

Errata

Title & Document Type: 180C/D Oscilloscope Operating & Service Manual

Manual Part Number: 00180-90935

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HP References in this Manual

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, semiconductor products and chemical analysis businesses are now part of Agilent Technologies. We have made no changes to this manual copy. The HP XXXX referred to in this document is now the Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A.

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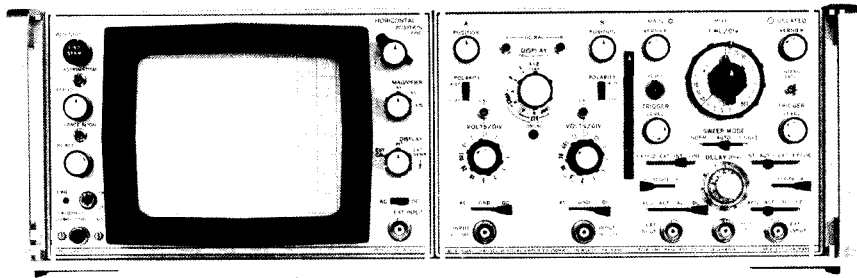
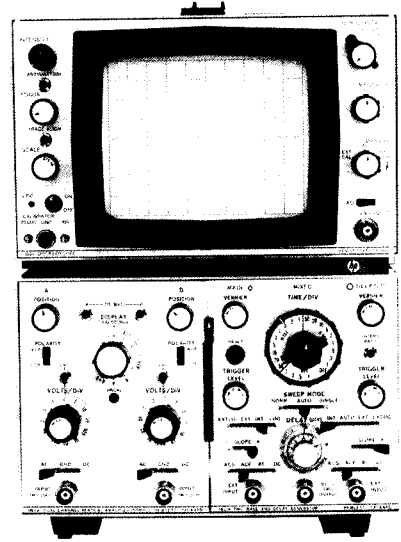
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OSCILLOSCOPE 180C/D



HEWLETT **hp** PAVISION RD



OPERATING AND SERVICE MANUAL

MODEL 180C/D OSCILLOSCOPE

**(Including Options 002, 003, 007, 010, 011, 013,
580, 602, 607, 611, 631, H03, and H51)**

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed 1351A (180C), 1340A (180D), and 1341A (180D-H51).

With changes described in Section VII, this manual also applies to instruments with serial numbers prefixed from 1125A through 1315A and 1434A.

For additional information about serial numbers, see MANUAL IDENTIFICATION AND CHANGES in Section I.

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

Manual Part Number: 00180-90935.
Microfiche Part Number: 00180-90835.

PRINTED: AUGUST 1976

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.**

TABLE OF CONTENTS

| Section | Page | Section | Page |
|---|------|---|------|
| I GENERAL INFORMATION | 1-1 | 3-68. Single Signal | 3-5 |
| 1-1. Introduction | 1-1 | IV PRINCIPLES OF OPERATION | 4-1 |
| 1-4. Instrument Description | 1-1 | 4-1. Introduction | 4-1 |
| 1-18. Cathode-ray Tube | 1-1 | 4-3. General Description | 4-1 |
| 1-21. Warranty | 1-2 | 4-8. Input Power | 4-1 |
| 1-24. Instrument Identification | 1-2 | 4-11. Horizontal Deflection | 4-1 |
| 1-26. Manual Identification and Changes | 1-2 | 4-20. Circuit Details | 4-2 |
| 1-30. Accessories Furnished | 1-2 | 4-21. Input Power | 4-2 |
| 1-35. Available Accessories | 1-2 | 4-24. Low Voltage Power Supply | 4-2 |
| 1-36. Mobile Test Stands | 1-2 | 4-40. Gate Amplifier | 4-4 |
| 1-38. Covers | 1-2 | 4-48. High Voltage Power Supply | 4-5 |
| 1-40. Cameras | 1-2 | 4-59. Calibrator | 4-6 |
| 1-43. Service Equipment | 1-4 | 4-63. Sweep Gate Output Amplifiers | 4-6 |
| 1-45. Other Accessories | 1-5 | 4-66. Horizontal Amplifier | 4-6 |
| | | 4-81. Power Supply Decoupling | 4-8 |
| II INSTALLATION | 2-1 | V PERFORMANCE CHECK AND | |
| 2-1. Introduction | 2-1 | ADJUSTMENTS | 5-1 |
| 2-3. Initial Inspection | 2-1 | 5-1. Introduction | 5-1 |
| 2-8. Claims | 2-1 | 5-3. Test Equipment | 5-1 |
| 2-11. Repackaging for Shipment | 2-1 | 5-5. Performance Check | 5-1 |
| 2-14. Preparation for Use | 2-1 | 5-9. Preliminary Setup | 5-1 |
| 2-15. Power Requirements | 2-1 | 5-11. Calibrator Check | 5-1 |
| 2-19. Three-conductor Power Cable | 2-1 | 5-12. Horizontal Magnifier Check | 5-3 |
| 2-22. Instrument Mounting | 2-2 | 5-13. Horizontal Bandwidth Check | 5-3 |
| 2-27. Instrument Cooling | 2-2 | 5-14. Beam Finder Check | 5-4 |
| 2-30. Contrast Filter | 2-2 | 5-16. Adjustment Procedure | 5-5 |
| 2-35. Instrument Compatibility | 2-3 | 5-19. Cover Removal | 5-5 |
| III OPERATION | 3-1 | 5-22. Preliminary Setup | 5-5 |
| 3-1. Introduction | 3-1 | 5-26. Low Voltage Power Supply Adjust- | |
| 3-3. General | 3-1 | ment | 5-6 |
| 3-6. Front Panel Controls and | | 5-27. High Voltage Power Supply Adjust- | |
| Connectors | 3-1 | ment | 5-7 |
| 3-8. Calibrator | 3-1 | 5-28. Astigmatism Adjustment | 5-8 |
| 3-10. Scale | 3-1 | 5-29. Intensity Limit Adjustment | 5-8 |
| 3-12. Trace Align | 3-1 | 5-30. Flood Gun Adjustment | 5-8 |
| 3-14. Focus and Astigmatism | 3-1 | 5-31. Trace Alignment Adjustment | 5-8 |
| 3-16. Find Beam | 3-1 | 5-32. Gate Amplifier Response Adjust- | |
| 3-18. Line Power Switch | 3-1 | ment | 5-9 |
| 3-20. Horizontal Display | 3-2 | 5-33. DC Balance Adjustment | 5-9 |
| 3-22. Horizontal External Coupling | 3-2 | 5-34. Vernier Balance Adjustment | 5-10 |
| 3-24. Horizontal Magnifier | 3-2 | 5-35. Horizontal Gain Adjustment | 5-10 |
| 3-27. External Sens | 3-2 | 5-36. Phase Adjustment | 5-11 |
| 3-29. Rear Panel Controls and | | 5-37. Transient Response Adjustment | 5-12 |
| Connectors | 3-2 | 5-38. Horizontal Linearity | |
| 3-31. Outputs | 3-2 | Adjustment | 5-13 |
| 3-34. Z-axis Input | 3-2 | VI REPLACEABLE PARTS | 6-1 |
| 3-36. AC Line Input | 3-2 | 6-1. Introduction | 6-1 |
| 3-38. Phase/Bandwidth Switch | 3-2 | 6-3. Ordering Information | 6-1 |
| 3-40. Plug-in Units | 3-2 | VII MANUAL CHANGES AND OPTIONS | 7-1 |
| 3-42. Phase Measurement | 3-3 | 7-1. Introduction | 7-1 |
| 3-47. Bright Display Photography | 3-4 | 7-3. Manual Changes | 7-1 |
| 3-50. Photographic Writing Speed | 3-4 | 7-5. Standard Options | 7-4 |
| 3-58. Camera Focusing | 3-5 | | |
| 3-61. Film Post-fogging | 3-5 | | |
| 3-66. Photographic Procedure | 3-5 | | |
| 3-67. Repetitive Signal | 3-5 | | |

TABLE OF CONTENTS (Cont'd)

| Section | Page | Section | Page |
|--|------|--|------|
| VIII SCHEMATICS AND TROUBLE- SHOOTING | 8-1 | 8-31. Troubleshooting Tables | 8-2 |
| 8-1. Introduction | 8-1 | 8-33. Repair and Replacement | 8-2 |
| 8-3. Schematics | 8-1 | 8-35. Servicing Etched Circuit Boards .. | 8-2 |
| 8-7. Reference Designations | 8-1 | 8-37. Semiconductor Replacement | 8-3 |
| 8-11. Component Location | 8-1 | 8-40. Detailed Troubleshooting | 8-4 |
| 8-14. Troubleshooting | 8-1 | 8-42. Low Voltage Power Supply | 8-4 |
| 8-19. Preliminary Checkout | 8-2 | 8-47. High Voltage Power Supply and Regulator | 8-4 |
| 8-21. Detailed Checkout | 8-2 | 8-52. Disassembly Information | 8-4 |
| 8-23. DC Voltages | 8-2 | 8-55. Cover Removal | 8-4 |
| 8-25. Waveforms | 8-2 | 8-57. Power Module Removal | 8-5 |
| 8-27. Test Points | 8-2 | 8-60. CRT Removal and Replacement .. | 8-6 |
| 8-29. Polarized Components | 8-2 | 8-63. High Voltage Supply Replace- ment | 8-6 |

LIST OF ILLUSTRATIONS

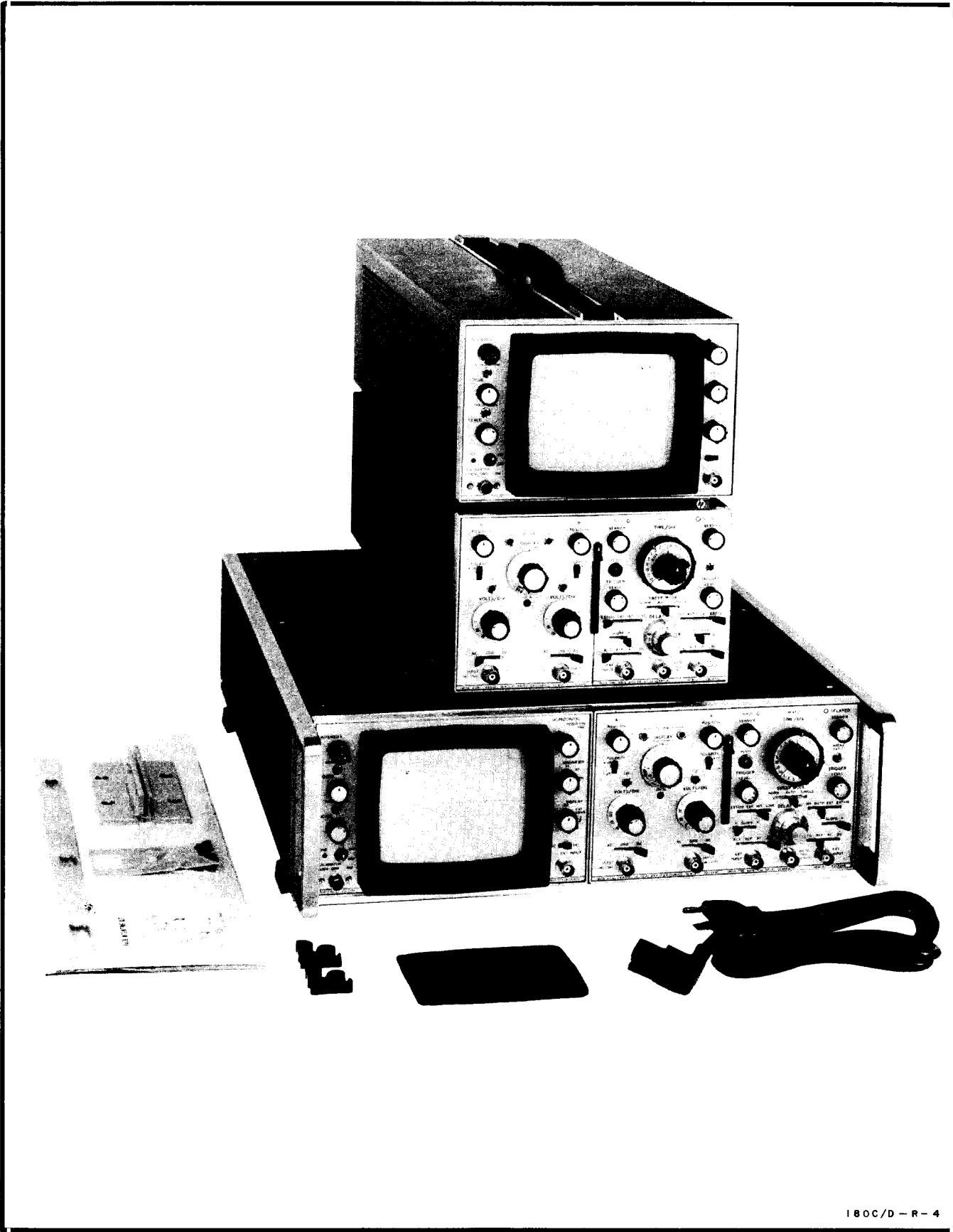
| Figure | Title | Page | Figure | Title | Page |
|--------|--|------|--------|--|------|
| 1-1. | Models 180C and 180D Oscilloscopes .. | 1-0 | 5-15. | Vernier Balance Adjustment Location | 5-10 |
| 1-2. | Instrument Identification | 1-2 | 5-16. | Calibration Display | 5-11 |
| 1-3. | Model 180C and 180D Dimensions .. | 1-4 | 5-17. | Gain Adjustment Location | 5-11 |
| 2-1. | Power Receptacles | 2-1 | 5-18. | Phase Adjustment | 5-12 |
| 2-2. | Rack Mount Procedure | 2-2 | 5-19. | Phase and Input Adjustment Location .. | 5-12 |
| 3-1. | Operating Controls and Connectors .. | 3-0 | 5-20. | Transient Response Adjustment | 5-12 |
| 3-2. | Phase Measurement | 3-4 | 5-21. | Horizontal Linearity Adjustment | 5-13 |
| 4-1. | Model 180C/D Block Diagram | 4-0 | 5-22. | Linearity Adjustment Location | 5-14 |
| 4-2. | Simplified Low Voltage Power Supply .. | 4-2 | 5-23. | Adjustment Locations | 5-15 |
| 4-3. | Gate Amplifier Block Diagram | 4-4 | 6-1. | Model 180D Mechanical Parts | 6-0 |
| 4-4. | High Voltage Power Supply Block Diagram | 4-5 | 6-2. | Model 180C/D Mechanical Parts | 6-0 |
| 4-5. | Horizontal Amplifier Block Diagram .. | 4-7 | 6-3. | Low Voltage Power Module Exploded View | 6-2 |
| 5-1. | Calibrator Check | 5-1 | 6-4. | Series Regulator Parts Identification .. | 6-3 |
| 5-2. | Horizontal Magnifier Check | 5-3 | 7-1. | Schematic for Option 003 | 7-5 |
| 5-3. | Horizontal Bandwidth Check | 5-4 | 7-2. | Gate Amplifier Component Identification .. | 7-6 |
| 5-4. | Cover Removal | 5-5 | 7-3. | Gate Amplifier Adjustment Location | 7-7 |
| 5-5. | Low Voltage Power Supply Adjust- ments | 5-6 | 7-4. | Gate Amplifier and Calibrator Schematic .. | 7-7 |
| 5-6. | High Voltage Adjustment | 5-7 | 7-5. | Low Voltage Rectifier Component Identification | 7-8 |
| 5-7. | High Voltage Adjustment Location .. | 5-7 | 7-6. | Low Voltage Regulator Component Identification | 7-8 |
| 5-8. | Astigmatism Adjustment | 5-8 | 7-7. | Low Voltage Power Supply Schematic | 7-9 |
| 5-9. | Flood Gun Adjustment Location | 5-8 | 7-8. | Revision to Gate Amplifier and Calibrator Schematic | 7-10 |
| 5-10. | Trace Alignment Adjustment | 5-8 | 8-1. | Semiconductor Terminal Identification .. | 8-3 |
| 5-11. | Y Alignment Adjustment Location .. | 5-9 | 8-2. | 180C/D Cover Removal | 8-5 |
| 5-12. | Gate Amplifier Response Adjustment .. | 5-9 | | | |
| 5-13. | Gate Amplifier Adjustment Location .. | 5-9 | | | |
| 5-14. | DC Balance Adjustment Location | 5-10 | | | |

LIST OF ILLUSTRATIONS (Cont'd)

| Figure | Title | Page | Figure | Title | Page |
|--------|---|------|--------|---|------|
| 8-3. | Low Voltage Power Connections | 8-9 | 8-10. | Gate Amplifier Waveforms | 8-17 |
| 8-4. | Low Voltage Rectifier Component Identification | 8-10 | 8-11. | Gate Amplifier and Calibrator Schematic | 8-17 |
| 8-5. | Low Voltage Regulator Component Identification | 8-12 | 8-12. | H.V. Multiplier | 8-18 |
| 8-6. | Low Voltage Power Supply Schematic . | 8-13 | 8-13. | H.V. Oscillator and Rectifier Component Identification | 8-18 |
| 8-7. | Horizontal Amplifier Component Identification | 8-14 | 8-14. | H.V. Oscillator Waveform | 8-21 |
| 8-8. | Horizontal Amplifier Schematic | 8-15 | 8-15. | High Voltage Power Supply Schematic . | 8-21 |
| 8-9. | Gate Amplifier Component Identification | 8-16 | 8-16. | Time Base Plug-in Connections | 8-22 |
| | | | 8-17. | Sweep Gate Component Identification | 8-23 |
| | | | 8-18. | Sweep-Gate Output Schematic | 8-23 |

LIST OF TABLES

| Table | Title | Page | Table | Title | Page |
|-------|---|-----------|-------|---|------|
| 1-1. | Model 180C/D Specifications | 1-3 | 8-1. | Schematic Notes | 8-8 |
| 1-2. | Reference Designators and Abbreviations | 1-5 | 8-2. | Miscellaneous Troubleshooting Tips . . | 8-9 |
| 3-1. | Available Plug-ins | 3-3 | 8-3. | Low Voltage Power Supply Trouble- shooting Tips | 8-11 |
| 4-1. | LVPS Current Capabilities | 4-4 | 8-4. | Low Voltage Power Supply Voltage Measurement Conditions | 8-13 |
| 5-1. | Recommended Test Equipment | 5-2 | 8-5. | Horizontal Amplifier Voltage Measure- ment Conditions | 8-15 |
| 6-1. | Abbreviations for Replaceable Parts List | 6-1 | 8-6. | Gate Amplifier & H.V. Regulator Voltage Measurement Conditions . . | 8-17 |
| 6-2. | Replaceable Parts | 6-4 | 8-7. | High Voltage Power Supply Trouble- shooting Tips | 8-19 |
| 6-3. | List of Manufacturers' Codes | 6-13/6-14 | 8-8. | CRT Intensity Troubleshooting Tips . . | 8-20 |
| 7-1. | Manual Changes | 7-1 | 8-9. | H.V. Power Supply Voltage Measure- ment Conditions | 8-21 |
| 7-2. | Replaceable Parts Changes for Option 003 | 7-5 | | | |



180C/D - R - 4

Figure 1-1. Models 180C and 180D Oscilloscopes

SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. This manual provides operating and service information for the Hewlett-Packard Models 180C and 180D Oscilloscopes. The manual is divided into eight sections, each covering a specific topic or aspect of the instrument. All schematics are located at the rear of the manual and can be unfolded and used for reference while reading any part of the manual.

1-3. This section contains complete instrument specifications, a description of features, warranty information, data for manual and instrument identification, and information regarding accessories available for use with the instrument. Table 1-2 lists and describes the abbreviations used in this manual.

1-4. INSTRUMENT DESCRIPTION.

1-5. The Model 180C/D (Figure 1-1) is a solid-state, light-weight laboratory and general-purpose oscilloscope with plug-in capabilities. The instrument is designed to display complex high frequency waveforms and to measure alternating and direct-current voltages. Complete instrument specifications are given in Table 1-1.

1-6. The Model 180C is a cabinet type instrument with a built-in tilt stand, convenient carrying handle on top, and feet mounted on both bottom and rear for either bench or upright operation.

1-7. The Model 180D is a rack type instrument with a built-in tilt stand and bottom-mounted feet. It may be bench operated or rack mounted. Figure 1-3 provides the outline dimensions.

1-8. A CRT accelerating potential of 15 kV provides bright visual display and high photographic writing speeds. This simplifies the measurement of low duty cycle signals.

1-9. The Model 180C/D has solid-state circuitry throughout for minimum size and weight with maximum reliability. Power consumption, with plug-ins, is less than 110 watts at normal line voltage. The instrument is convection cooled and designed to operate within specifications at temperatures between 0°C and 55°C with up to 95% relative humidity at 40°C.

1-10. All power supplies, a dual output calibrator, horizontal amplifier, gate amplifier and the CRT are contained in the instrument. Operation at either 115V or 230V ac is selectable by a switch located on the rear panel of the oscilloscope.

1-11. Located on the rear panel are connectors for time base output of main and delayed gate, and main and delayed sweep signals. Connection for input of an external signal for intensity modulation (Z-axis input) is also provided at the rear panel.

1-12. The Model 180C/D is designed to operate with a number of different plug-ins. Presently available plug-ins provide a wide choice of operating capabilities such as wide bandwidth, dual or four channel operation, single or delayed sweeps and sampling or time-domain reflectometer operation.

1-13. To facilitate servicing, the modular power supply may be disconnected and removed from the instrument for access to all components. It may also be operated from the built-in extender cable to simplify and speed up maintenance.

1-14. A calibrator provides a square-wave signal of approximately 1 kHz with a risetime of less than 3 usec. The calibrator output is available at the front panel at amplitudes of 250 mV and 10V p-p with an accuracy of $\pm 1\%$. The signal may be used to check horizontal and vertical deflection factors and to compensate divider probes.

1-15. The oscilloscope horizontal amplifier accepts sweep signals from the time base plug-in or an external source. The external input bandwidth is dc to 5 MHz dc-coupled, and 5 Hz to 5 MHz ac-coupled.

1-16. Three horizontal deflection factor ranges are front panel selectable: 1 V/div (X1) $\pm 5\%$, 0.2 V/div (X5) $\pm 5\%$, and 0.1 V/div (X10) $\pm 5\%$. In addition, a vernier control provides continuous adjustment between ranges for external inputs. The maximum external input level is 300 Vdc, ac-coupled, with a dynamic range of $\pm 20V$.

1-17. A beam finder pushbutton control assists the operator in rapidly bringing a displaced beam on screen. Its use increases intensity and reduces vertical and horizontal amplifier gain to quickly locate trace position.

1-18. CATHODE-RAY TUBE.

1-19. The Model 180C/D used a post-accelerator aluminumized CRT with an eight by ten division display area. Each division equals 1 cm, and 0.2-div subdivisions are provided on the major axes. The graticule is internal to the CRT which eliminates display parallax. A safety faceplate is fitted to the front of the CRT for operator protection.

1-20. The standard CRT supplied has P31 phosphor. Other phosphors with or without internal graticule are available.

Refer to Section VII of this manual for information on available phosphors or contact the nearest HP Sales/Service Office regarding special CRT requirements.

1-21. WARRANTY.

1-22. This instrument is certified and warranted as stated on the inside front cover of this manual.

1-23. In all correspondence with a Hewlett-Packard Sales/Service Office concerning an instrument, reference the complete serial number and model of this instrument.



The warranty may be void for instruments having a mutilated serial number tag.

1-24. INSTRUMENT IDENTIFICATION.

1-25. Hewlett-Packard uses a serial number for instrument identification (Figure 1-2). The first numerical group is the serial prefix number. It identifies a series of instruments. The last numerical group identifies a particular instrument in the series. The serial number appears on a plate located on the rear panel.

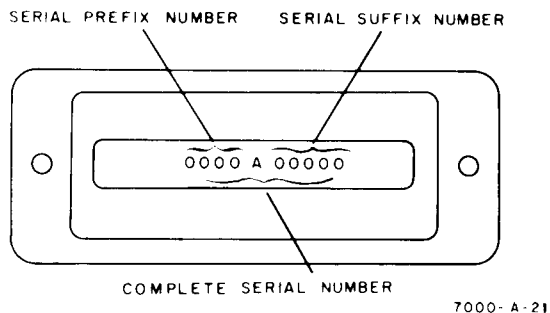


Figure 1-2. Instrument Identification

1-26. MANUAL IDENTIFICATION AND CHANGES.

1-27. The information in this manual applies directly to instruments (as manufactured) with a serial prefix as indicated on the title page. If the serial prefix of your instrument is different from that on the title page, a MANUAL CHANGES insert sheet, or Section VII of the manual, will describe the changes necessary to adapt this manual to provide the correct information.

1-28. Technical corrections (if any) to this manual due to known errors in print are called Errata and are shown on the manual changes sheet. Also shown are changes in parts which are applicable to all instruments should replacement become necessary. These are indicated as preferred replacement parts.

1-29. For information on manual coverage of any HP instrument, contact the nearest HP Sales/Service Office (addresses are listed at the rear of this manual).

1-30. ACCESSORIES FURNISHED.

1-31. The Model 180C/D is equipped with a screen mesh contrast filter. The filter snaps into place under the light shield to provide greater contrast and improved viewing under ambient light conditions. It may be removed if preferred.

1-32. A detachable power cord is supplied with each instrument. The three-conductor power cord and instrument receptacle conform to International Electrotechnical Commission (IEC) safety standards.

1-33. The Model 180D is supplied with all parts and hardware required for rack mounting. Refer to Section II of this manual for installation information.

1-34. Two probe hangers are furnished with each oscilloscope. Model 180C hangers are factory installed while probe hangers for the Model 180D are furnished for user installation.

1-35. AVAILABLE ACCESSORIES.

1-36. MOBILE TEST STANDS.

1-37. A series of mobile test stands are available for the Models 180C and 180D. The Model 1002B Testmobile is intended for use with the cabinet Model 180C. The Model 1117B Testmobile is intended for use with rack-model instruments such as the Model 180D.

1-38. COVERS.

1-39. A front-panel cover of fiberglass material, HP Model 10166A, can be used to provide front-panel protection for the cabinet Model 180C, and a metal cover for the rack Model 180D is available as HP Part No. 5060-0437.

1-40. CAMERAS.

1-41. The HP Model 197A is a general purpose camera with an electronic shutter and an optional ultra-violet light which illuminates internal gratitudes, providing accurate recordings of oscilloscope displays. The film back can be moved through 11 detented positions for multiple exposures and the continuous reduction ratio allows the entire film area to be used. Model 197A is supplied with a Polaroid pack film back for Type 107 film. Interchangeable backs on Model 197A allow selection of either Polaroid Flat Pack (Model 10353A), or Graflok 4x5-inch (Model 10352A).

Table 1-1. Model 180C/D Specifications

CATHODE-RAY TUBE AND CONTROLS

TYPE: post accelerator, approx 15 kV accelerating potential; aluminized P31 phosphor.

GRATICULE: 8 x 10 div internal graticule, 0.2 div subdivisions on major axes. (1 div = 1 cm.) Front panel recessed screwdriver adjustment aligns trace with graticule. Scale control illuminates CRT phosphor when viewing with hood or taking photographs.

BEAM FINDER: returns trace to CRT screen regardless of setting of horizontal, vertical, or intensity controls.

INTENSITY MODULATION (External Input)

Input: approx +2V, ≥ 50 ns pulse width (≤ 10 MHz sine wave) will blank trace of normal intensity.

Input R: approx 5k ohms.
Maximum Input: $\pm 20V$ (dc + pk ac).

PHOTOGRAPHIC WRITING SPEED: 1500 cm/ usec. Measured using 10,000 ASA film without film fogging and a camera with f/1.3 lens, and a 1: 0.5 object-to-image ratio. Writing speed may be increased substantially by using film fogging techniques, P11 phosphor and faster camera lenses.

CALIBRATOR

TYPE: approx 1 kHz square wave, < 3 usec risetime.

VOLTAGE: two outputs, 250 mV p-p and 10V p-p into ≥ 1 megohm; accuracy, $\pm 1\%$.

HORIZONTAL AMPLIFIER

EXTERNAL INPUT

Bandwidth: dc to 5 MHz dc-coupled; 5Hz to 5 MHz ac-coupled.

Deflection Factor: 1 V/div, x1; 0.2 V/div, x5; 0.1 V/div, x10; accuracy $\pm 5\%$. Vernier provides continuous adjustment between ranges.

Dynamic Range: $\pm 20V$.

Maximum Input: 600 Vdc (ac-coupled input).

Input RC: approx 1 megohm shunted by approx 30 pF.

INTERNAL SWEEP

Magnifier: x5, x10, accuracy $\pm 5\%$ (with 3% accuracy time base).

OUTPUTS

Four rear panel, emitter follower outputs provide main and delayed gates, main and delayed sweeps, or vertical and horizontal outputs when used with TDR/Sampling plug-ins. Maximum current available, ± 3 mA. Outputs will drive impedances of ≥ 1000 ohms without distortion.

ENVIRONMENT

(Mainframe operates within specifications over the following ranges.)

TEMPERATURE: 0 to 55°C.

HUMIDITY: to 95% relative humidity to 40°C.

ALTITUDE: to 15,000 ft.

VIBRATION: vibrated in three planes for 15 min each with 0.010 in. excursion, 10 to 55 Hz.

GENERAL

POWER: 115 or 230V, $\pm 10\%$; 48 to 440 Hz; normally $< 110W$ with plug-ins at normal line. Maximum mainframe power, 200 VA.

DIMENSIONS:

Cabinet Model 180C: 7-7/8 in. wide, 11-3/8 in. high, 21-1/4 in. deep behind panel (200 x 289 x 540 mm).

Rack Model 180D: see outline drawing.

ACCESSORIES FURNISHED: 7-1/2 ft power cord; blue contrast filter (HP P/N 5060-0548) rack mounting hardware and 2 probe holders (HP P/N 5040-0464) are also supplied with 180D Rack Model.

OPTIONS

Refer to Section VII for listing of options.

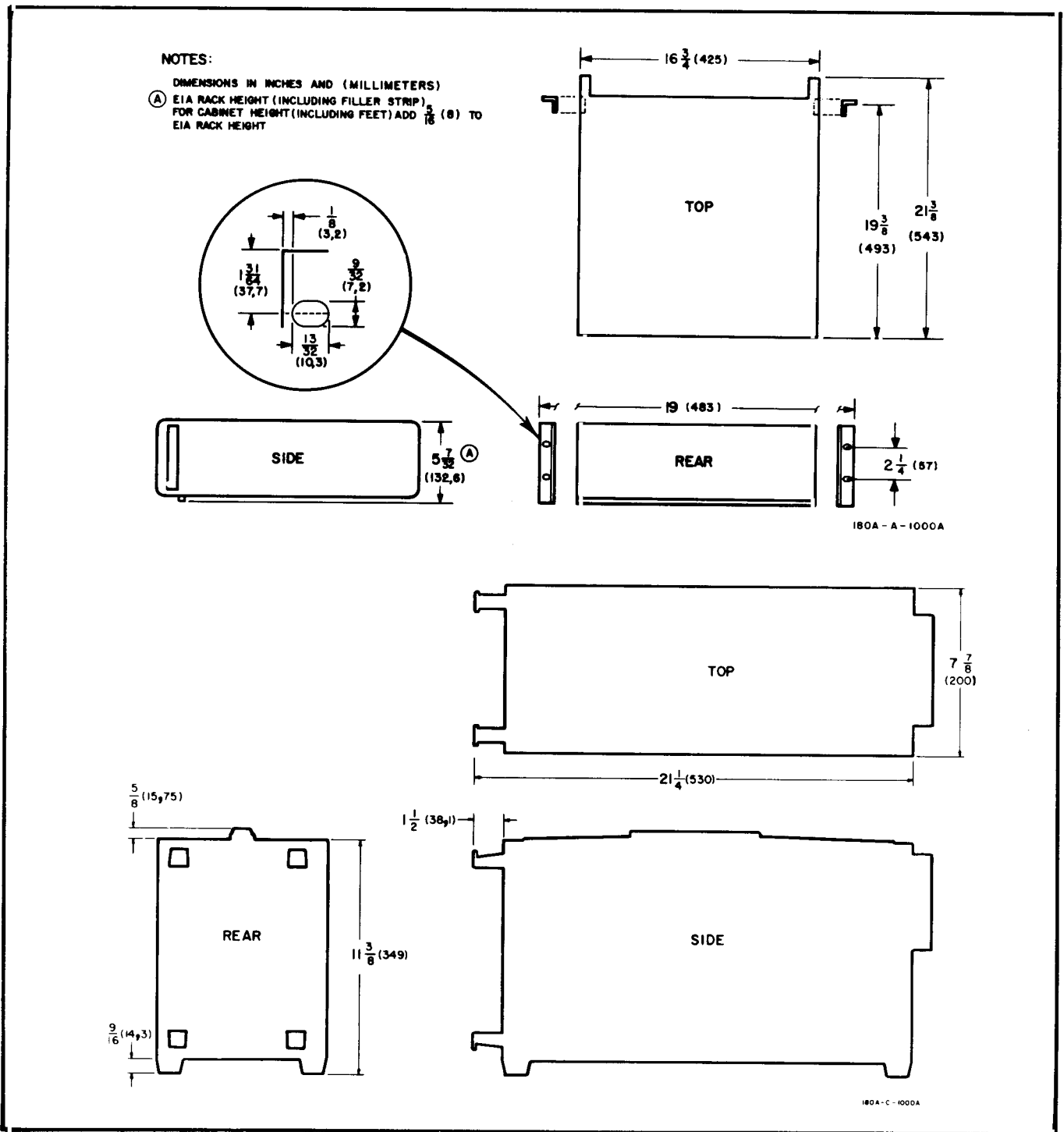


Figure 1-3. Model 180C and 180D Dimensions

1-43. SERVICE EQUIPMENT.

1-42. The HP Model 123A (with 10369A Adapter) is an economical, easy-to-use camera for general purpose oscilloscope photography which uses standard Polaroid flat-pack self-processing film. Most oscilloscope photographic applications can be solved with this camera.

1-44. For ease of calibration and maintenance, the HP Model 10407B Plug-in Extender can be obtained. It provides for removal of the vertical and time base plug-ins from the oscilloscope mainframe and exposes components and adjustments of the plug-ins for servicing.

1-45. OTHER ACCESSORIES.

1-46. Additional RFI shielding for the CRT display can be obtained by using the Model 10178A Metal Mesh Contrast Filter in place of the filter supplied.

1-47. Cameras, probes, viewing hoods, terminations and other accessory items are available for specialized requirements. Information on these and the above described accessories may be obtained from HP Sales/Service Offices listed in the rear of this manual.

Table 1-2. Reference Designators and Abbreviations

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

| ABBREVIATIONS | | | | | | | |
|---------------|-----------------------|------|------------------------------|------|-------------------------------|------|--------------------------------|
| A | = ampere(s) | FET | = field-effect transistor(s) | n | = nano (10^{-9}) | rfi | = radio frequency interference |
| ampl | = amplifier(s) | G | = giga (10^9) | nc | = normally closed | rms | = root mean square |
| assy | = assembly | gnd | = ground(ed) | no. | = normally open | rww | = reverse working voltage |
| ampltd | = amplitude | H | = henry(ies) | nnp | = negative-positive-negative | SCR | = silicon controlled rectifier |
| bd | = board(s) | hr | = hour(s) | ns | = nanosecond | sec | = second(s) |
| bp | = bandpass | HP | = Hewlett-Packard | pc | = printed (etched) circuit(s) | std | = standard |
| c | = centi (10^{-2}) | Hz | = hertz | pk | = peak | trmr | = trimmer |
| C | = carbon | if. | = intermediate freq. | pnp | = positive-negative-positive | u | = micro (10^{-6}) |
| ccw | = counterclockwise | intl | = internal | p/o | = part of | usec | = microsecond |
| coax. | = coaxial | k | = kilo (10^3) | p-p | = peak-to-peak | V | = volts |
| coef | = coefficient | lb | = pound(s) | prgm | = program | var | = variable |
| com | = common | lpf | = low-pass filter(s) | prv | = peak inverse voltage(s) | w/ | = with |
| CRT | = cathode-ray tube | m | = milli (10^{-3}) | ps | = picosecond | w/o | = without |
| cw | = clockwise | M | = mega (10^6) | pwv | = peak working voltage | wiv | = working inverse voltage |
| d | = deci (10^{-1}) | ms | = millisecond | rf | = radio frequency | | |
| dB | = decibel | | | | | | |
| ext | = external | | | | | | |
| F | = farad(s) | | | | | | |

SECTION II INSTALLATION

2-1. INTRODUCTION.

2-2. This section of the manual contains inspection and installation procedures for the Model 180C/D Oscilloscope. In addition, packing and claims procedures are discussed in the event damage occurs during shipment.

2-3. INITIAL INSPECTION.

2-4. The instrument was carefully inspected, mechanically and electrically, prior to shipment. On receipt, inspect it for any mechanical damage which may have occurred during shipment and test the electrical performance.

2-5. Check for physical damage such as bent or broken parts and dents or scratches. If damage is found, refer to the recommended claims procedure. Retain the packaging material for future use.

2-6. Check the electrical performance of the instrument as soon as possible after receipt. The performance check is contained in Section V of this manual. This check will verify that the instrument is operating to the specifications listed in Table 1-1.

2-7. The initial performance and accuracy of this instrument are certified as stated in the warranty on the inside front cover of this manual. If the instrument does not operate as specified, refer to the recommended claims procedure.

2-8. CLAIMS.

2-9. If physical damage is found or if the instrument is not within specifications when received, notify the carrier and the nearest Hewlett-Packard Sales/Service Office immediately. The Sales/Service Office will arrange for repair or replacement of the instrument without waiting for a claim to be settled with the carrier.

2-10. The warranty statement for this Hewlett-Packard instrument is on the inside front cover of this manual. Contact the nearest HP Sales/Service Office for information and assistance with warranty claims.

2-11. REPACKING FOR SHIPMENT.

2-12. If the instrument is to be shipped to a Hewlett-Packard Sales/Service Office, attach a tag to it showing owner's name, address, instrument model number and serial number, and a description of the service required.

2-13. Use the original shipping carton and packaging materials for reshipment. If they are not available, the

HP Sales/Service Office will provide information and recommendations on material to be used.

2-14. PREPARATION FOR USE.

2-15. POWER REQUIREMENTS.

2-16. The standard Model 180C/D requires a 115V or 230V $\pm 10\%$, single-phase, 48 to 440 Hz power source capable of supplying 200 VA maximum or approximately 110 watts at normal line voltage with plug-ins installed.

2-17. **115V OPERATION.** This instrument, as shipped, is ready for operation on 115V ac. Before applying power, check the rear-panel slide switch, labeled SELECTOR, for proper position. It should be set so the legend 115 is visible. Check the fuse to determine that it is the proper value to provide protection for 115V operation of the instrument.

2-18. **230V OPERATION.** If the instrument is to be operated from a 230V ac power source, set the rear-panel SELECTOR slide switch to 230. Replace the fuse with the proper value for 230V operation.

2-19. THREE-CONDUCTOR POWER CABLE.

2-20. This instrument is equipped with a three-conductor power cable that, when connected to an appropriate receptacle, grounds the instrument through the offset pin. The power cable required depends on the ac input voltage, and the country in which the instrument is to be used. Figure 2-1 illustrates the standard power receptacle (wall outlet) configurations that are used throughout the United States and in other countries. The HP part number shown adjacent to each receptacle drawing is the part number for a power cable equipped with a mating plug for that receptacle. If the appropriate power cable is not included with the instrument, notify the nearest Hewlett-Packard Sales/Service Office and a replacement cable will be provided.

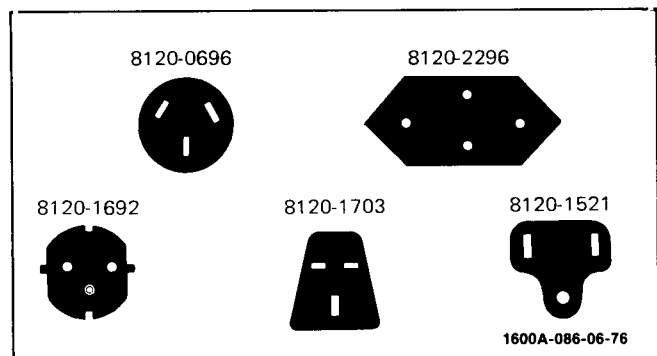


Figure 2-1. Power Receptacles

2-21. When operating the Model 180C/D from a two-contact power outlet, use a three-conductor to two-conductor adapter. Preserve the safety feature by grounding the adapter flexible (third) lead. A suitable three-pin to two-pin adapter is available from Hewlett-Packard. Order HP Part No. 1251-0048.

2-22. INSTRUMENT MOUNTING.

2-23. The Model 180C is intended for bench use. It has a built-in tilt stand and feet mounted on both bottom and rear for bench or upright operation.

2-24. The Model 180D is intended for either bench or rack use. It has a built-in tilt stand and feet mounted on the bottom for bench use. It may be rack mounted as described below.

2-25. **BENCH USE.** To use the tilt stand, lift the front of the instrument or place it vertically on the rear feet. The tilt stand is folded and locked into place against the cabinet bottom cover. Hold the instrument steady and squeeze the two tilt stand legs together to release them from the lock. Pull the stand toward the front of the instrument. When fully forward, release the legs and they will lock into position. The tilt stand will support the instrument with the front elevated.

2-26. **RACK MOUNTING.** A kit for converting the Model 180D to a rack mount configuration is supplied with each instrument. Instructions for making the conversion are given below. See Figure 2-2 for parts identification.

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

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

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

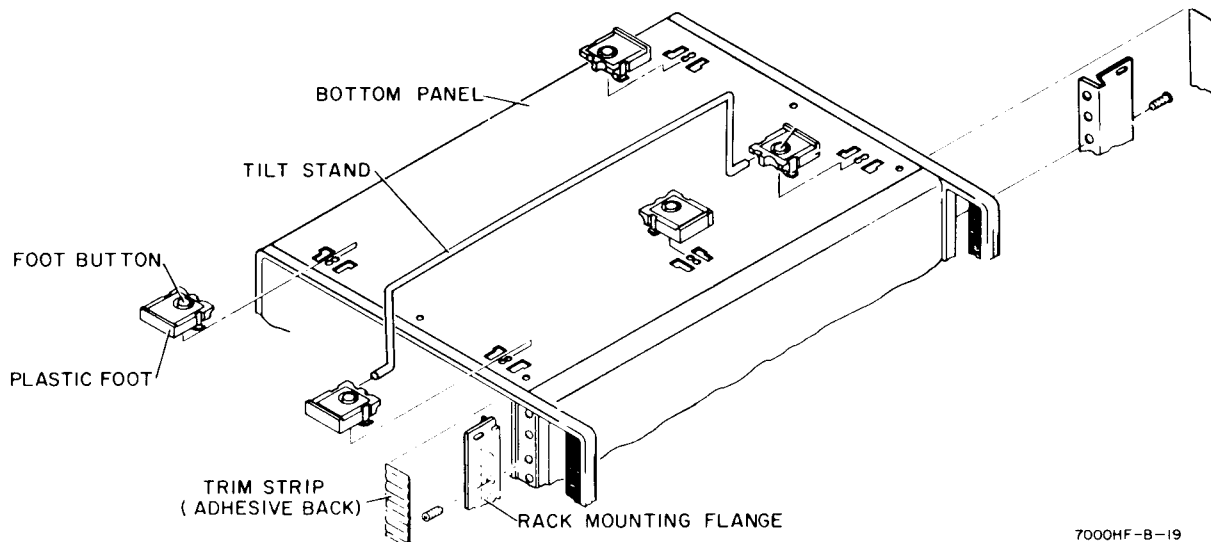
2-27. INSTRUMENT COOLING.

2-28. This instrument does not require forced-air-cooling when operated at room temperature or between 0 and +55 degrees C. Normal air circulation will maintain a reasonable operating temperature within the instrument.

2-29. Perforations in the covers provide for the required air flow. Do not obstruct them. Provide several inches of clearance around the top, rear and sides. Adequate air flow from the bottom of the instrument is provided by the mounting feet.

2-30. CONTRAST FILTER.

2-31. The contrast filter is designed to be easily removed from the CRT bezel. Use of the contrast filter provides comfortable viewing when the instrument is operated in normal and high ambient light.



7000HF-B-19

Figure 2-2. Rack Mount Procedure

2-32. The contrast filter is located behind the light shield. When a camera is attached for use, removal of the filter may be desirable.

2-33. To remove the plastic light shield, squeeze it at midpoint at top and on bottom. Apply pressure until upper and lower ears clear the slots in the bezel. Pull forward and remove.

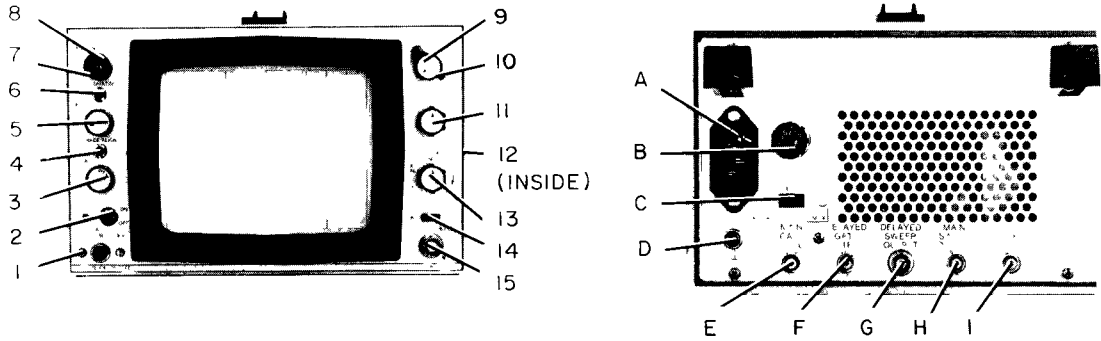
2-34. Remove the contrast filter, which is held in the bezel by a loose pressure fit.

2-35. INSTRUMENT COMPATIBILITY.

2-36. The Model 180C/D Oscilloscope is designed to operate with a wide variety of time base and vertical plug-ins. Table 3-1 lists the plug-ins currently available.

Note

Plug-ins specifically designed for use with the 500-MHz Model 183A/B/C/D Oscilloscope will not fit into or operate in the Model 180C/D. A mechanical interlock is provided on these plug-ins which prevents their full insertion into the Model 180C/D. Additionally, the Model 180C/D does not supply the required operating power.



1. CALIBRATOR. Provides a 1-kHz square wave at two amplitudes; 250 mV and 10V p-p.
2. LINE. Toggle switch with indicator light for turning oscilloscope on and off.
3. SCALE. Controls overall brightness of CRT face and graticule contrast.
4. TRACE ALIGN. Rotates trace around longitudinal axis of CRT.
5. FOCUS. Adjusts writing beam for sharpest trace.
6. ASTIGMATISM. Adjusts roundness of writing spot.
7. INTENSITY. Controls brightness of display.
8. FIND BEAM. Intensifies trace and always returns display to on-screen.
9. POSITION. Coarse adjustment of display's horizontal position.
10. FINE. Fine adjustment of display's horizontal position.
11. MAGNIFIER. Determines gain of horizontal amplifier.
12. PHASE/BANDWIDTH. Selects between normal full bandwidth operation (BANDWIDTH) and X-Y operation (PHASE).
13. DISPLAY. Selects source of horizontal input signal.

14. AC/DC. Selects ac or dc coupling for the external horizontal input signal.
15. EXT INPUT. BNC connector for coupling an external horizontal input signal to horizontal amplifier.

REAR PANEL

- A. Power Connector. 3-wire ac power line input.
- B. FUSE. 115V or 230V operation ac line fuse.
- C. SELECTOR. Provides for external selection of line operating voltage.
- D. Ground Connector. Provides a chassis ground connection point.
- E. MAIN GATE OUTPUT. BNC connector for main gate signal to external equipment.
- F. DELAYED GATE OUTPUT. BNC connector for output of delayed gate signal to external equipment.
- G. DELAYED SWEEP OUTPUT. BNC connector for output of delayed sweep signal to external equipment.
- H. MAIN SWEEP OUTPUT. BNC connector for output of main sweep signal to external equipment.
- I. Z-AXIS INPUT. BNC connector for input of CRT intensification or blanking signal.

Figure 3-1. Operating Controls and Connectors

SECTION III

OPERATION

3-1. INTRODUCTION.

3-2. This section of the manual presents information on the operation, function and capabilities of the instrument controls. Information regarding control turn-on procedures and front panel adjustments is explained to assist the operator in properly setting up and using the Model 180C/D.

3-3. GENERAL.

3-4. The Model 180C/D is designed to operate with plug-in time bases and vertical amplifiers, or plug-in sampling and time-domain reflectometers. These plug-ins are accommodated in the lower or right-hand portion of the instrument. The required operating power is obtained from the oscilloscope mainframe. Time base and vertical amplifier units must be locked together before being installed in the mainframe.

3-5. The vertical amplifier is always installed in the left-hand side and the time base on the right-hand side of the plug-in compartment. Refer to the plug-in operating and service manuals for mating and installation instructions. Sampling and TDR plug-ins use the entire active plug-in compartment.

3-6. FRONT PANEL CONTROLS AND CONNECTORS.

3-7. All operating controls and front panel adjustments are identified and described in Figure 3-1. The information presented gives the operator a quick reference regarding the operating function of each. Additional information regarding some of these is explained below in greater detail.

3-8. CALIBRATOR.

3-9. The calibrator has two outputs, 10V and 250 mV peak-to-peak, negative-going from ground, with an amplitude accuracy of $\pm 1\%$. The output is a square wave at a frequency of approximately 1 kHz. Risettime of the signal is less than 3 microseconds. These outputs are useful for checking vertical and horizontal sensitivity calibration, and divider probe calibration. A 3-way binding post provides a convenient ground connection point and may be used with banana plug, wire or spade-lug connection.

3-10. SCALE.

3-11. This control adjusts the overall brightness of the CRT face. It should be adjusted for good contrast

between the background and the graticule. The SCALE control is useful when using a hood to view the display or when photographing waveforms. Rotate the SCALE control counterclockwise to OFF when graticule illumination is not needed.

3-12. TRACE ALIGN.

3-13. A screwdriver adjustment is used to compensate for external magnetic fields that may affect alignment of the horizontal trace with the graticule. Use it to position the trace parallel to the graticule horizontal lines. The alignment should be checked when the instrument is moved to a new location and adjustment made whenever necessary.

3-14. FOCUS AND ASTIGMATISM.

3-15. These controls are used to obtain a display of uniform focus. Adjust both controls for the sharpest display possible.

3-16. FIND BEAM.

3-17. Occasionally the CRT beam may be driven offscreen by large dc input levels or improper control settings. Pressing the pushbutton increases intensity and reduces horizontal and vertical amplifier gains enough to always return a displaced beam to the viewing area. This enables the operator to determine the action necessary to center the display. All operating controls function while the FIND BEAM control is depressed. Obtaining a centered display may require adjustment of the deflection factor, horizontal and vertical position, coupling, trigger level or intensity. If the controls are properly set, the display will remain visible when FIND BEAM is released.

Note

Option 011 and 611 instruments do not increase intensity when FIND BEAM is pressed. Use the INTENSITY control to set intensity to viewing level.

3-18. LINE POWER SWITCH.

3-19. This toggle switch applies or removes ac line input power to the instrument. When ON, an indicator lamp, located next to the switch, is lit. Power for the lamp is obtained from the low voltage power supply. Both sides of the ac power line input are interrupted when switched to OFF.

3-20. HORIZONTAL DISPLAY.

3-21. Either of two modes of operation can be selected with this control. It selects the origin of the input signal applied to the horizontal amplifier. When INT is selected, the input signal to the horizontal amplifier is obtained from the time base plug-in. With the DISPLAY control positioned to EXT CAL, the sweep signal input from the plug-in is disconnected, and the EXT INPUT signal is used to develop the display sweep.

Note

Time base plug-ins are normally adjusted to provide a sweep length greater than 10 divisions. Refer to the applicable time base operating and service manual for adjustment information.

3-22. HORIZONTAL EXTERNAL COUPLING.

3-23. An external input signal may be connected to the horizontal amplifier via the EXT INPUT BNC connector when DISPLAY is set to EXT. The coupling switch is used to select ac coupling (capacitive coupling) or dc coupling to the amplifier.

3-24. HORIZONTAL MAGNIFIER.

3-25. This switch controls the gain of the horizontal amplifier in three steps. When INT DISPLAY is selected and MAGNIFIER is set to X1, the displayed sweep speed is as selected at the time base plug-in. When switched to X5, the gain is increased five times, and when set to X10, the gain is increased 10 times. Time base selected sweep speeds are thus increased X5 or X10 the indicated sweep speed.

3-26. When an EXT INPUT signal is selected to drive the horizontal amplifier, 1 volt of signal will result in 1 division of deflection in X1, 5 divisions of deflection in X5 and 10 divisions of deflection in X10.

3-27. EXTERNAL SENS.

3-28. The deflection factor of an external input signal can be continuously varied to decrease deflection by a factor of approximately 10 by using this control. When the vernier is in the maximum clockwise position (CAL detent), the horizontal amplifier is calibrated to provide 1.0 V/div deflection in the X1 magnifier range, 0.25 V/div in the X5 range, and 0.1 V/div in the X10 range. Counterclockwise rotation from the CAL POSITION decreases the uncalibrated gain.

3-29. REAR PANEL CONTROLS AND CONNECTORS.

3-30. Rear panel controls and connectors are identified and described in Figure 3-1. Additional information regarding these is explained below in greater detail.

3-31. OUTPUTS.

3-32. Four BNC connectors on the rear panel of the Model 180C/D are provided to supply signals from the time base or sampling plug-in to external equipment. The low impedance outputs are isolated from the high impedance input signals. The period of the signal output is directly related to the main and delayed sweep speed selected for the time base plug-in or the vertical and horizontal outputs when used with sampling plug-ins. Refer to the operating and service manual for the plug-in to determine signal identification.

3-33. The time base output of the MAIN SWEEP OUTPUT and the DELAYED SWEEP OUTPUT is a positive-going ramp of about 5 volts amplitude. The time base output of the MAIN GATE OUTPUT and the DELAYED GATE OUTPUT is a negative-going pulse of about 2.5 volts amplitude. These outputs can supply 3 mA and will drive impedances as low as 1000 ohms without distortion.

3-34. Z-AXIS INPUT.

3-35. An external signal can be utilized to control the CRT intensity. The intensity modulation signal is applied directly to the CRT intensity gate amplifier. A pulse of approximately +2V amplitude and a width of at least 50 nanoseconds or a +2V continuous wave (cw) input of 10 MHz or lower will blank a trace of normal intensity. Input of a negative signal can be used for display intensification.

3-36. AC LINE INPUT.

3-37. A three-conductor ac power cord is provided for ac input. A power line ground is obtained through the power cord. Also located on the rear panel is the SELECTOR line slide switch which allows operation from either 115V or 230V ac line power. Fuses are provided for both 115V and 230V operation, and must be changed to the proper value when line input is switched.

3-38. PHASE/BANDWIDTH SWITCH.

3-39. A PHASE/BANDWIDTH switch is located within the instrument on the horizontal amplifier assembly. The instrument top cover must be removed for access to this switch. Positioning the PHASE/BANDWIDTH switch to PHASE causes an external horizontal input signal to be delayed the same amount of time as the vertical input signal. This delay allows the Model 180C/D to be used for phase measurement. The switch should always be in the BANDWIDTH position unless the instrument is being used for phase measurement.

3-40. PLUG-IN UNITS.

3-41. The Model 180C/D Oscilloscope requires time base and vertical or sampling plug-in units. The deflection sensitivity of the CRT may vary slightly with different units. Vertical plug-ins should be calibrated when first installed or when shifted between oscilloscopes. The time

base and vertical plug-ins must be locked together prior to insertion into the Model 180C/D. Consult the respective plug-in operating and service manuals for operation and capability information. Table 3-1 lists the plug-ins currently available.

3-42. PHASE MEASUREMENT.

3-43. Section V of this manual contains the adjustment procedure. Accurate phase measurements may be made at frequencies up to 100 kHz.

Table 3-1. Available Plug-ins

| Vertical Plug-ins | | | | | | | | | Sampling (Vertical Section) | | |
|----------------------------|-----------------------------------|--------------------------|----------------|-----------------------|----------------|----------------|-----------------------|---------------------|--------------------------------|------------------|----------------|
| Model No. | 1801A | 1803A | 1804A | 1805A | 1806A | 1807A | 1808A | 1809A | 1810A | 1815A/B | 1811A |
| Bandwidth MHz | 50 | 40 (30) | 50 | 100 | 0.5 | 35 | 75 | 100 | 1 GHz | 4 or 12.4 GHz | 4 or 18 GHz |
| Min. deflection factor/div | 5 mV (500 uV opt 001 cascaded) | 10 mV (1 mV cascaded) | 20 mV | 5 mV | 100 uV | 10 mV | 5 mV | 10mV | 2 mV | 5 mV | 2 mV |
| Channels | 2 (opt 001, 1 cascaded) | 1 diff | 4 | 2 (1 cascaded) | 2 (both diff) | 2 | 2 | 4 | 2 | 1 | 2 |
| Input RC | 1 MΩ/ 25 pF | 1 MΩ/ 27 pF | 1 MΩ/ 25 pF | 1 MΩ/ 13 pF or 50Ω | 1 MΩ/ 45 pF | 1 MΩ/ 27 pF | 1 MΩ/ 12 pF or 50Ω | 1MΩ/ 12pF or 50Ω | 50Ω | 50Ω | 50Ω |
| Differential input | yes | yes (with dc offset) | no | yes | yes | yes | yes | yes | yes | no | yes |

| Time Base Plug-ins | | | | | Sampling (Time Base Section) | | | TDR | |
|-------------------------|--|-----------------|----------------|----------------|---------------------------------|-------------------------------|-------------------------------|--|---|
| Model No. | 1820C | 1821A | 1824A | 1825A | 1810A | 1815A/B | 1811A | 1818A | 1815A/B |
| Ext Trig Freq. (MHz) | 150 | 100 | 150 | 150 | <1 GHz | 18 GHz with trigger countdown | 18 GHz with trigger countdown | <160 ps risetime | <35 ps risetime |
| Int Trig Freq. | Determined by Vertical Amplifier Plug-in | | | | 1 GHz | | | TDR System | TDR |
| Sweep Speeds/div | 5 ns* 1 sec | 10 ns* 1 sec | 5 ns* 1 sec | 5 ns* 1 sec | 100 ps (expanded) - 50 usec | 10 ps - 1 usec | 10 ps (expanded) - 1 usec | Calibrated in feet, meters, and nano-seconds | 1815A calibrated in feet, 1815B calibrated in meters. |
| Delayed and mixed sweep | No | Yes | Expanded X100 | Yes | No | No | No | | |

*Includes X10 mainframe magnification.

