Errata

Title & Document Type: **184A/B Oscilloscope Operating and Service Manual**

Manual Part Number: **00184-90904**

Revision Date: **February 1977**

About this Manual

We've added this manual to the Agilent website in an effort to help you support your product. This manual provides the best information we could find. It may be incomplete or contain dated information, and the scan quality may not be ideal. If we find a better copy in the future, we will add it to the Agilent website.

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, life sciences, and chemical analysis businesses are now part of Agilent Technologies. The HP XXXX referred to in this document is now the Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A. We have made no changes to this manual copy.

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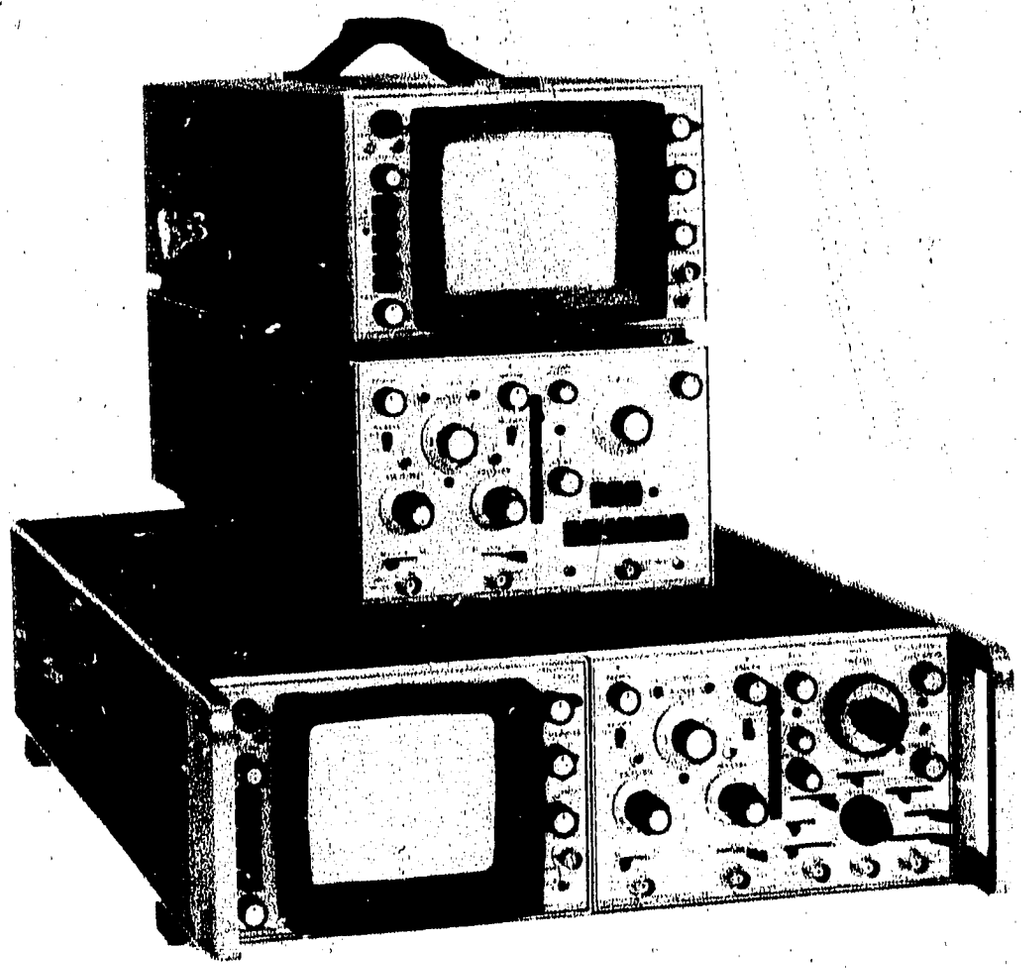
Agilent Technologies

OPERATING AND SERVICE MANUAL

184A/B
OSCILLOSCOPE



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CERTIFICATION

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

WARRANTY AND ASSISTANCE

This Hewlett-Packard product is warranted against defects in materials and workmanship for a period of one year from the date of shipment. Hewlett-Packard will, at its option, repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard, and provided the preventive maintenance procedures in this manual are followed. Repairs necessitated by misuse of the product are not covered by this warranty. NO OTHER WARRANTIES ARE EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANT-ABILITY AND FITNESS FOR A PARTICULAR PURPOSE. HEWLETT-PACKARD IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

Service contracts or customer assistance agreements are available for Hewlett-Packard products.

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

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OPERATING AND SERVICE MANUAL

MODEL 184A/B OSCILLOSCOPE

(Including Options 003, 005, and 580)

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed **1440A (184A)** and **1449A (184B).**

With changes described in Section VII, this manual also applies to instruments with serial numbers prefixed **1228A** through **1435A.**

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

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

Manual Part Number 00184-90904
Microfiche Part Number 00184-90804

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SAFETY SUMMARY

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

GROUND THE INSTRUMENT.

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

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE.

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

KEEP AWAY FROM LIVE CIRCUITS.

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

DO NOT SERVICE OR ADJUST ALONE.

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

USE CAUTION WHEN EXPOSING OR HANDLING THE CRT.

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

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT.

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

DANGEROUS PROCEDURE WARNINGS.

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

WARNING

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

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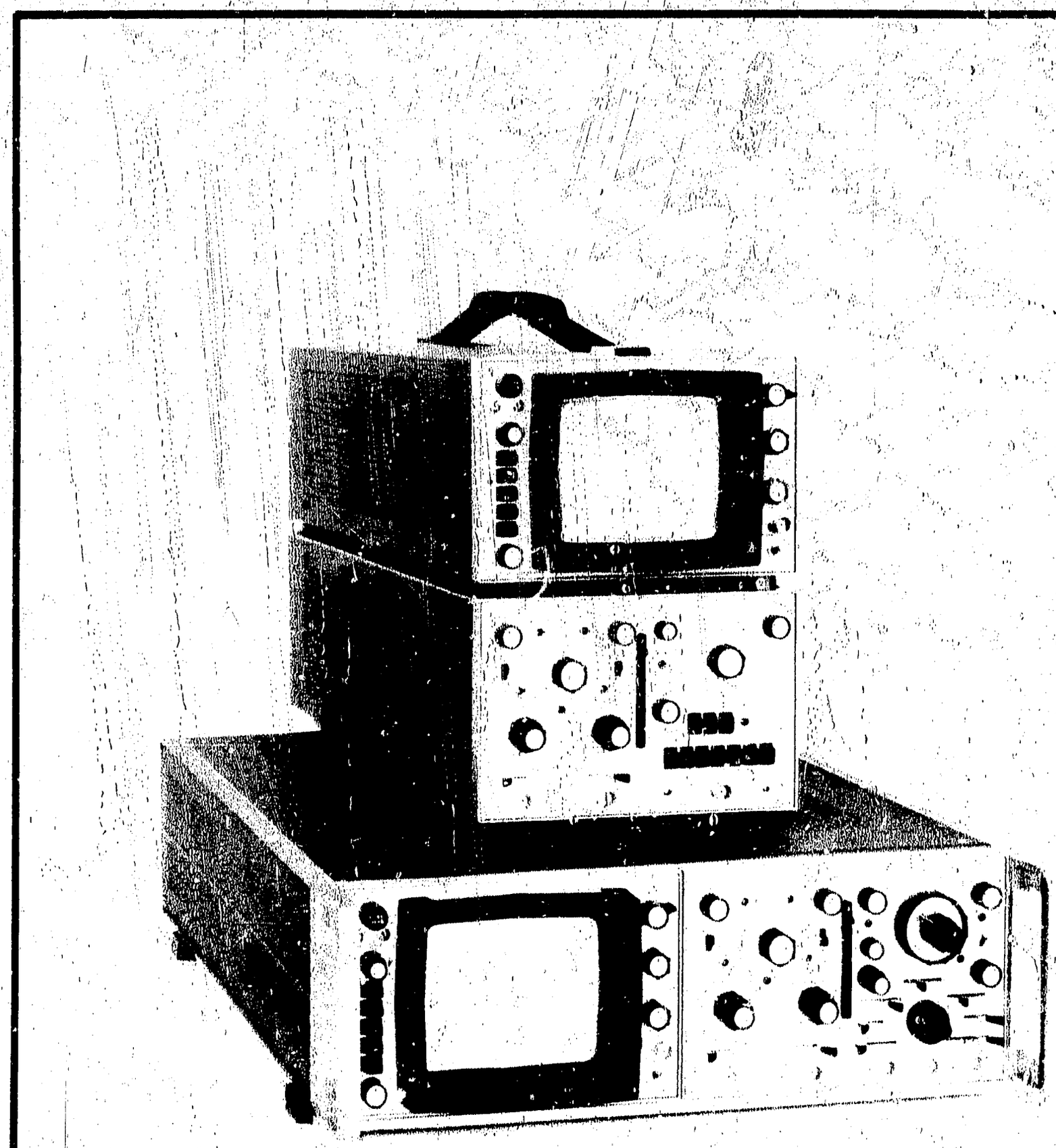


Figure 1-1. Model 184A and 184B Oscilloscopes

SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. This manual provides operating and service information for Hewlett-Packard Models 184A and 184B 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.

1-4. INSTRUMENT DESCRIPTION.

1-5. The Model 184A/B (figure 1-1) is a solid-state, lightweight laboratory and general-purpose variable persistence storage 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 oscilloscope has a high writing speed combined with a bright, easily viewed, CRT display. Operating in the FAST mode, the instrument has a writing speed of 100 cm/usec or greater. Display brightness is 50 foot lamberts or more at this speed. This provides a bright visual display to simplify the measurement of low duty cycle signals.

1-7. The variable persistence capability is especially useful for viewing slow-speed signals. Adjustment of persistence time can provide viewing of a complete trace with fading sufficient to prevent interference with the next trace. The display persistence can readily be adjusted to eliminate flicker and still provide high resolution.

1-8. The storage feature of Model 184A/B can be used to store single-shot occurrences for later viewing or photographing. Comparison of waveforms can be accomplished by storing several separate occurrences and later viewing them simultaneously.

1-9. Model 184A 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.

1-10. Model 184B 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.

1-11. Model 184A/B has solid-state circuitry throughout for minimum size and weight with maximum reliability. Power consumption, with plug-ins, is less than 115 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.

1-12. All power supplies, a calibrator, horizontal amplifier, gate amplifier, variable persistence storage circuitry 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.

1-13. The Model 184A/B is designed to operate with a number of different plug-ins with real-time bandwidths up to 100 MHz and sampling bandwidths up to 18 GHz. Presently available plug-ins provide a wide choice of operating capabilities such as wide bandwidth, dual or four channel operation, high sensitivity, differential offset, single or delayed sweeps, and sampling or time-domain reflectometer operation.

1-14. 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.

1-15. 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 10V p-p with an accuracy of ±1%. The signal may be used to check horizontal and vertical deflection factors and to compensate divider probes.

1-16. 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.

1-17. External outputs are provided through four rear panel mounted BNC connectors for coupling plug-in derived signals to external equipment. Since these outputs are dependent upon the plug-ins utilized, the appropriate plug-in operating and service manual should be referred to for identification of the output signals available. The output amplifiers can supply 3 mA, and will drive impedances as low as 1000 ohms without distortion.

1-18. Connection for input of an external signal for intensity modulation (Z-axis input) is also provided at the rear panel. A signal of approximately +2V, 50-ns pulse width (≤10 MHz cw) will blank a trace of normal intensity. The input resistance is 5100 ohms.

1-19. Pushbutton selection of operating modes provides a choice of fast or standard writing speeds for storage and variable persistence operation or conventional, nonstorage, oscilloscope display. In addition, stored signals may be quickly erased by pushbutton operation.

1-20. A continously variable persistence control allows adjustment of trace storage time for monitoring constantly changing slow speed signals. This permits establishing the optimum display compromise between flicker and response to new signals. Thus, the trace may be made to remain long enough to evaluate an entire waveform, yet fade fast enough to eliminate confusion with subsequent signals.

1-21. OPTIONS.

1-22. Standard options are modifications installed on HP instruments at the factory and are available on request. The following options extend the usefulness of Model 184A/B:

OPTION 003. This option is available to allow the instrument to operate from a 100V/200V primary power source. Option 003 instruments are the same as standard instruments except that assembly A1 and transformer A1T1 are replaced. Refer to Section VI for details.

OPTION 005. This option offers a fast storage CRT and viewing hood. Change table 1-1, specifications, to read: Storage Writing Speed, Fast (Option 005): 400 cm/usec (to be viewed using a hood 10104A). In paragraph 5-39, step t, change the frequency to 34 MHz. In paragraph 5-39, step u, add: and set MAGNIFIER to X5. Refer to Section VI for the HP Part No. for the Option 005 CRT and viewing hood.

OPTION 580. This option replaces instrument bottom covers (MP4, MP5, and MP76) with special covers that conform to CSA standards. Refer to Section VI for details.

1-23. INSTRUMENTS COVERED BY MANUAL.

1-24. Attached to the instrument is a serial number plate. The serial number is in the form: 0000A00000. It is in two parts; the first four digits and the letter are the serial prefix and the last five digits are the suffix. The prefix is the same for all identical instruments; it changes only when a change is made to the instrument. The suffix however, is assigned sequentially and is different for each instrument. The contents of this manual apply to instruments with the serial number prefix(es) listed under SERIAL NUMBERS on the title page.

1-25. An instrument manufactured after the printing of this manual may have a serial number prefix that is not listed on the title page. This unlisted serial number prefix indicates the instrument is different from those described in this manual. The manual for this newer instrument is accompanied by a yellow Manual Changes supplement. This supplement contains "change information" that explains how to adapt the manual to the newer instrument.

1-26. In addition to change information, the supplement may contain information for correcting errors in the manual. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement for this manual is identified with the manual print data and part number, both of which appear on the manual title page. Complimentary copies of the supplement are available from Hewlett-Packard.

1-27. For information concerning a serial number prefix that is not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

1-28. ACCESSORIES FURNISHED.

1-29. Model 184A/B is provided with two filters: a screen mesh interference reduction contrast filter, and a blue plastic contrast filter. Either filter snaps into place under the light shield to provide greater contrast and improved viewing under ambient light conditions. The filter may be removed if preferred. The metal screen mesh filter provides RFI reduction.

1-30. 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.

Table 1-1. Model 184A/B Specifications

CATHODE-RAY TUBE AND CONTROLS

TYPE: post-accelerator storage tube; aluminized P31 phosphor.

GRATICULE: 8 x 10 div internal graticule, 0.2-div subdivisions on major axes. 1 div = 0.95 cm. 8 x 10 div internal graticule superimposed in center of normal scope graticule (for fast writing speed mode). 1 div = 0.475 cm. Front panel adjustment aligns trace with graticule.

BEAM FINDER: returns trace to CRT screen regardless of setting of horizontal or vertical controls, excluding X10 magnification.

INTENSITY MODULATION: approx +2V, >50-ns pulse width (<10 MHz sine wave) blanks trace of normal intensity. Input R, 5000 ohms.

MAXIMUM INPUT: ±20V (dc + peak ac).

WRITING MODES: conventional (nonstorage), standard and fast (variable persistence and storage). Pressing STORE and either STD or FAST provides maximum persistence with floodguns off for ready-to-write state. CRT will remain primed and ready to write for >10 min in STD/STORE and >30 sec in FAST/STORE.

PERSISTENCE

CONVENTIONAL: natural persistence of P31 (approx 40 usec).

VARIABLE: from <50 ms to >1 min.

STORAGE WRITING SPEED

STANDARD: >0.2 cm/usec.

FAST: >100 cm/usec.

BRIGHTNESS

STANDARD: >342.6 cd/m² (100 fl).

FAST: >173.3 cd/m² (50 fl).

STORAGE TIME

(at +22°C. May vary with wide temperature changes.)

STANDARD WRITING SPEED: variable from >1 min at normal intensity to >10 min at reduced brightness.

FAST WRITING SPEED: variable from >10 sec at normal intensity to >30 sec at reduced brightness

ERASE: manual; pushbutton erasure takes approx 300 ms.

HORIZONTAL AMPLIFIER

EXTERNAL INPUT

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

Deflection Factor: 1 V/div in X1; 0.2 V/div in X5; 0.1 V/div in X10; accuracy ±5%.

Dynamic Range: ±20V.

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

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

INTERNAL SWEEP

Magnifier: X5, X10; accuracy, ±5% (with 3% accuracy time base).

GENERAL

CALIBRATOR

Type: approx 1-kHz square wave, 3 usec risetime.

Amplitude: 10V p-p into >1 megohm; accuracy, ±1%.

OUTPUTS: four rear panel emitter follower outputs for 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. Will drive impedances >1000 ohms without distortion.

WEIGHT (without plug-ins).

Model 184A (Cabinet): net, 10.9 kg (24 lb); shipping, 15 kg (33 lb).

Model 184B (Rack): net 11.8 kg (26 lb); shipping, 17.2 kg (38 lb).

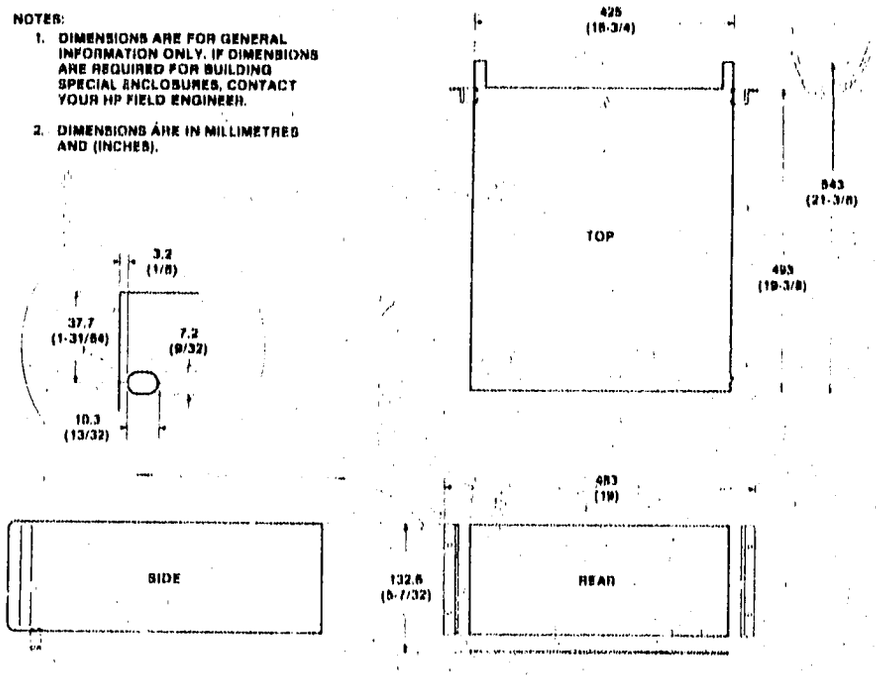
OPERATING ENVIRONMENT: temperature 0° to +55°C (+32°F to +130°F); humidity, to 95% relative humidity at 40°C; altitude, to 4600 m (15 000 ft); vibration, vibrated in three planes for 15 minutes each with 0.254 mm (0.010 in.) excursion, 10 to 55 Hz.

POWER: 115V or 230V +10%, 48 to 440 Hz, 115 watts at normal line with plug-ins. Maximum mainframe power, 225 VA.

DIMENSIONS:

184A: 200 mm wide, 289 mm high, 540 mm deep behind panel (7-7/8, 11-3/8, 21-1/4 inches).

184B: See outline drawing.



ACCESSORIES FURNISHED: detachable power cord; metal mesh contrast filter, blue plastic contrast filter; two probe holders and rack mounting hardware are supplied with Model 184B.

1-31. Model 184B is supplied with all parts and hardware required for rack mounting. Refer to Section II of this manual for installation information.

1-32. Two probe hangers are furnished with each oscilloscope. Model 184A hangers are factory installed while probe hangers for the Model 184B are furnished for user installation.

1-33. AVAILABLE ACCESSORIES.

1-34. MOBILE TEST STANDS.

1-35. Hewlett-Packard Testmobiles provide ease and convenience for moving 180-system oscilloscopes to different test locations. Testmobiles can also be equipped to provide extra storage spaces for plug-ins and accessories, which increases test bench working area.

1-36. CAMERAS.

1-37. The HP Model 197A is a general purpose camera with an electronic shutter. It can be ordered with an ultraviolet light which illuminates internal graticules. 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 Graflok® 4- by 5-inch (Model 10352A).

1-38. 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 economical camera.

1-39. SERVICE EQUIPMENT.

1-40. The plug-in board extender (HP Part No. 00184-66513) raises pulse circuit board A8 for troubleshooting. It is essential for troubleshooting A8 in Model 184B instruments.

1-41. OTHER ACCESSORIES.

1-42. 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.

INSTALLATION

SECTION II

INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains instructions for performing an initial inspection of the Model 184A/B. Installation procedures and precautions are presented in step-by-step order. The procedures for making a claim for warranty repairs and for repacking the instrument for shipment are also described in this section.

2-3. INITIAL INSPECTION.

2-4. The instrument was inspected mechanically and electrically before shipment. Upon receipt, inspect it for damage that may have occurred in transit. Check for broken knobs, bent or broken connectors, and dents or scratches. If damage is found, refer to the claims paragraph in this section. Retain the packing material for possible future use.

2-5. Check the operation of the instrument immediately after receipt. Refer to Section V for the performance check procedure. The performance check will determine whether or not the instrument is operating properly. If the instrument does not operate properly, refer to the claims paragraph in this section.

2-6. CLAIMS.

2-7. The warranty statement applicable to this instrument is printed inside the front cover of this manual. If physical damage is found or if operation is not as specified when the instrument is received, notify the carrier and nearest HP Sales/Service Office immediately (refer to the list in back of this manual for addresses). The HP Sales/Service Office will arrange for repair or replacement without waiting for settlement of the claim with the carrier.

2-8. REPACKING FOR SHIPMENT.

2-9. If the Model 184A/B is to be shipped to an HP Sales/Service Office for service or repair, attach a tag showing owner (with address), complete instrument serial number, and a description of the service required.

2-10. Use the original shipping carton and packing material. If the original packing material is not available, the HP Sales/Service Office will provide information and recommendations on materials to be used.

2-11. PREPARATION FOR USE.

2-12. POWER REQUIREMENTS. The standard Model 184A/B requires a 115V or 230V ±10%, single-phase, 48 to 440 Hz power source capable of supplying 225 VA maximum or approximately 115 watts at normal line voltage with plug-ins installed.

CAUTION

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

2-13. 115V Operation. This instrument, as shipped, is ready for operation on 115 Vac. 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.

2-14. 230V Operation. If the instrument is to be operated from a 230 Vac power source, set the rear-panel SELECTOR slide switch to 230. Replace the fuse with the proper value for 230V operation.

2-15. THREE-CONDUCTOR POWER CABLE. 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.

2-16. INSTRUMENT MOUNTING. Model 184A 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. Model 184B 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.

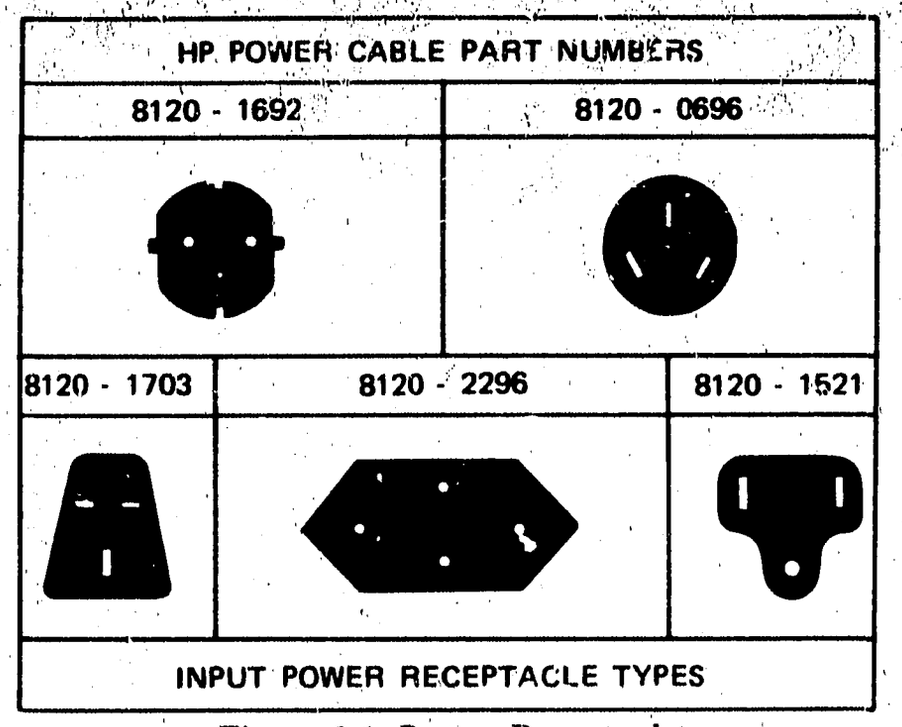


Figure 2-1. Power Receptacles

2-17. 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.

2-18. Rack Mounting. A kit for converting the 184B 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.

2-19. INSTRUMENT COOLING. 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.

2-20. 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.

2-21. CONTRAST FILTER.

2-22. The contrast filters are designed to be easily removed from the CRT bezel. Use of a contrast filter provides comfortable viewing when the instrument is operated in normal and high ambient light.

2-23. The contrast filter is located behind the light shield. When a camera is attached for use, removal of the filter may be desirable.

2-24. 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.

2-25. INSTRUMENT COMPATIBILITY.

2-26. Model 184A/B 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 Model 184A/B. These plug-ins have a mechanical interlock which prevents their full insertion into Model 184A/B. Additionally, Model 184A/B does not supply the required operating power.

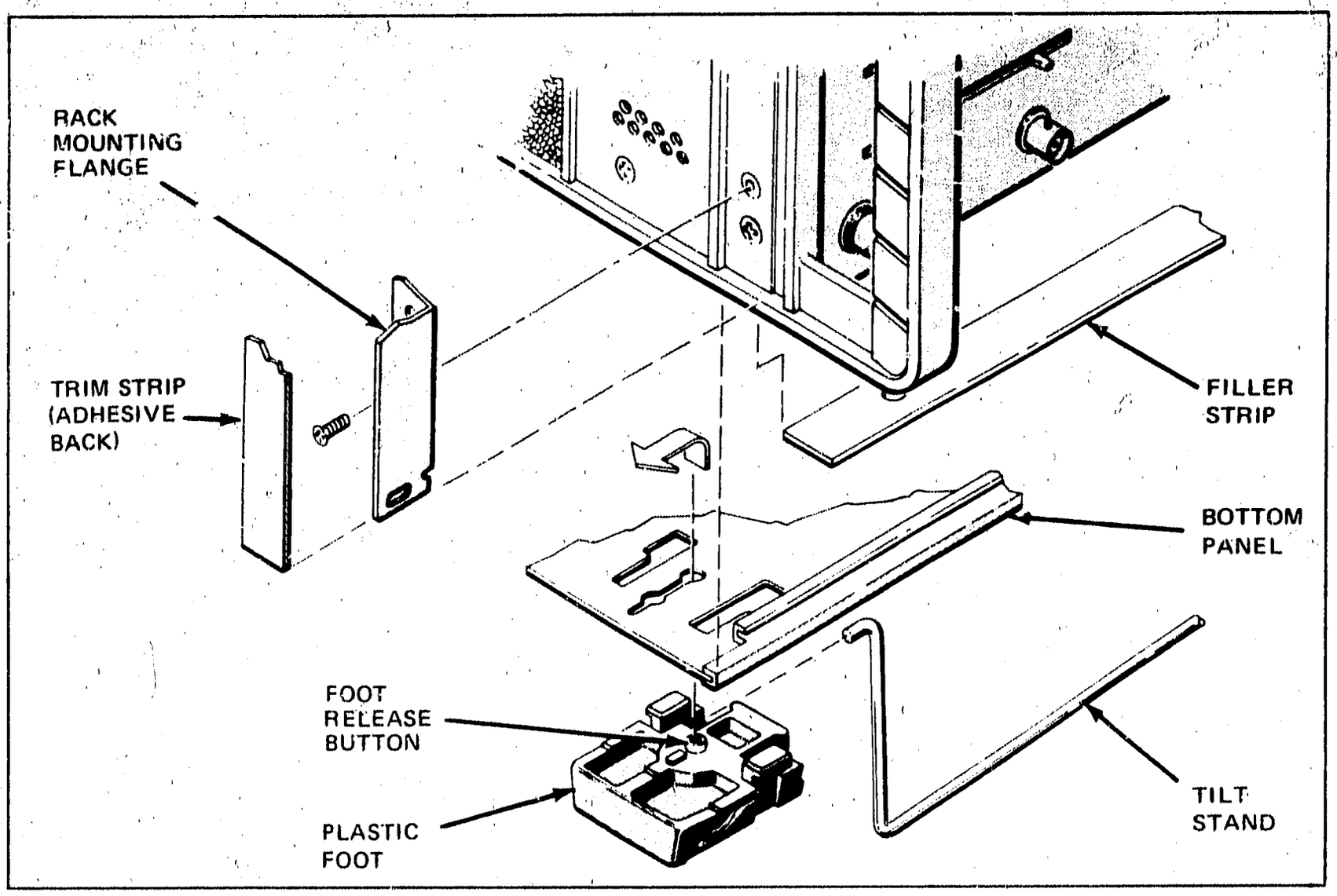
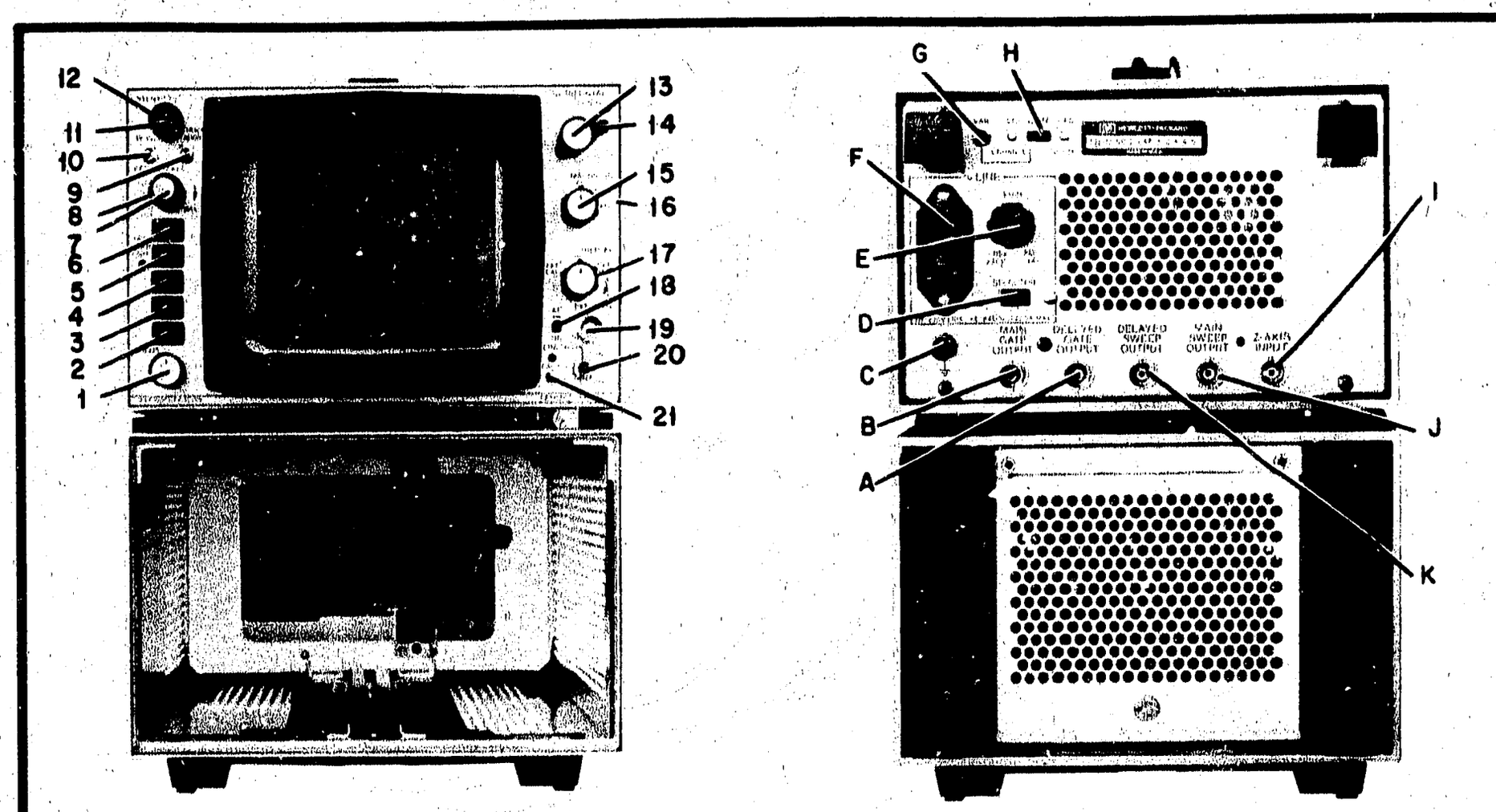


Figure 2-2. Rack Mounting Procedure

OPERATION



1. FOCUS. Adjusts writing beam for sharpest trace.

2. STORE. Retains displayed signal at reduced intensity for long-time storage.

3. CONV. Selects operation as a conventional nonstorage oscilloscope.

4. STD. Operates CRT at normal writing rate with variable persistence.

5. FAST. Operates CRT at maximum writing rate with variable persistence. Indicator light reminds that inner graticule must be used for measurement.

