

# 1311B

## X-Y DISPLAY



# MANUAL CHANGES

## MANUAL IDENTIFICATION

Model Number: 1311B  
 Date Printed: FEBRUARY 1980  
 Part Number: 01311-90907

This supplement contains important information for correcting manual errors and for adapting the manual to instruments containing improvements made after the printing of the manual.

To use this supplement:

Make all ERRATA corrections.

Make all appropriate serial number related changes indicated in the tables below.

Serial Prefix or Number	Make Manual Changes	Serial Prefix or Number	Make Manual Changes
1943A	ERRATA		

▲ NEW ITEM

▲ ERRATA

Table 1-3. Standard Options,

Add: OPTION 004 Delete front panel bezel, contrast filter and tilt stand.  
 Add 1311A type bezel and blue contrast filter.

Table 6-2. Replaceable Parts,

Add: MP1 (OUTER FRONT PANEL MASK) HP and Mfr Part No. 01311-44109.  
 Add: MP2 (BEZEL TRIM) HP and Mfr Part No. 5001-0439.  
 Add: MP4 (LIGHT INDICATOR) HP and Mfr Part No. 1450-0440.  
 Add: MP5 (POT BUSHING) HP and Mfr Part No. 1410-0052.  
 Add: MP10 (FRONT SUB PANEL) HP and Mfr Part No. 01311-00201.  
 Add: OPTION 004 MP1 (FRONT PANEL BEZEL ASSY) HP and Mfr Part No. 01311-68715.  
 MP6 (CONTRAST FILTER BLUE) HP and Mfr Part No. 01311-69507.

### NOTE

Manual change supplements are revised as often as necessary to keep manuals as current and accurate as possible. Hewlett-Packard recommends that you periodically request the latest edition of this supplement. Free copies are available from all HP offices. When requesting copies quote the manual identification information from your supplement, or the model number and print date from the title page of the manual.



OPERATING AND SERVICE MANUAL

# MODEL 1311B X-Y DISPLAY

(Including Options 639, 001, 003, 604, and 002.)

## SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed **1943A**.

J. Bachofen  
C. Fox  
H. Goller  
M. Harms  
R. Larson

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## **SAFETY**

*This product has been designed and tested according to International Safety Requirements. To ensure safe operation and to keep the product safe, the information, cautions, and warnings in this manual must be heeded. Refer to Section I and the Safety Summary for general safety considerations applicable to this product.*

## **CERTIFICATION**

*Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.*

## **WARRANTY**

This Hewlett-Packard product is warranted against defects in material and workmanship for a period of one year from date of shipment. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

The cathode-ray tube (CRT) in the instrument and any replacement CRT purchased from HP are also warranted against electrical failure for a period of one year from the date of shipment from Colorado Springs. BROKEN TUBES AND TUBES WITH PHOSPHOR OR MESH BURNS, HOWEVER, ARE NOT INCLUDED UNDER THIS WARRANTY.

For warranty service or repair, this product must be returned to a service facility designated by HP. However, warranty service for products installed by HP and certain other products designated by HP will be performed at Buyer's facility at no charge within the HP service travel area. Outside HP service travel areas, warranty service will be performed at Buyer's facility only upon HP's prior agreement and Buyer shall pay HP's round trip travel expenses.

For products returned to HP for warranty service, Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

### **LIMITATION OF WARRANTY**

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

**NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.**

### **EXCLUSIVE REMEDIES**

**THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HP SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.**

## **ASSISTANCE**

*Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.*

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

**S C W & A 9/78 (CRT)**



## SAFETY SUMMARY

***The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements.***

### **GROUND THE INSTRUMENT.**

To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The instrument is equipped with a three-conductor ac power cable. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adapter with the grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet. The power jack and mating plug of the power cable meet International Electrotechnical Commission (IEC) safety standards.

### **DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE.**

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

### **KEEP AWAY FROM LIVE CIRCUITS.**

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

### **DO NOT SERVICE OR ADJUST ALONE.**

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

### **USE CAUTION WHEN EXPOSING OR HANDLING THE CRT.**

Breakage of the Cathode-ray Tube (CRT) causes a high-velocity scattering of glass fragments (implosion). To prevent CRT implosion, avoid rough handling or jarring of the instrument. Handling of the CRT shall be done only by qualified maintenance personnel using approved safety mask and gloves.

### **DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT.**

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification of the instrument. Return the instrument to a Hewlett-Packard Sales and Service Office for service and repair to ensure that safety features are maintained.

### **DANGEROUS PROCEDURE WARNINGS.**

Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed.

**WARNING**

**Dangerous voltages, capable of causing death, are present in this instrument.  
Use extreme caution when handling, testing, and adjusting.**

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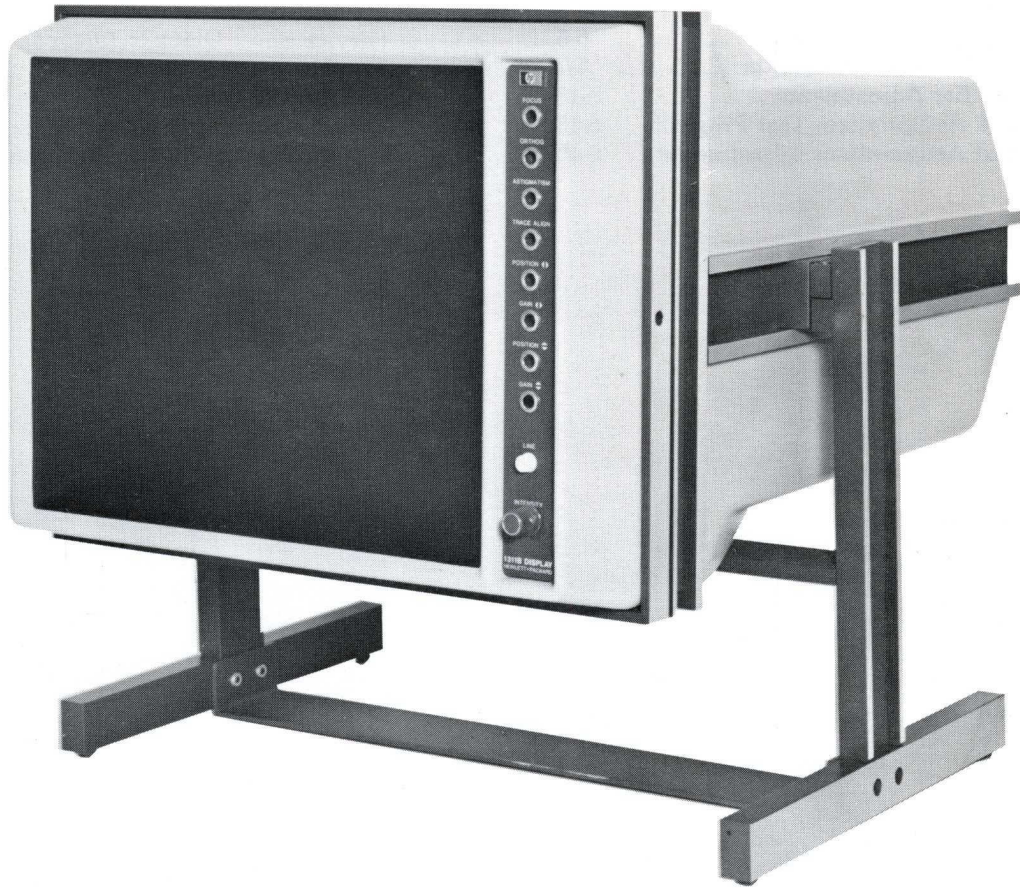
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*Figure 1-1. X-Y Display*

## SECTION I GENERAL INFORMATION

### 1-1. INTRODUCTION.

1-2. This operating and service manual contains information required to install, operate, test, adjust, and service Hewlett-Packard Model 1311B. The manual part number is listed on the title page. Also listed on the title page of this manual is a Microfiche part number. This number can be used to order 4x6-inch microfilm transparencies of the manual. Each microfiche contains up to 96 photo-duplicates of the manual pages. The microfiche package also includes the latest Manual Changes supplement as well as a pertinent Service Note.

### 1-3. SPECIFICATIONS.

1-4. Instrument specifications are listed in table 1-1. These specifications are the performance standards or limits against which the instrument is tested. Table 1-2 lists supplemental characteristics. Supplemental characteristics are not specifications but are typical characteristics included as additional information for the user.

### 1-5. INSTRUMENTS COVERED BY MANUAL.

1-6. Attached to the instrument is a serial number plate. The serial number is in the form: 0000A00000. It is in two parts; the first four digits and the letter are serial prefix and the last five digits are the suffix. The prefix is the same for all identical instruments; it changes only when a change is made to the instrument.

The suffix however, is assigned sequentially and is different for each instrument. The contents of this manual apply to instruments with the serial number prefix(es) listed under SERIAL NUMBERS on the title page.

1-7. An instrument manufactured after the printing of this manual may have a serial number prefix that is not listed on the title page. This unlisted serial number prefix indicates the instrument is different from those described in this manual. The manual for this newer instrument is accompanied by a yellow Manual Change supplement. This supplement contains "change information" that explains how to adapt the manual to the newer instrument.

1-8. In addition to change information, the supplement may contain information for correcting errors in the manual. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Change supplement. The supplement for this manual is identified with the manual print date and part number, both of which appear on the manual title page. Complementary copies of the supplement are available from Hewlett-Packard.

1-9. For Information concerning a serial number prefix that is not listed on the title page or in the Manual Change supplement, contact your nearest Hewlett-Packard office.

*Table 1-1. Specifications*

<p><b>VERTICAL AND HORIZONTAL AMPLIFIERS</b></p> <p><b>RISE TIME:</b> &lt;75 ns, 10% to 90% points for full screen deflection.</p> <p><b>BANDWIDTH:</b> dc to 5 MHz (3 dB down at 5 MHz) with 8.9 cm (3.5 in.) deflection.</p> <p><b>LINEAR WRITING SPEED:</b> &gt;25.4 cm/<math>\mu</math>s (&gt;10 in./<math>\mu</math>s).</p> <p><b>SETTLING TIME:</b> signal settles to within 1 spot diameter of final value in &lt;500 ns for any on screen movements.</p> <p><b>REPEATABILITY:</b> &lt;0.15% of full screen error in re-addressing any point on screen from any point on screen.</p> <p><b>CROSSTALK:</b> &lt;0.38 mm (&lt;0.015 in.) with one input terminated in 50<math>\Omega</math> and the other input driven by 1 V, 500 kHz signal.</p>	<p><b>DEFLECTION FACTOR:</b> front panel adjustable through the range indicated below:</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th style="padding: 5px;">Vertical</th> <th style="padding: 5px;">Horizontal</th> </tr> </thead> <tbody> <tr> <td style="padding: 5px;">from approx. 46.3 mV/cm (118 mV/in.) to 81 mV/cm (207 mV/in.)</td> <td style="padding: 5px;">from approx. 35.8 mV/cm (90 mV/in.) to 60.9 mV/cm (153 mV/in.)</td> </tr> </tbody> </table> <p><b>SPOT JITTER AND MOTION:</b> 0.13 mm (0.005 in.) with X INPUT and Y INPUT disconnected.</p> <p><b>POSITION:</b> zero input can be set to any on-screen position.</p> <p><b>POLARITY:</b> positive vertical input moves the beam up; positive horizontal input moves the beam right. Polarity can be changed by changing internal lead connections.</p>	Vertical	Horizontal	from approx. 46.3 mV/cm (118 mV/in.) to 81 mV/cm (207 mV/in.)	from approx. 35.8 mV/cm (90 mV/in.) to 60.9 mV/cm (153 mV/in.)
Vertical	Horizontal				
from approx. 46.3 mV/cm (118 mV/in.) to 81 mV/cm (207 mV/in.)	from approx. 35.8 mV/cm (90 mV/in.) to 60.9 mV/cm (153 mV/in.)				



Table 1-1. Specifications (Cont'd)

<p><b>X-Y INPUT:</b> rear panel BNC female connectors with floating shield.</p> <p><b>X-Y INPUT IMPEDANCE:</b> 50<math>\Omega</math>, switchable to 10 k<math>\Omega</math> shunted by 40 pF.</p> <p><b>MAXIMUM INPUT:</b> <math>\pm 50</math> V (dc + peak ac) with 10 k<math>\Omega</math> internal termination. <math>\pm 5</math> V (dc + peak ac) with 50<math>\Omega</math> internal termination.</p> <p><b>LINEARITY:</b> 1% of full scale display (along major axes).</p> <p><b>DRIFT:</b> 1.27 mm/hr (0.05 in./hr) and 2.54 mm/hr (0.10 in./hr) in 24 hours with covers installed.</p> <p><b>Z-AXIS AMPLIFIER</b></p> <p><b>RISE TIME:</b> &lt;25 ns.</p> <p><b>SENSITIVITY:</b> -1 V signal blanks trace; +1 V signal (INTENSITY at maximum) provides maximum intensity. Polarity may be reversed by changing internal lead connections.</p> <p><b>GAIN ADJUST:</b> adjustable by INTENSITY control over 5:1 attenuation ratio.</p> <p><b>BALANCE:</b> internal adjustment provides <math>\pm 1</math> V offset.</p> <p><b>Z-INPUT:</b> rear panel BNC female connector with grounded shield.</p> <p><b>Z-INPUT IMPEDANCE:</b> 50<math>\Omega</math> switchable to 10 k<math>\Omega</math> shunted by 60 pF.</p>	<p><b>TTL BLANKING:</b> high state blanks CRT. (POLARITY REVERSIBLE)</p> <p><b>MAXIMUM INPUT:</b> <math>\pm 50</math> V (dc + peak ac) with 10 k<math>\Omega</math> internal termination. <math>\pm 5</math> V (dc + peak ac) with 50<math>\Omega</math> internal termination.</p> <p><b>CATHODE-RAY TUBE</b></p> <p><b>VIEWING AREA:</b> 20.3 x 25.4 cm (8 x 10 in.)</p> <p><b>TYPE:</b> post-accelerator, 28.5 kV accelerating potential, P31 aluminized phosphor is standard. Electrostatic focus and deflection.</p> <p><b>SPOT SIZE:</b> 0.38 mm (0.015 in.) over entire viewing area.</p> <p><b>RESOLUTION:</b></p> <p><b>Center:</b> .043 cm (.017 in.)</p> <p><b>Corner:</b> typically &lt;.05 cm (&lt;.02 in.)</p> <p><b>BRIGHTNESS:</b> at least 84 cd/m<sup>2</sup> (50 fl) measured at 2.54 mm/<math>\mu</math>s (0.1 in./<math>\mu</math>s), 60 Hz rate, with spot size of 0.5 mm (0.020 in.).</p> <p><b>CONTRAST RATIO:</b> 4:1 or greater.</p> <p><b>X-RAY EMISSION:</b> CRT emission &lt;0.2 mR/hr; not measurable in background noise using Victoreen Model 440RF/C.</p> <p><b>IMPLOSION PROTECTION:</b> rim and tension banding prevents implosive devacuation. (UL/IEC348).</p> <p><b>PHOSPHOR PROTECTION:</b> circuit detects absence of deflection signals and limits beam current.</p>
--	--

Table 1-2. Supplemental Characteristics

<p><b>POWER:</b> selectable to 100 Vac, 120 Vac, 220 Vac, and 240 Vac +5%- 10%, 48 Hz to 440 Hz, 115 V maximum.</p> <p><b>ENVIRONMENT:</b></p> <p><b>ALTITUDE:</b> 4600m (15000 ft) operating at 25° C 7600m (25000 ft) non-operating.</p> <p><b>TEMPERATURE:</b> 0° C to +55° C operating; -40° C to +70° C non-operating.</p>	<p><b>HUMIDITY:</b> to 95% at 40° C.</p> <p><b>VIBRATION:</b> 10-55 Hz at .38 mm (0.015 in.) peak to peak excursion.</p> <p><b>SHOCK:</b> level 30g; duration 11 ms; shape 1/2 sine wave.</p> <p><b>X, Y, and Z INPUT CONNECTORS:</b> BNC type mounted on rear rail.</p> <p><b>WEIGHT:</b> net, 24.7 kg (54.5 lb); shipping 31 kg (68 lb).</p> <p><b>DIMENSIONS:</b> refer to figure 1-1 for complete details.</p>
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## 1-10. DESCRIPTION.

1-11. The HP Model 1311B is a large screen, high speed, computer graphic display designed for OEM system applications. The CRT has an aluminized P31 phosphor and a 100% usable viewing area.

## 1-12. SPECIAL FEATURES.

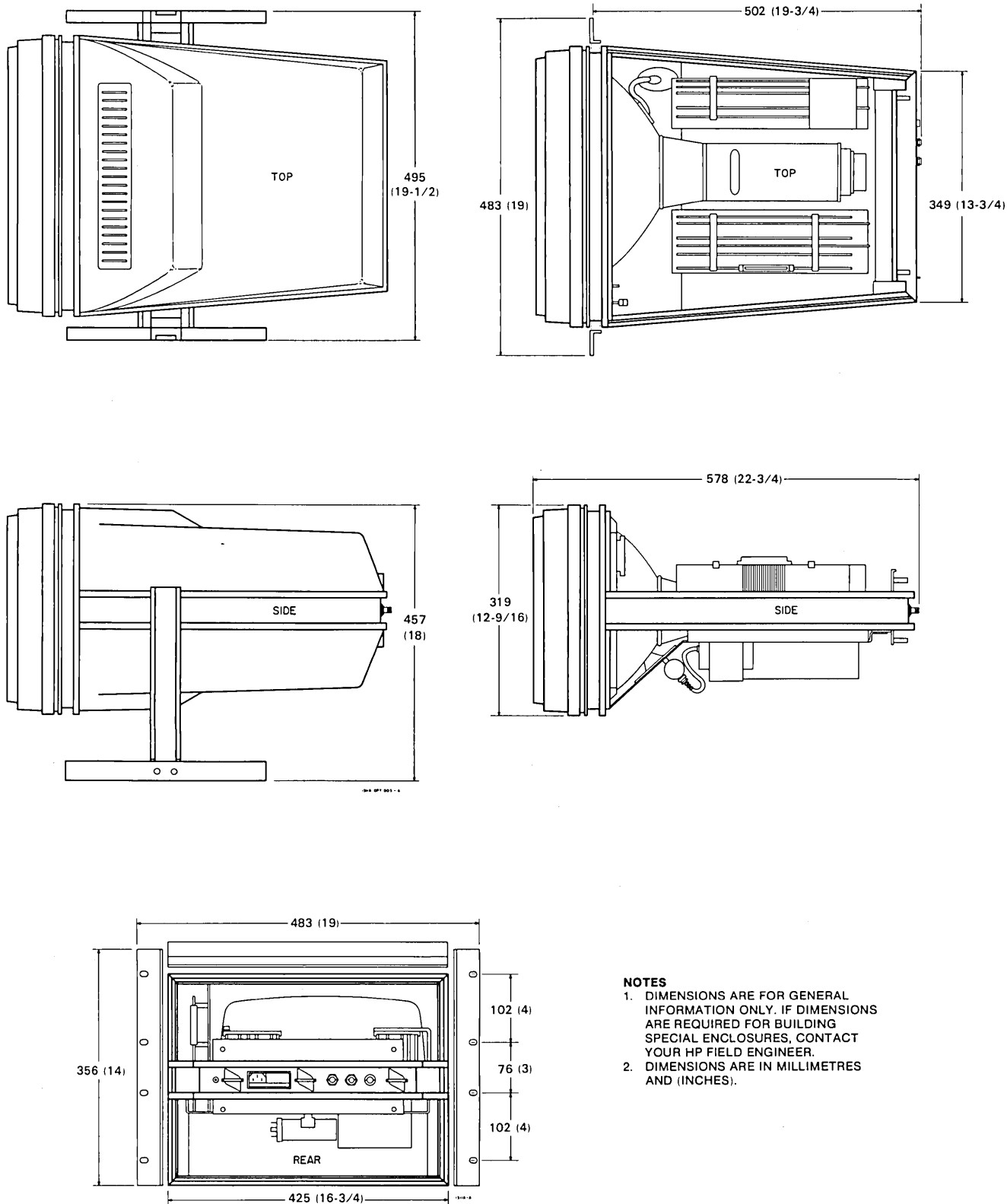
1-13. **Dynamic Focus-Astigmatism.** Voltages proportional to the position of the CRT beam are applied to the focus and astigmatism elements of the CRT. This causes spot size and shape to remain constant over the CRT viewing area. Focus is also corrected for changes in intensity level.

1-14. **Phosphor Protection.** A protection circuit senses slow or static deflection signals and limits beam intensity to prevent burning of the CRT phosphor and mesh.

1-15. **Input Modifications.** The input circuits to the X, Y, and Z amplifiers are designed to permit easy modification for single ended or differential operation. Additionally, the input termination resistance and the input attenuation ratio for the X and Y amplifiers can be changed.

## 1-16. OPTIONS.

1-17. Standard options are modifications installed on HP instruments and are available on request. Table 1-3 lists available options for the 1311B.



- NOTES**
1. DIMENSIONS ARE FOR GENERAL INFORMATION ONLY. IF DIMENSIONS ARE REQUIRED FOR BUILDING SPECIAL ENCLOSURES, CONTACT YOUR HP FIELD ENGINEER.
  2. DIMENSIONS ARE IN MILLIMETRES AND (INCHES).

Figure 1-2. Dimensional Detail, 1311B

*Table 1-3. Standard Options*

Option	Description
639	P39 phosphor, aluminized, open graticule CRT in lieu of P31.
001	Delete tilt stand and add a rack mount kit.
003	Delete contrast control and add brightness control.
604	P4 phosphor, aluminized, open graticule CRT in lieu of P31.
002	Delete tall tilt stand and add a short tilt stand.

**1-18. ACCESSORIES SUPPLIED.**

1-19. The following accessories are supplied with the 1311B.

- One Operating and Service Manual

- One AC line cord (for HP Part No. refer to Section II)
- One Application Note (Application Note No. 166)
- One Tilt Stand

**1-20. EQUIPMENT AVAILABLE.**

1-21. The following equipment is available for the 1311B:

- 1 metre four-coax cable HP Model 52126A
- 1.25 metre three-coax cable HP Model 10488A
- Rack mount slide kit, HP Stock No. 01311-68704
- Rack mount pivoting slide kit, HP Stock No. 01311-68705.

**1-22. RECOMMENDED TEST EQUIPMENT.**

1-23. Equipment required to test the 1311B performance is listed in table 1-4. Other equipment may be substituted if it meets or exceeds the critical specifications listed in the table.

Table 1-4. Recommended Test Equipment

Instrument Type	Recommended Model	Required Characteristics	Required For
Monitor Oscilloscope	HP Model 1740A	Bandwidth: 100 MHz Input Z: 50 $\Omega$ and 1 M $\Omega$ shunted by $\approx$ 20 pf Vertical Sensitivity: 5 mV	Adjustments
50:1 Divider Probe	HP Model 10002A	Shunt Capacitance: 2.5 pF Resistance 9 M $\Omega$ Max. dc Volts 1000 V	Adjustments
Function Generator	HP Model 3312A	Output Waveforms: sine, square, ramp Frequency Range: 1 Hz-10 MHz Square Wave Rise Time: 10% to 90% <18 ms Sine Wave Distortion: <.5% Output Impedance: 50 $\Omega$ Output Level: 20 V p-p into open circuit, 10 V p-p into 50 $\Omega$	Adjustments Performance Checks
Pulse Generator (Qty 2)	HP Model 8013B	Rep Rate: 1 Hz to 10 MHz Output Impedance: 50 $\Omega$ Output Level: app. 10 V across 50 $\Omega$	Adjustments Performance Checks
Digital Voltmeter	HP Model 3465B	Voltage Range: -15 V to 250 V Accuracy: 0.1% Input Resistance: 10 M $\Omega$	Adjustments
1000:1 Divider Probe	HP Model 34111A	Voltage Rating: 10 kV	Adjustments
*Power Supply	HP Model 6234A	Output Voltage: -10 V to +15 V Output Current: 200 ma Short circuit proof	Adjustment Performance Checks
HP-IB Controller	HP Model 9825A	23K byte R/W memory Equipped with: 98210A String Advance Program ROM 98214 Extended I/O ROM	Adjustments
HP-IB Interface	HP Model 98034A	IEEE Std. 488-1975 Interface	
Graphics Translator	HP Model 1350A	Input Interface: HP-IB	Adjustments

\*Use only if HP Model 3312A Function Generator is not used.



## SECTION II

### INSTALLATION

#### 2-1. INTRODUCTION.

2-2. This section provides installation instructions for the Model 1311B X-Y Display. This section also includes information about initial inspection and damage claims, preparation for use, and storage and shipment.

#### 2-3. INITIAL INSPECTION.

2-4. Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. The contents of the shipment should be as listed in the 'Accessories Supplied' paragraph in section I. Procedures for checking electrical performance are given in Section IV. If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the Performance Tests, notify the nearest Hewlett-Packard office. If the shipping container is damaged, or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping material for carrier's inspection. The HP office will arrange for repair or replacement at HP option without waiting for claim settlement.

#### 2-5. PREPARATION FOR USE.

**WARNING**

Read the Safety Summary in the front of this manual before installing or operating this instrument.

**2-6. POWER REQUIREMENTS.** The 1311B requires a power source of 100, 120, 220, or 240 Vac +5%, -10%, single phase, 48 Hz to 440 Hz that can deliver approximately 100 VA (maximum). Average power dissipation at 60 Hz and 120 Vac without any options is approximately 74 W.

#### 2-7. AC LINE VOLTAGE SELECTION.

**CAUTION**

Instrument damage may result if both line voltage selection switches are not set for the proper input voltage.

2-8. The instrument is normally set at the factory for 120 Vac operation. To operate the instrument from any other power source, proceed as follows:

a. Disconnect power cord from 1311B.

b. Using a blade-type screwdriver, position rear-panel LINE VOLTAGE SELECT switches for desired ac input. (Figure 2-1 shows switches set for 120 Vac operation.)

c. For 220 Vac or 240 Vac operation, replace rear-panel fuse (F1) with the 0.8 AT (slow blow) fuse, HP Part No. 2110-0020, supplied with the instrument.

d. Reconnect power cord.

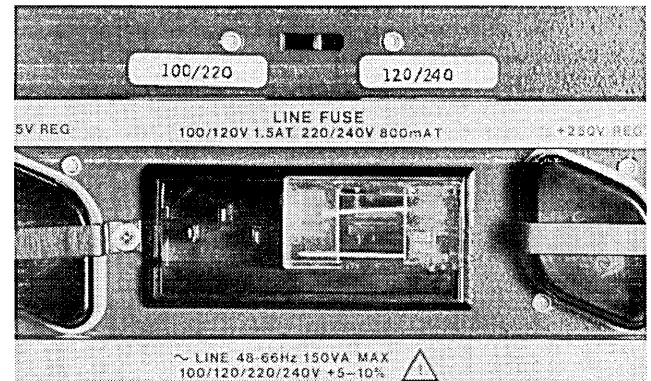


Figure 2-1. Line Voltage Selection Switches

**2-9. AC POWER CABLE.** This instrument is equipped with a three-wire power cable. When connected to an appropriate ac power receptacle this cable grounds the instrument cabinet. The type of power cable plug shipped with each instrument depends on the country of destination. Figure 2-2 shows the part numbers (and associated Option numbers) for the power cables and plug configurations available.

#### 2-10. OPERATING ENVIRONMENT.

**2-11. Temperature.** The instrument may be operated in temperatures from 0 degrees C to +55 degrees C (+32 F to +130 F).

**2-12. Humidity.** The instrument may be operated in environments with humidity up to 95%. However, the instrument should also be protected from temperature extremes which cause condensation within the instrument.

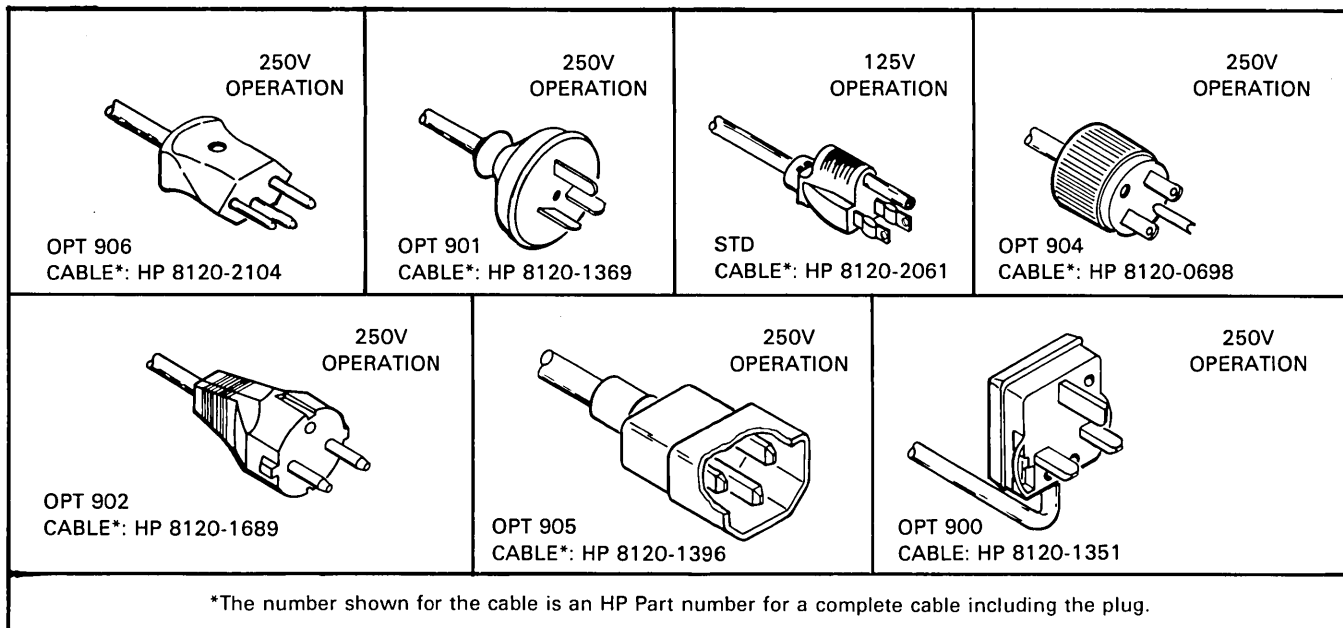


Figure 2-2. Power Cables Available

**2-13. Altitude.** The instrument may be operated at altitudes up to 4600 m (15,000 ft.).

**2-14. STORAGE AND SHIPMENT.**

**2-15. Environment.** The instrument may be stored or shipped in environments within the following limits:  
 Temperature -40 degrees C to +70 C (-40 F to +158 F)  
 Humidity Up to 95%  
 Altitude Up to 7600 m (26,000 ft.)

The instrument should also be protected from temperature extremes which cause condensation within the instrument.

**2-16. PACKAGING.**

**2-17. Original Packaging.** Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, model number, and full serial number. Also mark the container FRAGILE to ensure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

**2-18. Other Packaging.** The following general instructions should be used for re-packing with commercially available materials:

- a. Wrap instrument in heavy paper or plastic. (If shipping to Hewlett-Packard office or service center, attach tag indicating type of service required, return address, model number, and full serial number.)
- b. Use strong shipping container. A double-wall carton made of 350-pound test material is adequate.
- c. Use a layer of shock-absorbing material 70 to 100 mm (3 to 4 inch) thick around all sides of the instrument to provide firm cushioning and prevent movement inside container. Protect control panel with cardboard.
- d. Seal shipping container securely.
- e. Mark shipping container FRAGILE to ensure careful handling.
- f. In any correspondence, refer to instrument by model number and full serial number.



## SECTION III OPERATION

### 3-1. INTRODUCTION.

3-2. This section contains information and instructions for operating the HP Model 1311B.

### 3-3. PANEL FEATURES.

3-4. The instrument is intended for use as a general purpose graphic display. It is an X, Y, Z display with analog voltage inputs for X, Y, and Z-axis controls. All signals must be externally supplied through rear-panel connections. Intensity, focus, X-position, Y-position, astigmatism, X-gain, Y-gain and trace align controls are screwdriver adjustments accessible from the front panel.

### 3-5. CONTROLS AND CONNECTORS.

3-6. Front and rear panel controls and connectors are described in figure 3-1. Description numbers match the numbers on the illustration. The following paragraphs explain the switches located on printed circuit boards.

**WARNING**

Dangerous voltages capable of causing serious injury or death are present in this instrument. The following internal switches should be set by qualified personnel only.

**3-7. INPUT IMPEDANCE SWITCHES.** The input impedance selector switches permit selection of either 50 $\Omega$  or 10 K $\Omega$  for the X, Y, and Z axis amplifiers. A1S1 controls the X amplifier, A3S1 controls the Y axis amplifier, and A5S1 controls the Z axis amplifier.

**3-8. PHOSPHOR PROTECTION.** The Phosphor Protection switch (A5S1) is located on the right connector board (A8). This switch either enables or disables the phosphor protection circuit.

#### NOTE

Numbers in parentheses indicate control numbers from figure 3-1.

### 3-9. PREOPERATIONAL PROCEDURE.

3-10. Prepare the 1311B for operation as follows:

- a. Set INTENSITY (10) fully ccw.
- b. Set horizontal and vertical POSITION controls (5) (7) to midrange.
- c. Turn line switch (11) on. Power indicator lamp should light.

**CAUTION**

A high-intensity display over an extended period will burn the CRT phosphor.

d. Adjust INTENSITY (10) for a dimly visible display.

e. Adjust Y POSITION (7) through its full range. Display spot will move vertically on CRT, disappearing from the viewing area at either extreme of the control. Center the Y POSITION control.

f. Adjust X POSITION (5) through its full range. Display spot will move horizontally on CRT, disappearing from the viewing area at either extreme of the control. Center the X POSITION control.

g. Adjust FOCUS (1) and ASTIGMATISM (7) controls for smallest, sharpest spot on CRT.

h. Apply a 1 kHz, 1 V p-p sinewave to the X-INPUT (14) connector on rear panel.

i. Adjust TRACE ALIGN (4) to align trace horizontally.

j. Set X-GAIN (6) for a trace length as required for application, but not to exceed 27.9 cm (11 in.).

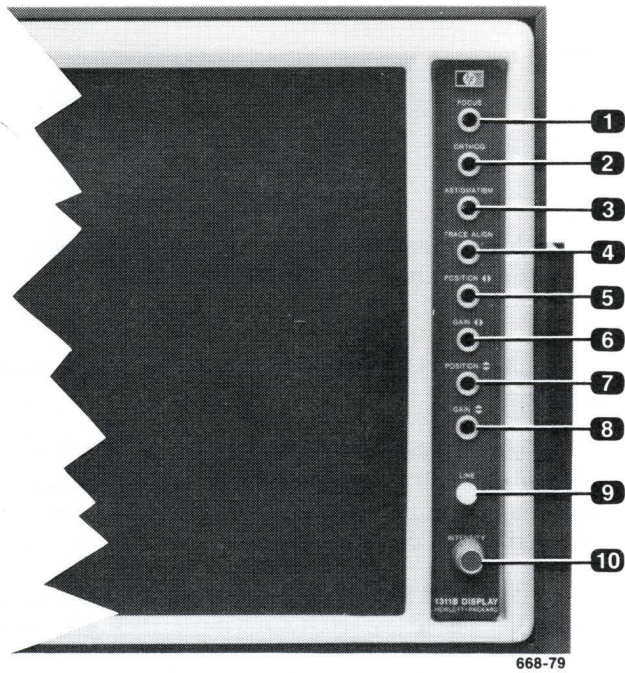
k. Apply a 1 kHz, 1 V p-p sinewave to the Y-INPUT (15) connector on rear panel and adjust ORTHOG control to cause the trace to lie perpendicular to the X-axis.

l. Set Y-GAIN (8) for a trace length as required by application, but not to exceed 21.7 cm (8.5 in.).

### 3-11. INTERFACING CONSIDERATIONS.

**3-12. GENERAL.** Standard sensitivities of the X and Y deflection amplifier are 1 V p-p for full screen deflection. Front panel gain controls for each axis reduce sensitivity to 1.75 V p-p for full screen deflection. X-Y deflection amplifiers may be configured for either single ended or differential operation. Input polarity may also be reversed by interchanging the input cable connections on the rear edge of the input amplifier board (A1 for X amplifier and A3 for Y amplifier). The input impedance selector switches permit selection of either 50 $\Omega$  or 10 K $\Omega$  for the X, Y, and Z axis amplifiers. A1S1 controls the X amplifier, A3S1 controls the Y amplifier, and A5S1 controls the Z axis amplifier.

**FRONT PANEL**



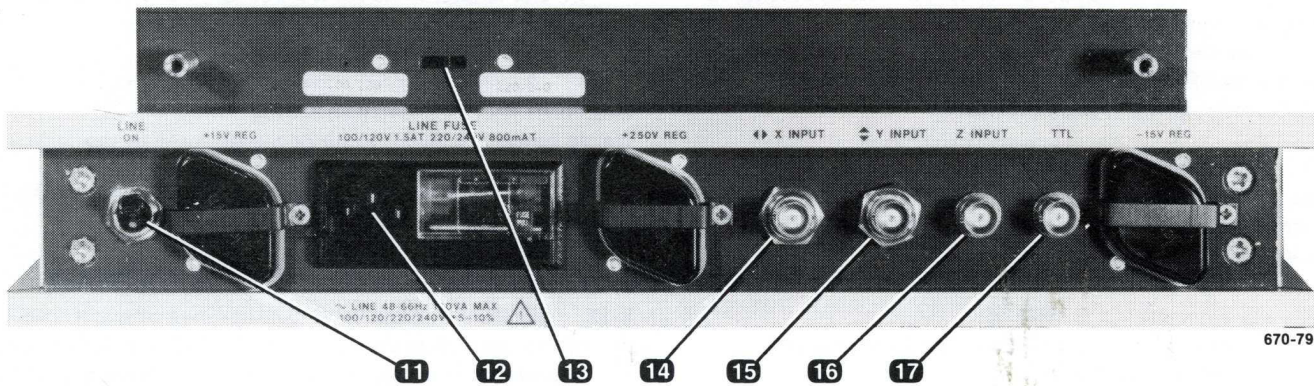
- 1. **FOCUS.** Focuses the trace; used in conjunction with **ASTIG** control to provide the sharpest CRT display.
- 2. **ORTHOGONAL.** Used to adjust perpendicularity of X and Y traces. Operates in conjunction with **TRACE ALIGN** control.

- 3. **ASTIGMATISM.** Control which adjusts the roundness of the spot.
- 4. **TRACE ALIGN.** Rotates X and Y traces about screen center.  
Aligns Y trace to vertical graticule line and X trace to horizontal graticule line. Used in conjunction with **ORTHOG** control which aligns vertical trace perpendicular to horizontal trace.
- 5. **POSN X.** Adjusts the trace position horizontally.
- 6. **GAIN X.** Adjustment for varying the gain of the X-amplifier. Gives 1.75:1 range of adjustment.
- 7. **POSN Y.** Adjusts the trace position vertically.
- 8. **GAIN Y.** Adjustment for varying the gain of the Y-amplifier. Gives 1.75:1 range of adjustment.
- 9. **POWER ON.** Light indicating power is applied to the instrument.
- 10. **INTENSITY.** Adjusts the brightness of the display.

**NOTE**

The **INTENSITY** control will have very little effect on the dot brightness in the absence of a Z-axis input signal.

**REAR PANEL**



- 11. **POWER ON switch.** Applies ac power to the instrument.
- 12. **INPUT ac power cord connector.**
- 13. **LINE VOLTAGE SELECT.** Selects line voltage for 100/220 or 120/240 V operation.

- 14. **X INPUT.** X-axis input connector.
- 15. **Y INPUT.** Y-axis input connector.
- 16. **Z INPUT.** Z-axis input connector.
- 17. **TTL INPUT.** TTL input connector for Z-axis control.

Figure 3-1. Controls and Connectors

X-INPUT			Y-INPUT			Z-INPUT		
IMPEDANCE	50Ω		IMPEDANCE	50Ω		IMPEDANCE	50Ω	
POLARITY	⌋		POLARITY	⌋		BLANKING POLARITY	⌋	
ATTENUATION	1 : 1		ATTENUATION	1 : 1		ATTENUATION	1 : 1	

Figure 3-2. Input Configuration Label

**3-13. INPUT CONFIGURATION LABEL.** Figure 3-2 is a duplicate of the Input Configuration Label. The information on the label shows the X-Y-Z amplifier input configuration for a standard instrument. If system installation requires any changes, clean the label with isopropyl alcohol and record the new information.

**3-14. ATTENUATORS.** The 1311B provides full scale X-axis and Y-axis deflection when a 1 V p-p signal is applied to either input. A front-panel GAIN control for each axis reduces sensitivity to 1.75 V p-p for full screen deflection. Attenuators may be added to provide full-scale deflection for input voltages up to ±50 Vdc + peak ac with 10 KΩ internal termination on ±5 V + peak ac with 50Ω internal termination. Space and pads are provided on the X-Y circuit boards for adding attenuators. (See Service Sheet 2 in Section VIII.) Regardless of input attenuation, range of the GAIN control is constant at a ratio of 1.75:1.

**3-15. POLARITY.** In a standard display, a positive going voltage deflects the beam to the right when applied to the X input center conductor, or up when applied to the Y input center conductor. To change polarity, interchange the input cable connections on the rear edge of the input amplifier board. When mounting the display physically inverted, interchange the CRT deflection plate connections to retain the sense of the position controls and maintain correct input polarity.

**3-16. BANDWIDTH REDUCTION.** In some cases, the full 5 MHz bandwidth of the deflection amplifier is not needed; in fact, in some applications it may be desirable to reduce the bandwidth to eliminate system noise problems. If the desired bandwidth is approximately 1 MHz or greater, the deflection amplifier can be modified internally by increasing the value of A1C8 and A1C9 for X-amplifier and A3C8 and A3C9 for the Y-amplifier. For a desired 3 dB bandwidth f, the value of C8 and C9 can be calculated with the equation:

$$C = \frac{1}{2 \pi f_o R}$$

Where:

- f<sub>o</sub> = -3 dB bandwidth desired
- R = shunt resistance (in this case 1000Ω)
- C = required capacitance

**NOTE**

This formula gives accurate results for bandwidth frequencies below 1 MHz. Above this frequency, other factors also influence the bandwidth; therefore, experimentation is necessary to achieve proper value. Use capacitors that do not exceed 1600 pf ±5% (or better).

**3-17. RINGING.** Ringing is one possible undesirable side effect of improperly terminated inputs. For instance, an abrupt transition from blanked to unblanked in an improperly terminated Z-axis input line may cause ringing which will appear as intensity fluctuation in the display. For minimum induced crosstalk and ringing, displays connected in parallel should be connected as shown in figure 3-3.

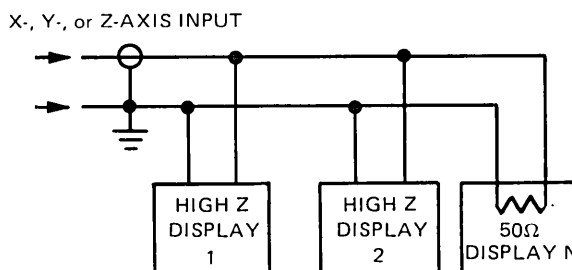
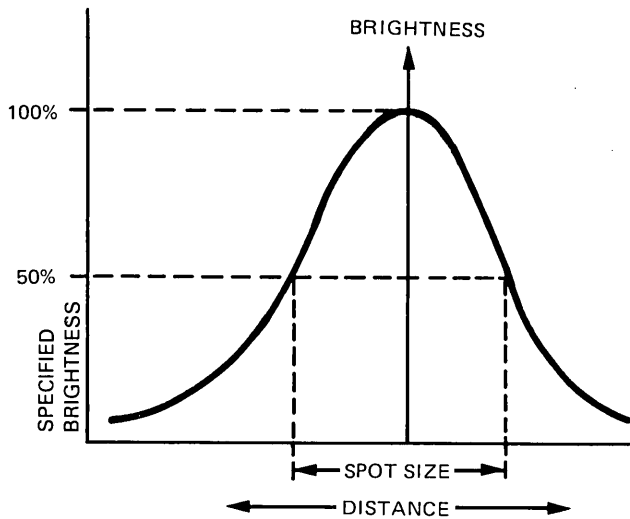


Figure 3-3. Input Termination Impedance of Displays Connected in Parallel

**3-18. PERFORMANCE SPECIFICATIONS.** Major performance specifications, and their meaning, how they are determined, and how they affect system performance are explained in the following paragraphs.

**3-19. SPOT SIZE AND RESOLUTION.** If you scan a CRT spot with a microscope photometer and plot brightness versus distance (spot width), the result approximates a Gaussian curve (see figure 3-4). Spot size is the width of the Gaussian curve at its 50% point (see Section I, table 1-2).





1304A-023-03-77

Figure 3-4. Brightness Versus Cross Section of Typical CRT Spot

3-20. In practice, the 50% point can be determined by using the shrinking raster measurement method. The shrinking raster measurement is obtained by displaying a raster of lines (or dots) on the CRT and then adjusting the vertical and horizontal gain until the individual lines (or dots) are no longer individually identifiable. The size of the raster is then divided by the number of lines in the raster to determine the spot size. The point where raster lines (or dots) merge is the theoretical 50% point on the Gaussian curve.

3-21. The shrinking raster method should be used if a scanning microscope photometer is not available, because observing an individual line (or dot) with an optical comparator can be very misleading. On a single dot, the eye can see to about the 3% point on the Gaussian curve. Here the dot appears to be approximately twice the width it is across the 50% points.

**3-22. BRIGHTNESS.** Brightness is specified only with respect to a specific combination of writing speed, refresh rate, and phosphor (P31 for 1311B). Maximum brightness for other given conditions can be calculated using the following formula:

Where:

$$B_{max} = (5.6 \text{ fl}) \left(\frac{0.1}{W}\right) \left(\frac{R}{60}\right) EP$$

5.6 fl = specified brightness

W = writing speed in inches per microseconds

EP = phosphor efficiency (relative to P31): P4 and P39 50%.

R = refresh rate in Hz.

3-23. For measuring brightness, two points should be remembered: (1) specific brightness is not measured in radiometric units but in photometric units which are normalized to the spectral response of the human eye, and (2) brightness is directly proportional to the refresh rate and inversely proportional to writing speed.

3-24. The brightness of a spot in a display that is made up of dots may be determined by using the following formula when the dot refresh rate and the pulse width used to generate the dots are known:

$$B = (B \text{ spec}) \left(\frac{Ws}{Rs Ds Cd}\right)$$

Where:

B = minimum spot brightness at full intensity and/or maximum Z-axis input level.

B spec = specified line brightness.

Ws = writing speed at which line brightness is specified.

Rs = refresh rate at which line brightness is specified.

Ds = specified spot diameter.

Cd = duty cycle calculated from: Z-axis pulse width × refresh rate.

**3-25. SETTling TIME.** Settling time is defined as the elapsed time between an input step command and the time for the beam to settle within a specified tolerance to its final position (see figure 3-5). Settling time must be taken into account when moving the beam from one location to another. Otherwise, there may be tails on dots or line distortions at the starting point of vectors.