3-44. To measure phase, set the internal PHASE/BANDWIDTH switch to PHASE and connect the input signals to the vertical amplifier input and the oscilloscope HORIZONTAL EXT INPUT. Set the HORIZONTAL DISPLAY to EXT. A display similar to Figure 3-2 will be observed. The size of the opening of the display is a relative indication of the phase difference of the input signals.

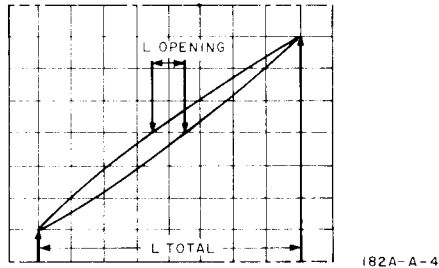


Figure 3-2. Phase Measurement

3-45. To obtain a more exact measurement of the phase difference, center the display in the X-axis and Y-axis. Increased measurement accuracy will be obtained by using horizontal and vertical deflection factors which result in maximum display size. The phase shift in degrees is determined by the following:

$$\theta = \sin^{-1} \left(\frac{L_{\text{opening}}}{L_{\text{total}}} \right)$$

3-46. As an example, assume that L_{total} is 8 divisions. If L_{opening} is 1 division, the phase shift is approximately 7 degrees.

Note

Make certain that the switch is returned to BANDWIDTH position after making phase measurements. This will allow full horizontal bandwidth operation.

3-47. BRIGHT DISPLAY PHOTOGRAPHY.

3-48. The standard CRT (aluminized P31 phosphor) used in the Model 180C/D has an accelerating potential of approximately 15 kV. This provides a bright display and makes possible a very high measurement capability of low duty cycle signals. Photographic writing speed is at least 1500 centimeters/microsecond using standard 10,000 ASA Polaroid® film, and a camera (with f/1.3 lens and a 1: 0.5 object-to-image ratio) without employing film-fogging techniques.

3-49. Higher writing speeds are readily achieved by using film-fogging techniques, a CRT with P11 phosphor, and

a camera with faster lenses. Additional information is provided in the following paragraphs and more detailed data can be obtained from Application Note 115, Principles of Cathode-ray Tubes, Phosphors, and High-speed Oscillography, available on request from HP Sales/Service Office.

3-50. PHOTOGRAPHIC WRITING SPEED.

3-51. The capability of an oscilloscope-camera-film system to record a high-speed one-time signal is described as the writing speed of the system. Many factors affect this performance. Basic information which will assist the operator in achieving the maximum capability of the system is provided here.

3-52. FILM. Type 410 Polaroid film has an ASA speed index of 10,000. This is an ultra high-speed film which is particularly useful for single-shot oscilloscope recording. The film is a high contrast type and produces very useable photographs for examination or reproduction. Its extreme sensitivity is helpful in recording the low light level obtained from CRT display of a very high speed transient waveform.

3-53. CRT SPOT SIZE AND SPEED. Uniformity of spot size over the CRT display area will result in best resolution and detail. The oscilloscope focus and astigmatism controls should be adjusted to obtain the sharpest spot for the intensity setting required.

3-54. Trace focus can vary at different sweep speeds. Oscilloscope focus should be set at the sweep speed and intensity level which will be used to display the signal to be photographed. When photographing a single-shot signal, the focus can be set by using a test signal input having a repetition rate of less than 10 milliseconds. As the speed of the spot increases, more exposure time or a higher intensity display may be required for film recording of the signal.

3-55. EXPOSURE. Evaluation of the signal to be photographed may make it desirable to overexpose one portion of a signal to capture the part which is of greater interest. This occurs because the speed of the spot (ie: spot writing speed) very directly affects the light output of the CRT. As an example: if the risetime of a fast pulse is the detail desired, display and photographic parameters could be set to capture this, while the flat-top portion might be overexposed and its detail uncertain. This occurs since the spot speed would be high for the risetime portion of the pulse and slower over the flat top portion.

3-56. CRT INTENSITY. The intensity level used to present a display for viewing or photography has a great effect on the oscilloscope writing rate and the proper photographic exposure. Small changes in intensity levels are usually compensated for by the overall range of film latitude. This results in a good exposure within a fairly wide range of exposure variables.

3-57. **SINGLE SHOT.** Signals of extremely short duration will require use of a high intensity level. The fast writing rate of the Model 180C/D is ideal for displaying single-shot signals. As a general rule, extended exposure times sufficient to make use of the phosphor after-glow will assist in recording very short duration signals.

3-58. CAMERA FOCUSING.

3-59. Make certain that the camera is focused properly, since decreased writing speeds will result from a defocused film image. The CRT calibration graticule is internally etched on the viewing face, and the trace and graticule are in the same object plane. Focusing the camera accurately on the graticule will provide the sharpness desired.

3-60. If it is necessary to use a large lens aperture, the depth of field is reduced and accurate focusing can become an important factor.

3-61. FILM POST-FOGGING.

3-62. After exposure to the displayed signal, a controlled exposure of Polaroid film to a light source can increase the effective writing speed. At very low light levels, little change in Polaroid film density occurs over considerable variation in light intensity. This occurs because near the threshold of film sensitivity, exposure and the resulting film contrast is a non-linear relationship. Additional exposure to light can effectively increase the low-level sensitivity of the film and provide greater viewing contrast.

3-63. Post-fogging is simple to accomplish with the Model 180C/D. The SCALE control provides this capability. It allows illuminating the CRT phosphor (and contrasting graticule) by flooding the face of the CRT with low-level excitation.

3-64. If the signal to be photographed is very fast, the post-fogging time should be longer than that required for maximum contrast of slower speed signals.

3-65. If desired, photography of the displayed signal and graticule may be accomplished simultaneously. Use of the SCALE control makes it unnecessary to illuminate the graticule by ultraviolet light, as provided in some cameras. It can be turned off, and the SCALE control can be quickly set to provide the desired level of graticule illumination.

3-66. PHOTOGRAPHIC PROCEDURE.

Note

When using high-speed ASA 10,000 film, allow the CRT phosphor to decay for 2 minutes after the camera viewing port is closed and before the photograph is taken. This will allow phosphor excitation by ambient light to decay and prevent film overexposure with long shutter times. (Allow 3 minutes if P11 CRT is installed.)

3-67. REPETITIVE SIGNAL.

- a. Adjust Model 180C/D, time base and vertical amplifier controls to obtain the desired signal display.
- b. Adjust INTENSITY and FOCUS for sharpest trace.
- c. Adjust SCALE for desired graticule contrast.
- d. Expose film using shutter and aperture settings based on type of film employed and camera characteristics.

3-68. SINGLE SIGNAL.

- a. Adjust Model 180C/D time base and vertical amplifier controls to obtain the desired signal display using a test signal to establish vertical deflection, trigger control and sweep time settings.
- b. Adjust INTENSITY and FOCUS for sharpest trace. Use a low repetition rate signal or single-shot signal in single-sweep operation while making these adjustments so that best approximation of the desired signal parameters is obtained.
- c. Set camera controls for desired operation, usually time or bulb.
- d. Open camera shutter and allow sweep to trigger on signal.
- e. Adjust SCALE control for desired level of graticule illumination and post-fog film if necessary for extremely fast signals. A very low level of illumination, small lens opening and fast shutter speed will provide adequate post-fogging.

Note

Increased writing speed can also be obtained by a controlled exposure of Polaroid film to a light source before exposure to the displayed signal. This is called pre-fogging. Either post-fogging or pre-fogging techniques may be used. Results are approximately equivalent.

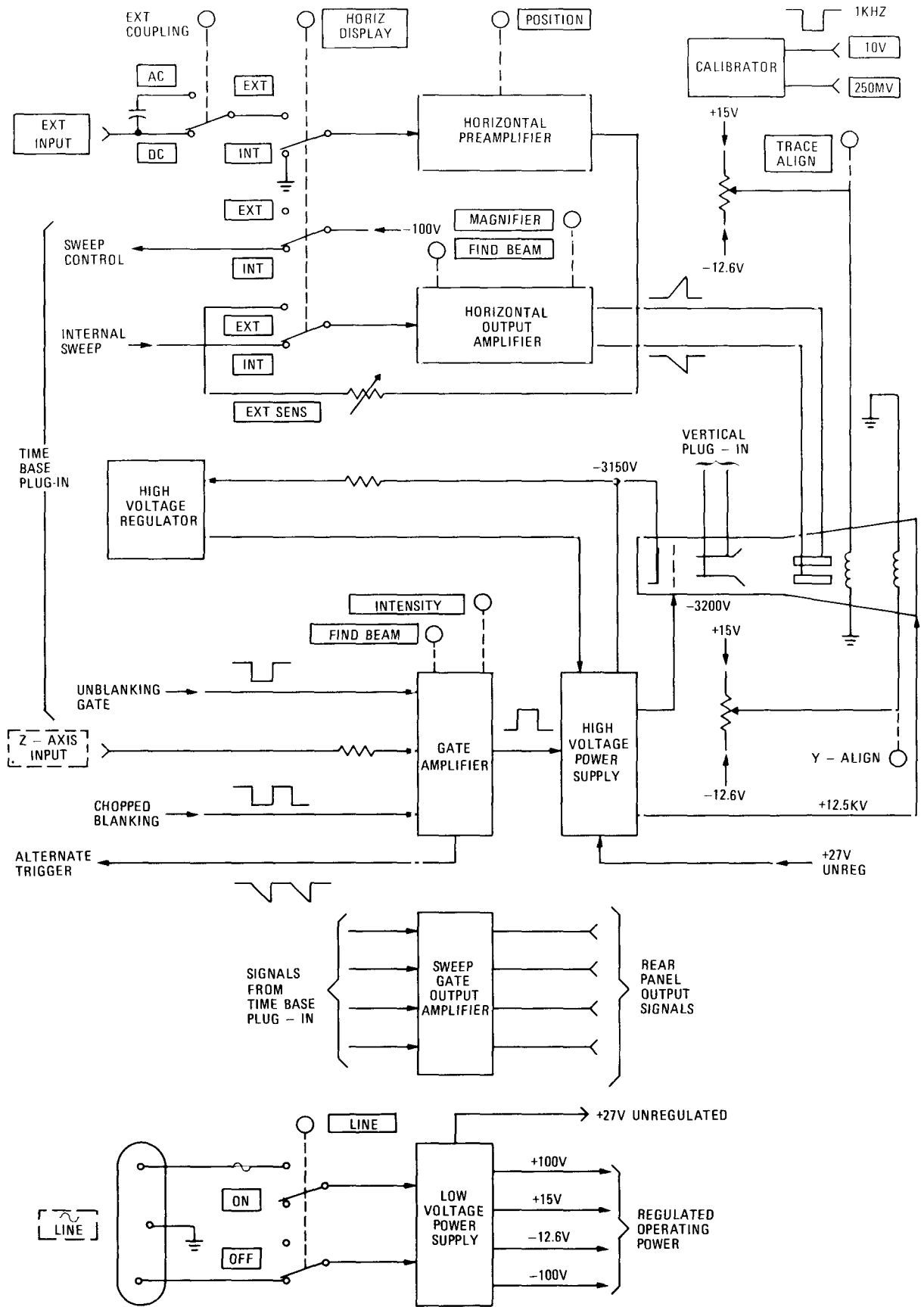


Figure 4-1. Model 180C/D Block Diagram

180C/D-L-8
(Changed 09-74)

SECTION IV

PRINCIPLES OF OPERATION

4-1. INTRODUCTION.

4-2. This section provides information about the circuits used in the Model 180C/D and how they operate. Refer to the overall block diagram (Figure 4-1) and the schematics in Section VIII while reading the text.

4-3. GENERAL DESCRIPTION.

4-4. The Model 180C/D is an X-Y axis display instrument designed to be used with a plug-in vertical amplifier and a plug-in time base generator, a sampling plug-in or a TDR plug-in. The instrument contains the CRT and its controls, the low voltage and high voltage regulated power supplies, a horizontal amplifier, and a gate amplifier. A sweep-gate output amplifier and a calibrator are also included.

4-5. To obtain a useful display on the CRT, three internal signals are necessary: vertical deflection, horizontal deflection, and intensity. The signal required for vertical deflection (Y-axis) of the CRT is supplied from a plug-in vertical amplifier. This signal is connected directly from the vertical plug-in to the CRT vertical deflection plates. The horizontal (X-axis) deflection signal is generated by the time base plug-in. It is further amplified by the oscilloscope horizontal amplifier in the mainframe before being applied to the CRT horizontal deflection plates.

4-6. The signal for CRT intensification must be time coincident with the horizontal deflection signal to increase the CRT brightness as the beam is swept through the CRT display area. This intensity determining signal is called the unblanking gate. It is developed in the time base plug-in and amplified by the gate amplifier for application to the CRT control grid.

4-7. Signals for horizontal deflection and intensity modulation may also be applied to the oscilloscope from external sources other than the plug-in units. External input jacks are provided for this purpose.

4-8. INPUT POWER.

4-9. Either 115V or 230V ac ($\pm 10\%$), single phase, 48 to 440 Hz can be applied as operating power. A rear-panel SELECTOR switch allows operation from either input line voltage. This switch connects two windings of the instrument power transformer in parallel for 115V operation. The windings are placed in series for 230V operation.

4-10. With power applied to the power transformer primary windings, several secondary voltages are produced. Rectified, filtered and regulated as required, they are used as the source of power for the various circuits of the oscilloscope and for operation of the vertical and time base plug-ins.

4-11. HORIZONTAL DEFLECTION.

4-12. The horizontal amplifier may be used with either internal or external deflection signal sources. Positioning the DISPLAY switch to INT arranges the circuitry to operate from signals supplied from time base plug-in. In this condition, $-100V$ power is applied to the time base plug-in, allowing it to operate and produce both a sweep signal and an unblanking gate signal.

4-13. The sweep signal from the time base plug-in is coupled to the oscilloscope horizontal output amplifier. Here it is converted to a differential signal, amplified, and applied to the CRT horizontal deflection plates.

4-14. Horizontal position of the X-axis sweep signal is controlled at the input to the first stage of the horizontal output amplifier. Two potentiometers are used to provide fine and coarse positioning control.

4-15. Horizontal amplifier gain is controlled by the MAGNIFIER switch. Three settings can be selected: X1, X5, or X10. With X1 selected, the sweep speed corresponds to the selected time base plug-in sweep speed. In X5 operation, the sweep speed is five times that selected at the time base plug-in; while in X10, the sweep speed is ten times that selected at the time base plug-in.

4-16. The unblanking gate from the time base plug-in is coupled to the gate amplifier where it is summed with the Z-axis input and chopped blanking signals (if they are applied). The resulting signal is amplified and coupled through the high voltage supply to the CRT control grid to set the intensity of the displayed signals.

4-17. At the end of each unblanking gate, the gate amplifier produces an alternate trigger signal. This signal is coupled to the vertical plug-in and is a negative-going pulse. The alternate trigger is used by the vertical plug-in to synchronize the channel switching of multichannel vertical plug-ins.

4-18. With the DISPLAY switch set to EXT, operating power ($-100V$) is removed from the time base plug-in. Without this $-100V$, the time base plug-in does not produce an internal sweep signal or an unblanking gate. The vertical amplifier plug-in operates normally.

4-19. An externally applied signal for horizontal deflection may be connected to the EXT INPUT jack. The EXT SENS controls the externally applied signal and provides a variable gain adjustment for setting the X-axis display size. The external coupling switch provides for either direct (DC) or capacitive (AC) coupling of the external input signal. The external signal is then coupled to a preamplifier, differentially amplified by the output amplifier, and applied to the CRT for horizontal deflection. Positioning and horizontal gain controls also function with external input signals.

4-20. CIRCUIT DETAILS.

4-21. INPUT POWER (SCHEMATIC 2).

4-22. Input line power is supplied by a detachable, three-conductor power cord. This cord has a standard plug for wall outlet connection, providing an electrical ground. Instrument power input is via a rear-panel IEC connector. Both sides of the line power are filtered immediately at the power input connector.

4-23. The line power transformer has two primary windings. The rear panel SELECTOR switch connects these windings in parallel for 115V operation and in series for 230V operation. Fuse F1 protects against excessive input current. When changing line voltage, the fuse must be changed. With the front panel LINE toggle switch S1 in the ON position, power is applied to the low voltage power supply transformer and LINE lamp DS1 lights.

4-24. LOW VOLTAGE POWER SUPPLY (SCHEMATIC 2).

4-25. The low voltage supply produces four regulated voltages for use throughout the oscilloscope and the plug-ins: +100V, -100V, +15V and -12.6V. Each supply is referenced to the +100V supply for regulation purposes with the +100V supply referenced to a 9-volt temperature-compensated zener diode A1A2VR2. The +100V and -100V supplies are also foldback current limited, providing short-circuit protection.

4-26. A simplified block diagram of a typical low voltage power supply is shown in Figure 4-2. Unregulated alternating power is supplied by the transformer, bridge rectified and filtered. Changes in output voltage caused by input voltage variation or load changes are detected by the voltage sensor. Compared against a voltage reference, changes in output voltage are detected and applied as feedback to the driver which controls the series regulator. The series regulator acts as a variable resistance, and operates to increase its series resistance if the output voltage is high or decrease resistance when the output voltage is low. The action of the series regulator is to maintain output voltage at a constant level.

4-27. Current sensing takes place simultaneously with voltage sensing. If the load current increases above a preset level, the current sensor detects the increased voltage drop across the series resistor. This increased voltage causes the driver to bias the series regulator off.

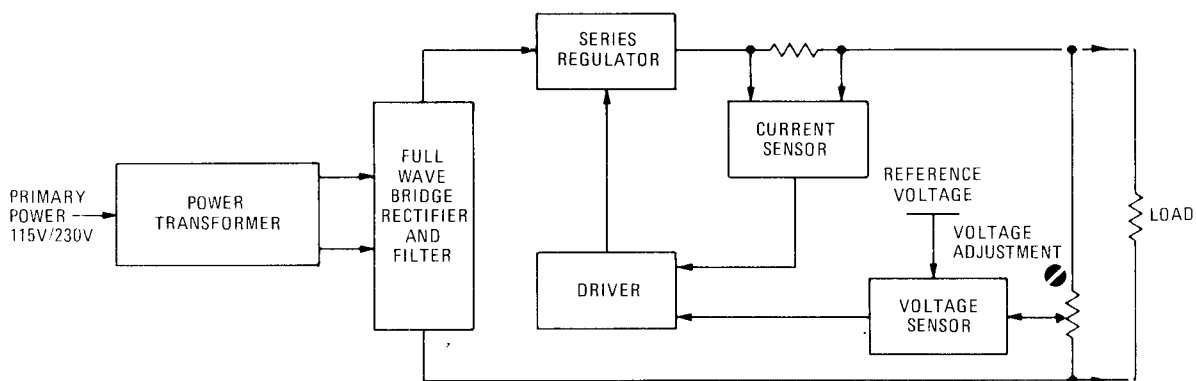


Figure 4-2. Simplified Low Voltage Power Supply

4-28. +100-VOLT SUPPLY. The +100V supply is used throughout the LVPS as a reference for the other supplies. It is both voltage and current regulated. Refer to the LVPS schematic while reading the following explanation.

4-29. One of the secondary outputs of A1T1 is coupled to a bridge rectifier consisting of A1A1CR5-CR8. This ac input is full-wave rectified, filtered by A1C1, and applied through fuse A1F1 to the regulator assembly. Fusing protects the rectifiers and transformer if a regulator malfunction results in excessive current flow. The regulator supplies sufficient current to the load to keep the output voltage at a constant +100 volts. Series regulator transistor A1Q1 is used to determine the amount of current which will be supplied to the load to maintain the output voltage at +100V. Variations in output voltage to changes in load or input line voltage are sensed by a differential comparator, A1A2Q3 and A1A2Q4. If the output of the +100V supply changes, the full amount of the voltage change is applied to A1A2Q3 by A1A2VR2, and A1A2Q4 senses only a small part of the change in output voltage. The +100V adjustment potentiometer A1A2R11 sets the operating point of A1A2Q4. The output of the differential comparator is coupled to driver A1A2Q1, amplified and used to control series regulator A1Q1.

4-30. A current limiting function is also part of the +100V supply operation. All current furnished by the supply flows through A1A2R4. The voltage drop across this resistor depends on the amount of current required. As the current requirements increase to the limit of the supply capability, the voltage drop across A1A2R4 is used to set A1A2Q2 into conduction. Since the collector of this transistor and the output of differential comparator A1A2Q2 and A1A2Q4 are coupled to drive A1A2Q1, the amount of current flowing, as well as voltage variations, controls the operation of series regulator A1Q1.

4-31. Resistors A1A2R2 and A1A2R3 are used in conjunction with A1A2R4 to set up a condition for current foldback operation. In this type of operating condition, fully regulated voltage will be provided to the limit of the supply capability. When current requirements exceed capability, the output voltage will begin to drop and the load will receive less current. If the output of the supply is short-circuited, the output current will be limited to considerably less than the current available at full loading.

4-32. The +100V supply is protected for turn-on and turn-off voltage transients. Diodes A1A2CR1 and A1A2CR2 provide transient protection for the differential amplifier, A1A2Q3 and A1A2Q4. To prevent the +100V supply from going negative in the event of an accidental short circuit, diode A1A2CR3 provides reverse voltage protection.

4-33. A separate supply is used to obtain a reference voltage for the +100V regulator. This supply is used only within the LVPS regulator. The ac voltage from pins 11

and 12 of A1T1 is bridge rectified by A1A1CR1-CR4 and filtered by A1A1C1. The supply produces about +10V which is added to the +100V supply to provide a reference source for the +100V regulator. Zener diode A1A2VR1 stabilizes the collector voltage for A1A2Q3.

4-34. +15-VOLT SUPPLY. This supply provides three voltages. Approximately 30V p-p is furnished for time base line synchronization; a rectified and filtered but unregulated +27V is furnished for operation of the HV oscillator; and a regulated +15V is produced for use in the mainframe and plug-ins.

4-35. The secondary voltage developed by the power transformer at pins 13 and 14 is full-wave bridge rectified by A1A2CR9-A1A2CR12 and filtered by A1C2. Diode A1A1CR21 provides reverse voltage protection. Series regulator A1Q2 determines the amount of current supplied to the load to maintain the output voltage at +15V. Variations in output voltage are sensed by differential comparator A1A2Q7 and A1A2Q8. A reference voltage derived from the +100V regulated supply is applied to A1A2Q7, while A1A2Q8 samples any change in output voltage due to load changes. The +15V adjustment potentiometer A1A2R20 sets the operating point of A1A2Q8. The output of the differential amplifier is coupled to driver A1A2Q5 and used to control the series regulator.

4-36. Current drawn from the supply flows through A1A2R13. The voltage drop across this resistor is used to control the conduction of A1A2Q6, which has its collector coupled to driver A1A2Q5. Thus, large currents sensed by A1A2Q6 and voltage changes sensed by the differential amplifier are both fed to the driver, A1A2Q5, to control series regulator A1Q2. Protection from turn-on or turn-off transients is provided by A1A2CR4. Fuse A1F2 protects the LV rectifier and transformer in the event of a regulator short circuit.

4-37. -12.6-VOLT SUPPLY. This supply operates in a manner similar to the +15V supply. Changes in output voltage are sensed by differential comparator A1A2Q11 and A1A2Q12. Amplified and coupled to driver A1A2Q9, voltage variations are used to control the conduction of series regulator A1Q3. Current limiting action is provided by A1A2R22 and A1A2Q10. Fuse A1F3 protects against damage due to regulator failure and A1A2CR5 is used for voltage transient protection.

4-38. -100-VOLT SUPPLY. Operation of the -100V supply is similar to the +100V supply. A1A2Q15 and A1A2Q16 operate as a differential comparator with A1A2Q16 sensing any change in output voltage. Transistor A1A2Q14 with A1A2R33 provides current limiting. Current foldback operation reduces the current output in the event of a short circuited load. Voltage and current variations are coupled to driver A1A2Q13 which is used to control the conduction of series regulator A1Q4. Adjustment of the supply output voltage is accomplished with potentiometer A1A2R40, and diode A1A2CR7 provides reverse voltage protection. The differential comparator is voltage transient protected by A1A2CR6.

4-39. SUPPLY CURRENT AVAILABLE. The oscilloscope power supplies may be used to furnish operating power for vertical or time base plug-ins designed by the user. Table 4-1 lists the maximum current available from each power supply to the plug-in compartment of the oscilloscope. There is no minimum current requirement for any supply.

Table 4-1. LVPS Current Capabilities

| Power Supply | Maximum Safe Current Available |
|--------------|--------------------------------|
| +100 VDC | 160 mA |
| +15 VDC | 750 mA |
| -12.6 VDC | 750 mA |
| -100 VDC | 80 mA |

from the vertical amplifier plug-in and an external input Z-axis signal. These three signals may be present singly or simultaneously, depending on control settings and signals applied. (See Figure 4-3.)

4-42. The unblanking gate is first applied as a current to A3Q11, a common-base amplifier, and then combined in the low impedance emitter circuit of A3Q1 with a current established by the INTENSITY, FIND BEAM, and DISPLAY front-panel controls. Depressing FIND BEAM shunts the adjustable INTENSITY potentiometer to increase emitter current and produce an intensified beam. Setting HORIZONTAL DISPLAY to EXT supplies additional current from the -100V supply. This establishes an unblanking current level to compensate for removal of the internal unblanking signal from the time base plug-in, and establishes a nominal brightness level.

4-40. GATE AMPLIFIER (SCHEMATICS 4 and 5).

4-41. The inputs to the gate amplifier are an unblanking gate from the time base plug-in, a chopped blanking signal

Note

The intensification function of the FIND BEAM switch is removed on instruments with a P11 phosphor CRT (Option 011 and Option 611). Additional information is provided in Section VII.

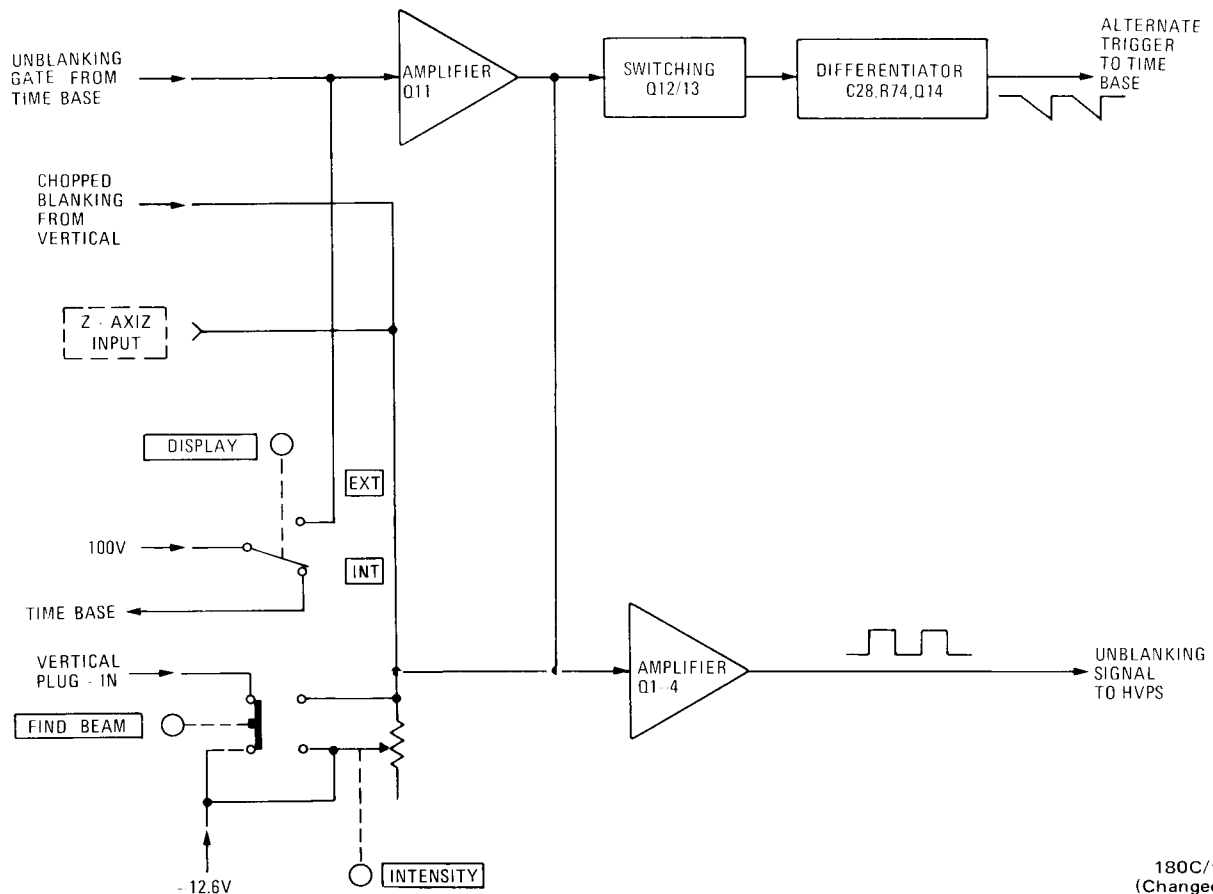


Figure 4-3. Gate Amplifier Block Diagram

180C/D-L-10
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4-43. The output voltage of A3Q1 is coupled through emitter follower A3Q2 to complementary amplifier A3Q3 and A3Q4. Diodes A3CR2 through A3CR4 provide a clamping action to prevent overdriving the amplifier.

4-44. A large negative feedback from the collectors of A3Q3 and A3Q4 ensures that the amplifier gain is very stable. Capacitors A3C3 and A3C5 provide for adjustment of the high frequency feedback and gain. Decreasing the capacitance of A3C3 decreases the high frequency feedback and increases high frequency gain, while decreasing the capacitance of A3C5 increases high frequency feedback and decreases high frequency gain.

4-45. Complementary amplifier transistors A3Q3 and A3Q4 are protected from the high voltage present at the CRT control grid circuit. Diodes A3CR6 through A3CR9 act to isolate these transistors in the event of high voltage transients which might otherwise be fed back and damage the transistors. The output of the complementary amplifier is coupled through the high-voltage power supply for application to the CRT control grid.

4-46. An alternate trigger signal is used by multichannel vertical amplifier plug-ins to initiate channel switching action. Transistors A3Q12 and A3Q13 function as a fast-acting switch. With A3Q12 normally conducting and A3Q13 nonconducting, the unblanking gate trailing edge causes A3Q13 to conduct and A3Q12 to cease conducting. The switching output is differentiated and applied to A3Q14, providing a negative pulse for vertical amplifier channel switching.

4-47. Z-AXIS INPUT. The input impedance to the Z-axis is approximately 5100 ohms. An input signal of approximately +2 volts amplitude is adequate to blank a trace of normal viewing intensity, while an input signal of -2 volts will provide unblanking. Since the gate amplifier has a Z-axis voltage gain of about 7, a 2-volt input will result in a 14-volt change at the CRT grid. This is sufficient to cause a large intensity change.

4-48. HIGH VOLTAGE POWER SUPPLY (SCHEMATIC 5).

4-49. The HVPS generates three regulated voltages. These are applied to the cathode (-3150V), control grid ($\approx -3200V$), and post accelerator (+12.5 kV) of the CRT to provide the accelerating potential required to produce excitation of the CRT phosphor for a visible trace. All three voltages are regulated by sampling the -3150-volt supply.

4-50. The HVPS is shown in simplified form in Figure 4-4. See this figure and schematic 5 in Section VIII while reading the following explanation of HVPS operation.

4-51. HIGH VOLTAGE OSCILLATOR. Transistor Q1 with transformer A5T1 is used as an oscillator to generate an ac voltage at approximately 50 kHz. A feedback winding on the transformer provides the regenerative coupling to sustain oscillation. Operating power is provided by the unregulated +27V supply. The supply source is fused and decoupled.

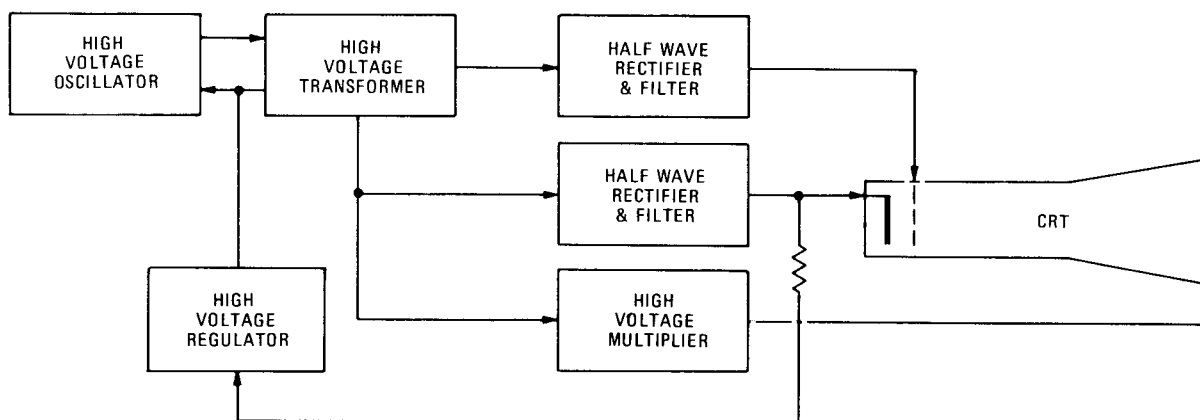


Figure 4-4. High Voltage Power Supply Block Diagram

180C/D-L-11
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4-52. HIGH VOLTAGE RECTIFIERS. The oscillator 50 kHz output is stepped up by the secondary windings of A5T1. Two half-wave rectifiers and a voltage multiplier circuit are used to develop the high voltages necessary for CRT operation.

4-53. CRT grid voltage is rectified by A5CR1 and the pulsating dc is filtered. The lower limit of display intensity, as determined by the CRT grid voltage, is set by A5R2. Approximately -3200V is developed for application to the CRT grid.

4-54. A secondary winding of A5T1 is used as the high voltage source for the CRT cathode and the CRT post accelerator. The full potential developed by the winding is rectified and filtered by the H.V. Multiplier assembly, A6, for application to the CRT post accelerator. This assembly develops approximately 12.5 kV.

4-55. The full secondary voltage is also rectified by A5CR2, filtered, and applied to the CRT cathode. The H.V. regulator is adjustable to ensure that cathode voltage is maintained at -3150V . To eliminate cathode to filament breakdown, the filament is brought to cathode potential by R4. A3VR3 and A3VR4 prevent the grid from becoming positive in relation to the cathode.

4-56. HV REGULATION. A portion of the rectified and filtered CRT cathode voltage is used to control the conduction of A3Q8. The -3150V cathode potential and the $+100\text{V}$ supply are applied across a resistor network consisting of A3R51, A3R48 and A3R49. The bias of A3Q8 is adjusted by A3R49. Any variation of the -3150V supply is sensed by A3Q8 and amplified by A3Q9 and A3Q10. The regenerative feedback winding of A5T1 for high voltage oscillator Q1 sets the base bias level of Q1. This controls the amplitude of oscillation.

4-57. The regulator output, as set by A3R49 and controlled by the divided output of the -3150V supply, is used to control the operating level of the oscillator through the feedback winding of A5T1. Thus, any variation in the high voltage output is used to vary the oscillator drive and maintain all high voltage outputs at a constant level.

4-58. If, for example, the CRT cathode voltage tends to decrease (go more positive), a positive-going signal is applied through the regulator to the base of oscillator Q1. The oscillator then conducts for a greater period of time, causing a large voltage change at the primary of A3T1. This increases the secondary voltage to restore cathode voltage to the desired level.

4-59. CALIBRATOR (SCHEMATIC 4).

4-60. The calibrator uses a free-running multivibrator whose output is a 1-kHz square wave. A voltage divider provides the output at two amplitudes: 10 volts and 250 millivolts. The calibrator output is a negative-going waveform.

4-61. Transistors A3Q6 and A3Q7 oscillate at a rate which is determined by the time constant of associated RC components. A3CR11 disconnects the collector of A3Q7 from the negative discharge of A3C15 as A3Q7 cuts off. This provides a faster risetime. Diodes A3CR12 and A3CR13 protect the transistors from voltage breakdown. A filter network, A3L2 and A3C16, isolates the the multivibrator from the -100V supply.

4-62. With A3Q7 conducting, the voltage divider consisting of A3R34, A3R36, and A3R35 divides the -100V supply voltage. The values selected for these resistors permit the output of 10V and 250 mV. These two outputs are available at the instrument front panel and may be used for probe compensation adjustment and horizontal or vertical deflection factor checks.

4-63. SWEEP GATE OUTPUT AMPLIFIERS (SCHEMATIC 7).

4-64. The output amplifiers are four emitter followers, A7Q1-A7Q4. They provide isolated outputs of time base, sampling, or TDR generated signals to rear-panel connectors. The operating and service manual for the plug-in will provide information on the characteristics of the output signals.

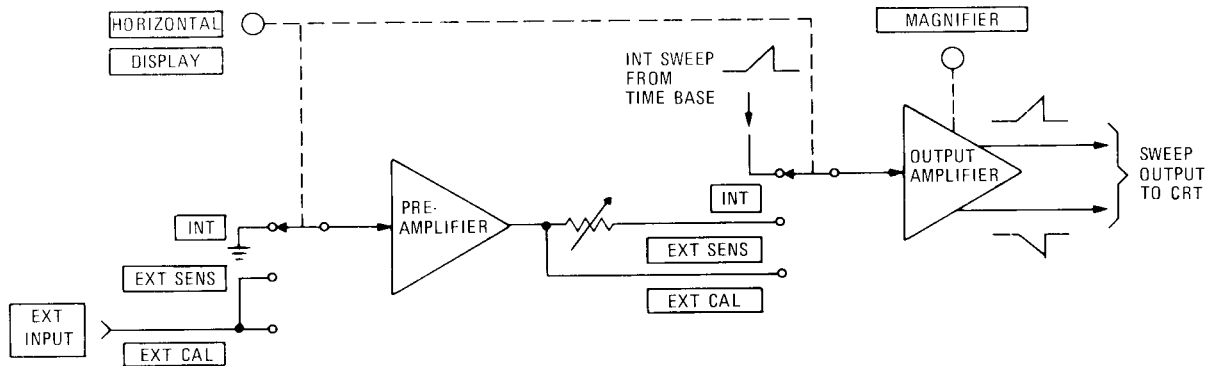
4-65. The four time base signal inputs to these amplifiers are the main sweep, delayed sweep, main gate, and delayed gate. The emitter followers convert the high impedance inputs to low impedance outputs and isolate the time base signals from external equipment.

4-66. HORIZONTAL AMPLIFIER (SCHEMATIC 3).

4-67. The input to the horizontal amplifier is either an internal sweep signal from the horizontal plug-in or an external signal applied to the HORIZONTAL EXT INPUT jack. Positioning DISPLAY to INT grounds the input of the preamplifier and disconnects the external signal preamplifier from the output amplifier. The internal sweep signal is connected through the horizontal DISPLAY switch to the output amplifier. (See Figure 4-5.)

4-68. Selecting horizontal DISPLAY EXT disconnects the internal sweep signal and connects the external signal through the preamplifier to the output amplifier. With EXT selected, the amplitude of the signal from the preamplifier is adjustable by rotating the EXT SENS control. When the control is in the EXT CAL detent position, the output amplitude of the amplifier is directly determined by the input amplitude.

4-69. The selected signal is applied to the output amplifier and summed with a current established by the horizontal POSITION and FINE controls. A horizontal MAGNIFIER allows the gain to be increased by a factor of 5 (X5), a factor of 10 (X10), or to be directly related to the amplitude of the input signal (X1). The resulting current is converted to a differential voltage signal, amplified, and applied to the horizontal deflection plates of the CRT.



180C/D-L 12
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Figure 4-5. Horizontal Amplifier Block Diagram

4-70. Refer to the schematic of the horizontal amplifier for the more detailed circuit explanation which follows.

4-71. An external signal applied to the preamplifier is coupled through a 3:1 divider composed of A2R4 and A2R6 to the gate of an FET, A2Q1. The high input impedance of A2Q1 in conjunction with the voltage divider and A2R5 provides a 1-megohm load to the external circuit. Transistor A2Q2 is an emitter follower. The output of A2Q2 is coupled through the horizontal EXT SENS control and the horizontal DISPLAY switch. The amount of current supplied to A2Q3 is determined by A2R12 and the setting of the EXT SENS control.

4-72. The bandwidth of the preamplifier is decreased when the Phase/Bandwidth switch is placed in the Phase position. This is accomplished by connecting A2C8 and A2C9 into the circuit. The phase shift caused by the decreased bandwidth compensates for the signal time delay from the delay line in the vertical amplifier plug-in. This allows accurate X-Y phase measurements to be made up to 100 kHz.

4-73. A vernier balance adjustment, A2R14, is used to establish a zero input voltage reference level. This eliminates horizontal dc shift as the EXT SENS control is rotated. The EXT SENS provides a range of control of the deflection factor when an EXT INPUT signal is used for horizontal deflection. It has sufficient range to reduce the deflection factor by at least 10.

4-74. The input signal to A2Q3 is summed in the low impedance emitter circuit with a current established by the horizontal POSITION and FINE controls. The output of A2Q3 has both a static dc level as determined by the POSITION and FINE controls and an active level as determined by the input signal.

4-75. The output of A2Q3 is coupled through emitter follower A2Q4 to drivers A2Q5 and A2Q10. The low impedance necessary to drive A2Q5 is provided by A2Q4, and A2Q9 maintains a similar low impedance voltage source for A2Q10.

4-76. The position of the MAGNIFIER switch, S3, selects between three values of emitter degeneration for A2Q5 and A2Q10 and controls the gain of these stages. As degeneration decreases, gain increases. The gain selection is accomplished by the setting of the MAGNIFIER control, with settings of X1, X5, and X10. Each has an adjustable element to provide for accurate calibration of the gain. With X1 magnification selected, A2R36 is used to set the gain. A2R34 sets the gain in X5, and A2R32 sets the X10 gain. The emitter potentials of A2Q5 and A2Q10 are balanced by A2R38. This prevents horizontal dc shift as the MAGNIFIER control is switched between ranges.

4-77. The differential signal at the collectors of A2Q5 and A2Q10 is applied to current-fed operational amplifiers A2Q6/A2Q7/A2Q8 and A2Q11/A2Q12/A2Q13. The amplifier low frequency gain is very stable because of the large amount of negative feedback employed. High frequency feedback for each side of the amplifier is separately adjustable.

4-78. High frequency feedback from the collectors of A2Q7/A2Q8 to the base of A2Q6 is controlled by A2C12 and high frequency feedback from the collectors of A2Q12/A2Q13 to the base of A2Q11 is controlled by A2C20. The ratio of feedback for each side of the amplifier is adjusted by A2C21. Amplifier output is a voltage which is used to drive the horizontal deflection plates of the CRT.

4-79. Diodes A2CR3/A2CR4 and A2CR7/A2CR8 limit the output to the deflection plates and prevent over-driving. Diodes A2CR2 and A2CR6 prevent A2Q5 and A2Q10, respectively, from saturating.

4-80. Depressing the FIND BEAM control disables diodes A2CR7 and A2CR8 and blocks the signal to A2Q11. The differential gain is effectively cut in half, and the horizontal deflection of the beam is confined to the limits of the CRT.

4-81. POWER SUPPLY DECOUPLING.

4-82. Decoupling networks are used on each etched circuit assembly for the supply voltages. The use of decoupling is important to prevent extraneous signals or noise from being introduced into circuitry from the power supplies or supply leads. Decoupling also prevents transients originating in other circuits from being introduced.

SECTION V

PERFORMANCE CHECK AND ADJUSTMENTS

5-1. INTRODUCTION.

5-2. This section provides a performance check procedure to determine if the Model 180C/D is operating within specifications and a procedure for adjustment and calibration. Physical location of the adjustments are shown in a foldout photograph at the end of this section and next to the adjustment procedure.

5-3. TEST EQUIPMENT.

5-4. Recommended test equipment is listed in Table 5-1. Test equipment having the required characteristics may be substituted. Use recently calibrated equipment to ensure proper results.

5-5. PERFORMANCE CHECK.

5-6. The purpose of the performance check is to determine if the instrument is operating within the specifications listed in Table 1-1. This check may also be used as part of an incoming quality assurance inspection, as a periodic operational check or to verify operation after repairs or adjustments have been made.

5-7. It is desirable to do the performance check in the sequence given since succeeding steps depend on control settings and results of previous steps. If desired, the checks may be accomplished individually by referring to the preliminary control settings and the preceding steps.

5-8. A performance check record is included at the end of these checks. As the initial performance check is accomplished, the actual readings should be entered on the form. The form may be removed from the manual and filed for future reference. Readings taken at a later date can be compared with the original performance check results.

5-9. PRELIMINARY SETUP.

5-10. Set line voltage SELECTOR switch, located on rear panel, to desired power line operating voltage (115V or 230V ac). Connect instrument to line power source and apply power by turning LINE power switch ON. Allow fifteen minutes for warm-up. Do not install plug-ins.

5-11. CALIBRATOR CHECK.

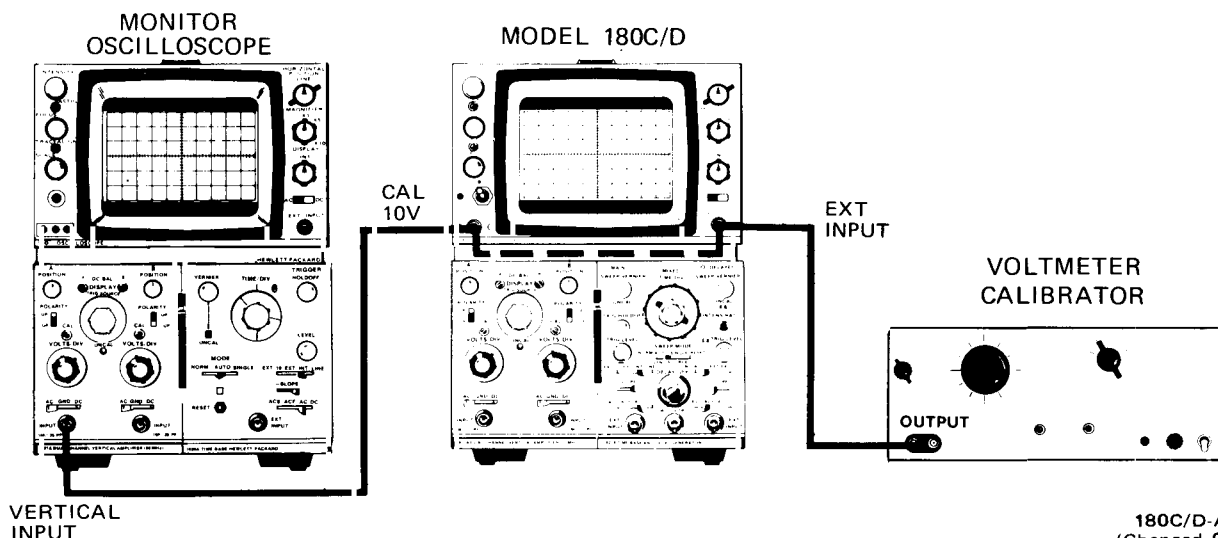
a. Set controls as follows:

| | |
|---------------------------|-----|
| MAGNIFIER | X10 |
| DISPLAY | EXT |
| HORIZONTAL Coupling | AC |

b. Connect 10V p-p signal from Voltmeter Calibrator to HORIZONTAL EXT INPUT (Figure 5-1).

c. Obtain horizontal trace by adjusting INTENSITY, FOCUS and POSITION controls.

d. Adjust HORIZONTAL DISPLAY to obtain displayed trace of exactly 10 divisions.



180C/D-A-1A
(Changed 09-74)

Figure 5-1. Calibrator Check

Table 5-1. Recommended Test Equipment

| Instrument | | Required Characteristics | Required For |
|--------------------------|--|---|---|
| Type | Model | | |
| Voltmeter Calibrator | HP 745A | 1V, 2V and 10V p-p $\pm 0.2\%$ | Calibrator Check Horizontal Magnifier Check |
| Monitor Oscilloscope | HP 180C/D w/1805A and 1825A plug-ins | Sensitivity 1 V/div Sweep speed < 3 usec Sweep output | Calibrator Check Gate Amplifier Response Adjustment |
| 10:1 Divider Probe | HP 10004D | $\pm 3\%$ | Gate Amplifier Response Adjustment |
| Digital Voltmeter | HP 3465A | ± 100 Vdc, $\pm 0.05\%$ | Low Voltage Power Supply Adjustment High Voltage Power Supply Adjustment |
| 1000:1 Divider Probe | HP K05-3440A | 3500 Vdc, $\pm 0.1\%$ | High Voltage Power Supply Adjustment |
| Square Wave Generator | HP 211B | 200 kHz, 1V p-p, risetime ≤ 30 ns | Transient Response Adjustment |
| Oscillator | HP 652A | 10 kHz-100 kHz, 10V p-p | Phase Adjustment Trace Alignment Adjustment Horizontal Bandwidth Check |
| Resistor: 40K ohms | HP Part No. 0698-6101 | 1/10%, 1/2W | Gain Adjustment |
| Time Mark Generator | HP 226A | 1-ns markers | Gain Adjustment Horizontal Linearity Adjustment |
| 50-ohm Tee | HP 1250-0781 | BNC | Phase Adjustment Transient Response Adjustment |
| Screwdriver | HP 8710-0900 | Posidrive | Cover Removal |
| BNC Cable | HP 10502A | 9 inch | Transient Response Adjustment |
| BNC Cable | HP 10501A | 44 inch | Phase Adjustment Transient Response Adjustment |

e. Disconnect Voltmeter Calibrator from EXT INPUT. Do not disturb HORIZONTAL DISPLAY.

f. Connect CALIBRATOR 10V output to EXT INPUT.

g. Note displayed trace of 10 ± 0.1 divisions. Trace should be set at low intensity to permit viewing sharply focused spots at both ends of trace.

h. Disconnect CALIBRATOR 10V output from EXT INPUT.

i. Observe CALIBRATOR 10V output using Monitor Oscilloscope.

j. Measure risetime of calibrator waveform (negative-going leading edge). It should be 3 usec or less. Risetime is measured at 10% to 90% amplitude points.

k. Disconnect Monitor Oscilloscope.

5-12. HORIZONTAL MAGNIFIER CHECK.

a. Set controls as follows:

MAGNIFIER X1
 DISPLAY EXT CAL

b. Connect 10V p-p signal from Voltmeter Calibrator output to HORIZONTAL EXT INPUT (Figure 5-2).

c. Note displayed trace of 10 ± 0.5 divisions.

d. Set MAGNIFIER to X5.

e. Set Voltmeter Calibrator for output of 2V p-p.

f. Note displayed trace of 10 ± 0.5 divisions.

g. Set MAGNIFIER to X10.

h. Set Voltmeter Calibrator for output of 1V p-p.

i. Note displayed trace of 10 ± 0.5 divisions.

j. Disconnect Voltmeter Calibrator.

5-13. HORIZONTAL BANDWIDTH CHECK.

a. Connect 50-kHz signal from Oscillator to EXT INPUT (Figure 5-3).

b. Set MAGNIFIER to X1.

c. Adjust output of Oscillator to obtain displayed trace of exactly 10 divisions.

d. Note indication on Oscillator output meter.

e. Set Oscillator for output frequency of 5 MHz.

f. Increase Oscillator output to that noted in step d.

g. Note displayed trace of 7.1 divisions or greater. (If displayed trace is approximately 2 divisions, check position of Phase/Bandwidth switch located in horizontal amplifier. It should be in Bandwidth position.)

5-14. BEAM FINDER CHECK.

a. Set controls as follows:

INTENSITY fully ccw
 POSITION fully ccw

b. Press FIND BEAM pushbutton.

c. Note that intensified beam is displayed.

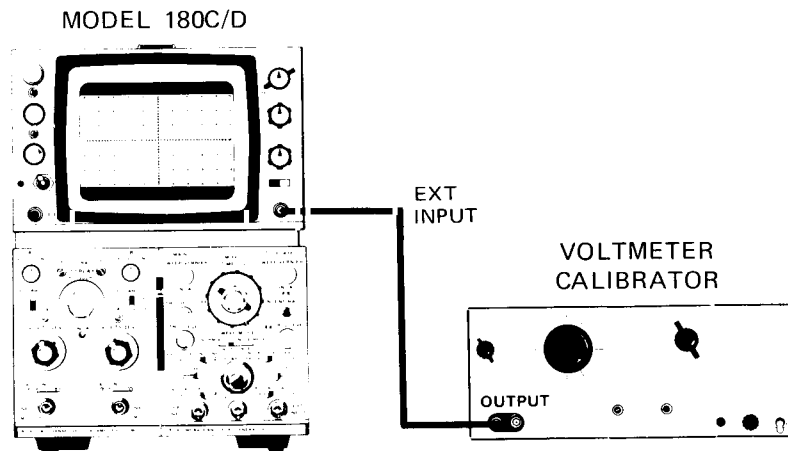
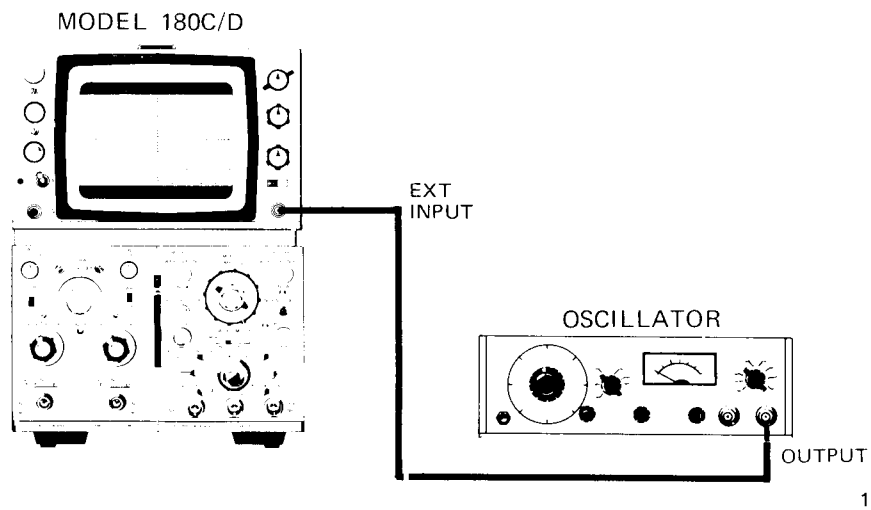


Figure 5-2. Horizontal Magnifier Check

180C/D-A-2A
 (Changed 09-74)



180C/D-A-3A-07-76

Figure 5-3. Horizontal Bandwidth Check

Note

Option 011 and Option 611 instruments are provided with P11 phosphor CRT. The display intensity will not increase when FIND BEAM is depressed. This eliminates phosphor burn. Use INTENSITY control to set intensity to viewing level.

5-15. This completes the Performance Check. If the instrument does not meet Model 180C/D specifications, the adjustment procedure which follows should be done. If this does not result in satisfactory instrument performance, refer to Section VIII of this manual for troubleshooting and maintenance information.

PERFORMANCE CHECK RECORD
Model 180C/D

Instrument Serial Number _____

Date _____

| Check | Specification | Measured |
|---|--|--|
| <p align="center">CALIBRATOR</p> <p>Amplitude Risetime</p> | <p>9.9 - 10.1 div ≤ 3 usec</p> | <p>_____</p> <p>_____</p> |
| <p align="center">MAGNIFIER</p> <p>X1 X5 X10</p> | <p>9.5 - 10.5 div 9.5 - 10.5 div 9.5 - 10.5 div</p> | <p>_____</p> <p>_____</p> <p>_____</p> |
| <p align="center">BANDWIDTH</p> <p>X1 50 kHz 5 MHz</p> <p>X5 50 kHz .5 MHz</p> <p>X10 50 kHz 5 MHz</p> | <p>Set to 10 div ≥ 7.1 div</p> <p>Set to 10 div ≥ 7.1 div</p> <p>Set to 10 div ≥ 7.1 div</p> | <p>_____</p> <p>_____</p> <p>_____</p> |
| <p align="center">BEAM FINDER</p> | <p>Intensified beam on-screen</p> | <p>_____</p> |

5-16. ADJUSTMENT PROCEDURE.

5-17. The following paragraphs outline the procedure for accomplishing the adjustments required for the Model 180C/D. Use the equipment recommended in Table 5-1 or similar equipment having at least equivalent capability. Use only a nonmetallic adjustment tool.

5-18. The adjustment procedures should be performed in the sequence listed since some adjustments are dependent on control settings and results of previous steps. The adjustments may be accomplished individually, if desired, by referring to the preliminary control settings and the steps before the desired procedure.

5-19. COVER REMOVAL.

5-20. Model 180C. To gain access to the adjustments, the top covers and the rear LVPS access panel must be removed. Use a Posidrive type screwdriver for removing cover screws. See Figure 5-4. Remove the covers as follows:

- a. Ensure that LINE power switch is OFF and disconnect power plug from ac line source.
- b. Remove four screws holding top cover from each side of instrument.
- c. Remove top cover by opening bottom end and pulling away from instrument.
- d. Remove rear access cover by releasing single quarter-turn fastener.

5-21. Model 180D. To gain access to the rack-type instrument, the top cover, side cover and the rear LVPS access

panel must be removed. See Figure 5-4. Remove the covers as follows:

- a. Ensure that LINE power switch is OFF and disconnect power plug from ac line source.
- b. Remove top cover, which is held in place with 8 screws.
- c. Remove left side cover, held in place with 6 screws.
- d. Remove rear access cover by releasing single quarter-turn fastener.

5-22. PRELIMINARY SETUP.

5-23. Install vertical and time base plug-ins in Model 180C/D. Set line voltage SELECTOR switch to desired power line operating voltage, 115V or 230V. Be sure that line fuse of correct value is installed. Connect instrument to line power source and apply power by turning LINE power switch ON. Allow 15 minutes for warm up. Check that Phase/Bandwidth switch is in Bandwidth position.

