



OPERATING AND SERVICE MANUAL

MODEL 1321A HIGH SPEED GRAPHIC DISPLAY

SERIALS PREFIXED: 1409A

Refer to Section VII for instruments with other Serial Prefixes, or for instruments with the following standard options: **005, 006, 007, 604, 050, 051, 052, 053, 054, 055, 056, and 639.**

IMPORTANT NOTICE

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

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

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

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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 to 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.*

CERTIFICATION

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

WARRANTY AND ASSISTANCE

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

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

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

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Figure 1-1. Model 1321A High Speed Graphic Display

SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. This manual provides operating and servicing information for the Hewlett-Packard Model 1321A High Speed Graphic Display (figure 1-1). The manual is divided into eight sections, each covering a specific aspect of the instrument. All schematics are located at the rear of Section VIII.

1-3. This section contains general information pertaining to the instrument. Table 1-2 lists the abbreviations used throughout this manual, except in Section VI. The parts list in Section VI is a computer printout and uses computer supplied abbreviations.

1-4. Available options are listed and described in Section VII.

1-5. DESCRIPTION.

1-6. This large-screen, general-purpose graphic display unit has been designed for OEM systems applications. Specifications are listed in table 1-1. Suggested applications are listed in Section III.

1-7. SPECIAL FEATURES.

1-8. *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, Y, and Z amplifiers can be changed. Refer to the paragraphs on input modifications in Section III.

1-9. *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.

1-10. *Phosphor Protection.* A protection circuit senses slow or static deflection signals and limits beam intensity to prevent burning of the CRT phosphor and mesh.

1-11. CATHODE-RAY TUBE.

1-12. The CRT has an aluminized P31 phosphor and a usable viewing area of approximately 14 inch (35.6 cm) x 12 inch (30.5 cm). A 28-kilovolt accelerating potential produces a bright display without harmful X-rays.

1-13. Other phosphors, as well as a number of low-reflection contrast filters are available as standard options. Refer to Section VII.

1-14. A rim and tension band are fitted around the faceplate seal line to provide protection against implosion injury.

1-15. Complete CRT specifications are located in table 1-1.

1-16. WARRANTY.

1-17. The instrument (except the CRT) is certified and warranted as stated at the front of this manual. The CRT warranty (and claim form) is located at the rear of this manual.

1-18. ACCESSORIES.

1-19. Hewlett-Packard has available a wide range of test equipment and accessories for use with HP instruments and instruments of other manufacturers. Refer to the latest HP catalog or request information from the nearest HP Sales/Service Office.

1-20. INSTRUMENT AND MANUAL IDENTIFICATION.

1-21. This manual applies directly to instruments with a serial prefix as listed on the title page. The serial prefix is the first group of digits in the serial number (figure 1-2). The serial number is on a tag affixed to the rear panel.

NOTE

The warranty may be void if the serial tag has been removed or mutilated.

1-22. Technical corrections (if any) are contained under errata on an enclosed manual changes sheet (if any).

1-23. INQUIRIES.

1-24. Refer any questions regarding the manual, the change pages, or the instrument to the nearest HP Sales/Service Office. Always identify the instrument by model number, name, and serial number in all correspondence. Refer to the rear of this manual for a world-wide listing of HP Sales/Service Offices.

VERTICAL AND HORIZONTAL AMPLIFIERS (See Section VII for Options)

RISE TIME: <70 ns (10% to 90% points) for full screen deflection.

BANDWIDTH: dc to 5 MHz (3 db down) for 5 inch (12.7 cm) deflection.

PHASE SHIFT: <0.1° to 50 kHz and <1° to 250 kHz for full screen signal inputs.

DEFLECTION FACTOR: 100 mV/inch (1 Volt peak to peak for 12 inch deflection).

GAIN ADJUST: allows continuous adjustment of deflection factor from approximately 50 mV/inch to 150 mV/inch. (Front panel Gain control has 1.75:1 range.)

POLARITY: positive vertical input moves beam up; positive horizontal input moves beam to the right.

LINEAR WRITING TIME: <100 ns/inch (39.4 ns/cm).

LINEAR WRITING SPEED: >10 inches/μs (25.4 cm/μs).

DIAGONAL SETTling TIME: signal settles to within 1 spot diameter of final value in <1 μs for any on or off screen movement. Off-screen deflection not to exceed one screen diameter.

REPEATABILITY: <0.15% error (of full screen) for re-addressing a point from any direction on or off screen. Off screen deflection not to exceed one screen diameter.

SEQUENTIAL POINT PLOTTING TIME: signal settles to within 0.010 inch (0.254 mm) of final value in <200 ns for any 0.10 inch (2.54 mm) step.

CROSSTALK: <0.015 inch (0.381 mm) with one input terminated in 50Ω and the other excited by a 1V 500 kHz signal.

SPOT JITTER AND MOTION: <0.005 inch (0.19 mm).

INPUTS: through BNC connectors where shield is floating.

INPUT RC: driven side 10kΩ shunted by approximately 40 pF. Shield input is 47Ω to ground (for differential operation this is replaced by 10kΩ). A switchable 50Ω termination between shield and center conductor is also provided.

MAXIMUM INPUT: ±50V (dc + peak ac) with 10kΩ internal termination, ±5V (dc + peak ac) with 50Ω internal termination.

POSITION: front panel controls allow zero input to be set off-screen in any direction from anywhere within the viewing area.

DYNAMIC RANGE: at least ±1-1/2 screen diameters from center screen.

DRIFT: 0.05 inch/hour (1.27 mm/hour) and 0.10 inch (2.54 mm) in 24 hours with covers installed.

Z-AXIS AMPLIFIER (See Section VII for Options)

RISETIME: <20 ns (c.w. bandwidth = 15 MHz).

INPUT: floating BNC connector with shield grounded.

INPUT RC: approximately 10kΩ shunted by approximately 60 pF. 50Ω termination may be selected with internal switch.

MAXIMUM INPUT: ±50V (dc + peak ac) with 10kΩ internal termination, ±5V (dc + peak ac) with 50Ω internal termination.

BLANKING RANGE: 0 to 1V (see balance).

BLANKING POLARITY: positive unblanks.

BALANCE: internal adjustment provides ±1V offset (continuous) to blanking range.

GAIN ADJUST: extends blanking range by over 2.5:1 (continuous).

CATHODE RAY TUBE (See Section VII for Options)

TYPE: Post deflection accelerator, 28.5 kV accelerating potential, P31 phosphor, aluminized, is standard (refer to Section VII for additional phosphor selection), electrostatic focus and deflection.

VIEWING AREA: 21 inch (53.34 cm) diagonal CRT, useable viewing area at least 14 inch (35.6 cm) x 12 inch (30.5 cm).

SPOT SIZE:

INSIDE QUALITY AREA	OUTSIDE QUALITY AREA	QUALITY AREA
0.020 in. (0.51 mm)	Under 0.040 in. (1.02 mm)	12 in. x 12 in. (30.5 cm) x (30.5 cm)

RESOLUTION: Approximately 50 line/inch (19.7 lines/cm) measured with a shrinking raster.

LINE BRIGHTNESS: 50 foot lamberts at a writing speed of 0.1 inch/μs, (0.25 cm/μs), 60 Hz refresh rate, P31 phosphor, 0.020 inch (0.51 mm) spot size.

CONTRAST RATIO: 4:1 or greater measured by photometrically summing the trace and background brightness.

GEOMETRY: <2% pincushion and barrel distortion over useable display area.

LINEARITY: <1% of full scale along major axes.

PHOSPHOR PROTECTION: automatically detects absence of deflection and limits beam current to a safe but viewable level.

DYNAMIC FOCUS: built-in circuitry automatically corrects spot geometry for position location and beam intensity (video drive level).

TRACE ALIGN: Rotates X-axis into geometric alignment with the CRT viewing area.

Table 1-1. Specifications (Cont'd)

SAFETY PROTECTION

IMPLOSION: exceeds safety requirements of IEC 348 (IEC 65) and ANSI C39.5 for Electronic Measuring Apparatus.

HIGH VOLTAGE: anode lead is permanently bonded to CRT, minimizing shock hazard. All high potentials are completely enclosed or covered in compliance with UL recommendations.

X-RAY EMISSION: <0.1 mr/hr. Measured with Victoreen Model 440 RF/C in background noise.

GENERAL

X, Y, AND Z INPUT CONNECTORS: BNC type mounted to rear panel.

DIMENSIONS: See outline drawing.

FRONT PANEL CONTROLS: Brightness, Position X, Gain X, Position Y, Gain Y, Trace Align, Orthogonality, Focus, and Astigmatism

located below CRT, behind control door. trol door.

LINE INDICATOR: lamps mounted behind front panel door and on rear panel..

POWER: selectable to 100 Vac, 120 Vac, 220 Vac and 240 Vac +5% -10%, 48 Hz to 440 Hz, 115VA maximum.

ENVIRONMENT

TEMPERATURE: -40°C to +70°C non-operating. 0°C to +50°C operating.

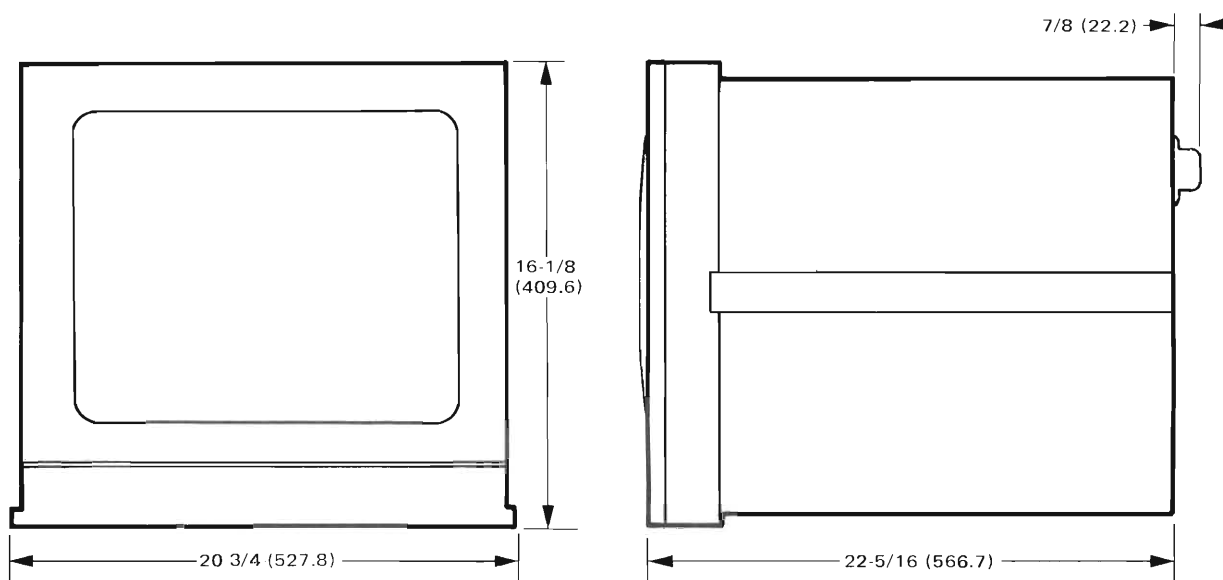
HUMIDITY: 50-95% relative humidity from 25°C to 40°C. (per MIL-E-16400E, class 3 and 4.)

ALTITUDE: 25,000 feet non-operating. 15,000 feet operating.

VIBRATION: vibrated in three planes for 15 minutes each with 0.010 to 0.060 peak to peak excursion. 10-55 Hz (per MIL-STD-167).

SHOCK: level 30G; duration 11 ms; shape 1/2 sinewave (Reference MIL-E-4970A, Procedure II).

NOTE: DIMENSIONS IN INCHES (AND MILLIMETERS)



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Table 1-2. Reference Designators and Abbreviations

REFERENCE DESIGNATIONS							
A	ASSEMBLY	E	MISC. ELECTRICAL PART	P	PLUG	U	INTEGRATED CIRCUIT (UNREPAIRABLE)
AT	ATTENUATOR	F	FUSE	PS	POWER SUPPLY	V	VACUUM TUBE, NEON BULB, PHOTOCELL, ETC.
	RESISTIVE TERMINATION	FL	FILTER	Q	TRANSISTOR	VR	VOLTAGE REGULATOR (DIODE)
B	MOTOR, FAN	H	HARDWARE	R	RESISTOR	W	CABLE
BT	BATTERY	J	JACK	RT	THERMISTOR	X	SOCKET
C	CAPACITOR	K	RELAY	S	SWITCH	Y	CRYSTAL
CP	COUPLING	L	INDUCTOR	T	TRANSFORMER	Z	NETWORK
CR	DIODE	LS	SPEAKER	TB	TERMINAL BOARD		
DL	DELAY LINE	M	METER	TP	TEST POINT		
DS	DEVICE SIGNALING (LAMP)	MP	MECHANICAL PART				

ABBREVIATIONS							
A	AMPERE(S)	F	FARAD(S)	n	NANO (10^{-9})	rfi	RADIO FREQUENCY INTERFERENCE
A	AMPERE TURN(S)	FET	FIELD-EFFECT TRANSISTOR(S)	nc	NORMALLY CLOSED	rms	ROOT MEAN SQUARE
ampl	AMPLIFIER(S)			no.	NORMALLY OPEN	rwv	REVERSE WORKING VOLTAGE
assy	ASSEMBLY	G	GIGA (10^9)	npn	NEGATIVE-POSITIVE-NEGATIVE		
ampltd	AMPLITUDE	gnd	GROUND(ED)	ns	NANOSECOND	SCR	SILICON CONTROLLED RECTIFIER
bd	BOARD(S)			p	PICO (10^{-12})	sec	SECOND(S)
bp	BANDPASS	H	HENRY(IES)	pc	PRINTED (ETCHED) CIRCUIT(S)	std	STANDARD
c	CENTI (10^{-2})	hr	HOUR(S)	pk	PEAK	trmr	TRIMMER
C	CARBON	HP	HEWLETT-PACKARD	pnp	POSITIVE-NEGATIVE-POSITIVE	u	MICRO (10^{-6})
ccw	COUNTERCLOCKWISE	Hz	HERTZ	p/o	PART OF	usec	MICROSECOND
coax.	COAXIAL	if.	INTERMEDIATE FREQ.	p-p	PEAK-TO-PEAK	V	VOLTS
coef	COEFFICIENT	intl	INTERNAL	prgm	PROGRAM	var	VARIABLE
com	COMMON	k	KILO (10^3)	prv	PEAK INVERSE VOLTAGE(S)	w/	WITH
CRT	CATHODE-RAY TUBE	lb	POUND(S)	ps	PICOSECOND	w/o	WITHOUT
cw	CLOCKWISE	lpf	LOW-PASS FILTER(S)	pwv	PEAK WORKING VOLTAGE	wiv	WORKING INVERSE VOLTAGE
d	DECI (10^{-1})	m	MILLI (10^{-3})	rf	RADIO FREQUENCY		
dB	DECIBEL	M	MEGA (10^6)				
ext	EXTERNAL	ms	MILLISECOND				

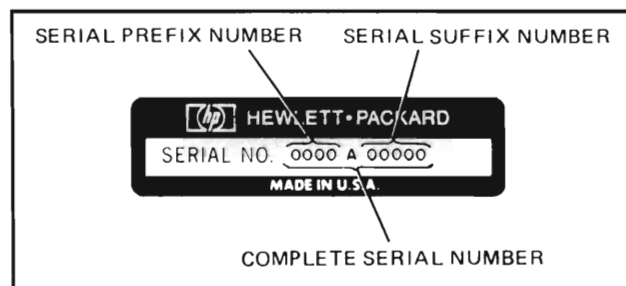


Figure 1-2. Instrument Serial Number

SECTION II

INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains instructions for preparing Model 1321A for operation and for performing an initial inspection. The procedures for making a claim for warranty repairs and for repacking the instrument for shipment are also contained in this section.

WARNING

Do not attempt to operate this instrument until the safety summary, located just before Section I, has been read and understood.

2-3. PREPARATION FOR USE.

2-4. The following paragraphs discuss facts that should be known by the operator before operation of the instrument.

2-5. STATIC ELECTRICITY.

2-6. Because of the high voltages used, there may be a large static charge buildup on the CRT faceplate. A 2-ounce bottle of type GTC-59 Glass Treatment Compound is shipped with each instrument. To reduce the static charge, apply the compound freely to the CRT faceplate only. Let the faceplate dry, then polish. The charge can also be removed by placing one hand on the frame of the instrument, then wiping the CRT faceplate with the palm of the other hand.

2-7. INSTRUMENT MOUNTING.

2-8. Because of the large number of mounting configurations, mounting hardware is not supplied. Contact the nearest Hewlett-Packard Sales/Service Office (address in rear of manual) for assistance with mounting problems.

2-9. POWER REQUIREMENTS.

2-10. *Power Cord.* The power cord required depends on, (1) the ac input voltage, and (2) the country in which the instrument is to be used. Figure 2-1 illustrates the standard power receptable (wall outlet) configurations that are used throughout the United States and in other countries. The HP part number shown directly above each receptable drawing is the part number for a power cord equipped with the

appropriate mating plug for that receptacle. If the appropriate power cord is not included with the instrument, notify the nearest HP Sales/Service Office and a replacement cord will be provided.

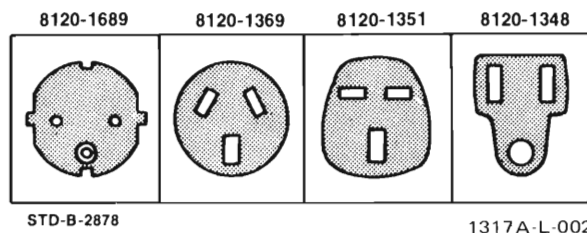


Figure 2-1. Power Receptacles

2-11. *Power Source.* The instrument requires a power source of either 100 Vac, 120 Vac, 220 Vac or 240 Vac +5% —10%, single-phase, 48 Hz to 440 Hz that can deliver approximately 115 volt-amperes. The instrument is normally shipped from the factory set to operate at 120 Vac. To operate from any of the other sources, proceed as follows:

- a. Remove power cord (if connected).
- b. Set switch on rear panel to desired voltage.
- c. For 220 Vac or 240 Vac remove 1.5 ampere fuse and replace with 0.75 ampere fuse.
- d. Install power cord.

2-12. INSTRUMENT COOLING.

2-13. When the ambient temperature is below 55°C the instrument is adequately cooled by normal air circulation. The instrument should never be mounted so that the air flow around it is completely restricted. Contact the nearest HP Sales/Service Office (address in rear of manual) for assistance with particular cooling problems.

2-14. INITIAL INSPECTION.

2-15. The instrument was inspected electrically and mechanically before shipment. Upon receipt, inspect it for damage that may have occurred in transit. Accomplish the performance checks in Section V. Retain the packing material for reshipment of the instrument.

2-16. CLAIMS.

2-17. The warranty statement applicable to this instrument is printed at the front of this manual. The CRT warranty and claims form is located at the rear of this manual. If damage is found or if performance is not as specified, notify the carrier and the HP Sales/Service Office immediately. Refer to the back of this manual for addresses. The HP Sales/Service Office will arrange for repair or replacement without waiting for settlement of a claim with the carrier.

2-18. REPACKING FOR SHIPMENT.

2-19. If the instrument is to be shipped to an HP Sales/Service Office for service or repair, attach a tag showing owner (with address), instrument serial number, and a description of the service required.

2-20. Use the original shipping carton the packing material, if available. If not available, the HP Sales/Service Office will provide information and recommendations on material to be used. Materials for

shipping an instrument normally include the following:

- a. A double-walled carton. Refer to table 2-1.
- b. Heavy paper or sheets of cardboard to protect all instrument surfaces; use a nonabrasive material such as Kimpak all around projecting parts.
- c. At least 4 inches of tightly-packed, industry-approved, shock-absorbing material such as extra-firm polyurethane foam.

Table 2-1. Shipping Carton Test Strength

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

SECTION III

OPERATION

3-1. INTRODUCTION.

3-2. This section contains an explanation of Model 1321A operating controls, applications, input modifications, operator maintenance, and step-by-step operating instructions for most applications.

3-3. CONTROLS AND CONNECTORS.

3-4. Most controls and connectors are located on either the front panel or the rear panel. These controls and connectors are illustrated and explained in figure 3-3. The following paragraphs explain switches located on printed circuit boards.

a. The input impedance selector switches permit selection of either 50 ohms or 10 kilohms input impedance for the x, y, and z amplifiers. A1S1 (x input) is located on x input assembly A1. A3S1 (y input) is located on y input assembly A3. A5S1 (z input) is located on z axis assembly A5.

b. PHOSPHOR PROTECTION switch A8S1 is located on right connector board A8. This switch either enables or disables the phosphor protection circuit.

CAUTION

The phosphor protection circuit protects the CRT against a number of malfunctions, including power line accidents. Unless it is absolutely necessary to obtain a brighter display for static or very slow deflection signals or, unless the time constants of the x and y input signals cause nonuniform intensity, leave PHOSPHOR PROTECTION switch A8S1 ON.

3-5. APPLICATIONS.

3-6. The instrument is designed as a large-screen, fast-writing, systems-readout device. It is suitable for displaying graphs and vectors, alpha-numerics and other symbology, and gray scale (z-axis) presentations. Some suggested applications are as follows:

a. Readout for interactive, computer-based, graphics systems (architecture, drafting, IC layout, mechanical design and tooling, educational systems, etc.)

b. Plots of test results in automated test systems (I_C vs V_{BE} , frequency vs amplitude, etc.).

c. Graphs of experimental variables in research systems (such as monitoring the spectral lines of a chemical sample while varying its composition).

d. Visual indicator in medical systems (analytical, diagnostic, or monitoring).

e. Raster type presentations (high-resolution TV, etc.).

3-7. INPUT MODIFICATIONS.

3-8. Two modifications can be made to the x, y and z axis input circuits. These circuits can be connected for either single-ended or differential operation and the input attenuation ratio can be changed. The modifications are described in the following paragraphs.

3-9. *Amplifier Inputs.* The inputs to the x and y amplifiers are through floating BNC connectors, with the shield and center conductor connected to the two inputs of a differential amplifier. Input to the z amplifiers is through floating BNC connector with the shield grounded. Figure 3-1 is a simplified schematic showing the configuration of one deflection amplifier input. As shipped from the factory, $R_a = R_b = 0$ ohm (a wire jumper is installed). $R_c = 10$ kilohms and $R_d = 47$ ohms. C_a , C_b , C_c , and C_d are not installed, but pads are provided on the circuit board (see figure 3-2) for customer installation. The inputs can be modified to be fully differential and balanced (both in impedance and sensitivity), completely single ended (jumper installed for R_d), or anything in between.

3-10. *Single-ended Operation.* When coaxial cable is used, large spurious currents may be generated in the cable shield through capacitive or inductive coupling and none, or very little, in the center conductor. This is especially true where long cables are used or where the cable is routed near units drawing or generating large currents. One method of reducing the interference is to ground the shield at the input. Sometimes, however, a common mode rejection capability is needed to reject noise common to both the shield and center conductor or ground loops may develop when the shield is directly grounded. In these cases, a satisfactory compromise is accomplished by substituting a low resistance for R_d . This is the input configuration ($R_d = 47$ ohms) of the x and y amplifiers as shipped from the factory.

Table 3-1. X-Y Attenuator Component Value

V _{fsd} FULL SCALE DEFLECTION VOLTAGE	R _a , R _b	R _c , R _d	C _a , C _b	APPROXIMATE INPUT IMPEDANCE
1V (as shipped)	0	10K, 47	0	10K
2V	7.5K	7.5 K	15 pF	15K
5V	12.1K	3.01K	2.4 pF	15K
10V	27.4K	3.01K	0	30K

Table 3-2. Attenuator Component Parts List

Description	HP Part Number
R:FXD MET FLM 10.0K OHM 1% 1/4W	0757-0340
R:FXD MET FLM 7.5K OHM 1% 1/8W	0757-0440
R:FXD MET FLM 3.01K OHM 1% 1/8W	0757-0273
R:FXD FLM 12.1K OHM 1% 1/8W	0757-0444
R:FXD MET FLM 27.4K OHM 1% 1/8W	0757-0452
C:VAR 1.9-15.7pF	0121-0455
C:VAR 4.5-20pF	0121-0446
C:FXD CER 2.4 pF +.25 pF 500 VDCW	0160-2242
C:FXD CER 15 pF 5% 500 VDCW	0160-2261

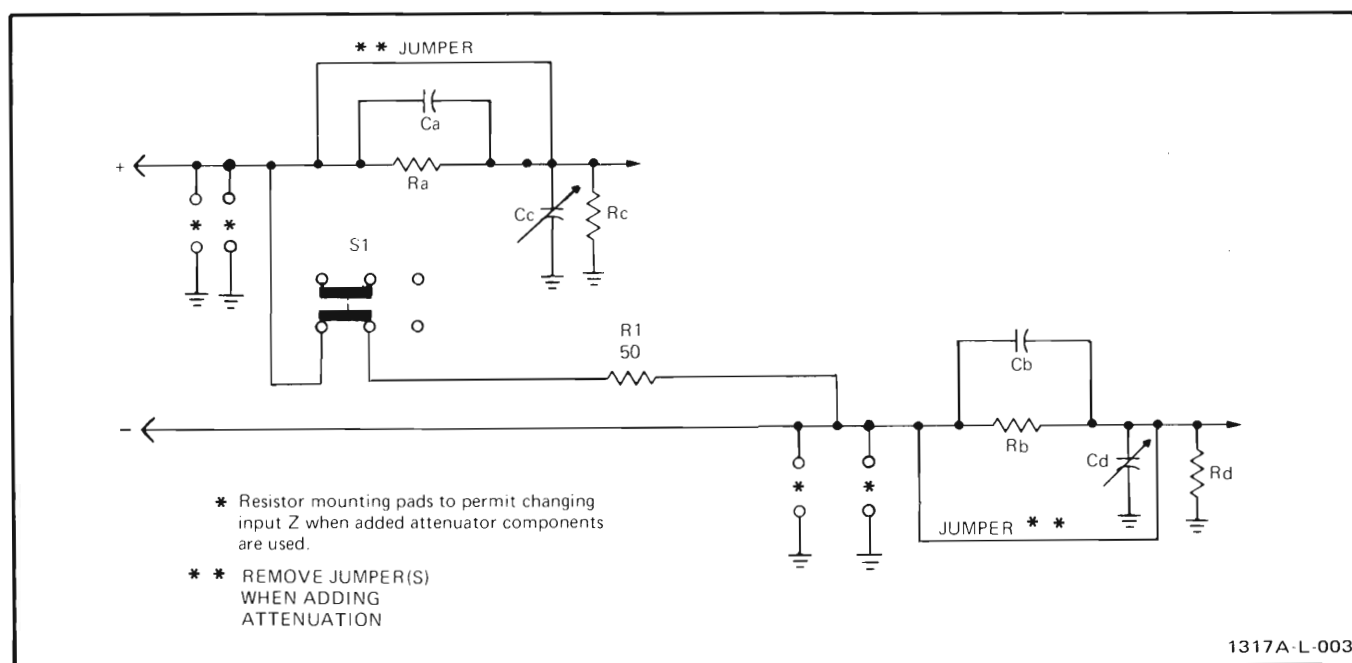


Figure 3-1. Amplifier Input Circuits

3-11. Differential Operation. If the input is driven by a balanced cable, it is usually better to maintain balanced impedances at the input; that is, $R_c = R_d$. As shipped from the factory, substituting a 10 kilohm resistor for R_d restores full differential balance.

3-12. Amplifier Input Attenuation. As shipped from the factory, 12 inches of deflection is accomplished with 1 volt at X INPUT or Y INPUT. The attenuation ratio can be changed by changing the values of the resistors in the input circuits. The physical locations of the components diagrammed in figure 3-1 are shown in figure 3-2. Table 3-1 lists the components required for four common attenuation ratios and table 3-2 describes the components and lists their HP Part Numbers.

3-13. Resistor values for attenuation ratios not listed in table 3-1 can be determined from the following formula:

$$V_{fsd} = \frac{R_a + R_c}{R_c}$$

3-14. The approximate values, in picofarads, of compensation capacitor C_a can be determined by the following formula when a 4.5-20 pF variable capacitor is used for shunt capacitor C_b .

$$C_c = 16 \frac{R_c}{R_a} - 1.6$$

3-15. If further information on input modification is required, contact the nearest HP Sales/Service Office (addresses in rear of manual) and ask for Application Note 166.

3-16. PREOPERATIONAL ADJUSTMENT AND OPERATOR CHECKS.

