R301-305, 310, 313-321, 325-328, 330-337, 341-354
T301
TP301
V301-303
VR301, 302

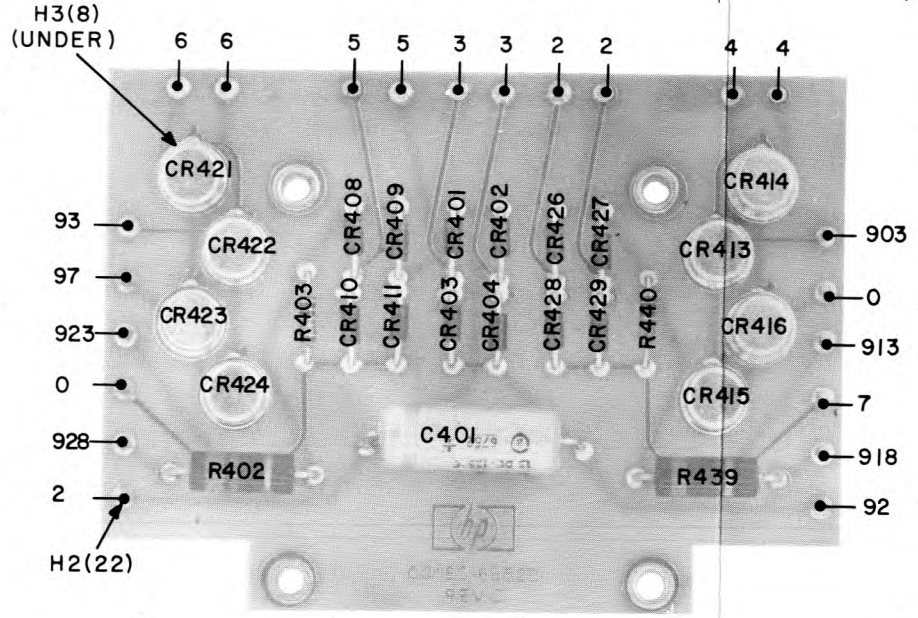
DELETED: R306-309



REAR VIEW
CRT NECK PIN CONNECTIONS

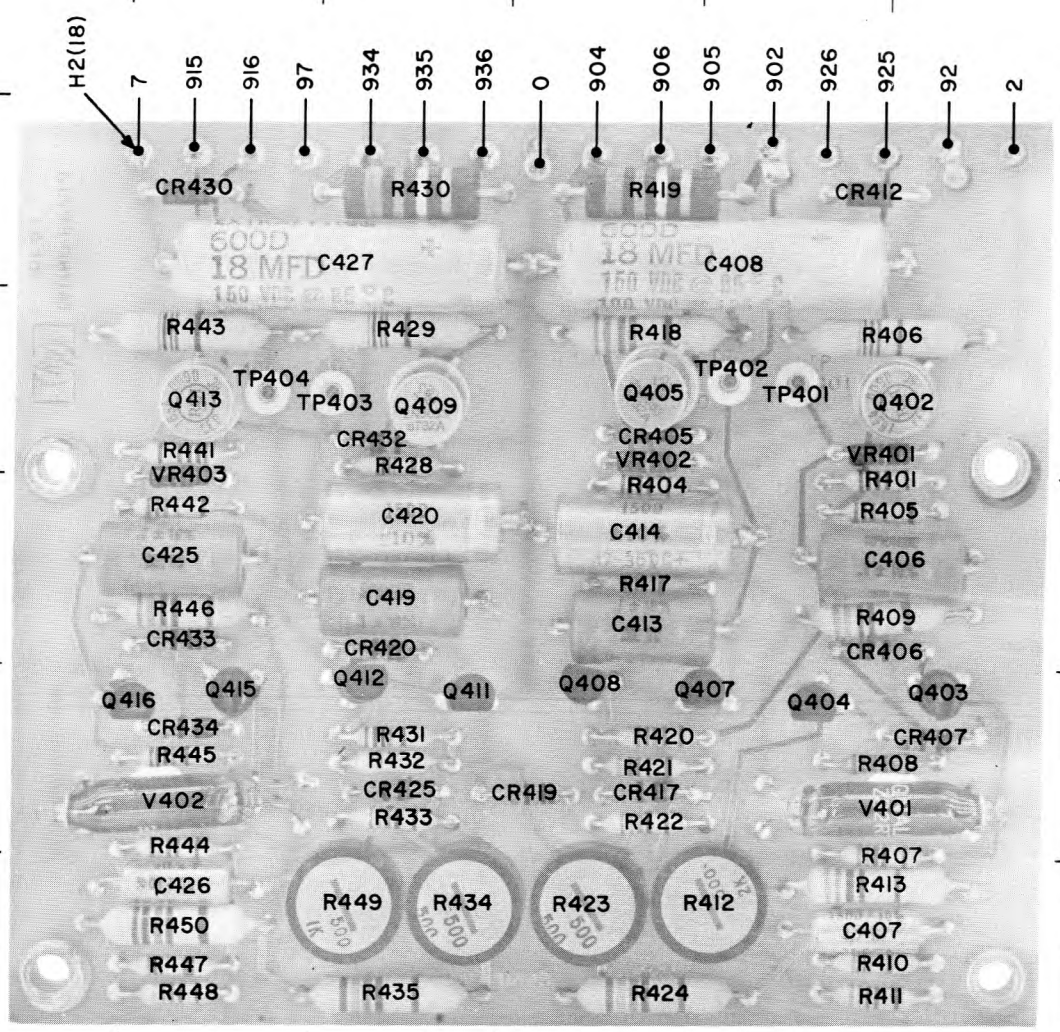


p/o Figure 8-5. High Voltage Power Supply



A6

REF DESIG	GRID LOC	REF DESIG	GRID LOC
C401	C-4	CR421	B-3
CR401	C-3	CR422	B-3
CR402	C-3	CR423	B-4
CR403	C-4	CR424	B-4
CR404	C-4	CR426	D-3
CR408	C-3	CR427	D-3
CR409	C-3	CR428	D-4
CR410	C-4	CR429	D-4
CR411	C-4	R402	B-5
CR413	D-3	R403	B-4
CR414	E-3	R439	D-5
CR415	D-4	R440	D-4
CR416	E-4		