5-24. Some adjustment locations are identified in photographs at the end of this section. The page may be folded out for easy reference while performing the adjustment. Other adjustment locations are identified next to the procedure.

5-25. There are several adjustments which directly affect the final accuracy of the horizontal sweep. These must be made accurately and to the test limits specified to ensure that sweep accuracy will be maintained as time base plug-ins are interchanged. The adjustments given for the Low Voltage Power Supply, High Voltage Power

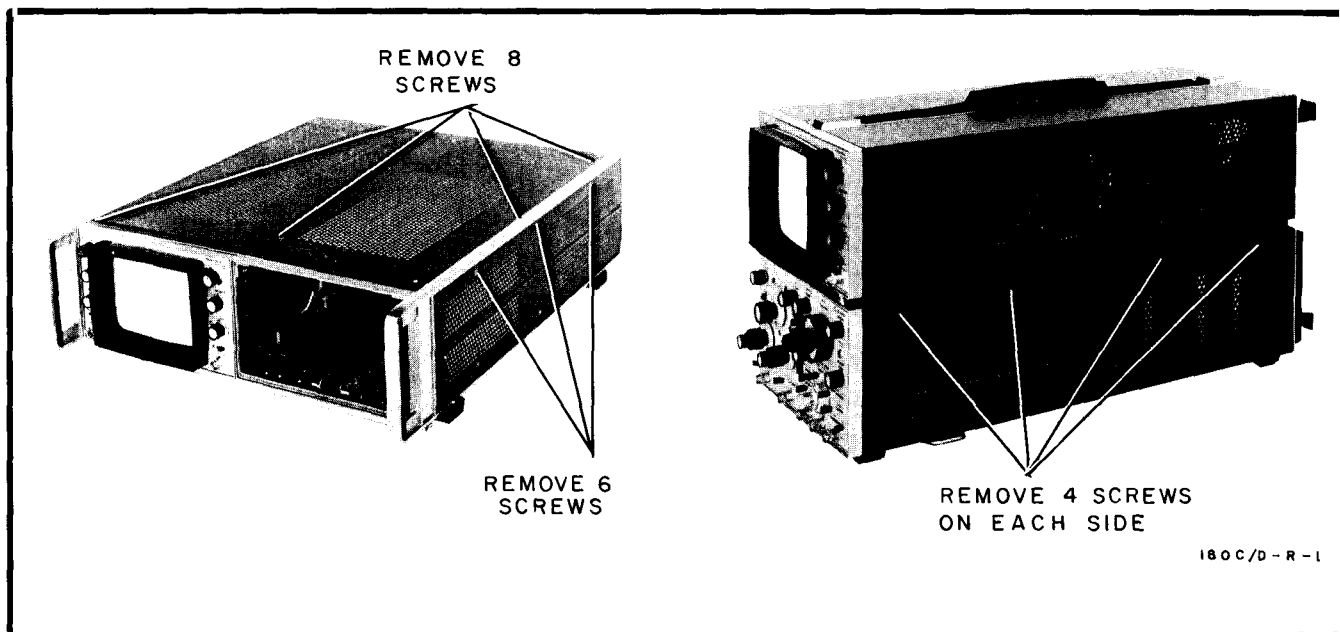


Figure 5-4. Cover Removal

Supply, and Horizontal Amplifier are particularly important in this respect.

5-26. LOW VOLTAGE POWER SUPPLY ADJUSTMENT.

a. Connect Digital Voltmeter to +100V test point A1A2TP1 (Figure 5-5).

b. Set +100V adjust A1A2R11 to obtain reading of $+100 \pm 0.1V$.

c. Connect Digital Voltmeter to +15V test point A1A2TP2.

d. Set +15V adjust A1A2R20 to obtain reading of $+15V \pm 0.1V$.

e. Connect Digital Voltmeter to $-12.6V$ test point A1A2TP3.

f. Set $-12.6V$ adjust A1A2R29 to obtain reading of $-12.6V \pm 0.1V$.

g. Connect Digital Voltmeter to $-100V$ test point A1A2TP4.

h. Set $-100V$ adjust A1A2R40 to obtain reading of $-100V \pm 0.1V$.

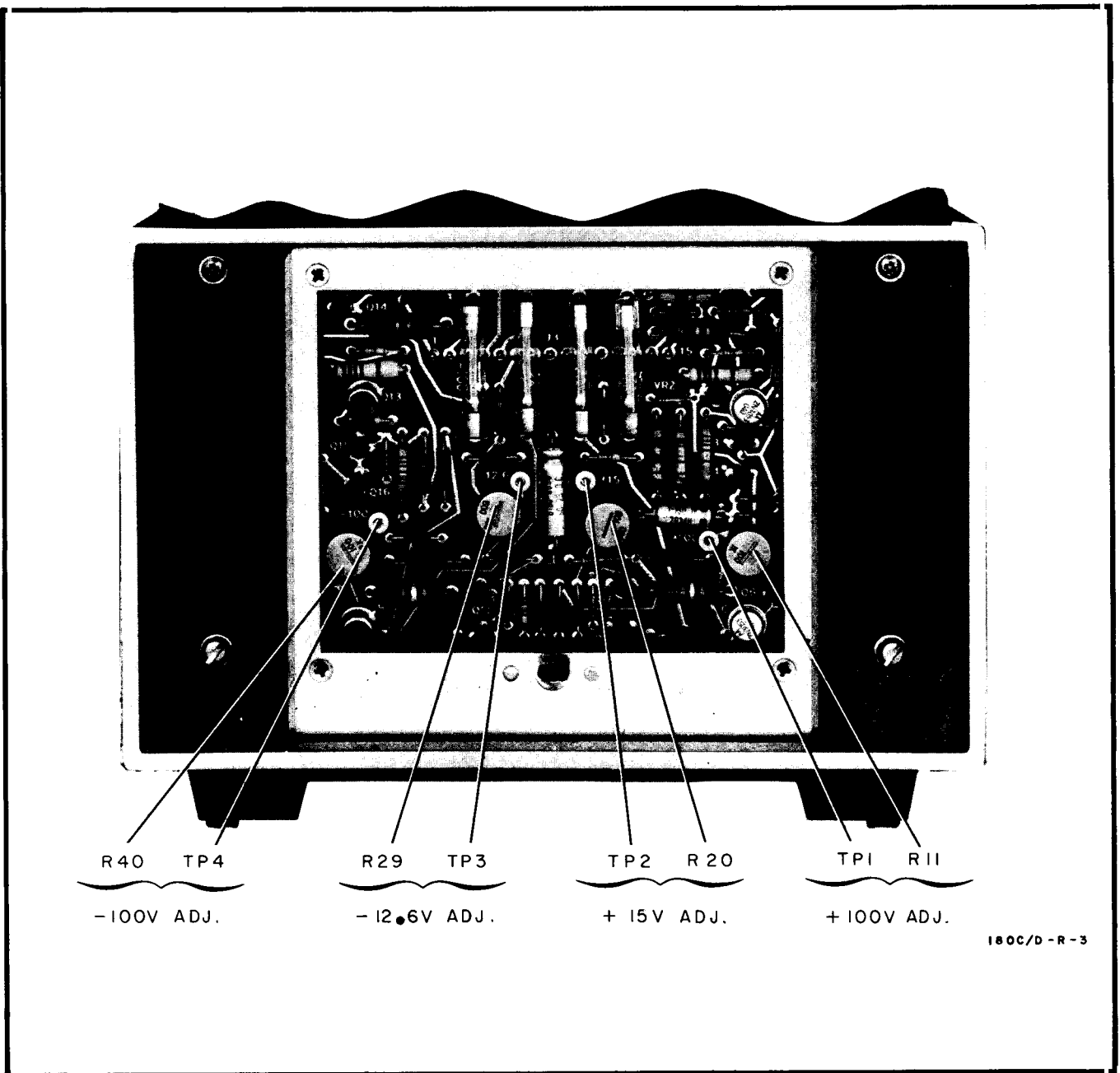


Figure 5-5. Low Voltage Power Supply Adjustments

5-27. HIGH VOLTAGE POWER SUPPLY ADJUSTMENT.

- a. The required high voltage output of the supply is $-3150V \pm 0.5\%$.
- b. Using 1000:1 Divider Probe, monitor voltage at $-100V$ test point A1A2TP4 with Digital Voltmeter (Figure 5-6).
- c. Note voltage reading which will be approximately $-0.100V$. Accuracy in noting the voltage is essential for proper adjustment.
- d. Multiply the reading obtained in step c by 31.50.

WARNING

This voltage is dangerous to life.

- e. Using 1000:1 Divider Probe, monitor high voltage at $-3150V$ Test Point A3TP1 with Digital Voltmeter (Figure 5-7).
- f. Set High Voltage Adj A3R49 to obtain a reading exactly equivalent to the result obtained in step d (approximately $-3.150V$).

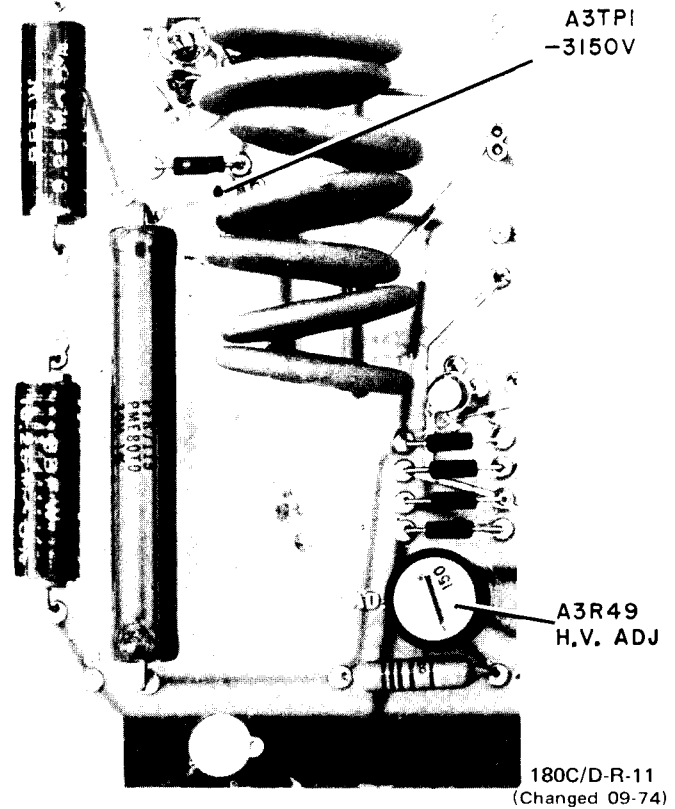


Figure 5-7. High Voltage Adjustment Location

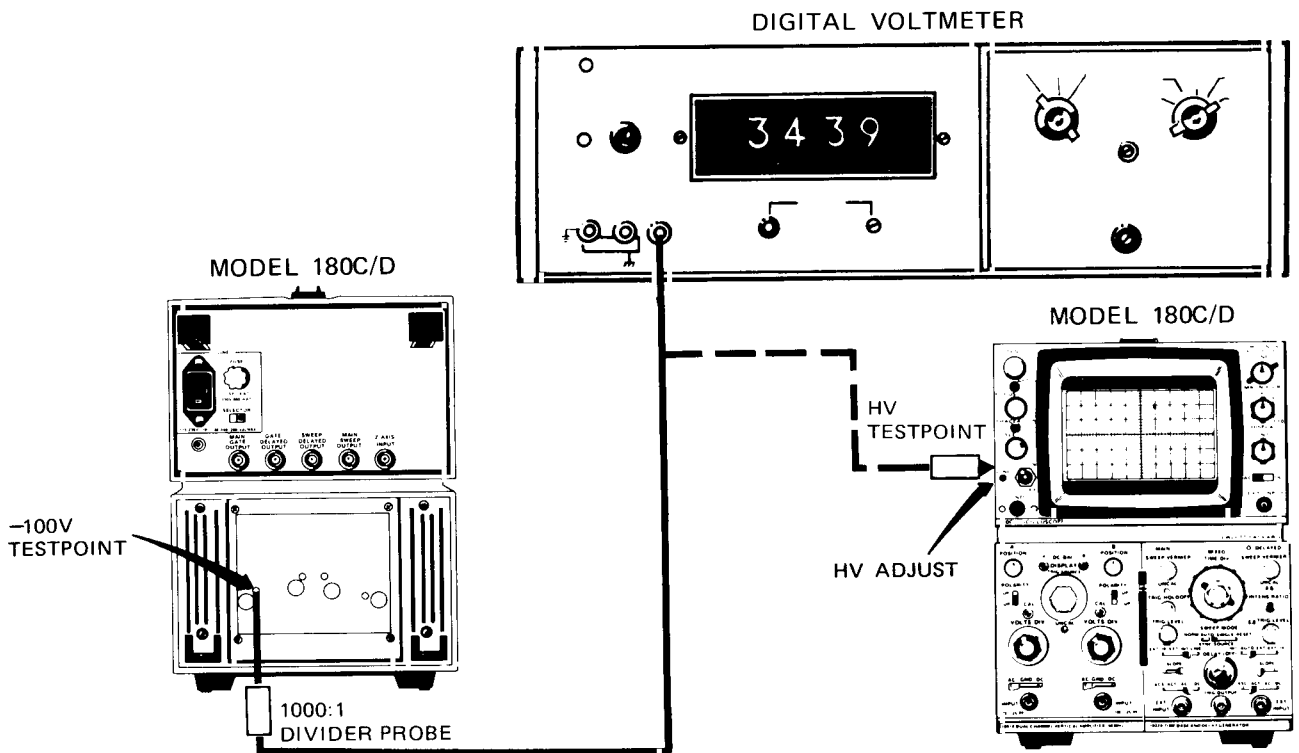


Figure 5-6. High Voltage Adjustment

180C/D-A-4A
(Changed 09-74)

5-28. ASTIGMATISM ADJUSTMENT.

- a. Set DISPLAY to EXT.
- b. Center low intensity spot with HORIZONTAL and Vertical POSITION controls.
- c. Adjust FOCUS and ASTIGMATISM front-panel screwdriver adjustment for smallest round spot (Figure 5-8).

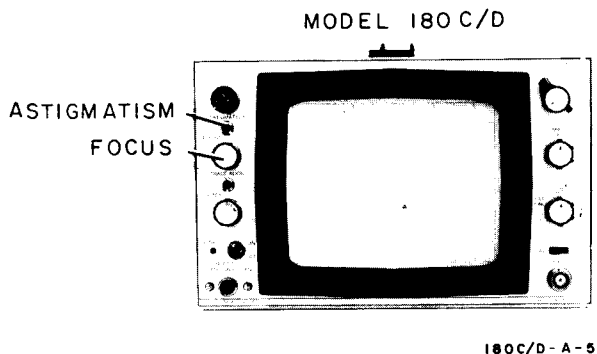


Figure 5-8. Astigmatism Adjustment

5-29. INTENSITY LIMIT ADJUSTMENT.

- a. Set DISPLAY to EXT.
- b. Center spot with HORIZONTAL and Vertical POSITION controls.
- c. Set INTENSITY control to center (12 o'clock) position.
- d. Adjust Intensity Limit Adj. A5R2 to just extinguish spot.

5-30. FLOOD GUN ADJUSTMENT.

- a. Set INTENSITY fully ccw.
- b. Set SCALE fully ccw.
- c. Adjust Flood Pattern Adj A3R60 for uniform illumination intensity when SCALE control is varied throughout its full range (Figure 5-9).

5-31. TRACE ALIGNMENT ADJUSTMENT.

- a. Set MAGNIFIER to X1.
- b. Set Coupling to AC.
- c. Connect Oscillator 400-Hz, 10V output to EXT INPUT (Figure 5-10).
- d. Position trace on center horizontal graticule line.

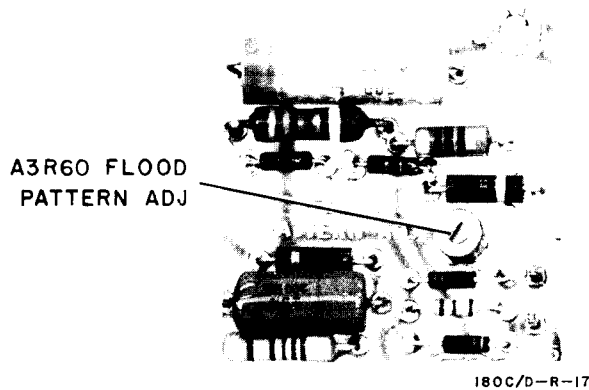


Figure 5-9. Flood Gun Adjustment Location

- e. Set INTENSITY and FOCUS to view sharply defined trace.
- f. Adjust TRACE ALIGN front-panel screwdriver adjustment R6 to align trace parallel to horizontal graticule line.
- g. Connect Oscillator 400-Hz, 10V output to vertical plug-in.
- h. Set vertical plug-in controls to obtain a vertical trace
- i. Adjust Y ALIGN adj A2R57 to align vertical trace parallel to vertical graticule line (Figure 5-11).
- j. Recheck trace alignment. Repeat adjustment procedure if necessary to ensure that exact X and Y alignment is obtained.

Note

Exact adjustment is very important if repeatable risetimes are to be obtained in both +UP and -UP operation.

- k. Disconnect Oscillator.

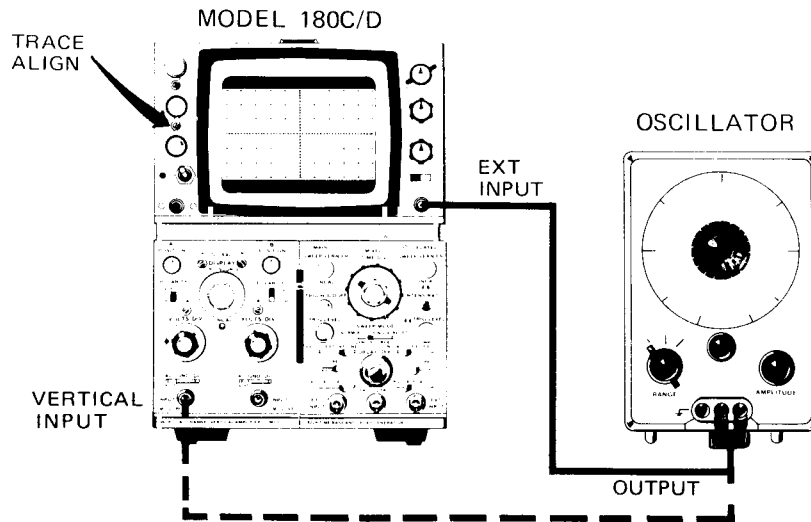
5-32. GATE AMPLIFIER RESPONSE ADJUSTMENT.

- a. Set the following controls as applicable:

| | |
|--------------------|----------|
| HORIZONTAL DISPLAY | INT |
| Main Time/Div | 0.1 usec |
| Main Vernier | CAL |
| Sweep Mode | AUTO |
| Sweep Display | MAIN |
| Delayed Time/Div | OFF |

- b. Set Monitor Oscilloscope controls as follows:

| | |
|----------------|----------|
| Volts/Div | 1 |
| Time/Div | 0.1 usec |
| Trigger Source | INT |
| Slope | + |
| Coupling | DC |



180C/D-A-6A
(Changed 09-74)

Figure 5-10. Trace Alignment Adjustment

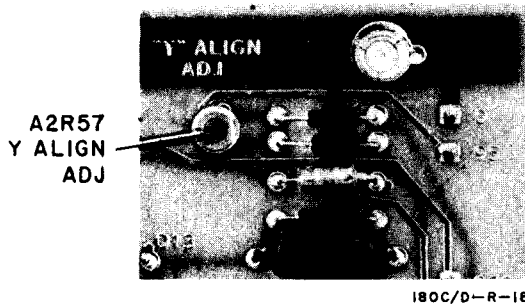


Figure 5-11. Y Alignment Adjustment Location

c. Using 10:1 Divider Probe and Monitor Oscilloscope, observe signal at collector of A3Q3, (Figure 5-12 and Figure 5-13).

d. Rotate INTENSITY control cw until gate pulse amplitude is 60V.

e. Adjust Gate Resp Adj No. 1 and No. 2 for optimum fast risetime and pulse flat-top response. Decreasing capacitance of No. 1 reduces risetime; decreasing capacitance of No. 2 reduces overshoot.

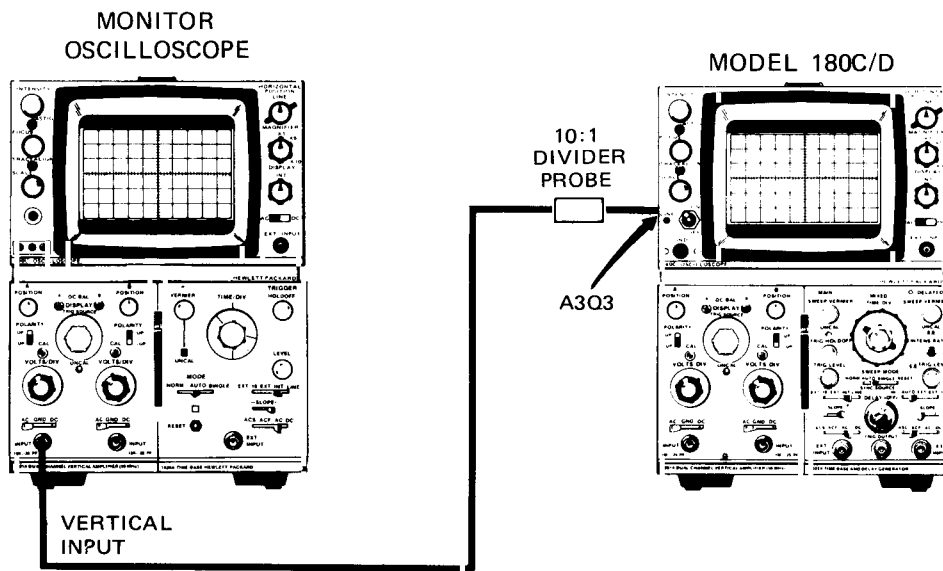
f. Disconnect Monitor Oscilloscope.

5-33. DC BALANCE ADJUSTMENT.

a. Set MAGNIFIER to X10.

b. Set HORIZONTAL DISPLAY to EXT CAL.

c. Center spot with HORIZONTAL POSITION control.



180C/D-A-7A
(Changed 09-74)

Figure 5-12. Gate Amplifier Response Adjustment

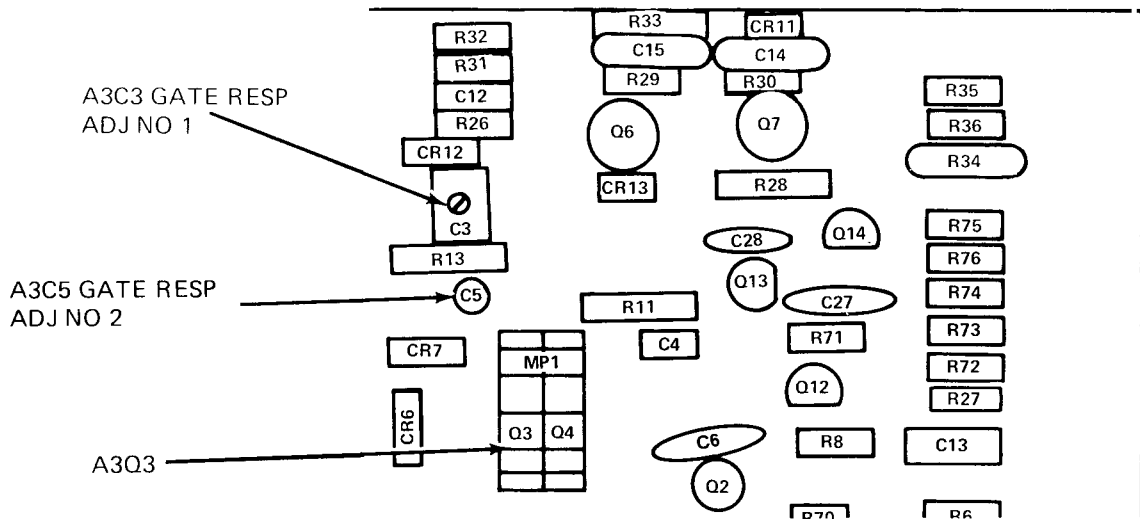
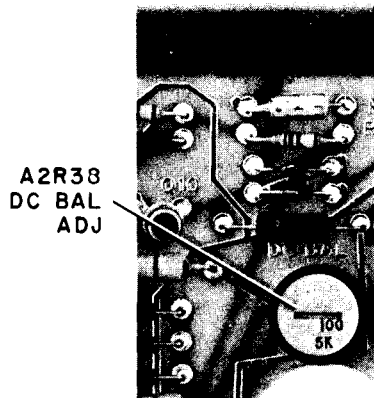


Figure 5-13. Gate Amplifier Adjustment Location

180C/D-L-001
(Changed 09-74)



180C/D-R-19

Figure 5-14. DC Balance Adjustment Location

- d. Set MAGNIFIER to X10.
- e. Adjust DC Bal adj A2R38 to recenter spot (Figure 5-14).
- f. Repeat steps a through e until spot does not shift from center while switching MAGNIFIER from X1 to X10.

5-34. VERNIER BALANCE ADJUSTMENT.

- a. Set MAGNIFIER to X1.
- b. Rotate HORIZONTAL DISPLAY to approximately 2 o'clock position, but not to INT detent.
- c. Center spot with HORIZONTAL POSITION control.
- d. Rotate HORIZONTAL DISPLAY to EXT CAL.
- e. Adjust Vern Bal adj A2R14 to recenter spot (Figure 5-15).

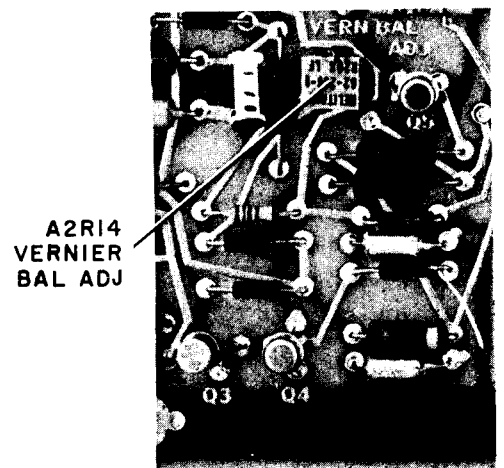
- f. Repeat steps b through e until spot does not shift from center when HORIZONTAL DISPLAY is rotated from fully ccw (not in INT) to EXT CAL.

5-35. HORIZONTAL GAIN ADJUSTMENT

- a. Set controls as follows:

HORIZONTAL DISPLAY EXT CAL
HORIZONTAL MAGNIFIER X1

- b. Check +100V supply for +100V ±0.1V.



180C/D-R-15

Figure 5-15. Vernier Balance Adjustment Location

WARNING

+100V is present at open lead of resistor.

c. Connect 40-kilohm, 0.1%, 1/2W resistor between +100V supply and emitter of A2Q3. Keep connection lead lengths short as possible to avoid stray pickup or oscillations. Do not leave resistor connected throughout adjustment as thermal rise will shift current reference.

d. Adjust HORIZONTAL POSITION to center left-hand spot exactly on left-hand vertical graticule line.

e. While alternately connecting and disconnecting resistor to emitter of A2Q3, adjust X1 Gain Adj A2R36 for exactly 10 major divisions of separation between spot positions (Figure 5-16 and Figure 5-17).

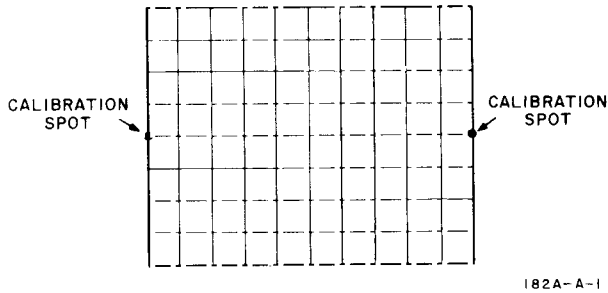


Figure 5-16. Calibration Display

f. Set HORIZONTAL DISPLAY to INT and time base for 1 ms/div sweep speed.

g. Apply 1-ms markers from Time Mark Generator to input of vertical plug-in.

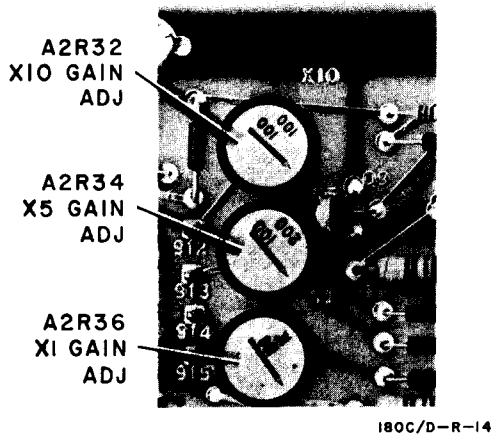


Figure 5-17. Gain Adjustment Location

h. Adjust Time Base 1-ms calibration adjustment to obtain display of eleven markers in 10 divisions. Second marker should be on 2nd graticule line and 10th marker on 10th graticule line.

i. Set HORIZONTAL MAGNIFIER to X5.

j. Adjust X5 Gain Adj A2R34 to obtain display of exactly 1 marker for each 5 divisions.

k. Set HORIZONTAL MAGNIFIER to X10.

l. Adjust X10 Gain Adj A2R32 obtain display of exactly 1 marker for each 10 divisions.

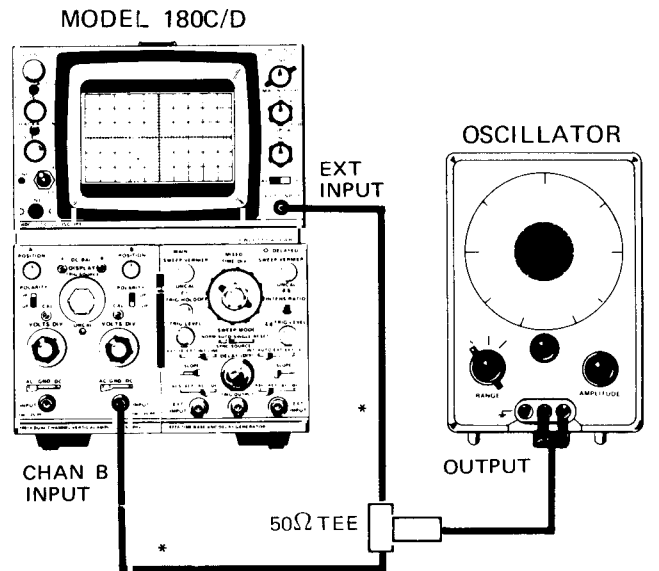
m. Disconnect Time Mark Generator.

5-36. PHASE ADJUSTMENT.

a. Set controls as follows:

- Phase/Bandwidth Switch Phase
- HORIZONTAL MAGNIFIER X1
- HORIZONTAL DISPLAY EXT CAL

b. Connect 10-kHz sine wave output of Oscillator to HORIZONTAL EXT INPUT and to vertical plug-in Channel B input (Figure 5-18).



* CABLES SHOULD BE EQUAL IN LENGTH AND TYPE.

180C/D-A-8A
(Changed 09-74)

Figure 5-18. Phase Adjustment

c. Adjust Oscillator output and vertical amplifier Volts/Div to obtain 8-division display.

d. Adjust Input Comp Adj A2C6 for display of single diagonal line (no phase shift). See Figure 5-19.

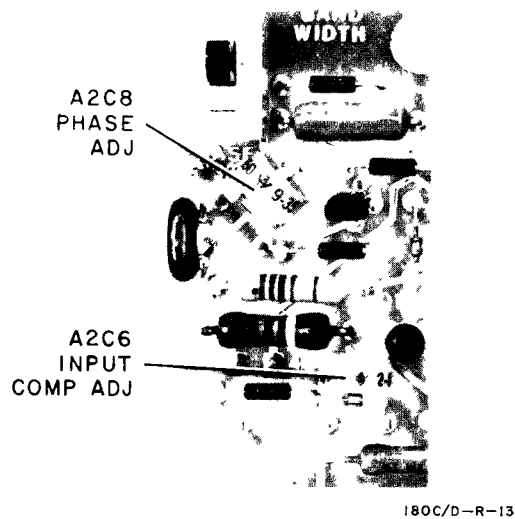


Figure 5-19. Phase and Input Adjustment Location

g. Repeat steps b through f until no phase shift occurs for either frequency.

h. Disconnect Oscillator.

i. Return Phase/Bandwidth switch to Bandwidth position.

5-37. TRANSIENT RESPONSE ADJUSTMENT.

Note

Omit this adjustment procedure for normal calibration and perform the Horizontal Linearity Adjustment. This procedure should only be used if major repairs or complete module replacement has been made.

a. Set HORIZONTAL DISPLAY to EXT CAL.

b. Connect 1V p-p square wave at 200-kHz repetition rate from Square Wave Generator to HORIZONTAL EXT INPUT and to Monitor Oscilloscope vertical input (Figure 5-20).

e. Set Oscillator for output of 100-kHz sine wave.

f. Adjust Phase Adj A2C8 for display of single diagonal line (no phase shift).

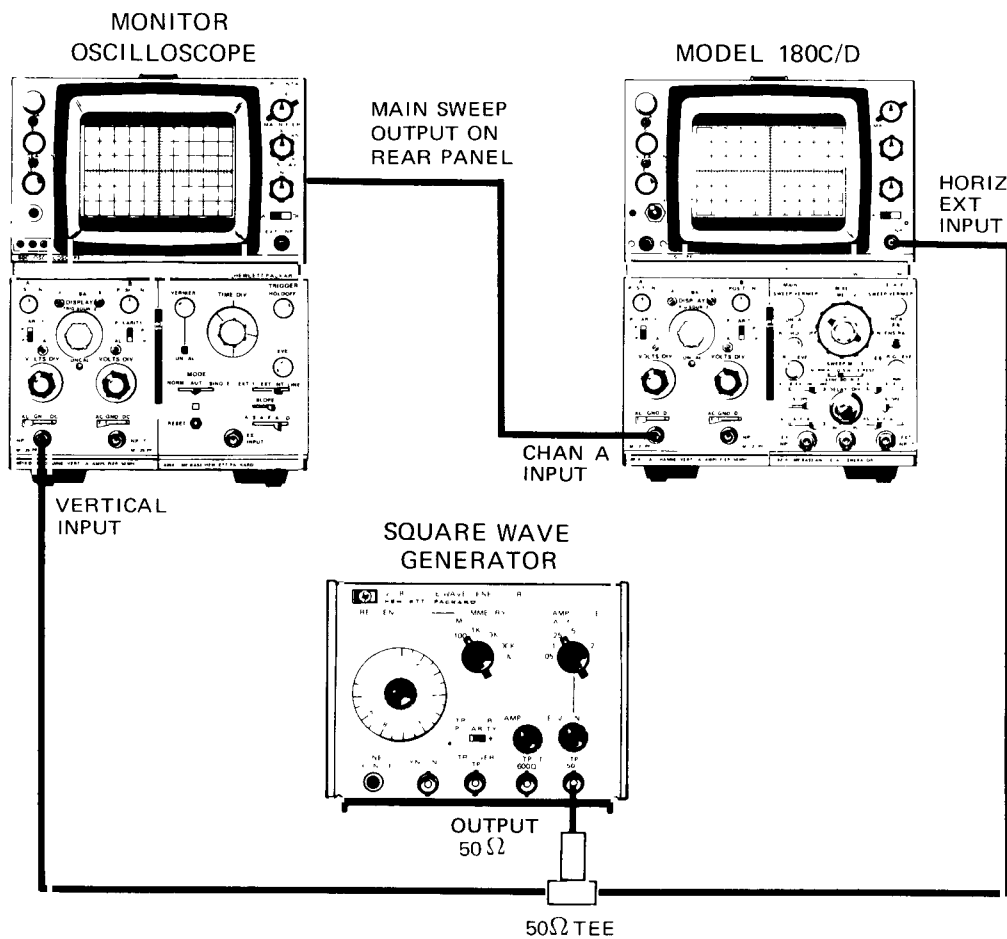


Figure 5-20. Transient Response Adjustment

180C/D-A-9A
(Changed 09 74)

c. Set Monitor Oscilloscope time base to operate at sweep of 1 usec/div and synchronize Monitor Oscilloscope with 200-kHz signal.

d. Connect 1 usec/div sweep signal from Monitor Oscilloscope rear-panel Main Sweep Output to Channel A input of Model 180C/D.

e. Adjust Vertical plug-in VOLTS/DIV and Vernier controls to obtain 8-division display.

f. Observe displayed waveform. At this stage of adjustment, waveform will typically exhibit 5% (approximately 0.5 div) overshoot. If overshoot is greater, adjust HF Adj No. 1 A2C12, HF Adj No. 2 A2C21, and HF Adj No. 3 A2C20 to obtain flat-top response with approximately 5% overshoot on lower right-hand corner of displayed pulse.

Note

Capacitors for HF Adj No. 1 and HF Adj No. 3 should be adjusted so their slugs are almost equally extended.

g. Disconnect Monitor Oscilloscope.

5-38. HORIZONTAL LINEARITY ADJUSTMENT.

Note

Ensure that time base plug-in has been properly calibrated before proceeding with this adjustment.

a. Set HORIZONTAL DISPLAY to INT.

b. Connect 4V p-p 50-MHz sine wave output from Time Mark Generator to vertical plug-in Channel A input (Figure 5-21).

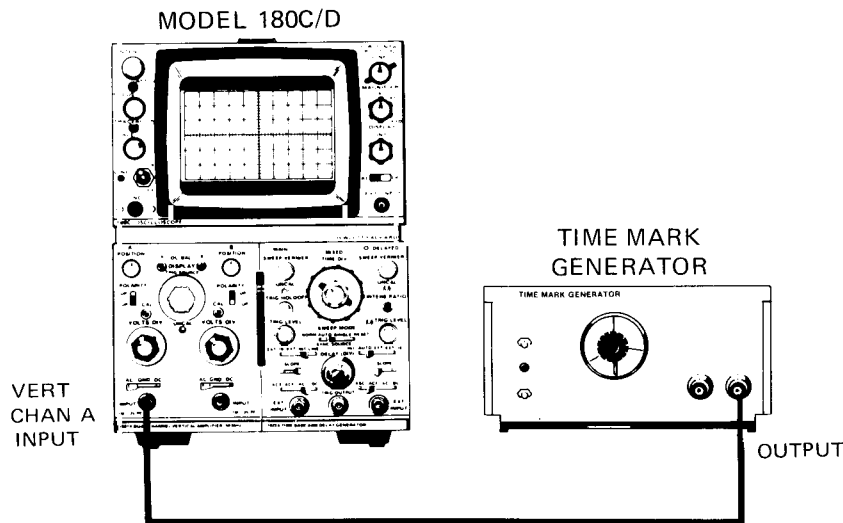
c. Select fastest sweep speed (.05 or .1 usec/div) and obtain display.

d. Set HORIZONTAL MAGNIFIER to X10.

e. Adjust HF Adjust No. 1, No. 2 and No. 3 for best overall linearity of center 80 divisions of available display. Use HORIZONTAL POSITION control to permit viewing right, center and left portions of display. HF Adj No. 1 affects left portion, HF Adj No. 2 center portion and HF Adj No. 3 right portion of sweep. (See Figure 5-22.)

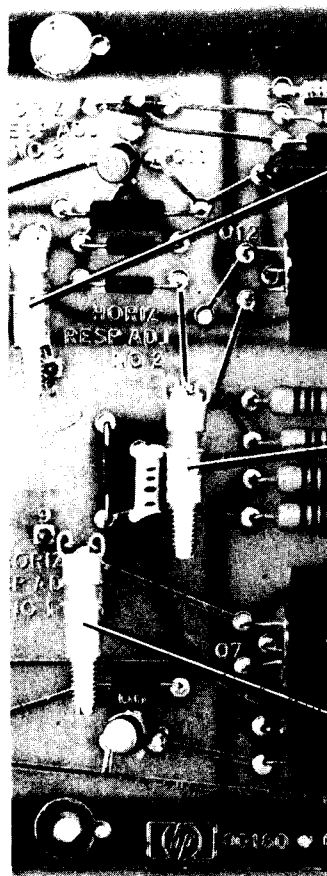
f. Disconnect Time Mark Generator.

5-39. This completes the adjustment procedure. If desired, the instrument performance may be tested to Model 180C/D specifications using the Performance Check procedure. If satisfactory adjustment or instrument performance is not obtained, refer to Section VIII of this manual for troubleshooting information.



180C/D-003-07-76

Figure 5-21. Horizontal Linearity Adjustment



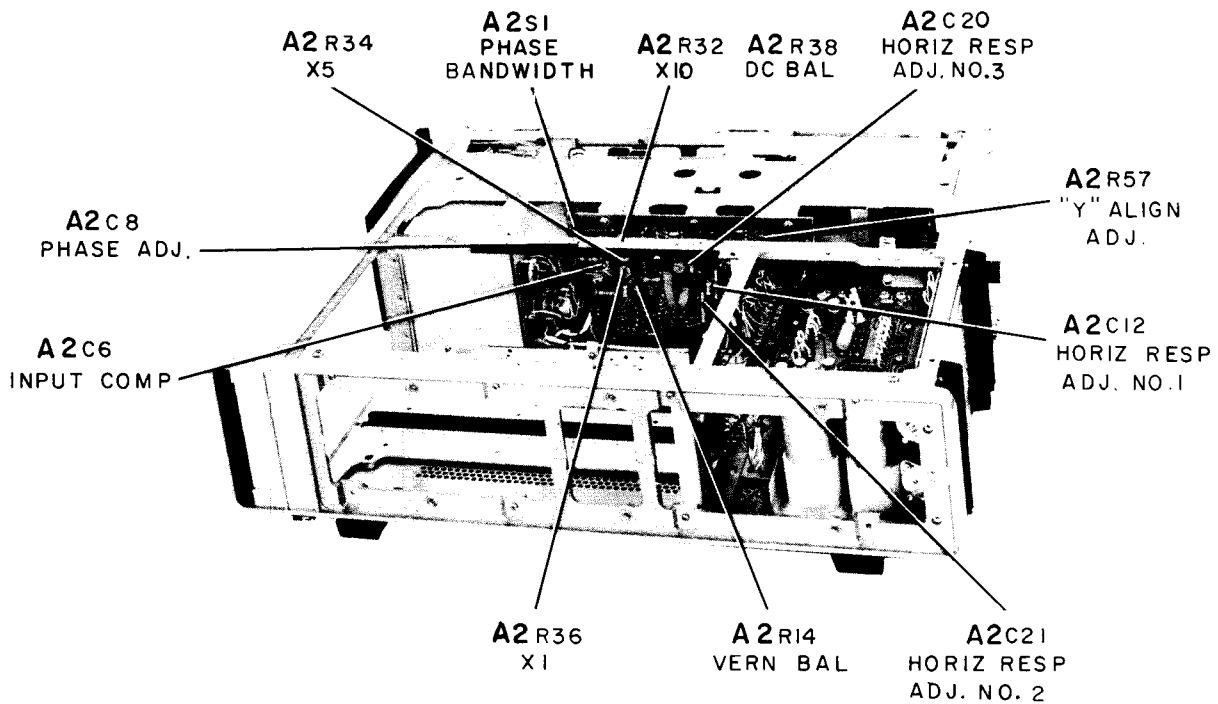
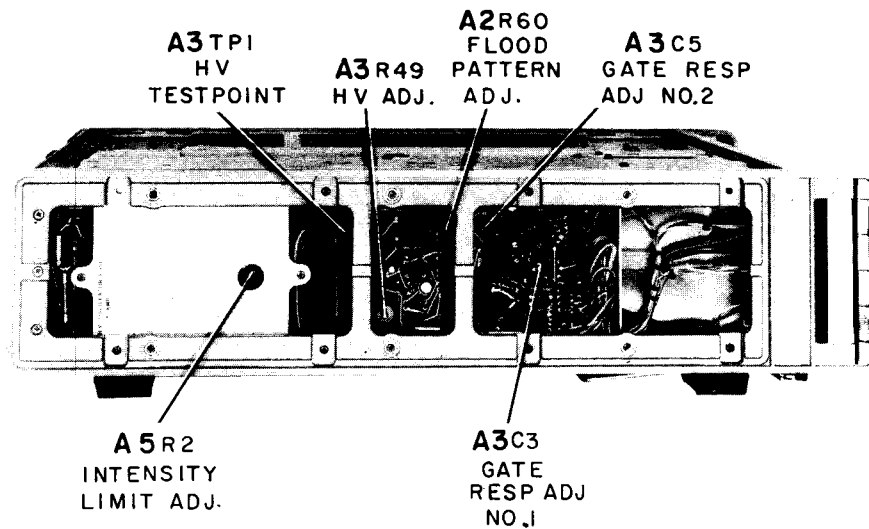
A2C20
HF
ADJ.
NO.3

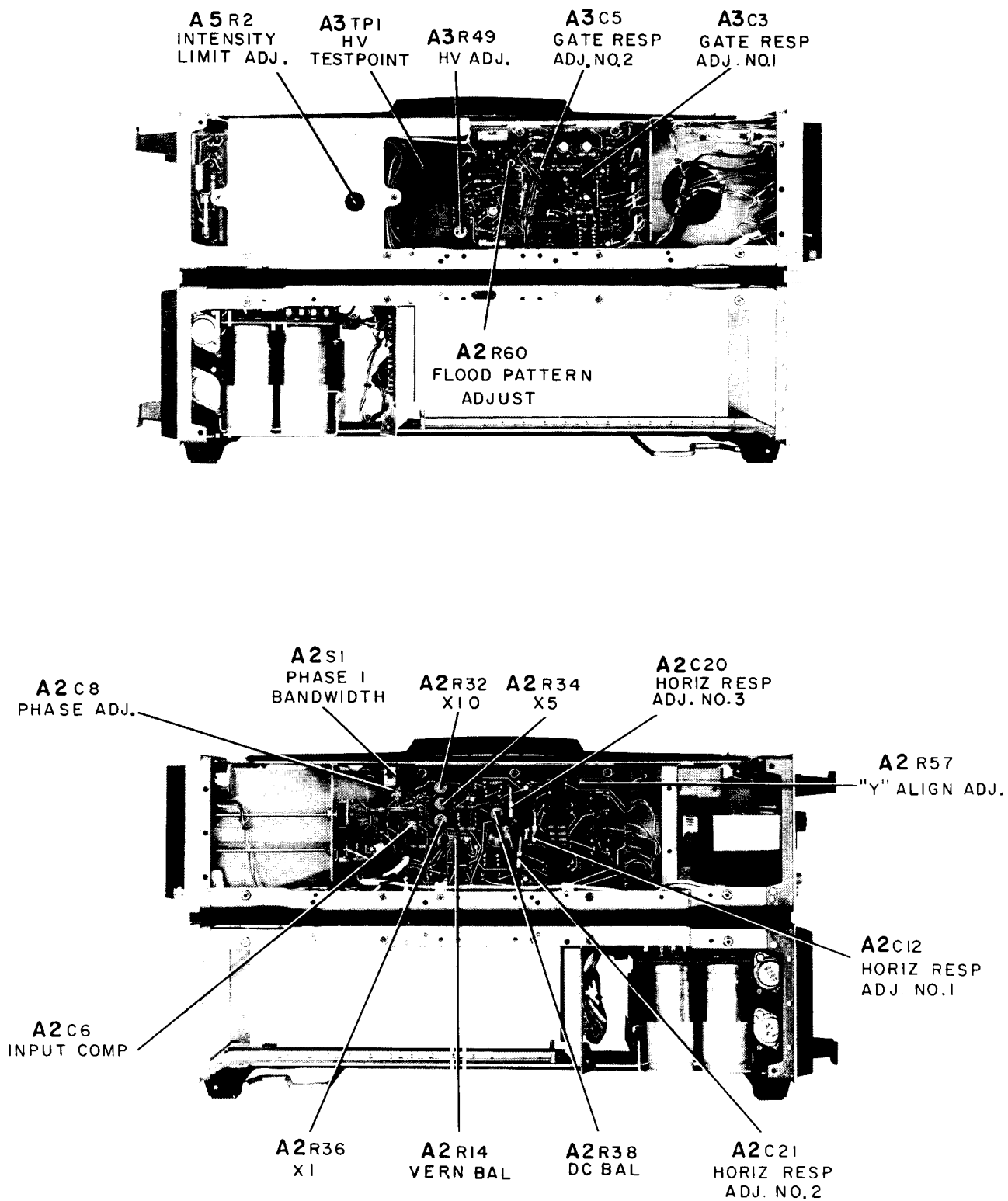
A2C21
HF
ADJ.
NO.2

A2C12
HF
ADJ.
NO.1

180C/D-R-16

Figure 5-22. Linearity Adjustment Location





180C/D - R-6

Figure 5-23. Adjustment Locations

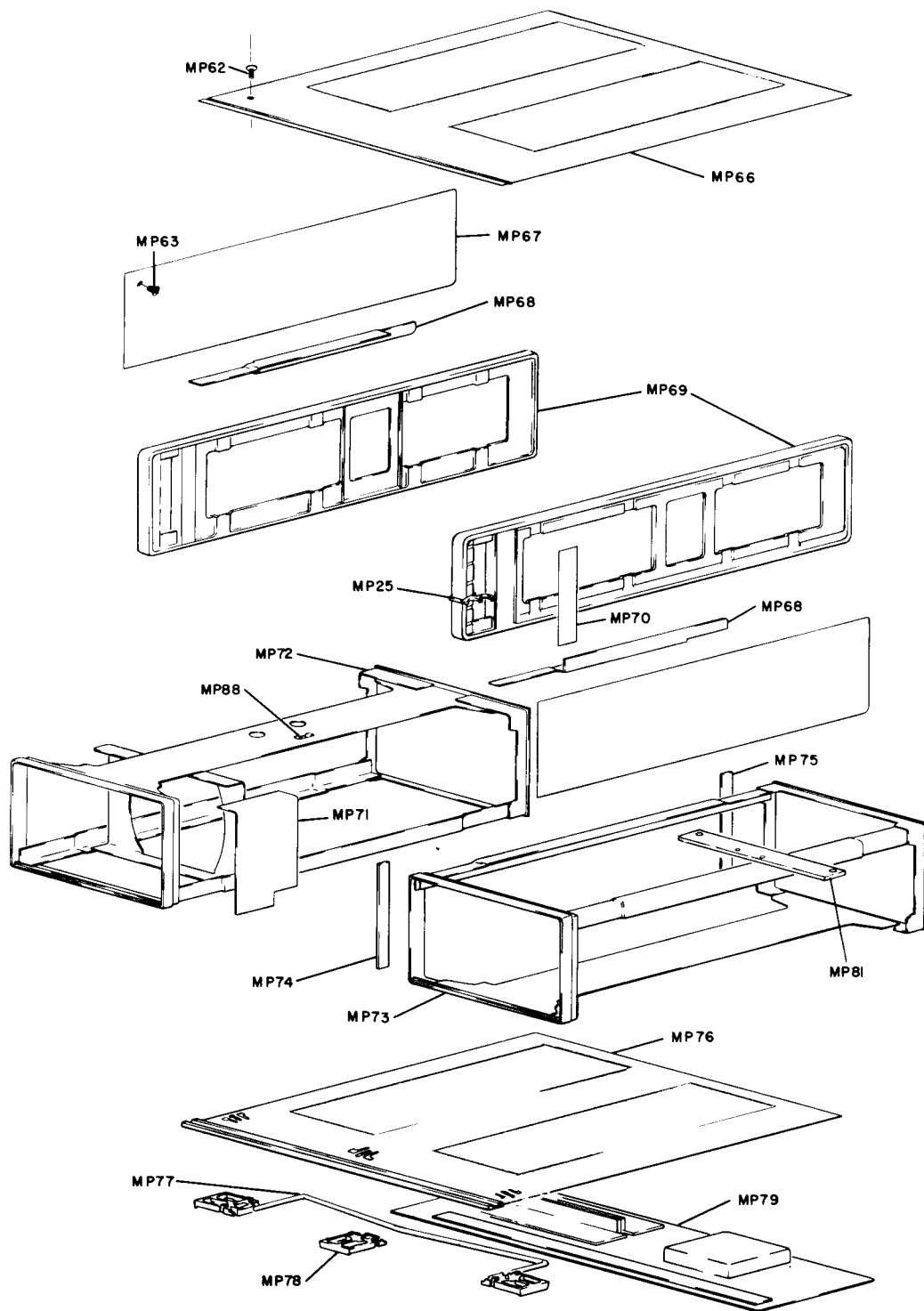
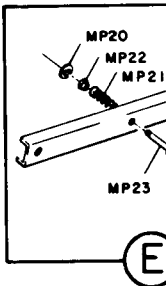
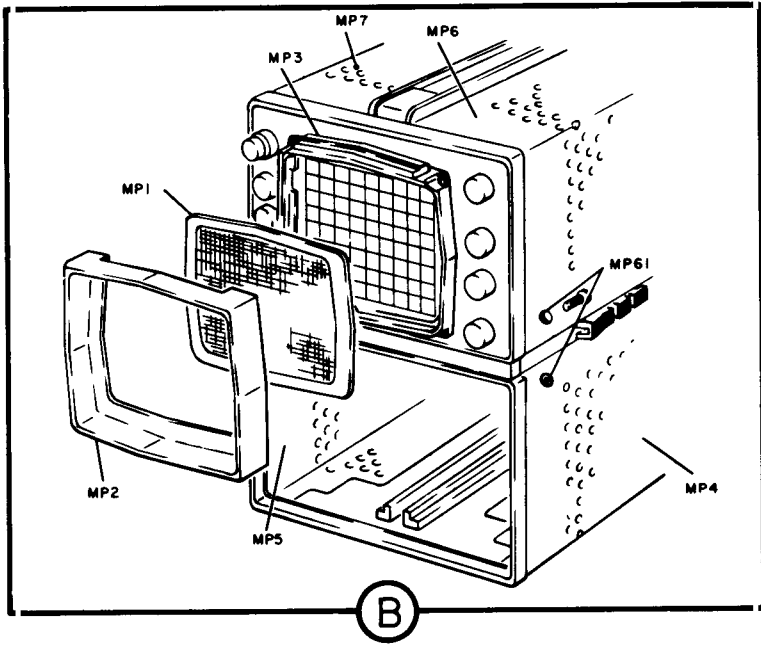
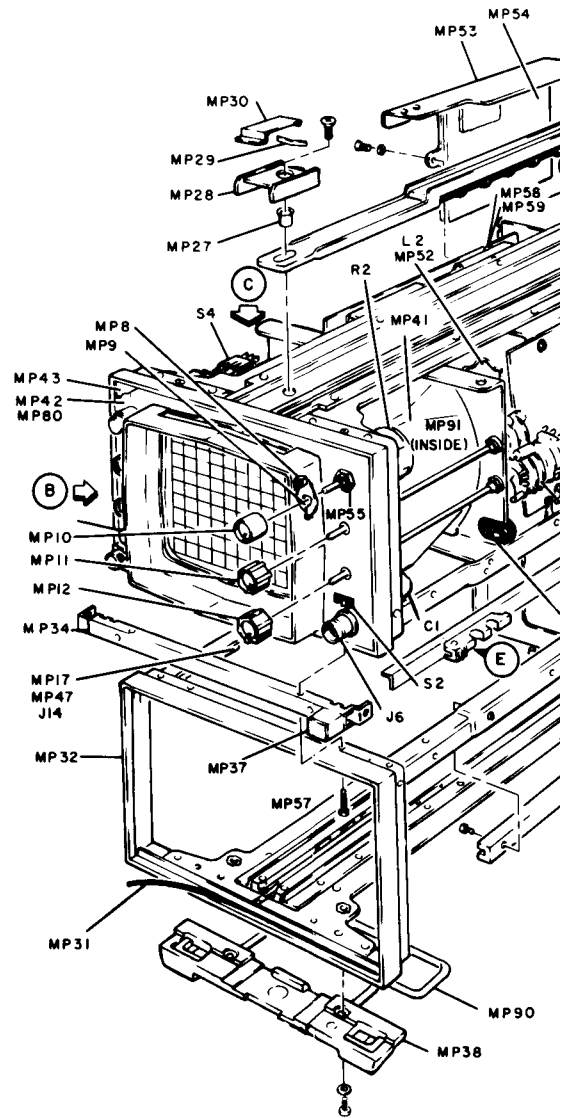
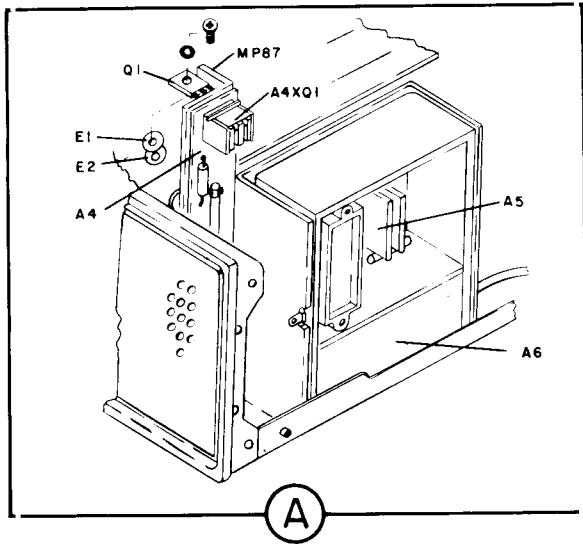
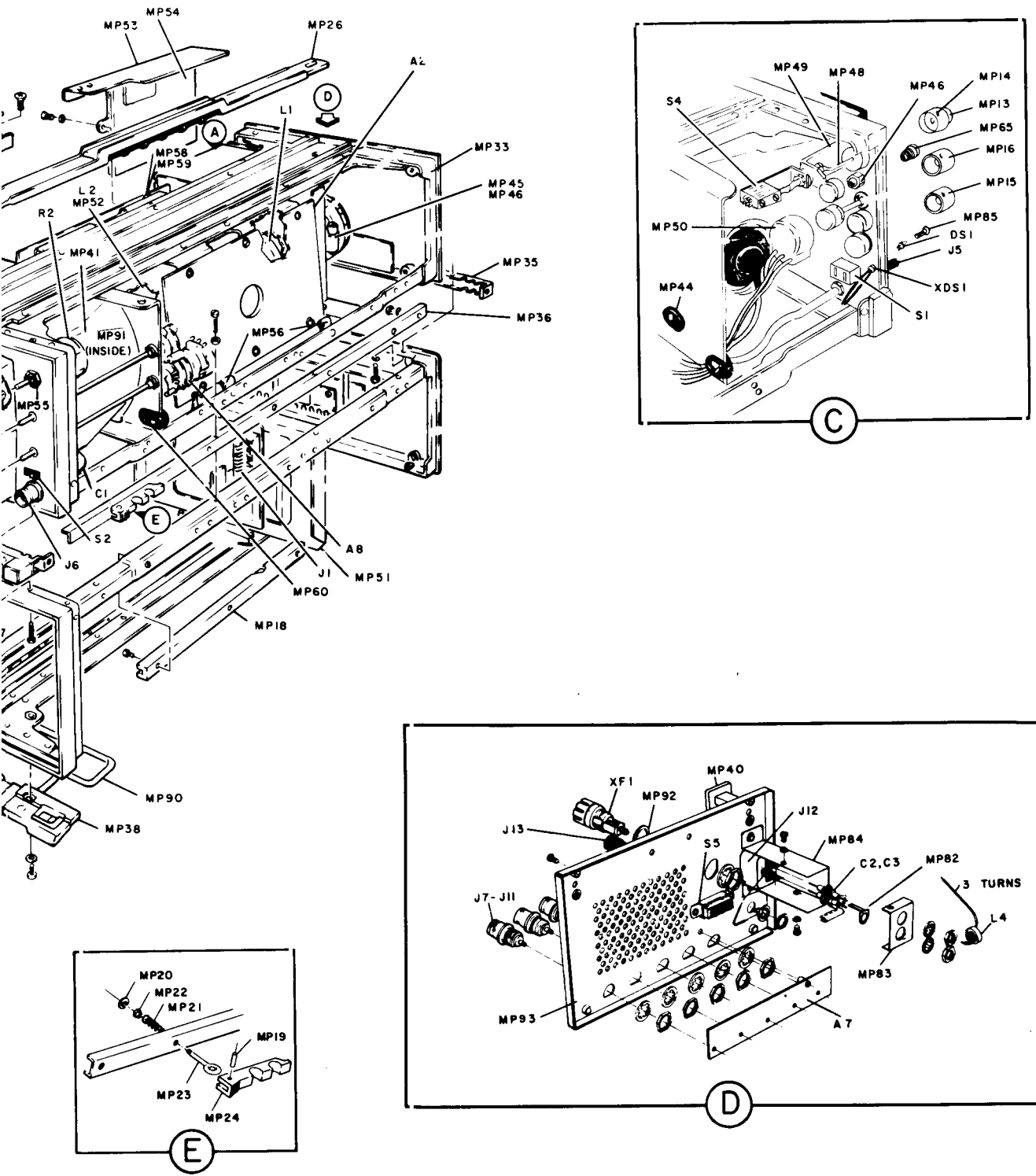


Figure 6-1. Model 180D Mechanical Parts





180C/D-D-5

Figure 6-2. Model 180C/D Mechanical Parts

SECTION VI REPLACEABLE PARTS

6-1. INTRODUCTION.