3-17. The preoperational procedure is shown in figure 3-4. This procedure also serves as an operator check to verify proper operation of the instrument.

3-18. OPERATOR MAINTENANCE.

3-19. Operator maintenance should be limited to the operator checks in paragraph 3-17 and exterior cleaning of the instrument. The glass and smooth metal surfaces can be cleaned with a commercial glass cleaner. Stubborn residues can be removed with a mild liquid household detergent. Plastic CRT filters should be cleaned only with alcohol.

CAUTION

If the CRT is equipped with a filter, be careful that no coarse or gritty substances are used as cleaning aids. Do not use cleaning tissues containing glass reinforcing fibers. The filters are plastic and are easily scratched.

3-20. OPERATING PROCEDURES.

3-21. Figures 3-4 and 3-5 contain step-by-step operating procedures. The index numbers on the drawings correspond to step numbers in the instructions. Only the basic operating techniques are covered. These techniques can be modified or combined to fill a variety of unique operating requirements.

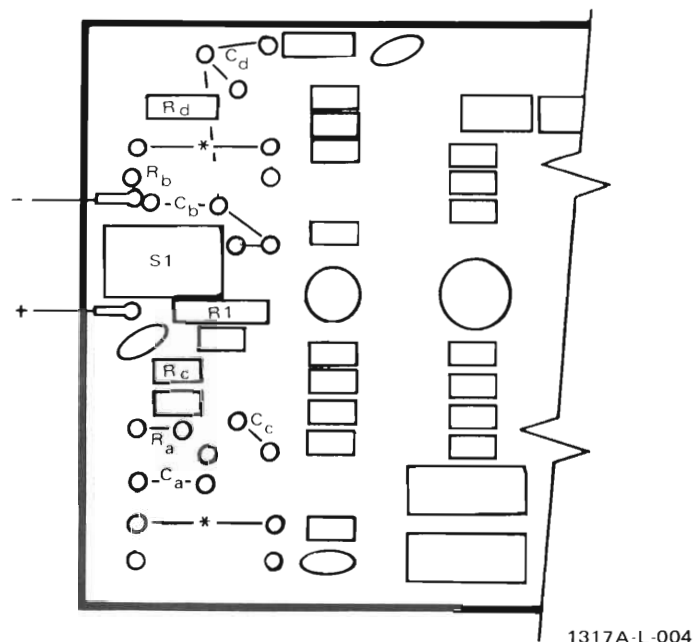
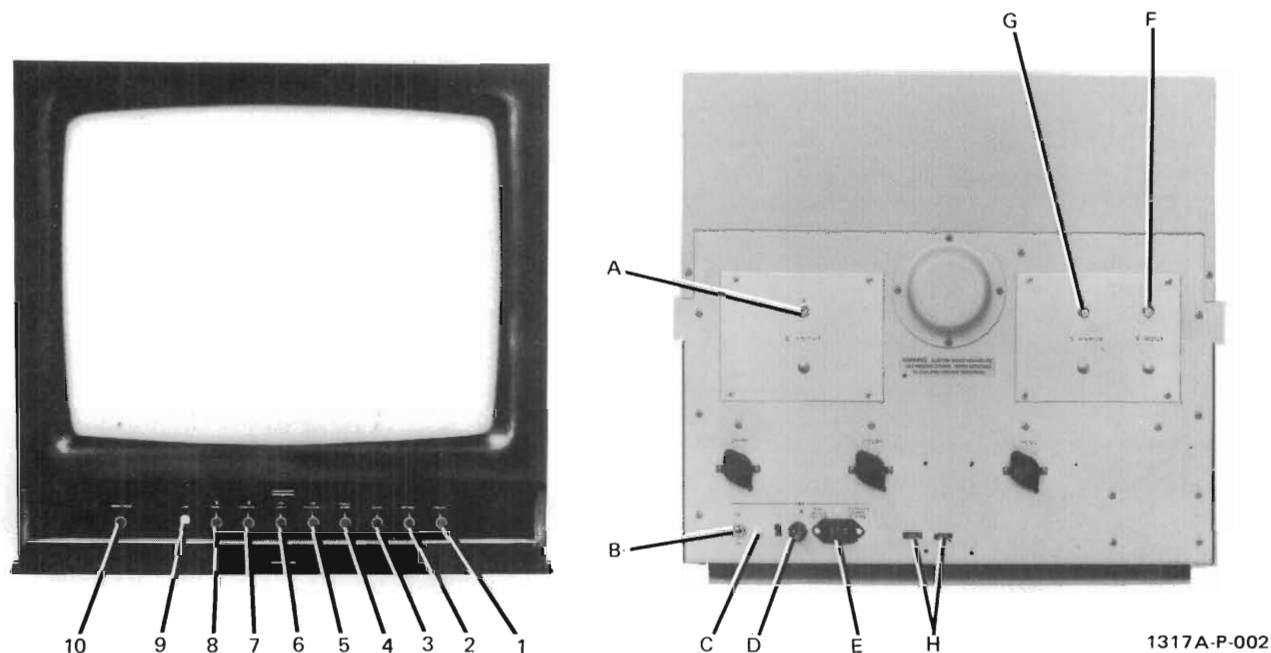
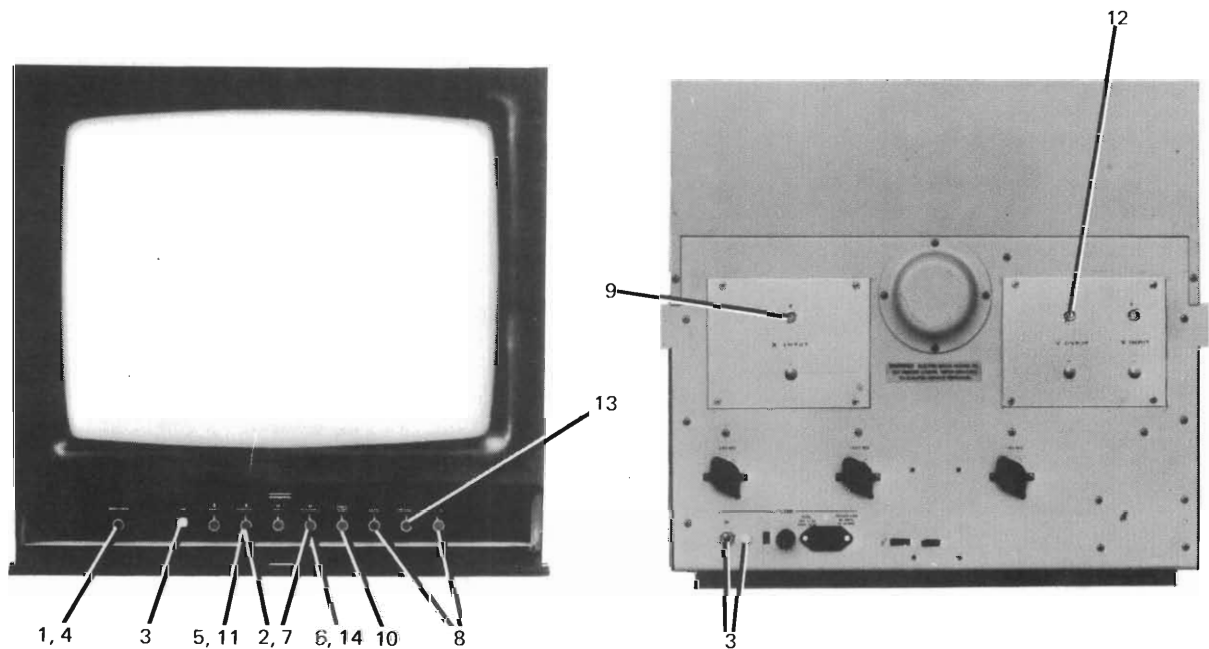


Figure 3-2. Attenuator Components Locator



1. **FOCUS.** Focuses the trace; used in conjunction with **ASTIG** control to provide the best CRT display.
 2. **ORTHO.** Used to adjust perpendicularity of X and Y traces. Operates in conjunction with **TRACE ALIGN** control.
 3. **ASTIG.** 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 **ORTHO** control which aligns vertical trace perpendicular to horizontal trace.
 5. **POSITION 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. **POSITION 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. **LINE.** Light indicating power is applied to the instrument.
 10. **BRIGHTNESS.** Adjust the brightness of the display.
- A. **X INPUT.** X-axis input connector.
 - B. **ON/OFF switch.** Applies ac power to the instrument.
 - C. **power indicator lamp.**
 - D. **line FUSE.**
 - E. **input ac power cord connector.**
 - F. **Z-INPUT.** Z-axis input connector.
 - G. **Y INPUT.** Y-axis input connector.
 - H. **LINE VOLTAGE SELECT.** 100 Vac, 120 Vac, 220 Vac, 240 Vac.

Figure 3-3. Controls and Connectors



1317A-P-003

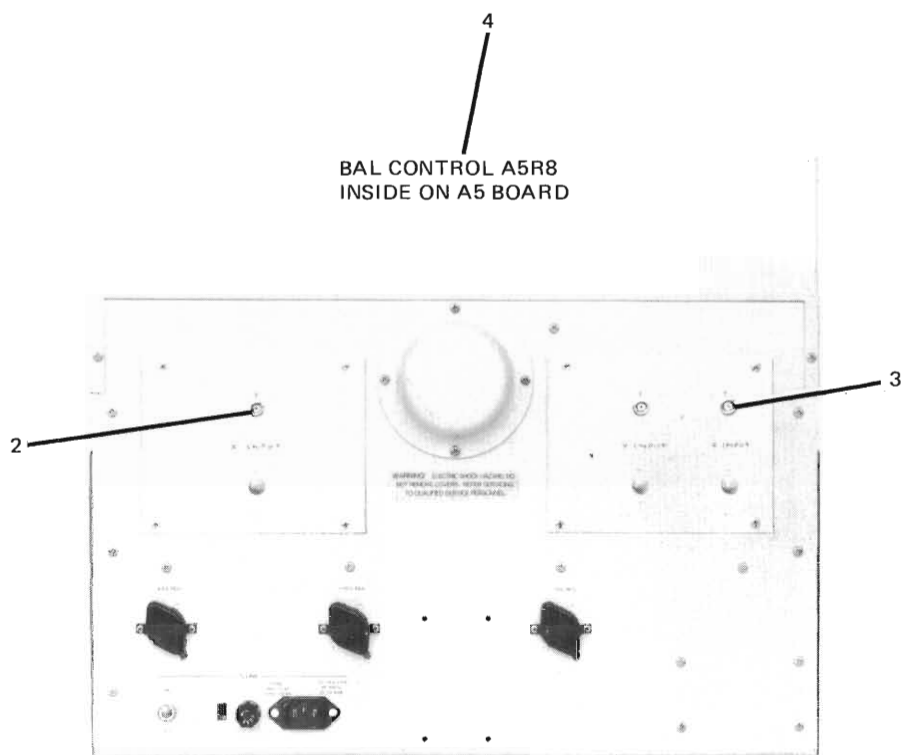
1. Set BRIGHTNESS fully ccw.
2. Set POSITION X and POSITION Y to midrange.
3. Set power switch to ON and observe that LINE and power indicator lamps light.

CAUTION

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

4. Adjust BRIGHTNESS control. Display dot brightness should vary from completely extinguished in full ccw position to an acceptable viewing brightness as control is turned cw. Adjust for comfortable viewing brightness of display dot.
5. Adjust POSITION Y control through its full range. Display dot will move vertically on the CRT. Dot will disappear from the viewing area at either extreme of the control.
6. Adjust POSITION X control through its full range. Display dot will move horizontally across the CRT. Dot will disappear from the viewing area at either extreme of the control.
7. Set POSITION X and POSITION Y controls to center display dot on CRT.
8. Set FOCUS and ASTIG for smallest display dot size.
9. Apply a 1-kHz, 1-volt p-p signal to X INPUT connector. A horizontal trace should appear on the CRT.
10. Adjust TRACE ALIGN, if necessary, to align trace horizontally.
11. Set GAIN X for trace length of exactly 10 inches.
12. Move input signal to Y INPUT.
13. Adjust ORTHOG, if necessary, to align trace vertically.
14. Set GAIN Y for trace length of exactly 10 inches.

Figure 3-4. Preoperational Procedure



1317A-P-004

1. Perform preoperational procedure (figure 3-4).
2. Apply signal to X INPUT connector.
3. Apply desired Z-axis signal (intensification/blanking) to the Z INPUT connector.
4. If the Z-axis signal has a positive or negative dc level, adjustment of the Z BAL potentiometer will compensate for dc level of the signal over a range of ± 1 volt.

Figure 3-5. Z-axis Operation

SECTION IV

PRINCIPLES OF OPERATION

4-1. INTRODUCTION.

4-2. This section contains function descriptions of Model 1321A, keyed to an overall block diagram. The block diagram and schematics are located in Section VIII.

4-3. BLOCK DIAGRAM DISCUSSION.

4-4. This discussion illustrates the function of each circuit group (block) and the relationship of the blocks to each other. It is based on the overall block diagram, figure 8-2. The conditioning and calibrating controls, as shown on the block diagram, illustrate the association of the control with a particular block and are not necessarily an accurate representation of the control's action.

4-5. LOW VOLTAGE POWER SUPPLIES.

4-6. This block (A11) provides operating power to all the other blocks, including the high voltage power supply and some of the CRT elements. Three regulated dc outputs are provided: +250V, +15V, and -15V. The +250V supply and the -15V supply are adjustable. The +15V supply is referenced to the -15V supply. Several other voltages are derived from the +250V supply by means of voltage dividers and avalanche diodes. Additionally, an unregulated dc output to the high voltage oscillator and a 6.3 Vac output to the CRT filament are provided.

4-7. HIGH VOLTAGE POWER SUPPLY.

4-8. The high voltage power supply (on A12 and A13) provides the high operating potentials for the CRT. The rf output of the high voltage oscillator is stepped up by the high voltage transformer and conditioned by the other components on A12. A sample of the high voltage output drives the error detector. The error detector controls the conduction angle of the high voltage oscillator to accomplish regulation.

4-9. DEFLECTION SYSTEM.

4-10. The X-axis amplifiers (on A1 and A2) and the Y-axis amplifiers (on A3 and A4) are identical. They drive the horizontal and vertical deflection plates of the CRT proportionally to the signals applied to the X INPUT and Y INPUT.

4-11. FOCUS AND ASTIGMATISM CIRCUITS.

4-12. Samples from the X and Y amplifiers, proportional to the CRT beam position, drive the focus and astigmatism circuits (on A6). These circuits develop correction voltages for the focus and astigmatism elements of the CRT. The astigmatism element is directly controlled by the output of the astigmatism driver. The focus element is connected to the -3400V output of the high voltage power supply. This supply is returned to (and controlled by) the output of the focus driver. The focus driver also receives a sample from the Z-axis amplifier and causes focus corrections for changes in beam intensity.

4-13. PHOSPHOR PROTECTION CIRCUITS.

4-14. The phosphor protect control circuits (on A1 and A3) detect static or slow moving deflection voltages and activate the phosphor protection circuit (on A5). The phosphor protection circuit limits the output of the Z-axis amplifier and protects the CRT mesh and phosphor from damage that a static, high-intensity beam could cause.

4-15. Z-AXIS AMPLIFIER.

4-16. The high voltage supply for the CRT control grid is returned to (and controlled by) the output of the Z-axis amplifier (on A6). Consequently, the voltage applied to the Z INPUT controls CRT beam intensity. The Z-axis amplifier can be switched to permit blanking by either a positive or negative voltage at the Z INPUT.

Table 5-1. Recommended Test Equipment

Instrument Type	Recommended Model	Required Characteristics	Required For
Monitor Oscilloscope	HP Model 180C		Performance Checks Adjustments
Vertical Plug-in	HP Model 1808A		
Horizontal Plug-in	HP Model 1820C		
Constant Amplitude Signal Generator	HP Model 651B	Frequency: 50 kHz to 5 MHz Distortion: <3%	Performance Checks Adjustments
Square Wave Generator	HP Model 211B	Frequency: 10 kHz to 100 kHz Amplitude: 1V p-p Risetime: < 5 ns Output Z: 50 Ω	Performance Checks Adjustments
Pulse Generator	HP Model 8004A	Variable pulse width, amplitude, polarity, and frequency	Performance Checks
Digital Voltmeter	HP Model 3440A with 3444A Plug-in	Voltage range: -15 to +250V Accuracy: $\pm 0.1\%$	Adjustments
Voltmeter Calibrator	HP Model 738BR	Frequency: 400 Hz Voltage: 1V p-p Accuracy: $\pm 0.1\%$	Performance Checks
10:1 Divider Probe (2)	HP Model 10004B	Voltage division ratio: 10:1 Accuracy: $\pm 3\%$	Performance Checks
1000:1 Divider Probe	HP Model K05-3440A	Voltage division ratio: 1000:1 Voltage rating: 10 kV Input Z: 100M Ω	Adjustments
Optical Comparator	Edmond Scientific Junior Comparator	Measure down to 0.005 inch	Performance Checks

SECTION VI

REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section contains information for ordering replacement parts. The abbreviations used in the parts list are described in table 6-1. Table 6-2 lists the parts in alphanumeric order by reference designation and includes the manufacturer and manufacturer's part number. Table 6-3 contains the list of manufacturers' codes.

6-3. ORDERING INFORMATION.

6-4. To obtain replacement parts from Hewlett-Packard, address order or inquiry to the nearest Hewlett-Packard Sales/Service Office and supply the following information:

- a. Instrument model and serial number.
- b. HP part number of item(s).
- c. Quantity of part(s) desired.
- d. Reference designator of part(s).

6-5. To order a part not listed in the table, provide the following information:

- a. Instrument model and serial number.
- b. Description of the part, including function and location in the instrument.
- c. Quantity desired.

Table 6-1. Abbreviations for Replaceable Parts List

A	AMPERE(S)	H	HENRY(IES)	NPN	NEGATIVE-POSITIVE-NEGATIVE	RWV	REVERSE WORKING VOLTAGE
ASSY	ASSEMBLY	HG	MERCURY	NSR	NOT SEPARATELY REPLACEABLE	S-B	SLOW-BLOW
BD	BOARD(S)	HP	HEWLETT-PACKARD			SCR	SILICON CONTROLLED RECTIFIER
BH	BINDER HEAD	HZ	HERTZ			SE	SELENIUM
BP	BANDPASS	IF	INTERMEDIATE FREQ.	OBD	ORDER BY DESCRIPTION	SEC	SECOND(S)
C	CENTI (10^{-2})	IMPG	IMPREGNATED	OH	OVAL HEAD	SECT	SECTION(S)
CAR	CARBON	INCD	INCANDESCENT	OX	OXIDE	SI	SILICON
CCW	COUNTERCLOCKWISE	INCL	INCLUDE(S)			SIL	SILVER
CER	CERAMIC	INS	INSULATION(ED)	P	PEAK	SL	SLIDE
CMO	CABINET MOUNT ONLY	INT	INTERNAL	PC	PRINTED (ETCHED) CIRCUIT(S)	SP	SINGLE POLE
COAX	COAXIAL	K	KILO (10^3)	PF	PICOFARADS	SPL	SPECIAL
COEF	COEFFICIENT	KG	KILOGRAM	PHL	PHILLIPS	ST	SINGLE THROW
COMP	COMPOSITION	LB	POUND(S)	PIV	PEAK INVERSE VOLTAGE(S)	STD	STANDARD
CONN	CONNECTOR(S)	LH	LEFT HAND	PNP	POSITIVE-NEGATIVE-POSITIVE	TA	TANTALUM
CRT	CATHODE-RAY TUBE	LIN	LINEAR TAPER	P/O	PART OF	TD	TIME DELAY
CW	CLOCKWISE	LOG	LOGARITHMIC TAPER	PORC	PORCELAIN	TFL	TEFLON
D	DECI (10^{-1})	LPF	LOW-PASS FILTER(S)	POT	POTENTIOMETER(S)	TGL	TOGGLE
DEPC	DEPOSITED CARBON	LVR	LEVER	P-P	PEAK-TO-PEAK	THYR	THYRISTOR
DP	DOUBLE POLE	M	MILLI (10^{-3})	PRGM	PROGRAM	TI	TITANIUM
DT	DOUBLE THROW	MEG	MEGA (10^6)	PS	POLYSTYRENE	TNLDIO	TUNNEL DIODE(S)
ELECT	ELECTROLYTIC	MET FILM	METAL FILM	PWV	PEAK WORKING VOLTAGE	TOL	TOLERANCE
ENCAP	ENCAPSULATED	MET OX	METAL OXIDE			TRIM	TRIMMER
EXT	EXTERNAL	MFR	MANUFACTURER	RECT	RECTIFIER(S)	U	MICRO (10^{-6})
F	FARAD(S)	MINAT	MINIATURE	RF	RADIO FREQUENCY	V	VOLTS
FET	FIELD-EFFECT TRANSISTOR(S)	MOM	MOMENTARY	RFI	RADIO FREQUENCY INTERFERENCE	VAR	VARIABLE
FH	FLAT HEAD	MTG	MOUNTING	RH	ROUND HEAD OR	VDCW	DC WORKING VOLT(S)
FIL H	FILLISTER HEAD	MY	MYLAR			W	WATT(S)
FXD	FIXED	N	NANO (10^{-9})			W/	WITH
G	GIGA (10^9)	N/C	NORMALLY CLOSED			WIV	WORKING INVERSE VOLTAGE
GE	GERMANIUM	NE	NEON			W/O	WITHOUT
GL	GLASS	N/O	NORMALLY OPEN	RMO	RACK MOUNT ONLY	WW	WIREWOUND
GRD	GROUNDED	NOP	NEGATIVE POSITIVE ZERO (ZERO TEMPERATURE COEFFICIENT)	RMS	ROOT MEAN SQUARE		

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	01317-66503		X INPUT BOARD	28480	01317-66503
A2	01310-66530		X OUTPUT BOARD	28480	01310-66530
A3	01317-66503		Y INPUT BOARD	28480	01317-66503
A4	01310-66530		Y OUTPUT BOARD	28480	01310-66530
A5	01317-66502		Z-AXIS BOARD ASSY	28480	01317-66502
A6	01317-66501		FOCUS/ASTIG BOARD ASSY	28480	01317-66501
A7	01317-66504		LEFT CONNECTOR BOARD	28480	01317-66504
A8	01310-66528		RIGHT CONNECTOR BOARD	28480	01310-66528
A9	01310-66511		CONTROL BOARD	28480	01310-66511
A10	01310-66513		TEST EXTENSION BOARD	28480	01310-66513
A11	01310-66533		LOW VOLTAGE POWER SUPPLY BOARD	28480	01310-66533
A12	01310-66526		HIGH VOLTAGE RECTIFIER BOARD	28480	01310-66526
A13	01310-66532		HIGH VOLTAGE REGULATOR BOARD	28480	01310-66532
A14	01310-61103		BOARD ASSY: HIGH VOLTAGE OCTUPLE	28480	01310-61103
C1	0180-0030	2	CAPACITOR-FXD; 120UF+75-10% 350VDC AL	28480	0180-0030
C2	0180-0030		CAPACITOR-FXD; 120UF+75-10% 350VDC AL	28480	0180-0030
C3	0180-2313	1	CAPACITOR-FXD; 6000UF+75-10% 30VDC AL	28480	0180-2313
C4	0180-0213		CAPACITOR-FXD; 5000UF+75-10% 25VDC AL	28480	0180-0213
C5	0160-2903	2	CAPACITOR-FXD .05UF+20% 500VDC	28480	0160-2903
C6	0160-2903		CAPACITOR-FXD .05UF+20% 500VDC	28480	0160-2903
DS1	1450-0419	1	LIGHT, INC, NEON, WHT TL LENS	72765	599-237-WHITE
DS2	1450-0440	1	LIGHT, INC, INCANDESCENT, WHT TL LENS	72765	599-172-WHITE TL
E1	0340-0114	2	INSULATOR, BSG, FLG, .14 ID	26365	974-401
E2	0340-0486	3	INSULATOR COVER, TO- 3, .33 THK	28480	0340-0486
E3	1200-0043	3	INSULATOR, XSTR, TO- 3, .02 THK	76530	322947
F1	2110-0020	1	FUSE; .8A 250V SLO-BLO	71400	MDL 5/10
F1	2110-0059	1	FUSE; 1.5A 125V SLO-BLO	75915	31301.5
F1	2110-0059	1	FUSE; 1.5A 125V SLO-BLO	75915	31301.5
H1	0380-0019	1	SPACER; ROUND; .188 L	28480	0380-0019
H2	0510-0123	1	RETAINER, PUSH CN, .312 DIA, CAD PLT	78553	017373-012-240
H3	1390-0231	1	FASTENER, PANEL, MAGNETIC CATCH,	94222	02-10-101-10
H4	01500-40130	1	HOLDER: LAMP	28480	01500-40130
J1			NSR, PART CF W7(X INPUT)		
J2			NSR, PART CF W8(Y INPUT)		
J3	1250-0118	1	CONNECTOR-COAX; BNC; 50 OHM FEMALE	90949	31-2221-1022
J4	1251-2357	1	CONNECTOR, AC PWR, HP-9 MALE FLANGE	32385	EAC301
L1	01701-66001	1	COIL ASSY: TRACE ALIGN	28480	01701-66001
L2	5060-0435	1	COIL: ALIGNMENT Z AXIS	28480	5060-0435
MP1	0370-1103	8	KNCR, BASE, PTR, .5 IN, OBP, OBP DECAL	28480	0370-1103
MP2	1400-0026	1	CLAMP, ADJ, 2 DIA .5 W SST	28480	1400-0026
MP3	5040-0170	14	GUIDE: PLUG-IN PC BOARD	28480	5040-0170
MP4	5040-5891	2	HOLDER: RIGHT CONNECTOR BOARD	28480	5040-5891
MP5	5040-5892	2	HOLDER: LEFT CONNECTOR BOARD	28480	5040-5892
MP6	01310-00601	4	SHIELD: AMPLIFIER	28480	01310-00601
MP7	01310-01208	3	STRAP: STR COVER	28480	01310-01208
MP8	01310-05101	1	SPRING: GROUNDING	28480	01310-05101
MP9	01310-21201	1	CLAMP: CRT	28480	01310-21201
MP10	01310-40601	1	SHIELD: HV COVER	28480	01310-40601
MP11	01321-40601	1	SHIELD, FOCUS/ASTIG BOARD	28480	01321-40601
MP12	01310-60604	1	SHIELD: CRT	28480	01310-60604
MP13	01321-00101	1	DECK MAIN	28480	01321-00101
MP14	01321-00201	1	PANEL REAR	28480	01321-00201
MP15	01321-00203	1	PANEL FRONT	28480	01321-00203
MP16	01317-01201	1	STRAP: GROUND	28480	01317-01201
MP17	01321-02201	1	BEZEL: OUTER RIM	28480	01321-02201
MP18	01317-04104	1	PLATE: INPUT RIGHT	28480	01317-04104
MP18 OPTION 050	01317-04107	1	PLATE: INPUT RIGHT	28480	01317-04107
MP18 OPTION 051	01317-04107	1	PLATE: INPUT RIGHT	28480	01317-04107
MP18 OPTION 052	01317-04107	1	PLATE: INPUT RIGHT	28480	01317-04107
MP18 OPTION 053	01317-04107	1	PLATE: INPUT RIGHT	28480	01317-04107
MP18 OPTION 054	01317-04107	1	PLATE: INPUT RIGHT	28480	01317-04107
MP19	01317-04105	1	PLATE: INPUT LEFT	28480	01317-04105
MP20	01321-04701	1	SUPPORT: T	28480	01321-04701
MP21	01321-20201	1	SUB PANEL: FRONT	28480	01321-20201
MP22	01321-24101	1	COVER: TOP	28480	01321-24101
MP23	01321-24102	1	COVER: BOTTOM	28480	01321-24102
MP24	01321-04103	1	COVER: CRT	28480	01321-04103
MP25	01321-24701	1	SUPPORT: FRONT HORIZ TOP	28480	01321-24701
MP26	01321-24702	2	SUPPORT: SIDE HORIZ	28480	01321-24702
MP27	01321-24703	1	SUPPORT: FRONT VERT LEFT	28480	01321-24703
MP28	01321-24704	1	SUPPORT: FRONT VERT RIGHT	28480	01321-24704
MP29	01321-24705	1	SUPPORT: ANGLE RIGHT	28480	01321-24705
MP30	01321-24706	1	SUPPORT: ANGLE LEFT	28480	01321-24706
MP31			NCT ASSIGNED		
MP32			NCT ASSIGNED		