6. ERASE. Removes stored or written displays.

7. PERSISTENCE. Controls endurance time of displayed signal.

8. STORE TIME. Increases or decreases length of time display is stored.

9. TRACE ALIGN. Aligns trace with horizontal graticule.

10. ASTIG. Adjusts roundness of writing beam.

11. FIND BEAM. Returns display to on-screen when pressed.

12. INTENSITY. Controls brightness of display.

13. POSITION. Coarse adjustment of display horizontal position.

14. FINE. Fine adjustment of display horizontal position.

15. MAGNIFIER. Determines gain of horizontal amplifier.

16. PHASE/BANDWIDTH. Selects between normal full bandwidth operation (BANDWIDTH) and X-Y operation (PHASE).

17. DISPLAY. Selects source of horizontal input signal.

18. AC/DC. Selects ac or dc coupling of external horizontal input signal.

19. EXT INPUT. BNC connector for coupling of external horizontal input signal.

20. LINE. Toggle switch (with indicator light) for turning oscilloscope on and off.

21. CAL. Provides 1-kHz square wave at 10V p-p.

Figure 3-1. Operating Controls and Connectors

SECTION III

OPERATION

3-1. INTRODUCTION.

3-2. This section contains an explanation of instrument operating controls, the available modes of operation, operator's checks and adjustments and step-by-step operating instructions for most applications.

3-3. GENERAL DESCRIPTION.

3-4. Model 184A/B is a lightweight, variable-persistence, storage oscilloscope using plug-in vertical and horizontal modules. High and low voltage power supplies, a calibrator, the CRT, and circuitry for the variable persistence and storage operations are contained in the oscilloscope. A compartment for the horizontal and vertical plug-ins is located in the lower portion of Model 184A and in the right-hand portion of Model 184B. In both models, the compartment is designed to accept the vertical plug-in on the left side and the horizontal plug-in on the right. The plug-in units must be locked together before being inserted into the compartment. The operating and service manuals for the plug-ins contain the procedure for mating and installing the plug-ins.

3-5. DEFINITIONS.

3-6. Several words and phrases whose definitions may vary slightly from common usage are used to describe the operation of Model 184A/B. The definitions of these words and phrases which apply to this instrument are:

a. WRITE - To transform an input signal into a visual display on the CRT screen.

b. PERSISTENCE - The length of time a single sweep written display remains visible on the CRT screen with intensity and sweep speed remaining constant.

c. STORE - To retain, at normal or reduced intensity, a display which has been written on the CRT screen.

d. ERASE - To remove all displays and blooms which have been stored, or written with persistence, on the CRT.

e. INTENSITY - The brightness of a display as it is written on the CRT screen with persistence and sweep speed remaining constant.

f. BLOOM - Visible, nonsymmetrical expansion and distortion of a display written on the CRT screen. See figure 3-2A.

g. FADE POSITIVE - The process whereby the storage mesh gradually charges more positive and allows flood-gun electrons to penetrate to the

A. DELAYED GATE OUTPUT. BNC connector for output of delayed gate signal to external equipment.

B. MAIN GATE OUTPUT. BNC connector for output of main gate signal to external equipment.

C. Ground Connector. Provides chassis ground connection point.

D. SELECTOR. Provides for external selection of line operating voltage.

E. FUSE. 115V or 230V operation ac line fuse.

F. Power Connector. 3-wire ac power line input.

G. VAR. With STD WRITE SPD set to ENHANCE, VAR adjusts writing speed of CRT (can be increased to approx 10 cm/usec).

H. STD WRITE SPD. Selects either normal (NORM) standard writing speed, or faster writing speed (ENHANCE), adjusted by VAR control.

I. Z-AXIS INPUT. BNC connector for input of CRT intensification or blanking signal.

J. MAIN SWEEP OUTPUT. BNC connector for output of main sweep signal to external equipment.

K. DELAYED SWEEP OUTPUT. BNC connector for output of delayed sweep signal to external equipment.

Figure 3-1. Operating Controls and Connectors (Cont'd.)

face-plate phosphors, obscuring or obliterating a stored display. A more detailed description of this condition is in Section IV, Principles of Operation.

h. BACKGROUND ILLUMINATION - A flood of light-green illumination covering the entire CRT viewing area. Visible in this illumination is a darker-colored, screen-like pattern when the instrument is used in the FAST mode. See figure 3-2B.

i. SWEEP-TIME - The time (in seconds, milliseconds, or microseconds) required for the beam to move horizontally one unit of distance across the CRT screen when writing a display.

3-7. OPERATING CONSIDERATIONS.

3-8. Prior to operating Model 184A/B, the operator must have a thorough understanding of instrument operation and control functions. This section should be read in its entirety before attempting to operate the instrument.

CAUTION

To avoid CRT damage, the following procedure should be followed every time the instrument is operated.

3-9. The following are steps that must be taken each time the instrument is turned on:

a. Depress STD pushbutton.

b. Set PERSISTENCE control fully ccw (minimum persistence).

c. Set INTENSITY control fully ccw (minimum intensity).

d. Apply power to Model 184A/B (LINE power ON).

e. After 3 minutes, the entire CRT viewing area should be evenly flooded green.

Note

If there is no green illumination, turn instrument off and check all CRT connections.

3-10. DISPLAY SELECTION.

3-11. Pushbutton controls select the mode in which the oscilloscope functions. With ERASE pushbutton depressed, the other functions are disconnected, and all stored and persisting displays are removed from the CRT. The STD and FAST modes are the only conditions in which a display may be written for storage on the CRT screen. The STORE mode disconnects the writing and ERASE functions and retains written displays (at reduced intensity) on the CRT. INTENSITY, PERSISTENCE, and ERASE do not function in the STORE mode.

3-12. When the FAST pushbutton is depressed and then the ERASE pushbutton is depressed and released, the storage surface is erased and then primed (or prefogged) to allow much faster writing on the storage surface. The display, however, has reduced contrast and fades positive more rapidly. The contrast and storage time are also reduced in this mode. When operating in the FAST mode, the inner (smaller) graticule is used for measurements.

3-13. CONVENTIONAL OPERATION.

3-14. The oscilloscope operates as a conventional, nonstorage, instrument when the display switch is set to CONV. The persistence is the natural persistence of P31 phosphor, which is approximately 40 microseconds.

3-15. SINGLE-SHOT STORAGE OPERATION.

3-16. When it is desired to store a signal which may occur at some future time, the oscilloscope may be primed to accept the signal for automatic storage. Selection of the operating mode depends on the expected time during which the signal may occur. If the signal is expected to occur within approximately 5 minutes, the maximum writing speed and storage capability of the instrument can be utilized by simultaneously pressing STORE and FAST. If the event may not take place for as much as an hour or so, the STORE and STD mode of operation should be used by simultaneously pressing these pushbuttons.

3-17. In both these modes of operation the CRT will be primed and ready to write when the ERASE pushbutton is pressed and released. The PERSISTENCE and STORE TIME are automatically set to maximum, regardless of the actual position of these controls.

3-18. To view what has been written in either of these modes, press the STORE pushbutton. This will release the STD or FAST pushbutton, and the display will show what has been written previously without allowing any additional writing to occur.

3-19. FRONT PANEL CONTROLS AND CONNECTORS.

3-20. 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.

3-21. FOCUS AND ASTIGMATISM.

3-22. These controls are provided to assure uniform focus of the trace over the entire CRT screen. To adjust, set the operating mode switch to STD and PERSISTENCE to minimum (fully ccw). Center a low-intensity spot on the CRT screen and adjust FOCUS and ASTIG (screwdriver adjustment) controls for a small, round sharply focused spot. Readjustment of the ASTIG control is seldom required except, for example, when the vertical plug-in is changed.

3-23. PERSISTENCE AND INTENSITY.

3-24. These controls determine the duration of afterglow of a display. The PERSISTENCE control sets the rate at which a display is erased; INTENSITY sets the brightness of the trace as it is written. With a given PERSISTENCE setting, the actual duration of trace afterglow may be increased by increasing the INTENSITY.

3-25. Since the PERSISTENCE control sets the rate of erasing a written display, it follows that a brighter trace will require more time to be erased. Conversely, a display of low intensity will disappear more rapidly. The same principle applies to a stored display of high or low intensity.

CAUTION

The storage mesh of the CRT is not easily damaged. However, it can be damaged if high intensity displays are repeatedly written for long periods of time. Retained images caused by this condition can often be removed by switching to the STD mode and turning PERSISTENCE to minimum for a period of from 5 minutes to 24 hours, depending on the severity of the image. To avoid this type of damage, use the minimum INTENSITY required for a usable display with a given PERSISTENCE setting.

3-26. STORE.

3-27. In order to retain whatever is visible on the CRT, depress the STORE pushbutton. The signal will be stored at the intensity set by the STORE TIME control, resulting in a storage time of up to 10 minutes. The INTENSITY, PERSISTENCE, FOCUS, ERASE, and HORIZONTAL POSITION controls do not affect the presentation in the STORE mode.

3-28. In some applications, it may be desirable to show several overlapping traces at once. This is possible through proper manipulation of the PERSISTENCE and INTENSITY controls. Simply obtain the desired multiple trace display in the mode; then depress the STORE pushbutton.

3-29. A display stored on the CRT when power is removed from the instrument will remain stored for several days. In order to observe this stored display, depress the STORE pushbutton and turn the POSITION control on the vertical plug-in counterclockwise prior to restoring power to the instrument. This prevents a bright spot from being portrayed on the screen due to the initial surge from the CRT write gun.

3-30. Several individual waveforms may also be stored, even though they are written at different times. Having stored a trace, for instance, the operator may choose to switch back to STD and record another trace, etc, prior to erasing. And, by turning the Model 184A/B power off, one trace a day can be recorded for a week or more, depending on total time the instrument is turned on, as storage time would decrease accordingly.

CAUTION

Excessive intensity for long duration may damage the CRT storage mesh. The INTENSITY setting for any sweep speed should be minimum usable intensity.

3-31. CONVENTIONAL OPERATION.

3-32. Selecting the CONV operating mode disables the variable persistence and storage features of the instrument. It will now function as a conventional, general purpose, oscilloscope. The PERSISTENCE control does not function in this mode. Always adjust INTENSITY in STD mode with minimum PERSISTENCE, for no blooming; then switch to CONV. Do not increase intensity beyond this level while in CONV.

3-33. STANDARD STORAGE MODE.

3-34. Pressing the STD pushbutton conditions the display for final adjustments before storage. Use the least INTENSITY and most PERSISTENCE that will provide a good display. In STD mode, the writing speed can be enhanced (increased up to approximately 10 cm/usec) using rear panel controls.

3-35. FAST WRITE STORAGE MODE.

3-36. Operation in the FAST mode provides a more rapid build-up and display of fast, single-shot signals. Since the background illumination also increases more rapidly, the CRT contrast level

and storage time are reduced. Operation in this mode also reduces the display area. The inner graticule markings should be used for measurements.

3-37. ERASE.

3-38. Depressing the ERASE pushbutton will remove stored signals from the CRT when either the STD or FAST pushbutton is depressed. Stored or written displays that remain visible after erasure may require several pressings of the ERASE pushbutton.

3-39. STORE TIME.

3-40. Operation of this control varies the length of time a displayed signal will be retained for later display. When set for minimum storage time and writing in the FAST mode with transfer to the STORE mode, this time is greater than 10 seconds at normal intensity. The maximum storage is greater than 30 seconds at reduced brightness. When writing a display in the STD mode and transferring to the STORE mode, the storage time varies from 1 minute (fully ccw setting of STORE TIME) to more than 10 minutes (fully cw STORE TIME setting). Light output is inversely proportional to the STORE TIME selected.

3-41. CALIBRATOR.

3-42. The calibrator has a 10V peak-to-peak output, negative-going from ground, with an amplitude accuracy of ±1%. The output is a square wave at a frequency of approximately 1 kHz. Risetime of the signal is less than 3 microseconds. The output is useful for checking vertical and horizontal sensitivity calibration, and divider probe calibration.

3-43. TRACE ALIGN.

3-44. 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.

3-45. FIND BEAM.

3-46. Occasionally the CRT beam may be driven offscreen by large dc input levels or improper control settings. Pressing the pushbutton 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. If necessary, adjust the INTENSITY control to obtain a visible trace. Then adjust the horizontal and vertical position controls to center the trace.

3-47. 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.

3-48. LINE POWER SWITCH.

3-49. 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.

3-50. HORIZONTAL DISPLAY.

3-51. 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.

3-52. HORIZONTAL EXTERNAL COUPLING.

3-53. An external input signal may be connected to the horizontal amplifier via the EXT INPUT connector when DISPLAY is set to EXT. The coupling switch located next to the external input connector is used to select ac coupling (capacitive coupling) or dc coupling to the amplifier.

3-54. EXTERNAL SENSITIVITY.

3-55. 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 (EXT CAL detent), the horizontal amplifier is calibrated to provide 1.0 V/div deflection in the X1 magnifier range, 0.2 V/div in the X5 range, and 0.1 V/div in the X10 range. Counterclockwise rotation from the EXT CAL position decreases the uncalibrated g ain.

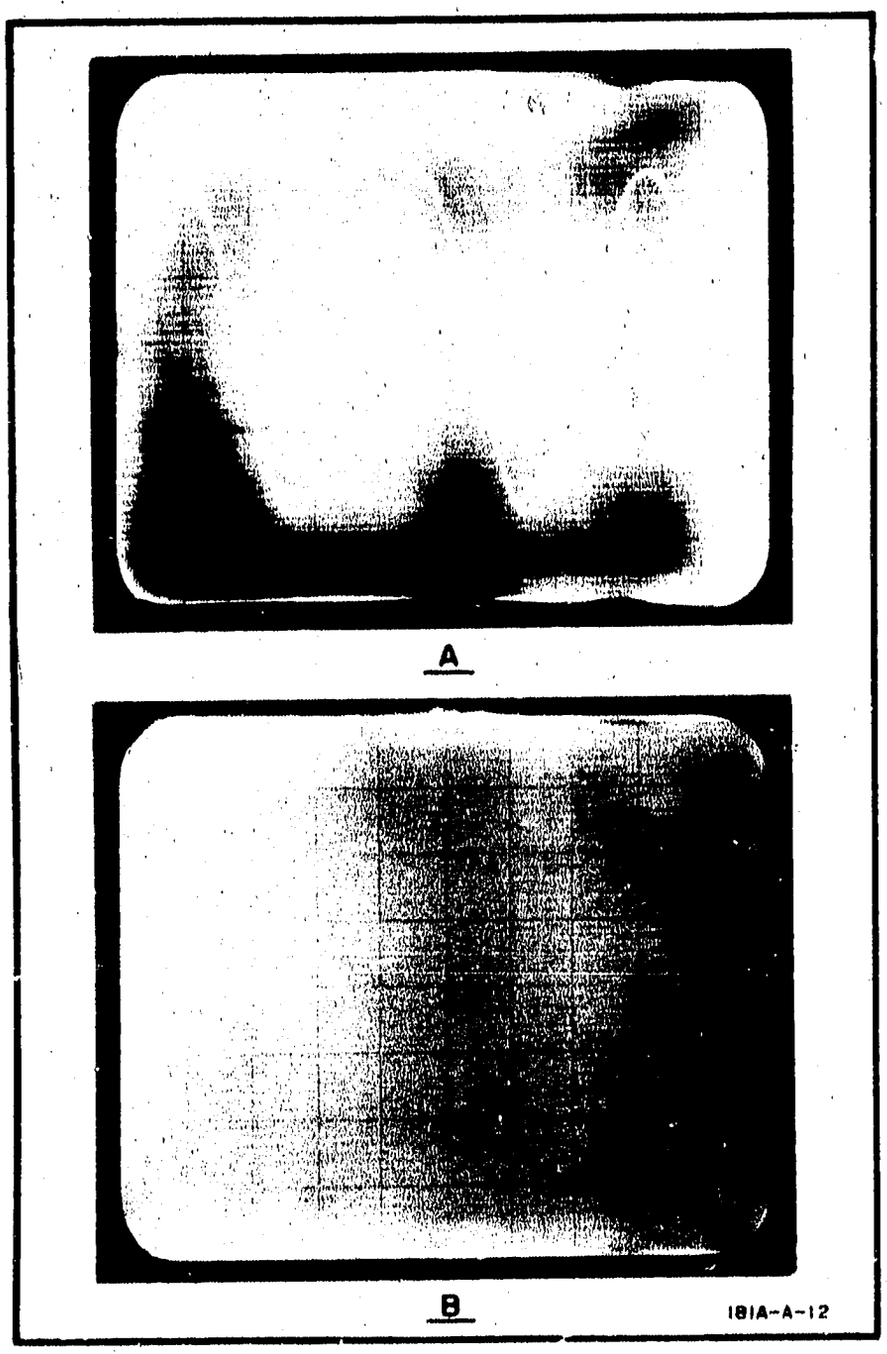


Figure 3-2. Fade Positive and Background Illumination

3-56. HORIZONTAL MAGNIFIER.

3-57. The MAGNIFIER can be used in both the internal and external input sweep modes. 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.

3-58. 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.

3-59. REAR PANEL CONTROLS AND CONNECTORS.

3-60. Rear panel controls and connectors are identified and described in figure 3-1. Additional information regarding these is explained in the following paragraphs.

3-61. OUTPUTS.

3-62. Four BNC connectors on the rear panel of the Model 184A/B 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. When used with sampling plug-ins, the outputs are the vertical and horizontal signals. Refer to the operating and service manual for the plug-in to determine signal identification.

3-63. 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.

3-64. AC LINE INPUT.

3-65. A three-conductor 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.

3-66. PHASE/BANDWIDTH SWITCH.

3-67. A PHASE/BANDWIDTH switch is located within the instrument on the horizontal amplifier assembly. The instrument 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 Model 184A/B to be used for phase measurement. The switch should always be in the BANDWIDTH position unless the instrument is being used for phase measurement.

3-68. Z-AXIS INPUT.

3-69. 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. Approximately —2V will give maximum intensity.

3-70. STD WRITE SPD AND VAR.

3-71. The STD WRITE SPD switch and VAR adjustment allow the operator to increase the CRT

writing speed in the STD mode. By selecting ENHANCE and adjusting VAR, the writing speed can be increased up to approximately 10 cm/usec.

3-72. OPERATING TIPS.

3-73. This information is provided to aid the operator in becoming familiar with the Model 184A/B controls and their functions, and to serve as a guide for obtaining the desired CRT display.

a. For normal persistence operation, depress STD pushbutton and turn PERSISTENCE control fully ccw. Slowly rotate INTENSITY control cw to where no trace blooming appears. Depress CONV pushbutton; do not increase INTENSITY while in CONV. If sweep speed is changed, always check for proper intensity using above procedure.

CAUTION

When not actively using the oscilloscope it should be switched to STD with the INTENSITY and PERSISTENCE controls set fully ccw. This will eliminate the possibility of displaying a high intensity signal for an extended period of time and damaging the CRT storage surface.

b. For variable persistence operation, press STD pushbutton. Use minimum INTENSITY and maximum PERSISTENCE compatible with display.

c. The FAST mode offers increased writing speed for capturing difficult single-shot displays. Scan size is automatically reduced to the high speed area of the CRT, maintaining optimum resolution of the display. Calibration is maintained by using the center graticule provided on the CRT face.

d. Writing speed in STD mode can be increased to obtain some benefits of FAST mode by setting rear panel STD WRITE SPD switch to ENHANCE. To obtain best ENHANCE display, set PERSISTENCE fully cw and switch STD WRITE SPD to ENHANCE. Adjust VAR on rear panel to derive same display background brightness in STD as appears in FAST mode. Adjust VAR in small increments and erase display after each adjustment.

e. To store display, press STD or FAST pushbutton, and adjust INTENSITY and PERSISTENCE for desired display. When display has been written, press STORE pushbutton.

f. When viewing stored display, rotate STORE TIME control ccw.

g. To store more than one display, press STD or FAST pushbutton, set PERSISTENCE fully clockwise, and INTENSITY as required; allow first display to be written. Set INTENSITY fully counterclockwise and connect second signal to be stored. Reset vertical POSITION if second display is not to be superimposed on first. Slowly rotate INTENSITY clockwise until second display appears. Press STORE pushbutton.

h. A display which is stored when Model 184A/B power is turned off will remain stored for several days. To display stored waveform, press STORE pushbutton, turn STORE TIME fully cw, and turn VERT and HORIZ POSITION controls fully ccw before turning power on. Apply power to Model 184A/B and allow 3-5 minute warmup. To view stored image turn STORE TIME fully ccw.

i. To erase persistent or stored display, set mode to STD or FAST. Depress and release ERASE pushbutton.

j. If only portion of slow sweep display is desired, press STORE pushbutton when trace has been written to desired point; write gun is blanked and written portion is then stored.

k. Use viewing hood, if desired, to improve screen-display contrast.

3-74. SINGLE-SHOT OPERATION.

3-75. To write or store single-shot phenomena, a trial setting of INTENSITY is the best approach. The amplitude of the phenomena and the sweep-time required to display it will affect the persistence. For example, with maximum PERSISTENCE and some settings of INTENSITY, a single-shot straight-line may bloom. A single-shot signal with amplitude variations may not cause bloom.

3-76. To determine the best INTENSITY setting, connect a signal which approximates the sweep time and amplitude of the single-shot signal to be written. Set PERSISTENCE fully clockwise and trigger a single sweep of the test signal. Set the INTENSITY as far as possible without causing blooming. Repeat this procedure, varying the INTENSITY, until the proper display is obtained. This setup should give maximum persistence to the single-shot display. After the signal has been written, press the STORE pushbutton to retain the display.

3-77. Single-shot signals which require a sweep time faster than 5 microseconds per division can be written with more brightness by switching to the FAST mode. The screen will be unevenly illuminated after erasing when in FAST, figure 3-2B. However, INTENSITY can be set high enough to make the display visible through the illumination. A display written in FAST offers less storage time than a signal written in STD.

Table 3-1. Plug-in Compatibility

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 rise time	<35 ps rise time
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 nanoseconds	1815A calibrated in feet. 1815B calibrated in meters.
Delayed and mixed sweep	No	Yes	Expanded X100	Yes	No	No	No		

*Includes X10 mainframe magnification.

3-78. MAGNETIC INTERFERENCE.

3-79. The CRT is provided with a metal shield for protection against magnetic fields. Due to the sensitivity of the CRT, it is possible that the strong magnetic field from nearby motors, ac line transformers, etc., may still result in a noticeable beam deflection. In this event, reorient or relocate the instrument with respect to the interfering device.

3-80. PLUG-IN UNITS.

3-81. Model 184A/B requires horizontal and vertical plug-ins. The deflection sensitivity of the CRT may vary slightly with different units. Plug-in units should be calibrated when first installed or when shifted between oscilloscopes. The horizontal and vertical plug-in units must be locked together prior to insertion into the mainframe. Consult the respective plug-in operating and service manual for operation and capability information. Table 3-1 lists the plug-ins which can be used in 184A or 184B mainframes.

3-82. Blank plug-ins, both single and dual, are available for customer fabrication of specialized vertical amplifier and time-base plug-ins. Section 1 of this manual lists the blank plug-ins that are available. Customer-designed plug-ins can obtain operating power from the oscilloscope power supplies. Table 4-1 lists the supply voltages and currents available.

3-83. PHASE MEASUREMENT.

3-84. Section V of this manual contains the adjustment procedure. Accurate phase measurements may be made at frequencies up to 100 kHz.

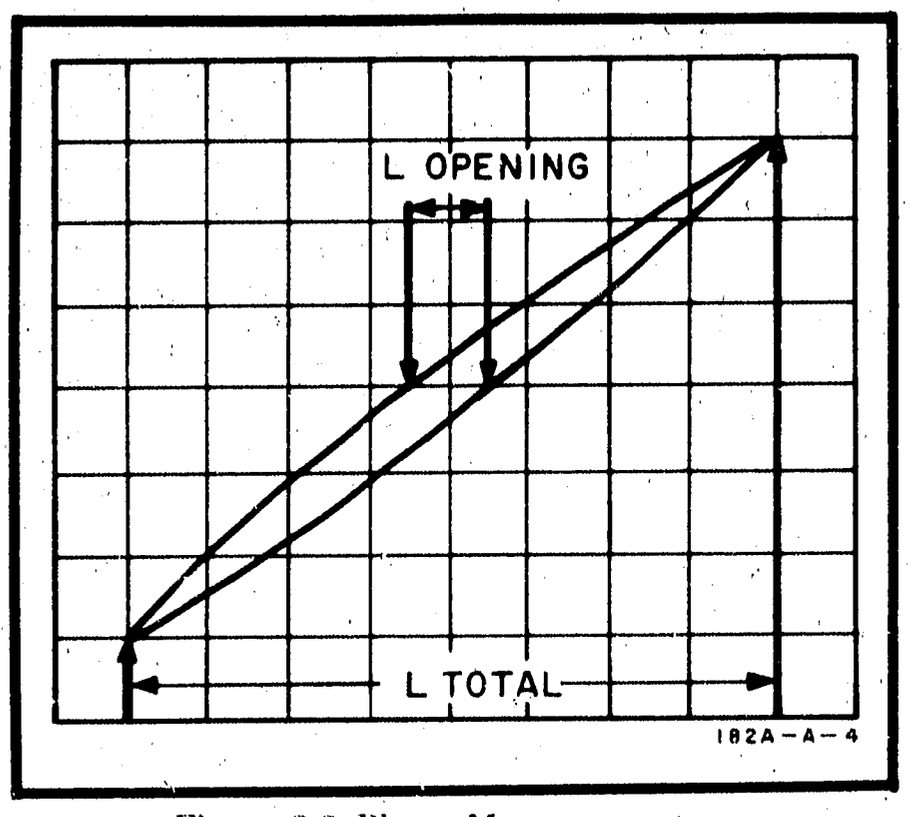


Figure 3-3. Phase Measurement

3-85. The PHASE/BANDWIDTH switch is located inside the instrument on the horizontal amplifier assembly. Access to the switch is obtained by removing the top right-hand cover of Model 184A. The switch can be reached in rack model instruments (Model 184B) by either removing the top cover or via the plug-in compartment. The PHASE position of the switch is toward the bottom of the instrument.

3-86. To measure phase, set the internal PHASE/BANDWIDTH switch to PHASE and connect the input signals to the vertical amplifier input and the oscilloscope EXT INPUT. Set the DISPLAY control to EXT CAL. A display similiar to figure 3-3 will be observed. The size of the opening of the display is a relative indication of the phase difference of the input signals.

3-87. 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:

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

3-88. 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.

3-89. GRATICULE MARKS AND MEASUREMENTS.

3-90. Two sets of graticule marks are placed on the CRT display area. Both sets of graticule marks are 8 x 10 divisions. The inner (smaller) graticule area is used for measurement when displaying a signal in the FAST mode of operation and when viewing a stored signal which has been written in that mode.

3-91. For convenience in making a risetime measurement, 10% and 90% points are marked on the graticules. Figure 3-4 shows where these points are located for vertical amplifier plug-ins which are specified at bandwidths with reference to 8 divisions and to 6 divisions.

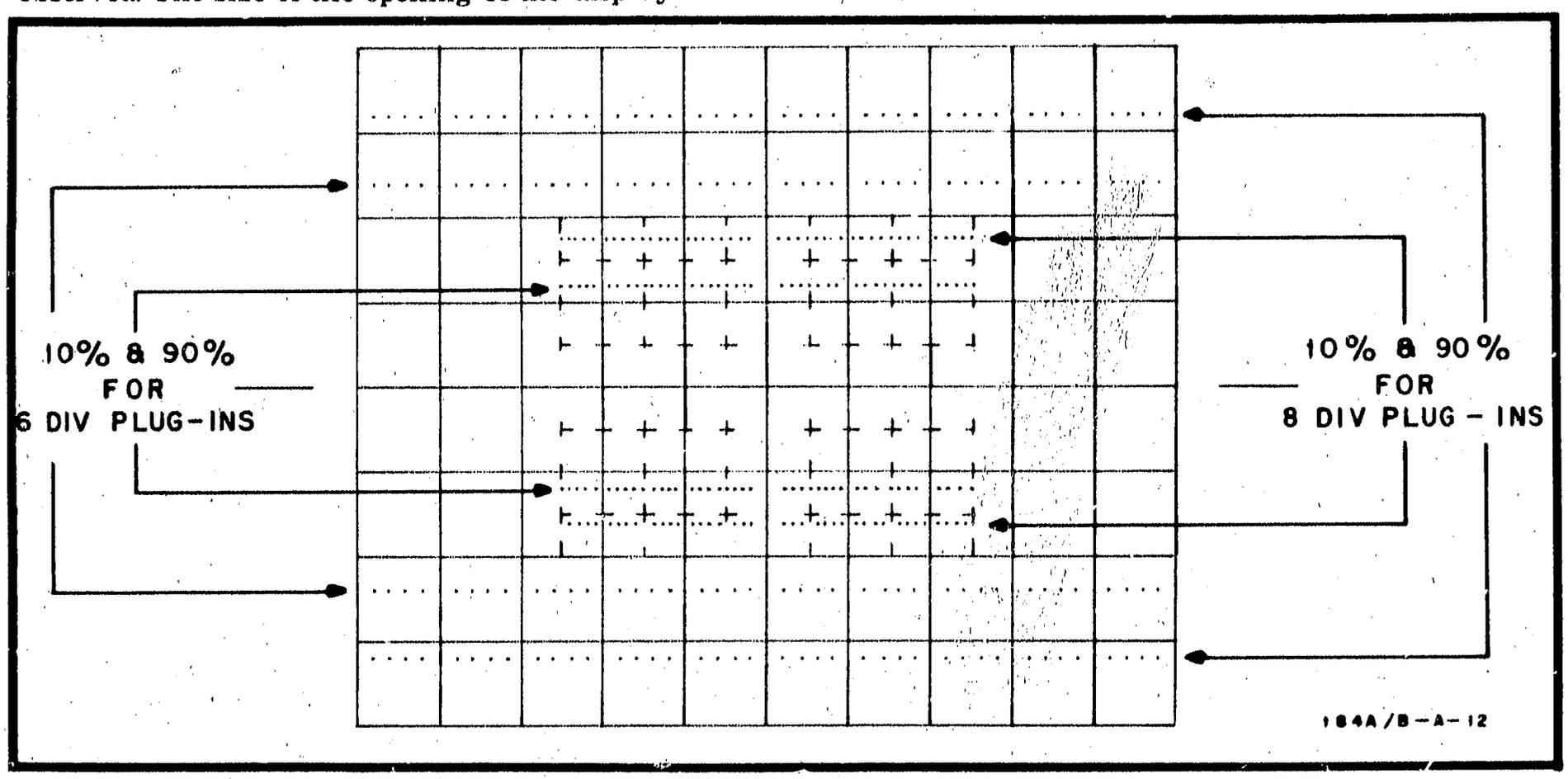


Figure 3-4. Graticule Marking

THEORY

SECTION IV

PRINCIPLES OF OPERATION

4-1. INTRODUCTION.