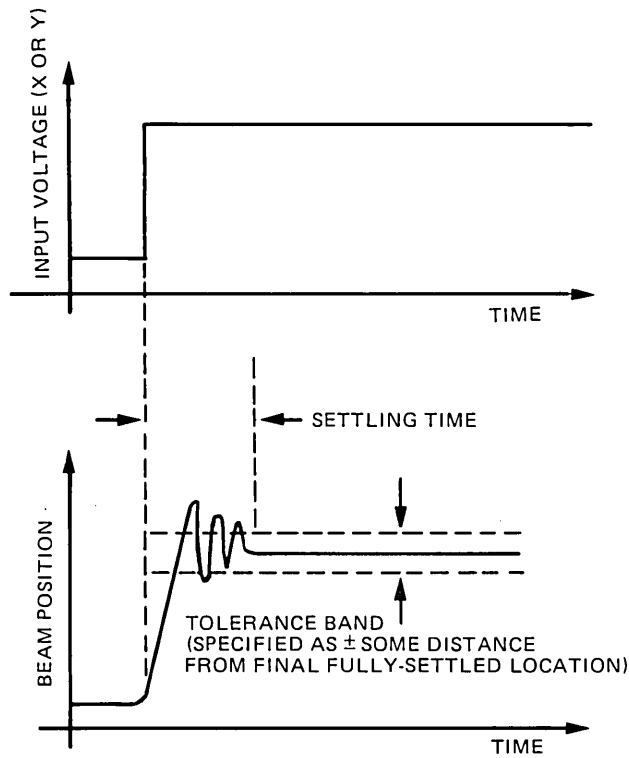


Figure 3-5. Settling Time

**3-26. LINEARITY.** Linearity (see figure 3-6) refers to the linearity to the relationship between the X or Y input voltage and the beam position (do not confuse this with the geometry specification).

**NOTE**

Linearity is specified only along the CRT's major axis.

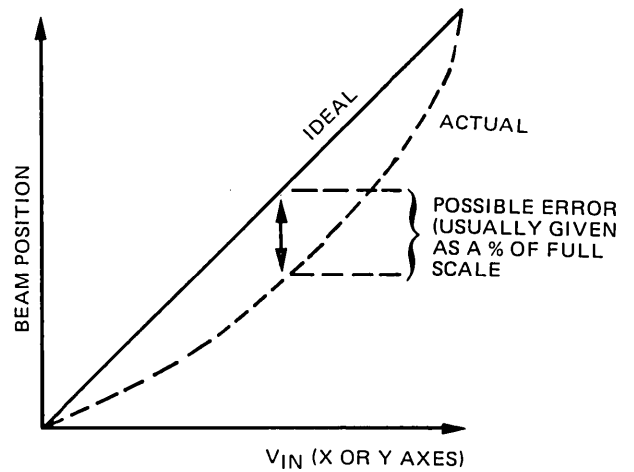


Figure 3-6. Linearity of Beam Position Showing Ideal Position and Possible Error

**3-27. OPERATOR MAINTENANCE.**

3-28. Operator maintenance should be limited to exterior cleaning of the instrument. Smooth metal surfaces can be cleaned with a commercial glass cleaner. Stubborn residues can be removed with a mild liquid household detergent. The CRT filter should be cleaned only with isopropyl alcohol.

## SECTION IV

### PERFORMANCE TESTS

#### 4-1. INTRODUCTION.

4-2. The procedures in this section test the instrument's electrical performance using the specifications of table 1-1 as the performance standards. All tests can be performed without access to the interior of the instrument.

#### 4-3. EQUIPMENT REQUIRED.

4-4. Equipment required for the performance tests is listed in section I, table 1-4. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended models.

#### 4-5. TEST RECORD.

4-6. Results of the performance test may be tabulated on the Performance Test Record at the end of this

section. The test record lists the tested specifications and their acceptable limits. The results recorded at incoming inspection can be used for comparison in periodic maintenance, troubleshooting, and after repairs or adjustment.

#### 4-7. CALIBRATION CYCLE.

4-8. Periodic performance verification is not normally required for this instrument. The performance checks should be made after service work has been performed or if improper operation is suspected.

4-9. Further checks that require access to the inside of the instrument are included in the adjustment section, but they are not required checks.

#### NOTE

The following Performance Tests are written for the standard instrument only. If optional attenuators have been installed, readjust all input signal levels accordingly.

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### PERFORMANCE TESTS

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#### 4-10. AMPLIFIER BANDWIDTH.

##### SPECIFICATION:

DC to 5 MHz (3 dB down at 5 MHz).

##### DESCRIPTION:

A function generator is used to provide the reference signal. A monitor oscilloscope is used to check for a constant signal at the display input connectors.

##### EQUIPMENT REQUIRED:

Function Generator  
Monitor Oscilloscope

##### PROCEDURE:

- a. Connect equipment as shown in figure 4-1.
- b. Apply a 600 mV, 50 kHz sine wave from function generator to the X-INPUT.
- c. Readjust the output of the function generator for exactly 12.7 cm (5 in.) of deflection.
- d. Note the above signal level on the monitor oscilloscope.
- e. Change signal frequency to 5 MHz and readjust output of function generator for the same signal level obtained in step d.
- f. The amplitude measured on the display should be greater than 9.1 cm (3.6 in.).

For Y-amplifier bandwidth, apply the function generator output to the Y-INPUT and repeat steps b through f.

---

PERFORMANCE TESTS

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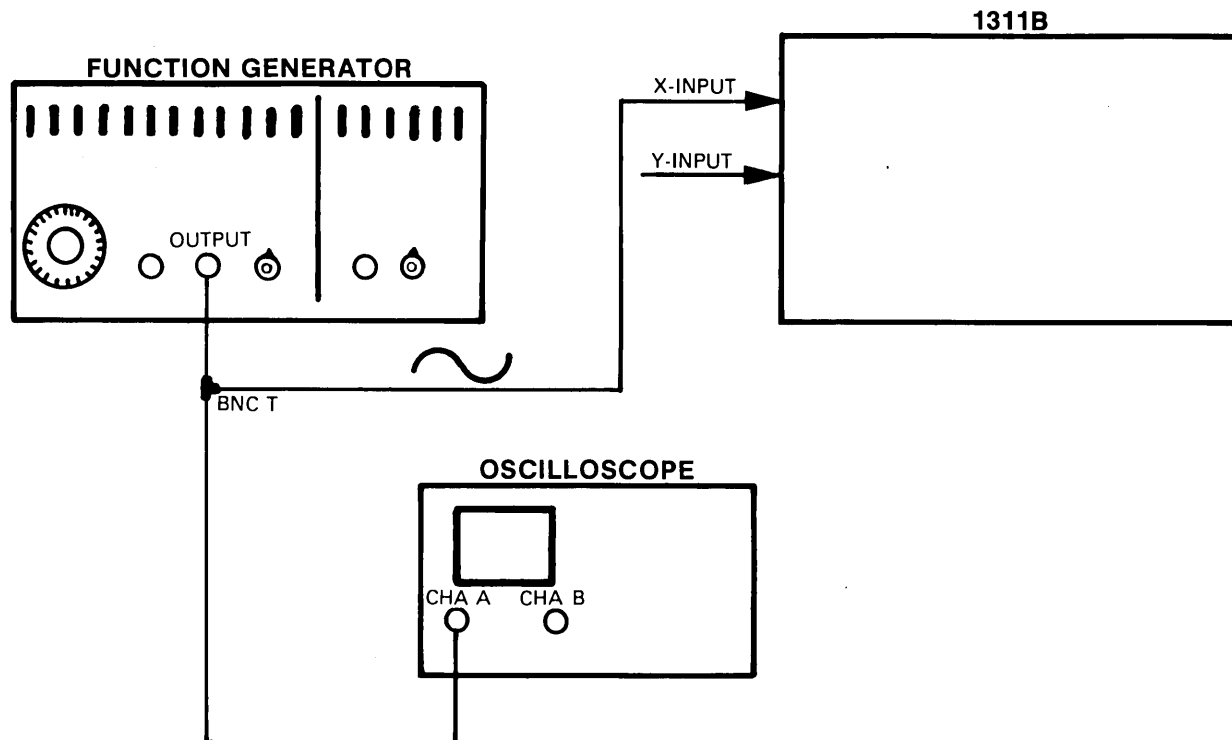


Figure 4-1. Amplifier Bandwidth Test Setup



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**PERFORMANCE TESTS**


---

**4-11. X-DEFLECTION FACTOR.****SPECIFICATION:**

Gain must be variable from 35.8 mV/cm (90 mV/in.) to 60.9 mV/cm (153 mV/in.).

**DESCRIPTION:**

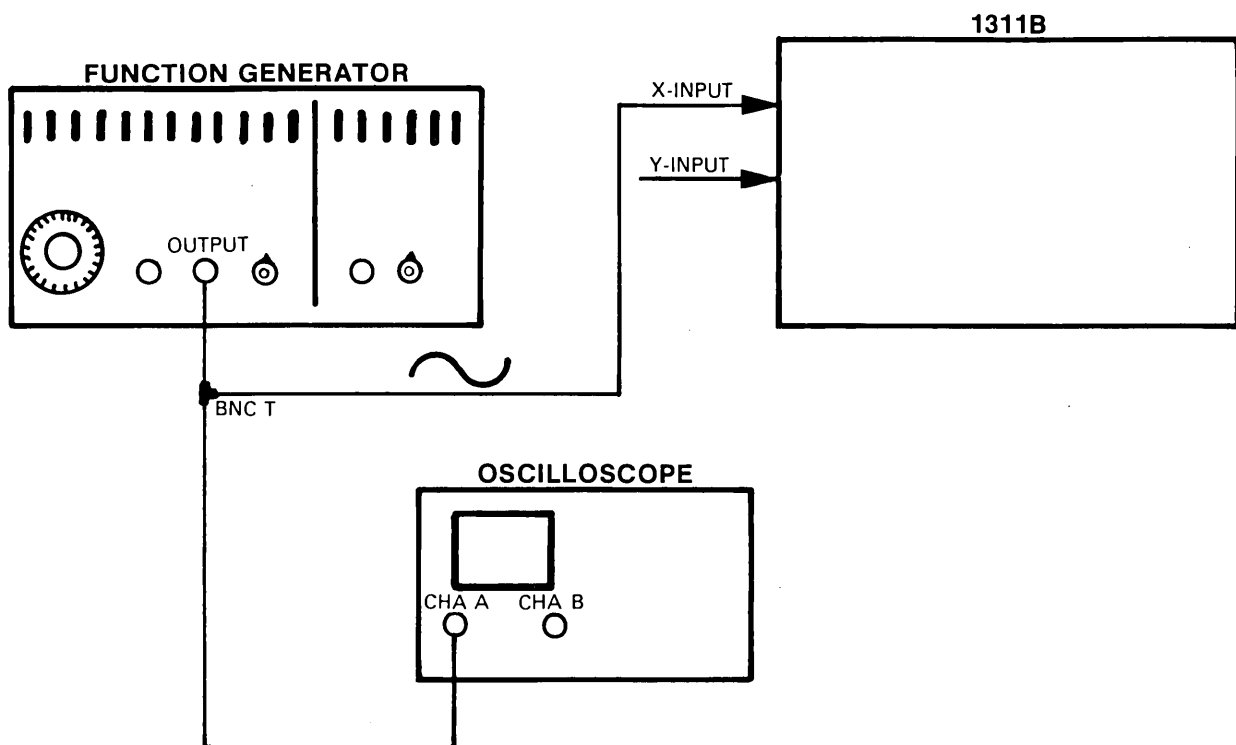
The X-GAIN control must vary the trace length from 16.4 cm (6.46 in.) to 27.9 cm (11 in.) with an input signal of 1 V.

**EQUIPMENT REQUIRED:**

Function Generator  
Monitor Oscilloscope

**PROCEDURE:**

- a. Connect equipment as shown in figure 4-2.



*Figure 4-2. X-deflection Factor Test Setup*

- b. Adjust output of function generator for 1 V, 1 kHz sine wave (check function generator amplitude with monitor oscilloscope).
- c. Turn front panel X-GAIN control fully ccw and check for a trace length of <16.4 cm (6.5 in.).
- d. Rotate the X-GAIN control fully cw and check for a trace length of >27.9 cm (11 in.).

---

**PERFORMANCE TESTS**


---

**4-12. Y-DEFLECTION FACTOR.****SPECIFICATION:**

Gain must be variable from 46.3 mV/cm (118 mV/in.) to 81 mV/cm (207 mV/in.).

**DESCRIPTION:**

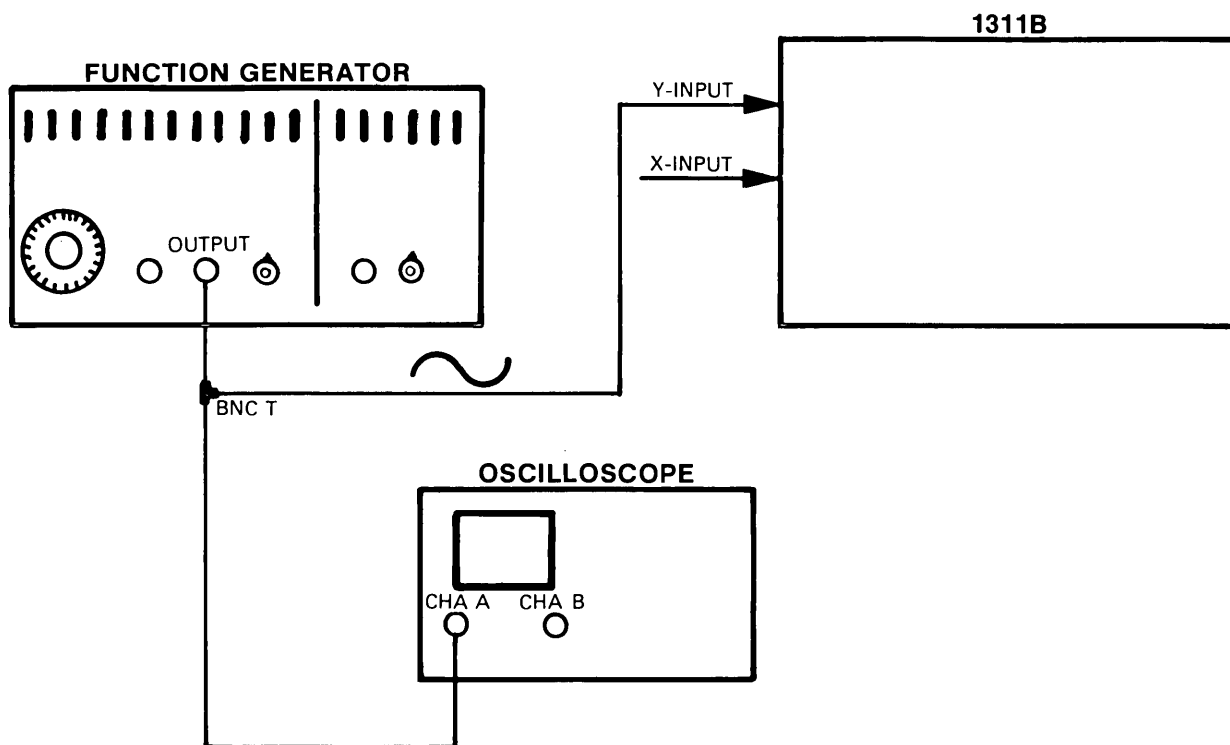
The gain control must vary the trace length from 12.2 cm (4.8 in.) to 21.6 cm (8.5 in.) with an input signal of 1 V.

**EQUIPMENT REQUIRED:**

Function Generator  
Monitor Oscilloscope

**PROCEDURE:**

- a. Connect equipment as shown in figure 4-3.



*Figure 4-3. Y-deflection Factor Test Setup*

- b. Adjust function generator for a 1 V, 1 kHz sine wave (check function generator amplitude with monitor oscilloscope).
- c. Turn front panel Y-GAIN control fully ccw and check for a trace length of <12.2 cm (4.8 in.).
- d. Rotate the Y-GAIN control fully cw and check for a trace length of >21.6 cm (8.5 in.).

---

**PERFORMANCE TESTS**


---

**4-13. REPEATABILITY.****SPECIFICATION:**

<0.15% of full screen error in readdressing any point on screen from any other point on screen.

**DESCRIPTION:**

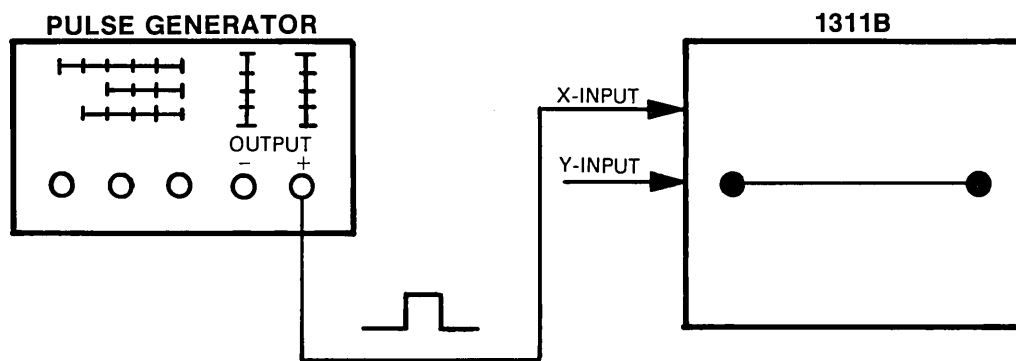
This test verifies amplifier performance stability with a varying input signal.

**EQUIPMENT REQUIRED:**

Pulse Generator

**PROCEDURE:**

- a. Connect equipment as shown in figure 4-4.



*Figure 4-4. Repeatability Test Setup*

- b. Set frequency of pulse generator for a 10 kHz signal. Adjust display POSITION controls to bring trace on screen. Set pulse generator amplitude for full screen deflection. (See figure 4-4).
- c. Vary the frequency of the pulse generator from 1 kHz to 100 kHz and notice the position change of the spot. Spot movement should be less than 1 spot diameter.
- d. Disconnect function generator from X-INPUT and reconnect to Y-INPUT.
- e. Repeat steps b and c for Y-deflection Amplifier.

---

**PERFORMANCE TESTS**


---

**4-14. CROSSTALK.****SPECIFICATION:**

<0.38 mm (0.015 in.) with one input terminated in  $50\Omega$  and the other input driven by 1 V, 500 kHz signal.

**DESCRIPTION:**

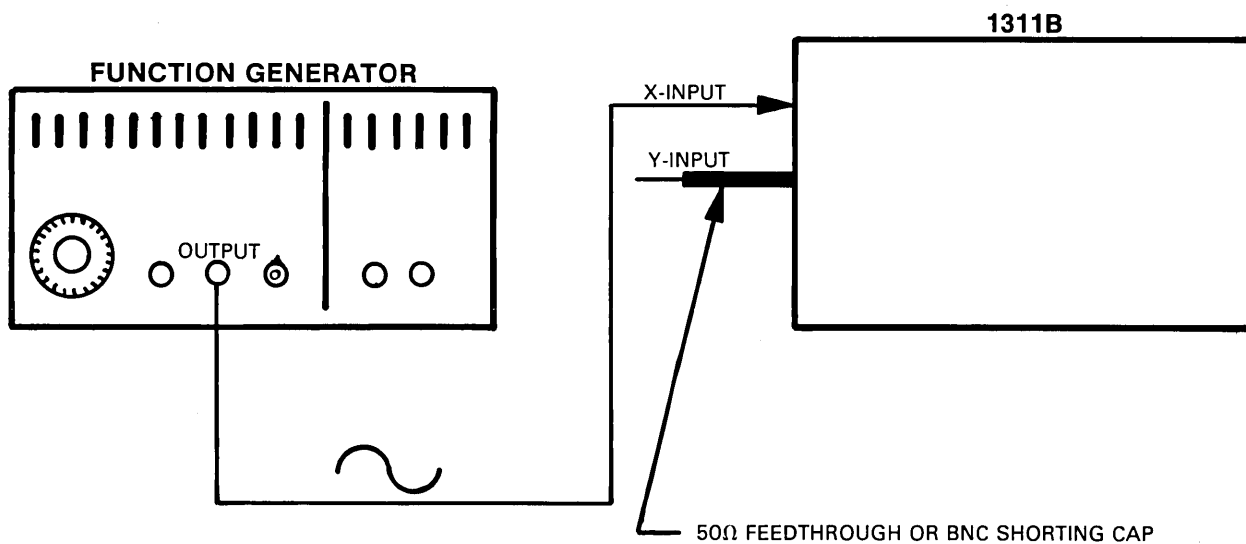
Crosstalk between deflection amplifiers is determined by measuring tracewidth when one input is terminated in  $50\Omega$  or a BNC shorting cap and a 1 V, 500 kHz is applied to the other input.

**EQUIPMENT REQUIRED:**

Function Generator.

**PROCEDURE:**

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



*Figure 4-5. Cross Talk Test Setup*

- b. Apply a 1 V p-p, 500 kHz sine wave from function generator to X-INPUT.
- c. Set front panel X and Y GAIN controls fully cw and check for no visible change in tracewidth.
- d. Reverse connections to X and Y INPUT and repeat steps b and c.

---

**PERFORMANCE TESTS**


---

**4-15. Z-AXIS BLANKING POLARITY.****SPECIFICATION:**

-1 Vdc (INTENSITY at maximum) blanks trace. 1 Vdc (INTENSITY at minimum) provides maximum trace intensity.

**DESCRIPTION:**

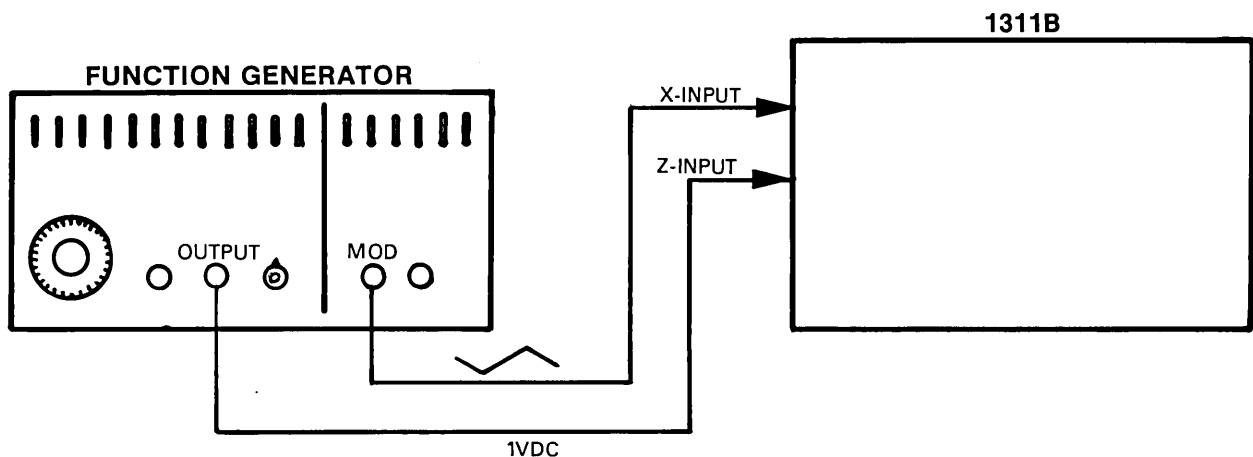
With INTENSITY set to maximum, a -1 Vdc signal at the Z-INPUT shall blank the CRT. With INTENSITY set to minimum a +1 Vdc signal at the Z-INPUT provides maximum trace intensity.

**EQUIPMENT REQUIRED:**

Function Generator

**PROCEDURE:**

- a. Connect equipment as shown in figure 4-6.



*Figure 4-6. Z-axis Blanking Polarity Test Setup*

- b. Apply +1 Vdc to Z-INPUT and check for maximum trace intensity. INTENSITY control should have no effect on trace brightness.
- c. Apply -1 Vdc to Z-INPUT and check for no trace on screen. INTENSITY control should not bring trace on screen.

---

**PERFORMANCE TESTS**


---

**4-16. SETTLING TIME.****SPECIFICATION:**

1 V Input <500 ns; 100 mV Input <200 ns.

**DESCRIPTION:**

The CRT beam, when moved from one position to another, must settle to within 1 spot diameter in less than 500 ns for a 1 V input and less than 200 ns for 100 mV input.

**PROCEDURE:**

- a. Set Display INTENSITY Control fully cew.
- b. Connect equipment as shown in figure 4-7. Do not connect Z-INPUT at this time.

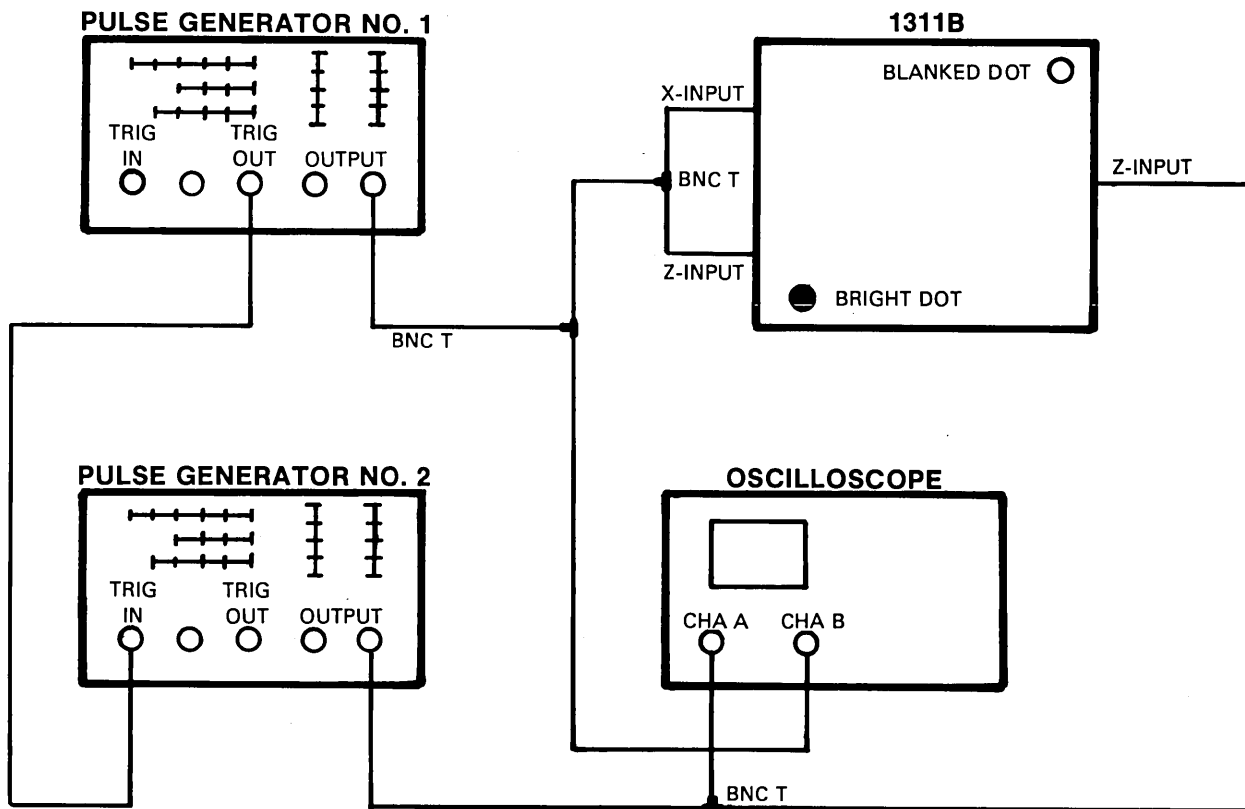


Figure 4-7. Settling Time Test Setup

- c. Using the monitor oscilloscope adjust Pulse Generator No. 1 to 10  $\mu$ s.
- d. Adjust output amplitude of Pulse Generator No. 1 for 1 V.
- e. Adjust Pulse Generator No. 2 for a pulse width of .2  $\mu$ s at an amplitude of 1 V, using the monitor oscilloscope.
- f. Connect Z-INPUT. Adjust Display INTENSITY to view one dot only. (See figure 4-7.)
- g. Check monitor oscilloscope for the following display (figure 4-8).

## PERFORMANCE TESTS

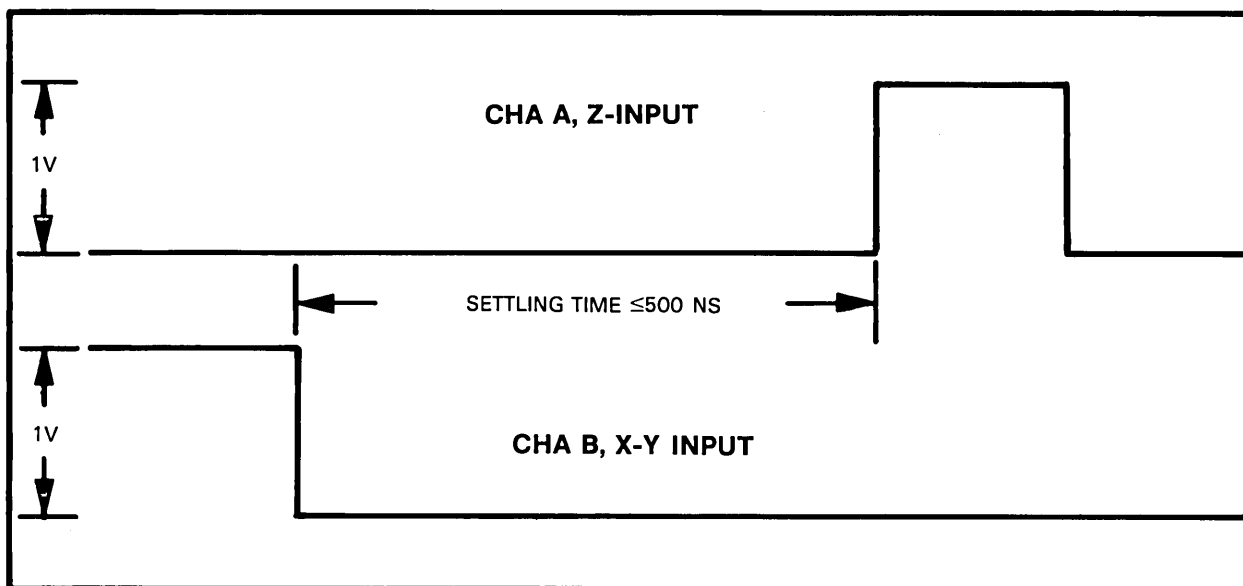


Figure 4-8. Settling Time Measurement with 1 V Input

- h. Monitor the display and adjust the PULSE DELAY VERNIER on Pulse Generator No. 2 until a tail appears on the bright dot.
- i. When the tail measures 1 dot diameter measure the time difference between the pulses displayed on the monitor oscilloscope. Time between pulses must not exceed 500 ns.
- j. Adjust Pulse Generator No. 2 for an output signal of 100 mV.
- k. Adjust PULSE DELAY VERNIER on Pulse Generator No. 1 ccw until tail appears on bright dot.
- l. Readjust PULSE DELAY VERNIER on Pulse Generator No. 2 cw until tail just disappears.
- m. The time difference measured between pulses on monitor oscilloscope must be less than 200 ns. (See figure 4-9.)

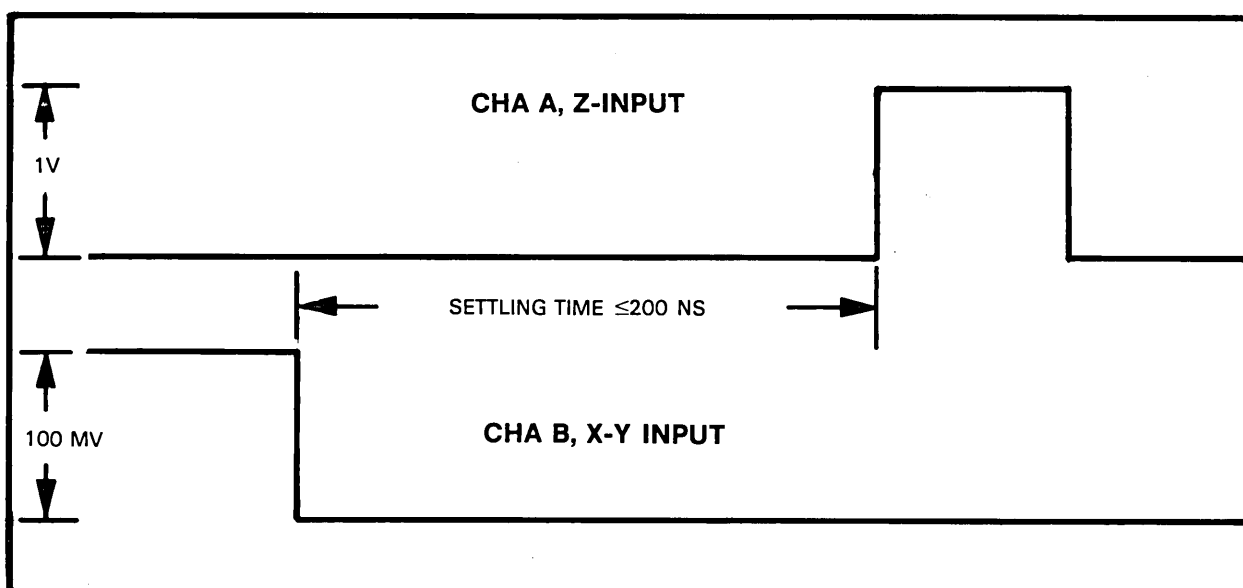


Figure 4-9. Settling Time Measurement with 100 mV Input





**PERFORMANCE TEST RECORD**

**HEWLETT-PACKARD**

**MODEL 1311B**

**X-Y DISPLAY**

**Tested by** \_\_\_\_\_

**SERIAL NO.** \_\_\_\_\_

**Date** \_\_\_\_\_

Paragraph Number	Test	Min	Results Actual	Max
4-10	X- Y-bandwidth X-bandwidth Y-bandwidth	$\geq 9.1$ cm (3.6 in.) $\geq 9.1$ cm (3.6 in.)	_____ _____	
4-11	X- Y-deflection Factor X-deflection Factor	$\leq 16.4$ cm (6.5 in.)	_____	
4-12	Y-deflection Factor	$\leq 12.2$ cm (4.8 in.)	_____	
4-13	Repeatability X-amplifier Y-amplifier		_____ _____	$\leq 0.15\%$ $\leq 0.15\%$
4-14	Crosstalk X-amplifier to Y-amplifier Y-amplifier to X-amplifier		_____ _____	$\leq 0.38$ mm (0.015 in.) $\leq 0.38$ mm (0.015 in.)
4-15	Z-axis Blanking Polarity +1 Vdc (Max. Intensity) -1 Vdc (No Trace)		_____ _____	
4-16	Settling Time Large Signal (1.0 V) Small Signal (0.1 V)		_____ _____	$\leq 500$ ms $\leq 200$ ms

## SECTION V

### ADJUSTMENTS

#### 5-1. INTRODUCTION.

5-2. This section describes adjustments and checks required to return the instrument to peak operating capabilities when repairs have been made. Included in this section are equipment setups and adjustment procedures.

#### 5-3. SAFETY REQUIREMENTS.

5-4. Although this instrument has been designed in accordance with international safety standards, general safety precautions must be observed during all phases of operation, service, and repair of the instrument. Failure to comply with the precautions listed in the Safety Summary at the front of this manual or with specific warnings given throughout this manual could result in serious injury or death. Service and adjustments should be performed only by qualified service personnel.

#### 5-5. EQUIPMENT REQUIRED.

5-6. A complete list of required test equipment is given in Section I, table 1-4. Test equipment equivalent to that recommended may be substituted, provided it meets the required characteristics. For best results, use recently calibrated test equipment.

#### 5-7. ADJUSTMENTS.

5-8. The adjustment procedures are arranged in a recommended sequence of adjustments. While most adjustments may be made independent of other adjustments, it is recommended that adjustments be made sequentially as a number of adjustments are directly related to preceding or following adjustments.

5-9. For best results, allow the instrument to warm up for 15 minutes before making adjustments. Adjustment locations for the Low Voltage and High Voltage Power Supplies are shown in figure 5-4. Figures 5-6, 5-11, and 5-18, show adjustment locations for Z-axis amplifier, X-Y amplifiers, and focus and astigmatism amplifier respectively.

#### 5-10. ADJUSTMENT PROCEDURES.

**WARNING**

#### ELECTRICAL SHOCK HAZARD

Use extreme caution when instrument covers are removed and power is applied. Voltages up to 24 kV are present around the CRT and HVPS areas and are capable of causing serious injury or death. Read the Safety Summary at the front of this manual before proceeding.



**ADJUSTMENTS**

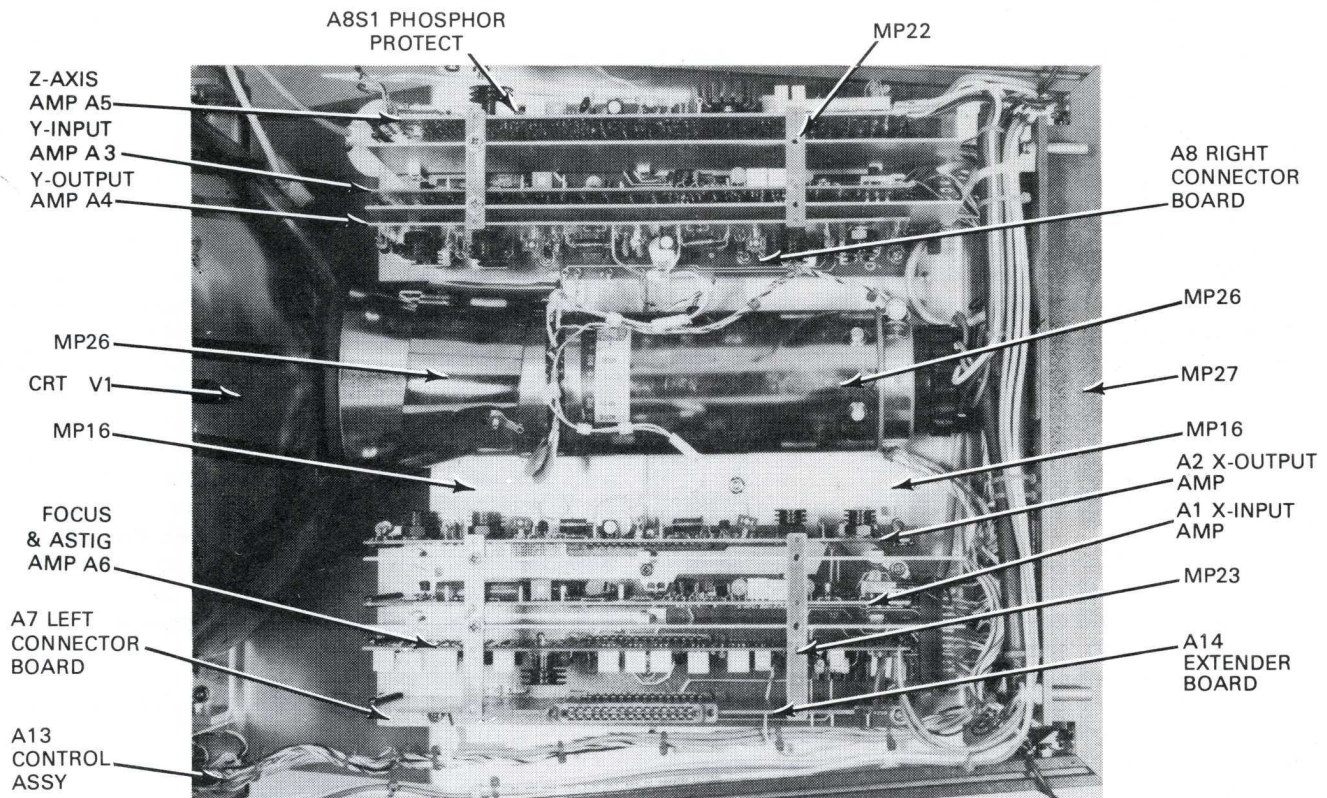


Figure 5-1. 1311B Top View

673-79

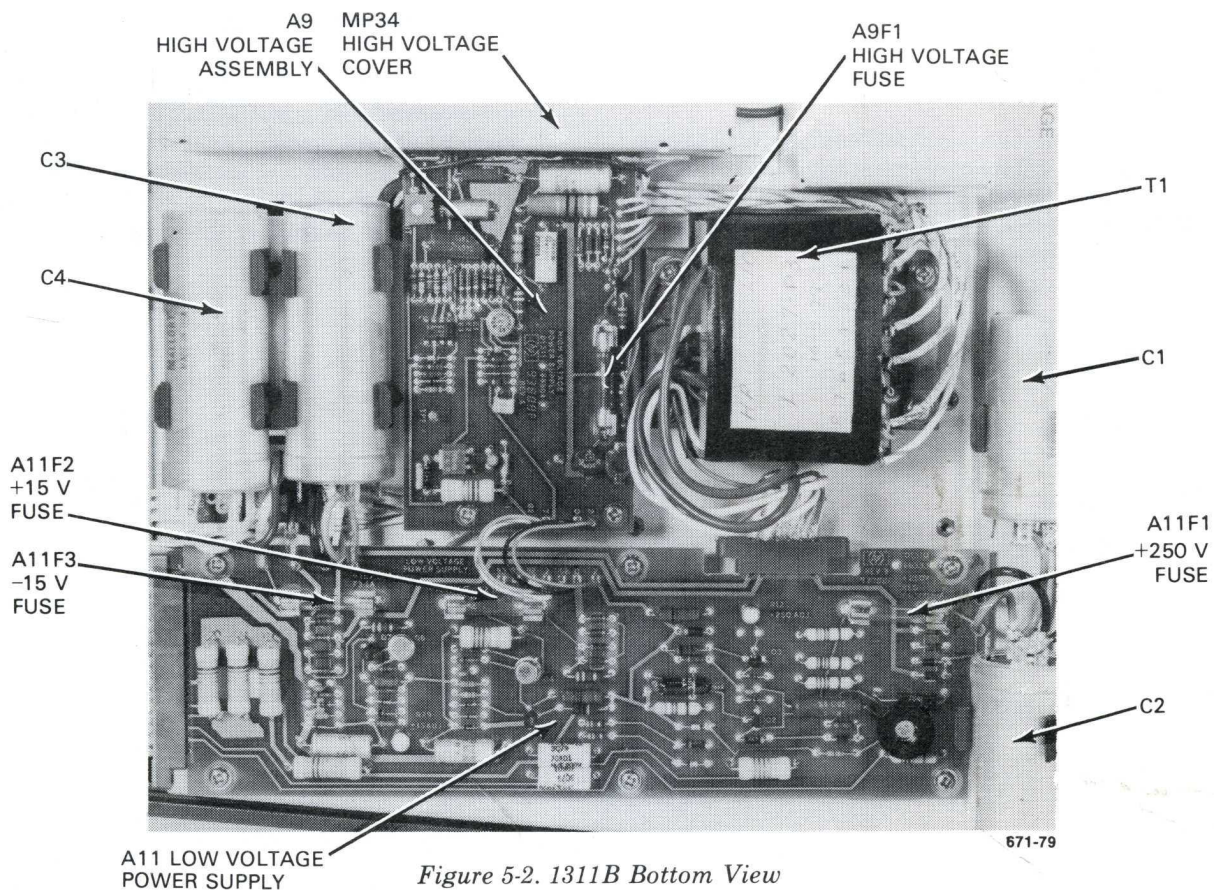


Figure 5-2. 1311B Bottom View

671-79

**NOTE**

The following Adjustment Procedures are written for the standard instrument only. If optional attenuators have been installed, readjust all input signal levels accordingly.

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**ADJUSTMENTS**

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**5-11. LOW VOLTAGE POWER SUPPLY ADJUSTMENTS.****REFERENCE:**

Service Sheet 8.

**DESCRIPTION:**

The +250 V and the -15 V are the adjustable power supplies. The +15 V supply is referenced to the -15 V supply. The +250 V supply is adjusted to within  $\pm 0.1$  V. The -15 V supply is adjusted so that both +15 V and -15 V supplies are within  $\pm 0.1$  V.

**EQUIPMENT:**

Digital Multimeter

**PROCEDURE:****CAUTION**

The +250 V supply is used as reference for the CRT cathode regulator circuit. Precise calibration of the +250 V supply is essential for proper reference of the cathode supply. If the +250 supply is not properly calibrated, the cathode voltage may exceed acceptable limits, and may cause activation of the HV shutdown circuit.

- a. Connect digital voltmeter between red wire and chassis ground on the low voltage power supply board A11.
- b. Adjust the +250 V supply (A11R12) for +250 V  $\pm 0.1$  V.
- c. Alternately connect the digital voltmeter to the violet and white/red wire on low voltage power supply board (A11) while adjusting the -15 V (A11R29) supply for equal error between the -15 V and +15 V supply. Final error on either supply must be  $\leq \pm 0.1$  V.



## ADJUSTMENTS

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### 5-12. HIGH VOLTAGE POWER SUPPLY.

#### NOTE

The following procedure need be performed only if repairs have been made to the high voltage power supply (A9) or if all of the high-voltage assembly has been replaced.

#### REFERENCE:

Service Sheet 7.

#### DESCRIPTION:

This procedure describes calibration of the high voltage shutdown circuit which ensures that the cathode voltage can never exceed  $-4750$  V.

#### EQUIPMENT REQUIRED:

Digital Voltmeter  
1000:1 Divider Probe

**WARNING**

Proper calibration of the high voltage shutdown circuit is necessary to prevent excessive cathode voltage being applied to the CRT. Cathode voltages in excess of  $-4750$  V may result in x-ray emissions exceeding .5 mR/hr. Proper operation of the high voltage shutdown circuit ensures that x-ray emissions do not exceed .5 mR/hr under normal operating conditions, and under misadjustment and failure conditions. See Section VIII for Theory of Operation.

#### PROCEDURE:

- a. Measure the +250 V power supply and ensure a reading of +250.1 V to 249.9 V. If necessary, readjust the +250 V power supply (see paragraph 5-11).
- b. Check the accuracy of the 1000:1 Divider Probe by measuring the +250 V power supply using the digital voltmeter and the 1000:1 Divider Probe. Record the reading as  $V_{CAL}$ .
- c. Measure the cathode voltage (4 wire on the A5 board) with the digital voltmeter and the 1000:1 Divider Probe. Record the reading as  $V_K$ .
- d. Plot  $V_{CAL}$  and  $V_K$  on the Nomograph in figure 5-3. If  $V_{CAL}$  plots off the Nomograph, then the 1000:1 Divider Probe does not meet the required  $\pm 3\%$  accuracy. If  $V_K$  or  $V_C$  plot off the Nomograph, then one or more of the following resistors must be out of tolerance: A9R3; A9R4; A9R24.
- e. Temporarily connect resistor "R" (value obtained from figure 5-3) in parallel with A9R3 (750 K $\Omega$ ). If the addition of resistor "R" triggers the high voltage shutdown circuit, (A9TP1 becomes positive and high voltage shuts down), remove "R" and proceed to the next test.
- f. If the addition of resistor "R" does not trigger the high voltage shutdown circuit (A9TP1 remains negative), remove in sequence A9E1, A9E2, and A9E3 until A9TP1 becomes positive and high voltage shutdown occurs. Leave out the required jumper (A9E1, A9E2, A9E3) when high voltage shutdown has been achieved. Complete the adjustment by removing resistor "R".
- g. If high voltage shutdown can not be accomplished check the tolerance of the following components:
  - A9VR3 - should be 5.11 V  $\pm 2\%$  (5.01 V to 5.21 V)
  - A9R21 - should be 38.3k  $\pm 1\%$  (37.917k to 38.683k)
  - A9R22 - should be 274 K $\Omega$   $\pm 10\%$  (301.4k to 246.6k)
  - A9R24 - should be 30 M $\Omega$   $\pm 1\%$  (29.7 M $\Omega$  to 30.3 M $\Omega$ ).