See introduction to this section for ordering information

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
MP33	01321-42201	1	BEZEL: CRT	28480	01321-42201
MP34	01321-60301	1	DOOR ASSY	28480	01321-60301
MP35	01321-00602	1	SHIELD, Z-AXIS BOARD	26480	01321-00602
MP36 OPTION 055	1490-0922	2	RACK SLIDES	28480	1490-0922
MP37 OPTION 055	2680-0099	6	MACHINE SCREW 10-32 X .375	28480	2680-0099
MP38 OPTION 055	2680-0105	16	MACHINE SCREW 10-32 X .625	28480	2680-0105
MP39 OPTION 055	3050-0179	16	WASHER FLAT .750	28480	3050-0179
MP40 OPTION 055	3050-0481	6	WASHER FLAT .750 X .125	28480	3050-0481
C1	1854-0417	1	TRANSISTOR NPN SI PD=80W	28480	1854-0417
C2	1854-0063		TRANSISTOR NPN 2N3055 SI PD=115W	28480	1854-0063
Q3	1854-0063		TRANSISTOR NPN 2N3055 SI PD=115W	28480	1854-0063
R1	0684-4731		R:FXD COMP 47K 10%	28480	0684-4731
S1	3101-0056	1	SWITCH; TGL; CPDT 10A/250VAC ON-NONE	27191	8926K316
S2	3101-1237	1	SWITCH; SL; OPDT NS; 3A 125VAC	82389	11A-1243
T1	9100-3437	1	TRANSFORMER	28480	9100-3437
V1	5083-4600	1	CRT:NON-IG P31	28480	5083-4600
W1	8120-1348	1	CABLE, UNSHLD 3-COND 18AWG	70903	KHS-7041
W2	00183-61625	1	CABLE:HORIZONTAL OUTPUT	28480	00183-61625
W3	00183-61625-1	1	CABLE:VERT. OUT	28480	00183-61625
W4	01317-61601	1	CABLE ASSY, MAIN	28480	01317-61601
W5	01321-61602	1	CABLE ASSY: CRT	28480	01321-61602
W6	01317-61605	1	CABLE ASSY, PRIMARY	28480	01317-61605
W7	01310-61606	2	CABLE ASSY:X-Y AXIS INPUT	28480	01310-61606
W8	01310-61606		CABLE ASSY:X-Y AXIS INPUT	28480	01310-61606
W9	01321-61608 3	1	CABLE ASSY, Z-INPUT	28480	01321-61608 3
XF1	1400-0084	1	FUSEHOLDER; EXTR PDST; BAY CAP; 15A	28480	1400-0084
XQ1	1200-0041	3	SOCKET, ELEC, XSTR 2-CONT TO-3 PKG SLD	70714	PTS-1
XQ2	1200-0041		SOCKET, ELEC, XSTR 2-CONT TO-3 PKG SLD	00014	PTS-1
XQ3	1200-0041		SOCKET, ELEC, XSTR 2-CONT TO-3 PKG SLD	00014	PTS-1
XV1	1200-C037	1	SOCKET, ELEC, TUBE 14-CONT CRT PKG	28480	1200-0037
A1	01317-66503	2	X INPUT BOARD	28480	01317-66503
A1C1	0160-3451	33	CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0160-3451
A1C2	0160-3451		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0160-3451
A1C3	0160-3451		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0160-3451
A1C4	0160-0174	5	CAPACITOR-FXD .47UF+80-20% 25WVDC	28480	0160-0174
A1C5	0160-3443		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0160-3443
A1C6	0160-3451		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0160-3451
A1C7	0160-0168	28	CAPACITOR-FXD .1UF+-10% 200WVDC	56289	292P10492
A1C8	0160-2197	4	CAPACITOR-FXD 10PF+-5% 300WVDC	28480	0160-2197
A1C9	0160-2197		CAPACITOR-FXD 10PF+-5% 300WVDC	28480	0160-2197
A1C10	0160-0168		CAPACITOR-FXD .1UF+-10% 200WVDC	56289	292P10492
A1C11	0160-0168		CAPACITOR-FXD .1UF+-10% 200WVDC	56289	292P10492
A1C12	0160-0168		CAPACITOR-FXD .1UF+-10% 200WVDC	56289	292P10492
A1C13	0160-0168		CAPACITOR-FXD .1UF+-10% 200WVDC	56289	292P10492
A1C14	0160-0168		CAPACITOR-FXD .1UF+-10% 200WVDC	56289	292P10492
A1C15	0160-0168		CAPACITOR-FXD .1UF+-10% 200WVDC	56289	292P10492
A1C16	0160-3451		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0160-3451
A1C17	0160-0168		CAPACITOR-FXD .1UF+-10% 200WVDC	56289	292P10492
A1C18	0160-0168		CAPACITOR-FXD .1UF+-10% 200WVDC	56289	292P10492
A1C19	0160-0174		CAPACITOR-FXD .47UF+80-20% 25WVDC	28480	0160-0174
A1C20	0140-0196	2	CAPACITOR-FXD 150PF+-5% 300WVDC	72136	NM15F151J0300WV1C9
A1C21	0160-0168		CAPACITOR-FXD .1UF+-10% 200WVDC	56289	292P10492
A1C22	0160-2254	2	CAPACITOR-FXD 7.5PF+-25% 500WVDC	28480	0160-2254
A1C23	0160-3443	23	CAPACITOR-FXD .1UF+80-20% 50WVDC	28480	0160-3443
A1C24	0160-3443		CAPACITOR-FXD .2UF+80-20% 50WVDC	28480	0160-3443
A1C25	1901-0376	12	DIODE; GEN PRP; SI; 35V MAX VRM 50MA	28480	1901-0376
A1C26	1901-0376		DIODE; GEN PRP; SI; 35V MAX VRM 50MA	28480	1901-0376
A1C27	1901-0376		DIODE; GEN PRP; SI; 35V MAX VRM 50MA	28480	1901-0376
A1C28	1901-0376		DIODE; GEN PRP; SI; 35V MAX VRM 50MA	28480	1901-0376
A1C29	1901-0376		DIODE; GEN PRP; SI; 35V MAX VRM 50MA	28480	1901-0376
A1C30	1901-0033	25	DIODE; GEN PRP; SI; 180V MAX VRM 200MA	28480	1901-0033
A1C31	1901-0033		DIODE; GEN PRP; SI; 180V MAX VRM 200MA	28480	1901-0033
A1C32	1901-0033		DIODE; GEN PRP; SI; 180V MAX VRM 200MA	28480	1901-0033
A1C33	1901-0033		DIODE; GEN PRP; SI; 180V MAX VRM 200MA	28480	1901-0033
A1C34	1901-0033		DIODE; GEN PRP; SI; 180V MAX VRM 200MA	28480	1901-0033
A1C35	1901-0033		DIODE; GEN PRP; SI; 180V MAX VRM 200MA	28480	1901-0033
A1C36	1901-0033		DIODE; GEN PRP; SI; 180V MAX VRM 200MA	28480	1901-0033
A1C37	1901-0033		DIODE; GEN PRP; SI; 180V MAX VRM 200MA	28480	1901-0033
A1C38	1901-0033		DIODE; GEN PRP; SI; 180V MAX VRM 200MA	28480	1901-0033
A1C39	1901-0040	71	DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C40	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C41	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C42	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C43	1901-0033		DIODE; GEN PRP; SI; 180V MAX VRM 200MA	28480	1901-0033
A1C44	1901-0033		DIODE; GEN PRP; SI; 180V MAX VRM 200MA	28480	1901-0033
A1C45	1901-0033		DIODE; GEN PRP; SI; 180V MAX VRM 200MA	28480	1901-0033
A1C46	1901-0033		DIODE; GEN PRP; SI; 180V MAX VRM 200MA	28480	1901-0033
A1C47	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C48	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C49	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C50	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C51	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C52	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C53	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C54	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C55	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C56	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C57	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C58	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C59	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C60	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C61	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C62	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C63	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C64	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C65	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C66	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C67	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C68	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C69	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C70	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C71	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C72	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C73	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C74	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C75	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C76	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C77	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C78	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C79	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C80	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C81	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C82	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C83	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C84	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C85	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C86	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C87	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C88	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C89	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C90	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C91	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C92	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C93	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C94	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C95	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C96	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C97	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C98	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C99	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C100	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C101	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C102	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C103	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C104	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C105	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C106	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C107	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C108	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C109	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C110	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C111	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C112	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C113	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C114	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C115	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C116	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C117	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C118	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C119	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C120	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A1C121	1901-0040		DIODE; SWITCHING; SI; 30V MAX VRM 50		

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1Q3	1853-0036	42	TRANSISTOR PNP SI CHIP PD=310MW	28480	1853-0036
A1Q4	1853-0036		TRANSISTOR PNP SI CHIP PD=310MW	28480	1853-0036
A1Q5	1854-0071	16	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1Q6	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1Q7	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1Q8	1853-0075	2	TRANSISTOR; BIPOL; SI; PNP DUAL	28480	1853-0075
A1Q9	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1Q10	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1Q11	1853-0276	6	TRANSISTOR PNP SI CHIP PD=360MW	28480	1853-0276
A1Q12	1853-0276		TRANSISTOR PNP SI CHIP PD=360MW	28480	1853-0276
A1Q13	1853-0276		TRANSISTOR PNP SI CHIP PD=360MW	28480	1853-0276
A1Q14	1853-0036		TRANSISTOR PNP SI CHIP PD=310MW	28480	1853-0036
A1Q15	1853-0036		TRANSISTOR PNP SI CHIP PD=310MW	28480	1853-0036
A1Q16	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1Q17	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1R1	0698-5565	3	RESISTOR-FXD 50 OHM 1% .5W F TUBULAR	19701	MF701/2-T0-5000-F
A1R2	0687-4701	4	RESISTOR-FXD 47 OHM 10% .5W C TUBULAR	01121	068701
A1R2 OPTION 056	0757-0340		RESISTOR FXD MTFM 10K OHM 1W	28480	0757-0340
A1R3	0757-0340	3	RESISTOR-FXD 10K 1% .25W F TUBULAR	24546	C4-1/8-T0-1002-F
A1R4	0684-1041	4	RESISTOR-FXD 10K 10% .5W CC TUBULAR	01121	CB1041
A1R5	0684-1041		RESISTOR-FXD 10K 10% .5W CC TUBULAR	01121	CB1041
A1R6	0684-3901	42	RESISTOR-FXD 39 OHM 10% .25W CC TUBULAR	01121	CB3901
A1R7	0684-3901		RESISTOR-FXD 39 OHM 10% .25W CC TUBULAR	01121	CB3901
A1R8			NOT ASSIGNED		
A1R9			NOT ASSIGNED		
A1R10	0757-0280	25	RESISTOR-FXD 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A1R11	2100-2633	4	RESISTOR, VAR, TRMR, 1K OHM 10% C	19701	FT50X102
A1R12	2100-2633		RESISTOR, VAR, TRMR, 1K OHM 10% C	19701	FT50X102
A1R13	0698-3447	2	RESISTOR-FXD 422 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-422R-F
A1R14	0757-0442	9	RESISTOR-FXD 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A1R15	0757-0273	4	RESISTOR-FXD 3.01K 1% .125W F TUBULAR	24546	C4-1/8-T0-3011-F
A1R16	0757-0409	6	RESISTOR-FXD 274 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-274R-F
A1R17			NOT ASSIGNED		
A1R18			NOT ASSIGNED		
A1R19	0757-0442		RESISTOR-FXD 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A1R20			NOT ASSIGNED		
A1R21			NOT ASSIGNED		
A1R22	0757-0442		RESISTOR-FXD 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A1R23	0757-0280		RESISTOR-FXD 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A1R24	0757-0417	4	RESISTOR-FXD 562 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-562R-F
A1R25	0757-0417		RESISTOR-FXD 562 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-562R-F
A1R26	0757-0394	8	RESISTOR-FXD 51.1 OHM 1% .125W F	24546	C4-1/8-T0-511R-F
A1R27	0757-0401		RESISTOR-FXD 100 OHM 1% .125W F	28480	0757-0401
A1R28	0757-0442	2	RESISTOR-FXD 10K 1% .125W F TUBULAR	28480	0757-0442
A1R29	0757-0401		RESISTOR-FXD 100 OHM 1% .125W F	28480	0757-0401
A1R30	2100-2413	2	RESISTOR, VAR, TRMR, 200 OHM 10% C	19701	FT50X201
A1R31	0757-0394		RESISTOR-FXD 51.1 OHM 1% .125W F	24546	C4-1/8-T0-511R-F
A1R32	0698-3084	4	RESISTOR-FXD 2.15K 1% .125W F TUBULAR	16299	C4-1/8-T0-2151-F
A1R33	0757-0403	4	RESISTOR-FXD 243 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-243R-F
A1R34	0757-0273		RESISTOR-FXD 3.01K 1% .125W F TUBULAR	24546	C4-1/8-T0-3011-F
A1R35	0757-0408		RESISTOR-FXD 243 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-243R-F
A1R36	0757-0416	17	RESISTOR-FXD 511 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-511R-F
A1R37	0757-0416		RESISTOR-FXD 511 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-511R-F
A1R38	0698-3132	2	RESISTOR-FXD 261 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-261R-F
A1R39	0684-5621	8	RESISTOR-FXD 5.6K 10% .25W CC TUBULAR	01121	CB5621
A1R40	0684-1531	4	RESISTOR-FXD 15K 10% .25W CC TUBULAR	01121	CB1531
A1R41	0757-0442		RESISTOR-FXD 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A1R42	0757-0415	4	RESISTOR-FXD 475 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-475R-F
A1R43	0757-0415		RESISTOR-FXD 475 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-475R-F
A1R44	0698-0085	7	RESISTOR-FXD 2.61K 1% .125W F TUBULAR	16299	C4-1/8-T0-2611-F
A1R45	0757-0421	6	RESISTOR-FXD 825 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-825R-F
A1R46	0757-0421		RESISTOR-FXD 825 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-825R-F
A1R47	0694-2201	10	RESISTOR-FXD 22 OHM 10% .25W CC TUBULAR	01121	CB2201
A1R48	0757-0280		RESISTOR-FXD 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A1R49	0757-0281	8	RESISTOR-FXD 2.74K 1% .125W F TUBULAR	24546	C4-1/8-T0-2741-F
A1R50	0757-0416		RESISTOR-FXD 511 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-511R-F
A1R51	0684-2201		RESISTOR-FXD 22 OHM 10% .25W CC TUBULAR	01121	CB2201
A1R52	0757-0280		RESISTOR-FXD 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A1R53	0757-0281		RESISTOR-FXD 2.74K 1% .125W F TUBULAR	24546	C4-1/8-T0-2741-F
A1R54	0684-2201		RESISTOR-FXD 22 OHM 10% .25W CC TUBULAR	01121	CB2201
A1R55	0684-2201		RESISTOR-FXD 22 OHM 10% .25W CC TUBULAR	01121	CB2201
A1R56	0684-2221	5	RESISTOR-FXD 2.2K 10% .25W CC TUBULAR	01121	CB2221
A1R57	0684-1021	7	RESISTOR-FXD 1K 10% .25W CC TUBULAR	01121	CB1021
A1R58	0684-2221		RESISTOR-FXD 2.2K 10% .25W CC TUBULAR	01121	CB2221
A1R59	0684-1021		RESISTOR-FXD 1K 10% .25W CC TUBULAR	01121	CB1021
A1R60	0684-2201		RESISTOR-FXD 22 OHM 10% .25W CC TUBULAR	01121	CB2201
A1R61	0698-3150	3	RESISTOR-FXD 2.37K 1% .125W F TUBULAR	16299	C4-1/8-T0-2371-F

See introduction to this section for ordering information

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A6K66	C684-4701		RESISTOR-FXD 47 OHM 10% .25W CC TUBULAR	01121	C84701
A6K69	C757-0439		RESISTOR-FXD 6.81K 1% .125W F TUBULAR	24546	C4-1/8-T0-6811-F
A6K70	C757-0421		RESISTOR-FXD 825 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-825R-F
A6K71	C757-0439		RESISTOR-FXD 6.81K 1% .125W F TUBULAR	24546	C4-1/8-T0-6811-F
A6K72	C684-4701		RESISTOR-FXD 47 OHM 10% .25W CC TUBULAR	01121	C84701
A6K73	C757-0438		RESISTOR-FXD 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A6K74	2100-3352		RESISTOR, VAR, TRMR, 1KOHM 10% C	73138	72XR102
A6K75	2100-3352		RESISTOR, VAR, TRMR, 1KOHM 10% C	73138	72XR102
A6K76	C757-0438		RESISTOR-FXD 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A6K77	C757-0438		RESISTOR-FXD 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A6K78	C757-0438		RESISTOR-FXD 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A6K79	C757-0416		RESISTOR-FXD 511 OHM 1% .125W F TUBULAR	24546	C4-1/3-T0-511R-F
A6K80	C757-0416		RESISTOR, VAR, TRMR, 1KOHM 10% C	24546	C4-1/8-T0-511R-F
A6K81	C684-4731		RESISTOR-FXD 47K 10% .25W CC TUBULAR	01121	C84731
A6K82	C684-4701		RESISTOR-FXD 47 OHM 10% .25W CC TUBULAR	01121	C84701
A6F83	C684-4701		RESISTOR-FXD 47 OHM 10% .25W CC TUBULAR	01121	C84701
A6K84	C757-0280	1	RESISTOR-FXD 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A6K85	C757-0462	1	RESISTOR-FXD 110 OHM 1% .125W F TUBULAR	24546	C4-1/3-T0-111-F
A6K86	C757-0254	1	RESISTOR-FXD 17.8 OHM 1% .125W F	30583	MF4C1/8-T0-178R-F
A6K87	C757-0416		RESISTOR-FXD 511 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-511R-F
A6K88	C757-04C9		RESISTOR-FXD 274 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-274R-F
A6K89	C757-0280		RESISTOR-FXD 1K 1% .125W F TUBULAR	24546	C4-1/3-T0-1001-F
A6K90	2100-3274		RESISTOR, VAR, TRMR, 10KOHM 10% C	28480	2100-3274
A6K91	C757-0438	1	RESISTOR-FXD 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A6K92	C757-0335	1	RESISTOR-FXD 3.01K 1% .25W F TUBULAR	24546	C5-1/4-T0-3011-F
A6K93	C757-04C9		RESISTOR-FXD 274 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-274R-F
A6K94	C757-0280		RESISTOR-FXD 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A6K95	C684-4701		RESISTOR-FXD 47 OHM 10% .25W CC TUBULAR	01121	C84701
A6K96	C811-0007	1	RESISTOR-FXD 10K 1% 5W PW TUBULAR	14841	55X
A6K97	C684-4701		RESISTOR-FXD 47 OHM 10% .25W CC TUBULAR	01121	C84701
A6K98	C687-4701		RESISTOR-FXD 47 OHM 10% .5W CC TUBULAR	01121	E84701
A6R99			NOT ASSIGNED		
A6R100	C757-0736	2	RESISTOR-FXD 1.5K 1% .25W F TUBULAR	24546	C5-1/4-T0-1501-F
A6R101	C757-0764	1	RESISTOR-FXD 33.2K 1% .25W F TUBULAR	24546	C5-1/4-T0-3322-F
A6R102	C764-0005	1	RESISTOR-FXD 10K 5% 2W MU TUBULAR	24546	FP42-2-T00-1002-J
A6R103	C757-0736		RESISTOR-FXD 1.5K 1% .25W F TUBULAR	24546	C5-1/4-T0-1501-F
A6F104	C757-0250	1	RESISTOR-FXD 6.19K 1% .125W F TUBULAR	30583	MF4C1/8-T0-6191-F
A6K105	C684-3901		RESISTOR-FXD 39 OHM 10% .25W CC TUBULAR	01121	C83901
A6K106	C684-3901		RESISTOR-FXD 39 OHM 10% .25W CC TUBULAR	01121	C83901
A6K107	C757-0427	1	RESISTOR-FXD 1.5K 1% .125W F TUBULAR	24546	C4-1/3-T0-1501-F
A6R108	C687-2231	1	RESISTOR-FXD 22K 10% .5W CC TUBULAR	01121	E8231
A6R109	C687-1051	2	RESISTOR-FXD 1M 10% .5W CC TUBULAR	01121	E81051
A6VR1	1502-0574		DIODE; ZENER; 64.9V VZ; 1W MAX PD	04713	SZ 11213-374
A6VR2	1502-0574		DIODE; ZENER; 64.9V VZ; 1W MAX PD	04713	SZ 11213-374
A6VR3	1502-0041		DIODE; ZENER; 5.11V VZ; .4W MAX PD	04713	SZ 13939-98
A6VR4	1502-0041		DIODE; ZENER; 5.11V VZ; .4W MAX PD	04713	SZ 13939-98
A7	01317-66504	1	LEFT CONNECTOR BOARD	28480	01317-66504
A7XA1	1251-0213	7	CONNECTOR, PC EDGE, 15-CONT, DIP SOLDER	26742	91-6915-1700-00
A7XA2	1251-0213		CONNECTOR, PC EDGE, 15-CONT, DIP SOLDER	26742	91-6915-1700-00
A7XA6	1251-0213		CONNECTOR, PC EDGE, 15-CONT, DIP SOLDER	26742	91-6915-1700-00
A7XA10	1251-0213		CONNECTOR, PC EDGE, 15-CONT, DIP SOLDER	26742	91-6915-1700-00
A8	01310-66528	1	RIGHT CONNECTOR BOARD	28480	01310-66528
A8S1	31C1-0973		SWITCH; SL; DPCT NS; .5A 125VAC/DC	79727	GF126-0918
A8XA3	1251-0213		CONNECTOR, PC EDGE, 15-CONT, DIP SOLDER	26742	91-6915-1700-00
A8XA4	1251-0213		CONNECTOR, PC EDGE, 15-CONT, DIP SOLDER	26742	91-6915-1700-00
A8XA5	1251-0213		CONNECTOR, PC EDGE, 15-CONT, DIP SOLDER	26742	91-6915-1700-00
A9	C1310-66511	1	CENTRAL BOARD	28480	01310-66511
A9K1	2100-3137	1	RESISTOR; VAR; CONT; 1K 20% MC	28480	2100-3137
A9R2	2100-3135	8	RESISTOR; VAR; CONT; 5K 20% MC	28480	2100-3135
A9R3	2100-3135		RESISTOR; VAR; CONT; 5K 20% MC	28480	2100-3135
A9R4	2100-3135		RESISTOR; VAR; CONT; 5K 20% MC	28480	2100-3135
A9R5	2100-3135		RESISTOR; VAR; CONT; 5K 20% MC	28480	2100-3135
A9R6	2100-3135		RESISTOR; VAR; CONT; 5K 20% MC	28480	2100-3135
A9R7	2100-3135		RESISTOR; VAR; CONT; 5K 20% MC	28480	2100-3135
A9R8	2100-3135		RESISTOR; VAR; CONT; 5K 20% MC	28480	2100-3135
A9R9	2100-3135		RESISTOR; VAR; CONT; 5K 20% MC	28480	2100-3135
A9R10	C667-5611	1	RESISTOR-FXD 560 OHM 10% .5W CC TUBULAR	01121	F85611
A10	C1310-66513	1	TEST EXTENSION BOARD	28480	01310-66513
A11	01310-66533	1	LOW VOLTAGE POWER SUPPLY BOARD	28480	01310-66533
A11C1	C160-3443		CAPACITOR-FXD .1UF+80-20% 50WVDC	28480	0160-3443
A11C2	C160-3443		CAPACITOR-FXD .1UF+80-20% 50WVDC	28480	0160-3443
A11C3	C180-0058	2	CAPACITOR-FXD; 50UF+75-10% 25VDC AL	56289	300506025CC2
A11C4	C160-3443		CAPACITOR-FXD .1UF+80-20% 50WVDC	28480	0160-3443
A11C5	C180-0058		CAPACITOR-FXD; 50UF+75-10% 25VDC AL	56289	300506025CC2
A11C6	C160-0168		CAPACITOR-FXD .1UF+10% 200WVDC	56289	292P10492
A11C7	C160-0168		CAPACITOR-FXD .1UF+10% 200WVDC	56289	292P10492
A11C8	1901-0030	4	DIODE; PWR RECT; SI; 800V MAX VRM 600MA	04713	SR1358-11