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

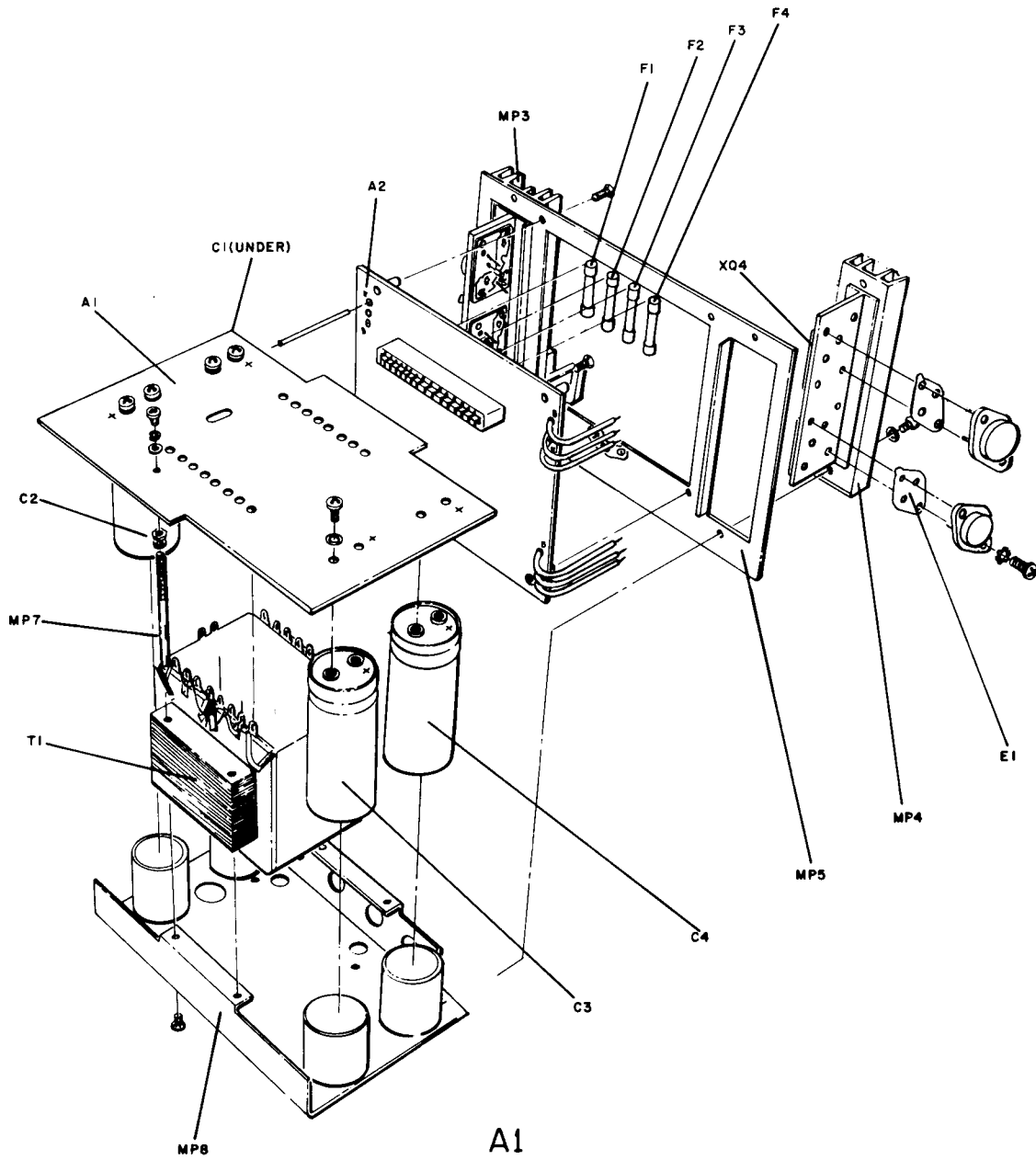
6-3. ORDERING INFORMATION.

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

- a. Instrument model and serial number.
 - b. HP Part Number of item(s).
 - c. Quantity of part(s) desired.
 - d. Reference designator of part(s).
- 6-5. To order a part not listed in the table, provide the following information:
- a. Instrument model and serial number.
 - b. Description of the part, including function and location in the instrument.
 - c. Quantity desired.

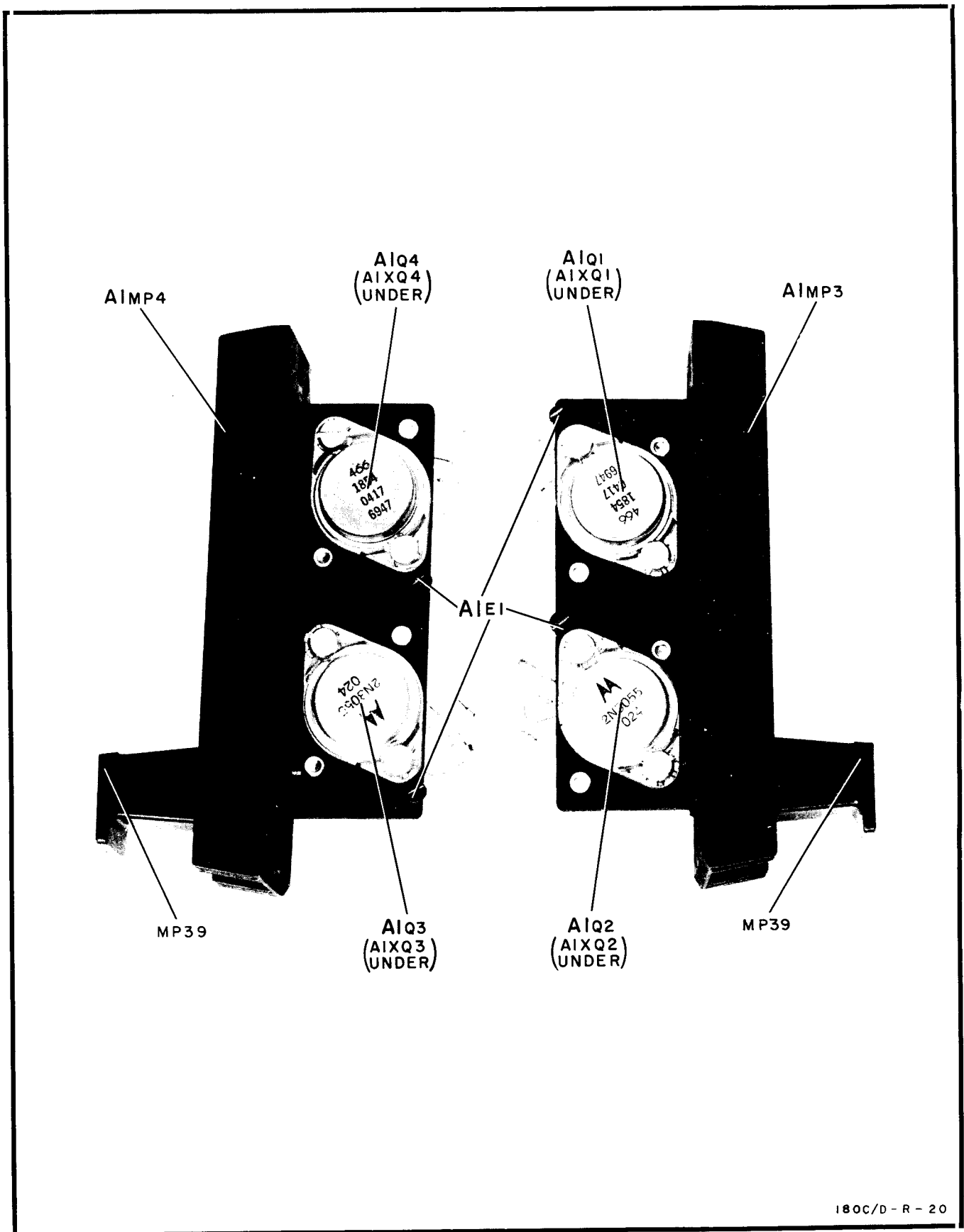
Table 6-1. Abbreviations for Replaceable Parts List

| | | | | | | | |
|-------|------------------------------|----------|-----------------------|------|---|--------|--------------------------------|
| A | = ampere(s) | GRD | = ground(ed) | NPO | = negative positive zero (zero temperature coefficient) | RWV | = reverse working voltage |
| ASSY | = assembly | H | = henry(ies) | NPN | = negative-positive-negative | S-B | = slow-blow |
| BD | = board(s) | HG | = mercury | NSR | = not separately replaceable | SCR | = silicon controlled rectifier |
| BH | = binder head | HP | = Hewlett-Packard | OBD | = order by description | SE | = selenium |
| BP | = bandpass | HZ | = hertz | OH | = oval head | SEC | = second(s) |
| C | = centi (10^{-2}) | IF | = intermediate freq. | OX | = oxide | SECT | = section(s) |
| CAR | = carbon | IMPG | = impregnated | P | = peak | SI | = silicon |
| CCW | = counterclockwise | INCD | = incandescent | PC | = printed (etched) circuit(s) | SIL | = silver |
| CER | = ceramic | INCL | = include(s) | PF | = picofarads | SL | = slide |
| CMO | = cabinet mount only | INS | = insulation(ed) | PHL | = Phillips | SP | = single pole |
| COAX | = coaxial | INT | = internal | PIV | = peak inverse voltage(s) | SPL | = special |
| COEF | = coefficient | K | = kilo (10^3) | PNP | = positive-negative-positive | ST | = single throw |
| COMP | = composition | KG | = kilogram | P/O | = part of | STD | = standard |
| CONN | = connector(s) | LB | = pound(s) | PORC | = porcelain | TA | = tantalum |
| CRT | = cathode-ray tube | LH | = left hand | POS | = position(s) | TD | = time delay |
| CW | = clockwise | LIN | = linear taper | POT | = potentiometer(s) | TFL | = teflon |
| D | = deci (10^{-1}) | LOG | = logarithmic taper | P-P | = peak-to-peak | TGL | = toggle |
| DEPC | = deposited carbon | LVR | = lever | PRGM | = program | THYR | = thyristor |
| DP | = double pole | M | = milli (10^{-3}) | PS | = polystyrene | TI | = titanium |
| DT | = double throw | MEG | = mega (10^6) | PWV | = peak working voltage | TNLDIO | = tunnel diode(s) |
| ELECT | = electrolytic | MET FILM | = metal film | RECT | = rectifier(s) | TOL | = tolerance |
| ENCAP | = encapsulated | MET OX | = metal oxide | RF | = radio frequency | TRIM | = trimmer |
| EXT | = external | MFR | = manufacturer | RFI | = radio frequency interference | U | = micro (10^{-6}) |
| F | = farad(s) | MINAT | = miniature | RH | = round head or right hand | V | = volts |
| FET | = field-effect transistor(s) | MOM | = momentary | RMO | = rack mount only | VAR | = variable |
| FH | = flat head | MTG | = mounting | RMS | = root mean square | VDCW | = dc working volt(s) |
| FIL H | = fillister head | MY | = mylar | | | W | = watt(s) |
| FXD | = fixed | N | = nano (10^{-9}) | | | W/ | = with |
| G | = giga (10^9) | N/C | = normally closed | | | WIV | = working inverse voltage |
| GE | = germanium | NE | = neon | | | W/O | = without |
| GL | = glass | N/O | = normally open | | | WW | = wirewound |



180C/D-D-6

Figure 6-3. Low Voltage Power Module Exploded View



180C/D - R - 20

Figure 6-4. Series Regulator Parts Identification

Table 6-2. Replaceable Parts

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|-----------------------|----------------|-----|---|----------|--------------------|
| A1 | 00184-60003 | 1 | POWER MODULE:LOW VOLTAGE | 28480 | 00184-60003 |
| A1C1 | 0180-1807 | 2 | C:FXD ELECT 290 UF +50-10% 200 VDCW | 56289 | 32D291F200AB2A-DQB |
| A1C2 | 0180-1865 | 1 | C:FXD ELECT 2100 UF +75-10% 40 VDCW | 56289 | 32D212G040AB2A-DQB |
| A1C3 | 0180-1809 | 1 | C:FXD ELECT 3400 UF +75-10% 25 VDCW | 56289 | 32D342G025AB2A-DQB |
| A1C4 | 0180-1807 | 1 | C:FXD ELECT 290 UF +50-10% 200 VDCW | 56289 | 32D291F200AB2A-DQB |
| A1E1 | 1200-0043 | 4 | INSULATOR:TSTR MOUNTING (TO-3) | 71785 | 293011 |
| A1MP3 | 00180-61103 | 1 | TRANSISTOR:HEAT SINK RH | 28480 | 00180-61103 |
| A1MP4 | 00180-61104 | 1 | TRANSISTOR:HEAT SINK LH | 28480 | 00180-61104 |
| A1MP5 | 00180-00249 | 1 | PANEL:REAR | 28480 | 00180-00249 |
| A1MP7 | 00182-24701 | 4 | SPACER:LVP5 | 28480 | 00182-24701 |
| A1MP8 | 00180-01252 | 1 | BRACKET:TRANSFORMER | 28480 | 00180-01252 |
| A1O1 | 1854-0417 | 2 | TSTR:SI NPN | 28480 | 1854-0417 |
| A1O2 | 1854-0063 | 2 | TSTR:SI NPN | 80131 | 2N3055 |
| A1O3 | 1854-0063 | 2 | TSTR:SI NPN | 80131 | 2N3055 |
| A1O4 | 1854-0417 | 1 | TSTR:SI NPN | 28480 | 1854-0417 |
| A1T1 | 9100-3401 | 1 | TRANSFORMER:POWER | 28480 | 9100-3401 |
| A1XQ1 | 1200-0041 | 4 | SOCKET:TRANSISTOR | 71785 | 133-32-10-013 |
| THRU | | | | | |
| A1XQ4 | | | | | |
| A1A1 | 00184-66511 | 1 | ASSY:LOW VOLTAGE RECTIFIER BOARD | 28480 | 00184-66511 |
| A1A1C1 | 0180-0091 | 1 | C:FXD ELECT 10 UF +50-10% 100 VDCW | 56289 | 30D106F100DC2-USM |
| A1A1CR1 | 1901-0028 | | DIODE:SILICON 0.75A 400 PIV | 04713 | SR1358-9 |
| THRU | | | | | |
| A1A1CR8 | | | | | |
| A1A1CR9 | 1901-0415 | 8 | DIODE:SILICON 50 PIV 3A | 28480 | 1901-0415 |
| THRU | | | | | |
| A1A1CR16 | | | | | |
| A1A1CR17 | 1901-0028 | | DIODE:SILICON 0.75A 400 PIV | 04713 | SR1358-9 |
| THRU | | | | | |
| A1A1CR20 | | | | | |
| A1A1CR21 | 1901-0045 | 2 | DIODE:SILICON 0.75A 100 PIV | 04713 | SR1358-7 |
| A1A1CR22 | 1901-0045 | 2 | DIODE:SILICON 0.75A 100 PIV | 04713 | SR1358-7 |
| A1A1R1 | 0687-1041 | | R:FXD COMP 100K OHM 10% 1/2W | 01121 | EB1041 |
| A1A1R2 | 0687-1041 | | R:FXD COMP 100K OHM 10% 1/2W | 01121 | EB1041 |
| A1A1R3 | 0760-0016 | | R:FXD MET OX 2.7K OHM 2% 1W | 28480 | 0760-0016 |
| A1A1R4 | 0757-0060 | | R:FXD MET FLM 24.3K OHM 1% 1/2W | 28480 | 0757-0060 |
| A1A1VR1 | 1902-0597 | | DIODE:BREAKDOWN 56.2V 5% 1W | 28480 | 1902-0597 |
| A1A2 | 00184-66509 | | ASSY:LOW VOLTAGE REGULATOR BOARD | 28480 | 00184-66509 |
| A1A2C1 | 0140-0176 | 1 | C:FXD MICA 100 PF +2-300 VDCW | 72136 | DM15F101G0300WICR |
| A1A2C2 | 0180-0269 | | C:FXD ELECT 1.0 UF +50-10% 150 VDCW | 56289 | 30D105F150BA2-DSM |
| A1A2C3 | 0180-0089 | 3 | C:FXD AL ELECT 10 UF +50-10% 150 VDCW | 56289 | 30D106F150DD2-DSM |
| A1A2C4 | 0160-0161 | | C:FXD MY 0.01 UF 10% 200 VDCW | 56289 | 192P10392-PTS |
| A1A2C5 | 0180-0058 | 2 | C:FXD AL ELECT 50 UF +75-10% 25 VDCW | 56289 | 30D506G025CC2-DSM |
| A1A2C6 | 0170-0040 | 3 | C:FXD MY 0.047 UF 10% 200 VDCW | 56289 | 192P47392-PTS |
| A1A2C7 | 0180-0058 | | C:FXD AL ELECT 50 UF +75-10% 25 VDCW | 56289 | 30D506G025CC2-DSM |
| A1A2C9 | 0180-0089 | | C:FXD AL ELECT 10 UF +50-10% 150 VDCW | 56289 | 30D106F150DD2-DSM |
| A1A2CR1 | 1901-0040 | 20 | DIODE:SILICON 30 MA 30 WV | 07263 | FDG1088 |
| A1A2CR2 | 1901-0040 | | DIODE:SILICON 30 MA 30 WV | 07263 | FDG1088 |
| A1A2CR3 | 1901-0026 | 2 | DIODE:SILICON 0.75A 200 PIV | 04713 | SR1358-8 |
| A1A2CR4 | 1901-0040 | | DIODE:SILICON 30 MA 30 WV | 07263 | FDG1088 |
| A1A2CR5 | 1901-0040 | | DIODE:SILICON 30 MA 30 WV | 07263 | FDG1088 |
| A1A2CR6 | 1901-0040 | | DIODE:SILICON 30 MA 30 WV | 07263 | FDG1088 |
| A1A2CR7 | 1901-0026 | | DIODE:SILICON 0.75A 200 PIV | 04713 | SR1358-8 |
| A1A2E1 | 2110-0269 | | CLIP:FUSE 0.250" DIA | 91506 | 6008-32CN |
| THRU | | | | | |
| A1A2E8 | | | | | |
| A1A2F1 | 2110-0065 | 2 | FUSE:0375A 250V (NOT P/O A1A2 - ORDER SEPARATELY) | 75915 | 312.375 |
| A1A2F2 | 2110-0002 | 2 | FUSE:2A 3 AG (NOT P/O A1A2 - ORDER SEPARATELY) | 75915 | 312.002 |
| A1A2F3 | 2110-0002 | 2 | FUSE:2A 3 AG (NOT P/O A1A2 - ORDER SEPARATELY) | 75915 | 312.002 |
| A1A2F4 | 2110-0065 | 1 | FUSE:0375A 250V (NOT P/O A1A2 - ORDER SEPARATELY) | 75915 | 312.375 |
| A1A2J3 | 1251-1633 | 1 | CONNECTOR:PC 15 CONTACT | 71785 | 252-15-30-310 |
| A1A2Q1 | 1854-0234 | | TSTR:SI NPN | 80131 | 2N3440 |
| A1A2Q2 | 1854-0071 | 16 | TSTR:SI NPN (SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| THRU | | | | | |
| A1A2Q4 | | | | | |
| A1A2Q5 | 1854-0039 | | TSTR:SI NPN | 80131 | 2N3053 |
| A1A2Q6 | 1854-0071 | | TSTR:SI NPN (SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| THRU | | | | | |
| A1A2Q8 | | | | | |
| A1A2Q9 | 1854-0039 | | TSTR:SI NPN | 80131 | 2N3053 |
| A1A2Q10 | 1854-0071 | | TSTR:SI NPN (SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A1A2Q11 | 1854-0071 | | TSTR:SI NPN (SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A1A2Q12 | 1854-0071 | | TSTR:SI NPN (SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A1A2Q13 | 1854-0039 | | TSTR:SI NPN | 80131 | 2N3053 |
| A1A2Q14 | 1854-0071 | | TSTR:SI NPN (SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A1A2Q15 | 1854-0071 | | TSTR:SI NPN (SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A1A2Q16 | 1854-0071 | | TSTR:SI NPN (SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A1A2R1 | 0757-0713 | 1 | R:FXD FLM 110 OHM 1% 1/4W | 28480 | 0757-0713 |
| A1A2R2 | 0757-0281 | 6 | R:FXD MET FLM 2.74K OHM 1% 1/8W | 28480 | 0757-0281 |
| A1A2R3 | 0757-0465 | 3 | R:FXD MET FLM 100K OHM 1% 1/8W | 28480 | 0757-0465 |
| A1A2R4 | 0812-0058 | 2 | R:FXD WW 0.2 OHM 5% 2W | 28480 | 0812-0058 |
| A1A2R5 | 0757-0060 | 2 | R:FXD MET FLM 24.3K OHM 1% 1/2W | 28480 | 0757-0060 |
| A1A2R6 | 0757-0060 | | R:FXD MET FLM 24.3K OHM 1% 1/2W | 28480 | 0757-0060 |
| A1A2R7 | 0757-0435 | 4 | R:FXD FLM 3920 OHM 1% 1/8W | 28480 | 0757-0435 |
| A1A2R8 | 0757-0438 | 9 | R:FXD MET FLM 5.11K OHM 1% 1/8W | 28480 | 0757-0438 |
| A1A2R9 | 0757-0044 | 2 | R:FXD MET FLM 33.2K OHM 1% 1/2W | 28480 | 0757-0044 |
| A1A2R10 | 0757-0435 | | R:FXD FLM 3920 OHM 1% 1/8W | 28480 | 0757-0435 |

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 |
|-----------------------|----------------|-----|--------------------------------------|----------|--------------------|
| A1A2R11 | 2100 1773 | 2 | R:VAR WW 1K OHM 5% TYPE H 1W | 28480 | 2100-1773 |
| A1A2R12 | 0757-0767 | 3 | R:FXD FLM 43.2K OHM 1% 1/4W | 28480 | 0757-0767 |
| A1A2R13 | 0811-1746 | 2 | R:FXD WW 0.36 OHM 5% 2W | 28480 | 0811-1746 |
| A1A2R14 | 0757-0767 | | R:FXD FLM 43.2K OHM 1% 1/4W | 28480 | 0757-0767 |
| A1A2R15 | 0757-0438 | | R:FXD MET FLM 5.11K OHM 1% 1/8W | 28480 | 0757-0438 |
| A1A2R16 | 0757-0767 | | R:FXD FLM 43.2K OHM 1% 1/4W | 28480 | 0757-0767 |
| A1A2R17 | 0757-0431 | 3 | R:FXD MET FLM 2.43K OHM 1% 1/8W | 28480 | 0757-0431 |
| A1A2R18 | 0757-0273 | 1 | R:FXD MET FLM 3.01K | 28480 | 0757-0273 |
| A1A2R19 | 0757-0283 | 7 | R:FXD MET FLM 2.00K OHM 1% 1/8W | 28480 | 0757-0283 |
| A1A2R20 | 2100-1772 | 2 | R:VAR WW 500 OHM 5% TYPE H 1W | 28480 | 2100-1772 |
| A1A2R21 | 0757-0438 | | R:FXD MET FLM 5.11K OHM 1% 1/3W | 28480 | 0757-0438 |
| A1A2R22 | 0811-1746 | | R:FXD WW 0.36 OHM 5% 2W | 28480 | 0811-1746 |
| A1A2R23 | 0757-0769 | 3 | R:FXD FLM 51.5K OHM 1% 1/4W | 28480 | 0757-0769 |
| A1A2R24 | 0757-0436 | 3 | R:FXD MET FLM 4.32K OHM 1% 1/8W | 28480 | 0757-0436 |
| A1A2R25 | 0757-0430 | 1 | R:FXD MET FLM 2.21K OHM 1% 1/8W | 28480 | 0757-0430 |
| A1A2R26 | 0757-0769 | | R:FXD FLM 51.1K OHM 1% 1/4W | 28480 | 0757-0769 |
| A1A2R27 | 0757-0281 | | R:FXD MET FLM 2.74K OHM 1% 1/8W | 28480 | 0757-0281 |
| A1A2R28 | 0757-0428 | 2 | R:FXD MET FLM 1.62K OHM 1% 1/8W | 28480 | 0757-0428 |
| A1A2R29 | 2100-1722 | | R:VAR WW 500 OHM 5% TYPE H 1W | 28480 | 2100-1722 |
| A1A2R30 | 0757-0435 | | R:FXD FLM 3920 OHM 1% 1/8W | 28480 | 0757-0435 |
| A1A2R31 | 0757-0367 | 3 | R:FXD MET FLM 100K OHM 1% 1/2W | 28480 | 0757-0367 |
| A1A2R32 | 0757-0281 | | R:FXD MET FLM 2.74K OHM 1% 1/8W | 28480 | 0757-0281 |
| A1A2R33 | 0812-0058 | | R:FXD WW 8.2 OHM 5% 2W | 28480 | 0812-0058 |
| A1A2R34 | 0757-0769 | | R:FXD FLM 51.5K OHM 1% 1/4W | 28480 | 0757-0769 |
| A1A2R35 | 0757-0768 | 2 | R:FXD FLM 47.5K OHM 1% 1/4W | 28480 | 0757-0768 |
| A1A2R36 | 0757-0044 | | R:FXD MET FLM 33.2K OHM 1% 1/2W | 28480 | 0757-0044 |
| A1A2R37 | 0757-0367 | | R:FXD MET FLM 100K OHM 1% 1/2W | 28480 | 0757-0367 |
| A1A2R38 | 0757-0450 | 1 | R:FXD MET FLM 22.1K OHM 1% 1/8W | 28480 | 0757-0450 |
| A1A2R39 | 0757-0280 | 8 | R:FXD MET FLM 1K OHM 1% 1/8W | 28480 | 0757-0280 |
| A1A2R40 | 2100-1774 | 1 | R:VAR WW 2K OHM 5% TYPE H 1W | 28480 | 2100-1774 |
| A1A2R41 | 0757-0768 | | R:FXD FLM 47.5K OHM 1% 1/4W | 28480 | 0757-0768 |
| A1A2R42 | 0687-5611 | | R:CON COMP 560 OHM 10% 1/2W | 01121 | EB5611 |
| A1A2TP1 | 1251-0206 | 5 | CONNECTOR:SOCKET 0.15 DDI DIA TEFLON | 98291 | SKT-400 |
| A1A2TP4 | | | | | |
| A1A2VR1 | 1902-3096 | 1 | DIODE BREAKDOWN: 5.23V 5% 400 MW | 28480 | 1902-3096 |
| A1A2VR2 | 1902-0787 | 1 | DIODE:T.C. REFERENCE 1N938 | 04713 | 1N938 |
| A2 | 00180-66543 | 1 | BOARD ASSY:HORIZONTAL AMPLIFIER | 28480 | 00180-66543 |
| A2C1 | 0160-0162 | 13 | C:FXD MY 0.022 UF 10% 200 VDCW | 56289 | 192P22392-PTS |
| A2C2 | 0160-0162 | | C:FXD MY 0.022 UF 10% 200 VDCW | 56289 | 192P22392-PTS |
| A2C3 | 0180-0197 | 4 | C:FXD ELECT 2.2 UF 10% 20 VDCW | 56289 | 150D225X9020A2-DYS |
| A2C4 | 0180-0197 | | C:FXD ELECT 2.2 UF 10% 20 VDCW | 56289 | 150D225X9020A2-DYS |
| A2C5 | 0160-0162 | | C:FXD MY 0.022 UF 10% 200 VDCW | 56289 | 192P22392-PTS |
| A2C6 | 0121-0059 | 1 | C:VAR CER 2.8 PF 300 VDCW | 28480 | 0121-0059 |
| A2C7 | 0160-2250 | 1 | C:FXD 5.1 PF 500 VDCW | 72982 | 301-000-COHO-519E |
| A2C8 | 0121-0105 | 1 | C:VAR CER 9-35 PF NPO | 28480 | 0121-0105 |
| A2C9 | 0160-2201 | 1 | C:FXD MICA 51 PF 5% 300 VDCW | 72136 | RDM15E510J1C |
| A2C10 | 0160-0162 | | C:FXD MY 0.022 UF 10% 200 VDCW | 56289 | 192P22392-PTS |
| A2C11 | 0160-0162 | | C:FXD MY 0.022 UF 10% 200 VDCW | 56289 | 192P22392-PTS |
| A2C12 | 0132-0007 | 3 | C:VAR POLY 0.7 TO 3.0 PF 350 VDCW | 72982 | 535-033-4R |
| A2C13 | 0170-0040 | | C:FXD MY 0.047 UF 10% 200 VDCW | 56289 | 192P47392-PTS |
| A2C14 | 0160-0162 | | C:FXD MY 0.022 UF 10% 200 VDCW | 56289 | 192-P22392-PTS |
| A2C15 | 0180-0197 | | C:FXD ELECT 2.2 UF 10% 20 VDCW | 56289 | 150D225X9020A2-DYS |
| A2C16 | 0180-0197 | | C:FXD ELECT 2.2 UF 10% 20 VDCW | 56289 | 150D225X9020A2-DYS |
| A2C17 | 0180-0218 | 1 | C:FXD ELECT 0.15 UF 10% 35 VDCW | 28480 | 0180-0218 |
| A2C18 | 0160-0162 | | C:FXD MY 0.022 UF 10% 200 VDCW | 56289 | 192P22392-PTS |
| A2C19 | 0170-0040 | | C:FXD MY 0.047 UF 10% 200 VDCW | 56289 | 192P47392-PTS |
| A2C20 | 0132-0007 | | C:VAR POLY 0.7 TO 3.0 PF 350 VDCW | 72982 | 535-033-4R |
| A2C21 | 0132-0007 | | C:VAR POLY 0.7 TO 3.0 PF 350 VDCW | 72982 | 535-033-4R |
| A2C22 | 0160-2235 | 1 | C:FXD CER 0.75 PF 500 VDCW | 72982 | 301-000-COKO-758C |
| A2CR1 | 1901-0040 | | DIODE:SILICON 30 MA 30 WV | 07263 | FDG1088 |
| A2CR2 | 1901-0040 | | DIODE:SILICON 30 MA 30 WV | 07263 | FDG1088 |
| A2CR3 | 1901-0040 | | DIODE:SILICON 30 MA 30 WV | 07263 | FDG1088 |
| A2CR4 | 1901-0040 | | DIODE:SILICON 30 MA 30 WV | 07263 | FDG1088 |
| A2CR5 | 1901-0040 | | DIODE:SILICON 30 MA 30 WV | 07263 | FDG1088 |
| A2CR6 | 1901-0040 | | DIODE:SILICON 30 MA 30 WV | 07263 | FDG1088 |
| A2CR7 | 1901-0040 | | DIODE:SILICON 30 MA 30 WV | 07263 | FDG1088 |
| A2CR8 | 1901-0040 | | DIODE:SILICON 30 MA 30 WV | 07263 | FDG1088 |
| A2CR9 | 1901-0040 | | DIODE:SILICON 30 MA 30 WV | 07263 | FDG1088 |
| A2E1 | 0360-1514 | 75 | PIN:SQUARE | 28480 | 0360-1514 |
| A2L1 | 9140-0179 | 7 | COIL/CHOKE 22.0 UH 10% | 28480 | 9140-0179 |
| A2L2 | 9140-0179 | | COIL/CHOKE 22.0 UH 10% | 28480 | 9140-0179 |
| A2L3 | 9170-0029 | 1 | CORE:FERRITE BEAD | 02114 | 56-590-65A2/4A |
| A2MP1 | 1205-0063 | 3 | HEAT SINK:SEMICONDUCTOR | 05820 | 224-CB |
| A2Q1 | 1855-0062 | 1 | TSTR:SI FET 30V | 01295 | 2N1595 |
| A2Q2 | 1854-0215 | 1 | TSTR:SI NPN | 80131 | 2N3904 |
| A2Q3 | 1850-0158 | 1 | TSTR:GE PNP | 80131 | 2N2635 |
| A2Q4 | 1854-0019 | 5 | TSTR:SI NPN | 28480 | 1854-0019 |
| A2Q5 | 1854-0019 | | TSTR:SI NPN | 28480 | 1854-0019 |
| A2Q6 | 1853-0009 | 3 | TSTR:SI NPN | 28480 | 1853-0009 |
| A2Q7 | 1854-0419 | 2 | TSTR:SI NPN | 04713 | SS657 |
| A2Q8 | 1853-0038 | 3 | TSTR:SI PNP | 28480 | 1853-0038 |
| A2Q9 | 1854-0071 | | TSTR:SI NPN (SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A2Q10 | 1854-0019 | | TSTR:SI NPN | 28480 | 1854-0019 |
| A2Q11 | 1853-0009 | | TSTR:SI PNP | 28480 | 1853-0009 |

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 |
|-----------------------|----------------|-----|-------------------------------------|----------|----------------------|
| A 1 | 1261 0419 | | T T F JFN | 1713 | 5 657 |
| A 1 | 0757 0630 | | T T C P WP | 26430 | 1 00 6 |
| A 2 | 1267 0401 | 1 | R FX MET FLM 100 OHM 1 1 8W | 28480 | 0 7 40 |
| A 2 | 0683 0227 | 1 | R FXD COMP 2 7 OHM 5 1 4W | 01121 | CB 705 |
| A 2 | 0757 0388 | 1 | R FXD FLM 301 OHM 1 1 8W | 28480 | C 7 0388 |
| A 2 | 0698 1530 | 1 | R FXD MET FLM MEGOHM 1 1 2W | 28480 | 0698 1530 |
| A 2 | 0757 0156 | 1 | R FXD MET FLM 1 5 MEGOHM 1 1 2W | 28480 | 0757 0156 |
| A 2 | 0757 0344 | 1 | R FXD MET FLM 1 00 MEGOHM 1 1 4W | 28480 | 0757 0344 |
| A 2 | 0757 0401 | 1 | R FXD MET FLM 100 OHM 1 1 8W | 28480 | 0757 0401 |
| A 2 | 07 7 0367 | 1 | R FXD MET FLM 100K OHM 1 1 2W | 28480 | 07 7 0367 |
| A 2 | 0757 0280 | 1 | R FXD MET FLM KOHM 1 1 8W | 28480 | 0757 0280 |
| A 2 | 0757 0407 | 6 | R FXD MET FLM 200 OHM 1 1 8W | 28480 | 0757 0407 |
| A 2 | 0757 0074 | 1 | R FXD MET OX 15K OHM 5 1W | 28480 | 0761 0074 |
| A 2 | 0757 0420 | 1 | R FXD FLM 1 3K OHM 1 1 8W | 28480 | 0757 0420 |
| A 2 | 0757 0417 | 1 | R FXD MET FLM 16 2K OHM 1 1 8W | 28480 | 0757 0417 |
| A 2 | 2100 2514 | 1 | R VAR CERMET 20K OHM 10 LIN 1 2W | 28480 | 2100 2514 |
| A 2 | 0698 3153 | 1 | R FXD MET FLM 3 83K OHM 1 1 8W | 28480 | 0698 3153 |
| A 2 | 0757 0463 | 1 | R FXD MET FLM 82 5K OHM 1 1 8W | 28480 | 0757 0463 |
| A 2 | 0757 0401 | 1 | R FXD MET FLM 100 OHM 1 1 8W | 28480 | 07 7 0401 |
| A 2 | 0757 0100 | 1 | R FXD MET FLM 681 OHM 1 1 4W | 28480 | 0757 0100 |
| A 2 | 0757 0401 | 1 | R FXD MET FLM 100 OHM 1 1 8W | 28480 | 0757 0401 |
| A 2 | 0757 0460 | 4 | R FXD MET FLM 61 9K OHM 1 1 8W | 28480 | 0757 0460 |
| A 2 | 0757 0441 | 2 | R FXD MET FLM 8 25K OHM 1 1 8W | 28480 | 0757 0441 |
| A 2 | 0757 0283 | 1 | R FXD MET FLM 2 00K OHM 1 1 8W | 28480 | 0757 0283 |
| A 2 | 0757 0714 | 1 | R FXD FLM 33 2K OHM 1 1 4W | 28480 | 0757 0714 |
| A 2 | 0757 0741 | 2 | R FXD MET FLM 2 43K OHM 1 1 4W | 28480 | 5 0741 |
| A 2 | 0757 0281 | 2 | R FXD MET FLM 2 74K OHM 1 1 8W | 28480 | 0757 0281 |
| A 2 | 0757 0443 | 2 | R FXD MET FLM 11 0K OHM 1 1 8W | 28480 | 0757 0443 |
| A 2 | 0757 0736 | 2 | R FXD MET FLM 1 50K OHM 1 1 4W | 28480 | 0757 0736 |
| A 2 | 0757 0413 | 2 | R FXD MET FLM 392 OHM 1 1 8W | 28480 | 0757 0413 |
| A 2 | 0757 0846 | 2 | R FXD MET FLM 22 1K OHM 1 0 1 2W | 28480 | 0757 0846 |
| A 2 | 0757 0407 | 2 | R FXD MET FLM 200 OHM 1 1 8W | 28480 | 0757 0407 |
| A 2 | 0757 0284 | 1 | R FXD MET FLM 150 OHM 1 1 8W | 28480 | 0757 0284 |
| A 2 | 2100 1770 | 1 | R VAR WW 100 OHM 5 TYPE H 1W | 28480 | 2100 1770 |
| A 2 | 0757 0411 | 1 | R FXD MET FLM 332 OHM 1 1 8W | 28480 | 0757 0411 |
| A 2 | 2100 1771 | 1 | R VAR WW 200 OHM 5 TYPE H 1W | 28480 | 2100 1771 |
| A 2 | 0757 0428 | 1 | R FXD MET FLM 1 62K OHM 1 1 8W | 28480 | 0757 0428 |
| A 2 | 2100 1773 | 1 | R VAR WW 1K OHM 5 TYPE H 1W | 28480 | 2100 1773 |
| A 2 | 0698 3416 | 4 | R FXD MET FLM 21 5K OHM 1 1 2W | 28480 | 0698 3416 |
| A 2 | 2100 1775 | 1 | R VAR WW 5K OHM 5 1W | 28480 | 2100 1775 |
| A 2 | 0698 3416 | 1 | R FXD MET FLM 21 5K OHM 1 1 2W | 28480 | 0698 3416 |
| A 2 | 0757 0434 | 3 | R FXD MET FLM 3 65K OHM 1 1 8W | 28480 | 0757 0434 |
| A 2 | 0757 0434 | 1 | R FXD MET FLM 3 65K OHM 1 1 8W | 28480 | 0757 0434 |
| A 2 | 0757 0448 | 1 | R FXD MET FLM 18 2K OHM 1 1 8W | 28480 | 0757 0448 |
| A 2 | 0757 0841 | 2 | R FXD MET FLM 12 1K OHM 1 1 2W | 28480 | 0757 0841 |
| A 2 | 0757 0841 | 1 | R FXD MET FLM 12 1K OHM 1 1 2W | 28480 | 0757 0841 |
| A 2 | 0757 0468 | 3 | R FXD FLM 130K OHM 1 1 8W | 28480 | 0757 0468 |
| A 2 | 0757 0440 | 1 | R FXD MET FLM 7 50K OHM 1 1 8W | 28480 | 07 7 0440 |
| A 2 | 0757 0427 | 1 | R FXD MET FLM 1 5K OHM 1 1 8W | 28480 | 0757 0427 |
| A 2 | 0757 0741 | 1 | R FXD MET FLM 2 43K OHM 1 1 4W | 28480 | 0757 0741 |
| A 2 | 0757 0281 | 1 | R FXD MET FLM 2 74K OHM 1 1 8W | 28480 | 0757 0281 |
| A 2 | 0757 0200 | 1 | R FXD MET FLM 5 62K OHM 1 1 8W | 28480 | 0757 0200 |
| A 2 | 0757 0443 | 1 | R FXD MET FLM 11 0K OHM 1 1 8W | 28480 | 0757 0443 |
| A 2 | 0757 0736 | 1 | R FXD MET FLM 1 50K OHM 1 1 4W | 28480 | 0757 0736 |
| A 2 | 0757 0846 | 1 | R FXD MET FLM 22 1K OHM 1 0 1 2W | 28480 | 0757 0846 |
| A 2 | 0757 0413 | 1 | R FXD MET FLM 392K OHM 1 1 1/8W | 28480 | 0757 0413 |
| A 2 | 0757 0407 | 1 | R FXD MET FLM 200 OHM 1 1 8W | 28480 | 0757 0407 |
| A 2 | 0757 0280 | 1 | R FXD MET FLM 1K OHM 1 1 8W | 28480 | 0757 0280 |
| A 2 | 2100 2030 | 1 | R VAR FLM 20K OHM 10% LIN 1 2W | 28480 | 2100 2030 |
| A 2 | 0757 0280 | 1 | R FXD MET FLM 1K OHM 1 1 8W | 28480 | 0757 0280 |
| A 3 | 3101 0982 | 1 | SWITCH SLIDE SPST 0 5A 125V | 79727 | GF124 0007 |
| A 3 | 06180 66552 | 1 | BOARD ASSY GATE | 28480 | 00180 66552 |
| A 3 | 0160 0162 | 1 | C FXD R Y 0 022 UF 10 200VDCW | 56289 | 192P22392 PTS |
| A 3 | 0160 0162 | 1 | C FXD MY 0 022 UF 10 200VDCW | 56289 | 192P22392 PTS |
| A 3 | 01 1 0429 | 1 | C VAR POLY 0 7 3 0 PF 600VDCW | 72982 | 53F 09 |
| A 3 | 0150 0048 | 1 | C FXD 0 22 PF 500 VDCW | 28480 | J 50 0048 |
| A 3 | 0121 0168 | 1 | C VAR TEF LON 0 75 1 50 PF 600VDCW | 28480 | 0121 0168 |
| A 3 | 0160 3451 | 1 | C FXD CER 0 01 UF 80 20 100VDCW | 56289 | CO23B101F 103ZS25 CD |
| A 3 | 0160 0162 | 1 | C FXD MY 0 022 UF 10 200VDCW | 56289 | 192P22392 PTS |
| A 3 | 0160 0303 | 1 | C FXD MYLAR 15 UF 10 200VDCW | 28480 | 0160 0303 |
| A 3 | 0180 0089 | 1 | C FXD AL ELECT 10UF +50 10 150VDCW | 56289 | 30D106F 150 DD2 DSM |
| A 3 | 0160 0162 | 1 | C FXD MY 0 022 UF 10 200VDCW | 56289 | 192P22392 PTS |
| A 3 | 0180 0155 | 3 | C FXD ELECT 2 2 UF 20 200VDCW | 56289 | 150D225X0020A2 DYS |
| A 3 | 0160 0162 | 1 | C FXD MY 0 022 UF 10 200VDCW | 56289 | 192P22392 PTS |
| A 3 | 0160 2961 | 2 | C FXD MICA 5825 PF 2 300VDCW | 04062 | RDM20F 5825 G3C |
| A 3 | 0160 2961 | 1 | C FXD MICA 5825 PF 2 300VDCW | 04062 | RDM20F 5825G3C |
| A 3 | 0180 0089 | 1 | C FXD AL ELECT 10 UF +50 10 150VDCW | 56289 | 30D106F 150DD2 DSM |
| A 3 | 0180 0049 | 1 | C FXD ELECT 20UF -75 10 50VDCW | 56289 | 30D206G050CC2 DSM |
| A 3 | 0170 0019 | 1 | C FXD MY 0 1 UF 5 200VDCW | 28480 | 0170 0019 |
| A 3 | 0160 3008 | 3 | C FXD CER 4700 PF 20 4K VDCW | 72982 | 3888 024 Y550 472M |
| A 3 | 0160 3007 | 4 | C FXD CER 4700 PF 20 4K VDCW | 72982 | 3888 024 Y550 472M |
| A 3 | 0160 3008 | 1 | C FXD CER 4700 PF 20 4K VDCW | 72982 | 3888 024 Y550 472M |
| A 3 | 0160 3007 | 1 | C FXD CER 4700 PF 20 4K VDCW | 72982 | 3888 024 Y550 472M |
| A 3 | 0160 3007 | 1 | C FXD CER 4700 PF 20 4K VDCW | 72982 | 3888 024 Y550 472M |
| A 3 | 0160 3008 | 1 | C FXD CER 4700 PF 20 4K VDCW | 72982 | 3888 024 Y550 472M |

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 |
|-----------------------|----------------|-----|------------------------------------|----------|-----------------|
| A307 | 130103 | 1 | DIODE SILICON 15V | 28480 | 190103 |
| A308 | 13010029 | 2 | DIODE SILICON 600 PIV | 28480 | 19010029 |
| A309 | 19010438 | 2 | DIODE SILICON 1600 PIV | 28480 | 19010438 |
| A310 | 19010096 | 3 | DIODE SILICON 120V | 01295 | UG 888 |
| A311 | 19010096 | | DIODE SILICON 120V | 01295 | UG 888 |
| A312 | 13010096 | | DIODE SILICON 120V | 01295 | UG 888 |
| A313 | 03601514 | | PIN SQUARE | 28480 | 03601514 |
| A314 | 91400179 | | COIL CHOKE 220UH 10 | 28480 | 91400179 |
| A315 | 91400179 | | COIL CHOKE 220UH 10 | 28480 | 91400179 |
| A316 | 17050063 | | HEAT SINK SEMICONDUCTOR | 05820 | 224CB |
| A317 | 18540032 | | TSTR SI NPN | 80131 | 2N3563 |
| A318 | 18540019 | | TSTR SI NPN | 28480 | 18540019 |
| A319 | 18530038 | | TSTR SI NPN | 28480 | 18530038 |
| A320 | 18540271 | 1 | TSTR SI NPN | 28480 | 18540271 |
| A321 | 19540234 | 2 | TSTR SI NPN | 80131 | 2N3440 |
| A322 | 18540234 | | TSTR SI NPN | 80131 | 2N3440 |
| A323 | 18540023 | 1 | TSTR SI NPN (SELECTED FROM 2N2484) | 28480 | 18540023 |
| A324 | 18540071 | | TSTR SI NPN (SELECTED FROM 2N3704) | 28480 | 18540071 |
| A325 | 18540039 | | TSTR SI NPN | 80131 | 2N3053 |
| A326 | 8540092 | | TSTR SI NPN | 80131 | 2N3563 |
| A327 | 8530049 | | TSTR SI NPN | 28480 | 18530049 |
| A328 | 18530049 | | TSTR SI NPN | 28480 | 18530049 |
| A329 | 18540215 | | TSTR SI NPN | 80131 | 2N3904 |
| A330 | 07570407 | | R FXD MET FLM 200 OHM 1 1.8W | 28480 | 07570407 |
| A331 | 07570407 | | R FXD MET FLM 200 OHM 1 1.8W | 28480 | 07570407 |
| A332 | 07570401 | | R FXD MET FLM 100 OHM 1 1.8W | 28480 | 07570401 |
| A333 | 07570456 | | R FXD MET FLM 51.1K OHM 1 1.8W | 28480 | 07570456 |
| A334 | 07570435 | | R FXD MET FLM 3.92K OHM 1 1.8W | 28480 | 07570435 |
| A335 | 07570419 | | R FXD MET FLM 681 OHM 1 1.8W | 28480 | 07570419 |
| A336 | 07570290 | | R FXD MET FLM 6.19K OHM 1 1.8W | 28480 | 07570290 |
| A337 | 07570724 | 1 | R FXD MET FLM 392 OHM 1 1.4W | 28480 | 07570724 |
| A338 | 07570727 | 1 | R FXD MET FLM 562 OHM 1 1.4W | 28480 | 07570727 |
| A339 | 06983421 | | R FXD MET FLM 38.3K OHM 1 1.2W | 28480 | 06983421 |
| A340 | 07570833 | | R FXD MET FLM 5.11K OHM 1 1.2W | 28480 | 07570833 |
| A341 | 07570280 | | R FXD MET FLM 1K OHM 1 1.8W | 28480 | 07570280 |
| A342 | 07570190 | 3 | R FXD MET FLM 20K OHM 1 1.2W | 28480 | 07570190 |
| A343 | 07570416 | 1 | R FXD MET FLM 511 OHM 1 1.8W | 28480 | 07570416 |
| A344 | 06871011 | 1 | R FXD COMP 100 OHM 10 1.2W | 01121 | EB 1011 |
| A345 | 07610083 | 1 | R FXD MET OX 68K OHM 5 1W | 28480 | 07610083 |
| A346 | 07570401 | | R FXD MET FLM 100 OHM 1 1.8W | 28480 | 07570401 |
| A347 | 07570401 | | R FXD MET FLM 100 OHM 1 1.8W | 28480 | 07570401 |
| A348 | 06830275 | | R FXD COMP 2.7 OHM 5 1.4W | 01121 | CB 27G5 |
| A349 | 07570401 | | R FXD MET FLM 100 OHM 1 1.8W | 28480 | 07570401 |
| A350 | 07570190 | | R FXD MET FLM 20K OHM 1 1.2W | 28480 | 07570190 |
| A351 | 07570468 | | R FXD FLM 130K OHM 1 1.8W | 28480 | 07570468 |
| A352 | 07570468 | | R FXD FLM 130K OHM 1 1.8W | 28480 | 07570468 |
| A353 | 07570283 | | R FXD MET FLM 2.00K OHM 1 1.8W | 28480 | 07570283 |
| A354 | 07570407 | | R FXD MET FLM 200 OHM 1 1.8W | 28480 | 07570407 |
| A355 | 07570190 | | R FXD MET FLM 20K OHM 1 1.2W | 28480 | 07570190 |
| A356 | 06985421 | 1 | R FXD MET FLM 7.82K OHM 0 1.2W | 28480 | 06985421 |
| A357 | 06385418 | 1 | R FXD FLM 50 OHM 0 1 1.8W | 28480 | 06385418 |
| A358 | 06985411 | 1 | R FXD FLM 195K OHM 0 1 1.8W | 28480 | 06985411 |
| A359 | 06830275 | | R FXD COMP 2.7 OHM 5 1.4W | 01121 | CB 27G5 |
| A360 | 07570465 | | R FXD MET FLM 100K OHM 1 1.8W | 28480 | 07570465 |
| A361 | 07570814 | 1 | R FXD MET FLM 511 OHM 1 1.2W | 28480 | 07570814 |
| A362 | 07570284 | | R FXD MET FLM 150 OHM 1 1.8W | 28480 | 07570284 |
| A363 | 07570465 | | R FXD MET FLM 100K OHM 1 1.8W | 28480 | 07570465 |
| A364 | 07570283 | | R FXD MET FLM 2.00K OHM 1 1.8W | 28480 | 07570283 |
| A365 | 07570280 | | R FXD MET FLM 1K OHM 1 1.8W | 28480 | 07570280 |
| A366 | 07570442 | 2 | R FXD MET FLM 0.0K OHM 1 1.8W | 28480 | 07570442 |
| A367 | 07570438 | | R FXD MET FLM 5.11K OHM 1 1.8W | 28480 | 07570438 |
| A368 | 06983553 | 1 | R FXD FLM 2.49 MEG OHM 1 1.2W | 28480 | 06983553 |
| A369 | 07570442 | 1 | R FXD MET FLM 10.0K OHM 1 1.8W | 28480 | 07570442 |
| A370 | 07570870 | | R FXD MET FLM 825K OHM 1 1.2W | 28480 | 07570870 |
| A371 | 07000944 | 1 | R VAR COMP 200K OHM 20% 3.4W | 75042 | CT 150 |
| A372 | 06875611 | 1 | R FXD COMP 560 OHM 10 1.2W | 01121 | EB 5611 |
| A373 | 01988018 | 1 | R FXD FLM 30 MEG OHM 1 1.9 3W | 03888 | EB 175 |
| A374 | 06871051 | 1 | R FXD COMP 1 MEG OHM 10 1.2W | 01121 | EB 1051 |
| A375 | 07570460 | | R FXD MET FLM 61.9K OHM 1 1.8W | 28480 | 07570460 |
| A376 | 07570156 | 3 | R FXD MET FLM 43.2K OHM 1 1.8W | 28480 | 07570156 |
| A377 | 07570466 | | R FXD MET FLM 43.2K OHM 1 1.8W | 28480 | 07570466 |
| A378 | 07570460 | | R FXD MET FLM 61.9K OHM 1 1.8W | 28480 | 07570460 |
| A379 | 06874721 | 1 | R FXD COMP 4700 OHM 10 1.2W | 01121 | EB 4721 |
| A380 | 0698535 | 1 | R FXD FLM 8.25 MEG OHM 5 1W | 28480 | 06985353 |
| A381 | 06986580 | 1 | R FXD FLM 16.25 MEG OHM 5 1W | 28480 | 06986580 |
| A382 | 21002031 | 1 | R VAR 50K OHM 10 LIN 1.2W | 28480 | 21002031 |
| A383 | 07570454 | 1 | R FXD MET FLM 33.2K OHM 1 1.8W | 28480 | 07570454 |
| A384 | 07570280 | 1 | R FXD MET FLM 1K OHM 1 1.8W | 28480 | 07570280 |
| A385 | 07570280 | | R FXD MET FLM 1K OHM 1 1.8W | 28480 | 07570280 |
| A386 | 07570280 | | R FXD MET FLM 1K OHM 1 1.8W | 28480 | 07570280 |
| A387 | 07570460 | | R FXD MET FLM 61.9K OHM 1 1.8W | 28480 | 07570460 |