4-2. This section provides information about the circuits used in Model 184A/B and how they operate. Since variable persistence and storage techniques may be somewhat unfamiliar, the basic theory of storage operation will be explained first to aid in grasping these concepts. An overall block diagram is explained next, followed by a detailed description of the individual circuits.

4-3. STORAGE PRINCIPLES.

4-4. The storage CRT used in Model 184A/B contains a conventional electron gun with deflection plates (write gun), an aluminized phosphor viewing screen, a pair of flood guns operated in parallel, flood beam shaping and accelerating grids, a flood beam collimator, a collector mesh, and a storage mesh as shown in figure 4-1.

4-5. The write gun functions as a conventional electrostatic deflection gun, delivering high velocity electrons to selected points on the phosphor viewing screen. The elements which provide storage and variable persistence are located between the write gun and the phosphor. It is for this reason we must pay attention to the intensity level in CONV since the writing beam goes through these storage elements.

4-6. The flood guns are physically located just outside the horizontal deflection plates. A cloud of electrons is emitted by each flood gun cathode. These clouds are combined, shaped, and accelerated by two control grids. It should be noted that under certain conditions the two electron clouds will appear as light areas on the viewing screen when the instrument is first turned on.

4-7. The combined cloud is further shaped and accelerated by the collimator (a coating on the inside of the funnel section of the glass). The positive voltage on the collimator is adjusted so that the flood-gun electron cloud just fills the CRT viewing screen. The cloud is further accelerated toward the storage mesh and viewing screen by the collector mesh. After passing through the collector mesh, the flood electrons are further controlled by potentials on the storage mesh and surface.

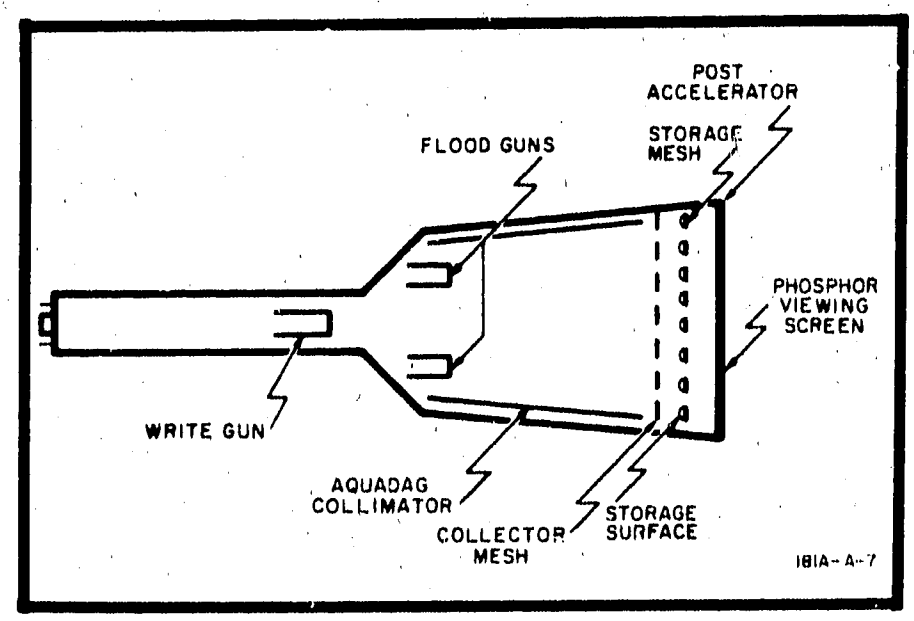


Figure 4-1. Simplified CRT Construction

4-8. The storage mesh is located between the collector mesh and the phosphor. The back side of this mesh is coated with a layer of nonconductive material. The storage of information takes place on the surface of this nonconductive material (storage surface).

4-9. The basis for storage of information on the nonconductive material is the secondary emission ratio curve shown in figure 4-2. This curve shows the ratio of the number of electrons leaving the surface to the energy of the electrons striking the surface. At an energy of about 40 electron/volts (eV), the number of electrons leaving the surface is equal to the number arriving.

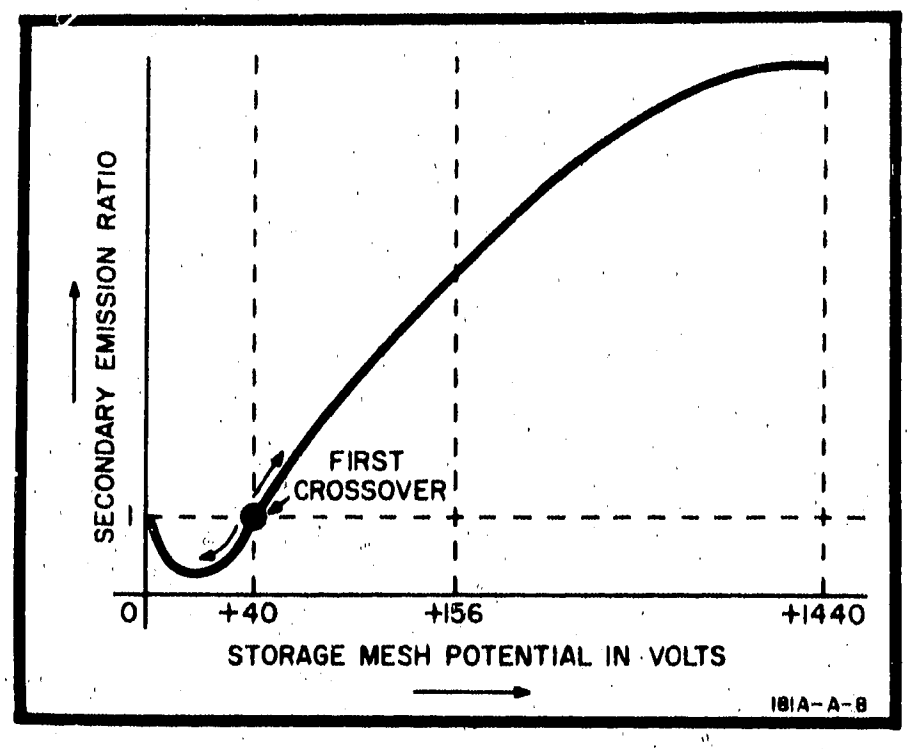


Figure 4-2. Secondary Emission Ratio

4-10. The point where the secondary emission ratio is equal to unity is called first crossover. If the surface is bombarded with electrons with more than 40 eV of energy, the surface potential rises because more electrons are leaving than arriving. If the surface is bombarded with electrons with less than 40 eV of energy, the surface potential decreases because fewer electrons are leaving than arriving.

4-11. When the ERASE pushbutton is pressed, the storage mesh is changed to the same potential as the collector mesh (+156V). The storage surface is also changed to nearly this same potential by capacitive coupling. Since the surface is then being bombarded by electrons with energies much higher than first crossover energy, the entire storage potential becomes equal to +156 volts. The surface potential cannot increase beyond +156 volts because the collector mesh would then repel the emitted electrons back to the storage surface, tending to decrease the surface potential.

4-12. After 100 milliseconds have elapsed (see figure 4-3), the storage mesh potential steps down negatively to —12.6 volts and immediately begins to ramp in a positive direction as an RC time constant response to almost +8.3 volts in about 50 milliseconds. Approximately 250 milliseconds after this time (at the end of the erase cycle), the storage mesh potential steps down again, but this time to return to +3.3 volts.

4-13. The storage surface potential follows the storage mesh response to slightly more than +3.3 volts by capacitive coupling, but immediately starts decaying toward 0 volts. This is caused by the capture of floodgun electrons. At the end of approximately 400 milliseconds the storage mesh potential returns to +3.3 volts and by capacitive coupling the storage surface potential is reduced from 0 volts to —5 volts.

4-14. Since the write gun electrons reach the storage surface with energy much higher than first crossover energy, they charge the surface in a positive direction wherever they strike. This charge pattern on the storage surface remains for a considerable length of time since the storage material is a good insulator.

4-15. Those areas of the storage surface which are charged to near 0 volt allow the field created by the high positive potential on the post-accelerator to reach through and capture flood gun electrons, accelerating them to strike the phosphor viewing screen, thereby causing the phosphor to emit light. Thus the pattern of charge on the storage surface is made visible.

4-16. The secondary electrons emitted by the storage surface where the write gun electrons strike must charge the surface from its erased potential to about —3 volts before flood electrons can be captured by

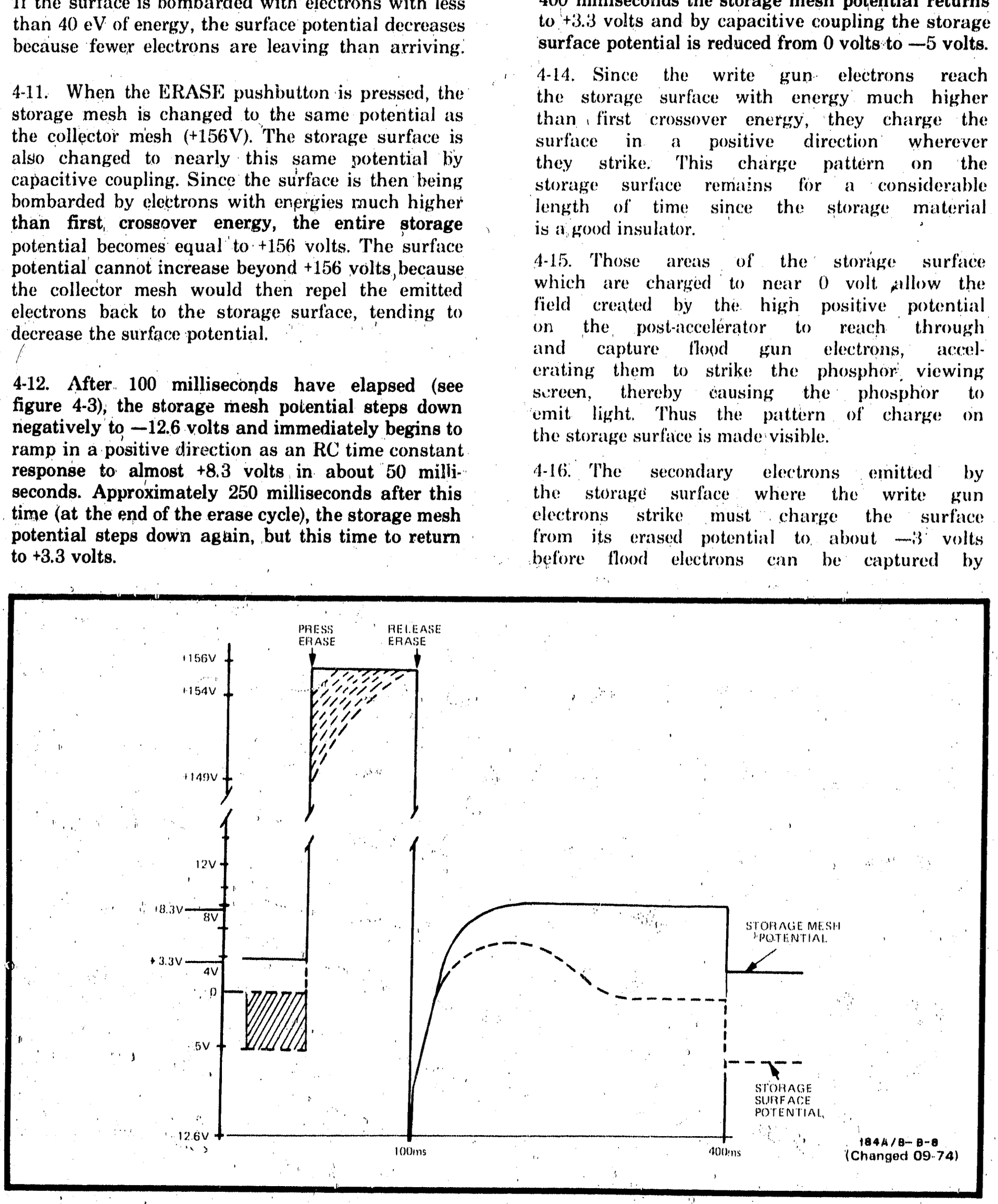


Figure 4-3. Storage Mesh and Surface Potentials During Erasure

the post-accelerator. Thus the writing speed of the CRT could be enhanced by erasing the surface to just below this cutoff level.

4-17. This is what the FAST mode does. The disadvantages of operating in this mode are reduced storage time and reduced contrast ratio. The cutoff potentials of various areas of the storage surface may not be exactly the same. Thus, the background illumination may not be uniform when the storage surface is erased in the FAST mode.

4-18. Figure 4-4 represents the method of obtaining variable persistence. The unwritten storage surface after erasure is at approximatley —5 volts. Those areas of the storage surface which are struck by electrons from the write gun become charged to near 0 volt. A +5 volt pulse applied to the storage mesh moves the unwritten areas of the storage surface to near 0 volt and the written areas to near +5 volts.

4-19. While at this potential, the written areas of the storage surface attract and capture flood gun electrons, which tends to lower the potential of these areas. When the storage mesh returns to its normal level, the storage surface drops 5 volts. The unwritten areas of the storage surface return to a —5 volt potential and the written areas return to a slightly negative potential, somewhat lower (more negative) than their initial value. This decrease in potential reduces the ability of the post-accelerator potential to reach through and capture flood electrons, thus reducing the trace brightness slightly.

4-20. If this procedure is repeated many times, the stored trace will eventually be erased. The time required to accomplish this erasure is controlled by varying the rate (frequency) of the pulses applied to the storage mesh.

4-21. During the time the storage mesh is pulsed positive, flood electrons are allowed through to the phosphor viewing screen. Thus a light background glow is visible when the CRT is used in the variable persistence mode.

4-22. CONVENTIONAL.

4-23. If the storage mesh potential is reduced to —32 volts, it acts as a control grid to flood gun electrons and prevents them from reaching the phosphor. However, it has little effect on write gun electrons and allows many of them to reach the phosphor viewing screen. Some of the write gun electrons strike the storage surface, charging it positively toward 0 volt wherever they strike. Thus the CRT appears to act as a conventional CRT without variable persistence or storage.

4-24. However, when the storage mesh is brought back to +3.3 volts, those areas of the storage surface which have been struck by write gun electrons allow flood electrons to be captured by the post-accelerator field, and thus display the pattern that was written on the phosphor while the storage mesh was at —32 volts.

4-25. In order to view a stored trace for 1 minute or more, the storage mesh is held at a constant +3.3 volts. This may be accomplished by reducing the rate of the variable persistence erase pulses to zero (corresponding to maximum persistence), or by actually disconnecting the pulses from the storage mesh. The write gun may be turned off if desired, to prevent additional writing on the storage surface.

4-26. The mechanism which limits viewing time is the fade positive of the storage surface (entire screen illuminated). This is caused by positive ions reaching the storage surface and charging it positive. The positive ions are generated by flood gun electrons striking residual gas molecules in the CRT. To obtain an extended storage time, the flood

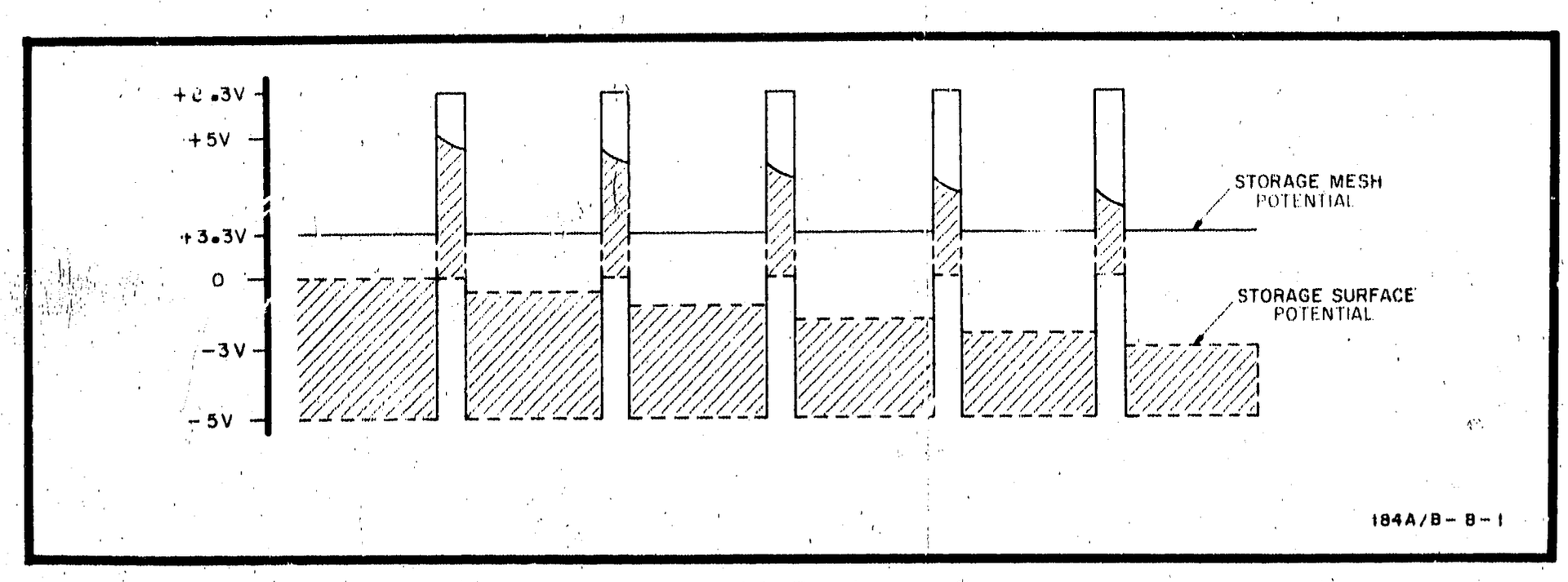


Figure 4-4. Variable Persistence Storage

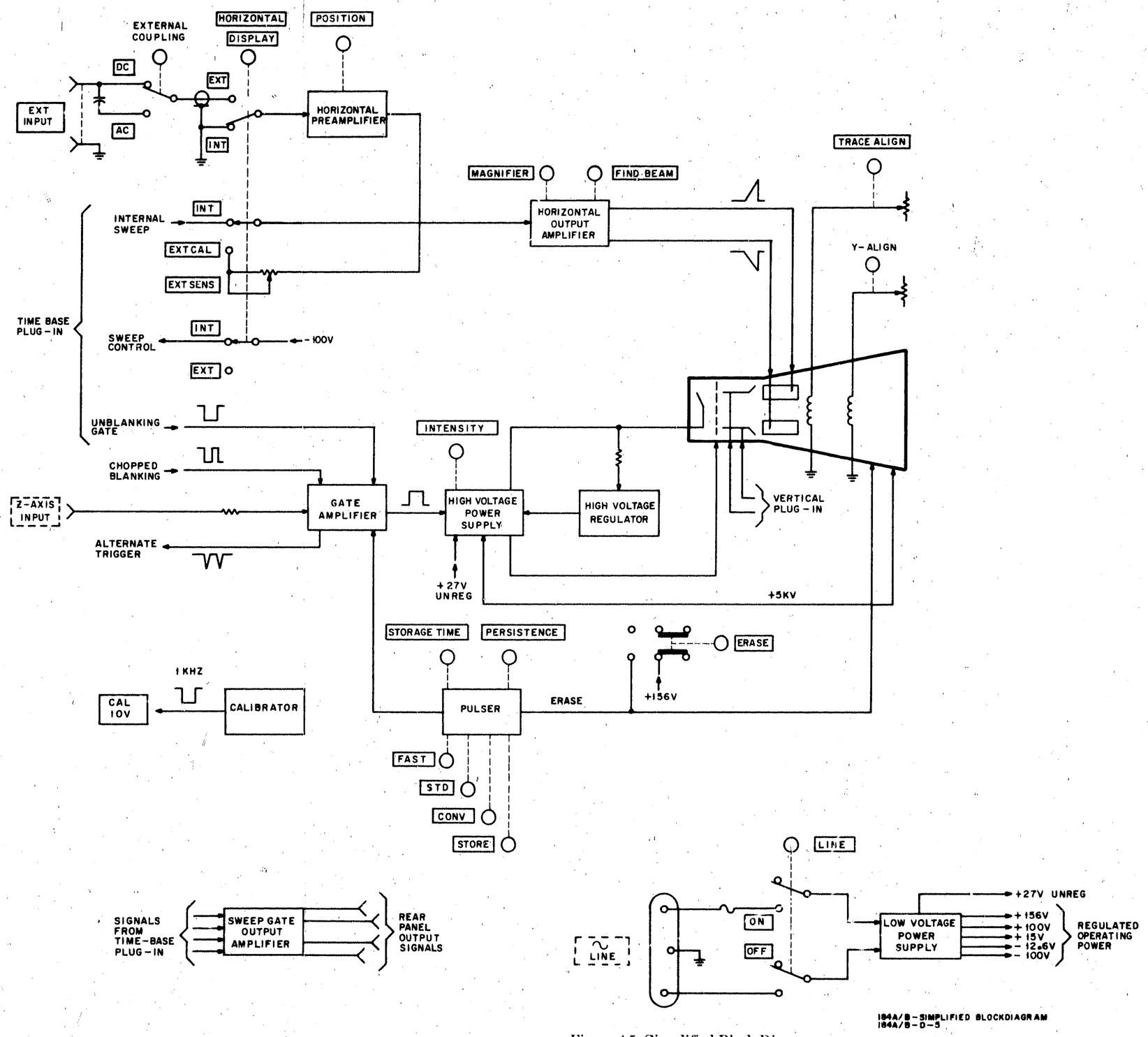


Figure 4-5. Simplified Block Diagram

guns should be turned off. This is done in the STORE mode; however, the flood guns may be turned on occasionally to permit viewing of the stored trace at a reduced intensity. The duty cycle of the flood guns is adjusted by the STORE TIME control.

4-27. GENERAL DESCRIPTION.

4-28. Model 184A/B 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, a gate amplifier, and circuitry for storage and variable persistence operation. A sweep-gate output amplifier and a calibrator are also included. The instrument may be operated as a storage oscilloscope, a variable persistence oscilloscope or as a standard, general purpose oscilloscope. Circuit operation in all three modes is described in this section. Refer to the overall block diagram (figure 4-5) and the schematics in Section VIII while reading the explanation of circuit operation.

4-29. 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.

4-30. 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 on the CRT control grid.

4-31. 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.

4-32. INPUT POWER.

4-33. Either 115V or 230V ac (±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, or in series for 230V operation.

4-34. With power applied to the power transformer primary windings, several secondary voltages are produced. Recified, 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.

4-35. HORIZONTAL DEFLECTION.

4-36. 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 by the 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.

4-37. 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.

4-38. 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 both fine and coarse positioning control.

4-39. 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.

4-40. 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.

4-41. 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.

4-42. 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.

4-43. An externally applied signal for horizontal deflection may be connected to the EXT INPUT jack. 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.

4-44. CIRCUIT DETAILS.

4-45. INPUT POWER. (See schematic 2.)

4-46. 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.

4-47. 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.

4-48. LOW VOLTAGE POWER SUPPLY. (See schematic 2.)

4-49. The low voltage supply produces five regulated voltages for use throughout the oscilloscope and the plug-ins: +100V, +156V, —100V, +15V and —12.6V. Each supply is referenced to the +100V supply for regulation purposes with the +100V supply referenced to 9-volt temperature-compensated, zener diode A1A2VR2. An unregulated +27V is produced for operation of the high voltage power supply. The +100V and —100V supplies are also foldback current limited, providing short-circuit protection.

4-50. A simplified block diagram of a typical low voltage power supply is shown in figure 4-6. Unregulated alternating current 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.

4-51. 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.

4-52. +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.

4-53. 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

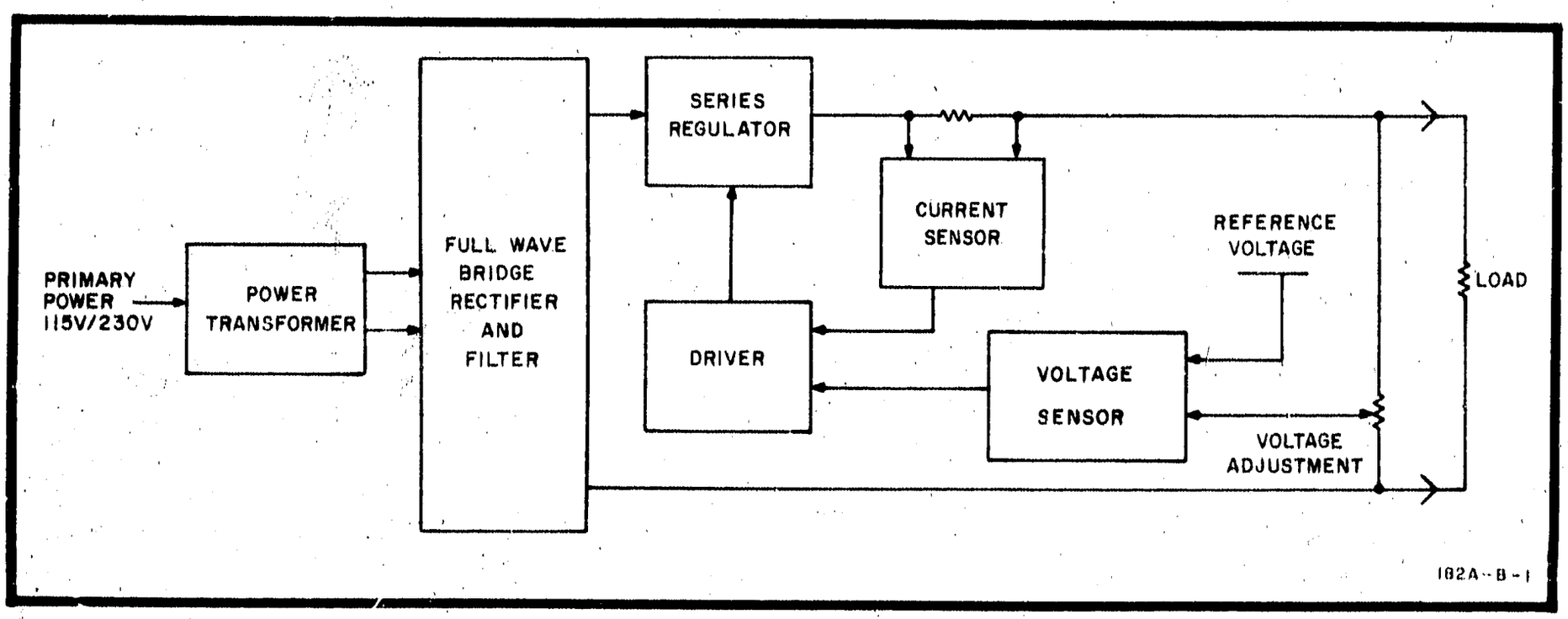


Figure 4-6. Simplified Low Voltage Power Supply

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 due 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.

4-54. 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 A1A2Q3 and A1A2Q4 are coupled to drive A1A2Q1, the amount of current flowing, as well as voltage variations, controls the operation of series regulator A1Q1.

4-55. 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.

4-56. 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.

4-57. 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 80V which is used in the +156-volt supply and as a reference source for the +100V regulator. Zener diode A1A2VR1 stabilizes the collector voltage for A1A2Q3.

4-58. +156-volt Supply. The rectified and filtered output from diodes A1A1CR1 through A1A1CR4 and A1A1C1 is applied across A1A1R3 and breakdown diode A1A1VR1. Zener action keeps the cathode of A1A1VR1 56.2 volts more positive than the anode, which is at +100V. The +156-volt potential at A1A1VR1 is applied to the collector mesh of the CRT and is also used for the ERASE function.

4-59. +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 oscillators, and a regulated +15V is produced for use in the mainframe and plug-ins.

4-60. The secondary voltage developed by the power transformer at pins 13 and 14 is full-wave bridge rectified by A1A1CR9-A1A1CR12 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.

4-61. 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.

4-62. —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.

4-63. —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.

4-64. 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. Power Supply Current Capability

Power Supply Voltage	Available at J1 Pin No.	Maximum Safe Current Available
+100V dc	30	160 mA
+15 V dc	29	900 mA
—12.6V dc	28	900 mA
—100V dc	27	80 mA
115V ac	10 & 26	100 mA (See Note)
115V ac	16 & 32	100 mA (See Note)
Ground	8 & 24	

Note

With 115/230 line SELECTOR switch in 115V position and operating the unit from a 115V line, the total available current from the primary winding connections to J1 is 200 mA for use with user-designed plug-ins With 115/230 switch in 230V position and operating the unit from a 230V line, the available current from the primary winding connection to J1 is 100 mA per winding. This load should be balanced between the two windings.

4-65. HIGH VOLTAGE POWER SUPPLY. (See schematic 7.)

4-66. The high voltage power supply develops the voltages used for operation of the CRT. The supply consists of two high voltage oscillators with their associated high voltage transformers, rectifiers, filters and high voltage regulating circuitry. Operating power for the high voltage supply is provided by an unregulated +27V from the low voltage power supply.

4-67. The CRT cathode and grid voltages are provided from one supply and the post-accelerator high voltage by a second supply. Cathode and grid supply voltages are regulated by sampling the supply output voltage and controlling the operating point of the oscillator. Fuse F2 provides overload protection and A3C1 decouples the high voltage supplies from the +27V power.

4-68. CRT Post-accelerator Voltage. Transistor Q3 with the transformer of assembly A9 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.

4-69. The high voltage used for the CRT post-accelerator is also regulated. This is accomplished by sensing the collector voltage of the post-accelerator oscillator transistor and using this to control the oscillator drive level. The post-accelerator is held to approximately 5 kV.

4-70. Variations in voltage at the collector of Q3 are sensed by the regulator. Since the high voltage output of the supply depends on the amount of oscillator drive to the transformer, the collector voltage is representative of the dc output of the supply. The peak collector voltage is rectified by A3CR4, filtered and divided across A3R2 and A3R3. The resultant voltage drives A3Q1, and the output of A3Q1 drives a darlington amplifier consisting of A3Q2 and Q2.

4-71. The amplifier output is applied to the oscillator, Q3, through the transformer. This change in drive level to the oscillator results in action to maintain the output voltage at a constant level. Thus, fluctuations of the unregulated +27V supply or of the CRT load are stabilized.

4-72. High Voltage Doubler. The oscillator output from the transformer is rectified by a voltage doubler and filtered. The output voltage of approximately +5 kV is used as the CRT post-accelerator voltage. The rectifier-doubler components are encapsulated as a complete assembly for environmental protection. (Should failure of a component occur, the entire assembly should be replaced.)

4-73. CRT Grid and Cathode Voltages. Transistor Q1 and transformer A4T1 operate at about 50-kHz to develop the CRT grid and cathode operating voltages. Regenerative coupling to sustain oscillation is provided by a feedback winding on the transformer. Separate secondary windings are used for developing the grid and cathode voltages. The CRT cathode voltage is half-wave rectified by A4CR2 and filtered by A6C19. The output voltage of the supply is established by the oscilloscope operating mode. When operated in the standard

(STD) or conventional (CONV) mode, the output is —1440V. When the instrument is operated in the FAST mode, the output voltage is approximately —2850V. The voltages developed are regulated as described later in this section.

4-74. The grid voltage is half-wave rectified by A4CR1 and filtered by A4C1. The lower limit of display intensity, as determined by the CRT grid voltage, is set by A6R94, the STD intensity limit adjustment, or by A6R98, the FAST intensity limit adjustment. (See schematic 4.) The front-panel INTENSITY control (R2) operates to set the intensity of the writing beam to the desired display level.