A7

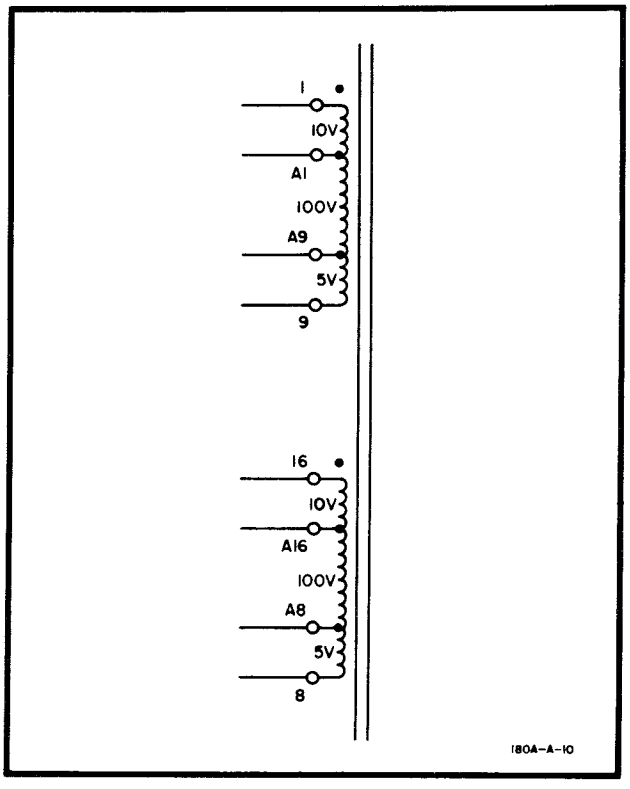
REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C406	J-4	CR405	I-3	CR433	G-4	Q412	H-5	R409	J-4	R422	I-5	R435	H-6	R450	G-6
C407	J-6	CR406	J-4	CR434	G-5	Q413	G-3	R410	J-6	R423	I-6	R441	G-3	TP401	J-3
C408	J-2	CR407	K-5	Q402	J-3	Q415	G-5	R411	J-6	R424	I-6	R442	G-4	TP402	J-3
C413	I-4	CR412	J-2	Q403	K-5	Q416	F-5	R412	I-6	R428	H-3	R443	G-3	TP403	G-3
C414	I-4	CR417	I-5	Q404	J-5	R401	J-4	R413	J-6	R429	H-3	R444	G-5	TP404	G-3