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

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|-----------------------|----------------|-----|--|----------|--------------------|
| A3R65 | 0757-0456 | | R:FXD MET FLM 43.2K OHM 1% 1/8W | 28480 | 0757-0456 |
| A3R66 | 0757-0436 | | R:FXD MET FLM 4320 OHM 1% 1/8W | 28480 | 0757-0436 |
| A3R67 | 0757-0442 | | R:FXD MET FLM 10.0K OHM 1% 1/8W | 28480 | 0757-0442 |
| A3R68 | 0757-0416 | | R:FXD MET FLM 511 OHM 1% 1/8W | 28480 | 0757-0416 |
| A3R69 | 0757-0433 | | R:FXD MET FLM 3320 OHM 1% 1/8W | 28480 | 0757-0433 |
| A3R70 | 0757-0442 | | R:FXD MET FLM 10.0K OHM 1% 1/8W | 28480 | 0757-0442 |
| A3R71 | 0757-0274 | | R:FXD MET FLM 1210 OHM 1% 1/8W | 28480 | 0757-0274 |
| A3R72 | 0757-0465 | | R:FXD MET FLM 100 K OHM 1% 1/8W | 28480 | 0757-0465 |
| A3R73 | 0757-0419 | | R:FXD MET FLM 681 OHM 1% 1/8W | 28480 | 0757-0419 |
| A3R74 | 0757-0416 | | R:FXD MET FLM 511 OHM 1% 1/8W | 28480 | 0757-0416 |
| A3R75 | 0757-0438 | | R:FXD MET FLM 5110 OHM 1% 1/8W | 28480 | 0757-0438 |
| A3R76 | 0757-0280 | | R:FXD MET FLM 1.0K OHM 1% 1/8W | 28480 | 0757-0280 |
| A3V1 | 2140-0013 | 2 | LAMP:GLOW T2 BULB 57V | 08806 | 5AB A(NE-23A) |
| A3V2 | 2140-0013 | | LAMP:GLOW T2 BULB 57V | 08806 | 5AB A(NE-23A) |
| A3VR1 | 1902-0025 | 1 | DIODE-ZNR 10V 5% PD=4W | 15818 | CD35706 |
| A3VR2 | 1902-0045 | 1 | DIODE-ZNR 7.32V 2% PD=4W | 15818 | CB35668 |
| A4 | 00180-66550 | 1 | BOARD ASSY:HIGH VOLTAGE OSCILLATOR | 28480 | 00180-66550 |
| A4C1 | 0180-0097 | 1 | C:FXD TANT .47UF 10% 35VDCW | 56289 | 150D476X9035S2-DYS |
| A4C2 | 0160-0380 | 1 | C:FXD MY 0.22 UF 10% 200VDCW | 28480 | 0160-0380 |
| A4CR1 | 1901-0049 | | DIODE:SILICON 50PIV | 28480 | 1901-0049 |
| A4CR2 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A4E1 | 0360-1514 | | PIN:SQUARE | 28480 | 0360-1514 |
| A4E2 | 2110-0269 | | CLIP:FUSE 0.250" DIA | 91506 | 6008-32CN |
| A4L1 | 9140-0071 | 1 | COIL:FXD RF:22UHY | 28480 | 9140-0071 |
| A4R1 | 0757-0900 | | R:FXD MET FLM 100 OHM 2% 1/8W | 28480 | 0757-0900 |
| A4XQ1 | 1251-3027 | 1 | CONNECTOR:F & P 3 FEMALE CONTACT | 27264 | 09-52-3032 |
| A5 | 00180-66544 | 1 | BOARD ASSY:HIGH VOLTAGE RECTIFIER | 28480 | 00180-66544 |
| A5C1 | 0160-0907 | 1 | C:FXD CER 0.01 UF +80-20% 500VDCW | 14655 | TM50R23Z-1 |
| A5C2 | 0160-2320 | 1 | C:FXD CER 0.01 UF 5000VDCW | 28480 | 0160-2320 |
| A5CR1 | 1901-0341 | 2 | DIODE:SI 7000 PIV 50MA | 28480 | 1901-0341 |
| A5CR2 | 1901-0341 | | DIODE:SI 7000 PIV 50MA | 28480 | 1901-0341 |
| A5H1 | 5040-0402 | 1 | MOUNT:TRANSFORMER | 28480 | 5040-0402 |
| A5H2 | 5040-0430 | 1 | MOUNT:TRANSFORMER | 28480 | 5040-0430 |
| A5H3 | 0340-0039 | 2 | INSULATOR:BUSHING | 28480 | 0340-0039 |
| A5R1 | 0687-2231 | 1 | R:FXD COMP 22K OHM 10% 1/2W | 01121 | EB2231 |
| A5R2 | 2100-0918 | 1 | R:VAR COMP 1 MEGOHM 20% LIN 1/5W | 28480 | 2100-0918 |
| A5R3 | 0836-0003 | 1 | R:FXD FLM 29 MEGOHM 10% 1W | 28480 | 0836-0003 |
| A5T1 | 00180-60801 | 1 | TRANSFORMER ASSY:HV | 28480 | 00180-60801 |
| A6 | 00180-61105 | 2 | H.V. MULTIPLIER ASSY(CAB) (NOT FIELD REPAIRABLE) | 28480 | 00180-61105 |
| | 00180-61106 | 1 | H.V. MULTIPLIER ASSY(RACK) (NOT FIELD REPAIRABLE) | 28480 | 00180-61106 |
| A7 | 00180-66546 | 1 | BOARD ASSY:SWEEP GATE | 28480 | 00180-66546 |
| A7C1 | 0180-0155 | | C:FXD ELECT 2.2 UF 20% 20VDCW | 56289 | 150D225X0020A2-DYS |
| A7C2 | 0180-0155 | | C:FXD ELECT 2.2 UF 20% 20VDCW | 56289 | 150D225X0020A2.DYS |
| A7E1 | 0360-1514 | | PIN:SQUARE | 28480 | 0360-1514 |
| A7L1 | 9140-0179 | | COIL/CHOKE 22.0 UH 10% | 28480 | 9140-0179 |
| A7L2 | 9140-0179 | | COIL/CHOKE 22.0 UH 10% | 28480 | 9140-0179 |
| A7Q1 | 1854-0071 | | TSTR:SI NPN (SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A7Q2 | 1854-0071 | | TSTR:SI NPN (SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A7Q3 | 1853-0016 | 2 | TSTR:SI PNP | 80131 | 2N3638 |
| A7Q4 | 1853-0016 | | TSTR:SI PNP | 80131 | 2N3638 |
| A7R1 | 0757-0451 | 2 | R:FXD MET FLM 24.3K OHM 1% 1/8W | 28480 | 0757-0451 |
| A7R2 | 0757-0438 | | R:FXD MET FLM 5.11K OHM 1% 1/8W | 28480 | 0757-0438 |
| A7R3 | 0757-0436 | | R:FXD MET FLM 4.32K OHM 1% 1/8W | 28480 | 0757-0436 |
| A7R4 | 0757-0451 | | R:FXD MET FLM 24.3K OHM 1% 1/8W | 28480 | 0757-0451 |
| A7R5 | 0757-0438 | | R:FXD MET FLM 5.11K OHM 1% 1/8W | 28480 | 0757-0438 |
| A7R6 | 0757-0436 | | R:FXD MET FLM 4.32K OHM 1% 1/8W | 28480 | 0757-0436 |
| A7R7 | 0757-0429 | | R:FXD MET FLM 1820 OHM 1% 1/8W | 28480 | 0757-0429 |
| A7R8 | 0757-0273 | | R:FXD MET FLM 3010 OHM 1% 1/8W | 28480 | 0757-0273 |
| A7R9 | 0757-0438 | | R:FXD MET FLM 5110 OHM 1% 1/8W | 28480 | 0757-0438 |
| A7R10 | 0757-0429 | | R:FXD MET FLM 1820 OHM 1% 1/8W | 28480 | 0757-0429 |
| A7R11 | 0757-0273 | | R:FXD MET FLM 3010 OHM 1% 1/8W | 28480 | 0757-0273 |
| A1 | 00184-60003 | | POWER MODULE: LOW VOLTAGE | 28480 | 00184-60003 |
| A1A1 | 00184-66511 | | ASSY:LOW VOLTAGE RECTIFIER BOARD | 28480 | 00184-66511 |
| A1A2 | 00184-66509 | | ASSY:LOW VOLTAGE REGULATOR BOARD | 28480 | 00184-66509 |
| A2 | 00180-66543 | | BOARD ASSY:HORIZONTAL AMPLIFIER | 28480 | 00180-66543 |
| A3 | 00180-66552 | | BOARD ASSY:GATE | 28480 | 00180-66552 |
| A4 | 00180-66550 | | BOARD ASSY: HIGH VOLTAGE OSCILLATOR | 28480 | 00180-66550 |
| A5 | 00180-66544 | | BOARD ASSY: HIGH VOLTAGE RECITIFIER | 28480 | 00180-66544 |
| A6 | 00180-61105 | | H.V. MULTIPLIER ASSY(CAB) | 28480 | 00180-61105 |
| | 00180-61106 | | H.V. MULTIPLIER ASSY (RACK) | 28480 | 00180-61106 |
| A7 | 00180-66546 | | BOARD ASSY: SWEEP GATE | 28480 | 00180-66546 |
| A8 | 00180-61904 | | SWITCH ASSY: DISPLAY | 28480 | 00180-61904 |
| C1 | 0170-0022 | 1 | C:FXD MY 0.1 UF 20% 600VDCW | 01934 | TYPE 24 |
| C2 | 0160-3484 | 2 | C:FXD CER FEED-THRU 1000 PF 20% 1000V | 72982 | 2432-009 X5U 102M |
| C3 | 0160-3484 | | C:FXD CER FEED-THRU 1000 PF 20% 1000V | 72982 | 2432-009 X5U 102M |
| DS1 | 2140-0346 | 1 | LAMP:INCANDESCENT 5V | 71744 | 7210 |
| E1 | 0340-0450 | 1 | WASHER: TRANSISTOR INSULATOR | 04713 | 14852600F12 |
| E2 | 0340-0451 | 1 | WASHER: INSULATED, TRANSISTOR | 04713 | 14852600F03 |
| E3 | 0362-0227 | 68 | TERMINATION: CRIMP LUG FOR 26 A*WG | 27264 | 0362-0227 |
| E4 | 1251-2039 | 9 | CONNECTOR: CRT NECK PIN | 28480 | 1251-2039 |
| E5 | 0362-0277 | 2 | TERMINATION: CRIMP LUG (CRT FIL LEADS) | 59730 | A18-187 |
| E6 | 0362-0265 | | TERMINATION: CRIMP LUG | 27264 | 1923 |
| F1 | 2110-0020 | | FUSE:0.8 A 250V SLOW-BLOW (230V OPERATION OPTIONAL) | 75915 | 313.800S |
| | 2110-0005 | 1 | FUSE:CARTRIDGE 1.6 AMP 125V (115V OPERATION STANDARD) | 71400 | MDL 1.6 |
| F2 | 2110-0033 | 1 | FUSE: 0.75A 250V | 75915 | F02GR750A |

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 |
|-----------------------|----------------|-----|---|----------|-----------------|
| J1 | 1251 0137 | 1 | CONNECTOR: PC 32 CONTACT | 02660 | 26 4200 32S |
| J2 | 1251 0172 | 1 | PART OF W6 CONNECTOR: PC EDGE 1 ROW 22 CONTACT | 71785 | 250-22-30-210 |
| J3 | | | PART OF W6 | | |
| J4 | | | NSR, PART OF MP42, MP80. | | |
| J5 | 1510 0038 | 2 | NSR, PART OF MP42, MP80. | 28480 | 1510-0038 |
| J6 | 1250 0083 | 6 | BINDING POST | 02660 | 31 221-1020 |
| J7 | 1250 0083 | | CONNECTOR: BNC | 02660 | 31 221-1020 |
| J8 | 1250 0083 | | CONNECTOR: BNC | 02660 | 31 221-1020 |
| J9 | 1250 0083 | | CONNECTOR: BNC | 02660 | 31 221-1020 |
| J10 | 1250 0083 | | CONNECTOR: BNC | 02660 | 31 221-1020 |
| J11 | 1250 0083 | | CONNECTOR: BNC | 02660 | 31 221-1020 |
| J12 | 1251-2357 | 1 | SOCKET: 3 PIN MALE POWER RECEPTACLE | 82389 | EAC-301 |
| J13 | 1510-0038 | | BINDING POST | 28480 | 1510-0038 |
| J14 | 0363 0006 | 2 | CONTACT: CONNECTOR SWITCH | 28480 | 0363 0006 |
| L1 | 00180 65601 | 1 | COIL ASSY: Y ALIGNMENT | 28480 | 00180-65601 |
| L2 | 5060 0435 | 1 | COIL: ALIGNMENT Z AXIS | 28480 | 5060-0435 |
| L3 | 9170 0013 | 1 | COIL: CORE, TOROID, GREEN | 72656 | CF-102-H |
| MP1 | 5060 0548 | 1 | KIT: CONTRAST FILTER; BLUE | 28480 | 5060 0548 |
| MP2 | 5040 0444 | 1 | SHIELD: LIGHT BLACK NYLON | 28480 | 5040-0444 |
| MP3 | 5020 0476 | 1 | BEZEL: CRT | 28480 | 5020-0476 |
| MP4 | 00180-04130 | 1 | COVER: BTM RIGHT | 28480 | 00180-04130 |
| MP5 | 00180-04132 | 1 | COVER: BTM LEFT | 28480 | 00180-04132 |
| MP6 | 00180-04134 | 1 | COVER: TOP RIGHT | 28480 | 00180-04134 |
| MP7 | 00180-04136 | 1 | COVER: TOP LEFT | 28480 | 00180-04136 |
| MP8 | 0370 0432 | 1 | KNOB: BLACK LEVER | 28480 | 00180-0432 |
| MP9 | 00180-05002 | 1 | LEVER: HORIZONTAL POSITION | 28480 | 00180 05002 |
| MP10 | 00180-67402 | 2 | KNOB: HORIZONTAL POSITION | 28480 | 00180 67402 |
| MP11 | 00180-67404 | 2 | KNOB ASSY: BAR WITH BLACK ARROW | 28480 | 00180-67404 |
| MP12 | 00180 67404 | | KNOB ASSY: BAR WITH BLACK ARROW | 28480 | 00180-67404 |
| MP13 | 00180-67405 | 1 | KNOB: RND BLK (FIND BEAM) | 28480 | 00180-67405 |
| MP14 | 0370-0348 | 1 | KNOB: RND BLK 0.540" DIA | 28480 | 0370-0348 |
| MP15 | 00180-67403 | 1 | KNOB ASSY | 28480 | 00180-67403 |
| MP16 | 00180-67402 | | KNOB: HORIZONTAL POSITION | 28480 | 00180-67402 |
| MP17 | 0403-0128 | 1 | GUIDE: PC BD PLUG-IN (LEFT) | 28480 | 0403-0128 |
| MP18 | 0403 0129 | 1 | GUIDE: PC BD PLUG-IN (RIGHT) | 28480 | 0403-0129 |
| MP19 | 0510 0705 | 2 | PIN: SPRING 0.094" DIA | 00287 | OBD# |
| MP20 | 0510-0952 | 2 | RING: RETAINING STL FOR 0.094" DIA SHAFT | 79136 | X5133-9-S-MD |
| MP21 | 1460-0706 | 2 | SPRING: COMPRESSION | 00000 | OBD |
| MP22 | 3050-0441 | 2 | WASHER: SHOULDER .125 ID FOR #4 HDW | 28480 | 3050-0441 |
| MP23 | 5020 0499 | 2 | HINGE: PROBE HANGER | 28480 | 5020-0499 |
| MP24 | 5040-0463 | 2 | HANGER: PROBE | 28480 | 5040-0463 |
| MP25 | 5040-0464 | 2 | HANGER: PROBE | 28480 | 5040-0464 |
| MP26 | 5040 0459 | 1 | HANDLE | 28480 | 5040-0459 |
| MP27 | 00180-24718 | 2 | SPACER: HANDLE | 28480 | 00180-24718 |
| MP28 | 00180 22301 | 2 | KEEPER: HANDLE | 28480 | 00180-22301 |
| MP29 | 00180-09103 | 2 | SPRING: INSERT | 28480 | 00180-09103 |
| MP30 | 00180-07201 | 2 | INSERT: KEEPER | 28480 | 00180-07201 |
| MP31 | 4320-0231 | 1 | RUBBER: RFI | 00000 | OBD# |
| MP32 | 00180-60118 | 1 | CHASSIS: CAB POWER | 28480 | 00180-60118 |
| MP33 | 00180 60117 | 1 | CHASSIS: CAB DISPLAY | 28480 | 00180-60117 |
| MP34 | 00180-24728 | 1 | SPACER: FRONT | 28480 | 00180-24728 |
| MP35 | 00180-24727 | 1 | SPACER: REAR | 28480 | 00180-24727 |
| MP36 | 00180-24726 | 2 | SPACER: SIDE | 28480 | 00180-24726 |
| MP37 | 7120-1254 | 1 | TRADEMARK | 28480 | 7120-1254 |
| MP38 | 5040-0445 | 2 | FOOT: BOTTOM | 28480 | 5040-0445 |
| MP39 | 5040 0446 | 2 | FOOT: REAR, SHORT | 28480 | 5040-0446 |
| MP40 | 5040 0447 | 2 | FOOT: REAR (LONG) | 28480 | 5040-0447 |
| MP41 | 00180-00602 | 1 | SHIELD: CRT | 28480 | 00180-00602 |
| MP42 | 00180-00245 | 1 | PANEL: FRONT (CAB) | 28480 | 00180-00245 |
| MP43 | 00180-0047 | 1 | PANEL: FRONT, SUB | 28480 | 00180-00247 |
| MP44 | 0400 0010 | 2 | GROMMET: VINYL 0.250" ID | 00000 | OBD# |
| MP45 | 1400-0026 | 1 | CLAMP: HOSE | 66295 | 36H |
| MP46 | 00180-41207 | 2 | BRACKET: PLASTIC | 28480 | 00180-41207 |
| MP47 | 00180-09104 | 2 | CLIP: GROUND | 28480 | 00180-09104 |
| MP48 | 00180-23701 | 1 | SHAFT: BEAM FINDER | 28480 | 00180-23701 |
| MP49 | 00180-01253 | 1 | BRACKET: BEAM FIND | 28480 | 00180-01253 |
| MP50 | 5040-0453 | 1 | COVER: POTENTIOMETER (FOCUS) | 28480 | 5040-0453 |
| MP51 | 00180-01209 | 1 | BRACKET: CONNECTOR PLUG-IN | 28480 | 00180-01209 |
| MP52 | 00180-01218 | 2 | BRACKET: ALIGNMENT COIL | 28480 | 00180-01218 |
| MP53 | 00180-04128 | 1 | COVER: HV PLATE | 28480 | 00180-04128 |
| MP54 | 00180 25402 | 1 | PLEXIGLASS | 28480 | 00180-25402 |
| MP55 | 00180-24301 | 1 | NUT: HORIZONTAL POSITION P07 | 28480 | 00180-61685 |
| MP56 | 1400-0325 | 2 | CLAMP: CABLE 0.125" DIA | 00000 | OBD |
| MP57 | 00180-44701 | 1 | SPACE: TRADEMARK | 28480 | 00180-44701 |
| MP58 | 00180-24702 | 1 | STANDOFF: GATE INSULATING | 28480 | 00180-24702 |
| MP59 | 0570-0031 | 1 | SCREW: RND HD SLOT DR 4-40 INSULATING | 00000 | OBD |
| MP60 | 0400 0010 | | GROMMET: VINYL 0.250" ID | 00000 | OBD# |
| MP61 | 2200-0762 | 20 | SCREW: TRUSS HD POZI DR 4-40 X 0.250" LG | 00000 | OBD |
| MP62 | 2200 0140 | 22 | SCREW: FLAT HD POZI DR 4-40 X 0.250" LG | 00000 | OBD |
| MP63 | 2360-0192 | 12 | SCREW: FLAT HD POZI DR 6-32 X 0.250" LG | 00000 | OBD |
| MP64 | 0590-0043 | 2 | NUT: HEX 1/4 X 32 INTERNAL THREAD | 00866 | OBD |
| MP65 | 1490-0968 | 2 | BUSHING: POTENTIOMETER 1/4-32 EXT THRD | 00000 | OBD |

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 |
|-----------------------|----------------|-----|--|----------|-----------------|
| MP66 | 00180-04138 | 1 | COVER: TOP (RACK) | 28480 | 00180-04138 |
| MP67 | 00180-04137 | 2 | COVER: SIDE (RACK) | 28480 | 00180-04137 |
| MP68 | 00180-01217 | 2 | BRACKET: COVER | 28480 | 00180-01217 |
| MP69 | 5060-0431 | 2 | FRAME ASSY: SIDE | 28480 | 5060-0431 |
| MP70 | 5000-0051 | 2 | TRIM STRIP | 28480 | 5000-0051 |
| MP71 | 00180-00601 | 1 | SHIELD: POST ACCELERATOR | 28480 | 00180-00601 |
| MP72 | 00180-60119 | 1 | CHASSIS ASSY: DISPLAY (RACK) | 28480 | 00180-60119 |
| MP73 | 00180-60120 | 1 | CHASSIS ASSY: POWER (RACK) | 28480 | 00180-60120 |
| MP74 | 5000-0449 | 1 | SPACER: FRONT | 28480 | 5000-0449 |
| MP75 | 5000-0469 | 1 | SPACER: REAR | 28480 | 5000-0469 |
| MP76 | 00180-64110 | 1 | COVER ASSY: BOTTOM | 28480 | 00180-64110 |
| MP77 | 1490-0030 | 1 | STAND: TILT | 28480 | 1490-0030 |
| MP78 | 5060-0767 | 5 | FOOT ASSY: FM | 28480 | 5060-0767 |
| MP79 | 5060-0552 | 1 | KIT: 5 H RACK MOUNT | 28480 | 5060-0552 |
| MP80 | 00180-00246 | 1 | PANEL: FRONT (RACK) | 28480 | 00180-00246 |
| MP81 | 00180-01255 | 1 | BRACKET: BRACE | 28480 | 00180-01255 |
| MP82 | 00180-01246 | 1 | BRACKET: GROUND LINE FILTER | 28480 | 00180-01246 |
| MP83 | 00182-01209 | 1 | BRACKET: LINE FILTER | 28480 | 00182-01209 |
| MP84 | 00182-00601 | 1 | SHIELD: LINE FILTER | 28480 | 00182-00601 |
| MP85 | 1450-0404 | 1 | LENS: CLEAR | 28480 | 1450-0404 |
| MP86 | 00180-01249 | 1 | BRACKET: VERTICAL LEADS | 28480 | 00180-01249 |
| MP87 | 00180-01251 | 1 | BRACKET: TRANSISTOR | 28480 | 00180-01251 |
| MP88 | 00180-41208 | 1 | CLIP: HORIZONTAL | 28480 | 00180-41208 |
| MP89 | 00180-01250 | 1 | BRACKET: VERTICAL LEADS | 28480 | 00180-01250 |
| MP90 | 1490-0710 | 1 | STAND: TILT (CAS) | 28480 | 1490-0710 |
| MP91 | 00180-09105 | 1 | CLIP-GROUND | 28480 | 00180-09105 |
| MP92 | 1400-0090 | 1 | WASHER: RUBBER 5/8" OD | 09000 | 03D |
| MP93 | 00180-60201 | 1 | PANEL: ASSY: REAR (INCLUDES J12, MP84, S5) | 28480 | 00180-60201 |
| MP111 | 00182-00206 | 1 | PANEL: ACCESS | 28480 | 00182-00206 |
| Q1 | 1854-0609 | 1 | ISTR: SI NPN | 28480 | 1854-0609 |
| R1 | 2100-3287 | 1 | R: VAR COMP 2X 100 K OHM 20% LIN | 28480 | 2100-3287 |
| R2 | 2100-1904 | 1 | R: VAR COMP 10K OHM 20% LIN 1/4W | 28480 | 2100-1904 |
| R3 | 2100-3147 | 1 | R: VAR COMP 5 MEGOHM 20% LIN | 28480 | 2100-3147 |
| R4 | 0683-1045 | 1 | R: FXD COMP 100K OHMS 5% 1/4W | 01121 | 08-1945 |
| R5 | 2100-1905 | 1 | R: VAR COMP 50K OHM 20% LIN 1/2W | 28480 | 2100-1905 |
| R6 | 2100-1903 | 1 | R: VAR WW 5K OHM 10% LIN 2W | 28480 | 2100-1903 |
| R7 | 2100-1901 | 1 | R: VAR WW 100 OHM 10% LIN 2W | 28480 | 2100-1901 |
| S1 | 3101-1508 | 1 | SWITCH: TOGGLE DPDT | 09353 | 73181 |
| S2 | 3101-0070 | 1 | SWITCH: SLIDE | 79727 | G-126 |
| S3 | 3100-1345 | 1 | SWITCH: ROTARY 1 SECTION 3 POSITION | 28480 | 3100-1345 |
| S4 | 3101-0977 | 1 | SWITCH: PUSHBUTTON DPDT | 82389 | 12S-1032 |
| S5 | 3101-1237 | 1 | SWITCH: SLIDE DPDT | 82389 | 11A-1243 |
| V1 | 5083-3552 | 1 | CRT: P31 ALUMINIZED INT GRAT | 28480 | 5083-3552 |
| W1 | 8120-1521 | 1 | CABLE ASSY: POWER 7.5 FT. | 28480 | 8120-1521 |
| W2 | 00180-61616 | 1 | CABLE ASSY: COAX FROM J1 PINS 1 AND 2 TO A5S1 (CAB) | 28480 | 00180-61616 |
| W3 | 00180-61617 | 1 | CABLE ASSY: COAX FROM J1 PINS 1 AND 2 TO A5S1 (RACK) | 28480 | 00180-61617 |
| W4 | 00180-61685 | 1 | CABLE: CRT VERTICAL | 28480 | 00180-61685 |
| W5 | 00180-61650 | 1 | CABLE ASSY: SWEEP OUT | 28480 | 00180-61650 |
| W6 | 00180-61651 | 1 | CABLE ASSY: HORIZONTAL (CAB) | 28480 | 00180-61651 |
| W7 | 00180-61656 | 1 | CABLE ASSY: HORIZONTAL (RACK) | 28480 | 00180-61656 |
| W8 | 00180-61694 | 1 | CABLE ASSY: MAIN (CAB) | 28480 | 00180-61694 |
| W9 | 00180-61695 | 1 | CABLE: MAIN (RACK) | 28480 | 00180-61695 |
| W10 | 00180-61657 | 1 | CABLE ASSY: HORIZONTAL MAGNIFIER | 28480 | 00180-61657 |
| W11 | 00180-61696 | 1 | CABLE ASSY: 4-COND (RACK) (S4 TO J2) | 28480 | 00180-61696 |
| W12 | 00180-61697 | 1 | CABLE ASSY: 4-COND (CAB) (S4 TO J2) | 28480 | 00180-61697 |
| W13 | 00180-61698 | 1 | PART OF W6 | 28480 | 00180-61698 |
| W14 | 00180-61699 | 1 | CABLE ASSY: 4-COND (RACK) (INCLUDES L3) | 28480 | 00180-61699 |
| W15 | 00180-61609 | 1 | CABLE ASSY: 4-COND (CAB) (INCLUDES L3) | 28480 | 00180-61609 |
| W16 | 00180-61609 | 1 | PART OF W6 | 28480 | 00180-61609 |
| W17 | 00180-61646 | 1 | CABLE: COAX, (EXT INPUT) | 28480 | 00180-61646 |
| W18 | 00180-61646 | 1 | PART OF W6 | 28480 | 00180-61646 |
| W19 | 00180-61647 | 1 | CABLE: COAX, BLUE (MAIN GATE) | 28480 | 00180-61647 |
| W20 | 00180-61647 | 1 | CABLE: COAX, WHITE (DELAYED GATE) | 28480 | 00180-61647 |
| W21 | 00180-61648 | 1 | CABLE: COAX, YELLOW (DELAYED SWEEP) | 28480 | 00180-61648 |
| W22 | 00180-61649 | 1 | CABLE: COAX, RED (MAIN SWEEP) | 28480 | 00180-61649 |
| W23 | 00180-61801 | 1 | CABLE: COAX, RED (Z-AXIS INPUT) | 28480 | 00180-61801 |
| W24 | 00180-61801 | 1 | CABLE: COAX, YELLOW (Z-AXIS INPUT) | 28480 | 00180-61801 |
| W25 | 00180-61642 | 1 | PART OF W6 | 28480 | 00180-61642 |
| W26 | 00180-61638 | 1 | NOT USED | 28480 | 00180-61638 |
| W27 | 00180-61642 | 1 | CABLE: COAX: RED-ST (ALT TRIGGER) (CAB) | 28480 | 00180-61642 |
| W28 | 00180-61638 | 1 | CABLE: COAX: RED-ST (ALT TRIGGER) (RACK) | 28480 | 00180-61638 |
| W29 | 00180-61640 | 1 | PART OF W6 | 28480 | 00180-61640 |
| W30 | 00180-61640 | 1 | CABLE: COAX, BLUE-ST (UNBLANK GATE) (RACK) | 28480 | 00180-61640 |
| W31 | 00180-61644 | 1 | CABLE: COAX, BLUE-ST (UNBLANK GATE) (CAB) | 28480 | 00180-61644 |
| W32 | 00180-61643 | 1 | CABLE: COAX, BLACK-ST (CHOP BLANK) (CAB) | 28480 | 00180-61643 |
| W33 | 00180-61641 | 1 | PART OF W6 | 28480 | 00180-61641 |
| W34 | 00180-61641 | 1 | CABLE: COAX, BLACK-ST (CHOP BLANK) (RACK) | 28480 | 00180-61641 |
| W35 | 00180-61645 | 1 | CABLE: SHIELDED (CALIBRATOR) | 28480 | 00180-61645 |
| W36 | 00180-61652 | 1 | PART OF W6 | 28480 | 00180-61652 |
| W37 | 00183-67701 | 1 | CABLE: COAX, DISPLAY SWITCH | 28480 | 00183-67701 |
| W38 | 1400-0084 | 1 | BASE: PILOT LIGHT | 75915 | 342014 |
| W39 | 1200-0037 | 1 | FUSEHOLDER: EXTRACTOR POST TYPE | 75915 | 342014 |
| W40 | 1200-0050 | 7 | PART OF W6. CONSISTS OF: | 72825 | 97097 |
| W41 | 1200-0408 | 1 | SOCKET: CRT TUBE | 72825 | 9553-1 |
| W42 | 1200-0408 | 1 | CONTACT: CRT SOCKET | 72825 | 9553-1 |
| W43 | 1200-0408 | 1 | COVER: CRT SOCKET | 28480 | 1200-0408 |

See introduction to this section for ordering information

Table 6-3. List of Manufacturers' Codes

| Mfr No. | Manufacturer Name | Address | Zip Code |
|---------|--|--------------------------|----------|
| 00001 | U.S.A. COMMON | ANY SUPPLIER OF U.S.A. | 06239 |
| 00287 | CEMCO | DANIELSON, CONN. | 29671 |
| 00853 | SANGAMO ELECTRIC CO. PICKENS DIV. | PICKENS, S.C. | 91746 |
| 00866 | GOE ENGINEERING CO. INC. | CITY OF INDUSTRY, CALIF. | 53204 |
| 01121 | ALLEN BRADLEY CO. | MILWAUKEE, WIS. | 75231 |
| 01295 | TEXAS INSTRUMENTS INC. SEMICONDUCTOR COMPONENTS DIV. | DALLAS, TEX. | 12477 |
| 02114 | FERROXCUBE CORP. | SAUGERTIES, N.Y. | 60153 |
| 02660 | AMPHENOL CORP. | BROADVIEW, ILL. | 08718 |
| 04062 | ARCO ELECTRONIC INC. | GREAT NECK, N.Y. | 85008 |
| 04713 | MOTOROLA SEMICONDUCTOR PROD. INC. | PHOENIX, ARIZ. | 01880 |
| 05820 | WAKEFIELD ENGINEERING INC. | WAKEFIELD, MASS. | 94040 |
| 07263 | FAIRCHILD CAMERA & INST. CORP. SEMICONDUCTOR DIV. | MOUNTAIN VIEW, CALIF. | 44112 |
| 08806 | G.E. CO. MINIATURE LAMP DEPT. | CLEVELAND, OHIO | 77042 |
| 09134 | TEXAS CAPACITOR CO. INC. | HOUSTON, TEX. | 02158 |
| 09353 | C & K COMPONENTS INC. | NEWTON, MASS. | 07105 |
| 14655 | CORNELL DUBLIER ELECT. DIV. FEDERAL PACIFIC ELECT. CO. | NEWARK, N.J. | 60515 |
| 27264 | MOLEX PROD. CO. | DOWNERS GROVE, ILL. | 94304 |
| 28480 | HEWLETT-PACKARD COMPANY | PALO ALTO, CALIF. | 01247 |
| 56289 | SPRAGUE ELECTRIC CO. | N. ADAMS, MASS. | 07207 |
| 59730 | THOMAS & BETTS CO. THE | ELIZABETH, N.J. | 60623 |
| 66295 | WITTEK MFG. CO. | CHICAGO, ILL. | 60644 |
| 70903 | BELDEN CORP. | CHICAGO, ILL. | 63017 |
| 71400 | BUSSMANN MFG. DIV. MC GRAW-EDISON CO. | ST. LOUIS, MO. | 60640 |
| 71744 | CHICAGO MINIATURE LAMP WORKS | CHICAGO, ILL. | 06226 |
| 71785 | CINCH MFG. CO. DIV TRW INC. | ELK GROVE VILLAGE, ILL. | 08832 |
| 72136 | ELECTRO MOTIVE MFG. CO. INC. | WILLIMANTIC, CONN. | 19144 |
| 72656 | INDIANA GENERAL CORP. ELECTRONIC DIV. | KEASBEY, N.J. | 16512 |
| 72825 | EBY HUGH H. INC. | PHILADELPHIA, PA. | 19108 |
| 72982 | ERIE TECHNOLOGICAL PROD. INC. | ERIE, PA. | 60016 |
| 75042 | INTERNATIONAL RESISTANCE CO. INC. | PHILADELPHIA, PA. | 11101 |
| 75915 | LITTELFUSE INC. | DES PLAINES, ILL. | 19144 |
| 79136 | WALDES KOHINOOR INC. | LONG IS. CITY, N.Y. | 20006 |
| 79727 | CONTINENTAL-WIRT ELECTRONICS CORP. | PHILADELPHIA, PA. | 60630 |
| 80131 | ELECTRONIC INDUSTRIES ASSOCIATION | WASHINGTON D.C. | 02703 |
| 82389 | SWITCHCRAFT INC. | CHICAGO, ILL. | 60008 |
| 91506 | AUGAT INC. | ATTLEBORO, MASS. | 10544 |
| 95354 | METHODE MFG. CO. | ROLLING MEADOWS, ILL. | |
| 98291 | SEAELECTRO CORP. | MAMARONECK, N.Y. | |

See introduction to this section for ordering information

SECTION VII MANUAL CHANGES AND OPTIONS

7-1. INTRODUCTION.

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

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 your 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 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 on the title page or in table 7-1, refer to the 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 |
|----------------|--------------|
| Model 180C | |
| 1125A | 5 thru 1 |
| 1218A | 5 thru 2 |
| 1222A | 5 thru 3 |
| 1252A | 5, 3 |
| 1301A | 5 |
| 1315A | 5 |
| 1434A | 6 |
| Model 180D | |
| 1125A | 5 thru 1 |
| 1218A | 5 thru 2 |
| 1222A | 5 thru 3 |
| 1250A | 5, 3 |
| 1301A | 5 |
| 1314A | 5 |
| Model 180D-H51 | |
| 1125A | 5 thru 3 |
| 1247A | 5 thru 4 |
| 1301A | 5 |

CHANGE 1

Table 6-2,

A1: Change to HP Part No. 00180-60001; POWER MODULE: LOW VOLTAGE; Mfr. Code 28480; Mfr. Part No. 00180-60001.

A1A2: Change to HP Part No. 00182-66506; ASSY: LOW VOLTAGE REGULATOR BOARD: Mfr. Code 28480; Mfr. Part No. 00180-66506.

A1A2C1: Change to HP Part No. 0160-0161; C: FXD MY 0.01-UF 10% 200 VDCW Mfr. Code 56289; Mfr. Part No. 192P10392-PTS.

Delete: A1A2R42; HP Part No. 0687-5611; R: FXD COMP 560 OHM 10% 1/2W; Mfr. Code 01121; Mfr. Part No. EB5611.

A3: Change to HP Part No. 00180-66542; BOARD ASSY: GATE; Mfr. Code 28480; Mfr. Part No. 00180-66542.

A3C3: Change to HP Part No. 0121-0168; C: VAR TEFLON 0.25-1.50 PF 600 VDCW; Mfr. Code 28480; Mfr. Part No. 0121-0168.

A3C4: Change to HP Part No. 0160-2240; C: FXD CER 2.0 PF 500 VDCW Mfr. Code 72982; Mfr. Part No. 301-000-COKO-209C.

A3C6: Change to HP Part No. 0140-0178; C: FXD MICA 560 PF 2%; Mfr. Code 72136; Mfr. Part No. RDM15F561G3C.

A3C10: Change to HP Part No. 0160-0162; C: FXD MY 0.022 UF 10% 200 VDCW; Mfr. Code 56289; Mfr. Part No. 192P22392-PTS.

A3CR2: Change to HP Part No. 1901-0040; DIODE: SILICON 30 MA 30 WV; Mfr. Code 07263; Mfr. Part No. FDG1088.

A3CR3: Change to HP Part No. 1901-0040; DIODE: SILICON 30 MA 30 WV; Mfr. Code 07263; Mfr. Part No. FDG1088.

A3CR4: Change to HP Part No. 1901-0040; DIODE: SILICON 30 MA 30 WV; Mfr. Code 07263; Mfr. Part No. FDG1088.

A3E1: Change to HP Part No. 5020-0495; PIN: SQUARE; Mfr. Code 28480; Mfr. Part No. 5020-0495.

A3Q1: Change to HP Part No. 1854-0019; TSTR: SI NPN; Mfr. Code 28480; Mfr. Part No. 1854-0019.

Add: A3R10; HP Part No. 0757-0402; R: FXD MET FLM 110 OHM 1% 1/8W; Mfr. Code 28480; Mfr. Part No. 0757-0402.

Add: A3R12; HP Part No. 0757-0469; R: FXD FLM 150K OHM 1% 1/8W; Mfr. Code 28480; Mfr. Part No. 0757-0469.

A3R11: Change to HP Part No. 0698-3416; R: FXD MET FLM 21.5K OHM 1% 1/2W; Mfr. Code 28480; Mfr. Part No. 0698-3416.

A3R13: Change to HP Part No. 0698-3416; R: FXD MET FLM 21.5K OHM 1% 1/2W; Mfr. Code 28480; Mfr. Part No. 0698-3416.

A1: Change to HP Part No. 00180-60001; POWER MODULE: LOW VOLTAGE; Mfr. Code 28480; Mfr. Part No. 00180-60001.

A1A2: Change to HP Part No. 00182-66506; ASSY: LOW VOLTAGE REGULATOR BOARD; Mfr. Code 28480; Mfr. Part No. 00182-66506.

A3: Change to HP Part No. 0180-66542; BOARD ASSY: GATE; Mfr. Code 28480; Mfr. Part No. 0180-66542.

MP1: Change to HP Part No. 10179A; CONTRAST IMPROVEMENT SCREEN; Mfr. Code 28480; Mfr. Part No. 10179A.

Figure 8-6,

A1A2C1: Change value to 0.01 UF.

Delete: A1A2R42, value 560 OHMS between +15V supply and collector of A1A2Q13.

Figure 8-11,

Revise as shown in figure 7-8.

CHANGE 2

Table 6-2,

MP55: Change to HP Part No. 00180-25703; NUT: HORIZONTAL POSITION POT; Mfr. Code 28480; Mfr. Part No. 00180-25703.

R1: Change to HP Part No. 2100-2076; R: VAR COMP 2 X 100K OHM 20% LIN; Mfr. Code 28480; Mfr. Part No. 2100-2076.

Figure 8-15,

A4C2: Delete connection to junction of A4C1 and A4CR2. Add ground to A4C2.

CHANGE 3

Table 6-2,

A1: Change to HP Part No. 00184-60003; POWER MODULE: LOW VOLTAGE; Mfr. Code 28480; Mfr. Part No. 00184-60003.

A1T1: Change to HP Part No. 9100-1129; TRANSFORMER: POWER; Mfr. Code 28480; Mfr. Part No. 9100-1129.

A1A1: Change to HP Part No. 00182-66505; ASSY: LOW VOLTAGE RECTIFIER BOARD; Mfr. Code 28480; Mfr. Part No. 00182-66505.

A1A1C1: Change to HP Part No. 0180-1811; C: FXD ELECT 100 UF +75 -10% 20 VDCW; Mfr. Code 56289; Mfr. Part No. 600D107G0200D4.

A1A1CR1: Change to HP Part No. 1901-0049; DIODE: SILICON 50 PIV; Mfr. Code 28480; Mfr. Part No. 1901-0049.

A1A1CR2: Change to HP Part No. 1901-0049; DIODE: SILICON 50 PIV; Mfr. Code 28480; Mfr. Part No. 1901-0049.

A1A1CR3: Change to HP Part No. 1901-0049; DIODE: SILICON 50 PIV; Mfr. Code 28480; Mfr. Part No. 1901-0049.

A1A1CR4: Change to HP Part No. 1901-0049; DIODE: SILICON 50 PIV; Mfr. Code 28480; Mfr. Part No. 1901-0049.

A1A1R1: Change to HP Part No. 0757-0342; R: FXD MET FLM 100K OHM 1% 1/4W; Mfr. Code 28480; Mfr. Part No. 0757-0342.

A1A1R2: Change to HP Part No. 0757-0342; R: FXD MET FLM 100K OHM 1% 1/4W; Mfr. Code 28480; Mfr. Part No. 0757-0342.

Delete: A1A1R3: HP Part No. 0760-0016; R: FXD MET OX 2700 OHM 2% 1W; Mfr. Code 28480; Mfr. Part No. 0760-0016.

Delete: A1A1R4; HP Part No. 0757-0060; R: FXD MET FLM 24.3K OHM 1% 1/2W; Mfr. Code 28480; Mfr. Part No. 0757-0060.

Delete: A1A1VR1; HP Part No. 1902-0597; DIODE: BREAKDOWN 56.2V 5% 1W; Mfr. Code 28480; Mfr. Part No. 1902-0597.

A1A2E1: Delete "thru E8".

A1A2Q1: Change to HP Part No. 1854-0039; TSTR: SI NPN; Mfr. Code 80131; Mfr. Part No. 2N3053.

A1: Change to HP Part No. 00184-60003; POWER MODULE: LOW VOLTAGE; Mfr. Code 28480; Mfr. Part No. 00184-60003.

A1A1: Change to HP Part No. 00182-66505; ASSY: LOW VOLTAGE RECTIFIER BOARD; Mfr. Code 28480; Mfr. Part No. 00182-66505.

Figure 8-4,

Replace with figure 7-5.

Figure 8-5,

Replace with figure 7-6.

Figure 8-6,

Replace with figure 7-7.

CHANGE 4

Table 6-2,

A1: Change to HP Part No. 00180-60006; POWER MODULE: LOW VOLTAGE; Mfr. Code 28480; Mfr. Part No. 00180-60006.

A3R40: Change to HP Part No. 0757-0401; R: FXD MET FLM 100 OHM 1% 1/8W; Mfr. Code 28480; Mfr. Part No. 0757-0401.

A4: Change to HP Part No. 00180-66541; BOARD ASSY: HIGH VOLTAGE OSCILLATOR; Mfr. Code 28480; Mfr. Part No. 00180-66541.

Delete: A4R1; HP Part No. 0757-0900; R: FXD MET FLM 100 OHM 2% 1/8W; Mfr. Code 28480; Mfr. Part No. 0757-0900.

Q1: Change to HP Part No. 1854-0320; TSTR: SI NPN; Mfr. Code 28480; Mfr. Part No. 1854-0320.

Table 6-2,

A1: Change to HP Part No. 00180-60006; POWER MODULE: LOW VOLTAGE; Mfr. Code 28480; Mfr. Part No. 00180-60006.

A4: Change to HP Part No. 00180-66541; BOARD ASSY: HIGH VOLTAGE OSCILLATOR; Mfr. Code 28480; Mfr. Part No. 00180-66541.

Figure 8-15,

A3R40: Change value to 100 ohms.

Delete: A4R1, value 100 ohms, between anode of A4CR1 and junction of A4CR2 and base of Q1.

CHANGE 5

Figure 5-13,

Replace with figure 7-3.

Table 6-2,

A3: Change to HP Part No. 00180-66549; BOARD ASSY: GATE; Mfr. Code 28480; Mfr. Part No. 00180-66549.

Add: A3C9: HP Part No. 0150-0061; C: FXD CER 20 PF 10% 100 VDCW; Mfr. Code 56289; Mfr. Part No. 53C47.

Delete: A3C26; HP Part No. 0160-2261; C: FXD CER 15 PF 5% 500 VDCW; Mfr. Code 72982; Mfr. Part No. 301-NPO-15 PF.

Delete: A3C27; HP Part No. 0150-0093; C: FXD CER 0.01 UF +80 -20% 100 VDCW; Mfr. Code 72982; Mfr. Part No. 801-K800011.

Delete: A3C28; HP Part No. 0160-2198; C: FXD MICA 20 PF 5%; Mfr. Code 72136; Mfr. Part No. RDM15-C200J3C.

Add: A3CR10, HP Part No. 1901-0040; DIODE: SILICON 30 MA 30 WV; Mfr. Code 07263; Mfr. Part No. FDG1088.

Add: A3Q5; HP Part No. 1853-0009; TSTR: SI PNP; Mfr. Code 28480; Mfr. Part No. 1853-0009.

Delete: A3Q11; HP Part No. 1854-0092; TSTR: SI NPN; Mfr. Code 80131; Mfr. Part No. 2N3563.

Delete: A3Q12; HP Part No. 1853-0049; TSTR: SI PNP; Mfr. Code 28480; Mfr. Code 28480; Mfr. Part No. 1853-0049.

Delete: A3Q13; HP Part No. 1853-0049; TSTR: SI PNP; Mfr. Code 28480; Mfr. Part No. 1853-0049.

Delete: A2Q14; HP Part No. 1854-0215; TSTR: SI NPN; Mfr. Code 80131; Mfr. Part No. 2N3904.

A3R5: Change to HP Part No. 0698-3151; R: FXD MET FLM 2.87K OHM 1% 1/8W; Mfr. Code 28480; Mfr. Part No. 0698-3151.

A3R6: Change to HP Part No. 0757-0424; R: FXD MET FLM 1.1K OHM 1% 1/8W; Mfr. Code 28480; Mfr. Part No. 0757-0424.

A3R7: Change to HP Part No. 0757-0437; R: FXD MET FLM 4.75K OHM 1% 1/8W; Mfr. Code 28480; Mfr. Part No. 0757-0437.

Add: A3R19; HP Part No. 0757-0441; R: FXD MET FLM 8.25K OHM 1% 1/8W; Mfr. Code 28480; Mfr. Part No. 0757-0441.

Add: A3R20; HP Part No. 0757-0434; R: FXD MET FLM 3.65K OHM 1% 1/8W; Mfr. Code 28480; Mfr. Part No. 0757-0434.

Add: A3R21; HP Part No. 0757-0438; R: FXD MET FLM 5.11K OHM 1% 1/8W; Mfr. Code 28480; Mfr. Part No. 0757-0438.

Add: A3R22; HP Part No. 0757-0283; R: FXD MET FLM 2.00K OHM 1% 1/8W; Mfr. Code 28480; Mfr. Part No. 0757-0283.

Add: A3R23; HP Part No. 0757-0280; R: FXD MET FLM 1K OHM 1% 1/8W; Mfr. Code 28480; Mfr. Part No. 0757-0280.

Delete: A3R66; HP Part No. 0757-0436; R: FXD MET FLM 4.32K OHM 1% 1/8W; Mfr. Code 28480; Mfr. Part No. 0757-0436.

Delete: A3R67; HP Part No. 0757-0442; R: FXD MET FLM 10.0K OHM 1% 1/8W; Mfr. Code 28480; Mfr. Code No. 0757-0442.

Delete: A3R68; HP Part No. 0757-0416; R: FXD MET FLM 511 OHM 1% 1/8W; Mfr. Code 28480; Mfr. Code No. 0757-0416.

Delete: A3R69; HP Part No. 0757-0433; R: FXD MET FLM 3.32K OHM 1% 1/8W; Mfr. Code 28480; Mfr. Part No. 0757-0433.

Delete: A3R70; HP Part No. 0757-0442; R: FXD MET FLM 10.0K OHM 1% 1/8W; Mfr. Code 28480; Mfr. Part No. 0757-0442.

Delete: A3R71; HP Part No. 0757-0274; R: FXD MET FLM 1.21K OHM 1% 1/8W; Mfr. Code 28480; Mfr. Part No. 0757-0274.

Delete: A3R72; HP Part No. 0757-0465; R: FXD MET FLM 100K OHM 1% 1/8W; Mfr. Code 28480; Mfr. Part No. 0757-0465.

Delete: A3R73; HP Part No. 0757-0419; R: FXD MET FLM 681 OHM 1% 1/8W; Mfr. Code 28480; Mfr. Part No. 0757-0419.

Delete: A3R74; HP Part No. 0757-0416; R: FXD MET FLM 511 OHM 1% 1/8W; Mfr. Code 28480; Mfr. Part No. 0757-0416.

Delete: A3R75; HP Part No. 0757-0438; R: FXD MET FLM 5.11K OHM 1% 1/8W; Mfr. Code 28480; Mfr. Part No. 0757-0438.

Delete: A3R76; HP Part No. 0757-0280; R: FXD MET FLM 1K OHM 1% 1/8W; Mfr. Code 28480; Mfr. Part No. 0757-0280.

A3: Change to HP Part No. 00180-66549; BOARD ASSY: GAGE; Mfr. Code 28480; Mfr. Part No. 00180-66549.

Figure 8-9,

Replace with figure 7-2.

Figure 8-11,

Replace with figure 7-4.

CHANGE 6

Table 6-2,

A1: Change HP Part No. and Mfr. Part No. to 00180-60006.

A1T1: Change HP Part No. and Mfr. Part No. to 9100-1129.

A1A1: Change HP Part No. and Mfr. Part No. to 00182-66505.

A1A1C1: Change to HP Part No. 0180-1811; C: FXD ELECT 100 UF +75 -10% 20 VDCW; Mfr. Code 56289; Mfr. Part No. 600D107G0200D4.

A1A1CR1 thru A1A1CR4: Change to HP Part No. 1901-0049; DIODE: SILICON 50 PIV; Mfr. Part No. 1901-0049.

A1A1R1, A1A1R2: Change to HP Part No. 0757-0342; R: FXD MET FLM 100K OHM 1% 1/4W; Mfr. Code 28480; Mfr. Part No. 0757-0342.

Delete: A1A1R3, A1A1R4, and A1A1VR1.

A1A2: Change HP Part No. and Mfr. Part No. to 00182-66514.

A1A2Q1: Change to HP Part No. 1854-0039; TSTR: SI NPN; Mfr. Code 80131; Mfr. Part No. 2N3053.

A1: Change HP Part No. and Mfr. Part No. to 00180-60006.

A1A1: Change HP Part No. and Mfr. Part No. to 00182-66505.

A1A2: Change HP Part No. and Mfr. Part No. to 00182-66514.

Figure 8-4,

Replace with figure 7-5.

Figure 8-5,

Replace with 7-6.

Figure 8-6,

Replace with figure 7-7.

7-5. STANDARD OPTIONS.

7-6. Standard options are modifications installed on HP instruments at the factory and are available on request. Contact the nearest Hewlett-Packard Sales/Service Office for information concerning standard options. The following paragraphs list the options available for Model 180C/D.

7-7. OPTION 002. Standard CRT is replaced with an aluminized P2 phosphor, internal graticule CRT; HP Part No. 5083-3522.

7-8. OPTION 003. Model 180C/D, Option 003 is the same as the standard instrument except that the standard low voltage power supply transformer has been replaced with one designed to operate from a source of 100V or 200V input power. Table 7-2 lists parts changes for instruments using the Option 003 low voltage power module. The differences in the optional circuitry are shown in figure 7-1.

7-9. OPTION 007. Standard CRT is replaced with an aluminized P7 phosphor, internal graticule CRT; HP Part No. 5083-3532. An amber CRT filter, HP Part No. 5020-0530, is also provided.

7-10. OPTION 010. Option 010 deletes rear panel outputs for main and delayed gates and main and delayed sweeps. Also deleted is W4, sweep out cable. A capacitor (HP Part No. 0160-3987, 86 pF 2% 500 VDCW) is added between pins 8 and 11 on mainframe connector J1.

7-11. OPTION 011. Standard CRT is replaced with an aluminized P11 phosphor internal graticule CRT; HP Part No. 5083-3532.

7-12. OPTION 013. Model 180C/D built to operate with 100/200V input power. If replacement of the entire low voltage power supply module A1 is desired, order HP Part No. 00180-60004. Rear panel outputs for main and delayed gates and main and delayed sweeps are deleted. Rear panel assembly MP93 is replaced with HP Part No. 00180-60202. Delete A7. Add MP93R1, HP Part No. 0757-0438, R: FXD MET FLM 5110 OHM 1% 1/8W, Mfr. Code 28480, Mfr. Part No. 0757-0438, to replace A7R15 on schematic 4. Add MP93E1, HP Part No. 0360-0013; TERMINAL BOARD, Mfr. Code 28480, Mfr. Part No. 0360-0013. Delete W4.

7-13. OPTION 580. Replaces instrument bottom covers with special covers that conform to CSA standards.

MP4: Change HP Part No. and Mfr. Part No. to 00180-64113.

MP5: Change HP Part No. and Mfr. Part No. to 00180-64114.

MP76: Change HP Part No. and Mfr. Part No. to 00180-64115.

7-14. OPTION 602. Standard CRT is replaced with an aluminized P2 phosphor, non-graticule CRT, HP Part No. 5083-3521.

7-15. OPTION 607. Standard CRT is replaced with an aluminized P7 phosphor, non-graticule CRT, HP Part No. 5083-3531.

7-16. OPTION 611. Standard CRT is replaced with an aluminized P11 phosphor, non-graticule CRT; HP Part No. 5083-3541.

7-17. OPTION 631. Standard CRT is replaced with an aluminized P31 phosphor, non-graticule CRT; HP Part No. 5083-3551.

7-18. OPTION H03. Standard Model 180C is modified to provide 10 mV/div maximum sensitivity for the horizontal amplifier.

7-19. OPTION H51. Standard Model 180D is modified to serve as the display section of a Hewlett-Packard Multichannel Digital Analyzer system.

