OPERATING AND SERVICE MANUAL

VARIABLE PERSISTENCE DISPLAY MODEL 1335A

(Including Options: 100, 101, 105, 106, 110, 200, 201, 205, 206, 210, 215, 300, 301, 302, 303, 304, 310, 315, 322, 323, 326, 330, 561, 562, 580, and 631.)

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed 1514A.

For additional important information about serial numbers, see INSTRUMENTS COVERED BY MANUAL in Section I.

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.

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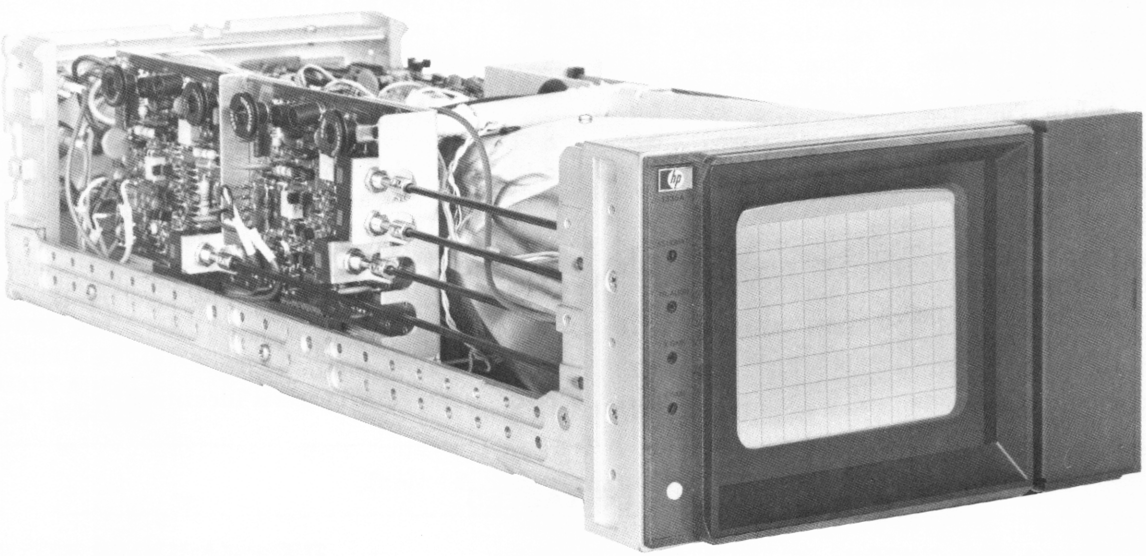


Figure 1-1. Model 1335A Variable Persistence Display

SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. This Operating and Service Manual contains information required to install, operate, test, adjust, and service the Hewlett-Packard Model 1335A X-Y Display (figure 1-1). Instrument identification, description, options, accessories, specifications, and other basic information are also included.

1-3. Also listed on the title page of this manual is a Microfiche part number. This number can be used to order 4 x 6-inch microfilm transparencies of the manual. Each microfiche contains up to 96 photo-duplicates of the manual pages. The microfiche package also includes the latest Manual Changes supplement as well as pertinent Service Notes.

1-4. DESCRIPTION.

1-5. The Hewlett-Packard Model 1335A X-Y Display (figure 1-1) has a variable persistence cathode-ray tube that provides bright, high quality readouts for both end user and OEM applications. Remote programming of erase, write, store, conventional, and variable persistence is provided through a rear-panel connector. The instrument is recommended for such applications as medical diagnosis, computer graphics and alphanumerics, electronic test systems, chemical and physical analytical systems, raster presentations, and amplitude vs time displays.

1-6. SPECIFICATIONS.

1-7. Instrument specifications are listed in Table 1-1. These specifications are the performance standards or limits against which the instrument is tested. Table 1-2 lists supplemental characteristics. Supplemental characteristics are not specifications but are typical characteristics included as additional information for the user.

Table 1-1. Specifications

VERTICAL AND HORIZONTAL AMPLIFIERS

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

BANDWIDTH: dc to approx 5 MHz for 5.1 cm (2 in.) deflection.

PHASE SHIFT: <1° dc to 1 MHz (measured with X and Y gain set to max).

DEFLECTION FACTOR

Horizontal: 100 mV/div (1 V p-p for 10 div deflection). Front panel adjustable from approx 80 mV/div to 200 mV/div. 1 div = 0.95 cm (0.37 in.).

Vertical: 100 mV/div (0.8 V p-p for 8 div deflection). Front panel adjustable from approx 80 mV/div to 200 mV/div. 1 div = 0.95 cm (0.37 in.).

SETTLING TIME: signal settles to within one spot diameter of final value on <300 ns for any large or small movement. Off-screen deflection not to exceed specified dynamic range.

INPUTS: rear panel BNC connectors with shield grounded. Full differential inputs available, see Options.

Input RC: approx 1 megohm shunted by <60 pF.

Maximum Input: ±50 V (dc + peak ac).

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

DYNAMIC RANGE: beam may be deflected off-screen up to one-half screen diameter in any direction, provided that zero input position is on screen, without degradation of specifications.

CROSSTALK: <0.254 mm (0.010 in.) with one input terminated in 50 ohms and the other driven by a 1 V, 500 kHz signal. <0.38 mm (0.015 in.) at 5 MHz when driven from a 50 ohm source.

DRIFT

Position: <0.5 mm/hr (0.020 in/hr) and <1.02 mm (0.040 in.) in 24 hr with covers installed after 15 min. warmup.

Gain: <1.0% under all combinations of specified line voltage with covers installed after 15 min. warmup and temperature between +20°C and +55°C.

COMMON MODE REJECTION RATIO (OPTION 106): at least 40 dB (100:1) up to 10 kHz for 1 V (full screen) inputs; at least 25 dB (18:1) at 1 MHz for 1 V (full screen) inputs.

Z-AXIS AMPLIFIER

RISE TIME: <25 ns; CW bandwidth approx 5 MHz.

BLANKING RANGE: 1 V change in input Z voltage causes a full scale change in brightness. The cutoff level can be set from +0.2 Vdc to —1 Vdc with the intensity control. With intensity control full CCW brightness is limited to a safe level for any Z-axis input voltage.

BLANKING POLARITY: a positive-going Z input voltage increases brightness.

INPUT: rear panel BNC connector with shield grounded. Full differential input available, see Options.

Table 1-1. Specifications (Cont'd)

Input RC: approx 1 megohm shunted by <60 pF.
Maximum Input: ±50 V (dc + peak ac).
GAIN: internally adjustable over 2.5:1 attenuation ratio.
LIGHT OUTPUT STABILITY (DRIFT): (conventional mode only) spot photometer measurements of light output made at one hour intervals will not vary more than 10% from previous measurement for any location within the useable display area, under all specified conditions of line voltage and temperature with intensity set to >5% of peak brightness.

CONVENTIONAL (NON-STORE) PARAMETERS

SPOT SIZE: 0.254 mm (0.010 in.) at center screen and varying by not more than 10% over entire quality area with intensity held constant. Measured using shrinking raster method. Non-stored line resolution is approx 39 lines/cm (100 lines /in.).
LINE BRIGHTNESS: 68.5 cd/m^2 (20 fl) at a writing speed of 0.254 cm/μs (0.1 in./μs). 60 Hz refresh rate, P31 phosphor, 0.0254 mm (0.010 in.) spot size.
PERSISTENCE: approx 40 μs for P31 phosphor.

CATHODE-RAY TUBE

TYPE: post deflection accelerator, approx 8.5 kV accelerating potential, aluminized P31 phosphor, electrostatic focus and deflection.
VIEWING AREA: 72.2 cm^2 (11.2 in.^{2}), approx 8 cm vertically by 10 cm horizontally (3.1 x 3.9 in.).
QUALITY AREA: center 9 div horizontally and center 7 div vertically.
GRATICULE: 8 x 10 div internal graticule. 1 div = 0.95 cm (0.37 in.).
GEOMETRY: <3% pincushion and barrel distortion over usable display area.
LINEARITY: <3% of full scale along major axes.
CONTRAST RATIO: 4:1 or greater. Measured by photometrically summing the trace brightness and background, then dividing by the background brightness.

STORAGE PARAMETERS

STORED SPOT RESOLUTION: approx 20 lines/cm (51 lines/in.)
BRIGHTNESS: >680 cd/m^2 (>200 fl) in WRITE mode.
ERASE TIME: <500 ms.
STORAGE TIME: >1 min. at full brightness in WRITE mode, extending to >30 min. in STORE mode at lower brightness.

> NOTE: storage time (brightness) in STORE mode is continuously adjustable from 1 min. (full brightness) to >30 min. (minimum brightness) with an internal adjustment.

VARIABLE PERSISTENCE: continuously adjustable from 0.2 s to full storage (one min.).
INFORMATION STORAGE RATE: 750 000 dots per second.
DOT WRITING TIME: will store a dot anywhere inside the quality area having an unblanking time of 1 μs.
WRITING SPEED: >50 cm/ms.

Table 1-2. Supplemental Characteristics

REMOTE PROGRAMMING

REMOTELY PROGRAMMABLE FUNCTIONS: ERASE, WRITE, STORE, CONVENTIONAL, and VARIABLE PERSISTENCE.
REMOTE SELECTION: a single TTL control line disables the front panel ERASE, WRITE, STORE, CONVENTIONAL, and VARIABLE PERSISTENCE functions and transfers control to the remote inputs.
CONTROL ENABLE: separate TTL inputs to enable front panel ERASE and/or VARIABLE PERSISTENCE controls during remote operation.
VARIABLE PERSISTENCE: an external dc voltage between 0 and +10 V sets the persistence. Or, a pot can be connected through the Remote Input connector to control persistence if 10 Vdc is not available.
ERASE VERIFY: a TTL high output during ERASE (will drive ten low-power gates).

SAFETY PROTECTION

IMPLOSION: safety panel between CRT and bezel protects viewer.
HIGH VOLTAGE SHOCK: anode lead is securely attached to CRT.
X-RAY EMISSION: <0.05 mr/hr. Not measurable with Victoreen Model 440 RF/C in background noise.
UL Listing: meets Underwriter's Laboratories listing for Dental and Medical Equipment (Option 330). Meets Underwriter's Laboratories listing for Electronic Data Processing Equipment (with Options 315 and 561).

ENVIRONMENT

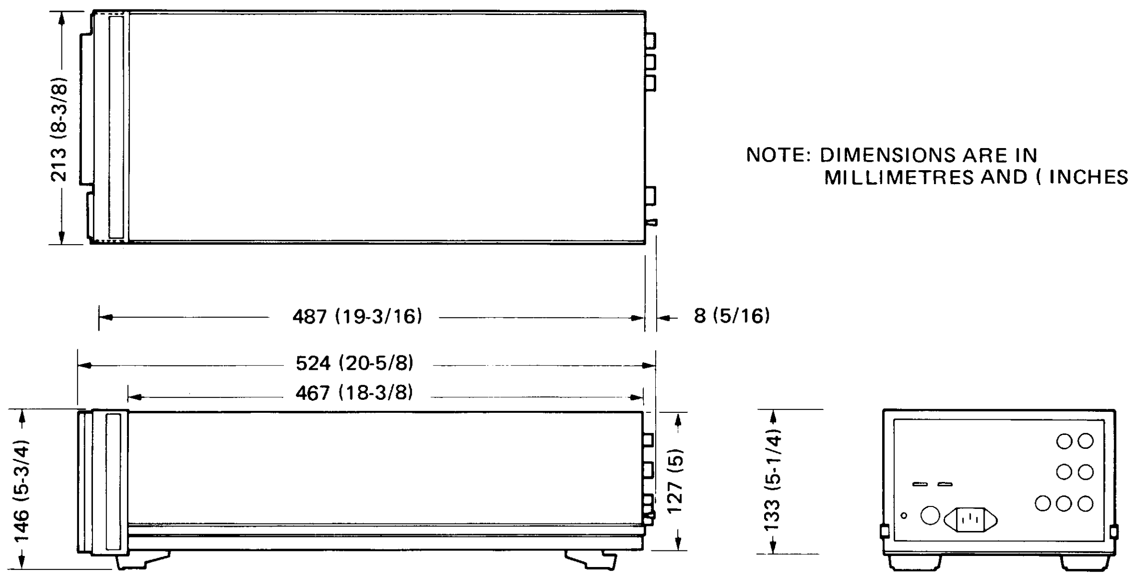
TEMPERATURE: operating 0 to +55°C; non-operating, —40° to 70°C.
HUMIDITY: to 90% relative humidity at 40°C.
ALTITUDE: to 4600 m (15 000 ft). non-operating, to 7620 m (25 000 ft).
SHOCK: 30g level with 11 ms duration and 1/2 sine wave shape.
VIBRATION: vibrated in three planes for 15 min. each with 0.254 mm (0.010 in.) excursion. 10 to 55 Hz.

Table 1-2. Supplemental Characteristics (Cont'd)

POWER: selectable 100-, 120-, 220-, or 240-Vac, +5%, —10%, 48 Hz to 440 Hz, max power 65 VA (approx 55 W). Average power dissipation at 60 Hz and 120 V without any options is approx 35 watts. Systems requiring UL Dental and Medical listing must operate from 48 Hz to 66 Hz only.

DIMENSIONS: see outline drawing.

WEIGHT: net, 8.6 kg (19 lb) with covers and feet; shipping, 10.5 kg (23 lb). Covers, feet, tilt stand, and trim are not supplied with standard 1335A.



1-8. OPTIONS.

1-9. The options listed in table 1-3 extend the usefulness of the 1335A.

1-10. ACCESSORIES SUPPLIED.

1-11. The following accessories are supplied with the 1335A:

01335-02701	Blue contrast filter
2110-0012	Fuse 0.5A
8120-1538	Power cord 2.3 m (7.5 ft)

1-12. ACCESSORIES AVAILABLE.

1-13. The following accessories are available for the 1335A:

Model No.	
10375A	Camera mounting kit.
10380A	Frame kit provides an empty 13.4 cm (5-1/4 in.) high half module frame for mounting on the left or right of Model 1335A.
10381A	Kit provides hardware for rack mounting Model 1335A.
10382A	Kit provides hardware for finishing the Model 10380A frame for bench use.
10383A	Rack mount adapter allows mounting one Model 1335A in a standard 48.3 cm (19 in.) EIA rack.
10384A	Rack mount kit permits mounting two Model 1335A's in a standard 48.3 cm (19 in.) EIA rack.
10385A	Rack mount kit permits mounting two Model 1335A's in a standard 48.3 cm (19 in.) EIA rack with handles.
10386A	Frame kit provides an empty half module frame for mounting above or below Model 1335A.
10488A	Input signal cable provides connection between Model 1335A and signal source.

1-14. INSTRUMENTS COVERED BY MANUAL.

1-15. Attached to the instrument is a serial number plate. The serial number is in the form: 0000A-00000. It is in two parts; the first four digits and the letter are the serial prefix and the last five digits are the suffix. The prefix is the same for all identical instruments; it changes only when a change is made to the instrument. The suffix, however, is assigned sequentially and is different for each instrument. The contents of this manual apply to instruments with the serial number prefix(es) listed under SERIAL NUMBERS on the title page.

Table 1-3. Available Options

Option	Description	Kit Part Number
100	X- and Y-axis amplifier deflection factor changed to 500 mV/div, 5 V p-p full screen deflection.	01332-88702
101	X- and Y-axis amplifier deflection factor changed to a 1 V/div, 10 V p-p full screen deflection.	01332-88703
105	X- and Y-axis amplifier polarity changed so negative input moves beam to the right and up.	None
106	X- and Y-axis amplifier changed to fully differential inputs.	See Replaceable Parts List
110	X- and Y-axis amplifier input impedance changed to 50 ohms. (Maximum input ±3 V, dc + peak ac).	01332-88705
200	Z-axis amplifier CRT blanking range changed from 0 to 5 V.	01332-88710
201	Z-axis amplifier CRT blanking range changed from 0 to 10 V.	01332-88711
205	Z-axis amplifier polarity changed so negative input unblanks trace.	None
206	Z-axis amplifier changed to fully differential input.	See Replaceable Parts List
210	Z-axis amplifier input impedance changed to 50 ohms. (Maximum input ±3 V, dc + peak ac).	01332-88715
215	Z-axis amplifier gain output changed to vary linearly (±20%) with linear change in Z-axis input voltage (gamma corrections).	01332-88718
300	Power cord for use in Great Britain and Singapore. 2.3 m (7.5 ft), 240 volt max, three conductor IEC.	8120-1703
301	Power cord for use in Australia and New Zealand. 2.3 m (7.5 ft), 240 volt max, three conductor IEC with 90° connection to instrument.	8120-1369
302	Power cord for use in East and West Europe. 2.3 m (7.5 ft) 240 volt max, three conductor IEC.	8120-1692
303	Power cord for use in USA, Canada, Japan and Mexico. 2.3 m (7.5 ft), 240-volt max, three conductor IEC to NEMA.	8120-0698
304	Power cord for use in USA, Canada, Japan and Mexico. 0.076 m (30 inch) coiled (extends to 1.8 m), 120 volt max, three conductor IEC to NEMA 5-15P.	8120-2061
310	Input power tolerance increased to +10% —20% at 100-, 120- 220-, 240-Vac; dissipation increased to approximately 60 watts.	See Replaceable Parts List
315	Display shipped with covers, feet, trim, and tilt stand.	See Replaceable Parts List
322	10-turn intensity pot and calibrated dial.	2100-3401 1140-0062

Table 1-3. Available Options (Cont'd)

Option	Description	Kit Part Number
323	Front-panel controls: Astigmatism, trace align, X-gain, and Y-gain become internal adjustments on amplifier board assembly A2.	See Replaceable Parts List
326	Front-panel controls: Intensity, focus, position X, and position Y become screwdriver adjustments.	01332-88723
330	Designed to meet Underwriter's Laboratories listing for Dental and Medical Equipment. Includes special three conductor ac line cord, covers, feet, tilt stand, trim, and U.L. label.	See Replaceable Parts List
561	Clear CRT filter.	See Replaceable Parts List
562	Clear, RFI coated surface and a metalized front panel.	See Replaceable Parts List
580	Display shipped with special covers, feet, trim, and tilt stand to meet CSA standards.	See Replaceable Parts List
631	P31, non-internal graticule, aluminized phosphor CRT.	See Replaceable Parts List
910	Standard instrument shipped with two Operating and Service Manuals.	NA
	For more information concerning these options, refer to Section III, or contact your nearest Hewlett-Packard Sales and Service Office.	

1-16. An instrument manufactured after the printing of this manual may have a serial number prefix that is not listed on the title page. This unlisted serial number prefix indicates the instrument is different from those described in this manual. The manual for this newer instrument is accompanied by a yellow Manual Changes supplement. This supplement contains "change information" that explains how to adapt the manual to the newer instrument.

1-17. In addition to change information, the supplement may contain information for correcting errors in the manual. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement for this manual is identified with the manual print date and part number, both of which appear on the manual title page. Complimentary copies of the supplement are available from Hewlett-Packard.

1-18. For information concerning a serial number prefix that is not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

X95 - Front panel olive black.
H01 - 10 to 20V apply to Z input.

SECTION II

INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains information and instructions necessary for installing the Model 1335A. Included are initial inspection procedures, power requirements, systems application information, and instructions for repacking for shipment.

WARNING

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

2-3. INITIAL INSPECTION.

2-4. This instrument was carefully inspected both mechanically and electrically before shipment. It should be free of mars or scratches and in perfect electrical order upon receipt. To confirm this, the instrument should be inspected for physical damage incurred in transit. If the instrument was damaged in transit, file a claim with the carrier. Check for supplied accessories (paragraph 1-10) and test the electrical performance of the instrument using the performance test procedures outlined in Section V. If there is damage or deficiency, see the warranty in the front of this manual.

2-5. POWER REQUIREMENTS.

2-6. The 1335A can be operated from any power source supplying 100 V, 120 V, 220 V, or 240 V (—10%, +5%), 48 Hz to 440 Hz. Power dissipation is approximately 65 VA.

2-7. 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 one-ampere fuse (HP Part No. 2110-0001) and replace with 0.5-ampere fuse (HP Part No. 2110-0012).

d. Connect power cord.

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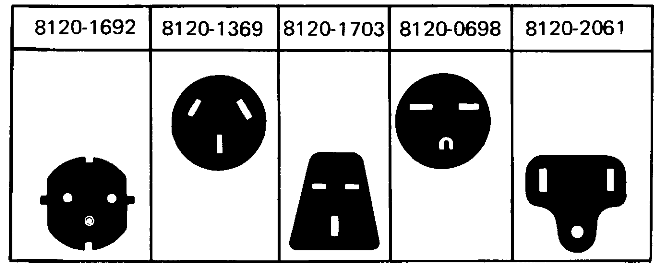


Figure 2-1. Power Cord Configurations

2-8. POWER CORDS AND RECEPTACLES.

2-9. Figure 2-1 illustrates the standard configurations used for -hp- power cords. The HP part number directly above each drawing is the part number for an instrument power cord equipped with a connector of that configuration. 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.

2-10. SYSTEMS APPLICATION. This instrument is designed and manufactured primarily for OEM systems and is shipped without protective covers.

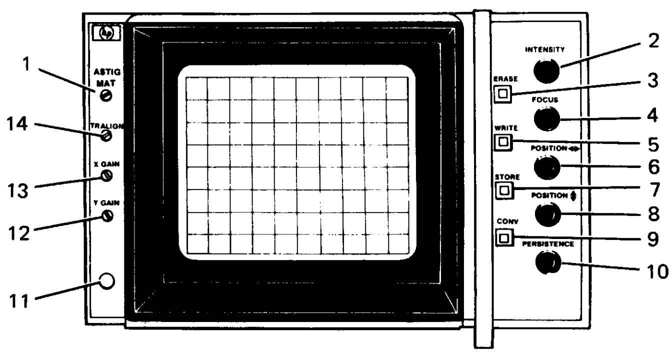
WARNING

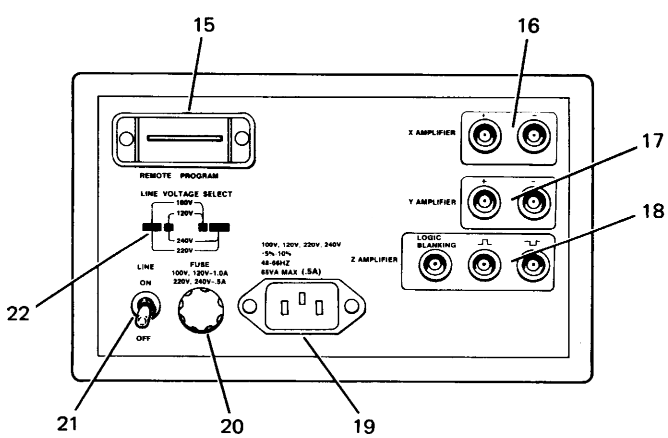
Operator protection from hazardous voltages within the instrument must be provided by the system in which the instrument is to be used.

2-11. REPACKING FOR SHIPMENT.

2-12. If the instrument is to be shipped to a Hewlett-Packard Sales/Service Office for service or repair, attach a tag showing owner (with address), complete instrument serial number, and a description of the service required.

2-13. Use the original shipping carton and packing material. If the original packing material is not available, the Hewlett-Packard Sales/Service Office will provide information and recommendations on materials to be used.





1. ASTIGMAT. Adjusts trace-dot symmetry.
2. INTENSITY. Adjusts brightness of trace.
3. ERASE. Press and release to remove display from screen (WRITE mode only).
4. FOCUS. Adjusts sharpness of trace.
5. WRITE. Input information written and retained on screen with variable persistence.
6. POSITION ◀▶. Adjusts horizontal position of display.
7. STORE. Press to store display for extended time.
8. POSITION ▲▼. Adjusts vertical position of display.
9. CONV. Selects operation as standard X-, Y-, and Z-display.
10. PERSISTENCE. Controls duration of display.
11. Indicator Lamp. Line power on.
12. Y GAIN. Adjusts Y-amplifier gain.
13. X GAIN. Adjusts X-amplifier gain.
14. TR ALIGN. Aligns trace with graticule line.
15. Remote programming connector. Provides input for remote programming of ERASE, WRITE, STORE, CONV, and PERSISTENCE.
16. X AMPLIFIER. X-axis input connectors.
17. Y AMPLIFIER. Y-axis input connectors.
18. Z AMPLIFIER. Z-axis input connectors.
19. Input power connector.
20. FUSE. Line power fuse.
21. LINE ON-OFF. Applies operating power to instrument.
22. LINE VOLTAGE SELECT. Input power switch for selection of 100-, 120-, 220-, or 240-Vac operation.

1335A-001-06-76

Figure 3-1. Controls and Connectors

SECTION III

OPERATION

3-1. INTRODUCTION.

3-2. This section provides general operating instructions and applications information for Model 1335A. Front- and rear-panel controls and connectors are identified and briefly described in figure 3-1. General operating instructions and initial turn-on procedures are also provided.

3-3. CONTROLS AND CONNECTORS.

3-4. The following paragraphs provide detailed descriptions of controls with multiple or complex functions.

3-5. PERSISTENCE AND INTENSITY. These controls determine the viewing time of a signal being displayed. INTENSITY sets the brightness (writing speed) of the trace as it is written. PERSISTENCE controls the desired duration of signal viewing without rewriting by varying the rate at which the displayed signal is erased.

3-6. ERASE. Pressing this pushbutton will remove stored or written displays from the CRT screen when in the WRITE mode only.

3-7. WRITE. In the write mode, the input information will be written and remain on screen with variable retention time (variable persistence). This information can be stored at any time by pressing STORE pushbutton.

3-8. STORE. Pressing the STORE pushbutton retains the displayed signal for viewing at a later time. The viewed display will be at a reduced intensity. No further information can be written on the screen when in the store mode.

3-9. CONV. This pushbutton selects the operation as a standard X-, Y-, and Z-display. The storage function is disabled in CONV. mode.

3-10. INTERFACING REQUIREMENTS.

3-11. The Model 1335A provides remote programming of ERASE, WRITE, STORE, CONVENTIONAL, and VARIABLE PERSISTENCE functions. The following paragraphs describe the interface requirements.

3-12. The remote program input requires a special 20-pin printed circuit connector with 0.254 cm (0.1 in.) center-to-center contact spacing. One connector (HP Part No. 01335-07601) and one cable hood, (HP Part No. 5040-4601), are supplied with each Model 1335A. The input connections are shown in the figure in table 3-1 as viewed from the rear of the instrument. Refer to table 3-1 for input-pin function. All inputs may be programmed by TTL, DTL, or contact closure to ground.

3-13. INTERNAL ADJUSTMENTS. The following internal adjustments may be set to alter the instruments operating characteristics, allowing optimization of different parameters for various applications.

3-14. Store Time. The Store Time Adj, A4R6, can be set to optimize either storage time or brightness of the stored image when in STORE mode. With Store Time Adj, A4R6, set fully ccw the stored image will be approximately one-half as bright as in WRITE mode, but store time will be approximately two minutes. With Store Time Adj, A4R6, set fully cw the stored image will not be visible in STORE mode, but storage time will be at least one hour. When adjusted as outlined in Section V, the stored image brightness will be approximately 10 percent of the brightness in WRITE mode, and storage time will be at least 30 minutes.

3-15. Write Depth. Rotating Write Depth Adj, A4R19 ccw, maximizes writing speed (minimizes dot writing time). Rotating Write Depth Adj, A4R19 cw provides: a shorter persistence of written information (when PERSISTENCE control is rotated cw); minimizes blooming of written image where it has been written excessively hard; improves uniformity of writing speed over CRT screen; and maximizes storage time in WRITE mode.

3-16. To maximize writing speed, proceed as follows:

a. Disconnect all X-, Y-, and Z-inputs.

b. Rotate INTENSITY control fully ccw.

c. Rotate PERSISTENCE control fully cw.

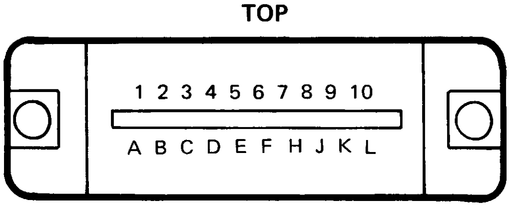
d. Press ERASE pushbutton switch while rotating A4R19 slowly ccw. Locate exact setting of A4R19 where no areas of screen retain green background glow.

e. Set A4R19 1 to 2 degrees cw of position established in step d.

Table 3-1. Remote Programming Connector Pin Function

Pin No.	Function	Description	Standard TTL loads)
Pin 10 (Top)	Analog Persistence:	0 V or short to ground = maximum persistence. +10 V or open circuit = minimum persistence. (A 100-kilohm potentiometer to ground or a 0 to +10 Vdc supply may be used to program persistence.)	N/A
Pin L (Bottom)	TTL Blank:	Wired in parallel with LOGIC BLANKING connector on instruments with Option 216. (No connection to this pin on units without Option 216.) TTL high or open-circuit input blanks CRT beam. TTL low or ground input enables CRT beam.	1
Pin 8 (Top)	Program Control:	A TTL low input disables front-panel storage controls and transfers control to program inputs.	8
Pin 7	Conventional:	A TTL low input places instrument in conventional mode, independent of MODE input state.	1
Pin 6	Erase Control:	A TTL low input enables the front-panel ERASE switch when operating under program control. If PROGRAM CONTROL and ERASE CONTROL inputs are both low, pressing front panel ERASE or applying a TTL low to the ERASE input will initiate an erase cycle.	1
Pin 5	Erase:	A TTL low input initiates the erase cycle.	1
Pin 4	Store/Write:	A TTL high (or open circuit) input places the instrument in the STORE mode. A TTL low input places the instrument in the WRITE mode. For writing dots, the instrument may be switched from STORE to WRITE and back to STORE by holding the mode line low for 7 μs or longer.	1
Pin 1	Persistence Control:	A TTL low input disables ANALOG PERSISTENCE input and restores front-panel PERSISTENCE control, when operating under program control.	3
Pin A (Bottom)	Erase Verify:	A TTL output which is normally low; produces a TTL high output for the duration of the erase cycle (can be used to indicate when 1335A is ready to receive new data after erasing).	N/A

TOP



PROGRAM CONNECTOR

TOP	BOTTOM
10 - Analog Persistence	L - TTL BLANK
9 - Ground	K - Ground
8 - Program Control	J - Program Control
7 - Conventional	H - Conventional
6 - Erase Control	F - Erase Control
5 - Erase	E - Erase
4 - Store/Write	D - Store/Write
3 - NC	C - NC
2 - NC	B - NC
1 - Persistence Control	A - Erase Verify

NOTE

Some pinholes of green may remain but these may be ignored unless they quickly grow in size or brilliance, or both. If this occurs, adjust A4R19 further cw to suppress them.

3-17. At the above write depth setting, the storage mesh is biased to its most sensitive point and writing speed will be highest (dot writing time shortest). The image, however, may not remain stored for the specified 60 seconds at maximum persistence in WRITE mode (15 minutes in STORE mode) without fading positive.

3-18. The optimum setting of write depth is to set storage mesh sensitivity (writing speed) to minimum sufficient to store information at the rate that it is presented. This will yield the shortest persistence and cleanest erasure of written information in minimum persistence, minimize tendency to bloom, optimize uniformity, and maximize storage time in maximum persistence. To achieve this optimum setting, Model 1335A should be interfaced to the system in which it is to be installed.

3-19. The system should then be operated to find the mode, if any, which writes information at a rate that is most difficult for Model 1335A to store, i.e: a radioisotope imaging system in a dynamic cerebral blood flow study; or in an ultrasonic diagnostic system, viewing an ultrasound cardiogram in M-mode.

3-20. Then rotate Write Depth Adj, A4R19, cw from the point indicated in paragraph 3-16 until writing speed is just adequate for the worst case. At the same time monitor storage mesh electrode (white/green wire connected to front inside corner of storage assembly A4) with an oscilloscope and 10:1 divider probe. Do not increase amplitude of pulses seen at this point to greater than 10 volts peak-to-peak with PERSISTENCE control set fully ccw.

3-21. Z Gain. The Model 1335A is shipped from the factory with Z-gain Adj, A1R11, set fully cw. In this condition, a 1-V change in Z-axis input voltage is required to vary CRT beam from cutoff to maximum brightness. The INTENSITY control may be adjusted such that the beam is just cutoff with —1 Vdc applied to the Z input. In this condition zero volts will result in maximum brightness, or it may be set such that the beam is just cutoff with zero volt at Z input. In this condition +1 Vdc is required to achieve maximum intensity. Intermediate setting of INTENSITY control varies cutoff voltage at the Z input linearly between —1 Vdc and zero volt dc.

3-22. With Z-gain Adj, A1R11, rotated fully ccw, gain of Z-axis amplifier is reduced by a factor of 2.5. Therefore a 2.5 V change in Z-axis input voltage is required to vary CRT beam from cutoff to maximum brightness. In this condition INTENSITY control may be used to set cutoff voltage, referenced to the Z-axis input, between —2.5 Vdc and zero volt dc.

NOTE

For Option 205, reverse polarities of all voltages in the preceding discussion. For Option 200, multiply voltages by 5 and for Option 201, multiply all voltages by 10 in the preceeding discussion.

3-23. FIELD-INSTALLED OPTIONS. Options listed in table 3-2 may be installed in the field. Note that on Schematics in Section VIII certain components are indicated by a number in a triangle. These are components that change value when an option or options are installed. Adjacent to the schematic is a table showing the value of each of these option components. Listed in table 6-3, Section VI, are components that make up the different Option kits. The individual parts listed may be ordered or the complete kit may be ordered.

Table 3-2. Field-installed Option Kits

Option	Schematic Reference	Order Kit No.
100	1	01332-88702
101	1 and 2	01332-88703
110	1 and 2	01332-88705
200	3	01332-88710
201	3	01332-88711
210	3	01332-88715
215	3	01332-88718

For detailed installation instructions on all field-installed options, refer to Application Note 199, Appendix A (available from your HP Sales/Service Office).

3-24. To change polarity of X-, Y-, or Z-inputs move the pin connector on appropriate input cable center conductor from square pin labeled + to square pin labeled —. Also, move shorting jumper from — input to + input (refer to appropriate schematic and corresponding parts locator in Section VIII for location of jumpers).

3-25. To install differential inputs on X-, Y-, or Z-AMPLIFIERS, order appropriate input cable(s) from the list below, along with one nut and one lockwasher for each cable. Remove plug buttons as necessary from the hole(s) provided on rear panel labelled X-, Y-, or Z⊓⊔ and install cable using nut and lockwasher listed below. Connect cable to the square pins on X-, Y-AMPLIFIER assembly A2 and/or main board A1 for Z-input. Remove shorting jumper between inputs labelled — and ground on circuit boards.

Description	HP Part No.
Nut, 1/2 - 28 x .125	2950-0054
Washer, Int. Lock x .500	2190-0054
Cable, X Input	01332-61603
Cable, Y Input	01332-61604
Cable, Z Input	01332-61605

3-26. INITIAL TURN-ON.

3-27. To place Model 1335A into operation perform the following.

a. Set INTENSITY fully ccw.

b. Set PERSISTENCE fully ccw.

c. Set POSITION ◀▶ to midrange.

d. Set POSITION ▲▼ to midrange.

e. Press WRITE pushbutton.

f. Set LINE to ON position, power indicator light should be on. Wait until green background appears on CRT.

g. Press ERASE pushbutton.

CAUTION

If green background does not appear, do not turn INTENSITY control clockwise. Turn instrument off and refer to troubleshooting procedures and Schematics in Section VIII.

h. Adjust INTENSITY and PERSISTENCE for comfortable viewing brightness.

CAUTION

To prevent damage to the CRT do not allow dot or trace to bloom.

i. Adjust POSITION controls to center display dot on CRT screen.

j. Adjust FOCUS and ASTIGMAT for smallest, roundest display dot. Final adjustment should be made with instrument interfaced to desired signal source with typical pattern on screen. This will assure the most uniform writing characteristics.

k. Apply 1-kHz, 1-volt p-p signal to X-AMPLIFIER input. Horizontal trace should appear on CRT screen.

l. Adjust TR. ALIGN, if necessary, to align trace with horizontal graticule line.

m. Adjust X GAIN for trace length of exactly 10 divisions or as required by application.

n. Move 1-kHz, 1-volt p-p signal to Y-AMPLIFIER input.

o. Adjust Y GAIN for trace length of exactly 8 divisions or as required by application.

SECTION IV

PRINCIPLES OF OPERATION

4-1. INTRODUCTION.

4-2. This section provides circuit theory analysis of Model 1335A. A general discussion keyed to an overall block diagram, figure 4-1, is presented first. This is followed by a detailed description of the individual circuits keyed to the schematics in Section VIII.

4-3. GENERAL.

4-4. The Model 1335A variable persistence display consists of a high-voltage power supply, a low-voltage power supply, an X-axis amplifier, a Y-axis amplifier, a Z-axis amplifier and a CRT. In addition, there is a pulse circuit to initiate the variable persistence and storage functions.

4-5. The instrument can be operated as a variable persistence and storage display, or as a conventional X-Y display when operated in the CONV mode. The write gun beam however, must still pass through the storage mesh in CONV mode, causing the presentation to be dimmer than a conventional display. Any attempts to make the trace as bright as a conventional display could cause damage to the CRT.

4-6. The high-voltage power supply produces operating potentials for the CRT grid and cathode. In addition, there is a multiplier assembly that increases the voltage to approximately 6.6 kV for the post accelerator.

4-7. The low-voltage power supply produces five dc voltages; +158 V, +15 V, +5 V, —12.6 V and —15 V. The —12.6 V supply is adjustable. All other supplies are individually regulated.

4-8. The X- and Y-amplifiers are nearly identical with the Y-amplifier having an additional beam deflection circuit to prevent stray electron emissions from striking the storage mesh when switching from any mode into store mode. The outputs of the X- and Y-amplifiers are used to drive the CRT deflection plates.

4-9. Pushbuttons in the control board assembly initiate the mode function; erase, write, store, or conventional by applying an open (logic high) or a ground (logic low) to the inputs of the storage circuits.

4-10. The input signals to the Z AMPLIFIER (TTL BLANKING, ⊓, ⊔) are amplified to provide the voltage and current gain required to drive the output gate amplifier. This provides intensity control (Z-axis modulation).

4-11. The pulse circuits receive logic signals on three input lines from the control board assembly. These signals generate the waveforms and voltages required to operate the storage elements of the CRT.

4-12. The CRT contains a standard write gun assembly to initiate and form a beam and deflection plates to control the beam. In addition, there is a flood gun and two added meshes for the variable persistence and storage functions. To form the flood electrons used in the variable persistence and storage mode, a collimation voltage is tied to the aquadag coating in the CRT funnel. The post-accelerator voltage is tied to a silver ring around the inner face of the CRT.

4-13. DETAILED DESCRIPTION.

4-14. The following paragraphs provide a more detailed description of the circuits of the Model 1335A. Refer to the schematics in Section VIII.

4-15. LOW-VOLTAGE POWER SUPPLY. (See schematic 4.) The low-voltage power supply can operate from 100 V, 120 V, 220 V, or 240 V, 48 Hz to 440 Hz (UL dental and medical listing must operate from 48 Hz to 66 Hz only). The line voltage is converted to five regulated voltages; +158 V, +15 V, +5 V, —12.6 V, and —15 V. Power ON - OFF switch S1 applies power through LINE VOLTAGE SELECT switch S2 to the primary winding of transformer T1. Line fuse F1 prevents excessive current from damaging the instrument.

4-16. Three full-wave rectified outputs are applied to regulation circuits for the +15 V, +5 V, —15 V, —12.6 V and +158 V supplies. The +5 V is taken from the +15 V supply set by A1VR9. The —12.6 V is taken from the —15 V supply and is determined by A1R91. Approximately +26 V is tapped off the +15 V supply (before regulation) for use in the high-voltage oscillator.

4-17. The output of bridge rectifier A1CR10 - A1CR13 is prefiltered by A1C15 and applied across A1R93 and A1VR8, and the load to ground. Variations in this output are sensed and compared to a fixed level in A1U3. The difference between these levels is amplified and used to control the conduction of series regulator Q3 by way of A1Q14. Q3 controls the current across A1R93 and A1VR8.

4-18. HIGH-VOLTAGE POWER SUPPLY. (See Schematic 5.) The high-voltage power supply provides operating potentials for the CRT. These include —3000 V for the cathode, —3050 V for the intensity grid, +6600 V for the post accelerator (by way of multiplier A6) and —50 V for CRT controls.

4-19. When line power is applied to the instrument, approximately +30 V is applied to high-voltage oscillator Q4 and the primary of transformer A3T1. Current is drawn through Q4 and the transformer primary producing a magnetic field. This field is coupled back to the base of Q4 turning Q4 on harder, producing more field and feedback to the base of Q4. This continues until the transformer core saturates and Q4 draws less current causing the field to collapse. The collapsing field is fed back to the base of Q4 as a turn off signal causing oscillations. The frequency of oscillation is controlled by the values of A1L1 and A1C22.

4-20. A sample of the CRT cathode voltage is fed into A1U4 and compared with a reference voltage. Any difference is amplified by A1U4. The amplified difference drives the base of Q4 to correct the error or difference.

4-21. X- AND Y-AMPLIFIERS. The X- and Y-axis amplifiers are identical, only the X-axis amplifier is described in the following paragraphs.

4-22. The instrument, as shipped from the factory, is wired for single-ended input operation, however the internal design allows for differential operation. The input signal is applied to FET source follower A2Q16 which is an impedance converter.

4-23. Differential shunt feedback amplifier A2Q17 thru A2Q20 provides a signal gain of about 100. X-gain center, A2R68 sets the voltage level at which X-gain, A2R55, varies.

4-24. Output operational amplifier has two balanced feedback amplifiers A2Q23/24/27/28 and A2Q25/26/29/30. A current input to the amplifier provides a voltage output to drive the horizontal deflection plates. High frequency adjust A2C27 with A2R75 and A2C28 with A2R76 are lead networks and A2R74 is a lag network, which provides a built-in rise time of <70 ns.

4-25. Z-AXIS AMPLIFIER. The high voltage supply for the CRT control grid is returned to, and controlled by, the output of the Z-axis amplifier. The current sources are the Z-axis signal which is applied through a rear-panel BNC connector and the current supplied by the intensity control. A positive going voltage level will increase the conduction of the CRT and brighten the display.

4-26. The single-ended output of operational amplifier A1Q10/Q11/Q12/Q13 is coupled into the high voltage circuit through A3R11 and A3C7. This output maintains a voltage level of about —3000 V on the CRT control grid.

4-27. STORAGE CRT. The CRT contains the conventional electron (writing) gun, deflection plates, post-accelerator, and phosphor screen. In addition, there are two floodguns, a collimator, a collector mesh, and a storage mesh. These added elements make possible the variable persistence and storage functions of the instrument.

4-28. Flood guns. Two flood guns are located just outside of the horizontal deflection plates. The guns operate continuously when the power switch is ON. An electron cloud, that is emitted by the flood guns, is accelerated toward the CRT screen by collimator and collector mesh voltages. These electrons make stored or persisting displays visible. They are also used to erase stored and persisting displays.

4-29. Collimator. The collimator is an internal coating along the tapered portion of the CRT. A positive voltage applied to the collimator focuses the flood-gun electrons. The flood-gun electrons are formed into a column perpendicular to, and approximately equal to, the width of the CRT screen.

4-30. Collector Mesh. The collector mesh is between the flood guns and the storage mesh (closer to the storage mesh). It is always positive with respect to the storage mesh except in the ERASE mode of operation; both are then at the same potential. In addition to accelerating flood gun electrons, the collector mesh also repels positive ions generated by the flood guns.