C419	H-4	CR419	H-5	Q405	I-3	R404	I-4	R417	I-4	R430	H-2	R445	G-5	V401	J-5
C420	H-4	CR420	H-4	Q407	I-5	R405	J-4	R418	I-3	R431	H-5	R446	G-4	V402	G-5
C425	G-4	CR425	H-5	Q408	I-5	R406	J-3	R419	I-2	R432	H-5	R447	G-6	VR401	J-3
C426	G-6	CR430	G-2	Q409	H-3	R407	J-6	R420	I-5	R433	H-5	R448	G-6	VR402	I-3
C427	H-2	CR432	H-3	Q411	H-5	R408	J-5	R421	I-5	R434	H-6	R449	H-6	VR403	G-3

180A-B-3C

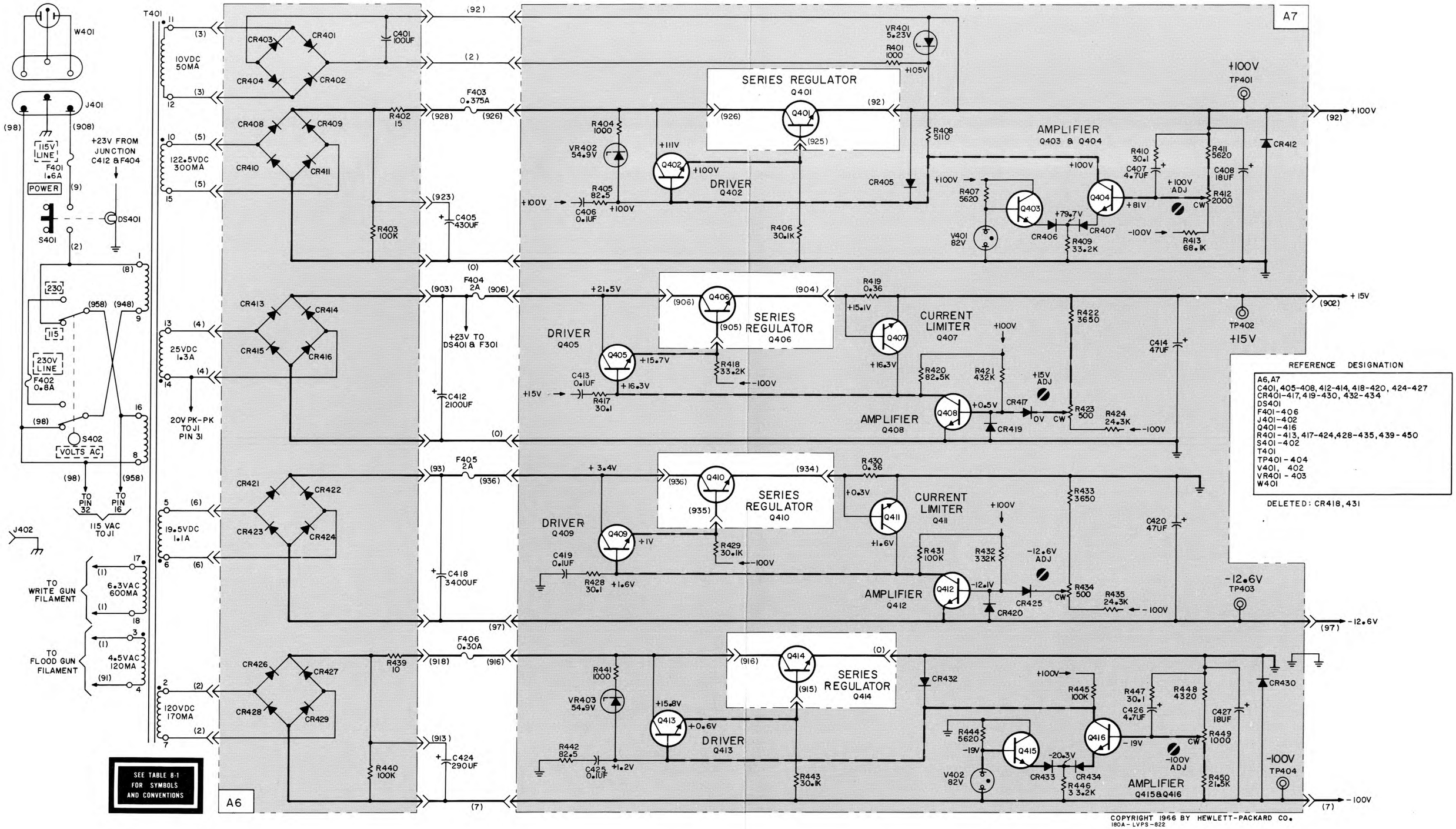
p/o Figure 8-6. Component Identification, A6 and A7