Table 7-2. Replaceable Parts Changes for Option 003

| Action | Ref. Desig. | HP Part No. | TQ | Description |
|--------|-------------------------------|----------------------------------|----|-----------------------------------|
| Change | A1 | 00184-60003 to 00180-60004 | 1 | POWER MODULE: LOW VOLTAGE |
| Change | A1T1 | 9100-3401 to 9100-3249 | 1 | TRANSFORMER: POWER |
| Change | A1A1 | 00184-66511 to 00182-66505 | 1 | ASSY: LOW VOLTAGE RECTIFIER BOARD |
| Change | A1A1C1 | 0180-0091 to 0180-1811 | 1 | C:FXD ELECT 100 UF +75-10% 20VDCW |
| Change | A1A1CR1 through A1A1CR4 | 1901-0028 to 1901-0049 | 4 | DIODE: SILICON 0.75A 50 PIV |
| Change | A1A1R1 and A1A1R2 | 0687-1041 to 0757-0342 | 2 | R: FXD MET FLM 100K OHM 1% 1/4W |
| Delete | A1A1R3 | | | |
| Delete | A1A1R4 | | | |
| Delete | A1A1VR1 | | | |
| Change | A1A2 | 00184-66509 to 00182-66514 | 1 | ASSY: LOW VOLTAGE REGULATOR BOARD |
| Change | A1A2C1 | 0140-0176 to 0160-2204 | 1 | C: FXD MY 100 PF 5% 300VDCW |
| Change | A1A2Q1 | 1854-0234 to 1854-0039 | 1 | TSTR: SI NPN 2N3053 |
| Add | MP201 | 7120-4106 | 1 | LABEL: CAUTION |
| Add | MP202 | 7120-4453 | 1 | TAG: 100 VOLT |

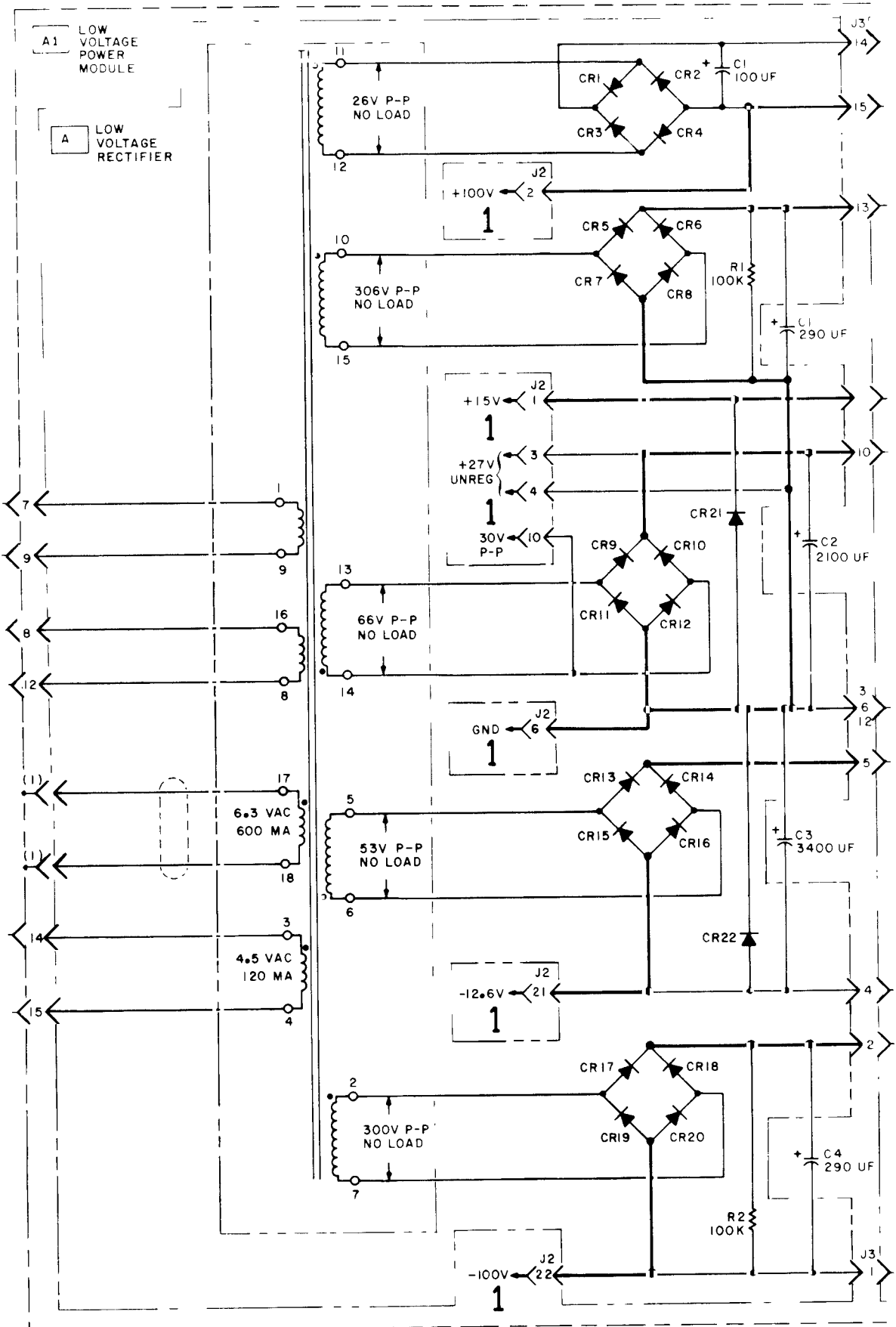
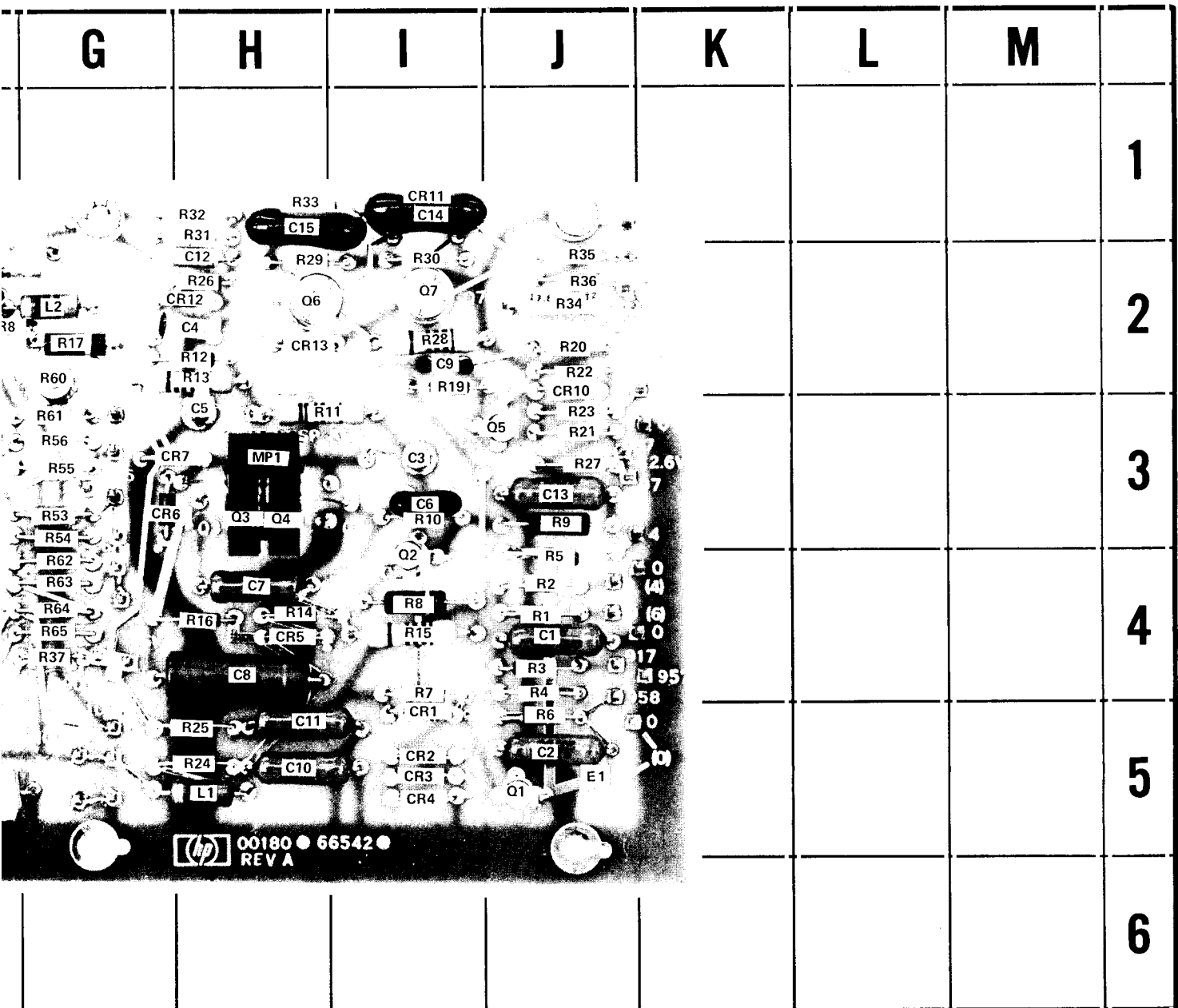


Figure 7-1.
Schematic for Option 003
7-5



A3

| REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|-----------|----------|-----------|----------|-----------|----------|-----------|----------|-----------|----------|
| R6 | H-2 | R11 | H-3 | R26 | H-2 | R41 | F-4 | R56 | G-3 |
| R7 | I-2 | R12 | H-2 | R27 | J-3 | R42 | E-4 | R57 | D-2 |
| R8 | E-4 | R13 | H-2 | R28 | I-2 | R43 | F-5 | R58 | C-2 |
| R9 | F-4 | R14 | H-4 | R29 | H-2 | R44 | E-4 | R59 | C-4 |
| R10 | F-4 | R15 | I-4 | R30 | I-2 | R45 | E-4 | R60 | G-2 |
| R11 | J-4 | R16 | H-4 | R31 | H-1 | R46 | F-3 | R61 | G-3 |
| R12 | J-4 | R17 | G-2 | R32 | H-1 | R47 | E-4 | R62 | G-4 |
| R13 | J-4 | R18 | F-2 | R33 | H-1 | R48 | E-5 | R63 | G-4 |
| R14 | J-4 | R19 | I-2 | R34 | J-2 | R49 | E-5 | R64 | G-4 |
| R15 | J-4 | R20 | J-2 | R35 | J-2 | R50 | F-3 | R65 | G-4 |
| R16 | J-5 | R21 | J-3 | R36 | J-2 | R51 | D-4 | TP1 | D-3 |
| R17 | I-4 | R22 | J-2 | R37 | G-4 | R52 | D-2 | VR1 | F-3 |
| R18 | I-4 | R23 | J-3 | R38 | F-3 | R53 | G-3 | VR2 | F-4 |
| R19 | J-3 | R24 | H-5 | R39 | F-3 | R54 | G-3 | VR3 | D-2 |
| R10 | I-3 | R25 | H-5 | R40 | F-4 | R55 | G-3 | VR4 | D-2 |

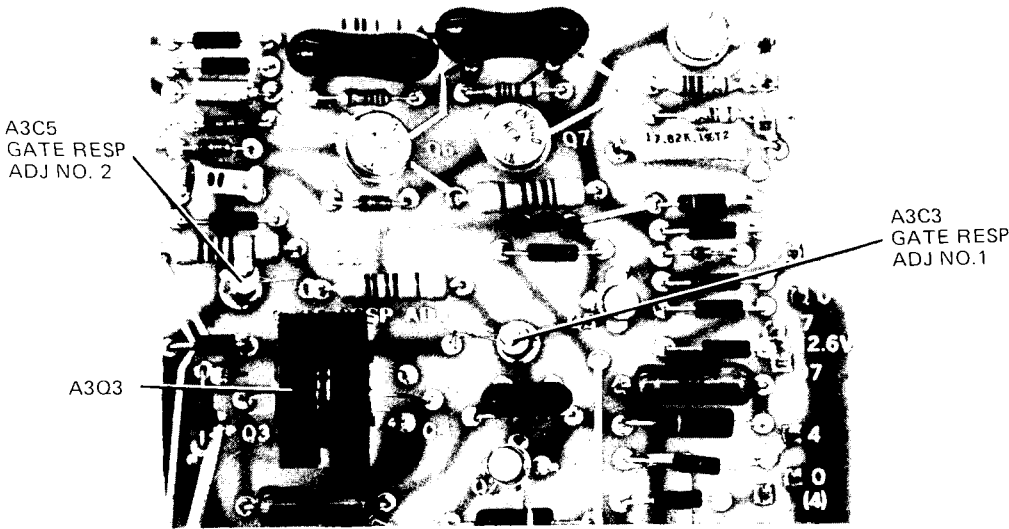
180C/D-R-8

Figure 7-2. Gate Amplifier Component Identification

| | A | B | C | D | E | F |
|---|---|---|-----|--|--|---|
| 1 | | | | | | |
| 2 | | | R58 | R52 VR3 VR4 C20 C21 C22 | | C16 R18 CR9 |
| 3 | | | | R57 TP1 C19 C23 C24 C25 | | R50 C18 R39 VR1 R38 R46 VR2 |
| 4 | | | R59 | R51 | Q8 R47 R42 R44 R45 R49 R48 | Q9 Q10 R41 R40 R43 |
| 5 | | | | | | R2502 C17 01 27 07 |
| 6 | | | | | | |

Circuit boards have plated through component holes. This permits soldering from either side of the board.

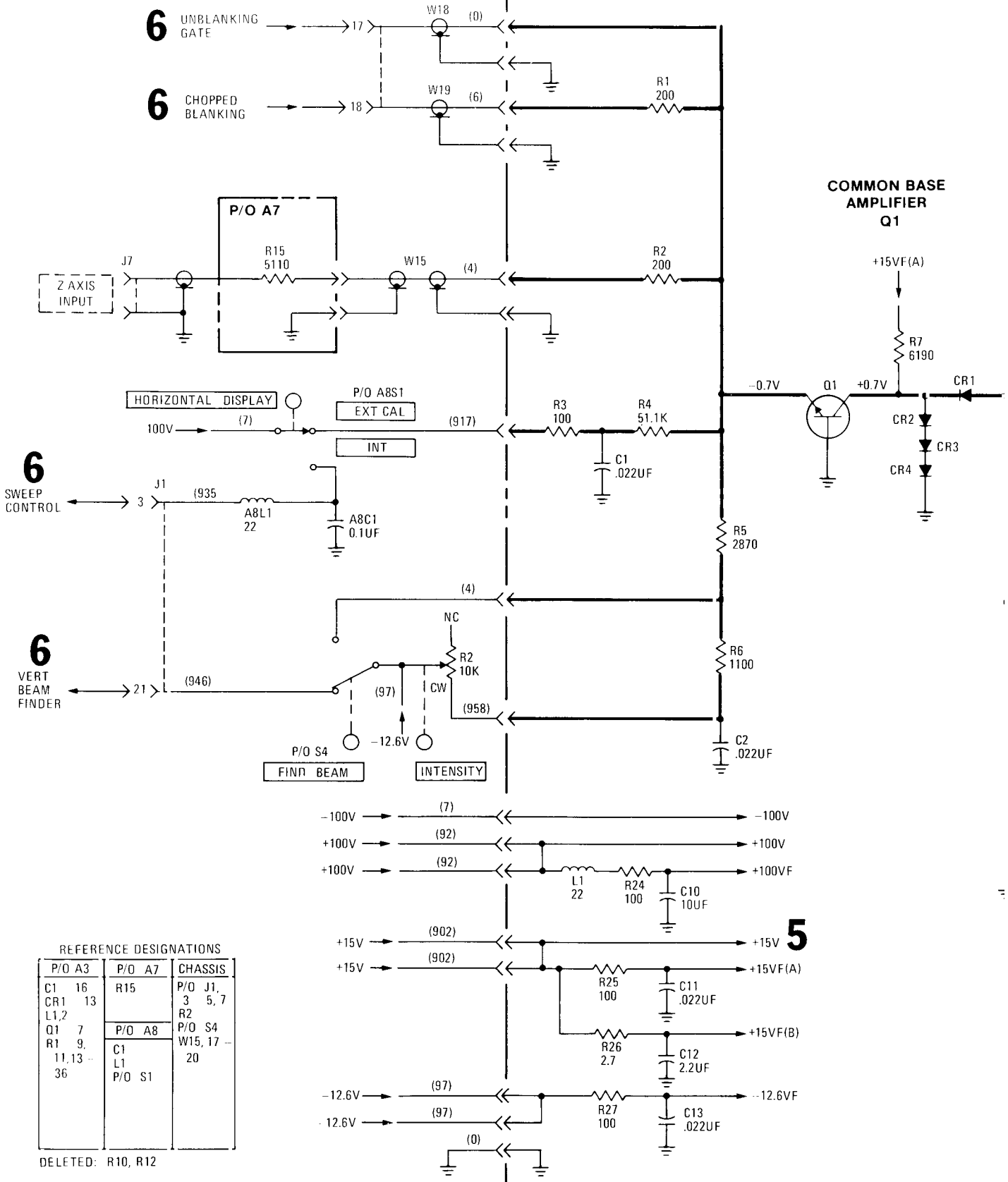
| REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG |
|--------------|-------------|--------------|-------------|--------------|-------------|--------------|
| C1 | J-4 | C17 | F-5 | CR8 | F-2 | Q6 |
| C2 | J-5 | C18 | F-3 | CR9 | F-2 | Q7 |
| C3 | I-3 | C19 | D-3 | CR10 | J-2 | Q8 |
| C4 | H-2 | C20 | D-2 | CR11 | J-1 | Q9 |
| C5 | H-3 | C21 | D-2 | CR12 | H-2 | Q10 |
| C6 | I-3 | C22 | D-2 | CR13 | H-2 | R1 |
| C7 | H-4 | C23 | D-3 | E1 | J-5 | R2 |
| C8 | H-4 | C24 | D-3 | L1 | H-5 | R3 |
| C9 | I-2 | C25 | D-3 | L2 | G-2 | R4 |
| C10 | H-5 | CR1 | I-5 | MP1 | H-3 | R5 |
| C11 | H-5 | CR2 | I-5 | Q1 | J-5 | R6 |
| C12 | H-2 | CR3 | I-5 | Q2 | I-4 | R7 |
| C13 | J-3 | CR4 | I-5 | Q3 | H-3 | R8 |
| C14 | I-1 | CR5 | H-4 | Q4 | H-3 | R9 |
| C15 | H-1 | CR6 | G-3 | Q5 | J-3 | R10 |
| C16 | F-1 | CR7 | H-3 | | | |



180C/D-R-12
(Changed 09-74)

Figure 7-3. Gate Amplifier Adjustment Location

P/O A3 GATE AMPLIFIER, CALIBRATOR AND REGULATOR ASSY



REFERENCE DESIGNATIONS

| P/O A3 | P/O A7 | CHASSIS |
|-----------|--------|-----------------|
| C1 16 | R15 | P/O J1, 3, 5, 7 |
| CR1 13 | | R2 |
| L1,2 | P/O A8 | P/O S4 |
| Q1 7 | | W15, 17 -- |
| R1 9, | C1 | 20 |
| 11, 13 -- | L1 | |
| 36 | P/O S1 | |

DELETED: R10, R12

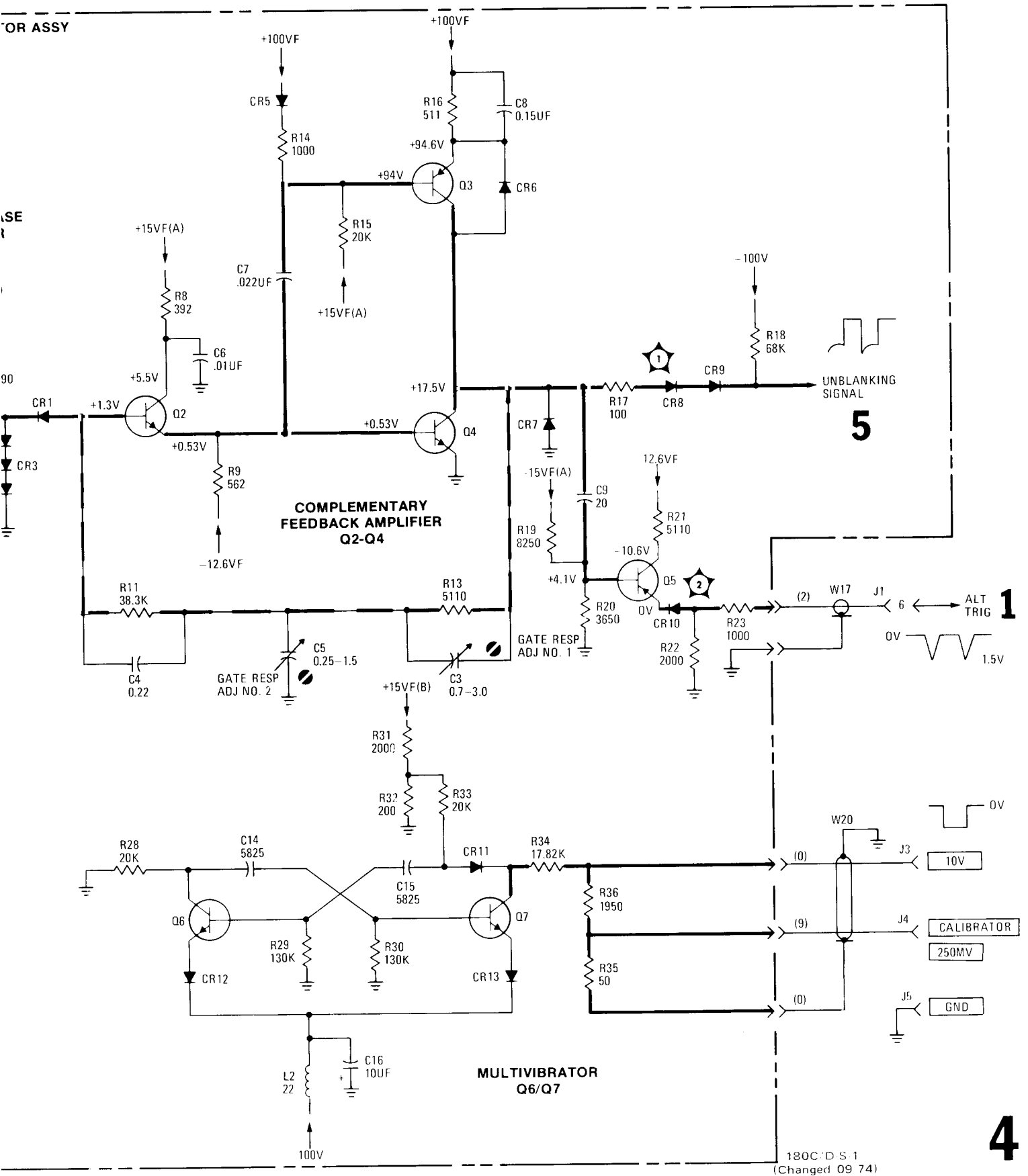
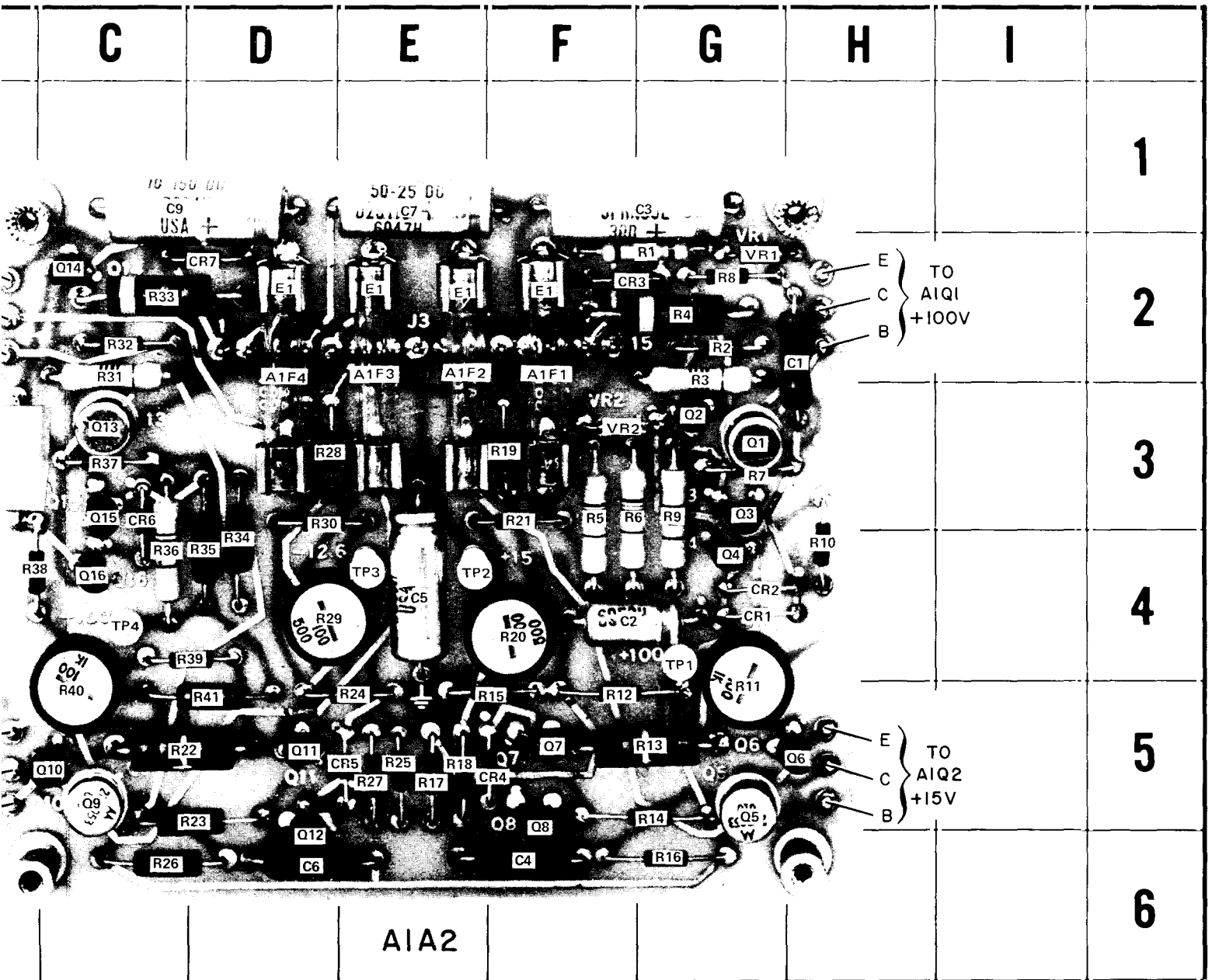
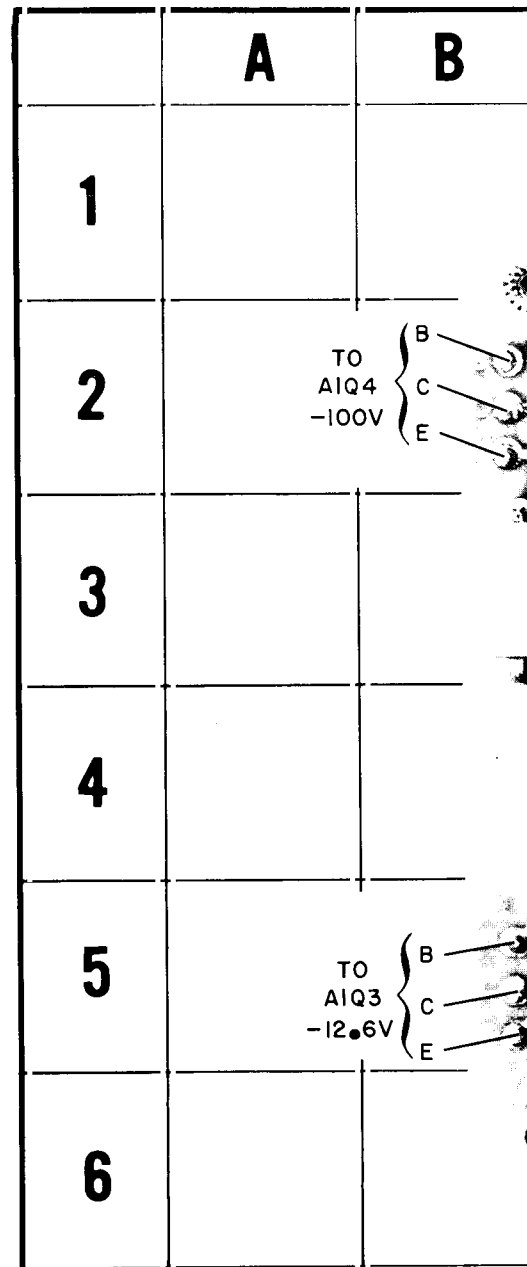
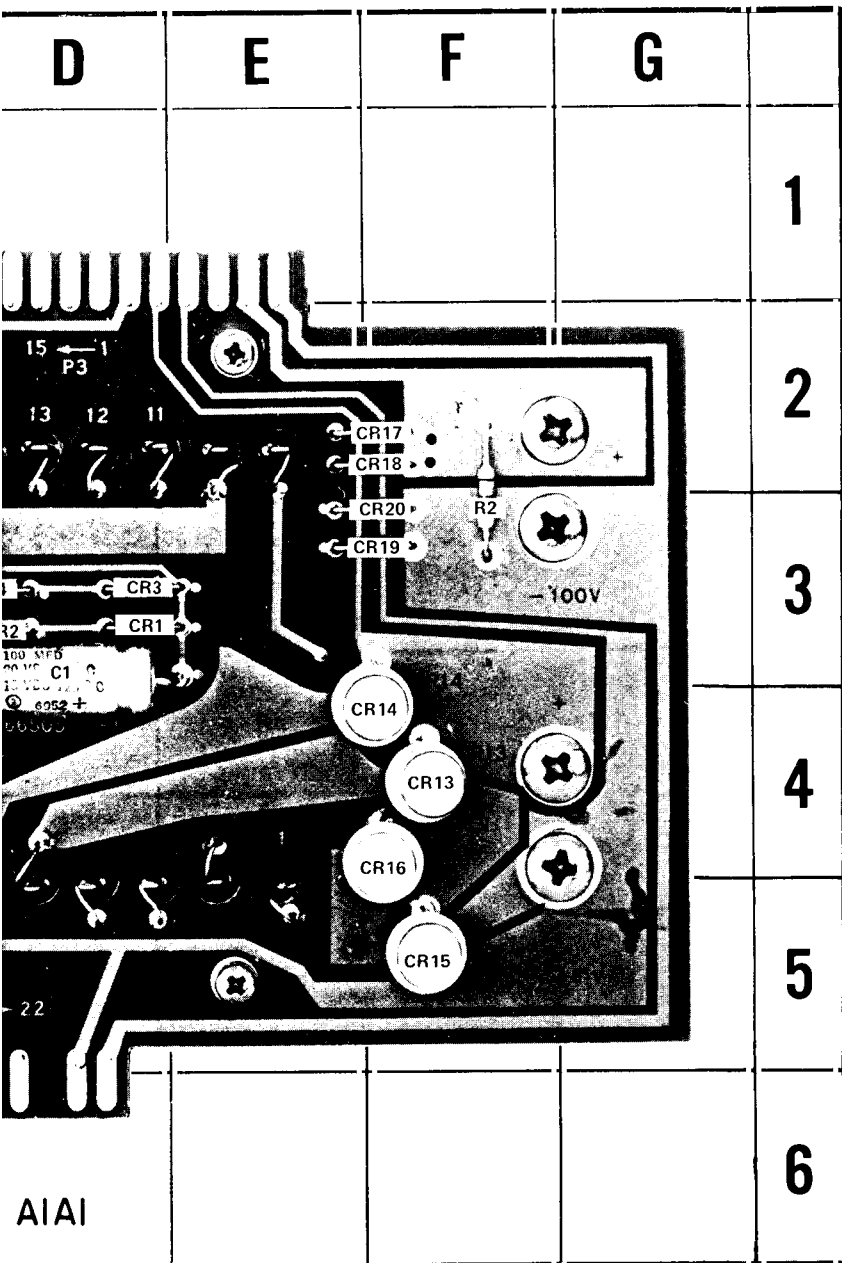


Figure 7-1. Gate Amplifier and Calibrator Schematic
7-7



| 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 |
|----------|-----------|----------|-----------|----------|-----------|----------|-----------|----------|-----------|----------|-----------|----------|-----------|----------|
| F-2 | C1 | H-2 | CR4 | E-5 | Q5 | G-5 | R1 | G-2 | R13 | G-5 | R25 | E-5 | R37 | C-3 |
| E-2 | C2 | F-4 | CR5 | E-5 | Q6 | H-5 | R2 | G-2 | R14 | G-5 | R26 | C-6 | R38 | B-4 |
| E-2 | C3 | G-1 | CR6 | C-3 | Q7 | F-5 | R3 | G-2 | R15 | F-5 | R27 | E-5 | R39 | D-4 |
| D-2 | C4 | F-6 | CR7 | D-2 | Q8 | F-5 | R4 | G-2 | R16 | G-6 | R28 | D-3 | R40 | C-5 |
| | C5 | E-4 | E1 | D-2 | Q9 | C-5 | R5 | F-3 | R17 | E-5 | R29 | D-4 | R41 | D-5 |
| | C6 | D-6 | E1 | E-2 | Q10 | C-5 | R6 | F-3 | R18 | E-5 | R30 | D-3 | TP1 | G-4 |
| | C7 | E-1 | E1 | E-2 | Q11 | D-5 | R7 | G-3 | R19 | F-3 | R31 | C-2 | TP2 | E-4 |
| | C9 | D-1 | E1 | F-2 | Q12 | D-6 | R8 | G-2 | R20 | F-4 | R32 | C-2 | TP3 | E-4 |
| | CR1 | G-4 | Q1 | G-3 | Q13 | C-3 | R9 | G-3 | R21 | F-3 | R33 | C-2 | TP4 | C-4 |
| | CR2 | G-4 | Q2 | G-3 | Q14 | C-2 | R10 | H-4 | R22 | C-5 | R34 | D-4 | VR1 | G-2 |
| | CR3 | F-2 | Q3 | G-3 | Q15 | C-3 | R11 | G-5 | R23 | D-5 | R35 | D-4 | VR2 | F-3 |
| | | | Q4 | G-4 | Q16 | C-4 | R12 | F-5 | R24 | E-5 | R36 | C-4 | | |

Figure 7-6. Low-Voltage Regulator Component Identification



is

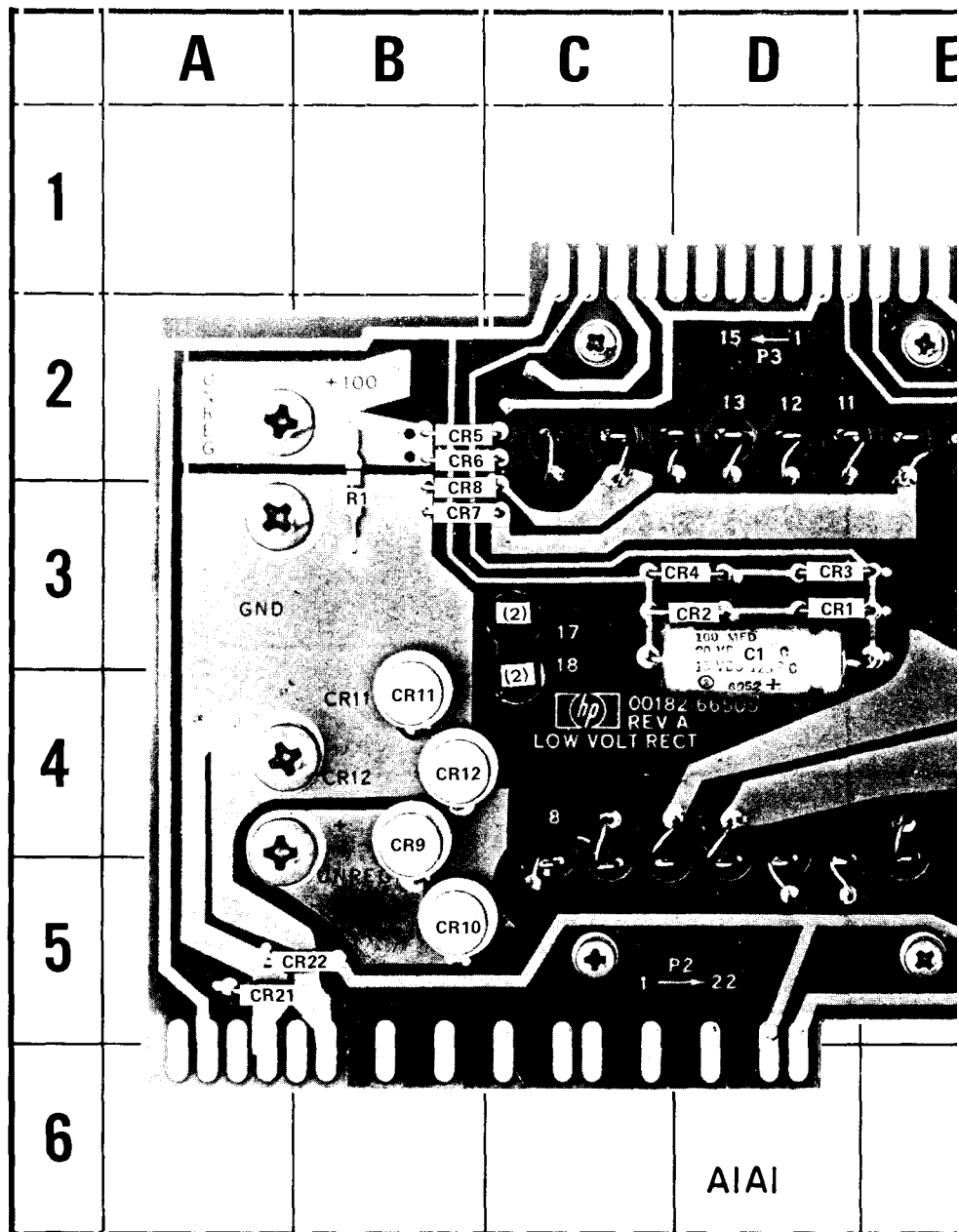
| REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|--------------|-------------|--------------|-------------|--------------|-------------|
| CR10 | B-5 | CR15 | F-5 | CR20 | F-3 |
| CR11 | B-4 | CR16 | F-4 | CR21 | A-5 |
| CR12 | B-4 | CR17 | F-2 | CR22 | B-5 |
| CR13 | F-4 | CR18 | F-2 | R1 | B-3 |
| CR14 | F-4 | CR19 | F-3 | R2 | F-3 |

| REF DESIG | GRID LOC |
|--------------|-------------|
| A1F1 | F-3 |
| A1F2 | E-3 |
| A1F3 | E-3 |
| A1F4 | D-3 |

A1F1 F-3
 A1F2 E-3
 A1F3 E-3
 A1F4 D-3

182A-8-6

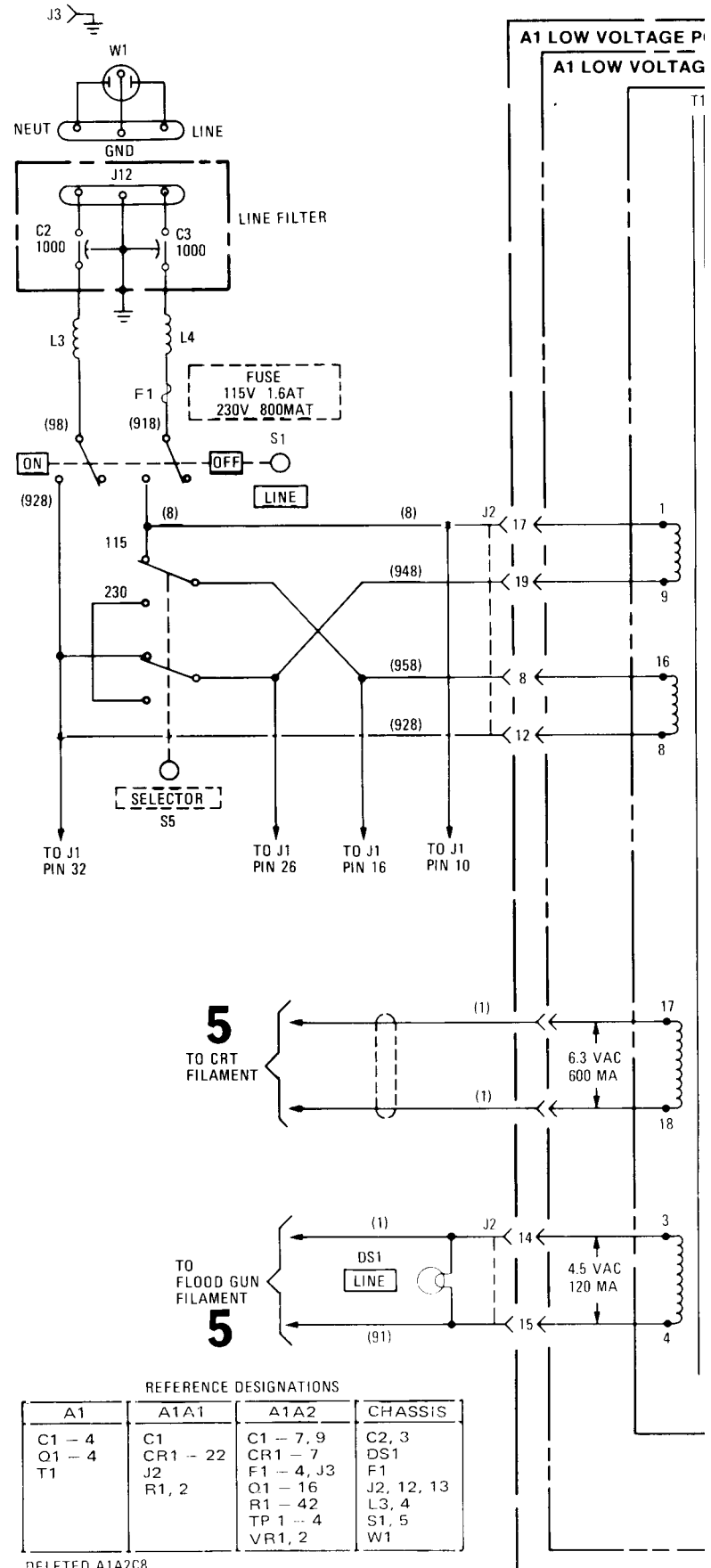
Etched circuit boards have plated-through component holes. This permits soldering from either side of the board.



Note: Circuit boards have plated through component holes. This permits soldering from either side of the board.

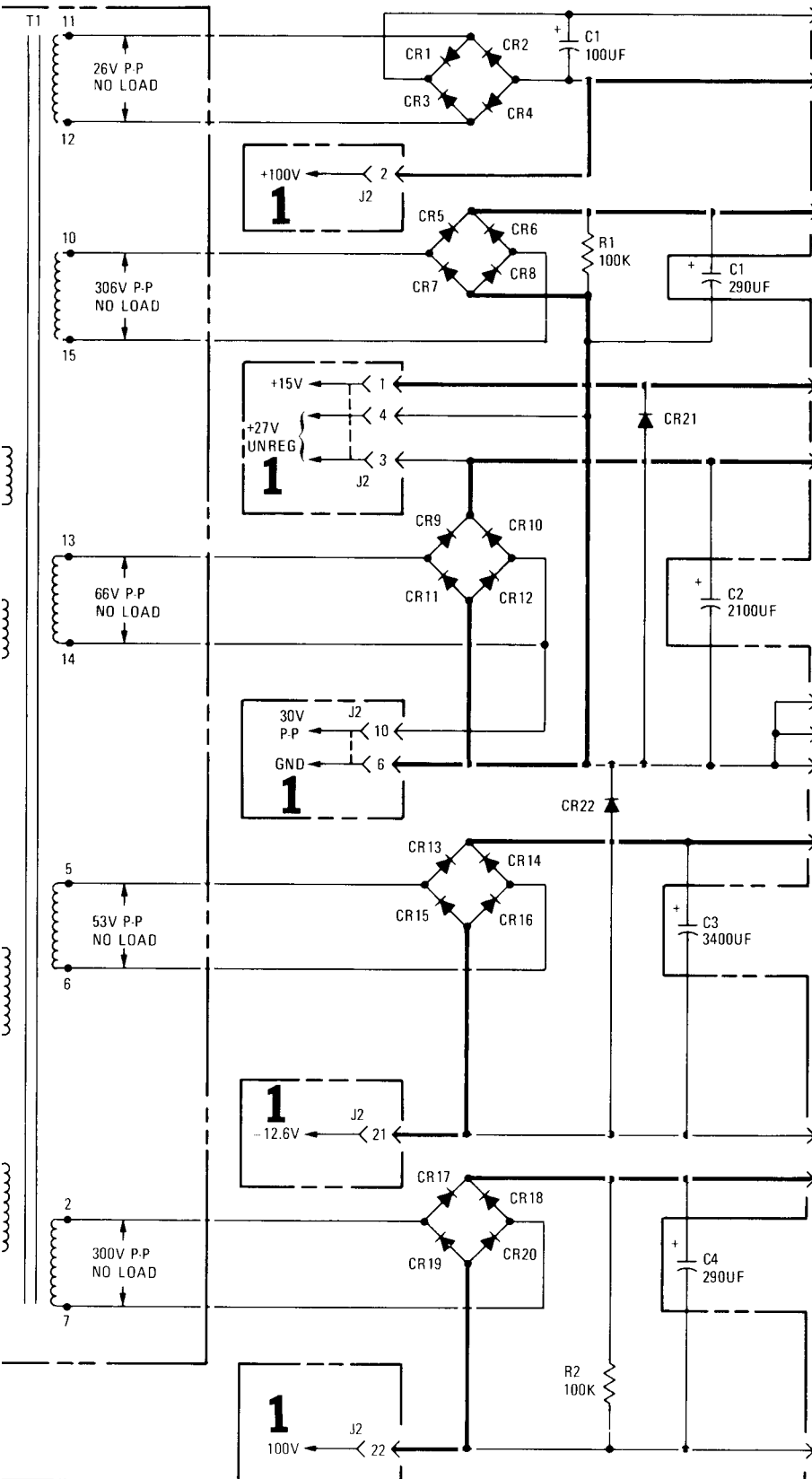
| REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG |
|--------------|-------------|--------------|-------------|--------------|-------------|--------------|
| C1 | D-3 | CR5 | B-2 | CR10 | B-5 | CR15 |
| CR1 | D-3 | CR6 | B-2 | CR11 | B-4 | CR16 |
| CR2 | D-3 | CR7 | B-3 | CR12 | B-4 | CR17 |
| CR3 | D-3 | CR8 | B-3 | CR13 | F-4 | CR18 |
| CR4 | D-3 | CR9 | B-4 | CR14 | F-4 | CR19 |

Figure 7-5. Low-Voltage Rectifier Component

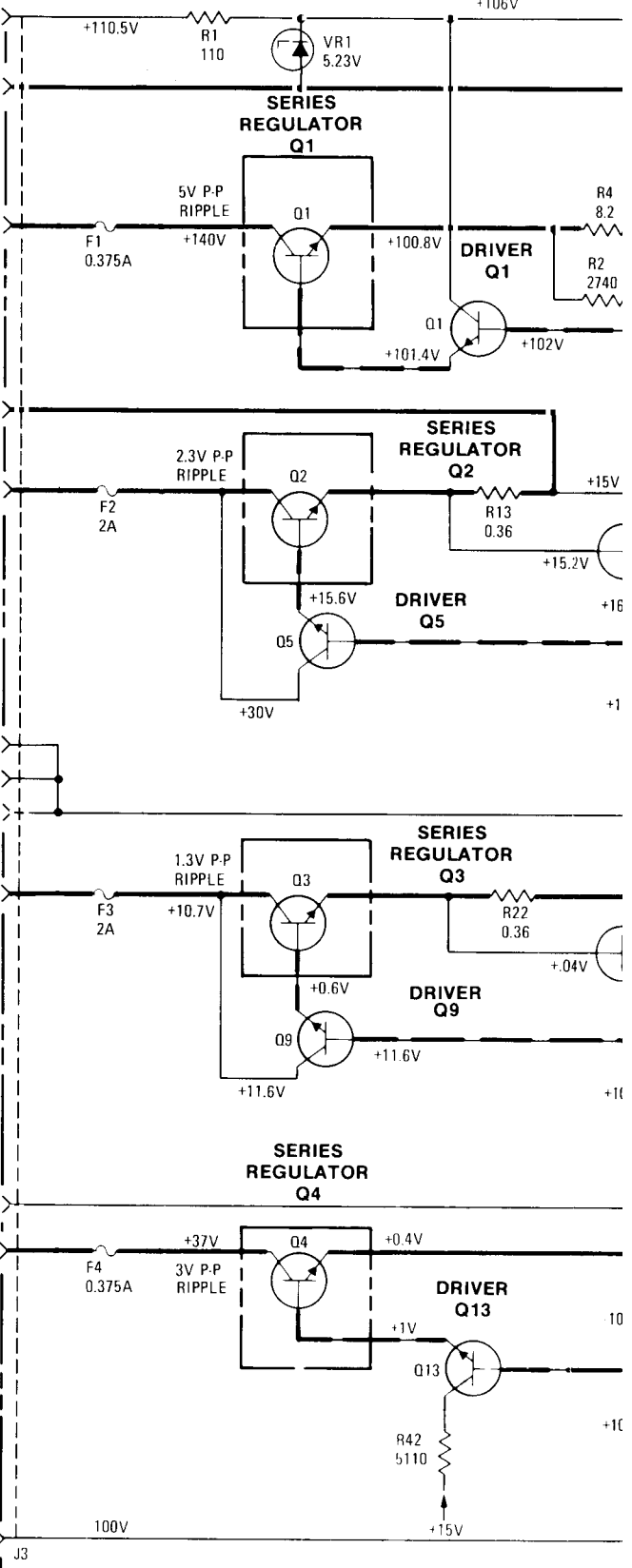


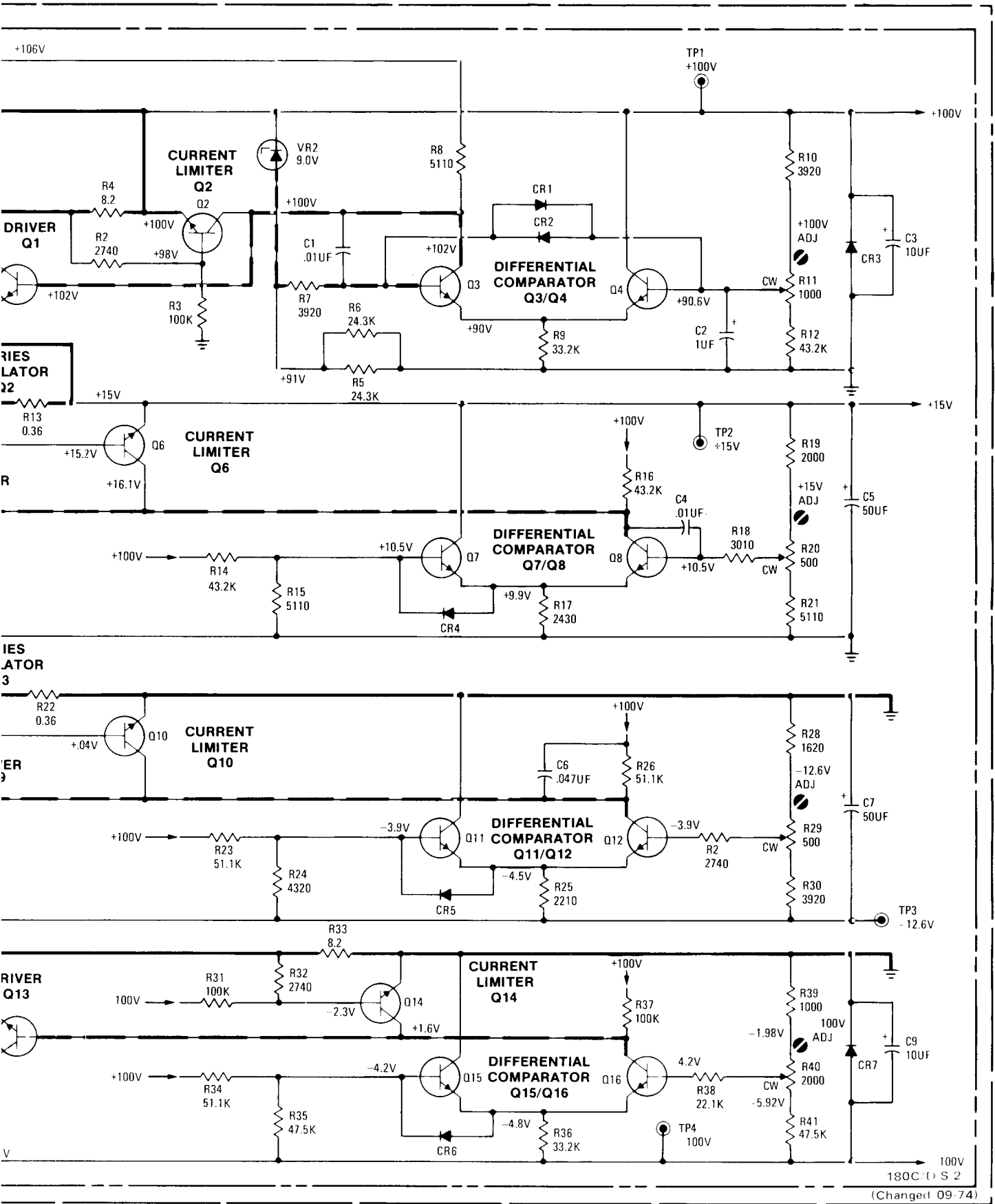
POWER MODULE

BRIDGE RECTIFIER



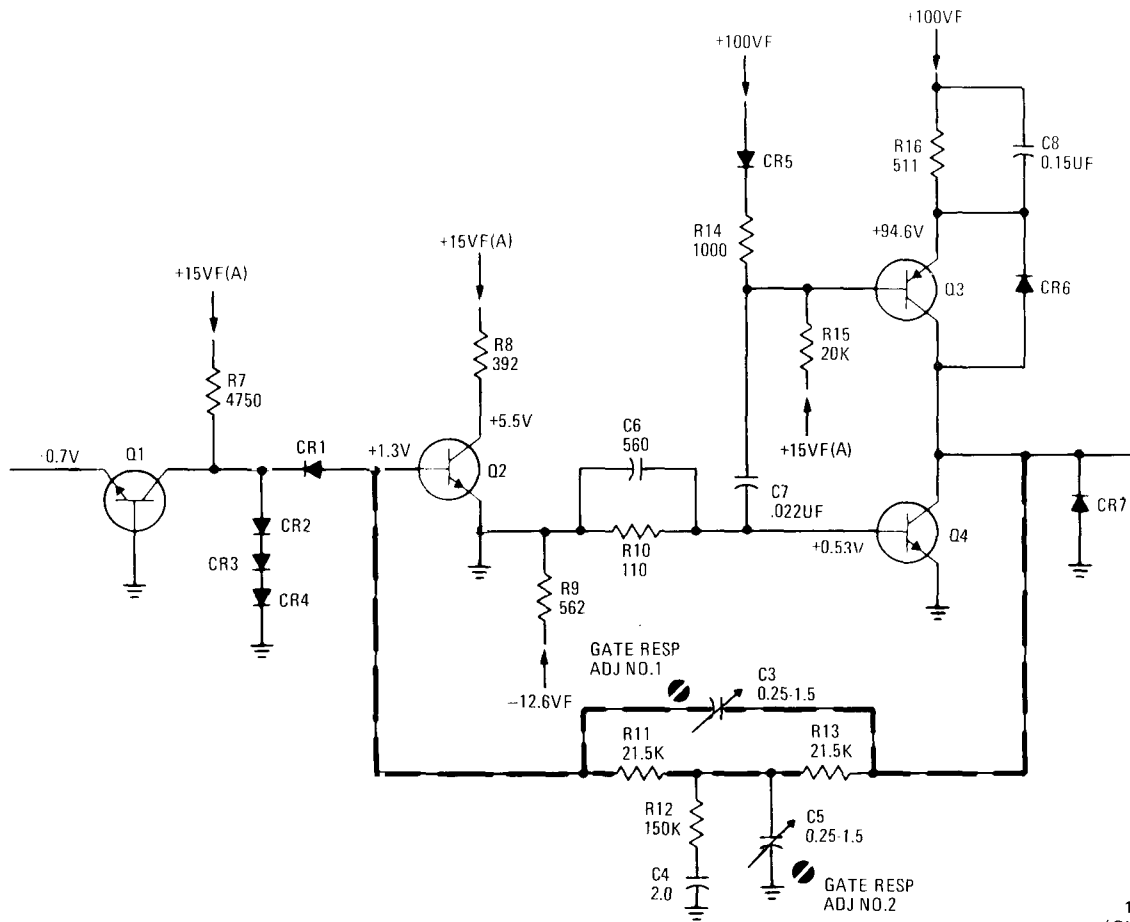
A2 LOW VOLTAGE REGULATOR





2

Figure 7-7.
Low-Voltage Power Supply Schematic
7-9



180C/D-L-1
(Changed 09-74)

Figure 7-8. Revision to Gate Amplifier and Calibrator Schematic

SECTION VIII

SCHEMATICS AND TROUBLESHOOTING

8-1. INTRODUCTION.

8-2. This section contains schematics, repair and replacement information, component identification illustrations, and troubleshooting and repair information. Table 8-1 defines symbols and conventions used on the schematics. The overall block diagram is located in Section IV.

8-3. SCHEMATICS.

8-4. Schematics appear on right-hand pages that unfold outside the right edge of the manual. This allows viewing the schematics while referring to text and figures in another section of the manual.

8-5. The schematics are drawn primarily to show the electronic function of the circuit and instrument. A given schematic may include all or part of several assemblies. Schematics also include dc voltages and waveforms at helpful points. Information explaining the symbols and conventions used in these schematics is provided by Table 8-1. Voltage measurement conditions applicable to each schematic are shown next to the schematic.

8-6. Each schematic is identified by a number. The number of the schematic is located in the lower right-hand corner near the figure number and title. These numbers are used to make it easy to trace a circuit that begins on one schematic and is continued on another. When a circuit leaves a schematic, it is identified with the code number of the schematic on which it is continued. Both schematics have the same circuit identification information such as voltage, function or circuit connection.

8-7. REFERENCE DESIGNATIONS.

8-8. The unit system of reference designations used in this manual is in accordance with provisions of the USA Standard Reference Designations for Electrical and Electronic Parts and Equipments dated March 1, 1968. Minor variations due to design and manufacturing practices not specifically covered by the standard may be noted.

8-9. Each electrical component is identified by a class letter and number. This letter-number combination is the basic designation for each component. Components that are separately replaceable and are part of an assembly have, in addition to the basic designation, a prefix designation indicating the assembly on which the component is physically located. Components not located on an assembly will have only the basic designation and are listed in the replaceable parts list (Section VI) under chassis parts.

8-10. All components within the shaded areas on the schematics are physically located on an etched circuit board and should be prefixed with the assembly number assigned to the board (e.g. resistor R23 on assembly A3 is referred to as A3R23). There may also be an R23 on several other assemblies, but the assembly designation will always be different (A2R23, A1R23, etc.).

8-11. COMPONENT LOCATION.

8-12. All adjustments are shown in Section V, and mechanical and miscellaneous electrical parts are shown on exploded view drawings in Section VI. For ready reference, circuit assembly photographs are placed adjacent to the associated schematics.

8-13. Circuit assembly photographs are subdivided by a grid, and components within each subdivision are indexed to a location table near the photograph. A component can be easily located on the photograph by first referring to the table. However, reference designators are not complete on the assembly photographs. For the complete reference designator, prefix the assembly designation given in the photograph to each component designator.

8-14. TROUBLESHOOTING.

8-15. The most important prerequisite for successful troubleshooting is understanding how the instrument operates and correct usage of controls.

8-16. Equipment troubles are frequently due simply to improper front-panel control settings. Refer to the operating instructions in Section III for a complete explanation of each control function along with typical operating instructions, if in doubt. Use the controls as a guide to help isolate a trouble to a specific area of the instrument.

8-17. Troubleshooting is easier if more than one symptom of a trouble is evident. Observe the instrument, and note all indications of faulty operation. If symptoms indicate more than one trouble, treat each problem individually and locate one trouble at a time. Don't waste time making random checks. Follow the procedure presented here, and refer to other areas of information in this manual if necessary.

8-18. Make a thorough check of instrument performance. A complete procedure is given in Section V, and forms are included to record results. A trouble, such as incorrect vertical gain or sweep speed, may be due to lack of calibration.

8-19. PRELIMINARY CHECKOUT.

8-20. To help isolate malfunctions, perform the following checkout procedure:

- a. Check for improper control settings (refer to Section III).
- b. Check for proper operation of accessory equipment.
- c. Visually inspect instrument for loose wire and cable connections. Check wiring to all board assemblies for proper connections.
- d. Visually inspect for burned, broken or chafed wires; charred or discolored components; and any other indication of physical damage.
- e. Check for proper power supply voltages and determine that fuses are not open.

8-21. DETAILED CHECKOUT.

8-22. If the trouble cannot be located using the preliminary checkout procedures, a detailed check of the circuits will be necessary. Troubleshooting charts, waveforms, and voltages are provided to help in locating problem areas and components. The troubleshooting charts and waveforms are to be used to isolate the problem to a specific area. The voltages can then be used to locate the faulty component within the problem area.




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


8-23. DC VOLTAGES.

8-24. Dc voltages are shown on the schematics for active components (transistors, etc.). Conditions under which the typical voltages were taken are listed adjacent to each schematic. Since these conditions may differ from one circuit to another, always check the specific conditions listed. The conditions have been set up to permit the greatest amount of troubleshooting voltage information possible.

8-25. WAVEFORMS.

8-26. Waveform measurement points ( with a number enclosed) are placed on the schematics at helpful locations. The numbers inside the measurement point symbols are keyed to corresponding waveforms adjacent to the schematic. Conditions for making the waveform measurement are also given if pertinent.

8-27. TEST POINTS.

8-28. Test points are shown on the schematics with this symbol (). These symbols refer to specific test

point pins which are a part of the etched circuit board assembly. They do not correspond to the waveform measurement points.

8-29. POLARIZED COMPONENTS.

8-30. As an aid to locating measurement points and identifying the proper orientation of components, a small dot etched on the circuit board is used to guide the service technician. Use these points to assist you in making voltage and resistance measurement checks and as guidance in properly replacing components. The dot is etched next to:

- emitter lead of each transistor,
- source lead of FET's,
- cathode end of diodes,
- positive end of electrolytics.

8-31. TROUBLESHOOTING TABLES.

8-32. Troubleshooting tips are given in several tables. The tables are not intended as a fool-proof tool for pinpointing every possible trouble. Some of the most common symptoms and probable faults are given. Before doing the checks, be sure that the symptom is valid by checking control settings. For example, what may at first appear as no display may really be a no-sweep problem.

8-33. REPAIR AND REPLACEMENT.

8-34. The following paragraphs contain recommended procedures for repair and replacement of defective components. A complete list of components, with Hewlett-Packard part numbers and ordering information, is in Section VI. Contact the nearest HP Sales/Service Office listed at the rear of this manual if satisfactory repair or operation cannot be achieved.

8-35. SERVICING ETCHED CIRCUIT BOARDS.

8-36. Etched circuit boards in this instrument have components mounted on one side of the board, conductive surfaces on both sides, and plated-through component mounting holes. Hewlett-Packard Service Note M-20E contains useful information on servicing etched circuit boards. Some important considerations are as follows:

- a. Use a 37 to 47.5 watt chisel tip soldering iron with a tip diameter of 1/16 to 1/8 inch, and a small diameter rosin core solder.
- b. Components may be removed by placing the soldering iron on the component leads on either side of the board and pulling the component straight away from the board. If heat is applied to the component side of the board, greater care is required to avoid damage to the components, especially semiconductors. Heat damage may

be minimized by gripping the lead with long-nose pliers between the soldering iron and the component, thereby forming a heat sink.