4-31. Storage Mesh. The storage mesh is just behind the CRT screen and is coated with non-conducting material. It is statically held at a slightly positive potential (approximately +3 volts). When the electron beam from the writing gun strikes the mesh coating, secondary electrons are emitted. This secondary emission creates a pattern of positive potential identical to the movement of the beam. Flood gun electrons are accelerated by this positive potential pattern and strike the phosphor screen, creating a visible display.

4-32. The storage mesh is pulsed with pulses of approximately 10 microseconds duration. These pulses erase the positive pattern on the storage mesh by discharging the mesh coating. Time required for this erasing operation is determined by the pulse repetition rate. The positive pattern on the mesh may also be neutralized manually by connecting the collector and storage meshes (erase). The high positive potential (approximately +156 volts) allows more uniform discharging of the surface. When the storage mesh is disconnected from the collector mesh and returned to +3 volts, the coated surface is at a uniformly equal potential of —9 volts. In both cases, the screen has no illumination. The pattern may be lost by the storage mesh fading positive and allowing the entire screen to be illuminated. This occurs when positive ions from the flood gun raise the surface potential of the storage mesh in random areas sufficiently to allow flood gun electrons to strike the screen.

4-33. PULSE CIRCUIT. The pulse circuit supplies pulses of variable repetition rate to control the operation of the CRT. The pulse timer generates a pulse that triggers the astable multivibrator. The output of the multivibrator is applied to the flood gun driver and output pulser. The flood gun driver applies pulses to the accelerator of the CRT to control storage time of the display.

4-34. The output pulser applies a positive voltage to the storage mesh of the CRT. The erase timer provides a signal to the multivibrator and output pulser to generate an erase pulse and also triggers the blanking circuit.

4-35. Control Switch Assembly. The pushbuttons initiate the mode function (write and store) and erase cycle by applying an open (logic HI) or a ground (logic LO) to the input of the storage board. The write and erase pushbuttons are electrically linked together. The logic LO to the erase line can only be applied through the closed contacts of the write switch. The write and store switches are mechanically linked together; closing the store switch causes the write switch to open.

4-36. Write Mode. In this configuration, the pulse circuits must apply: (1) the calibrated collimator voltage, (2) an unblanking voltage to the gate amplifier, (3) a dc flood gun accelerator voltage, and (4) variable persistence duty-cycle erase pulses to the storage mesh. The duty cycle of the pulse train is changed by varying the pulse frequency. Pulse frequency is changed by varying the pulse generator input current. Pulse generator input current is supplied from the PERSISTENCE potentiometer.

4-37. Store Mode. In this configuration, the pulse circuits must apply: (1) the calibrated collimator voltage, (2) a blanking voltage to the gate amplifier, (3) a deflecting voltage to one side of the Y-amplifier, (4) calibrated duty cycle pulses to the flood gun accelerator, and (5) a dc voltage to the storage mesh. The pulse generator input current is calibrated by supplying the current from the Store Time Adj, A4R6, potentiometer.

4-38. Erase Cycle. In this configuration, the pulse circuits must apply: (1) a modulated 500-millisecond over-collimating pulse to the collimator, (2) a 500-millisecond blanking pulse to the gate amplifier, (3) a 500-millisecond deflecting pulse to one side of the Y-amplifier, (4) a dc flood gun accelerator voltage, and (5) a 500-millisecond complex waveform to the storage mesh. Before and after the erase cycle, the pulse circuits are in the write mode. The erase cycle is initiated by a 125-millisecond pulse on the erase input; the duration of this pulse is called prime time. During the erase cycle, the output of the pulse generator is inhibited and the waveform to the storage mesh is a combination of the outputs of the prime switch and the Miller integrator. The timing is controlled by the output of the erase cycle timing switch.

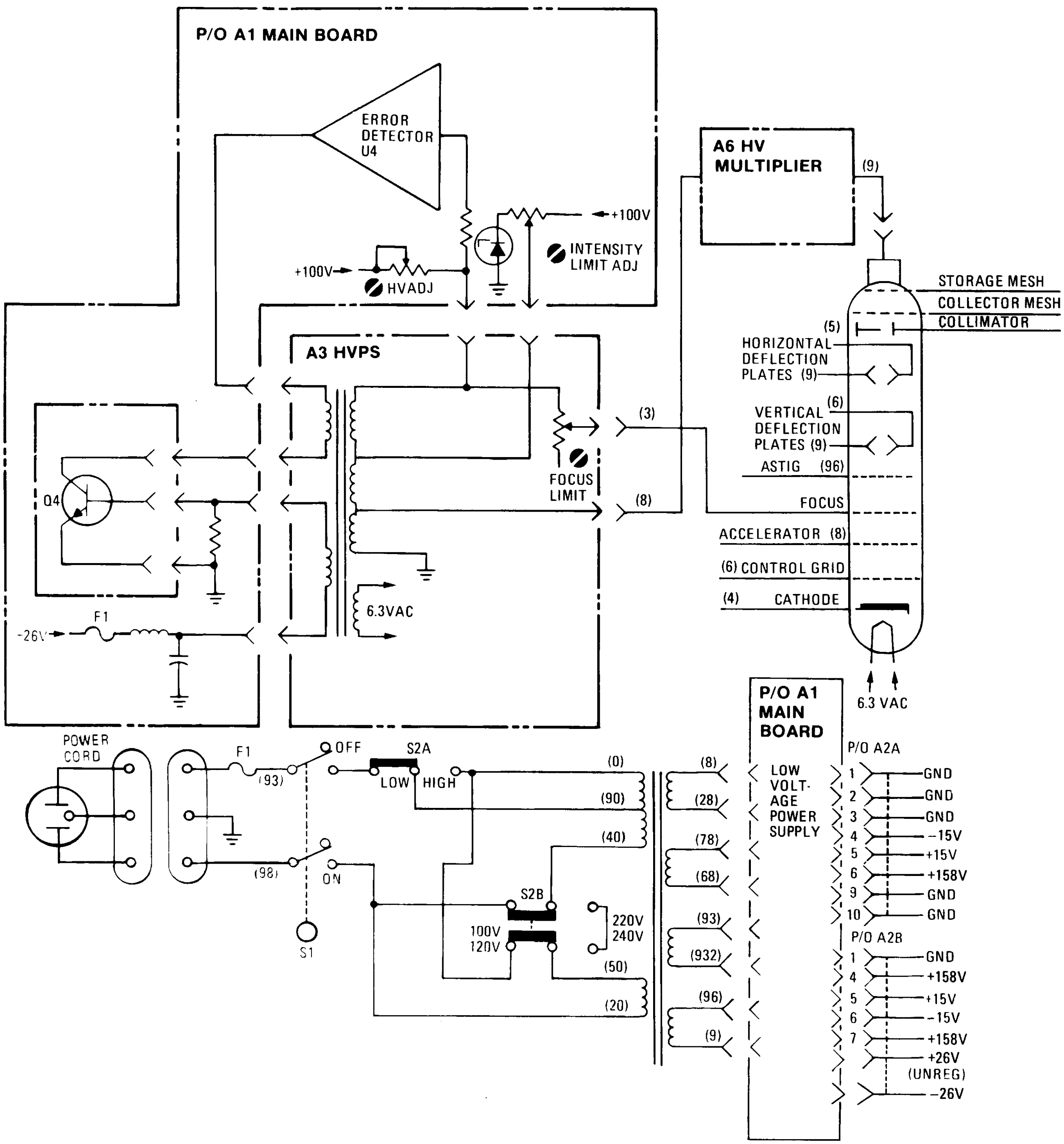


Figure 4-1. Model 1335A Block Diagram (Sheet 1 of 2)

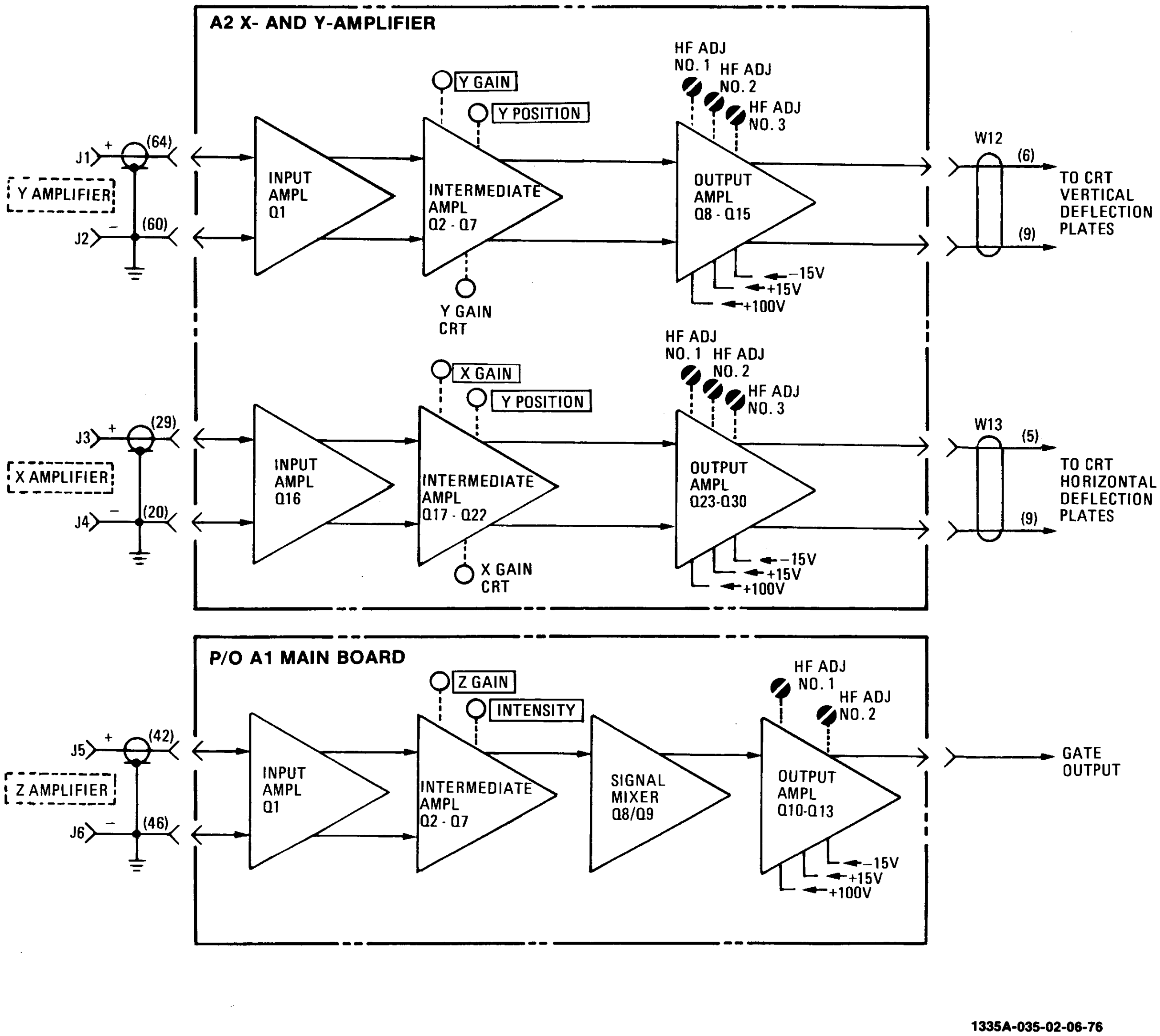


Figure 4-1. Model 1335A Block Diagram (Sheet 2 of 2)

Table 5-1. Recommended Test Equipment

Instrument Type	Recommended Model	Required Characteristics	Required For
Monitor Oscilloscope	HP 180C/1805A 1820C Plug-ins	100 MHz vertical BW, dual channel, 1 MΩ input resistance, external-sync input, sweep-ramp output, differential (A—B) capability	Performance Check and Adjustments
10:1 Divider Probes	HP 10004D	Compatible with above	Performance Check
Pulse Generator (2)	HP 8012B	Switchable output polarity (or dual outputs), Transition time ≤5 ns, symmetrical output	Performance Check
LCR Meter	HP 4332A	RANGE: to 60 pF	Performance Check
Test Oscillator	HP 651B	Output frequency up to 5 MHz, 10 V p-p output into 50Ω	Performance Check
DC Voltmeter/ Ohmmeter	HP 3465A	0.5% voltage accuracy, 3-1/2-digit resolution, dc volts and ohms function, constant input resistance on all voltage ranges (10 V and above).	Adjustments
1000:1 DC Divider Probe	HP K05-3440A	Voltage rating 10k Vdc, input resistance 100 MΩ	Adjustments
DC Power Supply	HP 6203B	0 to +5 V output (Option 216 only)	Performance Check
Function Generator (2)	HP 3311A	Output: triangle wave Frequency: 70 Hz - 4 kHz Amplitude: 1 V p-p	Performance Check and Adjustments
50Ω Termination (2)	HP 10100C	BNC-feedthrough type, 2 watt	Performance Check and Adjustments
Shorting Cap (3)	HP Part No. 1250-0645	Short unused input connectors	Performance Check
9-in. BNC Cables (2)	HP 10502A	BNC, 9-in. cable	Performance Check and Adjustments
44-in. BNC Cables (5)	HP 10501A	BNC, 44-in. cable	Performance Check and Adjustments
BNC Tee (3)	HP Part No. 1250-0781	BNC Tee Adapter	Performance Check
Adapter (2)	HP Part No. 1251-2277	BNC Female to dual banana plug	Performance Check
Test Leads	HP 16138A	Use with LCR Meter	Performance Check
Adapter	HP 10110A	BNC male to dual banana post	Performance Check

F = 1/T
T = 1/F

SECTION V

PERFORMANCE CHECK AND ADJUSTMENTS

5-1. INTRODUCTION.

WARNING

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

5-2. This section contains performance checks and adjustment procedures. The performance checks verify that the instrument meets its published specifications (table 1-1). Adjustment procedures are provided to help maintain the instrument within specification limits.

5-3. RECOMMENDED TEST EQUIPMENT.

5-4. Equipment required for the performance checks and adjustment procedures is listed in table 5-1. Any equipment that satisfies the critical characteristics given in the table may be substituted for the recommended model(s).

5-5. PERFORMANCE CHECK RECORD.

5-6. A Performance Check Record form is provided at the end of this section for the purpose of recording the results of the performance checks. This form lists all of the performance checks and their acceptable limits. The form may be removed from the manual and retained as a permanent record of the incoming inspection or routine maintenance performed on the instrument.

5-7. PERFORMANCE CHECKS.

5-8. The performance checks are designed to verify the published instrument specifications. Perform the checks in the order given, and record the measured information on the performance check record at the end of this section. Install BNC shorting caps on all unused inputs during all tests. For options with differential inputs, use the +X-, +Y-, or ⎍ Z-input unless otherwise stated.

WARNING

Dangerous voltages are present in the instrument. Standard instruments are shipped without covers. Operator protection must be provided by the system in which the instrument is used.

5-9. The position of a trace on the CRT always refers to the center of the trace. The distance between traces always refers to the orthogonal distance from trace center; or, from the edge of one trace to the corresponding edge of the other trace.

5-10. DEFLECTION AMPLIFIER RISE TIME. Rise time, measured between the 10% and 90% points on the displayed waveform shall be equal to or less than 70 ns for both X- and Y-amplifiers.

Equipment Required: 1743 Connection A+B B inverted DC mag 10

Pulse generator
Monitor oscilloscope
Two 10:1 divider Probes
44-in. BNC cable

5-11. Perform deflection amplifier rise time check as follows:

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

b. Set ~~pulse~~ Sq. wave generator output as follows:

10µsec
1 sq/0.1V

Standard	1 V p-p, 100 kHz
Option 100	5 V p-p, 100 kHz
Option 101	10 V p-p, 100 kHz

c. Set X-GAIN and X-POSITION controls for full-screen deflection with one dot on first graticule line and other dot on last graticule line.

d. Set monitor oscilloscope to A+B MODE and measure rise time between, 10% and 90% points (dotted lines on CRT).

e. Rise time shall be ≤70 ns.

f. Disconnect square-wave generator from X-AMPLIFIER input connector and connect to Y-AMPLIFIER input connector.

g. Disconnect probes from horizontal deflection plates, cable W13 wires (9) and (6), and connect to vertical deflection plates, cable W12 wires (9) and (5).

h. Repeat steps b, c, d, and e.

i. For option 106 repeat steps b, c, d, and e for —X and —Y inputs.

j. Disconnect test equipment.

note: Adj on leading edge Also effects trailing edge

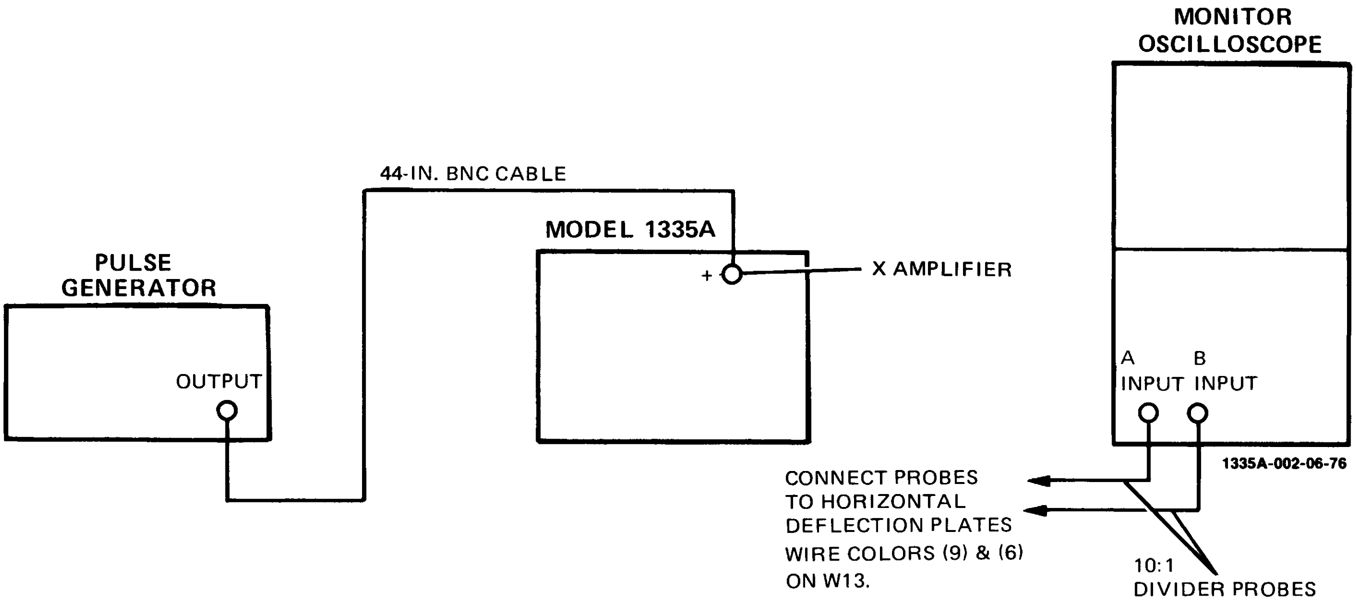


Figure 5-1. Rise Time Test Setup

5-12. DEFLECTION FACTOR. A signal with a specified range of amplitude applied to X-AMPLIFIER shall cause a 10-division horizontal beam deflection. A signal with a specified range of amplitude applied to Y-AMPLIFIER shall cause an 8-division vertical beam deflection.

Equipment Required:

Pulse generator
Monitor oscilloscope
Two 44-in. BNC cables
BNC tee

5-13. Perform deflection factor check as follows:

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

b. Set pulse generator output as follows:

1msec
1Pulse/div

Standard	0.5 V p-p, 1 kHz
Option 100	2.5 V p-p, 1 kHz
Option 101	5 V p-p, 1 kHz

c. Rotate X-gain control fully cw.

d. Displayed trace length shall be ≥6.3 ~~divisions~~ cm (8.1 Div).

e. Increase pulse generator output as follows:

Standard	1 V p-p
Option 100	5 V p-p
Option 101	10 V p-p

f. Rotate X-gain control fully ccw.

g. Displayed trace length shall be ~~≤5 divisions~~ ≤5.2cm (6.5div).

h. Connect pulse generator output to Y-AMPLIFIER input and repeat steps b through g using Y-GAIN control.

i. If test limits are not met, refer to X- and Y-GAIN centering adjustment.

j. Disconnect test equipment.

5-14. DIAGONAL SETTLING TIME. The CRT beam, when moved from one position to another, must settle to within 1 spot diameter in less than 300 nanoseconds.

Equipment Required:

Pulse generator no. 1 (switchable output polarity—or dual outputs, transition time ≤5 ns)
Pluse generator no. 2 (1 V, p-p, 100 kHz, symmetrical output)
Monitor oscilloscope
Three BNC tees
Five 44-in. BNC cables
Two 9-in. BNC cables

5-15. Perform diagonal settling time check as follows:

a. Connect equipment as shown in figure 5-3, except do not connect Z-AMPLIFIER input at this time.

b. Set pulse generator no. 2 for 1 V p-p, 100-kHz, symmetrical output.

c. Set POSITION and INTENSITY controls for bright dots at diagonal extremes of quality area (8 div by 8 div) of CRT.

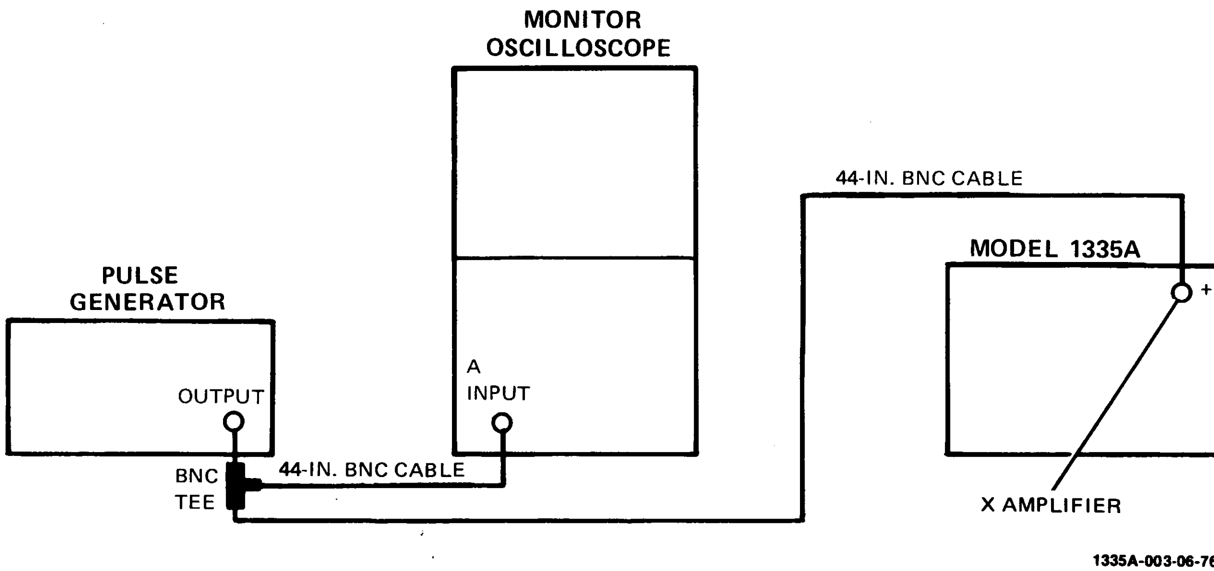


Figure 5-2. Deflection Factor Test Setup

d. Set INTENSITY fully ccw.

e. Connect Z-amplifier input as shown in figure 5-3.

f. Set pulse generator no. 1 for 100-kHz, 1 V p-p, 1-μs width pulse output.

g. Set sweep time of monitor oscilloscope to 0.1 μs/div and display switch to ALT, B TRIGGER.

h. Set monitor oscilloscope trigger controls to achieve stable display. If necessary slightly readjust symmetry control on pulse generator no. 2 to achieve synchronization between channels A and B.

i. Set pulse generator no. 1 delay to 10 ns and vernier cw. Note clean bright dot on lower left of CRT.

j. Turn delay vernier ccw. Note appearance of distorted trace segment projecting from dot.

k. Adjust delay vernier until length of trace segment is one dot diameter.

l. Measure time difference between two transitions displayed on monitor oscilloscope. Difference shall be equal to or less than 300 ns.

m. If test limits are not met, refer to X- and Y-HIGH FREQUENCY adjustments.

n. Disconnect equipment.

5-16. DEFLECTION POLARITY. A positive vertical input moves beam up. A positive horizontal input moves beam to right.

Equipment Required:

Pulse generator (switchable output polarity—or dual outputs, transition time ≤5 ns)
44-in. BNC cable

5-17. Perform deflection polarity check as follows:

a. Connect pulse-generator output to Model 1335A +X-AMPLIFIER input.

b. Set pulse generator output as follows:

POLARITY	positive
AMPLITUDE	0.5 V
Frequency/Pulse width	1% duty cycle

c. Set POSITION and INTENSITY to view two dots on CRT screen. The dimmer dot should be to right for standard instruments and to left for Option 105.

d. Connect pulse-generator output to Model 1335A +Y-AMPLIFIER input.

e. Set POSITION and INTENSITY to view two dots on CRT screen. The dimmer dot should be above brighter dot for standard instruments and below bright dot for Option 105.

NOTE

For Option 106 instruments perform steps f and g.

f. Reconnect pulse generator to —Y-AMPLIFIER input. The dimmer dot should be below brighter dot.

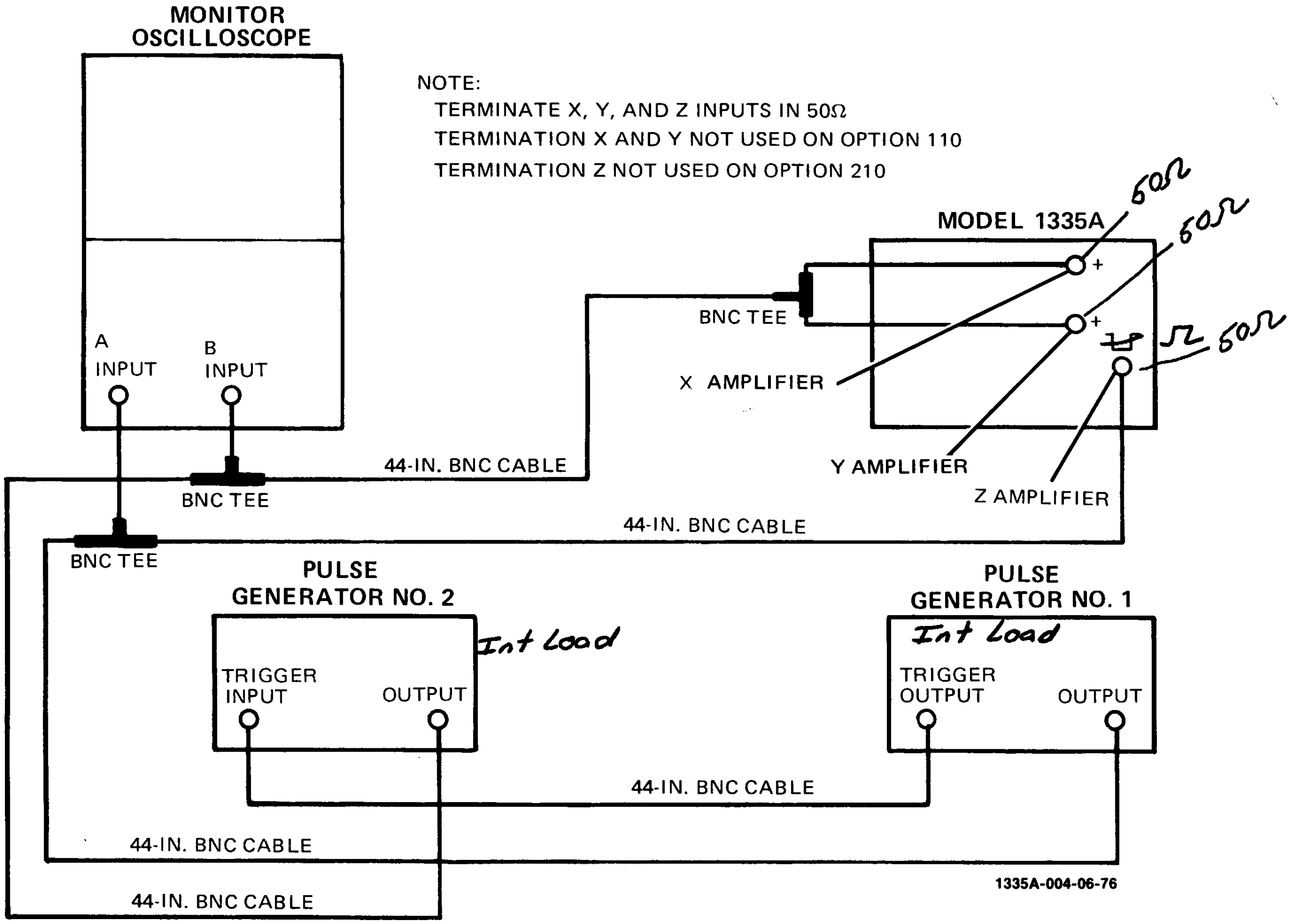


Figure 5-3. Diagonal Settling Time Test Setup

g. Reconnect pulse generator to —X-AMPLIFIER input. The dimmer dot should be to left.

h. Disconnect equipment.

5-18. POSITION CONTROL. Front-panel controls allow zero input to be set off screen in any direction from anywhere within the viewing area.

Equipment Required: None

5-19. Perform position control check as follows:

a. With no input to X-AMPLIFIER, rotate X-POSITION control fully cw. Beam should go off screen to right.

b. Rotate X-POSITION control fully ccw. Beam should go off screen to left.

c. With no input to Y-AMPLIFIER, rotate Y-POSITION control fully cw. Beam should move upward and off screen.

d. Rotate Y-POSITION control fully ccw. Beam should move downward and off screen.

5-20. INPUT RESISTANCE. Measure input resistance of X-, Y-, and Z-amplifiers.

Equipment Required:

Dc ohmmeter

5-21. Perform input resistance check as follows:

a. Measure each input resistance with ohmmeter leads connected positive-negative and then negative-positive and take average of both readings.

b. Perform measurements listed in table 5-2.

NOTE

Model 1335A instruments having differential inputs, in addition to low-impedance input terminations, contain a termination resistor between each input and ground.

Table 5-2. Input Resistance

Amplifier	Standard	Option 110	Option 210
X axis	1 meg nominal	50 ±1	NA
Y axis	1 meg nominal	50 ±1	NA
Z axis	1 meg nominal	NA	50 ±1

5-22. INPUT CAPACITANCE. Capacitance of X-, Y-, and Z-input must be 60 pF or less.

NOTE

For Option 110 and 210 instruments proceed to paragraph 5-24.

Equipment Required:

Test leads
LCR meter
Adapter (BNC male to dual banana post)

5-23. Perform input capacitance check as follows:

a. Using LCR meter, measure input capacitance of X-, Y-, and Z-amplifier inputs. Capacitance shall be 60 pF or less.

NOTE

If a capacitance bridge is used, special care must be taken to null out capacitance of connecting cable and to null out the effect of the 1-megohm input resistance.

5-24. DEFLECTION AMPLIFIER DYNAMIC RANGE. The dynamic range shall extend to at least 1/2 screen diameter beyond full screen.

Equipment Required:

Pulse generator (switchable output polarity—or dual outputs, transition time ≤5 ns)
Monitor oscilloscope
BNC tee
Three 44-in. BNC cables

5-25. Perform deflection amplifier check as follows:

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

b. Set pulse generator for a positive 100-kHz output with pulse width set for a 50 percent duty cycle.

c. Set monitor oscilloscope trigger to internal and sweep speed to display approximately one complete cycle of waveform on Model 1335A CRT.

d. Set Model 1335A X-GAIN fully ccw.

e. Adjust pulse generator for a 10-division p-p deflection.

f. Using Model 1335A X-POSITION control, position baseline of displayed waveform to left-hand side of screen (Option 105: right-hand side).

g. Increase pulse-generator amplitude by 50 percent. Shape of baseline portion of square wave should not move horizontally or change shape.

h. Change pulse-generator polarity to negative and repeat steps b through g except in step f, position baseline to right-hand side of screen (Option 105: left-hand side).

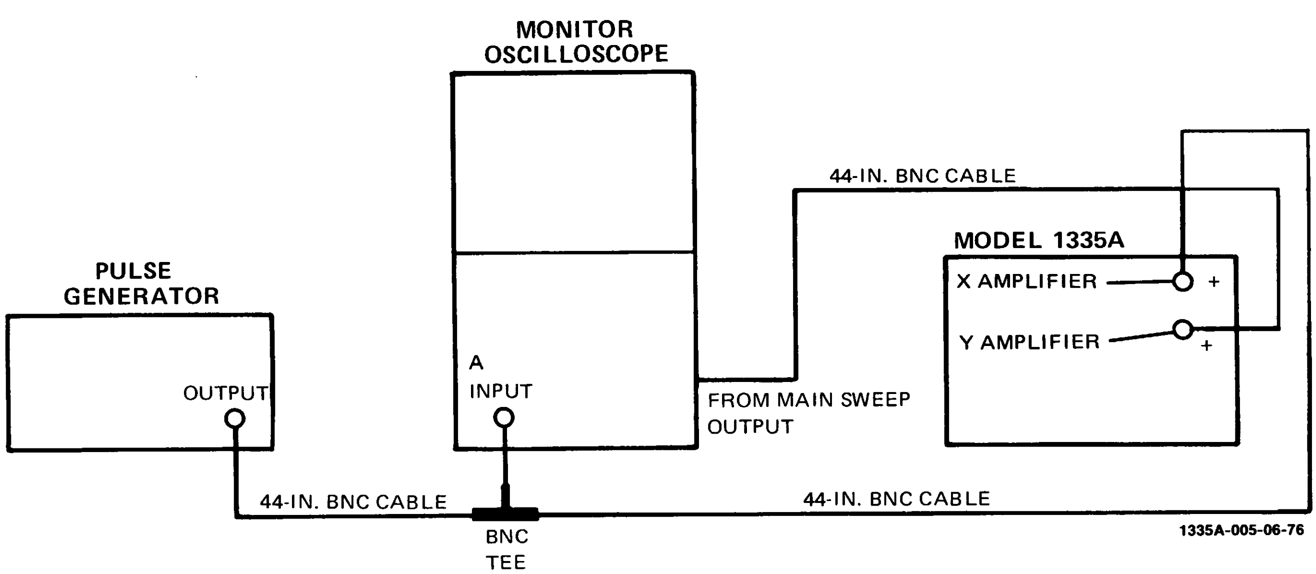


Figure 5-4. Deflection Amplifier Dynamic Range Test Setup

i. Interchange X- and Y-AMPLIFIER inputs.

j. Set pulse-generator amplitude for 8-division p-p deflection on 1335A.

k. Repeat steps b through h. In step f for positive pulse polarity, position baseline to lower edge of CRT (Option 105: upper edge); for negative pulse polarity, position baseline to upper edge of CRT (Option 105: lower edge).

l. Disconnect equipment.

5-26. CROSSTALK. Crosstalk between deflection amplifiers shall be less than 0.254 mm (0.010 in.) with one input terminated in 50 ohms and the other driven by a 1-volt, 500-kHz signal. 2usec/1pulse/div

Equipment Required:

Test oscillator
Two 50-ohm terminations
44-in. BNC cable

5-27. Perform crosstalk check as follows:

a. Connect test oscillator to X-AMPLIFIER input.

b. Connect 50-ohm termination to Y-AMPLIFIER input (not required for Option 110).

NOTE

For Option 106 instruments connect a 50-ohm termination to Y-AMPLIFIER input.

c. Set test oscillator output for 1 V p-p, 500 kHz.

d. Set Model 1335A Y-GAIN to midrange.

e. Set Model 1335A X-GAIN for a ~~10-division~~ max deflection. Trace opening shall be less than 0.254 mm (0.010 in.) measured from trace center to trace center.

f. Add 50-ohm termination to X-AMPLIFIER input (not required for Option 110).

NOTE

For Option 106 instruments, add 50-ohm terminations to both +X and —Y amplifier inputs.

g. Set test oscillator output for 1 V p-p, 5 MHz. .05usec 1pulse/div

h. Set 1335A X-GAIN for a ~~10-division~~ max deflection. Trace opening shall be 0.381 mm (0.015 in.) or less measured from trace center to trace center.

i. Connect test oscillator to Y-AMPLIFIER input.

j. Repeat steps b through h for Y-AMPLIFIER, except set Y-GAIN for ~~8-division~~ max deflection.

k. Disconnect equipment.

5-28. Z-AXIS POLARITY AND GAIN. Positive input unblanks trace. Negative input unblanks trace on Option 205 instruments.

Equipment Required:

Pulse generator (switchable output polarity—or dual outputs, transition time ≤5 ns)
Monitor oscilloscope
BNC tee
Three 44-in. BNC cables

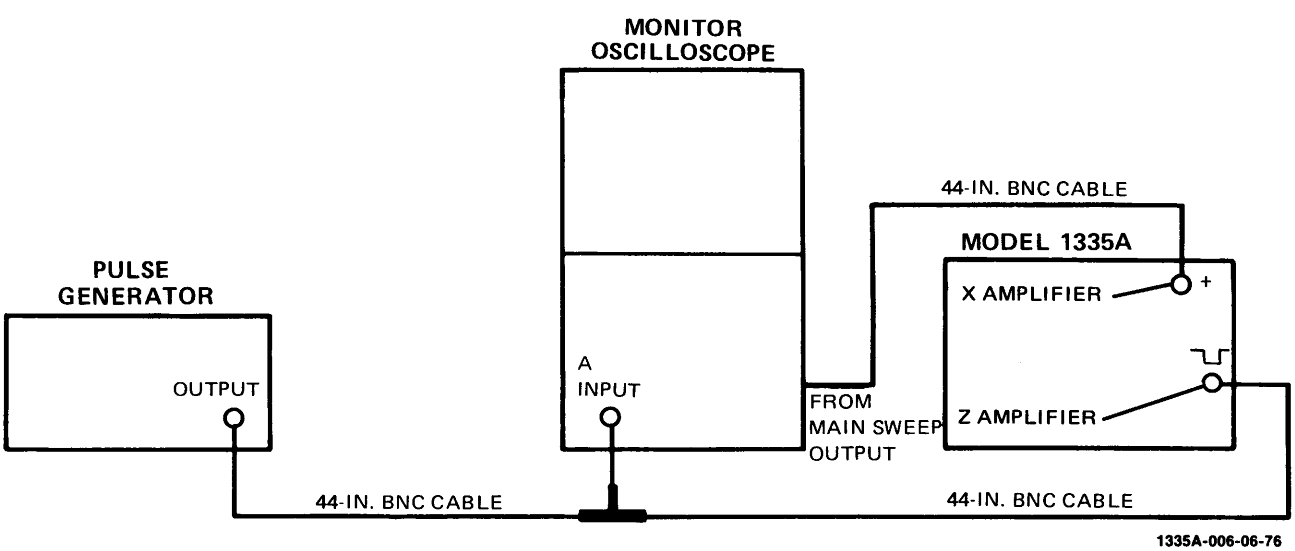


Figure 5-5. Z-axis Polarity and Gain Test Setup

5-29. Perform Z-axis polarity and gain check as follows:

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

b. Set pulse generator controls as follows:

Frequency	100 kHz
Pulse width	for 10% duty cycle
Polarity.....	positive (Option 205: negative)
Amplitude	1 V p-p (Option 200: 5 V p-p and for Option 201: 10 V p-p)

c. Set monitor oscilloscope sweep and trigger controls so that display begins on positive transition and terminates just after negative transition (figure 5-6).

d. Set Model 1335A INTENSITY so that widest square-wave segments are just blanked off. Presentation on Model 1335A shall consist of ~~fully~~ unblanked line segments and ~~fully-un~~blanked segments between them. Unblanked segments shall be shorter than blanked intervals.

e. Set pulse-generator polarity to negative (Option 205, positive).

f. Readjust monitor oscilloscope to achieve display as shown in figure 5-6.

g. Set Model 1335A INTENSITY control so that shortest square-wave segments are just blanked ~~off~~. Presentation on Model 1335A shall consist of ~~fully-~~ unblanked line segments and ~~fully-un~~blanked segments between them. Unblanked intervals shall be wider than blanked segments.

h. Rotate Z-gain Adj, A1R11, fully ccw.

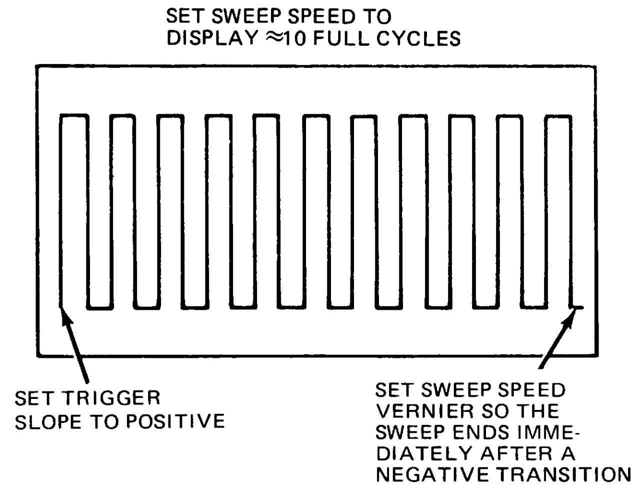


Figure 5-6. Monitor Oscilloscope Presentation

i. Increase pulse-generator amplitude until blanked segments on Model 1335A just disappear. Pulse amplitude on monitor oscilloscope shall be ≥2.5 volts (Option 200: ≥12.5 volts and Option 201: ≥25 volts).

j. Reset Z-gain Adj, A1R11, fully cw.

NOTE

On Option 205 and 206 instruments invert pulse-generator output polarity in all the above tests. Set monitor oscilloscope sweep and trigger controls so that presentation begins on a negative transition and terminates immediately following a positive transition.

k. Disconnect equipment.

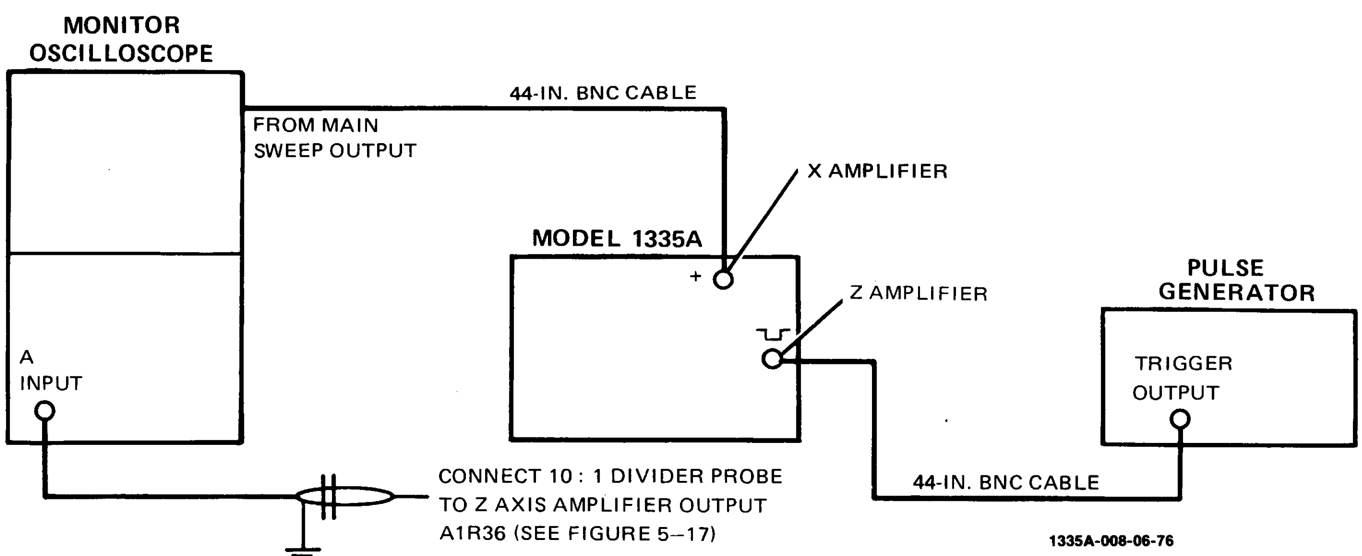


Figure 5-7. Z-axis Rise Time Test Setup

5-30. Z-AXIS RISE TIME. Rise time of the Z-axis amplifier shall be less than 25 nanoseconds.