4-75. When the instrument is operated in the STD or CONV modes, the operation of A6Q15 and A6Q16 provides intensity limiting. Transistor A6Q15 being in the non-conducting state holds A6Q16 off placing A6R49 in series between —12.6V and the INTENSITY control. Resistor A6R49 limits the current available to the gate amplifier input. When the FAST mode is selected, pushbutton switch A5S1 grounds the input to A6Q15, turning A6Q16 on. With A6Q16 on, —12.6V is supplied directly to the INTENSITY control.

4-76. In the STD and CONV modes (see schematic 4), a high input (about +2V) is applied at pin 6 of J2 turning A6Q24 on. Transistors A6Q24 and A6Q25 form a differential steering switch. When A6Q24 is on, +15V is supplied to the A6R96/A6CR14 junction, backbiasing A6CR14. Current from A6Q14 is dropped across A6CR15, A6R97, A6R98, and A6R99 to ground. A6R98 is adjusted for proper maximum display brightness in the FAST mode. When A6Q25 is on, +15V is supplied to the A6R97/A6CR15 junction, backbiasing A6CR15. Current from A6Q14 is dropped across A6CR14, A6R96, A6R94, and A6R95 to ground. A6R94 is adjusted for maximum display brightness in the STD mode.

4-77. *High Voltage Regulator.* (See schematic 7.) A portion of the rectified and filtered CRT cathode voltage is used to control the conduction of A6Q18. In STD and CONV operation, the —1440V supply and the +100V supply are applied across a resistor network consisting of A6R66, A6R80, A6R55 and A6R81. The base level of A6RQ18 is set by the adjustment of A6R55. Any variation of the —1440V supply is sensed by A6Q18 and amplified by A6Q19 and A6Q20. The regulator output, as set by A6R55 and controlled by the divided output of the —1440V supply, is used to control the operating level of the oscillator through the feedback winding of A4T1. Any variation in the high voltage output is used to vary the oscillator drive and maintain the CRT grid and cathode voltages at a constant level.

4-78. If, for example, the CRT cathode voltage tends to decrease (go more positive), a positive-going signal is applied to the regulator. This is amplified and applied to the base of the oscillator, Q1. The oscillator then conducts for a greater period of time, causing a large voltage change at the primary of the transformer. This increases the output voltage to the desired level.

4-79. When the instrument is operated in the FAST mode, A6Q17 is made nonconducting. Diode A6CR12 conducts. This places A6R54 in parallel with A6R55 (the standard H.V. adjustment) and A6R56. The base input to A6Q18 goes more positive, resulting in increasing the regulator output to oscillator Q1. This change in input causes the high voltage output to be approximately —2850V in the FAST mode.

4-80. Operation in a write-in-store mode (either FAST/STORE or STD/STORE) acts to slightly decrease the high voltage output. Cathode voltage changes about 2%. In the write-in-store mode, transistor A6Q22 is turned off and A6Q21 conducts. Additional current flows through A6R81 from the +100V supply by the series combination of A6R56, A6R84 and A6Q21. This causes the base of regulator transistor A6Q18 to go slightly more negative and results in a slightly reduced high voltage output.

4-81. GATE AMPLIFIER. (See schematics 4 and 7.)

4-82. The simplified block diagram of the gate amplifier (figure 4-7) illustrates the operation of the gate amplifier. Refer to it and the schematic while reading the following explanation.

4-83. The inputs to the gate amplifier are the unblanking gate from the time base plug-ins, a chopped blanking signal from the vertical amplifier plug-ins, the storage circuit pulse signal and an external input Z-axis signal. The output of the amplifier is used to unblank the display. These four signals may be present singly or simultaneously, depending on the control settings and signals applied.

4-84. The unblanking gate is combined in the low impedance input circuit of the amplifier with a current established by the INTENSITY and DISPLAY controls. Depressing the FIND BEAM pushbutton does not affect the intensity of the display. When the DISPLAY control is set to the external input position, additional current is supplied to the gate amplifier 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. This additional current sets a nominal brightness level.

4-85. The gate amplifier senses the summed input signal current, converts it to a voltage, amplifies the signal, and couples it to the grid of the CRT write gun. In addition, a portion of the input signal is differentiated, clipped, and coupled to the

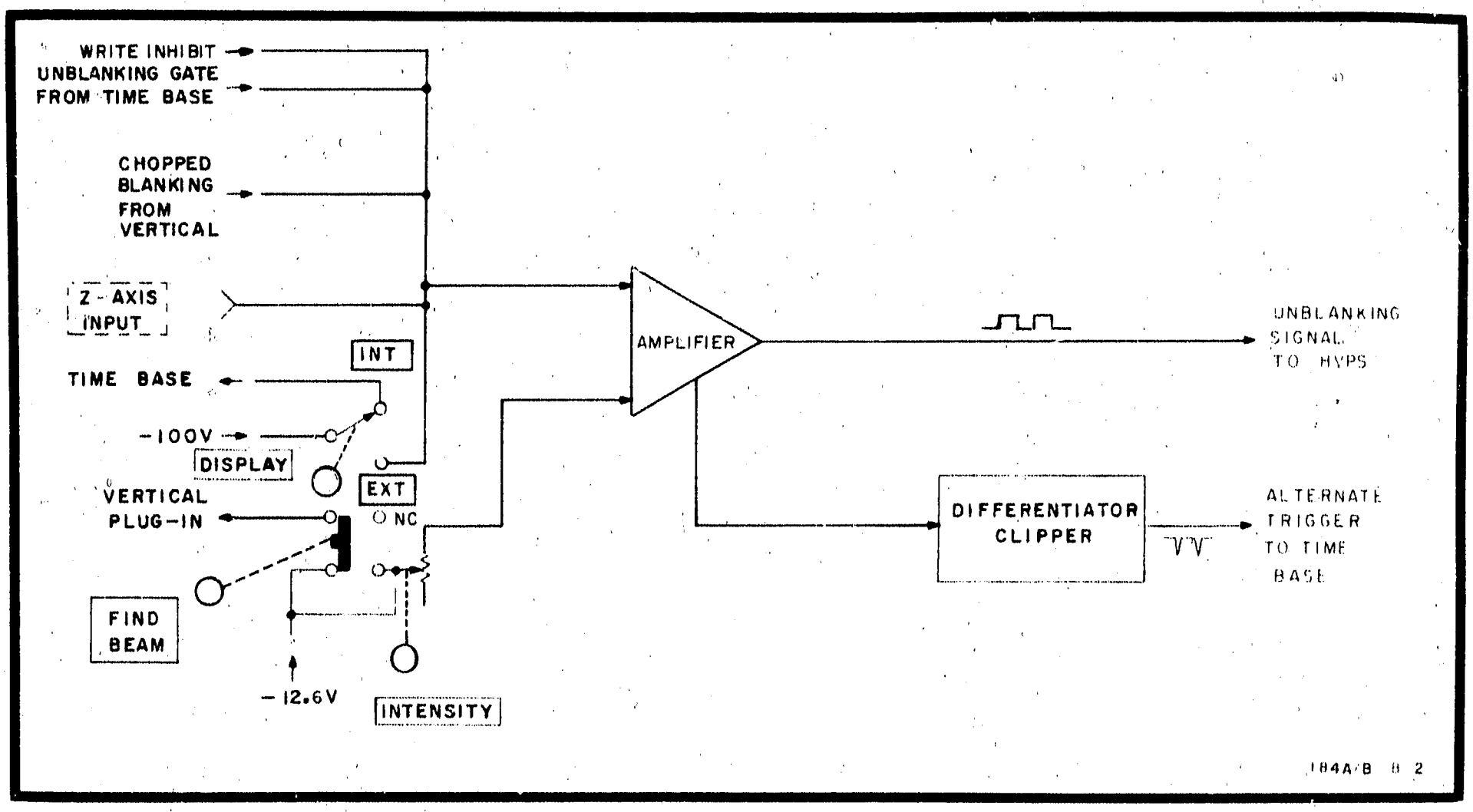


Figure 4-7. Gate Amplifier Block Diagram

vertical amplifier plug-in for use as an alternate trigger signal.

4-86. The signal input currents to the gate amplifier are summed in the low impedance emitter circuit of A6Q1. This current is added to the current from the INTENSITY control. The resulting current is coupled to a complementary feedback amplifier. This is a current-fed operational amplifier and consists of transistors A6Q4 through A6Q7. **Current from the INTENSITY control, R2, is coupled to the FOCUS control, R5, via A6Q26 to automatically correct focus as intensity is changed.**

4-87. The large negative feedback from the collectors of A6Q6 and A6Q7 to the bases of A6Q4 and A6Q5 results in a complementary amplifier with a very stable gain. Capacitors A6C3 and A6C4 provide adjustment of the high frequency feedback and gain. Decreasing the capacitance of A6C3 decreases the high frequency feedback and increases high frequency gain; decreasing the capacitance of A6C4 increases high frequency feedback and decreases high frequency gain. Diodes A6CR7 and A6CR8 provide voltage breakdown protection for A6Q6 and A6Q7.

4-88. Multichannel vertical amplifier plug-ins use an alternate trigger signal to initiate channel switching action. A portion of the summed signal from A6Q1 is coupled through emitter follower A6Q23, differentiated, and applied to A6Q8 and A6Q9. The signal is clipped, amplified by A6Q8 and A6Q9, and applied to an RC differentiator consisting of A6C11 and A6R34. The differentiated signal is amplified by A6Q10 and used as the alternate trigger signal for the vertical amplifier plug-in.

4-89. The write gun inhibit input signal to A6Q1 from pulse circuit assembly A8 is used to control write blanking. It operates to hold the gate amplifier off during the period of the ERASE pulse. The inhibit signal also holds the gate amplifier off when the instrument is operated in the STORE mode. The gate amplifier is enabled, however, when operated in a write-in store mode.

4-90. PULSE CIRCUIT. (See schematic 6.)

4-91. A unijunction oscillator, A8Q10, is the source of variable frequency pulses which are applied to A8U1, a monstable multivibrator. The operating frequency of A8Q10 is controlled by the setting of the PERSISTENCE and STORE TIME controls. These controls vary the current through A8Q9 to A8Q10 and change the operating frequency of A8Q10. The output of A8U1 is a pulse train of variable recurrence rate (frequency) with a constant pulse width of about 28 usec.

4-92. The constant width variable frequency pulses are applied through two NOR gates, A8U5C and A8U5A, to transistor A8Q5. The circuitry of A8Q5 modifies the level of the pulses and introduces a dc offset. Applied to the CRT storage mesh, this controls the CRT storage time. An increased pulse level increases the depth of erasure, thus decreasing writing speed and increasing storage time.

4-93. Erase. When the ERASE pushbutton is depressed, the CRT storage mesh is brought up to the +156V level by the 100-ms erase pulse from assembly A2. This is accomplished by turning A8Q6

on, turning A8Q17 off, A8Q23 on, and A8Q7 on.

4-94. **At the end of the erase pulse the CRT storage mesh is returned to the +3.3-volt level. A8Q6 turns off, which in turn causes A8Q7 to turn off. Since a capacitor and series limiting resistor are connected from the collector of A8Q7 to ac ground, the collector of A8Q7 will return to its quiescent value at a time constant determined by the RC time constant of A8C4 and the equivalent resistance it sees in the circuit. While A8C4 is charging, A8C5 is discharging and after the time time constant of A8C5 is discharging and after the time constant of A8C5 and A8R38 has reached a sufficient value, A8Q8 will turn on causing a low at pin 3 of A8U5A. The output of the NOR gate is coupled to A8U5. The signals are added together in the diode switching network of A8CR2, A8CR3, and A8CR5 and then applied to the storage mesh.**

4-95. During the ERASE interval, or when operating in the STORE mode, the input to A8Q13 is high. This provides a write gun inhibit signal to the gate amplifier and prohibits turning on the CRT write gun. A clean erasure of the storage mesh occurs since no writing of an input signal can take place while erasing.

4-96. Store. Operating the instrument in the STORE mode connects the STORE TIME control to the variable rate oscillator circuitry of A8Q9 and A8Q10. The resulting variable rate pulses are supplied through A8U1 and NOR gate A8U4B to the base of A8Q12. Normally A8Q12 is cut off and A8Q22 is saturated, grounding A8R59. Potentiometer A8R59 is adjusted for proper bias on the flood gun grid to give uniform flood illumination. The pulse train from A8U1 turns on A8Q12 which cuts off A8Q22. The —100V through A8R58 is then applied to the flood gun grid, stopping flood gun electrons. This cuts off flood illumination, reduces fade-positive of the display, and gives a long storage time.

4-97. With the instrument operating in a write-in-store mode (STD/STORE or FAST/STORE, the monostable multivibrator, A8U1, is made non-operational. Therefore, no pulses can be applied to the storage mesh for erasing or to the flood gun grid. However, the write gun is enabled and can write information for storage.

4-98. Write-in-store. Two NAND gates, A8U3A and A8U3B, form a flip-flop. This flip-flop is used to remember the operating mode (STD or FAST) used to write a display. Output of the flip-flop provides drive to A8Q16 which serves as the switch for turning front panel lamp DS2 on or off. When FAST operation is selected, DS2 is turned on to advise the operator that the CRT inner graticule must be used for measurements. The flip-flop also selects the required collimator adjustment for FAST or STD operation.

4-99. A8Q14 operates in a common base configuration and A8Q15 as an emitter follower. They operate to supply collimator voltage to the CRT for collimating the beam of flood gun electrons. To provide an evenly distributed erasure over the storage mesh, the 1-kHz signal from the calibrator oscillator is used to modulate the collimating voltage during erasure. The 1-kHz signal is applied to A8U3C, amplified by A8Q18 and coupled to A8Q14.

4-100. Conventional Operation. During conventional nonstorage operation, A8Q2 is off, turning A8Q1 off. A reduced current is provided to the junction of A8CR2 and A8CR3. Diode A8CR3 is reverse biased, resulting in —32V being applied to the CRT storage mesh. This large negative voltage on the storage mesh prevents flood gun electrons from reaching the CRT phosphor. However, write gun electrons will go through the storage mesh because they are at a higher energy level and will write on the phosphor to produce a visible trace.

4-101. CALIBRATOR. (See schematic 9.)

4-102. An integrated circuit, A6U1, is used as an oscillator for developing the CAL 10V output. Two transistors within A6U1 operate as a multivibrator whose output drives a compensated current steering switch (also contained in A6U1), and the switch output is divided across A6R58 and A6R59 to establish the calibrator output voltage.

4-103. TRACE ALIGNMENT. (See schematic 7.)

4-104. When the instrument is operated in the FAST mode, the writing beam is at a higher accelerating velocity than when in STD or CONV. This requires a different amount of trace correction current through the trace align and Y align coils.

4-105. The front panel TRACE ALIGN screwdriver adjustment, R6, is used to control trace alignment current for instrument operation in the STD and CONV MODES. Operational amplifier A7U1 has an offset input from a fixed voltage divider and an adjustable input from R6. Additional offset is switched in when operated in the FAST mode. The amount of offset is set by adjustment of A7R65. Transistors A7Q16 and A7Q17 buffer the output of A7U1 to the trace align coil.

4-106. Y-axis alignment current in the STD and and CONV modes is set by adjustment of A7R64. When operated in the FAST mode, the current is set by adjustment of A7R63.

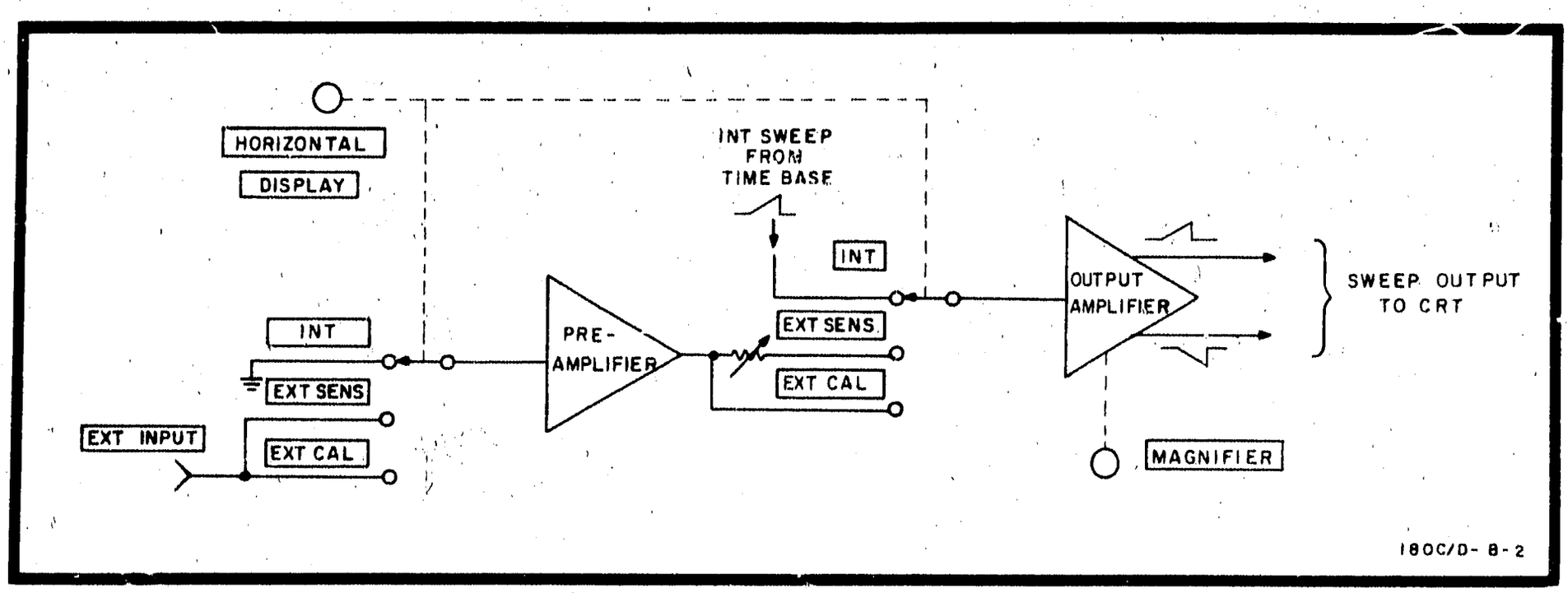


Figure 4-8. Horizontal Amplifier Block Diagram

4-107. HORIZONTAL AMPLIFIER. (See schematic 3.)

4-108. The input to the horizontal amplifier is either an internal sweep signal from the horizontal plug-in or an external input signal applied to the horizontal EXT INPUT jack.

4-109. Positioning the DISPLAY switch, A5S1, to INT grounds the input of the preamplifier and simultaneously disconnects the external signal preamplifier from the output amplifier. The internal sweep signal is then connected through the horizontal DISPLAY switch to the output amplifier. See figure 4-8.

4-110. With EXT selected, the amplitude of the signal from the preamplifier is adjustable by rotating the DISPLAY control. When the control is in the EXT CAL detent position, the output amplitude of the amplifier is directly determined by the input amplitude of the signal connected to the EXT INPUT jack.

4-111. 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.

4-112. Use schematic 3 as a reference for the more detailed explanation of circuit operation which follows.

4-113. An external signal applied to the preamplifier is coupled through a 3:1 divider composed of A7R2 and A7R3 to the gate of an FET, A7Q1. The high input impedance of A7Q1 in conjunction with the voltage divider and A7R1 provides a 1-megohm load to the external circuit. Transistor A7Q2 is an emitter follower. The output of A7Q2 is coupled through the horizontal EXT SENS control and the horizontal DISPLAY switch. The amount of current supplied to A7Q3 is determined by A7R9 and the setting of the EXT SENS control.

4-114. The bandwidth of the preamplifier is decreased when the Phase/Bandwidth switch A7S1 is placed in the Phase position. This is accomplished by connecting A7C3 and A7C4 into the circuit. The phase shift caused by the decreased bandwidth compensates for the signal time delay introduced by the delay line in the vertical amplifier plug-in. This allows accurate X-Y measurements to be made up to 100 kHz.

4-115. A vernier balance adjustment, A7R11, is used to establish a zero input voltage reference level. This eliminates horizontal dc shift as the EXT SENS control is operated. The EXT SENS provides a range of control of the deflection factor when an EXT INPUT signal is used for horizontal deflection The control has sufficient range to reduce the deflection factor by at least X10.

4-116. The input signal to A7Q3 is summed in the low impedance emitter circuit with a current established by the horizontal POSITION and FINE controls. The output of A7Q3 has both a static dc level as determined by the POSITION and FINE controls and an active level as determined by the input signal.

4-117. The output of A7Q3 is coupled through emitter follower A7Q4 to a differential amplifier consisting of A7Q6 and A7Q7. The low impedance necessary to drive A7Q6 is provided by A7Q4 and A7Q5 maintains a similar low impedance for A7Q7.

4-118. The position of the MAGNIFIER switch, S3, selects between three values of emitter de-

generation for A7Q6 and A7Q7 and controls the gain of these stages. As degeneration decreases, gain increases. The gain selection is accomplished by the setting selected for the MAGNIFIER control, with settings of X1, X5, and X10. Each has an adjustable element to provide for accurate calibration of the gain.

4-119. When X1 magnification is selected, A7R40 is used to set the gain. A7R38 sets the gain in X5, and A7R36 sets the X10 gain. The emitter potentials of A7Q6 and A7Q7 are balanced by A7R43. This prevents horizontal dc shift as the MAGNIFIER control is switched between ranges.

4-120. The differential signal at the collectors of A7Q6 and A7Q7 is applied to current-fed operational amplifiers A7Q8/A7Q9/A7Q10 and A7Q11/A7Q12/A7Q13. 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 differential output amplifier is separately adjustable.

4-121. High frequency feedback from the collectors of A7Q9/A7Q10 to the base of A7Q8 is controlled by A7C7 and high frequency feedback from the collectors of A7Q12/A7Q13 to the base of A7Q11 is controlled by A7C17. The ratio of feedback for each side of the amplifier is adjusted by A7C10. Amplifier output is a voltage used to drive the CRT horizontal deflection plates.

4-122. Diodes A7CR4/A7CR5 and A7CR8/A7CR9 limit the amplifier output to the CRT deflection plates and prevent overdriving. Diodes A7CR3 and A7CR7 prevent A7Q6 and A7Q7, respectively, from saturating.

4-123. Depressing the FIND BEAM pushbutton disables diodes A7CR8 and A7CR9. This blocks the deflection signal to A7Q8. The differential gain is effectively cut in half, and the horizontal deflection of the beam is confined to the limits of the CRT.

4-124. When the instrument is operated in the FAST mode, the horizontal amplifier gain is reduced. A7Q14 is normally off and A7Q15 normally on. Selecting the FAST mode of operation turns A7Q15 off and A7Q14 on. The conduction of A7Q14 activates relay A7K1 and reduces the amplifier gain. Accurate setting of the gain is controlled by the fast horizontal gain adjustment, A7R16. The dc balance of the amplifier is set by adjustment of the fast horizontal balance potentiometer, A7R18.

4-125. SWEEP GATE OUTPUT AMPLIFIERS. (See schematic 8.)

4-126. The output amplifiers are four emitter followers, A10Q1 through A10Q4. They provide isolated outputs of time base, sampling, or TDR generated signals to rear panel output connectors. The operating and service manual for the plug-in will provide information of the characteristics of the output signals.

4-127. 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 input signals to low impedance outputs and isolate the time base signals from external equipment.

4-128. The time base outputs available at the MAIN SWEEP OUTPUT and the DELAYED SWEEP OUTPUT connectors are positive-going ramps of about 5 volts amplitude. The time base outputs at the MAIN GATE OUTPUT and the DELAYED GATE OUTPUT are negative-going pulses of about 2.5 volts amplitude. These outputs can supply 3 mA and will drive impedances as low as 1000 ohms without distortion.

PERFORMANCE CHECK AND ADJUSTMENTS

Table 5-1. Recommended Test Equipment

Instrument Type	Recommended Model	Required Characteristics	Required For
Voltmeter Calibrator	HP 738AR or HP 738 BR	1V, 2V, and 10V p-p ±0.2%	Calibrator Check. Horizontal Magnifier Check.
Monitor Oscilloscope	HP 180C/D w/1801A and 1820C plug-ins	Sensitivity 1 V/div Sweep speed <3 usec Sweep output	Calibrator Check. Gate Amplifier Response Adjustment. Collimation and Writing Rate Adjustment. Transient Response Adjustment.
10:1 Divider Probe	HP 10004D	±3%	Gate Amplifier Response Adjustment.
Digital Voltmeter	HP3440A w/3441A or 3444A plug-in	Accuracy ±.05%	Low-voltage Power Supply Adjustment. High-voltage Power Supply Adjustment.
1000:1 Divider Probe	HP K05-3440A		High-voltage Power Supply Adjustment.
Square-wave Generator	HP 211B	200 kHz, 1 V p-p	Transient Response Adjustment.
Oscillator	HP 652A	400 Hz-100 kHz, 10V p-p	Horizontal Bandwidth Check. Fast Vertical Gain Adjustment. Collimation and Writing Rate Adjustment. Phase Adjustment. Trace Alignment Adjustment. Write-in-store Adjustment (2 reqd).
Resistor: 40K Ω	HP Part No. 0698-6101	1/10%, 1/2W	Horizontal Gain Adjustment (Alternate Procedure).
Time-mark Generator	HP 226A	1-ms markers	Horizontal Gain Adjustment (Alternate Procedure). Horizontal Linearity Adjustment.
50-ohm Tee	HP 1250-0781	BNC	Phase Adjustment.
Screwdriver	HP 8710-0900	Posidrive	Cover Removal.

7000-A-19

SECTION V

PERFORMANCE CHECK AND ADJUSTMENTS

5-1. INTRODUCTION.

5-2. This section provides a performance check procedure to determine if Model 184A/B is operating within specifications and a procedure for adjustment and calibration. Physical location of the adjustments is 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.

a. Install time base and vertical amplifier plug-in units in Model 184A/B.

b. Set INTENSITY fully ccw.

c. Set PERSISTENCE fully ccw.

d. Set STORE TIME fully ccw.

e. Depress STD pushbutton.

f. Set line voltage SELECTOR switch, located on rear panel, to desired power line operating voltage (115V or 230V ac).

g. Connect instrument to line power source and apply power by turning LINE power switch ON.

h. Entire screen should be evenly illuminated after 3 minutes.

i. Allow 30 minutes for warm-up.

5-10. CALIBRATOR CHECK.

a. Set Model 184A/B controls as follows:

MAGNIFIER X5
DISPLAY ..... EXT CAL
coupling ..... AC
operating mode ..... STD

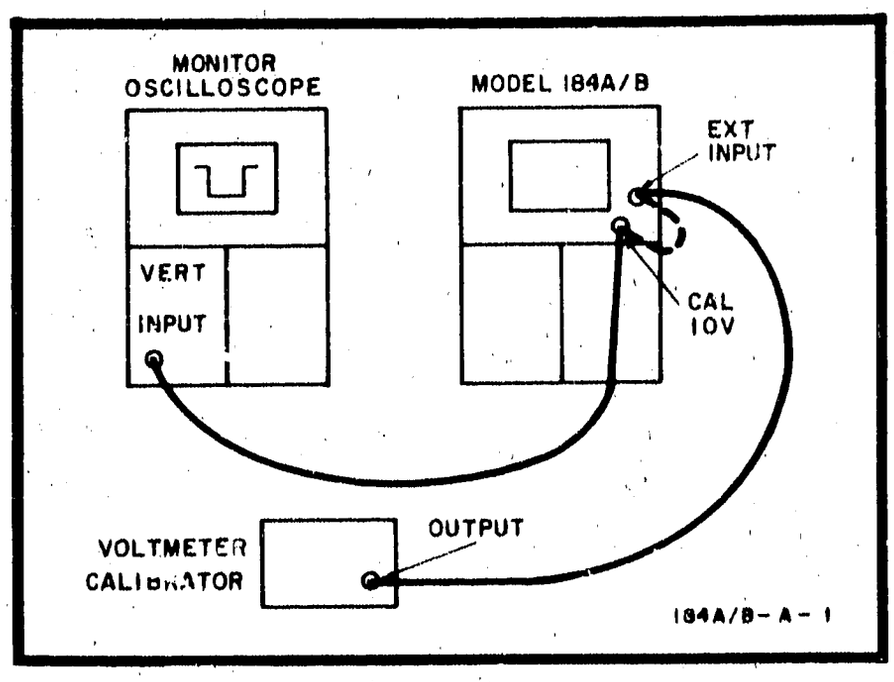


Figure 5-1. Calibrator Check

b. Connect 10V p-p signal from voltmeter calibrator to EXT INPUT (figure 5-1).

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

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

e. Disconnect voltmeter calibrator from EXT INPUT. Do not disturb DISPLAY.

f. Connect CAL 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 CAL 10V output from EXT INPUT.

i. Observe CAL 10V output using monitor oscilloscope.

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

k. Disconnect monitor oscilloscope.

l. Set INTENSITY fully ccw.

5-11. HORIZONTAL MAGNIFIER CHECK.

a. Set Model 184A/B controls as follows:

MAGNIFIER X1
DISPLAY ..... EXT CAL
operating mode ..... STD

b. Connect 10V p-p signal from voltmeter calibrator output to EXT INPUT (figure 5-2).

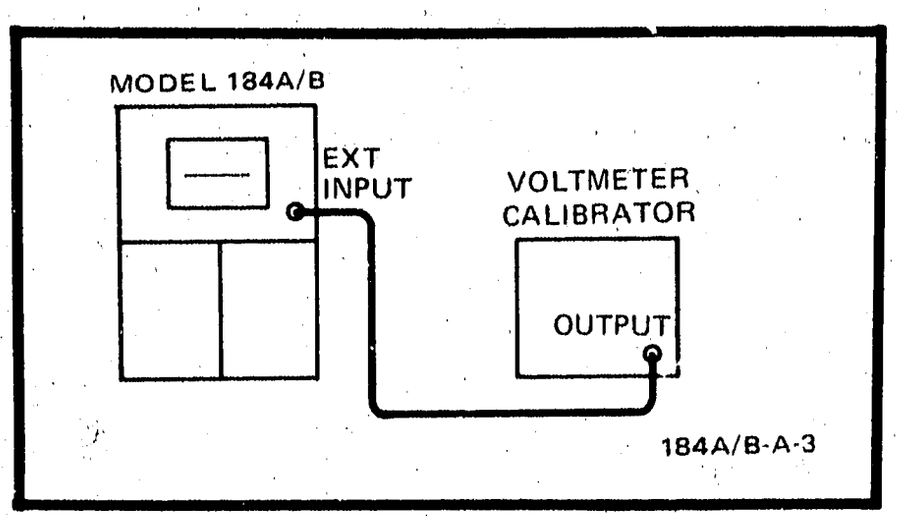


Figure 5-2. Horizontal Magnifier Check

c. Obtain display by adjusting INTENSITY cw.

d. Note displayed trace of 10 ±0.5 divisions.

e. Set MAGNIFIER to X5.

f. Set voltmeter calibrator for output of 2V p-p.

g. Note displayed trace of 10 ±0.5 divisions.

h. Set MAGNIFIER to X10.

i. Set voltmeter calibrator for output of 1V p-p.

j. Note displayed trace of 10 ±0.5 divisions.

k. Disconnect voltmeter calibrator.

l. Set INTENSITY fully ccw.

5-12. HORIZONTAL BANDWIDTH CHECK.

a. Connect 50-kHz signal from oscillator to EXT INPUT (figure 5-3).