ADJUSTMENTS

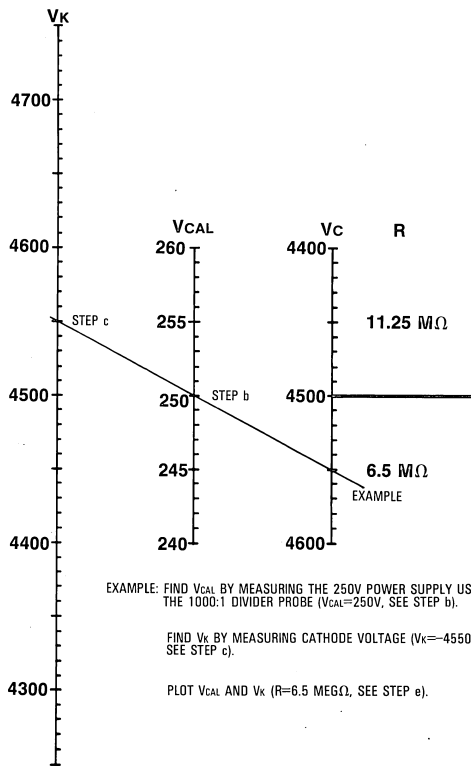


Figure 5-3. High Voltage Shutdown Circuit Nomograph

ADJUSTMENTS

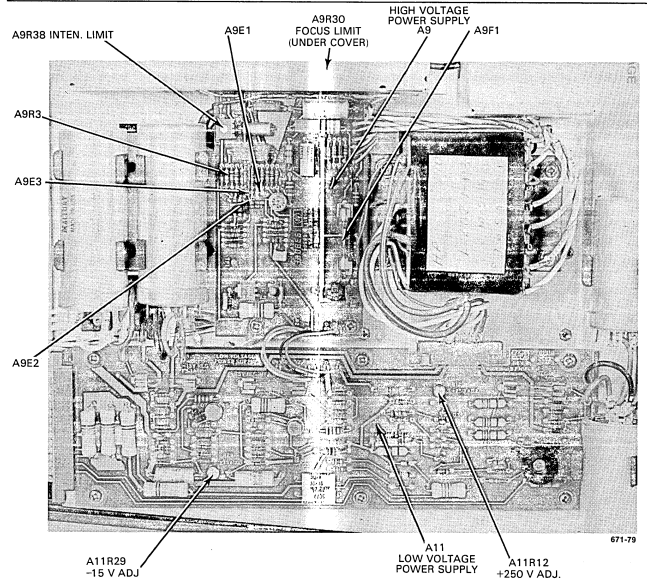


Figure 5-4. Low Voltage and High Voltage Power Supply Adjustment Locations

Table 5-1. Low Voltage and High Voltage Power Supply Adjustments

Reference Designator	Adjustment Name	Adjustment Paragraph	Service Sheet	Description
A11R12	+250 V SUPPLY	5-11	8	Adjust supply for 250 V $\pm 0.1$ V
A11R29	-15 V SUPPLY	5-11	8	Adjust -15 V and +15 V Supply for equal error not exceeding $\pm 1$ V
A9E1 A9E2 A9E3	HIGH VOLTAGE SHUTDOWN	5-12	7	Check for high voltage shutdown below -4750 V



## ADJUSTMENTS

### 5-13. Z-AXIS BALANCE ADJUSTMENTS.

**REFERENCE:**  
Service Sheet 4.

**DESCRIPTION:**  
The Z-axis amplifier balance (A5R13) is adjusted so that there is a 3 V increase in Z-axis amplifier output as the front panel INTENSITY control is rotated from minimum to maximum.

**EQUIPMENT:**  
Digital Voltmeter

- PROCEDURE:**
- Remove power and turn off phosphor protect switch (A8S1).
  - Disable high voltage oscillator by removing A9F1.
  - Preset all adjustments on the Z-axis board (A5) to midrange and the front-panel INTENSITY control fully CCW.
  - Apply power to the display.
  - Adjust Z-axis offset (A5R19) for approximately 20 V at the Z-axis output (A5TP1).
  - Monitor the Z-axis output (A5TP1) with the digital voltmeter and rotate the front panel INTENSITY control to minimum (fully ccw).
  - Adjust the Z-axis balance (A5R13) such that a 3 V increase is noted at the Z-axis output (A5TP1) as the front panel INTENSITY control is rotated from minimum to maximum.

#### NOTE

The amplifier offset will change when the balance is adjusted. After each balance adjustment recheck the Z-axis output voltage change by varying the front panel INTENSITY from minimum to maximum setting.

### 5-14. Z-AXIS GAIN, OFFSET, AND INTENSITY LIMIT ADJUSTMENTS.

**REFERENCE:**  
Service Sheet 4.

**DESCRIPTION:**  
The intensity limit and offset adjustments provide proper CRT grid bias as defined by the CRT cutoff voltage. The gain adjustment provides the proper CRT grid drive as defined by the CRT cutoff voltage.

**EQUIPMENT:**  
Monitor Oscilloscope  
Pulse Generator  
Digital Voltmeter  
Low Capacitance 50:1 Divider Probe

- PROCEDURE:**
- Readjust Z-axis offset (A5R19) for 20 V at the Z-axis output (A5TP1).
  - Set intensity limit (A9R38) for maximum voltage at A9C21.
  - Turn off power and enable high voltage oscillator by replacing A9F1.
  - Apply power and adjust intensity limit (A9R38) for a dimly visible dot on the screen.

Adjustments

Model 1311B

## ADJUSTMENTS

- Record the voltage at A9C21 and the Z-axis output (A5TP1). The difference between the two voltages is the CRT cutoff voltage.

$$\text{CRT cutoff voltage} = V_{\text{at A9C21}} - V_{\text{at A5TP1}}$$

- Position the beam off-screen and apply a 10 kHz +1 V, 1 microsecond wide (1% duty cycle) pulse to the Z-INPUT.
- Set front panel INTENSITY control (A13R1) fully cw and monitor the Z-axis output (A5TP1) with the monitor oscilloscope (use 50:1 divider probe).
- Adjust the Z-axis gain (A5R14) and Z-axis offset (A5R19) for a peak-to-peak amplitude signal equal to 75% of the CRT cutoff voltage or 47 V, whichever is less (see step e for CRT cutoff voltage).
- Adjust Z-axis offset (A5R19) such that the positive position of the pulse is just equal to the maximum Z-axis output, maintaining the same peak-to-peak amplitude obtained in step h (see figure 5-5).

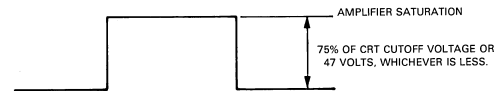


Figure 5-5. Z-axis Gain and Offset Adjustment

- Apply 10 kHz, a 1 V p-p, 1 microsecond wide (1% duty cycle) pulse having a -1 V base line to the Z-axis INPUT. Position the beam on-screen and rotate the front panel INTENSITY control to minimum. Adjust the intensity limit (A9R38) for a visible, low intensity dot on the screen. Rotation of the front panel INTENSITY control towards maximum, or removal of the Z-axis input signal should produce a brighter dot. If not, recheck gain, offset, and balance adjustments.

**ADJUSTMENTS**

**5-15. Z-AXIS PULSE RESPONSE.**

**REFERENCE:**  
Service Sheet 4

**DESCRIPTION:**  
The high frequency response adjustments (A5C27, A5R36) trim the Z-axis amplifier pulse response for a fast rise time consistent with minimum overshoot (rise time =  $\leq 25$  microseconds, overshoot typically is  $\leq 5\%$ ).

**EQUIPMENT:**  
Monitor Oscilloscope  
Pulse Generator  
Low Capacitance 50:1 Divider Probe

- PROCEDURE:**
- Position beam off-screen and apply 10 kHz, a +1 V, 1 microsecond wide (1% duty cycle) pulse to the Z-axis INPUT.
  - Set front panel INTENSITY CCW.
  - Connect the monitor oscilloscope to the Z-axis output (A5TP1). Use the 50:1 divider probe.
  - Monitor the oscilloscope and adjust HF1 (A5C27) and HF2 (A5R36) to obtain a pulse of  $\leq 25$  nanosecond rise time with minimum perturbations ( $\pm 5\%$  typical).

Model 1311B

Adjustments

**ADJUSTMENTS**

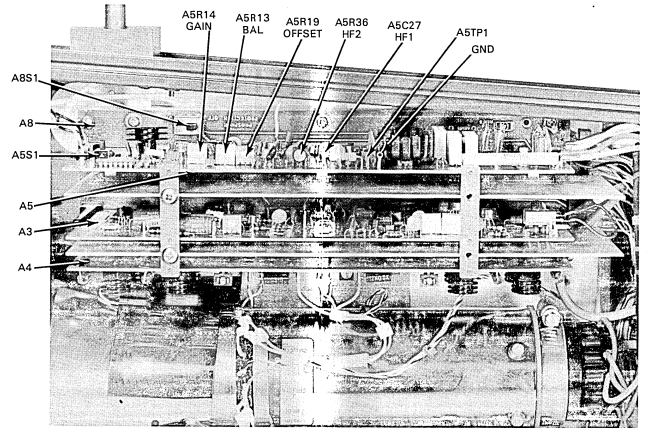


Figure 5-6. Z-axis Amplifier Adjustment Locations

Table 5-2. Z-axis Amplifier Adjustments

Reference Designator	Adjustment Name	Adjustment Paragraph	Service Sheet	Description
A5R19	Z-AXIS OFFSET	5-13	4	Adjust Z-OFFSET for 20 V output at Z-AXIS output (A5TP1)
A5R13	Z-AXIS BALANCE	5-13	4	Adjust for 3 V increase at Z-AXIS output when intensity control is turned from minimum to maximum
A9R38	INTENSITY LIMIT	5-14	7	Adjust for dimly visible dot on screen with INTENSITY at minimum and 1 V p-p at Z-AXIS input
A5R14	Z-AXIS GAIN	5-14	4	Adjust to 75% of CRT cutoff or +47 V whichever is less (monitor at A5TP1)
A5R19	Z-AXIS OFFSET	5-14	4	Adjust so that positive portion of pulse is equal to maximum Z-AXIS output (monitor at A5TP1)
A5C27 A5R36	Z-AXIS HF1 Z-AXIS HF2	5-15	4	Adjust for pulse rise time of $\leq 25$ ms

**ADJUSTMENTS**

**5-16. X-AMPLIFIER GAIN ADJUSTMENT.**

**REFERENCE:**  
Service Sheet 2.

**DESCRIPTION:**  
The X amplifier gain is adjusted so that the front-panel X-GAIN control has a range of .9 V to 1.6 V (1.75:1 ratio).

**EQUIPMENT:**

Function Generator  
Monitor Oscilloscope

**PROCEDURE:**

- a. Connect equipment as shown in figure 5-7.
- b. Set front-panel X-Gain control fully clockwise.
- c. Set function generator output as follows:

FREQUENCY ..... 1 kHz  
 FUNCTION ..... Sine Wave  
 AMPLITUDE ..... .9 V p-p as monitored on oscilloscope

- d. Adjust X amplifier gain A1R12 for 26 cm (10.25 in.) of deflection.
- e. Increase output of function generator to 1.6 V p-p.
- f. Set front-panel X-GAIN fully counterclockwise and check for  $\leq 25.4$  cm (10 in.) of deflection.

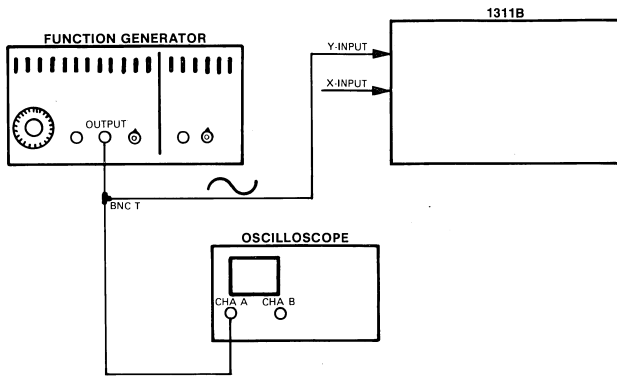


Figure 5-7. Gain-set Adjustment Test Setup

**ADJUSTMENTS**

**5-17. Y-AMPLIFIER GAIN ADJUSTMENT.**

**REFERENCE:**  
Service Sheet 2.

**DESCRIPTION:**  
The Y-amplifier gain is adjusted so that the front panel Y-GAIN has a range of .9 V to 1.6 V (1.75:1 ratio).

**EQUIPMENT:**

Function Generator  
Monitor Oscilloscope

**PROCEDURE:**

- a. Connect equipment as shown in figure 5-7.
- b. Set front-panel Y-Gain control fully clockwise.
- c. Set function generator output as follows:

FREQUENCY ..... 1 kHz  
 FUNCTION ..... Sine Wave  
 AMPLITUDE ..... .9 V p-p as monitored on oscilloscope

- d. Adjust Y-Amplifier gain A3R12 for 22.2 cm (8.75 in.).
- e. Increase output of function generator to 1.6 V p-p.
- f. Set front-panel Y-GAIN fully counterclockwise and check for  $\leq 21.6$  cm (8.5 in.) of deflection.

**5-18. X-AMPLIFIER DC BALANCE ADJUSTMENT.****REFERENCE:**

Service Sheet 2.

**DESCRIPTION:**

The X-amplifier average and balance adjustments (A1R64, A1R11) are set to minimize dc shift when the front panel X-GAIN control is rotated throughout its range.

**EQUIPMENT:**

Digital Voltmeter

**PROCEDURE:**

- a. Remove ground strap from digital voltmeter and connect voltmeter leads differentially to the horizontal deflection plates (9 and 5 wires on X output amplifier, A2).
  - b. Set front panel X-POSITION control for a 0 V reading on digital voltmeter.
  - c. Disconnect digital voltmeter common lead and connect it to chassis ground.
  - d. Set average adjustment (A1R64) for a reading of +108 V on digital voltmeter.
  - e. Turn front panel X-GAIN control back and forth between its cw and ccw position while observing spot on display. Set balance adjustment (A1R11) to minimize movement of spot. Spot movement shall not exceed 0.8 cm (0.3 in.).
- 

**5-19. Y-AMPLIFIER DC BALANCE ADJUSTMENT.****REFERENCE:**

Service Sheet 2.

**DESCRIPTION:**

The Y-amplifier average and balance adjustments (A3R64, A3R11) are set to minimize dc shift when the front panel Y-GAIN control is rotated throughout its range.

**EQUIPMENT:**

Digital Voltmeter

**PROCEDURE:**

- a. Remove ground strap from digital voltmeter and connect voltmeter leads differentially to the vertical deflection plates (9 and 5 wires on Y-output amplifier, A4).
  - b. Set front panel Y-POSITION control for a 0 V reading on digital voltmeter.
  - c. Disconnect digital voltmeter common lead and connect it to chassis ground.
  - d. Set average adjustment (A3R64) for a reading of +108 V on digital voltmeter.
  - e. Turn front panel X-GAIN control back and forth between its cw and ccw position while observing spot on display. Set balance adjustment (A3R11) to minimize movement of spot. Spot movement shall not exceed 0.8 cm (0.3 in.).
-

**5-20. X-AMPLIFIER PULSE RESPONSE AND BANDWIDTH ADJUSTMENTS.****REFERENCE:**

Service Sheet 3.

**DESCRIPTION:**

The X-amplifier response adjustments are set for an amplifier rise time of  $\leq 75$  nanoseconds at minimum overshoot and a bandwidth of 5 MHz.

**EQUIPMENT:**

Pulse Generator  
Monitor Oscilloscope  
Function Generator

**PROCEDURE:**

- a. Set 50 $\Omega$ /10 K $\Omega$  input impedance switch (A1S1) to 50 $\Omega$ .
- b. Connect equipment as shown in figure 5-8.

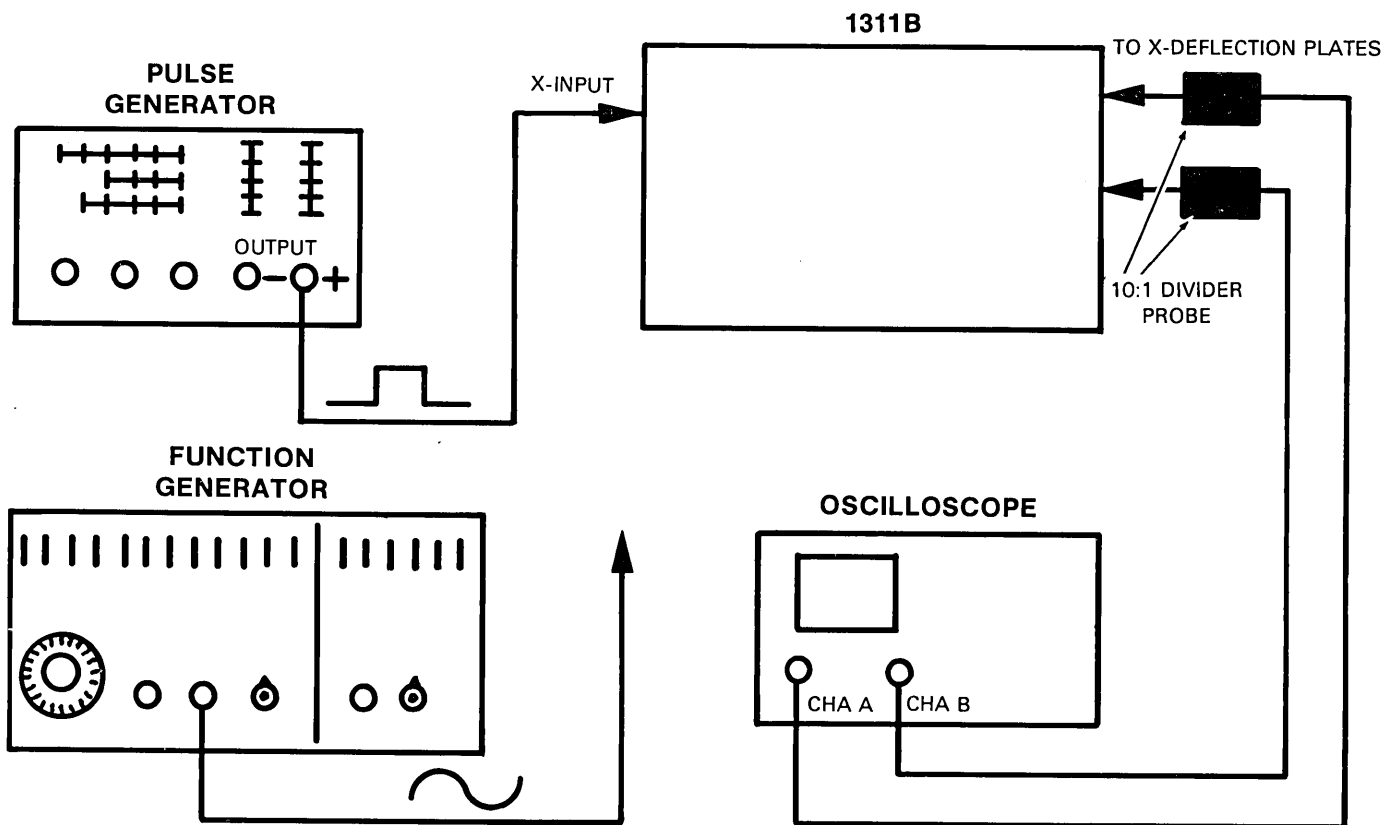


Figure 5-8. X-amplifier Pulse Response and Bandwidth Adjustment Setup

- c. Set pulse generator controls as follows:

PULSE PERIOD .....  $\cong 10$  microsecond  
 PULSE WIDTH ..... 50% duty cycle  
 AMPLITUDE ..... full screen deflection

---

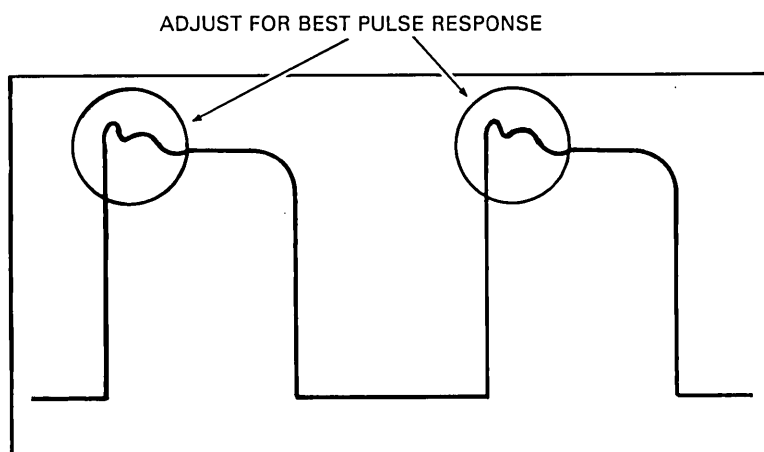
**ADJUSTMENTS**


---

- d. Connect oscilloscope to the X-deflection plates (9 and 5 wires on X-output amplifier, A2), and set oscilloscope controls as follows:

DISPLAY .....	A+B
TIME/DIV .....	10 microsecond/DIV
CHANNEL INPUT ATTENUATORS .....	1 V/DIV
CHANNEL B .....	INVERT
COUPLING .....	AC

- e. Set LF ADJ No. 1 (A2R24) and LF ADJ No. 2 (A1C17) for flattest pulse response as indicated in figure 5-9.



*Figure 5-9. X-amplifier Pulse Response Adjustment*

- f. Measure rise time of the pulse between the 10% to 90% points as displayed on the oscilloscope. Rise time must be  $\leq 75$  nanoseconds.
- g. Disconnect Pulse Generator from X-INPUT and connect the function generator.
- h. Apply a 50 kHz sine wave from function generator to the X-INPUT. Set output amplitude of function generator to cause 12.7 cm (5 in.) of deflection on the CRT.
- i. Change frequency of function generator to 5 MHz.
- j. Adjust HF ADJ No. 1 (A2C8) and HF ADJ No. 2 (A4C12) for 9.4 cm (3.6 in.) of vertical deflection.
- k. Repeat steps e through j until amplifier rise time and bandwidth are within specified limits.
-

---

**ADJUSTMENTS**


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**5-21. Y-AMPLIFIER PULSE RESPONSE AND BANDWIDTH ADJUSTMENTS.****REFERENCE:**

Service Sheet 4.

**DESCRIPTION:**

The Y-amplifier response adjustments are set for an amplifier rise time of  $\leq 75$  nanoseconds at minimum overshoot and a bandwidth of 5 MHz.

**EQUIPMENT:**

Pulse Generator  
Monitor Oscilloscope  
Function Generator

**PROCEDURE:**

- a. Set 50 $\Omega$ /10 K $\Omega$  input impedance switch (A3S1) to 50 $\Omega$ .
- b. Connect equipment as shown in figure 5-10.

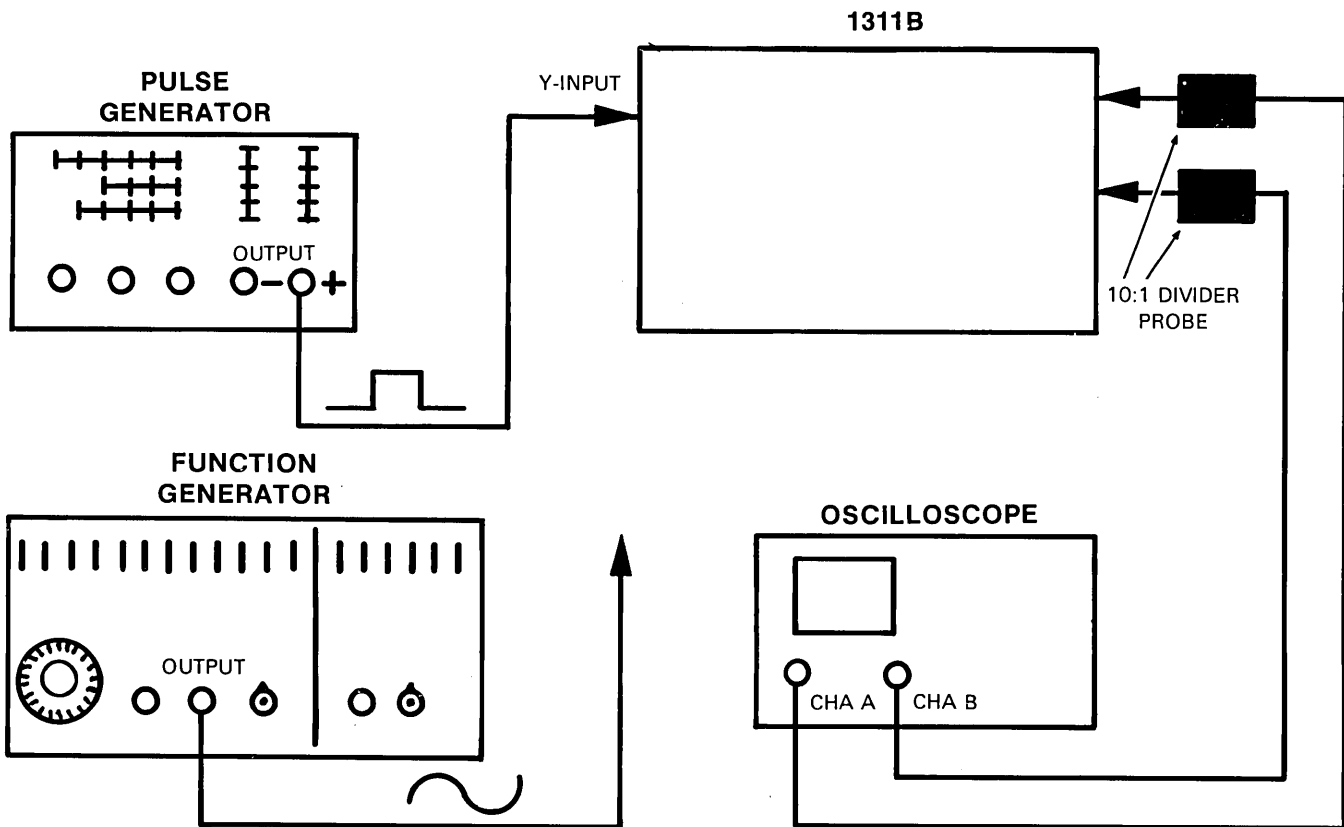


Figure 5-10. Y-amplifier Pulse Response and Bandwidth Adjustment Setup

- c. Set pulse generator controls as follows:

PULSE PERIOD .....	$\cong 10$ microseconds
PULSE WIDTH .....	50% duty cycle
AMPLITUDE .....	full screen deflection

---



**ADJUSTMENTS**

- d. Connect oscilloscope to the Y-deflection plates (9 and 5 wires on Y-output amplifier, A4), and set oscilloscope controls as follows:
- |                                 |                 |
|---------------------------------|-----------------|
| DISPLAY .....                   | A+B             |
| TIME/DIV .....                  | 10 microseconds |
| CHANNEL INPUT ATTENUATORS ..... | 1 V/DIV         |
| CHAN B .....                    | invert          |
- e. Set LF ADJ No. 1 (A4R24) and LF ADJ No. 2 (A4C17) for flattest pulse response as indicated in figure 5-11.

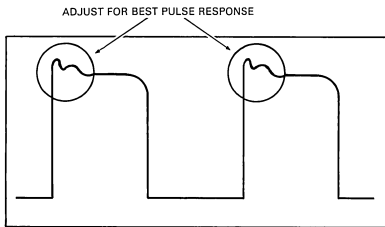


Figure 5-11. Y-amplifier Pulse Response Adjustment

- f. Measure rise time of the pulse between the 10% and 90% points as displayed on the oscilloscope. Rise time must be  $\leq 75$  nanoseconds.
- g. Disconnect pulse generator from Y-INPUT and connect the function generator.
- h. Apply a 50 kHz sine wave from function generator to the Y-INPUT. Set output amplitude of function generator to cause 12.7 cm (5 in.) of deflection on the CRT.
- i. Change frequency of function generator to 5 MHz.
- j. Adjust HF ADJ No. 1 (A4C28) and HF ADJ No. 2 (A4C12) for 9.4 cm (3.6 in.) of vertical deflection.
- k. Repeat steps e through j until amplifier rise time and bandwidth are within specified limits.

**ADJUSTMENTS**

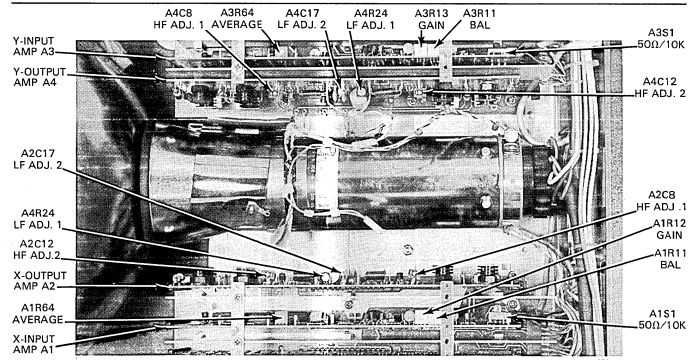


Figure 5-12. X-Y Amplifier Adjustment Locations

Table 5-3. X-Y Amplifier Adjustments

Reference Designator	Adjustment Name	Adjustment Paragraph	Service Sheet	Description
A1R12	X-GAIN	5-16	2	Adjust so that front panel X-GAIN provides .9 V to 1.6 V adjustment range.
A1R11	X-BALANCE	5-18	2	Adjust to minimize movement of display when X-GAIN is moved from minimum to maximum
A2R24; A2C17	LF NO. 1; LF NO. 2	5-20	3	Adjust for flattest pulse response at 75 ms
A2C28; A2C12	HF NO. 1; HF NO. 2	5-20	3	Adjust for bandwidth of 5 MHz
A3R12	Y-GAIN	5-17	2	Adjust so that front panel Y-GAIN provides .9 V to 1.6 V adjustment range.
A3R11	Y-BALANCE	5-19	2	Adjust to minimize movement of display when Y-GAIN is moved from minimum to maximum
A4C17; A4R24	LF NO. 1; LF NO. 2	5-21	3	Adjust for flattest pulse response at 75 ms
A4C28; A4C12	HF NO. 1; HF NO. 2	5-21	3	Adjust for bandwidth of 5 MHz

**ADJUSTMENTS**

**5-22. TRACE-ALIGN AND ORTHO ADJUSTMENT.**

**REFERENCE:**  
Service Sheet 7.

**DESCRIPTION:**  
The trace is electrically aligned horizontally and vertically with the sides of the 1311B.

**EQUIPMENT:**  
Function Generator

- PROCEDURE:**
- Apply a 1 V p-p, 1 kHz Sine Wave from function generator to the X-INPUT.
  - Set TRACE ALIGN to cause trace to lie parallel to the top or bottom of the cabinet.
  - Disconnect function generator from X-INPUT and connect to Y-INPUT.
  - Set ORTHOG to cause the trace to lie parallel to the cabinet sides.

**5-23. DYNAMIC FOCUS AND ASTIGMATISM ADJUSTMENT.**

**REFERENCE:**  
Service Sheets 5 and 6.

**DESCRIPTION:**  
The following procedure describes the dynamic focus and astigmatism adjustments using the HP Model 1350A Graphics Translator and the HP Model 9825A, HP-IB Controller.

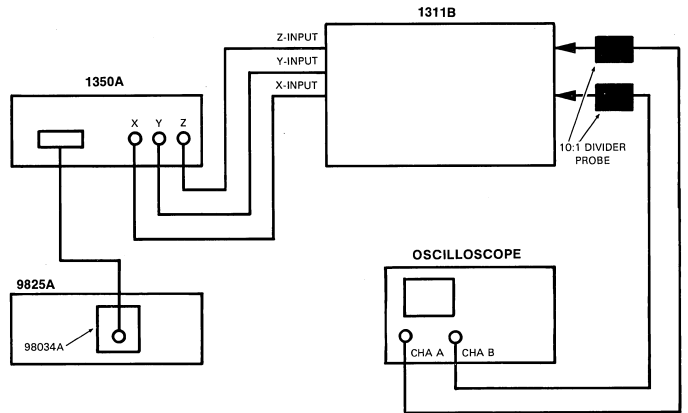
**EQUIPMENT:**  
9825A HP-IB Controller, equipped with 98210A String Advanced Program ROM;  
98214 Extended I/O ROM;  
98034A HP-IB Interface;  
1350A Graphics Translator;  
Monitor Oscilloscope.

- PROCEDURE:**
- Set up test equipment as shown in figure 5-13.

Adjustments

Model 1311B

**ADJUSTMENTS**



NOTE. CONNECT CHANNEL A DIVIDER PROBE TO JUNCTION OF A6Q25 AND A6R111.  
CONNECT CHANNEL B DIVIDER PROBE TO JUNCTION OF A6Q21 AND A6R96.

Figure 5-13. Dynamic Focus and Astigmatism Test Setup

**NOTE**

If Option 003 is installed, set front panel INTENSITY control for a dimly viewable spot before connecting the X-Y-Z-INPUTS. Leave INTENSITY setting for the remainder of this adjustment procedure.

- Set X-Y-Z-amplifier input impedance switches (A1S1, A3S1, A5S1) to 50 $\Omega$ .
- Preset all adjustments on the focus and astigmatism board (A6) to center range.
- Preset focus gain adjustment (A6R43) fully ccw.
- Center the front panel FOCUS and ASTIGMATISM controls.
- Load program\* listed in table 5-4 into the 1350A Graphics Translator using the 9825A Controller.

\*The program is available on cassette tape. Order HP Part No. 5010-0905.

## ADJUSTMENTS

Table 5-4. Focus and Astigmatism Test Program

```

0: dim A$,B$,C$,D$[5]
1: cli 7
2: wtb 718,3,20,13,10,"EM::EN::EX::SN::UM::"
3: fmt 1,f4.0,"",f4.0,";"
4: wrt 718,"PE0,::PA0,0"
5: wrt 718,"PE1,::PA0,1022;1022,1022;1022,0;0,0;"
6: 0→X;0→Y;"FC"→A$;"AC"→B$;gsb "X"
7: 896→Y;gsb "X"
8: 896→X;gsb "X"
9: 0→Y;gsb "X"
10: 0→X;200→Y;"FY1"→A$;"AY1"→B$;gsb "X"
11: 696→Y;gsb "X"
12: 896→X;gsb "X"
13: 200→Y;gsb "X"
14: 200→X;0→Y;" "→A$;" "→B$;"FX1"→C$;"AX1"→D$;gsb "X"
15: 896→Y;gsb "X"
16: 696→X;gsb "X"
17: 0→Y;gsb "X"
18: 448→X;" "→A$;" "→B$;"FX2"→C$;"AX2"→D$;gsb "X"
19: 896→Y;gsb "X"
20: 0→X;448→Y;"FY2"→A$;"AY2"→B$;" "→C$;" "→D$;gsb "X"
21: 896→X;gsb "X"
22: 448→X;448→Y;"ZG"→A$;"ZG"→B$;"ZG"→C$;"ZG"→D$;gsb "X"
23: wrt 718.1,"PE0,::PA",X,Y
24: for I=0 to 719
25: wrt 718,"PE0,"
26: if frc(I/8)≠0;goto 28
27: wrt 718,"PE1,"
28: wrt 718.1,"PA",90cos(I/2-135)+X+63,90sin(I/2-135)+Y+63
29: next I
30: stp
31: "X":
32: wrt 718.1,"PE0,::PA",X,Y
33: wrt 718.1,"PE1,::PA",X+126,Y+126
34: wrt 718.1,"PE0,::PA",X,Y+126
35: wrt 718.1,"PE1,::PA",X+126,Y
36: wrt 718.1,"PE0,::PA",X+50,Y+5
37: wtb 718,"PE1,::CS0,::TX",A$,3,13,10
38: wrt 718.1,"PE0,::PA",X+50,Y+90
39: wtb 718,"PE1,::CS0,::TX",B$,3,13,10
40: wrt 718.1,"PE0,::PA",X+5,Y+56
41: wtb 718,"PE1,::CS0,::TX",C$,3,13,10
42: wrt 718.1,"PE0,::PA",X+90,Y+56
43: wtb 718,"PE1,::CS0,::TX",D$,3,13,10
44: ret
*297

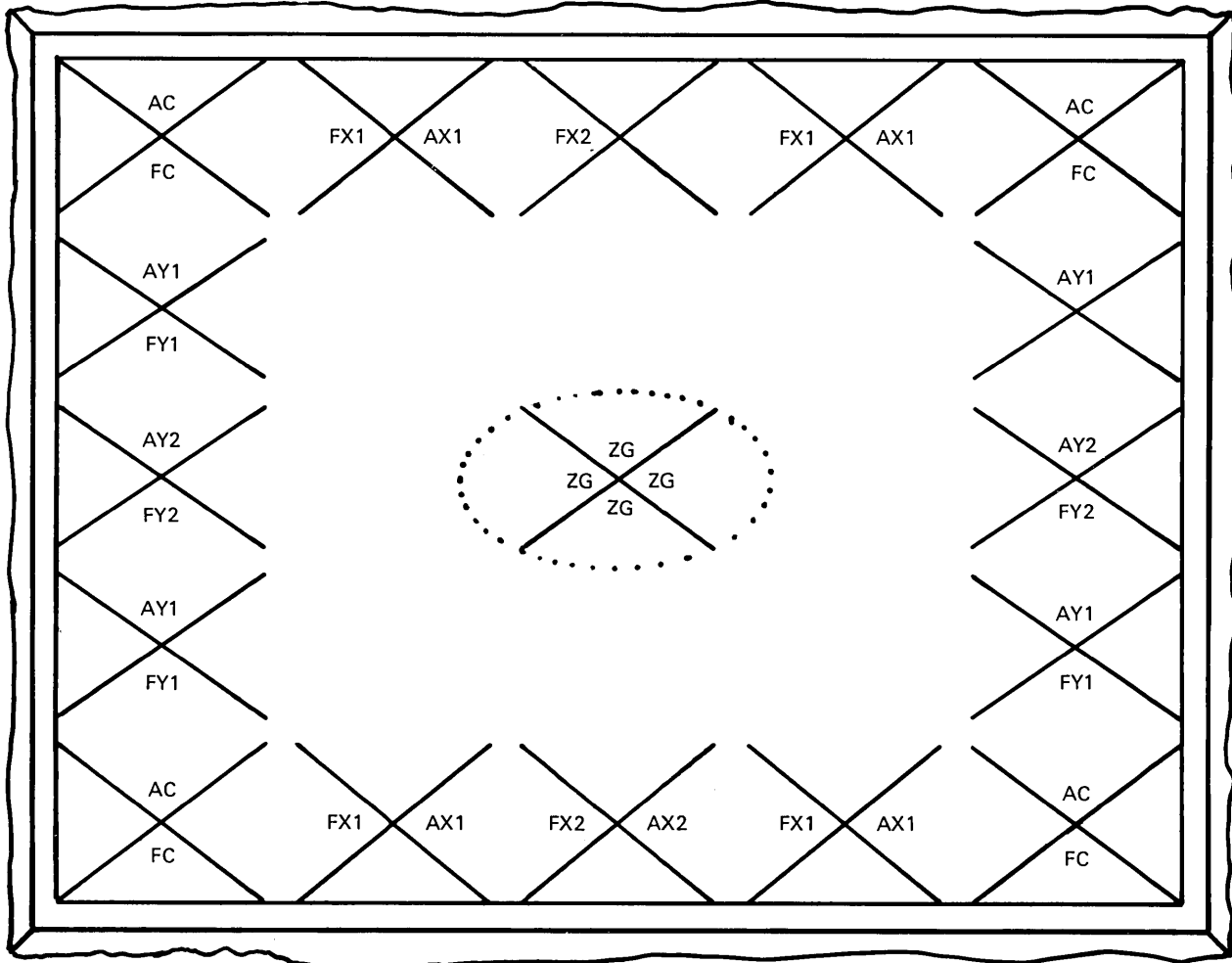
```

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**ADJUSTMENTS**


---

- g. Adjust front panel X-Y GAIN so that the pattern on screen fills the viewing area. Set front panel INTENSITY fully cw (except Option 003). Check figure 5-13 for correct pattern.



*Figure 5-14. Focus and Astigmatism Test Pattern*

- h. Adjust astigmatism balance (A6R90) and focus limit (A9R30) for sharpest "X" crossings at the corners of the display.
- i. Monitor the focus output (junction of A6Q25 and A6R110) and the astigmatism output (junction of A6Q21 collector and A6R96) with the monitor oscilloscope for the remainder of the adjustment procedure.
- j. Set oscilloscope controls as follows and obtain the display as shown in figure 5-15:

DISPLAY ..... ALT  
 TIME/DIV ..... 2 milliseconds  
 CHANNEL INPUT ATTENUATORS ..... 50 V/DIV

## ADJUSTMENTS

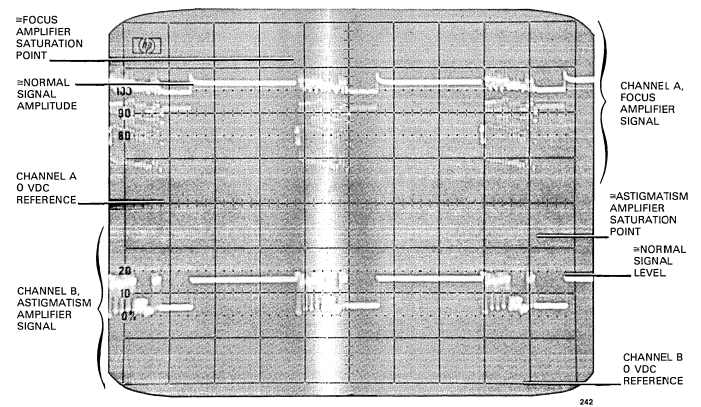


Figure 5-15. Focus and Astigmatism Output Waveforms

- k. After each of the following adjustments (steps l through p) check the signal levels displayed on the oscilloscope. If either signal reaches 0 V or +165 V (amplifier saturation), readjust focus balance (A6R44) and/or astigmatism balance (A6R90) until each signal is between 0 V and +165 V.
- l. Adjust FX2 and AX2 for sharpest "X" crossing at positions indicated on screen.
- m. Adjust FX1 and AX1 for sharpest "X" crossing at positions indicated on screen.
- n. Adjust FY2 and AY2 for sharpest "X" crossing at positions indicated on screen.
- o. Adjust FY1 and AY1 for sharpest "X" crossing at positions indicated on screen.
- p. All "X" crossings on screen, including the center, should now appear sharply focused. Repeat steps c through o if display is not focused.
- q. Adjust focus gain (A6R43) for best focused dotted figure at center screen.
- r. All elements of the displayed pattern, including alphanumerics, should now be sharply focused. If not, repeat procedure from step l on.

ADJUSTMENTS

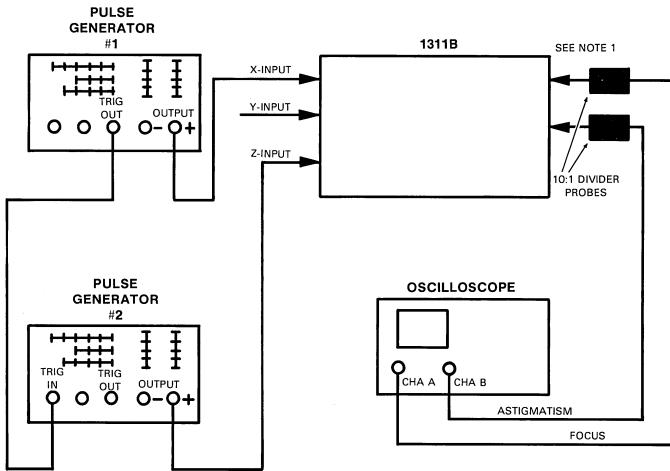
5-24. DYNAMIC FOCUS AND ASTIGMATISM ADJUSTMENT (Alternate Procedure).

**REFERENCE:**  
Service Sheets 5 and 6.

**DESCRIPTION:**  
The following procedure describes the dynamic focus and astigmatism adjustment when the 1350A Graphics Translator and the 9825A HP-IB Controller are not available.

**EQUIPMENT:**  
Pulse Generators (2)  
Monitor Oscilloscope

**PROCEDURE:**  
a. Connect equipment as shown in figure 5-16.



NOTE 1. CONNECT CHANNEL A DIVIDER PROBE TO JUNCTION OF A6Q25 AND A6R111.  
CONNECT CHANNEL B DIVIDER PROBE TO JUNCTION OF A6Q21 AND A6R96.

Figure 5-16. Dynamic Focus and Astigmatism Test Setup

Adjustments

Model 1311B

ADJUSTMENTS

b. Set pulse generator No. 1 controls as follows:

PULSE PERIOD ..... .2 milliseconds  
PULSE WIDTH ..... 50% duty cycle  
AMPLITUDE ..... 1 V p-p

c. Set pulse generator No. 2 controls as follows:

PULSE PERIOD ..... EXT. TRIGGER  
PULSE WIDTH ..... 10 microseconds  
AMPLITUDE ..... 1 V p-p

d. Set oscilloscope controls as follows and obtain the display as shown in figure 5-17.

DISPLAY ..... ALT  
TIME/DIV ..... 50 microseconds  
CHANNEL INPUT ATTENUATORS ..... 50 V/DIV

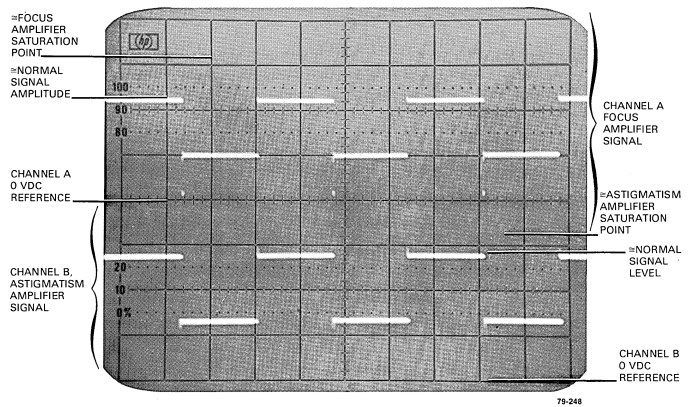


Figure 5-17. Focus and Astigmatism Waveforms

e. Set focus gain (A6R43) fully ccw. Set all other adjustments on the focus and astigmatism assembly (A6) to center. Adjust front panel FOCUS and ASTIGMATISM to center.

f. Disconnect pulse generator No. 1 and position beam to location No. 1 on screen (see figure 5-18).