DC VOLTAGE MEASUREMENT CONDITIONS

Turn POWER on



T401 primary winding for Options 003 and 004.



REFERENCE DESIGNATION
A6, A7
C401, 405-408, 412-414, 418-420, 424-427
CR401-417, 419-430, 432-434
DS401
F401-406
J401-402
Q401-416
R401-413, 417-424, 428-435, 439-450
S401-402
T401
TP401-404
V401, 402
VR401-403
W401

DELETED: CR418, 431

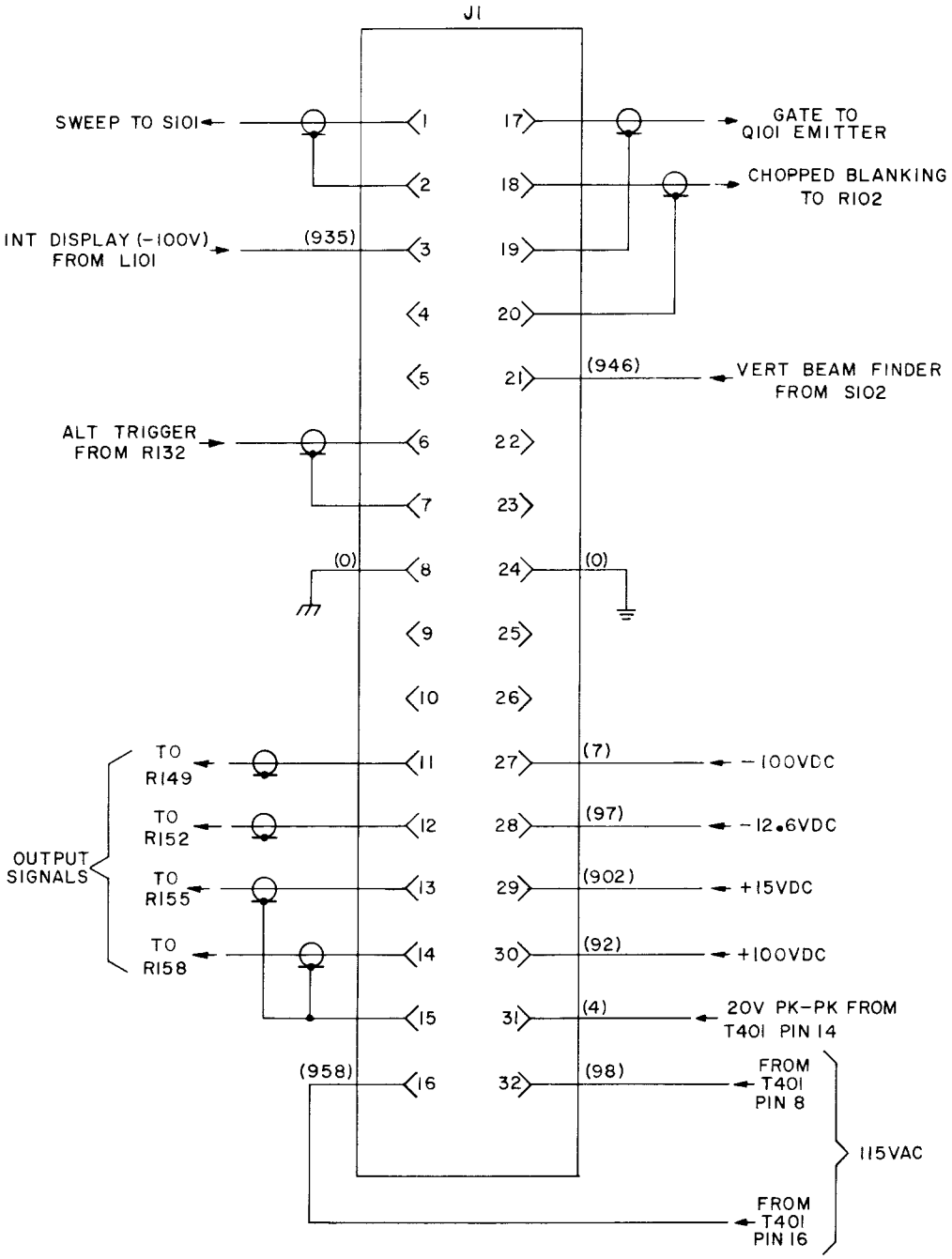


Figure 8-7. Jack Connections

CATHODE-RAY TUBE WARRANTY

The cathode-ray tube (CRT) supplied in your Hewlett-Packard Oscilloscope and replacement CRT's purchased from hp are warranted by the Hewlett-Packard Company against electrical failure for a period of one year from the date of sale. Broken tubes and tubes with phosphor or mesh burns are not included under this warranty. If the CRT is broken when received, a claim should be made with the responsible carrier.

Your nearest Hewlett-Packard Sales/Service Office (listed at rear of instrument manual) maintains a stock of replacement tubes and will assist in processing the warranty claim.

We would like to evaluate every defective CRT. This engineering evaluation helps us to provide a better product for you. Please fill out the CRT Failure Report on the reverse side of this sheet and return it with the defective CRT to:

Hewlett-Packard Company
1900 Garden of the Gods Road
Colorado Springs, Colorado 80907

Attention: CRT QA

To avoid damage to the tube while in shipment, please follow the shipping instructions below; warranty credit is not allowed on broken tubes.

SHIPPING INSTRUCTIONS

It is preferable that the defective CRT be returned in the replacement CRT carton. If the carton or packaging material is not available, pack the CRT according to the instructions below:

1. Carefully wrap the tube in 1/4 inch thick cotton batting or other soft padding material.

2. Wrap the above in heavy kraft paper.

3. Pack wrapped tube in a rigid container which is at least 4 inches larger than the tube in each dimension.

4. Surround the tube with at least 4 inches of packed excelsior or similar shock absorbing material; be sure the packing is tight all around the tube.

Thank you,

CRT Department