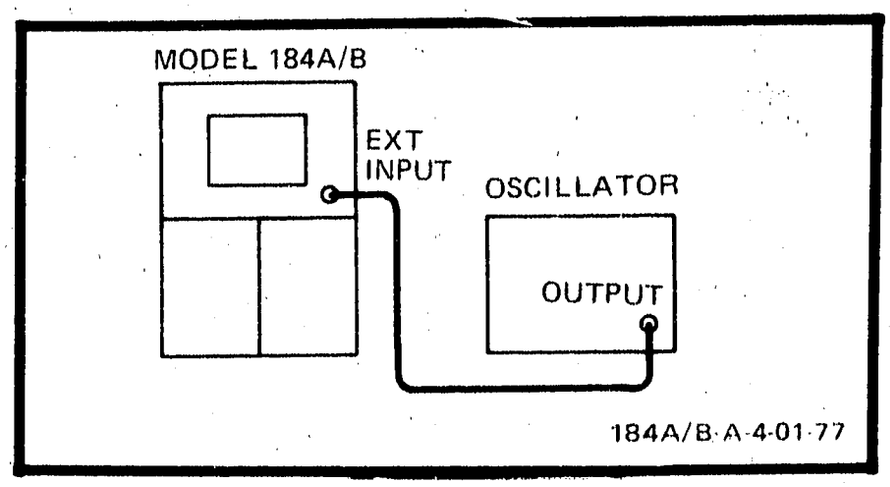


Figure 5-3. Horizontal Bandwidth Check

b. Set MAGNIFIER to X1.

c. Obtain display by adjusting INTENSITY.

d. Adjust output of oscillator to obtain displayed trace of exactly 10 divisions.

e. Note indication on oscillator output meter.

f. Set oscillator for output freqency of 5 MHz.

g. Increase oscillator output to that noted in step e.

h. 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.)

5-13. BEAM FINDER CHECK.

a. Adjust INTENSITY and POSITION to obtain display.

b. Set POSITION fully ccw.

c. Depress FIND BEAM pushbutton.

d. Observe that display appears on-screen.

Note

Beam intensity is not increased when FIND BEAM is depressed. Use INTENSITY to set viewing level.

5-14. PERSISTENCE AND STORE TIME CHECK.

a. Set Model 184A/B controls as follows:

DISPLAY	INT
MAGNIFIER	X1
operating mode	STD
PERSISTENCE	fully ccw

b. Set vertical amplifier plug-in controls as follows:

display	A
volts/div	0.5
input coupling	AC

c. Set time base plug-in controls as follows:

sweep display (if applicable)	MAIN
time/div	0.1 sec
sweep mode	AUTO
trigger source	INT
trigger coupling	AC

d. Slowly rotate INTENSITY cw until spot just appears. If necessary, use POSITION and vertical amplifier position control to display spot on-screen.

e. Observe tail on spot. Tail shall be no longer than 1/2 div anywhere on display.

f. Slowly rotate PERSISTENCE cw. Length of tail shall increase with cw rotation of control.

g. Set time base for sweep speed of 50 μsec/div.

h. Set PERSISTENCE fully cw and INTENSITY fully ccw. Display shall remain visible for 1 minute.

i. Depress STORE pushbutton.

j. Set STORE TIME fully ccw. Display shall remain visible at slightly reduced intensity.

k. Rotate STORE TIME cw. Display intensity shall decrease with cw rotation and extinguish when fully cw.

l. Depress STD pushbutton.

m. Press ERASE pushbutton. Display shall be dark, except for possible few small brilliant spots (figure 5-4).

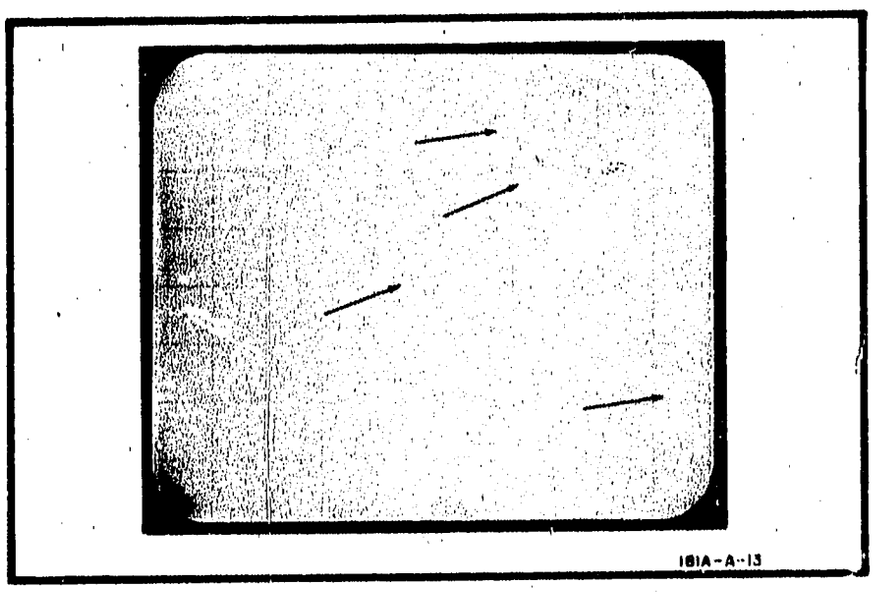


Figure 5-4. Brilliant Spots in CRT Display

n. Rotate INTENSITY slowly cw until display is at normal viewing intensity, then fully ccw.

o. Set PERSISTENCE fully ccw. Display background shall become illuminated and displayed signal shall disappear.

p. Rotate PERSISTENCE fully cw. Display background shall become dark.

q. Set time base for single sweep operation.

r. Rotate INTENSITY control cw until spot just appears at left edge of display or until fully cw.

s. Press ERASE pushbutton.

t. Trigger sweep with time base reset control. If necessary, vary time base trigger level control to trigger sweep. (Adjust FOCUS as required to obtain sharpest trace.)

Note

Use single sweep operating mode to obtain sharply focused display. Press ERASE pushbutton after each display. Slightly readjust FOCUS, and retrigger sweep. Repeat as necessary, erasing each time FOCUS is changed.

u. Depress STORE pushbutton and set STORE TIME fully cw.

v. After 10 minutes, press STD pushbutton. Display shall be visible.

w. Press ERASE pushbutton.

x. Rotate INTENSITY fully ccw.

y. Depress FAST pushbutton.

z. Set time base for sweep speed of 0.1 usec/div and single sweep operation.

aa. Set MAGNIFIER to X10.

ab. Press ERASE pushbutton. Display background will be illuminated with both bright and dark areas. Mesh pattern may also be visible.

ac. Rotate INTENSITY control fully cw or until spot just appears at left-hand edge of center graticule area or until fully cw. Adjust horizontal and vertical POSITION controls to place spot at left-hand edge of inner graticule and approximate vertical center of CRT.

ad. Set time base for operation from line trigger source.

ae. Trigger single sweep by setting time base trigger level control fully cw, pressing reset pushbutton to arm sweep, and rotating trigger level control. (Adjust FOCUS control as required to obtain sharpest trace.) Display shall remain visible within center 7 x 9 divisions (small graticule) of CRT for at least 10 seconds.

Note

Use single sweep operating mode to obtain sharply focused display. Press ERASE pushbutton after each display. Slightly readjust FOCUS control, and retrigger sweep. Repeat as necessary erasing each time FOCUS is changed.

af. Set STORE TIME fully cw.

ag. Press ERASE pushbutton.

ah. Trigger single sweep by setting time base trigger level control fully cw, pressing reset pushbutton to arm sweep, and rotating trigger level control.

ai. Depress STORE pushbutton.

aj. After 30 seconds, press FAST pushbutton. Display shall be 90% visible within center 7 x 9 divisions (small graticule) of CRT.

Note

If fade positive condition (defined in paragraph 3-5) has existed for several minutes prior to checking FAST writing speed, CRT writing speed may be temporarily reduced. To restore normal writing speed, switch to STD mode and set PERSISTENCE to minimum for 5 minutes. Return to step y and repeat this procedure.

ak. Depress STD pushbutton.

al. Set INTENSITY fully ccw.

am. Set PERSISTENCE fully ccw.

5-15. WRITE-IN-STORE CHECK.

a. Set Model 184A/B controls as follows:

operating mode	STD
STORE TIME	fully ccw
PERSISTENCE	fully cw
MAGNIFIER	X1
INTENSITY	fully ccw
STD WRITE SPD	NORM

b. Set time base for sweep speed of 5 usec/div and for single sweep operation.

c. Simultaneously depress STD and STORE pushbuttons.

d. Rotate INTENSITY cw until spot just appears at left edge of display or until fully cw.

e. Press ERASE pushbutton.

f. Trigger single sweep with time base reset control. If necessary, vary time base trigger level control to trigger sweep.

g. Depress STORE pushbutton. Trace shall be visible.

h. Simultaneously depress FAST and STORE pushbuttons.

i. Set time base for sweep speed of 0.1 usec/div.

j. Set MAGNIFIER to X10.

k. Press ERASE pushbutton.

l. Rotate INTENSITY cw until spot just appears at left edge of display or until fully cw.

m. Press ERASE pushbutton.

n. Trigger single sweep with time base reset control. If necessary, vary time base trigger level control to trigger sweep.

o. Depress STORE pushbutton. Trace shall be visible.

p. Depress STD pushbutton.

q. Set INTENSITY fully ccw.

r. Set PERSISTENCE fully ccw.

PERFORMANCE CHECK RECORD

MODEL 184A/B

Instrument Serial Number _____ **Date** _____

Check	Specification	Measured
CALIBRATOR CHECK		
Amplitude	9.9 – 10.1 div	
Risetime	⩽3 usec	
MAGNIFIER CHECK		
X1	9.5 – 10.5 div	
X5	9.5 – 10.5 div	
X10	9.5 – 10.5 div	
BANDWIDTH CHECK		
X1		
50 kHz	Set to 10 div	
5 MHz	⩾7.1 div	
BEAM FINDER CHECK		
	Beam on-screen	
PERSISTENCE AND STORETIME CHECK		
Minimum (fully ccw)	⩽1/2 div	
Maximum (fully cw)	⩾1 min	
STD storetime (50 usec/div sweep)	>10 min	
FAST storetime (0.1 usec/div sweep, X10)	⩾10 sec	
FAST storetime (fully cw)	>30 sec	
WRITE–IN–STORE CHECK		
STD/STORE	Visible display	
FAST/STORE	Visible display	

5-16. ADJUSTMENT PROCEDURE.

5-17. The following paragraphs outline the procedure for accomplishing the adjustments required for Model 184A/B. 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. 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.

5-20. 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 supply, and horizontal amplifier are particularly important in this respect.

5-21. COVER REMOVAL.

WARNING

The servicing procedures are performed with power supplied to the instrument while protective covers are removed. Be careful when performing these operations. Line voltage is always present on terminals including the power input connector, fuse holder, power switch, etc. When the instrument is on, voltages are present at many points and can result in injury or death when contacted.

5-22. Model 184A. 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. 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.

5-23. Model 184B. To gain access to the rack-type instrument, the top cover, side cover and the rear LVPS access panel must be removed. 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 left side cover, held in place with six screws.

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

5-24. PRELIMINARY SETUP.

a. Install time base and vertical amplifier plug-ins in Model 184A/B.

b. Set INTENSITY fully ccw.

c. Set PERSISTENCE fully ccw.

d. Set STORE TIME fully ccw.

e. Depress STD pushbutton.

f. Set line voltage SELECTOR switch, located on rear panel, to desired power line operating voltage (115V or 230V ac).

g. Check that fuse of proper size is installed.

h. Connect instrument to line power source.

i. Apply power by turning LINE power switch ON.

j. Check that Phase/Bandwidth switch is in Bandwidth position.

k. Allow 15 minutes for warmup.

5-25. LOW VOLTAGE POWER SUPPLY ADJUSTMENT.

a. Connect digital voltmeter to +100V test point A1A2TP1 (figure 5-5).

b. Set +100V Adj A1A2R11 to obtain reading of +100V ±0.1V.

c. Connect digital voltmeter to +15V test point A1A2TP2.

d. Set +15V Adj A1A2R20 to obtain reading of +15V ±0.1V.

e. Connect digital voltmeter to —12.6V test point A1A2TP3.

f. Set —12.6V Adj A1A2R29 to obtain reading of —12.6V ±0.1V.

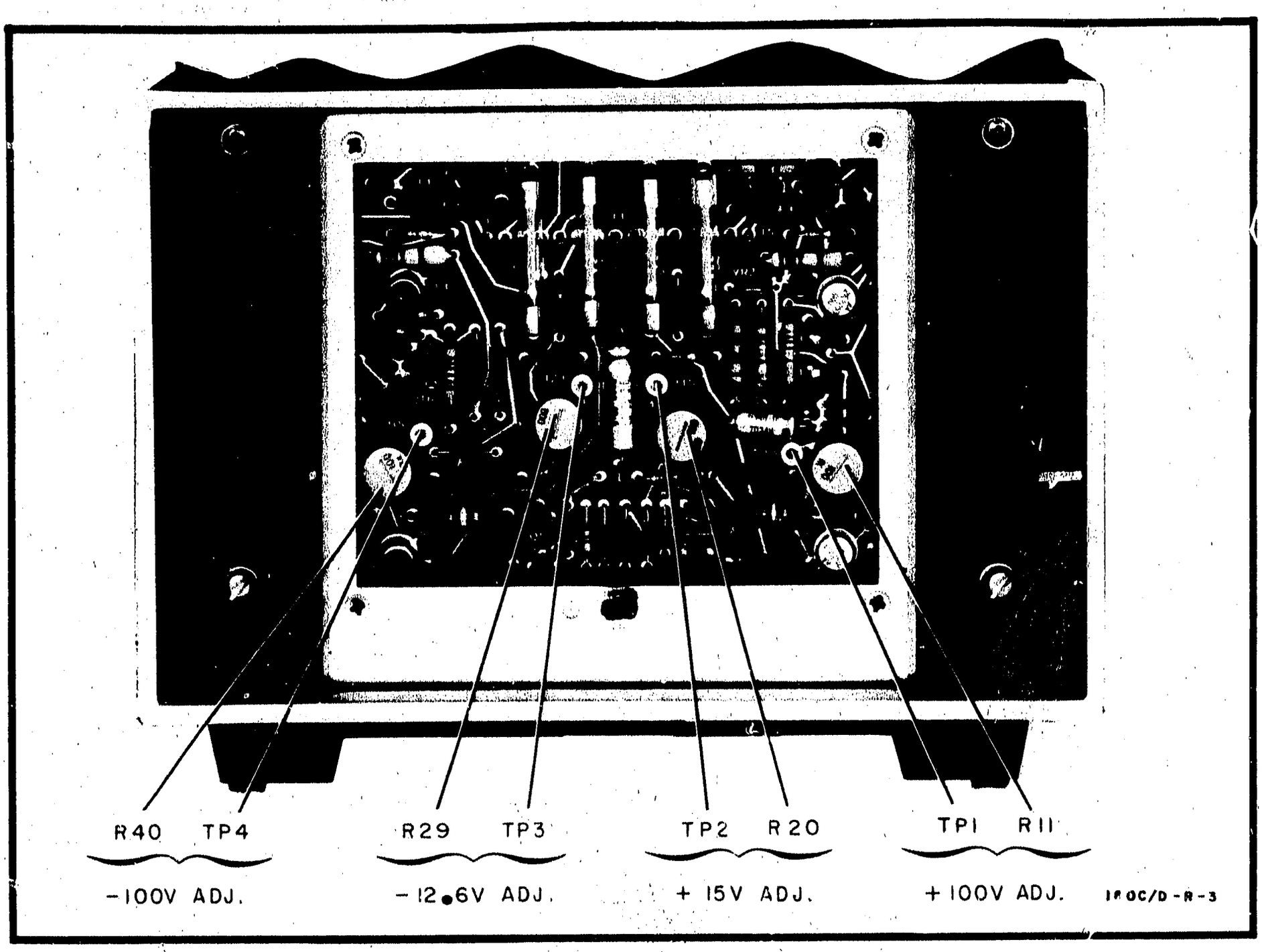


Figure 5-5. Low Voltage Power Supply Adjustments

g. Connect digital voltmeter to —100V test point A1A2TP4.

h. Set —100V Adj A1A2R40 to obtain reading of —100V ±0.1V.

5-26. HIGH VOLTAGE POWER SUPPLY ADJUSTMENT.

a. Using 1000:1 divider probe, monitor voltage at —100V test point A1A2TP4 with digital voltmeter (figure 5-6).

b. Note voltage reading, which will be approximately —0.100V. Accuracy in measuring voltage is essential for accurate high voltage adjustment.

c. Multiply reading obtained in step b by 1.440.

WARNING

High voltage is present and easily accesible when making the following measurement and adjustment. Be careful. Use an insulated screwdriver to make the adjustment.

d. Using 1000:1 divider probe, monitor high voltage at A6TP1 with digital voltmeter (figure 5-6).

e. Set Std HV Adj A6R55 to obtain reading exactly equivalent to result obtained in step c. Required high voltage output of supply is —1440V.

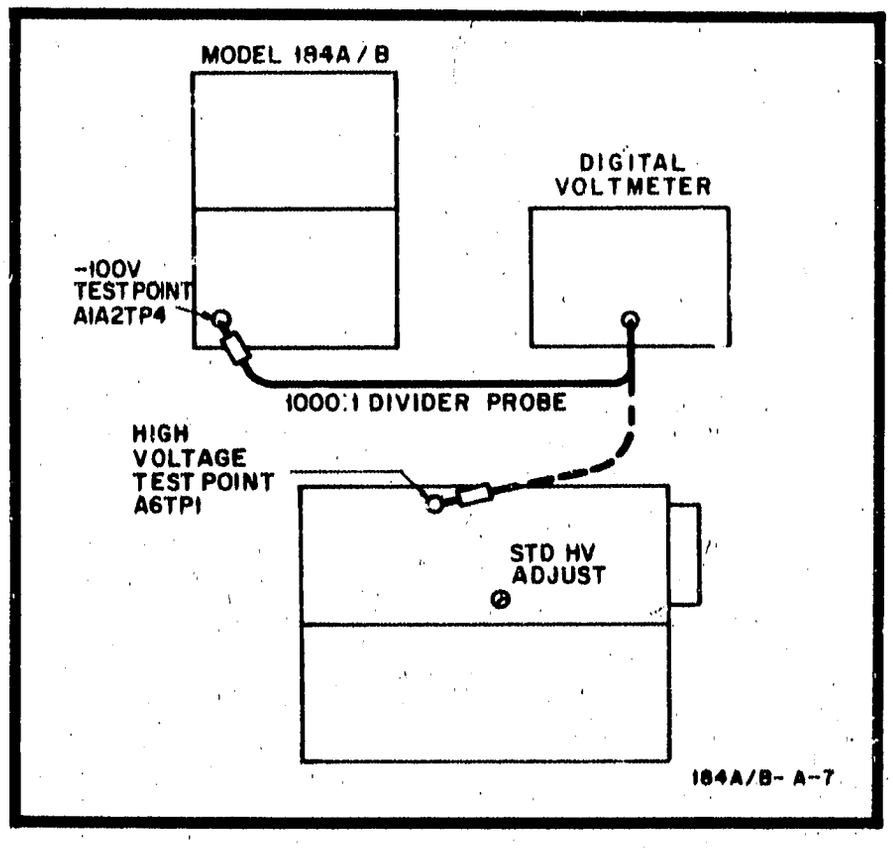


Figure 5-6. High Voltage Adjustment

5-27. ASTIGMATISM ADJUSTMENT.

a. Set DISPLAY to EXT CAL.

b. Slowly rotate INTENSITY control cw until low intensity spot appears.

c. Center spot with POSITION and vertical amplifier position control.

d. Adjust FOCUS and ASTIG front-panel screwdriver adjustment for smallest round spot.

5-28. INTENSITY LIMIT ADJUSTMENT.

a. On time base, set sweep mode to single.

b. Set Model 184A/B controls as follows:

DISPLAY ..... INT
PERSISTENCE ..... fully ccw
operating mode ..... FAST

c. Press ERASE pushbutton.

d. Rotate INTENSITY control fully cw. A spot may appear at left-hand edge of display.

e. Adjust Fast Int Limit A6R98 until spot is just extinguished when INTENSITY control is fully cw. ERASE display after each adjustment of A6R98.

f. Set PERSISTENCE fully cw and readjust A6R98 as necessary if spot appears.

g. Depress STD pushbutton.

h. Repeat steps c through f and in step e adjust Std Int Limit A6R94 instead of A6R98.

i. Set INTENSITY fully ccw.

j. Set PERSISTENCE fully ccw.

5-29. TRACE ALIGNMENT ADJUSTMENT.

a. Set Model 184A/B controls as follows:

MAGNIFIER X1
DISPLAY ..... EXT CAL
PERSISTENCE ..... fully ccw
STORE TIME ..... fully ccw
operating mode ..... STD

b. Connect oscillator 400-Hz 10V output to EXT INPUT (figure 5-7).

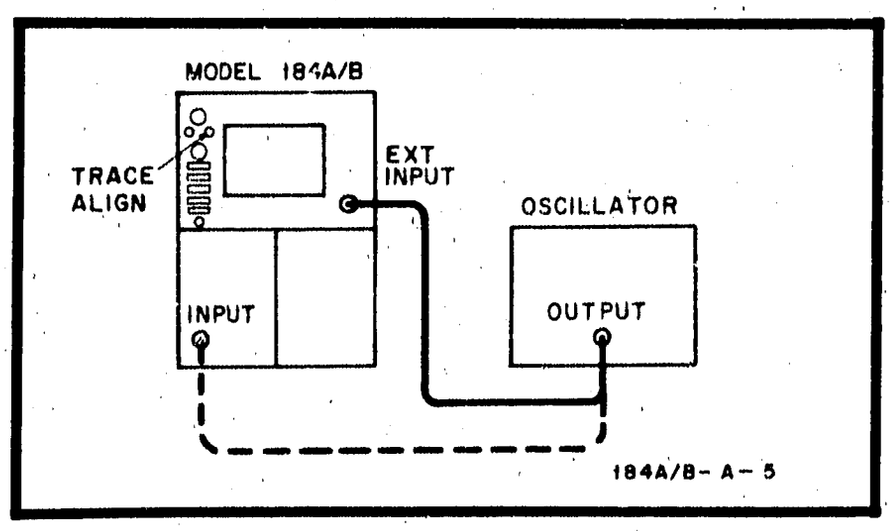


Figure 5-7. Trace Alignment Adjustment

c. Rotate INTENSITY slowly cw until display appears.

d. Center trace horizontally and position trace on center graticule line.

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 input of vertical amplifier plug-in (figure 5-7).

h. Set DISPLAY to EXT CAL.

i. Set vertical amplifier plug-in controls to obtain vertical trace of exactly 8 divisions.

j. Adjust Std Y Align Adj A7R64 to align vertical trace parallel to center vertical graticule line.

k. 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 rise times are to be obtained in both —up and +up operation.

l. Set INTENSITY fully ccw.

m. Depress FAST pushbutton.

n. Press ERASE pushbutton.

o. Repeat steps b through f, adjusting Fast Trace Align A7R65.

p. Press ERASE pushbutton.

q. Repeat steps g through k, adjusting Fast Y Align A7R63.

r. Depress STD pushbutton.

s. Adjust Patt Adj A6R56 for straightest trace when trace is positioned to left and right sides of graticule.

t. Set INTENSITY fully ccw.

u. Disconnect oscillator.

5-30. GATE AMPLIFIER RESPONSE ADJUSTMENT.

a. Set Model 184A/B controls as follows:

PERSISTENCE ..... fully ccw
DISPLAY ..... INT
MAGNIFIER X1
operating mode ..... FAST

b. Set time base controls to obtain baseline display with sweep speed of 0.1 usec/div.

c. Set vertical amplifier position control fully ccw for off-screen display.

d. Set monitor oscilloscope controls as follows:

volts/div 1
time/div ..... 0.1 usec
trigger source ..... internal
trigger slope ..... +
coupling ..... dc

e. Using 10:1 divider probe and monitor oscilloscope, observe gate pulse signal at collector of A6Q6 (figure 5-8).

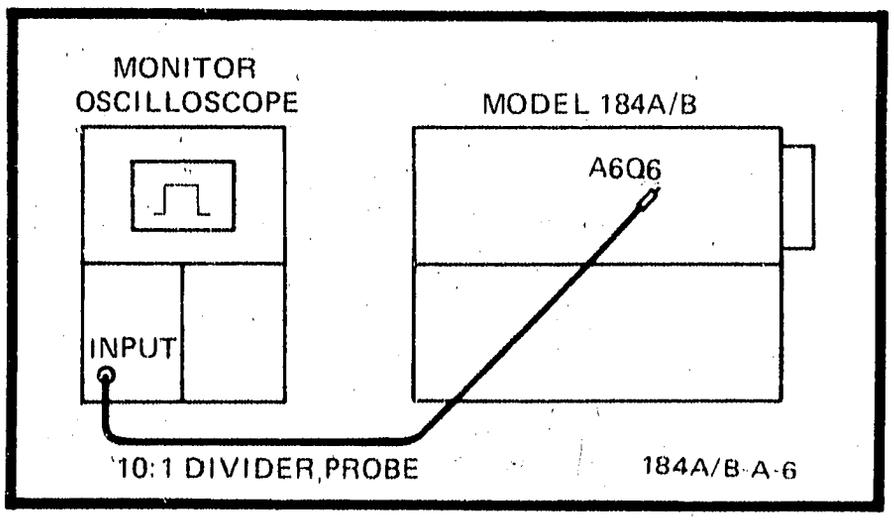


Figure 5-8. Gate Amplifier Response Adjustment

f. Rotate INTENSITY control cw until gate pulse amplitude is 70V.

g. Adjust Gate Resp Adj No. 1 A6C3 and Gate Resp Adj No. 2 A6C4 for optimum fast risetime and pulse flat-top response. Decreasing capacitance of No. 1 reduces risetime; decreasing capacitance of No. 2 reduces overshoot.

h. Set INTENSITY fully ccw.

i. Depress STD pushbutton.

j. Disconnect monitor oscilloscope.

5-31. FAST VERTICAL GAIN ADJUSTMENT.

a. Set Model 184A/B controls as follows:

DISPLAY ..... EXT CAL
MAGNIFIER X1
PERSISTENCE ..... fully ccw
operating mode ..... STD

b. Connect oscillator to input of vertical amplifier (figure 5-9).

c. Adjust oscillator for 10 kHz output and amplitude to display exactly 8 divisions of vertical deflection.

d. Set INTENSITY fully ccw.

e. Depress FAST pushbutton.

f. Rotate INTENSITY cw to view display.

g. Adjust Fast HV Adj A6R54 to display exactly 8 divisions of vertical deflection as measured with inner graticule.

h. Depress STD pushbutton.

i. Disconnect oscillator.

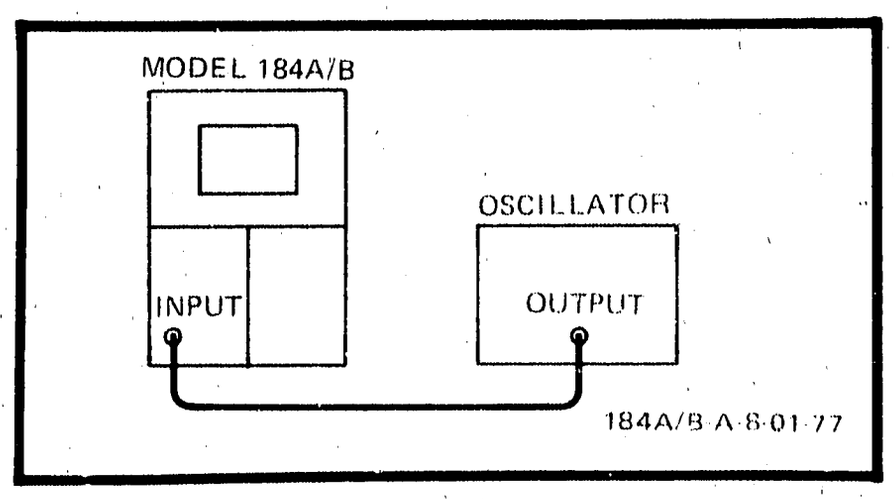


Figure 5-9. Fast Vertical Gain Adjustment

5-32. HORIZONTAL GAIN ADJUSTMENT.

a. Set controls as follows:

DISPLAY ..... EXT CAL
MAGNIFIER X1
PERSISTENCE ..... fully ccw
operating mode ..... STD

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

WARNING

+100V will be present at open lead of resistor connected in next step.

c. Connect 40-kilohm, 0.1%, 1/2W resistor between +100V supply and emitter of A7Q3. 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 POSITION to center left-hand spot exactly on left-hand vertical graticule line.

e. While alternately connecting and disconnecting resistor to emitter of A7Q3, adjust X1 Gain Adj A7R40 for exactly 10 major divisions of separation between spot positions (figure 5-10).

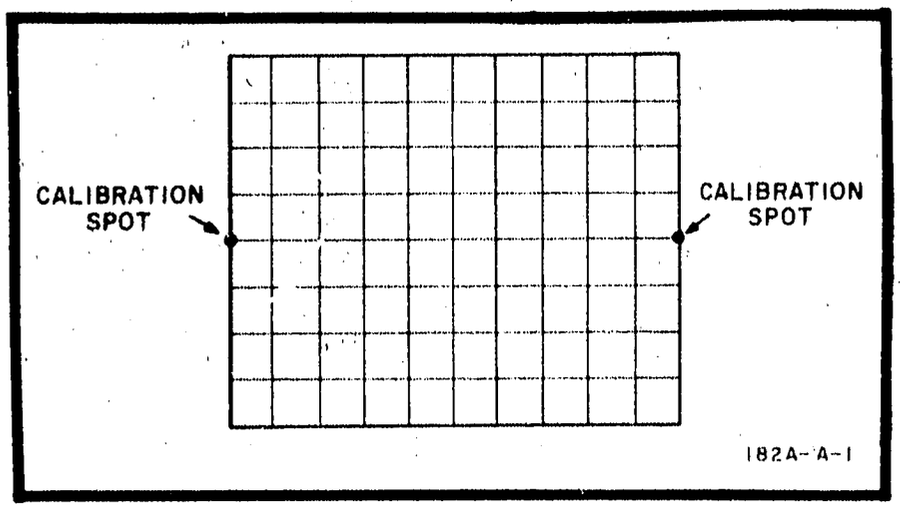


Figure 5-10. Calibration Display

f. Set DISPLAY to INT.

g. Set for 1 ms/div sweep speed.

h. Apply 1-ms markers from time mark generator to input of vertical plug-in.

i. 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.

j. Set MAGNIFIER to X5.

k. Adjust X5 Gain Adj A7R38 to obtain display of exactly 1 marker for 5 divisions.

l. Set MAGNIFIER to X10.

m. Adjust X10 Gain Adj A7R36 obtain display of exactly 1 marker for 10 divisions.

n. Set MAGNIFIER to X1.

o. Depress FAST pushbutton.

p. Press ERASE pushbutton.

q. Adjust Fast Horiz Gain Adj A7R16 for display of 11 markers in 10 divisions of inner graticule. Second marker should be on 2nd graticule line and 10th marker on 10th graticule line.

r. Disconnect time mark generator.

s. Depress STD pushbutton.

5-33. DC BALANCE ADJUSTMENT.

a. Set Model 184A/B controls as follows:

DISPLAY ..... EXT CAL
MAGNIFIER X10
operating mode ..... STD

b. Rotate INTENSITY control slowly cw until spot just appears.

c. Center spot on center graticule lines with POSITION and vertical amplifier position control.

d. Set MAGNIFIER to X1.

e. Adjust DC Bal Adj A7R43 to recenter spot.

f. Set MAGNIFIER to X10 and repeat steps c through f until spot does not shift from center when MAGNIFIER is switched from X1 to X10.

g. Set MAGNIFIER to X1.

h. Set INTENSITY fully ccw.

i. Depress FAST pushbutton.

j. Press ERASE pushbutton.

k. Rotate INTENSITY slowly cw until spot just appears.

l. Press ERASE pushbutton.

m. Adjust Fast Horiz Bal Adj A7R18 to center spot on center graticule line.

n. Depress STD pushbutton.

5-34. VERNIER BALANCE ADJUSTMENT.

a. Set Model 184A/B controls as follows:

MAGNIFIER X10
operating mode ..... STD

b. Rotate DISPLAY cw until it is just out of INT position (approximately 2 o'clock position).

c. Center spot with POSITION.

d. Set DISPLAY to EXT CAL.

e. Adjust Vern Bal Adj A7R11 to recenter spot.