See introduction to this section for ordering information

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A11CR2	19C1-003C		DICDE; PWR RECT; SI; 800V MAX VRM 600MA	04713	SR1358-11
A11CR3	19C1-0030		DICDE; PWR RECT; SI; 800V MAX VRM 600MA	04713	SR1358-11
A11CR4	19C1-0030		DICDE; PWR RECT; SI; 800V MAX VRM 600MA	04713	SR1358-11
A11CR5	19C1-0026		DICDE; PWR RECT; SI; 200V MAX VRM 750MA	04713	SR1358-8
A11CR6	19C1-0026		DICDE; PWR RECT; SI; 200V MAX VRM 750MA	04713	SR1358-8
A11CR7	1901-0026		DICDE; PWR RECT; SI; 200V MAX VRM 750MA	04713	SR1358-8
A11CR8	19C1-0026		DICDE; PWR RECT; SI; 200V MAX VRM 750MA	04713	SR1358-8
A11CR9	1901-0026		DICDE; PWR RECT; SI; 200V MAX VRM 750MA	04713	SR1358-8
A11CR10	19C1-0026		DICDE; PWR RECT; SI; 200V MAX VRM 750MA	04713	SR1358-8
A11CR11	1901-0026		DICDE; PWR RECT; SI; 200V MAX VRM 750MA	04713	SR1358-8
A11CR12	1901-0026		DICDE; PWR RECT; SI; 200V MAX VRM 750MA	04713	SR1358-8
A11CR13	19C1-0040		DICDE; SWITCHING SI; 30V MAX VRM 50MA	28480	1901-0040
A11CR14	1901-0040		DICDE; SWITCHING SI; 30V MAX VRM 50MA	28480	1901-0040
A11CR15	1901-0028		DICDE; PWR RECT; SI; 400V MAX VRM 750MA	04713	SR1358-9
A11CR16	1901-0040	10	DICDE; SWITCHING SI; 30V MAX VRM 50MA	28480	1901-0040
A11CR17	1901-0040		DICDE; SWITCHING SI; 30V MAX VRM 50MA	28480	1901-0040
A11CR18	1901-0040		DICDE; SWITCHING SI; 30V MAX VRM 50MA	28480	1901-0040
A11CR19	1901-0040		DICDE; SWITCHING SI; 30V MAX VRM 50MA	28480	1901-0040
A11CR20	1901-0040		DICDE; SWITCHING SI; 30V MAX VRM 50MA	28480	1901-0040
A11CE21	1901-0040		DICDE; SWITCHING SI; 30V MAX VRM 50MA	28480	1901-0040
A11F1	211C-0067	1	FUSE; .3A 250V	71409	AGC 3/10
A11F2	211C-0061	2	FUSE; 1A 250V	71409	AGC-1
A11F3	211C-00C1		FUSE; 1A 250V	71409	AGC-1
A11MP1	211C-0269	9	FUSEHOLDER; CLIP TYPE	28480	2110-0269
A11Q1	1854-0334		TRANSISTOR NPN 2N3440 SI PD=1W	02735	2N3440
A11Q2	1854-0358	2	TRANSISTOR NPN SI PD=310MW FT=60MHZ	28480	1854-0358
A11Q3	1854-0358		TRANSISTOR NPN SI PD=310MW FT=60MHZ	28480	1854-0358
A11Q4	1854-0234		TRANSISTOR NPN 2N3440 SI PD=1W	02735	2N3440
A11Q5	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A11Q6	1854-0022	1	TRANSISTOR NPN SI PD=700MW FT=50MHZ	07263	517843
A11Q7	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A11R1	0764-0027	1	RESISTOR-FXD 75K 5% 2W MJ TUBULAR	24546	FP42-2-T00-7502-J
A11R2	069E-3691	1	RESISTOR-FXD 24 OHM 5% 1W MJ TUBULAR	16299	FP32-1-T00-24R0-J
A11R3	0764-0001	1	RESISTOR-FXD 6.2K 5% 2W MJ TUBULAR	24546	FP42-2-T00-6201-J
A11R4	0757-0388	3	RESISTOR-FXD 30.1 OHM 1% .125W F	24546	C4-1/8-T0-30R1-F
A11R5	0757-0128	1	RESISTOR-FXD 200K 1% .5W F TUBULAR	30983	MF7C1/2-T0-2003-F
A11R6	0757-0395	1	RESISTOR-FXD 82.5 OHM 1% .125W F	24546	C4-1/8-T0-82R5-F
A11R7	0757-0433	1	RESISTOR-FXD 3.32K 1% .125W F TUBULAR	24546	C4-1/8-T0-3321-F
A11R8	0757-0855	3	RESISTOR-FXD 68.1K 1% .5W F TUBULAR	30983	MF7C1/2-T0-6812-F
A11R9	0757-0855		RESISTOR-FXD 68.1K 1% .5W F TUBULAR	30983	MF7C1/2-T0-6812-F
A11R10	0757-0341	1	RESISTOR-FXD 30.1K 1% .25W F TUBULAR	24546	C5-1/4-T0-3012-F
A11R11	0757-0848	1	RESISTOR-FXD 30.1K 1% .5W F TUBULAR	30983	MF7C1/2-T0-3012-F
A11R12	2100-2216	1	RESISTOR, VAR, TRMR, 5KOHM 10% C	28480	2100-2216
A11R13	0757-0855		RESISTOR-FXD 68.1K 1% .5W F TUBULAR	30983	MF7C1/2-T0-6812-F
A11R14	0757-0850		RESISTOR-FXD 39.2K 1% .5W F TUBULAR	30983	MF7C1/2-T0-3922-F
A11R15	0687-3321	2	RESISTOR-FXD 3.3K 10% .5W CC TUBULAR	01121	E83321
A11R16	069E-3622	1	RESISTOR-FXD 120 OHM 5% 2W MJ TUBULAR	24546	FP42-2-T00-120R-J
A11R17	0757-0446	2	RESISTOR-FXD 15K 1% .125W F TUBULAR	24546	C4-1/8-T0-1502-F
A11R18	0757-0368		RESISTOR-FXD 30.1 OHM 1% .125W F	24546	C4-1/8-T0-30R1-F
A11R19	0757-0352	2	RESISTOR-FXD 150K 1% .5W F TUBULAR	30983	MF7C1/2-T0-1503-F
A11R20	0757-0344	1	RESISTOR-FXD 1M 1% .25W F TUBULAR	24546	C5-1/4-T0-1004-F
A11R21	0757-0434	1	RESISTOR-FXD 3.65K 1% .125W F TUBULAR	24546	C4-1/8-T0-3651-F
A11R22	069E-3152	1	RESISTOR-FXD 3.48K 1% .125W F TUBULAR	16299	C4-1/3-T0-3481-F
A11R23	0687-3321		RESISTOR-FXD 3.3K 10% .5W CC TUBULAR	01121	E83321
A11R24	0757-0440	2	RESISTOR-FXD 7.5K 1% .125W F TUBULAR	24546	C4-1/3-T0-7501-F
A11R25	0757-0368		RESISTOR-FXD 30.1 OHM 1% .125W F	24546	C4-1/3-T0-30R1-F
A11R26	0757-0737	1	RESISTOR-FXD 1.62K 1% .25W F TUBULAR	24546	C5-1/4-T0-1621-F
A11R27	0757-0458	3	RESISTOR-FXD 51.1K 1% .125W F TUBULAR	24546	C4-1/8-T0-5112-F
A11R28	069E-3150		RESISTOR-FXD 2.37K 1% .125W F TUBULAR	16299	C4-1/3-T0-2371-F
A11R29	2100-2061	1	RESISTOR, VAR, TRMR, 200 OHM 10% C	28480	2100-2061
A11R30	0757-1054	1	RESISTOR-FXD 1.47K 1% .125W F TUBULAR	24546	C4-1/8-T0-1471-F
A11R31	0767-00C9	2	RESISTOR-FXD 12K 5% 3W MJ TUBULAR	24546	FP32-3-250-1202-J
A11R32	0767-00C9		RESISTOR-FXD 12K 5% 3W MJ TUBULAR	24546	FP32-3-250-1202-J
A11R33	0684-3321	2	RESISTOR-FXD 3.3K 10% .25W CC TUBULAR	01121	C83321
A11R34	0684-3321		RESISTOR-FXD 3.3K 10% .25W CC TUBULAR	01121	C83321
A11R35	0811-2729	1	RESISTOR-FXD 5K 3% 3W PW TUBULAR	00213	12005
A11V1	194C-0013	1	TUBE, ELCTR, 282R7, DIODE, V RGLTR	74276	Z82R7
A11VR1	1902-0175	2	DICDE; ZENER; 100V VZ; 1W MAX PD	04713	SZ-11213-428
A11VR2	1902-0049	1	DICDE; ZENER; 6.19V VZ; .4W MAX PD	28480	1902-0049
A11VR3	1902-0065	1	DICDE; ZENER; 46.4V VZ; .4W MAX PD	04713	SZ 10939-373
A11VR4	1902-3393		DICDE; ZENER; 75V VZ; .4W MAX PD	04713	SZ 10939-434
A11VR5	1902-0033	1	DICDE; ZENER; 6.2V VZ; .25W MAX PD	03677	1N823
A11VR6	1902-3256		DIODE ZENER 23.7VZ	28480	1902-3256
A12	G131C-66526	1	HIGH VOLTAGE RECTIFIER BOARD	28480	01310-66526
A12C1	C16C-0094	1	CAPACITOR-FXD; 100UF+75-10% 25VDC AL	56289	30D107G025D02
A12C2	C16C-0678	3	CAPACITOR-FXD .01UF+20% 6000WVDC	84411	HEW-337
A12C3	C16C-0678		CAPACITOR-FXD .01UF+20% 6000WVDC	84411	HEW-337
A12C4	C16C-3560		CAPACITOR-FXD .001UF+20% 8000WVDC	84411	HEW337

See introduction to this section for ordering information

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A12C5	C16C-3660	2	CAPACITOR-FXC .001UF+-20% 8000WVDC	84411	HEW337
A12C6	C16C-0678		CAPACITOR-FXC .01UF+-20% 6000WVDC	84411	HEW-337
A12C7	C16C-2264	2	CAPACITOR-FXC 20PF+-5% 500WVDC	28480	0160-2264
A12C8	C160-0543		CAPACITOR-FXC .0047UF+-20% 4000WVDC	84411	HEW-337
A12C9	C160-0543	2	CAPACITOR-FXC .0047UF+-20% 4000WVDC	84411	HEW-337
A12C10	C160-2264		CAPACITOR-FXC 20PF+-5% 500WVDC	28480	0160-2264
A12C11	C160-3448	1	CAPACITOR-FXC .001UF+-10% 1030WVDC	28480	0160-3448
A12C12	C18C-0269	2	CAPACITOR-FXD; 1UF+75-10% 150VDC AL	56289	30D1C5G150BA2
A12CR1	1901-0652	1	DIODE: SILICON 12KV PIV 10MA	28480	1901-0652
A12CR2	1901-0028		DIODE: PWR RECT; SI; 400V MAX VRM 750MA	04713	SR1358-9
A12CR3	1901-0028	1	DIODE: PWR RECT; SI; 400V MAX VRM 750MA	04713	SR1358-9
A12CR4	1901-0028		DIODE: PWR RECT; SI; 400V MAX VRM 750MA	04713	SR1358-9
A12CR5	1901-0028	1	DIODE: PWR RECT; SI; 400V MAX VRM 750MA	04713	SR1358-9
A12CR6	1901-0028		DIODE: PWR RECT; SI; 400V MAX VRM 750MA	04713	SR1358-9
A12CR7	1901-0028	1	DIODE: PWR RECT; SI; 400V MAX VRM 750MA	04713	SR1358-9
A12CR8	1901-0028		DIODE: PWR RECT; SI; 400V MAX VRM 750MA	04713	SR1358-9
A12CR9	1901-0028	1	DIODE: PWR RECT; SI; 400V MAX VRM 750MA	04713	SR1358-9
A12R1	0757-C747		RESISTOR-FXD 511K 1% .25W F TUBULAR	24546	C5-1/4-T-5111-F
A12R2	C684-7182	1	RESISTOR-FXD 30M 1% 2W F TUBULAR	03888	PME80-2-TG-3005-F
A12R3	C684-1021		RESISTOR-FXD 1K 10% .25W CC TUBULAR	01121	C81021
A12R4	C687-1061	2	RESISTOR-FXD 10M 10% .5W CC TUBULAR	01121	E81061
A12R5	C687-3941	2	RESISTOR-FXD 390K 10% .5W CC TUBULAR	01121	E83941
A12R6	2100-3148		RESISTOR, VAR, TRMR, 200OHM 20% MS	28480	2100-3148
A12R7	C684-0006	1	RESISTOR-FXD 20M 10% 1W CF TUBULAR	77764	8AKW
A12R8	C684-1031		RESISTOR-FXD 10K 10% .25W CC TUBULAR	01121	C81031
A12R9	C687-1061	2	RESISTOR-FXD 10M 10% .5W CC TUBULAR	01121	E81061
A12R10	C687-3941		RESISTOR-FXD 390K 10% .5W CC TUBULAR	01121	E83941
A12R11	C684-1021	1	RESISTOR-FXD 1K 10% .25W CC TUBULAR	01121	C81021
A12R12	C683-1555		RESISTOR-FXD 1.5M 5% .25W CC TUBULAR	01121	C81555
A12R13	C637-0105	2	THERMISTOR, 200K OHM 10%	28480	0837-0105
A12R14	C637-0105		THERMISTOR, 200K OHM 10%	28480	0837-0105
A12T1	01310-61104	1	TRANSFORMER ASSY: HIGH VOLTAGE	28480	01310-61104
A12VR1	1902-0668		DIODE: ZENER; 200V VZ; 1W MAX PD	04713	SZ 11213-449
A12VR2	1902-0668	1	DIODE: ZENER; 200V VZ; 1W MAX PD	04713	SZ 11213-449
A12VR3	1902-0668		DIODE: ZENER; 200V VZ; 1W MAX PD	04713	SZ 11213-449
A12VR4	1902-0668	2	DIODE: ZENER; 200V VZ; 1W MAX PD	04713	SZ 11213-449
A12VR5	1902-0668		DIODE: ZENER; 200V VZ; 1W MAX PD	04713	SZ 11213-449
A12VR6	1902-0175	2	DIODE: ZENER; 100V VZ; 1W MAX PD	04713	SZ-11213-428
A12VR7	1902-3381		DIODE: ZENER; 68.1V VZ; .4W MAX PD	04713	SZ 10939-422
A12VR8	1902-3381	2	DIODE: ZENER; 68.1V VZ; .4W MAX PD	04713	SZ 10939-422
A12	01310-66532	1	HIGH VOLTAGE REGULATOR BOARD	28480	01310-66532
A13C1	C16C-0174	1	CAPACITOR-FXD .47UF+80-20% 25WVDC	28480	0160-0174
A13C2	C16C-3453		CAPACITOR-FXC .05UF+80-20% 100WVDC	28480	0160-3453
A13C3	C16C-0380	1	CAPACITOR-FXC .22UF+-10% 200WVDC	84411	HEW238T
A13C4	0160-3453		CAPACITOR-FXD .05UF+80-20% 100WVDC	28480	0160-3453
A13C5	C16C-0166	1	CAPACITOR-FXD .068UF+-10% 200WVDC	56289	292P68392
A13C6			NOT ASSIGNED		
A13C7	C18C-0269	1	CAPACITOR-FXD; 1UF+75-10% 150VDC AL	56289	30D1C5G150BA2
A13CR1	1901-0040		DIODE: SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A13CR2	1901-0040	1	DIODE: SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A13CR3	1901-0040		DIODE: SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A13CR4	1901-0040	1	DIODE: SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A13CR5	1901-0040		DIODE: SWITCHING; SI; 30V MAX VRM 50MA	28480	1901-0040
A13CR6	1901-0045	1	DIODE: PWR RECT; SI; 100V MAX VRM 750MA	28480	1901-0045
A13CR7	1901-0028		DIODE: PWR RECT; SI; 400V MAX VRM 750MA	04713	SR1358-9
A13F1	211C-C0C7	1	FUSE; 1A 250V SLO-BLO	71400	MOL-1
A13J1	1251-2965		CONNECTOR, PC EDGE, 13-CONT, RTANG DP	26742	92-6010-5800-00
A13L1	914J-0138	1	COIL; FXD; MOLDED RF CHUKE; 180UH 5%	24226	15/183
A13MP1	1205-0242	1	HEAT-DISSIPATOR, SGL, TO-3 PKG	28480	1205-0242
A13Q1	1854-0023		TRANSISTOR NPN SI PD=300MW FT=15MHZ	28480	1854-0023
A13Q2	1854-0215	1	TRANSISTOR NPN SI PD=310MW FT=300MHZ	04713	SPS 3611
A13Q3	1853-0336		TRANSISTOR PNP SI CHIP PD=310MW	28480	1853-0036
A13Q4	1854-0063	3	TRANSISTOR NPN 2N3055 SI PD=115W	28480	1854-0063
A13Q5	1854-0215	1	TRANSISTOR NPN SI PD=310MW FT=300MHZ	04713	SPS 3611
A13R1	0757-0156		RESISTOR-FXD 1.5M 1% .5W F TUBULAR	30983	MF7C1/2-T0-1504-F
A13R2	2100-2650	1	RESISTOR, VAR, TRMR, 200KOHM 10% C	28480	2100-2650
A13R3	C757-0280		RESISTOR-FXD 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A13R4	0757-0442	1	RESISTOR-FXD 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A13R5	C757-0446		RESISTOR-FXD 15K 1% .125W F TUBULAR	24546	C4-1/8-T0-1502-F
A13R6	0757-0440	1	RESISTOR-FXD 7.5K 1% .125W F TUBULAR	24546	C4-1/8-T0-7501-F
A13R7	0757-0178		RESISTOR-FXD 100 OHM 1% .25W F TUBULAR	24546	C5-1/4-T0-101-F
A13R8	0757-0458	1	RESISTOR-FXD 51.1K 1% .125W F TUBULAR	24546	C4-1/8-T0-5112-F
A13R9	C687-2711		RESISTOR-FXD 270 OHM 10% .5W CC TUBULAR	01121	E82711

See introduction to this section for ordering information

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A13R10	0757-0438		RESISTOR-FXD 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A13R11	0757-0401		RESISTOR-FXD 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-101-F
A13R12	0757-0458		RESISTOR-FXD 51.1K 1% .125W F TUBULAR	24546	C4-1/8-T0-5112-F
A13R13	0757-0401		RESISTOR-FXD 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-101-F
A13R14	0757-0352		RESISTOR-FXD 150K 1% .5W F TUBULAR	30983	MF7C1/2-T0-1503-F
A13R15	0757-0285	1	RESISTOR-FXD 2K 1% .125W F TUBULAR	24546	C4-1/8-T0-2001-F
A13R16	2100-2031		RESISTOR, VAR, TRMR, 50KOHM 10% C	28480	2100-2031
A12V1	214C-0006	1	LAMP, GLOW, BULB T-2, 55V	71744	A1A (NE-2)
A12VR1	1904-3357		DIODE; ZENER; 56.2V VZ; .4W MAX PD	04713	SZ 10935-398
A13XF1	2110-0269	1	FUSEHOLDER; CLIP TYPE	26480	2110-0269
A14	C1310-61103		BOARD ASSY:HIGH VOLTAGE OCTUPLER	29480	01310-61103

Table 6-3. Manufacturers' Code

MFR NO.	MANUFACTURE NAME	ADDRESS	ZIP CODE
FF003	NO MFR DESCRIPTION FOR THIS MFG NUMBER	LE MESTRET FRANCE	
00014	SOURCE ELECTRONIQUE		
00210	NO MFR DESCRIPTION FOR THIS MFG NUMBER		
01121	SAGE ELECTRONICS CORP	ROCHESTER NY	14610
02726	ALLER BRADLEY CO	MILWAUKEE WI	53212
03877	KCA CORP SOLID STATE DIV	SOMMERVILLE NJ	08874
03889	TRANSITION ELECTRONIC CORP	WARREFIELD MA	01990
04713	DIODELY CORP	WHIPPANY NJ	07981
07243	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX AZ	85038
13102	FATCHELL SEMI-INDUCTOR DIV	MOUNTAIN VIEW CA	94040
14941	THERMALLY CO	DALLAS TX	75247
16229	JASO LEONARD HAGERSTOWN DIV	HAGERSTOWN MD	21740
16701	COATING GL WK PLANT CMPT DIV	BALEIGH NC	27604
24226	MERCOR/ELECTRA CORP (MFR RES)	MINERAL WELLS TX	76067
24546	ORWANDA ELECTRONICS CORP	ORWANDA NY	14070
24938	OPENING GLASS WORKS (C STYLE RES)	BRADFORD PA	16701
26365	ENVIRONMENTAL CONTR SYS (RATE-RITE)	PALO ALTO CA	94304
26742	GOISS REPRODUCER CORP	NEW ROCHELLE NY	10802
27191	METRON ELECTRONICS INC	CHICAGO IL	60656
28480	CUTLER-HAMMER INC POWER DISTR CONT	MILWAUKEE WI	53212
30933	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO CA	94304
56280	MERCOR/ELECTRA CORP (VAR RES)	SAN DIEGO CA	92121
70903	SPRAGUE ELECTRONIC CO	NORTH ADAMS MA	01247
71400	BELDEN CORP	CHICAGO IL	60644
71744	ALSCHEM MFR DIV OF MONADRONIC CO	ST LOUIS MO	63017
72136	CHICAGO MINIATURE LAMP WORKS	CHICAGO IL	60640
72765	ELECTROACTIVE MFG CO INC	WILLIMANTIC CT	06226
72922	ORLKE MFG CO	HARDWOOD HEIGHTS IL	60656
73138	ERIC TECHNOLOGICAL PRODUCTS INC	SPRNG BR	16512
74276	BECKMAN INSTRUMENTS INC BELTPOD DIV	CHILLICOTTE CA	02624
75915	SIGNALITE INC	MERTON NJ	07753
76920	LITTLEFUSE INC	DES PLAINES IL	60016
77764	TOW FLEX CMPT CINC-MONADRONIC DIV	CITY OF INDUSTRY CA	91747
78553	RESISTANCE PRODUCTS CO	HARRISBURG PA	17104
79727	THINERMAN PRODUCTS INC	CLEVELAND OH	44129
82200	C-W INDUSTRIES	WINCHESTER PA	18974
84411	NO MFR DESCRIPTION FOR THIS MFG NUMBER		
89649	TWV CAPACITOR DIV	DALLAS TX	75243
94222	ANDREW L SALES DIV OF BUNKER-DAND	HAZELWOOD MO	63043
98201	SOUTHERN INC	LESTER PA	19113
	SEALITE CO	MAMARONECK NY	10544

SECTION VII

MANUAL CHANGES AND OPTIONS

7-1. INTRODUCTION.

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

7-3. MANUAL CHANGES.

7-4. This manual applies directly to instruments having the same serial prefix shown on the manual title page. If the serial prefix of the instrument is not the same as the one on the title page, find your serial prefix in table 7-1 and make the changes to the manual that are listed for that serial prefix. When making changes listed in table 7-1, make the change with the highest number first. Example: if backdating changes 1, 2, and 3 are required for your serial prefix, do change 3 first, then change 2, and finally change 1. If the serial prefix of the instrument is not listed either in the title page or in table 7-1, refer to the enclosed replacement pages in the front of this manual.

Table 7-1. Manual Changes

Serial Prefix	Make Changes
1332A	Manual Applies

7-5. SPECIAL OPTIONS.

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

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

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

7-9. STANDARD OPTIONS.

7-10. Standard options are modifications installed on HP instruments at the factory and are available on request. Contact the nearest Hewlett-Packard Sales/Service Office for information concerning standard options. Table 7-2 lists the Model 1321A standard options.

Table 7-2. Standard Options

OPTION	DESCRIPTION
005	Form fitting neutral density (smoke gray) contrast filter with antiglare coating to improve trace contrast for easier viewing in bright lighting.
006	Form fitting blue contrast filter with antiglare coating.
050	TTL blanking input. High state (+2.5V to +5V) blanks any analog Z-input. Low level (0.0V to 0.8V) returns blanking to analog Z-axis input.
051	Differential input Z amplifier. Input through separate BNC connectors (shield grounded). Four bit binary Z-axis input provides 16 levels of gray (TTL compatible).
052	Four bit binary Z-axis input provides 16 levels of gray (TTL compatible)
053	Light output varies linearly (+20%) with linear change in Z-axis drive (Gamma correction).
054	TTL blanking input. Low state (0.0V to +0.8V) blanks any analog input. High stage (+2.5V to +5V) returns blanking to analog Z-axis input.
055	Fixed slides for use in EIA standard 19 inch rack.
056	Differential inputs to X and Y amplifiers. Input for each axis through separate BNC connectors (shield grounded).
604	P4 phosphor, aluminized, open graticule CRT in lieu of P31
607	P7 phosphor, aluminized, open graticule CRT in lieu of P31. Includes amber contrast filter with antiglare coating.
639	P39 phosphor aluminized, open graticule CRT in lieu of P31.

Table 8-1. Schematic Notes

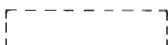
Refer to MIL-STD-15-1A and MIL-STD-806 for schematic symbols not listed in this table.



ETCHED CIRCUIT BOARD



FRONT-PANEL MARKING



REAR-PANEL MARKING



FRONT-PANEL CONTROL



SCREWDRIVER ADJUSTMENT

P/O

PART OF

NC

NO CONNECTION

CW

CLOCKWISE END OF VARIABLE RESISTOR



MAIN SIGNAL PATH



PRIMARY FEEDBACK PATH



SECONDARY FEEDBACK PATH

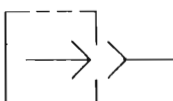


TP1

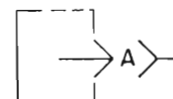
MAJOR ELECTRICAL TEST POINT
TP (WITH NUMBER)



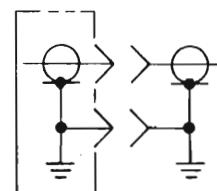
MINOR WAVEFORM TEST POINT
(WITH NUMBER)



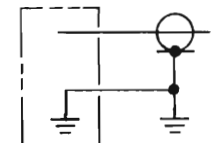
SINGLE-PIN CONNECTOR ON BOARD



PIN OF A PLUG-IN BOARD
(WITH LETTER OR NUMBER)



COAXIAL CABLE CONNECTED TO SNAP-ON JACK



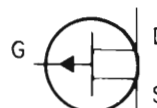
COAXIAL CABLE CONNECTED DIRECTLY TO BOARD

6

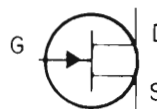
SIGNAL
REFERENCE

2

SCHEMATIC
REFERENCE



FIELD-EFFECT TRANSISTOR
(P-TYPE BASE)



FIELD-EFFECT TRANSISTOR
(N-TYPE BASE)



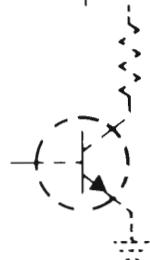
BREAKDOWN DIODE
(VOLTAGE REGULATOR)



TUNNEL DIODE



STEP-RECOVERY DIODE



CIRCUITS OR COMPONENTS
DRAWN WITH DASHED LINES
(PHANTOM) SHOW FUNCTION
ONLY AND ARE NOT INTENDED
TO BE COMPLETE. THE CIRCUIT
OR COMPONENT IS SHOWN IN
DETAIL ON ANOTHER SCHEMATIC.

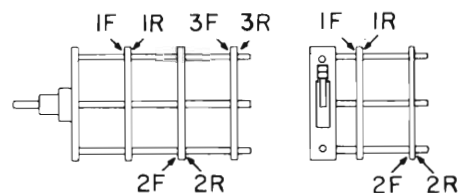
(925)

WIRE COLORS ARE GIVEN
BY NUMBERS IN PARENTHESIS
USING THE RESISTOR COLOR
CODE

[(925) IS WHT-RED-GRN]

0 - BLACK 5 - GREEN
1 - BROWN 6 - BLUE
2 - RED 7 - VIOLET
3 - ORANGE 8 - GRAY
4 - YELLOW 9 - WHITE

SWITCH WAFERS ARE IDENTIFIED
AS FOLLOWS:



*

OPTIMUM VALUE SELECTED
AT FACTORY, TYPICAL
VALUE SHOWN; PART MAY
HAVE BEEN OMITTED.

UNLESS OTHERWISE INDICATED:
RESISTANCE IN OHMS
CAPACITANCE IN PICO FARADS
INDUCTANCE IN MICROHENRIES

SECTION VIII

SCHEMATICS AND TROUBLESHOOTING

8-1. INTRODUCTION.

8-2. This section contains schematics, repair and replacement information, component locator illustrations, and troubleshooting information. Table 8-1 defines symbols used on the schematics.

8-3. SCHEMATICS.

8-4. Schematics are printed on foldout pages for easy reference to the text and figures in other sections. The schematics are drawn to show the electronic function of the circuits. Any one schematic may include all or part of several different physical assemblies. Non MIL-standard symbols and conventions used in the schematics are defined in table 8-1.

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

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

8-7. All components within the inclosed areas of the schematic (refer to the first illustration on table 8-1) are physically located on etched circuit board. Components not physically located on etched circuit boards are shown in the uninclosed areas of the schematic.

8-8. REFERENCE DESIGNATIONS.

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

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

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

8-12. COMPONENT LOCATIONS.

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

8-14. The locations of all adjustments are shown in Section V.

8-15. PREVENTIVE MAINTENANCE.

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

8-17. MECHANICAL INSPECTION.

8-18. Periodically inspect the instrument for damaged components, excess grease, dirt, and corrosion. Look for loose and misaligned assemblies. Ensure that all screws and fasteners are tight and serviceable.

8-19. CLEANING.

8-20. Painted, glass, and plastic surfaces can be cleaned with a spray-type, window cleaner or with a mild soap and water solution. Excess grease can be removed with a degreaser such as M-180 FREON TF DEGREASER produced by Miller-Stevenson Company. Use alcohol to clean plastic CRT Filters.

8-21. Corroded spots are best removed with soap and water. Stubborn residue can be removed with a fine abrasive. When using abrasives be careful that fine particles do not fall into the instrument. The cleaned spots can be protected from further corrosion by an application of a silicone resin such as GE DRIFILM 88.

8-22. ETCHED CIRCUIT BOARDS.

8-23. The following paragraphs provide servicing procedures for etched circuit boards.

8-24. BOARD CONNECTIONS.

8-25. Single-pin connectors on circuit boards are identified by the color code of the connecting wire. Connector pins on plugs and jacks are identified by a numeral or a letter. The letters G, I, O, and Q are not used. Table 8-1 shows the type of board connections used in the instrument.

8-26. SWITCH MAINTENANCE.

8-27. The slide switches used on the etched circuit boards have been designed for long, trouble-free service. Should one of these switches become defective, replacement rather than repair is recommended.

8-28. HEAT SINKS.

8-29. The heat sinks used on the instrument are all of the friction type. They can be removed by carefully pulling them off. When reinstalling, support the bottom of the transistor while pushing the heat sink on. Transistor damage may result if the transistor leads are bent.

8-30. SERVICING ETCHED CIRCUIT BOARDS.

8-31. The etched circuit boards in the instrument have plated-through component holes. This permits components to be removed by unsoldering from either side of the board. When removing large components, such as potentiometers, rotate the soldering iron tip from lead to lead while applying pressure to lift the part from the board. HP Service Note M-20E contains additional information on repair of etched circuit boards.

8-32. SEMICONDUCTOR REPLACEMENT.

8-33. Figure 8-1 is included to help identify the leads of common sizes and shapes of semiconductor devices. When removing a semiconductor, use long-nosed pliers as a heat sink between the device and the soldering iron. When installing a semiconductor, ensure sufficient lead length to dissipate the soldering heat by using the same length of exposed lead as used for the original part.

3-34. TROUBLESHOOTING.

8-35. The most important prerequisite for successful troubleshooting is understanding how the instrument is designed to operate and correct use of front-panel controls. Suspected malfunctions may be caused by improper control settings or circuit connections. Before doing the test and/or troubleshooting procedures, read Section III (Operation) for an explanation of controls and connectors and general operating considerations, and Section IV (Principles of Operation) for an explanation of circuit theory.

8-36. If trouble is suspected, visually inspect the instrument. Look for loose or burned components that might suggest a source of trouble. Check to see that all circuit board connections are making good contact. If no obvious trouble is found, check the power supply voltages in the unit. Prior to any extensive troubleshooting, check the external power sources also.

8-37. TROUBLESHOOTING THE LOW VOLTAGE POWER SUPPLY.

8-38. If the supply is completely inoperative, inspect the line fuse located on the rear of the instrument. If the line fuse is open, the power lamps will not be lighted. Check input voltage source for proper voltage.