ADJUSTMENTS

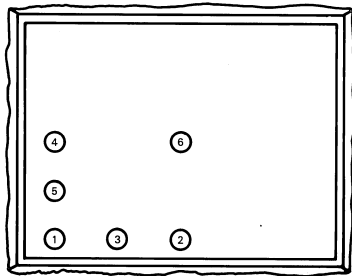


Figure 5-18. Beam Locations for Focus and Astigmatism Procedure

- g. Adjust focus limit (A9R30) and astigmatism balance (A6R90) for best focused dot at location No. 1.
- h. Connect pulse generator No. 1 to the X-INPUT and adjust amplitude to move beam to location No. 2.
- i. After each of the following adjustments (steps j through n) check the signal levels displayed on the oscilloscope. If either signal reaches 0 V or +165 V (amplifier saturation), readjust focus balance A6R44 and/or astigmatism balance (A6R90) until each signal is between 0 V and +165 V.
- j. Adjust FX2 and AX2 for best focused dot at location No. 2.
- k. Adjust pulse generator No. 1 amplitude to move beam to location No. 3. Adjust FX1 and AX1 for best focused dot at location No. 3.
- l. Disconnect pulse generator No. 1 from X-INPUT and check focus at location No. 1. If beam is not focused repeat this adjustment procedure from step g on.
- m. Connect pulse generator No. 1 to the Y-INPUT and adjust amplitude to move beam to location No. 4. Adjust FY2 and AY2 for best focused dot at location No. 4.
- n. Adjust pulse generator No. 1 amplitude to move beam to location No. 5 and adjust FY1 and AY1 for best focused dot at location No. 5.
- o. Disconnect pulse generator No. 1 and check focus at location No. 1. If beam appears defocused, repeat this procedure from step g on.
- p. Connect pulse generator No. 1 to both X- and Y-INPUT and adjust amplitude to move beam to location No. 6. (It may be necessary to readjust X- or Y-GAIN to move beam to location No. 6.)
- q. Beam should appear well focused. If not, repeat this procedure starting with step g.
- r. Reduce amplitude of pulse generator No. 2 and adjust front panel INTENSITY for a dimly viewable beam at location No. 6. Adjust focus gain (A6R43) for best focused spot.
- s. Recheck beam focus at all locations. Should adjustment be necessary, repeat this procedure starting with step g.
- t. After completion of adjustments set input impedance switches (A1S1; A3S1; A5S1) to desired positions and fill out input configuration tag on the rear rail of 1311B.

ADJUSTMENTS

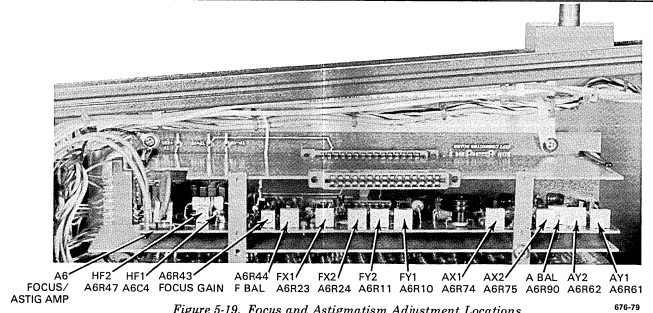


Figure 5-19. Focus and Astigmatism Adjustment Locations

Table 5-5. Focus and Astigmatism Adjustments

Reference Designator	Adjustment Name	Adjustment Paragraph	Service Sheet	Description
<b>Front Panel Adjustment</b>				
A13R8	TRACE ALIGN	5-22	7	Adjust trace to lie along X-AXIS of CRT
A13R9	ORTHO	5-22	7	Adjust trace to lie along Y-AXIS of CRT
A9R30	FOCUS LIMIT	5-23; 5-24	7	Adjust for best focus in the corners of the display
A6R90	ASTIGMATISM BALANCE	5-23; 5-24	6	Adjust to keep astigmatism output signal between a signal level of 0 V to +140 V
A6R44	FOCUS BALANCE	5-23; 5-24	5	Adjust to keep focus output signal between a signal level of 0 V to +140 V
A6R24; A6R75	FX2; AX2	5-23; 5-24	5; 6	Adjust for best focused dot at location No. 2 (see figure 5-11 for location)
A6R23; A6R71	FX1; AX1	5-23; 5-24	5; 6	Adjust for best focused dot at location No. 3 (see figure 5-11)
A6R11; A6R62	FY2; AY2	5-23; 5-24	5; 6	Adjust for best focused dot at location No. 4 (see figure 5-11)
A6R10; A6R61	FY1; AY1	5-23; 5-24	5; 6	Adjust for best focused dot at location No. 5 (see figure 5-11)
A6R43	FOCUS GAIN	5-23; 5-24	5	Adjust for best focused dot at location No. 6 (see figure 5-11)



## SECTION VI

### REPLACEABLE PARTS

#### 6-1. INTRODUCTION.

6-2. This section contains information for ordering parts. Table 6-1 lists abbreviations used in the parts list, table 6-2 lists all replaceable parts in reference designator order.

#### 6-3. ABBREVIATIONS.

6-4. Table 6-1 lists abbreviations used in the parts list, the schematics, and throughout the manual. In some cases, two forms of the abbreviation are used, one all in capital letters, and one partial or no capitals. This occurs because the abbreviations in the parts list are always all capitals. However, in other parts of the manual other abbreviation forms are used with both lower-case and uppercase letters.

#### 6-5. REPLACEABLE PARTS LIST.

6-6. Table 6-2 is the list of replaceable parts and is organized as follows:

- a. Electrical assemblies in alphanumerical order by reference designation.
- b. Chassis-mounted parts in alphanumerical order by reference designation.
- c. Electrical assemblies and their components in alphanumerical order by reference designation.

The information given for each part consists of the following:

- a. Complete reference designation.
- b. Hewlett-Packard part number.
- c. Total quantity (Qty) in instrument.
- d. Description of part.
- e. Check digit.

The total quantity for each part is given only once — at the first appearance of the part number in the list.

#### 6-7. ORDERING INFORMATION.

6-8. To order a part listed in the replaceable parts table, quote the Hewlett-Packard part number, check digit, indicate the quantity required, and address the order to the nearest Hewlett-Packard office.

6-9. To order a part that is not listed in the replaceable parts table, include the instrument model number, instrument serial number, the description and function of the part, and the number of parts required. Address the order to the nearest Hewlett-Packard office.

#### 6-10. DIRECT MAIL ORDER SYSTEM.

6-11. Within the USA, Hewlett-Packard can supply parts through a direct mail order system. Advantages of using the system are as follows:

- a. Direct ordering and shipment from HP Parts Center in Mountain View, California.
- b. No maximum or minimum on any mail order (there is minimum order amount for parts ordered through local HP offices when orders require billing and invoicing).
- c. Prepaid transportation (there is small handling charge for each order).
- d. No invoices — to provide these advantages, check or money order must accompany each order.

6-12. Mail order forms and specific ordering information are available through your local HP office.

Table 6-1. Reference Designators and Abbreviations

REFERENCE DESIGNATORS					
<b>A</b>	= assembly	<b>F</b>	= fuse	<b>MP</b>	= mechanical part
<b>B</b>	= motor	<b>FL</b>	= filter	<b>P</b>	= plug
<b>BT</b>	= battery	<b>IC</b>	= integrated circuit	<b>Q</b>	= transistor
<b>C</b>	= capacitor	<b>J</b>	= jack	<b>R</b>	= resistor
<b>CP</b>	= coupler	<b>K</b>	= relay	<b>RT</b>	= thermistor
<b>CR</b>	= diode	<b>L</b>	= inductor	<b>S</b>	= switch
<b>DL</b>	= delay line	<b>LS</b>	= loud speaker	<b>T</b>	= transformer
<b>DS</b>	= device signaling (lamp)	<b>M</b>	= meter	<b>TB</b>	= terminal board
<b>E</b>	= misc electronic part	<b>MK</b>	= microphone	<b>TP</b>	= test point
				<b>U</b>	= integrated circuit
				<b>V</b>	= vacuum, tube, neon bulb, photocell, etc
				<b>VR</b>	= voltage regulator
				<b>W</b>	= cable
				<b>X</b>	= socket
				<b>Y</b>	= crystal
				<b>Z</b>	= tuned cavity network
ABBREVIATIONS					
<b>A</b>	= amperes	<b>H</b>	= henries	<b>N/O</b>	= normally open
<b>AFC</b>	= automatic frequency control	<b>HDW</b>	= hardware	<b>NOM</b>	= nominal
<b>AMPL</b>	= amplifier	<b>HEX</b>	= hexagonal	<b>NPO</b>	= negative positive zero (zero temperature coefficient)
<b>BFO</b>	= beat frequency oscillator	<b>HG</b>	= mercury	<b>NPN</b>	= negative-positive-negative
<b>BE CU</b>	= beryllium copper	<b>HR</b>	= hour(s)	<b>NRFR</b>	= not recommended for field replacement
<b>BH</b>	= binder head	<b>HZ</b>	= hertz	<b>NSR</b>	= not separately replaceable
<b>BP</b>	= bandpass	<b>IF</b>	= intermediate freq	<b>OB</b>	= order by description
<b>BRS</b>	= brass	<b>IMPG</b>	= impregnated	<b>OH</b>	= oval head
<b>BWO</b>	= backward wave oscillator	<b>INCD</b>	= incandescent	<b>OX</b>	= oxide
<b>CCW</b>	= counter-clockwise	<b>INCL</b>	= includets)	<b>P</b>	= peak
<b>CER</b>	= ceramic	<b>INS</b>	= insulation(ed)	<b>PC</b>	= printed circuit
<b>CMO</b>	= cabinet mount only	<b>INT</b>	= internal	<b>PF</b>	= picofarads= 10 <sup>-12</sup> farads
<b>COEF</b>	= coefficient	<b>K</b>	= kilo=1000	<b>PH BRZ</b>	= phosphor bronze
<b>COM</b>	= common	<b>LH</b>	= left hand	<b>PHL</b>	= phillips
<b>COMP</b>	= composition	<b>LIN</b>	= linear taper	<b>PIV</b>	= peak inverse voltage
<b>COMPL</b>	= complete	<b>LK WASH</b>	= lock washer	<b>PNP</b>	= positive-negative-positive
<b>CONN</b>	= connector	<b>LOG</b>	= logarithmic taper	<b>P/O</b>	= part of
<b>CP</b>	= cadmium plate	<b>LPF</b>	= low pass filter	<b>POLY</b>	= polystyrene
<b>CRT</b>	= cathode-ray tube	<b>M</b>	= milli=10 <sup>-3</sup>	<b>PORC</b>	= porcelain
<b>CW</b>	= clockwise	<b>MEG</b>	= meg=10 <sup>6</sup>	<b>POS</b>	= position(s)
<b>DEPC</b>	= deposited carbon	<b>MET FLM</b>	= metal film	<b>POT</b>	= potentiometer
<b>DR</b>	= drive	<b>MET OX</b>	= metallic oxide	<b>PP</b>	= peak-to-peak
<b>ELECT</b>	= electrolytic	<b>MFR</b>	= manufacturer	<b>PT</b>	= point
<b>ENCAP</b>	= encapsulated	<b>MHZ</b>	= mega hertz	<b>PWV</b>	= peak working voltage
<b>EXT</b>	= external	<b>MINAT</b>	= miniature	<b>RECT</b>	= rectifier
<b>F</b>	= farads	<b>MOM</b>	= momentary	<b>RF</b>	= radio frequency
<b>FH</b>	= flat head	<b>MOS</b>	= metal oxide substrate	<b>RH</b>	= round head or right hand
<b>FIL H</b>	= fillister head	<b>MTG</b>	= mounting		
<b>FXD</b>	= fixed	<b>MY</b>	= "mylar"		
<b>G</b>	= giga (10 <sup>9</sup> )	<b>N</b>	= nano (10 <sup>-9</sup> )		
<b>GE</b>	= germanium	<b>N/C</b>	= normally closed		
<b>GL</b>	= glass	<b>NE</b>	= neon		
<b>GRD</b>	= grounded	<b>NI PL</b>	= nickel plate		
				<b>RMO</b>	= rack mount only
				<b>RMS</b>	= root-mean square
				<b>RWV</b>	= reverse working voltage
				<b>S-B</b>	= slow-blow
				<b>SCR</b>	= screw
				<b>SE</b>	= selenium
				<b>SECT</b>	= section(s)
				<b>SEMICON</b>	= semiconductor
				<b>SI</b>	= silicon
				<b>SIL</b>	= silver
				<b>SL</b>	= slide
				<b>SPG</b>	= spring
				<b>SPL</b>	= special
				<b>SST</b>	= stainless steel
				<b>SR</b>	= split ring
				<b>STL</b>	= steel
				<b>TA</b>	= tantalum
				<b>TD</b>	= time delay
				<b>TGL</b>	= toggle
				<b>THD</b>	= thread
				<b>TI</b>	= titanium
				<b>TOL</b>	= tolerance
				<b>TRIM</b>	= trimmer
				<b>TWT</b>	= traveling wave tube
				<b>U</b>	= micro=10 <sup>-6</sup>
				<b>VAR</b>	= variable
				<b>VDCW</b>	= dc working volts
				<b>W/</b>	= with
				<b>W</b>	= watts
				<b>WIV</b>	= working inverse voltage
				<b>WW</b>	= wirewound
				<b>W/O</b>	= without

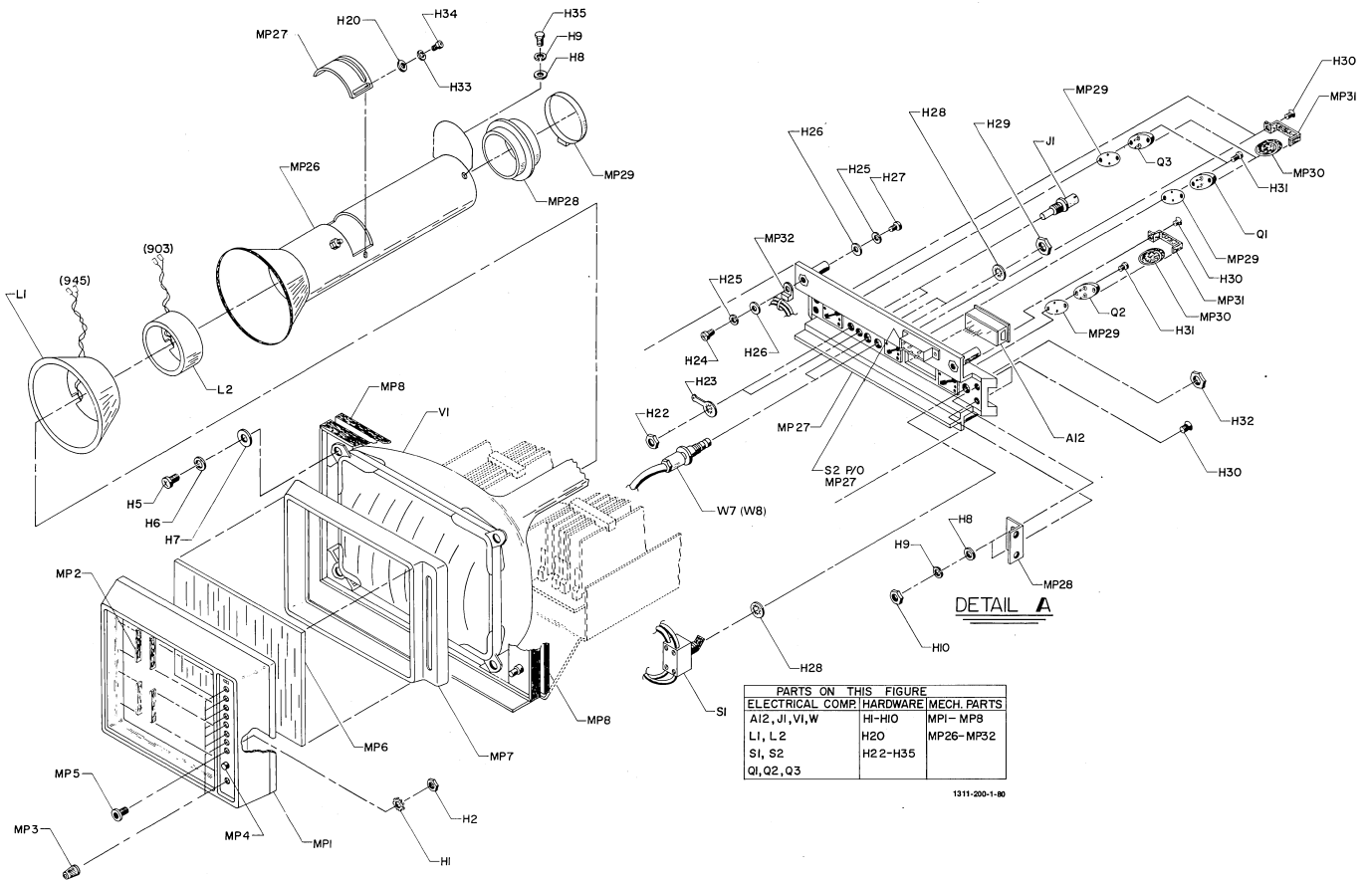


Figure 6-1.  
Chassis Parts and Board Assembly Identification  
(Sheet 1 of 3)  
6-3

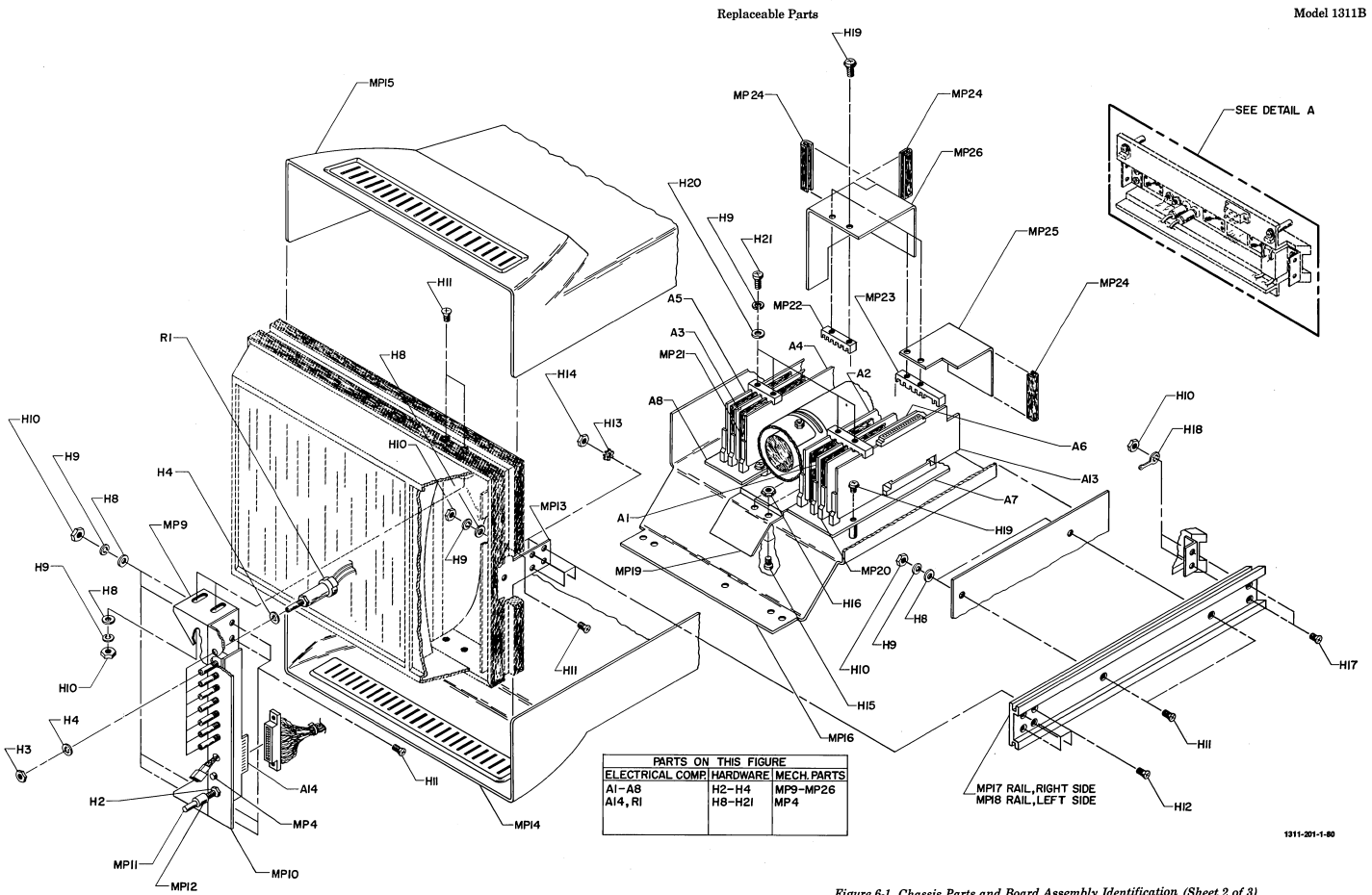


Figure 6-1. Chassis Parts and Board Assembly Identification (Sheet 2 of 3)

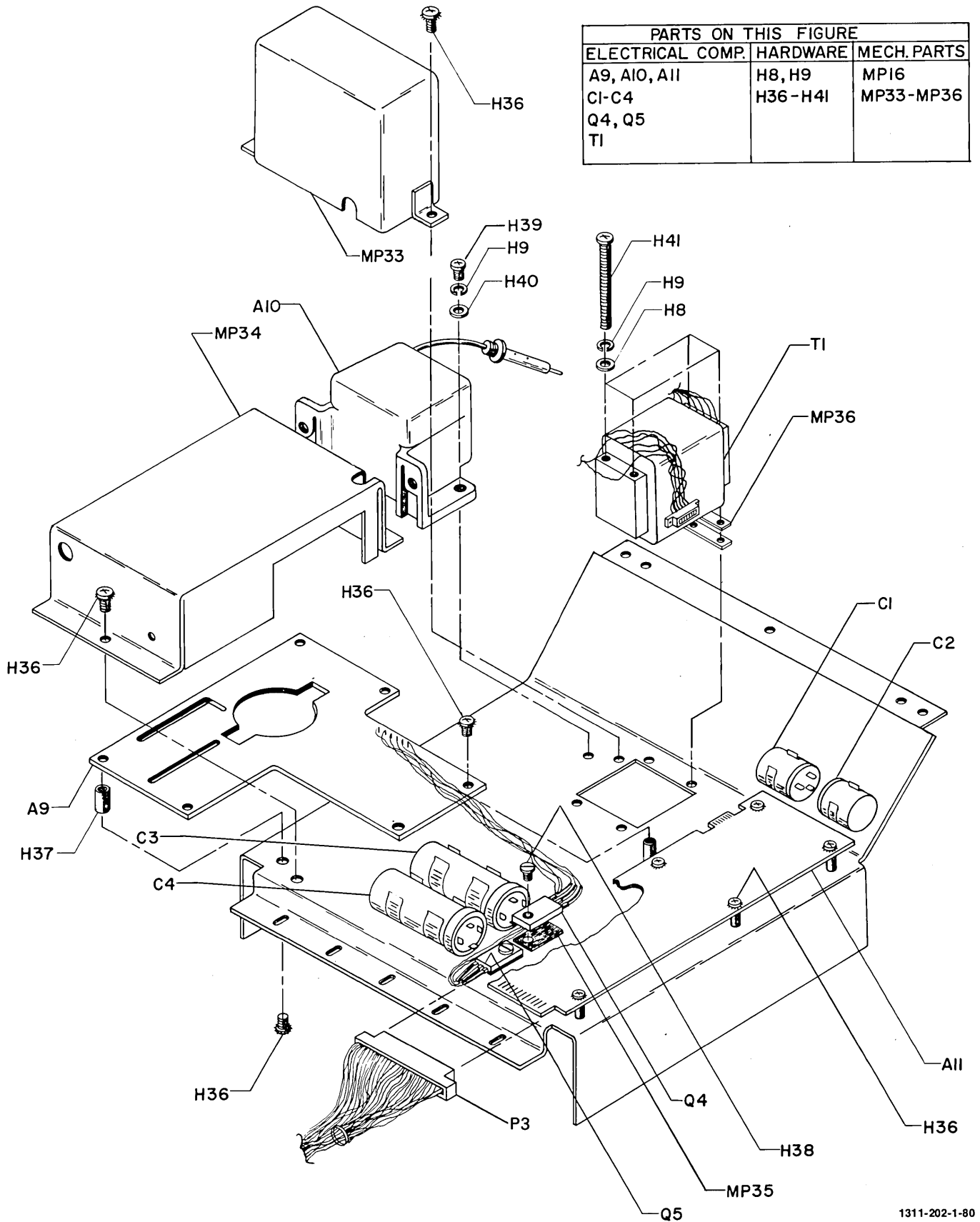


Figure 6-1. Chassis Parts and Board Assembly Identification (Sheet 3 of 3)

1311-202-1-80

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
CHASSIS PARTS						
A1	01317-66503	6	2	BOARD ASSEMBLY-INPUT AMPLIFIER	28480	01317-66503
A2	01310-66530	2	2	PC BOARD ASSEMBLY-OUTPUT AMPLIFIER	28480	01310-66530
A3	01317-66503	6		BOARD ASSEMBLY-INPUT AMPLIFIER	28480	01317-66503
A4	01310-66530	2		PC BOARD ASSEMBLY-OUTPUT AMPLIFIER	28480	01310-66530
A5	01311-66502	9	1	Z-AXIS BOARD	28480	01311-66502
A6	01317-66501	4	1	BOARD ASSEMBLY-FOCUS	28480	01317-66501
A7	01317-66504	7	1	BOARD ASSEMBLY-LEFT CONNECTOR	28480	01317-66504
A8	01317-66505	8	1	PC BOARD ASSEMBLY-RIGHT CONNECTOR	28480	01317-66505
A9	01311-66504	1	1	BOARD ASSEMBLY-HIGH VOLTAGE	28480	01311-66504
A10	0960-0560	3	1	MULTIPLIER-HV	28480	0960-0560
A11	01310-66533	5	1	PC BOARD ASSEMBLY-LOW VOLTAGE POWER SUPP	28480	01310-66533
A12	0960-0444	2	1	LINE MODULE-UNFILTERED	28480	0960-0444
A13	01311-66503	0	1	BOARD ASSEMBLY-CONTROL	28480	01311-66503
A14	01310-66513	1	1	PC BOARD ASSEMBLY-EXT	28480	01310-66513
C1	0180-0030	2	2	CAPACITOR-FXD 120UF+75-10X 350VDC AL	28480	0180-0030
C2	0180-0030	2		CAPACITOR-FXD 120UF+75-10X 350VDC AL	28480	0180-0030
C3	0180-0213	9	2	CAPACITOR-FXD 5000UF+75-10X 25VDC AL	28480	0180-0213
C4	0180-0213	9		CAPACITOR-FXD 5000UF+75-10X 25VDC AL	28480	0180-0213
C5	0150-0052	1	2	CAPACITOR-FXD .05UF +-20X 400VDC CER	28480	0150-0052
C6	0150-0052	1		CAPACITOR-FXD .05UF +-20X 400VDC CER	28480	0150-0052
DS1	1450-0440	8	1	LIGHT-IND MHT-TL .4-DIA FKD-TERM PUSH-ON	28480	1450-0440
F1	2110-0020	1	1	FUSE .8A 250V 1.25X.25 UL	75915	313.800
F1	2110-0059	6	1	FUSE 1.5A 250V 1.25X.25 UL	71400	MOX 1-1/2
H1	0510-0123	1	1	RETAINER-PUSH ON RECT EXT .312-IN-DIA	28480	0510-0123
H1	2190-0008	3	6	WASHER-LK EXT T NO. 6 .141-IN-ID	28480	2190-0008
H2	2950-0006	3	1	NUT-HEX=OBL-CHAM 1/4-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
H2	2950-0001	8	9	NUT-HEX=OBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
H4	2190-0083	4	1	WASHER-LK INTL T 1/2 IN .512-IN-ID	28480	2190-0083
H5	2680-0105	0	4	SCREW-MACH 10-32 .625-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H6	2190-0019	6	7	WASHER-LK HLCL NO. 4 .115-IN-ID	28480	2190-0019
H7	3050-0179	4	4	WASHER-FL MTLC NO. 10 .203-IN-ID	28480	3050-0179
H8	3050-0066	8	36	WASHER-FL MTLC NO. 6 .147-IN-ID	28480	3050-0066
H9	2190-0017	4	7	WASHER-LK HLCL NO. 8 .168-IN-ID	28480	2190-0017
H10	2420-0002	6	16	NUT-HEX=OBL-CHAM 6-32-THD .109-IN-THK	28480	2420-0002
H11	2360-0200	8	14	SCREW-MACH 6-32 .5-IN-LG 100 DEG	00000	ORDER BY DESCRIPTION
H12	2360-0120	1	12	SCREW-MACH 6-32 .438-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
H13	2190-0034	5	4	WASHER-LK HLCL NO. 10 .194-IN-ID	28480	2190-0034
H14	2420-0002	6		NUT-HEX=OBL-CHAM 6-32-THD .109-IN-THK	28480	2420-0002
H15	2420-0001	5	1	NUT-HEX=W/LKWR 6-32-THD .109-IN-THK	00000	ORDER BY DESCRIPTION
H16	2360-0115	4	39	SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H17	2360-0118	7	4	SCREW-MACH 6-32 .375-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
H18	0360-0001	5	8	TERMINAL-SLDR LUG LK-MTG FOR-#6-SCR	28480	0360-0001
H19	2360-0117	6	4	SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H21	2360-0201	9	15	SCREW-MACH 6-32 .5-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H21	2950-0001	8		NUT-HEX=OBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
H23	0360-1632	0	1	TERMINAL-SLDR LUG LK-MTG FOR-#3/8-SCR	28480	0360-1632
H24	2510-0103	9	3	SCREW-MACH 8-32 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H25	2190-0016	3	8	WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
H26	3050-0001	1	9	WASHER-FL MTLC NO. 8 .172-IN-ID	28480	3050-0001
H27	2510-0107	3	4	SCREW-MACH 8-32 .5-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H28	2190-0047	0	24	WASHER-LK 82 CYSK EXT T NO. 6 .142-IN-ID	28480	2190-0047
H29	2950-0054	1	2	NUT-HEX=OBL-CHAM 1/2-28-THD .125-IN-THK	00000	ORDER BY DESCRIPTION
H31	0624-0232	4	6	SCREW-TPG 6-20 .5-IN-LG PAN-HD-8TL 8TL	00000	ORDER BY DESCRIPTION
H32	2950-0035	8	1	NUT-HEX=OBL-CHAM 15/32-32-THD	00000	ORDER BY DESCRIPTION
H33	2190-0018	5	41	WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0018
H34	2200-0139	4	4	SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H35	0624-0310	9	2	SCREW-TPG 6-19 .312-IN-LG HEX-HD 8TL	28480	0624-0310
H40	3050-0235	3	4	WASHER-FL MTLC NO. 4 .117-IN-ID	28480	3050-0235
J1	1250-0118	3	1	CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0118
MP3	0370-1093	4	1	KNOB-BASE-PTR 3/8 OBP .125-IN-ID	28480	0370-1007
MP8	01311-63707	0	1	EXTRUSION ASSEMBLY-FRAME	28480	01311-63707
MP9	01310-01203	0	2	BRACKET-CORNER SUPPORT	28480	01310-01203
MP11	01311-23708	7	1	SHAFT-EXTENSION	28480	01311-23708
MP12	1490-0841	7	1	COUPLER-RGD .375-LG BR8	28480	1490-0841
MP13	01311-01201	9	2	BRACKET-T SPLICE	28480	01311-01201
MP14	01311-44106	3	2	COVER	28480	01311-44106
MP15	01311-44106	3		COVER	28480	01311-44106
MP16	01311-00102	7	1	DECK-MAIN	28480	01311-00102
MP17	01311-23707	6	1	RAIL-RIGHT SIDE	28480	01311-23707

See introduction to this section for ordering information  
 \*Indicates factory selected value

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

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
MP18	01311-23706	5	1	RAIL-LEFT SIDE	28480	01311-23706
MP19	01311-00603	3	1	SHIELD-TRANSFORMER	28480	01311-00603
MP20	5040-0170	6	14	GUIDEPLUG-IN PC BOARD	28480	5040-0170
MP21	01310-00601	0	4	SHIELD-AMPLIFIER	28480	01310-00601
MP22	5040-5892	9	2	HOLDER-PC BOARD, RIGHT	28480	5040-5892
MP23	5040-5891	8	2	HOLDER-PC BOARD, LEFT	28480	5040-5891
MP24	4320-0095	7	1	U CHANNEL NPRN .047-WD=CHAN .219-WD.	28480	4320-0095
MP25	01321-00601	3	1	SHIELD-FOCUS	28480	01321-00601
MP26	01310-60608	3	1	SHIELD ASSEMBLY-CRT	28480	01310-60608
MP26	01321-00603	5	1	SHIELD-Z AXIS	28480	01321-00603
MP27	01311-23720	3	1	RAIL-REAR	28480	01311-23720
MP28	01311-01204	2	2	BRACKET-REAR	28480	01311-01204
MP29	01310-21201	0	1	CLAMP-CRT	28480	01310-21201
	0340-0875	9	3	INSULATOR-XSTR THRM-CNDCT	28480	0340-0875
MP30	5020-8762	6	3	SCREW-MACHINE	28480	5020-8762
	0340-0486	8	3	INSULATOR-COVER NYLON	28480	0340-0486
MP31	01310-01215	4	3	STRAP-TRANSISTOR COVER	28480	01310-01215
MP32	1400-0335	5	3	CABLE TIE 1.75-DIA .188-WD NYL	28480	1400-0335
MP33	01311-04102	5	1	COVER-MULTIPLIER	28480	01311-04102
MP34	01311-04101	4	1	COVER-HIGH VOLTAGE	28480	01311-04101
MP36	01310-04702	0	4	SPACER-TRANSFORMER	28480	01310-04702
MP37	01311-68710	5	1	STAND ASSEMBLY-TILT	28480	01311-68710
P1	1251-1190		2	CONN PC 24 F	28480	1251-1190
P2	1251-1190			CONN PC 24 F	28480	1251-1190
P3	1251-0159		1	CONN PC .30 F	28480	1251-0159
P4	01317-27601		1	CONN PC 20 F	28480	01317-27601
Q1	1854-0417	5	1	TRANSISTOR NPN SI TO-3 PD=80W	28480	1854-0417
Q2	1854-0063	7	2	TRANSISTOR NPN 2N3055 SI TO-3 PD=115W	01928	2N3055
Q3	1854-0063	7		TRANSISTOR NPN 2N3055 SI TO-3 PD=115W	01928	2N3055
Q4	1854-0558	5	1	TRANSISTOR NPN SI DARL PD=70W FT=1MHZ	28480	1854-0558
Q5	1854-0433	5	1	TRANSISTOR NPN SI PD=90W FT=2MHZ	28480	1854-0433
R1	2100-3811	3	1	RESISTOR-VAR CONTROL CCP 500K 20% LIN	28480	2100-3811
	01311-68712	7	1	KIT-TILT STAND	28480	01311-68712
S1	3101-2332	4	1	SWITCH-TGL BASIC DPST 6A 250VAC/DC 8CR	28480	3101-2332
T1	9100-0484	7	1	TRANSFORMER-POWER	28480	9100-0484
V1	5083-3251		1	CRT P31	28480	5083-3251
W1	8120-2061	1	1	POWER CORD ASSY-DC	28480	8120-2061
W2	00183-61625	9	2	CABLE-HORIZ OUTPUT	28480	00183-61625
W3	00183-61625	9		CABLE-HORIZ OUTPUT	28480	00183-61625
W4				NOT ASSIGNED		
W7	01310-61606	3	2	CABLE ASSEMBLY-INPUT	28480	01310-61606
W8	01310-61606	3		CABLE ASSEMBLY-INPUT	28480	01310-61606
W9	01310-61622	3	1	CABLE ASSEMBLY-HV	28480	01310-61622

See introduction to this section for ordering information  
 \*Indicates factory selected value



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

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	01317-66503	6	1	BOARD ASSEMBLY-INPUT AMPLIFIER	28480	01317-66503
A1C1	0160-3451	1	5	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A1C2	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A1C3	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A1C4	0160-0174	9	2	CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A1C5	0160-3443	1	7	CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A1C6	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A1C7	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A1C8	0160-2197	0	2	CAPACITOR-FXD 10PF +-5% 300VDC MICA	28480	0160-2197
A1C9	0160-2197	0		CAPACITOR-FXD 10PF +-5% 300VDC MICA	28480	0160-2197
A1C10	0160-0168	1	7	CAPACITOR-FXD .1UF +-10% 200VDC POLYE	28480	0160-0168
A1C11	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A1C12	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A1C13	0160-0168	1		CAPACITOR-FXD .1UF +-10% 200VDC POLYE	28480	0160-0168
A1C14	0160-0168	1		CAPACITOR-FXD .1UF +-10% 200VDC POLYE	28480	0160-0168
A1C15	0160-0168	1		CAPACITOR-FXD .1UF +-10% 200VDC POLYE	28480	0160-0168
A1C16	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A1C17	0160-0168	1		CAPACITOR-FXD .1UF +-10% 200VDC POLYE	28480	0160-0168
A1C18	0160-0168	1		CAPACITOR-FXD .1UF +-10% 200VDC POLYE	28480	0160-0168
A1C19	0160-0174	9		CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A1C20	0140-0196	3	1	CAPACITOR-FXD 150PF +-5% 300VDC MICA	72136	DM15F151J0300MV1CR
A1C21	0160-0168	1		CAPACITOR-FXD .1UF +-10% 200VDC POLYE	28480	0160-0168
A1C22	0160-2254	0	1	CAPACITOR-FXD 7.5PF +-25PF 500VDC CER	28480	0160-2254
A1C23	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A1C24	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A1C25	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A1CR1	1901-0376	6	4	DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A1CR2	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A1CR3	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A1CR4	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A1CR5	1901-0033	2	8	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A1CR6	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A1CR7	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A1CR8	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A1CR9	1901-0040	1	7	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR10	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR11	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR12	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR13	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A1CR14	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A1CR15	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A1CR16	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A1CR17	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR18	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR20	1901-0513	3	4	DIODE-DUAL 100V	28480	1901-0513
A1CR21	1901-0513	3		DIODE-DUAL 100V	28480	1901-0513
A1CR22	1901-0513	3		DIODE-DUAL 100V	28480	1901-0513
A1CR23	1901-0513	3		DIODE-DUAL 100V	28480	1901-0513
A1CR24	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1L1	9100-2276	9	2	COIL-MLD 100UH 10% Q=50 .095DX.25LG-NOM	28480	9100-2276
A1L2	9100-2276	9		COIL-MLD 100UH 10% Q=50 .095DX.25LG-NOM	28480	9100-2276
A1O1	1855-0262	0	1	TRANSISTOR-JFET DUAL N-CHAN D=MODE SI	28480	1855-0262
A1O3	1853-0036	2	4	TRANSISTOR PNP SI PD=310MH FT=250MHZ	28480	1853-0036
A1O4	1853-0036	2		TRANSISTOR PNP SI PD=310MH FT=250MHZ	28480	1853-0036
A1O5	1854-0071	7	7	TRANSISTOR NPN SI PD=300MH FT=200MHZ	28480	1854-0071
A1O6	1854-0071	7		TRANSISTOR NPN SI PD=300MH FT=200MHZ	28480	1854-0071
A1O7	1854-0071	7		TRANSISTOR NPN SI PD=300MH FT=200MHZ	28480	1854-0071
A1O8	1853-0316	1	1	TRANSISTOR-DUAL PNP PD=500MH	28480	1853-0316
A1O9	1854-0071	7		TRANSISTOR NPN SI PD=300MH FT=200MHZ	28480	1854-0071
A1O10	1854-0071	7		TRANSISTOR NPN SI PD=300MH FT=200MHZ	28480	1854-0071
A1O11	1853-0276	2	3	TRANSISTOR PNP SI TO=52 PD=360MH	04713	MM3906
A1O12	1853-0276	2		TRANSISTOR PNP SI TO=52 PD=360MH	04713	MM3906
A1O13	1853-0276	2		TRANSISTOR PNP SI TO=52 PD=360MH	04713	MM3906
A1O14	1853-0036	2		TRANSISTOR PNP SI PD=310MH FT=250MHZ	28480	1853-0036
A1O15	1853-0036	2		TRANSISTOR PNP SI PD=310MH FT=250MHZ	28480	1853-0036
A1O16	1854-0071	7		TRANSISTOR NPN SI PD=300MH FT=200MHZ	28480	1854-0071
A1O17	1854-0071	7		TRANSISTOR NPN SI PD=300MH FT=200MHZ	28480	1854-0071
A1R1	0698-5965	5	1	RESISTOR 50 1X .5W F TC=0+-100	28480	0698-5965
A1R2	0687-4701	2	1	RESISTOR 47 10X .5W CC TC=0+412	01121	E84701
A1R3	0757-0340	6	1	RESISTOR 10K 1X .25W F TC=0+-100	24546	C5-1/4-T0-1002-F
A1R4	0684-1041	1	2	RESISTOR 100K 10X .25W FC TC=400/+800	01121	C81041
A1R5	0684-1041	1		RESISTOR 100K 10X .25W FC TC=400/+800	01121	C81041

See introduction to this section for ordering information  
 \*Indicates factory selected value

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

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1R6	0684-3901	6	2	RESISTOR 39 10X .25W FC TC=400/+500	01121	C83901
A1R7	0684-3901	6		RESISTOR 39 10X .25W FC TC=400/+500	01121	C83901
A1R10	0757-0280	3	7	RESISTOR 1K 1X .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R11	2100-3352	7	2	RESISTOR-TRMR 1K 10X C SIDE-ADJ 1-TRN	28480	2100-3352
A1R12	2100-3352	7		RESISTOR-TRMR 1K 10X C SIDE-ADJ 1-TRN	28480	2100-3352
A1R13	0698-3447	4	1	RESISTOR 422 1X .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A1R14	0757-0283	6	1	RESISTOR 2K 1X .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A1R15	0757-0419	0	1	RESISTOR 681 1X .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A1R16	0757-0412	3	2	RESISTOR 365 1X .125W F TC=0+-100	24546	C4-1/8-T0-365R-F
A1R19	0757-0442	9	4	RESISTOR 10K 1X .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R22	0757-0442	9		RESISTOR 10K 1X .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R23	0757-0280	3		RESISTOR 1K 1X .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R24	0757-0417	8	2	RESISTOR 562 1X .125W F TC=0+-100	24546	C4-1/8-T0-562R-F
A1R25	0757-0417	8		RESISTOR 562 1X .125W F TC=0+-100	24546	C4-1/8-T0-562R-F
A1R26	0757-0394	0	2	RESISTOR 51.1 1X .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1R27	0757-0401	0	2	RESISTOR 100 1X .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1R28	0757-0442	9		RESISTOR 10K 1X .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R29	0757-0401	0		RESISTOR 100 1X .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1R31	0757-0394	0		RESISTOR 51.1 1X .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1R32	0698-0084	9	2	RESISTOR 2.15K 1X .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A1R33	0757-0408	7	2	RESISTOR 243 1X .125W F TC=0+-100	24546	C4-1/8-T0-243R-F
A1R34	0757-0273	4	1	RESISTOR 3.01K 1X .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
A1R35	0757-0408	7		RESISTOR 243 1X .125W F TC=0+-100	24546	C4-1/8-T0-243R-F
A1R36	0757-0416	7	3	RESISTOR 511 1X .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1R37	0757-0416	7		RESISTOR 511 1X .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1R38	0757-0412	3		RESISTOR 365 1X .125W F TC=0+-100	24546	C4-1/8-T0-365R-F
A1R39	0684-5621	1	3	RESISTOR 5.6K 10X .25W FC TC=400/+700	01121	C85621
A1R40	0684-1531	4	2	RESISTOR 15K 10X .25W FC TC=400/+800	01121	C81531
A1R41	0757-0442	9		RESISTOR 10K 1X .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R42	0757-0415	6	2	RESISTOR 475 1X .125W F TC=0+-100	24546	C4-1/8-T0-475R-F
A1R43	0757-0415	6		RESISTOR 475 1X .125W F TC=0+-100	24546	C4-1/8-T0-475R-F
A1R44	0698-0085	0	1	RESISTOR 2.61K 1X .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A1R45	0757-0421	4	1	RESISTOR 825 1X .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A1R46	0757-0280	3		RESISTOR 1K 1X .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R47	0684-2201	7	5	RESISTOR 22 10X .25W FC TC=400/+500	01121	C82201
A1R48	0757-0280	3		RESISTOR 1K 1X .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R49	0757-0281	4	4	RESISTOR 2.74K 1X .125W F TC=0+-100	24546	C4-1/8-T0-2741-F
A1R50	0757-0416	7		RESISTOR 511 1X .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1R51	0684-2201	7		RESISTOR 22 10X .25W FC TC=400/+500	01121	C82201
A1R52	0757-0280	3		RESISTOR 1K 1X .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R53	0757-0281	4		RESISTOR 2.74K 1X .125W F TC=0+-100	24546	C4-1/8-T0-2741-F
A1R54	0684-2201	7		RESISTOR 22 10X .25W FC TC=400/+500	01121	C82201
A1R55	0684-2201	7		RESISTOR 22 10X .25W FC TC=400/+500	01121	C82201
A1R56	0684-2221	1	2	RESISTOR 2.2K 10X .25W FC TC=400/+700	01121	C82221
A1R57	0684-1021	7	2	RESISTOR 1K 10X .25W FC TC=400/+600	01121	C81021
A1R58	0684-2221	1		RESISTOR 2.2K 10X .25W FC TC=400/+700	01121	C82221
A1R59	0684-1021	7		RESISTOR 1K 10X .25W FC TC=400/+600	01121	C81021
A1R60	0684-2201	7		RESISTOR 22 10X .25W FC TC=400/+500	01121	C82201
A1R61	0698-3150	6	1	RESISTOR 2.37K 1X .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A1R62	0684-5601	7	11	RESISTOR 56 10X .25W FC TC=400/+500	01121	C85601
A1R63	0684-5601	7		RESISTOR 56 10X .25W FC TC=400/+500	01121	C85601
A1R64	2100-3349	2	1	RESISTOR-TRMR 100 10X C SIDE-ADJ 1-TRN	28480	2100-3349
A1R65	0684-5601	7		RESISTOR 56 10X .25W FC TC=400/+500	01121	C85601
A1R66	0684-5621	1		RESISTOR 5.6K 10X .25W FC TC=400/+700	01121	C85621
A1R67	0684-5601	7		RESISTOR 56 10X .25W FC TC=400/+500	01121	C85601
A1R68	0757-0281	4		RESISTOR 2.74K 1X .125W F TC=0+-100	24546	C4-1/8-T0-2741-F
A1R69	0757-0280	3		RESISTOR 1K 1X .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R70	0757-0281	4		RESISTOR 2.74K 1X .125W F TC=0+-100	24546	C4-1/8-T0-2741-F
A1R71	0684-5621	1		RESISTOR 5.6K 10X .25W FC TC=400/+700	01121	C85621
A1R72	0684-5601	7		RESISTOR 56 10X .25W FC TC=400/+500	01121	C85601
A1R73	0684-5601	7		RESISTOR 56 10X .25W FC TC=400/+500	01121	C85601
A1R74	0698-3153	9	2	RESISTOR 3.83K 1X .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A1R75	0698-3153	9		RESISTOR 3.83K 1X .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A1R76	0684-1841	9	1	RESISTOR 180K 10X .25W FC TC=800/+900	01121	C81841
A1R77	0684-5601	7		RESISTOR 56 10X .25W FC TC=400/+500	01121	C85601
A1R78	0684-1051	3	1	RESISTOR 1M 10X .25W FC TC=800/+900	01121	C81051
A1R79	0684-2231	3	1	RESISTOR 22K 10X .25W FC TC=400/+800	01121	C82231
A1R80	0684-1531	4		RESISTOR 15K 10X .25W FC TC=400/+800	01121	C81531
A1R81	0684-5601	7		RESISTOR 56 10X .25W FC TC=400/+500	01121	C85601
A1R82	0757-0284	7	2	RESISTOR 150 1X .125W F TC=0+-100	24546	C4-1/8-T0-151-F
A1R83	0757-0469	0	1	RESISTOR 150K 1X .125W F TC=0+-100	24546	C4-1/8-T0-1503-F
A1R84	0757-0284	7		RESISTOR 150 1X .125W F TC=0+-100	24546	C4-1/8-T0-151-F
A1R85	0684-5601	7		RESISTOR 56 10X .25W FC TC=400/+500	01121	C85601
A1R86	0757-0407	6	1	RESISTOR 200 1X .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A1R87	0757-0280	3		RESISTOR 1K 1X .125W F TC=0+-100	24546	C4-1/8-T0-1001-F