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

5-35. WRITE-IN-STORE ADJUSTMENT.

a. Set Model 184A/B controls as follows:

PERSISTENCE ..... fully ccw
DISPLAY ..... EXT
operating mode ..... STD

b. Connect oscillator A 50-kHz sine wave output to vertical amplifier input (figure 5-11).

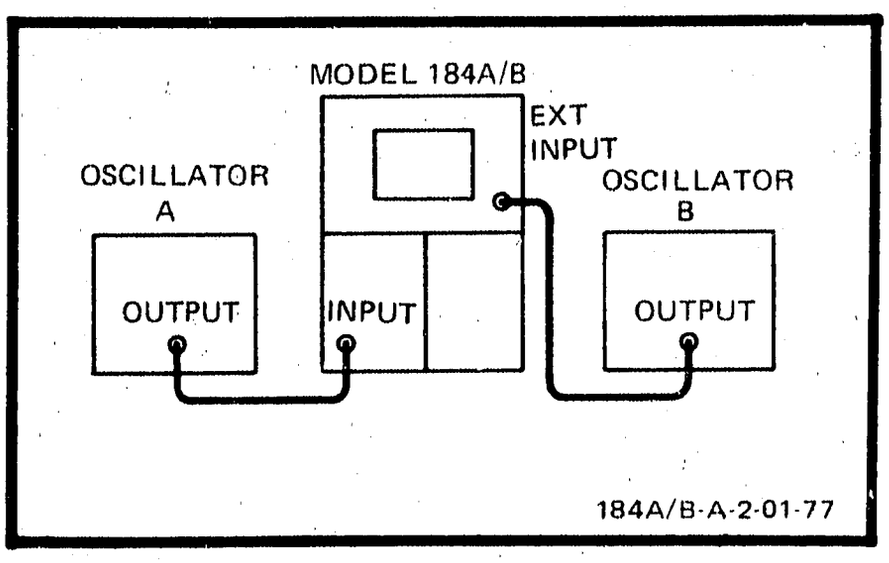


Figure 5-11. Write-in-store Adjustment

c. Connect oscillator B 10-kHz sine wave output to EXT INPUT.

d. Set outputs of oscillators A and B to display signal of exactly 6 divisions vertical amplitude and 8 divisions horizontal amplitude.

e. Simultaneously depress STD and STORE pushbuttons. Observe that vertical and horizontal amplitudes of displayed signal are slightly reduced.

f. Adjust Hv Adj Wrt In Str Adj A6R56 to obtain best compromise between 6-division vertical amplitude and 8-division horizontal amplitude.

g. Disconnect both oscillators.

h. Depress STD pushbutton.

5-36. PHASE ADJUSTMENT.

a. Set controls as follows:

Phase Bandwidth switch ..... Phase
MAGNIFIER X1
DISPLAY ..... EXT CAL
operating mode ..... CONV

b. Connect 10-kHz sine wave output of oscillator to EXT INPUT and to vertical plug-in channel B input (figure 5-12).

Note

Channel B of a multichannel vertical plug-in is normally used for phase measurement. If another channel must be used, connect oscillator to that channel.

c. Adjust oscillator output and deflection control of vertical amplifier to obtain 8-division display.

d. Adjust Input Comp Adj A7C1 for display of single diagonal line (no phase shift).

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

f. Adjust Phase Adj A7C3 for display of single diagonal line (no phase shift).

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.

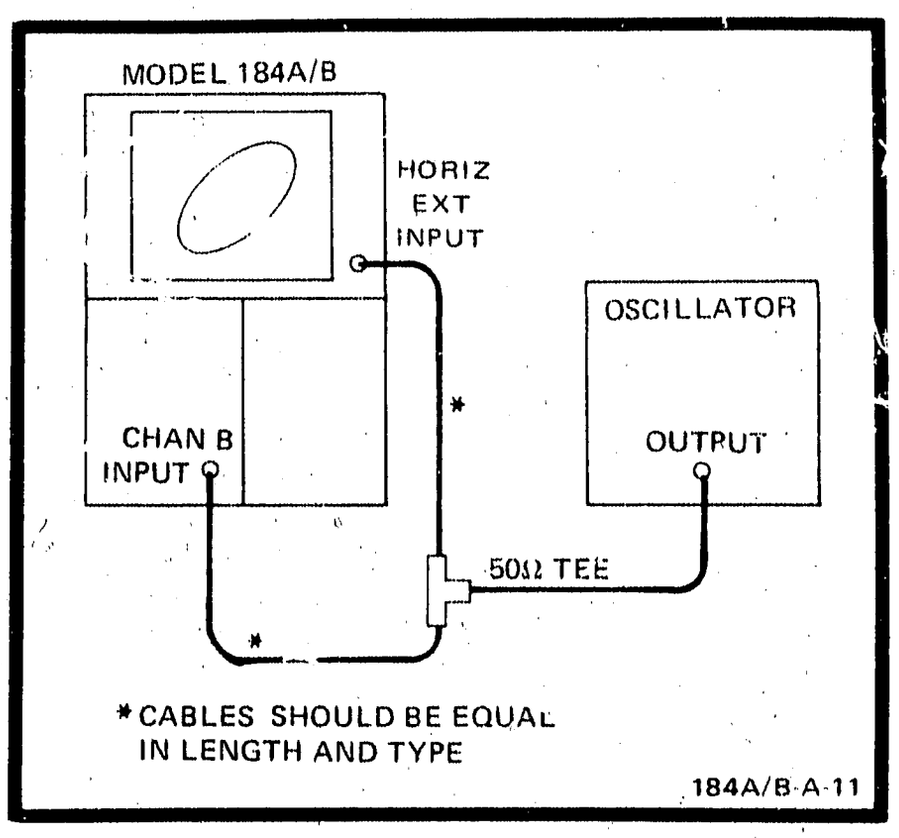


Figure 5-12. Phase and Compensation Adjustment

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 Model 184A/B controls as follows:

DISPLAY ..... EXT CAL
MAGNIFIER X1
operating mode ..... CONV

b. Connect 1V p-p square wave at 200-kHz repetition rate from square wave generator to EXT INPUT and to monitor oscilloscope vertical input (figure 5-13).

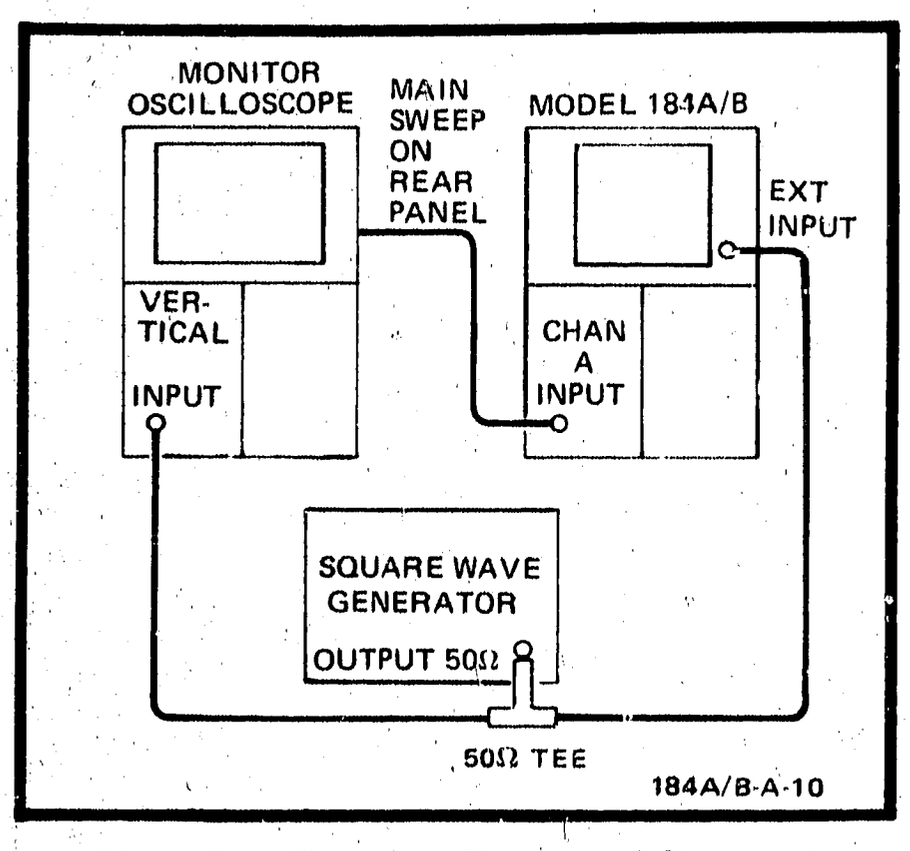


Figure 5-13. Transient Response Adjustment

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 184A/B vertical amplifier plug-in.

e. Adjust vertical plug-in 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 H Res Adj No. 1 A7C7, H Res Adj No. 2 A7C10, and H Resp Adj No. 3 A7C17 to obtain flat-top response with approximately 5% overshoot on lower right-hand corner of displayed pulse.

Note

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

g. Disconnect monitor oscilloscope.

h. Disconnect square wave generator.

5-38. HORIZONTAL LINEARITY ADJUSTMENT.

Note

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

a. Set Model 184A/B controls as follows:

MAGNIFIER X10
DISPLAY ..... INT
operating mode ..... CONV

b. Connect 20-nanosecond output from time-mark generator to vertical channel A input (figure 5-14).

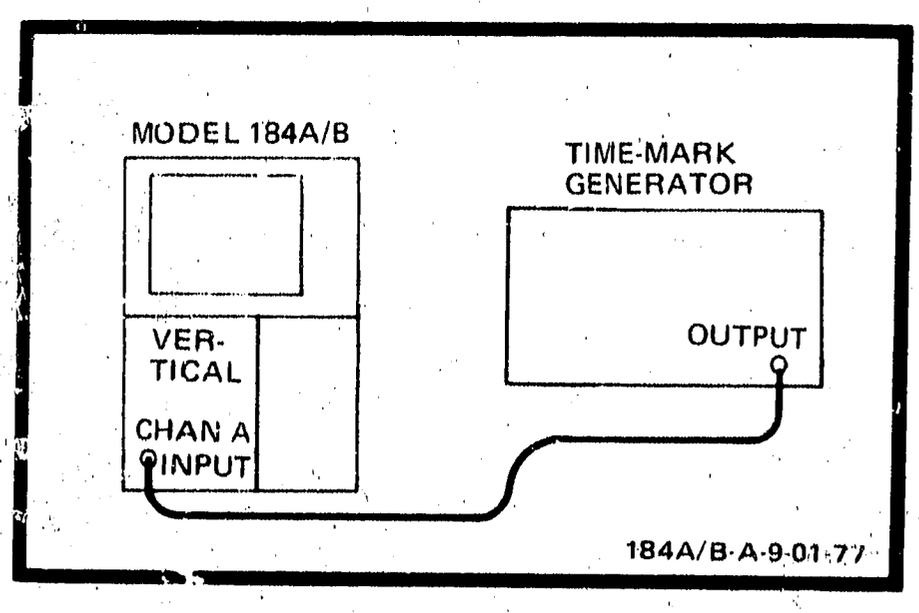


Figure 5-14. Horizontal Linearity Adjustment

c. Select fastest time base sweep speed (0.05 or 0.1 usec/div) and obtain display.

d. Adjust H Res Adj No. 1 A7C7, H Res Adj No. 2 A7C10, and H Resp Adj No. 3 A7C17 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. H Res Adj No. 1 affects left portion, H Res Adj No. 2 center portion, and H Res Adj No. 3 right portion of sweep.

e. Disconnect time-mark generator.

5-38. COLLIMATION AND WRITING RATE ADJUSTMENT.

a. Set Model 184A/B controls as follows:

PERSISTENCE	fully ccw
DISPLAY	INT
operating mode	STD
INTENSITY	fully ccw
MAGNIFIER	X1
STD WRITE SPD	NORM

b. Press ERASE pushbutton.

c. Set Std Lvl Adj A8R10 fully ccw.

d. Press ERASE pushbutton.

e. Adjust Std Col Adj A8R21 to just fill display area at uniform brightness level.

f. Press ERASE pushbutton.

g. Adjust G1 Lvl Adj A8R59 to obtain uniform background brightness level over entire display area.

h. Set time base controls for single sweep operation with sweep speed of 5 usec/div and to trigger from line.

i. Set PERSISTENCE fully cw.

j. Rotate INTENSITY cw until spot is just visible or until control is fully cw.

k. Trigger single sweep. Single trace should be displayed. It may be necessary to adjust FOCUS to obtain sharp trace.

Note

To obtain sharp display, adjust FOCUS control slightly, ERASE, and retrigger sweep. Repeat until sharpest display is obtained.

l. Displayed sweep should be visible across entire display area. If it is not, adjust Std Lvl Adj A8R10 slightly cw, ERASE and trigger single sweep. Repeat procedure until sweep is visible across entire display.

m. With sharply focused sweep visible across entire display, turn INTENSITY fully ccw and check that display remains visible for 1 minute. If it does not, readjust Std Lvl Adj A8R10 slightly ccw, ERASE, trigger single sweep and recheck for 1 minute display.

n. Depress FAST pushbutton.

o. Press ERASE pushbutton.

p. Set Fast Lvl Adj A8R8 fully ccw.

q. Adjust Fast Col Adj A8R25 to evenly illuminate display area. Entire display may not be illuminated at this time.

r. Set PERSISTENCE fully cw.

s. Adjust Fast Lvl Adj A8R8 cw in small increments, pressing ERASE after each change in adjustment. Adjust to obtain best compromise between light and dark background illumination over display area.

t. Connect oscillator 8.5-MHz sine wave output to vertical amplifier input (figure 5-15).

u. Set time base for normal sweep operation with sweep speed of 0.1 usec/div.

v. Depress STD and set PERSISTENCE fully ccw.

w. Rotate INTENSITY control cw until trace just appears.

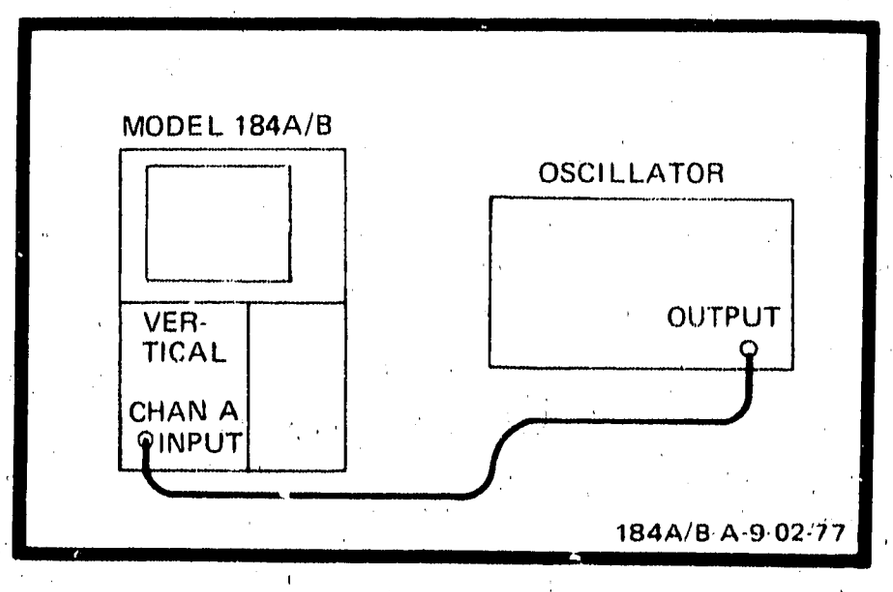


Figure 5-15. Fast Writing Rate Adjustment

x. Adjust oscillator and vertical amplifier controls to display exactly 8 divisions of vertical deflection as measured with internal graticule.

y. Set time base for normal sweep operation with sweep speed of 0.1 usec/div.

z. Set time base for single sweep operation.

aa. Set Model 184A/B controls as follows:

operating mode ..... FAST
PERSISTENCE..... fully cw
MAGNIFIER X1

ab. Press ERASE pushbutton.

ac. Rotate INTENSITY cw until vertical line just appears or control is fully cw.

ad. Trigger single sweep. An 8.5-MHz waveform should be visible across reduced display area. If not, adjust Fast Lvl Adj A8R8 slightly cw, ERASE, and trigger single sweep. Repeat procedure until signal is visible across reduced display.

ae. With sharply focused signal visible across reduced display, turn INTENSITY fully ccw and check that display remains visible for 10 seconds. If it does not, readjust Fast Lvl Adj A8R8 slightly ccw, ERASE, trigger single sweep and recheck for 10-second display.

af. Disconnect oscillator.

ag. Depress STD pushbutton.

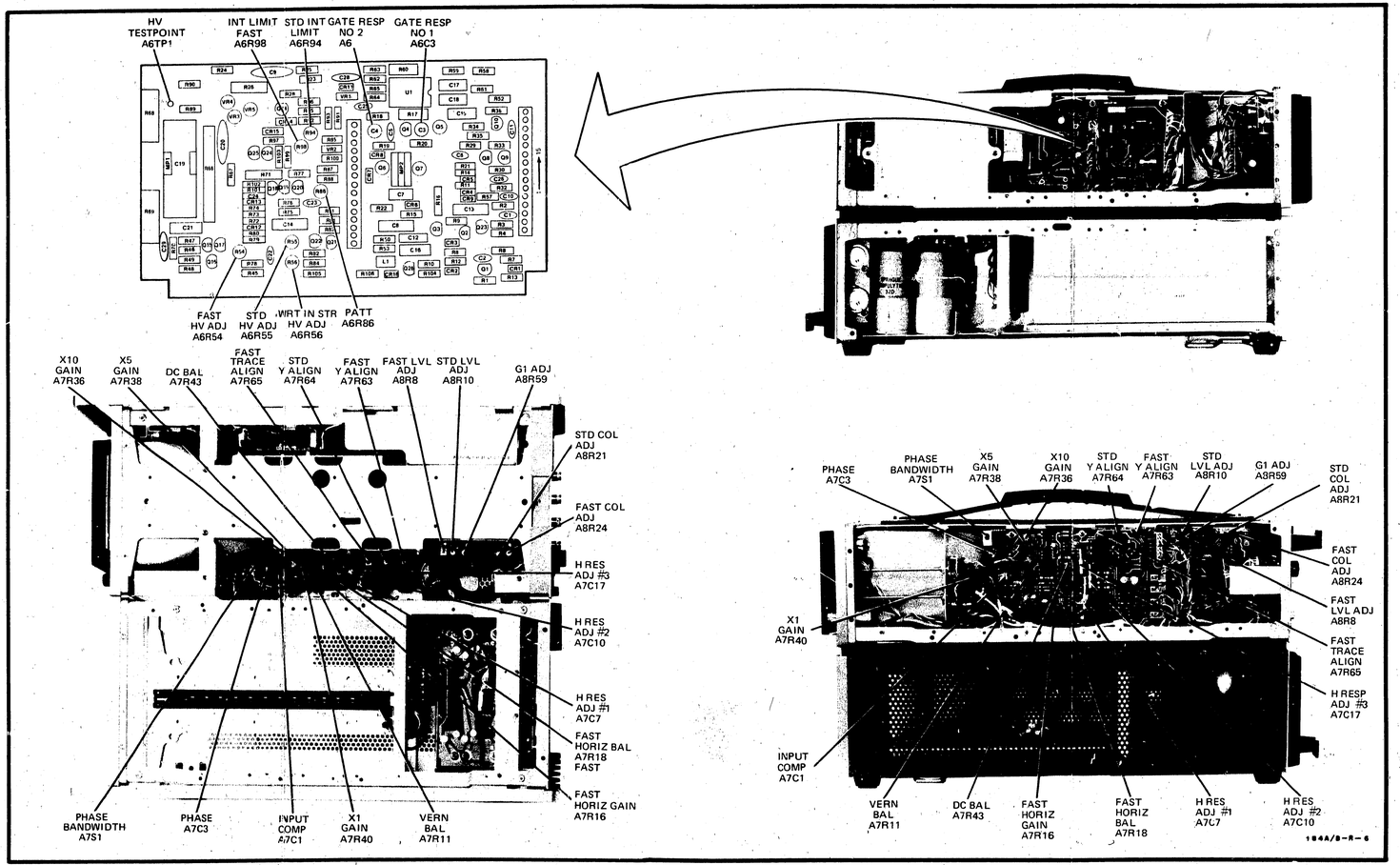


Figure 5-16.
Adjustment Locations

PARTS LIST

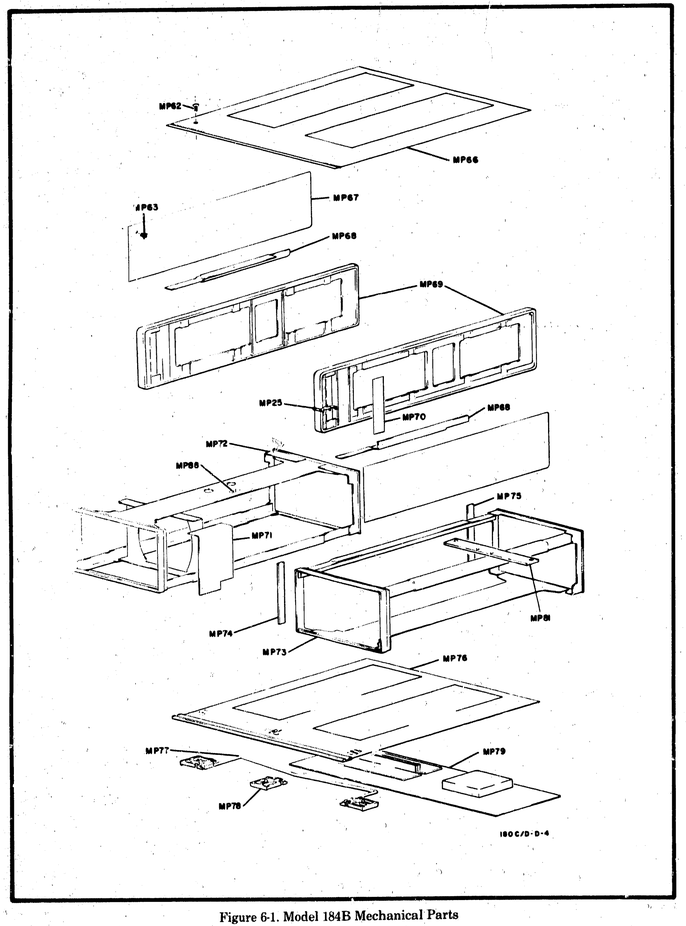
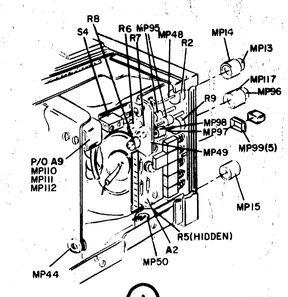
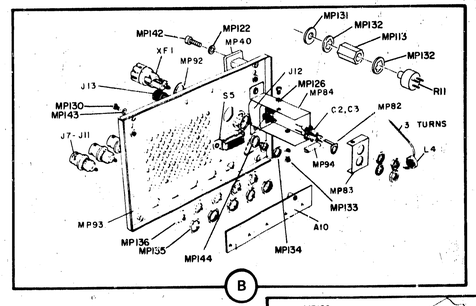
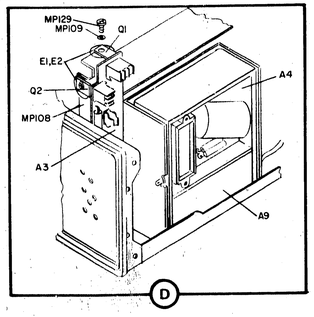
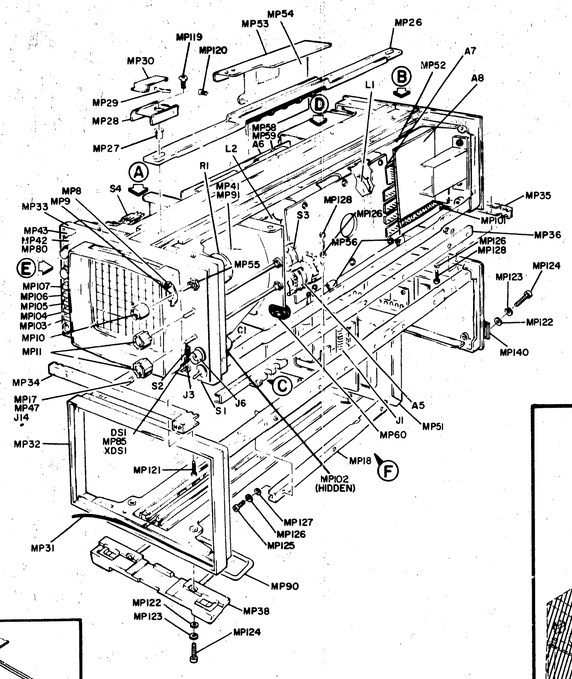


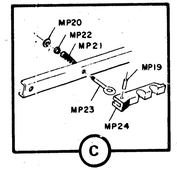
Figure 6-1. Model 184B Mechanical Parts

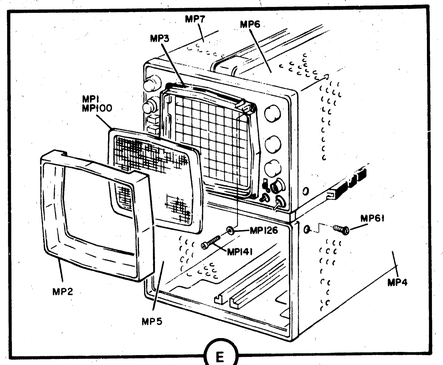












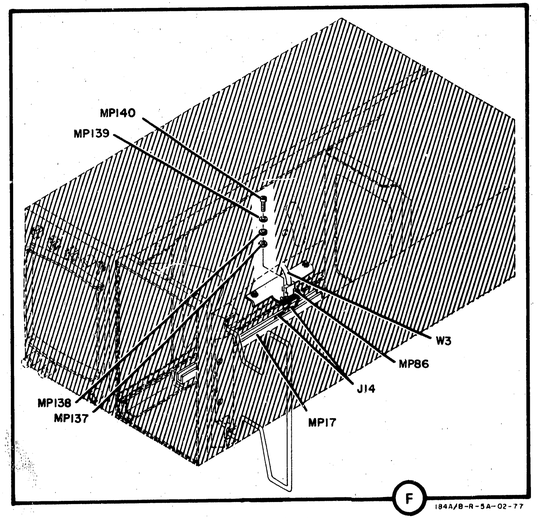


Figure 6-2. Model 184A/B Parts Identification

SECTION VI

REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section contains information for ordering parts. Table 6-1 lists abbreviations used in the parts list. Table 6-2 lists all replaceable parts in reference designator order. Table 6-3 contains the names and addresses that correspond to the manufacturer's code numbers.

6-3. REPLACEABLE PARTS LIST.

6-4. Table 6-2 is the list of replaceable parts and is organized as follows:

a. Electrical assemblies and their components in alphanumerical order by reference designation.

b. Chassis-mounted parts in alphanumerical order by reference designation.

c. Miscellaneous parts.

d. Illustrated parts breakdowns, if appropriate.

The information given for each part consists of the following:

a. The Hewlett-Packard part number.

b. The total quantity (Qty) in the instrument.

c. The description of the part.

d. A typical manufacturer of the part in a five-digit code.

e. The manufacturers' number for the part.

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

6-5. ORDERING INFORMATION.

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

6-7. To order a part that is not listed in the replaceable parts table, include the instrument model number, instrument serial number, the description and function of the part, and the number of parts required. Address the order to the nearest Hewlett-Packard office.

6-8. SPARE PARTS KIT.

6-9. Stocking spare parts for an instrument is often done to ensure quick return to service after a malfunction occurs. Hewlett-Packard has a Spare Parts Kit available for this purpose. The kit consists of selected replaceable assemblies and components for this instrument. The contents of the kit and the Recommended Spares list are based on failure reports and repair data, and parts support for one year. A Recommended Spares list for this instrument may be obtained on request and the Spare Parts Kit may be ordered through your nearest Hewlett-Packard office.

6-10. DIRECT MAIL ORDER SYSTEM.

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

a. Direct ordering and shipment from the HP Parts Center in Mountain View, California.

b. No maximum or minimum on any mail order (there is a minimum order amount for parts ordered through a local HP office when the orders require billing and invoicing).

c. Prepaid transportation (there is a small handling charge for each order).

d. No invoices — to provide these advantages, a check or money order must accompany each order.

6-12. Mail order forms and specific ordering information is available through your local HP office. Addresses and phone numbers are located at the back of this manual.