Equipment Required:

Pulse generator (switchable output polarity—or dual outputs, transition time ≤5 ns)
Monitor oscilloscope
10:1 divider probe
Two 44-in. BNC cables

5-31. Perform Z-axis rise time check as follows:

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

b. Set pulse-generator frequency to 100 kHz and adjust pulse width for 50 percent duty cycle.

c. Set pulse-generator amplitude and Model 1335A INTENSITY control for a pulse at ~~A1TP1~~ collector A1Q12 (as seen on monitor oscilloscope) of highest amplitude attainable without clamping on either positive or negative excursions.

d. Rise time shall be ≤25 ns for both positive and negative going transitions.

e. Disconnect equipment.

5-32. LINEARITY. With 11 equally-spaced pulses displayed on screen leading edge of each pulse shall be within 3 percent of full scale of corresponding graticule line.

Equipment Required:

Pulse generator (switchable output polarity—or dual outputs, transition time ≤5 ns)
Monitor oscilloscope
BNC tee
Three 44-in. BNC cables
Termination (except option 110)

5-33. Perform linearity check as follows:

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

b. Set pulse generator controls for 0.5-volt, 100-kHz, 1-μs wide pulse.

c. Set monitor oscilloscope sweep speed to 2 μs/div, internal trigger.

d. Adjust Model 1335A X-POSITION control so sweep starts 1 to 2 divisions off screen.

e. Adjust pulse generator frequency and Model 1335A X-POSITION control for exactly 11 pulses displayed on Model 1335A CRT screen (figure 5-9).

f. Using Model 1335A X-POSITION and pulse-generator frequency control, position leading edge of first pulse exactly on the left edge of the graticule and leading edge of 11th pulse exactly on the right edge of the graticule.

g. Every other leading edge must fall on corresponding graticule line within 0.3 division. Spacing between any two leading edges must be 1 ±0.3 division.

h. Interchange X- and Y-AMPLIFIER inputs and repeat for Y-AMPLIFIER, except adjust for 9 pulses and position on bottom and top graticule lines; every other leading edge must fall on corresponding graticule line within 0.24 division. Spacing between any leading edges must be 1 ±0.24 division.

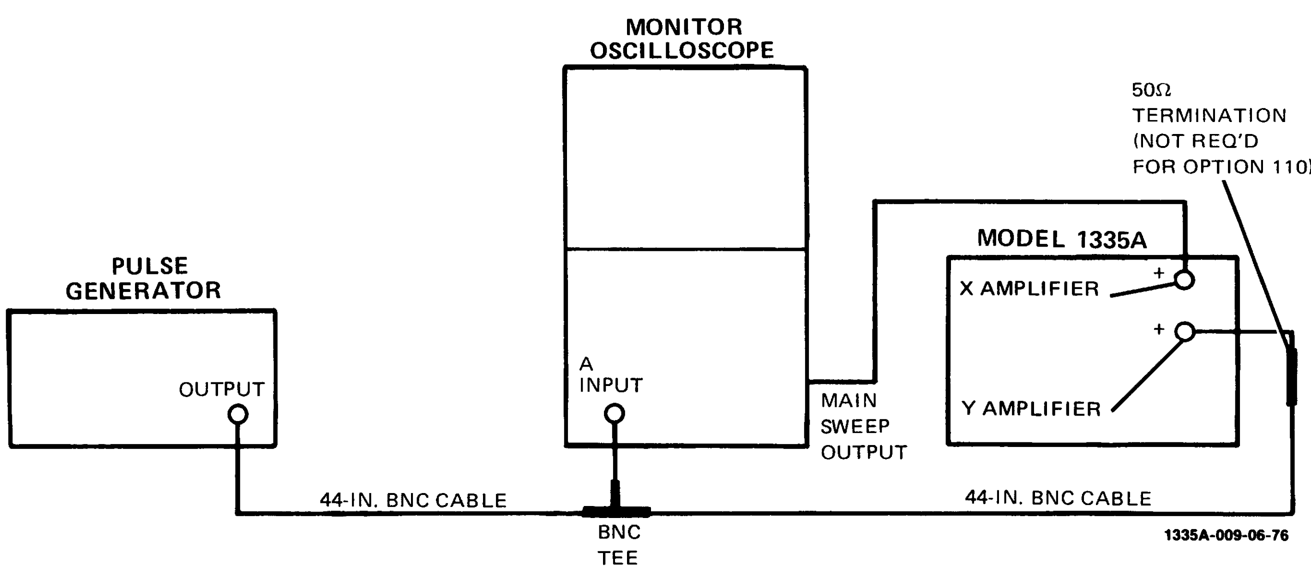


Figure 5-8. Linearity Test Setup

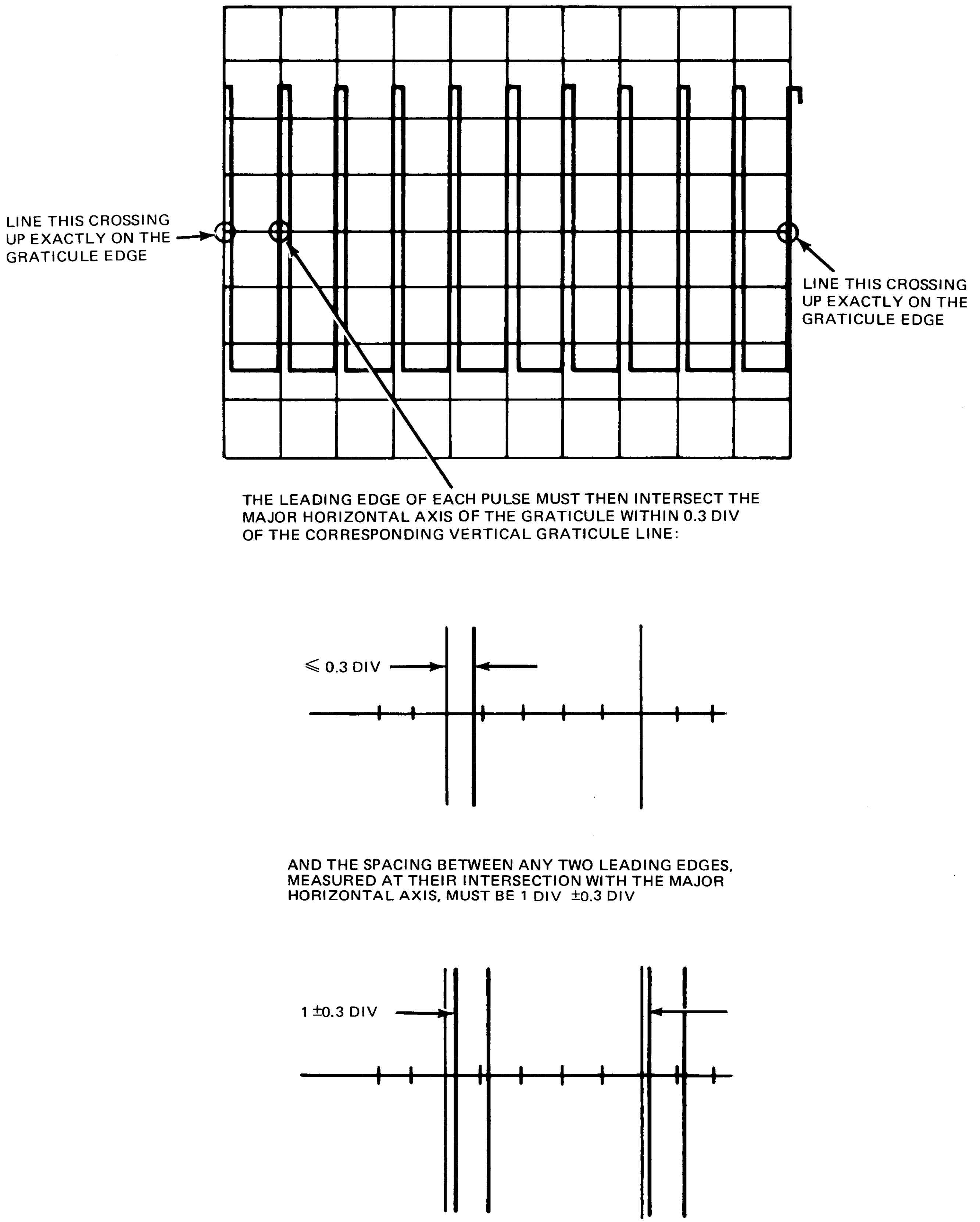


Figure 5-9. Linearity Presentation

5-34. GEOMETRY. Trace deviation from vertical shall be equal to or less than 0.24 division over height of graticule.

Equipment Required:

Test oscillator
44-in. BNC cable

5-35. Perform geometry check as follows:

a. Connect test oscillator output to Y-AMPLIFIER input.

b. Set test oscillator output for approximately 10 kHz and display amplitude of 8 divisions.

c. Position trace to coincide with vertical center line of graticule. Exactly align trace using TR ALIGN control.

d. Move trace to left edge of graticule. Total trace deviation from vertical must be ≤0.24 division when measured from trace center to trace center within the 8-division graticule.

e. Move trace to right edge of graticule, and repeat deviation test in step d.

f. Connect test oscillator output to X-AMPLIFIER input.

g. Set test oscillator output for approximately 10 kHz and horizontal display of 10 divisions.

h. Position trace to coincide with horizontal center line of graticule.

NOTE

If necessary adjust Ortho, A1R77, to align trace exactly with graticule line.

i. Move trace to top edge of graticule. Total trace deviation from horizontal shall be ≤0.3 division when measured within the 10-division graticule.

j. Move trace to bottom of graticule and repeat step i.

k. Disconnect equipment.

5-36. CMRR-OPTION 106 ONLY. By applying identical signals to +X-AMPLIFIER and —X-AMPLIFIER inputs, display on CRT will be common mode signal. Amplitude of common mode signal must be at least 40 dB below input signal at 10 kHz and at least 25 dB below input signal at 1 MHz.

Equipment Required:

Test oscillator
Monitor oscilloscope
Two BNC tees
50-ohm termination
Two 44-in. BNC cables
Two 9-in. BNC cables
Shorting cap

5-37. Perform CMRR-Option 106 check as follows:

a. Connect equipment as shown in figure 5-10, except do not connect —X-AMPLIFIER input at this time. (Option 110 does not use 50-ohm termination.)

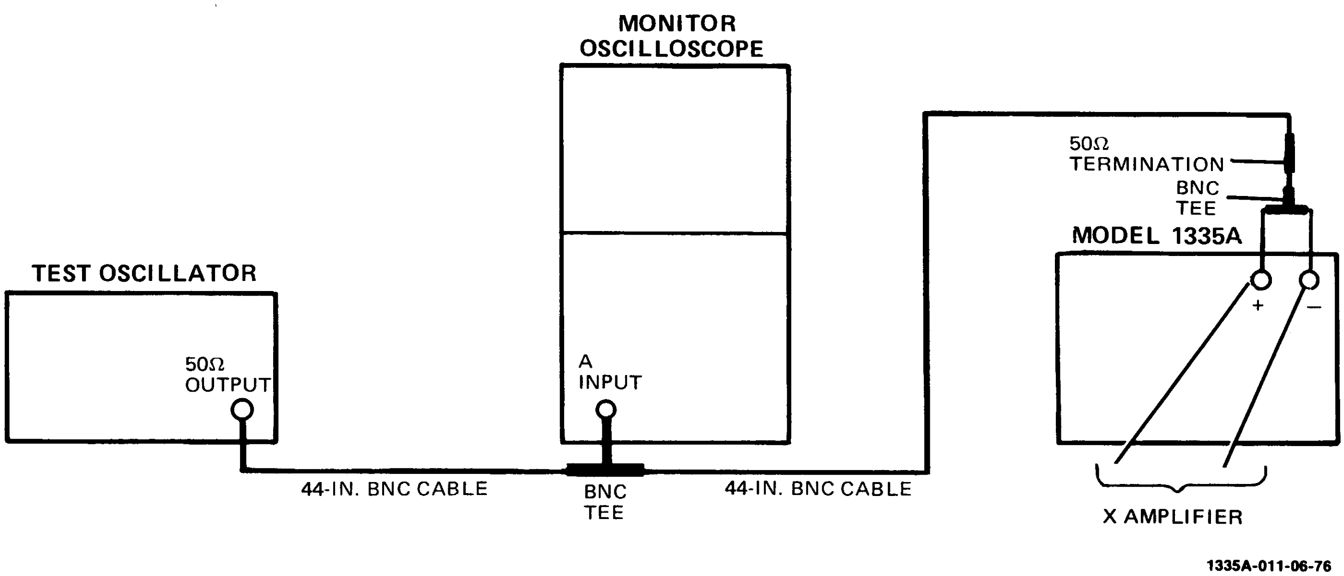


Figure 5-10. CMRR Test Setup

b. Place shorting cap on —X-AMPLIFIER input connector.

c. Set sine-wave oscillator output to 10-kHz, 1 V p-p. For Option 100 instruments set to 10-kHz, 5 V p-p. For Option 101 instruments set to 10-kHz, 10 V p-p.

d. Adjust Model 1335A X-GAIN for 10-division deflection.

e. Remove shorting cap and connect cable to —X-AMPLIFIER as shown in figure 5-10.

f. Deflection on Model 1335A shall be ≤0.1 division.

g. Repeat steps b through d, except increase frequency to 1 MHz. Horizontal deflection on 1335A shall be ≤0.4 division.

h. Repeat steps a through g for Y-AMPLIFIER inputs, except adjust Y-GAIN for 8-division deflection.

i. Vertical deflection (at 1 MHz) on 1335A shall be ≤0.32 division.

j. Disconnect equipment.

5-38. TTL BLANKING-OPTION 216 ONLY. A logic high level (+2.5 volts to 5.0 volts) blanks any analog Z-axis input signal. A logic low level (0 volt to 0.8 volt) returns control of display brightness to analog Z-axis input.

Equipment Required:

Dc power supply
Digital voltmeter
Dual-banana to BNC adapter
44-in. BNC cable

5-39. Perform TTL blanking Option 216 check as follows:

a. Connect equipment as shown in figure 5-11.

b. Adjust power-supply output to +2.5 Vdc.

c. Rotate INTENSITY control fully cw. Trace should not appear on screen.

d. Rotate INTENSITY control fully ccw.

e. Set power-supply output to +0.8 Vdc.

f. Rotate INTENSITY control cw. Spot shall appear on CRT.

g. Disconnect cable from Model 1335A TTL blanking.

h. Rotate INTENSITY control fully cw. Trace shall not appear on CRT.

5-40. VARIABLE PERSISTENCE FUNCTIONS. Dots shall be written in 1 microsecond or less. Maximum persistence in write mode shall be 1 minute or more. In store mode, displays shall be stored 30 minutes or more. Erase cycle time shall be 500 milliseconds or less.

Equipment Required:

Monitor oscillator
Pulse generator (switchable output polarity—or dual outputs, transition time ≤5 ns)
Two function generators
Four 44-in. BNC cables
Two adapters (BNC to dual banana plug)

5-41. Perform variable persistence function check as follows:

a. Connect equipment as shown in figure 5-12. Note that pulse generator is not connected to Z-AMPLIFIER.

b. Set function switches on both function generators to triangle function.

c. Set frequency of function generator no. 1 to ~~4 kHz~~.
400 hz .5msec
, pulse/5 div

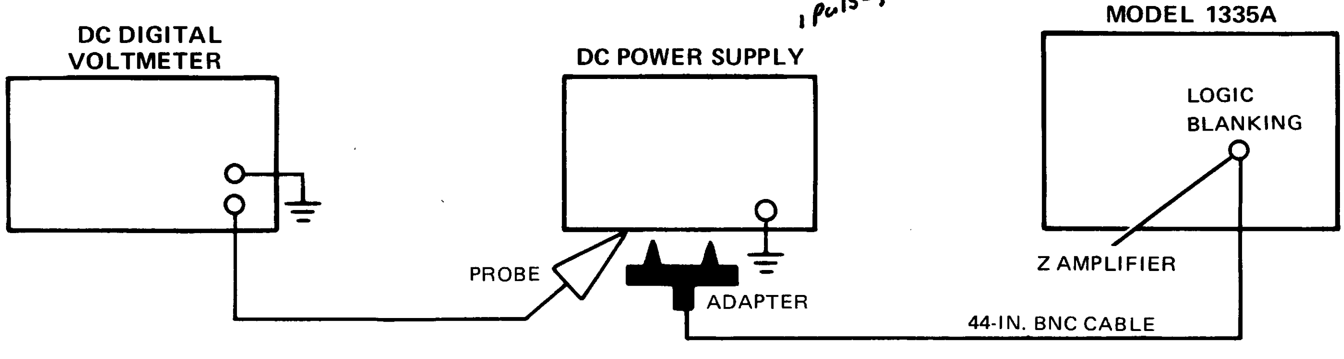


Figure 5-11. TTL Blanking Test Setup

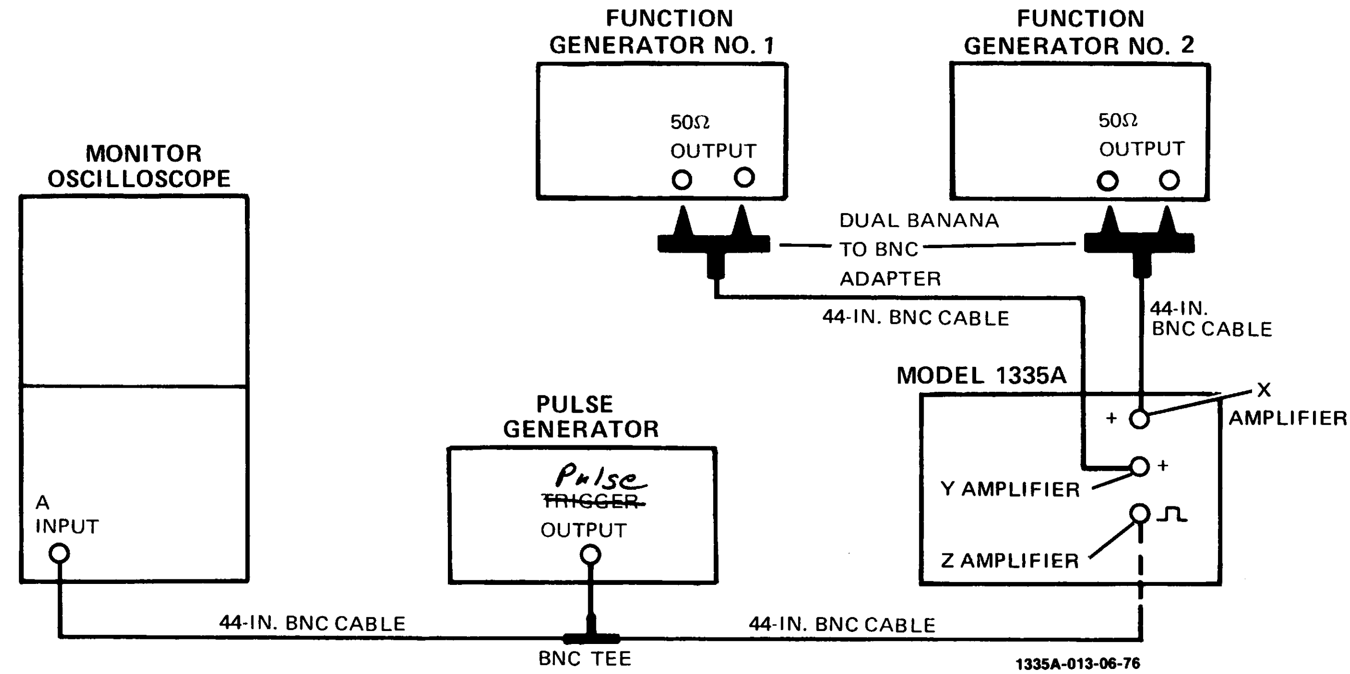


Figure 5-12. Variable Persistence Test Setup

d. Set frequency of function generator no. 2 to 70 Hz.

e. Set PERSISTENCE ccw.

f. Press WRITE pushbutton.

g. Set amplitudes of function generators and Model 1335A POSITION controls to achieve centered 7 by 9 division raster display on CRT.

h. Disconnect inputs to X- and Y-AMPLIFIERS.

i. Set INTENSITY control so beam is just at cutoff (spot just extinguished).

j. Reconnect inputs to X- and Y-AMPLIFIERS.

k. Connect monitor oscilloscope to output of pulse generator.

l. Set pulse generator for positive 1-V, p-p, 1-μs pulse width, 1-kHz repetition rate as displayed on monitor oscilloscope.

m. Disconnect monitor oscilloscope and connect output of pulse generator to Z-AMPLIFIER. If line structure is visible in pattern, shift frequency of 4-kHz triangle-wave generator slightly.

n. Set FOCUS and ASTIGMAT for best dot resolution over 7 by 9 division area.

o. Set pulse-generator polarity switch to negative.

p. Set PERSISTENCE cw.

q. Press and release ERASE pushbutton.

r. Set pulse generator polarity switch to positive, then quickly back to negative. Dot pattern shall appear and remain visible over entire 7 by 9 division area, with no fade positive or fade negative for 60 seconds or longer.

s. Press and release ERASE pushbutton.

t. Set pulse generator polarity switch to positive, then back to negative and immediately press STORE pushbutton. Dot pattern shall appear and remain visible over entire 7 by 9 division area, with no fade positive or fade negative, for 30 minutes or more.

Press write,

u. Press and release ERASE pushbutton.

v. Set pulse generator to positive, then back to negative, when dot pattern appears, immediately press and release ERASE pushbutton. Erasure shall be complete.

w. Connect monitor oscilloscope to CRT storage mesh, white/green (95) on storage board, A4.

x. Set monitor oscilloscope to observe a one-shot, one-second occurrence.

y. Press and release ERASE pushbutton. Compare display pattern with figure 5-13. Time T shall be 500 milliseconds or less.

z. Disconnect equipment.

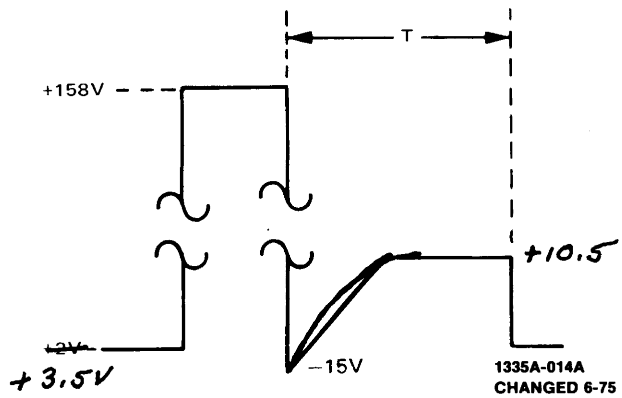


Figure 5-13. Erase Waveform

5-42. ADJUSTMENTS.

WARNING

Read the Safety Summary at the front of this manual before performing adjustment procedures.

5-43. The following paragraphs describe procedures to calibrate the instrument so that it will perform as specified in table 1-1. The entire adjustment procedure can be done in sequence, or any separate adjustment can be made by following the steps outlined in the appropriate paragraph. However do not attempt to subdivide major sections.

5-44. Use a nonmetallic screwdriver and recently calibrated test equipment with characteristics as specified in table 5-1. After adjustments are complete, check instrument performance by doing the performance check procedure at the beginning of this section.

5-45. Install BNC shorting caps on all unused inputs during all tests. Also, for options with differential inputs use the +X, +Y, or ⎍ Z input unless otherwise stated.

5-46. For options without a graticule in the CRT, the safety faceplate may be temporarily replaced with an external graticule. Handle the safety faceplate with care and be certain to replace it.

5-47. The position of a trace on the CRT always refers to the center of the trace, and the distance between traces always refers to the orthogonal distance from trace center to trace center; or, from the edge of one trace to the corresponding edge of the other trace.

5-48. If an assembly or an adjustable component is replaced, set all adjustments on the replaced assembly to midrange (except A1R76, Intensity Limit, which should not be changed) before turning the instrument on. If the CRT is replaced, rotate A1R76 fully ccw and set front-panel INTENSITY control fully ccw before applying power.

NOTE

Allow Model 1335A and all test equipment to warmup for one hour before making any adjustments.

5-49. LOW-VOLTAGE POWER SUPPLY.

Equipment Required:

Dc voltmeter

5-50. There are no low-voltage power supply adjustments; however, each supply should be checked for proper output. Measure each power supply output at the test points listed in table 5-3.

Table 5-3. Low-voltage Power Supply ≥ 1949A

Supply	Test Point	Test Limits
+158 V	A1TP +158	~~+150 V to +166~~ V +158 ± 1.5
+15 V	A1TP +15	+14.25 V to +15.75 V
−15 V	A1TP −15	−14.25 V to −15.75 V
−12.6 V	A1TP −12.6	Adjust for −12.6 V
+5 V	A1TP +5	+4.75 V to +5.25 V

5-51. HIGH-VOLTAGE POWER SUPPLY.

WARNING

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

Equipment Required:

Dc voltmeter
1000:1 divider probe

5-52. Perform high-voltage adjustment as follows:

a. Measure output of +158-volt power supply at test point A1TP2 using 10 V range (if DVM used has different input resistance on 10 V range versus lower ranges). Note reading.

b. Connect 1000:1 divider probe to voltmeter.

c. Set dc voltmeter to 100-millivolt range.

d. Measure +158-volt power supply through 1000:1 divider probe and note reading.

e. Divide reading noted in step a into reading noted in step d.

f. Measure voltage output of CRT cathode power supply at HVTP test point on assembly A3.

g. Adjust H.V. Adj, A1R84, for a reading of —30 times value of step e.

-3000 or 4650 / depending on serial # OR BOARD

5-53. FOCUS CENTERING.

Equipment Required: None

5-54. Perform focus centering adjustment as follows:

a. Adjust INTENSITY and X-POSITION controls for a spot of normal intensity at center screen.

b. Set FOCUS control to midrange.

c. Adjust Focus Limit, A3R13, and ASTIGMAT control for sharpest focused, round spot.

5-55. INTENSITY LIMIT.

Equipment Required:

Monitor oscilloscope
10:1 divider probe
Dc voltmeter

5-56. Perform intensity limit adjustment as follows:

a. Connect monitor oscilloscope, through 10:1 divider probe, to A3TP1.

b. Set Model 1335A X-, and Y-POSITION, and INTENSITY controls fully cw.

c. Adjust Intensity Limit, A1R76, for a 5-V p-p, amplitude at A3TP1.

d. Set INTENSITY control fully ccw and center X- and Y-POSITION controls.

e. Disconnect equipment.

5-57. TRACE ALIGNMENT AND ORTHOGONALITY.

Equipment Required:

Test oscillator
44-in. BNC cable

5-58. Perform trace alignment and orthogonality adjustment as follows:

a. Connect test oscillator output to Model 1335A X-AMPLIFIER input.

b. Set oscillator frequency to 10 kHz and amplitude for 10 horizontal divisions of display.

c. Position trace to center screen.

d. Align trace with center horizontal graticule line using front-panel control TR ALIGN.

e. Reconnect test oscillator output to Model 1335A Y-AMPLIFIER input.

f. Adjust test oscillator output for 8 vertical divisions of display.

g. Position trace to center screen.

h. Align trace with center vertical graticule line using ortho adj: A1R77.

i. Disconnect equipment.

5-59. Z-AXIS HIGH FREQUENCY.

Equipment Required:

Pulse generator (switchable output polarity—or dual outputs, transition time ≤5 ns)
Monitor oscilloscope
10:1 divider probe
44-in. BNC cable
50-ohm termination

5-60. Perform Z-axis high frequency adjustment as follows:

a. Set X- and Y-POSITION controls fully cw.

b. Set INTENSITY fully ccw.

NOTE

For Options 200 and 201 instruments, install jumper across A1R3.

c. Connect pulse-generator output to monitor oscilloscope vertical input; terminate in 50 ohms.

d. Adjust pulse generator for a positive 1-V p-p, 100-kHz output with a 50% duty cycle pulse width.

NOTE

For Option 205 instruments, set pulse generator to negative polarity.

e. Reconnect pulse-generator output to Model 1335A Z-AMPLIFIER input through 50 ohm termination.

NOTE

50-ohm termination is not required on Options 210 and 211 instruments.

f. Connect monitor oscilloscope vertical input through 10:1 divider probe to Model 1335A Z-amplifier output (front end of A1R36).

g. Set Z-gain, A1R11, fully cw. Displayed waveform should go from baseline of <+5 Vdc to a peak of >+55 Vdc (by adjusting INTENSITY control).

h. Adjust HF adj #1, A1R31, and HF adj #2, A1C8, for best pulse shape with a rise time of ≤25 ns.

NOTE

For Options 200 and 201 instruments, perform the following steps.

i. Remove shorting jumper across A1R3.

.1m sec/div
1pulse

j. Readjust pulse-generator output amplitude to 5 V p-p, for Option 200 (10 V p-p, for Option 201), 10-kHz, and a 50% duty cycle pulse width.

k. Repeat step g.

l. Adjust input compensation, A1C1, for best wave shape as seen on monitor oscilloscope.

NOTE

For Option 200 with 206 or Option 201 with 206 instruments, perform the following steps:

m. Set pulse-generator polarity to negative and amplitude to 5 V p-p (Option 200 with 206) or 10 V p-p (Option 201 with 206).

n. Reconnect pulse-generator output to Model 1335A ⊔⊓ Z-input.

o. Adjust input compensation, A1C2, for best wave shape as seen on monitor oscilloscope.

p. Disconnect equipment.

5-61. X- AND Y-GAIN.

Equipment Required:

Test oscillator
Monitor oscilloscope
BNC tee
Three 44-in. BNC cables

5-62. Perform X- and Y-gain adjustment as follows:

a. Connect test oscillator output to monitor oscilloscope vertical input and to Model 1335A X-AMPLIFIER input.

b. Set test oscillator output to 1-kHz, 0.5 V p-p (Option 100 to 2.5 V p-p and Option 101 to 5 V p-p) as seen on monitor oscilloscope.

c. Rotate X- and Y-GAIN fully cw.

7cm (8.75 Div

d. Adjust X-gain ctr, A2R68, for ~~7 horizontal divisions~~ of display.

e. Reconnect test oscillator output to Model 1335A Y-AMPLIFIER input.

5.7cm (7.1 div

f. Adjust Y-gain ctr, A2R24, for ~~5.7 vertical divisions~~ of display.

g. Disconnect equipment.

5-63. X- AND Y-AXIS HIGH FREQUENCY.

Equipment Required:

Pulse generator (switchable output polarity—or dual outputs, transition time ≤5 ns)
Monitor oscilloscope
50-ohm termination
BNC tee
Three 44-in. BNC cables
Two 9-in. BNC cables
Two 10:1 divider probes

5-64. Perform X- and Y-axis high frequency adjustment as follows:

a. Connect equipment as shown in figure 5-14.

NOTE

For Options 100 and 101 instruments, install shorting jumpers across A2R3 and A2R4 for Y-axis, and A2R47 and A2R48 for X-axis.
For Option 205 instruments connect monitor oscilloscope gate output to Z-AMPLIFIER input. For Option 206 instruments, connect monitor oscilloscope to ⊓⊔ Z-input.

b. Set X- and Y-GAIN fully cw.

c. Set pulse generator output for 100 kHz, amplitude for 8 vertical divisions of display, and 50% duty cycle.

d. Set monitor oscilloscope sweep and trigger controls for stable display of one fully cycle of square wave.

e. Position both ends of square wave on screen.

f. Adjust HF adj #1, A2R30, for best displayed wave shape.

g. Connect monitor oscilloscope vertical inputs to Y-axis deflection plates through 10:1 divider probes.

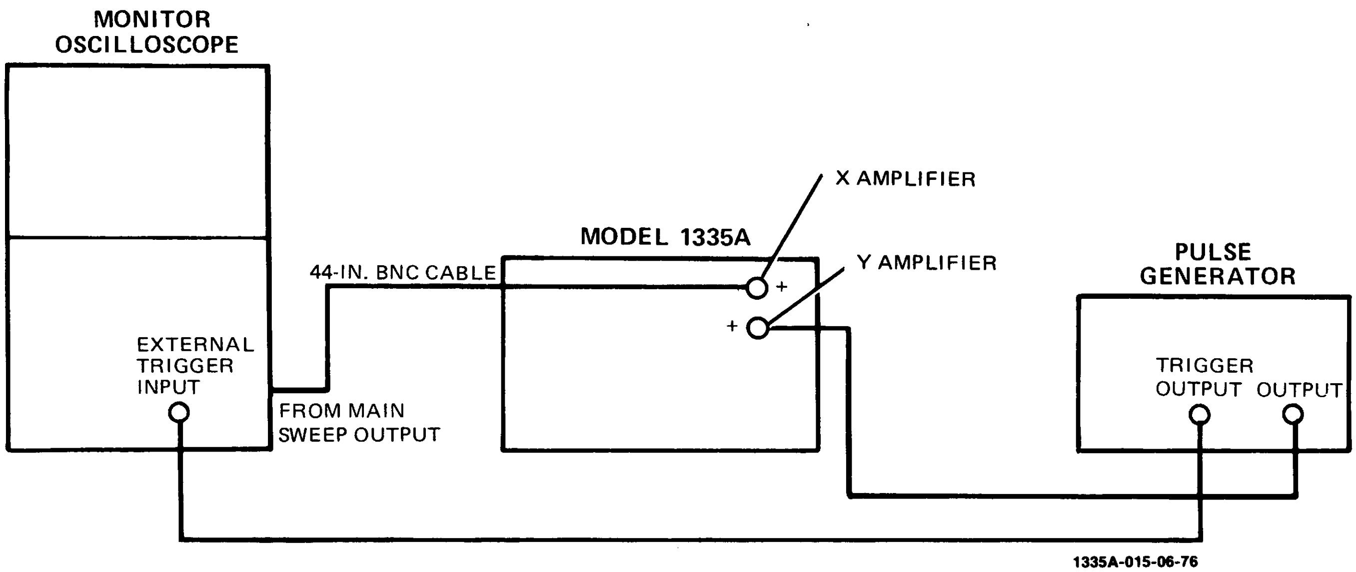


Figure 5-14. X- and Y-axis Test Setup

h. Set monitor oscilloscope to operate in differential (A—B) mode.

i. Adjust Y HF adj #2, A2C11, and Y HF adj #3, A2C10, for 70-ns rise time as seen on monitor oscilloscope (adjust HF adj A2C10 and A2C11 adjustment screws to equal lengths).

j. Measure pulse perturbations (overshoot ringing). Perturbation must be <3% deviation from pulse top in either direction.

k. Interchange connections to Model 1335A X- and Y-AMPLIFIER inputs.

l. Remove probes from Y-axis deflection plates.

m. Set pulse generator amplitude for 10 horizontal divisions of display.

n. Set monitor oscilloscope sweep and trigger controls for a stable presentation of one full cycle of square wave.

o. Position both ends of square wave on screen.

p. Adjust HF adj #1, A2R74, for best displayed wave shape.

q. Disconnect all inputs from Model 1335A. Do not change equipment settings.

r. Connect equipment as shown in figure 5-15.

s. Set test oscillator output frequency to 1 MHz.

t. Adjust test oscillator amplitude for 8 vertical divisions of display.

u. Adjust HF adj #2, A2C27, and HF adj #3, A2C28, for straight line display (adjust A2C27 and A2C28 adjustment screws to equal lengths).

v. Reconnect equipment as shown in figure 5-14, except interchange X- and Y-AMPLIFIER inputs.

w. Connect monitor oscilloscope vertical inputs to Model 1335A X-axis deflection plates through 10:1 divider probes.

x. Set monitor oscilloscope controls to operate in differential (A—B) mode.

y. Rise time shall be ≤70 ns and perturbations must be ≤3% deviation from pulse top in either direction.

NOTE

For Option 100 and 101 instruments, perform the following steps:

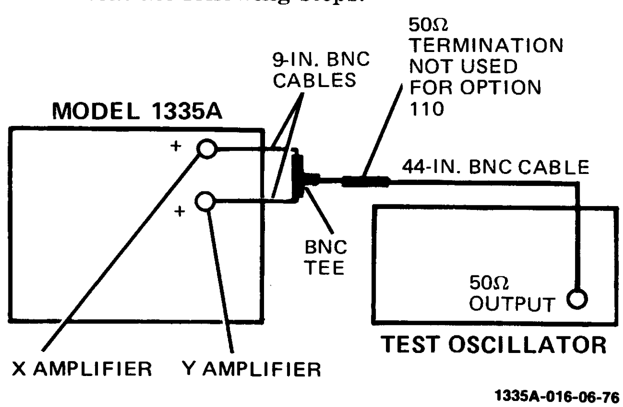


Figure 5-15. X- and Y-axis Test Setup

z. Remove jumpers from across A2R3, A2R4, A2R47, and A2R48.

aa. Repeat steps a through f except set pulse generator frequency to 10 kHz.

ab. Adjust input compensation, A2C1, for best appearing square-wave shape (do not adjust A2R30).

NOTE

For Option 100 and 106 or Option 101 and 106 instruments, connect pulse generator to —Y-AMPLIFIER input and adjust A2C2 for best square-wave shape.

5-65. COLLIMATION.

Equipment Required: None

5-66. Perform collimator adjustments as follows:

a. Disconnect all inputs.

b. Set INTENSITY and PERSISTENCE ccw.

c. Press WRITE pushbutton.

d. Press and release ERASE pushbutton.

e. Set Coll Adj, A4R72, to overcollimate flood-gun beam.

f. Set Flood Gun Grid (FGG), A4R77, fully ccw.

g. Slowly adjust A4R77 cw until first initial rapid increase in pattern brightness is passed. 72

Line (goes up)

NOTE

77

When adjusting A4R77, the background brightness will first increase rapidly, then increase more slowly, then decrease (starting at the edges). Set A4R77 at point of transition from rapid increase to increasing more slowly in pattern brightness.

h. Adjust Collimator Adj, A4R72, until bright green area just fills 8- by 10-graticule outline on CRT (see figure 5-16).

NOTE

Adjust A4R72 so that dimple in worst corner intrudes into graticule area exactly 0.2 major division. This provides best writing speed uniformity.

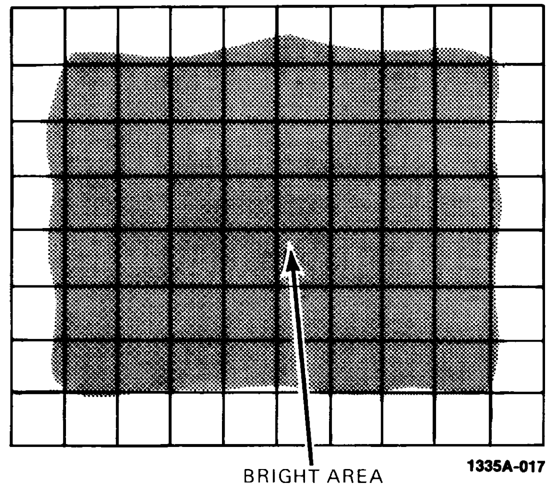


Figure 5-16. Overcollimated CRT

erase.

5-67. VARIABLE PERSISTENCE.

Equipment Required: Jumpy at start normal

Pulse generator (switchable output polarity—or dual outputs, transition time <5 ns)
Monitor oscilloscope
BNC tee
Four 44-in. BNC cables
Two function generators
Two adapters (BNC to dual banana plug)

5-68. Perform variable persistence adjustments as follows:

a. Connect equipment as shown in figure 5-12. Note that output of pulse generator is not yet connected to Z-AMPLIFIER input.

b. Set function switches on both function generators to triangle function.

c. Set frequency of function generator no. 1 to 4 kHz.

d. Set frequency of function generator no. 2 to 70 Hz.

e. Set PERSISTENCE ccw.

f. Set amplitudes of function generators and Model 1335A POSITION controls to achieve centered 7 by 9-division raster display on CRT.

g. Disconnect inputs to X- and Y-AMPLIFIER and set INTENSITY at cutoff.

h. Reconnect inputs to X- and Y-AMPLIFIER.

i. Connect output of pulse generator to Z-AMPLIFIER input.

j. Set pulse generator for positive, 1-V p-p, 1-μs pulse width, 1-kHz output.

k. Dot pattern covering 7- by 9-division area shall appear. If line structure is apparent in pattern, readjust 4-kHz frequency of function generator no. 1 slightly.

l. Set FOCUS and ASTIGMAT for optimum dot size and shape over 7- by 9-division area.

m. Set pulse-generator polarity switch to negative.

n. Set PERSISTENCE cw.

with mod on

o. Press and release ERASE pushbutton.

p. Set Write Depth Adj, A4R19, ccw. full off

q. While pressing and releasing ERASE pushbutton, adjust Write Depth, A4R19, cw until no green areas are visible inside 8- by 10-division area. Rotate Write Depth an additional 5 to 10 degrees cw for final setting.

NOTE

Up to three light, dim spots are acceptable as long as they do not fade positive (becomes brighter) within 60 seconds, and if they are less bright than area written by the beam.

r. Set pulse-generator polarity switch to positive, then back to negative. Dots shall appear and remain visible for at least 60 seconds with no fade positive or fade negative.

Picker displays
-Adj write depth 3/4 CW
Press Erase ck for Blank CRT
P- CW

NOTE

If dots fade negatively or background fades positively, a small readjustment of Write Depth Adj, A4R19, may be required. If the dots near the top and bottom edges of the screen rapidly fade negative, it may be necessary to set Coll Adj, A4R72, slightly ccw. Flood Gun Grid Adj, A4R77, or Coll Adj, A4R72, or both may require slight readjustment to meet the 60 second requirement in step r.

s. Connect monitor oscilloscope probe to flood-gun accelerator, white/blue (94) wire on board A4.

t. Press STORE pushbutton.

u. Adjust monitor oscilloscope so that one pulse occupies one horizontal division on CRT with leading edge at left edge of graticule.

v. Set Store Time Adj, A4R6, to place leading edge of adjacent pulse on right edge of graticule (10% duty cycle).

w. Press write pushbutton.

x. Press and release ERASE pushbutton.

y. Set pulse generator polarity switch to positive, then back to negative and immediately press STORE pushbutton. Stored pattern shall remain visible for 30 minutes or more. Brightness of stored pattern is approximately one-tenth that of write pattern.