See introduction to this section for ordering information  
 \*Indicates factory selected value

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

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1R88	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A1R89	0684-5601	7		RESISTOR 56 10% .25W FC TC=400/+500	01121	CB5601
A1R90	0684-5601	7		RESISTOR 56 10% .25W FC TC=400/+500	01121	CB5601
A1R91	0757-0441	8	1	RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A1S1	3101-0973	5	1	SWITCH=8L DPDT MINTR .5A 125VAC/DC PC	28480	3101-0973
A1U1	1820-0352	6	1	TRANSISTOR ARRAY	0192B	CA301B
A1U2	1858-0040	8	1	TRANSISTOR ARRAY	0192B	CA3127E
A1VR1	1902-3139	7	1	DIODE-ZNR 8.25V 5% DO-7 PD=.4W TC=+.053%	28480	1902-3139

See introduction to this section for ordering information  
 \*Indicates factory selected value

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

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2	01310-66530	2	1	PC BOARD ASSEMBLY-OUTPUT AMPLIFIER	28480	01310-66530
A2C1	0160-3451	1	8	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A2C2	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A2C3	0160-2150	5	2	CAPACITOR-FXD 33PF +-5% 300VDC MICA	28480	0160-2150
A2C4	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A2C5	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A2C6	0170-0063	6	2	CAPACITOR-FXD .02UF +-10% 400VDC POLYE	84411	663UW20394
A2C7	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A2C8	0121-0407	9	2	CAPACITOR-V TRMR-PSTN .7-3PF 600V	72982	536-016
A2C9	0170-0022	7	3	CAPACITOR-FXD .1UF +-20% 600VDC POLYE	28480	0170-0022
A2C11	0160-2150	5		CAPACITOR-FXD 33PF +-5% 300VDC MICA	28480	0160-2150
A2C12	0121-0407	9		CAPACITOR-V TRMR-PSTN .7-3PF 600V	72982	536-016
A2C13	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A2C14	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A2C15	0170-0063	6		CAPACITOR-FXD .02UF +-10% 400VDC POLYE	84411	663UW20394
A2C16	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A2C17	0121-0474	0	1	CAPACITOR-V TRMR-PSTN .3-1.5PF 600V	28480	0121-0474
A2C18	0170-0022	7		CAPACITOR-FXD .1UF +-20% 600VDC POLYE	28480	0170-0022
A2C19	0170-0022	7		CAPACITOR-FXD .1UF +-20% 600VDC POLYE	28480	0170-0022
A2C20	0180-0374	3	2	CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X902082
A2C21	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X902082
A2C22	0160-3443	1	2	CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A2C23	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A2CR1	1901-0033	2	4	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A2CR2	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A2CR3	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A2CR4	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A2CR5	1901-0040	1	12	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR6	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR7	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR8	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR9	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR10	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR11	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR12	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR13	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR14	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR15	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR16	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2Q1	1853-0036	2	4	TRANSISTOR PNP SI PD=310MHZ FT=250MHZ	28480	1853-0036
A2Q2	1853-0036	2		TRANSISTOR PNP SI PD=310MHZ FT=250MHZ	28480	1853-0036
A2Q4	1853-0036	2		TRANSISTOR PNP SI PD=310MHZ FT=250MHZ	28480	1853-0036
A2Q5	1854-0215	1	2	TRANSISTOR NPN SI PD=350MHZ FT=300MHZ	04713	2N3904
A2Q6	1853-0038	4	4	TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0038
A2Q7	1853-0038	4		TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0038
A2Q8	1854-0271	9	2	TRANSISTOR NPN SI TO-39 PD=1W FT=150MHZ	28480	1854-0271
A2Q9	1854-0523	4	7	TRANSISTOR NPN SI TO-39 PD=1W FT=150MHZ	28480	1854-0523
A2Q10	1854-0215	1		TRANSISTOR NPN SI PD=350MHZ FT=300MHZ	04713	2N3904
A2Q11	1853-0036	2		TRANSISTOR PNP SI PD=310MHZ FT=250MHZ	28480	1853-0036
A2Q12	1854-0271	9		TRANSISTOR NPN SI TO-39 PD=1W FT=150MHZ	28480	1854-0271
A2Q13	1854-0523	4		TRANSISTOR NPN SI TO-39 PD=1W FT=150MHZ	28480	1854-0523
A2Q14	1853-0038	4		TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0038
A2Q15	1853-0038	4		TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0038
A2R1	0684-4701	6	4	RESISTOR 47 10% .25W FC TC=-400/+500	01121	CB4701
A2R2	0684-4701	6		RESISTOR 47 10% .25W FC TC=-400/+500	01121	CB4701
A2R3	0684-5601	7	2	RESISTOR 56 10% .25W FC TC=-400/+500	01121	CB5601
A2R4	0684-5601	7		RESISTOR 56 10% .25W FC TC=-400/+500	01121	CB5601
A2R5	0698-3153	9	1	RESISTOR 3.83K 1% .125W F TC=0/+100	24546	C4-1/8-T0-3831-F
A2R6	0757-0280	3	1	RESISTOR 1K 1% .125W F TC=0/+100	24546	C4-1/8-T0-1001-F
A2R7	0698-0085	0	2	RESISTOR 2.61K 1% .125W F TC=0/+100	24546	C4-1/8-T0-2611-F
A2R8	0757-0278	9	2	RESISTOR 1.78K 1% .125W F TC=0/+100	24546	C4-1/8-T0-1781-F
A2R9	0698-3159	5	2	RESISTOR 26.1K 1% .125W F TC=0/+100	24546	C4-1/8-T0-2612-F
A2R10	0684-1811	3	5	RESISTOR 180 10% .25W FC TC=-400/+600	01121	CB1811
A2R11	0684-2711	4	2	RESISTOR 270 10% .25W FC TC=-400/+600	01121	CB2711
A2R12	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0/+100	24546	C4-1/8-T0-2611-F
A2R13	0757-0278	9		RESISTOR 1.78K 1% .125W F TC=0/+100	24546	C4-1/8-T0-1781-F
A2R14	0698-3159	5		RESISTOR 26.1K 1% .125W F TC=0/+100	24546	C4-1/8-T0-2612-F
A2R15	0684-2711	4		RESISTOR 270 10% .25W FC TC=-400/+600	01121	CB2711
A2R16	0684-1811	3		RESISTOR 180 10% .25W FC TC=-400/+600	01121	CB1811
A2R17	0684-1001	3	2	RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A2R18	0698-3655	6	2	RESISTOR 56K 5% 2W MO TC=0/+200	27167	FP42-2-T00-5602-J
A2R19	0698-3155	1	2	RESISTOR 4.64K 1% .125W F TC=0/+100	24546	C4-1/8-T0-4641-F
A2R20	0757-0159	5	2	RESISTOR 1K 1% .5W F TC=0/+100	28480	0757-0159

See introduction to this section for ordering information  
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Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2R21	0764-0021	5	4	RESISTOR 9.1K 5% 2W MO TC=0+-200	28480	0764-0021
A2R22	0764-0021	5		RESISTOR 9.1K 5% 2W MO TC=0+-200	28480	0764-0021
A2R23	0684-1021	7	2	RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A2R24	2100-2692	6	1	RESISTOR-TMR 1M 20% C 8IDE-ADJ 1-TRN	30983	ET50X105
A2R25	0757-0438	3	2	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2R26	0684-4701	6		RESISTOR 47 10% .25W FC TC=-400/+500	01121	CB4701
A2R27	0761-0076	4	2	RESISTOR 18K 5% 1W MO TC=0+-200	28480	0761-0076
A2R28	0761-0074	2	2	RESISTOR 15K 5% 1W MO TC=0+-200	28480	0761-0074
A2R29	0698-3646	5	4	RESISTOR 12K 5% 2W MO TC=0+-200	27167	FP42-2-T00-1202-J
A2R30	0698-3646	5		RESISTOR 12K 5% 2W MO TC=0+-200	27167	FP42-2-T00-1202-J
A2R31	0757-0480	5	1	RESISTOR 432K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-4323-F
A2R32	0698-3646	5		RESISTOR 12K 5% 2W MO TC=0+-200	27167	FP42-2-T00-1202-J
A2R33	0684-1811	3		RESISTOR 180 10% .25W FC TC=-400/+600	01121	CB1811
A2R34	0698-3646	5		RESISTOR 12K 5% 2W MO TC=0+-200	27167	FP42-2-T00-1202-J
A2R35	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2R36	0684-4701	6		RESISTOR 47 10% .25W FC TC=-400/+500	01121	CB4701
A2R37	0684-1001	3		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A2R38	0698-3655	6		RESISTOR 56K 5% 2W MO TC=0+-200	27167	FP42-2-T00-5602-J
A2R39	0684-1811	3		RESISTOR 180 10% .25W FC TC=-400/+600	01121	CB1811
A2R40	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A2R41	0757-0159	5		RESISTOR 1K 1% .5W F TC=0+-100	28480	0757-0159
A2R42	0761-0074	2		RESISTOR 15K 5% 1W MO TC=0+-200	28480	0761-0074
A2R43	0761-0076	4		RESISTOR 18K 5% 1W MO TC=0+-200	28480	0761-0076
A2R44	0764-0021	5		RESISTOR 9.1K 5% 2W MO TC=0+-200	28480	0764-0021
A2R45	0764-0021	5		RESISTOR 9.1K 5% 2W MO TC=0+-200	28480	0764-0021
A2R46	0684-1021	7		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A2R47	0684-1811	3		RESISTOR 180 10% .25W FC TC=-400/+600	01121	CB1811

See introduction to this section for ordering information  
 \*Indicates factory selected value

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

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3	01317-66503	6	1	PC BOARD ASSEMBLY-INPUT AMPLIFIER	28480	01317-66503
A3C1	0160-3451	1	5	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3C2	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3C3	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3C4	0160-0174	9	2	CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A3C5	0160-3443	1	7	CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A3C6	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3C7	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A3C8	0160-2197	0	2	CAPACITOR-FXD 10PF +-5% 300VDC MICA	28480	0160-2197
A3C9	0160-2197	0		CAPACITOR-FXD 10PF +-5% 300VDC MICA	28480	0160-2197
A3C10	0160-0168	1	7	CAPACITOR-FXD .1UF +-10% 200VDC POLYE	28480	0160-0168
A3C11	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A3C12	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A3C13	0160-0168	1		CAPACITOR-FXD .1UF +-10% 200VDC POLYE	28480	0160-0168
A3C14	0160-0168	1		CAPACITOR-FXD .1UF +-10% 200VDC POLYE	28480	0160-0168
A3C15	0160-0168	1		CAPACITOR-FXD .1UF +-10% 200VDC POLYE	28480	0160-0168
A3C16	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3C17	0160-0168	1		CAPACITOR-FXD .1UF +-10% 200VDC POLYE	28480	0160-0168
A3C18	0160-0168	1		CAPACITOR-FXD .1UF +-10% 200VDC POLYE	28480	0160-0168
A3C19	0160-0174	9		CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A3C20	0140-0196	3	1	CAPACITOR-FXD 150PF +-5% 300VDC MICA	72136	DM15F151J0300MV1CR
A3C21	0160-0168	1		CAPACITOR-FXD .1UF +-10% 200VDC POLYE	28480	0160-0168
A3C22	0160-2254	0	1	CAPACITOR-FXD 7.5PF +-25PF 500VDC CER	28480	0160-2254
A3C23	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A3C24	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A3C25	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A3CR1	1901-0376	6	4	DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A3CR2	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A3CR3	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A3CR4	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A3CR5	1901-0033	2	8	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3CR6	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3CR7	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3CR8	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3CR9	1901-0040	1	7	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR10	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR11	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR12	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR13	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3CR14	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3CR15	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3CR16	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3CR17	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR18	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR20	1901-0513	3	4	DIODE-DUAL 100V	28480	1901-0513
A3CR21	1901-0513	3		DIODE-DUAL 100V	28480	1901-0513
A3CR22	1901-0513	3		DIODE-DUAL 100V	28480	1901-0513
A3CR23	1901-0513	3		DIODE-DUAL 100V	28480	1901-0513
A3CR24	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3L1	9100-2276	9	2	COIL-MLD 100UH 10% Q=50 .095DX,25LG-NOM	28480	9100-2276
A3L2	9100-2276	9		COIL-MLD 100UH 10% Q=50 .095DX,25LG-NOM	28480	9100-2276
A3Q1	1855-0262	0	1	TRANSISTOR-JFET DUAL N-CHAN D-MODE SI	28480	1855-0262
A3Q3	1853-0036	2	4	TRANSISTOR PNP SI PD=310MHZ FT=250MHZ	28480	1853-0036
A3Q4	1853-0036	2		TRANSISTOR PNP SI PD=310MHZ FT=250MHZ	28480	1853-0036
A3Q5	1854-0071	7	7	TRANSISTOR NPN SI PD=300MHZ FT=200MHZ	28480	1854-0071
A3Q6	1854-0071	7		TRANSISTOR NPN SI PD=300MHZ FT=200MHZ	28480	1854-0071
A3Q7	1854-0071	7		TRANSISTOR NPN SI PD=300MHZ FT=200MHZ	28480	1854-0071
A3Q8	1853-0316	1	1	TRANSISTOR-DUAL PNP PD=500MHZ	28480	1853-0316
A3Q9	1854-0071	1		TRANSISTOR NPN SI PD=300MHZ FT=200MHZ	28480	1854-0071
A3Q10	1854-0071	7		TRANSISTOR NPN SI PD=300MHZ FT=200MHZ	28480	1854-0071
A3Q11	1853-0276	2	3	TRANSISTOR PNP SI TO-52 PD=360MHZ	04713	MM3906
A3Q12	1853-0276	2		TRANSISTOR PNP SI TO-52 PD=360MHZ	04713	MM3906
A3Q13	1853-0276	2		TRANSISTOR PNP SI TO-52 PD=360MHZ	04713	MM3906
A3Q14	1853-0036	2		TRANSISTOR PNP SI PD=310MHZ FT=250MHZ	28480	1853-0036
A3Q15	1853-0036	2		TRANSISTOR PNP SI PD=310MHZ FT=250MHZ	28480	1853-0036
A3Q16	1854-0071	7		TRANSISTOR NPN SI PD=300MHZ FT=200MHZ	28480	1854-0071
A3Q17	1854-0071	7		TRANSISTOR NPN SI PD=300MHZ FT=200MHZ	28480	1854-0071
A3R1	0698-5965	5	1	RESISTOR 50 1% .5W F TC=0+-100	28480	0698-5965
A3R2	0687-4701	2	1	RESISTOR 47 10% .5W CC TC=0+412	01121	EB4701
A3R3	0757-0340	6	1	RESISTOR 10K 1% .25W F TC=0+-100	24546	C5=1/4-T0=1002-F
A3R4	0684-1041	1	2	RESISTOR 100K 10% .25W FC TC=400/+800	01121	CB1041
A3R5	0684-1041	1		RESISTOR 100K 10% .25W FC TC=400/+800	01121	CB1041

See introduction to this section for ordering information  
 \*Indicates factory selected value



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

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3R6	0684-3901	6	2	RESISTOR 39 10X .25W FC TC=-400/+500	01121	CB3901
A3R7	0684-3901	6		RESISTOR 39 10X .25W FC TC=-400/+500	01121	CB3901
A3R10	0757-0280	3	7	RESISTOR 1K 1X .125W F TC=0+100	24546	C4-1/8-T0-1001-F
A3R11	2100-3352	7	2	RESISTOR-TRMR 1K 10X C SIDE-ADJ 1-TRN	28480	2100-3352
A3R12	2100-3352	7		RESISTOR-TRMR 1K 10X C SIDE-ADJ 1-TRN	28480	2100-3352
A3R13	0698-3447	4	1	RESISTOR 422 1X .125W F TC=0+100	24546	C4-1/8-T0-422R-F
A3R14	0757-0283	6	1	RESISTOR 2K 1X .125W F TC=0+100	24546	C4-1/8-T0-2001-F
A3R15	0757-0419	0	1	RESISTOR 681 1X .125W F TC=0+100	24546	C4-1/8-T0-681R-F
A3R16	0757-0412	3	2	RESISTOR 365 1X .125W F TC=0+100	24546	C4-1/8-T0-365R-F
A3R19	0757-0442	9	4	RESISTOR 10K 1X .125W F TC=0+100	24546	C4-1/8-T0-1002-F
A3R22	0757-0442	9		RESISTOR 10K 1X .125W F TC=0+100	24546	C4-1/8-T0-1002-F
A3R23	0757-0280	3		RESISTOR 1K 1X .125W F TC=0+100	24546	C4-1/8-T0-1001-F
A3R24	0757-0417	8	2	RESISTOR 562 1X .125W F TC=0+100	24546	C4-1/8-T0-562R-F
A3R25	0757-0417	8		RESISTOR 562 1X .125W F TC=0+100	24546	C4-1/8-T0-562R-F
A3R26	0757-0394	0	2	RESISTOR 51.1 1X .125W F TC=0+100	24546	C4-1/8-T0-511R-F
A3R27	0757-0401	0	2	RESISTOR 100 1X .125W F TC=0+100	24546	C4-1/8-T0-101-F
A3R28	0757-0442	0		RESISTOR 10K 1X .125W F TC=0+100	24546	C4-1/8-T0-1002-F
A3R29	0757-0401	9		RESISTOR 100 1X .125W F TC=0+100	24546	C4-1/8-T0-101-F
A3R31	0757-0394	0		RESISTOR 51.1 1X .125W F TC=0+100	24546	C4-1/8-T0-511R-F
A3R32	0698-0084	9	2	RESISTOR 2.15K 1X .125W F TC=0+100	24546	C4-1/8-T0-2151-F
A3R33	0757-0408	7	2	RESISTOR 243 1X .125W F TC=0+100	24546	C4-1/8-T0-243R-F
A3R34	0757-0273	4	1	RESISTOR 3.01K 1X .125W F TC=0+100	24546	C4-1/8-T0-3011-F
A3R35	0757-0408	7		RESISTOR 243 1X .125W F TC=0+100	24546	C4-1/8-T0-243R-F
A3R36	0757-0416	7	3	RESISTOR 511 1X .125W F TC=0+100	24546	C4-1/8-T0-511R-F
A3R37	0757-0416	7		RESISTOR 511 1X .125W F TC=0+100	24546	C4-1/8-T0-511R-F
A3R38	0757-0412	3		RESISTOR 365 1X .125W F TC=0+100	24546	C4-1/8-T0-365R-F
A3R39	0684-5621	1	3	RESISTOR 5.6K 10X .25W FC TC=-400/+700	01121	CB5621
A3R40	0684-1531	4	2	RESISTOR 15K 10X .25W FC TC=-400/+800	01121	CB1531
A3R41	0757-0442	9		RESISTOR 10K 1X .125W F TC=0+100	24546	C4-1/8-T0-1002-F
A3R42	0757-0415	6	2	RESISTOR 475 1X .125W F TC=0+100	24546	C4-1/8-T0-475R-F
A3R43	0757-0415	6		RESISTOR 475 1X .125W F TC=0+100	24546	C4-1/8-T0-475R-F
A3R44	0698-0085	0	1	RESISTOR 2.61K 1X .125W F TC=0+100	24546	C4-1/8-T0-2611-F
A3R45	0757-0421	4	1	RESISTOR 825 1X .125W F TC=0+100	24546	C4-1/8-T0-825R-F
A3R46	0757-0280	3		RESISTOR 1K 1X .125W F TC=0+100	24546	C4-1/8-T0-1001-F
A3R47	0684-2201	7	5	RESISTOR 22 10X .25W FC TC=-400/+500	01121	CB2201
A3R48	0757-0280	3		RESISTOR 1K 1X .125W F TC=0+100	24546	C4-1/8-T0-1001-F
A3R49	0757-0281	4	4	RESISTOR 2.74K 1X .125W F TC=0+100	24546	C4-1/8-T0-2741-F
A3R50	0757-0416	7		RESISTOR 511 1X .125W F TC=0+100	24546	C4-1/8-T0-511R-F
A3R51	0684-2201	7		RESISTOR 22 10X .25W FC TC=-400/+500	01121	CB2201
A3R52	0757-0280	3		RESISTOR 1K 1X .125W F TC=0+100	24546	C4-1/8-T0-1001-F
A3R53	0757-0281	4		RESISTOR 2.74K 1X .125W F TC=0+100	24546	C4-1/8-T0-2741-F
A3R54	0684-2201	7		RESISTOR 22 10X .25W FC TC=-400/+500	01121	CB2201
A3R55	0684-2201	7		RESISTOR 22 10X .25W FC TC=-400/+500	01121	CB2201
A3R56	0684-2221	1	2	RESISTOR 2.2K 10X .25W FC TC=-400/+700	01121	CB2221
A3R57	0684-1021	7	2	RESISTOR 1K 10X .25W FC TC=-400/+600	01121	CB1021
A3R58	0684-2221	1		RESISTOR 2.2K 10X .25W FC TC=-400/+700	01121	CB2221
A3R59	0684-1021	7		RESISTOR 1K 10X .25W FC TC=-400/+600	01121	CB1021
A3R60	0684-2201	7		RESISTOR 22 10X .25W FC TC=-400/+500	01121	CB2201
A3R61	0698-3150	6	1	RESISTOR 2.37K 1X .125W F TC=0+100	24546	C4-1/8-T0-2371-F
A3R62	0684-5601	7	11	RESISTOR 56 10X .25W FC TC=-400/+500	01121	CB5601
A3R63	0684-5601	7		RESISTOR 56 10X .25W FC TC=-400/+500	01121	CB5601
A3R64	2100-3349	2	1	RESISTOR-TRMR 100 10X C SIDE-ADJ 1-TRN	28480	2100-3349
A3R65	0684-5601	7		RESISTOR 56 10X .25W FC TC=-400/+500	01121	CB5601
A3R66	0684-5621	1		RESISTOR 5.6K 10X .25W FC TC=-400/+700	01121	CB5621
A3R67	0684-5601	7		RESISTOR 56 10X .25W FC TC=-400/+500	01121	CB5601
A3R68	0757-0281	4		RESISTOR 2.74K 1X .125W F TC=0+100	24546	C4-1/8-T0-2741-F
A3R69	0757-0280	3		RESISTOR 1K 1X .125W F TC=0+100	24546	C4-1/8-T0-1001-F
A3R70	0757-0281	4		RESISTOR 2.74K 1X .125W F TC=0+100	24546	C4-1/8-T0-2741-F
A3R71	0684-5621	1		RESISTOR 5.6K 10X .25W FC TC=-400/+700	01121	CB5621
A3R72	0684-5601	7		RESISTOR 56 10X .25W FC TC=-400/+500	01121	CB5601
A3R73	0684-5601	7		RESISTOR 56 10X .25W FC TC=-400/+500	01121	CB5601
A3R74	0698-3153	9	2	RESISTOR 3.83K 1X .125W F TC=0+100	24546	C4-1/8-T0-3831-F
A3R75	0698-3153	9		RESISTOR 3.83K 1X .125W F TC=0+100	24546	C4-1/8-T0-3831-F
A3R76	0684-1841	9	1	RESISTOR 180K 10X .25W FC TC=-800/+900	01121	CB1841
A3R77	0684-5601	7		RESISTOR 56 10X .25W FC TC=-400/+500	01121	CB5601
A3R78	0684-1051	3	1	RESISTOR 1M 10X .25W FC TC=-800/+900	01121	CB1051
A3R79	0684-2231	3	1	RESISTOR 22K 10X .25W FC TC=-400/+800	01121	CB2231
A3R80	0684-1531	4		RESISTOR 15K 10X .25W FC TC=-400/+800	01121	CB1531
A3R81	0684-5601	7		RESISTOR 56 10X .25W FC TC=-400/+500	01121	CB5601
A3R82	0757-0284	7	2	RESISTOR 150 1X .125W F TC=0+100	24546	C4-1/8-T0-151-F
A3R83	0757-0469	0	1	RESISTOR 150K 1X .125W F TC=0+100	24546	C4-1/8-T0-1503-F
A3R84	0757-0284	7		RESISTOR 150 1X .125W F TC=0+100	24546	C4-1/8-T0-151-F
A3R85	0684-5601	7		RESISTOR 56 10X .25W FC TC=-400/+500	01121	CB5601
A3R86	0757-0407	6	1	RESISTOR 200 1X .125W F TC=0+100	24546	C4-1/8-T0-201-F
A3R87	0757-0280	3		RESISTOR 1K 1X .125W F TC=0+100	24546	C4-1/8-T0-1001-F

See introduction to this section for ordering information  
 \*Indicates factory selected value



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

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3R88	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+/-100	24546	C4-1/8-T0-2151-F
A3R89	0684-5601	7		RESISTOR 56 10% .25W FC TC=-400/+500	01121	CB5601
A3R90	0684-5601	7		RESISTOR 56 10% .25W FC TC=-400/+500	01121	CB5601
A3R91	0757-0441	8	1	RESISTOR 8.25K 1% .125W F TC=0+/-100	24546	C4-1/8-T0-8251-F
A3S1	3101-0973	5	1	SWITCH-8L DPDT MINTR .5A 125VAC/DC PC	28480	3101-0973
A3U1	1820-0352	6	1	TRANSISTOR ARRAY	0192B	CA3018
A3U2	1856-0040	8	1	TRANSISTOR ARRAY	0192B	CA3127E
A3VR1	1902-3139	7	1	DIODE-ZNR 8.25V 5% DO-7 Pd=.4W TC=+.053X	28480	1902-3139

See introduction to this section for ordering information  
 \*Indicates factory selected value

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

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4	01310-66530	2	1	PC BOARD ASSEMBLY-OUTPUT AMPLIFIER	28480	01310-66530
A4C1	0160-3451	1	8	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A4C2	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A4C3	0160-2150	5	2	CAPACITOR-FXD 33PF +-5% 300VDC MICA	28480	0160-2150
A4C4	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A4C5	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A4C6	0170-0063	6	2	CAPACITOR-FXD .02UF +-10% 400VDC POLYE	84411	663UM20394
A4C7	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A4C8	0121-0407	9	2	CAPACITOR-V TRMR=PSTN .7-3PF 600V	72982	536-016
A4C9	0170-0022	7	3	CAPACITOR-FXD .1UF +-20% 600VDC POLYE	28480	0170-0022
A4C11	0160-2150	5		CAPACITOR-FXD 33PF +-5% 300VDC MICA	28480	0160-2150
A4C12	0121-0407	9		CAPACITOR-V TRMR=PSTN .7-3PF 600V	72982	536-016
A4C13	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A4C14	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A4C15	0170-0063	6		CAPACITOR-FXD .02UF +-10% 400VDC POLYE	84411	663UM20394
A4C16	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A4C17	0121-0474	0	1	CAPACITOR-V TRMR=PSTN 0.25-1.5PF 600V	28480	0121-0474
A4C18	0170-0022	7		CAPACITOR-FXD .1UF +-20% 600VDC POLYE	28480	0170-0022
A4C19	0170-0022	7		CAPACITOR-FXD .1UF +-20% 600VDC POLYE	28480	0170-0022
A4C20	0180-0374	3	2	CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A4C21	0180-0374	3	3	CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A4C22	0160-3443	1	2	CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A4C23	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A4CR1	1901-0033	2	4	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A4CR2	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A4CR3	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A4CR4	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A4CR5	1901-0040	1	12	DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A4CR6	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A4CR7	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A4CR8	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A4CR9	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A4CR10	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A4CR11	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A4CR12	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A4CR13	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A4CR14	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A4CR15	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A4CR16	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A4Q1	1853-0036	2	4	TRANSISTOR PNP SI PD=310MHZ FT=250MHZ	28480	1853-0036
A4Q2	1853-0036	2		TRANSISTOR PNP SI PD=310MHZ FT=250MHZ	28480	1853-0036
A4Q4	1853-0036	2		TRANSISTOR PNP SI PD=310MHZ FT=250MHZ	28480	1853-0036
A4Q5	1854-0215	1	2	TRANSISTOR NPN SI PD=350MHZ FT=300MHZ	04713	2N3904
A4Q6	1853-0038	4	4	TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0038
A4Q7	1853-0038	4		TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0038
A4Q8	1854-0271	9	2	TRANSISTOR NPN SI TO-39 PD=1W FT=150MHZ	28480	1854-0271
A4Q9	1854-0523	4	2	TRANSISTOR NPN SI TO-39 PD=1W FT=150MHZ	28480	1854-0523
A4Q10	1854-0215	1		TRANSISTOR NPN SI PD=350MHZ FT=300MHZ	04713	2N3904
A4Q11	1853-0036	2		TRANSISTOR PNP SI PD=310MHZ FT=250MHZ	28480	1853-0036
A4Q12	1854-0271	9		TRANSISTOR NPN SI TO-39 PD=1W FT=150MHZ	28480	1854-0271
A4Q13	1854-0523	4		TRANSISTOR NPN SI TO-39 PD=1W FT=150MHZ	28480	1854-0523
A4Q14	1853-0038	4		TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0038
A4Q15	1853-0038	4		TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0038
A4R1	0684-4701	6	4	RESISTOR 47 10% .25W FC TC=-400/+500	01121	CB4701
A4R2	0684-4701	6		RESISTOR 47 10% .25W FC TC=-400/+500	01121	CB4701
A4R3	0684-5601	7	2	RESISTOR 56 10% .25W FC TC=-400/+500	01121	CB5601
A4R4	0684-5601	7		RESISTOR 56 10% .25W FC TC=-400/+500	01121	CB5601
A4R5	0698-3153	9	1	RESISTOR 3.83K 1% .125W F TC=0/+100	24546	C4-1/8-T0-3831-F
A4R6	0757-0280	3	1	RESISTOR 1K 1% .125W F TC=0/+100	24546	C4-1/8-T0-1001-F
A4R7	0698-0085	0	2	RESISTOR 2.61K 1% .125W F TC=0/+100	24546	C4-1/8-T0-2611-F
A4R8	0757-0278	9	2	RESISTOR 1.78K 1% .125W F TC=0/+100	24546	C4-1/8-T0-1781-F
A4R9	0698-3159	5	2	RESISTOR 26.1K 1% .125W F TC=0/+100	24546	C4-1/8-T0-2612-F
A4R10	0684-1811	3	5	RESISTOR 180 10% .25W FC TC=-400/+600	01121	CB1811
A4R11	0684-2711	4	2	RESISTOR 270 10% .25W FC TC=-400/+600	01121	CB2711
A4R12	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0/+100	24546	C4-1/8-T0-2611-F
A4R13	0757-0278	9		RESISTOR 1.78K 1% .125W F TC=0/+100	24546	C4-1/8-T0-1781-F
A4R14	0698-3159	5		RESISTOR 26.1K 1% .125W F TC=0/+100	24546	C4-1/8-T0-2612-F
A4R15	0684-2711	4		RESISTOR 270 10% .25W FC TC=-400/+600	01121	CB2711
A4R16	0684-1811	3		RESISTOR 180 10% .25W FC TC=-400/+600	01121	CB1811
A4R17	0684-1001	3	2	RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A4R18	0698-3655	6	2	RESISTOR 56K 5% 2W MO TC=0/+200	27167	FP42-2-T00-5602-J
A4R19	0698-3155	1	2	RESISTOR 4.64K 1% .125W F TC=0/+100	24546	C4-1/8-T0-4641-F
A4R20	0757-0159	5	2	RESISTOR 1K 1% .5W F TC=0/+100	28480	0757-0159

See introduction to this section for ordering information  
 \*Indicates factory selected value

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

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4R21	0764-0021	5	4	RESISTOR 9.1K 5% 2W MO TC=0+-200	28480	0764-0021
A4R22	0764-0021	5		RESISTOR 9.1K 5% 2W MO TC=0+-200	28480	0764-0021
A4R23	0684-1021	7	2	RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A4R24	2100-2692	6	1	RESISTOR-TRMR 1M 20% C SIDE-ADJ 1-TRN	30983	ET50X105
A4R25	0757-0438	3	2	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A4R26	0684-4701	6		RESISTOR 47 10% .25W FC TC=-400/+500	01121	CB4701
A4R27	0761-0076	4	2	RESISTOR 18K 5% 1W MO TC=0+-200	28480	0761-0076
A4R28	0761-0074	2	2	RESISTOR 15K 5% 1W MO TC=0+-200	28480	0761-0074
A4R29	0698-3646	5	4	RESISTOR 12K 5% 2W MO TC=0+-200	27167	FP42-2-T00-1202-J
A4R30	0698-3646	5		RESISTOR 12K 5% 2W MO TC=0+-200	27167	FP42-2-T00-1202-J
A4R31	0757-0480	5	1	RESISTOR 432K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-4323-F
A4R32	0698-3646	5		RESISTOR 12K 5% 2W MO TC=0+-200	27167	FP42-2-T00-1202-J
A4R33	0684-1811	3		RESISTOR 180 10% .25W FC TC=-400/+600	01121	CB1811
A4R34	0698-3646	5		RESISTOR 12K 5% 2W MO TC=0+-200	27167	FP42-2-T00-1202-J
A4R35	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A4R36	0684-4701	6		RESISTOR 47 10% .25W FC TC=-400/+500	01121	CB4701
A4R37	0684-1001	3		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A4R38	0698-3655	6		RESISTOR 56K 5% 2W MO TC=0+-200	27167	FP42-2-T00-5602-J
A4R39	0684-1811	3		RESISTOR 180 10% .25W FC TC=-400/+600	01121	CB1811
A4R40	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A4R41	0757-0159	5		RESISTOR 1K 1% .5W F TC=0+-100	28480	0757-0159
A4R42	0761-0074	2		RESISTOR 15K 5% 1W MO TC=0+-200	28480	0761-0074
A4R43	0761-0076	4		RESISTOR 18K 5% 1W MO TC=0+-200	28480	0761-0076
A4R44	0764-0021	5		RESISTOR 9.1K 5% 2W MO TC=0+-200	28480	0764-0021
A4R45	0764-0021	5		RESISTOR 9.1K 5% 2W MO TC=0+-200	28480	0764-0021
A4R46	0684-1021	7		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A4R47	0684-1811	3		RESISTOR 180 10% .25W FC TC=-400/+600	01121	CB1811
				MISCELLANEOUS PARTS		
	1200-0185	9	8	INSULATOR-XSTR NYLON	28480	1200-0185
	1205-0073	4	8	HEAT SINK TO-5/T0-39-CS	28480	1205-0073

See introduction to this section for ordering information  
 \*Indicates factory selected value

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

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A5	01311-66502	9	1	Z-AXIS BOARD ASSEMBLY	28480	01311-66502
ASC1	0160-2055	9	16	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
ASC2	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
ASC3	0160-2243	7	4	CAPACITOR-FXD 2.7PF +- .25PF 500VDC CER	28480	0160-2243
ASC4	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
ASC5	0160-3508	9	4	CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
ASC6	0160-3508	9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
ASC7	0160-2243	7		CAPACITOR-FXD 2.7PF +- .25PF 500VDC CER	28480	0160-2243
ASC8	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
ASC9	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
ASC10	0160-3443	1	5	CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
ASC11	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
ASC12	0160-2243	7		CAPACITOR-FXD 2.7PF +- .25PF 500VDC CER	28480	0160-2243
ASC13	0160-2243	7		CAPACITOR-FXD 2.7PF +- .25PF 500VDC CER	28480	0160-2243
ASC14	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
ASC15	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
ASC16	0140-0203	3	2	CAPACITOR-FXD 30PF +-5% 500VDC MICA	72136	DM15E300J0500MV1CR
ASC17	0140-0203	3		CAPACITOR-FXD 30PF +-5% 500VDC MICA	72136	DM15E300J0500MV1CR
ASC18	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
ASC19	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
ASC20	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
ASC21	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
ASC22	0160-4908	5	3	CAPACITOR-FXD .68UF +-10% 250VDC	28480	0160-4908
ASC23	0160-3460	2	2	CAPACITOR-FXD .05UF +80-20% 100VDC CER	28480	0160-3460
ASC24	0160-3460	2		CAPACITOR-FXD .05UF +80-20% 100VDC CER	28480	0160-3460
ASC25	0160-4908	5		CAPACITOR-FXD .68UF +-10% 250VDC	28480	0160-4908
ASC26	0160-4908	5		CAPACITOR-FXD .68UF +-10% 250VDC	28480	0160-4908
ASC27	0121-0474	0	1	CAPACITOR-FXD .68UF +-10% 250VDC	28480	0121-0474
ASC28	0160-3960	7	1	CAPACITOR-FXD .68UF +-10% 250VDC	28480	0160-3960
ASC29	0160-2055	9		CAPACITOR-V TRMR-PTN 0.25 - 1.25PF 600V	28480	0160-2055
ASC30	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
ASC31	0160-0374	3	2	CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X902082
ASC32	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
ASC33	0160-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X902082
ASC34	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
ASC35	0160-3508	9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
ASC36	0160-3508	9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
ASC37	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
ASC38	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
ASC39	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
ASC41	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
ASC41	1901-0376	6	4	DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
ASC42	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
ASC43	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
ASC44	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
ASC45	1906-0042	3	1	DIODE-DUAL 70V VF DIFF=10MV	28480	1906-0042
ASC46	1901-0040	1	3	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
ASC47	1901-0045	6	2	DIODE-PWR RECT 100V 750MA DO-29	28480	1901-0045
ASC48	1901-0045	6		DIODE-PWR RECT 100V 750MA DO-29	28480	1901-0045
ASC49	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
ASC410	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
ASC411	1901-0050	3	2	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
ASC412	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
	1251-0206	2	2	CONNECTOR-SGL CONT 8KT .04-IN-BSC-8Z RND	28480	1251-0206
ASL1	9140-0210	1	2	COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
ASL2	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
ASMP1	1205-0213	4	1	HEAT SINK SGL TO-5/TO-39-C8	28480	1205-0213
ASMP2	1205-0235	0	1	HEAT SINK SGL TO-18-C8	28480	1205-0235
ASMP3	01300-21102	8	1	HEAT SINK-CLAMP	28480	01300-21102
ASMP4	01300-21103	9	1	HEAT SINK-BASE	28480	01300-21103
ASMP5	1205-0226	9	1	HEAT SINK SGL TO-5/TO-39-C8	28480	1205-0226
ASQ1	1855-0262	0	1	TRANSISTOR-JFET DUAL N-CHAN D=MODE 8I	28480	1855-0262
ASQ2	1853-0316	1	2	TRANSISTOR-DUAL PNP PD=500MW	28480	1853-0316
ASQ3	1854-0280	0	1	TRANSISTOR-DUAL NPN PD=400MW	28480	1854-0280
ASQ5	1854-0260	6	1	TRANSISTOR NPN 2N3227 8I TO-18 PD=360MW	04713	2N3227
ASQ6	1853-0089	5	1	TRANSISTOR PNP 2N4917 8I PD=200MW	07263	2N4917
ASQ7	1853-0232	0	1	TRANSISTOR PNP 8I TO-39 PD=1W FT=200MHZ	28480	1853-0232
ASQ8	1854-0419	7	2	TRANSISTOR NPN 8I TO-39 PD=1W FT=200MHZ	28480	1854-0419
ASQ9	1853-0316	1		TRANSISTOR-DUAL PNP PD=500MW	28480	1853-0316
ASQ10	1854-0221	9	1	TRANSISTOR-DUAL NPN PD=750MW	28480	1854-0221
ASQ11	1854-0419	7		TRANSISTOR NPN 8I TO-39 PD=1W FT=200MHZ	28480	1854-0419

See introduction to this section for ordering information  
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Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
ASR1	0757-0442	9	4	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
ASR2	0698-7648	5	1	RESISTOR 50 1% .25W MO TC=0+-100	28480	0698-7648
ASR3	0757-0391	7	4	RESISTOR 39.2 1% .125W F TC=0+-100	24546	C4-1/8-T0-39R2-F
ASR4	0757-0391	7		RESISTOR 39.2 1% .125W F TC=0+-100	24546	C4-1/8-T0-39R2-F
ASR5	0757-0288	1	2	RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
ASR6	0757-0288	1		RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
ASR7	0757-0415	6	2	RESISTOR 475 1% .125W F TC=0+-100	24546	C4-1/8-T0-475R-F
ASR8	0757-0415	6		RESISTOR 475 1% .125W F TC=0+-100	24546	C4-1/8-T0-475R-F
ASR9	0757-0431	6	1	RESISTOR 2.43K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2431-F
ASR10	0757-0418	9	1	RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
ASR11	0757-0434	9	1	RESISTOR 3.65K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3651-F
ASR12	0698-3150	6	1	RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
ASR13	2100-3353	8	1	RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	32997	3386X-Y46-203
ASR14	2100-3352	7	1	RESISTOR-TRMR 1K 10% C SIDE-ADJ 1-TRN	28480	2100-3352
ASR15	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
ASR16	0757-0416	7	1	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
ASR17	0757-0719	3	1	RESISTOR 221 1% .25W F TC=0+-100	24546	C5-1/4-T0-221R-F
ASR18	0757-0720	6	1	RESISTOR 243 1% .25W F TC=0+-100	24546	C5-1/4-T0-243R-F
ASR19	2100-3426	6	1	RESISTOR-TRMR 20 10% C SIDE-ADJ 1-TRN	28480	2100-3426
ASR20	0757-0338	2	2	RESISTOR 1K 1% .25W F TC=0+-100	24546	C5-1/4-T0-1001-F
ASR21	0757-0338	2		RESISTOR 1K 1% .25W F TC=0+-100	24546	C5-1/4-T0-1001-F
ASR22	0698-3132	4	1	RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
ASR23	0757-0411	2	2	RESISTOR 332 1% .125W F TC=0+-100	24546	C4-1/8-T0-332R-F
ASR24	0757-0411	2		RESISTOR 332 1% .125W F TC=0+-100	24546	C4-1/8-T0-332R-F
ASR25	0698-3431	6	4	RESISTOR 23.7 1% .125W F TC=0+-100	03888	PME55-1/8-T0-23R7-F
ASR26	0698-3431	6		RESISTOR 23.7 1% .125W F TC=0+-100	03888	PME55-1/8-T0-23R7-F
ASR27	0757-0274	5	1	RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
ASR28	0757-0408	7	3	RESISTOR 243 1% .125W F TC=0+-100	24546	C4-1/8-T0-243R-F
ASR29	0757-0408	7		RESISTOR 243 1% .125W F TC=0+-100	24546	C4-1/8-T0-243R-F
ASR30	0757-0403	2	2	RESISTOR 121 1% .125W F TC=0+-100	24546	C4-1/8-T0-121R-F
ASR31	0757-0403	2		RESISTOR 121 1% .125W F TC=0+-100	24546	C4-1/8-T0-121R-F
ASR32	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
ASR33	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
ASR34	0757-0443	7	1	RESISTOR 11K 1% .125W F TC=0+-100	28480	0757-0443
ASR35	0757-0441	8	1	RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
ASR36	2100-2574	3	1	RESISTOR-TRMR 500 10% C SIDE-ADJ 1-TRN	30983	ET50X501
ASR37	0757-0449	6	1	RESISTOR 20K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2002-F
ASR40	0757-0391	7		RESISTOR 39.2 1% .125W F TC=0+-100	24546	C4-1/8-T0-39R2-F
ASR41	0757-0391	7		RESISTOR 39.2 1% .125W F TC=0+-100	24546	C4-1/8-T0-39R2-F
ASR42	0757-0725	1	2	RESISTOR 475 1% .25W F TC=0+-100	24546	C5-1/4-T0-475R-F
ASR43	0757-0730	8	2	RESISTOR 750 1% .25W F TC=0+-100	24546	C5-1/4-T0-751-F
ASR44	0757-0730	8		RESISTOR 750 1% .25W F TC=0+-100	24546	C5-1/4-T0-751-F
ASR45	0757-0725	1		RESISTOR 475 1% .25W F TC=0+-100	24546	C5-1/4-T0-475R-F
ASR46	0757-0845	6	1	RESISTOR 18.2K 1% .5W F TC=0+-100	28480	0757-0845
ASR47	0698-3417	8	1	RESISTOR 23.7K 1% .5W F TC=0+-100	28480	0698-3417
ASR48	0698-3431	6		RESISTOR 23.7 1% .125W F TC=0+-100	03888	PME55-1/8-T0-23R7-F
ASR49	0698-3431	6		RESISTOR 23.7 1% .125W F TC=0+-100	03888	PME55-1/8-T0-23R7-F
ASR50	0761-0076	4	2	RESISTOR 18K 5% 1W MO TC=0+-200	28480	0761-0076
ASR51	0761-0076	4		RESISTOR 18K 5% 1W MO TC=0+-200	28480	0761-0076
ASR52	0761-0016	2	1	RESISTOR 7.5K 5% 1W MO TC=0+-200	28480	0761-0016
ASR53	0687-4721	6	1	RESISTOR 4.7K 10% .5W CC TC=0+-647	01121	EB4721
ASR54	0687-1051	9	1	RESISTOR 1M 10% .5W CC TC=0+-1000	01121	EB1051
ASR55	0757-0465	6	3	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
ASR56	0757-0280	3	3	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
ASR57	0757-0408	7		RESISTOR 243 1% .125W F TC=0+-100	24546	C4-1/8-T0-243R-F
ASR58	0757-0461	2	1	RESISTOR 68.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6812-F
ASR59	0757-0283	6	1	RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
ASR60	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
ASR61	0757-0473	6	2	RESISTOR 221K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2213-F
ASR62	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
ASR63	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
ASR64	0757-0473	6		RESISTOR 221K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2213-F
ASR65	0687-2711	0	1	RESISTOR 270 10% .5W CC TC=0+-529	01121	EB2711
ASR66	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
AS81	3101-1341	3	1	SWITCH-8L 8PDT SUBMIN .5A 125VAC/DC	28480	3101-1341
ASU1	1820-0427	6	1	IC MODULATOR TD-100	04713	MC1496G
ASU2	1820-0352	6	1	TRANSISTOR ARRAY	01928	CA3018
ASU3	1820-0681	4	1	IC GATE TTL 8 NAND QUAD 2-INP	01295	SN74800N
ASV1	2140-0008	8	7	LAMP-GLOW A1A 115/59VDC 500UA T-2-BULB	28480	2140-0008
ASV2	2140-0008	8		LAMP-GLOW A1A 115/59VDC 500UA T-2-BULB	28480	2140-0008
ASV3	2140-0008	8		LAMP-GLOW A1A 115/59VDC 500UA T-2-BULB	28480	2140-0008
ASV4	2140-0008	8		LAMP-GLOW A1A 115/59VDC 500UA T-2-BULB	28480	2140-0008
ASV5	2140-0008	8		LAMP-GLOW A1A 115/59VDC 500UA T-2-BULB	28480	2140-0008