8-39. The voltage from each secondary winding of input transformer T1 is rectified by a full-wave bridge rectifier and filtered by a capacitor (the +250V supply is filtered by two capacitors). In the event of diode failure, the supply voltage will vary considerably from the design value and filtering will be severely affected. Loss of a filter capacitor will affect the voltage and result in excess ripple at the series regulator input.

8-40. Fuses and adjustments for the dc voltages are located on the low voltage power supply board, A11. The fuses are connected in series with the regulator transistors. In case a fuse is open, check the series regulator and driver transistors.

8-41. *No Output Voltage.* No output voltage may be the result of an open fuse, open series regulator transistor, or loss of the +250V reference voltage. When all supplies are inoperative, check the +250V power supply first. Output from this supply is required for the +15V supply. Output from the +15V supply is required for the -15V supply.

8-42. *Voltage Too High.* Too high a voltage may be caused by a shorted series regulator transistor, shorted driver transistor, +250V reference voltage out of regulation, or a defective sensor amplifier. If the +15V supplies are low, check the output of the +250V supply.

8-43. *Voltage Too Low.* Adjust the +250V supply (A11R12) while measuring the output of the supply. If proper adjustment cannot be made, check the resistor divider network, A11R11, A11R12, and A11R13 for proper values. Check for low input line voltage.

8-44. TROUBLESHOOTING THE HIGH VOLTAGE POWER SUPPLY.

WARNING

Contact with the high voltage power supply voltage can result in injury or death.

8-45. Malfunction of the high voltage power supply will usually result in loss of beam spot or unstable intensity. Troubleshooting may be accomplished by resistance checks of the high voltage oscillator, high voltage transformer, and regulator circuits. In the event of complete failure, check fuse A13F1. If fuse is all right, check -15V supply. Failure of the -15V supply will turn off high voltage oscillator A13Q4. In the event of octupler failure, replace the assembly.

8-46. TROUBLESHOOTING X-, Y-, Z-AXIS AMPLIFIERS.

8-47. The X-axis and Y-axis amplifiers are identical. When trouble develops in either the X-axis circuit or Y-axis circuit (not both), the quickest way to isolate the problem to a board assembly is by substitution. Interchange board assembly A1 with board assembly A3. If trouble still exists, interchange board assembly A2 with board assembly, A4. This procedure should isolate the problem to a particular board assembly.

8-48. Trouble in the X-axis and Y-axis amplifier circuits will usually result in an unbalanced condition. The spot will usually shift from the center of the CRT and, in some instances, may leave the viewing area completely. Troubleshooting the differential stages may be done by clamping the stages within a differential amplifier together. The following steps describe this method.

CAUTION

When clamping the bases of the differential amplifier stages together do not allow the jumper wire to contact the chassis or other components. Damage to the equipment may result.

a. Use short jumper wire with insulated miniature clip at each end.

b. Turn instrument off while making connection.

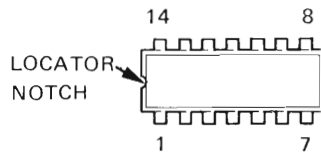
c. For example, connect jumper between bases of A1Q11 and A1Q12 (see schematic 2). Connection between bases may be made at base side of A1R77 and base side of A1R81.

d. With jumper in place, turn instrument on. If beam spot returns to center of CRT, A1Q11 and A1Q12, along with output amplifier assembly, A2, are functioning properly. The trouble is back toward input circuit.

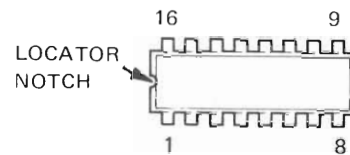
e. By selecting differential stages, either toward input or toward output, faulty stage can be isolated. Using voltage and resistance measurements, faulty component should be easily identified.

INTEGRATED CIRCUITS

14 PIN INTEGRATED CIRCUIT



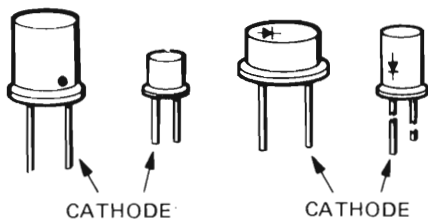
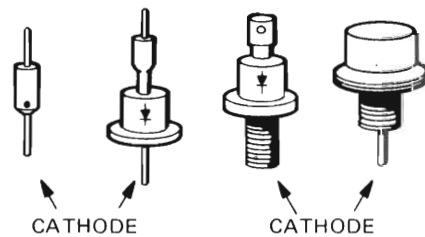
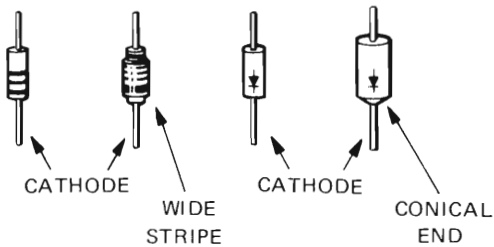
16 PIN INTEGRATED CIRCUIT



DIODES

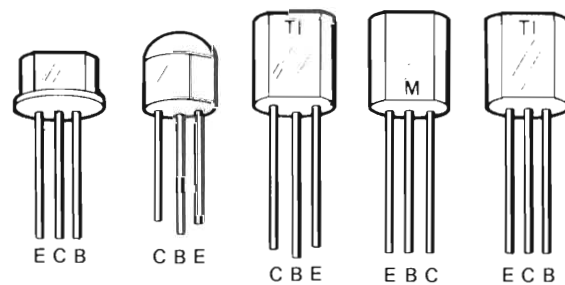
DIODE SYMBOL

ANODE ———> CATHODE

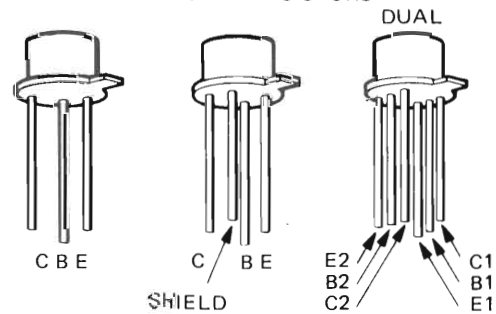


BI-POLAR TRANSISTORS

BLACK EPOXY (PLASTIC) TRANSISTORS



METAL CASE TRANSISTORS



FIELD EFFECT TRANSISTORS

METAL CASE BLACK EPOXY (PLASTIC) METAL CASE

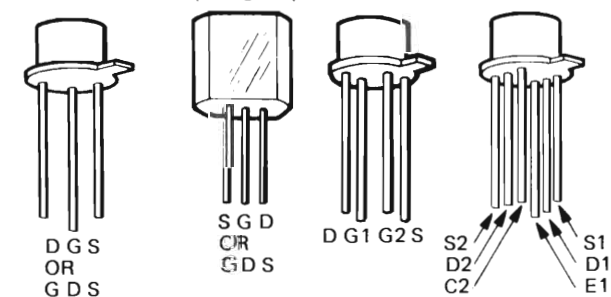


Figure 8-1. Semiconductor Terminal Identification

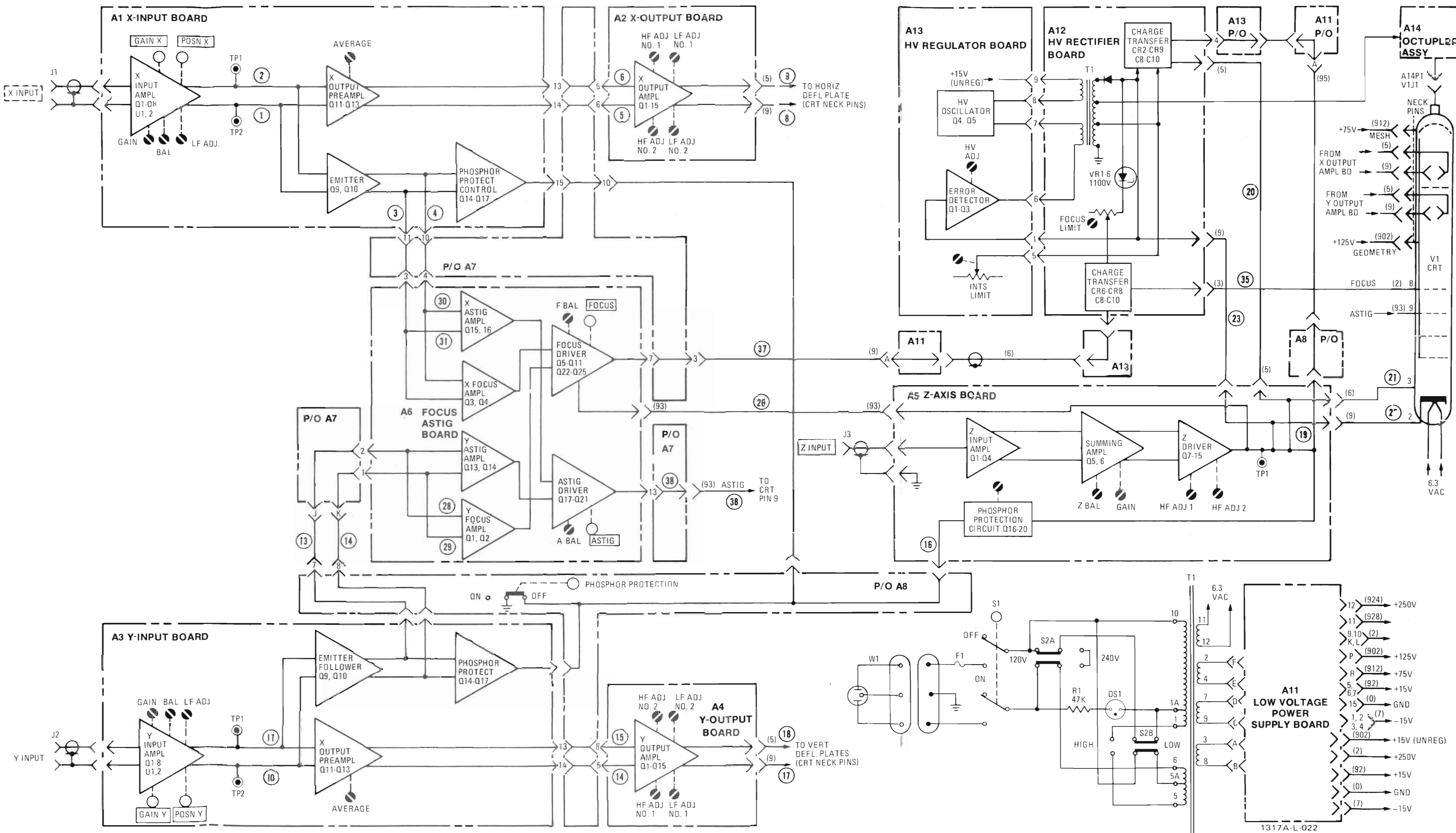
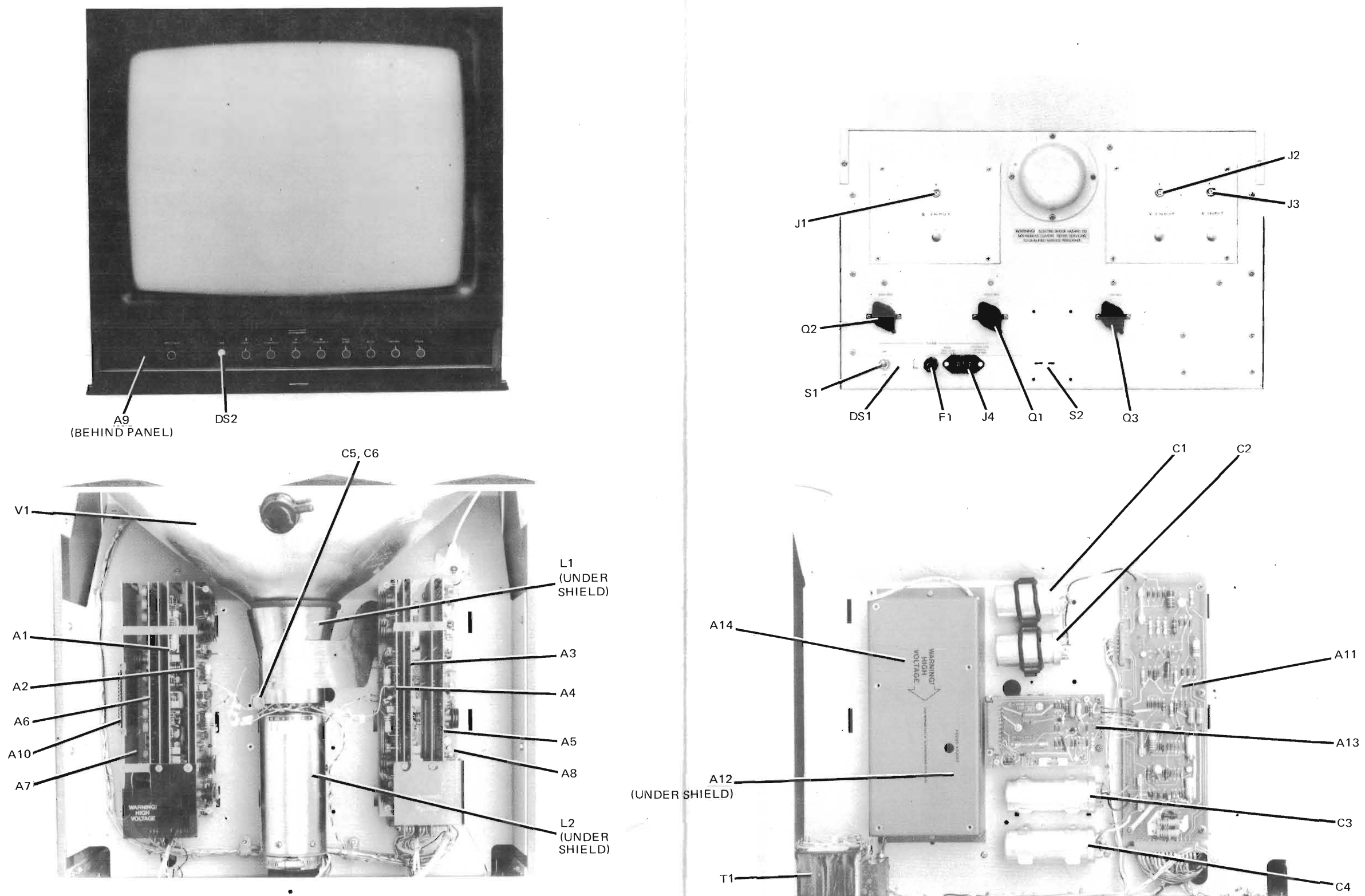


Figure 8-2.
Troubleshooting Block Diagram
8-5



1317A-P-006

Figure 8-3. Assembly and Chassis Parts Locator

Table 8-2. X-axis Input Measurement Conditions

DC VOLTAGE MEASUREMENT CONDITIONS

1. Disconnect all inputs from X-, Y-, and Z-INPUT connectors.
2. Adjustments:
Z-axis GAIN (A5R20) fully cw
Z-axis BAL (A5R65)..... Equal voltages at emitters of A5Q3 and A5Q4
3. Control settings:
POSN X Centered
POSN Y Centered
GAIN X fully cw
GAIN Y fully cw
INTENSITY +7.0V at Test Point A5TP1

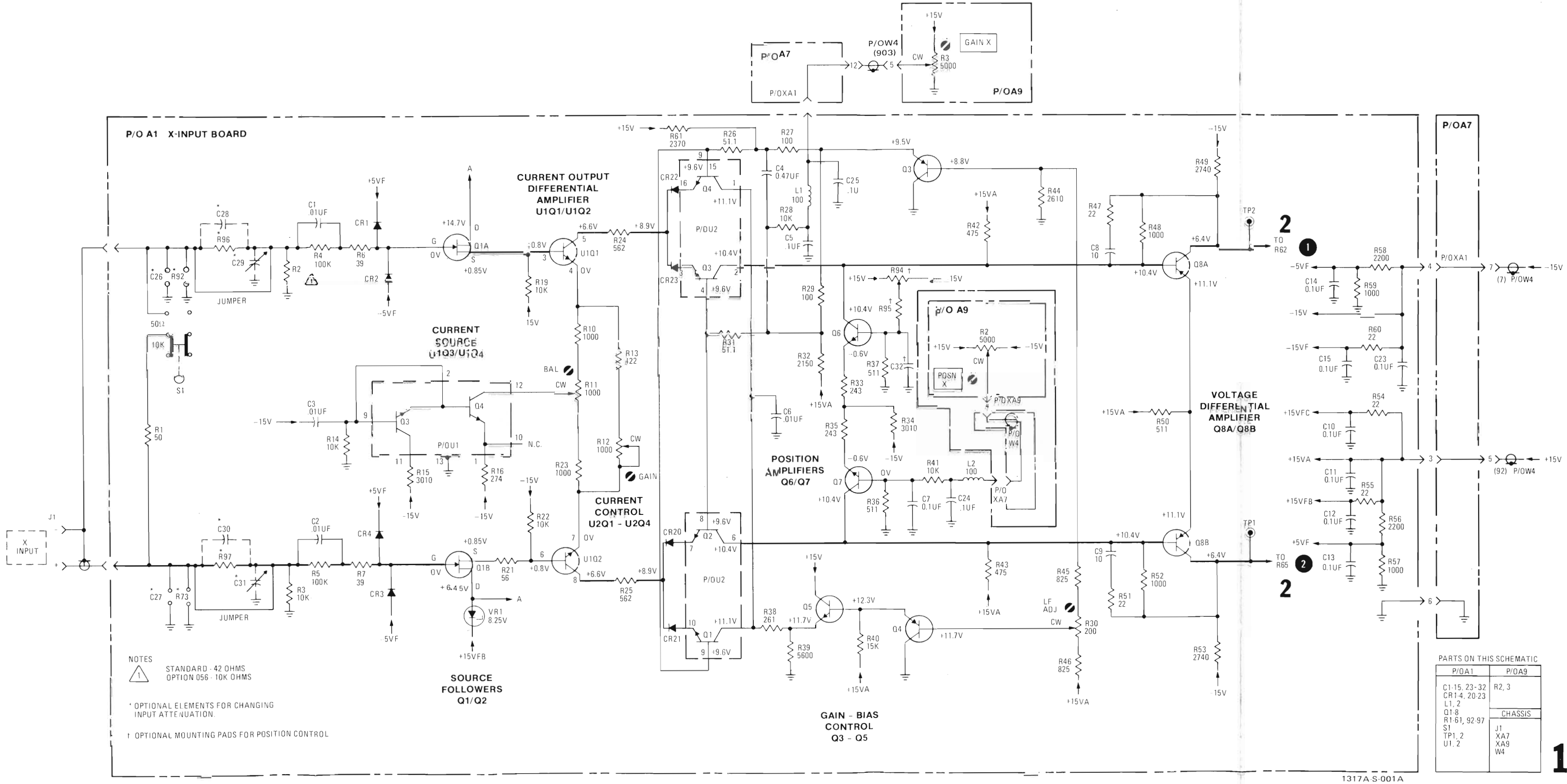
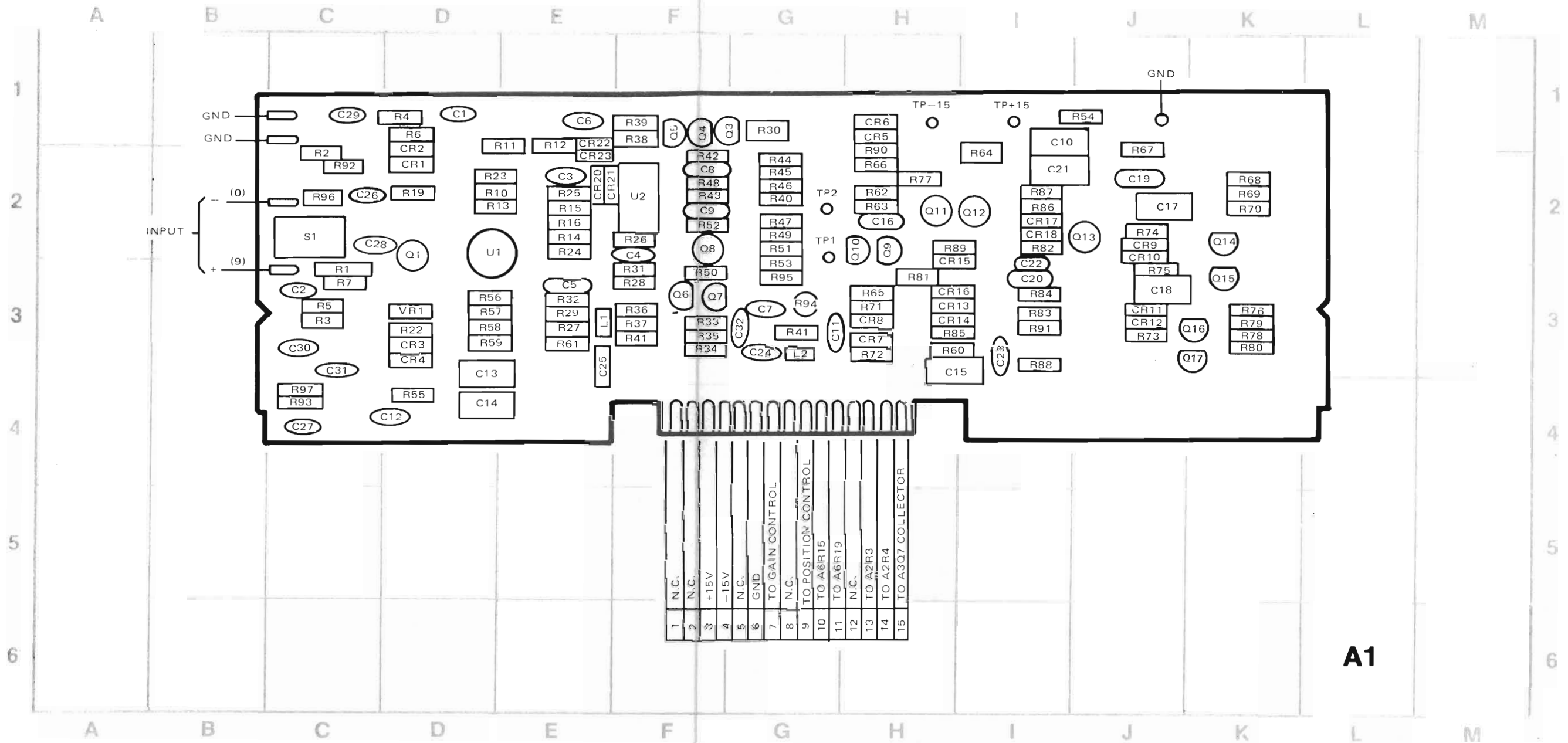


Figure 8-4.
X-axis Amplifier Schematic 1 Sheet 1 of 2
8-7



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	D-1	C17	J-2	CR1	D-2	CR17	I-2	Q9	H-2	R10	E-2	R30	G-1	R46	G-2	R62	H-2	R78	K-3	R94	G-3
C2	C-3	C18	J-3	CR2	D-2	CR18	I-2	Q10	H-2	R11	E-2	R31	F-3	R47	G-2	R63	H-2	R79	K-3	R95	G-3
C3	E-2	C19	J-2	CR3	D-3	CR20	E-2	Q11	H-2	R12	E-2	R32	E-3	R48	F-2	R64	I-2	R80	K-3	R96	C-2
C4	F-2	C20	I-3	CR4	D-3	CR21	E-2	Q12	I-2	R13	E-2	R33	F-3	R49	G-2	R65	H-3	R81	H-3	R97	C-4
C5	E-3	C21	I-2	CR5	H-1	CR22	E-2	Q13	J-2	R14	E-2	R34	F-3	R50	F-3	R66	H-2	R82	I-2	S1	C-2
C6	E-1	C22	I-3	CR6	H-1	CR23	E-2	Q14	K-2	R15	E-2	R35	F-3	R51	G-2	R67	J-2	R83	I-3	TP1	G-2
C7	G-3	C23	I-3	CR7	H-3	L1	E-3	Q15	K-3	R16	E-2	R36	F-3	R52	F-2	R68	K-2	R84	I-3	TP2	G-2
C8	F-2	C24	G-3	CR8	H-3	L2	G-4	Q16	K-3	R19	D-2	R37	F-3	R53	G-3	R69	K-2	R85	H-3	TP-15	H-1
C9	F-2	C25	E-4	CR9	J-2	Q1	D-2	Q17	K-3	R22	D-3	R38	F-1	R54	J-1	R70	K-2	R86	I-2	TP+15	I-1
C10	I-2	C26	C-2	CR10	J-3	Q2	D-3	R1	C-3	R23	E-2	R39	F-1	R55	D-4	R71	H-3	R87	I-2	U1	D-2
C11	G-3	C27	C-4	CR11	J-3	Q3	G-1	R2	C-2	R24	E-2	R40	G-2	R56	D-3	R72	H-3	R88	I-3	U2	F-2
C12	C-4	C28	C-2	CR12	J-3	Q4	F-1	R3	C-3	R25	E-2	R41	G-3	R57	D-3	R73	J-3	R89	H-2		
C13	D-4	C29	C-1	CR13	I-3	Q5	F-1	R4	D-1	R26	F-2	R42	F-2	R58	D-3	R74	J-2	R90	H-2		
C14	D-4	C30	C-3	CR14	I-3	Q6	F-3	R5	C-3	R27	E-3	R43	F-2	R59	D-3	R75	J-3	R91	I-3		
C15	H-3	C31	C-3	CR15	I-3	Q7	F-3	R6	D-1	R28	F-3	R44	G-2	R60	H-3	R76	K-3	R92	C-2		
C16	H-2	C32	G-3	CR16	I-3	Q8	F-2	R7	C-3	R29	E-3	R45	G-2	R61	E-3	R77	H-2	R93	C-4		

Figure 8-5. A1 Component Locator

Table 8-3. X-axis Preamplifier Measurement Conditions

DC VOLTAGE MEASUREMENT CONDITIONS

1. Disconnect all inputs from X-, Y-, and Z-INPUT connectors.
2. Adjustments:

Z-axis GAIN (A5R20) fully cw

Z-axis BAL (A5R65)..... Equal voltages at emitters of A5Q3 and A5Q4
3. Control settings:

POSN X Centered

POSN Y Centered

GAIN X fully cw

GAIN Y fully cw

INTENSITY+7.0V at Test Point A5TP1

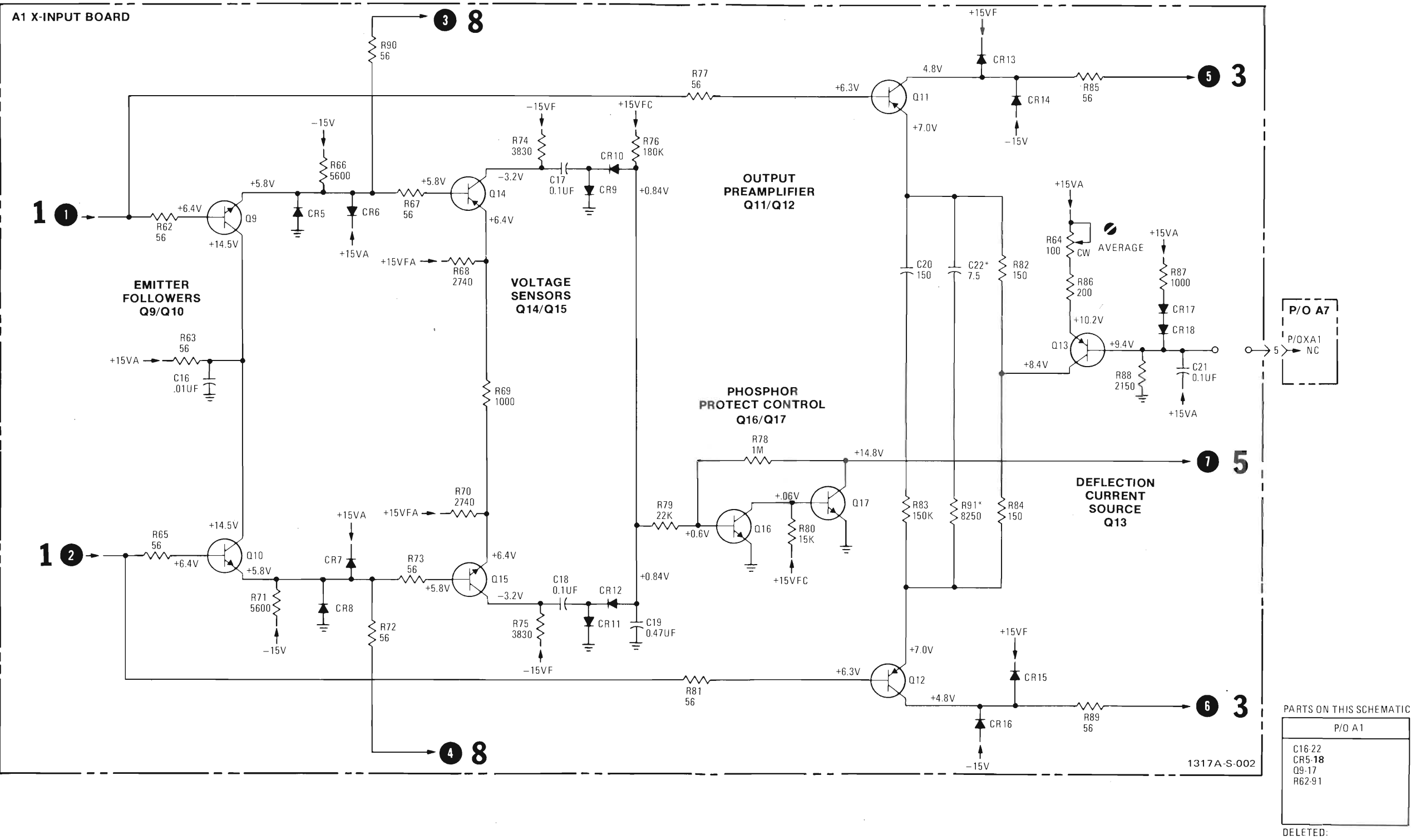
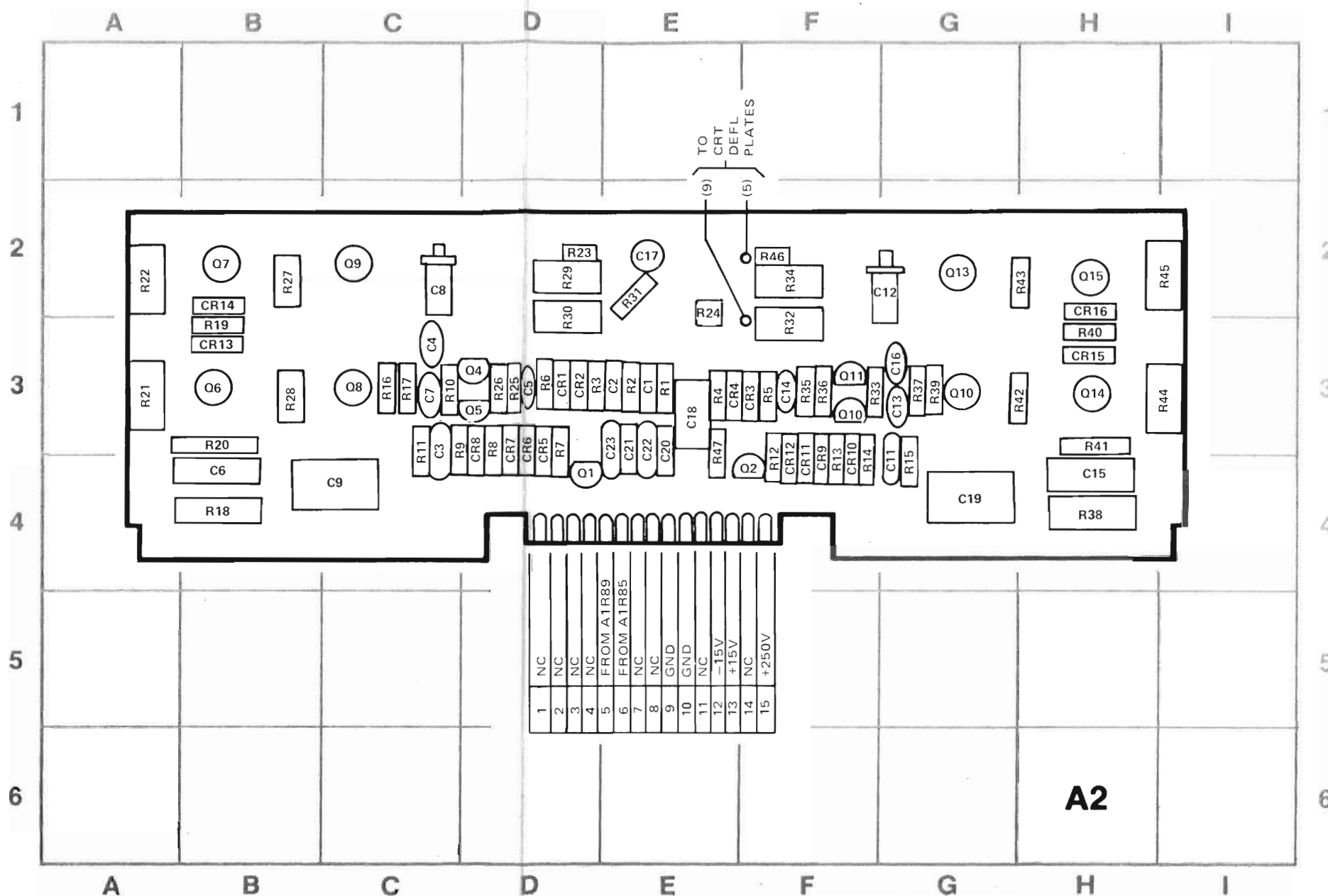


Figure 8-6.
X-axis Amplifier
8-9



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	E-3	C21	E-3	Q2	F-4	R8	D-3	R28	B-3
C2	E-3	C22	E-3	Q4	D-3	R9	D-3	R29	D-2
C3	C-3	C23	E-3	Q5	D-3	R10	C-3	R30	D-2
C4	C-3	CR1	D-3	Q6	B-3	R11	C-3	R31	E-2
C5	D-3	CR2	D-3	Q7	B-2	R12	F-4	R32	F-3
C6	B-4	CR3	F-3	Q8	C-3	R13	F-4	R33	F-3
C7	C-3	CR4	E-3	Q9	C-2	R14	F-4	R34	F-2
C8	C-2	CR5	D-3	Q10	F-3	R15	G-4	R35	F-3
C9	B-4	CR6	D-3	Q11	F-3	R16	C-3	R36	F-3
C11	G-4	CR7	D-3	Q12	G-3	R17	C-3	R37	G-3
C12	G-2	CR8	D-3	Q13	G-2	R18	B-4	R38	H-4
C13	G-3	CR9	F-4	Q14	H-3	R19	B-3	R39	G-3
C14	F-3	CR10	F-4	Q15	H-2	R20	B-3	R40	H-3
C15	H-4	CR11	F-4	R1	E-3	R21	A-3	R41	H-3
C16	G-3	CR12	F-4	R2	E-3	R22	A-2	R42	H-3
C17	E-2	CR13	B-3	R3	D-3	R23	D-2	R43	H-2
C18	E-3	CR14	B-2	R4	E-3	R24	E-2	R44	I-3
C19	G-4	CR15	H-3	R5	F-3	R25	D-3	R45	I-2
C20	E-3	CR16	H-2	R6	D-3	R26	D-3	R46	F-2
		Q1	D-4	R7	D-3	R27	B-2	R47	E-3

Figure 8-7. A2 Component Locator

Table 8-4. X-axis Output Amplifier Measurement Conditions

DC VOLTAGE MEASUREMENT CONDITIONS

- 1. Disconnect all inputs from X-, Y-, and Z-INPUT connectors.
- 2. Adjustments:
Z-axis GAIN (A5R20) fully cw
Z-axis BAL (A5R65) Equal voltages at emitters of A5Q3 and A5Q4
- 3. Control settings:
POSN X Centered
POSN Y Centered
GAIN X fully cw
GAIN Y fully cw
INTENSITY +7.0V at Test Point A5TP1

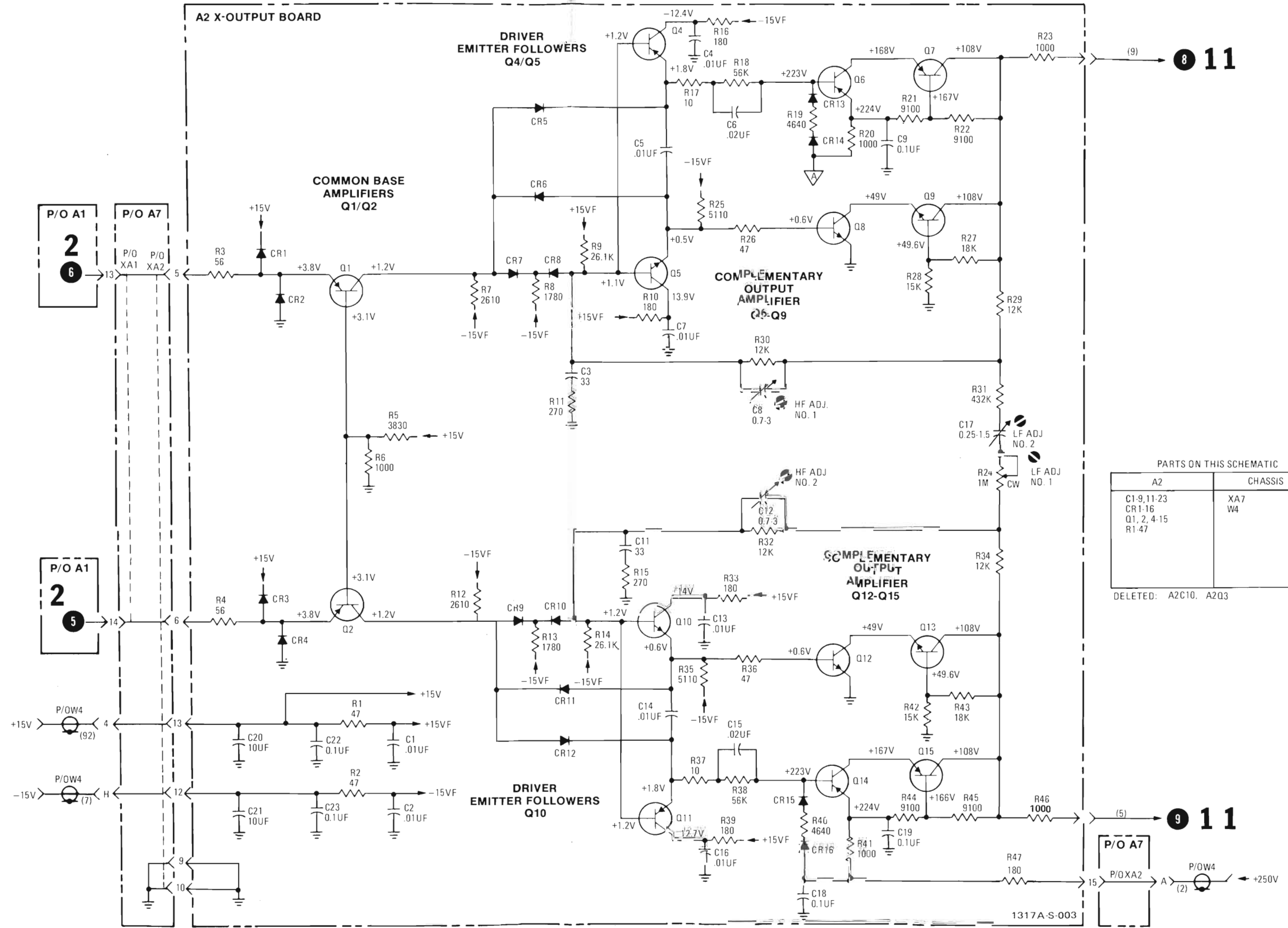


Figure 8-8.
X-axis Output Amplifier
8-11/(8-12 blank)

Table 8-5. Y-axis Input Measurement Conditions

DC VOLTAGE MEASUREMENT CONDITIONS

1. Disconnect all inputs from X-, Y-, and Z-INPUT connectors.
2. Adjustments:
- Z-axis GAIN (A5R20) fully cw
- Z-axis BAL (A5R65) Equal voltages at emitters of A5Q3 and A5Q4
3. Control settings:
- POSN X Centered
- POSN Y Centered
- GAIN X fully cw
- GAIN Y fully cw
- INTENSITY +7.0V at Test Point A5TP1

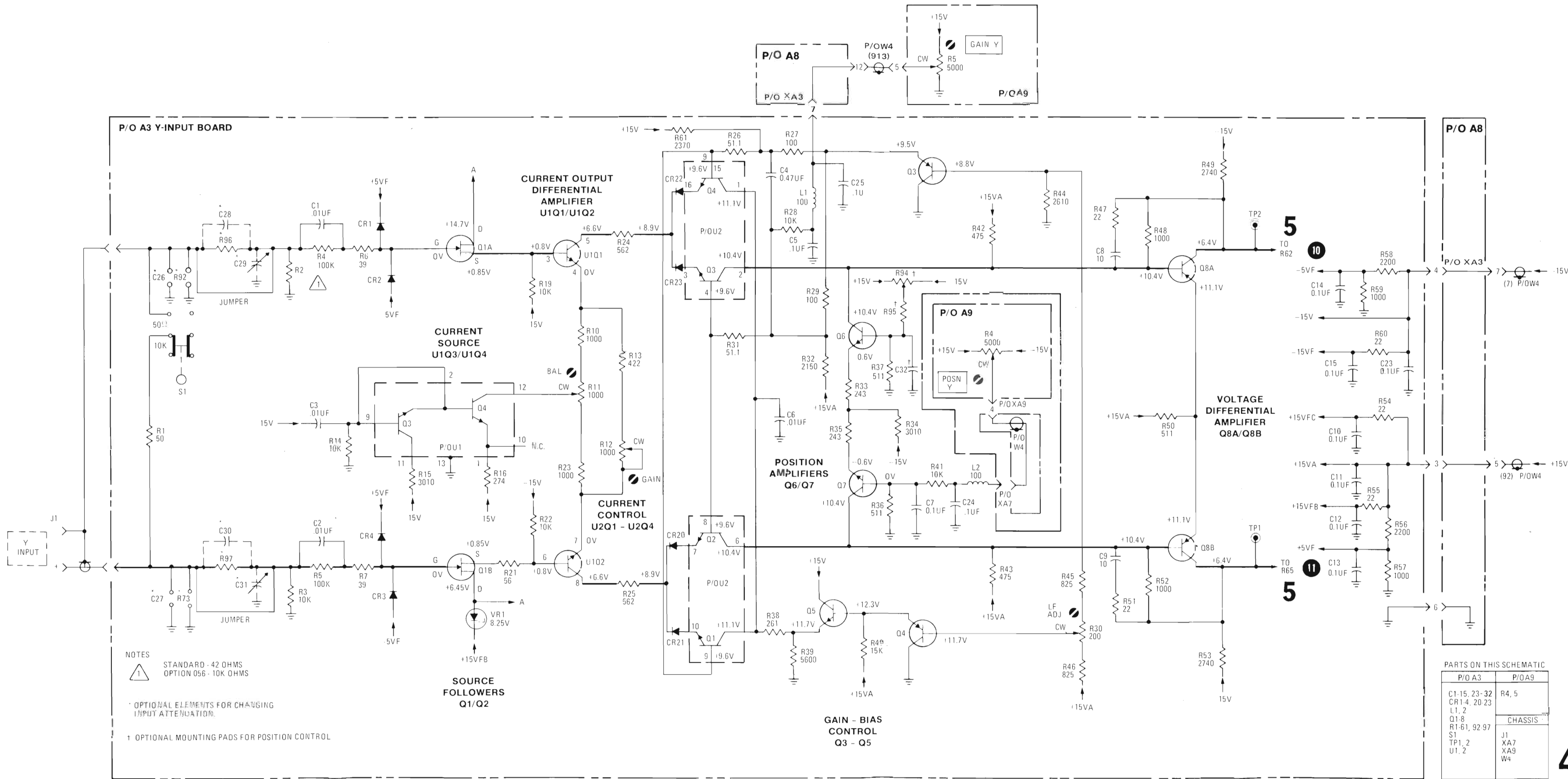
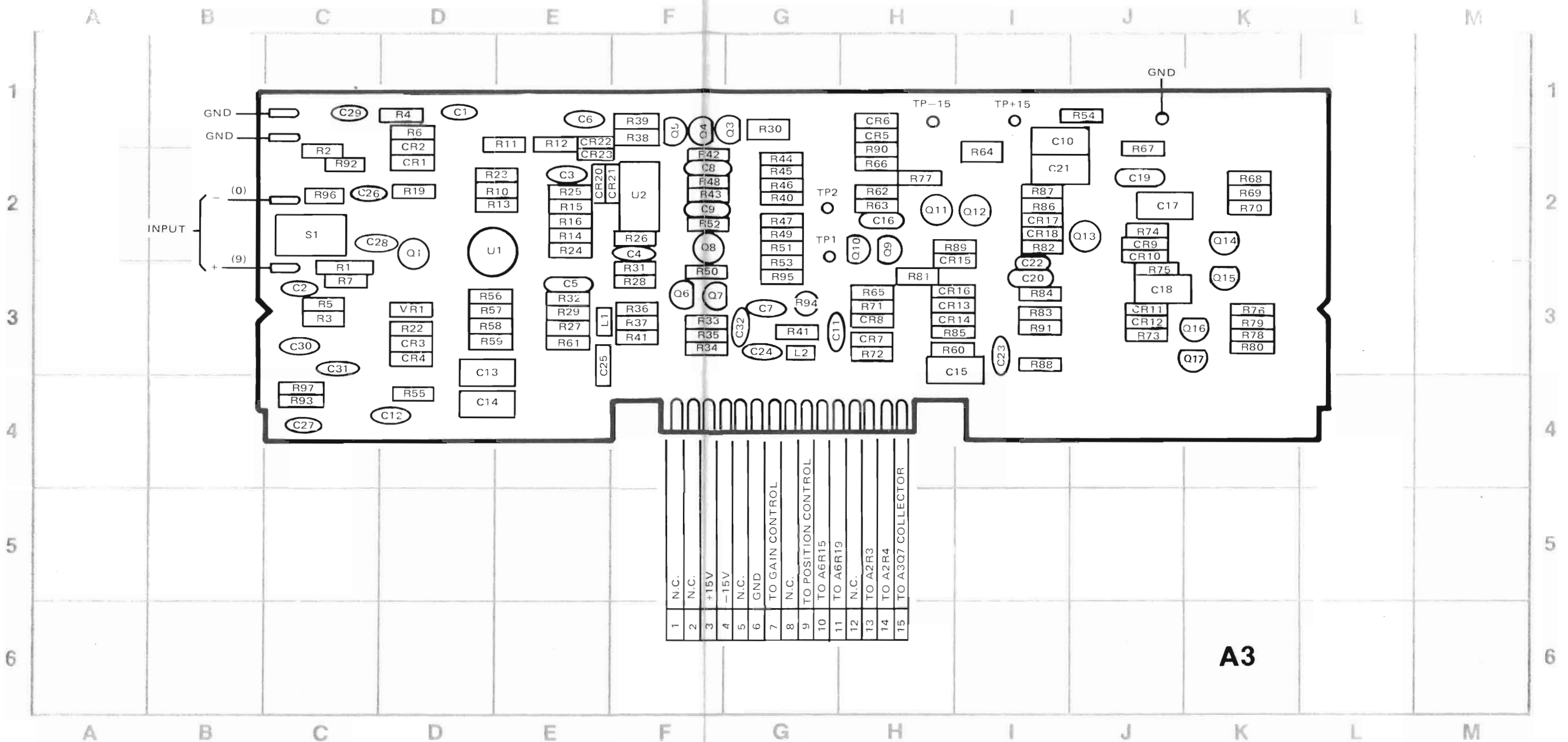


Figure 8-9.
Y-axis Amplifier Schematic 4
8-13



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	D-1	C17	J-2	CR1	D-2	CR17	I-2	Q9	H-2	R10	E-2	R30	G-1	R46	G-2	R62	H-2	R78	K-3	R94	G-3		
C2	C-3	C18	J-3	CR2	D-2	CR18	I-2	Q10	H-2	R11	E-2	R31	F-3	R47	G-2	R63	H-2	R79	K-3	R95	G-3		
C3	E-2	C19	J-2	CR3	D-3	CR20	E-2	Q11	H-2	R12	E-2	R32	E-3	R48	F-2	R64	I-2	R80	K-3	R96	C-2		
C4	F-2	C20	I-3	CR4	D-3	CR21	E-2	Q12	I-2	R13	E-2	R33	F-3	R49	G-2	R65	H-3	R81	H-3	R97	C-4		
C5	E-3	C21	I-2	CR5	H-1	CR22	E-2	Q13	J-2	R14	E-2	R34	F-3	R50	F-3	R66	H-2	R82	I-2	S1	C-2		
C6	E-1	C22	I-3	CR6	H-1	CR23	E-2	Q14	K-2	R15	E-2	R35	F-3	R51	G-2	R67	J-2	R83	I-3	TP1	G-2		
C7	G-3	C23	I-3	CR7	H-3	L1	E-3	Q15	K-3	R16	E-2	R36	F-3	R52	F-2	R68	K-2	R84	I-3	TP2	G-2		
C8	F-2	C24	G-3	CR8	H-3	L2	G-4	Q16	K-3	R19	D-2	R37	F-3	R53	G-3	R69	K-2	R85	H-3	TP-15	H-1		
C9	F-2	C25	E-4	CR9	J-2	Q1	D-2	Q17	K-3	R22	D-3	R38	F-1	R54	J-1	R70	K-2	R86	I-2	TP+15	I-1		
C10	I-2	C26	C-2	CR10	J-3	Q2	D-3	R1	C-3	R23	E-2	R39	F-1	R55	D-4	R71	H-3	R87	I-2	U1	D-2		
C11	G-3	C27	C-4	CR11	J-3	Q3	G-1	R2	C-2	R24	E-2	R40	G-2	R56	D-3	R72	H-3	R88	I-3	U2	F-2		
C12	C-4	C28	C-2	CR12	J-3	Q4	F-1	R3	C-3	R25	E-2	R41	G-3	R57	D-3	R73	J-3	R89	H-2				
C13	D-4	C29	C-1	CR13	I-3	Q5	F-1	R4	D-1	R26	F-2	R42	F-2	R58	D-3	R74	J-2	R90	H-2				
C14	D-4	C30	C-3	CR14	I-3	Q6	F-3	R5	C-3	R27	E-3	R43	F-2	R59	D-3	R75	J-3	R91	I-3				
C15	H-3	C31	C-3	CR15	I-3	Q7	F-3	R6	D-1	R28	F-3	R44	G-2	R60	H-3	R76	K-3	R92	C-2				
C16	H-2	C32	G-3	CR16	I-3	Q8	F-2	R7	C-3	R29	E-3	R45	G-2	R61	E-3	R77	H-2	R93	C-4				

Figure 8-10. A3 Component Locator

Table 8-6. Y-axis Preamplifier Measurement Conditions

DC VOLTAGE MEASUREMENT CONDITIONS

1. Disconnect all inputs from X-, Y-, and Z-INPUT connectors.
2. Adjustments:

Z-axis GAIN (A5R20) fully cw

Z-axis BAL (A5R65)..... Equal voltages at emitters of A5Q3 and A5Q4
3. Control settings:

POSN X Centered

POSN Y Centered

GAIN X fully cw

GAIN Y fully cw

INTENSITY+7.0V at Test Point A5TP1

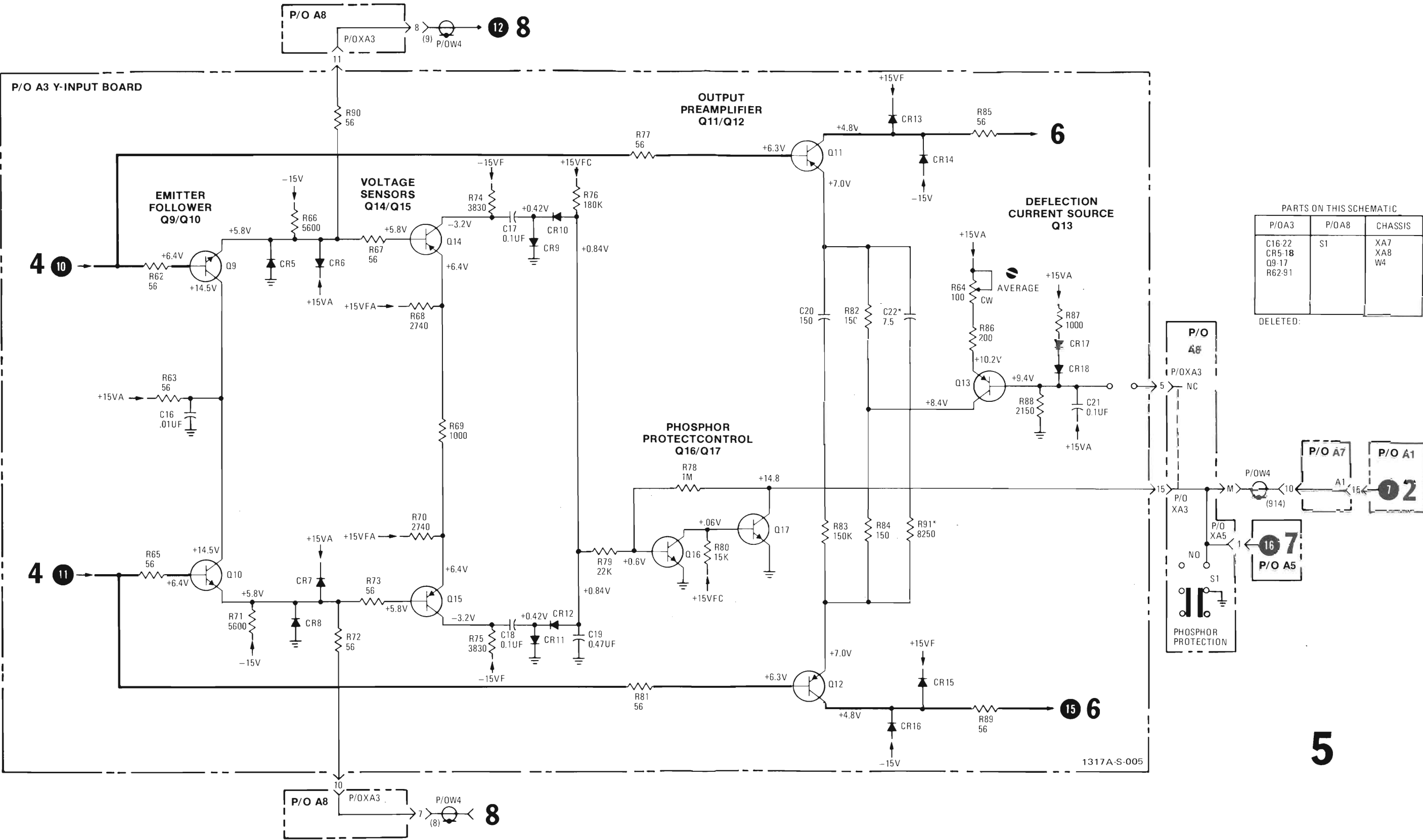


Figure 8-11.
Y-axis Amplifier
8-15

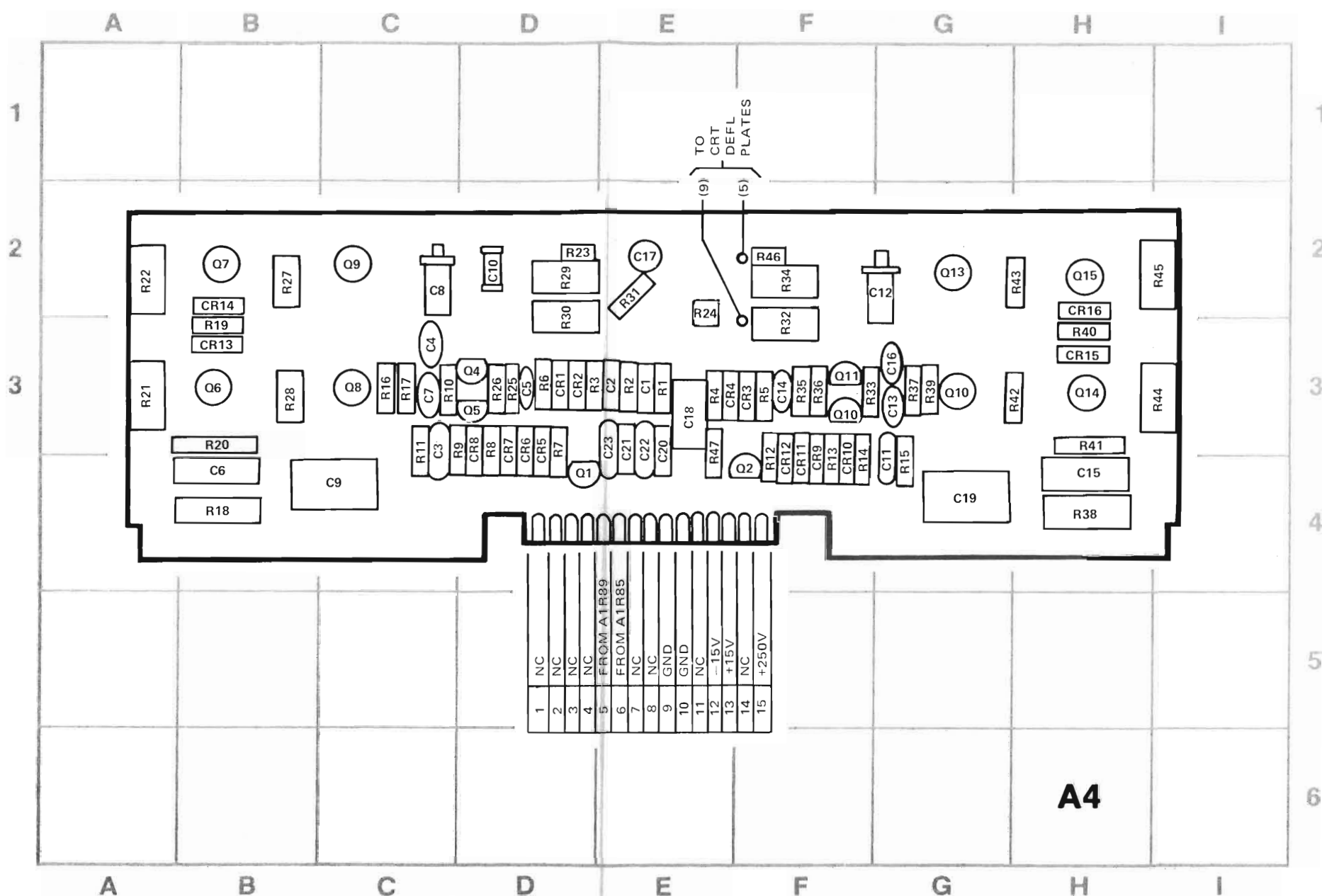


Figure 8-12. A4 Component Locator

Table 8-9. Dynamic Focus Measurement Conditions

- DC VOLTAGE MEASUREMENT CONDITIONS**
1. Disconnect all inputs from X-, Y-, and Z-INPUT connectors.
 2. Adjustments:
Z-axis GAIN (A5R20) fully cw
Z-axis BAL (A5R65) Equal voltages at emitters of A5Q3 and A5Q4
 3. Control settings:
POSN X Centered
POSN Y Centered
GAIN X fully cw
GAIN Y fully cw
INTENSITY +7.0V at Test Point A5TP1