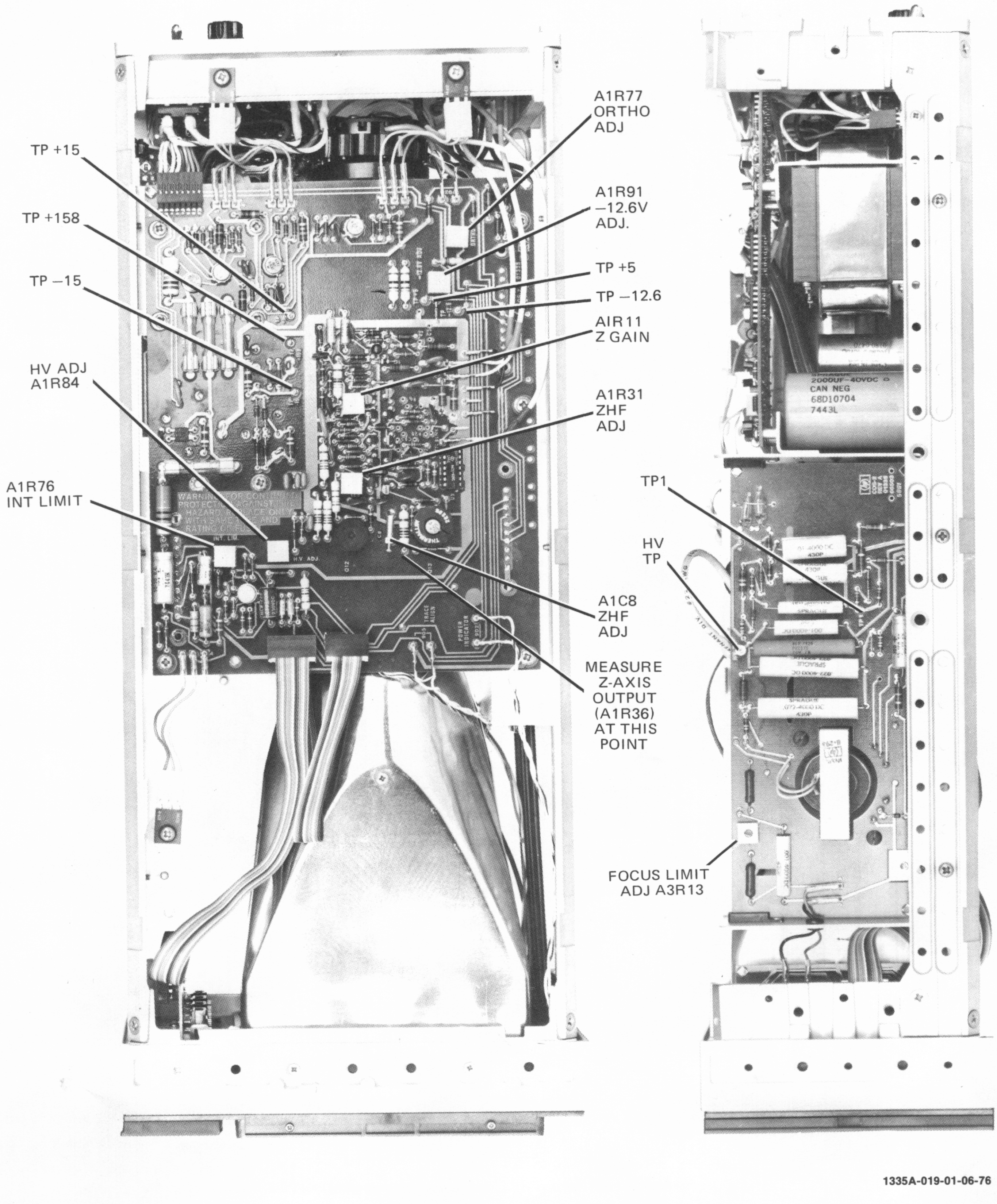
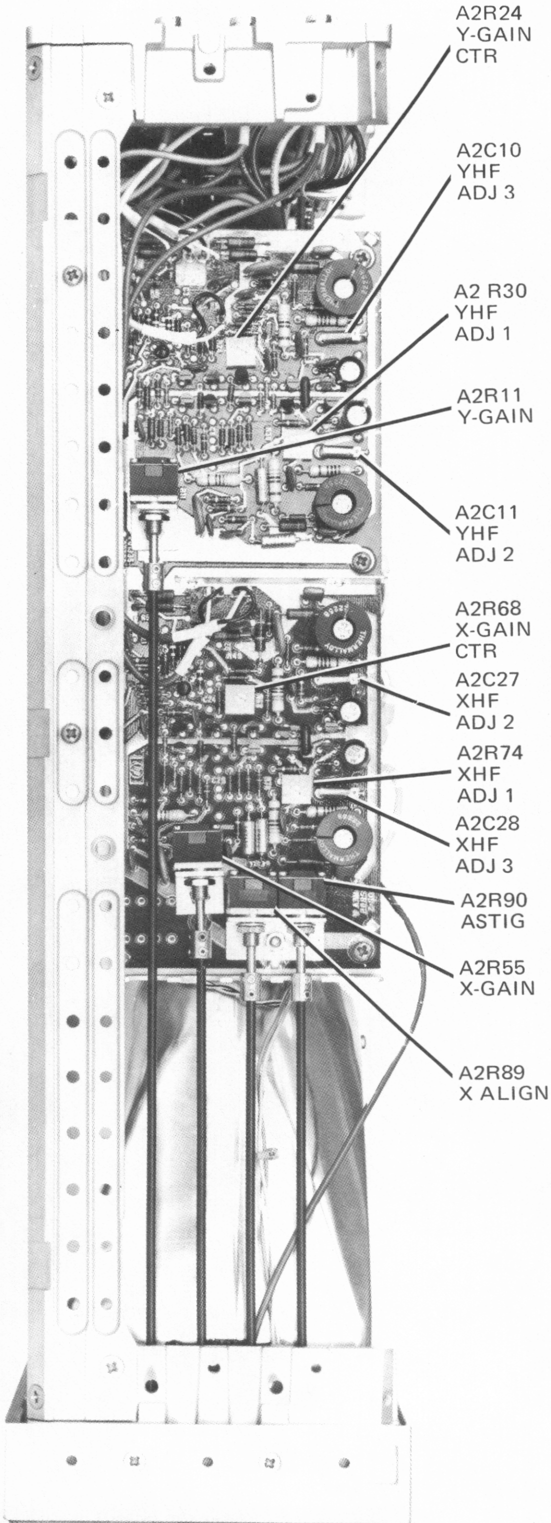


Figure 5-17. Adjustment Locations (Sheet 1 of 2)



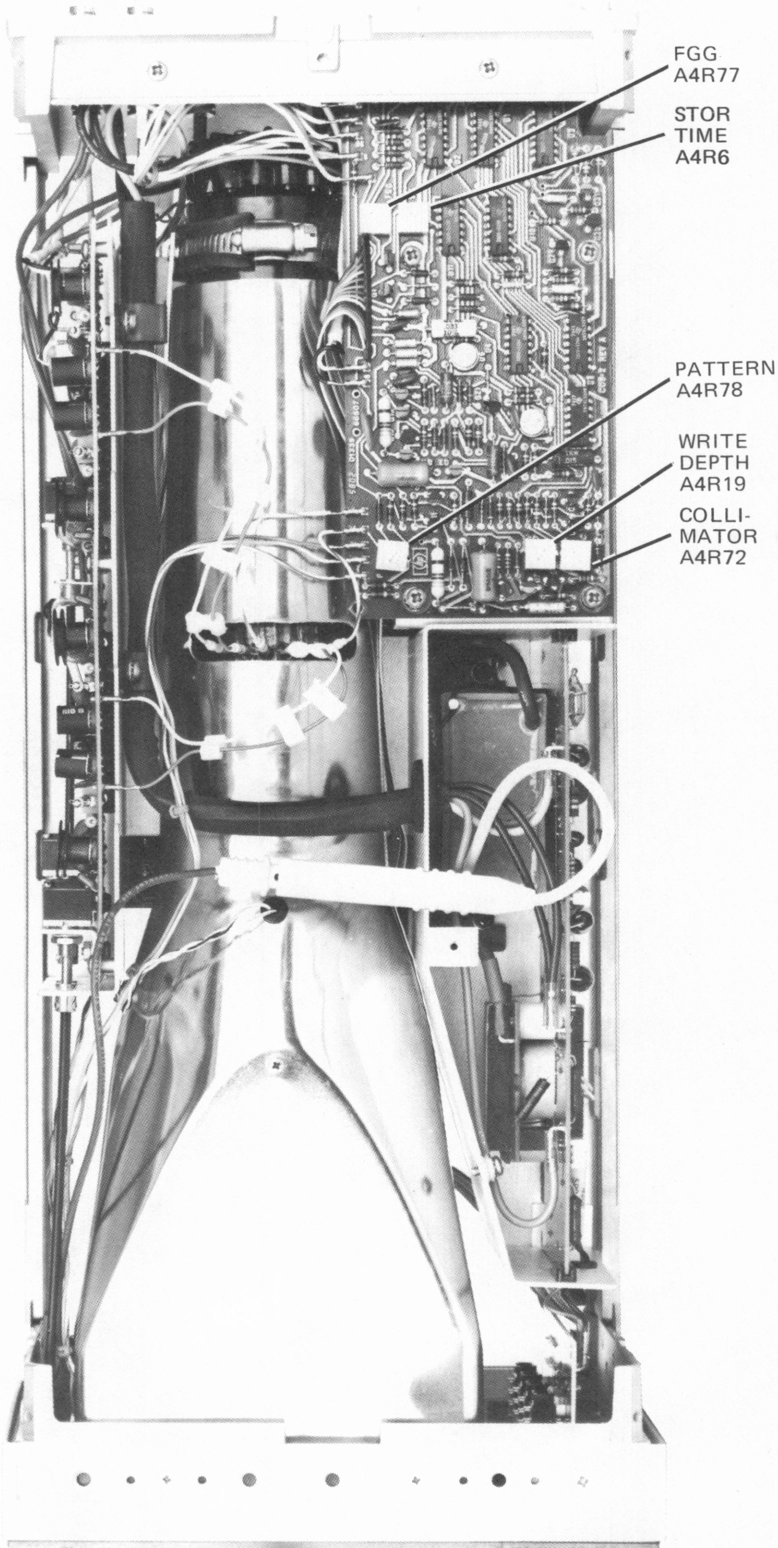


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Figure 5-17. Adjustment Locations (Sheet 2 of 2)

PERFORMANCE CHECK RECORD
MODEL 1335A

Instrument Serial Number ______________ **Date** ______________

Check	Specification	Measured
DEFLECTION AMPLIFIER RISE TIME		
X and Y Amplifier		
Standard	$\leqslant$ 70 ns	______
DEFLECTION FACTOR		
X Amplifier		
Minimum	$\leqslant$ 5 div	______
Maximum	$\geqslant$ 6.3 div	______
Y Amplifier		
Minimum	$\leqslant$ 5 div	______
Maximum	$\geqslant$ 6.3 div	______
DIAGONAL SETTLING TIME	$\leqslant$ 300 ns	______
DEFLECTION POLARITY		
Standard-dimmer dot above brighter dot		______
Option 105 and 106-dimmer dot below brighter dot		______
INPUT RESISTANCE		
X Amplifier		
Standard	1 meg nominal	______
Option 110	50 ±1	______
Y Amplifier		
Standard	1 meg nominal	______
Option 110	50 ±1	______
Z Amplifier		
Standard	1 meg nominal	______
Option 210	50 ±1	______
		______
INPUT CAPACITANCE		
Standard	$\leqslant$ 60 pF	______

PERFORMANCE CHECK RECORD
MODEL 1335A (Cont'd)

Instrument Serial Number ______________ **Date** ______________

Check	Specification	Measured
DEFLECTION AMPLIFIER DYNAMIC RANGE		
X Amplifier		______
Y Amplifier		______
CROSSTALK	$<$ 0.010 inch	______
Z-AXIS POLARITY AND GAIN		
per text steps d and g		______
Z-AXIS RISE TIME	$\leqslant$ 25 ns	______
LINEARITY		
per text step g		______
GEOMETRY	$\leqslant$ 0.3 div	______
	$\leqslant$ 0.24 div	______
CMRR-OPTION 106 ONLY		
10 kHz		
Y Amplifier	$\leqslant$ 0.1 div	______
X Amplifier	$\leqslant$ 0.1 div	______
1 MHz		
Y Amplifier	$\leqslant$ 0.4 div	______
X Amplifier	$\leqslant$ 0.32 div	______
TTL BLANKING-OPTION 216 ONLY		
per text steps f and h		______
VARIABLE PERSISTENCE		
Persistence	$>$ 60 s	______
Store	$>$ 30 minutes	______
Erase	$\leqslant$ 500 ms	______

SECTION VI

REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section contains information for ordering parts. Abbreviations used in the parts list are described in table 6-1. Table 6-2 lists all replaceable parts in reference designation order. Table 6-3 lists replacement parts for available options. Table 6-4 lists names and addresses that correspond to manufacturers' code numbers.

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

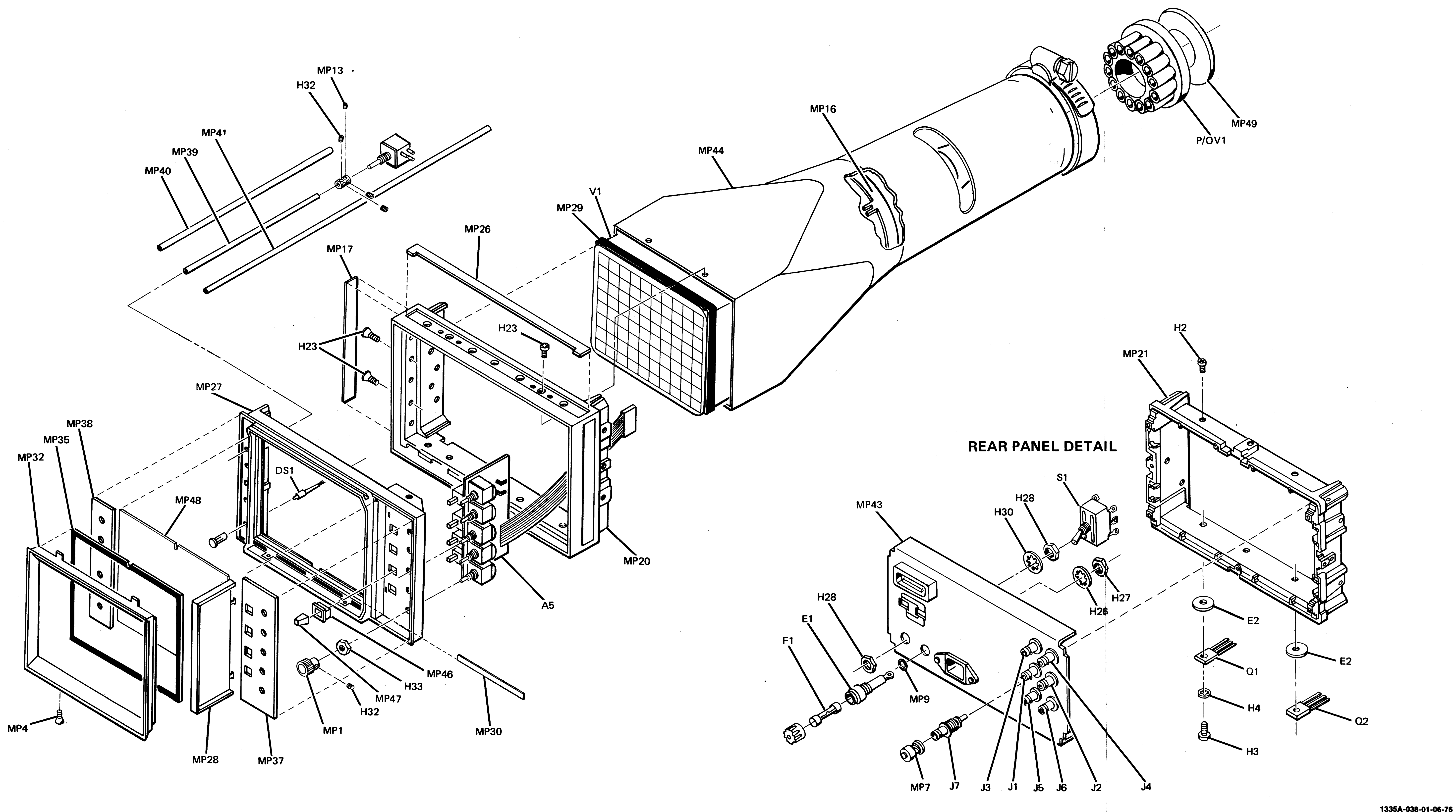


Figure 6-1.
Illustration Parts Breakdown (Sheet 1 of 2)

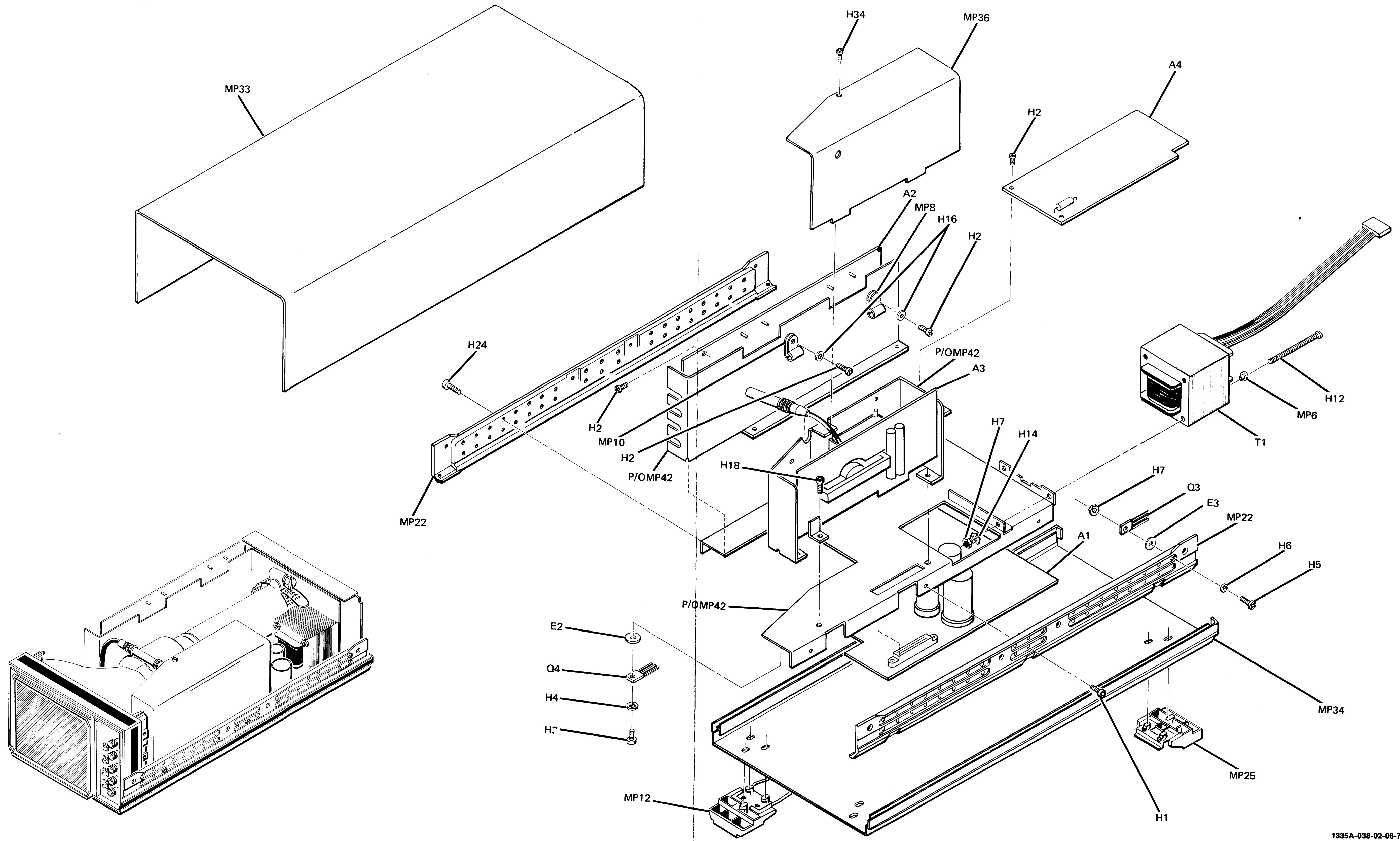


Figure 6-1. Illustration Parts Breakdown (Sheet 2 of 2)

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			CHASSIS PARTS		
A1	01335-66501		BOARD ASSEMBLY, MOTHER	28480	01335-66501
A2	01335-66502		BOARD ASSEMBLY, X-Y	28480	01335-66502
A3	01335-66503		BOARD ASSEMBLY, HIGH VOLTAGE	28480	01335-66503
A4	01335-66507		BOARD ASSEMBLY, STORAGE	28480	01335-66507
A5	01335-66505		BOARD ASSEMBLY, CONTROL	28480	01335-66505
A6	0960-0432		ASSEMBLY, HIGH VOLTAGE MULTIPLIER	28480	0960-0432
DS1	1450-0746	1	LIGHT-IND INCANDESCENT WHT TL LENS	28480	1450-0746
E1	1400-0084	1	FUSEHOLDER-EXTR POST 15A 250V UL	28480	1400-0084
E2	0340-0450	3	INSULATOR, XSTR, X58A, .145 ID, .003	91500	148SB52600F13
E3	0340-0451	1	INSULATOR; XSTR; D.A.T.A. X-58; .13 ID	34344	14B52600F03
F1	2110-0001	1	FUSE 1A 250V NORM-BLO 1.25X.25 IEC	71400	AGC-1
F1	2110-0012	1	FUSE .5A 250V 1.25X.25 IEC	71400	AGC 1/2
H1	2360-0331	5	SCREW-MACH 6-32 .250-IN-LG PAN HD	28480	2360-0331
H2	2360-0115	26	SCREW-MACH 6-32 .312-IN-LG PAN HD	28480	2360-0115
H3	2360-0117	4	SCREW-MACH 6-32 .375-IN-LG	28480	2360-0117
H4	2190-0909	4	WASHER-LK NO. 6 .146 IN ID .333-IN-OD	04713	04A52200F02
H5	2200-0145	1	SCREW-MACH 4-40 .438-IN-LG PAN HD	28480	2200-0145
H6	3050-0235	2	WASHER-FL MTLC NO. 4 .117-IN ID .250-IN-OD	28480	3050-0235
H7	2260-0001	3	NUT-HEX-DBL CHAM 4-40-THD .094 THK	28480	2260-0001
H8 THROUGH H11			NOT ASSIGNED		
H12	2200-0550	2	SCREW-MACH 4-40 2.50-IN-LG PAN HD	28480	2200-0550
H13			NOT ASSIGNED		
H14	2190-0008	2	WASHER-LK EXT T NO. 6 .141-IN-ID .32-IN-OD	78189	1806-00
H15			NOT ASSIGNED		
H16	3050-0066	5	WASHER-FL MTLC NO. 6 .147-IN-ID .375-IN-OD	28480	3050-0066
H17 THROUGH H22			NOT ASSIGNED		
H23	2360-0194	8	SCREW-MACH 6-32 .312-IN-LG 100 DEG FL HD	28480	2360-0194
H24	2510-0192	8	SCREW-MACH 8-32 .250-IN-LG 100 DEG FL HD	04866	YELLOW PATCH
H25			NOT ASSIGNED		
H26	2190-0037		WASHER-LK INTL T NO. 1/2 .512-IN-ID .789-IN-OD	78189	1224-08
H27	2950-0038	1	NUT-SPECIALTY 1/2-24-THD .125-THK	75915	903-12
H28	2950-0035	2	NUT-HEX-DBL CHAM 15/32-32-THD .078-THK	28480	2950-0035
H29			NOT ASSIGNED		
H30	2190-0102	1	WASHER-LK INTL T NO. 7/16 .472-IN-ID	78189	1222-09
H31			NOT ASSIGNED		
H32	2200-0143	16	SCREW-MACH SET	28480	2200-0143
H33	2950-0072	7	NUT-HEX-DBL-CHAM 1/4-32-THD .062-THK	82389	P-1975
H34	2200-0103	1	SCREW-MACH 4-40 .25-IN-LG PAN HD	28480	2200-0103
J1	01250-00102		BNC CONNECTOR	28480	01250-00102
J2	01250-00102		BNC CONNECTOR	28480	01250-00102
J3	01250-00102		BNC CONNECTOR	28480	01250-00102
J4	01250-00102		BNC CONNECTOR	28480	01250-00102
J5	01250-00102		BNC CONNECTOR	28480	01250-00102
J6	01250-00102		BNC CONNECTOR	28480	01250-00102
J7	01250-00102		BNC CONNECTOR	28480	01250-00102
L1	5060-0435	1	COIL ASSEMBLY, ALIGNMENT	28480	5060-0435
MP1	0370-2785	5	KNOB, ROUND, 0.530" DIA	28480	0370-2785
MP2	0400-0001	1	GROMMET, RUBBER 0.750" DIA HOLE	73734	1662
MP3	0400-0009	3	GROMMET:VINYL FITS 1/4" DIA HOLE	01538	G250
MP4	0520-0127	2	SCREW-MACH 2-56 .188-IN-LG PAN-HD	28480	0520-0127
MP5	1140-0062	1	DIAL-TURNS COUNTING, 10-TURNS (OPTION 322)	05129	781
MP6	1200-0081	4	INSULATOR, BSHG, FLG, .115 ID	26365	974-307
MP7	1250-0929	2	CAP-COAX; SHORTING BNC CW-159/U (OPTIONS 106, 208, 216)	24931	28PC104-1
MP8	1400-0023	2	CLAMP-CA .5-IN-WD NYL	28520	3329
MP9	1400-0090	1	WASHER:RUBBER 5/3" OD	00000	OBD
MP10	1400-0325	1	CLAMP, CABLE, .125 DIA .375 W NYL	06915	N-2
MP12	1460-1345	2	SPRING WFRM 1.34-W 3-LG SST (OPTIONS 315, 330, 580)	28480	1460-1345
MP13	1490-0841	4	COUPLER-RGD .127-ID .281-OD .375-L	28480	1490-0841
MP14	1490-0968	5	BUSHING; PANEL; 1/4-32 THD STAINLESS (OPTION 326)	28480	1490-0968
MP15	4320-0003		RUBBER EXTRUSION	13445	T-08688
MP16	5000-0408	2	BRACKET, COIL	28480	5000-0408
MP17	5001-0439	2	TRIM, FRONT SIDE (OPTIONS 315, 330, 580)	28480	5001-0439
MP18	5001-1035	1	COVER	28480	5001-1035
MP19	5001-1043	1	FILTER, RFI (OPTION 562)	28480	5001-1043
MP20	5020-8815	1	CASTING, FRONT FRAME	28480	5020-8815
MP21	5020-8816	1	CASTING, REAR FRAME	28480	5020-8816
MP22	5020-8837	2	STRUT, CORNER	28480	5020-8837
MP23	5040-0526	1	PANEL, FRONT (OPTION 562)	28480	5040-0526
MP24	5040-4601	1	HOOD, CONNECTOR	28480	5040-4601
MP25	5040-7201	4	FEET (OPTIONS 315, 330, 580)	28480	5040-7201
MP26	5040-7203	1	TRIM, TOP FRONT (OPTIONS 315, 330, 580)	28480	5040-7203
MP27	5040-8118	1	PANEL, FRONT	28480	5040-8118
MP28	5040-7620	1	COVER, PANEL	28480	5040-7620

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
MP29	5040-8117	1	CRT SHIELD SUPPORT	28480	5040-8117
MP30	7120-3812	1	LABEL, WARNING	28480	7120-3812
MP31			NOT ASSIGNED		
MP32	01332-02201	1	BEZEL, CRT	28480	01332-02201
MP33	01332-04102	1	COVER, TOP (OPTIONS 315, 580)	28480	01332-04102
MP33	01332-04104	1	COVER, TOP (OPTION 330)	28480	01332-04104
MP34	01332-04103	1	COVER, BOTTOM (OPTIONS 315, 330, 580)	28480	01332-04103
MP35	01335-02201	1	FRAME, METAL, RECT	28480	01335-02201
MP36	01335-04102	1	COVER, HIGH VOLTAGE	28480	01335-04102
MP37	01335-07201	1	INSERT, RIGHT	28480	01335-07201
MP38	01335-07202	1	INSERT, LEFT	28480	01335-07202
MP39	01335-23701	2	SHAFT-TA/AST	28480	01335-23701
MP40	01335-23702	1	SHAFT-X GAIN	28480	01335-23702
MP41	01335-23703	1	SHAFT-Y GAIN	28480	01335-23703
MP42	01335-60102	1	CHASSIS ASSEMBLY	28480	01335-60102
MP43	01335-60201	1	PANEL ASSEMBLY, REAR	28480	01335-60201
MP44	01335-60601	1	SHIELD, CRT ASSEMBLY	28480	01335-60601
MP45	0370-0439	4	KNOB:RND, BLK, 0.125" SHAFT 0.430" DIA (OPTION 323)	28480	0370-0439
MP46	0370-0607	4	BEZEL, BLACK SQUARE	28480	0370-0607
MP47	0370-0683	4	PUSHBUTTON, OLIVE BLACK 0370-0604	28480	0370-0683
MP48	01332-02706	1	SAFETY FACEPLATE, BLUE Gray	28480	01332-02706
MP48	USA 01332-02707	1	FACEPLATE, CLEAR LEXAN (OPTIONS 330, 561)	28480	01332-02707
MP49	1200-0408	1	CRT SOCKET COVER	28480	1200-0408
Q1	1854-0433	3	TRANSISTOR NPN SI PD=90W FT=2MHZ	28480	1854-0433
Q2	1854-0433		TRANSISTOR NPN SI PD=90W FT=2MHZ	28480	1854-0433
Q3	1854-0330	1	TRANSISTOR NPN SI PD=21W FT=10MHZ	28480	1854-0330
Q4	1854-0433		TRANSISTOR NPN SI PD=90W FT=2MHZ	28480	1854-0433
S1	3101-0056	1	SWITCH-TGL DPDT NS 10A 250VAC SLDR LUG	27191	8926K316
T1	9100-3463	1	TRANSFORMER, POWER, 4 SEC	28480	9100-3463
T1	9100-3471	1	TRANSFORMER, POWER, 4 SEC (OPTION 310)	28480	9100-3471
V1	5083-~~4452~~ 4454	1	CRT, P31 AL INTERNAL GRAT	28480	5083-4452
V1	5083-~~4451~~ 4453	1	CRT, P31 AL, NO GRATICULE (OPTION 631)	28480	5083-4451
W1	8120-0645	1	CABLE CA ASSY 15-COND 26 AWG	28480	8120-0645
W2	8120-1538	1	CABLE, POWER 7.5 FT (EXCEPT OPTIONS 300, 301, 302, 303, 304, 305, AND 330)	28480	8120-1538
W2	8120-0698	1	CABLE; UNSHLD 3-COND 18AWG (FOR OPTION 303 ONLY)	28480	8120-0698
W2	8120-1369	1	CABLE CA ASSY 3-COND 18AWG (FOR OPTION 301)	28480	8120-1369
W2	8120-1692	1	CABLE CA ASSY 3-COND (FOR OPTION 302)	0007K	402 310
W2	8120-1703	1	CABLE, POWER CORD (FOR OPTION 300)	28480	8120-1703
W2	8120-1992	1	CABLE, POWER CORD (FOR OPTION 330)	28480	8120-1992
W2	8120-2061	1	CABLE CA ASSY 3-COND 18AWG (FOR OPTION 304)	28480	8120-2061
W3	00191-66004	1	CABLE ASSEMBLY, ALIGNMENT	28480	00191-66004
W4	01332-61101	1	CABLE, TRANS CONN	28480	01332-61101
W5	01332-61102	3	CABLE, TRANS CONN	28480	01332-61102
W6	01332-61603	1	CABLE ASSEMBLY, INPUT X	28480	01332-61603
W7	01332-61604	1	CABLE ASSEMBLY, INPUT Y	28480	01332-61604
W8	01332-61605	1	CABLE ASSEMBLY, INPUT Z	28480	01332-61605
W9	01332-61608	1	CABLE, LOGIC, BLANK	28480	01332-61608
W10	01335-61601	1	CABLE ASSEMBLY, CRT	28480	01335-61601
W11	01335-61602	1	CABLE, COAX, YELLOW/WHITE	28480	01335-61602
W12	01335-61604	1	CABLE - Y OUTPUT	28480	01335-61604
W13	01335-61605	1	CABLE - X OUTPUT	28480	01335-61605
A1	01335-66501	1	BOARD ASSEMBLY, MOTHER	28480	01335-66501
A1C5	0160-3451	36	CAPACITOR-FXD .01UF +80−20% 100WVDC CER	28480	0160-3451
A1C6	0160-3451		CAPACITOR-FXD .01UF +80−20% 100WVDC CER	28480	0160-3451
A1C7	0160-2308	1	CAPACITOR-FXD 36PF +−5% 300WVDC MICA	28480	0160-2308
A1C8	0121-0474	5	CAPACITOR-VAR; TRMR; PSTN; .3/1.5PF	28480	0121-0474
A1C9	0160-3451		CAPACITOR-FXD .01UF +80−20% 100WVDC CER	28480	0160-3451
A1C10	0160-3451		CAPACITOR-FXD .01UF +80−20% 100WVDC CER	28480	0160-3451
A1C11	0160-3670	3	CAPACITOR-FXD .1UF +−20% 200WVDC CER	28480	0160-3670
A1C12			NOT ASSIGNED		
A1C13	0160-3451		CAPACITOR-FXD .01UF +80−20% 100WVDC CER	28480	0160-3451
A1C14	0160-3451		CAPACITOR-FXD .01UF +80−20% 100WVDC CER	28480	0160-3451
A1C15	0160-3665	6	CAPACITOR-FXD .01UF +80−20% 500WVDC CER	28480	0160-3665
A1C16	0180-0640	1	CAPACITOR-FXD 2000UF +100−10% 40VDC AL	28480	0180-0640
A1C17	0180-0470	1	CAPACITOR-FXD 1100UF +100−10% 40VDC AL	90201	20-36238
A1C18	0180-0639	1	CAPACITOR-FXD 90UF +75−10% 250VDC AL	28480	0180-0639
A1C19	0160-3448	3	CAPACITOR-FXD 1000PF +−10% 1000WVDC CER	28480	0160-3448
A1C20	0160-3448		CAPACITOR-FXD 1000PF +−10% 1000WVDC CER	28480	0160-3448
A1C21	0160-3448		CAPACITOR-FXD 1000PF +−10% 1000WVDC CER	28480	0160-3448
A1C22	0180-0141	1	CAPACITOR-FXD 50UF +75−10% 50VDC AL	56289	30D506G050DD2
A1C23	0160-0164	1	CAPACITOR-FXD .039UF +−10% 200WVDC POLYE	56289	292P39392

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
A1C24	0160-3558	1	CAPACITOR-FXD .1UF +-20% 50WVDC CER	28480	0160-3558
A1C25	0180-0269	1	CAPACITOR-FXD 1UF +75-10% 150VDC AL	56289	30D105G150BA2
A1C26	0170-0066	1	CAPACITOR-FXD .027UF +-10% 200WVDC POLYE	56289	292P27392
A1C27	0160-3665		CAPACITOR-FXD .01UF +80-20% 500WVDC CER	28480	0160-3665
A1C28	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-3451
A1C29	0180-1746	6	CAPACITOR-FXD 15UF +-10% 20VDC TA-SOLID	56289	150D156X9020B2
A1C30	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-3451
A1C31	0180-1746		CAPACITOR-FXD 15UF +-10% 20VDC TA-SOLID	56289	150D156X9020B2
A1C32	0180-0197	4	CAPACITOR-FXD 2.2UF +-10% 20VDC TA	56289	150D225X9020A2
A1C33	0180-0197		CAPACITOR-FXD 2.2UF +-10% 20VDC TA	56289	150D225X9020A2
A1C34	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-3451
A1C35	0160-3466		CAPACITOR-FXD 100PF +-10% 250WVDC	28480	0160-3466
A1C41	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-3451
A1C42	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-3451
A1C43	0160-3670		CAPACITOR-FXD .1UF +-20% 200WVDC CER	28480	0160-3670
A1C44	0160-3670		CAPACITOR-FXD .1UF +-20% 200WVDC CER	28480	0160-3670
A1C45	0160-3670		CAPACITOR-FXD .1UF +-20% 200WVDC CER	28480	0160-3670
A1CR1	1901-0376	6	DIODE-GEN PRP 35V 50MA	28480	1901-0376
A1CR2	1901-0376		DIODE-GEN PRP 35V 50MA	28480	1901-0376
A1CR3	1901-0040	19	DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A1CR4	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A1CR5			NOT ASSIGNED		
A1CR6			NOT ASSIGNED		
A1CR7			NOT ASSIGNED		
A1CR8	1906-0023	2	DIODE-MULT FULL WAVE BRIDGE RECTIFIER	04713	MDA922-4
A1CR9	1906-0023		DIODE-MULT FULL WAVE BRIDGE RECTIFIER	04713	MDA922-4
A1CR10	1901-0028	13	DIODE-PWR RECT 400V 750MA	04713	SR1358-9
A1CR11	1901-0028		DIODE-PWR RECT 400V 750MA	04713	SR1358-9
A1CR12	1901-0028		DIODE-PWR RECT 400V 750MA	04713	SR1358-9
A1CR13	1901-0028		DIODE-PWR RECT 400V 750MA	04713	SR1358-9
A1CR14			NOT ASSIGNED		
A1CR15			NOT ASSIGNED		
A1CR16			NOT ASSIGNED		
A1CR17			NOT ASSIGNED		
A1CR18			NOT ASSIGNED		
A1CR19			NOT ASSIGNED		
A1CR20	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A1CR21			NOT ASSIGNED		
A1CR22	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A1CR23	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A1CR24	1901-0028		DIODE-PWR RECT 400V 750MA	04713	SR1358-9
A1CR25	1901-0045	1	DIODE-PWR RECT 100V 750MA	28480	1901-0045
A1CR26	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A1CR27	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A1CR28	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A1CR29	1901-0096	1	DIODE-SWITCHING 100NS 120V 50MA	28480	1901-0096
A1CR30	1901-0028		DIODE-PWR RECT 400V 750MA	04713	SR1358-9
A1CR31	1901-0028		DIODE-PWR RECT 400V 750MA	04713	SR1358-9
A1E1	1200-0185	13	INSULATOR, XSTR, TO-5, .075 THK	13103	7717-22 N RED
A1E2	1205-0073	1	HEAT-DISSIPATOR SGL TO-5/TO-39 PKG	28480	1205-0073
A1E3	1205-0095	5	HEAT-DISSIPATOR SGL TO-5/TO-39 PKG	28480	1205-0095
A1E4	1205-0226	5	HEAT-DISSIPATOR SGL TO-5/TO-39 PKG	28480	1205-0226
A1E5	2110-0269	1	FUSEHOLDER-CLIP TYPE .25FUSE	28480	2110-0269
A1F1	2110-0065	2	FUSE .375A 250V 1.25X.25 IEC	71400	AGC-3/8
A1F2	2110-0065		FUSE .375A 250V 1.25X.25 IEC	71400	AGC-3/8
A1F3	2110-0004	1	FUSE .25A 250V 1.25X.25 IEC	71400	AGC-1/4
A1F4	2110-0007	1	FUSE 1A 250V SLO-BLO	28480	2110-0007
A1J1	1200-0438		SOCKET:ELECT; IC 16-CONT DIP SLDR TERM	24995	583529-1
A1J2	1200-0441		SOCKET:ELECT; IC 14-CONT DIP SLDR TERM	24995	583527-1
A1L1	9140-0171	1	COIL-FXD MOLDED RF CHOKE 40UH 10%	06560	10608-1
A1L2	9100-1641	1	COIL-FXD MOLDED RF CHOKE 240UH 5%	24226	15/243
A1Q1	1855-0202	3	TRANSISTOR-JFET DUAL N-CHAN D-MODE SI	17856	E421
A1Q2	1853-0036	18	TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A1Q3	1853-0036		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A1Q4	1853-0036		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A1Q5	1853-0036		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A1Q6	1854-0215	14	TRANSISTOR NPN SI PD=310MW FT=300MHZ	04713	SPS 3611
A1Q7	1854-0215		TRANSISTOR NPN SI PD=310MW FT=300MHZ	04713	SPS 3611
A1Q8	1854-0215		TRANSISTOR NPN SI PD=310MW FT=300MHZ	04713	SPS 3611
A1Q9	1854-0215		TRANSISTOR NPN SI PD=310MW FT=300MHZ	04713	SPS 3611
A1Q10	1853-0036		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A1Q11	1854-0215		TRANSISTOR NPN SI PD=310MW FT=300MHZ	04713	SPS 3611
A1Q12	1853-0038	5	TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0038
A1Q13	1854-0419	1	TRANSISTOR NPN SI TO-39 PD=1W FT-200MHZ	28480	1854-0419
A1Q14	1854-0234	1	TRANSISTOR NPN 2N3440 SI TO-5 PD=1W	02735	2N3440
A1R7	0684-3901	6	RESISTOR 39 10% .25W FC TC=-400/+500	01121	CB3901
A1R8	0684-3901		RESISTOR 39 10% .25W FC TC=-400/+500	01121	CB3901
A1R9	0757-0290	13	RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A1R10	0757-0290		RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A1R11	2100-3252	2	RESISTOR-VAR TRMR 5K OHM 10% C TOP ADJ	73138	72PR5K