Table 6-1. Abbreviations for Replaceable Parts List

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

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			CHASSIS PARTS		
A1	00184-60003	1	POWER MODULE:LOW VOLTAGE (EXCEPT OPTION 003)	28480	00184-60003
A1	00184-60005	1	POWER MODULE:LOW VOLTAGE (OPTION 003)	28480	00184-60005
A1A1	00184-66511	1	BOARD ASSY:LV RECTIFIER	28480	00184-66511
A1A2	00184-66509	1	BOARD ASSY:LV REGULATOR	28480	00184-66509
A2	00184-66515	1	BOARD ASSY:MODE SWITCH	28480	00184-66515
A3	00184-66510	1	BOARD ASSY:HV OSCILLATOR	28480	00184-66510
A4	00184-66504	1	BOARD ASSY:HV RECTIFIER	28480	00184-66504
A5	00180-61904	1	SWITCH ASSY:DISPLAY	28480	00180-61904
A6	00184-66520	1	BOARD ASSY: GATE	28480	00184-66520
A7	00184-66517	1	BOARD ASSY: HORIZONTAL AMPLIFIER	28480	00184-66517
A8	00184-66518	1	BOARD ASSY: HORIZONTAL AMPLIFIER	28480	00184-66518
A9	00184-61101	1	MULTIPLIER ASSY: HV (MODEL 184A CABINET TYPE)	28480	00184-61101
A9	00184-61103	1	MULTIPLIER ASSY: HV (MODEL 184B RACK TYPE)	28480	00184-61103
A10	00180-66546	1	BOARD ASSY:SWEEP GATE	28480	00180-66546
C1	0170-0022	1	C:FXD MY 0.1UF 20% 600VDCW	09134	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
C4	5060-1398	1	CAPACITOR ASSY:0.3 PF	28480	5060-1398
DS1	2140-0346	2	LAMP: INCANDESCENT 5V	71744	7210
XDS1	00183-67701	2	BASE:PILOT LIGHT	28480	00183-67701
DS2	2140-0352		LAMP:INCANDESCENT 18-0V 0.026 AMP	71744	CM 7220
XDS2	00183-67701		BASE:PILOT LIGHT	28480	00183-67701
E1	0340-0450	3	WASHER:TRANSISTOR INSULATOR	04713	14852600F12
E2	0340-0451	3	WASHER:INSULATED, TRANSISTOR	04713	14852600F03
E3	1251-3073	61	CONNECTOR:SINGLE FEMALE CONTACT (PINS FOR J15 THRU J19)	27264	08-50-0101(2138T)
E4	0362-0227	1	TERMINATION:CRIMP LUG FOR 26 AWG WIRE (USED WITH R11)	27264	2125
F1	2110-0007	1	FUSE:CARTRIDGE 1 AMP 250V SLOW BLOW (FOR 230V OPERATION – OPTIONAL)	75915	313001
F1	2110-0303		FUSE:CARTRIDGE 2A 250V SLOW-BLOW (FOR 115V OPERATION – STANDARD)	71400	MDX-2A
F2	2110-0007	1	FUSE: CARTRIDGE 1 AMP 250V SLOW BLOW (HV OSC)	75915	313001
J1	1251-0137	1	CONNECTOR:PC 32 CONTACT	02660	26-4200-32S
J2	1251-0172	1	CONNECTOR:PC EDGE 1 ROW 22 CONTACT (LVPS)	71785	250-22-30-210
J3			N.S.R. PART OF MP42, MP80.		
J6	1250-0083	6	CONNECTOR:BNC	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	1	BINDING POST	28480	1510-0038
J14	0363-0006	2	CONTACT:CONNECTOR SWITCH	28480	0363-0006
J15	1251-1190	1	CONNECTOR:PC EDGE (2 X 12) 24 CONTACT (A8)	71785	251-12-30-261
J16	1251-3069	1	CONNECTOR:PC 8 MALE CONTACT (A7)	28480	1251-3069
J17	1251-3070	1	CONNECTOR:PC 12 MALE CONTACT (A2)	28480	1251-3070
J18	1251-3167	1	CONNECTOR:4 POST TYPE FEMALE CONTACT (A7)	27264	09-50-3041(2139-4)
J19	1251-3202	1	CONNECTOR:PC 15 FEMALE CON	27264	09-50-7151(2139-15)
L1	00191-66004	1	COIL:ALIGNMENT, Y AXIS (A6)	28480	00191-66004
L2	5060-0443	1	COIL:TRACE ALIGNMENT	28480	5060-0443
L3	9170-0013	1	COIL:CORE, TOROID, GREEN	72656	CF-102-H
MP1	10178A	1	FILTER:CONTRAST	28480	10178A
MP2	5040-0444	1	SHIELD:LIGHT,BLACK NYLON(OPT A85,X95)	28480	5040-0444
MP3	5020-0476	1	BEZEL:CRT	28480	5020-0476
MP4	00180-04130	1	COVER:BTM RIGHT (EXCEPT OPTION 580)	28480	00180-04130
MP4	00180-64113		COVER:BTM RIGHT (OPTION 580)	28480	00180-64113
MP5	00180-04132	1	COVER:BTM LEFT (EXCEPT OPTION 580)	28480	00180-04132
MP5	00180-64114		COVER:BTM LEFT (OPTION 580)	28480	00180-64114
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	0370-0432
MP9	00180-05002	1	LEVER:HORIZONTAL POSITION	28480	00180-05002
MP11	00180-67404	2	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	00180-67402	2	KNOB ASSY:BLACK,FOCUS & HORIZ.	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#

See introduction to this section for ordering information

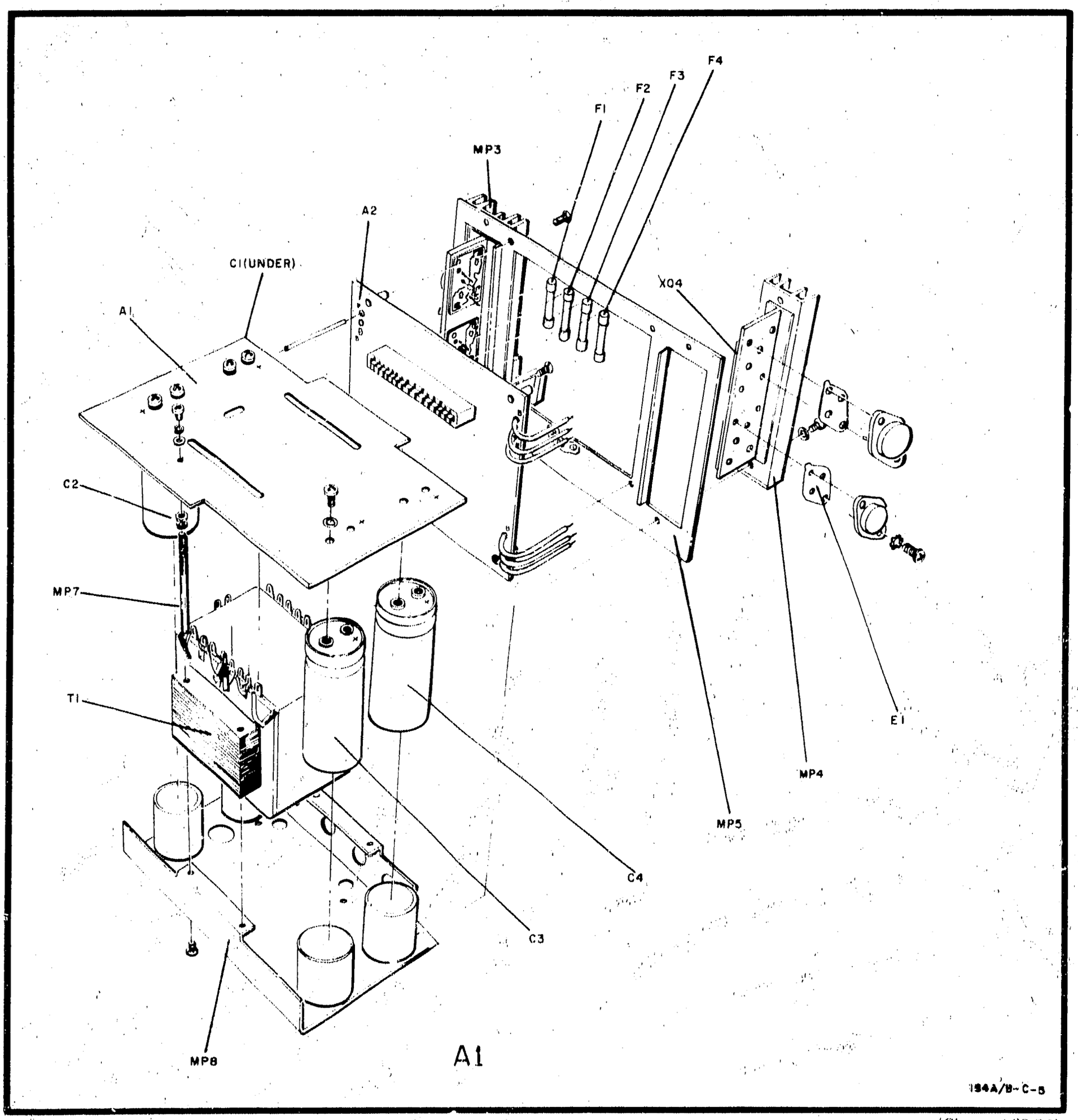
Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
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 (CAB)	28480	5040-0463
MP25	00180-88702	2	KIT:PROBE HANGER (184B ONLY)	28480	00180-88702
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
MP38	5040-0445	1	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	00181-00601	1	SHIELD:CRT	28480	00181-00601
MP42	00184-00207	1	PANEL:FRONT(CAB)	28480	00184-00207
MP43	00184-00206	1	PANEL:FRONT-SUB	28480	00184-00206
MP44	0400-0009	3	GROMMET:VINYL FITS 1/4" DIA HOLE	01538	G250
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	00181-01202	1	BRACKET:CRT CONTROL MOUNTING	28480	00181-01202
MP50	5040-0453	1	COVER:POTENTIOMETER(FOCUS)	28480	5040-0453
MP51	00180-01209	1	BRACKET:CONNECTOR PLUG-IN	28480	00180-01209
MP52	00181-01201	1	BRACKET:CRT CLAMP	28480	00181-01201
MP53	00184-04101	1	COVER PLATE:HV SUPPLY	28480	00184-04101
MP54	00180-25401	1	PLEXIGLASS:HV	28480	00180-25401
MP55	00180-24301	1	NUT:HORIZONTAL POS. POT	28480	00180-24301
MP56	1400-0325	1	CLAMP:CABLE 0.125" DIA	00000	OBD
MP58	00180-24702	1	STANDOFF:GATE BOARD	28480	00180-24702
MP59	0370-0031	1	SCREW:RND HD SLOT DR 4-40 X 0.500" LG	00000	OBD
MP60	0400-0010	1	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"	00000	OBD
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 (EXCEPT OPTION 580)	28480	00180-64110
MP76	00180-64115		COVER ASSY:BOTTOM (OPTION 580)	28480	00180-64115
MP77	1490-0030	1	STAND:TILT	28480	1490-0030
MP78	5060-0767	5	FOOT ASSY:FM	28480	5060-0767
MP79	5060-0552	1	KIT:RACK MOUNT 5H (184B ONLY)	28480	5060-0552
MP80	00184-00208	1	PANEL:FRONT(RACK)	28480	00184-00208
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	2	LENS:CLEAR	28480	1450-0404
MP86	00180-01249	1	BRACKET:VERTICAL LEADS	28480	00180-01249
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	28480	1490-0710
MP91	00180-09105	1	CLIP:GROUND	28480	00180-09105
MP92	1400-0090	1	WASHER:RUBBER 5/8" OD	00000	OBD
MP93	00184-60202	1	PANEL ASSY:REAR (INCLUDES J12, S5, S6, MP84)	28480	00184-60202
MP94	4320-0002	35	CHANNEL:RUBBER	71485	X-200
MP95	00181-23201	2	COUPLER:SHAFT	28480	00181-23201
MP96	00184-67401	1	KNOB ASSY:STR TIM	28480	00184-67401
MP97	01703-23702	1	SHAFT:PUSHBUTTON	28480	01703-23702
MP98	01802-23202	1	COUPLER:SHAFT	28480	01802-23202
MP99	0370-0451	5	BEZEL:PUSHBUTTON KNOB BLK NYLON	28480	0370-0451
MP100	5060-0548	1	KIT:CONTRAST FILTER	28480	5060-0548
MP102	00184-00601	1	SHIELD	28480	00184-00601
MP103	01331-67404	1	PUSHBUTTON ASSY	28480	01331-67404
MP104	00184-67404	1	PUSHBUTTON:CONV	28480	00184-67404

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
MP105	00184-67402	1	PUSHBUTTON:STANDARD	28480	00184-67402
MP106	00184-67403	1	PUSHBUTTON:FAST	28480	00184-67403
MP107	00184-67405	1	PUSHBUTTON:ASSY	28480	00184-67405
MP108	00184-01201	1	BRACKET:TRANSISTOR	28480	00184-01201
MP109	2190-0910	3	LOCKWASHER:STL .120 ID X .275 OD	00000	OBD
MP110	00181-04101	1	COVER:HIGH VOLTAGE CONNECTOR	28480	00181-04101
MP111	00181-47101	2	GASKET	28480	00181-47101
MP112	1490-0968	1	BUSHING:POTENTIOMETER 1/4-32 EXT THD (USED WITH R11)	00000	OBD
MP113	0590-0043	1	NUT:HEX 1/4 x 32 INT THD (USED WITH R11)	00866	OBD
MP114			DELETED		
MP115	1200-0408	1	COVER:CRT SOCKET	28480	1200-0408
MP116	00182-00206		PANEL:ACCESS	28480	00182-00206
MP117	00184-07401	1	KNOB:RND BLACK .470 DIA	28480	00184-07401
MP118	10176A		VIEWING HOOD:OPTION 005 ONLY	28480	10176A
MP119	2680-0104	2	SCREW-MACH 10-32 0.5-IN-LG 100 DEG FL-HD	28480	2680-0104
MP120	2200-0103	8	SCREW-MACH 4-40 .25-IN-LG PAN-HD	28480	2200-0103
MP121	2200-0768	2	SCREW-MACH 4-40 .812-IN-LG 100 DEG FL-HD	28480	2200-0768
MP122	3050-0010	9	WASHER-FL MTLC NO. 6 .147-IN-ID .312-IN	76210	65
MP123	2190-0018	4	WASHER-LK HLCL NO. 6 .141-IN-ID .269-IN	28480	2190-0018
MP124	0624-0263	2	SCREW-TPG 6-32 .438-IN-LG PAN-HD	28480	0624-0263
MP125	2270-0019	9	SCREW-MACH 4-40 .312-IN-LG PAN-HD	28480	2270-0019
MP126	2190-0019	43	WASHER-LK HLCL NO. 4 .115-IN-ID .226-IN	28480	2190-0019
MP127	3050-0235	19	WASHER-FL MTLC NO. 4 .117-IN-ID .25-IN	28480	3050-0235
MP128	2200-0757	6	SCREW-MACH 4-40 .688-IN-LG PAN-HD	28480	2200-0757
MP129	2200-0141	15	SCREW-MACH 4-40 .312-IN-LG PAN-HD	28480	2200-0141
MP130	2200-0149	4	SCREW-MACH 4-40 .625-IN-LG PAN-HD	28480	2200-0149
MP131	3050-0017	1	WASHER-FL MTLC NO. 1/4 .26-IN-ID .385-IN	28480	3050-0017
MP132	2190-0084	5	WASHER-LK INTL T NO. 1/4 .256-IN-ID .408-IN	78189	1214-05
MP133	2200-0139	6	SCREW-MACH 4-40 .25-IN-LG PAN-HD	28480	2200-0139
MP134	2950-0006	2	NUT-HEX-DBL CHAM 1/4-32-THD .094-THK	73734	9000
MP135	2950-0043	1	NUT-HEX-DBL CHAM 3/8-32-THD .094-THK	04605	28200-10-101
MP136	2190-0016	1	WASHER-LK INTL T NO. 3/8 .377-IN-ID .057	78189	1920-02
MP137	0610-0001	2	NUT-HEX-DBL CHAM 2-56-THD .062-THK	28480	0610-0001
MP138	2190-0045	2	WASHER-LK HLCL NO. 2 .088-IN-ID .165-IN	04757	1501-009
MP139	3050-0703	2	WASHER-FL MTLC NO. 2 .094-IN-ID .312-IN	28480	3050-0703
MP140	0520-0129	2	SCREW-MACH 2-56 .312-IN-LG PAN-HD	28480	0520-0129
MP141	2200-0143	5	SCREW-MACH 4-40 .375-IN-LG PAN-HD	28480	2200-0143
MP142	2360-0300	4	SCREW-MACH 6-32 .438-IN-LG PAN-HD	28480	2360-0300
MP143	2190-0469	9	WASHER-LK INTL T NO. 4 .116-IN-ID .286	78189	1704-00-00-4102
MP144	0360-0040	1	TERMINAL-LUG-SLDR 1/4 SCR .25/.093 ID	28480	0360-0040
MP184	00184-01202	1	BRACKET:REAR	28480	00184-01202
Q1	1854-0320	3	TSTR:SI NPN	28480	1854-0320
Q2	1854-0320		TSTR:SI NPN	28480	1854-0320
Q3	1854-0320		TSTR:SI NPN	28480	1854-0320
R1	2100-3287	1	R:VAR 2 X 100K OHM	28480	2100-3287
R2	2100-2602	1	R:VAR COMP 10K OHM 20% LIN 1/4W (INTENSITY)	28480	2100-2602
R5	2100-2563	1	R:VAR COMP 5 MEGOHM 20% LIN 1/2W (FOCUS)	28480	2100-2563
R6	2100-2086	1	R:VAR COMP 5K OHM 20% LIN 1/2W (TRACE ALIGN)	28480	2100-2086
R7	2100-1717	1	R:VAR COMP 50K OHM 20% LIN 1/2W (ASTIG)	28480	2100-1717
R8	2100-2083	1	R:VAR COMP 20K OHM 20% LIN 1/2W (SWEEP TIME)	28480	2100-2083
R9	2100-2608	1	R:VAR COMP 10K OHM 20% LOG 1/4W (PERSISTENCE)	28480	2100-2608
R10	0683-1045	1	R:FXD COMP 100K OHMS 5% 1/4W	01121	CB 1045
R11	2100-2488		R:VAR COMP 10K OHM 20% LIN 1/2W	28480	2100-2488
S1	3101-1508	2	SWITCH:TOGGLE DPDT	09353	7318I
S2	3101-0070	2	SWITCH: SLIDE	79727	G126
S3	3100-1345	2	SWITCH:ROTARY 1 SECTION 3 POSITION	28480	3100-1345
S4	3101-0977	2	SWITCH:PUSHBUTTON DPDT	82389	12S-1032
S5	3101-1237	1	SWITCH:SLIDE DPDT	82389	11A-1243
S6	3101-0070	1	SWITCH:COAXIAL DPDT	28480	3101-0070
V1	5083-3752	1	CRT:P31 ALIG (EXCEPT OPTION 005)	28480	5083-3752
V1	5083-3770	1	CRT:FAST STORAGE (OPTION 005)	28480	5083-3770
W1	8120-1545	1	CABLE ASSY:AC POWER CORD 7.5 FT (RACK)	70903	KH 7171
W1	8120-1538	1	CABLE ASSY:POWER 7.5 FT (CAB)	28480	8120-1538
W2	00180-61617	1	CABLE ASSY:COAX FROM J1 PINS 1 AND 2 TO A6S1(RACK)	28480	00180-61617
W2	00180-61616	1	CABLE ASSY:COAX FROM J1 PINS 1 AND 2 TO A6S1(CAB)	28480	00180-61616
W3	00180-61685	1	CABLE: CRT VERTICAL PLATES	28480	00180-61685
W4	00180-61650	1	CABLE ASSY:SWEEP OUT	28480	00180-61650
W5	00183-61625	1	CABLE:HORIZONTAL OUTPUT (RACK)	28480	00183-61625
W5	01701-61605	1	CABLE:HORIZ. OUTPUT(CAB)	28480	01701-61605
W6	00184-61622	1	CABLE:MAIN (RACK)	28480	00184-61622
W6	00184-61621	1	CABLE:CABINET, MAIN	28480	00184-61621
W7	00180-61657	1	CABLE ASSY:HORIZONTAL MAGNIFIER	28480	00180-61657
W8	00180-61697	1	CABLE ASSY:4-COND(CAB)	28480	00180-61697
W8	00180-61696	1	CABLE ASSY:4-COND(RACK) (S4 TO J2)	28480	00180-61696
W9	00184-61607	1	CABLE ASSY:COAX (INCLUDES L3)	28480	00184-61607
W10	00184-61623	1	CABLE:COAX,	28480	00184-61623
W20	00184-61602	1	CABLE ASSY:CALIBRATOR	28480	00184-61602
W21	00184-61614	1	CABLE ASSY(HV OSC.) (HV OSC.)	28480	00184-61614
W22	00180-61652		CABLE: COAX DISPLAY SWITCH	28480	00180-61652
XF1	1400-0085	1	FUSEHOLDER:EXTRACTOR POST TYPE	75915	342004
XV1	1200-0037	1	SOCKET:CRT TUBE	72825	97097
XV1	1200-0050	7	CONTACT:CRT SOCKET	72825	9553-1



(Changed 09 74)

Figure 6-3. Low-voltage Power Supply Module Exploded View

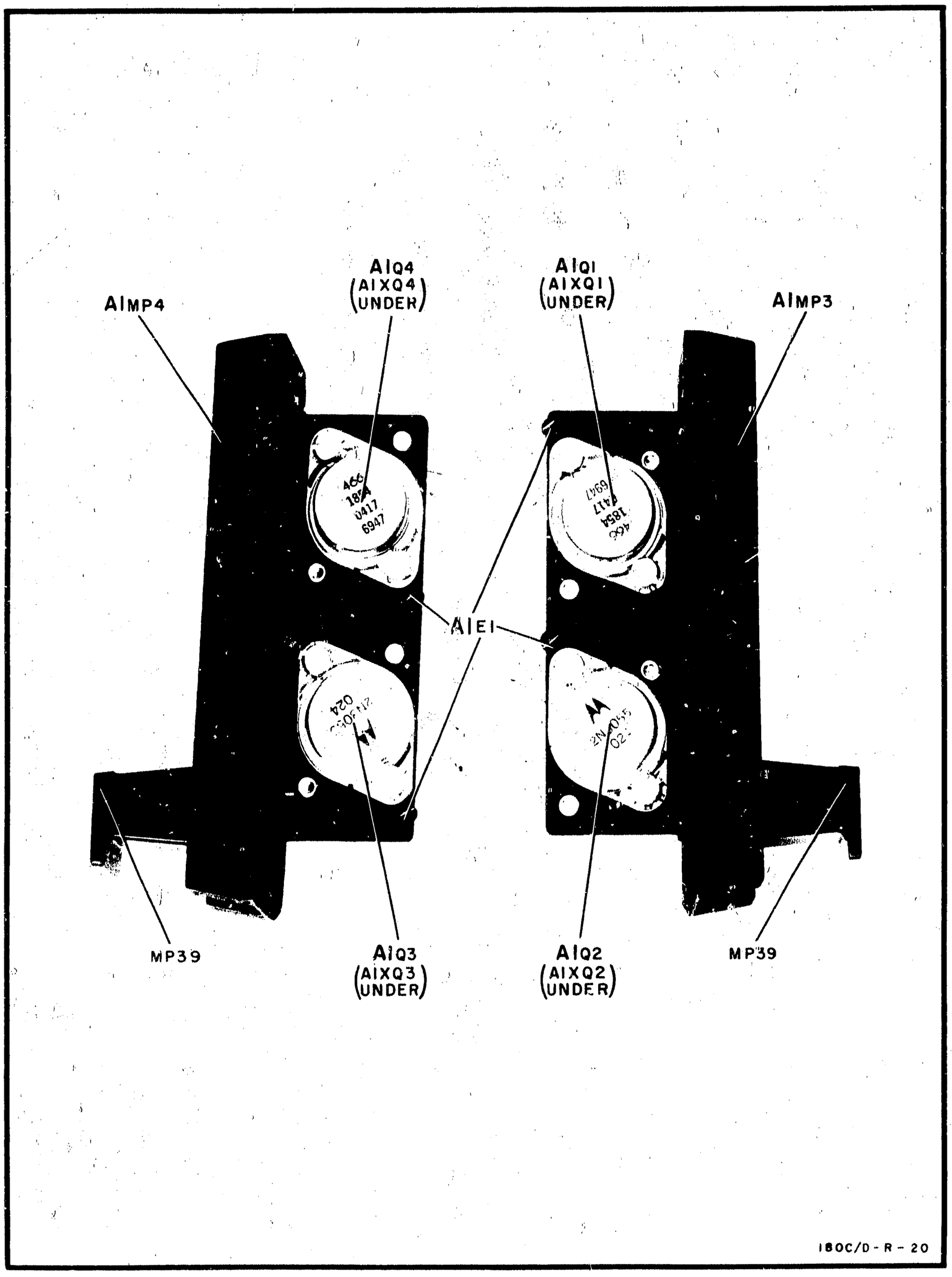


Figure 6-4. Series Regulator Parts Identification

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	00184-60003	1	POWER MODULE:LOW VOLTAGE (EXCEPT OPTION 003)	28480	00184-60003
A1	00184-60005		POWER MODULE:LOW VOLTAGE (OPTION 003)	28480	00184-60005
A1C1	0180-1807	2	C:FXD ELECT 290 UF +50-10% 200VDCW	56289	32D291F200AB2A-DQB
A1C2	0180-1865	1	C:FXD ELECT 2100 UF +75-10% 40VDCW	56289	32D212G040AB2A-DQB
A1C3	0180-1809	1	C:FXD ELECT 3400 UF +75-10% 25VDCW	56289	32D342G025AB2A-DQB
A1C4	0180-1807		C:FXD ELECT 290 UF +50-10% 200VDCW	56289	32D291F200AB2A-DQB
A1E1	0340-0858	4	INSULATOR:TSTR MOUNTING(TO-3)	28480	0340-0858
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
A1MP6			NOT USED		
A1MP7	00182-24701	4	SPACER:LVPS	28480	00182-24701
A1MP8	00180-01252	1	BRACKET:TRANSFORMER	28480	00180-01252
A1Q1	1854-0417	2	TSTR:SI NPN	28480	1854-0417
A1Q2	1854-0063	2	TSTR:SI NPN	80131	2N3055
A1Q3	1854-0063		TSTR:SI NPN	80131	2N3055
A1Q4	1854-0417		TSTR:SI NPN	28480	1854-0417
A1T1	9100-3401	1	TRANSFORMER:POWER (EXCEPT OPTION 003)	28480	9100-3401
A1T1	9100-3414		TRANSFORMER:POWER (OPTION 003)	28480	9100-3414
A1XQ1	1200-0041	4	SOCKET:TRANSISTOR	71785	133-32-10-013
A1XQ2	1200-0041		SOCKET:TRANSISTOR	71785	133-32-10-013
A1XQ3	1200-0041		SOCKET:TRANSISTOR	71785	133-32-10-013
A1XQ4	1200-0041		SOCKET:TRANSISTOR	71785	133-32-10-013
A1A1	00184-66511		BOARD ASSY:LV RECTIFIER	28480	00184-66511
A1A1C1	0180-0091	1	C:FXD ELECT 10 UF +50-10% 100VDCW	56289	30D106F100DC2-DSM
A1A1CR1	1901-0028	12	DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A1A1CR2	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A1A1CR3	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A1A1CR4	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A1A1CR5	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A1A1CR6	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A1A1CR7	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A1A1CR8	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A1A1CR9	1901-0415	8	DIODE:SILICON 50 PIV 3A	28480	1901-0415
A1A1CR10	1901-0415		DIODE:SILICON 50 PIV 3A	28480	1901-0415
A1A1CR11	1901-0415		DIODE:SILICON 50 PIV 3A	28480	1901-0415
A1A1CR12	1901-0415		DIODE:SILICON 50 PIV 3A	28480	1901-0415
A1A1CR13	1901-0415		DIODE:SILICON 50 PIV 3A	28480	1901-0415
A1A1CR14	1901-0415		DIODE:SILICON 50 PIV 3A	28480	1901-0415
A1A1CR15	1901-0415		DIODE:SILICON 50 PIV 3A	28480	1901-0415
A1A1CR16	1901-0415		DIODE:SILICON 50 PIV 3A	28480	1901-0415
A1A1CR17	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A1A1CR18	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A1A1CR19	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A1A1CR20	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A1A1CR21	1901-0045	2	DIODE:SILICON 0.75A 100PIV	04713	SR1358-7
A1A1CR22	1901-0045		DIODE:SILICON 0.75A 100PIV	04713	SR1358-7
A1A1R1	0687-1041	3	R:FXD COMP 100K OHM 10% 1/2W	01121	EB 1041
A1A1R2	0687-1041		R:FXD COMP 100K OHM 10% 1/2W	01121	EB 1041
A1A1R3	0760-0016	1	R:FXD MET OX 2700 OHM 2% 1W	28480	0760-0016
A1A1R4	0757-0060	3	R:FXD MET FLM 24.3K OHM 1% 1/2W	28480	0757-0060
A1A1VR1	1902-0597	1	DIODE BREAKDOWN:56.2V 5% 1W	28480	1902-0597
A1A2	00184-66509		BOARD ASSY:LV REGULATOR	28480	00184-66509
A1A2C1	0140-0176	1	C:FXD MICA 100 PF 2%	28480	0140-0176
A1A2C2	0180-0269	1	C:FXD ELECT 1.0 UF +50-10% 150VDCW	56289	30D105F150BA2-DSM
A1A2C3	0180-0089	2	C:FXD AL ELECT 10 UF +50-10% 150VDCW	56289	30D106F150DD2-DSM
A1A2C4	0160-0161	3	C:FXD MY 0.01 UF 10% 200VDCW	56289	192P10392-PTS
A1A2C5	0180-0058	2	C:FXD AL ELECT 50 UF +75-10% 25VDCW	56289	30D506G025CC2-DSM
A1A2C6	0170-0040	4	C:FXD MY 0.047 UF 10% 200VDCW	56289	192P47392-PTS
A1A2C7	0180-0058		C:FXD AL ELECT 50 UF +75-10% 25VDCW	56289	30D506G025CC2-DSM
A1A2C9	0180-0089		C:FXD AL ELECT 10 UF +50-10% 150VDCW	56289	30D106F150DD2-DSM
A1A2CR1	1901-0040	31	DIODE:SILICON 30MA 30WV	07263	FDG1088
A1A2CR2	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1A2CR3	1901-0026	5	DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
A1A2CR4	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1A2CR5	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1A2CR6	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1A2CR7	1901-0026		DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
A1A2E1	2110-0269	10	CLIP:FUSE 0.250" DIA	91506	6008-32CN
A1A2E2	2110-0269		CLIP:FUSE 0.250" DIA	91506	6008-32CN
A1A2E3	2110-0269		CLIP:FUSE 0.250" DIA	91506	6008-32CN
A1A2E4	2110-0269		CLIP:FUSE 0.250" DIA	91506	6008-32CN