See introduction to this section for ordering information  
 \*Indicates factory selected value

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

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A5V6	2140-0008	8		LAMP-GLOW A1A 115/59VDC 500UA T-2-BULB	28480	2140-0008
A5V7	2140-0008	8		LAMP-GLOW A1A 115/59VDC 500UA T-2-BULB	28480	2140-0008
A5VR1	1902-3139	7	1	DIODE-ZNR 8.25V 5% DO-7 PD=.4W TC=+.053%	28480	1902-3139
A5VR2	1902-3149	9	1	DIODE-ZNR 9.09V 5% DO-7 PD=.4W TC=+.057%	28480	1902-3149
A5VR3	1902-0184	6	1	DIODE-ZNR 16.2V 5% DO-7 PD=.4W TC=+.066%	28480	1902-0184
A5VR4	1902-0041	4	2	DIODE-ZNR 5.11V 5% DO-7 PD=.4W TC=-.009%	28480	1902-0041
A5VR5	1902-0041	4		DIODE-ZNR 5.11V 5% DO-7 PD=.4W TC=-.009%	28480	1902-0041

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

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A6	01317-66501	4	1	PC BOARD ASSEMBLY=FOCUS	28480	01317-66501
A6C1	0160-3443	1	7	CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A6C2	0140-0203	3	1	CAPACITOR-FXD 30PF +-5% 500VDC MICA	72136	DM15E300J0500MV1CR
A6C3	0160-3670	6	3	CAPACITOR-FXD .1UF +-20% 200VDC CER	28480	0160-3670
A6C4	0121-0474	0	1	CAPACITOR-V TRMR=P8TN .3-1.5PF 600V	28480	0121-0474
A6C5	0170-0022	7	1	CAPACITOR-FXD .1UF +-20% 600VDC POLYE	28480	0170-0022
A6C6	0160-3670	6		CAPACITOR-FXD .1UF +-20% 200VDC CER	28480	0160-3670
A6C7	0160-3007	3	1	CAPACITOR-FXD 4700PF +-20% 4KVDC CER	28480	0160-3007
A6C8	0180-0374	3	2	CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X902082
A6C9	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A6C10	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A6C11	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A6C12	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A6C13	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X902082
A6C14	0160-0168	1	4	CAPACITOR-FXD .1UF +-10% 200VDC POLYE	28480	0160-0168
A6C15	0160-0168	1		CAPACITOR-FXD .1UF +-10% 200VDC POLYE	28480	0160-0168
A6C16	0160-0168	1		CAPACITOR-FXD .1UF +-10% 200VDC POLYE	28480	0160-0168
A6C17	0160-0168	1		CAPACITOR-FXD .1UF +-10% 200VDC POLYE	28480	0160-0168
A6C18	0160-2207	3	1	CAPACITOR-FXD 300PF +-5% 300VDC MICA	28480	0160-2207
A6C19	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A6C20	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A6C21	0160-3670	6		CAPACITOR-FXD .1UF +-20% 200VDC CER	28480	0160-3670
A6C22	0140-0178	1	1	CAPACITOR-FXD 560PF +-2% 300VDC MICA	72136	DM15F561G0300MV1CR
A6CR1	1901-0040	1	24	DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A6CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A6CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A6CR4	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A6CR5	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A6CR6	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A6CR7	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A6CR8	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A6CR9	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A6CR10	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A6CR11	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A6CR12	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A6CR13	1901-0026	3	4	DIODE-PWR RECT 200V 750MA DO-29	28480	1901-0026
A6CR14	1901-0026	3		DIODE-PWR RECT 200V 750MA DO-29	28480	1901-0026
A6CR15	1901-0026	3		DIODE-PWR RECT 200V 750MA DO-29	28480	1901-0026
A6CR16	1901-0026	3		DIODE-PWR RECT 200V 750MA DO-29	28480	1901-0026
A6CR17	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A6CR18	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A6CR19	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A6CR20	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A6CR21	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A6CR22	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A6CR23	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A6CR24	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A6CR25	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A6CR26	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A6CR27	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A6CR28	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A6E6	1205-0213	4	1	HEAT SINK gGL TO-5/T0-39-C8	28480	1205-0213
A6E7	01300-21102	8	1	HEAT SINK-CLAMP	28480	01300-21102
A6E8	5040-0401	6	1	SUPPORT-CAPACITOR	28480	5040-0401
A6E9	01300-21103	9	1	HEAT SINK-BASE	28480	01300-21103
A6L1	9100-2276	9	2	COIL=MLD 100UH 10% Q=50 .095DX.25LG-NOM	28480	9100-2276
A6L2	9100-2276	9		COIL=MLD 100UH 10% Q=50 .095DX.25LG-NOM	28480	9100-2276
A6Q1	1853-0036	2	15	TRANSISTOR PNP SI PD=310MHZ FT=250MHZ	28480	1853-0036
A6Q2	1853-0036	2		TRANSISTOR PNP SI PD=310MHZ FT=250MHZ	28480	1853-0036
A6Q3	1853-0036	2		TRANSISTOR PNP SI PD=310MHZ FT=250MHZ	28480	1853-0036
A6Q4	1853-0036	2		TRANSISTOR PNP SI PD=310MHZ FT=250MHZ	28480	1853-0036
A6Q5	1854-0215	1	3	TRANSISTOR NPN SI PD=350MHZ FT=300MHZ	04713	2N3904
A6Q6	1853-0036	2		TRANSISTOR PNP SI PD=310MHZ FT=250MHZ	28480	1853-0036
A6Q7	1854-0215	1		TRANSISTOR NPN SI PD=350MHZ FT=300MHZ	04713	2N3904
A6Q8	1853-0036	2		TRANSISTOR PNP SI PD=310MHZ FT=250MHZ	28480	1853-0036
A6Q9	1853-0036	2		TRANSISTOR PNP SI PD=310MHZ FT=250MHZ	28480	1853-0036
A6Q10	1853-0036	2		TRANSISTOR PNP SI PD=310MHZ FT=250MHZ	28480	1853-0036
A6Q11	1854-0092	2	1	TRANSISTOR NPN SI PD=200MHZ FT=600MHZ	28480	1854-0092
A6Q13	1853-0036	2		TRANSISTOR PNP SI PD=310MHZ FT=250MHZ	28480	1853-0036
A6Q14	1853-0036	2		TRANSISTOR PNP SI PD=310MHZ FT=250MHZ	28480	1853-0036
A6Q15	1853-0036	2		TRANSISTOR PNP SI PD=310MHZ FT=250MHZ	28480	1853-0036
A6Q16	1853-0036	2		TRANSISTOR PNP SI PD=310MHZ FT=250MHZ	28480	1853-0036

See introduction to this section for ordering information  
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Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A6Q17	1854-0404	0	2	TRANSISTOR NPN 8I TO-18 PD=360MW	28480	1854-0404
A6Q18	1853-0036	0	2	TRANSISTOR PNP 8I PD=310MW FT=250MHZ	28480	1853-0036
A6Q19	1854-0404	0	2	TRANSISTOR NPN 8I TO-18 PD=360MW	28480	1854-0404
A6Q20	1853-0036	2	2	TRANSISTOR PNP 8I PD=310MW FT=250MHZ	28480	1853-0036
A6Q21	1854-0234	4	1	TRANSISTOR NPN 2N3440 8I TO-5 PD=1W	01928	2N3440
A6Q22	1854-0215	1	1	TRANSISTOR NPN 8I PD=350MW FT=300MHZ	04713	2N3904
A6Q23	1853-0036	2	2	TRANSISTOR PNP 8I PD=310MW FT=250MHZ	28480	1853-0036
A6Q24	1853-0038	4	1	TRANSISTOR PNP 8I TO-39 PD=1W FT=100MHZ	28480	1853-0038
A6Q25	1854-0419	7	1	TRANSISTOR NPN 8I TO-39 PD=1W FT=200MHZ	28480	1854-0419
A6R1	0684-4701	6	16	RESISTOR 47 10X .25W FC TC=-400/+500	01121	CB4701
A6R2	0757-0439	4	8	RESISTOR 6.81K 1X .125W F TC=0+/-100	24546	C4=1/8-T0-6811-F
A6R3	0757-0317	7	1	RESISTOR 1.33K 1X .125W F TC=0+/-100	24546	C4=1/8-T0-1331-F
A6R4	0757-0439	4	4	RESISTOR 6.81K 1X .125W F TC=0+/-100	24546	C4=1/8-T0-6811-F
A6R5	0684-4701	6	4	RESISTOR 47 10X .25W FC TC=-400/+500	01121	CB4701
A6R6	0757-0438	3	16	RESISTOR 5.11K 1X .125W F TC=0+/-100	24546	C4=1/8-T0-5111-F
A6R7	0757-0438	3	3	RESISTOR 5.11K 1X .125W F TC=0+/-100	24546	C4=1/8-T0-5111-F
A6R8	0757-0438	3	3	RESISTOR 5.11K 1X .125W F TC=0+/-100	24546	C4=1/8-T0-5111-F
A6R9	0757-0438	3	3	RESISTOR 5.11K 1X .125W F TC=0+/-100	24546	C4=1/8-T0-5111-F
A6R10	2100-3352	7	8	RESISTOR-TRMR 1K 10X C 8IDE=ADJ 1-TRN	28480	2100-3352
A6R11	2100-3352	7	7	RESISTOR-TRMR 1K 10X C 8IDE=ADJ 1-TRN	28480	2100-3352
A6R12	0757-0416	7	9	RESISTOR 511 1X .125W F TC=0+/-100	24546	C4=1/8-T0-511R-F
A6R13	0757-0416	7	2	RESISTOR 511 1X .125W F TC=0+/-100	24546	C4=1/8-T0-511R-F
A6R14	0684-4731	2	4	RESISTOR 47K 10X .25W FC TC=-400/+800	01121	CB4731
A6R15	0684-4701	6	6	RESISTOR 47 10X .25W FC TC=-400/+500	01121	CB4701
A6R16	0757-0439	4	4	RESISTOR 6.81K 1X .125W F TC=0+/-100	24546	C4=1/8-T0-6811-F
A6R17	0757-0424	7	1	RESISTOR 1.1K 1X .125W F TC=0+/-100	24546	C4=1/8-T0-1101-F
A6R18	0757-0439	4	4	RESISTOR 6.81K 1X .125W F TC=0+/-100	24546	C4=1/8-T0-6811-F
A6R19	0684-4701	6	6	RESISTOR 47 10X .25W FC TC=-400/+500	01121	CB4701
A6R20	0757-0438	3	3	RESISTOR 5.11K 1X .125W F TC=0+/-100	24546	C4=1/8-T0-5111-F
A6R21	0757-0438	3	3	RESISTOR 5.11K 1X .125W F TC=0+/-100	24546	C4=1/8-T0-5111-F
A6R22	0757-0438	3	3	RESISTOR 5.11K 1X .125W F TC=0+/-100	24546	C4=1/8-T0-5111-F
A6R23	2100-3352	7	7	RESISTOR-TRMR 1K 10X C 8IDE=ADJ 1-TRN	28480	2100-3352
A6R24	2100-3352	7	7	RESISTOR-TRMR 1K 10X C 8IDE=ADJ 1-TRN	28480	2100-3352
A6R25	0757-0438	3	3	RESISTOR 5.11K 1X .125W F TC=0+/-100	24546	C4=1/8-T0-5111-F
A6R26	0757-0416	7	7	RESISTOR 511 1X .125W F TC=0+/-100	24546	C4=1/8-T0-511R-F
A6R27	0757-0416	7	2	RESISTOR 511 1X .125W F TC=0+/-100	24546	C4=1/8-T0-511R-F
A6R28	0684-4731	2	2	RESISTOR 47K 10X .25W FC TC=-400/+800	01121	CB4731
A6R29	0684-4701	6	6	RESISTOR 47 10X .25W FC TC=-400/+500	01121	CB4701
A6R30	0684-4701	6	6	RESISTOR 47 10X .25W FC TC=-400/+500	01121	CB4701
A6R31	0757-0414	5	2	RESISTOR 432 1X .125W F TC=0+/-100	24546	C4=1/8-T0-432R-F
A6R32	0757-0414	5	5	RESISTOR 432 1X .125W F TC=0+/-100	24546	C4=1/8-T0-432R-F
A6R33	0757-0409	8	4	RESISTOR 274 1X .125W F TC=0+/-100	24546	C4=1/8-T0-274R-F
A6R34	0757-0280	3	6	RESISTOR 1K 1X .125W F TC=0+/-100	24546	C4=1/8-T0-1001-F
A6R35	0757-0409	8	8	RESISTOR 274 1X .125W F TC=0+/-100	24546	C4=1/8-T0-274R-F
A6R36	0757-0280	3	3	RESISTOR 1K 1X .125W F TC=0+/-100	24546	C4=1/8-T0-1001-F
A6R37	0757-0728	4	1	RESISTOR 619 1X .25W F TC=0+/-100	24546	C5=1/4-T0-619R-F
A6R38	0757-0907	1	2	RESISTOR 200 2X .125W F TC=0+/-100	24546	C4=1/8-T0-201-0
A6R39	0757-0907	1	1	RESISTOR 200 2X .125W F TC=0+/-100	24546	C4=1/8-T0-201-0
A6R40	0757-0280	3	3	RESISTOR 1K 1X .125W F TC=0+/-100	24546	C4=1/8-T0-1001-F
A6R41	0698-0085	0	1	RESISTOR 2.61K 1X .125W F TC=0+/-100	24546	C4=1/8-T0-2611-F
A6R42	0757-0346	2	1	RESISTOR 10 1X .125W F TC=0+/-100	24546	C4=1/8-T0-10R0-F
A6R43	2100-2574	3	1	RESISTOR-TRMR 500 10X C 8IDE=ADJ 1-TRN	30983	ET50X501
A6R44	2100-3274	2	2	RESISTOR-TRMR 10K 10X C 8IDE=ADJ 1-TRN	28480	2100-3274
A6R45	0757-0437	2	1	RESISTOR 4.75K 1X .125W F TC=0+/-100	24546	C4=1/8-T0-4751-F
A6R46	0757-0283	6	1	RESISTOR 2K 1X .125W F TC=0+/-100	24546	C4=1/8-T0-2001-F
A6R47	2100-2489	9	1	RESISTOR-TRMR 5K 10X C 8IDE=ADJ 1-TRN	30983	ET50X502
A6R48	0684-4701	6	6	RESISTOR 47 10X .25W FC TC=-400/+500	01121	CB4701
A6R49	0684-4701	6	4	RESISTOR 47 10X .25W FC TC=-400/+500	01121	CB4701
A6R50	0687-0711	4	2	RESISTOR 470 10X .5W CC TC=0+529	01121	EB4711
A6R51	0684-3901	6	3	RESISTOR 39 10X .25W FC TC=-400/+500	01121	CB3901
A6R52	0687-0711	4	4	RESISTOR 470 10X .5W CC TC=0+529	01121	EB4711
A6R53	0684-4701	6	6	RESISTOR 47 10X .25W FC TC=-400/+500	01121	CB4701
A6R54	0757-0439	4	4	RESISTOR 6.81K 1X .125W F TC=0+/-100	24546	C4=1/8-T0-6811-F
A6R55	0757-0421	4	4	RESISTOR 6.81K 1X .125W F TC=0+/-100	24546	C4=1/8-T0-6811-F
A6R56	0757-0421	4	2	RESISTOR 6.81K 1X .125W F TC=0+/-100	24546	C4=1/8-T0-6811-F
A6R57	0757-0439	4	4	RESISTOR 6.81K 1X .125W F TC=0+/-100	24546	C4=1/8-T0-6811-F
A6R58	0684-4701	6	6	RESISTOR 47 10X .25W FC TC=-400/+500	01121	CB4701
A6R59	0757-0438	3	3	RESISTOR 5.11K 1X .125W F TC=0+/-100	24546	C4=1/8-T0-5111-F
A6R60	0757-0438	3	3	RESISTOR 5.11K 1X .125W F TC=0+/-100	24546	C4=1/8-T0-5111-F
A6R61	2100-3352	7	7	RESISTOR-TRMR 1K 10X C 8IDE=ADJ 1-TRN	28480	2100-3352
A6R62	2100-3352	7	7	RESISTOR-TRMR 1K 10X C 8IDE=ADJ 1-TRN	28480	2100-3352
A6R63	0757-0438	3	3	RESISTOR 5.11K 1X .125W F TC=0+/-100	24546	C4=1/8-T0-5111-F
A6R64	0757-0438	3	3	RESISTOR 5.11K 1X .125W F TC=0+/-100	24546	C4=1/8-T0-5111-F
A6R65	0757-0416	7	7	RESISTOR 511 1X .125W F TC=0+/-100	24546	C4=1/8-T0-511R-F
A6R66	0757-0416	7	7	RESISTOR 511 1X .125W F TC=0+/-100	24546	C4=1/8-T0-511R-F

See introduction to this section for ordering information  
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Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A6R67	0684-4731	2		RESISTOR 47K 10% .25W FC TC=-400/+800	01121	CB4731
A6R68	0684-4701	6		RESISTOR 47 10% .25W FC TC=-400/+500	01121	CB4701
A6R69	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+/-100	24546	C4=1/8-T0-6811-F
A6R70	0757-0421	4		RESISTOR 825 1% .125W F TC=0+/-100	24546	C4=1/8-T0-825R-F
A6R71	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+/-100	24546	C4=1/8-T0-6811-F
A6R72	0684-4701	6		RESISTOR 47 10% .25W FC TC=-400/+500	01121	CB4701
A6R73	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+/-100	24546	C4=1/8-T0-5111-F
A6R74	2100-3352	7		RESISTOR-TRMR 1K 10% C SIDE-ADJ 1-TRN	28480	2100-3352
A6R75	2100-3352	7		RESISTOR-TRMR 1K 10% C SIDE-ADJ 1-TRN	28480	2100-3352
A6R76	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+/-100	24546	C4=1/8-T0-5111-F
A6R77	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+/-100	24546	C4=1/8-T0-5111-F
A6R78	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+/-100	24546	C4=1/8-T0-5111-F
A6R79	0757-0416	7		RESISTOR 511 1% .125W F TC=0+/-100	24546	C4=1/8-T0-511R-F
A6R80	0757-0416	7		RESISTOR 511 1% .125W F TC=0+/-100	24546	C4=1/8-T0-511R-F
A6R81	0684-4731	2		RESISTOR 47K 10% .25W FC TC=-400/+800	01121	CB4731
A6R82	0684-4701	6		RESISTOR 47 10% .25W FC TC=-400/+500	01121	CB4701
A6R83	0684-4701	6		RESISTOR 47 10% .25W FC TC=-400/+500	01121	CB4701
A6R84	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+/-100	24546	C4=1/8-T0-1001-F
A6R85	0757-0402	1		RESISTOR 110 1% .125W F TC=0+/-100	24546	C4=1/8-T0-111-F
A6R86	0757-0294	9	1	RESISTOR 17.8 1% .125W F TC=0+/-100	19701	MF4C1/8-T0-178R-F
A6R87	0757-0416	7		RESISTOR 511 1% .125W F TC=0+/-100	24546	C4=1/8-T0-511R-F
A6R88	0757-0409	8		RESISTOR 274 1% .125W F TC=0+/-100	24546	C4=1/8-T0-274R-F
A6R89	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+/-100	24546	C4=1/8-T0-1001-F
A6R90	2100-3274	2		RESISTOR-TRMR 10K 10% C SIDE-ADJ 1-TRN	28480	2100-3274
A6R91	0757-0747	7	1	RESISTOR 5.11K 1% .125W F TC=0+/-100	24546	C5=1/4-T0-5111-F
A6R92	0757-0339	3	1	RESISTOR 3.01K 1% .25W F TC=0+/-100	24546	C5=1/4-T0-3011-F
A6R93	0757-0409	8		RESISTOR 274 1% .125W F TC=0+/-100	24546	C4=1/8-T0-274R-F
A6R94	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+/-100	24546	C4=1/8-T0-1001-F
A6R95	0684-4701	6		RESISTOR 47 10% .25W FC TC=-400/+500	01121	CB4701
A6R96	0811-0007	8	1	RESISTOR 10K 1% 5W PW TC=0+/-20	28480	0811-0007
A6R97	0684-4701	6		RESISTOR 47 10% .25W FC TC=-400/+500	01121	CB4701
A6R98	0687-4701	2	1	RESISTOR 47 10% .5W CC TC=0+412	01121	EB4701
A6R100	0757-0736	4	2	RESISTOR 1.5K 1% .25W F TC=0+/-100	24546	C5=1/4-T0-1501-F
A6R101	0757-0764	8	1	RESISTOR 33.2K 1% .25W F TC=0+/-100	24546	C5=1/4-T0-3322-F
A6R102	0764-0005	5	1	RESISTOR 10K 5% 2W MO TC=0+/-200	28480	0764-0005
A6R103	0757-0736	4		RESISTOR 1.5K 1% .25W F TC=0+/-100	24546	C5=1/4-T0-1501-F
A6R104	0757-0290	5	1	RESISTOR 6.19K 1% .125W F TC=0+/-100	19701	MF4C1/8-T0-6191-F
A6R105	0684-3901	6		RESISTOR 39 10% .25W FC TC=-400/+500	01121	CB3901
A6R106	0684-3901	6		RESISTOR 39 10% .25W FC TC=-400/+500	01121	CB3901
A6R107	0687-1821	1	1	RESISTOR 1.8K 10% .5W CC TC=0+647	01121	EB1821
A6R108	0687-2231	9	1	RESISTOR 22K 10% .5W CC TC=0+765	01121	EB2231
A6R109	0687-1051	9	1	RESISTOR 1M 10% .5W CC TC=0+1000	01121	EB1051
A6R110	0687-6801	7	1	RESISTOR 68 10% .5W CC TC=0+412	01121	EB6801
A6VR3	1902-0041	4	2	DIODE-ZNR 5.11V 5X DO-7 PD=.4W TC=-.009X	28480	1902-0041
A6VR4	1902-0041	4	2	DIODE-ZNR 5.11V 5X DO-7 PD=.4W TC=-.009X	28480	1902-0041

See introduction to this section for ordering information  
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Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A9	01311-66504	1	1	PC BOARD ASSEMBLY-HIGH VOLTAGE	28480	01311-66504
A9C1	0180-1784	1	1	CAPACITOR-FXD 1000UF+75-10X 40VDC AL	28480	0180-1784
A9C2	0160-3558	9	2	CAPACITOR-FXD .1UF +-20X 50VDC CER	28480	0160-3558
A9C3	0180-0094	4	1	CAPACITOR-FXD 100UF+75-10X 25VDC AL	56289	30D107G025DD2
A9C4	0180-0089	1	1	CAPACITOR-FXD 10UF +50-10% 150VDC AL	28480	0160-0168
A9C5	0180-0197	8	1	CAPACITOR-FXD 2.2UF+-10X 20VDC TA	56289	150D225X9020A2
A9C6	0160-3508	9	2	CAPACITOR-FXD 1UF +80-20X 50VDC CER	28480	0160-3508
A9C7	0160-0302	5	1	CAPACITOR-FXD .018UF +-10X 200VDC POLYE	28480	0160-0302
A9C8	0160-3508	9	9	CAPACITOR-FXD 1UF +80-20X 50VDC CER	28480	0160-3508
A9C9	0160-0166	9	1	CAPACITOR-FXD .1UF +-10% 200VDC POLYE	28480	0160-0166
A9C10	0160-3558	9	9	CAPACITOR-FXD .1UF +-20X 50VDC CER	28480	0160-3558
A9C11	0180-2255	3	1	CAPACITOR-FXD 2.2UF+-20X 20VDC TA	28480	0180-2255
A9C12	0160-2055	9	1	CAPACITOR-FXD .01UF +40-20X 100VDC CER	28480	0160-2055
A9C13	0160-4148	5	2	CAPACITOR-FXD .033UF +-20X 6KVDC	56289	430P333060
A9C14	0160-4148	5	2	CAPACITOR-FXD .033UF +-20X 6KVDC	56289	430P333060
A9C15	0160-3960	7	2	CAPACITOR-FXD 1000PF +-20X 8KVDC	28480	0160-3960
A9C16	0160-2264	2	2	CAPACITOR-FXD 20PF +-5X 500VDC CER 0+-30	28480	0160-2264
A9C17	0160-2264	2	2	CAPACITOR-FXD 20PF +-5X 500VDC CER 0+-30	28480	0160-2264
A9C18	0180-0269	5	2	CAPACITOR-FXD 1UF+50-10X 150VDC AL	56289	30D105G150BA2
A9C19	0160-3960	7	2	CAPACITOR-FXD 1000PF +-20X 8KVDC	28480	0160-3960
A9C20	0160-0678	8	1	CAPACITOR-FXD .01UF +-20X 6KVDC	28480	0160-0678
A9C21	0180-0269	5	2	CAPACITOR-FXD 1UF+50-10X 150VDC AL	56289	30D105G150BA2
A9C22	0160-0544	7	1	CAPACITOR-FXD .022UF +-20X 4KVDC	28480	0160-0544
A9C23	0160-0684	6	1	CAPACITOR-FXD 1000PF +-20X 4KVDC	28480	0160-0684
A9C24	0160-4051	9	1	CAPACITOR-FXD .01UF +-20X 4KVDC	28480	0160-4051
A9CR1	1901-0040	1	3	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A9CR2	1901-0040	1	3	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A9CR3	1901-0028	5	11	DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A9CR4	1901-0028	5	11	DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A9CR5	1901-0028	5	11	DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A9CR6	1901-0040	1	3	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A9CR7	1901-0652	1	1	DIODE-HV RECT 12KV 10MA 250NS	28480	1901-0652
A9CR8	1901-0028	5	11	DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A9CR9	1901-0028	5	11	DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A9CR10	1901-0028	5	11	DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A9CR11	1901-0028	5	11	DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A9CR12	1901-0028	5	11	DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A9CR13	1901-0028	5	11	DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A9CR14	1901-0028	5	11	DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A9CR15	1901-0028	5	11	DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A9CR16	1906-0006	9	1	DIODE-FW BRDG 400V 1A	28480	1906-0006
A9F1	2110-0304	4	1	FUSE 1.5A 250V 1.25X.25 UL	28480	2110-0304
A9L1	9140-0171	3	1	COIL-MLD 40UH 10X 0=20 .296DX.968LG=NOM	28480	9140-0171
A9L2	9140-0138	2	1	COIL-MLD 180UH 5X 0=65 .155DX.375LG=NOM	28480	9140-0138
A9Q3	1884-0064	1	1	THYRISTOR-SCR VRRM=200	03508	C106841
A9R1	0687-3921	6	1	RESISTOR 3.9K 10X .5W CC TC=0+647	01121	EB3921
A9R2	0687-3311	8	1	RESISTOR 330 10X .5W CC TC=0+529	01121	EB3311
A9R3	0757-0486	1	1	RESISTOR 750K 1X .125W F TC=0+-100	24546	0757-0486
A9R4	0757-0488	3	1	RESISTOR 909K 1X .125W F TC=0+-100	28480	0757-0488
A9R5	0698-3620	5	1	RESISTOR 100 5X 2W MO TC=0+-200	28480	0698-3620
A9R6	0683-0335	2	1	RESISTOR 3.3 5X .25W FC TC=-400/+500	01121	CB3305
A9R7	0757-0465	6	2	RESISTOR 100K 1X .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A9R8	0683-2265	1	1	RESISTOR 22M 5X .25W FC TC=-900/+1200	01121	CB2265
A9R9	0757-0465	6	2	RESISTOR 100K 1X .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A9R10	0684-1011	5	1	RESISTOR 100 10X .25W FC TC=-400/+500	01121	CB1011
A9R11	0757-0479	2	1	RESISTOR 392K 1X .125W F TC=0+-100	19701	MF4C1/8-T0-3923-F
A9R12	0684-1021	7	8	RESISTOR 1K 10X .25W FC TC=-400/+600	01121	CB1021
A9R13	0687-3911	4	1	RESISTOR 220 10X .5W CC TC -0+529	01121	EB3911
A9R14	0757-0273	4	1	RESISTOR 3.01K 1X .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
A9R15	0757-0440	7	1	RESISTOR 7.5K 1X .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A9R16	0757-0442	9	2	RESISTOR 10K 1X .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A9R17	0757-0442	9	2	RESISTOR 10K 1X .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A9R18	0683-1555	0	3	RESISTOR 1.5M 5X .25W FC TC=-900/+1100	01121	CB1555
A9R19	0683-1555	0	3	RESISTOR 1.5M 5X .25W FC TC=-900/+1100	01121	CB1555
A9R20	0683-1555	0	3	RESISTOR 1.5M 5X .25W FC TC=-900/+1100	01121	CB1555
A9R21	0698-3161	9	1	RESISTOR 38.3K 1X .125W F TC=0+-100	24546	C4-1/8-T0-3832-F
A9R22	0757-0475	8	1	RESISTOR 274K 1X .125W F TC=0+-100	24546	C4-1/8-T0-2743-F
A9R23	0687-4721	6	1	RESISTOR 4.7K 10X .5W CC TC=0+647	01121	EB4721
A9R24	0698-8018	5	2	RESISTOR 30M 1X 3W C TC=0+-100	03888	PVC175-3-T0-3004-F
A9R25	0687-3941	0	2	RESISTOR 390K 10X .5W CC TC=0+882	01121	EB3941

See introduction to this section for ordering information  
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Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A9R26	0687-3941	0		RESISTOR 390K 10% .5W CC TC=0+882	01121	EB3941
A9R27	0698-8018	5		RESISTOR 30M 1% 3W C TC=0+-100	03888	PVC175-3-TD=3004-F
A9R28	0684-1021	7		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A9R29	0757-0156	2	1	RESISTOR 1.5M 1% .5W F TC=0+-100	28480	0757-0156
A9R30	2100-3626	8	1	RESISTOR-TRMR 2M 20% C 8IDE-ADJ 1-TRN	73138	72XR2M
A9R31	0699-0167	1	1	RESISTOR 20M 5% 1W C TC=0+-250	28480	0699-0167
A9R32	0684-1021	7		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A9R33	0684-1061	5	2	RESISTOR 10M 10% .25W FC TC=-900/+1100	01121	CB1061
A9R34	0684-1021	7		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A9R35	0684-1021	7		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A9R36	0684-1021	7		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A9R38	2100-3253	7	1	RESISTOR-TRMR 50K 10% C TOP-ADJ 1-TRN	28480	2100-3253
A9R39	0684-1061	5		RESISTOR 10M 10% .25W FC TC=-900/+1100	01121	CB1061
A9R40	0684-1021	7		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A9R41	0684-1021	7		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A9R42	0684-6811	3	1	RESISTOR 680 10% .25W FC TC=-400/+600	01121	C86811
A9RT1	0837-0105	1	2	THERMISTOR BEAD 200K-OHM TC=-4.9%/C-DEG	28480	0837-0105
A9RT2	0837-0105	1		THERMISTOR BEAD 200K-OHM TC=-4.9%/C-DEG	28480	0837-0105
A9T1	01311-61101	4	1	TRANSFORMER ASSEMBLY-MV	28480	01311-61101
A9U1	1826-0167	3	1	IC OP AMP PRGMBL TO-99	01928	CA3094AT
A9U2	1820-0217	2	1	IC OP AMP GP 8-DIP-P	28480	1820-0217
A9VR1	1902-3249	0	1	DIODE-ZNR 22.1V 2% DO-7 PD=.4W TC=+.071%	28480	1902-3249
A9VR2	1902-0041	4	2	DIODE-ZNR 5.11V 5% DO-7 PD=.4W TC=-.009%	28480	1902-0041
A9VR3	1902-0041	4		DIODE-ZNR 5.11V 5% DO-7 PD=.4W TC=-.009%	28480	1902-0041
A9VR4	1902-3381	1	2	DIODE-ZNR 68.1V 5% DO-7 PD=.4W TC=+.079%	28480	1902-3381
A9VR5	1902-3381	1		DIODE-ZNR 68.1V 5% DO-7 PD=.4W TC=+.079%	28480	1902-3381
A9VR6	1902-0668	1	5	DIODE-ZNR 200V 5% DO-15 PD=1W TC=+.088%	28480	1902-0668
A9VR7	1902-0668	1		DIODE-ZNR 200V 5% DO-15 PD=1W TC=+.088%	28480	1902-0668
A9VR8	1902-0668	1		DIODE-ZNR 200V 5% DO-15 PD=1W TC=+.088%	28480	1902-0668
A9VR9	1902-0668	1		DIODE-ZNR 200V 5% DO-15 PD=1W TC=+.088%	28480	1902-0668
A9VR10	1902-0668	1		DIODE-ZNR 200V 5% DO-15 PD=1W TC=+.088%	28480	1902-0668
A9VR11	1902-0175	5	1	DIODE-ZNR 100V 5% DO-15 PD=1W TC=+.083%	28480	1902-0175
A9VR12	1902-3557	7	1	DIODE-ZNR 56.2V 2% DO-7 PD.4W	28480	1902-3402

See introduction to this section for ordering information  
 \*Indicates factory selected value

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

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A11	01310-66533	5	1	PC BOARD ASSEMBLY-LVPS	28480	01310-66533
A11C1	0160-3443	1	3	CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A11C2	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A11C3	0180-0058	0	2	CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D5068025CC2
A11C4	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A11C5	0180-0058	0		CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D5068025CC2
A11C6	0160-0168	1	2	CAPACITOR-FXD .1UF +/-10% 200VDC POLYE	28480	0160-0168
A11C7	0160-0168	1		CAPACITOR-FXD .1UF +/-10% 200VDC POLYE	28480	0160-0168
A11C8	0170-0022			CAPACITOR-FXD .1UF +/-20% 600 VDC	28480	0170-0022
A11C9	0160-0168			CAPACITOR-FXD .1UF +/-10% 200 VDC	28480	0160-0168
A11C10	0160-0168			CAPACITOR-FXD .1UF +/-10% 200 VDC	28480	0160-0168
A11CR1	1901-0030	9	4	DIODE-PWR RECT 800V 600MA DO-29	28480	1901-0030
A11CR2	1901-0030	9		DIODE-PWR RECT 800V 600MA DO-29	28480	1901-0030
A11CR3	1901-0030	9		DIODE-PWR RECT 800V 600MA DO-29	28480	1901-0030
A11CR4	1901-0030	9		DIODE-PWR RECT 800V 600MA DO-29	28480	1901-0030
A11CR5	1901-0026	3	8	DIODE-PWR RECT 200V 750MA DO-29	28480	1901-0026
A11CR6	1901-0026	3		DIODE-PWR RECT 200V 750MA DO-29	28480	1901-0026
A11CR7	1901-0026	3		DIODE-PWR RECT 200V 750MA DO-29	28480	1901-0026
A11CR8	1901-0026	3		DIODE-PWR RECT 200V 750MA DO-29	28480	1901-0026
A11CR9	1901-0026	3		DIODE-PWR RECT 200V 750MA DO-29	28480	1901-0026
A11CR10	1901-0026	3		DIODE-PWR RECT 200V 750MA DO-29	28480	1901-0026
A11CR11	1901-0026	3		DIODE-PWR RECT 200V 750MA DO-29	28480	1901-0026
A11CR12	1901-0026	3		DIODE-PWR RECT 200V 750MA DO-29	28480	1901-0026
A11CR13	1901-0040	1	8	DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A11CR14	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A11CR15	1901-0028	5	1	DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A11CR16	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A11CR17	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A11CR18	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A11CR19	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A11CR20	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A11CR21	1901-0040	1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A11F1	2110-0067	6	1	FUSE .3A 250V 1.25X.25 UL	28480	2110-0067
A11F2	2110-0001	8	2	FUSE 1A 250V 1.25X.25 UL	75915	312001
A11F3	2110-0001	8		FUSE 1A 250V 1.25X.25 UL	75915	312001
A1101	1854-0234	4	2	TRANSISTOR NPN 2N3440 8I TO-5 PD=1W	01928	2N3440
A1102	1854-0358	3	2	TRANSISTOR NPN 8I PD=310MW FT=60MHZ	28480	1854-0358
A1103	1854-0358	3		TRANSISTOR NPN 8I PD=310MW FT=60MHZ	28480	1854-0358
A1104	1854-0234	4		TRANSISTOR NPN 2N3440 8I TO-5 PD=1W	01928	2N3440
A1105	1854-0071	7	2	TRANSISTOR NPN 8I PD=300MW FT=200MHZ	28480	1854-0071
A1106	1854-0022	8	1	TRANSISTOR NPN 8I TO-39 PD=700MW	07263	817843
A1107	1854-0071	7		TRANSISTOR NPN 8I PD=300MW FT=200MHZ	28480	1854-0071
A11R1	0764-0027	1	1	RESISTOR 75K 5% 2W MO TC=0+-200	28480	0764-0027
A11R2	0811-1853	4	1	RESISTOR 25 5% 5W PW TC=0+-20	28480	0811-1853
A11R3	0764-0001	1	1	RESISTOR 6.2K 5% 2W MO TC=0+-200	28480	0764-0001
A11R4	0757-038A	2	3	RESISTOR 30.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-30R1-F
A11R5	0757-0128	8	1	RESISTOR 200K 1% .5W F TC=0+-100	28480	0757-0128
A11R6	0757-0399	5	1	RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A11R7	0757-0433	8	1	RESISTOR 3.32K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3321-F
A11R8	0757-0855	8	3	RESISTOR 68.1K 1% .5W F TC=0+-100	28480	0757-0855
A11R9	0757-0855	8		RESISTOR 68.1K 1% .5W F TC=0+-100	28480	0757-0855
A11R10	0757-0341	7	1	RESISTOR 30.1K 1% .25W F TC=0+-100	24546	C5-1/4-T0-3012-F
A11R11	0757-0848	9	1	RESISTOR 30.1K 1% .5W F TC=0+-100	28480	0757-0848
A11R12	2100-1986	0	1	RESISTOR-TRMR 1K 10% C TOP-ADJ 1 TRN	73138	2100-1986
A11R13	0757-0309	8		RESISTOR 61.9K 1% .5W F TC=0+-100	28480	0757-0309
A11R14	0757-0850	3	1	RESISTOR 39.2K 1% .5W F TC=0+-100	28480	0757-0850
A11R15	0687-3321	0	2	RESISTOR 3.3K 10% .5W CC TC=0+647	01121	E83321
A11R16	0698-3622	7	1	RESISTOR 120 5% 2W MO TC=0+-200	28480	0698-3622
A11R17	0757-0446	3	1	RESISTOR 15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1502-F
A11R18	0757-0388	2		RESISTOR 30.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-30R1-F
A11R19	0757-0352	0	1	RESISTOR 15K 1% .5W F TC=0+-100	28480	0757-0352
A11R20	0757-0344	0	1	RESISTOR 1M 1% .25W F TC=0+-100	24546	C5-1/4-T0-1004-F
A11R21	0757-0434	9	1	RESISTOR 3.65K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3651-F
A11R22	0698-3152	8	1	RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A11R23	0687-3321	0		RESISTOR 3.3K 10% .5W CC TC=0+647	01121	E83321
A11R24	0757-0440	7	1	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A11R25	0757-0388	2		RESISTOR 30.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-30R1-F
A11R26	0757-0737	5	1	RESISTOR 1.62K 1% .25W F TC=0+-100	24546	C5-1/4-T0-1621-F
A11R27	0757-0458	7	1	RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A11R28	0698-3150	6	1	RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A11R29	2100-2061	3	1	RESISTOR-TRMR 200 10% C TOP-ADJ 1-TRN	73138	82PR200
A11R30	0757-1094	9	1	RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F

See introduction to this section for ordering information  
 \*Indicates factory selected value

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

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A11R31	0767-0009	5	2	RESISTOR 12K 5% 3W MO TC=0+-250	27167	FP3-3-250-1202-J
A11R32	0767-0009	5		RESISTOR 12K 5% 3W MO TC=0+-250	27167	FP3-3-250-1202-J
A11R33	0684-3321	4	2	RESISTOR 3.3K 10% .25W FC TC=-400/+700	01121	CB3321
A11R34	0684-3321	4		RESISTOR 3.3K 10% .25W FC TC=-400/+700	01121	CB3321
A11R35	0767-0008	4	2	RESISTOR 10K 5% 3W MO TC=0+-250	27167	FP3-3-250-1002-J
A11R36	0767-0008	4		RESISTOR 10K 5% 3W MO TC=0+-250	27167	FP3-3-250-1002-J
A11V1	1940-0025	4	1	TUBE-ELECTRON DIODE-V RGLTR	28480	1940-0025
A11VR1	1902-0175	5	1	DIODE-ZNR 100V 5% DO-15 PD=1W TC=+.083%	28480	1902-0175
A11VR2	1902-0049	2	1	DIODE-ZNR 6.19V 5% DO-7 PD=.4W TC=+.022%	28480	1902-0049
A11VR3	1902-0065	2	1	DIODE-ZNR 46.4V 10% DO-7 PD=.4W	28480	1902-0065
A11VR4	1902-3393	5	1	DIODE-ZNR 75V 5% DO-7 PD=.4W TC=+.077%	28480	1902-3393
A11VR5	1902-0033	4	1	DIODE-ZNR 1N623 6.2V 5% DO-7 PD=.4W	24046	1N623
A11VR6	1902-0185	7	1	DIODE-ZNR 27.4V 5% DO-7 PD=.4W TC=+.079%	28480	1902-0185
A11XF1	2110-0269	0	6	FUSEHOLDER-CLIP TYPE,250-FUSE	28480	2110-0269
A11XF2	2110-0269	0		FUSEHOLDER-CLIP TYPE,250-FUSE	28480	2110-0269
A11XF3	2110-0269	0		FUSEHOLDER-CLIP TYPE,250-FUSE	28480	2110-0269
A12	0960-0444			POWER MODULE: NON-FILTERED	28480	0960-0444
A13	01311-66503	0	1	BOARD ASSEMBLY-CONTROL	28480	01311-66503
A13R1	2100-3838	4	1	RESISTOR-VAR, 1K, +-20%, 1W, LIN	28480	2100-3838
A13R2	2100-3839	5	7	RESISTOR-VAR, 5K, +-20%, 1W, LIN	28480	2100-3839
A13R3	2100-3839	5		RESISTOR-VAR, 5K, +-20%, 1W, LIN	28480	2100-3839
A13R4	2100-3839	5		RESISTOR-VAR, 5K, +-20%, 1W, LIN	28480	2100-3839
A13R5	2100-3839	5		RESISTOR-VAR, 5K, +-20%, 1W, LIN	28480	2100-3839
A13R6	2100-3839	5		RESISTOR-VAR, 5K, +-20%, 1W, LIN	28480	2100-3839
A13R7	2100-3839	5		RESISTOR-VAR, 5K, +-20%, 1W, LIN	28480	2100-3839
A13R8	2100-3839	5		RESISTOR-VAR, 5K, +-20%, 1W, LIN	28480	2100-3839
A13R9	0687-1001	9	1	RESISTOR 10 10% .5W CC TC=0+412	01121	EB1001
MP38	01311-68701		1	OPTION 001 RACK MOUNT KIT	28480	01311-68701
MP39	01311-68712		1	OPTION 002 SHORT TILT STAND	28480	01311-68712
A5	01317-66502			OPTION 003 Z-AXIS BOARD	28480	01317-66502
V1	5083-3261			OPTION 604 CRT-P4	28480	5083-3261
V1	5083-3270			OPTION 639 CRT-P39	28480	5083-3270

See introduction to this section for ordering information  
\*Indicates factory selected value

Table 6-3. List of Manufacturers' Codes

MFR NO.	MANUFACTURER NAME	ADDRESS	ZIP CODE
00000	ANY SATISFACTORY SUPPLIER		
01121	ALLEN-BRADLEY CO	MILWAUKEE WI	53204
01295	TEXAS INSTR INC SEMICOND CMPNT DIV	DALLAS TX	75222
0192B	RCA CORP SOLID STATE DIV	SOMERVILLE NJ	08876
03508	GE CO SEMICONDUCTOR PROD DEPT	SYRACUSE NY	13201
03888	KDI PYROFILM CORP	WHIPPANY NJ	07981
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX AZ	85062
07263	FAIRCHILD SEMICONDUCTOR DIV	MOUNTAIN VIEW CA	94042
19701	MEPCO/ELECTRA CORP	MINERAL WELLS TX	76067
24046	TRANSITRON ELECTRONIC CORP	WAKEFIELD MA	01880
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD PA	16701
27167	CORNING GLASS WORKS (WILMINGTON)	WILMINGTON NC	28401
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO CA	94304
30983	MEPCO/ELECTRA CORP	SAN DEIGO CA	92121
32997	BOURNS INC TRIMPOT PROD DIV	RIVERSIDE CA	92507
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS MA	01247
74100	BUSSMAN MFG DIV OF MCGRAW-EDISON CO	ST LOUIS MO	63107
72136	ELECTRO MOTIVE CORP SUB IEC	WILLIMANTIC CT	06226
72982	ERIE TECHNOLOGICAL PRODUCTS INC	ERIE PA	16512
73138	BECKMAN INSTRUMENTS INC HELIPOT DIV	FULLERTON CA	92634
75915	LITTLEFUSE INC	DES PLAINES IL	60016
84411	TRW CAPACITOR DIV	OGLLALALA NE	69153

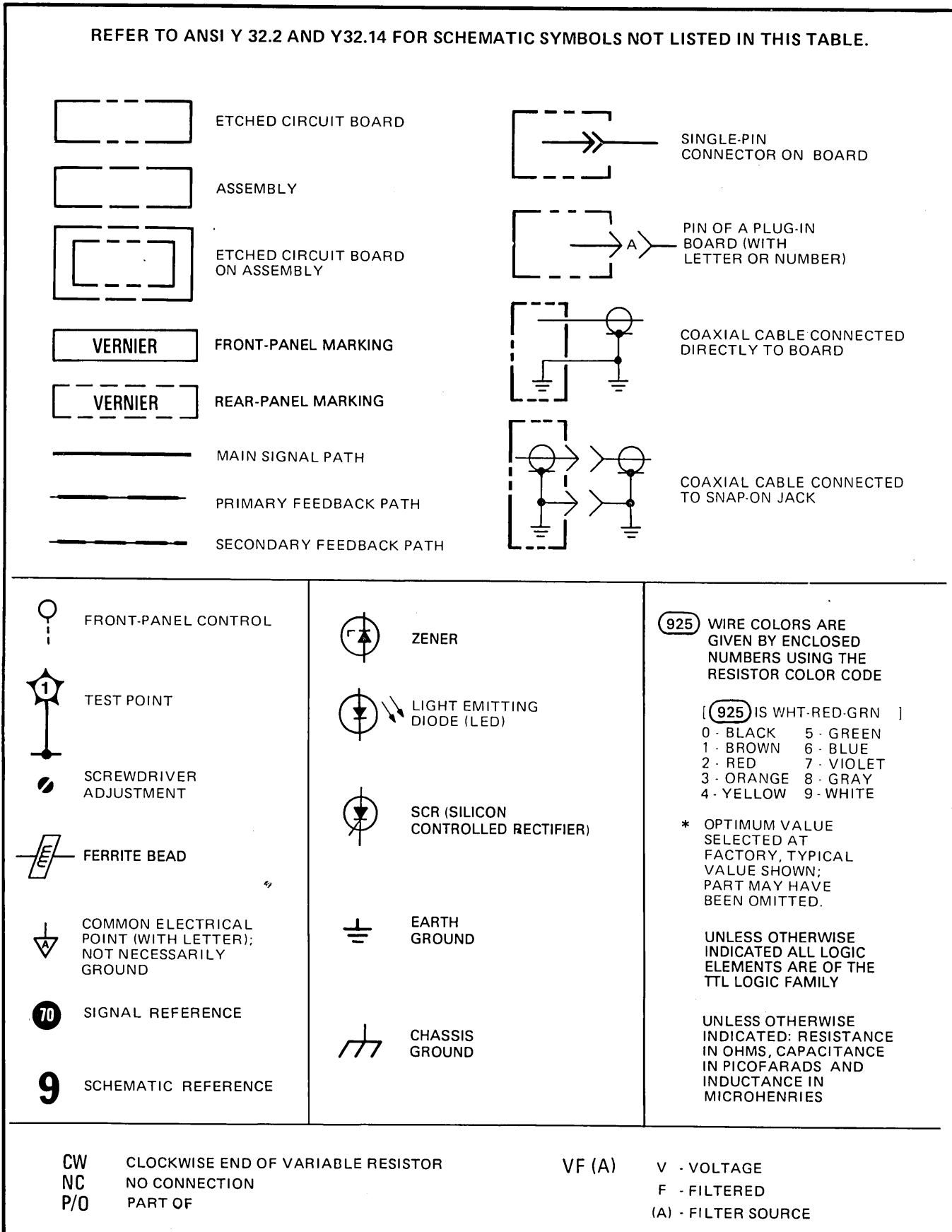


## SECTION VII

### MANUAL CHANGES

#### 7-1. INTRODUCTION.

7-2. This section normally contains information for adapting this manual to instruments for which the content does not apply directly. Since this manual does apply directly to all instruments up to the serial number listed on the title page, no change information is given here. Refer to INSTRUMENTS COVERED BY MANUAL in Section I for additional important information about serial number coverage.