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
A1R12	0757-0420	1	RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A1R13	0757-0442	7	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R14	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R15	0757-0855	5	RESISTOR 68.1K 1% .5W F TC=0+-100	19701	MF7C1/2-T0-6812-F
A1R16	0757-0290		RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A1R17	0757-0290		RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A1R18	0757-0283	13	RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A1R19	0757-0283		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A1R20	0757-0283		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A1R21	0757-0283		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A1R22	0698-3155	4	RESISTOR 4.64K 1% .125W F TC=0+-100	16299	C4-1/8-T0-4641-F
A1R23	0757-0427	3	RESISTOR 1.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1501-F
A1R24	0698-0083	2	RESISTOR 1.96K 1% .125W F TC=0+-100	16299	C4-1/8-T0-1961-F
A1R25	0698-0083		RESISTOR 1.96K 1% .125W F TC=0+-100	16299	C4-1/8-T0-1961-F
A1R26	0757-0419	1	RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A1R27	0757-0457	1	RESISTOR 47.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4752-F
A1R29			NOT ASSIGNED		
A1R30			NOT ASSIGNED		
A1R31	2100-3252		RESISTOR-VAR TRMR 5K OHM 10% C TOP ADJ	73138	72PR5K
A1R32			NOT ASSIGNED		
A1R33	0757-0430	1	RESISTOR 2.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2211-F
A1R34	0757-0444	1	RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A1R35	0757-0437	1	RESISTOR 4.75K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4751-F
A1R36	0757-0839	1	RESISTOR 10K 1% .5W F TC=0+-100	19701	MF7C1/2-T0-1002-F
A1R37	0757-0847	1	RESISTOR 27.4K 1% .5W F TC=0+-100	19701	MF7C1/2-T0-2742-F
A1R38	0698-3413	2	RESISTOR 13.3K 1% .5W F TC=0+-100	24546	NA6
A1R39	0684-1001	22	RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A1R40	0684-1001		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A1R41	0698-3413		RESISTOR 13.3K 1% .5W F TC=0+-100	24546	NA6
A1R42	0698-3416	1	RESISTOR 21.5K 1% .5W F TC=0+-100	24546	NA6
A1R43	0687-3921	2	RESISTOR 3.9K 10% .5W CC TC=0+647	01121	EB3921
A1R44	0757-0435	2	RESISTOR 3.92K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3921-F
A1R45	0757-0407	1	RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A1R46	0757-0446	2	RESISTOR 15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1502-F
A1R47	0699-0001	2	RESISTOR 2.7 10% .5W CC TC=0+412	01121	EB27G1
A1R48	0757-0440	2	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A1R49	0757-0441	3	RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A1R50	0687-3921		RESISTOR 3.9K 10% .5W CC TC=0+647	01121	EB3921
A1R51	0757-0435		RESISTOR 3.92K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3921-F
A1R52	0757-0409	1	RESISTOR 274 1% .125W F TC=0+-100	24546	C4-1/8-T0-274R-F
A1R53	0757-0446		RESISTOR 15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1502-F
A1R54	0699-0001		RESISTOR 2.7 10% .5W CC TC=0+412	01121	EB27G1
A1R55	0757-0440		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A1R56	0757-0441		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A1R57	0687-1541	1	RESISTOR 150K 10% .5W CC TC=0+882	01121	EB1541
A1R58	0764-0005	1	RESISTOR 10K 5% 2W MO TC=0+-200	24546	FP42-2-T00-1002-J
A1R59	0757-0274		RESISTOR 1.21K 1% .125W F	24546	C4-1/8-T0-1211-F
A1R60	0757-0274		RESISTOR 1.21K 1% .125W F	24546	C4-1/8-T0-1211-F
A1R61	0757-0433	1	RESISTOR 3.32K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3321-F
A1R62	0757-0779	2	RESISTOR 150K 1% .25W F TC=0+-100	24546	C5-1/4-T0-1503-F
A1R63	0757-0418	1	RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A1R64	0757-1093	1	RESISTOR 3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3001-F
A1R65	0757-0779		RESISTOR 150K 1% .25W F TC=0+-100	24546	C5-1/4-T0-1503-F
A1R66	0686-3005	1	RESISTOR 30 5% .5W CC TC=0+412	01121	EB3005
A1R67	0757-0156	1	RESISTOR 1.5M 1% .5W F TC=0+-100	19701	MF7C1/2-T0-1504-F
A1R68	0757-0465	2	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A1R69	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A1R70	0684-1211	1	RESISTOR 120 10% .25W FC TC=-400/+600	01121	CB1211
A1R71	0683-2265	1	RESISTOR 22M 5% .25W FC TC=-900/+1200	01121	CB2265
A1R72	0683-1055	1	RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A1R73	0687-5611	2	RESISTOR 560 10% .5W CC TC=0+529	01121	EB5611
A1R74	0684-2221	1	RESISTOR 2.2K 10% .25W FC TC=-400/+700	01121	CB2221
A1R75	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R76	2100-3253	3	RESISTOR-VAR TRMR 50K OHM 10% C TOP ADJ	73138	72PR50K
A1R77	2100-0558	1	RESISTOR-VAR TRMR 20K OHM 10% C TOP ADJ	73138	72PR20K
A1R78			NOT ASSIGNED		
A1R79			NOT ASSIGNED		
A1R80	0684-1001		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A1R81	0684-1001		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A1R82	0684-1001		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A1R83	0684-1011	1	RESISTOR 100 10% .25W FC TC=-400/+500	01121	CB1011
A1R84	2100-3213	1	RESISTOR-VAR TRMR 200K OHM 10% C TOP ADJ	73138	72PR200K
A1R85	0684-2231	13	RESISTOR 22K 10% .25W FC TC=-400/+800	01121	CB2231
A1R86	0757-0454		RESISTOR 33.2K 1% .125W F	24546	C4-1/8-T0-3322-F
A1R87	0757-0441		RESISTOR 8.25K 1% .125W F	24546	C4-1/8-T0-8251-F
A1R88	0684-2231		RESISTOR 22K 10% .25W FC TC=-400/+800	01121	CB2231
A1R89	0698-3402		RESISTOR 316 1% .5W F TC=0+-100	24546	NA6
A1R90	0757-0989	1	RESISTOR 16.2 1% .5W F TC=0+-100	19701	MF7C1/2-T0-16R2-F
A1R91	2100-0568	1	RESISTOR-VAR TRMR 100 OHM 10% C TOP ADJ	73138	72PR100
A1R92	0757-1092	1	RESISTOR 287 1% .5W F TC=0+-100	19701	MF7C1/2-T0-287R-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
A1R93	0757-0341	1	RESISTOR 30.1K 1% .25W F TC=0+-100	24546	C5-1/4-T0-3012-F
A1R94	0698-3402		RESISTOR 316 1% .5W F TC=0+-100	24546	NA6
A1U1	1820-0196	3	IC REGULATOR	07263	723HC
A1U2	1820-0196		IC REGULATOR	07263	723HC
A1U3	1820-0196		IC REGULATOR	07263	723HC
A1U4	1826-0167	1	IC CA3094AT	02735	CA3094AT
A1U5	1820-1144	3	IC SN74LS 02 N	01295	SN74LS02N
A1VR1	1902-3104	3	DIODE-ZNR 5.62V 5% D0-7 PD=.4W TC=+.016%	04713	SZ 10939-110
A1VR2	1902-3070	3	DIODE-ZNR 4.22V 5% D0-7 PD=.4W TC=-.038%	04713	SZ 10939-74
A1VR3	1902-0025	1	DIODE-ZNR 10V 5% D0-7 PD=.4W TC=+.06%	04713	SZ 10939-182
A1VR4	1902-0594	1	DIODE-ZNR 18.2V 5% D0-15 PD=1W TC=+.068%	28480	1902-0594
A1VR5	1902-3354	2	DIODE-ZNR 54.9V 5% D0-7 PD=.4W TC=+.081%	04713	SZ 10939-395
A1VR6	1902-3354		DIODE-ZNR 54.9V 5% D0-7 PD=.4W TC=+.081%	04713	SZ 10939-395
A1VR7	1902-0574	1	DIODE-ZNR 64.9V 5% D0-15 PD=1W TC=+.083%	04713	SZ 11213-374
A1VR8	1902-3381		DIODE-ZNR 68.1V 5% 400MW MAX	04713	SZ 10939-422
A1VR9	1902-0533	1	DIODE-ZNR 4.99V 2% D0-15 PD=1W TC=-.012%	04713	SZ 11213-54
A1VR10	1902-3193	1	DIODE-ZNR 13.3V 5% D0-7 PD=.4W TC=+.059%	04713	SZ 10939-218
A1VR11	1902-0049	1	DIODE-ZNR 6.19V 5% D0-7 PD=.4W TC=+.022%	04713	SZ 10939-122
A1VR12	1902-3357		DIODE-ZNR 56.2V 5% D0-7 PD=.4W TC=+.081%	04713	SZ 10939-398
A1XA2	1251-1768	2	CONNECTOR; PC EDGE; 10-CONT; DIP SOLDER	26742	190-244-03
A1XA3	1251-1768		CONNECTOR; PC EDGE; 10-CONT; DIP SOLDER	26742	190-244-03
A2	01335-66502	1	BOARD ASSEMBLY, X-Y	28480	01335-66502
A2C5	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-3451
A2C6	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-3451
A2C9	0140-0149	2	CAPACITOR-FXD 470PF +-5% 300WVDC MICA	72136	DM15F471J0300WV1CR
A2C10	0121-0474		CAPACITOR-VAR; TRMR; PSTN; .3/1.5PF	28480	0121-0474
A2C11	0121-0474		CAPACITOR-VAR; TRMR; PSTN; .3/1.5PF	28480	0121-0474
A2C12	0160-3665		CAPACITOR-FXD .01UF +80-20% 500WVDC CER	28480	0160-3665
A2C13	0160-3665		CAPACITOR-FXD .01UF +80-20% 500WVDC CER	28480	0160-3665
A2C14	0160-3665		CAPACITOR-FXD .01UF +80-20% 500WVDC CER	28480	0160-3665
A2C15	0160-3665		CAPACITOR-FXD .01UF +80-20% 500WVDC CER	28480	0160-3665
A2C16	0160-3670		CAPACITOR-FXD .1UF +-20% 200WVDC CER	28480	0160-3670
A2C17	0160-3670		CAPACITOR-FXD .1UF +-20% 200WVDC CER	28480	0160-3670
A2C22	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-3451
A2C23	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-3451
A2C26	0140-0149		CAPACITOR-FXD 470PF +-5% 300WVDC MICA	72136	DM15F471J0300WV1CR
A2C27	0121-0474		CAPACITOR-VAR; TRMR; PSTN; .3/1.5PF	28480	0121-0474
A2C28	0121-0474		CAPACITOR-VAR; TRMR; PSTN; .3/1.5PF	28480	0121-0474
A2C29	0160-3665		CAPACITOR-FXD .01UF +80-20% 500WVDC CER	28480	0160-3665
A2C30	0160-3665		CAPACITOR-FXD .01UF +80-20% 500WVDC CER	28480	0160-3665
A2C31	0160-3665		CAPACITOR-FXD .01UF +80-20% 500WVDC CER	28480	0160-3665
A2C32	0160-3665		CAPACITOR-FXD .01UF +80-20% 500WVDC CER	28480	0160-3665
A2C33	0160-3670		CAPACITOR-FXD .1UF +-20% 200WVDC CER	28480	0160-3670
A2C34	0160-3670		CAPACITOR-FXD .1UF +-20% 200WVDC CER	28480	0160-3670
A2C36	0160-3665		CAPACITOR-FXD .01UF +80-20% 500WVDC CER	28480	0160-3665
A2C37	0160-3665		CAPACITOR-FXD .01UF +80-20% 500WVDC CER	28480	0160-3665
A2C38	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-3451
A2C39	0180-1746		CAPACITOR-FXD 15UF +-10% 20VDC TA-SOLID	56289	150D156X9020B2
A2C40	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-3451
A2C41	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-3451
A2C42	0180-1746		CAPACITOR-FXD 15UF +-10% 20VDC TA-SOLID	56289	150D156X9020B2
A2C43	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-3451
A2C44	0160-3665		CAPACITOR-FXD .01UF +80-20% 500WVDC CER	28480	0160-3665
A2C45	0160-3665		CAPACITOR-FXD .01UF +80-20% 500WVDC CER	28480	0160-3665
A2C46	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-3451
A2C47	0180-1746		CAPACITOR-FXD 15UF +-10% 20VDC TA-SOLID	56289	150D156X9020B2
A2C48	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-3451
A2C49	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-3451
A2C50	0180-1746		CAPACITOR-FXD 15UF +-10% 20VDC TA-SOLID	56289	150D156X9020B2
A2C51	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-3451
A2C52	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-3451
A2C53	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-3451
A2CR1	1901-0376		DIODE-GEN PRP 35V 50MA	28480	1901-0376
A2CR2	1901-0376		DIODE-GEN PRP 35V 50MA	28480	1901-0376
A2CR3	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A2CR4	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A2CR5	1901-0376		DIODE-GEN PRP 35V 50MA	28480	1901-0376
A2CR6	1901-0376		DIODE-GEN PRP 35V 50MA	28480	1901-0376
A2CR7	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A2CR8	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A2CR9	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A2CR10	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A2CR11	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A2E1	1205-0095		HEAT-DISSIPATOR SGL T0-5/T0-39 PKG	28480	1205-0095
A2E2	1205-0226		HEAT-DISSIPATOR SGL T0-5/T0-39 PKG	28480	1205-0226
A2E3	1200-0185		INSULATOR, XSTR, T0-5, .075 THK	13103	7717-22 N RED

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
A2MP1	01332-01203	1	BRACKET, X GAIN	28480	01332-01203
A2MP2	01332-01204	1	BRACKET, Y GAIN	28480	01332-01204
A2MP3	01332-01205	1	BRACKET, TA & AST	28480	01332-01205
A2MP4 THROUGH A2MP7	1205-0213	4	HEAT SINK:TSTR	28480	1205-0213
A2Q1	1855-0202		TRANSISTOR-JFET DUAL N-CHAN D-MODE SI	17856	E421
A2Q2	1853-0036		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A2Q3	1853-0036		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A2Q4	1853-0036		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A2Q5	1853-0036		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A2Q6	1854-0215		TRANSISTOR NPN SI PD=310MW FT=300MHZ	04713	SPS 3611
A2Q7	1854-0215		TRANSISTOR NPN SI PD=310MW FT=300MHZ	04713	SPS 3611
A2Q8	1854-0215		TRANSISTOR NPN SI PD=310MW FT=300MHZ	04713	SPS 3611
A2Q9	1853-0036		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A2Q10	1853-0036		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A2Q11	1854-0215		TRANSISTOR NPN SI PD=310MW FT=300MHZ	04713	SPS 3611
A2Q12	1853-0038		TRANSISTOR PNP SI T0-39 PD=1W FT=100MHZ	28480	1853-0038
A2Q13	1854-0523	4	TRANSISTOR NPN SI T0-39 PD=1W FT=150MHZ	28480	1854-0523
A2Q14	1854-0523		TRANSISTOR NPN SI T0-39 PD=1W FT=150MHZ	28480	1854-0523
A2Q15	1853-0038		TRANSISTOR PNP SI T0-39 PD=1W FT=100MHZ	28480	1853-0038
A2Q16	1855-0202		TRANSISTOR-JFET DUAL N-CHAN D-MODE SI	17856	E421
A2Q17	1853-0036		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A2Q18	1853-0036		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A2Q19	1853-0036		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A2Q20	1853-0036		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A2Q21	1854-0215		TRANSISTOR NPN SI PD=310MW FT=300MHZ	04713	SPS 3611
A2Q22	1854-0215		TRANSISTOR NPN SI PD=310MW FT=300MHZ	04713	SPS 3611
A2Q23	1854-0215		TRANSISTOR NPN SI PD=310MW FT=300MHZ	04713	SPS 3611
A2Q24	1853-0036		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A2Q25	1853-0036		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A2Q26	1854-0215		TRANSISTOR NPN SI PD=310MW FT=300MHZ	04713	SPS 3611
A2Q27	1853-0038		TRANSISTOR PNP SI T0-39 PD=1W FT=100MHZ	28480	1853-0038
A2Q28	1854-0523		TRANSISTOR NPN SI T0-39 PD=1W FT=150MHZ	28480	1854-0523
A2Q29	1854-0523		TRANSISTOR NPN SI T0-39 PD=1W FT=150MHZ	28480	1854-0523
A2Q30	1853-0038		TRANSISTOR PNP SI T0-39 PD=1W FT=100MHZ	28480	1853-0038
A2Q31	1854-0215		TRANSISTOR NPN SI PD=310MW FT=300MHZ	04713	SPS 3611
A2R7	0684-3901		RESISTOR 39 10% .25W FC TC=−400/+500	01121	CB3901
A2R8	0684-3901		RESISTOR 39 10% .25W FC TC=−400/+500	01121	CB3901
A2R9	0757-0290		RESISTOR 6.19K 1% .125W F TC=0+−100	19701	MF4C1/8-T0-6191-F
A2R10	0757-0290		RESISTOR 6.19K 1% .125W F TC=0+−100	19701	MF4C1/8-T0-6191-F
A2R11	2100-0646	2	RESISTOR-VAR 5K 10% CC	01121	70M4N056R502U
A2R12	0757-0424	2	RESISTOR 1.1K 1% .125W F TC=0+−100	24546	C4-1/8-T0-1101-F
A2R13	0757-0442		RESISTOR 10K 1% .125W F TC=0+−100	24546	C4-1/8-T0-1002-F
A2R14	0757-0442		RESISTOR 10K 1% .125W F TC=0+−100	24546	C4-1/8-T0-1002-F
A2R15	0757-0855		RESISTOR 68.1K 1% .5W F TC=0+−100	19701	MF7C1/2-T0-6812-F
A2R16	0757-0290		RESISTOR 6.19K 1% .125W F TC=0+−100	19701	MF7C-1/8-T0-6191-F
A2R17	0757-0290		RESISTOR 6.19K 1% .125W F TC=0+−100	19701	MF4C1/8-T0-6191-F
A2R18	0757-0283		RESISTOR 2K 1% .125W F TC=0+−100	24546	C4-1/8-T0-2001-F
A2R19	0757-0283		RESISTOR 2K 1% .125W F TC=0+−100	24546	C4-1/8-T0-2001-F
A2R20	0698-3155		RESISTOR 4.64K 1% .125W F TC=0+−100	16299	C4-1/8-T0-4641-F
A2R21	0757-0427		RESISTOR 1.5K 1% .125W F TC=0+−100	24546	C4-1/8-T0-1501-F
A2R22	0757-0283		RESISTOR 2K 1% .125W F TC=0+−100	24546	C4-1/8-T0-2001-F
A2R23	0757-0283		RESISTOR 2K 1% .125W F TC=0+−100	24546	C4-1/8-T0-2001-F
A2R24	2100-3211	4	RESISTOR-VAR TRMR 1K OHM 10% C TOP ADJ	73138	72PR1K
A2R25	0698-3447	2	RESISTOR 422 1% .125W F TC=0+−100	16299	C4-1/8-T0-422R-F
A2R26	0757-0431	4	RESISTOR 2.43K 1% .125W F TC=0+−100	24546	C4-1/8-T0-2431-F
A2R27	0757-0431		RESISTOR 2.43K 1% .125W F TC=0+−100	24546	C4-1/8-T0-2431-F
A2R28	0757-0460	4	RESISTOR 61.9K 1% .125W F TC=0+−100	24546	C4-1/8-T0-6192-F
A2R29	0757-0460		RESISTOR 61.9K 1% .125W F TC=0+−100	24546	C4-1/8-T0-6192-F
A2R30	2100-3211		RESISTOR-VAR TRMR 1K OHM 10% C TOP ADJ	73138	72PR1K
A2R31	0761-0004		RESISTOR 20K 5% 1W MO	24546	FP32-1-2002-J
A2R32	0761-0004		RESISTOR 20K 5% 1W MO	24546	FP32-1-2002-J
A2R33	0684-6821	4	RESISTOR 6.8K 10% .25W FC TC=−400/+700	01121	CB6821
A2R34	0684-6821		RESISTOR 6.8K 10% .25W FC TC=−400/+700	01121	CB6821
A2R35	0757-0856	4	RESISTOR 75K 1% .5W F TC=0+−100	19701	MF7C1/2-T0-7502-F
A2R36	0757-0856		RESISTOR 75K 1% .5W F TC=0+−100	19701	MF7C1/2-T0-7502-F
A2R37	0684-1001		RESISTOR 10 10% .25W FC TC=−400/+500	01121	CB1001
A2R38	0698-7096	4	RESISTOR 10 10% .125W CC TC=0+588	01121	BB1001
A2R39	0698-7096		RESISTOR 10 10% .125W CC TC=0+588	01121	BB1001
A2R40	0684-1001		RESISTOR 10 10% .25W FC TC=−400/+500	01121	CB1001
A2R41	0757-0438	4	RESISTOR 5.11K 1% .125W F TC=0+−100	24546	C4-1/8-T0-5111-F
A2R42	0757-0438		RESISTOR 5.11K 1% .125W F TC=0+−100	24546	C4-1/8-T0-5111-F
A2R43	0757-0735	4	RESISTOR 1.3K 1% .25W F TC=0+−100	24546	C5-1/4-T0-1301-F
A2R44	0757-0735		RESISTOR 1.3K 1% .25W F TC=0+−100	24546	C5-1/4-T0-1301-F
A2R51	0684-3901		RESISTOR 39 10% .25W FC TC=−400/+500	01121	CB3901
A2R52	0684-3901		RESISTOR 39 10% .25W FC TC=−400/+500	01121	CB3901
A2R53	0757-0290		RESISTOR 6.19K 1% .125W F TC=0+−100	19701	MF4C1/8-T0-6191-F
A2R54	0757-0290		RESISTOR 6.19K 1% .125W F TC=0+−100	19701	MF4C1/8-T0-6191-F
A2R55	2100-0646		RESISTOR-VAR 5K 10% CC	01121	70M4N056R502U
A2R56	0757-0424		RESISTOR 1.1K 1% .125W F TC=0+−100	24546	C4-1/8-T0-1101-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
A2R57	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R58	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R59	0757-0855		RESISTOR 68.1K 1% .5W F TC=0+-100	19701	MF7C1/2-T0-6812-F
A2R60	0757-0290		RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A2R61	0757-0290		RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A2R62	0757-0283		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A2R63	0757-0283		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A2R64	0698-3155		RESISTOR 4.64K 1% .125W F TC=0+-100	16299	C4-1/8-T0-4641-F
A2R65	0757-0427		RESISTOR 1.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1501-F
A2R66	0757-0283		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A2R67	0757-0283		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A2R68	2100-3211		RESISTOR-VAR TRMR 1K OHM 10% C TOP ADJ	73138	72PR1K
A2R69	0698-3447		RESISTOR 422 1% .125W F TC=0+-100	16299	C4-1/8-T0-422R-F
A2R70	0757-0431		RESISTOR 2.43K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2431-F
A2R71	0757-0431		RESISTOR 2.43K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2431-F
A2R72	0757-0460		RESISTOR 61.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A2R73	0757-0460		RESISTOR 61.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A2R74	2100-3211		RESISTOR-VAR TRMR 1K OHM 10% C TOP ADJ	73138	72PR1K
A2R75	0761-0004		RESISTOR 20K 5% 1W MO	24546	FP32-1-2002-J
A2R76	0761-0004		RESISTOR 20K 5% 1W MO	24546	FP32-1-2002-J
A2R77	0684-6821		RESISTOR 6.8K 10% .25W FC TC=-400/+700	01121	CB6821
A2R78	0684-6821		RESISTOR 6.8K 10% .25W FC TC=-400/+700	01121	CB6821
A2R79	0757-0856		RESISTOR 75K 1% .5W F TC=0+-100	19701	MF7C1/2-T0-7502-F
A2R80	0757-0856		RESISTOR 75K 1% .5W F TC=0+-100	19701	MF7C1/2-T0-7502-F
A2R81	0684-1001		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A2R82	0698-7096		RESISTOR 10 10% .125W CC TC=0+588	01121	BB1001
A2R83	0698-7096		RESISTOR 10 10% .125W CC TC=0+588	01121	BB1001
A2R84	0684-1001		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A2R85	0757-0438		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2R86	0757-0438		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2R87	0757-0735		RESISTOR 1.3K 1% .25W F TC=0+-100	24546	C5-1/4-T0-1301-F
A2R88	0757-0735		RESISTOR 1.3K 1% .25W F TC=0+-100	24546	C5-1/4-T0-1301-F
A2R89	2100-0645	2	RESISTOR-VAR 50K 10% CC	01121	70M4N056R503U
A2R90	2100-0645		RESISTOR-VAR 50K 10% CC	01121	70M4N056R503U
A2R91	0684-1001		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A2R92	0684-1001		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A2R93	0684-1001		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A2R94	0684-1001		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A2R95	0684-1001		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A2R96	0684-1001		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A2R97	0684-1001		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A2R98	0684-1001		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A2R99	0684-1001		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A2R100	0684-1001		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A2R101	0684-1001		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A2R102	0684-1001		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A2R103	0684-1001		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A2VR1	1902-3104		DIODE-ZNR 5.62V 5% D0-7 PD=.4W TC=+.016%	04713	SZ 10939-110
A2VR2	1902-3104		DIODE-ZNR 5.62V 5% D0-7 PD=.4W TC=+.016%	04713	SZ 10939-110
A2VR3	1902-3070		DIODE-ZNR 4.22V 5% D0-7 PD=.4W TC=-.038%	04713	SZ 10939-74
A2VR4	1902-3070		DIODE-ZNR 4.22V 5% D0-7 PD=.4W TC=-.038%	04713	SZ 10939-74
A3	01335-66503	1	BOARD ASSEMBLY, HIGH VOLTAGE	28480	01335-66503
A3C1	0160-0544	2	CAPACITOR-FXD .022UF +-20% 4000WVDC MET	84411	HEW-337
A3C2	0160-0544		CAPACITOR-FXD .022UF +-20% 4000WVDC MET	84411	HEW-337
A3C3	0160-0684	3	CAPACITOR-FXD 1000PF +-20% 4000WVDC MET	84411	HEW-337
A3C4	0160-2264	1	CAPACITOR-FXD 20PF +-5% 500WVDC CER	28480	0160-2264
A3C5	0160-0684		CAPACITOR-FXD 1000PF +-20% 4000WVDC MET	84411	HEW-337
A3C6	0160-4051	2	CAPACITOR-FXD .01UF +-20% 4000WVDC MET	84411	HEW-337
A3C7	0160-4051		CAPACITOR-FXD .01UF +-20% 4000WVDC MET	84411	HEW-337
A3C8	0160-0684		CAPACITOR-FXD 1000PF +-20% 4000WVDC MET	84411	HEW-337
A3C9	0180-0089	1	CAPACITOR-FXD 10UF +50-10% 150VDC AL	56289	30D106F150DD2
A3CR1	1901-0683	1	DIODE-HV RECT 250NS 10KV 5MA	28480	1901-0683
A3CR2	1901-0028		DIODE-PWR RECT 400V 750MA	04713	SR1358-9
A3CR3	1901-0028		DIODE-PWR RECT 400V 750MA	04713	SR1358-9
A3CR4	1901-0028		DIODE-PWR RECT 400V 750MA	04713	SR1358-9
A3CR5	1901-0028		DIODE-PWR RECT 400V 750MA	04713	SR1358-9
A3CR6	1901-0033	1	DIODE-GEN PRP 180V 200MA	28480	1901-0033
A3J1	1251-0206	1	CONNECTOR; 1-CONT SKT .04 DIA; WHT TFE	98291	SKT-400
A3MP1	0340-0007	2	STANDOFF-RND FEM .5-LG 6-32-THD .5-OD	28480	0340-0007
A3MP2	01332-01201	1	BRACKET, HIGH VOLTAGE BOARD	28480	01332-01201
A3R1	0684-1041	2	RESISTOR 100K 10% .25W FC TC=-400/+800	01121	CB1041
A3R2	0687-4721		RESISTOR 4.7K 10% .5W CC	01121	EB4721
A3R3	0687-4721	1	RESISTOR 4.7K 10% .5W CC	01121	EB4721
A3R4	0698-8018	1	RESISTOR 30M 1% 3W CP TC=0+-100	03888	PVC175-3-T0-3004-F
A3R5	0683-1025	1	RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A3R6	0684-6811	3	RESISTOR 680 10% .25W FC TC=-400/+600	01121	CB6811

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
A3R7	0687-1061	1	RESISTOR 10M 10% .5W CC TC=0+1059	01121	EB1061
A3R8	0684-6811		RESISTOR 680 10% .25W FC TC=–400/+600	01121	CB6811
A3R9	0684-1051	1	RESISTOR 1M 10% .25W FC TC=–800/+900	01121	CB1051
A3R10	0687-2221	1	RESISTOR 2.2K 10% .5W CC TC=0+647	01121	EB2221
A3R11	0687-1001	1	RESISTOR 10 10% .5W CC TC=0+412	01121	EB1001
A3R12	0698-5353	1	RESISTOR 8.25M 5% 1W CF TUBULAR	28480	0698-5353
A3R13	2100-3501		RESISTOR-VAR TRMR 2M OHM 20% 400VDC	02111	63P205
A3R14	0698-6579	1	RESISTOR 10M 5% 1W CF TUBULAR	28480	0698-6579
A3R15	0684-6811		RESISTOR 680 10% .25W FC TC=–400/+600	01121	CB6811
A3R16	0683-1015	1	RESISTOR 100 5% .25W FC TC=–400/+500	01121	CB1015
A3R17	0687-5611		RESISTOR 560 10% .5W CC TC=0+529	01121	EB5611
A3R18	0684-4741	2	RESISTOR 470K 10% .25W FC TC=–800/+900	01121	CB4741
A3T1	01335-61101	1	TRANSFORMER ASSEMBLY, HIGH VOLTAGE	28480	01335-61101
A3TP1	0360-0535	1	TERMINAL, TEST POINT	4G819	OBD
A3V1	2140-0018	2	LAMP, GLOW, BULB T-2, 58V	08806	A9A (NE-2E1)
A3V2	2140-0018		LAMP, GLOW, BULB T-2, 58V	08806	A9A (NE-2E1)
A3VR1	1902-3333	1	DIODE-ZNR 46.4V 5% D0-7 PD=.4W TC=+.081%	04713	SZ 10939-374
A4	01335-66507	1	BOARD ASSEMBLY, STORAGE	28480	01335-66507
A4C1	0160-0194	1	CAPACITOR-FXD .015UF +–10% 200WVDC POLYE	56289	292P15392
A4C2	0160-0163	1	CAPACITOR-FXD .033UF +–10% 200WVDC POLYE	56289	292P33392
A4C3	0180-0197		CAPACITOR-FXD 2.2UF +–10% 20VDC TA	56289	150D225X9020A2
A4C4	0160-0168	2	CAPACITOR-FXD .1UF +–10% 200WVDC POLYE	56289	292P10492
A4C5	0160-0168		CAPACITOR-FXD .1UF +–10% 200WVDC POLYE	56289	292P10492
A4C6	0180-0117	1	CAPACITOR-FXD 2.7UF +–10% 35VDC TA	56289	150D275X9035B2
A4C7	0180-0376	1	CAPACITOR-FXD .47UF +–10% 35VDC TA	56289	150D474X9035A2
A4C8	0180-0195	1	CAPACITOR-FXD .33UF +–20% 35VDC TA	56289	150D334X0035A2
A4C9	0180-0197		CAPACITOR-FXD 2.2UF +–10% 20VDC TA	56289	150D225X9020A2
A4C10	0160-3451		CAPACITOR-FXD .01UF +80–20% 100WVDC CER	28480	0160-3451
A4C11	0160-3466	2	CAPACITOR-FXD 100PF +–10% 1000WVDC CER	28480	0160-3466
A4C12	0160-0153	2	CAPACITOR-FXD 1000PF +–10% 200WVDC POLYE	56289	292P10292
A4C13	0160-0153		CAPACITOR-FXD 1000PF +–10% 200WVDC POLYE	56289	292P10292
A4C14	0160-3466		CAPACITOR-FXD 100PF +–10% 1000WVDC CER	28480	0160-3466
A4C15	0160-3451		CAPACITOR-FXD .01UF +80–20% 100WVDC CER	28480	0160-3451
A4C16	0160-3451		CAPACITOR-FXD .01UF +80–20% 100WVDC	28480	0160-3451
A4C17	0160-3665		CAPACITOR-FXD .01UF +80–20% 500WVDC	28480	0160-3665
A4C18	0160-3451		CAPACITOR-FXD .01UF +80–20% 100WVDC	28480	0160-3451
A4C19	0180-0197		CAPACITOR-FXD 2.2UF +–10% 20VDC TA	56289	150D225X9020A2
A4C20	0180-0197		CAPACITOR-FXD 2.2UF +–10% 20VDC TA	56289	150D225X9020A2
A4C21	0180-0197		CAPACITOR-FXD 2.2UF +–10% 20VDC TA	56289	150D225X9020A2
A4C22	0160-3443		CAPACITOR-FXD .1UF +–80% 50WVDC	28480	0160-3443
A4CR1	1901-0513		DIODE-MULT	04713	SSD 101
A4CR2	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A4CR3	1901-0050	1	DIODE-SWITCHING 2NS 80V 200MA	28480	1901-0050
A4CR4	1901-0028		DIODE-PWR RECT 400V 750MA	04713	SR1358-9
A4CR5	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A4CR6	1901-0028		DIODE-PWR RECT 400V 750MA	04713	SR1358-9
A4CR7	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A4CR8	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A4CR9	1901-0513	1	DIODE; MULT; SILICON; DUAL	28480	1901-0513
A4Q1	1853-0020	1	TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A4Q2	1854-0575	5	TRANSISTOR NPN SI PD=625MW FT=50MHZ	04713	MPS-A42
A4Q3	1854-0071	6	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A4Q4	1853-0336	2	TRANSISTOR PNP SI PD=625MW FT=50MHZ	04713	MPSA92
A4Q5	1853-0036		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A4Q6	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A4Q7	1854-0575		TRANSISTOR NPN SI PD=625MW FT=50MHZ	04713	MPS-A42
A4Q8	1853-0336		TRANSISTOR PNP SI PD=625MW FT=50MHZ	04713	MPSA92
A4Q9	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A4Q10	1854-0358	1	TRANSISTOR NPN SI PD=310MW FT=60MHZ	28480	1854-0358
A4Q11	1854-0575		TRANSISTOR NPN SI PD=625MW FT=50MHZ	04713	MPS-A42
A4Q12	1853-0080	1	TRANSISTOR PNP SI PD=300MW FT=30MHZ	28480	1853-0080
A4Q13	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A4Q14	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A4Q15	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A4Q16	1854-0575		TRANSISTOR NPN SI PD=625MW FT=50MHZ	04713	MPS-A42
A4Q17	1854-0575		TRANSISTOR NPN SI PD=625MW FT=50MHZ	04713	MPS-A42
A4R1	0757-0288	1	RESISTOR 9.09K 1% .125W F TC=0+–100	19701	MF4C1/8-T0-9091-F
A4R2	0698-3159	1	RESISTOR 26.1K 1% .125W F TC=0+–100	16299	C4-1/8-T0-2612-F
A4R3	0698-3156	1	RESISTOR 14.7K 1% .125W F TC=0+–100	16299	C4-1/8-T0-1472-F
A4R4	0757-0452	1	RESISTOR 27.4K 1% .125W F TC=0+–100	24546	C4-1/8-T0-2742-F
A4R5	0698-3155		RESISTOR 4.64K 1% .125W F TC=0+–100	16299	C4-1/8-T0-4641-F
A4R6	2100-3253		RESISTOR-VAR TRMR 50K OHM 10% C TOP ADJ	73138	72PR50K
A4R7	0698-3154		RESISTOR 4.22K 1% .125W F TC=0+–100	16299	C4-1/8-T0-4221-F
A4R8	1810-0055	1	CIRCUIT:PSIV, NON-REPAIRABLE IN	28480	1810-0055
A4R9	0684-0271	3	RESISTOR 2.7K 10% FC TC=–400/+500 (NOT PART OF STANDARD INSTRUMENT)	01121	CB27G1
A4R10	0684-2231		RESISTOR 22K 10% .25W FC TC=–400/+800	01121	CB2231

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
A4R11	0757-0450	1	RESISTOR 22.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2212-F
A4R12	0757-0458	1	RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A4R13	0684-1021	6	RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A4R14	0684-4731	5	RESISTOR 47K 10% .25W FC TC=-400/+800	01121	CB4731
A4R15	0684-1031		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A4R16	0684-2231		RESISTOR 22K 10% .25W FC TC=-400/+800	01121	CB2231
A2R17	0684-0271		RESISTOR 2.7K 10% .25W TC=-400/+500 (NOT PART OF STANDARD INSTRUMENT)	01121	CB27G1
A2R18	0698-3154		RESISTOR 4.22K 1% .125W F TC=0+-100	16299	C4-1/8-T0-4221-F
A4R19	2100-3210	1	RESISTOR-VAR TRMR 10K OHM 10% C TOP ADJ	73138	72PR10K
A4R20	0684-3341	3	RESISTOR 330K 10% .25W FC TC=-800/+900	01121	CB3341
A4R21	0684-1031		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A4R22	0684-1041		RESISTOR 100K 10% .25W FC TC=-400/+800	01121	CB1041
A4R23	0684-1021		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A4R24	0757-0855		RESISTOR 68.1K 1% .5W F TC=0+-100	19701	MF7C1/2-T0-6812-F
A4R25	0684-1031		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A4R26	0684-4741		RESISTOR 470K 10% .25W FC TC=-800/+900	01121	CB4741
A4R27	0684-1021		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A4R29	0684-1031		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A4R30			RESISTOR 10K (NSR - P/O A4R8)		
A4R31			RESISTOR 10K (NSR - P/O A4R8)		
A4R32	0684-2231		RESISTOR 22K 10% .25W FC TC=-400/+800	01121	CB2231
A4R33	0684-2231		RESISTOR 22K 10% .25W FC TC=-400/+800	01121	CB2231
A4R34	0757-0317	1	RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A4R35	0684-1031		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A4R36	0684-3331	1	RESISTOR 33K 10% .25W FC TC=-400/+800	01121	CB3331
A4R37	0684-2231		RESISTOR 22K 10% .25W FC TC=-400/+800	01121	CB2231
A4R38	0684-4731		RESISTOR 47K 10% .25W FC TC=-400/+800	01121	CB4731
A4R39	0683-3935	2	RESISTOR 39K 5% .25W FC TC=-400/+800	01121	CB3935
A4R40	0684-2231		RESISTOR 22K 10% .25W FC TC=-400/+800	01121	CB2231
A4R41	0683-3935		RESISTOR 39K 5% .25W FC TC=-400/+800	01121	CB3935
A4R42	0757-0342	2	RESISTOR 100K 1% .25W F TC=0+-100	24546	C5-1/4-T0-1003-F
A4R43	0757-0475	1	RESISTOR 274K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2743-F
A4R44	0757-0855		RESISTOR 68.1K 1% .5W F TC=0+-100	19701	MF7C1/2-T0-6812-F
A4R45	0757-0473	1	RESISTOR 221K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2213-F
A4R46	0684-5631	1	RESISTOR 56K 10% .25W FC TC=-400/+800	01121	CB5631
A4R47			RESISTOR 10K (NSR - P/O A4R8)		
A4R48	0684-4711	1	RESISTOR 470 10% .25W FC TC=-400/+600	01121	CB4711
A4R49	0684-0271		RESISTOR 2.7K 10% .25W FC TC=-400/+500 (NOT P/O STANDARD INSTRUMENT)	01121	CB27G1
A4R50			RESISTOR 10K (NSR - P/O A4R8)		
A4R51	0684-2231		RESISTOR 22K 10% .25W FC TC=-400/+700	01121	CB2231
A4R52			RESISTOR 10K (NSR - P/O A4R8)		
A4R53	0684-1021		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A4R54	0684-4721	2	RESISTOR 4.7K 10% .25W FC TC=-400/+700	01121	CB4721
A4R55	0684-4721		RESISTOR 4.7K 10% .25W FC TC=-400/+700	01121	CB4721
A4R56	0684-2231		RESISTOR 22K 10% .25W FC TC=-400/+800	01121	CB2231
A4R57	0684-3341		RESISTOR 330K 10% .25W FC TC=-800/+900	01121	CB3341
A4R58	0684-4731		RESISTOR 47K 10% .25W FC TC=-400/+800	01121	CB4731
A4R59			NOT ASSIGNED		
A4R60	0684-1031		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A4R61	0684-2231		RESISTOR 22K 10% .25W FC TC=-400/+800	01121	CB2231
A4R62	0684-3341		RESISTOR 330K 10% .25W FC TC=-800/+900	01121	CB3341
A4R63	0684-4731		RESISTOR 47K 10% .25W FC TC=-400/+800	01121	CB4731
A4R64	0684-2231		RESISTOR 22K 10% .25W FC TC=-400/+800	01121	CB2231
A4R65	0684-0469	2	RESISTOR, 150K 1% .125W MF	01121	CB1531
A4R66	0684-2231		RESISTOR 22K 10% .25W FC TC=-400/+800	01121	CB2231
A4R67	0684-1031		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A4R68	0757-0290		RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A4R69	0684-0469		RESISTOR, 150K 1% .125W MF	01121	CB1531
A4R70	0684-1021		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A4R71	0684-4731		RESISTOR 47K 10% .25W FC TC=-400/+800	01121	CB4731
A4R72	2100-3253		RESISTOR-VAR TRMR 50K OHM 10% C TOP ADJ	73138	72PR50K
A4R73	0684-1541	1	RESISTOR 150K 10% .25W FC TC=-800/+900	01121	CB1541
A4R74	0684-1241	1	RESISTOR 120K 10% .25W FC TC=-800/+900	01121	CB1241
A4R75	0684-1531	1	RESISTOR 15K 10% .25W FC TC=-400/+800	01121	CB1531
A4R76	0757-0342		RESISTOR 100K 1% .25W F TC=0+-100	24546	C5-1/4-T0-1003-F
A4R77	2100-3214	2	RESISTOR-VAR TRMR 100K OHM 10% C TOP ADJ	73138	72PR100K
A4R78	2100-3214		RESISTOR-VAR TRMR 100K OHM 10% C TOP ADJ	73138	72PR100K
A4R79	0757-0458		RESISTOR-FXD 51.1K .125W	28480	0757-0458
A4U1	1820-1210	2	IC SN74LS 51 N	01295	SN74LS51N
A4U2	1820-1210		IC SN74LS 51 N	01295	SN74LS51N
A4U3	1820-1200	4	IC SN74LS 05 N	01295	SN74LS05N
A4U4	1820-1144	1	IC SN74LS 02 N	01295	SN74LS021N
A4U5	1820-1197	1	IC SN74LS 00 N	01295	SN74LS00N
A4U6	1826-0119	2	IC NE 555T	18324	NE555T
A4U7	1826-0119		IC NE 555T	18324	NE555T
A4U8	1820-1144		IC SN74LS 02 N	01295	SN74LS02N
A4U9	1820-1200		IC SN74LS 05 N	01295	SN74LS05N
A4U10	1820-1200		IC SN74LS 05 N	01295	SN74LS05N
A4VR1	1902-3268	1	DIODE-ZNR 26.1V 5% D0-7 PD=.4W TC=+.079%	04713	SZ10939-302
A4W1	8120-0622	1	CABLE CA ASSY 14-COND 26AWG	28480	8120-0622

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A5	01335-66505	1	BOARD ASSEMBLY, CONTROL	28480	01335-66505
A5C1	0160-3443	2	CAPACITOR-FXD .1UF +80–20% 50WVDC CER	28480	0160-3443
A5C2	0160-3443		CAPACITOR-FXD .1UF +80–20% 50WVDC CER	28480	0160-3443
A5J1	1200-0473		SOCKET, IC 16-CONT DIP SLDR TERM	28480	1200-0473
A5MP1	0380-0327	1	SPACER-RND .125-LG .09-ID .153-OD CER	76854	15523-003
A5R1	2100-0649	4	RESISTOR-VAR 20K 10% CC (VERT POSITION)	01121	70M4G035L203U
A5R2	2100-0649		RESISTOR-VAR 20K 10% CC (HORIZ POSITION)	01121	70M4G035L203U
A5R3	2100-0649		RESISTOR-VAR 20K 10% CC (INTENSITY)	01121	70M4G035L203U
A5R3	2100-3401	1	RESISTOR-VAR 20K 10T (OPTION 322)	28480	2100-3401
A5R4	2100-0650	1	RESISTOR-VAR 2.5M 10% CC (FOCUS)	01121	70M4G035L255U
A5R5	2100-0649		RESISTOR-VAR 20K 10% CC (PERSISTENCE)	01121	70M4G035L203U
A5R6	0684-2721	1	RESISTOR 2.7K 10% .25W FC TC=–400/+700	01121	CB2721
A5S1	3101-1927	1	SWITCH, PUSHBUTTON DPDT 7-STATION	28480	3101-1927
A6	0960-0432	1	ASSEMBLY, HIGH VOLTAGE MULTIPLIER	28480	0960-0432