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

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

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

f. Before replacing a component, heat the remaining solder in the component hole and clean it out. Sharp-

pointed metallic tools are not recommended since they may loosen eyelets in boards or remove plating from the inside of holes on plated-through etched circuit boards.

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

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

8-37. SEMICONDUCTOR REPLACEMENT.

8-38. Semiconductor devices are available in a wide variety of shapes and sizes. This can make it confusing to identify the leads. Examples of some of the most common configurations are shown in Figure 8-1.

8-39. When removing a semiconductor, use long-nose pliers as a heat sink between the device and the soldering iron. When replacing a semiconductor, ensure sufficient lead length to dissipate soldering heat by using the same length of exposed lead as used for the original part.

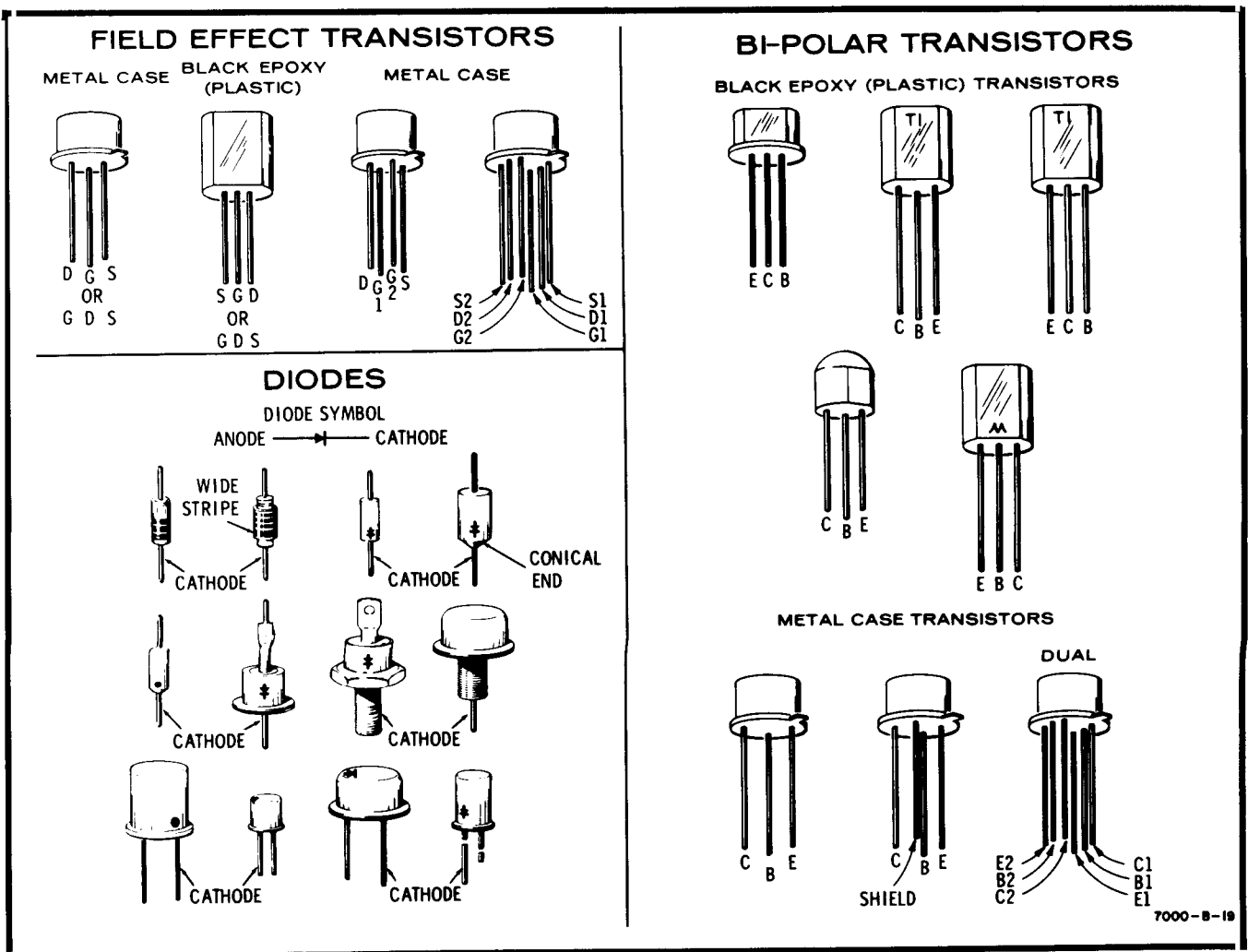


Figure 8-1. Semiconductor Terminal Identification

8-40. DETAILED TROUBLESHOOTING.

8-41. The following troubleshooting tips are categorized according to the various areas of the instrument. These tips can be helpful only after a trouble is localized to one of these areas. Read the theory of operation in Section IV to learn how a circuit should operate. With the aid of this information, it is easier to discover why a defective circuit is inoperative. Finally, make resistance checks to uncover the faulty component. If it appears necessary to calibrate the instrument, refer to Section V for the proper procedures.

4-42. LOW VOLTAGE POWER SUPPLY.

8-43. Fuses, test points for measuring regulated output voltages and voltage adjustment controls are located on the low voltage regulator assembly. Access to the assembly is obtained by removing the instrument rear panel. Each low voltage supply is fused. The fuses are in series with the regulator transistors, and all regulated output power flows through the fuse for the respective supply.

8-44. Since the +100V and -100V supplies are current fold-back limited, and the +15V and -12.6V supplies are current limited, an open fuse generally indicates that trouble exists in the regulator portion of the supply. If a fuse is open, check the series regulator transistor, driver transistor and comparator.

8-45. Troubleshooting the low voltage supply is facilitated by removing the power supply from the oscilloscope. This will provide access to the power transformer, rectifiers and filters. The procedure for removing the power supply module is explained later in this section of the manual.

WARNING

Lethal voltages are exposed when the power supply module is operated outside the oscilloscope mainframe.

8-46. The +100V supply should be checked first, since all other supplies use it as a reference. Unregulated operation of all of the other supplies may be the result of a defective +100V supply. Use the convenient test points to monitor the regulated output of a supply. If the +100V supply is defective, verify operation of the reference supply which is regulated by the 9-volt zener diode.

8-47. HIGH VOLTAGE POWER SUPPLY AND REGULATOR.

8-48. High voltage power supply problems are usually indicated by no display, a display that is too bright, an arcing sound, slow trace shift, blooming, or sudden

shifts in display intensity. Regulator problems may result in no high voltage or excessive high voltage.

8-49. Check the waveform at the collector of the high voltage oscillator transistor if there is no high voltage. Normally, the oscillator output should be a 50-kHz sine wave. If only one high voltage is absent, check the appropriate rectifier and filter circuit. Refer to the troubleshooting tables if high voltage is present but not properly adjustable.

WARNING

The CRT post accelerator lead may have a high voltage present even if the instrument has been turned off for a long time. Ground both CRT and H.V. multiplier connections to discharge.

8-50. If no high voltage is present, check the H.V. oscillator supply voltage. An unregulated +27V furnishes oscillator operating power. The +27V power is fused, and the fuse is located on the H.V. oscillator assembly. With the high voltage multiplier disconnected, the oscillator frequency will increase if the circuit is operating properly.

8-51. The CRT cathode and grid high voltage leads can be disconnected by removing the CRT socket. This will further isolate the trouble. If it is determined that the H.V. multiplier is faulty, it must be replaced as a complete unit, since it is a sealed assembly.

8-52. DISASSEMBLY INFORMATION.

8-53. Many of the connections to etched circuit board assemblies are made by means of quick-disconnect connectors. This permits rapid removal of the assembly without unsoldering connections. Be sure to lift them off with a straight, direct pull.

8-54. If it is necessary to remove an assembly for servicing or replacement, the following information will provide guidance in accomplishing this in a manner to prevent damage and facilitate removal and replacement.

8-55. COVER REMOVAL.

8-56. Use a Posidrive type screwdriver for removing cover screws. (See Figure 8-2.)

Model 180C. Remove the covers as follows:

- a. Ensure that LINE power switch is OFF and disconnect power plug from ac line source.
- b. Remove four screws holding top cover from each side of instrument.
- c. Remove top cover by opening bottom end and pulling away from instrument.

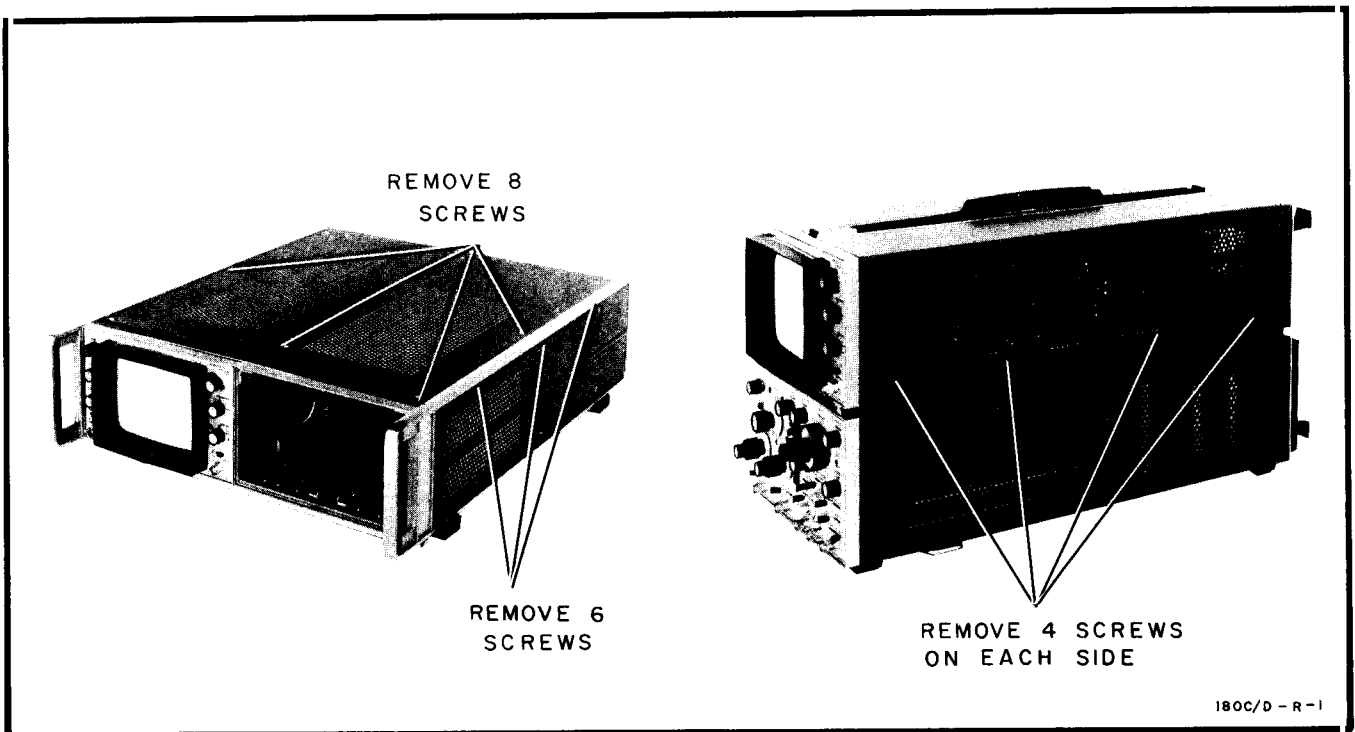


Figure 8-2. 180C/D Cover Removal

d. Remove rear access cover by releasing single quarter-turn fastener.

Model 180D. Remove the covers as follows:

- a. Ensure that LINE power switch is OFF and disconnect power plug from ac line source.
- b. Remove top cover, which is held in place with eight screws.
- c. Remove both side covers. Each is held in place with six screws.
- d. Remove rear access cover by releasing single quarter-turn fastener.

8-57. POWER MODULE REMOVAL.

8-58. The low voltage power supply module includes the power transformer, low voltage rectifier assembly, low voltage regulator assembly and the series regulators. The entire module is removable as a unit which can be further disassembled if desired. To facilitate servicing, the module may be simply disconnected and removed from the mainframe, or it may be operated outside the mainframe while connected to simplify troubleshooting.

8-59. To remove the power module, first disconnect the ac line power input. Then proceed as follows:

- a. Remove bottom covers from Model 180C, or top and bottom covers from Model 180D.

- b. Set instrument on rear end.
- c. Remove four screws located on underside of power module.
- d. Return instrument to horizontal position.
- e. Model 180C: remove two nuts from screws extending into module from bottom feet. Model 180D: remove two screws from horizontal cross brace to power module.
- f. Remove four rear screws. One screw is located near top and one near bottom of each series regulator heat sink. Model 180C: do not remove screws holding rear feet to heat sink.
- g. Remove module by grasping filter capacitors on each side and pressing toward rear of instrument. Be careful not to pull module beyond length of connecting cable. Model 180C: lift module to clear screws before removing.

WARNING

Lethal voltages are exposed when the power supply module is operated outside the oscilloscope mainframe.

h. Disconnect two CRT filament leads (brown wires) and power connection jack before completely removing module.

8-60. CRT REMOVAL AND REPLACEMENT.

8-61. To remove the CRT, proceed as follows:

WARNING

To prevent personal injury, always wear a face mask or safety goggles when handling the CRT. Wear protective gloves and handle carefully.

- a. Disconnect ac power input and remove plug-ins.
- b. Remove all four covers from Model 180C or top and bottom covers from Model 180D.
- c. Model 180D: remove shield (two screws) next to CRT post accelerator lead. Shield is between CRT and plug-in compartment.

WARNING

The CRT post accelerator lead may have a high voltage present even if the instrument has been turned off for a long time. Ground both CRT and H.V. multiplier connection to discharge.

- d. Use grounded screwdriver and carefully lift insulator cap. Ground spring wire clip as lead is loosened from CRT.
- e. Remove post accelerator lead from CRT. Lead is held in place by spring wire clip. To remove it from CRT, compress clip by pressing against one side of spring wire with screwdriver blade while gently lifting same side of insulator cap.
- f. Remove connections from CRT neck pins. Use long-nose pliers through access holes in CRT shield and brackets. There are nine connections.

g. Squeeze plastic light shield at midpoint on top and on bottom, and remove it.

Remove the CRT safety faceplate.

CAUTION

If faceplate is to be cleaned, use a soft cloth or tissue. Never use coarse or abrasive tissues because these will scratch the plastic.

- h. Remove four screws holding metal bezel on front panel.
- i. Carefully loosen and pry socket from CRT base.
- j. Loosen clamp at rear of CRT.
- k. Place one hand on CRT face. With other hand, slide CRT forward and out of instrument. Be careful not to damage CRT neck pin connections.
- l. Before replacing CRT, carefully clean the area of the H.V. post accelerator connection. Use a mild solution of detergent and water or freon degreaser. Carefully dry the area completely.
- m. Gently clean any oxidation from neck pins, being careful to not bend pins or scratch glass.
- n. To replace CRT, reverse above procedure. Before tightening clamp, align CRT to place graticule lines square with oscilloscope frame.

Note

If the standard P31 phosphor CRT is replaced with a P11 phosphor CRT, circuit modification is required. The increase in intensity from use of the FIND BEAM switch can cause phosphor burn. Refer to Section VII for information about the circuit change required.

8-62. After replacing CRT, check the following adjustments: Intensity Limit, Flood Gun, Trace Alignment, Horizontal Amplifier, Astigmatism, Vernier Balance, Gain and Horizontal Linearity.

8-63. HIGH VOLTAGE SUPPLY REPLACEMENT.

8-64. The following procedure should be used when replacing the high voltage rectifier assembly, high voltage multiplier assembly or high voltage oscillator assembly.

- a. Remove Model 180C left top cover or Model 180D left side and rear covers.
- b. Remove cover to high voltage compartment (two screws).

- c. Unsolder five wires connecting H.V. rectifier transformer circuit board and H.V. oscillator assembly.
- d. Unsolder white (9) wire from A5CR2 and gray (8) wire from transformer circuit board.
- e. Remove four screws from corners of H.V. rectifier assembly.
- f. Remove H.V. rectifier assembly from compartment of H.V. multiplier assembly.
- g. Unsolder white (9) wire, orange (3) wire and blue (6) wire from H.V. rectifier assembly.
- h. Remove two screws holding H.V. oscillator circuit board.
 - i. From top of instrument, remove one screw holding H.V. oscillator transistor to mounting bracket. (Two mica insulating washers are between transistor and mounting bracket.) This step may be omitted and transistor left mounted if desired. If left in place, exercise care to properly seat transistor in socket when replacing board.
 - j. Disconnect three square-pin connectors from underside of circuit board, and remove circuit board.
 - k. H.V. multiplier assembly is also free and can be removed from supporting bracket.

Table 8-1. Schematic Notes

Refer to American National Standard Y32.2 for schematic symbols not listed in this table.


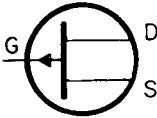
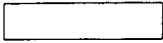
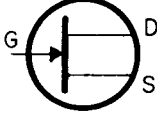







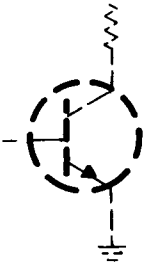


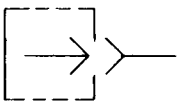

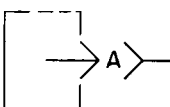
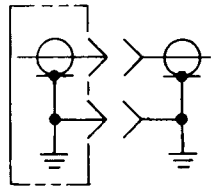
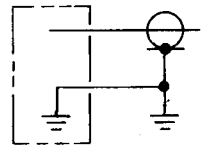



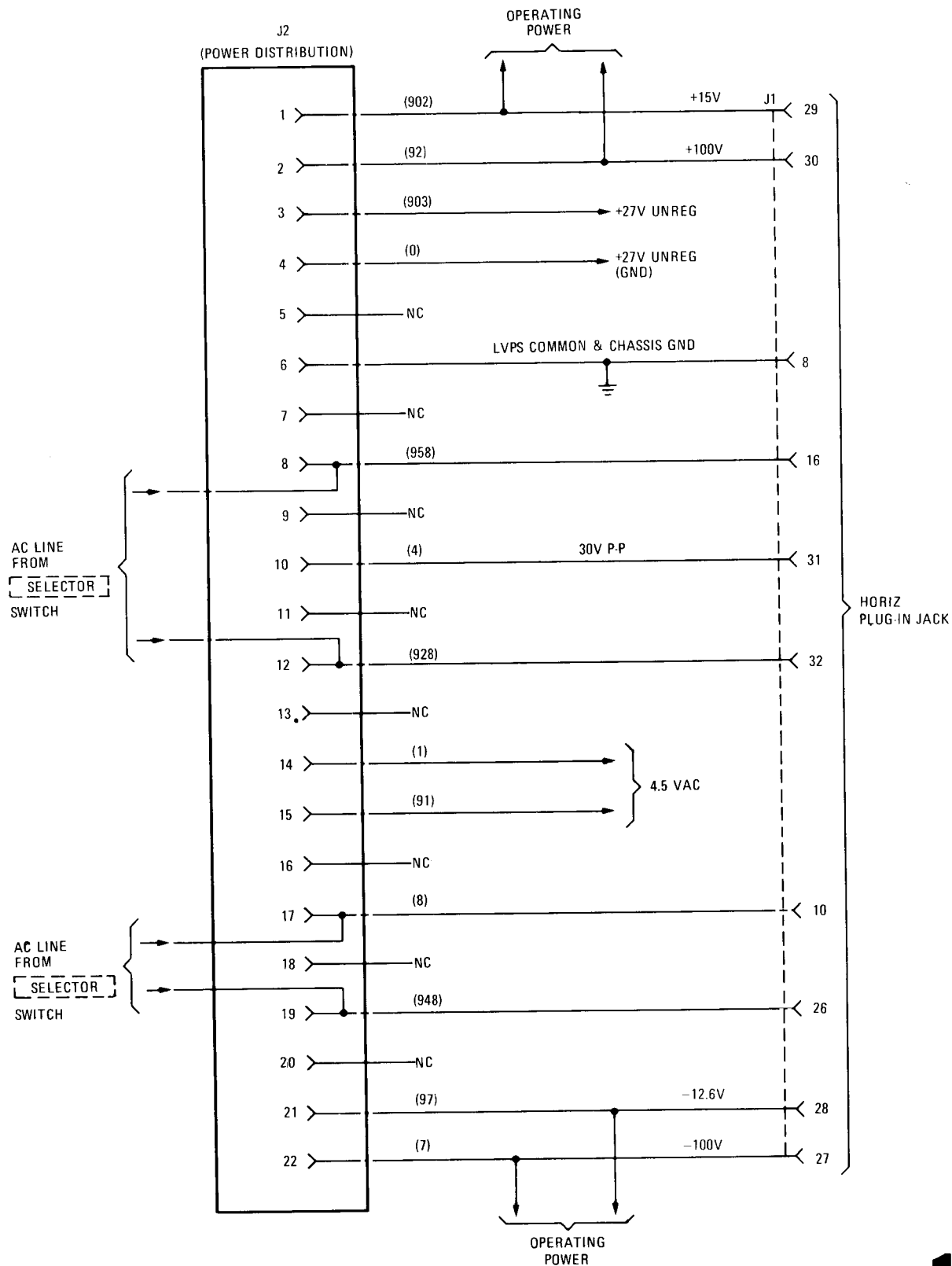
| | | | |
|---|--|---|--|
|  | ETCHED CIRCUIT BOARD |  | FIELD-EFFECT TRANSISTOR (P-TYPE BASE) |
|  | FRONT-PANEL MARKING |  | FIELD-EFFECT TRANSISTOR (N-TYPE BASE) |
|  | REAR-PANEL MARKING |  | BREAKDOWN DIODE (VOLTAGE REGULATOR) |
|  | FRONT-PANEL CONTROL |  | TUNNEL DIODE |
|  | SCREWDRIVER ADJUSTMENT |  | STEP-RECOVERY DIODE |
| TP1  | ELECTRICAL TEST POINT TP (WITH NUMBER) |  | 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. |
|  | WAVEFORM TEST POINT (WITH NUMBER) |  | 6 SIGNAL REFERENCE |
|  | SINGLE-PIN CONNECTOR ON BOARD |  | 2 SCHEMATIC REFERENCE |
|  | PIN OF A PLUG-IN BOARD (WITH LETTER OR NUMBER) | | |
|  | COAXIAL CABLE CONNECTED TO SNAP-ON JACK | (925) | WIRE COLORS ARE GIVEN BY NUMBERS IN PARENTHESES USING THE RESISTOR COLOR CODE |
|  | COAXIAL CABLE CONNECTED DIRECTLY TO BOARD | [(925) IS WHT-RED-GRN] | |
|  | MAIN SIGNAL PATH | 0 - BLACK | 5 - GREEN |
|  | PRIMARY FEEDBACK PATH | 1 - BROWN | 6 - BLUE |
|  | SECONDARY FEEDBACK PATH | 2 - RED | 7 - VIOLET |
| P/O | PART OF | 3 - ORANGE | 8 - GRAY |
| NC | NO CONNECTION | 4 - YELLOW | 9 - WHITE |
| CW | CLOCKWISE END OF VARIABLE RESISTOR | * | OPTIMUM VALUE SELECTED AT FACTORY, TYPICAL VALUE SHOWN; PART MAY HAVE BEEN OMITTED. |
| | | | UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS CAPACITANCE IN PICOFARADS INDUCTANCE IN MICROHENRIES |

Table 8-2. Miscellaneous Troubleshooting Tips

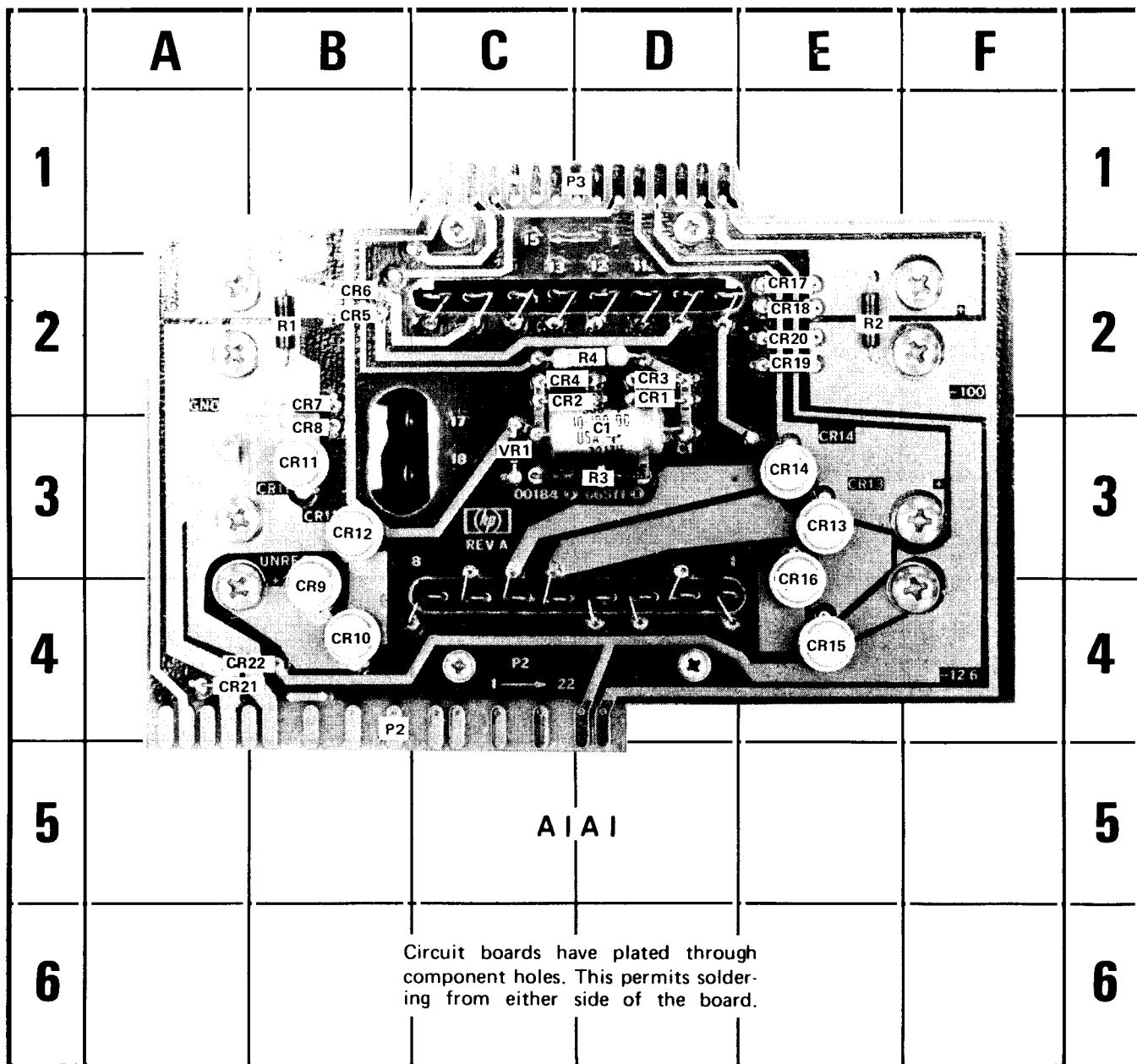
| Symptom | Suggested Checks |
|---|---|
| Intermittent deflection. | Check for loose or corroded connections to CRT neck pins. Check for intermittent open in deflection leads. |
| Intensity variation causes trace shift (either axis). | Check for open deflection lead in axis affected. If trouble is in vertical axis, check vertical plug-in connector and mating connector in oscilloscope. |
| No output from Gate or Sweep output jacks. | Check emitter-follower for output affected. Check circuit interconnections (cables, connectors). |
| Improper Z-axis modulation. | Check normal operation with plug-ins installed. If OK, check connections and check inputs. |
| CRT trace develops distortion over long period. | Instrument may have been subjected to high magnetic field, magnetizing CRT elements. Possible CRT malfunction. |
| Improper deflection. | If symptom is apparent in both vertical and horizontal axes, check high voltage. If H.V. is low, expanded display results. If H.V. is high, causes contracted display. Vertical axis only: check vertical plug-in, deflection leads and connectors. Horizontal axis only: check with replacement time base plug-in. If OK, problem is in time base plug-in. Otherwise check oscilloscope horizontal amplifier, deflection leads and connectors. |



130C/D-L-13
(Changed 09-74)

1

Figure 8-3.
Low Voltage Power Connections
8-9



| REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|--------------|-------------|--------------|-------------|
| C1 | D-3 | CR15 | E-4 |
| CR1 | D-2 | CR16 | E-4 |
| CR2 | C-2 | CR17 | E-2 |
| CR3 | D-2 | CR18 | E-2 |
| CR4 | C-2 | CR19 | E-2 |
| CR5 | B-2 | CR20 | E-2 |
| CR6 | B-2 | CR21 | A-4 |
| CR7 | B-2 | CR22 | A-4 |
| CR8 | B-3 | P2 | C-4 |
| CR9 | B-4 | P3 | C-1 |
| CR10 | B-4 | R1 | B-2 |
| CR11 | B-3 | R2 | E-2 |
| CR12 | B-3 | R3 | C-3 |
| CR13 | E-3 | R4 | D-2 |
| CR14 | E-3 | VR1 | C-3 |

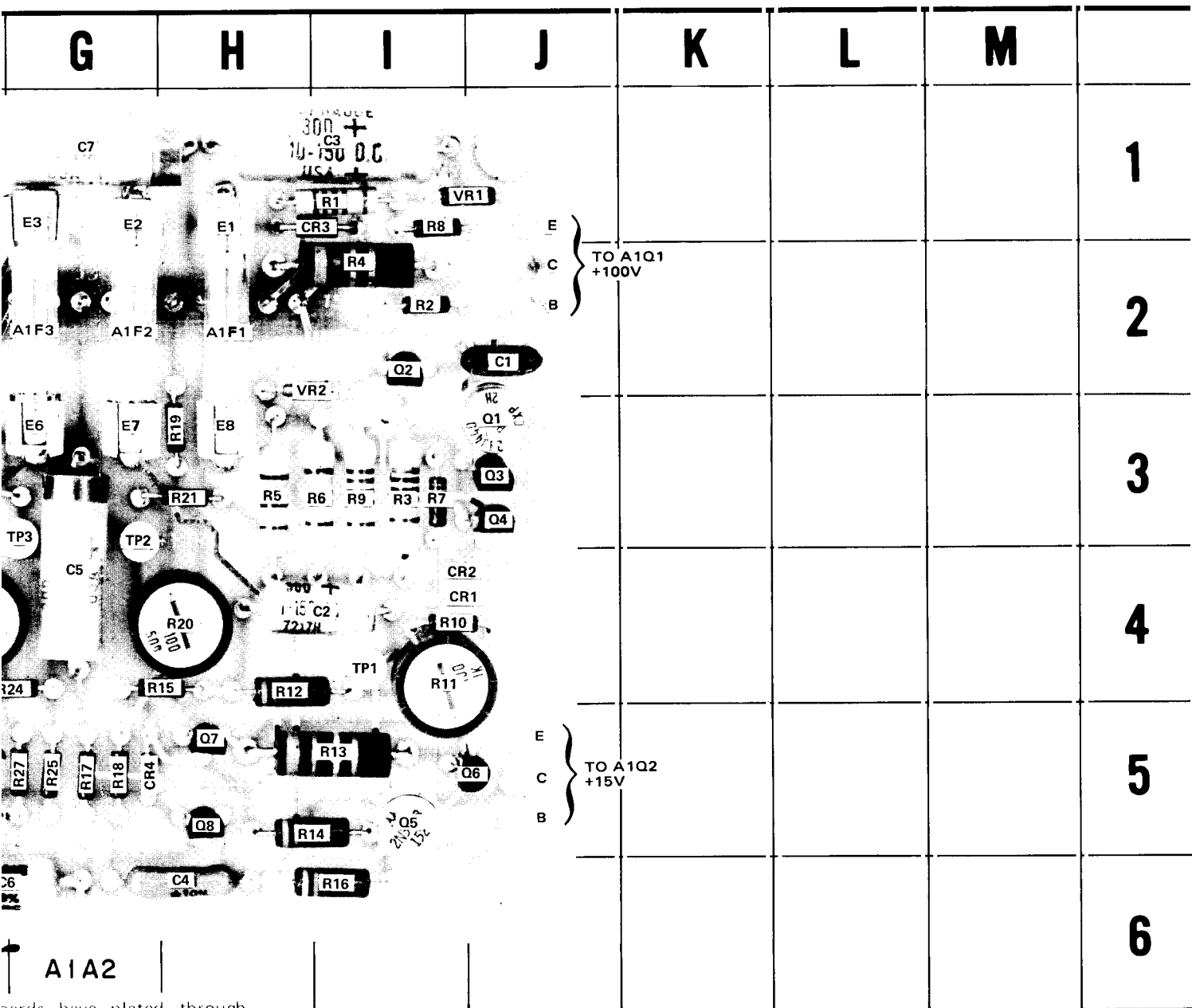
180C/D-R-13

Figure 8-4. Low Voltage Rectifier Component Identification

Table 8-3. Low Voltage Power Supply Troubleshooting Tips

| Symptom | Suggested Checks |
|---|---|
| All supplies low or high and unregulated. | Check ac input line voltage and position of rear-panel SELECTOR switch (115 or 230V) *Check +100V supply and A1A2VR2. (+100V supply is used as reference for -100V, +15V, -12.6V supplies and A1A2VR2 provides reference voltage for +100V supply). |
| One supply high and unregulated with high ripple. | Check comparator and series regulator. |
| One supply low. | Check for excessive current drain. *Check comparator. |
| No output from one supply. | Check fuse. Check regulator. (Supplies are current limited. Fuse will not open due to shorted load.) |
| Open line fuse. | Check ac line voltage and position of rear-panel SELECTOR switch. *Check rectifier diodes. Check filter capacitors. Check power transformer. |

* Most common fault.



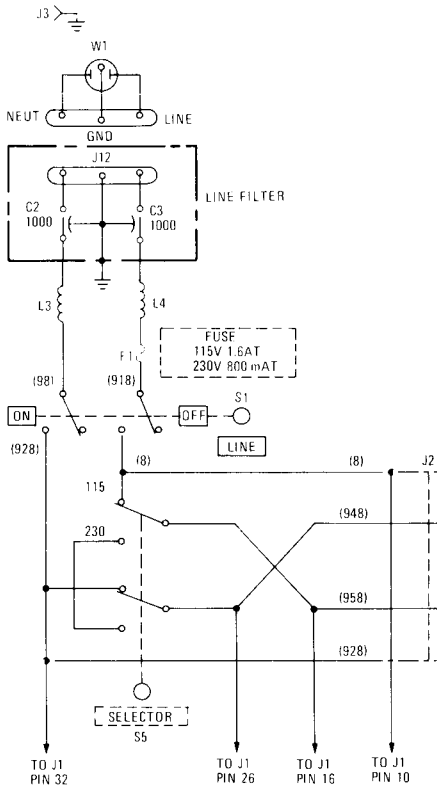
boards have plated through holes. This permits soldering on either side of the board.

| GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|----------|-----------|----------|-----------|----------|-----------|----------|-----------|----------|-----------|----------|
| 5 | Q15 | E-3 | R9 | I-3 | R19 | H-3 | R29 | F-4 | R39 | D-4 |
| 5 | Q16 | E-4 | R10 | I-4 | R20 | H-4 | R30 | F-3 | R40 | D-4 |
| 5 | R1 | I-1 | R11 | I-4 | R21 | H-3 | R31 | E-2 | R41 | E-4 |
| 5 | R2 | I-2 | R12 | H-4 | R22 | E-4 | R32 | D-3 | R42 | E-2 |
| 5 | R3 | I-3 | R13 | I-5 | R23 | E-5 | R33 | E-1 | TP1 | I-4 |
| 5 | R4 | I-2 | R14 | H-5 | R24 | F-4 | R34 | F-3 | TP2 | G-3 |
| 5 | R5 | H-3 | R15 | G-4 | R25 | G-5 | R35 | E-3 | TP3 | G-3 |
| 5 | R6 | I-3 | R16 | I-6 | R26 | E-6 | R36 | E-3 | TP4 | E-4 |
| 2 | R7 | I-3 | R17 | G-5 | R27 | G-5 | R37 | D-4 | VR1 | J-1 |
| 2 | R8 | I-2 | R18 | G-5 | R28 | F-3 | R38 | D-4 | VR2 | H-2 |

Figure 8-5.
Low Voltage Regulator Component Identification
8-11/8-12

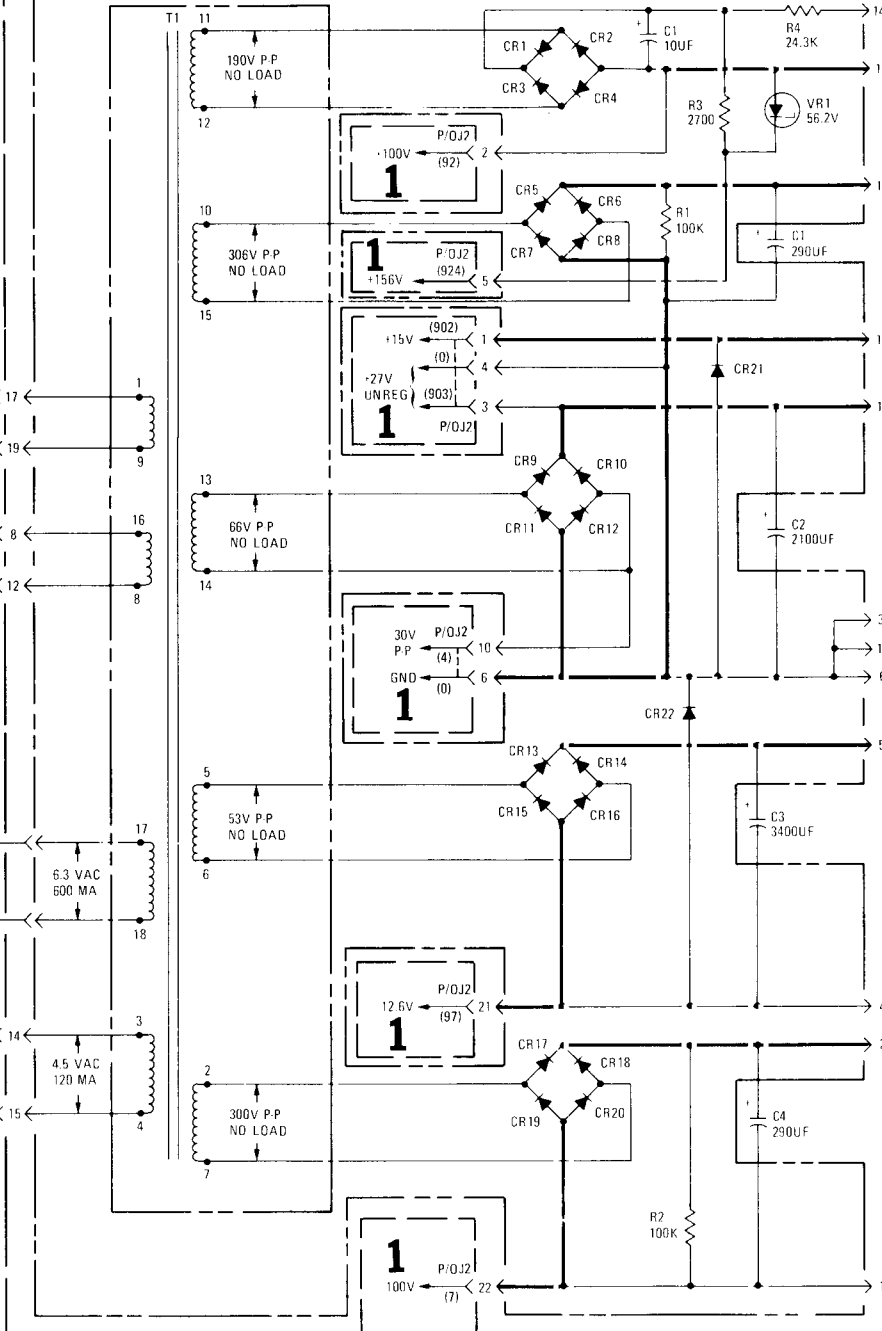
Table 8-4. Low Voltage Power Supply Voltage Measurement Conditions

1. Plug-ins not installed.
2. LINE power ON.
3. Line voltage 115V or 230V ac.
4. All dc voltages are referenced to ground. Use chassis ground or soldering lug ground located on LV Rectifier board.
5. All dc voltages measured with HP Model 414A Auto Voltmeter (100 M Ω input impedance).

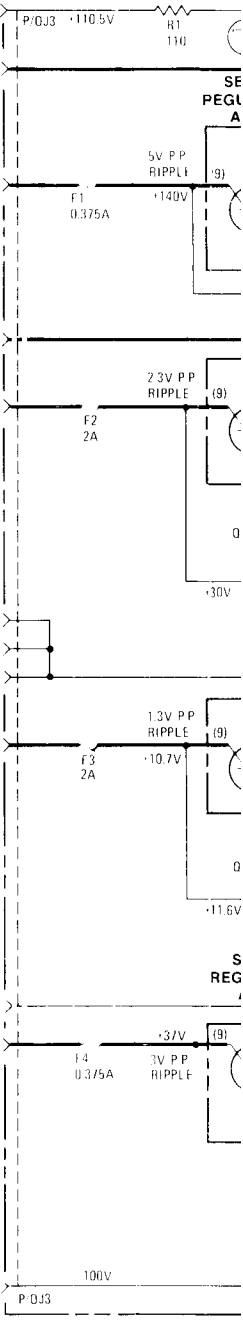


A1 LOW VOLTAGE POWER MODULE

A1 LOW VOLTAGE RECTIFIER



A2 LOW VOLTAGE REGULAT



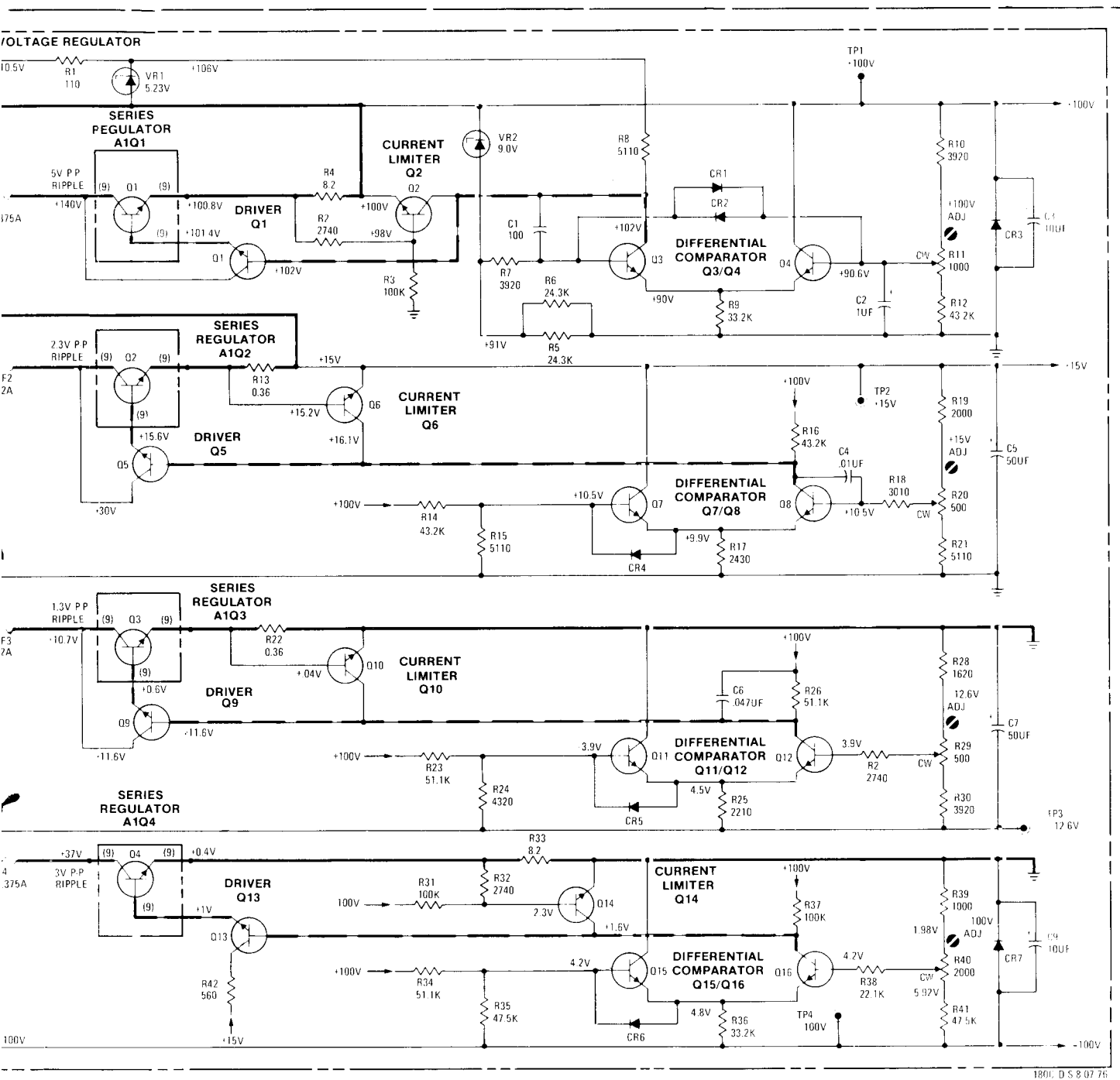
5
TO CRT FILAMENT

5
TO FLOOD GUN FILAMENT

REFERENCE DESIGNATIONS

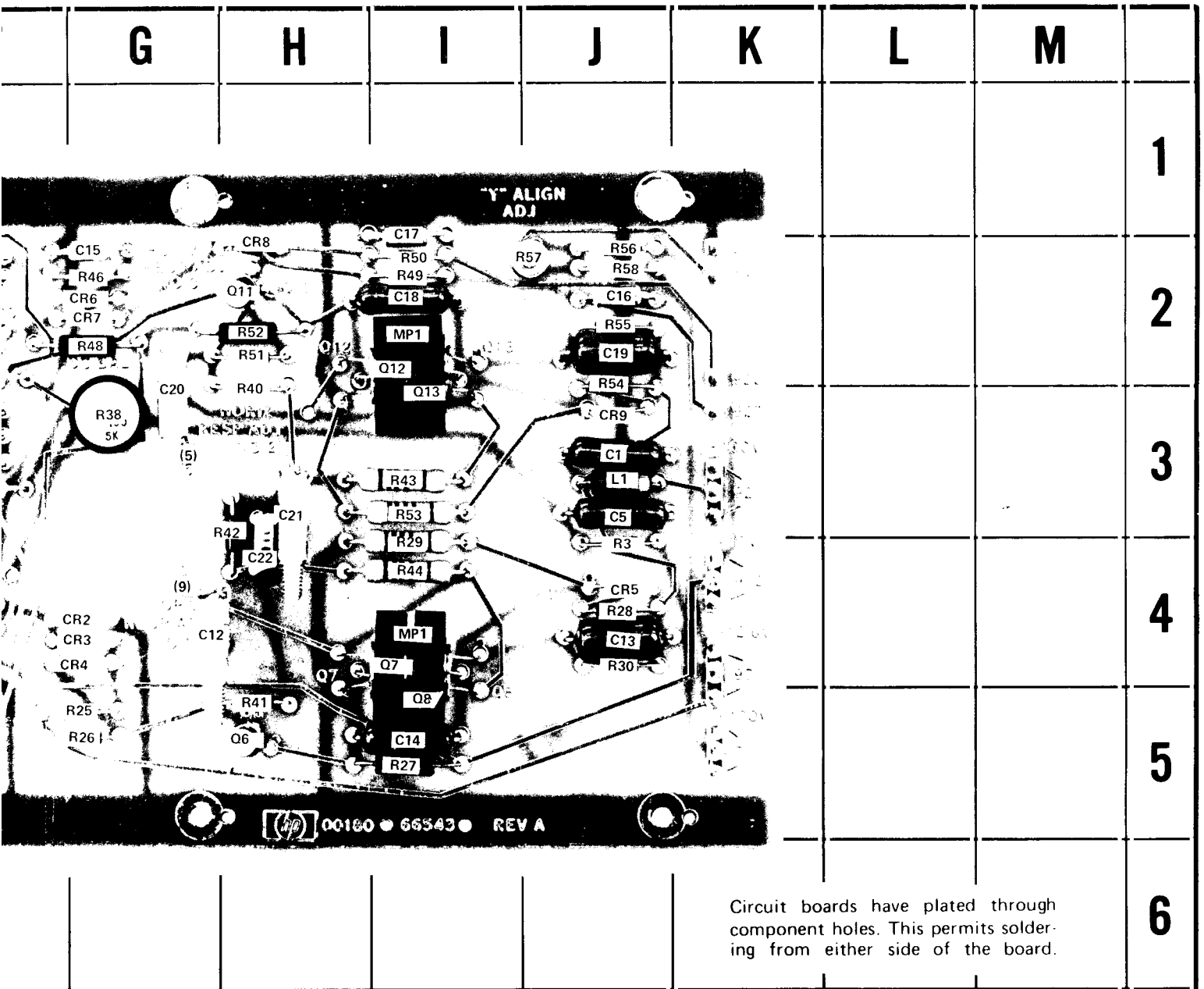
| A1 | A1A1 | A1A2 | CHASSIS |
|------|--------|----------|----------|
| C1 4 | C1 | C1 29 | C2 3 |
| O1 4 | CR1 22 | CR1 7 | DS1 |
| T1 | R1 5 | F1 4, J3 | F1 |
| | VR1 | O1 16 | J2 12 13 |
| | | R1 42 | L3 4 |
| | | TP1 4 | S1 5 |
| | | VR1 2 | W1 |

DELETED A1A2C8



2

Figure 8-6.
Low Voltage Power Supply Schematic
8-13

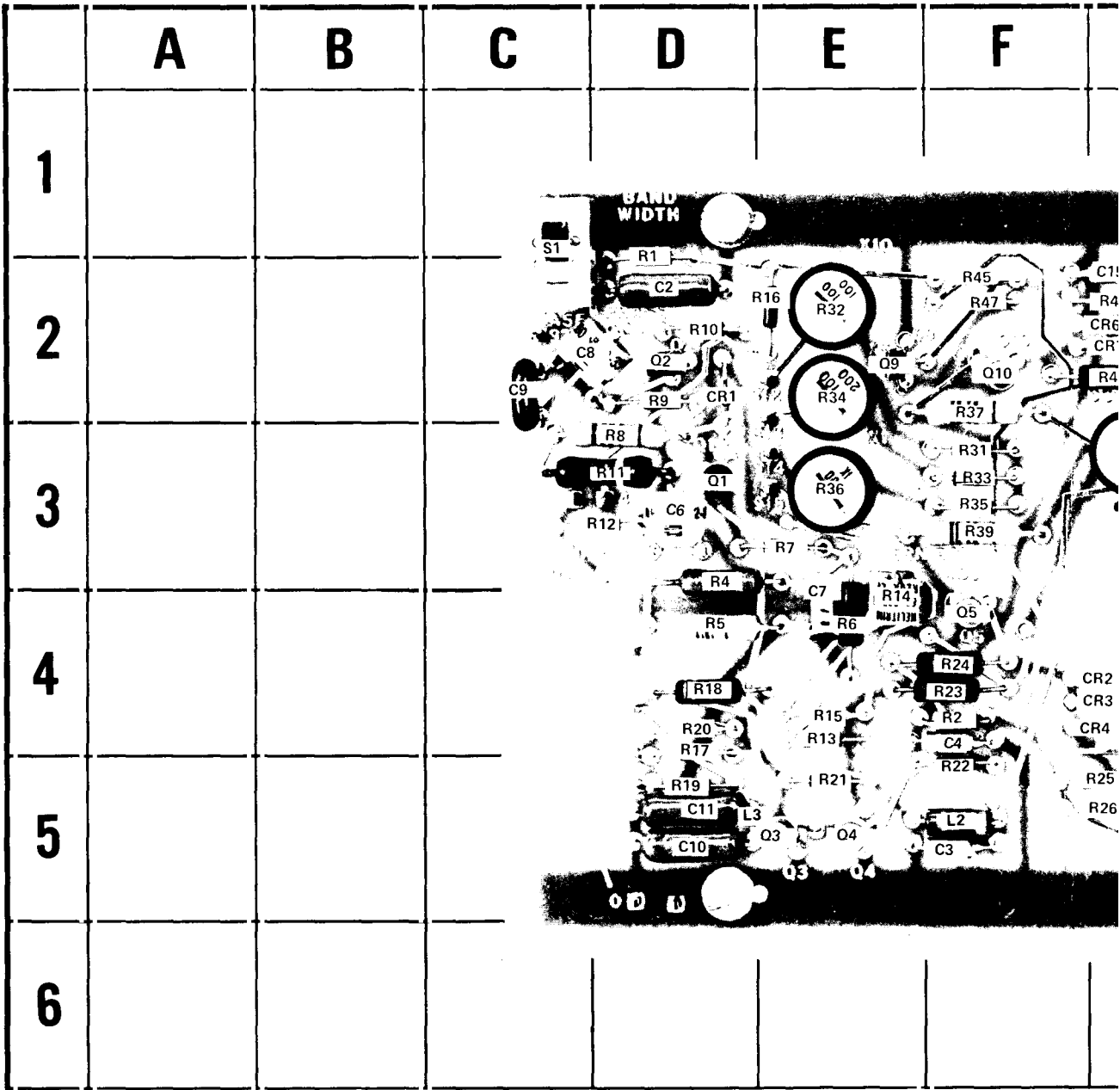


Circuit boards have plated through component holes. This permits soldering from either side of the board.

A 2

| GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG |
|----------|-----------|----------|-----------|----------|-----------|----------|-----------|----------|-----------|----------|-----------|
| G-2 | Q8 | I-5 | R8 | D-3 | R21 | E-5 | R34 | E-2 | R47 | F-2 | |
| H-2 | Q9 | E-2 | R9 | D-2 | R22 | F-5 | R35 | F-3 | R48 | G-2 | |
| J-3 | Q10 | F-2 | R10 | D-2 | R23 | F-4 | R36 | E-3 | R49 | I-2 | |
| J-3 | Q11 | H-2 | R11 | D-3 | R24 | F-4 | R37 | F-2 | R50 | I-2 | |
| F-5 | Q12 | I-2 | R12 | D-3 | R25 | G-5 | R38 | G-3 | R51 | H-2 | |
| D-5 | Q13 | I-3 | R13 | E-4 | R26 | G-5 | R39 | F-3 | R52 | H-2 | |
| I-2 | R1 | D-1 | R14 | E-4 | R27 | I-5 | R40 | H-3 | R53 | I-3 | |
| D-3 | R2 | F-4 | R15 | E-4 | R28 | J-4 | R41 | H-5 | R54 | J-2 | |
| D-2 | R3 | J-4 | R16 | E-2 | R29 | I-4 | R42 | H-3 | R55 | J-2 | |
| E-5 | R4 | D-3 | R17 | D-4 | R30 | J-4 | R43 | I-3 | R56 | J-2 | |
| E-5 | R5 | D-4 | R18 | D-4 | R31 | F-3 | R44 | I-4 | R57 | J-2 | |
| F-4 | R6 | E-4 | R19 | D-5 | R32 | E-2 | R45 | F-2 | R58 | J-2 | |
| H-5 | R7 | E-3 | R20 | D-4 | R33 | F-3 | R46 | G-2 | S1 | C-1 | |

Figure 8-7. Horizontal Amplifier Component Identification

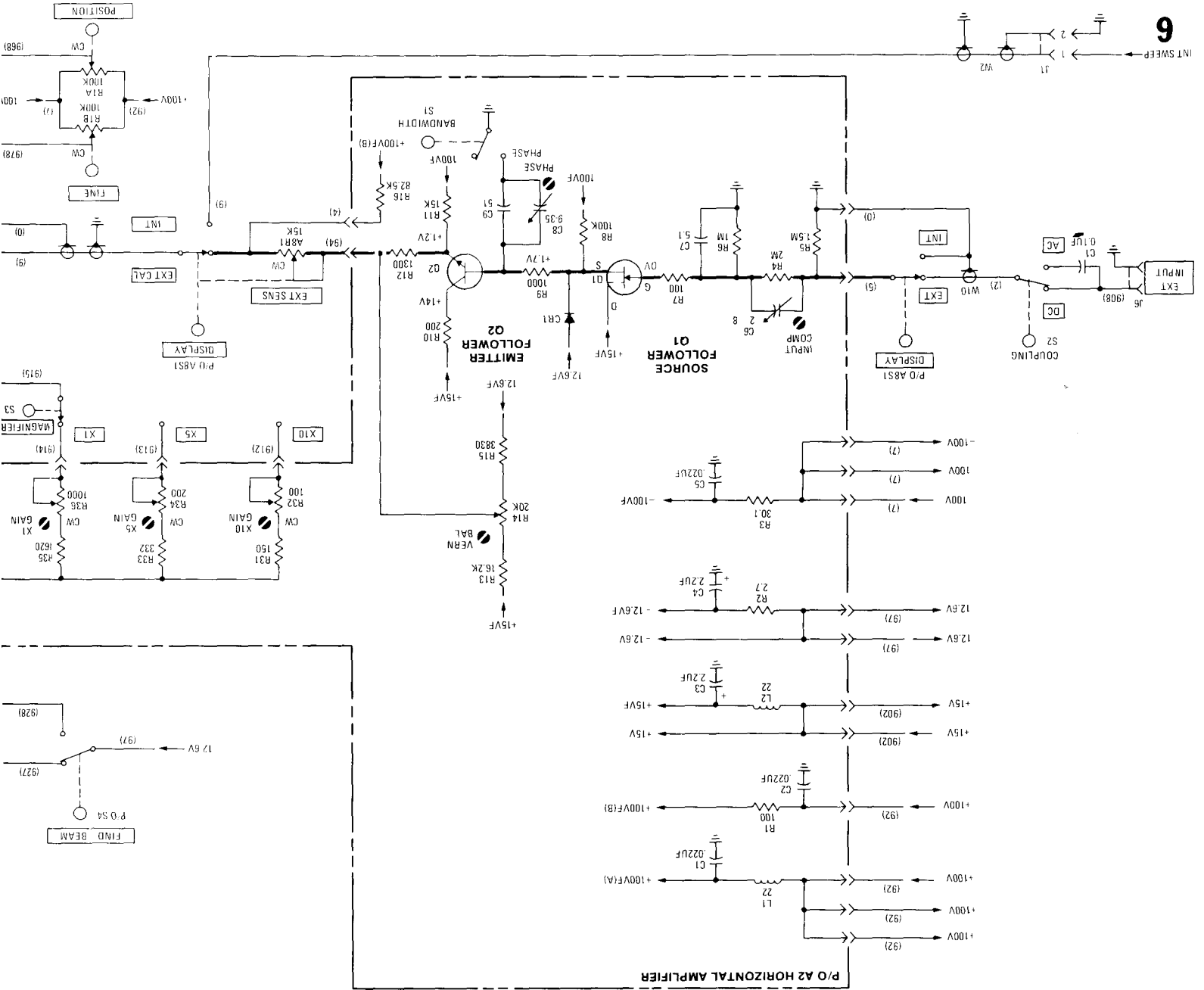


| REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG |
|--------------|-------------|--------------|-------------|--------------|-------------|--------------|
| C1 | J-3 | C15 | G-2 | CR7 | G-2 | Q8 |
| C2 | D-2 | C16 | J-2 | CR8 | H-2 | Q9 |
| C3 | F-5 | C17 | I-1 | CR9 | J-3 | Q10 |
| C4 | F-4 | C18 | I-2 | L1 | J-3 | Q11 |
| C5 | J-3 | C19 | J-2 | L2 | F-5 | Q12 |
| C6 | D-3 | C20 | G-3 | L3 | D-5 | Q13 |
| C7 | E-4 | C21 | H-3 | MP1 | I-2 | R1 |
| C8 | D-2 | C22 | H-4 | Q1 | D-3 | R2 |
| C9 | C-2 | CR1 | D-2 | Q2 | D-2 | R3 |
| C10 | D-5 | CR2 | G-4 | Q3 | E-5 | R4 |
| C11 | D-5 | CR3 | G-4 | Q4 | E-5 | R5 |
| C12 | G-4 | CR4 | G-4 | Q5 | F-4 | R6 |
| C13 | J-4 | CR5 | J-4 | Q6 | H-5 | R7 |
| C14 | I-5 | CR6 | G-2 | Q7 | I-4 | |

Table 8-5. Horizontal Amplifier Voltage Measurement Conditions

1. Plug-ins not installed.
2. LINE power ON.
3. No signal input.
4. Set controls as follows:

INTENSITY fully ccw
SCALE OFF
FOCUS fully ccw
POSITION centered
DISPLAY EXT CAL
MAGNIFIER X1
5. All voltages referenced to ground.
6. All voltages measured with HP Model 414A Auto Voltmeter (100 M Ω input impedance).