*Figure 8-1. Schematic Diagram Symbols*

## SECTION VIII SERVICE

### 8-1. INTRODUCTION.

8-2. This section provides instructions for troubleshooting and repairing the Model 1311B X-Y Display.

8-3. Detailed theory of operation and troubleshooting information are located opposite the schematics on foldout Service Sheets. The remainder of this section has general service information that should help you quickly service and repair the X-Y display.

### 8-4. THEORY OF OPERATION.

8-5. Overall theory of operation appears on pages opposite the block diagram (Service Sheet 1). Each section of the diagram refers to service sheets where detailed theory, schematics, and troubleshooting information are presented. Figure 8-1 explains any unusual symbols that appear on the schematics.

### 8-6. TROUBLESHOOTING.



Read the Safety Summary at the front of this manual before troubleshooting the instrument.

**8-7. INITIAL TROUBLESHOOTING PROCEDURE.** Before troubleshooting the 1311B in detail, try to perform the adjustment procedures listed in Section V of this manual. Some apparent malfunctions may be corrected by these adjustments, or failure to obtain a correct adjustment will often reveal the source of trouble.

#### NOTE

Before performing any troubleshooting procedure, eliminate static charge from glass of the CRT faceplate by solidly grounding one hand while rubbing the CRT faceplate with the other hand.

**8-8. DC VOLTAGES AND WAVEFORMS.** DC voltages, waveforms, and conditions for making these measurements are given on, or adjacent to schematics on the service sheets. Since conditions for making measurements may differ from one circuit to another, always check the specific conditions listed for each schematic.

### 8-9. RECOMMENDED TEST EQUIPMENT.

8-10. Test equipment required to maintain the 1311B is listed in Section I, table 1-4. Equipment other than that listed may be used if it meets the listed critical specifications.

### 8-11. REPAIR.

**8-12. ASSEMBLY REMOVAL.** Instructions for removing major assemblies are contained in the service sheet instructions for that particular assembly. Before servicing the instrument, remove top and bottom covers. Refer to table 8-1 for the list of assemblies indexed to Service Sheets.

*Table 8-1. Service Sheet Quick Reference*

Assembly	Name	Service Sheet(s)
A1	X-input Amplifier	2
A2	X-output Amplifier	3
A3	Y-input Amplifier	2
A4	Y-output Amplifier	3
A5	Z-axis Amplifier	4
A6	Dynamic Focus and Astigmatism	5; 6
A7	Left Connector Board	9
A8	Right Connector Board	9
A9	High Voltage Power Supply	7
A10	High Voltage Multiplier	7
A11	Low Voltage Power Supply	8
A12	Line Module	8
A13	Control Assembly	2; 4; 7
A14	Extender Board	N/A

**8-13. PREVENTIVE MAINTENANCE.** Painted surfaces can be cleaned with a commercial, spray-type window cleaner or with a mild soap and water solution.



Do not use chemical cleaning agents that might damage the plastics used in this instrument. Recommended cleaning agents are isopropyl alcohol, kelite (1 part kelite, 20 parts water), or a solution of 1% mild detergent and 99% water.

8-14. Corroded spots are best removed with soap and water. Stubborn residues can be removed with a fine abrasive. Protect such areas from further corrosion with an application of silicone resin such as GE DRIFILM 88.

## 8-15. CIRCUIT BOARDS.

**8-16. BOARD CONNECTIONS.** Square-pin connectors are identified on circuit boards by color code of connecting wire or by the signal name. Connector pins on plugs and jacks are identified by either a number or a letter. Coaxial wires are identified by different shrink-tubing colors.

**8-17. SERVICING ETCHED CIRCUIT BOARDS.** All the etched circuit boards have plated-through component holes. This allows components to be removed or replaced from either side of the board. When unsoldering large components such as potentiometers, rotate the soldering iron tip from lead to lead while applying pressure to the part to lift it from the board. HP Service Note M-20E contains additional information for repair of circuit boards.

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## 8-18. SERVICE SHEET 1 BASIC PRINCIPLES OF OPERATION.

### 8-19. GENERAL.

The following paragraphs contain functional descriptions keyed to the simplified block diagram on the opposite page. The block diagram is drawn for function and does not show circuit details. Circuit details and circuit description are located on the schematics following the block diagram (schematic 1). Refer to table 8-1 for schematic identification.

### 8-20. DEFLECTION AMPLIFIERS.

The X and Y amplifier circuits are identical. They amplify the input signals to the necessary level to drive the CRT horizontal and vertical deflection plates. Each amplifier can be connected for positive, negative, or differential input with the input impedance selectable for 10 kohms or 50 ohms.

### 8-21. Z-AXIS AMPLIFIER.

The high voltage supply for the CRT grid is controlled by the Z-axis amplifier output level. Consequently, the voltage applied to the Z-INPUT controls the CRT beam intensity. The Z-axis amplifier can be connected to permit blanking by either a positive or negative voltage at the Z-INPUT.

### 8-22. PHOSPHOR PROTECTION.

The phosphor protection circuits prevent CRT phosphor by high intensity or a static slow moving beam. When a low frequency signal, or the absence of an input signal, is detected by either X or Y phosphor protection circuit, the output of the Z-axis amplifier is limited to approxi-

mately +18 V. This action in turn limits CRT grid drive. In some system applications, automatic beam current limiting may not be desirable. In such cases the phosphor protection circuit may be disabled by an internal switch (A8S1).

### 8-23. DYNAMIC FOCUS AND ASTIGMATISM.

The purpose of the dynamic focus and astigmatism circuits is to provide optimum focus of the displayed signals over the entire screen. Samples from the X and Y deflection amplifiers, proportional to the CRT beam position, drive the focus and astigmatism circuits. The astigmatism element is directly controlled by the output of the astigmatism driver. The output of the focus amplifier is applied to the focus level translator on the high voltage power supply assembly where it establishes operating potential for the CRT focus grid.

### 8-24. LOW VOLTAGE POWER SUPPLY.

The low voltage power supply converts the ac line input to three regulated dc power supplies, +250 V, +15 V, and -15 V. The +250 V and the -15 V supplies are adjustable and the +15 V supply is referenced to the -15 V supply. A separate dc supply, approximately 21.5 V, is provided for the high voltage oscillator.

### 8-25. HIGH VOLTAGE POWER SUPPLY.

The high voltage power supply provides the high operating potentials for the CRT:  $\cong -4550$  V for the cathode, a grid voltage referenced to the cathode, CRT filament voltage, and a post-accelerator potential of  $\cong 24$  kV. The high voltage power supply also contains a focus level translator circuit which, along with the dynamic focus amplifier, automatically adjusts the beam focus with changes in intensity level.

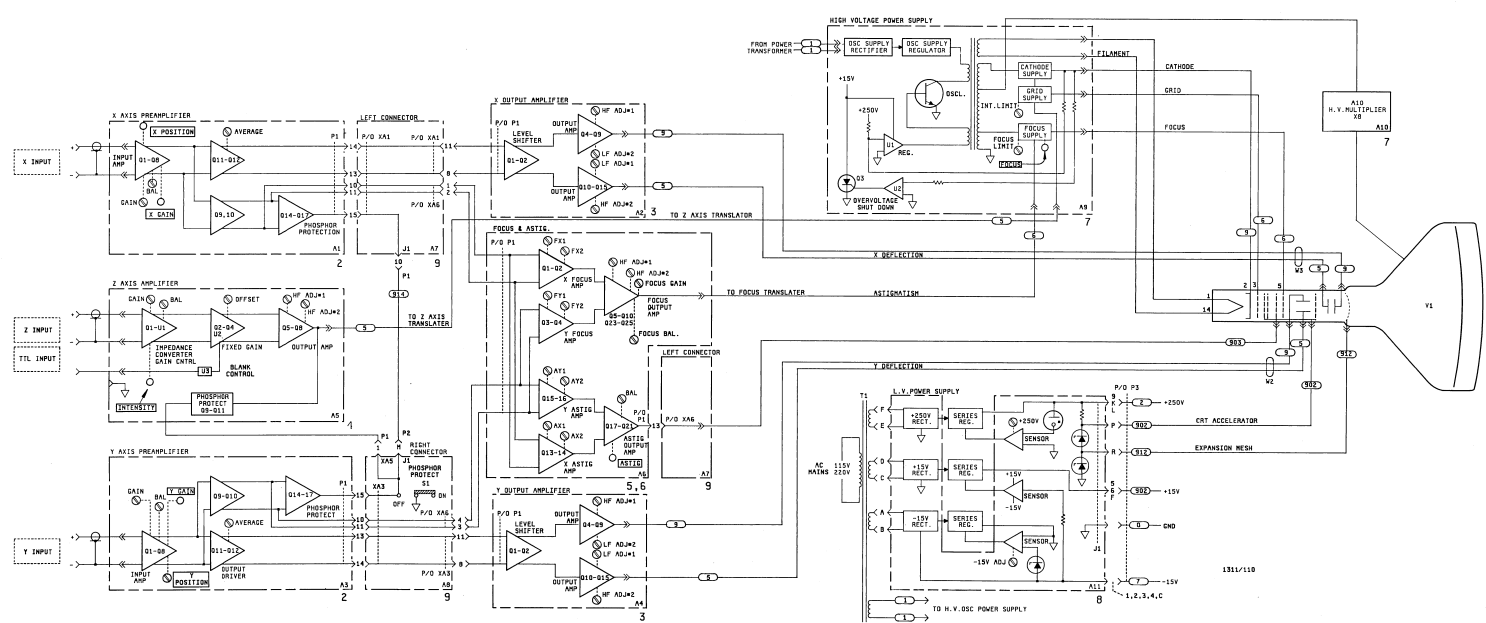


Figure 8.2  
Service Sheet 1, Overall Block Diagram  
8.3

**8-26. SERVICE SHEET 2 PRINCIPLES OF OPERATION.**

**8-27. INPUT AMPLIFIER AND GAIN CONTROL CIRCUIT (Q1A, Q1B).**

Q1A and Q1B are high input impedance source followers that provide unity gain with respect to the input signal. The bias point of Q1 is determined by the FET characteristics (VP and IDSS) for the particular device.

VP = pinch off voltage

IDSS = drain current with drain to source voltage = 0 V.

Vs will be between 0 V and +5 V with the gate at 0 V.

**8-28. GAIN CONTROL (U1, U2, Q5).**

The signal from the source follower (Q1) is applied to the gain control circuit. (See figure 8-3 for the following discussion.)

U1Q3 and U1Q4 make up the current source for the gain control circuit. R11 balances current paths I1 and I2 in the absence of an input signal. R12 determines the current differential between I1 and I2 when a signal is applied. Collector circuit of U2Q2 and U2Q3 comprise the differential signal path to Q5 collector of U2Q1 and U2Q4 make up the current sink path to Q5.

The front panel GAIN control (A13R3) determines the amount of current applied to the signal path (I4) versus the amount of current applied to the current sink path (I5). If the front panel GAIN control (A13R3) is set for minimum gain (cw) then less current is applied to the signal path (I4) and more current is shunted to current sink Q5 (I5). At the maximum gain setting (ccw) the opposite is true. This is accomplished by decreasing (front panel GAIN ccw) or increasing (front panel GAIN cw) current through R29 and R3. Q8 converts the differential signal current from U2Q2 and U2Q3 to a differential signal voltage which is applied to the bases of Q11 and Q12. Position control is accomplished by controlling current through Q5 and Q7.

The voltage applied to the bases of Q11 and Q12 determines the differential current flowing through Q11, Q12, Q13 supplies current for Q11 and Q12. Average adjustment (R64) sets current available for Q11 and Q12.

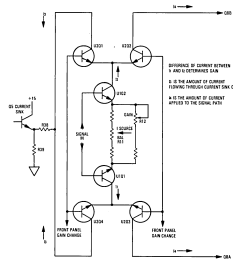
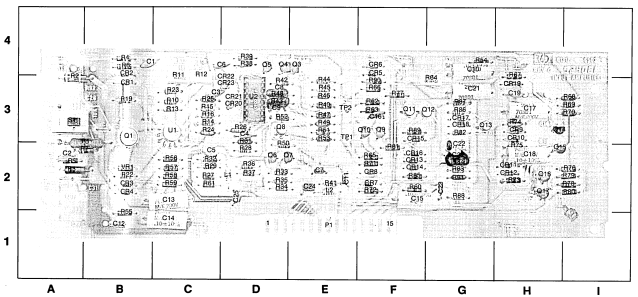
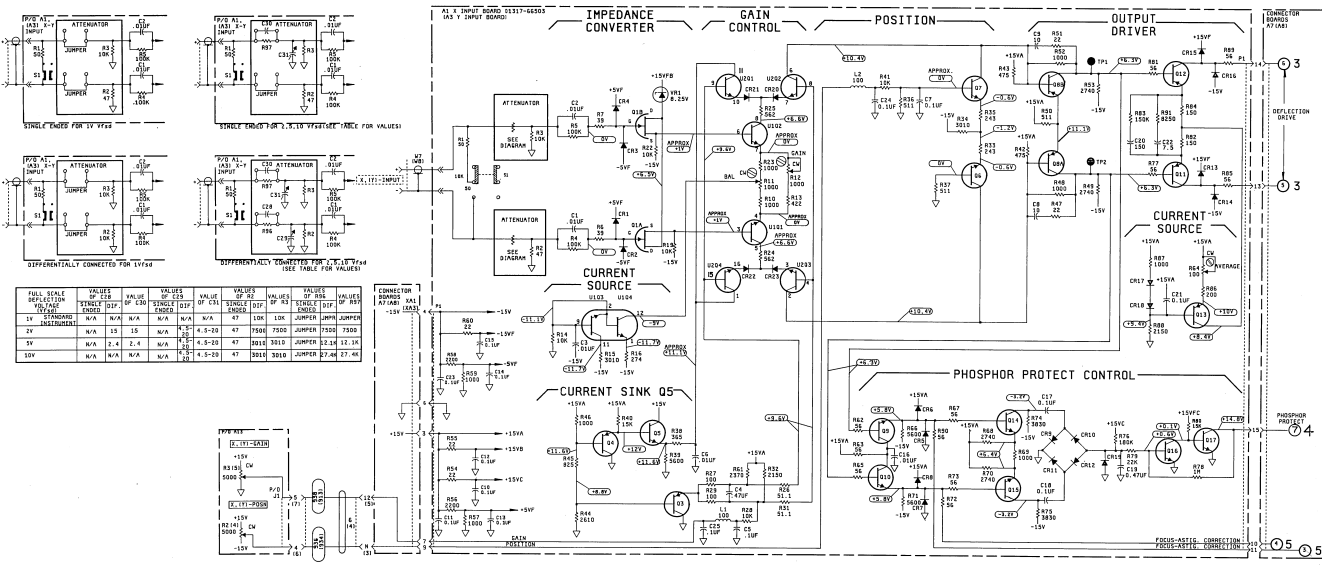


Figure 8-3. Simplified Schematic of XY Gain Control



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
Q1	B-4	C19	H-3	CR12	H-2	Q5	D-4	R6	B-4	R29	C-3	R47	E-3	R64	G-3
Q2	A-2	C20	G-3	CR13	F-2	Q6	D-3	R7	A-2	R31	C-3	R48	D-3	R65	F-2
Q3	C-3	C21	G-3	CR14	F-2	Q7	D-3	R10	C-3	R32	C-2	R49	E-3	R66	F-3
Q4	D-3	C22	G-3	CR15	F-3	Q8	D-3	R11	C-3	R33	C-2	R50	E-3	R67	H-4
Q5	E-2	C23	G-3	CR16	F-2	Q9	F-3	R12	C-4	R34	D-2	R51	E-3	R68	F-3
Q6	C-4	C24	E-2	CR17	G-3	Q10	F-3	R13	C-3	R35	D-2	R52	D-3	R69	I-3
Q7	E-2	C25	D-3	CR18	G-3	Q11	F-3	R14	C-3	R36	D-2	R53	E-3	R70	I-3
Q8	D-3	CR1	B-3	CR19	H-3	Q12	G-3	R15	C-3	R37	D-2	R54	E-4	R71	F-3
Q9	E-3	CR2	B-3	CR20	D-3	Q13	G-3	R16	C-3	R38	D-4	R55	E-4	R72	F-3
Q10	G-4	CR3	B-2	CR21	D-3	Q14	H-3	R19	B-3	R39	D-4	R56	C-2	R73	H-2
Q11	E-2	CR4	B-3	CR22	D-3	Q15	G-3	R16	C-3	R38	D-4	R55	E-4	R74	H-3
Q12	B-1	CR5	F-4	CR23	D-3	Q16	H-2	R23	C-3	R41	E-2	R58	C-2	R75	H-2
Q13	C-2	CR6	F-4	L1	D-2	Q17	H-2	R24	C-3	R42	D-3	R59	C-2	R76	I-4
Q14	C-1	CR7	F-2	L2	E-2	R1	A-3	R25	C-3	R43	D-3	R60	F-2	R77	F-3
Q15	F-2	CR8	H-3	F1	E-1	R2	A-3	R26	C-3	R44	E-3	R61	C-2	R78	I-2
Q16	F-3	CR9	H-3	F2	E-1	R3	A-3	R27	C-2	R45	E-3	R62	F-3	R79	I-2
Q17	H-3	CR10	H-3	D3	E-4	R4	A-2	R28	D-2	R46	E-3	R63	F-3	R80	I-2
Q18	H-2	CR11	H-2	D4	E-4	R5	A-2	R29	D-2	R47	E-3	R64	F-3	R81	I-2

Figure 8-4. XY Input Amplifier (A1, A3) Component Locator



**NOTES:**  
 1. UNLESS OTHERWISE NOTICED, RESISTANCE IN OHMS, CAPACITANCE IN PICOGRAMS, INDUCTANCE IN MICROHENNES.

**PARTS ON THIS SCHEMATIC**

A1 OR A3	A13
C1-20, 28-31, C16, C24	R2 (41, 43, 51)
C1-17, 17	R1 (1, 11, 13)
R17-18, 19, 22-23	R2 (1, 11, 13)
R19-21, 25, 27	R1 (1, 11, 13)
U1-10	U1 (1, 11, 13)

3311B 104  
1/1/68

2

Figure 8-6  
 Service Sheet 2, X-Y Axis Input Amplifier (A1, A3) Schematic  
 8-5



**8-23. SERVICE SHEET 3 PRINCIPLES OF OPERATION.**

**NOTE:** The output amplifier assembly (A2, A4) consists of two identical amplifiers each driving separate deflection plates. The following circuit description describes amplifier Q4 through Q9 and also applies to amplifier Q10 through Q15. (See figure 8-6, simplified output amplifier schematic).

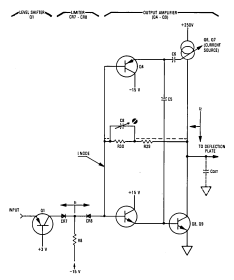


Figure 8-6. Simplified Output Amplifier Schematic

**8-30. X-Y OUTPUT AMPLIFIER (Q4 through Q9, Q10 through Q15).**

The output amplifier Q4 through Q9 operates as a current-to-voltage converter; that is, a small current change from the input results in a large voltage swing at the deflection plates. Q4 and Q5 are emitter followers. Q6 and Q7 make up the constant current source for the output amplifier (current I<sub>2</sub> remains constant except for very fast transitions). Transistors Q8 and Q9 perform the signal amplification. Q1 is a common base voltage level shifter. R8 supplies current to the output amplifier and the level shifter.

The current flowing through CR8 equals the current flowing through R29 and R30. When the input signal current changes, the portion of R8 current I<sub>1</sub> flowing through CR8 changes inversely. This action changes current flow through Q6, Q8 and Q9. The current supplied by Q6, Q7 (I<sub>2</sub>) flows through Q8, Q9 or through feedback path R29 and R30. The current through the feedback path R29 and R30 is inversely proportional to current flow through Q8 and Q9. These varying currents through R29 and R30 equal the current changes through CR8. The I NODE side of R30 is always 1.2 V above ground, i.e., two diode drops (base emitter junctions of Q6 and Q9).

When the current through the feedback path changes, the voltage drops across R29 and R30 change, resulting in large output voltage swings to the deflection plates. The purpose of Q4 is to speed up the fast low to high transitions by modifying the constant current source Q6, Q7. During these faster transition times more current is supplied to the circuit capacitance (CCT). During the high to low transition the signal is coupled through C5, momentarily decreasing current I<sub>2</sub>. This action allows Q6 and Q9 to discharge the circuit capacitance (CCT) at a faster rate.

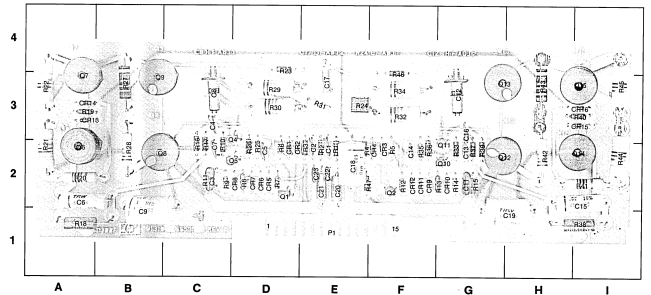
Due to the high voltage (250 V) and large voltage swings required by the deflection plates, the output devices actually consist of two stacked transistors sharing the voltage. Q8 and Q9 make up the output amplifiers, while transistors Q6 and Q7 supply the current. Pulse fidelity is compensated for by adjustment C8 (HF ADF No. 1).

**8-31. TROUBLESHOOTING.**

If trouble is suspected, visually inspect the instrument. Look for loose or burned components that might suggest a source of trouble. Verify that all circuit board connections are making good contact. If no obvious trouble is found, check power supply voltages in the unit. Because there is a high degree of negative feedback in the output amplifier, the stage is relatively free of bias differences in the transistors. Use table 8-2 as a guide for major failures.

Table 8-2. Troubleshooting Guide for X-Y Output Amplifier

DEFLECTION PLATE VOLTAGE IS	AND THE I NODE VOLTAGE IS	
	LOW	HIGH
near 0 V	Check Q6, Q7 and associated resistors	Q1, R8, CR7, CR8
greater than 200 V	R29, R30 Q6, Q8, Q9 open	Q5, Q6, Q9 open Q1



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC		
C1	E-2	C13	G-2	CR1	D-2	CR12	F-2	Q7	A-3	R3	E-2	R14	G-2	R25	D-2	R36	F-2
C2	E-2	C14	F-2	CR2	D-2	CR13	A-3	Q8	B-2	R4	E-2	R15	G-2	R26	D-2	R37	F-2
C3	C-2	C15	F-2	CR3	F-2	CR14	A-3	Q9	B-3	R5	F-2	R16	C-2	R27	B-2	R38	F-2
C4	C-2	C16	G-2	CR4	F-2	CR15	F-2	Q10	G-2	R6	D-2	R17	C-2	R28	B-2	R39	F-2
C5	D-2	C17	F-2	CR5	D-2	CR16	F-2	Q11	G-2	R7	D-2	R18	A-1	R29	D-3	R40	F-2
C6	A-2	C18	E-2	CR6	D-2	CR17	F-2	Q12	H-2	R8	D-2	R19	A-3	R30	D-3	R41	F-2
C7	C-2	C19	H-1	CR7	D-2	CR18	F-2	Q13	H-3	R9	C-2	R20	A-2	R31	F-3	R42	F-2
C8	C-1	C20	E-2	CR8	D-2	CR19	F-2	Q14	H-2	R10	C-2	R21	A-2	R32	F-2	R43	F-2
C9	B-1	C21	F-2	CR9	F-2	CR20	F-2	Q15	I-3	R11	C-2	R22	A-3	R33	F-2	R44	F-2
C10	G-2	C22	E-2	CR10	G-2	CR21	F-2	Q16	E-2	R12	F-2	R23	D-4	R34	F-3	R45	F-2
C11	G-2	C23	E-2	CR11	F-2	CR22	G-2	Q17	E-2	R13	G-2	R24	E-3	R35	F-2	R46	F-4

Figure 8-7. X-Y Output Amplifier (A2, A4) Component Locator

NOTES

Model 1311B

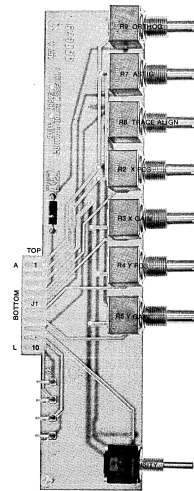
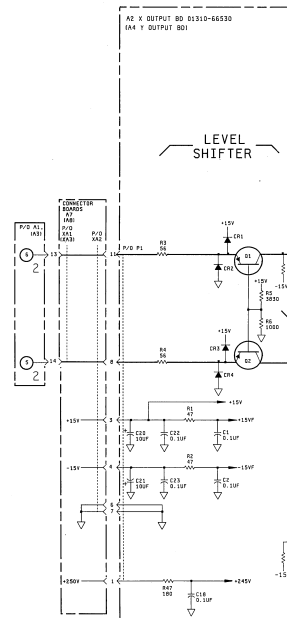


Figure 8-8. Control Board (A13) Component Locator



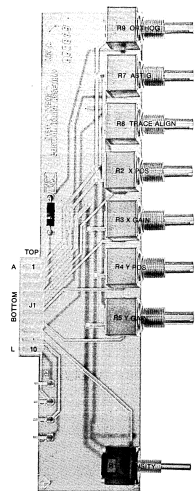
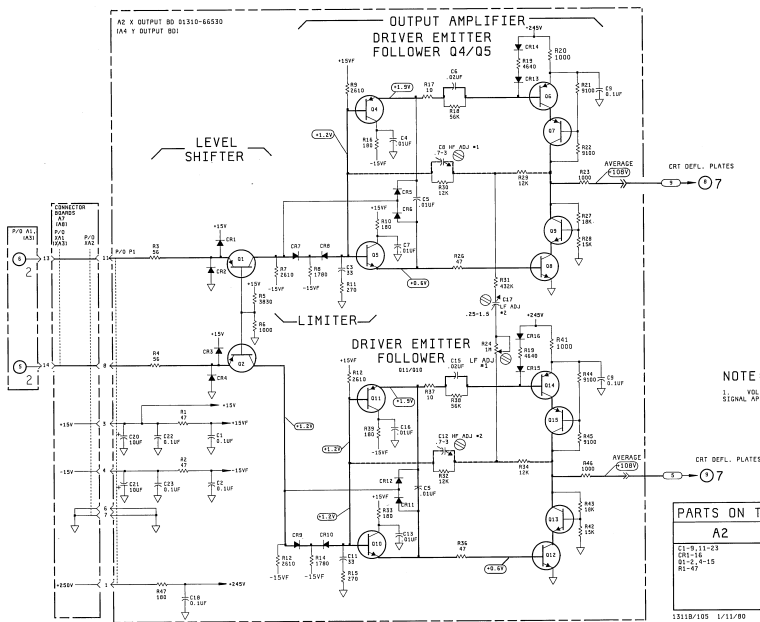


Figure 8-8. Control Board (A13) Component Locator



NOTE:  
 1. VOLTAGE SHOWN WITH NO SIGNAL APPLIED AND BEAM CENTERED.

PARTS ON THIS SCHEMATIC	
A2	CHASSIS
C1-8, C11-23	AA7
C9-10, C15	AA4
R1-45, R-115	

1311B/105 1/11/80

3

Figure 8-9. Service Sheet 3, X-Y Axis Output Amplifier (A2, A4) Schematic 8-7

**8-32. SERVICE SHEET 4 PRINCIPLES OF OPERATION.**

**8-33. IMPEDANCE CONVERTER AND GAIN CONTROL (ASQ1, ASU1).**

Q1 is a high input impedance source follower that provides unity gain with respect to the input signal. The signal from the source follows Q1 and is applied to gain control circuit U1. (See figure 8-10 for the following discussion of the gain control circuit.)

Q1 and Q2 comprise the current source for the Z-axis gain control circuit (U1). R13 balances the current paths I1 and I2. Collector circuits of Q5, Q7 and Q8, Q6 make up the differential signal path to Q2A and Q2B. The front panel INTENSITY control sets the current differential between I1 and I2. During the low gain condition (large signal input) current paths I3 and I4 are

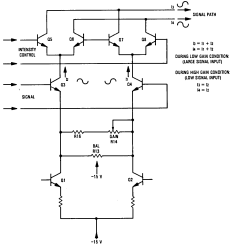


Figure 8-10. Simplified Schematic of Z-axis Gain Control

approximately equal. During the high gain condition (low input signal) current paths I3 and I4 equal current path I2.

The output of the gain control circuit is fed to shunt-feedback amplifiers Q2A and Q2B. Transistor array U2 consists of four separate transistors (U2Q1 to U2Q4). U2Q1 is connected as a current source that supplies current to U2Q2 and U2Q3. U2Q3 provides signal current for the dynamic focus amplifier. U2Q2 and Q2B are connected in a cascade amplifier configuration and provide signal drive to the Z-axis output amplifier.

**8-34. Z-AXIS OUTPUT AMPLIFIER (ASQ5 through ASQ8).**

Transistors Q5 and Q6 function as emitter followers, while Q7 and Q8 are a complementary pair. A feedback circuit is provided through C27 and R52 with C27 providing adjustment for the fast corners of the output signal. Slower compensation is provided by network C17 and R36. CR7 and CR8 are high current diodes and provide protection for the output amplifiers against arcs and transients. The output of the Z-axis amplifier is applied to grid level translator on the high-voltage power supply assembly (A9) where it establishes the potential difference between the CRT grid and cathode (see service sheet 7).

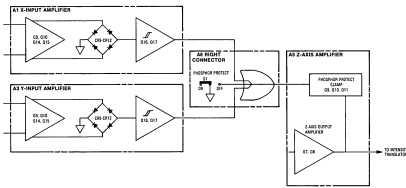


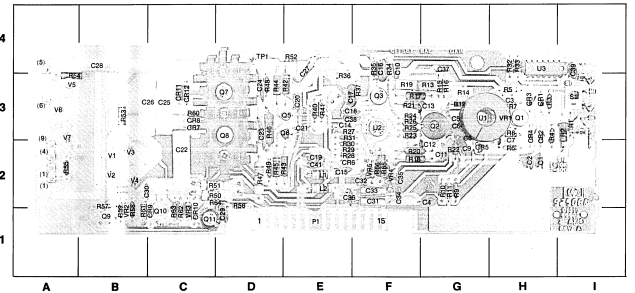
Figure 8-11. Simplified Block Diagram of the Phosphor Protection Circuit

**8-35. PHOSPHOR PROTECTION.**

The purpose of the phosphor protection circuit is to prevent CRT phosphor or expansion mesh damage caused by a high intensity, slow moving or static beam. Refer to figure 8-11, schematics 2 and 4 for the following discussion of circuit details.

The phosphor protection control voltage is picked off at the collectors of Q8A/Q8B and is applied to emitter followers Q9 and Q10. The signal is amplified by Q14 and Q15 and rectified by bridge rectifier CR9/CR15. C19 provides filtering for the bridge rectifier circuit. The output of the bridge rectifier is a negative voltage that is proportional to the X-Y axis input voltage. Low frequency or low amplitude input signals will not provide sufficient negative voltage at C19 to turn off Q16. Q17, ASQ9A and ASQ10A will remain off for as long as Q16 remains turned on. ASC3D charges to approximately +2.5 V through ASQ9B, turning ASQ10B, ASQ11 on. As long as ASQ11 is conducting, the Z-axis output level is clamped to approximately +18 V, therefore limiting CRT beam current.

Automatic beam current limiting may not be desirable in some system applications. In such cases the phosphor protection circuit may be disabled by an internal switch (ASS1).



REF	GRID	REF	GRID	REF	GRID	REF	GRID	REF	GRID	REF	GRID	REF	GRID	REF	GRID	REF	GRID
DESIG	LOC	DESIG	LOC	DESIG	LOC	DESIG	LOC	DESIG	LOC	DESIG	LOC	DESIG	LOC	DESIG	LOC	DESIG	LOC
C1	H-2	C18	E-3	C35	F-2	CR11	C-3	R2	I-3	R18	F-2	R34	#-4	R52	E-4	TP1	D-4
C2	H-2	C19	E-2	C36	E-1	CR12	C-3	R3	H-3	R19	F-2	R35	F-4	R53	B-3	U2	F-3
C3	H-3	C20	E-3	C37	G-4	L1	E-2	R4	H-3	R20	F-2	R36	E-3	R54	A-3	U3	F-3
C4	G-2	C21	E-3	C38	E-2	L2	E-2	R5	H-3	R21	F-3	R37	F-3	R55	A-2	U4	H-4
C5	G-3	C22	C-2	C39	I-4	P1	E-1	R6	H-2	R22	G-2	R40	E-3	R56	D-2	V1	B-2
C6	G-3	C23	D-3	C40	E-1	Q1	H-3	R7	H-3	R23	F-3	R41	E-3	R57	B-2	V2	B-2
C7	H-3	C24	D-3	CR1	H-3	Q2	G-3	R8	H-3	R24	F-3	R42	D-3	R58	B-1	V3	B-2
C8	G-3	C25	C-3	CR2	H-3	Q3	F-3	R9	G-2	R25	F-3	R43	D-2	R59	B-1	V4	B-2
C9	G-2	C26	B-3	CR3	H-3	Q5	F-3	R10	G-2	R26	F-3	R44	D-3	R60	C-3	V5	A-3
C10	F-4	C27	E-4	CR4	H-3	Q6	E-3	R11	G-2	R27	E-3	R45	D-2	R61	B-1	V6	A-3
C11	G-2	C28	B-4	CR5	G-2	Q7	D-3	R12	G-3	R28	E-3	R46	D-3	R62	C-1	V7	A-3
C12	G-3	C29	D-1	CR6	E-3	Q8	B-3	R13	G-3	R29	E-3	R47	D-3	R63	C-1	V8	B-1
C13	G-3	C30	B-2	CR7	C-3	Q9	B-1	R14	G-3	R30	E-3	R48	D-3	R64	C-1	V9	B-1
C14	E-3	C31	F-2	CR8	C-1	Q10	C-1	R15	G-3	R31	E-3	R49	D-2	R65	F-2	V10	C-1
C15	E-2	C32	F-2	CR9	C-1	Q11	C-1	R16	G-3	R32	H-4	R50	C-2	R66	F-2	V11	F-2
C16	F-4	C33	F-2	CR10	C-1	R1	I-3	R17	F-3	R33	H-4	R51	C-2	R67	I-3	V12	F-2
C17	E-3	C34	F-2														

Figure 8-12. Z-axis Amplifier (AS) Component Locator

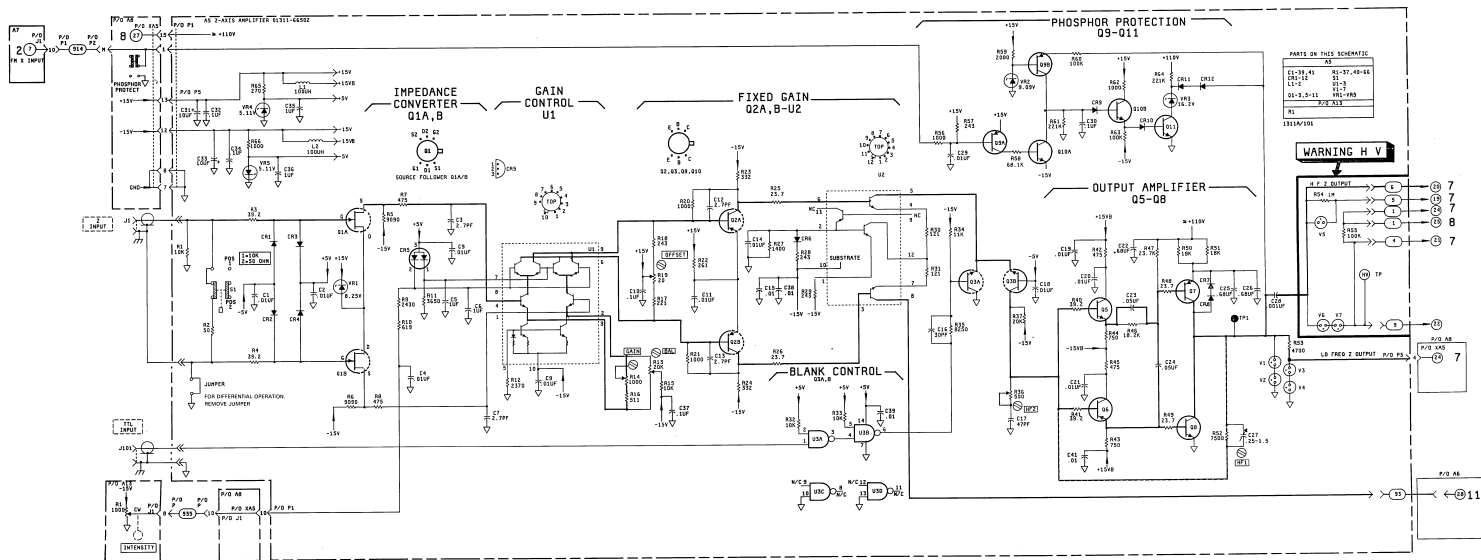


Figure 8-13. Service Sheet 4, Z-axis Amplifier (A5) Schematic 8-5

**8-36. SERVICE SHEET 5 PRINCIPLES OF OPERATION.**

**8-37. DYNAMIC FOCUS.**

The purpose of focus correction is to provide optimum focus of the displayed signal over the entire screen. The focus voltage required for optimum spot size varies as the square of the distance from center screen. The focus correction circuit approximates this variation using a differential amplifier with two diode-controlled gain break points.

**8-38. X-Y INPUT AMPLIFIERS (A5Q1 through A5Q4).**

The required square law response is achieved in the following manner with gain adjustments FY1 and FY2 (R10 and R11) set to center and with a 0 V differential input to Q1 and Q2 (beam at center screen) the differential voltage at collectors of Q1 and Q2 is also at 0 V. Under these conditions the parallel combination of R6, R8 and R12 provides the collector load resistance for Q1. The load resistance for Q2 is made up of parallel combination R7, R9 and R13. As the beam is moved vertically so that the base of Q1 becomes more negative, the collector voltage will move in a positive direction. When the collector of Q2 becomes more positive than the wiper of FY2 (R11), CR5 stops conducting, leaving the parallel combination R6 and R8 as the collector load for Q1. As beam movement continues in the same direction CR1 stops conducting leaving R6 as the collector load resistor. The collector load change increases gain from approximately 1 to 6 and 12 respectively. Note that beam movement in this direction does not cause any gain changes of Q3 (CR2 and CR6 remain forward biased). Vertical movement of the beam in the opposite direction causes the gain of Q2 to change from approximately 1 to 6 and to 12 in the same manner as Q1.

**8-39. CURRENT AMPLIFIERS (Q5, Q6, Q7, Q8).**

The purpose of CR9 and CR10 is to connect the more positive of the collectors voltages (collector of Q1 or collector of Q2) to the base of Q5. As a result, current through Q5 increases asymmetrically as the beam is moved vertically. Q6 is the voltage source for Q5.

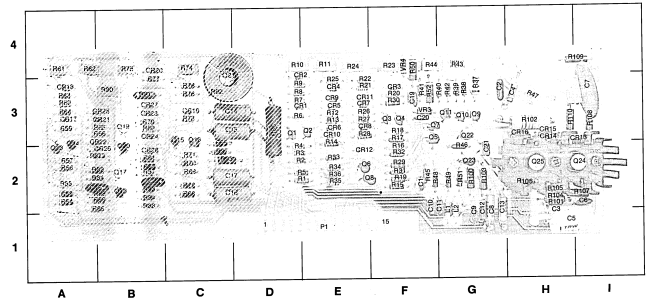
**8-40. FOCUS OUTPUT (A5Q22 through A5Q25).**

Transistors Q22 and Q23 function as emitter followers, while Q24 and Q25 are a complementary pair. A feedback circuit is provided through C4 and R102 with C4 providing fast corner adjustment to maintain output pulse fidelity. Slower frequency compensation is accomplished by network C2 and R47. CR15 through CR16 are high current diodes and offer protection for the output amplifiers against arcs and transients. The output of the focus amplifier is applied to focus level translator on the high voltage power supply assembly (A6) where it establishes the operating potential for the CRT focus grid.

**8-41. Z-AXIS FOCUS CORRECTION (A6, Q9, Q10, Q11).**

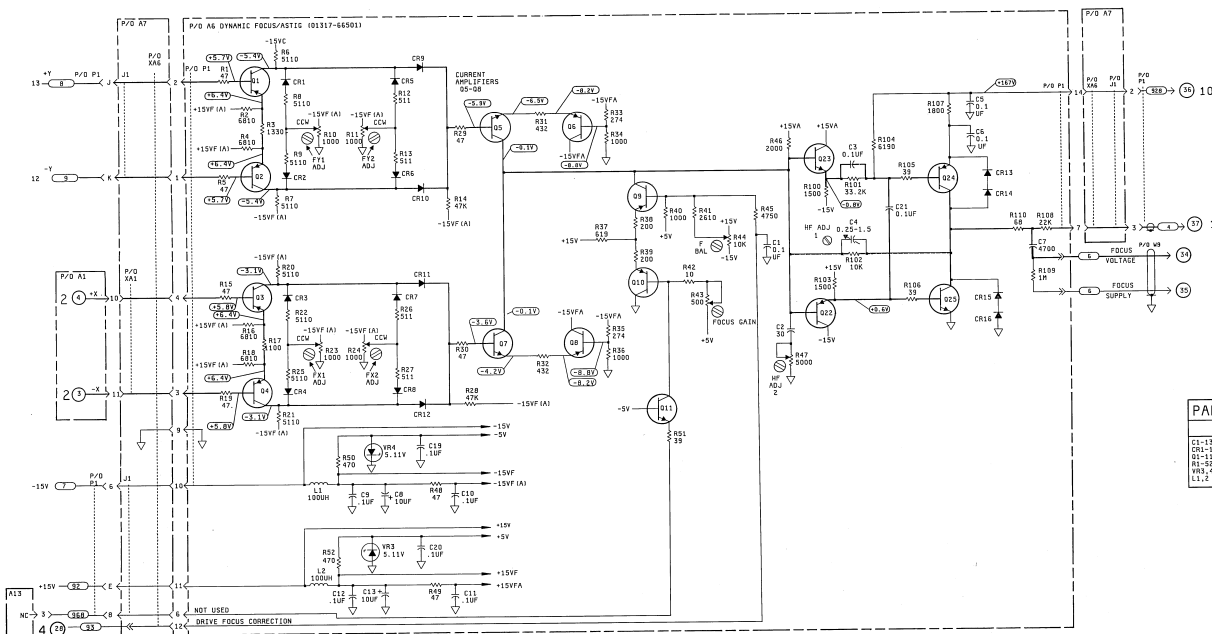
The purpose of the Z-axis focus correction is to provide a more negative focus voltage as beam current is increased (Z-axis output more positive). This is accomplished by differential amplifier Q9 and Q10. The bias of Q9 is set by focus balance R14, while bias for Q10 is established by focus gain (R45).

As Z-axis output voltage increases, the current through Q11 decreases (see Z-axis schematic on service sheet 4) resulting in less current flow through Q10. Because Q9 and Q10 are connected in a differential amplifier configuration, more current will flow through Q9 and cause a decrease in focus output voltage.



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	F-2	C37	B-2	CR21	B-3	Q11	A-3	R6	E-3	R29	F-2	R30	F-4
C2	G-3	CR1	E-3	CR22	B-3	Q13	A-2	R8	E-3	R31	F-2	R32	F-3
CR	H-1	CR2	E-3	CR23	B-3	Q14	A-3	R10	D-4	R33	F-2	R34	A-2
CR	H-3	CR3	F-3	CR24	B-3	Q15	C-3	R11	E-4	R32	F-2	R34	A-2
CR	I-2	CR4	E-3	CR25	B-3	Q16	C-3	R13	E-3	R34	E-2	R35	A-2
CR	I-3	CR5	E-3	CR26	B-3	Q17	C-3	R14	E-3	R35	E-2	R37	B-3
CR	I-3	CR6	E-3	CR27	B-3	Q18	B-2	R14	E-3	R35	E-2	R37	B-3
CR	G-1	CR7	E-3	CR28	B-2	Q19	B-3	R15	F-2	R36	E-2	R35	A-2
CR	S-1	CR8	E-3	CR29	B-1	Q1	G-1	R16	F-2	R37	G-3	R38	A-2
CR	F-2	CR9	E-3	L2	G-1	Q21	C-4	R17	F-3	R38	G-3	R39	A-3
C11	G-2	CR10	E-3	P1	G-1	Q22	G-3	R18	F-2	R40	G-3	R41	A-3
C12	G-1	CR11	E-3	Q1	D-3	Q23	G-2	R19	F-2	R40	G-3	R42	A-4
C13	G-1	CR12	E-2	Q2	E-3	Q24	H-2	R20	F-3	R41	F-3	R43	A-3
C14	C-3	CR13	H-3	Q3	F-3	Q25	H-2	R21	E-3	R42	F-3	R44	A-3
C15	C-3	CR14	H-3	Q4	F-2	R1	E-2	R22	E-2	R43	F-3	R45	A-3
C16	C-2	CR15	H-3	Q5	F-2	R2	E-2	R23	F-4	R44	F-3	R46	B-3
C17	C-2	CR16	H-3	Q6	F-2	R3	E-2	R24	F-4	R45	F-3	R47	B-2
C18	B-2	CR17	A-3	Q7	F-3	R4	E-2	R25	E-2	R46	G-3	R48	C-2
C19	F-3	CR18	C-3	Q8	E-2	R5	E-2	R26	E-3	R47	H-3	R49	C-2
CR0	F-3	CR19	C-3	Q9	G-3	R6	D-3	R27	E-3	R48	F-2	R50	B-3
C21	G-2	CR20	B-4	Q10	G-3	R7	E-3	R28	E-3	R49	G-2	R51	B-3

Figure 8-14. Part of Focus and Astigmatism Amplifier (A6) Component Locator



PARTS ON THIS SCHEMATIC		
A6	A7	CHASSIS
C1-10, 19-20	J1	
C11-14, 22-29	J2	
C15-18, 100-110	J3	
VR1, 4	J4	
L1, 2	J5	

5

Figure 8-15, Service Sheet 5, Dynamic Focus (A6) Schematic 8-11



**8-42. SERVICE SHEET 6 PRINCIPLES OF OPERATION.**

**8-43. DYNAMIC ASTIGMATISM.**

The purpose of the dynamic astigmatism circuit is to aid in obtaining an optimum focused display over the entire screen. With the exception of the output amplifiers, the dynamic astigmatism circuit operation is identical to the dynamic focus circuit.