See introduction to this section for ordering information

Table 6-3. Replaceable Parts for Available Kits

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			KIT, STANDARD Z AMPLIFIER		
A1	01332-88709		KIT, STANDARD Z AMPLIFIER	28480	01332-88709
A1C1	0160-3451		CAPACITOR-FXD .01UF +80–20% 100WVDC	28480	0160-3451
A1C2	0160-3451		CAPACITOR-FXD .01UF +80–20% 100WVDC	28480	0160-3451
A1R3	0757-0342		RESISTOR 100K 1% .25W F TUBULAR	24546	C5-1/4-T0-1003-F
A1R4	0757-0342		RESISTOR 100K 1% .25W F TUBULAR	24546	C5-1/4-T0-1003-F
			KIT, STANDARD DEFLECTION		
A2	01332-88701	1	KIT, STANDARD DEFLECTION	28480	01332-88701
A2C1	0160-3451		CAPACITOR-FXD .01UF +80–20% 100WVDC	28480	0160-3451
A2C2	0160-3451		CAPACITOR-FXD .01UF +80–20% 100WVDC	28480	0160-3451
A2C18	0160-3451		CAPACITOR-FXD .01UF +80–20% 100WVDC	28480	0160-3451
A2C19	0160-3451		CAPACITOR-FXD .01UF +80–20% 100WVDC	28480	0160-3451
A2R3	0757-0342		RESISTOR 100K 1% .25W F TUBULAR	24546	C5-1/4-T0-1003-F
A2R4	0757-0342		RESISTOR 100K 1% .25W F TUBULAR	24546	C5-1/4-T0-1003-F
A2R47	0757-0342		RESISTOR 100K 1% .25W F TUBULAR	24546	C5-1/4-T0-1003-F
A2R48	0757-0342		RESISTOR 100K 1% .25W F TUBULAR	24546	C5-1/4-T0-1003-F
			KIT, OPTION 100		
A2	01332-88702	1	KIT, OPTION 100	28480	01332-88702
A2C1	0121-0455	8	CAPACITOR-VAR; TRMR; AIR; 1.9/15.7PF	74970	187-0109-005
A2C2	0121-0455		CAPACITOR-VAR; TRMR; AIR; 1.9/15.7PF	74970	187-0109-005
A2C3	0160-2200	8	CAPACITOR-FXD 43PF +–5% 300WVDC	28480	0160-2200
A2C4	0160-2200		CAPACITOR-FXD 43PF +–5% 300WVDC	28480	0160-2200
A2C18	0121-0455		CAPACITOR-VAR; TRMR; AIR; 1.9/15.7PF	74970	187-0109-005
A2C19	0121-0455		CAPACITOR-VAR; TRMR; AIR; 1.9/15.7PF	74970	187-0109-005
A2C20	0160-2200		CAPACITOR-FXD 43PF +–5% 300WVDC	28480	0160-2200
A2C21	0160-2200		CAPACITOR-FXD 43PF +–5% 300WVDC	28480	0160-2200
A2R3	0698-6654		RESISTOR 800K 1% .25W F TUBULAR	19701	MF4C1/8-T0-8003-F
A2R4	0698-6654		RESISTOR 800K 1% .25W F TUBULAR	19701	MF4C1/8-T0-8003-F
A2R5	0757-0782		RESISTOR 200K 1% .25W F TUBULAR	24546	C5-1/4-T0-2003-F
A2R6	0757-0782		RESISTOR 200K 1% .25W F TUBULAR	24546	C5-1/4-T0-2003-F
A2R47	0698-6654		RESISTOR 800K 1% .25W F TUBULAR	19701	MF4C1/8-T0-8003-F
A2R48	0698-6654		RESISTOR 800K 1% .25W F TUBULAR	19701	MF4C1/8-T0-8003-F
A2R49	0757-0782		RESISTOR 200K 1% .25W F TUBULAR	24546	C5-1/4-T0-2003-F
A2R50	0757-0782		RESISTOR 200K 1% .25W F TUBULAR	24546	C5-1/4-T0-2003-F
			KIT, OPTION 101		
A2	01332-88703	1	KIT, OPTION 101	28480	01332-88703
A2C1	0121-0455		CAPACITOR-VAR; TRMR; AIR; 1.9/15.7PF	74970	187-0109-005
A2C2	0121-0455		CAPACITOR-VAR; TRMR; AIR; 1.9/15.7PF	74970	187-0109-005
A2C3	0160-2200		CAPACITOR-FXD 43PF +–5% 300WVDC	28480	0160-2200
A2C4	0160-2200		CAPACITOR-FXD 43PF +–5% 300WVDC	28480	0160-2200
A2C18	0121-0455		CAPACITOR-VAR; TRMR; AIR; 1.9/15.7PF	74970	187-0109-005
A2C19	0121-0455		CAPACITOR-VAR; TRMR; AIR; 1.9/15.7PF	74970	187-0109-005
A2C20	0160-2200		CAPACITOR-FXD 43PF +–5% 300WVDC	28480	0160-2200
A2C21	0160-2200		CAPACITOR-FXD 43PF +–5% 300WVDC	28480	0160-2200
A2R3	0698-6400		RESISTOR 900K 1% .25W F TUBULAR	19701	MF52C1/4-T0-9003-F
A2R4	0698-6400		RESISTOR 900K 1% .25W F TUBULAR	19701	MF52C1/4-T0-9003-F
A2R5	0757-0342		RESISTOR 100K 1% .25W F TUBULAR	24546	C5-1/4-T0-1003-F
A2R6	0757-0342		RESISTOR 100K 1% .25W F TUBULAR	24546	C5-1/4-T0-1003-F
A2R47	0698-6400		RESISTOR 900K 1% .25W F TUBULAR	19701	MF52C1/4-T0-9003-F
A2R48	0698-6400		RESISTOR 900K 1% .25W F TUBULAR	19701	MF52C1/4-T0-9003-F
A2R49	0757-0342		RESISTOR 100K 1% .25W F TUBULAR	24546	C5-1/4-T0-1003-F
A2R50	0757-0342		RESISTOR 100K 1% .25W F TUBULAR	24546	C5-1/4-T0-1003-F
			KIT, STANDARD INPUT X-Y		
A2	01332-88704	1	KIT, STANDARD INPUT X-Y	28480	01332-88704
A2R1	0757-0344		RESISTOR 1M 1% .25W F TUBULAR	24546	C5-1/4-T0-1004-F
A2R2	0757-0344		RESISTOR 1M 1% .25W F TUBULAR	24546	C5-1/4-T0-1004-F
A2R45	0757-0344		RESISTOR 1M 1% .25W F TUBULAR	24546	C5-1/4-T0-1004-F
A2R46	0757-0344		RESISTOR 1M 1% .25W F TUBULAR	24546	C5-1/4-T0-1004-F
			KIT, OPTION 110		
A2	01332-88705	1	KIT, OPTION 110	28480	01332-88705
A2R1	0698-7648		RESISTOR 50 OHM 1% .25W MO	24546	C-5
A2R2	0698-7648		RESISTOR 50 OHM 1% .25W MO	24546	C-5
A2R45	0698-7648		RESISTOR 50 OHM 1% .25W MO	24546	C-5
A2R46	0698-7648		RESISTOR 50 OHM 1% .25W MO	24546	C-5
			KIT, STANDARD, LINEAR AMPLIFIER		
A1	01332-88717	1	KIT, STANDARD, LINEAR AMPLIFIER	28480	01332-88717
A1R26	0757-0418	1	RESISTOR 619 OHMS 1% .125W	28480	0757-0418
			KIT, OPTION 200		
A1	01332-88710	1	KIT, OPTION 200	28480	01332-88710
A1C1	0121-0451	4	CAPACITOR-VAR; TRMR; AIR; 1.7/11PF	74970	187-0106-005
A1C2	0121-0451		CAPACITOR-VAR; TRMR; AIR; 1.7/11PF	74970	187-0106-005
A1C3	0140-0190	4	CAPACITOR-FXD 39PF +–5% 300WVDC	72136	DM15E390J0300WV1CR
A1C4	0140-0190		CAPACITOR-FXD 39PF +–5% 300WVDC	72136	DM15E390J0300WV1CR
A1R3	0698-6654	6	RESISTOR 800K 1% .25W F TUBULAR	19701	MF4C1/8-T0-8003-F
A1R4	0698-6654		RESISTOR 800K 1% .25W F TUBULAR	19701	MF4C1/8-T0-8003-F
A1R5	0757-0782	6	RESISTOR 200K 1% .25W F TUBULAR	24546	C5-1/4-T0-2003-F
A1R6	0757-0782		RESISTOR 200K 1% .25W F TUBULAR	24546	C5-1/4-T0-2003-F

See introduction to this section for ordering information

Table 6-3. Replaceable Parts for Available Kits (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			KIT, OPTION 201		
A1	01332-88711	1	KIT, OPTION 201	28480	01332-88711
A1C1	0121-0451		CAPACITOR-VAR; TRMR; AIR; 1.7/11PF	74970	187-0106-005
A1C2	0121-0451		CAPACITOR-VAR; TRMR; AIR; 1.7/11PF	74970	187-0106-005
A1C3	0140-0190		CAPACITOR-FXD 39PF +-5% 300WVDC	72136	DM15E390J0300WV1CR
A1C4	0140-0190		CAPACITOR-FXD 39PF +-5% 300WVDC	72136	DM15E390J0300WV1CR
A1R3	0698-6400	6	RESISTOR 900K 1% .25W F TUBULAR	19701	MF52C1/4-T0-9003-F
A1R4	0698-6400		RESISTOR 900K 1% .25W F TUBULAR	19701	MF52C1/4-T0-9003-F
A1R5	0757-0342		RESISTOR 100K 1% .25W F TUBULAR	24546	C5-1/4-T0-1003-F
A1R6	0757-0342		RESISTOR 100K 1% .25W F TUBULAR	24546	C5-1/4-T0-1003-F
			KIT, STANDARD 1M INPUT		
A1	01332-88709	1	KIT, STANDARD, 1M INPUT	28480	01332-88709
A1R1	0757-0344	6	RESISTOR 1M 1% .25W F TUBULAR	24546	C5-1/4-T0-1004-F
A1R2	0757-0344		RESISTOR 1M 1% .25W F TUBULAR	24546	C5-1/4-T0-1004-F
			KIT, OPTION 210		
A1	01332-88715	1	KIT, OPTION 210	28480	01332-88715
A1R1	0698-7648	6	RESISTOR 50 OHM 1% .25W MO	24546	C-5
A1R2	0698-7648		RESISTOR 50 OHM 1% .25W MO	24546	C-5
			KIT, OPTION 215		
A1	01332-86718	1	KIT, OPTION 215	28480	01332-86718
A1CR5	1901-0535	1	DIODE-SI .5 VOLT 20 MA	28480	1901-0535
A1R26	0757-0424		RESISTOR 1.1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1101-F
A1R28	0757-0422		RESISTOR 909 OHMS 1% .25W	28480	0757-0422

Table 6-4. List of Manufacturers' Codes

Mfr No.	Manufacturer Name	Address	Zip Code
00000	NO M/F DESCRIPTION FOR THIS MFG NUMBER		
0007K	KABELMETAL		
01121	ALLEN BRADLEY CO	MILWAUKEE WI	53212
01295	TEXAS INSTR INC SEMICOND CMPNT DIV	DALLAS TX	75231
01538	SMALL PARTS INC	COSTA MESA CA	92626
02735	RCA CORP SOLID STATE DIV	SOMMERVILLE NJ	08876
03888	PYROFILM CORP	WHIPPANY NJ	07981
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX AZ	85008
05129	KILO ENGINEERING CO	LA VERNE CA	91750
06560	AIRCO SPEER ELEK DIV AIR RDCN CO	NOGALES AZ	85621
06915	RICHCO PLASTIC CO	CHICAGO IL	60646
07263	FAIRCHILD SEMICONDUCTOR DIV	MOUNTAIN VIEW CA	94040
08806	GE CO MINIATURE LAMP PROD DEPT	CLEVELAND OH	44112
13103	THERMALLOY CO	DALLAS TX	75247
13445	COLE-HERSEE CO	BOSTON MA	02127
16299	CORNING GL WK ELEC CMPNT DIV	RALEIGH NC	27604
17856	SILICONIX INC	SANTA CLARA CA	75050
18324	SIGNETICS CORP	SUNNYVALE CA	94086
19701	MEPCO/ELECTRA CORP	MINERAL WELLS TX	76067
24226	GOWANDA ELECTRONICS CORP	GOWANDA NY	14070
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD PA	16701
24931	SPECIALTY CONNECTOR CO INC	INDIANAPOLIS IN	46227
26365	GRIES REPRODUCER CORP	NEW ROCHELLE NY	10802
26742	METHODE ELECTRONICS INC	CHICAGO IL	60656
27191	CUTLER-HAMMER INC POWER DISTR CONT	MILWAUKEE WI	53216
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO CA	94304
28520	HEYMAN MFG CO	KENILWORTH NJ	07033
34344	MOTOROLA INC	FRANKLIN PARK IL	60131
4G819	OVERLAND PRODUCTS CO	FREMONT NE	68025
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS MA	01247
71400	BUSSMAN MFG DIV OF MCGRAW-EDISON CO	ST LOUIS MO	63017
72136	ELECTRO MOTIVE MFG CO INC	WILLIMANTIC CT	06226
73138	BECKMAN INSTRUMENTS INC HELIPOT DIV	FULLERTON CA	92634
73734	FEDERAL SCREW PRODUCTS CO	CHICAGO IL	60618
76854	OAK IND INC SW DIV	CRYSTAL LAKE IL	60014
84048	TRW INC ST PETERSBURG DIV	ST PETERSBURG FL	33702
84411	TRW CAPACITOR DIV	OGALLALA NE	69153
90201	MALLORY CAPACITOR CO	INDIANAPOLIS IN	46206
91500	ASHEVILLE-SCHOONMAKER MICA CO	NEWPORT NEWS MD	23607
98291	SEALECTRO CORP	MAMARONECK NY	10544

See introduction to this section for ordering information

SECTION VII

MANUAL CHANGES

7-1. INTRODUCTION.

7-2. This section contains information required to backdate or update this manual for a specific instrument.

7-3. MANUAL CHANGES.

7-4. This manual applies directly to the instrument 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 an enclosed MANUAL CHANGES sheet for updating information. Also, if a MANUAL CHANGES sheet is supplied, make all indicated ERRATA corrections.

Table 7-1. Manual Changes

Serial Prefix	Make Changes
No backdating changes are required at this time.	

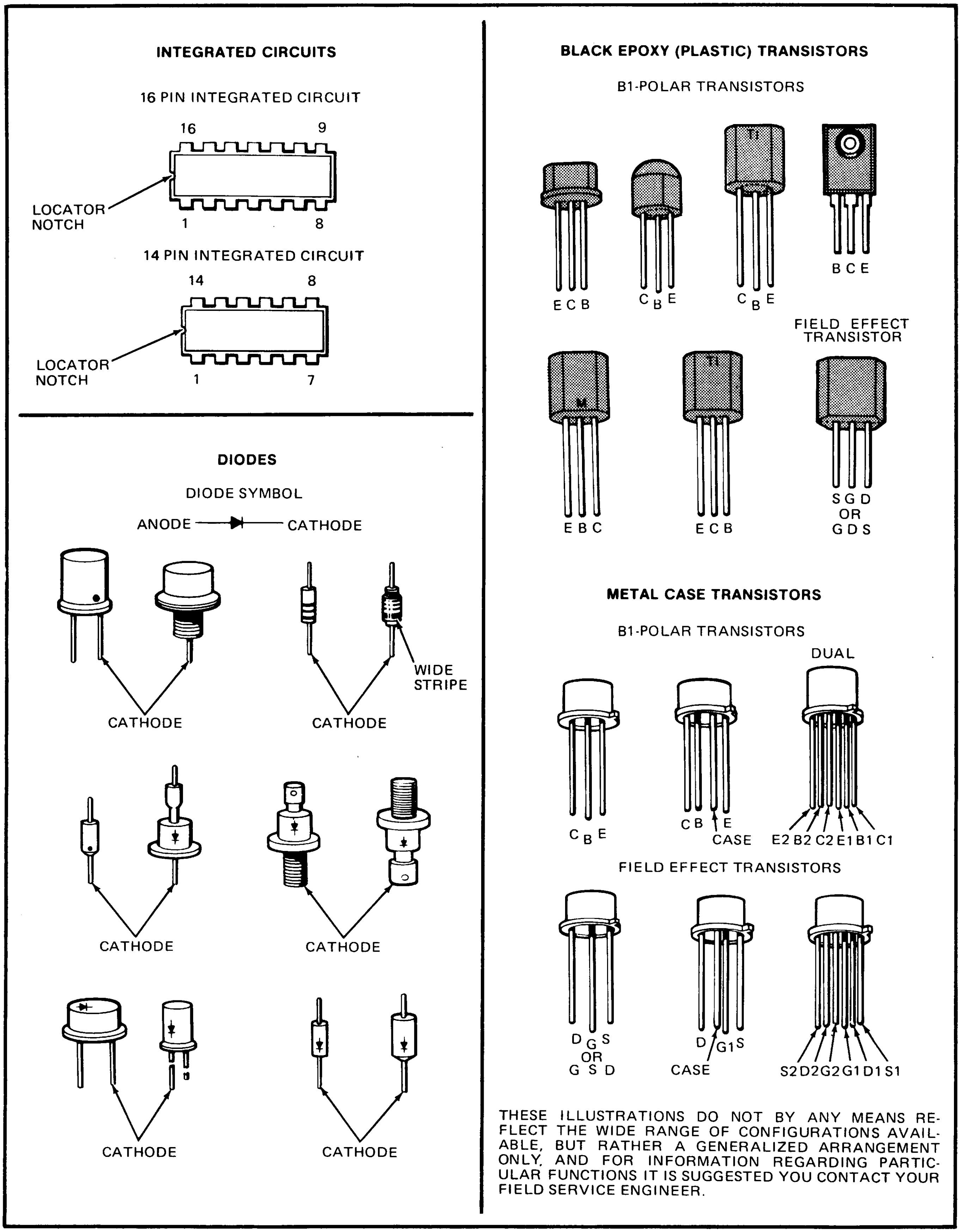


Figure 8-1. Semiconductor Terminal Identification

SECTION VIII

SCHEMATICS AND TROUBLESHOOTING

8-1. INTRODUCTION.

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

8-3. PREVENTIVE MAINTENANCE.

8-4. CLEANING. Painted, glass, and plastic surfaces can be cleaned with a commercial, 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.

8-5. Corroded spots are best removed with soap and water. Stubborn residues can be removed with a fine abrasive. When using abrasive, be careful that fine particules do not fall into the instrument. Such areas should be protected from further corrosion by an application of a silicone resin such as GE DRI-FILM 88.

8-6. SEMICONDUCTOR REMOVAL AND REPLACEMENT. Figure 8-1 is included to help identify the leads on the common shapes and sizes of semiconductor devices. When removing a semiconductor, use long-nosed pliers as a heat sink between the device and the soldering iron. When replacing a semiconductor, ensure sufficient lead length to dissipate the soldering heat by using the same length of exposed lead as used for the original part.

8-7. BOARD CONNECTIONS. Square-pin connectors are identified on circuit boards by the color code of the connecting wire. Connector pins on plugs and jacks are identified by either a numeral or a letter. The letters G, I, O, and Q have been omitted. Table 8-1 shows the types of board connections used in the instrument.

8-8. SERVICING ETCHED CIRCUIT BOARDS. This instrument uses etched circuit boards with plated-through component holes. This allows components to be removed or replaced 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 the part to lift it from the board. HP Service Note M-20E contains additional information on repair of etched circuit boards.

8-9. HEAT SINKS. The heat sinks used on this instrument are all of the friction type. They can be removed by carefully pulling them off. When reinstalling, support the bottom of the transistor before pushing the heat sink on. Transistor damage may result if the transistor leads are bent.

8-10. TROUBLESHOOTING.

8-11. The most important prerequisite for successful troubleshooting is understanding how the instrument is designed to operate and correct use of operating controls. Improper control setting or improper interfacing can cause apparent malfunctions. Read Section III (operation and interfacing) for a general explanation of operating considerations. Read Section IV (principles of operation) for explanations of circuit theory.

8-12. 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 connections are making good contact and are not shorting to adjacent circuits. If no obvious trouble is found, check power supply voltages. Prior to extensive troubleshooting, also check the external power source.

8-13. DC VOLTAGES. On some of the schematics, dc voltages are indicated for active components. Conditions for making these voltage measurements are listed adjacent to the schematics. Because the conditions for making the measurements may differ from one circuit to another, always check the specific condition shown adjacent to the schematic.

Table 8-1. Schematic Notes

REFER TO ANSI Y 32.2 AND Y32.14 FOR SCHEMATIC SYMBOLS NOT LISTED IN THIS TABLE.

ETCHED CIRCUIT BOARD

ASSEMBLY

ETCHED CIRCUIT BOARD ON ASSEMBLY

VERNIER — FRONT-PANEL MARKING

VERNIER — REAR-PANEL MARKING

MAIN SIGNAL PATH

PRIMARY FEEDBACK PATH

SECONDARY FEEDBACK PATH

SINGLE-PIN CONNECTOR ON BOARD

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

COAXIAL CABLE CONNECTED DIRECTLY TO BOARD

COAXIAL CABLE CONNECTED TO SNAP-ON JACK

FRONT-PANEL CONTROL

TP4 — TEST POINT (TP WITH NUMBER)

SCREWDRIVER ADJUSTMENT

7 — WAVEFORM TEST POINT (WITH NUMBER)

A — COMMON ELECTRICAL POINT (WITH LETTER); NOT NECESSARILY GROUND

70 — SIGNAL REFERENCE

9 — SCHEMATIC REFERENCE

BREAKDOWN DIODE (VOLTAGE REGULATOR)

LIGHT EMITTING DIODE (LED)

TUNNEL DIODE

G D S — FIELD-EFFECT TRANSISTOR (N-TYPE BASE)

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

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

UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS, CAPACITANCE IN PICOFARADS AND INDUCTANCE IN MICROHENRIES

CW	CLOCKWISE END OF VARIABLE RESISTOR
NC	NO CONNECTION
P/O	PART OF

VF (A)

V - VOLTAGE
F - FILTERED
(A) - FILTER SOURCE

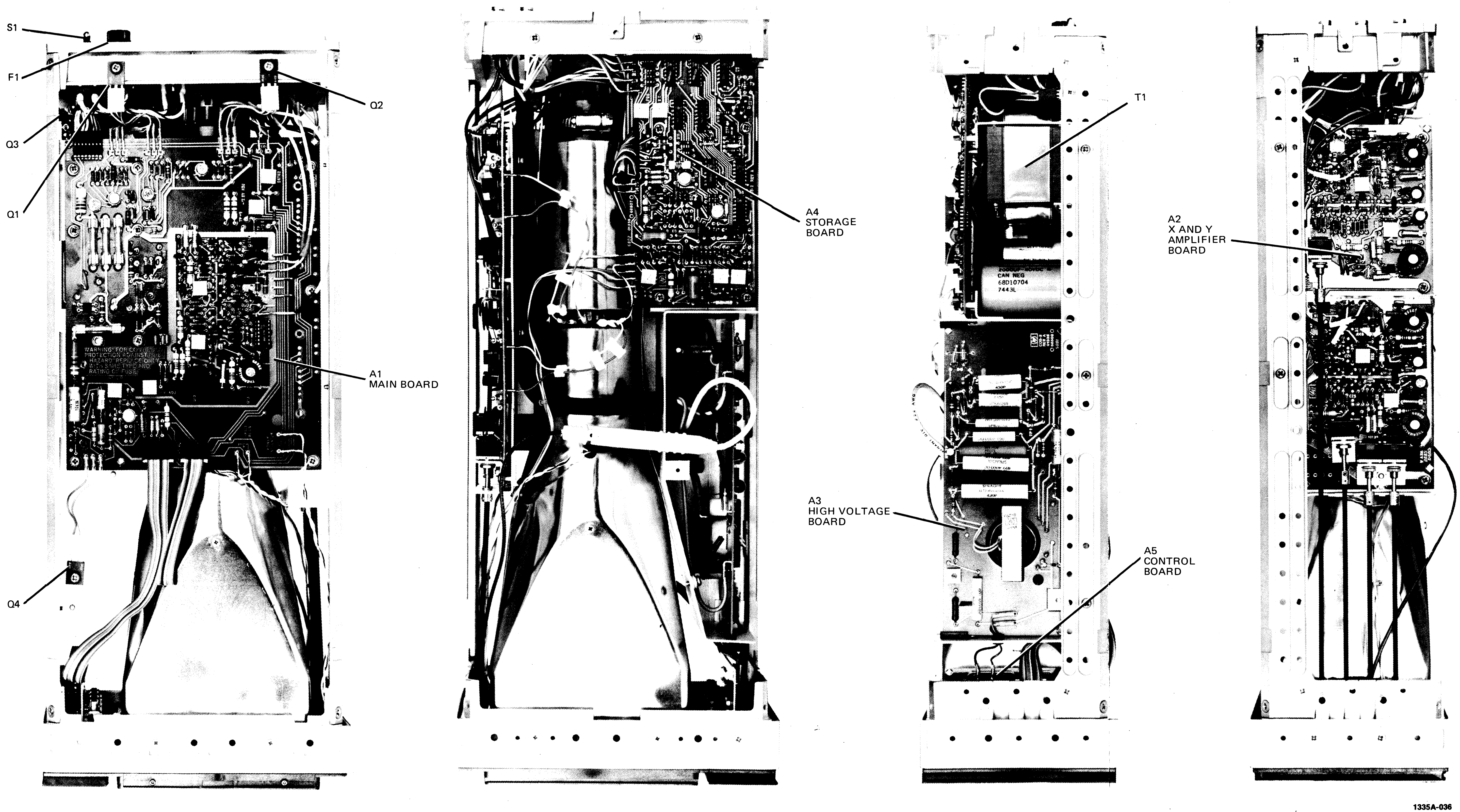
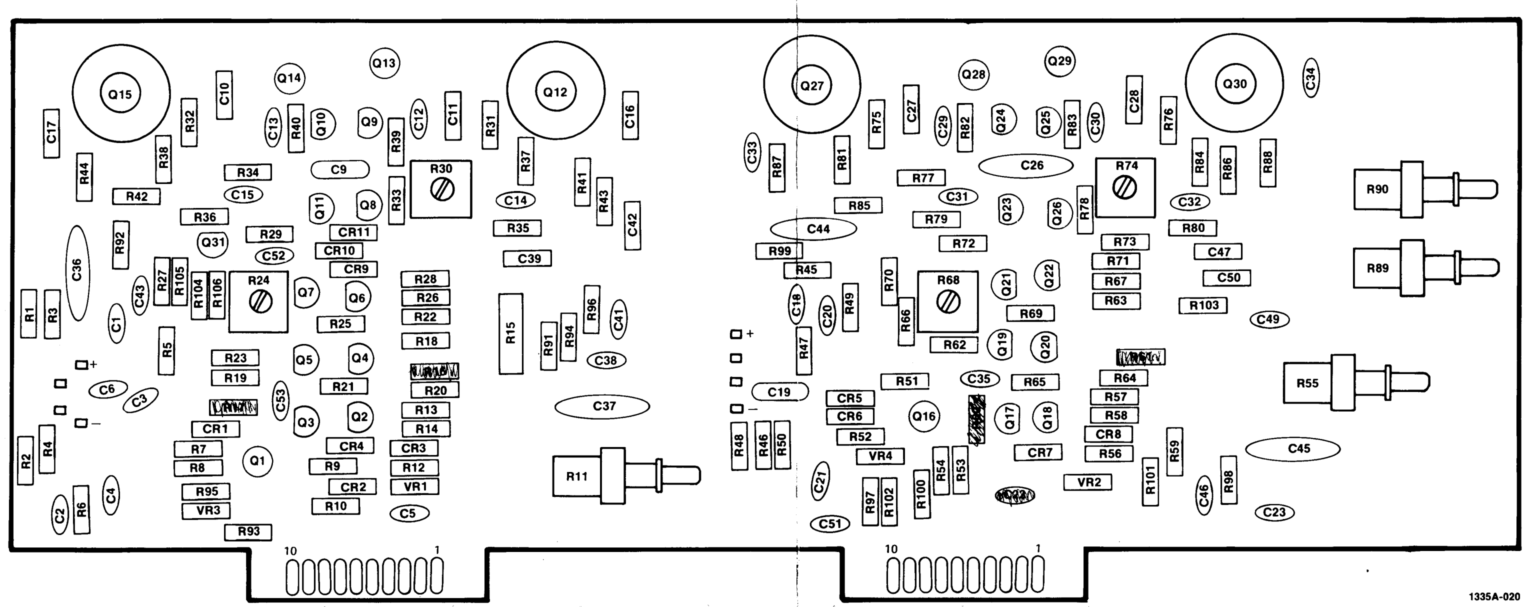


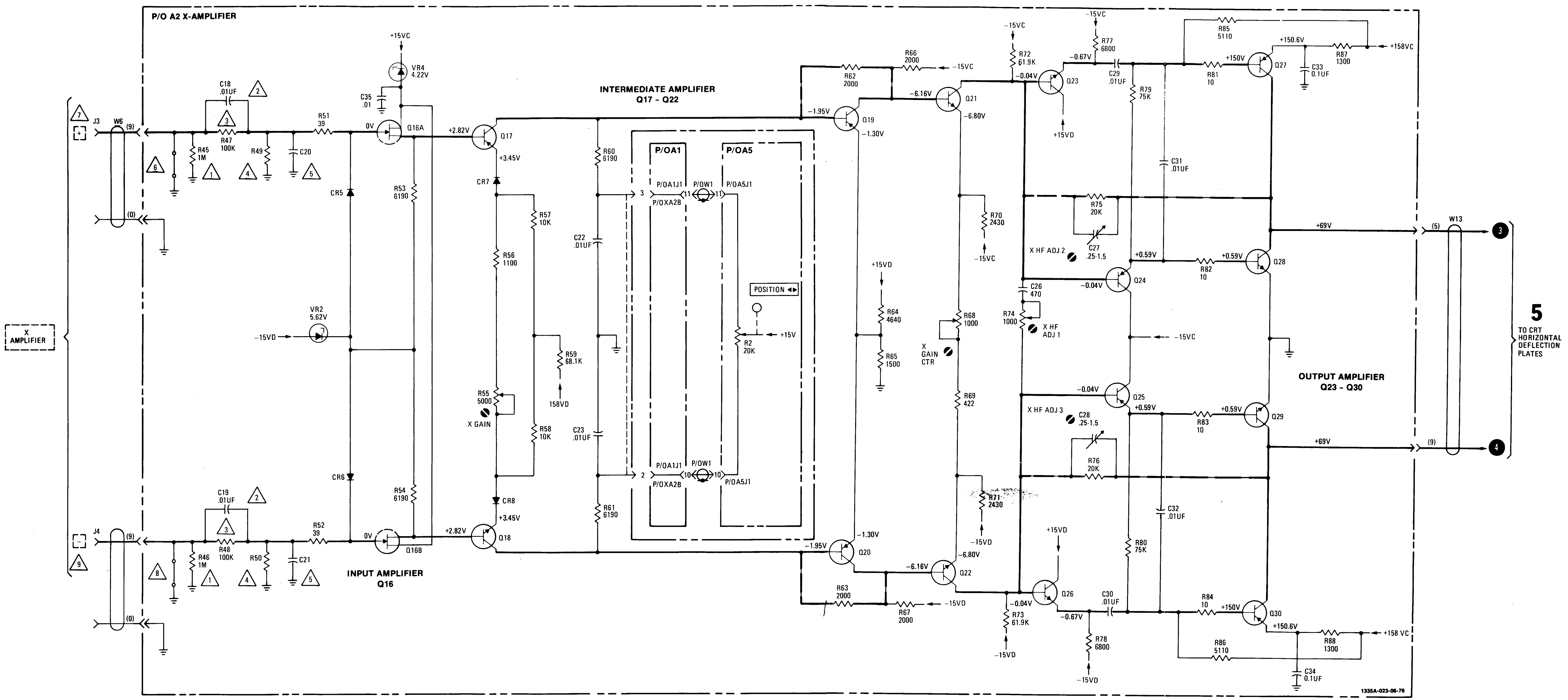
Figure 8-2.
Assembly and Chassis Parts Locator



A2

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	B-4	C21	G-5	C42	F-3	CR8	J-4	Q16	H-4	R3	A-4	R21	D-4	R39	D-2	R57	J-4	R75	H-2	R93	C-5
C2	A-5	C22	I-5	C43	B-3	CR9	D-3	Q17	I-4	R4	A-5	R22	D-4	R40	C-2	R58	J-4	R76	J-2	R94	E-4
C3	B-4	C23	K-5	C44	G-3	CR10	D-3	Q18	I-4	R5	B-4	R23	C-4	R41	F-3	R59	J-5	R77	H-2	R95	C-5
C4	B-5	C26	I-2	C45	K-5	CR11	D-3	Q19	I-4	R6	B-5	R24	C-3	R42	B-3	R60	I-4	R78	I-3	R96	F-4
C5	D-5	C27	H-2	C46	J-5	Q1	C-5	Q20	I-4	R7	B-5	R25	D-4	R43	F-3	R61	J-4	R79	H-3	R97	H-5
C6	B-4	C28	J-2	C47	K-3	Q2	D-4	Q21	I-3	R8	B-5	R26	D-3	R44	B-2	R62	H-4	R80	J-3	R98	K-5
C9	D-2	C29	H-2	C49	K-4	Q3	C-4	Q22	I-3	R9	D-5	R27	B-3	R45	G-3	R63	J-3	R81	H-2	R99	G-3
C10	C-2	C30	J-2	C50	K-3	Q5	C-4	Q23	I-3	R10	D-5	R28	D-3	R46	G-5	R64	J-4	R82	I-2	R100	H-5
C11	D-2	C31	H-3	C51	G-5	Q6	D-3	Q24	I-2	R11	F-5	R29	C-3	R47	G-4	R65	I-4	R83	I-2	R101	J-5
C12	D-2	C32	J-3	C52	C-3	Q7	C-3	Q25	I-2	R12	D-5	R30	D-2	R48	G-5	R66	H-4	R84	J-2	R102	H-5
C13	C-2	C33	G-2	C53	C-4	Q8	D-3	Q26	I-3	R13	D-4	R31	E-2	R49	H-4	R67	J-3	R85	H-3	R103	J-3
C14	E-3	C34	K-2	CR1	C-4	Q9	D-2	Q27	G-2	R14	D-4	R32	B-2	R50	G-5	R68	H-3	R86	K-2	R104	B-3
C15	C-3	C35	I-4	CR2	D-5	Q10	C-2	Q28	I-2	R15	E-4	R33	D-3	R51	H-4	R69	I-4	R87	G-2	R105	B-3
C16	F-2	C36	B-3	CR3	D-5	Q11	C-3	Q29	I-2	R16	D-4	R34	C-2	R52	H-4	R70	H-3	R88	K-2	R106	C-3
C17	A-2	C37	E-4	CR4	D-5	Q12	E-2	Q30	K-2	R17	C-4	R35	E-3	R53	H-5	R71	J-3	R89	L-3	VR1	D-5
C18	G-3	C38	F-4	CR5	H-4	Q13	D-4	Q31	C-3	R18	D-4	R36	C-3	R54	H-5	R72	I-3	R90	L-3	VR2	I-5
C19	G-4	C39	E-3	CR6	H-4	Q14	C-2	R1	A-4	R19	C-4	R37	E-2	R55	K-4	R73	J-3	R91	E-4	VR3	C-5
C20	G-4	C41	F-4	CR7	I-5	Q15	B-2	R2	A-5	R20	D-4	R38	B-2	R56	J-5	R74	J-2	R92	B-3	VR4	H-5

Figure 8-3. A2 Y-axis Amplifier Component Locator



PARTS ON THIS SCHEMATIC

P/OA2	
C18-23, 26-35 CR5-8 Q16-30 R45-88 VR2, 4	
P/OA5	P/OA1
R2	P/OXA2B P/OP1
CHASSIS	
J3, 4 W6, 13	

DELETED: A2C24, A2C25

2

Figure 8-5.
X-axis Amplifier

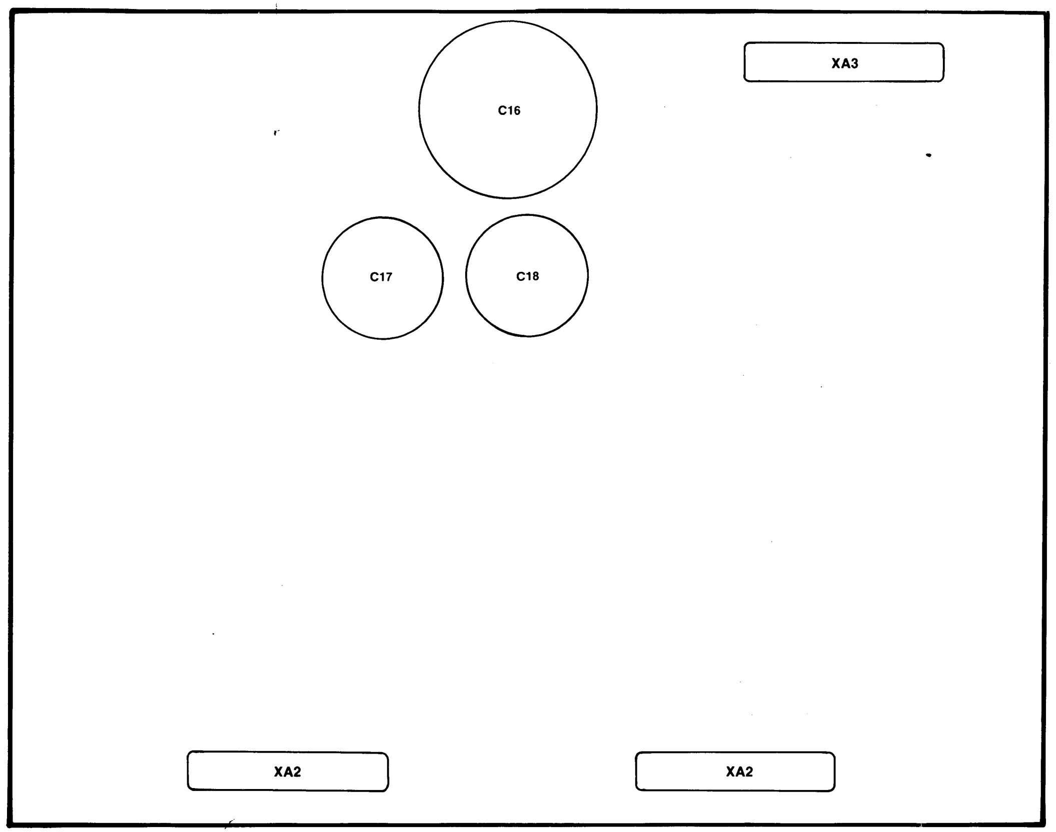
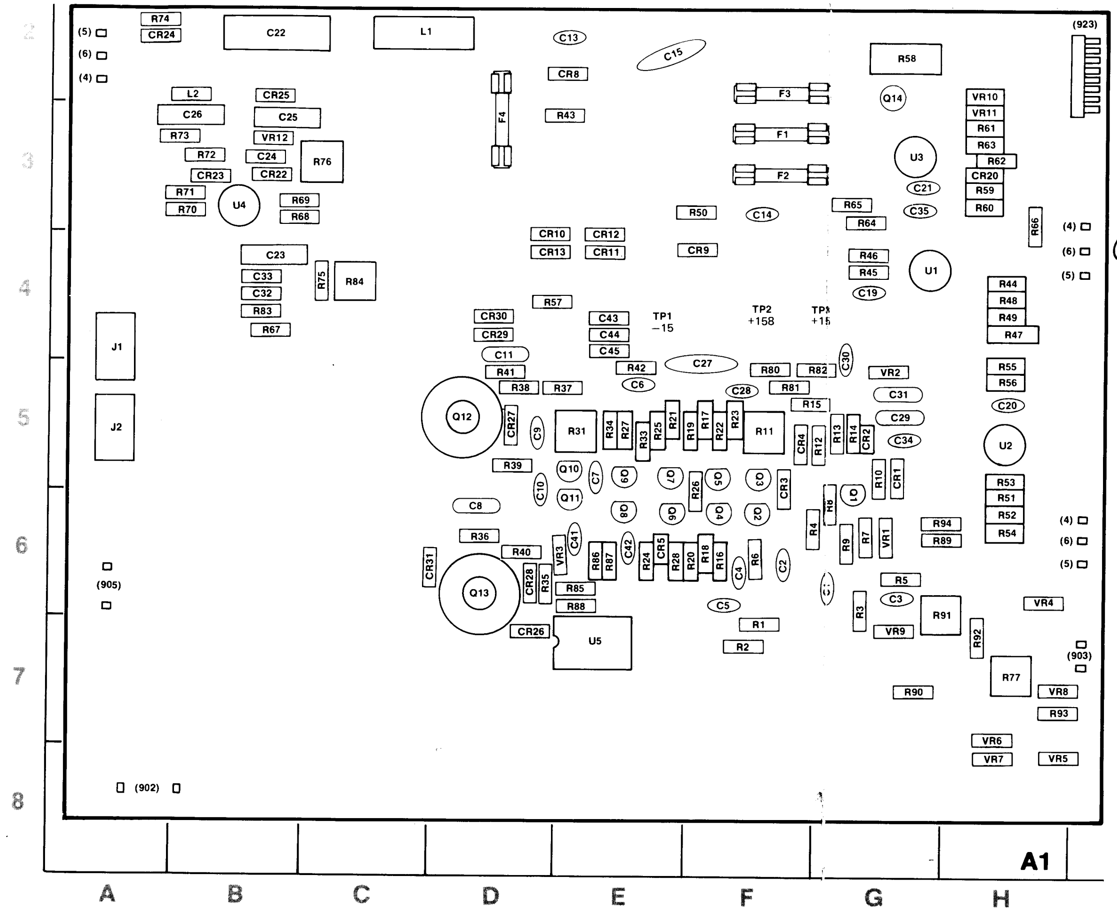


Figure 8-6. A1 Main Board Component Locator (Back)