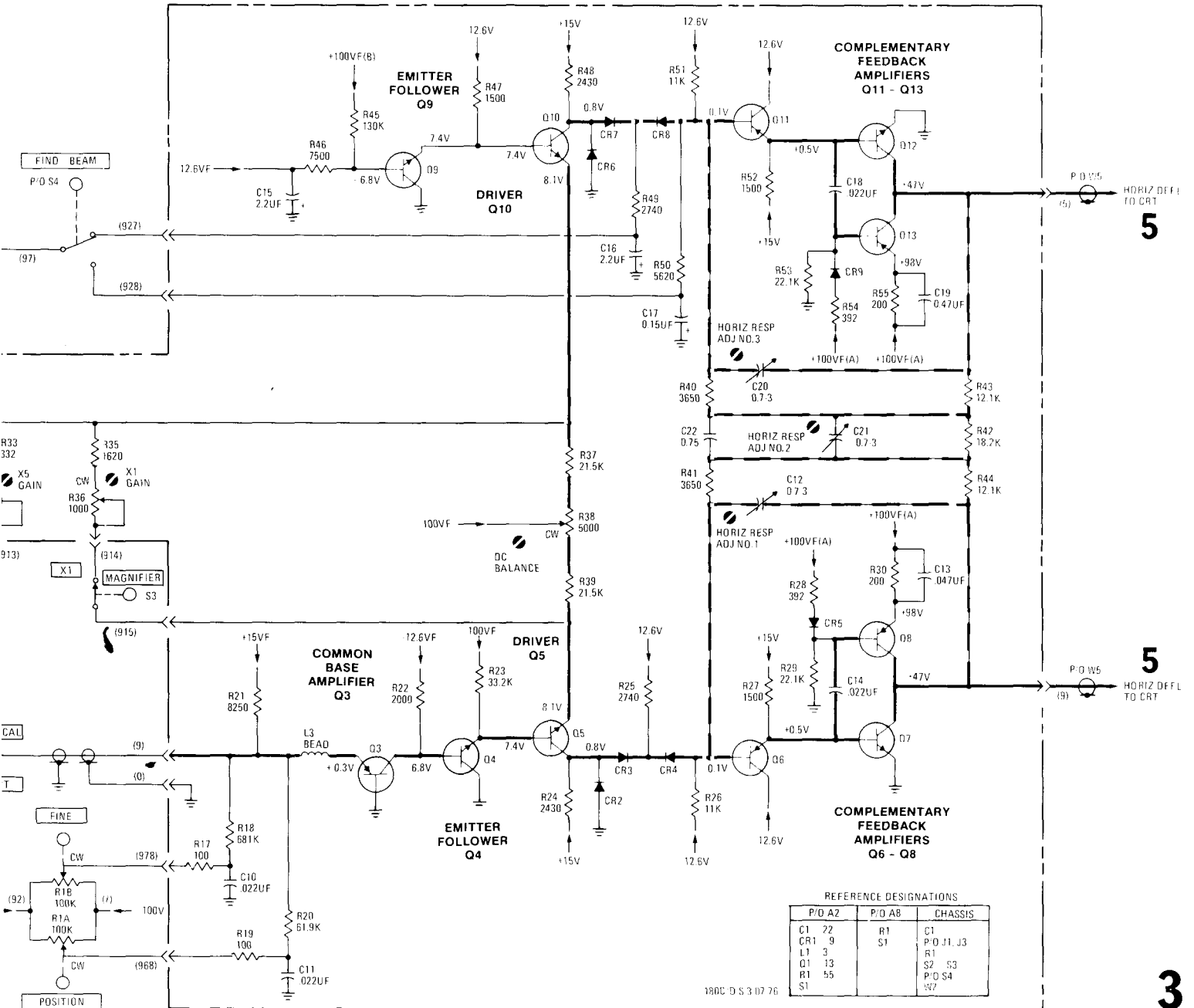
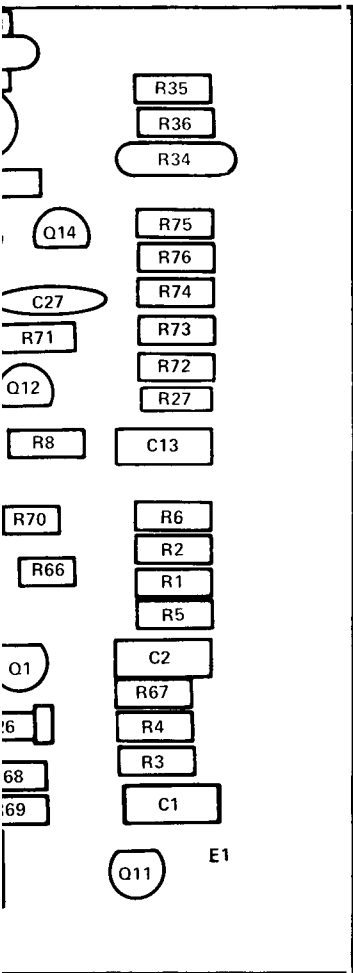


Figure 8-8.
Horizontal Amplifier Schematic
8-15



| REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|-----------|----------|-----------|----------|-----------|----------|-----------|----------|
| C1 | I-5 | CR7 | F-3 | R13 | F-2 | R50 | D-2 |
| C2 | I-4 | CR8 | E-2 | R14 | F-4 | R51 | B-4 |
| C3 | F-2 | CR9 | D-2 | R15 | G-4 | R52 | B-1 |
| C4 | G-3 | CR11 | H-1 | R16 | F-4 | R53 | E-3 |
| C5 | F-2 | CR12 | F-2 | R17 | E-2 | R54 | E-4 |
| C6 | G-3 | CR13 | G-2 | R18 | D-2 | R55 | E-3 |
| C7 | G-4 | E1 | I-5 | R24 | F-5 | R56 | E-3 |
| C8 | F-4 | L1 | F-5 | R25 | G-5 | R57 | B-2 |
| C10 | G-5 | L2 | E-2 | R26 | F-2 | R58 | A-2 |
| C11 | F-5 | MP1 | G-3 | R27 | I-3 | R59 | A-4 |
| C12 | F-1 | Q1 | H-4 | R28 | H-2 | R60 | E-2 |
| C13 | I-3 | Q2 | G-3 | R29 | G-1 | R61 | E-2 |
| C14 | H-1 | Q3 | G-3 | R30 | H-1 | R62 | E-4 |
| C15 | G-1 | Q4 | G-3 | R31 | F-1 | R63 | E-4 |
| C16 | E-1 | Q6 | G-2 | R32 | F-1 | R64 | E-4 |
| C17 | E-5 | Q7 | H-1 | R33 | G-1 | R65 | E-4 |
| C18 | D-3 | Q8 | D-4 | R34 | I-2 | R66 | H-4 |
| C19 | C-2 | Q9 | D-4 | R35 | I-1 | R67 | I-4 |
| C20 | C-2 | Q10 | E-4 | R36 | I-2 | R68 | H-5 |
| C21 | C-2 | Q11 | I-5 | R37 | E-5 | R69 | H-5 |
| C22 | C-2 | Q12 | H-3 | R38 | D-3 | R70 | H-4 |
| C23 | C-3 | Q13 | H-2 | R39 | D-3 | R71 | H-3 |
| C24 | C-3 | Q14 | H-2 | R40 | D-5 | R72 | I-3 |
| C25 | C-3 | R1 | I-4 | R41 | D-4 | R73 | I-3 |
| C26 | H-5 | R2 | I-4 | R42 | D-4 | R74 | I-2 |
| C27 | H-2 | R3 | I-5 | R43 | D-5 | R75 | I-2 |
| C28 | H-2 | R4 | I-5 | R44 | D-4 | R76 | I-2 |
| CR1 | H-4 | R5 | I-4 | R45 | D-4 | TP1 | B-3 |
| CR2 | G-5 | R6 | I-4 | R46 | D-4 | VR1 | D-3 |
| CR3 | G-5 | R7 | G-4 | R47 | D-4 | VR2 | D-4 |
| CR4 | G-5 | R8 | H-3 | R48 | C-5 | V1 | B-2 |
| CR5 | G-4 | R9 | G-4 | R49 | C-5 | V2 | B-2 |
| CR6 | F-3 | R11 | G-3 | | | | |

180C/D-L-002-07-76

A3

Figure 8-9. Gate Amplifier Component Identification

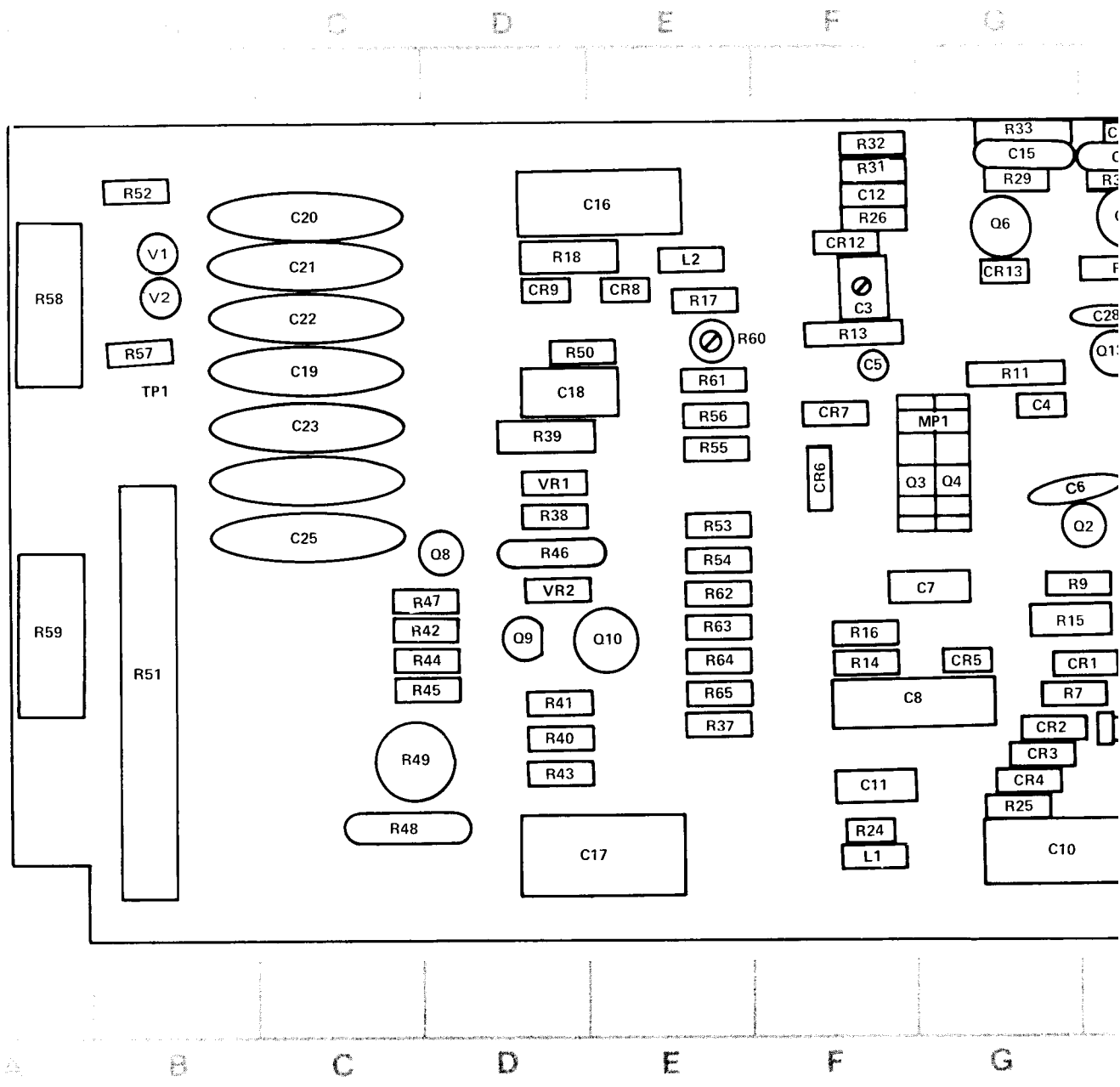
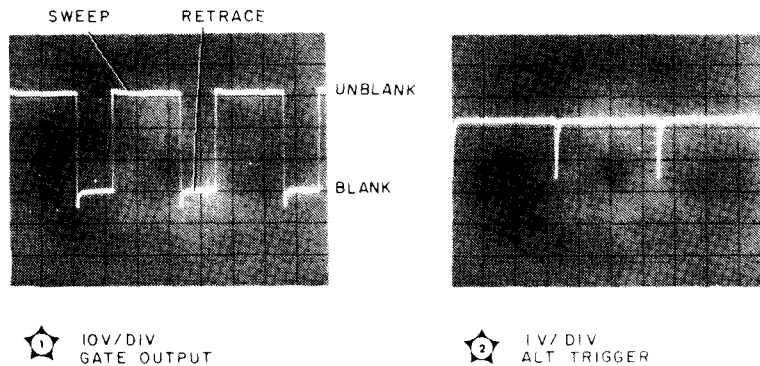


Table 8-6. Gate Amplifier and H.V. Regulator Voltage Measurement Conditions

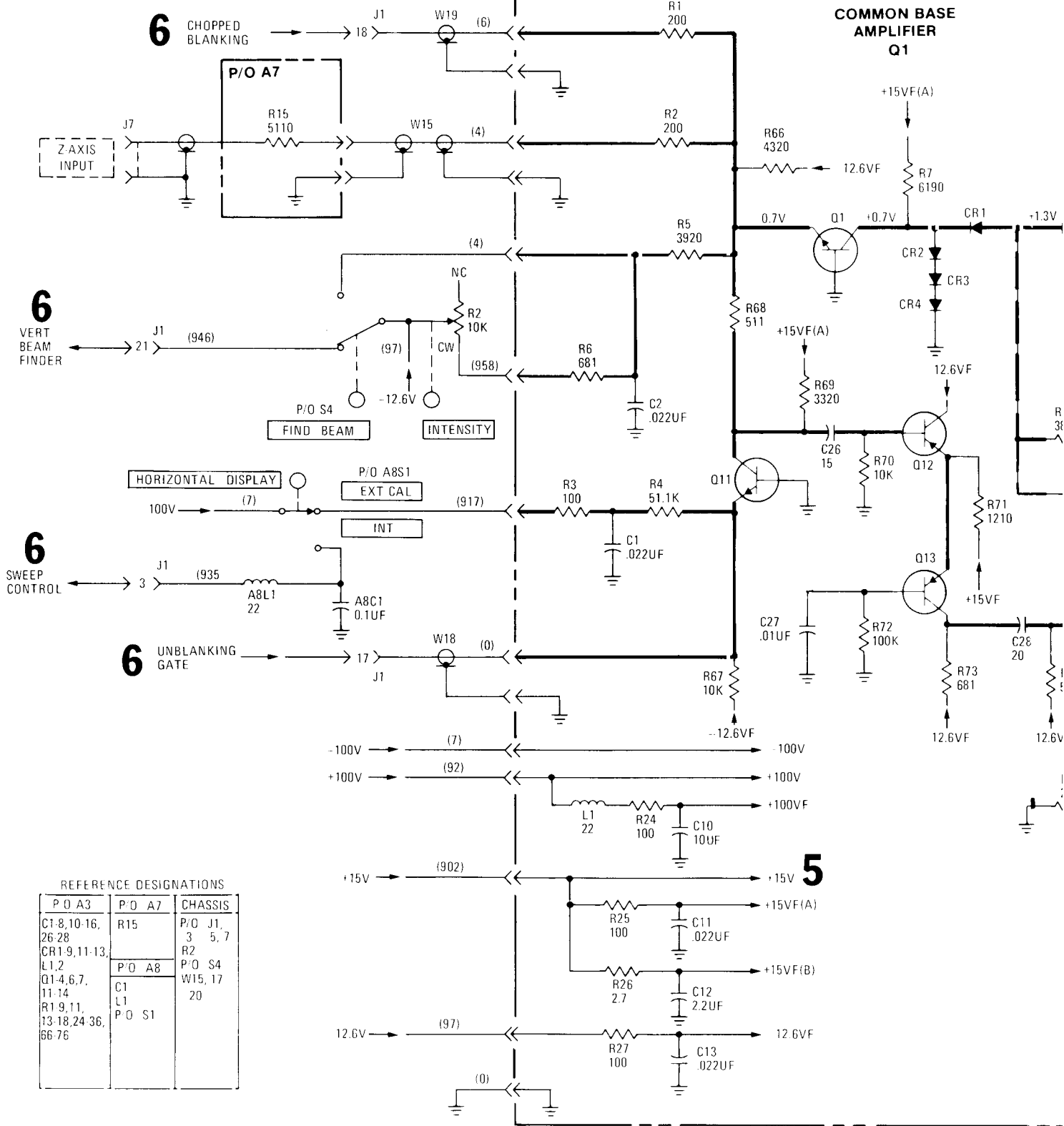
1. Plug-ins not installed.
2. LINE power ON.
3. No signal input.
4. Set controls as follows:
 - INTENSITY fully ccw
 - SCALE OFF
 - FOCUS fully ccw
 - POSITION centered
 - DISPLAY EXT CAL
 - MAGNIFIER X1
5. All voltages referenced to ground.
6. All voltages measured with HP Model 414A Auto Voltmeter (100 MΩ input impedance).



180C/D-A-11

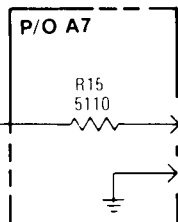
Figure 8-10. Gate Amplifier Waveforms

P/O A3 GATE AMPLIFIER, CALIBRATOR AND REGULATOR ASSY



6

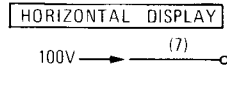
CHOPPED BLANKING



COMMON BASE AMPLIFIER Q1

6

VERT BEAM FINDER



6

SWEEP CONTROL

6

UNBLANKING GATE

REFERENCE DESIGNATIONS

| P/O A3 | P/O A7 | CHASSIS |
|-----------------------------|--------|-----------------|
| C1-8,10-16, 26-28 | R15 | P/O J1, 3, 5, 7 |
| CR1-9,11-13, L1,2 | P/O A8 | P/O S4 |
| Q1-4,6,7, 11-14 | C1 | W15, 17 |
| R1-9,11, 13-18,24-36, 66-76 | L1 | P/O S1 |
| | P/O S1 | |

5

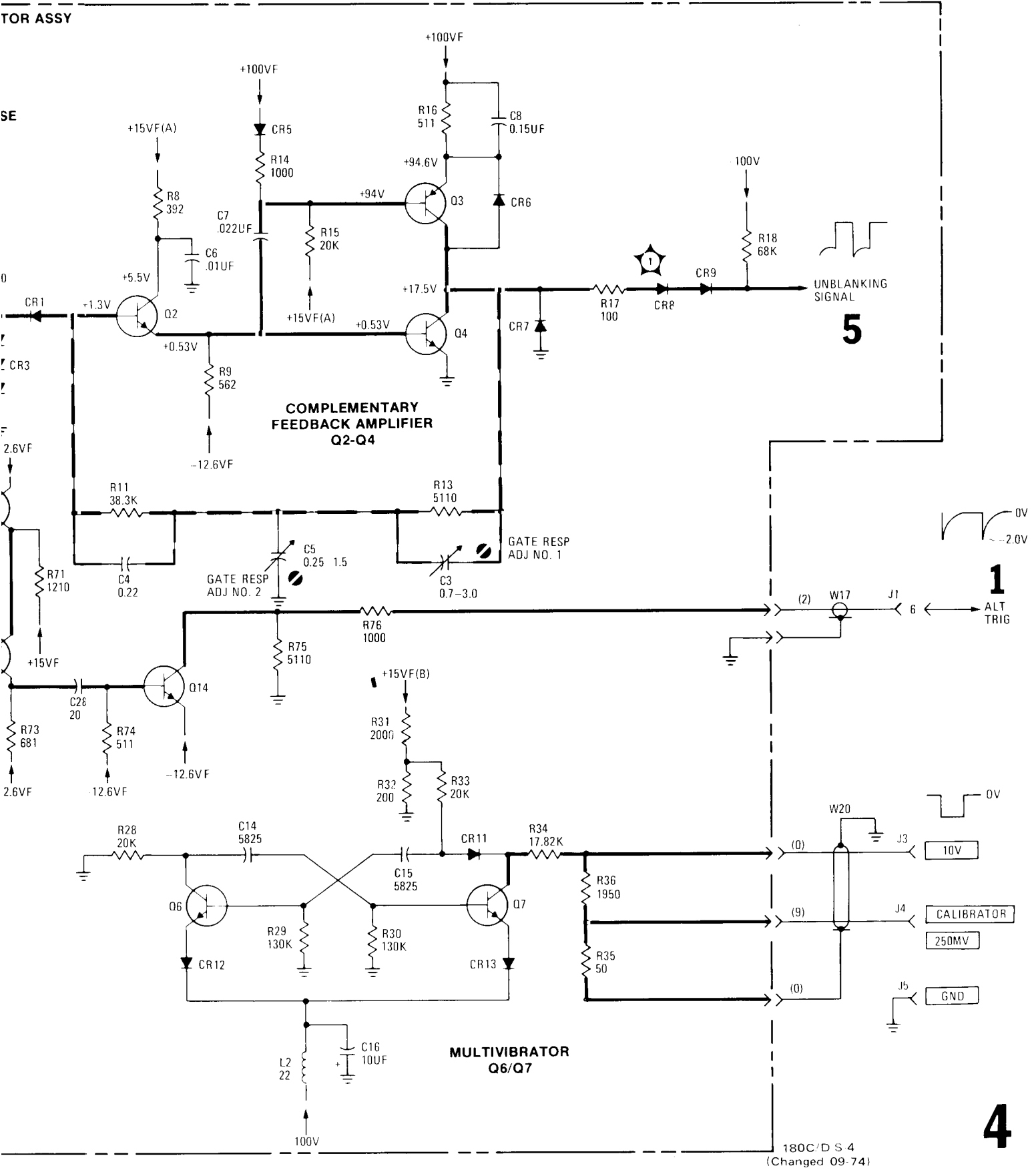
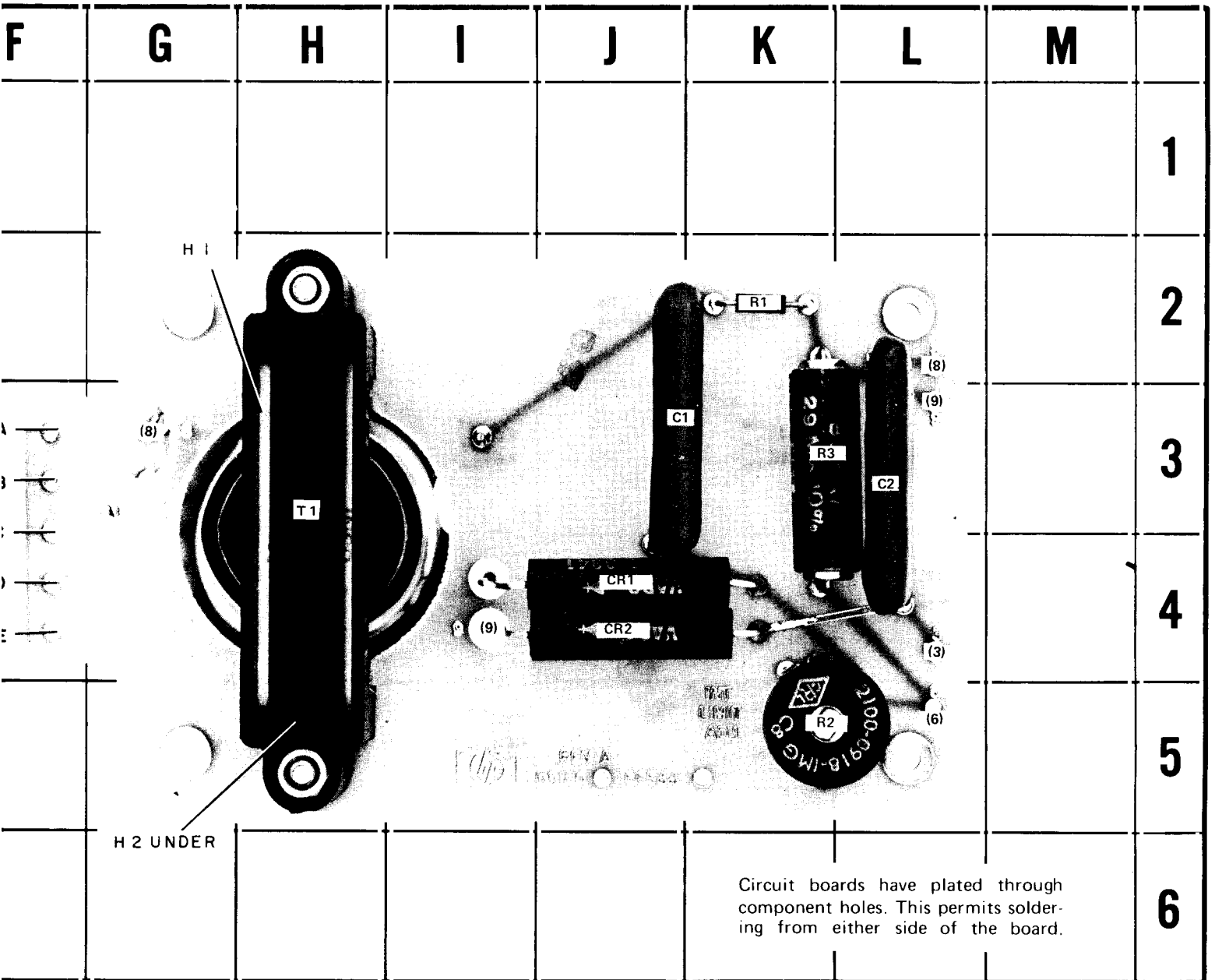


Figure 8-11.
Gate Amplifier and Calibrator Schematic
8-17



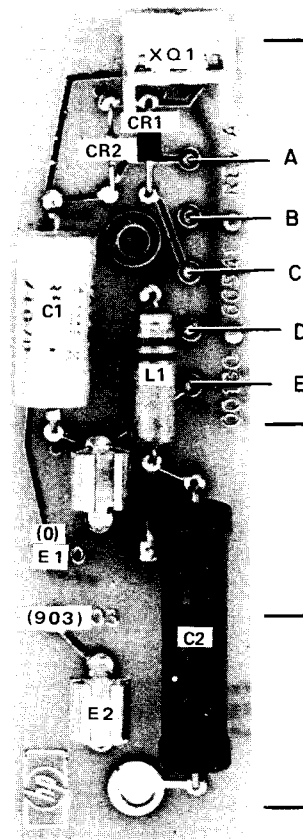
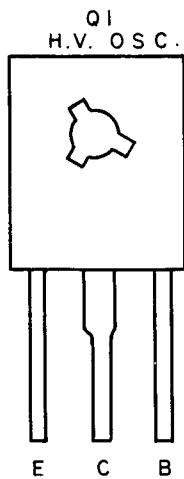
A 5

| REF DESIG | GRID LOC |
|--------------|-------------|
|--------------|-------------|

| | |
|-----|-----|
| C1 | J-3 |
| C2 | L-3 |
| CR1 | J-4 |
| CR2 | J-4 |
| R1 | K-2 |
| R2 | L-5 |
| R3 | K-3 |
| T1 | H-3 |

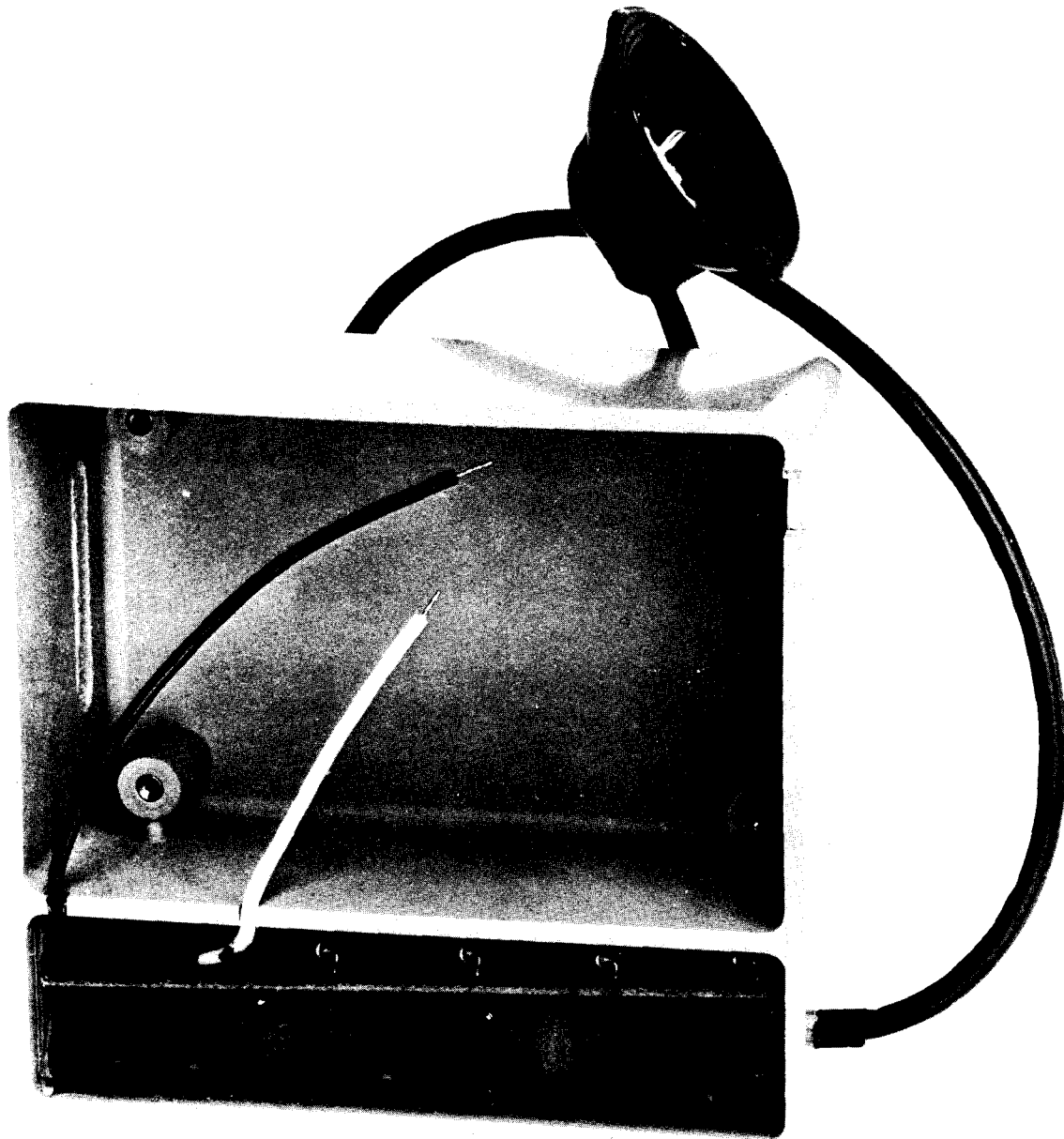
Figure 8-13. H.V. Oscillator and Rectifier Component Identification

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |
| 6 | | | | | | |



A 4

| REF DESIG | GRID LOC |
|--------------|-------------|
| C1 | C-3 |
| C2 | D-5 |
| CR1 | D-2 |
| CR2 | C-2 |
| E1 | C-4 |
| E2 | C-5 |
| L1 | D-3 |
| XQ1 | D-2 |



A 6

180C/D-5

Figure 8-12. H.V. Multiplier

Table 8-7. High Voltage Power Supply Troubleshooting Tips

| Symptom | Suggested Checks |
|---|--|
| No high voltage. | *Check oscillator power supply fuse. Check oscillator components: transistor, H.V. transformer, diodes, etc. |
| Voltage too high. | Check H.V. Adjust. Check regulator components and feedback loop. *Increased resistance in regulator feedback loop. |
| Voltage too low. | Check H.V. Adjust. Check regulator components and feedback loop. *Decreased resistance in regulator feedback loop or CRT loading supply. |
| <p style="text-align: center;">NOTE</p> <p style="text-align: center;">Refer to CRT Intensity Troubleshooting Tips for additional checks.</p> | |

* Most common fault.

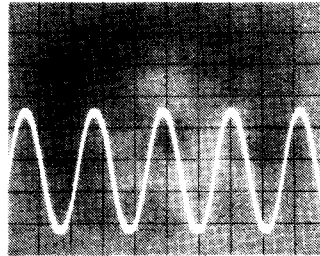
Table 8-8. CRT Intensity Troubleshooting Tips

| Symptom | Suggested Checks |
|--|---|
| Low intensity. | Check intensity limit adj. Check low voltage supplies. Check high voltage supply. Check gate amplifier. *Check CRT. (See Notes for additional tips.) |
| High intensity. | Make checks listed for low intensity. *Check H.V. power supply diodes. Check CRT for grid-cathode leakage. Check CRT for open grid circuit. (See Notes for additional tips.) |
| Flickering intensity. | Check high voltage supply for arcing. Check high voltage leads for arcing. Check CRT for loose connections to pins. Check CRT for possible intermittent internal connection. Check high voltage regulator for intermittent components or connections. Check high voltage supply for intermittent components or connections. Check oscillator connections. (See Notes for additional tips.) |
| NOTE 1 | |
| <p>When troubleshooting the high voltage power supply or CRT, it is helpful to isolate the CRT. Do this by disconnecting CRT base socket and post accelerator high voltage connection. With CRT disconnected, the high voltage circuit is not loaded by the CRT if it is at fault, and the CRT is protected if the high voltage supply is faulty.</p> | |
| NOTE 2 | |
| <p>The CRT may be checked to determine if grid-cathode voltage is correct. Use a high-impedance voltmeter (VTVM) which has isolated input terminals to measure grid-cathode voltage. (Voltmeter input terminals must be isolated from ground, i.e.: floating, since grid and cathode are at high voltage in relation to ground.) With INTENSITY control set for maximum intensity (fully cw), grid should be more negative than cathode by about 20V. With control set for minimum intensity (fully ccw) grid should be more negative than cathode by about 75V.</p> | |
| NOTE 3 | |
| <p>In checking for cause of excessive high voltage, remember that increased resistance in the feedback regulator loop will result in increasing the H.V. oscillator output. High voltage output from the supply will therefore be increased. Conversely, low output from the high voltage supply will result if the feedback loop resistance is lower than normal. Low voltage can also be the result of increased loading.</p> | |

*Most common fault

Table 8-9. H.V. Power Supply Voltage Measurement Conditions

1. Plug-ins not installed.
2. LINE power ON.
3. No signal input.
4. Set controls as follows:
INTENSITY fully ccw
SCALE OFF
FOCUS fully ccw
5. All dc voltages referenced to ground.
6. Low voltages measured with HP Model 414A Auto Voltmeter (100 M Ω input impedance).
7. To measure high voltages, use HP Model K05-3440A 1000:1 Divider Probe and HP Model 3440A Digital Voltmeter with HP Model 3441A or 3444A plug-in.

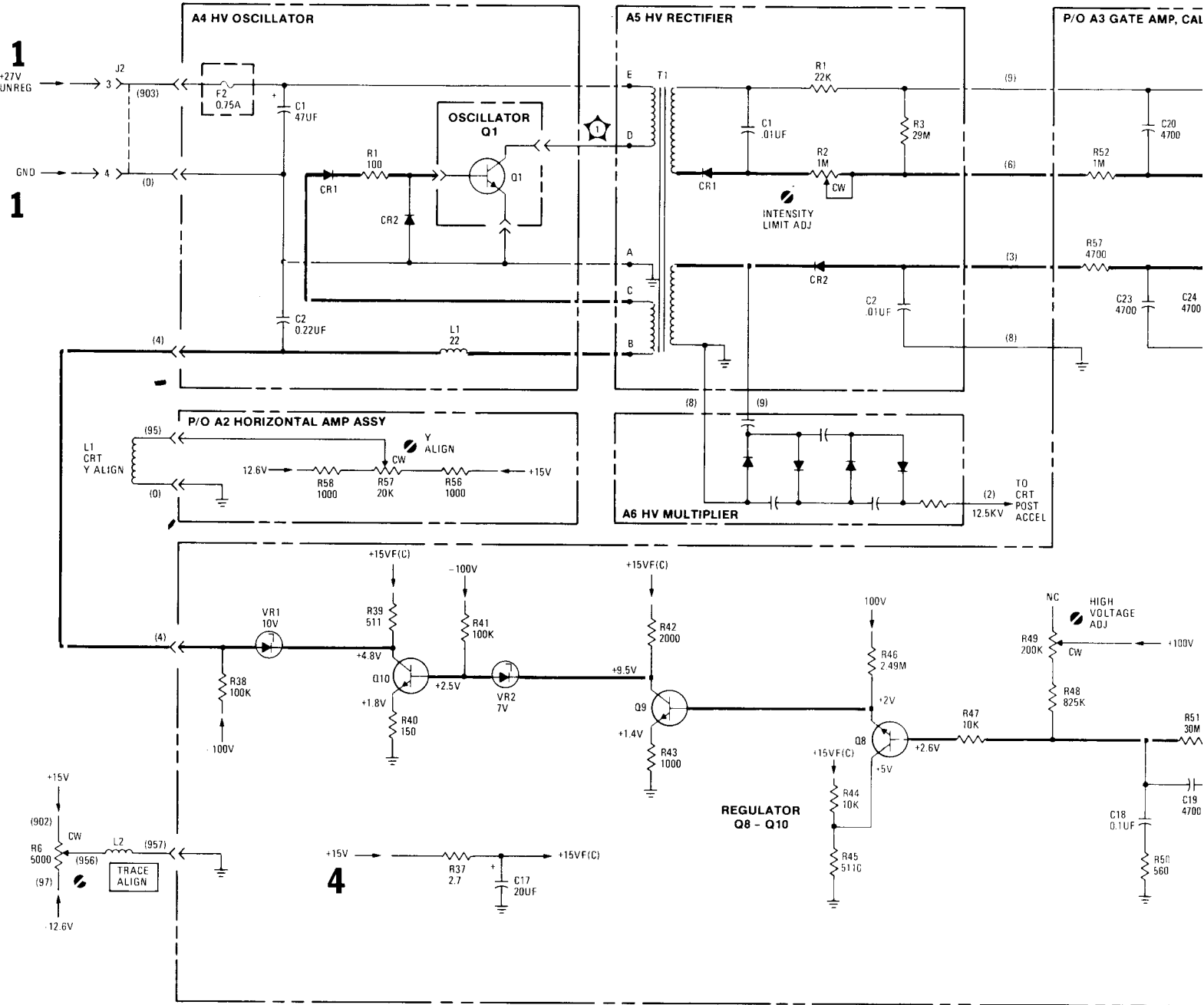


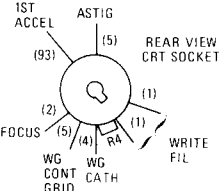
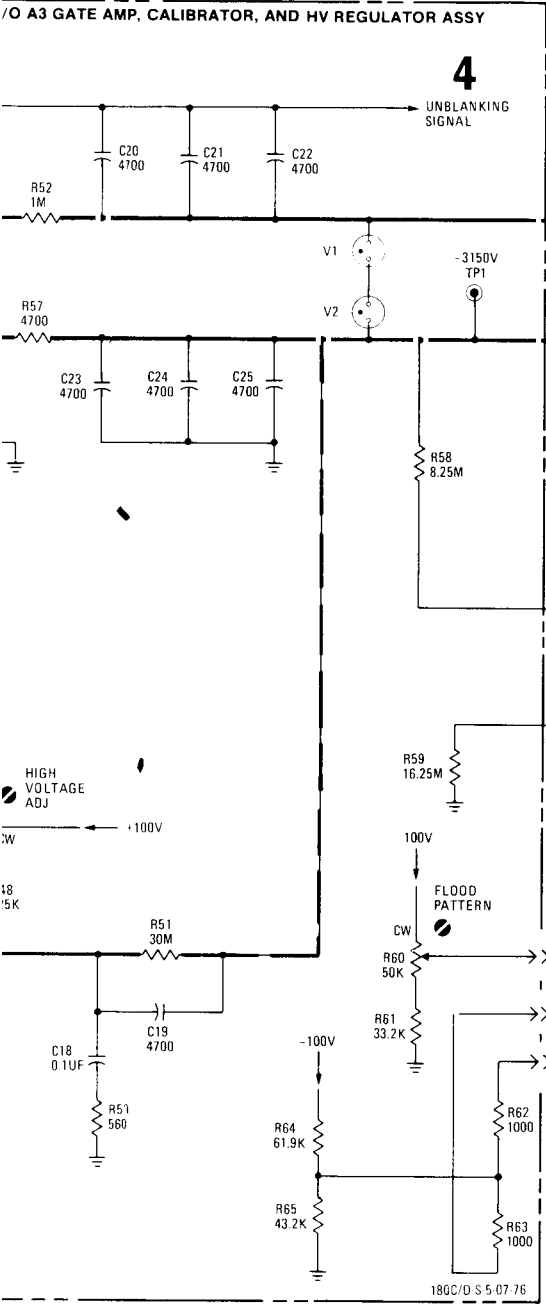
10V/DIV
COLLECTOR, HV OSC

180C/D- A-12

Figure 8-14. H.V. Oscillator Waveform

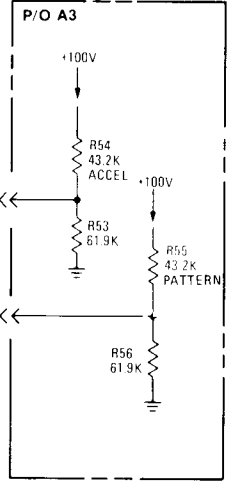
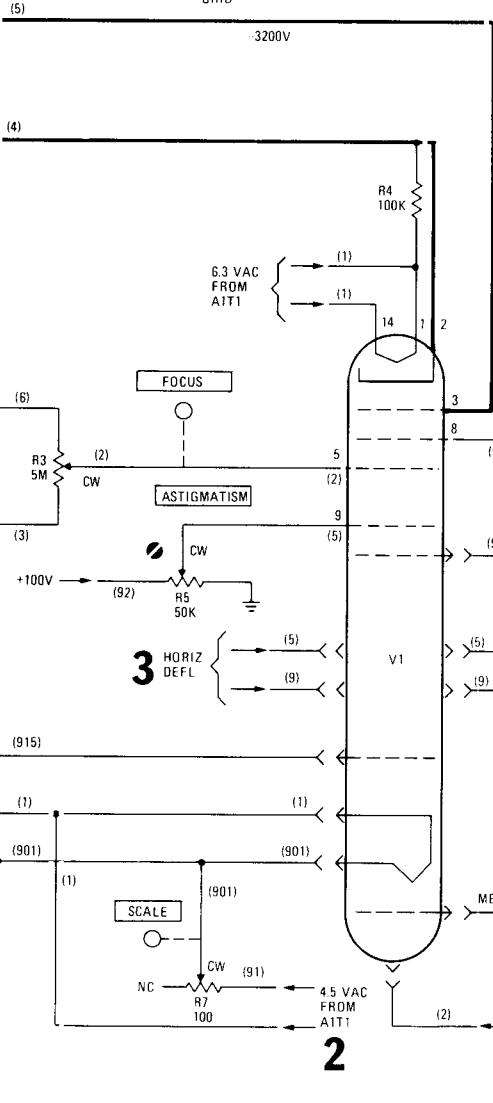
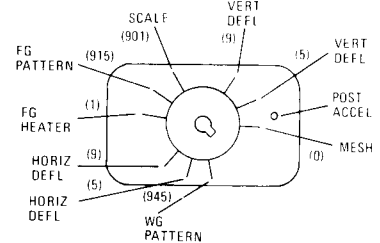
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NOTE: REVERSE HORIZ DEFL LEADS (9) AND (5) FOR MODEL 1800

REAR VIEW CRT NECK PIN CONNECTIONS



REFERENCE DESIGNATIONS

| P/O A3 | P/O A2 | A5 |
|--------|--------|-------------|
| C17 25 | R56 58 | C1 2 |
| Q8 10 | A4 | CR1 2 |
| R37 65 | | R1 3 |
| TP1 | | T1 |
| VR1,2 | | |
| V1,2 | | |
| | C1 2 | |
| | CR1, 2 | |
| | F1 | |
| | L1 | |
| | R1 | |
| | | CHASSIS |
| | | P (1), 2, 7 |
| | | L1, 2 |
| | | R3 7 |
| | | V1 |
| | | W3 |

5

Figure 8-15. High Voltage Power Supply Schematic 8-21

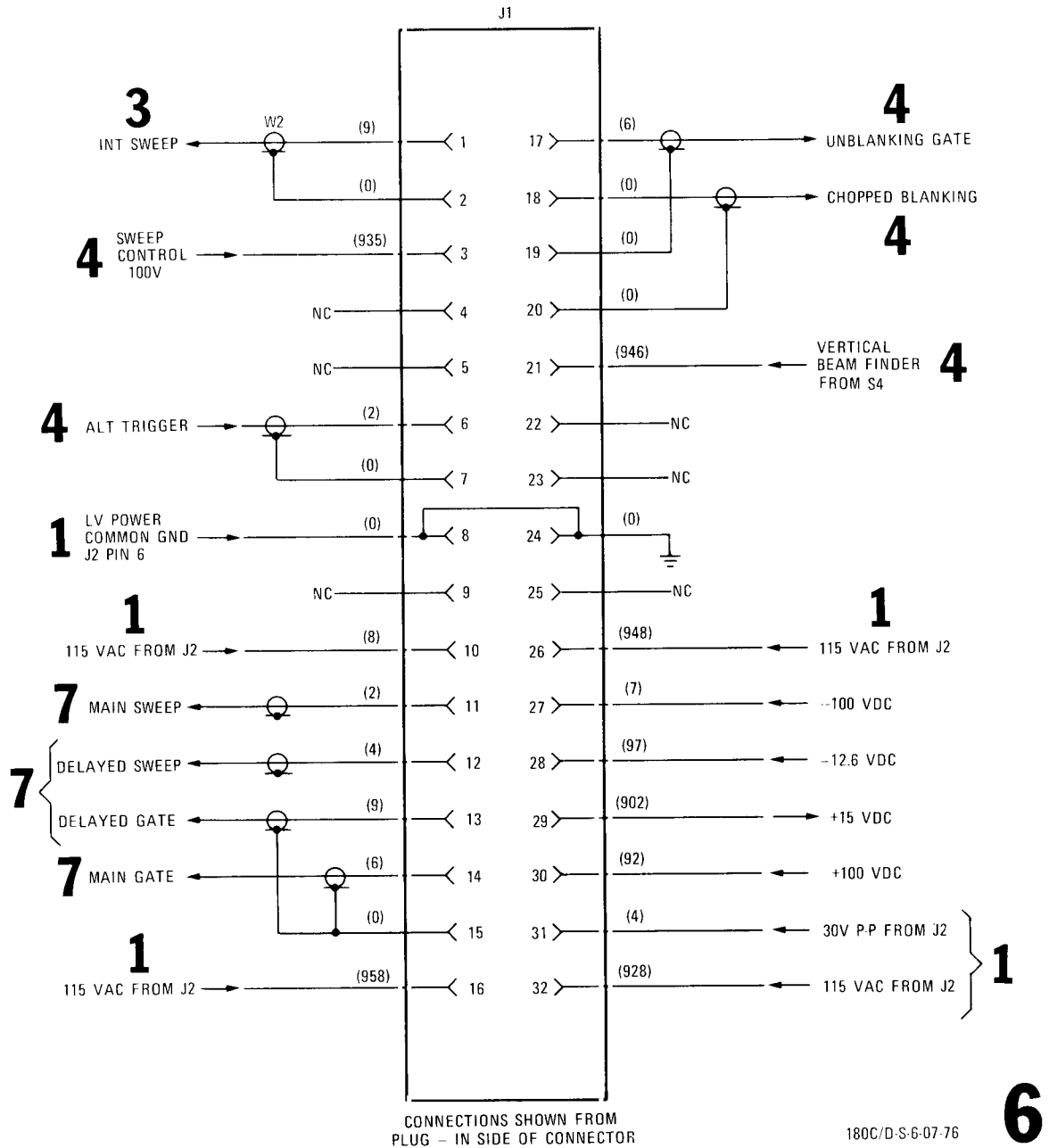


Figure 8-16. Time Base Plug-in Connections

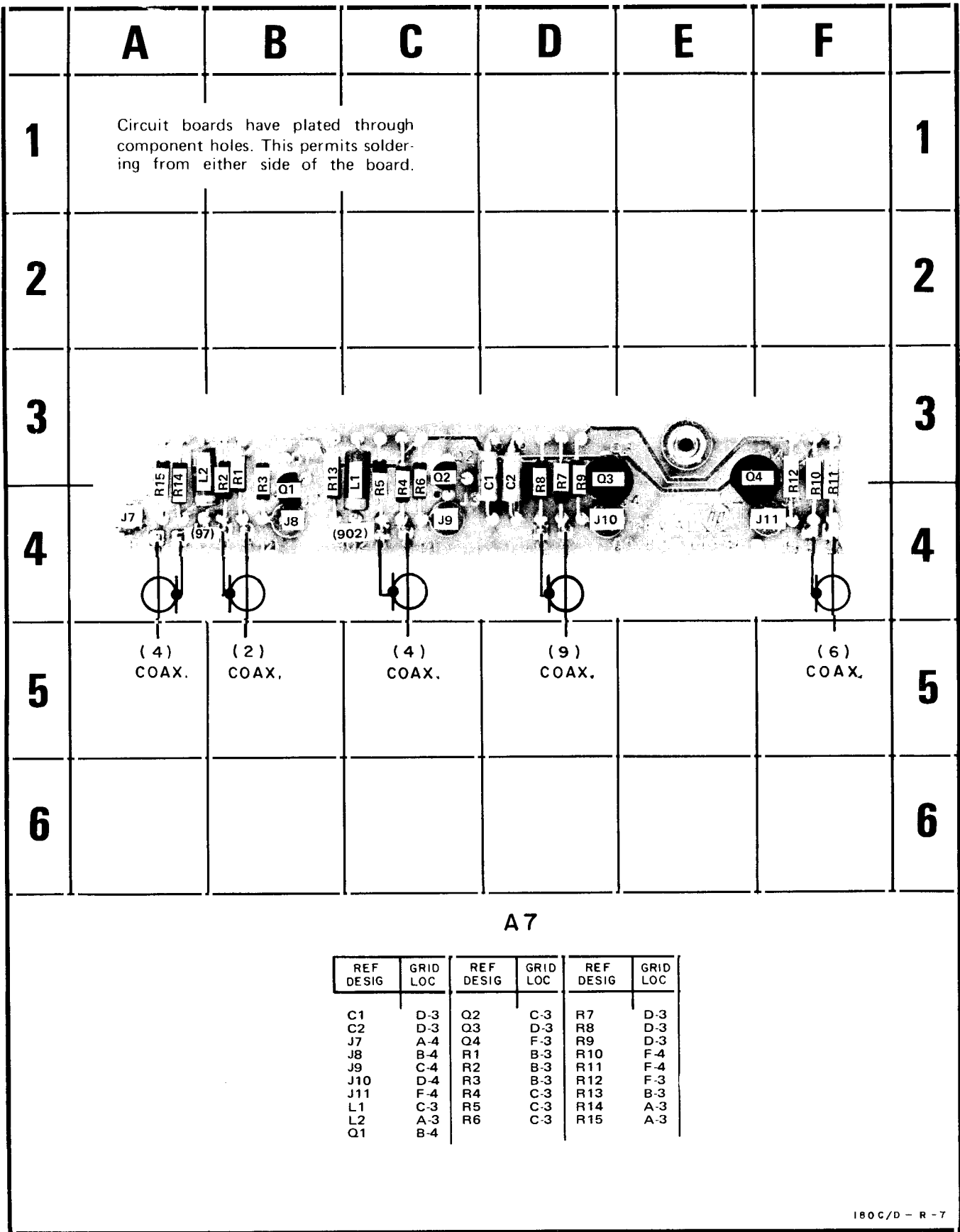
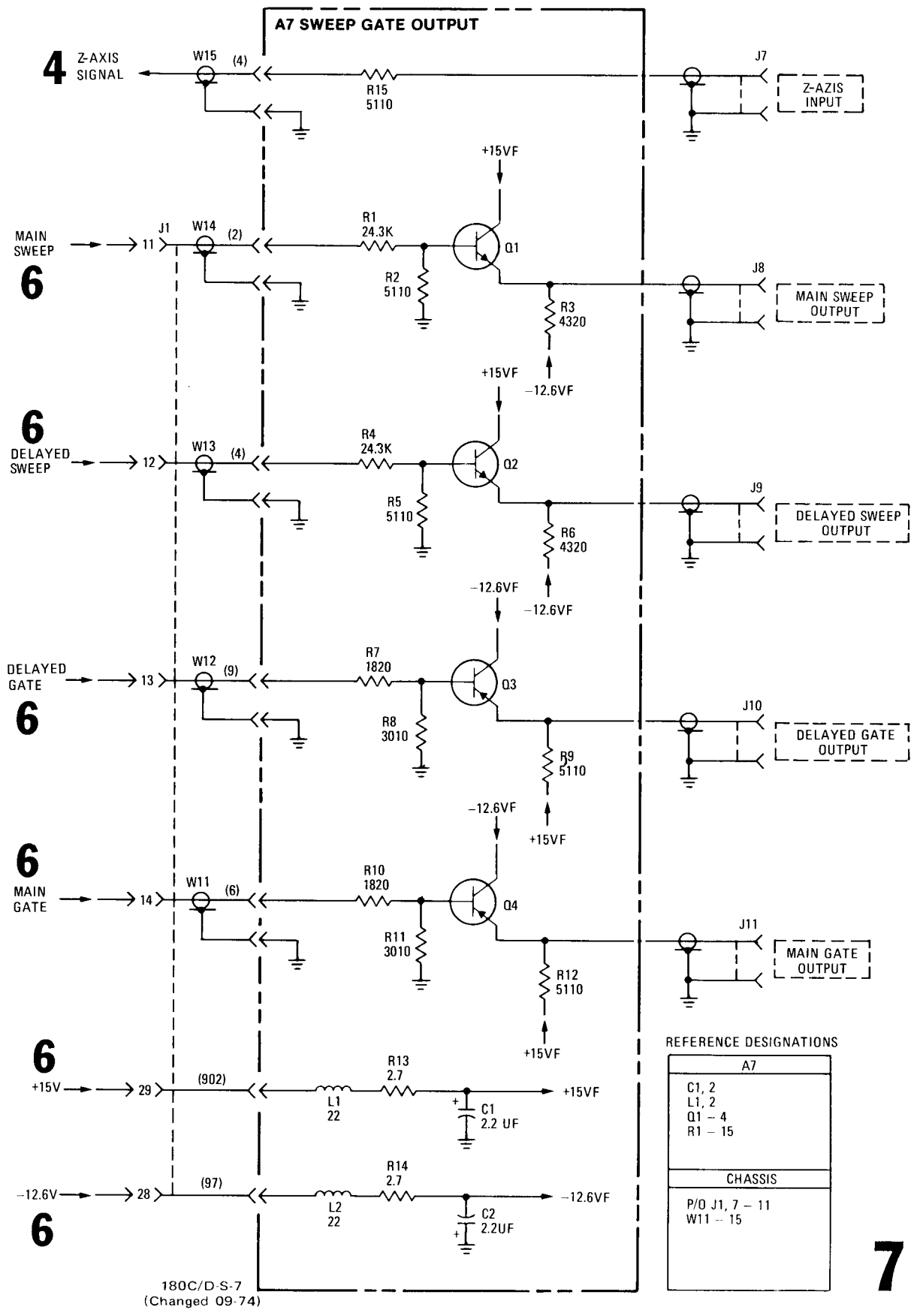


Figure 8-17. Sweep-Gate Component Identification



7

Figure 8-18.
Sweep-Gate Output Schematic
8-23/8-24