**8-44. X-Y INPUT AMPLIFIERS (A6Q13 through A6Q16).**

With gain adjustments AY1 and AY2 (R51 and R62) set to midrange and with a 0 V differential input applied to Q13 and Q14 (beam at center screen) the differential voltage at the collectors of Q13 and Q14 is also 0 V. Under these conditions the parallel combination of R59, R60 and R66 provides the collector load resistance for Q13. The collector load resistance for Q14 is made up of the parallel combination R64, R65, R66. As the beam is moved vertically so that the base of Q13 becomes more negative, the collector voltage will move in a positive direction. When the collector of Q13 becomes more positive than the wiper of AY2 (R62), CR21 stops conducting leaving the parallel combination of R59 and R60 as the collector load for Q13. As beam movement continues in the same direction, CR17 stops conducting leaving R59 as the collector load resistor. This collector load change increases gain from approximately 1 to 6 and to 12

respectively. Note that beam movement in this direction does not cause any gain changes of Q14 (CR18 and CR22 remain forward biased).

Vertical movement of the beam in the opposite direction causes the gain of Q14 to change from approximately 1 to 6 and to 12 in the same manner as Q13.

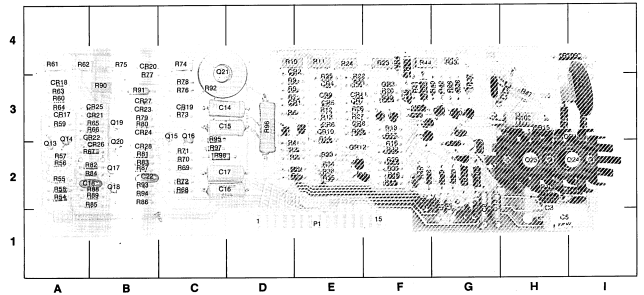
**8-45. CURRENT AMPLIFIERS (A6Q17 through A6Q20).**

The purpose of CR25 and CR26 is to connect the more positive of the collector voltages (collector of Q13 or collector of Q14) to the base of Q17. As a result, current through Q17 increases symmetrically as the beam is moved vertically. Q18 is the voltage source for Q17.

The X-axis correction current is derived from Q15, Q16, Q19 and Q20 in the same manner as the Y-axis correction current except in the opposite polarity. The Y and X-axis correction currents are summed at the collector of Q17 and Q19.

**8-46. FOCUS OUTPUT AMPLIFIER (A6Q21).**

Common base amplifier Q21, astigmatism balance R90, and collector load resistor R96 make up the focus output amplifier. The astigmatism correction currents are converted to a signal voltage which is applied to the focus level translator on the high voltage power supply assembly A6. Astigmatism balance R90 sets the dc bias current for Q21.



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC				
C1	F-2	C22	H-2	CR1	H-3	CR2	H-3	CR3	H-3	R1	E-3	R2	F-3				
C2	G-3	CR1	E-3	CR22	H-3	CR3	D13	A-2	R9	E-3	R30	F-3	R31	G-3			
C3	H-3	CR2	E-3	CR23	H-3	CR4	A-3	R10	D-4	R31	F-2	R32	F-3	R33	H-2		
C4	H-3	CR3	F-3	CR24	H-3	CR5	C-3	R11	E-4	R32	F-2	R34	A-2	R76	B-4		
C5	I-2	CR4	E-3	CR25	H-3	CR6	D13	E-3	R12	E-3	R33	E-2	R35	A-2	R76	C-3	
CR	I-2	CR5	E-3	CR26	H-2	CR7	D-2	R13	E-3	R34	E-2	R36	A-2	R77	B-3	R97	C-2
CR	I-3	CR6	E-3	CR27	H-3	CR8	H-2	R14	E-3	R35	E-2	R37	A-2	R78	B-3	R100	G-2
CR	G-1	CR7	E-3	CR28	H-2	CR9	H-3	R15	F-2	R36	E-2	R38	A-2	R79	B-3	R100	G-2
CR	G-1	CR8	E-3	L1	G-1	CR10	D-2	R16	F-2	R37	G-3	R39	A-3	R80	B-3	R101	H-2
CR	F-2	CR9	E-3	L2	G-1	CR11	D-2	R17	F-3	R38	G-3	R40	A-3	R81	B-3	R102	H-2
CR	G-1	CR10	E-3	P1	E-1	CR12	D-2	R18	F-3	R39	G-3	R41	A-3	R82	B-3	R103	H-2
CR	G-1	CR11	E-3	Q1	E-3	CR13	D-2	R19	F-3	R40	G-3	R42	A-3	R83	B-3	R104	H-2
CR	G-1	CR12	E-3	Q2	E-3	CR14	H-3	R20	F-3	R41	F-3	R43	A-3	R84	B-3	R105	H-2
CR	G-1	CR13	E-3	Q3	F-3	CR15	H-3	R21	E-3	R42	G-3	R44	A-3	R85	B-3	R106	H-2
CR	G-1	CR14	H-3	Q4	F-3	CR16	H-3	R22	E-3	R43	G-4	R45	B-3	R86	B-3	R107	H-2
CR	G-1	CR15	H-3	Q5	F-3	CR17	H-3	R23	E-3	R44	F-4	R46	A-3	R87	B-3	R108	H-2
CR	G-1	CR16	H-3	Q6	E-2	CR18	H-3	R24	E-4	R45	F-2	R47	B-2	R88	B-2	R109	H-2
CR	G-1	CR17	H-3	Q7	F-3	CR19	H-3	R25	E-2	R46	G-2	R48	C-2	R89	C-2	R110	H-3
CR	G-1	CR18	H-3	Q8	E-2	CR20	H-3	R26	E-3	R47	H-3	R49	C-2	R90	B-3	R111	H-3
CR	G-1	CR19	C-3	Q9	G-3	CR21	H-3	R27	E-3	R48	F-2	R50	C-2	R91	B-3	R112	H-3
CR	G-1	CR20	H-4	Q10	G-3	CR22	H-3	R28	E-3	R49	G-3	R51	C-2	R92	B-3	R113	H-3

Figure 8-16. Part of Focus and Astigmatism Amplifier (A6) Component Locator

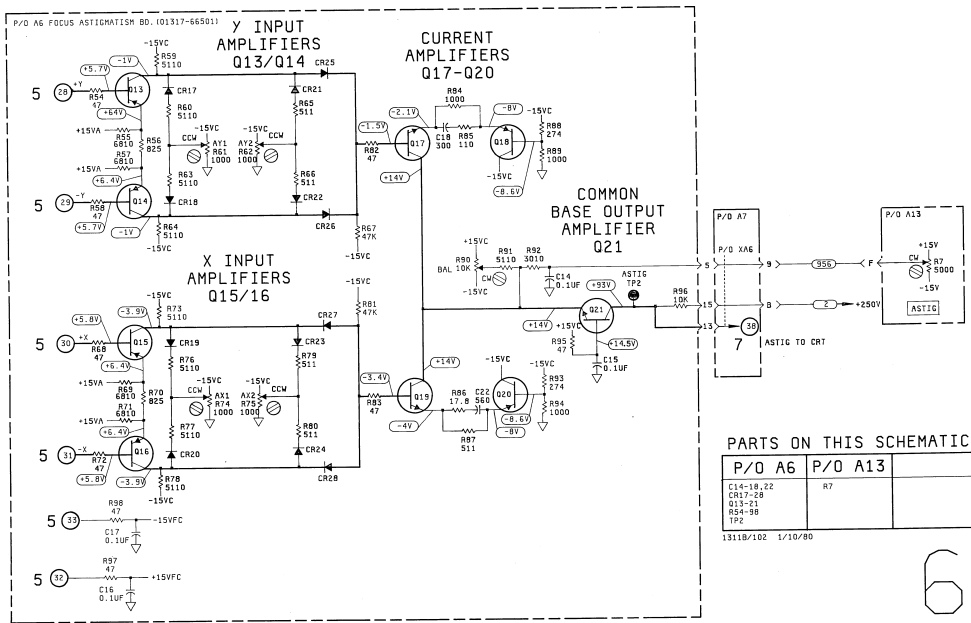


Figure 8-17.  
Service Sheet 6, Dynamic Astigmatism (A6) Schematic  
8-13

6

**8-47. SERVICE SHEET 7 PRINCIPLES OF OPERATION.**

**8-48. OSCILLATOR POWER SUPPLY (A9Q4, A9VR1, ASCR16).**

The oscillator power supply provides a regulated +21 V for the high voltage oscillator Q5. The full wave bridge rectifier CR16 rectifies the ac voltage from power transformer T1. VR1 establishes the ac voltage from power transformer T1. VR1 establishes the reference voltage for the output supply and Q4 is the regulator. A decrease in output voltage will turn regulator Q4 on harder. This action causes more current flow through Q4, therefore restoring the output to its proper voltage. The reverse is true should the output voltage increase.

**8-49. HIGH VOLTAGE OSCILLATOR (A9Q5, Primary of A9T1).**

The high voltage oscillator operates as a class C oscillator (conduction less than 50% of the oscillator period). The voltage across the collector winding (pins 3 and 4 of T1) is coupled through the transformer T1 to the feedback winding (pins 1 and 2 of T1) to provide base drive for the oscillator. CR3, CR4, CR5, and R12 provide reverse bias protection for Q5. The series resonant circuit C9, L2 provide a low impedance termination for the feedback winding at the oscillator frequency (approximately 20 kHz).

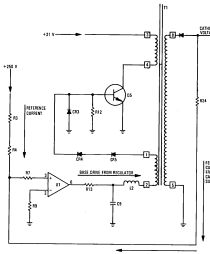


Figure 8-18. Simplified Schematic of High Voltage Regulator Circuit

**8-50. CATHODE SUPPLY (ASCRT, Secondary of A9T1).**

The cathode voltage is derived from the high ac voltage present at pin 8 of T1 with respect to pin 5 of T1. CR7 is the rectifier and CR5, CR4 and R9 provide the filtering for the cathode supply.

**8-51. HIGH VOLTAGE REGULATOR (A9U1).**

For the following discussion refer to figure 8-18.

The cathode voltage induces current flow through R24. A reference current established by R3 and R4 is compared to the current through R24 (feedback current). A decrease in cathode voltage causes less current flow through R24. The excess reference current at pin 3 U1 produces a higher output voltage at pin 6 U1. The higher output voltage at U1 turns the high voltage oscillator on harder increasing the cathode voltage until a current balance is achieved at the input of U1. The cathode supply voltage (VK) can be calculated by the following equation:

$$VK = \frac{-250}{R3+R4} (R24) = -4521 V \pm 2\%$$

where  $R3+R4 = 1.659 M\Omega \pm 1\%$   
 $R4 = 30 M\Omega \pm 1\%$

**8-52. HIGH VOLTAGE SHUTDOWN (ASU2, ASQ3, ASU1).**

**8-53. PURPOSE.**

The purpose of the high voltage shutdown circuit is to prevent excessive cathode voltage from being applied to the CRT. If the cathode voltage exceeds -4750 V, it may be possible for the CRT in this instrument to emit x-rays exceeding the internationally recognized maximum allowable level (0.5 mR/hr at 5 cm from the surface of the instrument).

**8-54. CAUSES OF X-RAY EMISSIONS.**

X-ray radiation results from high velocity electrons striking a target, in this case the inside surface of the CRT. The magnitude of radiation depends on the electron density (beam current) and the total accelerating voltage (cathode + post accelerator voltage).

**8-55. PREVENTING X-RAY EMISSIONS.**

1. Control of electron density (beam current) is accomplished by proper alignment of the intensity limit circuit, which limits front panel INTENSITY adjustment. (See Section V, paragraph 5-14 for intensity limit adjustment.)

2. Since the post accelerator voltage is determined by the cathode voltage, total accelerating potential can be controlled by limiting the cathode voltage to the acceptable limits. The high voltage shutdown circuit limits cathode voltage to -4750 V. (See Section V, paragraph 5-12 for high voltage shutdown calibration.)

3. The high voltage shutdown circuit uses the +250 V supply as the reference. Proper alignment of the +250 V supply ensures correct cathode voltage limiting. (See Section V, paragraph 5-11 for +250 V adjustment.)

When all affected circuits have been properly calibrated, x-ray emissions from this instrument will not exceed 0.2 mR/hr.

**8-56. PRINCIPLES OF OPERATION.**

Refer to figure 8-19 for the following discussion.

The difference between cathode voltage and the +5.11 V reference (VR3) induces current flow through R27 and

network R18 through R22. Cathode voltages between -400 V and -4600 V (normal operating potential) produce a positive voltage at pin 2 U2.

The output of U2 (pin 6) is negative and Q3 is reversed biased. Cathode voltages between -4650 V and -4750 V produce a negative voltage at U2 pin 2. The output of U2 pin 6 changes to a positive voltage, forward biasing Q3. When Q3 is forward biased, U1 pin 7 is grounded, which reverse biases the high voltage Q5, preventing oscillations. The cathode voltage drops to 0 V and remains at 0 V until the instrument is turned off and the problem is corrected.

**8-57. TROUBLESHOOTING.**

If trouble is suspected, visually inspect the instrument. Look for loose or burned components that might suggest a source of trouble. Verify that all circuit board connections are making good contact. If no obvious trouble is found, check table 8-3 for symptoms and probable causes.

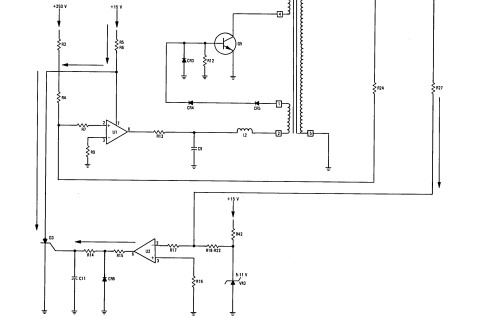


Figure 8-19. Simplified Schematic of High Voltage Shutdown Circuit

Table 8-3. Troubleshooting Hints for High Voltage Shutdown Circuit

Symptom	Probable Cause
NO CATHODE VOLTAGE (A9T1 is Positive)	<ol style="list-style-type: none"> <li>Excess cathode voltage generated, high voltage oscillator Q5 is reversed bias.                             <ol style="list-style-type: none"> <li>+250 V power supply is too high or out of regulation.</li> <li>A9R3/R4 changed value</li> <li>ASU1 shorted, or improperly installed</li> <li>A9C4/CB5 are shorted</li> </ol> </li> <li>High voltage shutdown occurred at less than -4650 V                             <ol style="list-style-type: none"> <li>reference voltage (A9VR3) too low</li> <li>changed value of A9VR18 through A9R22</li> <li>changed value of A9R27</li> <li>U2 aborted to +15 V supply</li> <li>ASCRT2 shorted</li> <li>open circuit between U2 pin 2 and junction of A9R42 and A9VR3.</li> </ol> </li> </ol>
High voltage shutdown does not occur between -4650 V and -4750 V (A9T1) is negative	<ol style="list-style-type: none"> <li>A9R27 is open or changed value to more than 30 M<math>\Omega</math></li> <li>A9VR3 is open or high</li> <li>One of the resistors from A9R18 through A9R22 changed value (lower than specified)</li> <li>A9C12 shorted to ground</li> <li>A9U2 shorted to ground or to -15 V supply</li> <li>A9CR8 shorted to ground</li> <li>A9C11 shorted to ground</li> </ol>

**8-58. CRT CIRCUITS.**

**8-59. GRID LEVEL TRANSLATOR (ASCBS, ASCR10, ASCR11, ASCR12).**

The grid supply provides CRT grid bias with provision to compensate for CRT cutoff between different CRT's. The large sine wave at A9T1 pin 6 is coupled through A9R25 and A9C16 (isolation network) to junction of ASCR11 and ASCR12. ASCR11 clips the negative going portion of the waveform at a voltage equal to the output of the Z-axis amplifier. ASCR12 clips the positive going portion of the waveform at a voltage determined by the setting of the intensity limit adjust (A9R38). The peak to peak amplitude at the junction of ASCR11 and ASCR12 is therefore equal to the difference between the intensity limit voltage and the output of the Z-axis amplifier. This signal is coupled through ASCR19 to the junction of ASCBS and ASCR10 which is clamped to the cathode voltage of ASCR8. ASCR10 charges ASCR20 to the cathode voltage minus the peak to peak amplitude of the signal at the junction of ASCR11 and ASCR12. This voltage is then applied to the CRT grid. Fast transitions from the Z-axis output are directly coupled to the CRT grid via ASCR28, while slower transitions are coupled through the grid level translator.

**8-60. FOCUS LEVEL TRANSLATOR (ASCBS, ASCR13, ASCR14, ASCR15).**

The focus level translator provides the operating potential for the CRT focus grid. The large sine wave at A9T1

pin 6 is coupled through ASCR17 and ASCR26 (isolation network) to junction of ASCR8 and ASCR15. ASCR15 clips the negative going portion of the waveform at a voltage equal to the output of the focus amplifier. ASCR8 clips the positive going portion of the waveform at a voltage determined by A9VR4 and A9VR5 (136 V). The peak to peak amplitude at the junction of ASCR8 and ASCR15 is therefore equal to the difference between the voltage established by A9VR4, A9VR5 and the output voltage of the focus amplifier. This signal is coupled through A9C23 to the junction of ASCR13 and ASCR14. ASCR13 then clamp the output voltage to a level established by the focus limit adjust (A9R60) and the front panel FOCUS control. ASCR14 charges ASCR24 to the reference voltage established by the focus limit adjustment and the focus control minus the peak to peak amplitude at the junction of ASCR8 and ASCR15. This voltage is then applied to the CRT focus grid.

**8-61. FILAMENT AND PA SUPPLY (P10 T1, A10).**

The filament supply is provided by a separate secondary winding of T1. The supply voltage should range from 5.6 V to 5.8 V. The voltage should only be measured with an isolated R.M.S. meter rated at 5 kV or better.

The multiplier assembly (A10) supplies the post accelerator voltage for the CRT. Part of the secondary of T1 is applied to high voltage multiplier assembly A10 where the voltage is multiplied approximately eight times, rectified, filtered, and then applied to the post accelerator of the CRT.

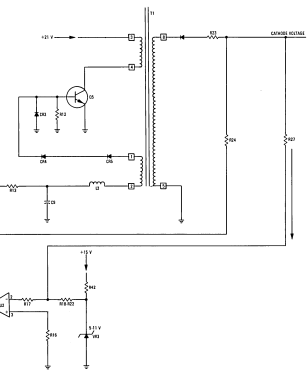
age is determined by the negative potential can be applied to the accept-down circuit (limitation V, paragraph 8-57).

network R18 through R22. Cathode voltages between -4400 V and -4000 V (normal operating potential) produce a positive voltage at pin 2 U2.

The output of U2 (pin 6) is negative and Q3 is reversed biased. Cathode voltages between -4650 V and -4750 V produce a negative voltage at U2 pin 2. The output of U2 pin 6 changes to a positive voltage, forward biasing Q3. When Q3 is forward biased, U1 pin 7 is grounded, which reverse biases the high voltage Q5, preventing oscillations. The cathode voltage drops to 0 V and remains at 0 V until the instrument is turned off and the problem is corrected.

**8-57. TROUBLESHOOTING.**

If trouble is suspected, visually inspect the instrument. Look for loose or burned components that might suggest a source of trouble. Verify that all circuit board connections are making good contact. If no obvious trouble is found, check table 8-3 for symptoms and probable causes.



Simplified Schematic of High Voltage Shutdown Circuit

*Table 8-3. Troubleshooting Hints for High Voltage Shutdown Circuit*

Symptom	Probable Cause
NO CATHODE VOLTAGE (ASTP) is Positive	<ol style="list-style-type: none"> <li>Excess cathode voltage generated, high voltage oscillator Q5 is reversed bias.               <ol style="list-style-type: none"> <li>+250 V power supply is too high or out of regulation</li> <li>A9R3/R4 changed value</li> <li>A9U1 shorted, or improperly installed</li> <li>A9CRA/CRS are shorted</li> </ol> </li> <li>High voltage shutdown occurred at less than -4650 V               <ol style="list-style-type: none"> <li>reference voltage (AVR38) too low</li> <li>changed value of A9R18 through A922</li> <li>changed value of A9R27</li> <li>U2 shorted to +15 V supply</li> <li>A9CR12 shorted</li> <li>open circuit between U2 pin 2 and junction of A9R42 and A9VR3.</li> </ol> </li> </ol>
High voltage shutdown does not occur between -4650 V and -4750 V (ASTP) is negative	<ol style="list-style-type: none"> <li>A9R27 is open or changed value to more than 30 M<math>\Omega</math></li> <li>AVR38 is open or high</li> <li>One of the resistors from A9R18 through A9E22 changed value (lower than specified)</li> <li>A9C12 shorted to ground</li> <li>A9U2 shorted to ground or to -15 V supply</li> <li>A9CR8 shorted to ground</li> <li>A9C11 shorted to ground</li> </ol>

**8-58. CRT CIRCUITS.**

**8-59. GRID LEVEL TRANSLATOR (A9CR8, A9CR10, A9CR11, A9CR12).**

The grid supply provides CRT grid bias with provision to compensate for CRT cutoff between different CRTs. The large sine wave at A9T1 pin 6 is coupled through A9R25 and A9C16 (isolation network) to junction of A9CR11 and A9CR12. A9CR11 clips the negative going portion of the waveform at a voltage equal to the output of the Z-axis amplifier. A9CR12 clips the positive going portion of the waveform at a voltage determined by the setting of the intensity limit adjust (A9R38). The peak to peak amplitude at the junction of A9CR11 and A9CR12 is therefore equal to the difference between the intensity limit voltage and the output of the Z-axis amplifier. This signal is coupled through A9C19 to the junction of A9CR9 and A9CR10 which is clamped to the cathode voltage of A9CR9. A9CR10 charges A9C20 to the cathode voltage minus the peak to peak amplitude of the signal at the junction of A9CR11 and A9CR12. This voltage is then applied to the CRT grid. Fast transitions from the Z-axis output are directly coupled to the CRT grid via A9C28, while slower transitions are coupled through the grid level translator.

**8-60. FOCUS LEVEL TRANSLATOR (A9CR8, A9CR13, A9CR14, A9CR15).**

The focus level translator provides the operating potential for the CRT focus grid. The large sine wave at A9T1

pin 6 is coupled through A9C17 and A9R26 (isolation network) to junction of A9CR8 and A9CR15. A9CR15 clips the negative going portion of the waveform at a voltage equal to the output of the focus amplifier. A9CR8 clips the positive going portion of the waveform at a voltage determined by A9VR4 and A9VR5 (138 V). The peak to peak amplitude at the junction of A9CR8 and A9CR15 is therefore equal to the difference between the voltage established by A9VR4, A9VR5 and the output voltage of the focus amplifier. This signal is coupled through A9C23 to the junction of A9CR13 and A9CR14. A9CR13 then clamps the output voltage to a level established by the focus limit adjust (A9R60) and the front panel FOCUS control. A9CR14 charges A9C24 to the reference voltage established by the focus limit adjustment and the focus control minus the peak to peak amplitude at the junction of A9CR8 and A9CR15. This voltage is then applied to the CRT focus grid.

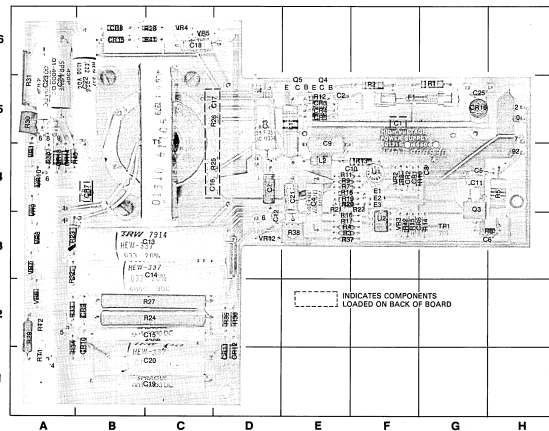
**8-61. FILAMENT AND PA SUPPLY (P/O T1, A10).**

The filament supply is provided by a separate secondary winding of T1. The supply voltage should range from 5.6 V to 5.8 V. The voltage should only be measured with an isolated R.M.S. meter rated at 5 kV or better.

The multiplier assembly (A10) supplies the post accelerator voltage for the CRT. Part of the secondary of T1 is applied to high voltage multiplier assembly A10 where the voltage is multiplied approximately eight times, rectified, filtered, and then applied to the post accelerator of the CRT.

Service

Model 1811B



REF. LOC.	REF. DESIG.	GRID LOC.	REF. DESIG.	GRID LOC.	REF. DESIG.	GRID LOC.	REF. DESIG.	GRID LOC.	REF. DESIG.	GRID LOC.	REF. DESIG.	GRID LOC.	REF. DESIG.	GRID LOC.			
C1	F-5	C14	C-3	C17	F-4	C18	A-4	O5	F-4	R12	F-6	R24	C-2	R36	D-2	VR2	F-5
C2	E-5	C15	C-2	C18	F-4	C19	A-4	R1	G-5	R13	F-4	R25	D-4	R37	E-3	VR4	C-5
C3	E-5	C16	D-4	C19	E-5	C20	B-6	E2	F-5	R14	G-3	R26	D-1	R38	E-3	VR5	C-5
C4	E-4	C17	D-6	C20	E-5	C21	G-6	R3	E-3	R15	F-3	R27	C-2	R39	A-4	VR6	A-2
C5	E-4	C18	C-6	C21	O-5	E1	F-4	RA	E-3	R16	E-3	R28	C-6	R40	A-4	VR7	A-3
C6	H-3	C19	C-1	C22	G-3	E2	F-4	RB	H-4	R17	E-3	R29	A-2	R41	C-6	VR8	A-2
C7	D-4	C20	C-1	C23	B-4	E1	F-4	RC	H-3	R18	E-4	R30	A-3	R42	F-3	VR9	A-4
C8	E-5	C21	B-5	C24	B-6	F1	F-2	RD	E-4	R19	E-4	R31	A-5	T1	C-5	VR10	A-4
C9	E-5	C22	B-5	C25	C-1	E1	E-4	RE	F-4	R20	E-4	R32	A-3	TP1	G-3	VR11	A-4
C10	F-4	C23	A-5	C26	A-5	O1	E-4	RF	E-4	R21	E-4	R33	A-1	U1	F-4	VR12	D-3
C11	G-4	C24	A-5	C27	D-1	O3	G-4	R10	G-4	R22	F-4	R34	A-1	U2	F-3	VR13	A-1
C12	D-3	C25	G-6	C28	D-1	O4	E-6	R11	A-1	R23	A-3	R35	D-2	VR2	F-4	VR2	A-2

Figure 8-20. High Voltage Power Supply (A9) Component Locator

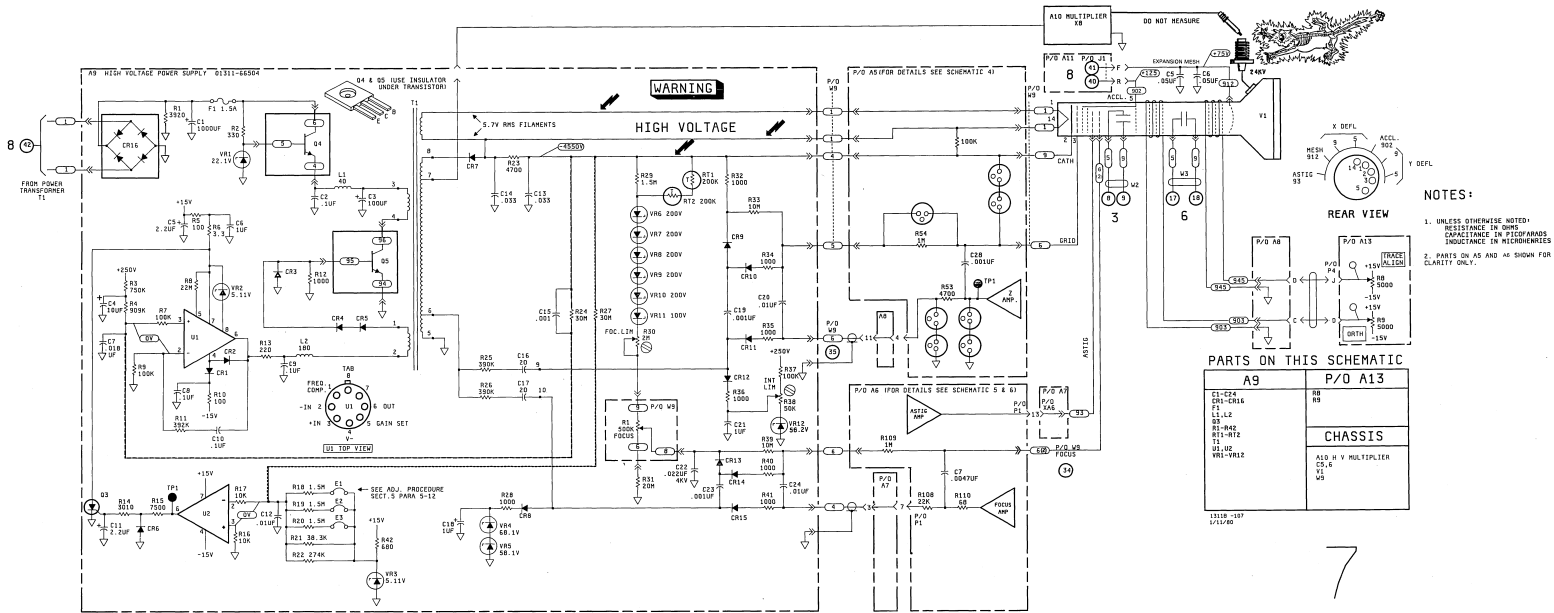


Figure 8-21.  
Service Sheet 7, High Voltage Power Supply (A9) Schematic  
8-15

**8-62. SERVICE SHEET 8 PRINCIPLES OF OPERATION.**

**8-63. +250 V SUPPLY (A11CR1 through A11CR4, A11Q1 through A11R3, Q2).**

A11CR1 through A11CR4 rectify the ac voltage from secondary of T1 to provide the unregulated dc voltage for the +250 V supply. Driver A11Q1 provides base current for series regulator Q1. Differential sensor amplifier, A11Q2 and A11Q3, compares the +250 V supply output voltage with a reference voltage determined by A11V1. A11Q3 also provides thermo compensation and allows output voltage adjustment in conjunction with divider network A11R1, A11R12, and A11R13.

An increase in output voltage will cause A11Q2 to conduct harder and therefore decrease base drive to regulator driver A11Q1. Less current flow through the driver will cause series regulator to conduct less and therefore decrease the output voltage. The series combination of A11V2 and A11V4 sets the operating potential for the CRT accelerator while A11V4 determines the supply voltage for the CRT expansion mesh.

**8-64. -15 V SUPPLY (A11CR9 through A11CR12, A6Q6, A6Q7, Q3).**

A11CR9 through A11CR12 rectify the ac voltage from secondary of T1 to provide the unregulated dc voltage for the -15 V supply. A11Q6 provides base current for series regulator Q3. Base current for driver A11Q4 is provided by sensor amplifier A11Q7. A11V5 provides the reference voltage for the -15 V supply. Output volt-

age changes are coupled directly to base of A11Q7 through A11V5. A 1 V change in output voltage causes a 1 V change in emitter voltage. Output voltage changes are coupled proportionally to cathode of A11CR19 by divider network A11R28, A11R29 and A11R30. A 1 V change in output voltage causes an approximate change of 5 V at the cathode of A11CR19.

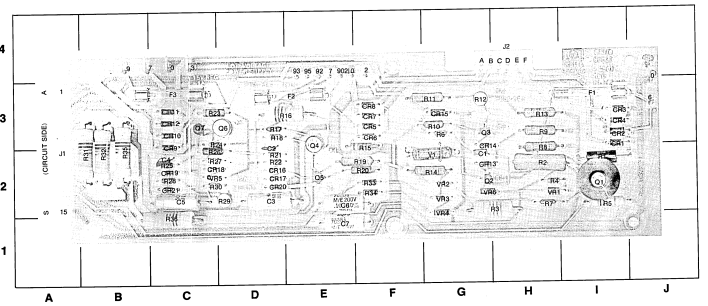
A decrease in supply output voltage will increase current through A11CR19 and decrease base current supplied to the sensor amplifier.

As a result, collector voltage of A11Q7 will increase, turning driver A11Q6 and series regulator Q3 on harder. The output voltage will increase restoring the supply to its proper output voltage.

**8-65. +15 V SUPPLY (A11CR5 through A11CR8, A6Q4, A6Q5, Q2).**

Circuit operation of the +15 V supply is identical to the -15 V. A11CR5 through A11CR8 make up the rectifier bridge. Driver A11Q4 supplies base current to series regulator Q2. Base current for the driver is supplied by sensor amplifier A11Q5. Reference voltage for this power supply is established by the -15 V.

A decrease in supply output voltage causes an increase in current flow through A11CR16, thereby decreasing current through sensor amplifier A11Q5. The resultant increase in collector voltage of the sensor amplifier will induce more current flow through driver A11Q4 and series regulator Q2. The output voltage will increase, restoring the power supply to its proper output voltage.



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC		
C1	G-3	CR4	F-3	CR14	D-2	F2	C-3	Q5	D-3	R8	H-2	R17	D-3	R26	C-2	R35	B-2
C2	D-2	CR5	F-3	CR15	D-3	F3	C-3	Q7	C-3	R9	H-3	R18	D-3	R27	C-2	R36	C-1
C3	D-2	CR6	F-2	CR16	D-2	J1	A-2	R1	L-2	R10	G-3	R19	F-2	R28	D-2	R37	G-2
C4	C-2	CR7	F-3	CR17	D-2	J2	H-4	R2	H-2	R11	G-3	R20	F-2	R29	D-2	R38	H-2
C5	C-2	CR8	F-3	CR18	C-2	G1	L-2	R3	H-2	R12	G-3	R21	F-2	R30	C-2	R39	D-2
C6	E-2	CR9	C-3	CR19	D-2	G2	C-3	R4	H-2	R13	H-3	R22	C-3	R31	B-2	R40	B-2
C7	F-1	CR10	C-3	CR20	D-2	G3	C-3	R5	H-2	R14	G-2	R23	C-3	R32	B-2	R41	B-2
CR1	L-3	CR11	C-3	CR21	C-2	L4	C-3	R6	L-3	R15	F-2	R24	C-3	R33	F-2	R42	C-2
CR2	L-3	CR12	C-3	F1	L-3	G8	E-2	R7	H-2	R16	D-3	R25	C-2	R34	F-2	R43	G-2
CR3	L-3	CR13	D-2														

Figure 8-22. Low Voltage Power Supply (A11) Component Locator

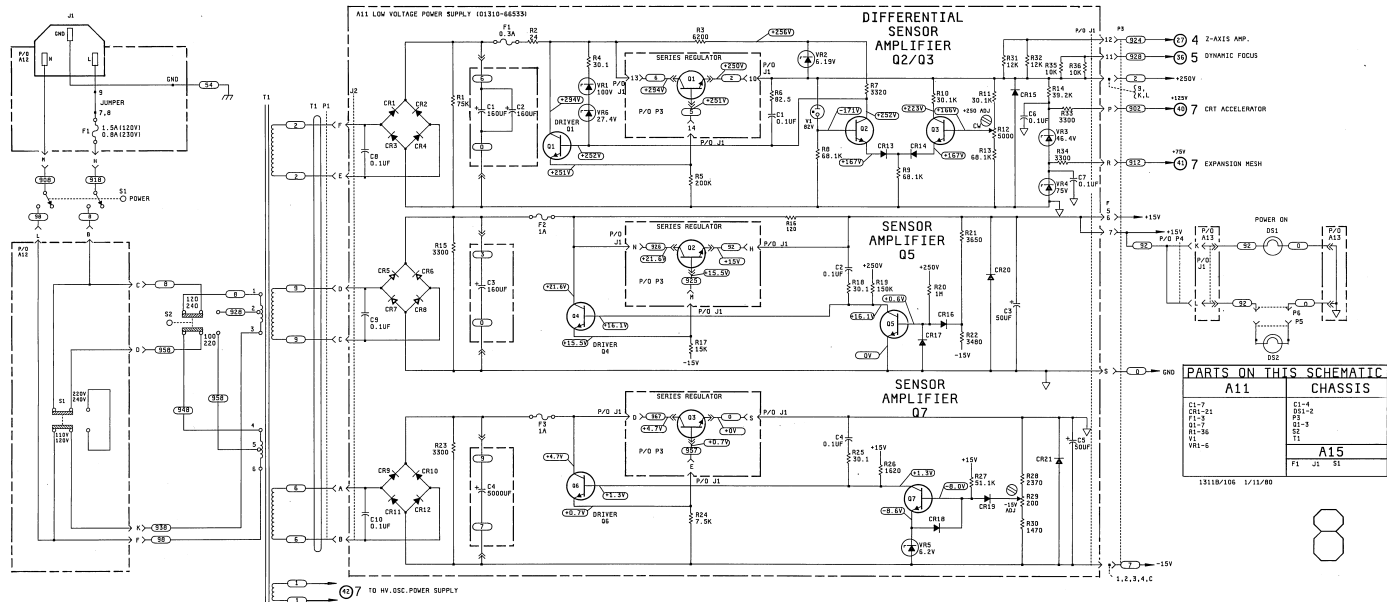
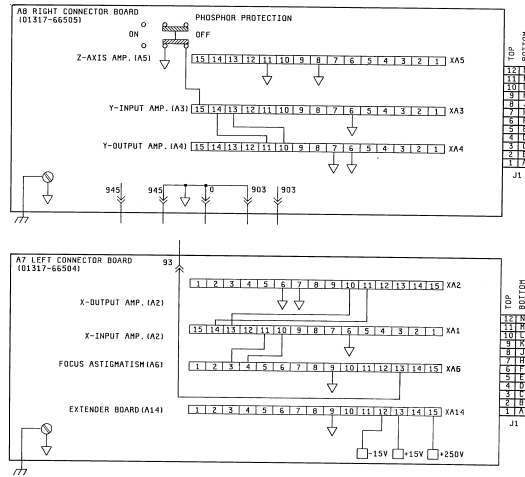


Figure 8-23.  
Service Sheet 8, Low Voltage Power Supply (A11) Schematic  
8-17





LEFT CONNECTOR BOARD WIRING CONNECTION LIST

CONN. WIRE NO.	SIGNAL	CONN. WIRE NO.
1	13	2
2	14	3
3	Y	4
4	15	5
5	13	6
6	10	7
7	12	8
8	11	9
9	8	10
10	5	11
11	11	12
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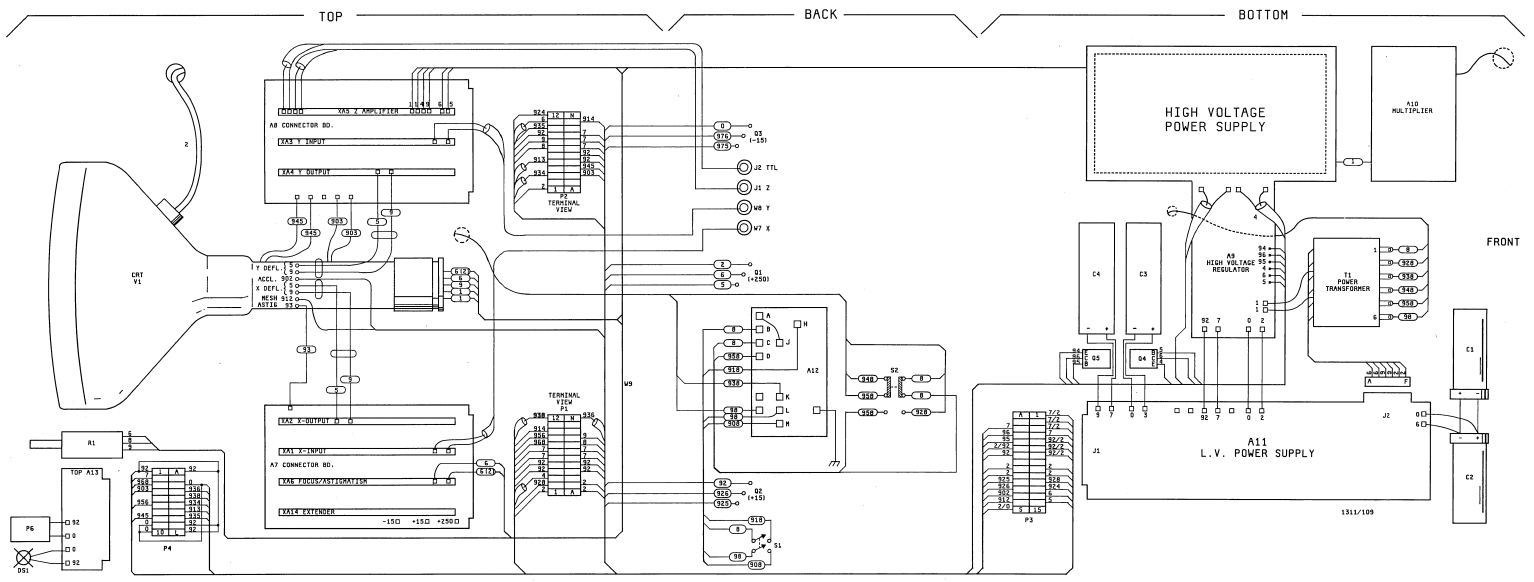


Figure 8-25. Main Wiring Diagram 8-19

## PRODUCTION TEST PROCEDURE

### OPTION 057 Z-AXIS AMPLIFIER ON 1310A/11A/17A/21A DISPLAYS

#### 1. GENERAL

The test limits and procedures stated herein shall be adhered to for the production testing of all 1310A/1311A/1317A/1321A displays equipped with option 057.

Colorado Springs R&D Department and Quality Assurance authorization is required for any change in methods, tools, procedures, or acceptance limits. Change authorization shall be obtained by use of the formal production change procedure.

#### 2. CALIBRATION

##### 2.1 Z-AXIS BALANCE ADJUSTMENT

- a. Remove power and turn off phosphor protect switch (A8S1).
- b. Disable H.V. oscillator by removing A13F1.
- c. Preset all adjustments on the A5 board to midrange.
- d. Apply power to the display.
- e. Adjust Z-axis offset (A5R19) for approximately 20V at the Z-axis output (A5TP1).
- f. Monitor the Z-axis output with the digital voltmeter and rotate the front panel intensity control to minimum (fully CCW).
- g. Adjust the Z-axis balance (A5R13) such that a 3V increase is noted at the Z-axis output as the front panel INTENSITY control is rotated from MIN. to MAX. (20V-23V).

NOTE: The amplifier offset will change when the balance is adjusted. After each balance adjustment, recheck the Z-axis output voltage change by varying front panel INTENSITY from minimum to maximum settings.

##### 2.2 GAIN, OFFSET, AND INTENSITY LIMIT ADJUSTMENTS

- a. Readjust Z-axis offset (A5R19) for 20V at the Z-axis output (A5TP1).
- b. Set intensity limit (A13R16) for maximum voltage at A13C7.
- c. Turn off power and enable H.V. oscillator by replacing A13F1.

Continued . . . .

- d. Apply power and adjust intensity limit (A13R16) for a dimly visible dot on the screen.
- e. Record the voltage at A13C7 and the Z-axis output (A5TP1). The difference between the voltages is the CRT cutoff voltage.
- f. Position the beam off screen and apply a +1V, 1 $\mu$ S wide 1% duty cycle pulse to the Z-axis input. (For example: rep rate approximately 10KHz.)
- g. Set front panel INTENSITY control (A9R1) fully CW and monitor the Z-axis output (A5TP1) with the monitor oscilloscope.
- h. Adjust the Z-axis gain (A5R14) and Z-axis offset (A5R19) for a peak-to-peak amplitude signal equal to 75% of the CRT cutoff voltage or 47V, whichever is less. When CRT cut-off is  $\leq 62.6V$ , calculate gain. Reference step e.
- i. Adjust the Z-axis offset (A5R19) such that the positive portion of the pulse is just equal to the maximum Z-axis output, maintaining the same peak-to-peak amplitude obtained in step h. (See figure 1)

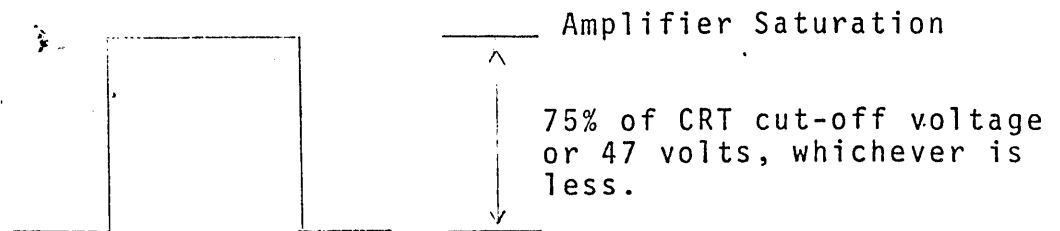


Figure 1. Z-axis gain and Offset Adjustment

### 2.3 INTENSITY LIMIT

- a. Apply a 1VPP, 1 $\mu$ s wide, 1% duty cycle pulse having a -1V baseline to the Z-axis input.
- b. Position the beam on screen and the front panel INTENSITY control to minimum (fully CCW).
- c. Adjust Intensity limit (A13R16) for a viewable, low intensity dot. Rotation of the front panel intensity control towards maximum or removal of the input signal should produce a brighter dot. If not, recheck balance, gain, and offset adjustments.

Set with 1350A display - diagonal's blanked.

#### 2.4 PULSE RESPONSE

- a. Position the beam off screen and apply a +1V, 1 $\mu$ s wide, 1% duty cycle pulse to the Z-axis input.
- b. Connect the monitor oscilloscope to the Z-axis output (A5TP1) using the 10002A 50:1 probe.
- c. Adjust HF1 (A5C27) and HF2 (A5R36) to obtain  $\leq 25$  ns rise time with minimum perturbations ( $\pm 5\%$  typical).

#### 2.5 FINAL

- a. X, Y, and Z inputs are set to 50 ohms.
- b. Position beam just off screen near the lower left corner.
- c. Phosphor protect to off.