Q3

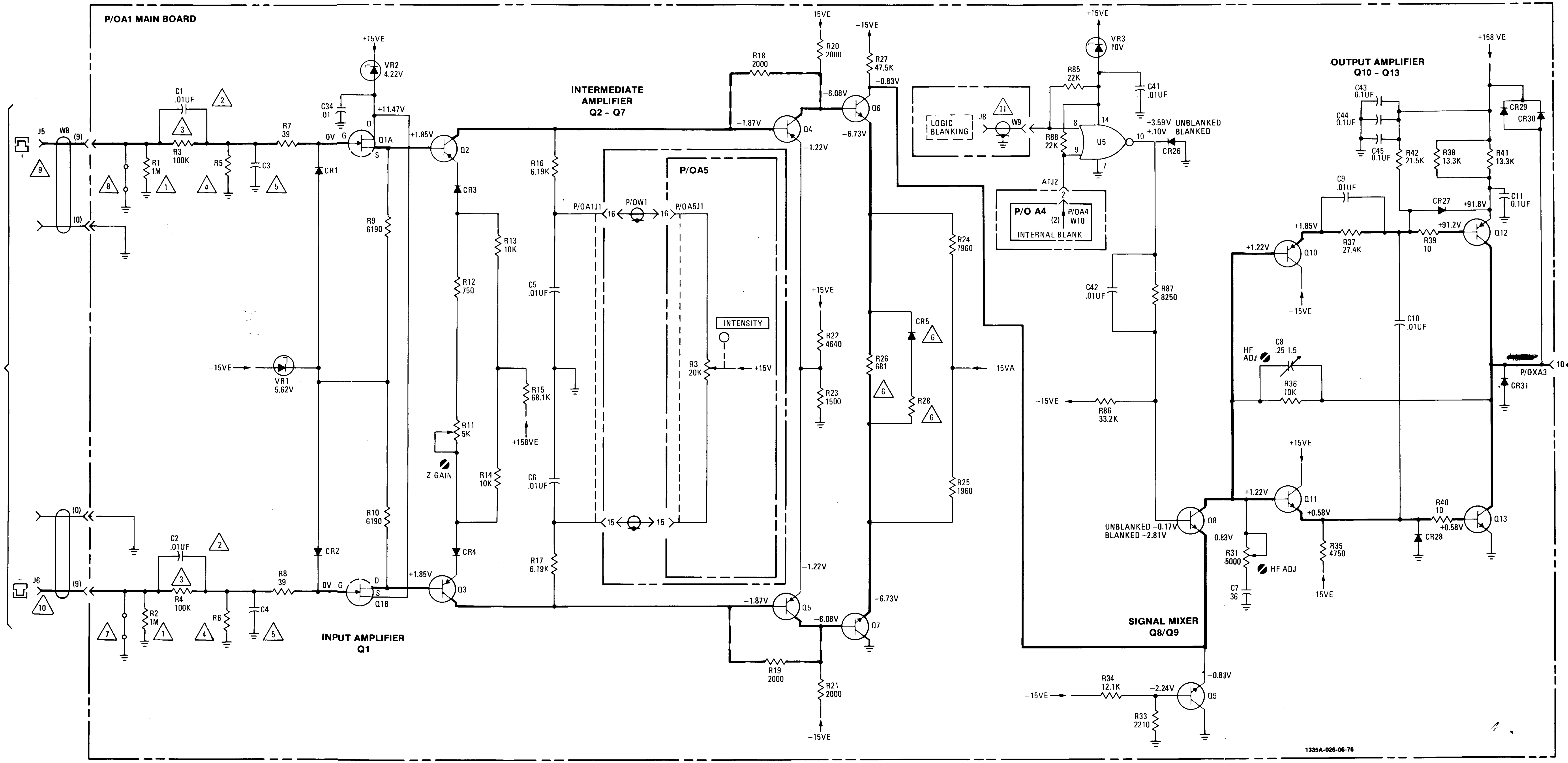
REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	G-6	C11	D-4	C25	B-3	C35	G-3	CR5	E-6	CR24	A-2	F3	F-2	Q5	F-5	R1	F-7	R11	F-5	R21	E-5	R34	E-5	R44	H-4	R54	H-6	R64	G-3	R74	A-2	R86	E-6	TP2	F-4	VR4	H-6
C2	F-6	C13	E-2	C26	B-3	C41	E-6	CR8	E-2	CR25	B-2	F4	D-3	Q6	E-6	R2	F-7	R12	G-5	R22	F-5	R35	G-3	R45	G-4	R55	H-5	R65	G-3	R75	C-4	R87	E-6	TP3	G-4	VR5	H-8
C3	G-6	C14	F-3	C27	F-5	C42	E-6	CR9	F-4	CR26	D-7	J1	A-4	Q7	E-5	R3	G-6	R13	G-5	R23	F-5	R36	D-6	R46	G-4	R56	H-5	R66	H-3	R76	C-3	R88	E-6	U1	G-4	VR6	H-7
C4	F-6	C15	E-2	C28	F-5	C43	E-4	CR10	D-4	CR27	D-5	J2	A-5	Q8	E-6	R4	G-6	R14	G-5	R24	E-6	R37	D-5	R47	H-4	R57	D-4	R67	B-4	R77	H-7	R89	H-6	U2	H-5	VR7	H-8
C5	F-6	C19	G-4	C29	G-5	C44	E-4	CR11	E-4	CR28	D-6	L1	C-2	Q9	E-5	R5	G-6	R15	G-5	R25	E-5	R38	D-5	R48	H-4	R58	G-2	R68	B-3	R80	F-5	R90	G-7	U3	G-3	VR8	H-7
C6	E-5	C20	H-5	C30	G-4	C45	E-4	CR12	E-4	CR29	D-4	L2	B-2	Q10	E-5	R6	F-6	R16	F-6	R26	F-6	R39	D-5	R49	H-4	R59	H-3	R69	B-3	R81	F-5	R91	H-6	U4	B-3	VR9	G-7
C7	E-5	C21	G-3	C31	G-5	CR1	G-5	CR13	D-4	CR30	D-4	Q1	G-6	Q11	E-6	R7	G-6	R17	F-5	R27	E-5	R40	D-6	R50	F-3	R60	H-3	R70	B-3	R82	G-5	R92	H-7	U5	E-7	VR10	H-2
C8	D-6	C22	B-2	C32	B-4	CR2	G-5	CR20	H-3	CR31	D-6	Q2	F-6	Q12	D-5	R8	G-6	R18	F-6	R28	E-6	R41	D-4	R51	H-6	R61	H-3	R71	B-3	R83	B-4	R93	H-7	VR1	G-6	VR11	H-3
C9	D-5	C23	B-4	C33	B-4	CR3	F-6	CR22	B-3	F1	F-3	Q3	F-5	Q13	D-6	R9	G-6	R19	F-5	R31	E-5	R42	E-5	R52	H-6	R62	H-3	R72	B-3	R84	C-4	R94	H-6	VR2	G-5	VR12	B-3
C10	D-6	C24	B-3	C34	G-5	CR4	F-5	CR23	B-3	F2	F-3	Q4	F-6	Q14	G-2	R10	G-5	R20	F-6	R33	E-5	R43	E-3	R53	H-5	R63	H-3	R73	B-3	R85	E-6	TP1	E-4	VR3	E-6		

SCHEMATIC NOTES

1	Standard - 1M Option 210 - 50
2	Standard - .01UF Option 200 - 1.7 - 11 VAR Option 201 - 1.7 - 11 VAR
3	Standard - 100K Option 200 - 800K Option 201 - 900K
4	Standard - NOT USED Option 200 - 200K Option 201 - 100K
5	Standard - NOT USED Option 200 - 39 Option 201 - 39
6	Standard - COMP / VALUE R26 681 R28 NOT USED CR5 NOT USED Option - 215 R26 1100 R28 909 CR5 USED (1901-0535)
7	Standard - Jumper USED
8	Standard - Jumper NOT USED Option 205 - Jumper USED
9	Standard - J5 USED Option 205 - J5 NOT USED Option 206 - J5 USED
10	Standard - J6 NOT USED Option 206 - J6 USED
11	Standard - J8 NOT USED Option 216 - J8 USED

Figure 8-7. A1 Main Board Component Locator (Front)

use other #3



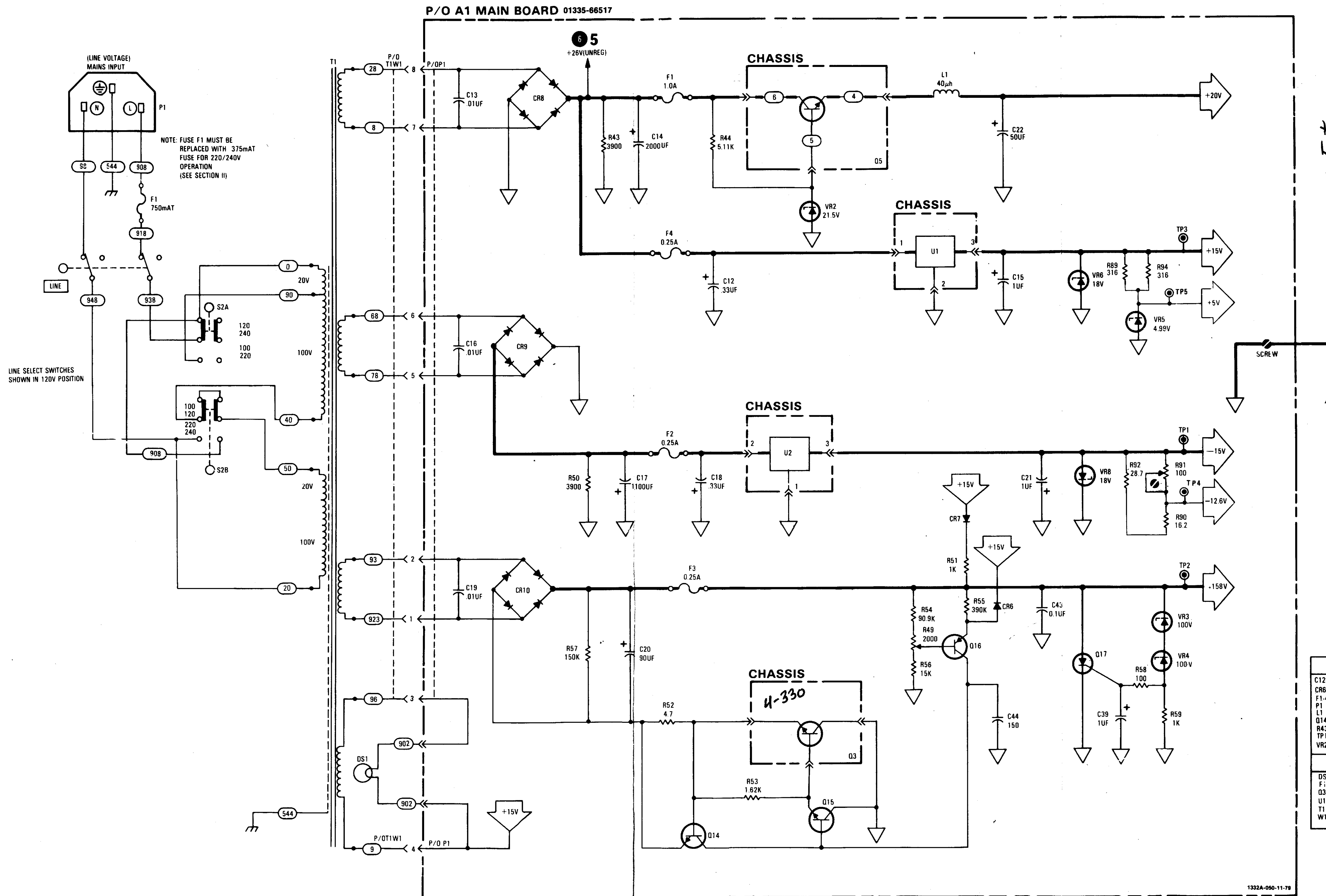
PARTS ON THIS SCHEMATIC

P/OA1	P/OA5
C1-11, 34, 41-45 CR1-5, 26-31 Q1-13 R1-28, 31, 33-42 85-88 VR1, 2, 3 U5	R3
CHASSIS	
J5, 6, 8 R3 W8	

DELETED: A1C12, 1CR6, CR7, R29, R30, R32

3

Figure 8-8
Z-axis Amplifier

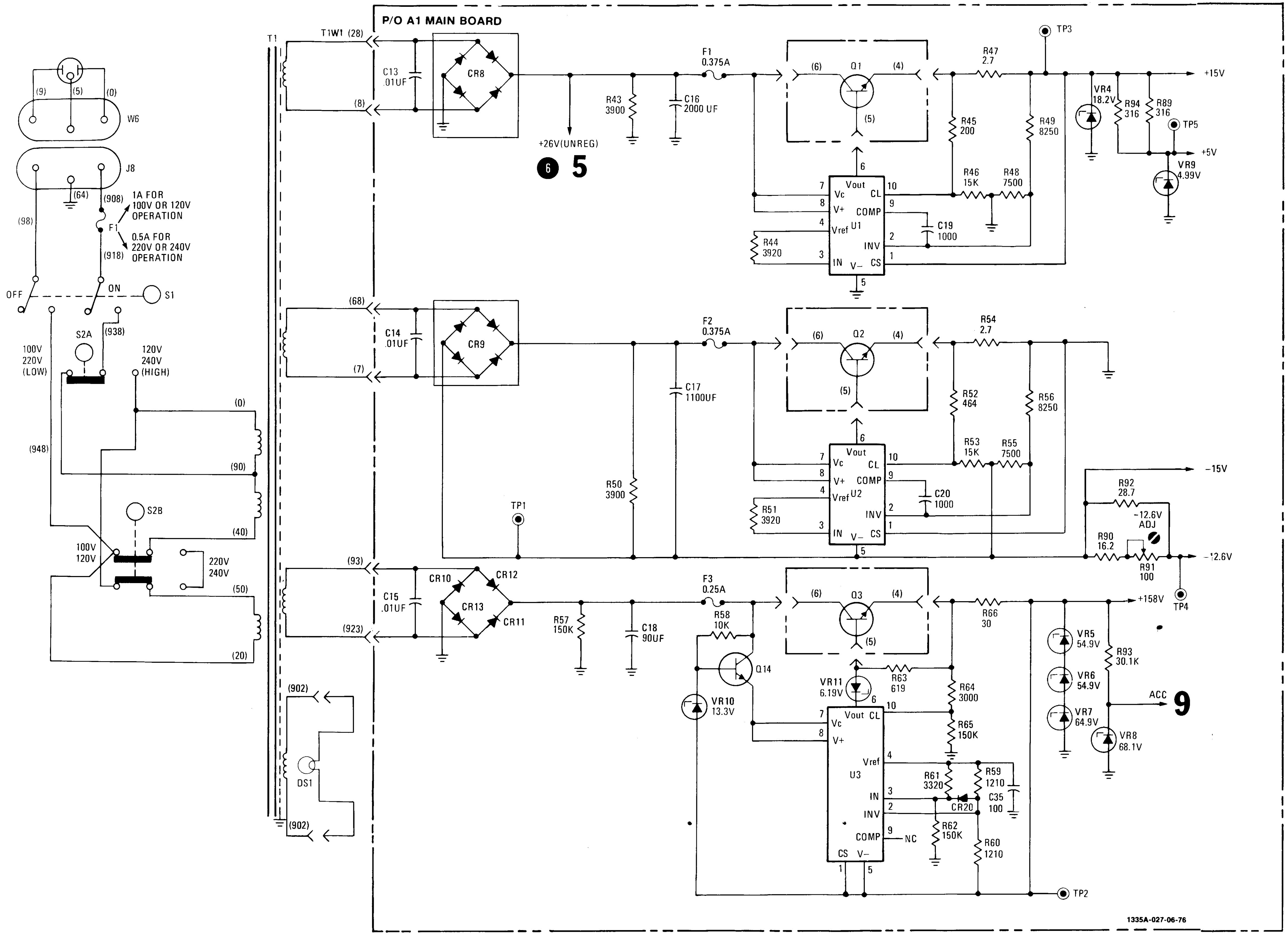


PARTS ON THIS SCHEMATIC	
A1	
C12-22, 39, 43, 44 CR6-10 CR11-19 NOT ASSIGNED F1-4 P1 L1 Q14-17 R43-44,50-59,100 TP1 2,3 VR2-4,6,8	
CHASSIS	
DS1 F1 Q3,5 U1,2 T1 W1	S1,2 J8

output reg. pos.

4

Figure 8-9.
Low Voltage Power Supply

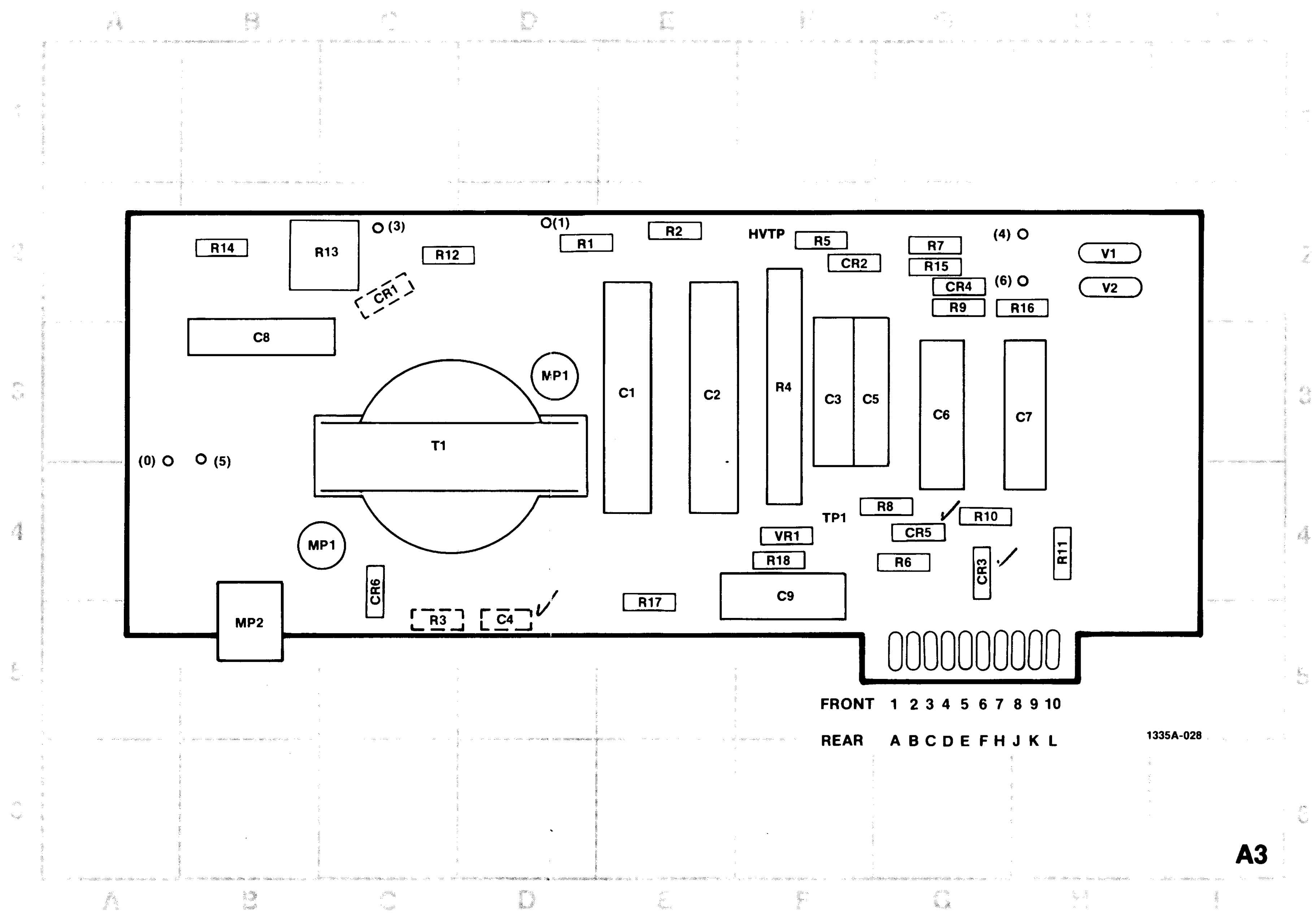


PARTS ON THIS SCHEMATIC

A1
C13-21, 35 CR8-13 F1-3 P2 Q14 R43, 66, 89-94 U1-3 TP1, 2, 3, 4, 5 VR4-11
CHASSIS
DS1 F1 J8 Q1-3 S1, 2 T1 W6
A5
R5

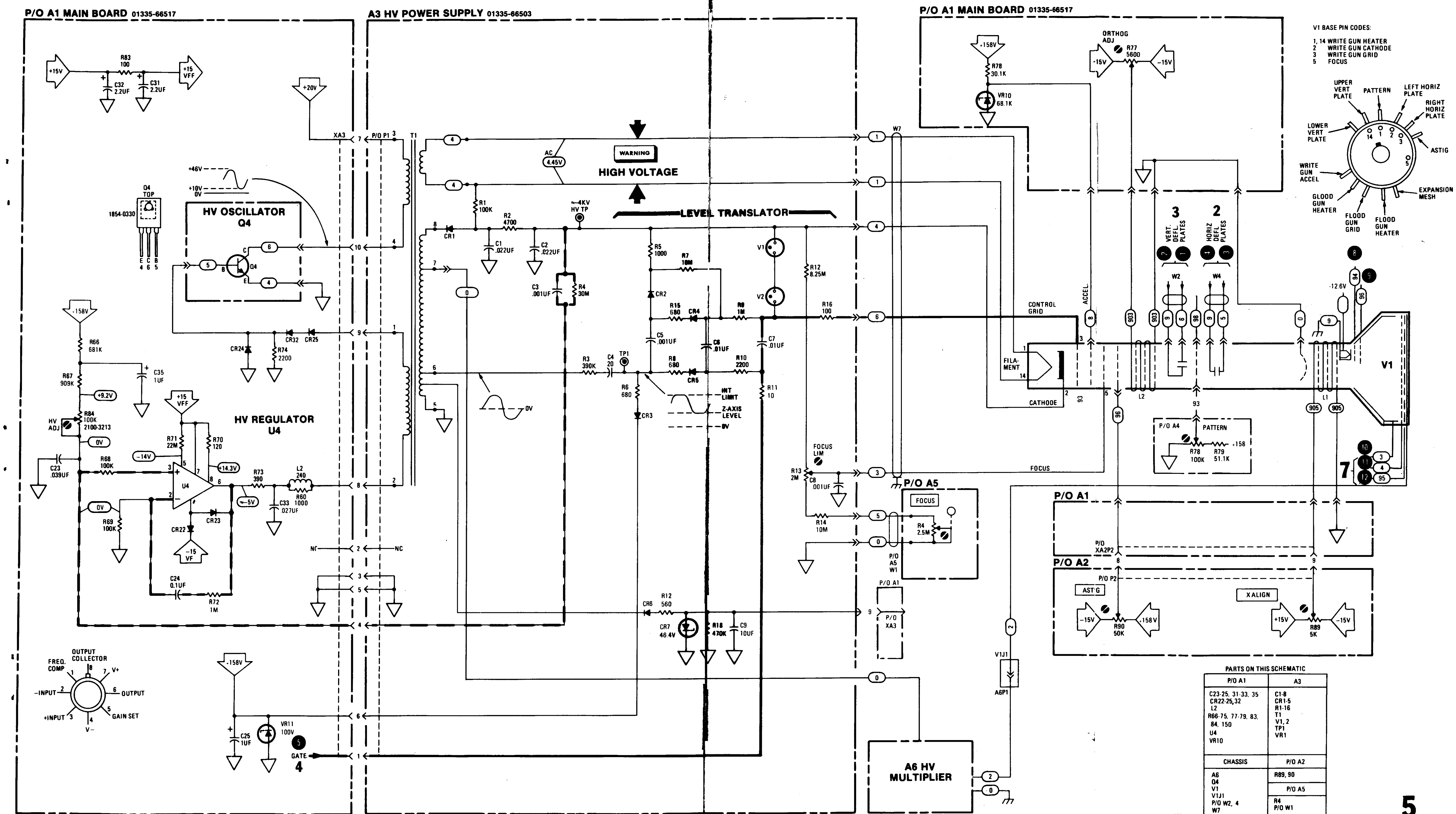
4

Figure 8-9.
Low Voltage Power Supply



REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	E-3	R4	F-3
C2	E-3	R5	F-2
C3	F-3	R6	G-4
C4	D-5	R7	G-2
C5	F-3	R8	G-4
C6	G-3	R9	G-2
C7	H-3	R10	G-4
C8	B-3	R11	H-4
C9	F-4	R12	C-2
CR1	C-2	R13	C-2
CR2	F-2	R14	B-2
CR3	G-4	R15	G-2
CR4	G-2	R16	H-2
CR5	G-4	R17	E-5
CR6	C-4	R18	F-4
HVTP	F-2	T1	C-3
R1	D-2	TP1	F-4
R2	E-2	VR1	F-4
R3	C-5		

Figure 8-10. A3 High Voltage Board Component Locator

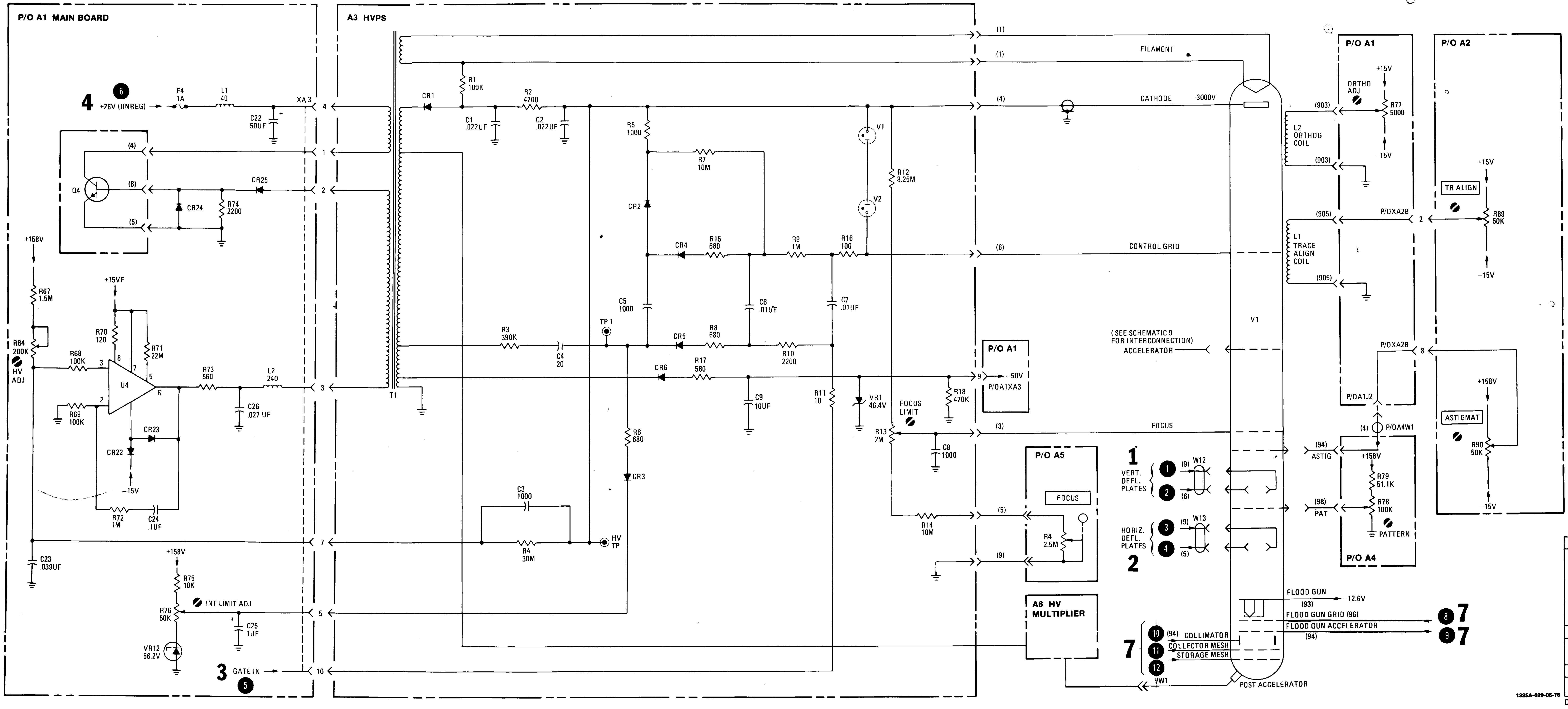


PARTS ON THIS SCHEMATIC

P/O A1	A3
C23-25, 31-33, 35 CR22-25,32 L2 R66-75, 77-79, 83, 84, 150 U4 VR10	C1-8 CR1-5 R1-16 T1 V1, 2 TP1 VR1
CHASSIS	**P/O A2**
A6 Q4 V1 V1J1 P/O W2, 4 W7	R89, 90 **P/O A5** R4 P/O W1

5

Figure 8-11.
High Voltage Power Supply



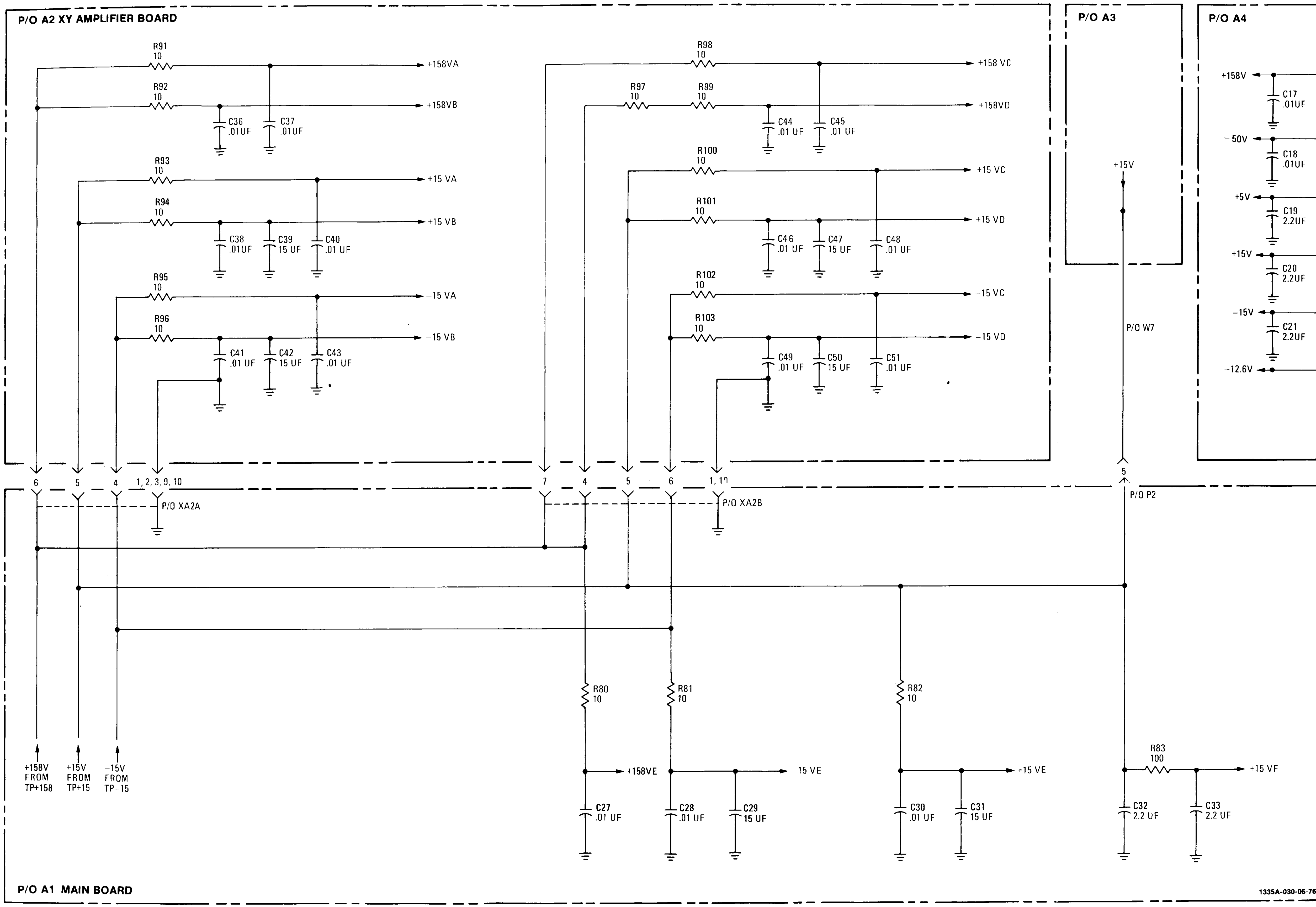
PARTS ON THIS SCHEMATIC

P/OA1	A3
C22-26 CR22-25 F4 L1, 2 R67, 77, 84 VR12 U4	C1-9 CR1-6 R1-18 T1 V1, 2 TP1 VR1
CHASSIS	P/OA2
Q4 V1 J1	R89, 90
A4	P/OA5
R78, 79	R4

DELETED: A1R78, 79

5

Figure 8-11.
High Voltage Power Supply

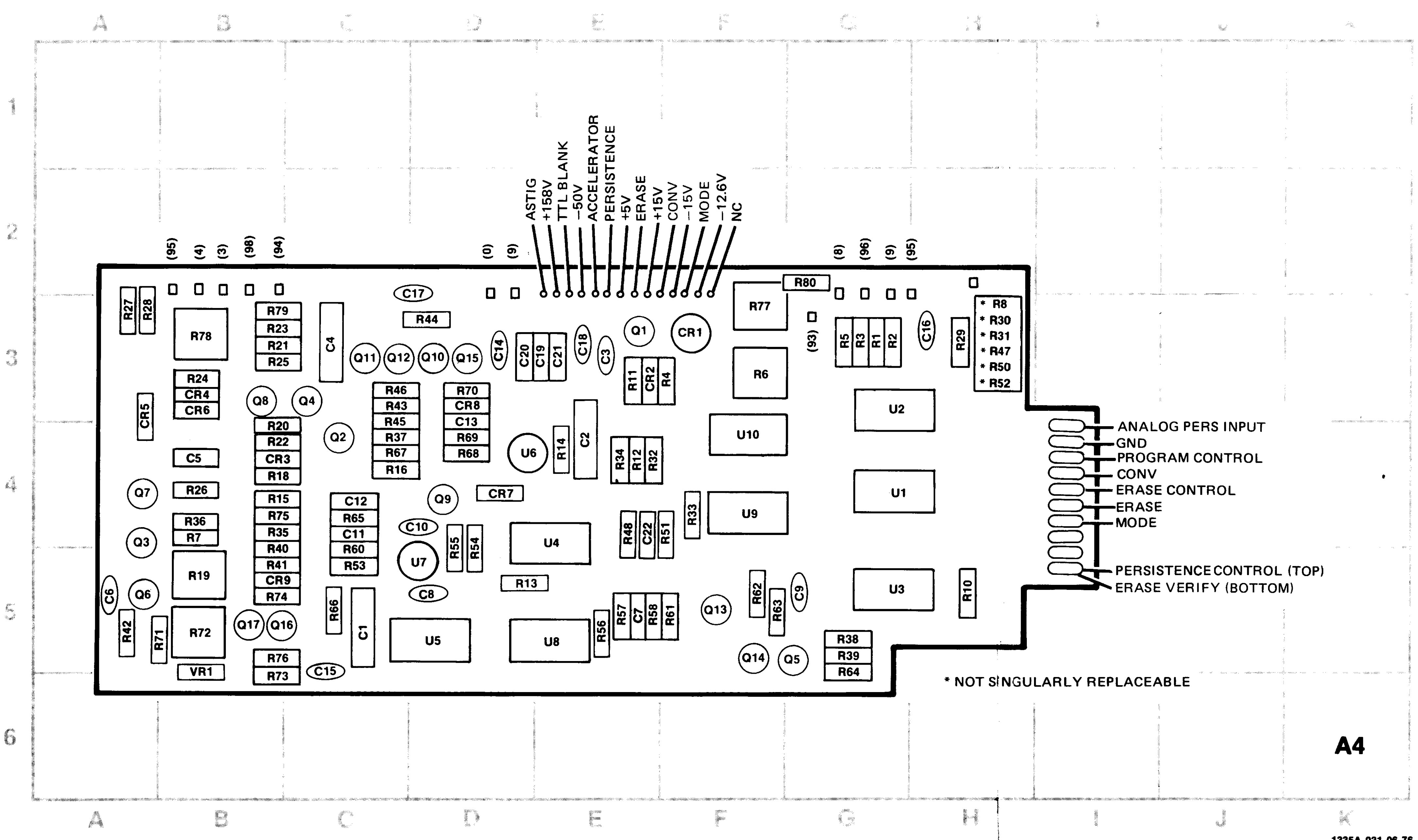


PARTS ON THIS SCHEMATIC

P/OA1
C27-33 R80-83 XA2A, XA2B, XA4
P/OA2
C36-51 R91-103
P/OA4
C17-21
CHASSIS
W7

6

Figure 8-12.
DC Voltage Distribution



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	C-5	C18	E-3	Q4	C-3	R4	F-3	R23	B-3	R40	B-5	R58	E-5	R76	B-5
C2	E-4	C19	E-3	Q5	G-5	R5	G-3	R24	B-3	R41	B-5	R60	C-5	R77	F-3
C3	E-3	C20	D-3	Q6	A-5	R6	F-3	R25	B-3	R42	A-5	R61	F-5	R78	B-3
C4	C-3	C21	E-3	Q7	A-4	R7	B-4	R26	B-4	R43	C-3	R62	F-5	R79	B-3
C5	B-4	C22	E-4	Q8	B-3	R8	H-3	R27	A-3	R44	D-3	R63	F-5	R80	G-2
C6	A-5	CR1	F-3	Q9	D-4	R10	H-5	R28	A-3	R45	C-3	R64	G-6	U1	G-4
C7	E-5	CR2	E-3	Q10	D-3	R11	E-3	R29	H-3	R46	C-3	R65	C-4	U2	G-3
C8	D-5	CR3	B-4	Q11	C-3	R12	E-4	R30	H-3	R47	H-3	R66	C-5	U3	G-5
C9	G-5	CR4	B-3	Q12	C-3	R13	D-5	R31	H-3	R48	E-4	R67	C-4	U4	E-4
C10	D-4	CR5	A-3	Q13	F-5	R14	E-4	R32	E-4	R50	H-3	R68	D-4	U5	D-5
C11	C-4	CR6	B-3	Q14	F-5	R15	B-4	R33	F-4	R51	F-4	R69	D-4	U6	D-4
C12	C-4	CR7	D-4	Q15	D-3	R16	C-4	R34	E-4	R52	H-3	R70	D-3	U7	C-5
C13	D-3	CR8	D-3	Q16	B-5	R18	B-4	R35	B-4	R53	C-5	R71	B-5	U8	E-5
C14	D-3	CR9	B-5	Q17	B-5	R19	B-5	R36	B-4	R54	D-4	R72	B-5	U9	F-4
C15	C-6	Q1	E-3	R1	G-3	R20	B-4	R37	C-4	R55	D-4	R73	B-6	U10	F-4
C16	H-3	Q2	C-4	R2	G-3	R21	B-3	R38	G-5	R56	E-5	R74	B-5	VR1	B-5
C17	D-3	Q3	A-4	R3	G-3	R22	B-4	R39	G-5	R57	E-5	R75	B-4		

Figure 8-13. A4 Storage Board Component Locator

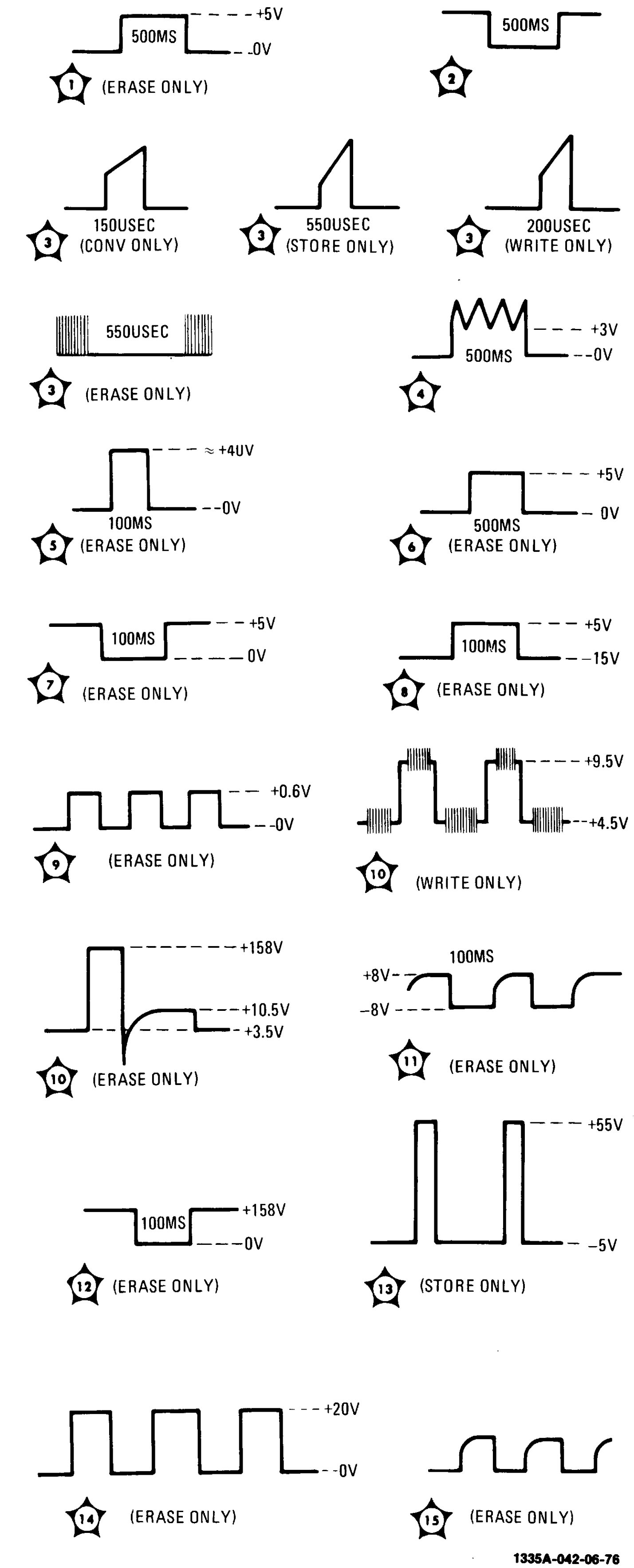


Figure 8-14. Storage Circuit (Sheet 1 of 2)

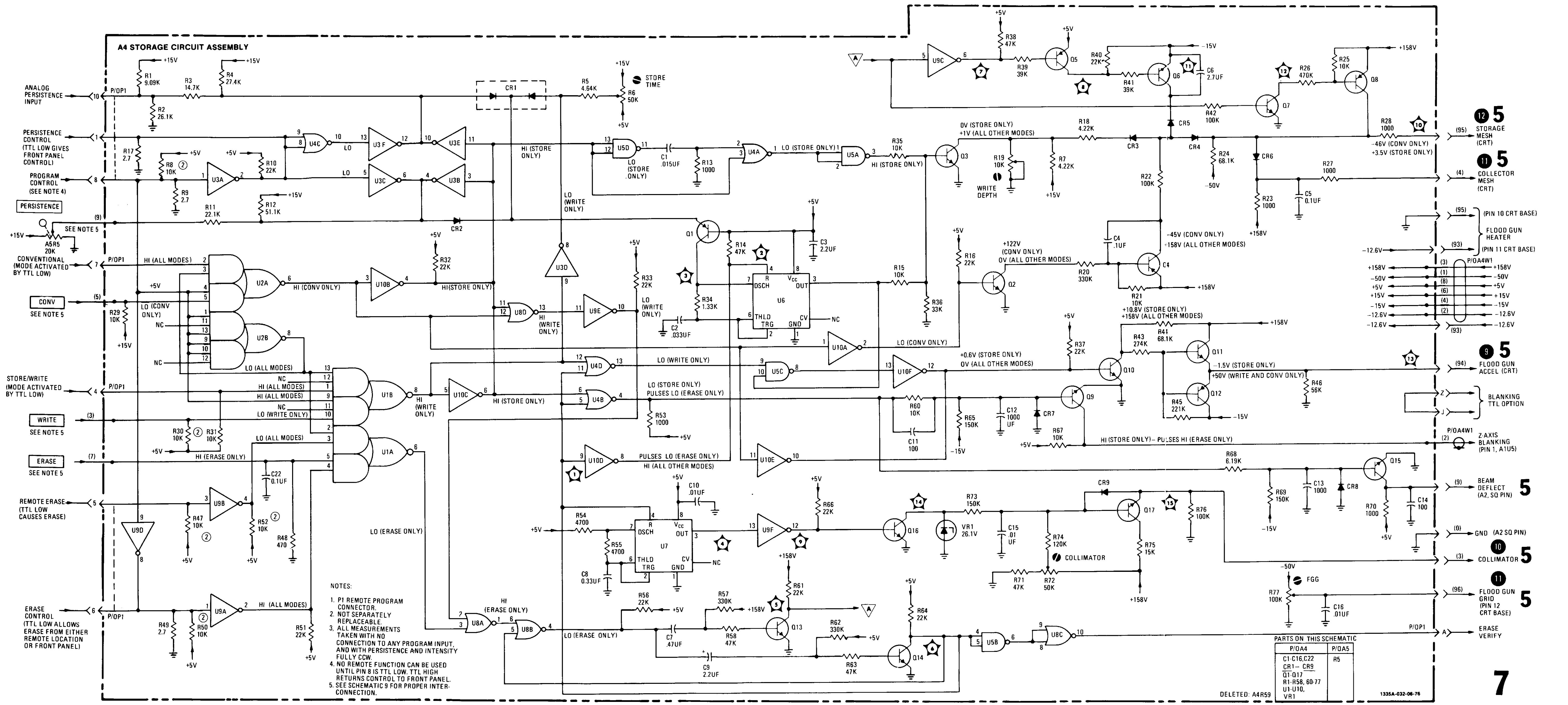


Figure 8-14.
Storage Circuit (Sheet 2 of 2)