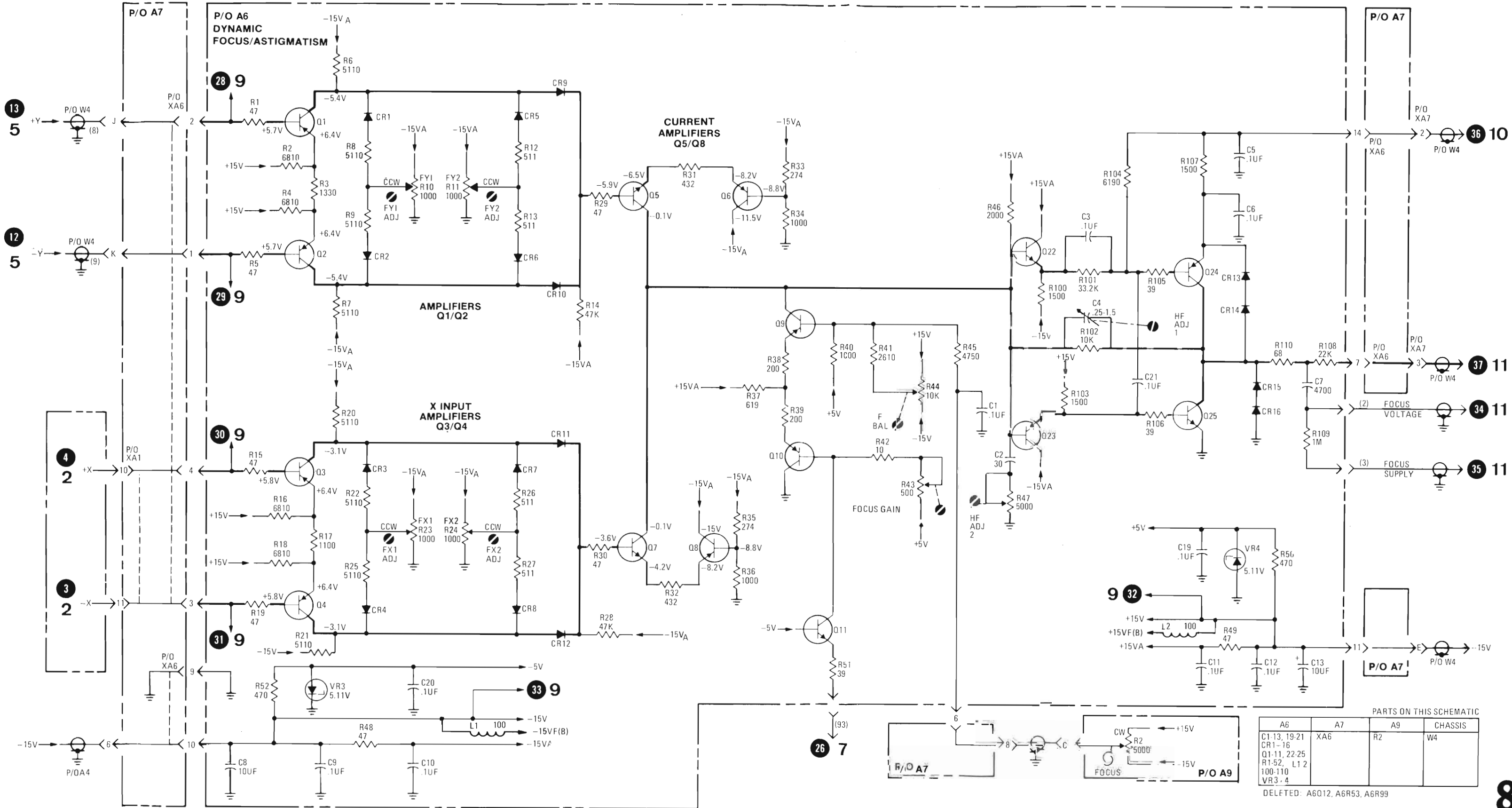


Table 8-10. Dynamic Astigmatism Measurement Conditions

DC VOLTAGE MEASUREMENT CONDITIONS

1. Disconnect all inputs from X-, Y-, and Z-INPUT connectors.
2. Adjustments:

Z-axis GAIN (A5R20) fully cw

Z-axis BAL (A5R65)..... Equal voltages at emitters of A5Q3 and A5Q4
3. Control settings:

POSN X Centered

POSN Y Centered

GAIN X fully cw

GAIN Y fully cw

INTENSITY+7.0V at Test Point A5TP1

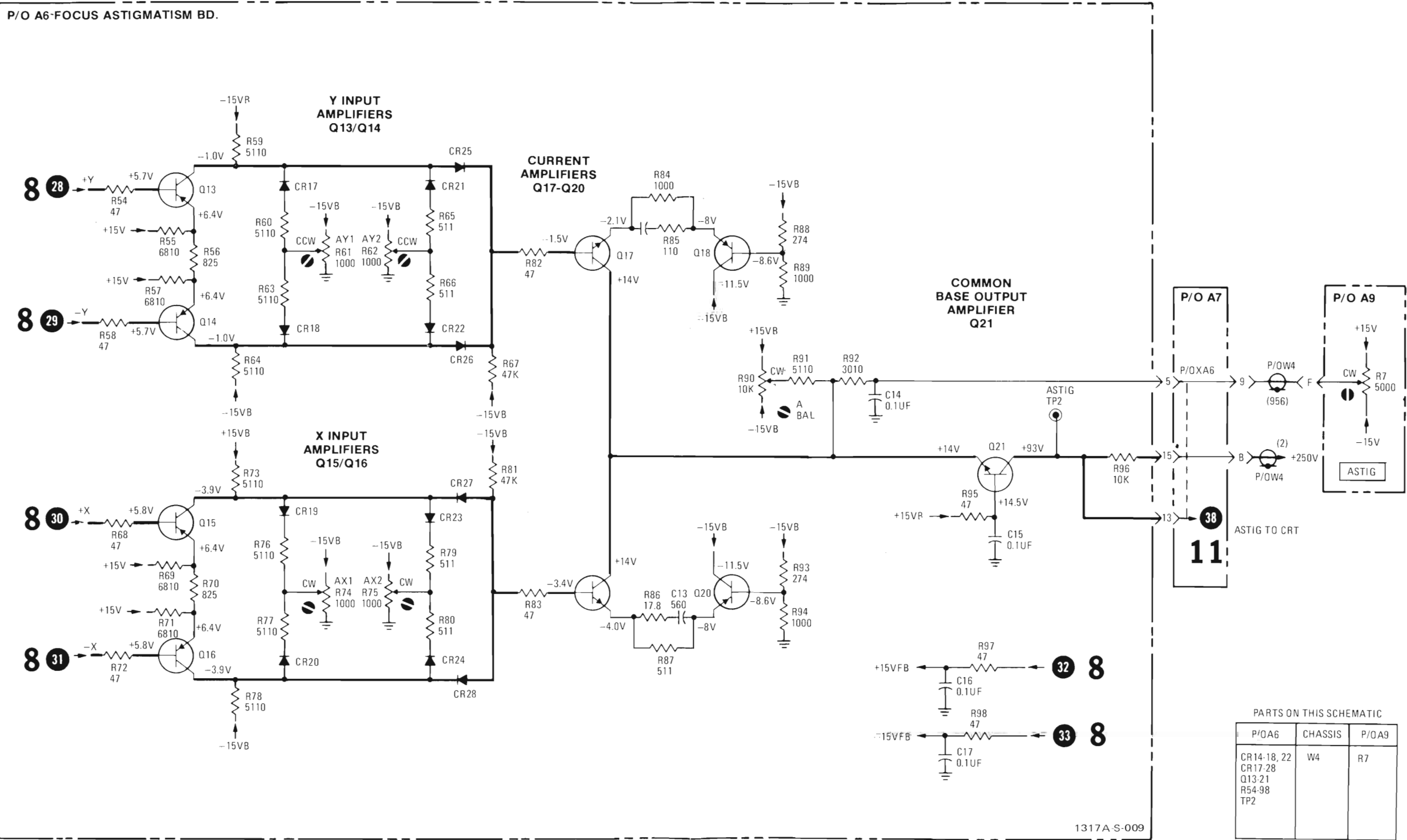


Figure 8-18.
Astigmatism Circuit
8-23

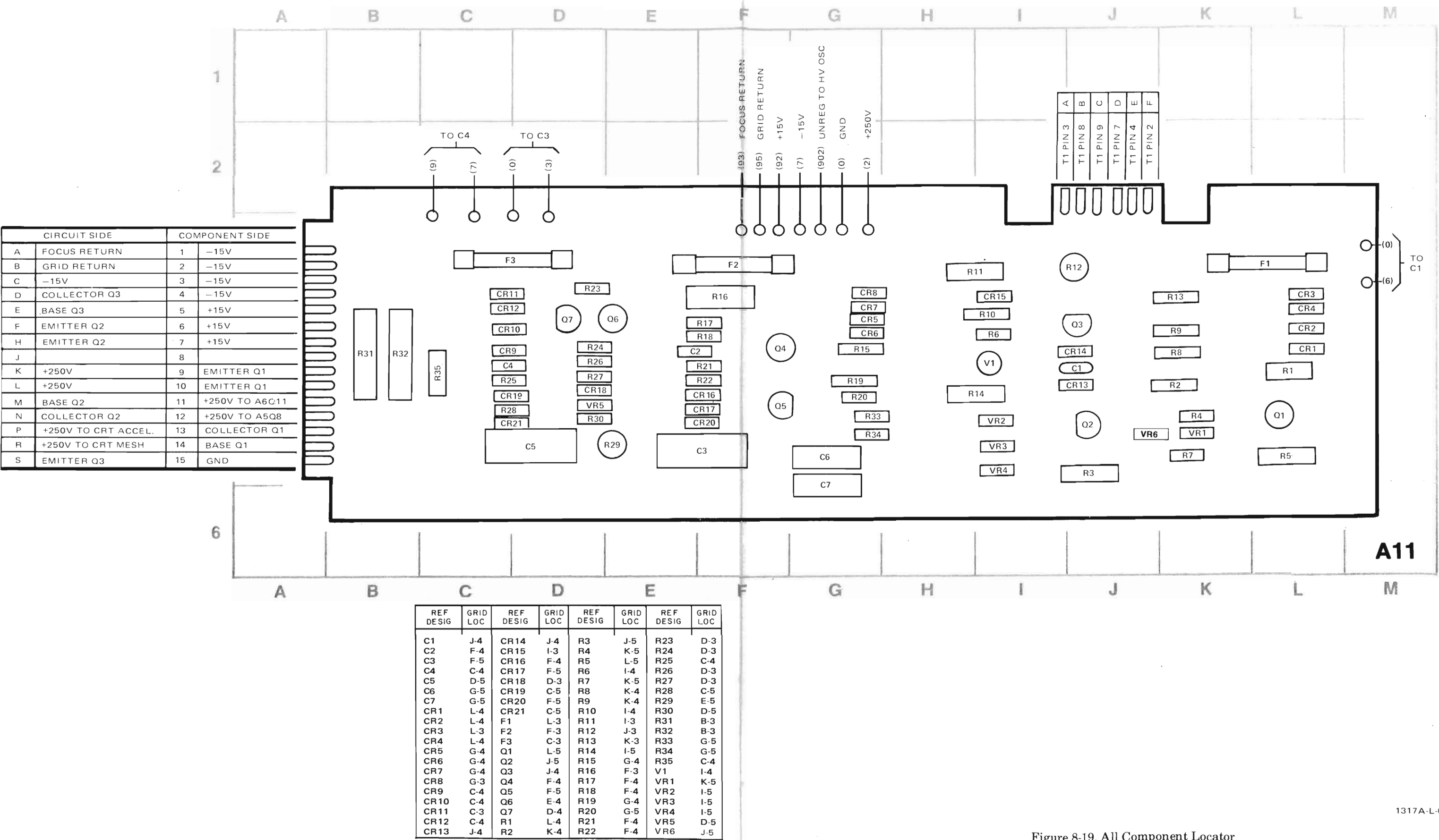


Figure 8-19. All Component Locator

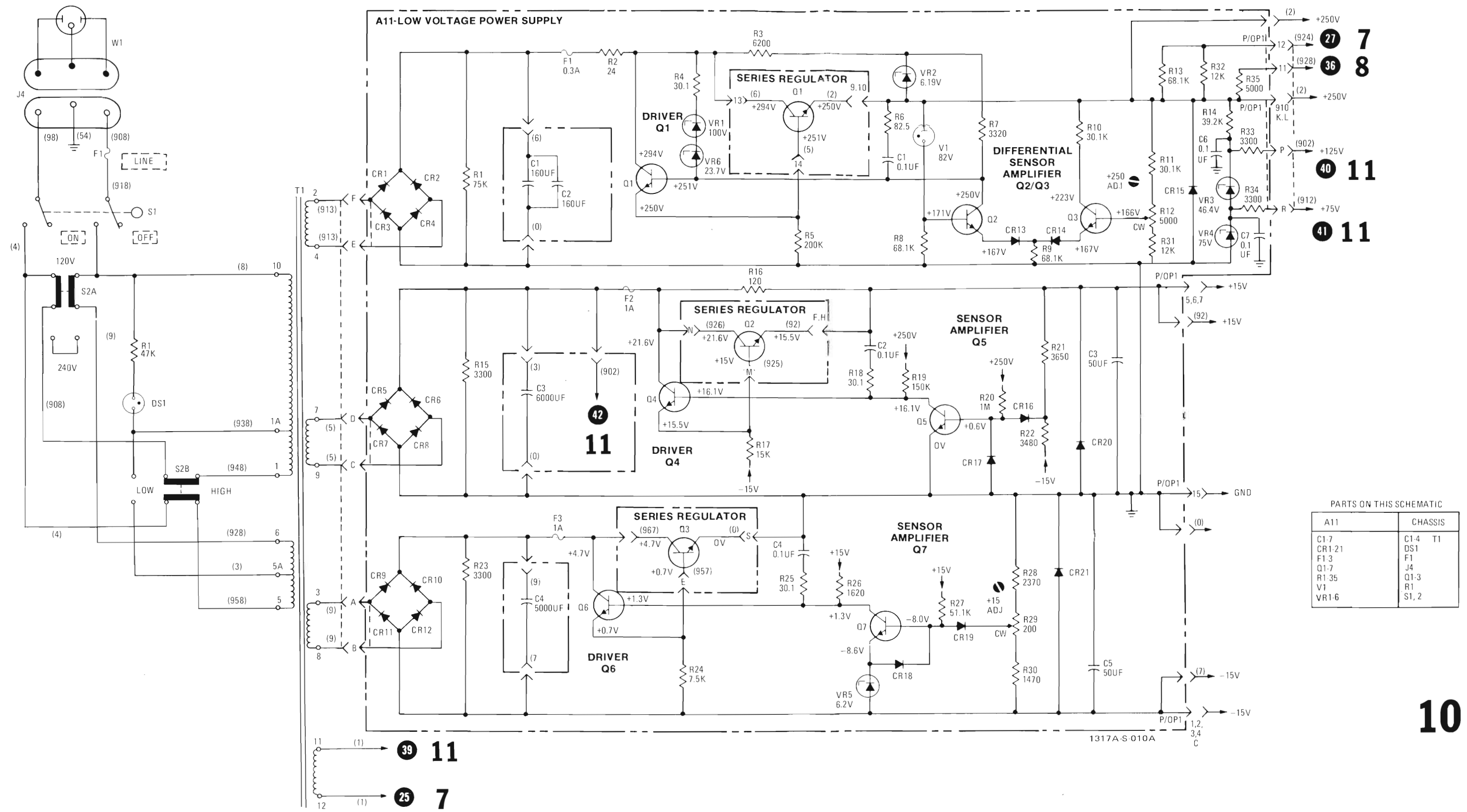


Figure 8-20.
Low Voltage Power Supply
8-25

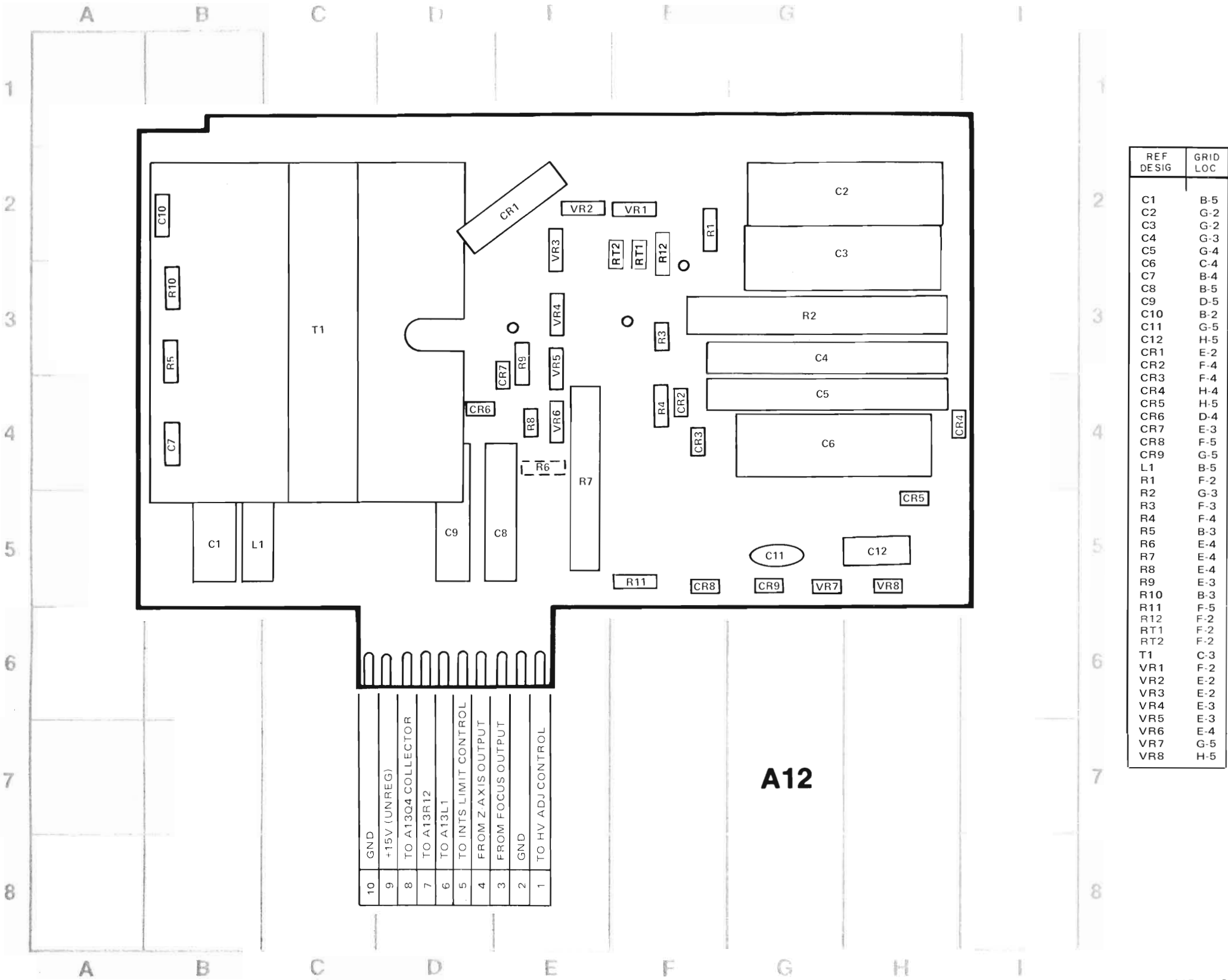


Figure 8-21. A12 Component Locator

1317A-L-030

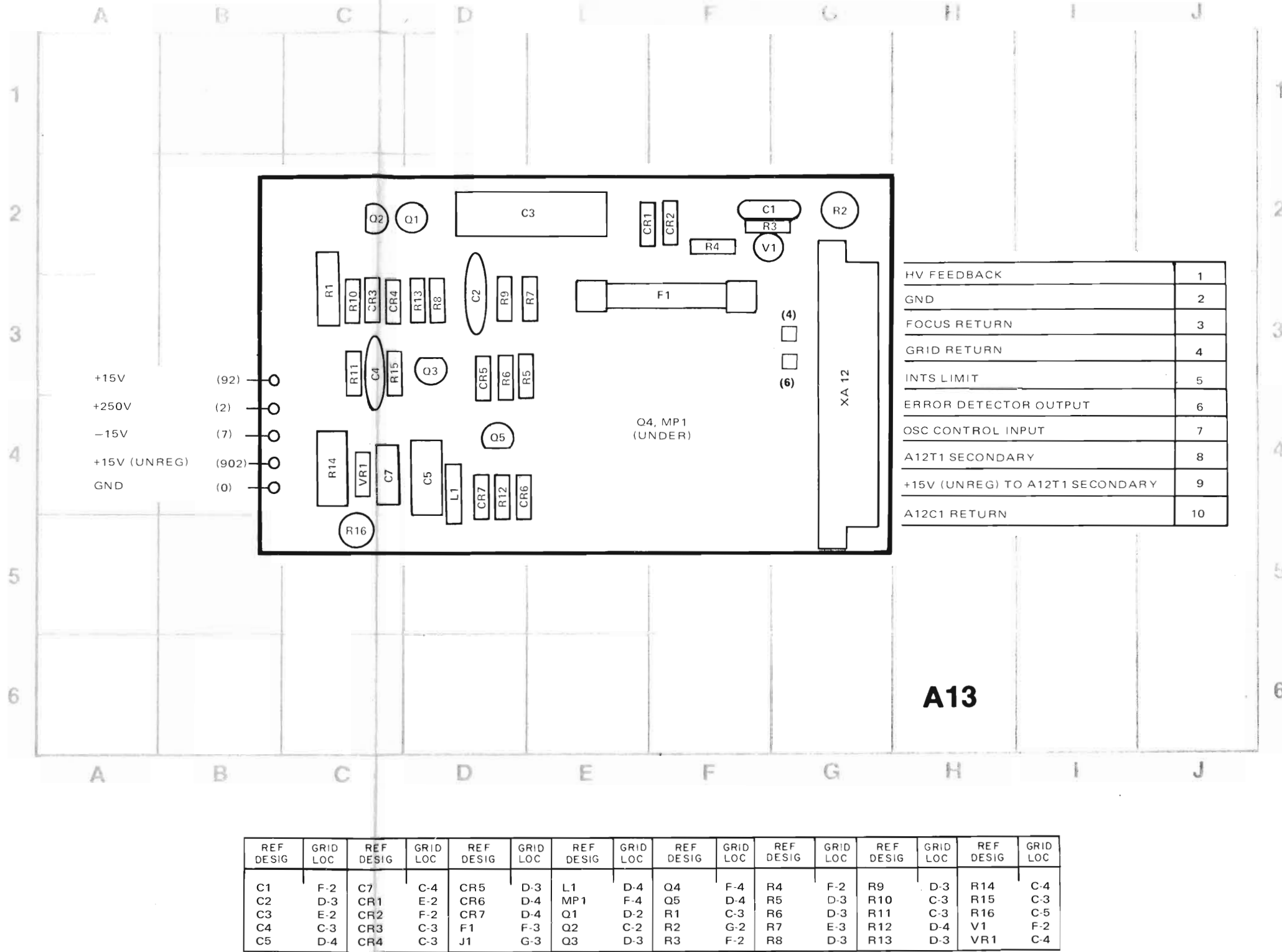


Figure 8-22. A13 Component Locator

1317A-L-031

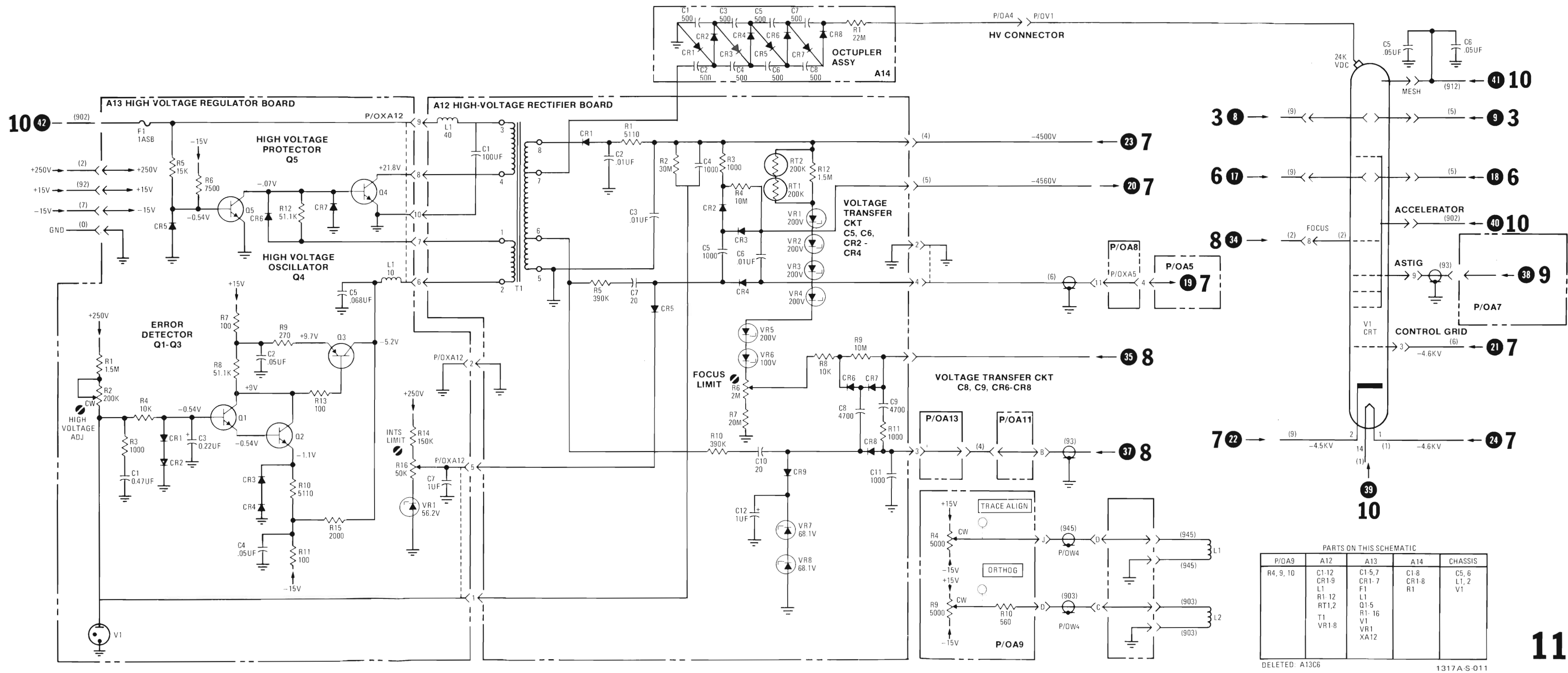
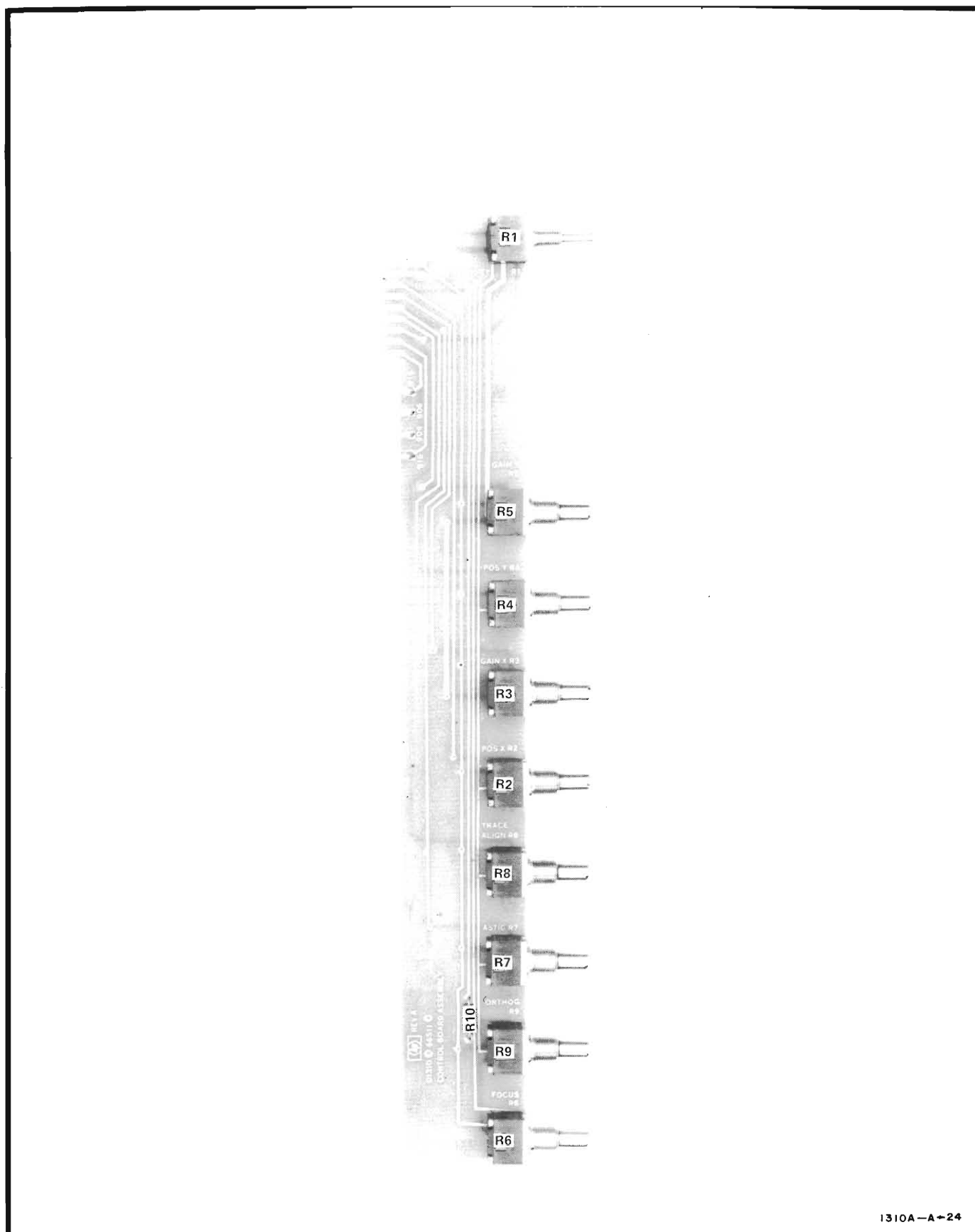


Figure 8-23.
High Voltage Power Supply
8-27



1310A-A-24

Figure 8-24 A9 Component Identification

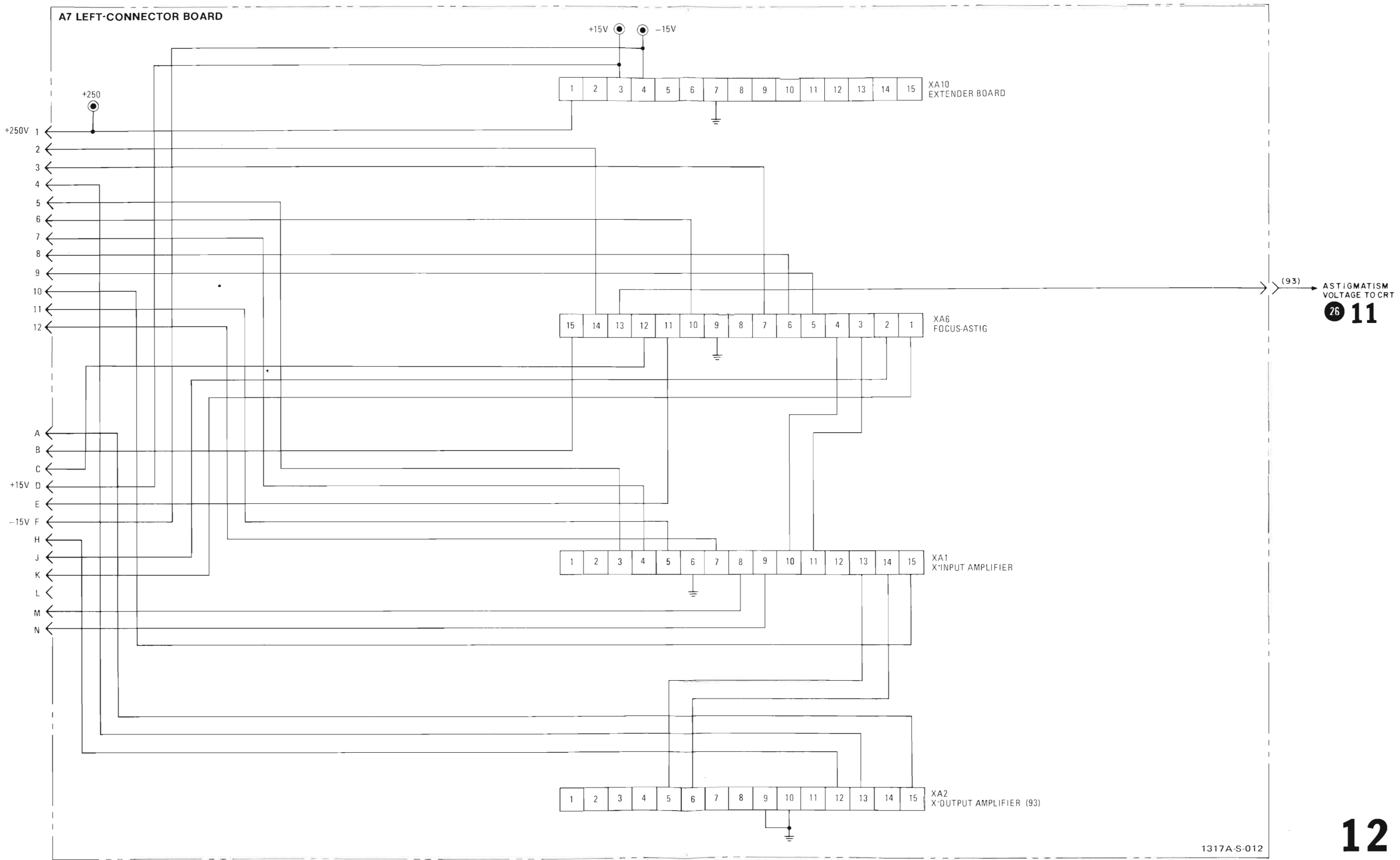
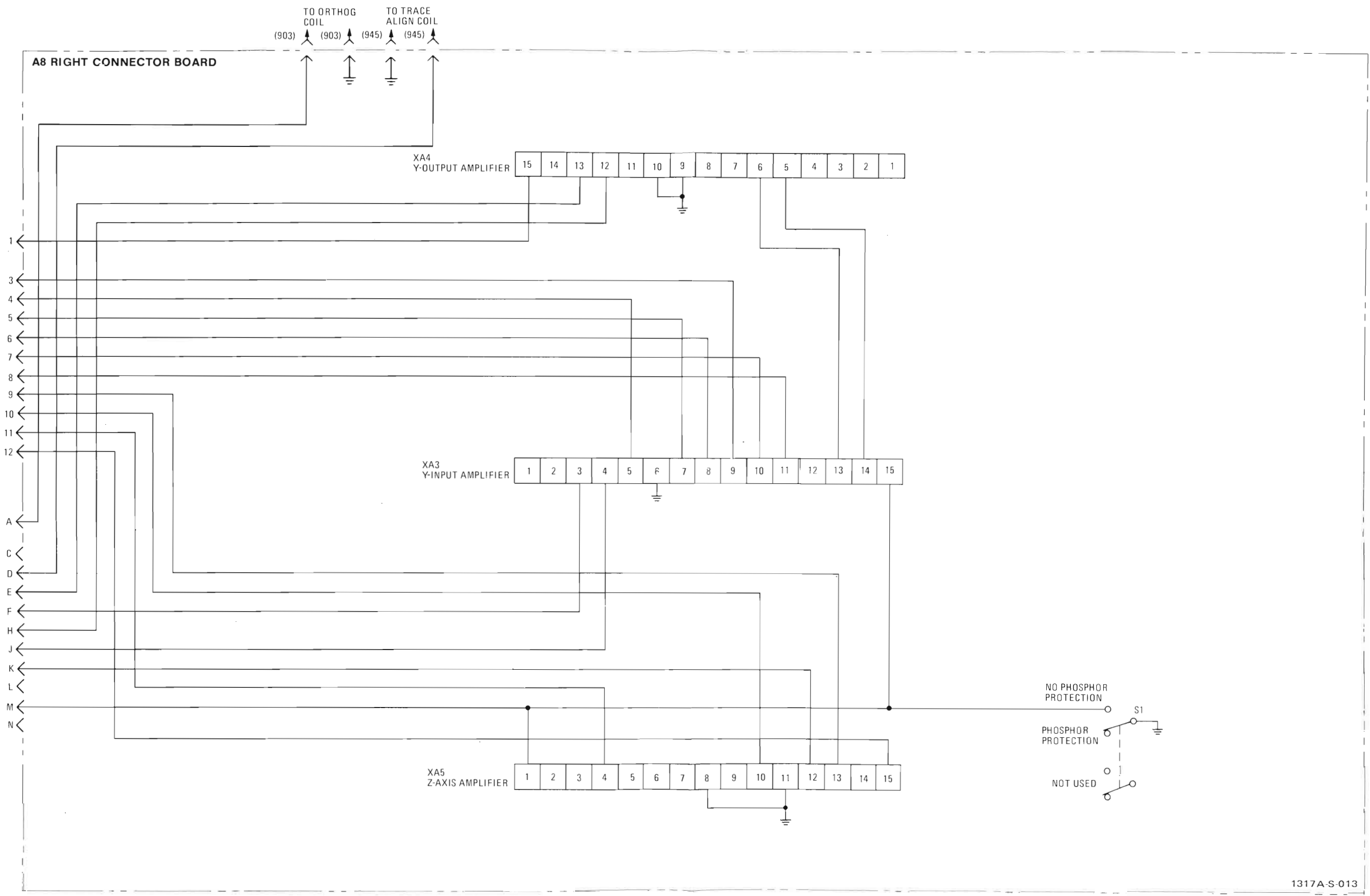


Figure 8-25.
A7 Left-Connector Board Schematic 12
8-29/(8-30 blank)



1317A-S-013

Figure 8-26.
A8 Right-Connector Board Schematic 13
8-31/(8-32 blank)



CATHODE-RAY TUBE WARRANTY

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

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

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

Attention: CRT QA

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

SHIPPING INSTRUCTIONS

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

1. Carefully wrap the tube in 1/4 inch thick cotton batting or other soft padding material.
2. Wrap the above in heavy kraft paper.
3. Pack wrapped tube in a rigid container which is at least 4 inches larger than the tube in each dimension.
4. Surround the tube with at least 4 inches of packed excelsior or similar shock absorbing material; be sure the packing is tight all around the tube.

Thank you,

CRT Department

5950-7124

CATHODE-RAY TUBE FAILURE REPORT

DATE _____

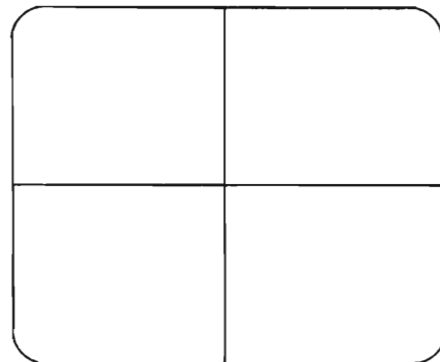
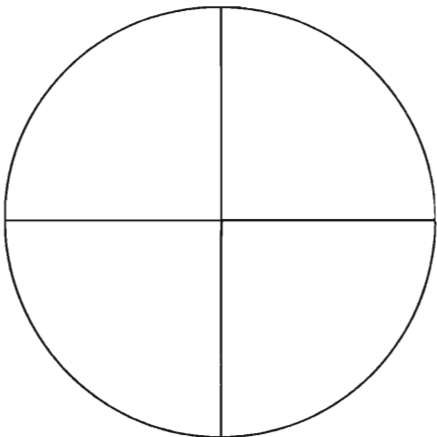
FROM:

NAME _____

COMPANY _____

ADDRESS _____

1. HP instrument MODEL NO. _____
2. HP instrument SERIAL NO. _____
3. CRT SERIAL NO. _____
4. Please describe the failure and, if possible, show the trouble on the appropriate CRT face below.



5. Warranty claimed? Yes _____ No _____

6. HP Sales/Service Office _____ Repair Order No. _____

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S-431 41 Mölndal
Tel: (031) 27 68 00. 01
Telex: Via Bromma

SWITZERLAND
Hewlett-Packard (Schweiz) AG
Zürcherstrasse 20
P.O. Box 64
CH-8952 Schlieren Zurich
Tel: (01) 98 18 21/24
Cable: HPAG CH
Telex: 53933 hpag ch

Hewlett-Packard (Schweiz) AG
9, Chemin Louis-Pictet
CH-1214 Vernier—Genève
Tel: (022) 41 4950
Cable: HEWPAKSA Geneva
Telex: 27 333 hpsa ch

TURKEY
Telekom Engineering Bureau
Saglik Sok No. 15/1
Ayaspa-Beyoglu
TB-Istanbul
Tel: 49 40 40
Cable: TELEMATON Istanbul

UNITED KINGDOM
Hewlett-Packard Ltd.
224 Bath Road
GB-Slough, SL1 4 DS, Bucks
Tel: Slough (0753) 33341
Cable: HEWPIE Slough
Telex: 484813

Hewlett-Packard Ltd.
"The Graftons"
Stamford New Road
GB-Altrincham, Cheshire
Tel: (061) 928-9021
Telex: 668068

Hewlett-Packard, Ltd.
c/o Makro
South Service Wholesale Centre
Amber Way
Halesowen Industrial Estate
GB-Wolverhampton
Tel: Birmingham 7860

Hewlett-Packard Ltd's registered
address for V.A.T. purposes
only:
70, Finsbury Pavement
London, EC2A1SX
Registered No: 690597

**SOCIALIST COUNTRIES
PLEASE CONTACT:**
Hewlett-Packard Ges.m.b.H.
Handelska 52/3
P.O. Box 7
A-1205 Vienna
Ph: (0222) 33 66 06 to 09
Cable: HEWPAK Vienna
Telex: 75923 hewpak a

**ALL OTHER EUROPEAN
COUNTRIES CONTACT:**
Hewlett-Packard S.A.
Rue du Bois-du-Lan 7
P.O. Box 85
CH-1217 Meyrin 2 Geneva
Switzerland
Tel: (022) 41 54 00
Cable: HEWPAKSA Geneva
Telex: 2 24 86

AFRICA, ASIA, AUSTRALIA

ANGOLA
Teletra-Empresa Técnica
de Equipamentos Eléctricos
SARL
Rua de Barbosa, Rodrigues,
42-1°, D1°
P.O. Box 6487
Luanda
Cable: ELECTRA Luanda

AUSTRALIA
Hewlett-Packard Australia
Pty. Ltd.,
31-51 Joseph Street
Victoria, 3130
Tel: 89 6351
Cable: HEWPAK Melbourne
Telex: 31 024

Hewlett-Packard Australia
Pty. Ltd.,
31 Bridge Street
Pymble,
New South Wales, 2073
Tel: 449 6566
Telex: 21561
Cable: HEWPAK Sydney

Hewlett-Packard Australia
Pty. Ltd.,
97 Churchill Road
Prospect 5082
South Australia
Tel: 44 8151
Cable: HEWPAK Adelaide

Hewlett-Packard Australia
Pty. Ltd.,
Casablanca Buildings
196 Agouja Terrace
Perth, W.A. 6000
Tel: 25-6800
Cable: HEWPAK Perth

Hewlett-Packard Australia
Pty. Ltd.,
10 Woolley Street
P.O. Box 191
Dickson A.C.T. 2602
Tel: 49 8194
Cable: HEWPAK Canberra ACT

Hewlett-Packard Australia
Pty. Ltd.,
2nd Floor, 49 Gregory Terrace
Brisbane, Queensland, 4000
Tel: 29 1544

CEYLON
United Electricals Ltd.
P.O. Box 581
60, Park St.
Colombo 2
Tel: 26596
Cable: HOTPOINT Colombo

CYPRUS
Kypronic
19 Gregorios & Xenopoulos Road
P.O. Box 1152
CY-Nicosia
Tel: 45628/29
Cable: KYPRONICS PANDEHIS

ETHIOPIA
African Salespower & Agency
Private Ltd., Co.
P.O. Box 718
58/59 Cunningham St.
Addis Ababa
Tel: 12285
Cable: ASACO Addisababa

HONG KONG
Schmidt & Co. (Hong Kong) Ltd.
P.O. Box 297
Connaught Centre
39th Floor
Connaught Road, Central
Hong Kong
Tel: 240168, 232735
Telex: HX4766
Cable: SCHMIDTCO Hong Kong

INDIA
Blue Star Ltd.
Kasturi Buildings
Jamshedji Tata Rd.
Bombay 400 020
Tel: 29 50 21
Telex: 3751
Cable: BLUEFROST

Blue Star Ltd.
Sahas
414/2 Vir Savarkar Marg
Prabhadevi
Bombay 400 025
Tel: 45 78 87
Telex: 4093
Cable: FROSTBLUE

Blue Star Ltd.
Band Box House
Prabhadevi
Bombay 400 025
Tel: 45 73 01
Telex: 3751
Cable: BLUESTAR

Blue Star Ltd.
14/40 Civil Lines
Kampur 208 001
Tel: 6 88 82
Cable: BLUESTAR

Blue Star Ltd.
7 Hare Street
P.O. Box 506
Calcutta 700 001
Tel: 23-0131
Telex: 655
Cable: BLUESTAR

Blue Star Ltd.
Blue Star House,
34 Ring Road
Lajpat Nagar
New Delhi 110 024
Tel: 62 32 76
Telex: 2463
Cable: BLUESTAR

Blue Star Ltd.
19 Gregorios & Xenopoulos Road
P.O. Box 1152
CY-Nicosia
Tel: 45628/29
Cable: KYPRONICS PANDEHIS

Blue Star, Ltd.
1-11/17/1
Sarajini Devi Road
Secunderabad 500 003
Tel: 7 63 91, 7 73 93
Cable: BLUEFROST
Telex: 459

Blue Star, Ltd.
23/24 Second Line Beach
Madras 600 001
Tel: 23954
Telex: 379
Cable: BLUESTAR

Blue Star, Ltd.
Nathraj Mansions
2nd Floor Bistapur
Jamshedpur 831 001
Tel: 38 04
Cable: BLUESTAR
Telex: 240

INDONESIA
Bah Bolon Trading Coy. N.V.
Djalang Merdeka 29
Bandung
Tel: 4915, 51560
Cable: ILMU
Telex: 08-809

IRAN
Multi Corp International Ltd.
Avenue Soraya 130
P.O. Box 1212
JR-Teheran
Tel: 83 10 35-39
Cable: MULTICORP Tehran
Telex: 2893 MCI TN

ISRAEL
Electronics & Engineering
Div. of Motorola Israel Ltd.
17 Amlinadav Street
Tel-Aviv
Tel: 36941 (3 lines)
Cable: BASTEL Tel-Aviv
Telex: 33569

JAPAN
Yokogawa-Hewlett-Packard Ltd.
Ohashi Building
1-59-1 Yoyogi
Shibuya-ku, Tokyo
Tel: 03-370-2281/92
Telex: 232-20247W
Cable: YHPMARKET TOK 23-724

Yokogawa-Hewlett-Packard Ltd.
Nishi Ibaragi Bldg.
2-2-8 Kasuga
Ibaragi-Shi
Osaka
Tel: (0726) 23-1641
Telex: 5332-385 YHP OSAKA

Yokogawa-Hewlett-Packard Ltd.
Nakamo Building
No. 24 Kamisazima-cho
Nakamura-ku, Nagoya City
Tel: (052) 571-5171

Yokogawa-Hewlett-Packard Ltd.
Nitto Bldg.
2-4-2 Shinohara-Kita
Kohoku-ku
Yokohama 222
Tel: 045-432-1504
Telex: 382-3204 YHP YOK

Yokogawa-Hewlett-Packard Ltd.
Chuo Bldg.
Rm. 603 3,
2-Chome
IZUMI-CHO,
Mito, 310
Tel: 0292-25-7470

KENYA
Kenya Kinetics
P.O. Box 18311
Nairobi, Kenya
Tel: 57726
Cable: PROTON

KOREA
American Trading Company
Korea,
I.P.O. Box 1103
Dae Kyung Bldg., 8th Floor
107 Sejong-Ro
Chongro-Ku, Seoul
Tel: (4 lines) 73-8924-7
Cable: AMTRACO Seoul

LEBANON
Constantin E. Macridis
P.O. Box 7213
RI-Beirut
Tel: 220846
Cable: ELECTRONUCLEAR Beirut

MALAYSIA
MECOMB Malaysia Ltd.
2 Lorong 13/6A
Section 13
Petaling Jaya, Selangor
Cable: MECONB Kuala Lumpur

MOZAMBIQUE
A.N. Gonçalves, Lda.
162, Av. D. Luis
P.O. Box 107
Lourenço Marques
Tel: 27091, 27114
Telex: 6-203 Negon Mo
Cable: NEGON

NEW ZEALAND
Hewlett-Packard (N.Z.) Ltd.
94-96 Dixon Street
P.O. Box 9443
Courtenay Place,
Wellington
Tel: 59-559
Telex: 3898
Cable: HEWPAK Wellington

Hewlett-Packard (N.Z.) Ltd.
Pakuranga Professional Centre
267 Pakuranga Highway
Box 51092
Pakuranga
Tel: 565-951
Cable: HEWPAK, Auckland

NIGERIA
The Electronics Instrumenta-
tions Ltd. (TEIL)
18 Agege Motor Rd., Mushin
P.O. Box 6845
Lagos
Cable: THETEL Lagos

The Electronics Instrumenta-
tions Ltd. (TEIL)
38 Chung Shiao West Road
Sec. 1
Ibadan
Tel: 23225
Cable: THETEL Ibadan

PAKISTAN
Mushko & Company, Ltd.
Osman Chambers
Abdullah Haroon Road
Karachi 3
Tel: 511027, 512927
Cable: COOPERATOR Karachi
Mushko & Company, Ltd.
38B, Satellite Town
Rawalpindi
Tel: 41924
Cable: FEMUS Rawalpindi

PHILIPPINES
Electromex, Inc.
6th Floor, Amalgamated
Development Corp. Bldg.
Ayala Avenue, Makati, Rizal
C.C.P.O. Box 1028
Makati, Rizal
Tel: 86-18-87, 87-76-77,
87-86-88, 87-18-45, 88-91-71,
83-81-12, 83-82-12
Cable: ELEMEX Manila

SINGAPORE
Mechanical & Combustion
Engineering Company Pte.,
Ltd.
10-12, Jalan Kilang
Red Hill Industrial Estate
Singapore, 3
Tel: 647151 (7 lines)
Cable: MECOMB Singapore

Hewlett-Packard Far East
Area Office
P.O. Box 87
Alexandra Post Office
Singapore 3
Tel: 633022
Cable: HEWPAK SINGAPORE

SOUTH AFRICA
Hewlett-Packard South Africa
(Pty.), Ltd.
Hewlett-Packard House
Daphne Street, Wendywood,
Sandton, Transvaal 2001
Tel: 407641 (five lines)

Hewlett-Packard South Africa
(Pty.), Ltd.
Breechle House
Bree Street
Cape Town
Tel: 2-6941/2/3
Cable: HEWPAK Cape Town
Telex: 0006 CT

Hewlett-Packard South Africa
(Pty.), Ltd.
41 Ridge Road, Durban
P.O. Box 99
Overport, Natal
Tel: 88-6102
Telex: 567554
Cable: HEWPAK

TAIWAN
Hewlett-Packard Taiwan
38 Chung Shiao West Road
Sec. 1
Overseas Insurance
Corp. Bldg. 7th Floor
Taipei
Tel: 389160, 1, 2, 375121,
Ext. 240-249
Telex: 17924 HEWPAK
Cable: HEWPAK Taipei

THAILAND
UNIMESA Co., Ltd.
Chongkoine Building
56 Surinwongse Road
Bangkok
Tel: 37956, 31300, 31307,
37540
Cable: UNIMESA Bangkok

UGANDA
Uganda Tele-Electric Co., Ltd.
P.O. Box 4449
Kampala
Tel: 57279
Cable: COMCO Kampala

VIETNAM
Peninsular Trading Inc.
P.O. Box H-3
216 Hien-Vuong
Saigon
Tel: 20-805, 93398
Cable: PENTRA, SAIGON 242

ZAMBIA
R. J. Tilbury (Zambia) Ltd.
P.O. Box 2792
Lusaka
Zambia, Central Africa
Tel: 37393
Cable: ARIAYTEE, Lusaka

**MEDITERRANEAN AND
MIDDLE EAST COUNTRIES
NOT SHOWN PLEASE
CONTACT:**
Hewlett-Packard
Co-ordination Office for
Mediterranean and Middle
East Operations
Piazza Marconi 25
I-00144 Rome-Eur, Italy
Tel: (6) 59 40 29
Cable: HEWPAKIT Rome
Telex: 61514

**OTHER AREAS NOT
LISTED, CONTACT:**
Hewlett-Packard
Export Trade Company
3200 Hillview Ave.
Palo Alto, California 94304
Tel: (415) 493-1501
TWX: 910-373-1267
Cable: HEWPAK Palo Alto
Telex: 034-8300, 034-8493

**OTHER AREAS NOT
LISTED, CONTACT:**
Hewlett-Packard
Export Trade Company
3200 Hillview Ave.
Palo Alto, California 94304
Tel: (415) 493-1501
TWX: 910-373-1267
Cable: HEWPAK Palo Alto
Telex: 034-8300, 034-8493

**OTHER AREAS NOT
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Hewlett-Packard
Export Trade Company
3200 Hillview Ave.
Palo Alto, California 94304
Tel: (415) 493-1501
TWX: 910-373-1267
Cable: HEWPAK Palo Alto
Telex: 034-8300, 034-8493