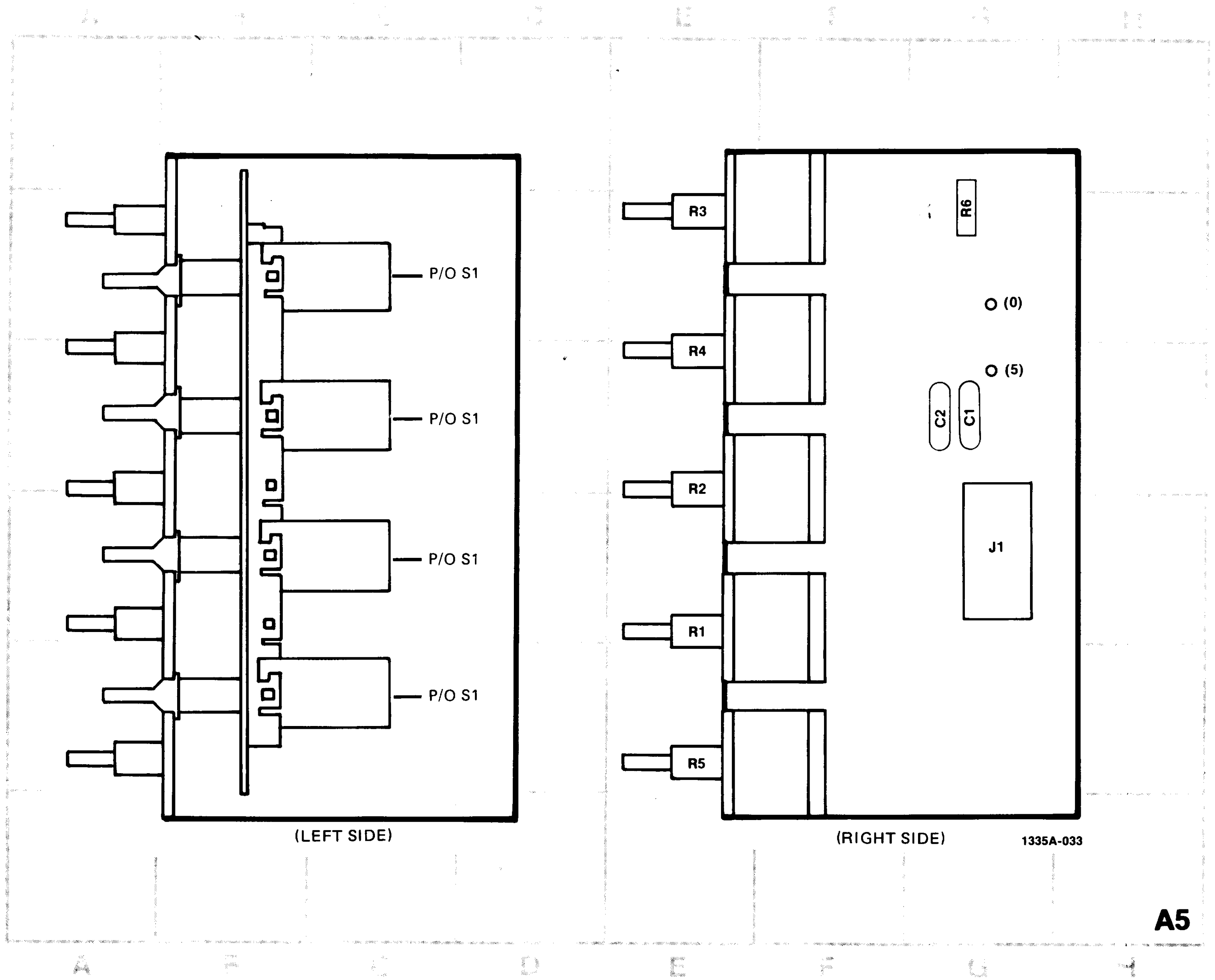


Figure 8-15. A5 Control Board Component Locator

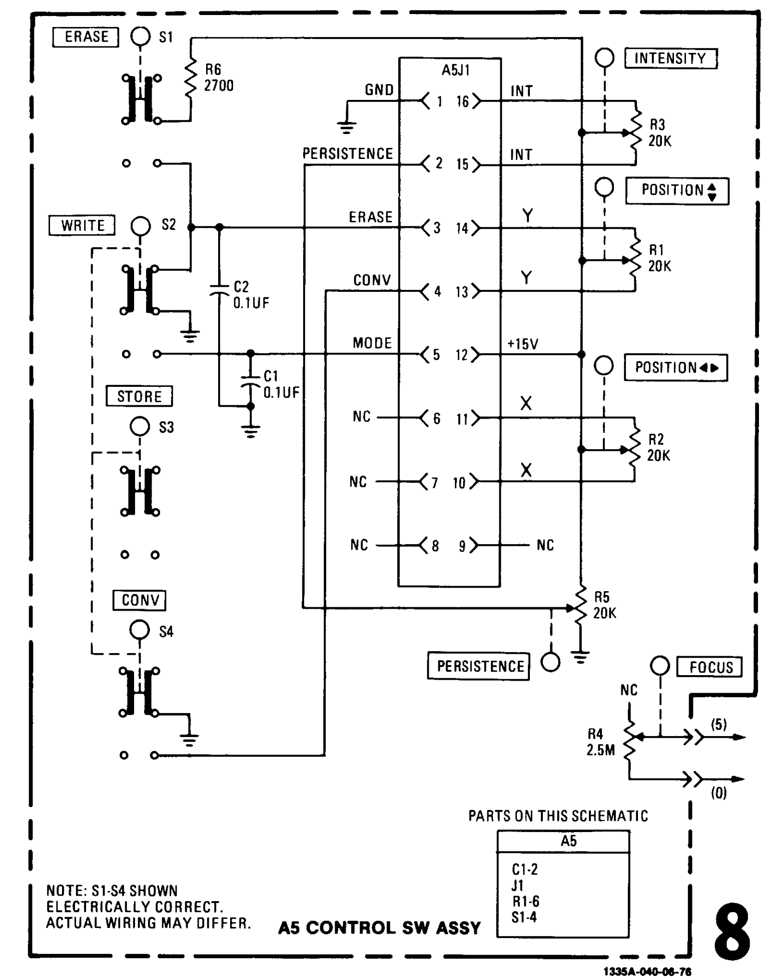
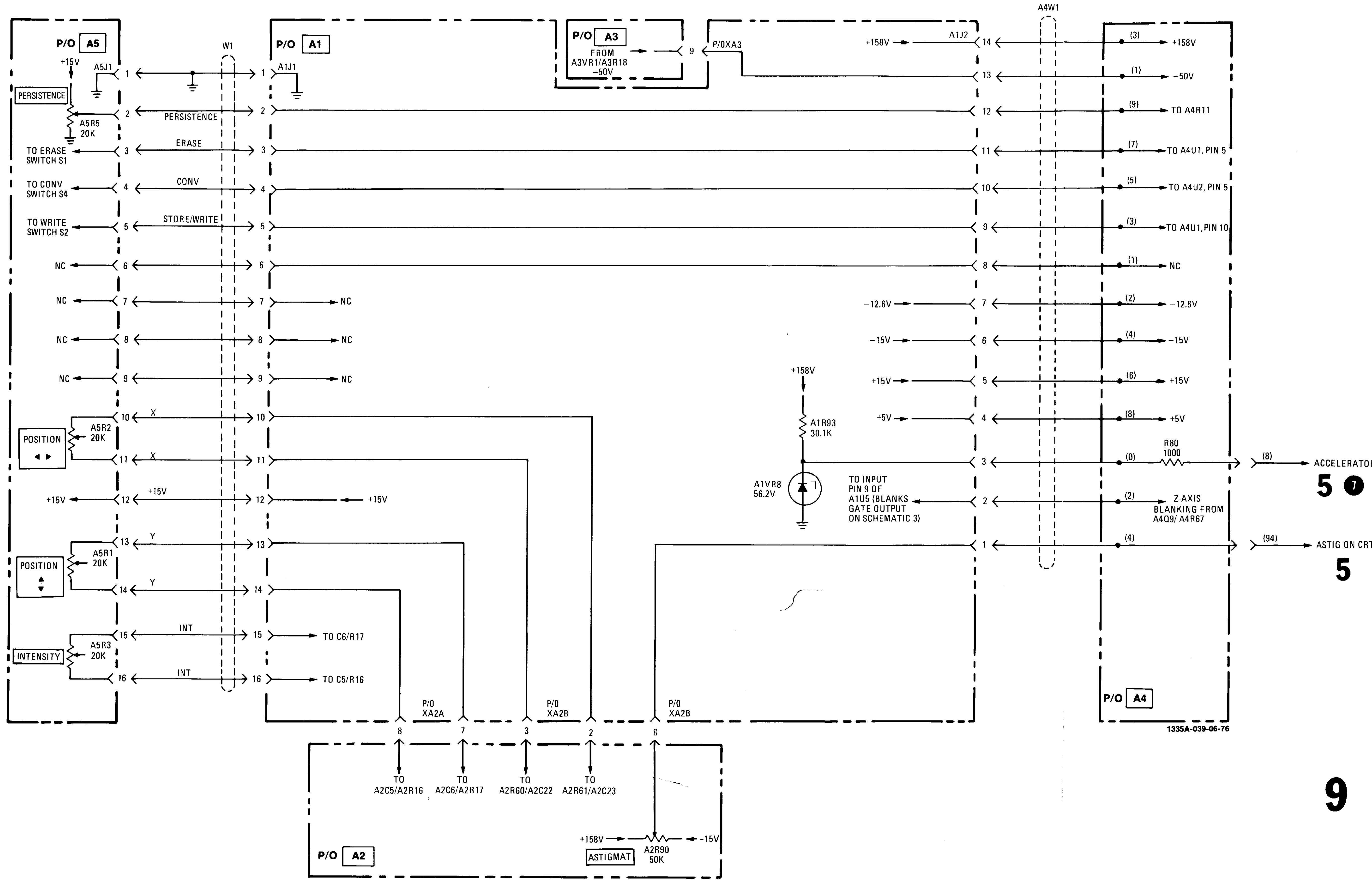
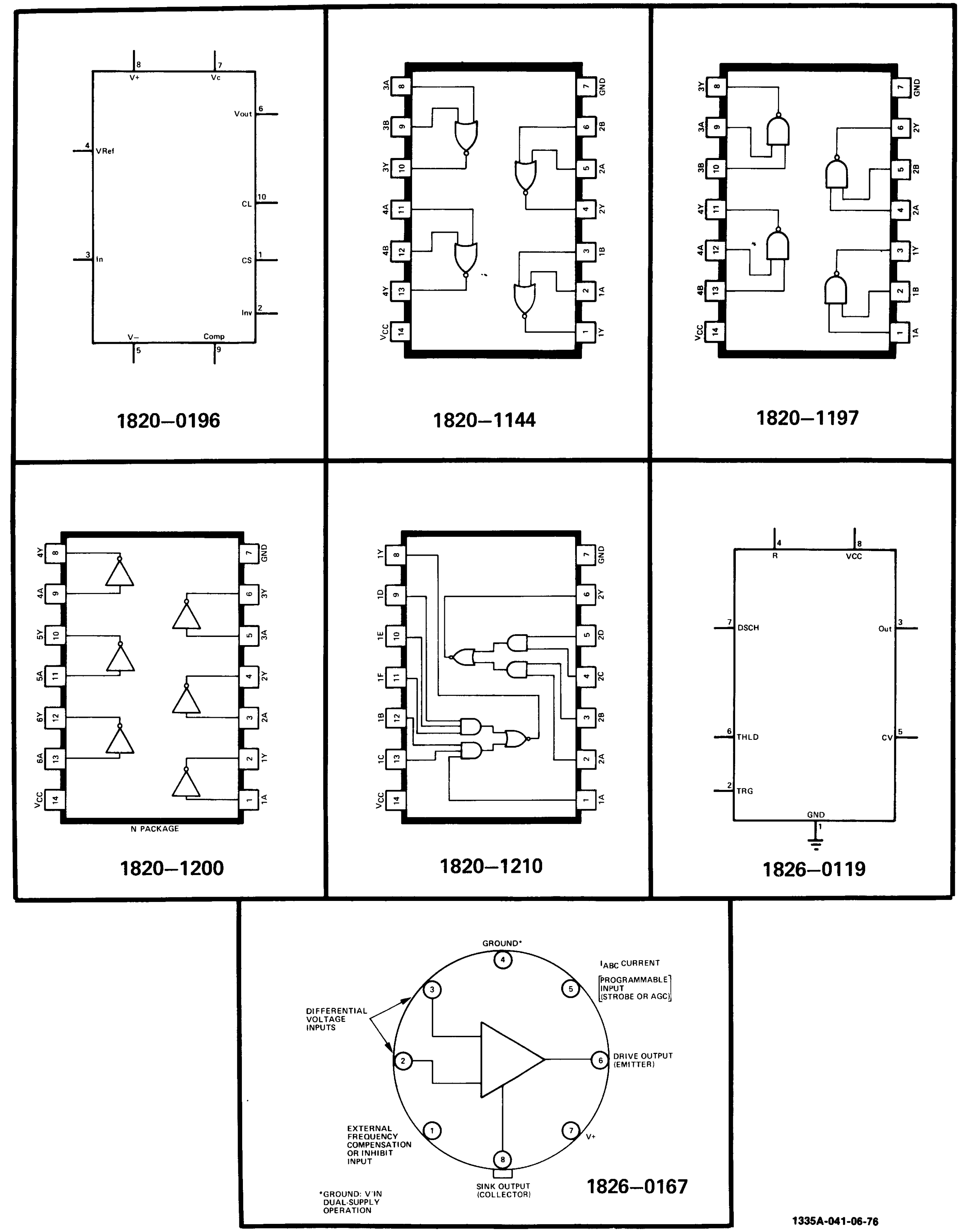


Figure 8-16. Control Board Schematic



9

Figure 8-17.
Interconnection Schematic



1335A-041-06-76

Figure 8-18. Integrated Circuit Identification

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SALES & SERVICE OFFICES

AFRICA, ASIA, AUSTRALIA

ANGOLA
Telectra
Empresa Técnica de
Equipamentos
Eléctricos, S.A.R.L
R. Barbosa Rodrigues, 42-I°DT
Caixa Postal, 6487
Luanda
Tel: 35515/6
Cable: TELECTRA Luanda

AUSTRALIA
Hewlett-Packard Australia
Pty. Ltd.
31-41 Joseph Street
Blackburn, Victoria 3130
P.O. Box 36
Doncaster East, Victoria 3109
Tel: 89-6351
Telex: 31-024
Cable: HEWPARD Melbourne

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

Hewlett-Packard Australia
Pty. Ltd.
153 Greenhill Road
Parkside, S.A., 5063
Tel: 272-5911
Telex: 82536 ADEL
Cable: HEWPARD ADELAID

Hewlett-Packard Australia
Pty Ltd
141 Stirling Highway
Nedlands, W.A. 6009
Tel: 86-5455
Telex: 93859 PERTH
Cable: HEWPARD PERTH

Hewlett-Packard Australia
Pty. Ltd
121 Wollongong Street
Fyshwick, A.C.T. 2609
Tel: 95-2733
Telex: 62650 Canberra
Cable: HEWPARD CANBERRA

Hewlett Packard Australia
Pty. Ltd.
5th Floor
Teachers Union Building
495-499 Boundary Street
Spring Hill, 4000 Queensland
Tel: 229-1544
Cable: HEWPARD Brisbane

GUAM
Medical/Pocket Calculators Only
Guam Medical Supply, Inc
Jay E*** Building, Room 210
P.O. Box 8947
Tamuning 96911
Tel: 646-4513
Cable: EARMED Guam

HONG KONG
Schmidt & Co.(Hong Kong) Ltd.
P.O. Box 297
Connalight Centre
39th Floor
Connaught Road, Central
Hong Kong
Tel: H-255291-5
Telex: 74766 SCHMC HX
Cable: SCHMIDTCO Hong Kong

INDIA
Blue Star Ltd
Kasturi Buildings
Jamshedji Tata Rd
Bombay 400 020
Tel. 29 50 21
Telex: 001-2156
Cable BLUEFROST

Blue Star Ltd.
Sahas
414/2 Vir Savarkar Marg
Prabhadevi
Bombay 400 025
Tel: 45 78 87
Telex: 011-4093
Cable: FROSTBLUE

Blue Star Ltd.
Band Box House
Prabhadevi
Bombay 400 025
Tel: 45 73 01
Telex: 011-3751
Cable: BLUESTAR

Blue Star Ltd
7 Hare Street
P.O. Box 506
Calcutta 700 001
Tel: 23-0131
Telex: 021-7655
Cable: BLUESTAR

Blue Star Ltd
7th & 8th Floor
Bhandari House
91 Nehru Place
New Delhi 110024
Tel: 634770 & 635166
Telex: 031-2463
Cable: BLUESTAR

Blue Star Ltd
Blue Star House
11/11A Magarath Road
Bangalore 560 025
Tel: 55668
Telex: 043-430
Cable: BLUESTAR

Blue Star Ltd.
Meeakshi Mandiran
xxx/1678 Mahatma Gandhi Rd.
Cochin 682 016
Tel: 32069,32161,32282
Telex: 0885-514
Cable: BLUESTAR

Blue Star Ltd.
1-1-117/1
Sarojini Devi Road
Secunderabad 500 003
Tel: 70126, 70127
Cable: BLUEFROST
Telex: 015-459

Blue Star Ltd.
2/34 Kodambakkam High Road
Madras 600034
Tel: 82056
Telex: 041-379
Cable: BLUESTAR

INDONESIA
BERCA Indonesia P.T.
P.O. Box 496/Jkt.
JLN•Abdul Muis 62
Jakarta
Tel: 40369, 49886,49255,356038
JKT 42895
Cable: BERCACON

BERCA Indonesia P.t
63 JL. Raya Gubeng
Surabaya
Tel: 44309

ISRAEL
Electronics & Engineering Div.
of Motorola Israel Ltd.
17, Kremenetski Street
P.O. Box 25016
Tel-Aviv
Tel: 38973
Telex: 33569
Cable: BASTEL Tel-Aviv

JAPAN
Yokogawa-Hewlett-Packard Ltd.
Ohashi Building
59-1 Yoyogi 1-Chome
Shibuya-ku, **Tokyo** 151
Tel: 03-370-2281/92
Telex: 232-2024YHP MARKET
TOK 23-724
Cable: YHPMARKET

Yokogawa-Hewlett-Packard Ltd.
Chuo Bldg., 4th Floor
4-20, Nishinakajima 5-chome
Yodogawa-ku, Osaka-shi
Osaka,532
Tel: 06-304-6021

Yokogawa-Hewlett-Packard Ltd.
Nakamo Building
24 Kami Sasajima-cho
Nakamura-ku, **Nagoya**, 450
Tel. (052) 571-5171

Yokogawa-Hewlett-Packard Ltd.
Tanigawa Building
2-24-1 Tsuruya-cho
Kanagawa-ku
Yokohama, 221
Tel: 045-312-1252
Telex: 382-3204 YHP YOK

Yokogawa-Hewlett-Packard Ltd.
Mito Mitsu Building
105, Chome-1,San-no-maru
Mito, Ibaragi 310
Tel: 0292-25-7470

Yokogawa-Hewlett-Packard Ltd.
Inoue Building
1348-3, Asahi-cho, 1-chome
Atsugi, Kanagawa 243
Tel: 0462-24-0452

Yokogawa-Hewlett-Packard Ltd.
Kumagaya Asahi
Hackijuni Building
4th Floor
3-4, Tsukuba
Kumagaya, Saitama 360
Tel: 0485-24-6563

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Technical Engineering
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Nairobi
Tel: 557726/556762
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Nairobi Airport
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Telex: 22201/22301
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KOREA
Samsung Electronics Co., Ltd.
20th Fl. Dongbang Bldg. 250, 2-KA
C.P.O. Box 2775
Taepyung-Ro, Chung-Ku
Seoul
Tel: (23) 6811
Telex: 22575
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Teknik Mutu Sdn. Bhd.
2 Lorong 13/6A
Section 13
Petaling Jaya,**Selangor**
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Protel Engineering
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Tel: 2400
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162, 1 Apt. 14 Av. D. Luis
Caixa Postal 107
Lourenco Marques
Tel: 27091, 27114
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Cable: NEGON

NEW ZEALAND
Hewlett-Packard (N.Z.) Ltd.
P.O. Box 9443
Courtenay Place
Wellington
Tel: 877-199
Cable: HEWPACK Wellington

Hewlett-Packard (N.Z.) Ltd.
Pakuranga Professional Centre
267 Pakuranga Highway
Box 51092
Pakuranga
Tel: 569-651
Cable: HEWPACK,Auckland

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Auckland
Tel. 75-289
Cable DENTAL Auckland

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239 Stanmore Road
Christchurch
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Cable: DENTAL, Christchurch

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Dunedin
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Karachi-3
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Legaspi Village, Makati
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SINGAPORE
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(Pte.) Ltd.
1150 Depot Road
Alexandra P.O. Box 58
Singapore 4
Tel: 270-2355
Telex: HPSG RS 21486
Cable: HEWPACK, Singapore

SOUTH AFRICA
Hewlett-Packard South Africa
(Pty.), Ltd.
Private Bag Wendywood
Sandton, Transvaal 2144
Hewlett-Packard Centre
Daphne Street, Wendywood,
Sandton, Transvaal 2144
Tel. 802-10408
Telex: 8-4782
Cable: HEWPACK JOHANNESBURG

Service Department
Hewlett-Packard South Africa
(Pty.), Ltd
P.O. Box 39325
Gramley, Sandton, 2018
451 Wynberg Extension 3,
Sandton, 2001
Tel: 636-8188/9
Telex: 8-2391

Hewlett-Packard South Africa
(Pty.), Ltd.
P.O. Box 120
Howard Place, Cape Province, 7450
Pine Park Centre, Forest Drive,
Pinelands, Cape Province, 7405
Tel: 53-7955 thu 9
Telex: 57-0006

Service Department
Hewlett-Packard South Africa
(Pty.), Ltd.
P.O. Box 37099
Overport, Durban 4067
Braby House
641 Ridge Road
Durban, 4001
Tel: 88-7478
Telex: 6-7954

TAIWAN
Hewlett-Packard Far East Ltd.,
Taiwan Branch
39 Chung Hsiao West Road
Sec. 1, 7th Floor
Taipei
Tel: 3819160-4
Cable: HEWPACK TAIPEI

Hewlett-Packard Far East Ltd.
Taiwan Branch
68-2, Chung Cheng 3rd. Road
Kaohsiung
Tel. (07) 242318-Kaohsiung

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Dar es Salaam
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Telex: 41030

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UNIMESA Co., Ltd.
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2538 Sukumvit Ave
Bangkok
Tel: 3932387, 3930338
Cable: UNIMESA Bangkok

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Kampala
Tel: 54388
Cable: INTAERIO Kampala

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P.O. Box 2792
Lusaka
Tel: 73793
Cable: ARJAYTEE, Lusaka

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Palo Alto, California 94304
Tel: (415) 493-1501
TWX: 910-373-1267
Cable: HEWPACK Palo Alto

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Hewlett-Packard (Canada) Ltd.
11620A * ?th Street
EdmontonT5M 3T9
Tel: (403) 452-3670
TWX: 610-831-2431

Hewlett-Packard (Canada) Ltd.
210,7220 Fisher St. S.E.
Calgary T2H 2H8
Tel: (403) 253-2713
Twx: 610-821-6141

BRITISH COLUMBIA
Hewlett-Packard (Canada) Ltd.
837 E. Cordova Street
Vancouver V6A 3R2
Tel: (604) 254-0531
TWX: 610-922-5059

MANITOBA
Hewlett-Packard (Canada) Ltd.
513 Century St.
St. James
Winnipeg R3H 0L8
Tel: (204) 786-7581
TWX: 610-671-3531

NOVA SCOTIA
Hewlett-Packard (Canada) Ltd.
800 Windmill Road
Dartmouth B3B 1L1
Tel: (902) 469-7820
TWX: 610-271-4482 HFX

ONTARIO
Hewlett-Packard (Canada) Ltd
1020 Morrison Dr.
Ottawa K2H 8K7
Tel: (613) 820-6483
TWX: 610-563-1636

Hewlett-Packard (Canada) Ltd.
6877 Goreway Drive
Mississauga L4V 1M8
Tel: (416) 678-9430
TWX: 610-492-4246

QUEBEC
Hewlett-Packard (Canada) Ltd
275 Hymus Blvd.
Pointe Claire H9R 1G7
Tel: (514) 697-4232
TWX: 610-422-3022
TLX: 05-821521 HPCL

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Ltd. in Mississauga.

CENTRAL AND SOUTH AMERICA

ARGENTINA
Hewlett-Packard Argentina
S.A.
Av. Leandro N. Alem 822 - 12°
1001**Buenos Aires**
Tel: 31-6063,4,5,6 and 7
Telex: 122443 AR CIGY
Cable: HEWPACK ARG

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Casa Kavlin S.A.
Calle Potosi' 1130
P.O. Box 500
La Paz
Tel: 41530,53221
Telex: CWC BX 5298,ITT 3560082
Cable: KAVLIN

BRAZIL
Hewlett-Packard do Brasil
I.e.C. Ltda.
Avenida Rio Negro, 980
Alphaville
06400**Barueri** SP
Tel: 429-3222

Hewlett-Packard do Brasil
I.e.C. Ltda
Rua Padre Chagas, 32
90000-**Pôrto Alegre**-RS
Tel: (0512) 22-2998, 22-5621
Cable: HEWPACK Porto Alegre

Hewlett-Packard do Brasil
I.E.C. Ltda
Rua Siqueira Campos, 53
Copacabana
20000-**Rio de Janeiro**
Tel: 257-80-94-DDD (021)
Telex: 391-212-1905 HEWP-BR
Cable: HEWPACK
Rio de Janeiro

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Alameda 580-Of. 807
Casilla 2118
Santiago, 1
Tel: 398613
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Cable: CALMET Santiago

COLOMBIA
Instrumentación
Henrik A. Langebaek & Kier S.A.
Carrera 7 No. 48-75
Apartado Aéreo 6287
Bogotá, I.D.E.
Tel. 69-88-77
Cable: AARIS Bogotá
Telex: 044-400

COSTA RICA
Científica Costarricense S.A.
Avenida 2, Calle 5
San Pedro de Montes de Oca
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EL SALVADOR
Instrumentacion y Procesamiento
Electronico de el Salvador
Bulevar de los Heroes 11-48
San Salvador
Tel. 252787

GUATEMALA
IPESA
Avenida La Reforma 3-48,
Zona 9
Guatemala City
Tel: 63627, 64786
Telex: 4192 Teletro Gu

MEXICO
Hewlett-Packard Mexicana,
S.A. de C.V.
Av. Periférico Sur No. 6501
Tepepan, Xochimilco
Mexico 23, D.F.
Tel: 905-676-4600

Hewlett-Packard Mexicana,
S.A. de C.V.
Ave. Constitución No. 2184
Monterrey, N.L.
Tel. 48-71-32, 48-71-84
Telex: 038-410

NICARAGUA
Roberto Terán G.
Apartado Postal 689
Edificio Terán
Managua
Tel: 25114, 23412,23454
Cable: ROTERAN Managua

PANAMA
Electrónico Balboa, S.A.
P.O. Box 4929
Calle Samuel Lewis
Cuidad de Panama
Tel: 64-2700
Telex: 3483103 Curunda,
Canal Zone
Cable: ELECTRON Panama

PERU
Compañia Electro Médica S.A.
Los Flamencos 145
San Isidro Casilla 1030
Lima 1
Tel: 41-4325
Cable: ELMED Lima

PUERTO RICO
Hewlett-Packard Inter-Americas
Puerto Rico Branch Office
Calle 272,
No. 203 Urb. Country Club
Carolina 00924
Tel: (809) 762-7255
Telex: 345 0514

URUGUAY
Pablo Ferrando S.A.
Comercial e Industrial
Avenida Italia 2877
Casilla de Correo 370
Montevideo
Tel: 40-3102
Cable: RADIUM Montevideo

VENEZUELA
Hewlett-Packard de Venezuela
C.A.
P.O. Box 50933
Caracas 105
Los Ruices Norte
3a Transversal
Edificio Segre
Caracas 107
Tel: 35-00-11 (20 lines)
Telex: 25146 HEWPACK
Cable: HEWPACK Caracas

FOR AREAS NOT LISTED, CONTACT:
Hewlett-Packard
Inter-Americas
3200 Hillview Ave.
Palo Alto, California 94304
Tel: (415) 493-1501
TWX: 910-373-1260
Cable: HEWPACK Palo Alto
Telex: 034-8300, 034-8493

EUROPE, NORTH AFRICA AND MIDDLE EAST

AUSTRIA
Hewlett-Packard Ges m b H
Handelskai 52
P O oox 7
A-1205 **Vienna**
Tel (0222) 351621 to 27
cable HEWPAK Vienna
Telex 75923 hewpak a

BELGIUM
Hewlett-Packard Benelux
S A /N V
Avenue de Col-Vert, 1
(Groenkraaglaan)
B-1170 **Brussels**
Tel (02) 672 22 40
Cable PALOBEN Brussels
Telex 23 494 paloben bru

CYPRUS
Kypronics
19. Gregorios & Xenopoulos Rd
P.O Box 1152
CY-**Nicosia**
Tel 45628/29
Cable KYPRONICS PANDEHIS
Telex 3018

CZECHOSLOVAKIA
Vyvojova a Provozni Zakladna
Vyzkumnych Ustavu v Bechovicich
CSSR-25097 **Bechovice u Prahy**
Tel 89 93 41
Telex 121333

Institute of Medical Bionics
Vyskumny Ustav Lekarskej Bioniky
Jedlova 6
CS-88346 **Bratislava-Kramare**
Tel 44-551/45-541

DDR
Entwicklungslabor der TU Dresden
Forschungsinstitut Meinsberg
DDR-7305
Waldheim/Meinsberg
Tel 37 667
Telex 112145

Export Contact AG Zuerich
Guenther Forgber
Schlegelstrasse 15
1040 **Berlin**
Tel 42-74-12
Telex 111889

DENMARK
Hewlett-packard A/S
Datavej 52
DK-3460 **Birkerød**
Tel (02) 81 66 40
Cable HEWPACK AS
Telex 37409 hpas dk

Hewlett-Packard A/S
Navervej 1
DK-8600 **Silkeborg**
Tel (06) 82 71 66
Telex 37409 hpas dk
Cable HEWPACK AS

FINLAND
Hewlett-Packard OY
Nahkahousuntie 5
P O Box 6
SF-00211 **Helsinki** 21
Tel (90) 6923031
Cable HEWPACKOY Helsinki
Telex 12-1563 HEWPA SF

FRANCE
Hewlett-Packard France
Quartier de Courtaboeuf
Boite Postale No 6
F-91401 **Orsay** Cédex
Tel (1) 907 78 25
Cable HEWPACK Orsay
Telex 600048

Hewlett-Packard France
Agency Régionale
Le Saquin
Chemin des Mouilles
B P 162
F-69130 **Ecully**
Tel (78) 33 81 25
Cable HEWPACK Eculy
Telex 31 06 17

Hewlett-Packard France
Agence Régionale
Péricentre de la Cépière
Chemin de la Cépière, 20
F-31300 **Toulouse-Le Mirail**
Tel (61) 40 11 12
Cable HEWPACK 51957
Telex 510957

Hewlett-Packard France
Agence Régionale
Aéroport principal de
Marseille-Marignane
F-13721 **Marignane**
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Cable HEWPACK MARGN
Telex 410770

Hewlett-Packard France
Agence Régionale
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B P 1124
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Cable HEWPACK 74912
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74, Allée de la Robertsau
F-67000 **Strasbourg**
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Telex 890141
Cable HEWPACK STRBG

Hewlett-Packard France
Agence Régionale
Centre Vauban
201, rue Colbert
Entrée A2
F-59000 **Lille**
Tel (20) 51 44 14
Telex 820744

Hewlett-Packard France
Centre d'Affaires Paris-Nord
Bâtiment Ampère
Rue de La Commune de Paris
B P 300
F-93153 **Le Blanc Mesnil Cédex**
Tel (01) 931 88 50

GERMAN FEDERAL REPUBLIC
Hewlett-Packard GmbH
Vertriebszentrale Frankfurt
Bernerstrasse 117
Postfach 560 140
D-6000 **Frankfurt** 56
Tel (0611) 50 04-1
Cable HEWPACKSA Frankfurt
Tel (0611) 50 04-1
Cable HEWPACKSA Frankfurt
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Hewlett-Packard GmbH
Technisches Buero Böblingen
Herrenbergerstrasse 110
D-7030 **Böblingen** Wurttemberg
Tel (07031) 667-1
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Telex 07265739 bbn

Hewlett-Packard GmbH
Technisches Buero Dusseldorf
Emanuel-Leutze-Str 1 (Seestern)
D-4000 **Dusseldorf** 11
Tel (0211) 59711
Telex 085/86 533 hpdd d

Hewlett-Packard GmbH
Technisches Buero Hamburg
Wendenstrasse 23
D-2000 **Hamburg** 1
Tel (040) 24 13 93
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Telex 21 63 032 hphh d

Hewlett-Packard GmbH
Technisches Buero Hannover
Am Grossmarkt 6
D-3000 **Hannover 91**
Tel (0511) 46 60 01
Telex 092 3259

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Werk Groetzingen
Ohmstrasse 6
D-7500 **Karlsruke 41**
Tel (0721) 69 40 06
Telex 07-825707

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Technisches Buero Nuremberg
Neumeyer Str 90
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Tel (0911) 56 30 83/85
Telex 0623 860

Hewlett-Packard GmbH
Technisches Buero München
Unterhachinger Strasse 28
ISAR Center
D-8012 **Ottobrunn**
Tel (089) 601 30 61/7
Cable HEWPACKSA München
Telex 0524985

Hewlett-Packard GmbH
Technisches Buero Berlin
Keith Strasse 2-4
D-1000 **Berlin** 30
Tel (030) 24 90 86
Telex 18 3405 hpbln d

GREECE
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08, Omirou Street
GR-**Athens** 133
Tel 3237731
Cable RAKAR Athens
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Hewlett-Packard Trading Co
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Telex 2455 hepairaq ik
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Baghdad Iraq

IRELAND
Hewlett-Packard Ltd
King Street Lane
GB-**Winnersh**, Wokingham
Berks, RG11 5AR
Tel (0734) 78 47 74
Telex 847178/848179

ITALY
Hewlett-Packard Italiana S p A
Via Amerigo Vespucci 2
Casella postale 3645
I-20100 **Milano**
Tel (2) 6251 (10 lines)
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Tel (081) 33 77 11

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I-40137 **Bologna**
Tel (051) 30 78 87

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Al-Khaldiya Trading &
Contracting Co
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Kuwait
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LUXEMBURG
Hewlett-Packard Benelux
S A /N V
Avenue du Col-Vert, 1,
(Groenkraaglaan)
B-1170 **Brussels**
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Cable PALOBEN Brussels
Telex 23 494

MOROCCO
Gerep
190, Blvd Brahim Roudani
Casablanca
Tel 25-16-76/25-90-99
Cable Gerep-Casa
Telex 23739

NETHERLANDS
Hewlett-Packard Benelux N V
Van Heuven Goedhartlaan 121
P O Box 667
NL-1134 **Amstelveen**
Tel (020) 47 20 21
Cable PALOBEN Amsterdam
Telex 13 216 hepa nl

NORWAY
Hewlett-Packard Norge A/S
Nesveien 13
Box 149
N-1344 **Haslum**
Tel (02) 53 83 60
Telex 16621 hpnas n

POLAND
Biuro Informacji Technicznej
Hewlett-Packard
U1 Stawki 2 6P
00-950 **Warszawa**
Tel 395962/395187
Telex 81 24 53 hepa pl

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Budowy Aparatury Naukowej
U1 Krajowej Rady Narodowej 51/55
00-800 **Warszawa**
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Zaklady Naprawcze Sprzetu
Medycznego
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90-007 **Lódź**
Tel 334-41, 337-83

PORTUGAL
Telectra-Empresa Técnica de
Equipamentos Eléctricos S.a r.l.
Rua Rodrigo da Fonseca 103
P O Box 2531
P-**Lisbon** 1
Tel (19) 68 60 72
Cable TELECTRA Lisbon
Telex 12598

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S a r l
Av A A de Aguiar 138
P.O Box 2761
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Tel (19) 53 21 31/7
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RUMANIA
Hewlett-Packard Reprezentanta
Bd N Balcescu 16
Bucharest
Tel 158023/138885
Telex 10440

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Intretinerea
Si Repararea Utilajelor de Calcul
B-dul prof Dimitrie Pompei 6
Bucharest-Sectorul 2
Tel 12 64 30
Telex 11716

SAUDI ARABIA
Modern Electronic Establishment
King Abdul Aziz str (Head office)
P O Box 1228
Jeddah
Tel 31173-332201
Cable ELECTRA

P O Box 2728 (Service center)
Riyadh
Tel 62596-66232
Cable RAOUFCO

SPAIN
Hewlett-Packard Española, S A
Jerez, Calle 3
E-**Madrid 16**
Tel (1) 458 26 00 (10 lines)
Telex 23515 hpe

Hewlett-Packard Española, S A
Milanesado 21-23
E-**Barcelona** 17
Tel (3) 203 6200 (5 lines)
Telex 52603 hpbe e

Hewlett-Packard Española, S A
Av Ramón y Cajal, 1
Edificio Sevilla, planta 9
E-**Seville** 5
Tel 64 44 54/58

Hewlett-Packard Española S A
Edificio Albia II 7 B
E-**Bilbao**-1
Tel 23 83 06/23 82 06

Calculators Only
Hewlett-Packard Española S A
Gran Via Fernando El Católico, 67
E-**Valencia**-8
Tel 326 67 28/326 85 55

SWEDEN
Hewlett-Packard Sverige AB
Enighetsvägen 1-3
Fack
S-161 20 **Bromma** 20
Tel (08) 730 05 50
Cable MEASUREMENTS
Stockholm
Telex 10721

Hewlett-Packard Sverige AB
Ostra Vintergatan 22
S-702 40 **Orebro**
Tel (019) 14 07 20

Hewlett-Packard Sverige AB
Frötallsgatan 30
S-421 32 **Vastra Frölunda**
Tel (031) 49 09 50
Telex 10721 Via Bromma Office

SWITZERLAND
Hewlett-Packard (Schweiz) AG
Zurcherstrasse 20
P O Box 307
CH-8952 **Schlieren-Zurich**
Tel (01) 730 52 40/730 18 21
Cable HPAG CH
Telex 53933 hpag ch

Hewlett-Packard (schweiz) AG
Château Bloc 19
CH-1219 **Le Lignon-Geneva**
Tel (022) 96 03 22
Cable HEWPACKAG Geneva
Telex 27 333 hpag ch

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B P 2308
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Cable SAWAH Damascus

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Cable TELEMATION Istanbul
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Adakale Sokak 41/6
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Tel 175622

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Milli Mudafaa Cad No 16/6
Kizilay
TR-**Ankara**
Tel 25 03 09
Telex 42576 ozek tr

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Hewlett-Packard Ltd
King Street Lane
GB-**Winnersh**, Wokingham
Berks RG11 5AR
Tel (0734) 78 47 74
Cable Hewpie London
Telex 847178/9

Hewlett-Packard Ltd
Trafalgar House,
Navigation Road
Altrincham
Cheshire WA14 1NU
Tel (061) 928 6422
Telex 668068

Hewlett-Packard Ltd
Lygon Court
Hereward Rise
Dudley Road
Halesowen
West Midlands B62 8SD
Tel (021) 550 9911
Telex 339105

Hewlett-Packard Ltd
Wedge House
799, London Road
GB-**Thornton Heath**
Surrey CR4 6XL
Tel (01) 684 0103/8
Telex 946825

Hewlett-Packard Ltd
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Washington
GB-**New Town**, County Durham
Tel Washington 464001 ext 57/58

Hewlett-Packard Ltd
10, Wesley St
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Telex 825981

Hewlet-Packard Ltd
2C Avonbeg Industrial Estate
Long Mile Road
Dublin 12
Tel Dublin 509458
Telex 30439

USSR
Hewlett-Packard
Representative Office USSR
Pokrovsky Boulevard 4/17-KW 12
Moscow 101000
Tel 294-2024
Telex 7825 hewpak su

YUGOSLAVIA
Iskra-standard/Hewlett-Packard
Miklosiceva 38/VII
61000 **Ljubljana**
Telb 31 58 79/32 16 74
Telex 31583

SOCIALIST COUNTRIES NOT SHOWN PLEASE CONTACT:
Hewlett-Packard Ges m b H
P O Box 7
A-1205 **Vienna**, Austria
Tel (0222) 35 16 21 to 27
Cable HEWPAK Vienna
Telex 75923 hewpak a

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Mediterranean and Middle
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Platia Kefallariou
GR-Kifissia-**Athens**, Greece
Tel 8080337/359/429
Telex 21-6588
Cable HEWPACKSA Athens

FOR OTHER AREAS NOT LISTED CONTACT
Hewlett-Packard S A
7, rue du Bois-du-Lan
P O Box
CH-1217 Meyrin 2 - **Geneva**
Switzerland
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Cable HEWPACKSA Geneva
Telex 2 24 86

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Huntsville 35802
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Telex 723-705

ILLINOIS
5201 Tollview Dr
Rolling meadows 60008
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TWX 910-687-2260

INDIANA
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Indianapolis 46250
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TWX 810-260-1797

IOWA
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Iowa City 52240
Tel (319) 338-9466

KENTUCKY
Medical Only
Atkinson Square
3901 Atkinson Dr
Suite 407 Atkinson Square
Louisville 40218
Tel (502) 456-1573

LOUISIANA
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3229-39 Williams Boulevard
Kenner 70063
Tel (504) 443-6201

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6707 Whitestone Road
Baltimore 21207
Tel (301) 944-5400
TWX 710-862-9157

2 Choke Cherry Road
Rockville 20850
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TWX 710-828-9684

MASSACHUSETTS
32 Hartwell Ave
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Tel (617) 861-8960
TWX 710-326-6904

MICHIGAN
23855 Research Drive
Farmington Hills 48024
Tel (313) 476-6400

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St. Paul 55113
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Tel (314) 878-0200

NEBRASKA
Medical Only
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Suite 110
Omaha 68106
Tel (402) 392-0948

NEW JERSEY
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Paramus 07652
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Crystal Brook Professional
Building
Eatontown 07724
Tel (201) 542-1384

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Station E
11300 Lomas Blvd , N E
Albuquerque 87123
Tel (505) 292-1330
TWX 910-989-1185

156 Wyatt Drive
Las Cruces 88001
Tel (505) 526-2484
TWX 910-9983-0550

NEW YORK
6 Automation Lane
Computer Park
Albany 12205
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201 South Avenue
Poughkeepsie 12601
Tel (914) 454-7330
TWX 510-253-5981

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Tel (716) 223-9950

5858 East Molloy Road
Syracuse 13211
Tel (315) 454-2486
TWX 710-541-0482

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Tel (516) 921-0300
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NORTH CAROLINA
P O Box 5188
1923 North Main Street
High Point 27262
Tel (919) 885-8101

OHIO
16500 Sprague Road
Cleveland 44130
Tel (216) 243-7300
TWX 810-423-9430

330 Progress Rd
Dayton 45449
Tel (513) 859-8202

1041 Kingsmill Parkway
Columbus 43229
Tel (614) 436-1041

OKLAHOMA
P O Box 32008
Oklahoma City 73132
Tel (405) 721-0200

OREGON
17890 SW Lower Boones
Ferry Road
Tualatin 97062
Tel (503) 620-3350

PENNSYLVANIA
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Pittsburgh 15238
Tel (412) 782-0400

1021 8th Avenue
King of Prussia Industrial Park
King of Prussia 19406
Tel (215) 265-7000
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Tel (713) 776-6400

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Tel (512) 434-8241

UTAH
2160 South 3270 West Street
Salt Lake City 84119
Tel (801) 972-4711

VIRGINIA
P O Box 12778
No 7 Koger Exec Center
Suite 212
Norfolk 23502
Tel (804) 461-4025/6

P O Box 9669
2914 Hungary Springs Road
Richmond 23228
Tel (804) 285-3431

WASHINGTON
Bellefield Office Pk
1203-114th Ave S E
Bellevue 98004
Tel (206) 454-3971
TWX 910-443-2446

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Charleston
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