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
A1A2E5	2110-0269		CLIP:FUSE 0.250" DIA	91506	6008-32CN
A1A2E6	2110-0269		CLIP:FUSE 0.250" DIA	91506	6008-32CN
A1A2E7	2110-0269		CLIP:FUSE 0.250" DIA	91506	6008-32CN
A1A2E8	2110-0269		CLIP:FUSE 0.250" DIA	91506	6008-32CN
A1A2F1	2110-0085	2	FUSE:0.375A 250V (NOT SUPPLIED WITH A1A2 - ORDER SEPARATELY)	75915	312.375
A1A2F2	2110-0002	2	FUSE:CARTRIDGE 2AMP 3AG (NOT SUPPLIED WITH A1A2 - ORDER SEPARATELY)	75915	312.002
A1A2F3	2110-0002		FUSE:CARTRIDGE 2AMP 3AG (NOT SUPPLIED WITH A1A2 - ORDER SEPARATELY)	75915	312.002
A1A2F4	2110-0065		FUSE:0.375A 250V (NOT SUPPLIED WITH A1A2 - ORDER SEPARATELY)	75915	312.375
A1A2J3	1251-1633	1	CONNECTOR:PC (1 X 15) 15 CONTACT	71785	252-15-30-310
A1A2Q1	1854-0234	2	TSTR:SI NPN	80131	2N3440
A1A2Q2	1854-0071	17	TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A1A2Q3	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A1A2Q4	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A1A2Q5	1854-0039	3	TSTR:SI NPN	80131	2N3053
A1A2Q6	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A1A2Q7	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A1A2Q8	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
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	5	R:FXD MET FLM 2.74K OHM 1% 1/8W	28480	0757-0281
A1A2R3	0757-0465	5	R:FXD MET FLM 100K OHM 1% 1/8W	28480	0757-0465
A1A2R4	0812-0058	2	R:FXD WW 8.2 OHM 5% 2W	28480	0812-0058
A1A2R5	0757-0060		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	16	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
A1A2R11	2100-1773	1	R:VAR WW 1K OHM 5% TYPE H 1W	28480	2100-1773
A1A2R12	0757-0767	5	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	4	R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A1A2R18	0757-0273	4	R:FXD MET FLM 3.01K OHM 1% 1/8W	28480	0757-0273
A1A2R19	0757-0283	8	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% 1/8W	28480	0757-0438
A1A2R22	0811-1746		R:FXD WW 0.36 OHM 5% 2W	28480	0811-1746
A1A2R23	0757-0769	3	R:FXD FLM 51.1K 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	2100-1772		R:VAR WW 500 OHM 5% TYPE H 1W	28480	2100-1772
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 51.1K 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	9	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	1	R:FXD COMP 560 OHM 10% 1/2W	01121	EB 5611
A1A2TP1	1251-0206	5	CONNECTOR:SOCKET 0.15 BDY DIA TEFLON	98291	SKT-400
A1A2TP2	1251-0206		CONNECTOR:SOCKET 0.15 BDY DIA TEFLON	98291	SKT-400
A1A2TP3	1251-0206		CONNECTOR:SOCKET 0.15 BDY DIA TEFLON	98291	SKT-400
A1A2TP4	1251-0206		CONNECTOR:SOCKET 0.15 BDY DIA TEFLON	98291	SKT-400
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	00184-66515		BOARD ASSY:MODE SWITCH	28480	00184-66515
A2C1	0160-0168	2	C:FXD MY 0.1 UF 10% 200VDCW	56289	192P10492-PTS
A2C2	0160-3443		C:FXD CER 0.1 UF +80-20% 50 VDCW	72982	8131-050-651-104Z
A2C3	0180-0309		C:FXD ELECT 4.7 UF 20% 10 VDCW	56289	150D475X0010A2 DYS
A2C4	0160-3443		C:FXD CER 0.1 UF +80-20% 50 VDCW	72982	8131-050-651-104Z
A2C5	0180-2210		C:FXD ELECT 2 UF +50-10% 150 VDCW	28480	0180-2210
A2CR1	1901-0418	1	DIODE:SI 3A 400PRRV	04713	SR1846-12
A2CR2	1901-0028		DIODE:SILICON 0.75A 400 PIV	04713	SR 1358-9
A2CR3	1901-0028		DIODE:SILICON 0.75A 400 PIV	04713	SR 1358-9
A2J1	1251-3072	1	CONNECTOR:R & P, 12 MALE CONTACTS	27264	09-56-1121(2183-12A)
A2Q1	1854-0215		TSTR:SI NPN	80131	2N3904
A2Q2	1854-0216		TSTR:SI NPN	80131	2N3904
A2Q3	1854-0232		TSTR:SI NPN (SELECTED FROM 2N3440)	28480	1854-0232
A2Q4	1853-0336		TSTR:SI PNP	04713	SPS-6781
A2R1	0684-1021	3	R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A2R2	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A2R3	0684-2221	1	R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A2R4	0684-2731		R:FXD COMP 27K OHM 10% 1/4W	01121	CB 2731
A2R5	0684-4741		R:FXD COMP 470K OHM 10% 1/4W	01121	CB 4741
A2R6	0684-5631		R:FXD COMP 56K OHM 10% 1/4W	01121	CB 5631
A2R7	0684-3941		R:FXD COMP 390K OHM 10% 1/4W	01121	CB 3941
A2R8	0684-3941		R:FXD COMP 390K OHM 10% 1/4W	01121	CB 3941
A2R9	0684-5631		R:FXD COMP 56K OHM 10% 1/4W	01121	CB 5631
A2R10	0684-1541		R:FXD COMP 150K OHM 10% 1/4W	01121	CB 1541
A2R11	0684-2231		R:FXD COMP 22K OHM 10% 1/4W	01121	CB 2231
A2S1	00184-21901	1	SWITCH:PUSHBUTTON 5 STATION	28480	00184-21901
A3	00184-66510		BOARD ASSY:HV OSCILLATOR	28480	00184-66510
A3C1	0180-0097	1	C:FXD TANT. 47 UF 10% 35VDCW	56289	150D476X9035S2-DYS
A3C2	0170-0040		C:FXD MY 0.047 UF 10% 200VDCW	56289	192P47392-PTS
A3C3	0180-1731	1	C:FXD ELECT 4.7 UF 10% 50VDCW	56289	150D475X9050B2-DYS
A3C4	0180-1731	2	C:FXD ELECT 4.7 UF 10% 50VDCW	56289	150D475X9050B2-DYS
A3C5	0160-3443	8	C:FXD CER 0.1 UF +80-20% 50VDCW	72982	8131-050-651-104Z
A3CR1	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A3CR2	1901-0049		DIODE:SILICON 750 MA 50WV	04713	SR1358-6
A3CR3	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A3CR4	1901-0050	1	DIODE:SI 200 MA AT 1V	07263	FDA 6308
A3CR5	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A3CR6	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A3CR7	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG 1088
A3E1	2110-0269		CLIP:FUSE 0.25" DIA	91506	6008 32CN
A3E2	0360-1653	24	TERMINAL PIN:SQUARE	28480	0360-1653
A3J1	1251-3165	2	CONNECTOR:R & P, 5 MALE POST CONTACT	27264	09-56-1051(A-2183-5A
A3J2	1251-3165		CONNECTOR:R & P, 5 MALE POST CONTACT	27264	09-56-1051(A-2183-5A
A3L1	9100-2268	3	COIL:FXD 22.0 UH 10%	82142	09-1316-4K
A3L2	9100-2268	2	COIL:FXD 22.0 UH 10%	82142	09-1316-4K
A3Q1	1854-0215	27	TSTR:SI NPN	80131	2N3904
A3Q2	1854-0215		TSTR:SI NPN	80131	2N3904
A3R1	0757-0435		R:FXD FLM 3920 OHM 1% 1/8W	28480	0757-0435
A3R2	0757-0447	1	R:FXD MET FLM 16.2K OHM 1% 1/8W	28480	0757-0447
A3R3	0757-0452	1	R:FXD MET FLM 27.4K OHM 1% 1/8W	28480	0757-0452
A3R4	0757-0453	2	R:FXD MET FLM 30.1K OHM 1% 1/8W	28480	0757-0453
A3R5	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A3XQ1	1251-3027	3	CONNECTOR:R & P 3 FEMALE CONTACT	27264	09-52-3032
A3XQ2	1251-3027		CONNECTOR:R & P 3 FEMALE CONTACT	27264	09-52-3032
A3XQ3	1251-3027		CONNECTOR:R & P 3 FEMALE CONTACT	27264	09-52-3032
A4	00184-66504		BOARD ASSY:HV RECTIFIER	28480	00184-66504
A4C1	0160-4024	2	C:FXD 0.1 UF 4K VDCW	28480	0160-4024
A4CR1	1901-0341	2	DIODE:SI 7000 PIV 50MA	28480	1901-0341
A4CR2	1901-0341		DIODE:SI 7000 PIV 50MA	28480	1901-0341
A4MP1	1400-0845	2	CLAMP:COMPONENT, 0.500" LG	00000	08D
A4MP2	5040-0402	1	MOUNT:TRANSFORMER	28480	5040-0402
A4MP3	5040-0430	1	MOUNT:TRANSFORMER	28480	5040-0430
A4R1	0757-0449	4	R:FXD FLM 20K OHM 1% 1/8W	28480	0757-0449
A4T1	00180-60801	1	TRANSFORMER ASSY:HV	28480	00180-60801
A5	00180-61904		SWITCH ASSY:DISPLAY	28480	00180-61904
A5C1	0160-0168		C:FXD MY 0.1 UF 10% 200VDCW	56289	192P1o492-PTS
A5L1	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A5R1			PART OF S1		
A5S1	3100-2543	1	SWITCH:ROTARY 2 POSITION	28480	3100-2543
A5S1			(INCLUDES R1)		
A6	00184-66520		BOARD ASSY:GATE	28480	00184-66520
A6C1	0160-3443		C:FXD CER 0.1 UF +80-20% 50VDCW	72982	8131-050-651-104Z
A6C2	0160-3451	6	C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C0238101F103ZS25-CDH
A6C3	0121-0168	2	C:VAR TEFLON 0.25-1.50 PF 600VDCW	28480	0121-0168
A6C4	0121-0168		C:VAR TEFLON 0.25-1.50 PF 600VDCW	28480	0121-0168
A6C5	0160-2248	1	C:FXD CER 4.3 PF 500VDCW	28480	0160-2248
A6C6	0160-3443		C:FXD CER 0.1 UF +80-20% 50VDCW	72982	8131-050-651-104Z
A6C7	0160-0162	9	C:FXD MY 0.022 UF 10% 200VDCW	56289	192P22392-PTS
A6C8	0160-0303	1	C:FXD MYLAR .15 UF 10% 200VDCW	28480	0160-0303
A6C9	0160-2403	2	C:FXD CER 1500 PF 20% 5K VDCW FACTORY SELECTED	72982	828-025-X5R0-152M
A6C9	0160-0151	1	C:FXD CER 4700 PF +80-20% 4K VDCW FACTORY SELECTED	28480	0160-0151
A6C10	0160-2197	1	C:FXD MICA 10 PF 5%	72136	RDM15G100J3C
A6C11	0160-2198	1	C:FXD MICA 20 PF 5%	72136	RDM15C200J3C
A6C12	0180-1746	3	C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A6C13	0180-0098	1	C:FXD ELECT 100 UF 20% 20VDCW	56289	150D107X0020S2-DYS
A6C14	0180-1746		C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A6C15	0180-1746		C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A6C16	0160-0162		C:FXD MY 0.022 UF 10% 200VDCW	56289	192P22392-PTS
A6C17	0160-0161		C:FXD MY 0.01 UF 10% 200VDCW	56289	192P10392-PTS
A6C18	0160-0161		C:FXD MY 0.01 UF 10% 200VDCW	56289	192P10392-PTS
A6C19	0160-4024		C:FXD 0.1 UF 4K VDCW	28480	0160-4024
A6C20	0160-2403	1	C:FXD CER 1500 PF 20% 5K VDCW	72982	828-025-X5R0-152M
A6C21	0160-0163	1	C:FXD MY 0.033 UF 10% 200VDCW	56289	192P33392-PTS
A6C22	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023B101F103ZS25-CDH
A6C23	0160-3461		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023B101F103ZS25-CDH
A6C24	0160-3443		C: FXD CER 0.1 UF +80-20% 50VDCW	56289	8131-050-651-104Z
A6C25	0160-2068		C: FXD CER 1000 PF +100-0% 600VDCW		C087K102E102ZE19
A6C26	0160-3461		C:FXD CER 0.01 UF +80-20% 100VDCW	28480	0160-3461
A6C27			NOT USED		
A6C28	0160-3463	1	C: FXD .05UF +80-20% 100VDCW	28480	0160-3463
A6C29	0150-0012	1	C: FXD .01UF 20% 1000VDCW	56289	C023A102G103MS3B
A6CR1	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A6CR2	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A6CR3	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A6CR4	1901-0535		DIODE:HYBRID HOT CARRIER	28480	1901-0535
A6CR5	1901-0535		DIODE:HYBRID HOT CARRIER	28480	1901-0535
A6CR6	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088

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
A6CR7	1901-0029	2	DIODE:SILICON 600 PIV	28480	1901-0029
A6CR8	1901-0029		DIODE:SILICON 600 PIV	28480	1901-0029
A6CR9	1901-0040		DIODE:SILICON 30MA 30NV	07263	FD61088
A6CR10			NOT USED		
A6CR11	1901-0040		DIODE:SILICON 30MA 30NV	07263	FDG1088
A6CR12	1901-0376		DIODE: SILICON 35V	28480	1901-0376
A6CR13	1901-0376		DIODE: SILICON 35V	28480	1901-0376
A6CR14	1901-0040		DIODE: SWITCHING; 50MA 30V MAX	28480	1901-0040
A6CR15	1901-0040		DIODE: SWITCHING; 50MA 30V MAX	28480	1901-0040
A6CR16	1901-0040		DIODE: SWITCHING; 50MA 30V MAX	28480	1901-0040
A6E1	0360-1653	7	TERMINAL:PIN (CDA 260)	00000	OBD
A6J1	1251-3243	2	CONNECTOR:PC 15 MALE CONTACT	27264	09-64-1151(A2402-15A
A6J2	1251-3243		CONNECTOR:PC 15 MALE CONTACT	27264	09-64-1151(A2402-15A
A6L1	9100-1611	1	COIL:FXD 0.22 UH 20%	28480	9100-1611
A6MP1	1400-0845		CLAMP:COMPONENT, 0.500" LG	00000	OBD
A6MP2	1205-0063	3	HEAT SINK:SEMICONDUCTOR	05820	224-CB
A6Q1	1854-0215		TSTR:SI NPN	80131	2N3904
A6Q2	1853-0036	8	TSTR:SI PNP	80131	2N3906
A6Q3	1854-0215		TSTR:SI NPN	80131	2N3904
A6Q4	1854-0215		TSTR:SI NPN	80131	2N3904
A6Q5	1853-0203	1	TSTR:SI PNP	28480	1853-0203
A6Q6	1853-0232	1	TSTR:SI PNP	28480	1853-0232
A6Q7	1854-0271	1	TSTR:SI NPN	28480	1854-0271
A6Q8	1853-0049	2	TSTR:SI PNP	28480	1853-0049
A6Q9	1853-0049		TSTR:SI PNP	28480	1853-0049
A6Q10	1854-0215		TSTR:SI NPN	80131	2N3904
A6Q11 thru A6Q13			NOT USED		
A6Q14	1854-0284		TSTR:SI NPN	80131	2N3440
A6Q15	1853-0086		TSTR:SI PNP	80131	2N3906
A6Q16	1854-0215		TSTR:SI NPN	80131	2N3904
A6Q17	1854-0215		TSTR:SI NPN	80131	2N3904
A6Q18	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6Q19	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6Q20	1853-0036		TSTR:SI PNP	80131	2N3906
A6Q21	1854-0358	4	TSTR:SI NPN	28480	1854-0358
A6Q22	1854-0215		TSTR:SI NPN	80131	2N3904
A6Q23	1853-0036		TSTR:SI PNP	80131	2N3906
A6Q24	1853-0080		TSTR: SI PNP	28480	1853-0080
A6Q25	1853-0080		TSTR: SI PNP	28480	1853-0080
A6Q26	1854-0358		TSTR: SI PNP	28480	1854-0358
A6R1	0757-0444	1	R:FXD MET FLM 12.1K OHM 1% 1/8W	28480	0757-0444
A6R2	0757-0437	1	R:FXD MET FLM 4750 OHM 1% 1/8W	28480	0757-0437
A6R3	0757-0407	5	R:FXD MET FLM 200 OHM 1% 1/8W	28480	0757-0407
A6R4	0757-0407		R:FXD MET FLM 200 OHM 1% 1/8W	28480	0757-0407
A6R5	0757-0401	9	R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A6R6	0757-0770	1	R:FXD FLM 56.2K OHM 1% 1/4W	28480	0757-0770
A6R7	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A6R8	0757-0416	3	R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A6R9	0757-0429	1	R:FXD MET FLM 1.82K OHM 1% 1/8W	28480	0757-0429
A6R10	0757-0442	14	R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A6R11	0757-0290	2	R:FXD MET FLM 6.19K OHM 1% 1/8W	28480	0757-0290
A6R12	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A6R13	0757-0433	1	R:FXD MET FLM 3.32K OHM 1% 1/8W	28480	0757-0433
A6R14	0757-0463		R: FXD MET FLM 82.5K OHM 1% 1/8W	28480	0757-0463
A6R15	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A6R16	0757-0190	1	R:FXD MET FLM 20K OHM 1% 1/2W	28480	0757-0190
A6R17	0757-0860	1	R: FXD MET FLM 3.92K OHM 1.0% 1/2W	28480	0757-0860
A6R18	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A6R19	0757-0479	1	R:FXD MET FLM 392K OHM 1% 1/8W	28480	0757-0479
A6R20	0757-0273		R:FXD MET FLM 3.01K OHM 1% 1/8W	28480	0757-0273
A6R21	0757-0273		R:FXD MET FLM 3.01K OHM 1% 1/8W	28480	0757-0273
A6R22	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A6R23	0687-1011	1	R:FXD COMP 100 OHM 10% 1/2W	01121	EB 1011
A6R24	0687-1041		R:FXD COMP 100K OHM 10% 1/2W	01121	EB 1041
A6R25	0687-2231	1	R:FXD COMP 22K OHM 10% 1/2W	01121	EB 2231
A6R26	0698-5357	1	R:FXD FLM 22 MEGOHM 5% 1-1/2W	28480	0698-5357
A6R27			NOT USED		
A6R28	0684-1011	3	R:FXD COMP 100 OHM 10% 1/4W	01121	CB 1011
A6R29	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A6R30	0757-0274	1	R:FXD MET FLM 1.21K OHM 1% 1/8W	28480	0757-0274
A6R32	0757-0465		R:FXD MET FLM 100K OHM 1% 1/8W	28480	0757-0465
A6R33	0757-0419	1	R:FXD MET FLM 681 OHM 1% 1/8W	28480	0757-0419
A6R34	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A6R35	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A6R36	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A6R37 thru A6R44			NOT USED		

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A6R45	0698-3158	1	R:FXD MET FLM 23.7K OHM 1% 1/8W	28480	0698-3158
A6R46	0757-0465		R:FXD MET FLM 100K OHM 1% 1/8W	28480	0757-0465
A6R47	0757-0458	2	R:FXD MET FLM 51.1K OHM 1% 1/8W	28480	0757-0458
A6R48	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A6R49	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A6R50	0757-0346	3	R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A6R51	0757-0346		R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A6R52	0757-0346		R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A6R53	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A6R54	2100-2650		R:VAR FLM 200K OHM 10% LIN 1/2W	28480	2100-2650
A6R55	2100-2650		R:VAR FLM 200K OHM 10% LIN 1/2W	28480	2100-2650
A6R56	2100-1618		R:VAR FLM 1 MEGOHM 20% LIN 1/2W	28480	2100-1618
A6R57	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A6R58	0757-0276	1	R:FXD MET FLM 61.9 OHM 1% 1/8W	28480	0757-0276
A6R59	0698-6612	1	R:FXD MET FLM 2K OHM 0.1% 1/8W	28480	0698-6612
A6R60	0698-5421	1	R:FXD MET FLM 1.82K OHM 0.1% 1/2W	28480	0698-5421
A6R61	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A6R62	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A6R63	0757-0461	2	R:FXD MET FLM 68.1K OHM 1% 1/8W	28480	0757-0461
A6R64	0757-0461		R:FXD MET FLM 68.1K OHM 1% 1/8W	28480	0757-0461
A6R65	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A6R66	0698-8220	1	R: FXD FLM 15 MEGOHM 1% 3W	28480	0698-8220
A6R67	0687-1031	1	R:FXD COMP 10K OHM 10% 1/2W	01121	EB 1031
A6R68	0698-5353	1	R:FXD FLM 8.25 MEGOHM 5% 1W	28480	0698-5353
A6R69	0698-6580	1	R:FXD FLM 16.25 MEGOHM 5% 1W	28480	0698-6580
A6R70	0757-0417	1	R:FXD MET FLM 562 OHM 1% 1/8W	28480	0757-0417
A6R71	0698-3553	1	R:FXD FLM 2.49 MEGOHM 1% 1/2W	28480	0698-3553
A6R72	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A6R73	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A6R74	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A6R75	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A6R76	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A6R77	0684-5631	1	R:FXD COMP 56K OHM 10% 1/4W	01121	CB 5631
A6R78	0757-0449		R:FXD FLM 20K OHM 1% 1/8W	28480	0757-0449
A6R79	0757-0488	2	R:FXD MET FLM 909K OHM 1% 1/8W	28480	0757-0488
A6R80	0757-0488		R:FXD MET FLM 909K OHM 1% 1/8W	28480	0757-0488
A6R81	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A6R82	0684-2231		R: FXD COMP 22K OHM 10% 1/4W	01121	CB 2231
A6R83	0684-1531	14	R:FXD COMP 15K OHM 10% 1/4W	01121	CB 1531
A6R84	0757-0465		R:FXD MET FLM 100K OHM 1% 1/8W	28480	0757-0465
A6R85	0757-0460	2	R:FXD MET FLM 62.9K OHM 1% 1/8W	28480	0757-0460
A6R86	2100-2031	1	R:VAR 50K OHM 10% LIN 1/2W	28480	2100-2031
A6R87	0684-2221		R: FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A6R88	0684-3331		R: FXD COMP 33K OHM 10% 1/4W	01121	CB 3331
A6R89	0687-1001		R:FXD COMP 10 OHM 10% 1/2W	01121	EB 1001
A6R90	0757-0350	1	R:FXD MET FLM 909K OHM 1% 1/4W (FACTORY SELECTED)	30983	MF52C1/4-TO-9093-F
A6R91	0757-0340		R: FXD TUBULAR 10K OHM 1% 1/4W	24546	C5-1/4 TO-1002-F
A6R92	0684-1011		R: FXD CC 100 OHM 10% 1/4W	01121	CB1011
A6R93	0757-0760		R: FXD TUBULAR 20K OHM 1% 1/4W	24546	C5-1/4-TO-2002-F
A6R94	2100-2031		R: VAR TRMR 50K OHM 10%	28480	2100-2031
A6R95	0757-0466		R: FXD TUBULAR 43.2K OHM 1% 1/8W	24546	C4-1/8-TO-4322-F.
A6R96	0757-0446		R: FXD TUBULAR 15K OHM 1% 1/8W	24546	C4-1/8-TO-1502-F.
A6R97	0757-0443		R: FXD TUBULAR 11K OHM 1% 1/8W	24546	C4-1/8-TO-1102-F.
A6R98	2100-2031		R: VAR TRMR 50K OHM 10%	28480	2100-2031
A6R99	0757-0466		R: FXD TUBULAR 43.2K OHM 1% 1/8W	24546	C4-1/8-TO-4322-F.
A6R100	0757-0280		R: FXD TUBULAR 1K OHM 1% 1/8W	24546	C4-1/8-TO-1001-F
A6R101	0757-0435		R: FXD TUBULAR 3.92K OHM 1% 1/8W	24546	C4-1/8-TO-3921-F.
A6R102	0757-0438		R: FXD TUBULAR 5.11K OHM 1% 1/8W	24546	C4-1/8-TO-5111-F
A6R103	0757-0416		R: FXD TUBULAR 511 OHM 1% 1/8W	24546	C4-1/8-TO-511R-F
A6R104	0757-0449		R: FXD TUBULAR 20K OHM 1% 1/8W	24546	C4-1/8-TO-2002-F
A6R105	0757-0458		R: FXD TUBULAR 51.1K OHM 1% 1/8W	24546	C4-1/8-TO-5112-F
A6R106	0757-0482		R: FXD TUBULAR 511K OHM 1% 1/8W	28480	0757-0482
A6TP1	1251-0206		CONNECTOR:SOCKET 0.15 BDY DIA TEFLON	98291	SKT-400
A6U1	1821-0002	1	TRANSISTOR ARRAY:SI NPN	02735	CA3045
A6VR1	1902-0064	1	DIODE BREAKDOWN:7.5V	28480	1902-0064
A6VR2	1902-0038	1	DIODE BREAKDOWN:45.3V 5%	28480	1902-0038
A6VR3	2140-0018			08806	A9A-C(NE-2E1)
A6VR4	2140-0018		LAMP: GLOW 1.0 MILLIAMP 0.1W	08806	A9A-C(NE-2E1)
A6VR5	2140-0018		LAMP GLOW 1MA 0.1W	08806	A9A-CINE-2E11
A6XU1	1200-0441	6	SOCKET:IC 14 PIN MINIATURE	28480	1200-0441
A7	00184-66517		BOARD ASSY:HORIZONTAL AMPLIFIER	28480	00184-66517
A7C1	0121-0059	1	C:VAR CER 2-8 PF 300VDCW	28480	0121-0059
A7C2	0160-2250	1	C:FXD CER 5.1 PF 500VDCW	72982	301-000-COHO-519E
A7C3	0121-0105	1	C:VAR CER 9-35 PF NPO	28480	0121-0105
A7C4	0140-0193	1	C:FXD MICA 82 PF 5% 300VDCW	72136	DM15E820J0300WV1CR
A7C5	0160-0162		C:FXD MY 0.022 UF 10% 200VDCW	56289	192P22392-PTS
A7C6	0160-0162		C:FXD MY 0.022 UF 10% 200VDCW	56289	192P22392-PTS
A7C7	0132-0007	3	C:VAR POLY 0.7 TO 3.0 PF 350VDCW	72982	535-033-4R
A7C8	0160-0162		C:FXD MY 0.022 UF 10% 200VDCW	56289	192P22392-PTS
A7C9	0170-0040		C:FXD MY 0.047 UF 10% 200VDCW	56289	192P47392-PTS
A7C10	0132-0007		C:VAR POLY 0.7 TO 3.0 PF 350VDCW	72982	535-033-4R
A7C11	0160-2235	1	C:FXD CER 0.75 PF 500VDCW	72982	301-000-C0K0-758C
A7C12	0180-0197	5	C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A7C13	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS

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
A7C14			NOT USED		
A7C15	0170-0040		C:FXD MY 0.047 UF 10% 200VDCW	56289	192P47392-PTS
A7C16	0160-0162		C:FXD MY 0.022 UF 10% 200VDCW	56289	192P22392-PTS
A7C17	0132-0007		C:VAR POLY 0.7 TO 3.0 PF 350VDCW	72982	535-033-4R
A7C18	0160-0162		C:FXD MY 0.022 UF 10% 200VDCW	56289	192P22392-PTS
A7C19	0160-0162		C:FXD MY 0.022 UF 10% 200VDCW	56289	192P22392-PTS
A7C20	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A7C21	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A7C22	0160-0162		C:FXD MY 0.022 UF 10% 200VDCW	56289	192P22392-PTS
A7C23	0160-3443		C:FXD CER 0.1 UF +80-20% 50VDCW	72982	8131-050-651-104Z
A7C24	0160-3443		C:FXD CER 0.1 UF +80-20% 50VDCW	72982	8131-050-651-104Z
A7C25	0160-3451		C:FXD CER 0.01 UF +80 -20% 100VDCW	56289	C023B101F103ZS25-CDH
A7CR1	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A7CR2	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A7CR3	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A7CR4	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A7CR5	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A7CR6	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A7CR7	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A7CR8	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A7CR9	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A7CR10	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A7E1	0360-1653		TERMINAL PIN:SQUARE	28480	0360-1653
A7J1	1251-3071	1	CONNECTOR:R & P,8 MALE CONTACTS	27264	09-56-1081(2183-8A)
A7J2	1251-3164	4	CONNECTOR:R & P, 4 MALE CONTACT	27264	09-56-1041(A2183-4A)
A7J3	1251-3164		CONNECTOR:R & P, 4 MALE CONTACT	27264	09-56-1041(A2183-4A)
A7J4	1251-3164		CONNECTOR:R & P, 4 MALE CONTACT	27264	09-56-1041(A2183-4A)
A7J5	1251-3164		CONNECTOR:R & P, 4 MALE CONTACT	27264	09-56-1041(A2183-4A)
A7K1	0490-0929	1	RELAY:REED 0.5 A 500 OHM COIL	15636	RA30271121
A7L1	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A7L2	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A7L3	9170-0029	1	CORE:FERRITE BEAD	02114	56-590-65A2/4A
A7L4	9100-2265	1	COIL:FXD RF CHOKE 10 UH 10%	24226	10/102
A7MP1	1205-0063		HEAT SINK:SEMICONDUCTOR	05820	224-CB
A7MP2	1205-0063		HEAT SINK:SEMICONDUCTOR	05820	224-CB
A7Q1	1P55-0081	1	TSTR:SI FET 30V	01295	2N5245
A7Q2	1854-0215		TSTR:SI NPN	80131	2N3904
A7Q3	1850-0158	1	TSTR:GE PNP	80131	2N2635
A7Q4	1854-0019	3	TSTR:SI NPN	28480	1854-0019
A7Q5	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A7Q6	1854-0019		TSTR:SI NPN	28480	1854-0019
A7Q7	1854-0019		TSTR:SI NPN	28480	1854-0019
A7Q8	1853-0009	2	TSTR:SI PNP	28480	1853-0009
A7Q9	1854-0419	2	TSTR:SI NPN	04713	SS657
A7Q10	1853-0038	2	TSTR:SI PNP	28480	1853-0038
A7Q11	1853-0009		TSTR:SI PNP	28480	1853-0009
A7Q12	1854-0419		TSTR:SI NPN	04713	SS657
A7Q13	1853-0038		TSTR:SI PNP	28480	1853-0038
A7Q14	1854-0215		TSTR:SI NPN	80131	2N3904
A7Q15	1854-0215		TSTR:SI NPN	80131	2N3904
A7Q16	1853-0006	1	TSTR:SI PNP	80131	2N3134
A7Q17	1854-0022	1	TSTR:SI NPN	07263	S17843
A7R1	0757-0156	1	R:FXD MET FLM 1.5 MEGOHM 1% 1/2W	28480	0757-0156
A7R2	0698-5539	1	R:FXD MET FLM 2 MEGOHM 1.0% 1/2W	28480	0698-5539
A7R3	0757-0344	1	R:FXD MET FLM 1.00 MEGOHM 1% 1/4W	28480	0757-0344
A7R4	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A7R5	0757-0367		R:FXD MET FLM 100K OHM 1% 1/2W	28480	0757-0367
A7R6	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A7R7	0757-0407		R:FXD MET FLM 200 OHM 1% 1/8W	28480	0757-0407
A7R8	0761-0074	1	R:FXD MET OX 15K OHM 5% 1W	28480	0761-0074
A7R9	0757-0426	1	R:FXD FLM 1.3K OHM 1% 1/8W	28480	0757-0426
A7R10	0757-0447	1	R:FXD MET FLM 16.2K OHM 1% 1/8W	28480	0757-0447
A7R11	2100-2514	5	R:VAR CERMET 20K OHM 10% LIN 1/2W	28480	2100-2514
A7R12	0698-3153	1	R:FXD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3153
A7R13	0757-0441	1	R:FXD MET FLM 8.25K OHM 1% 1/8W	28480	0757-0441
A7R14	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A7R15	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A7R16	2100-2515	1	R:VAR CERMET 200K OHM 10% LIN 1/2W	28480	2100-2515
A7R17	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A7R18	2100-2489	4	R:VAR FLM 5K OHM 10% LIN 1/2W	28480	2100-2489
A7R19	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A7R20	0684-1031	3	R:FXD COMP 10K OHM 10% 1/4W	01121	CB 1031
A7R21	0684-2231		R:FXD COMP 22K OHM 10% 1/4W	01121	CB 2231
A7R22	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A7R23	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A7R24	0757-0460		R:FXD MET FLM 61.9K OHM 1% 1/8W	28480	0757-0460
A7R25	0757-0764	1	R:FXD FLM 33.2K OHM 1% 1/4W	28480	0757-0764
A7R26	0757-0741	2	R:FXD MET FLM 2.43K OHM 1%/1/4W	28480	0757-0741
A7R27	0757-0281		R:FXD MET FLM 2.74K OHM 1% 1/8W	28480	0757-0281

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A7R28	0757-0443	2	R:FXD MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A7R29	0757-0736	2	R:FXD MET FLM 1.50K OHM 1% 1/4W	28480	0757-0736
A7R30	0757-0413	2	R:FXD MET FLM 392 OHM 1% 1/8W	28480	0757-0413
A7R31	0757-0846	2	R:FXD MET FLM 22.1K OHM 1.0% 1/2W	28480	0757-0846
A7R32	0757-0407		R:FXD MET FLM 200 OHM 1% 1/8W	28480	0757-0407
A7R33	0757-0434	2	R:FXD MET FLM 3.65K OHM 1% 1/8W	28480	0757-0434
A7R34	0757-0841	2	R:FXD MET FLM 12.1K OHM 1% 1/2W	28480	0757-0841
A7R35	0757-0448	1	R:FXD MET FLM 18.2K OHM 1% 1/8W	28480	0757-0448
A7R36	2100-2632	1	R:VAR FLM 100 OHM 10% LIN 1/2W	28480	2100-2632
A7R37	0757-0284	1	R:FXD MET FLM 150 OHM 1% 1/8W	28480	0757-0284
A7R38	2100-2413	1	R:VAR FLM 200 OHM 10% LIN 1/2W	28480	2100-2413
A7R39	0757-0411	1	R:FXD MET FLM 332 OHM 1% 1/8W	28480	0757-0411
A7R40	2100-2633	1	R:VAR CERMET 1K OHM 10% LIN 1/2W	28480	2100-2633
A7R41	0757-0428		R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
A7R42	0698-3416	2	R:FXD MET FLM 21.5K OHM 1% 1/2W	28480	0698-3416
A7R43	2100-2489		R:VAR FLM 5K OHM 10% LIN 1/2W	28480	2100-2489
A7R44	0698-3416		R:FXD MET FLM 21.5K OHM 1% 1/2W	28480	0698-3416
A7R45	0757-0468	1	R:FXD FLM 130K OHM 1% 1/8W	28480	0757-0468
A7R46	0757-0440	1	R:FXD MET FLM 7.50K OHM 1% 1/8W	28480	0757-0440
A7R47	0757-0427	1	R:FXD MET FLM 1.5K OHM 1% 1/8W	28480	0757-0427
A7R48	0757-0741		R:FXD MET FLM 2.43K OHM 1%/1/4W	28480	0757-0741
A7R49	0757-0281		R:FXD MET FLM 2.74K OHM 1% 1/8W	28480	0757-0281
A7R50	0757-0443		R:FXD MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A7R51			NOT USED		
A7R52	0757-0434		R:FXD MET FLM 3.65K OHM 1% 1/8W	28480	0757-0434
A7R53	0757-0413		R:FXD MET FLM 392 OHM 1% 1/8W	28480	0757-0413
A7R54	0757-0846		R:FXD MET FLM 22.1K OHM 1.0% 1/2W	28480	0757-0846
A7R55	0757-0407		R:FXD MET FLM 200 OHM 1% 1/8W	28480	0757-0407
A7R56	0757-0841		R:FXD MET FLM 12.1K OHM 1% 1/2W	28480	0757-0841
A7R57	0757-0736		R:FXD MET FLM 1.50K OHM 1% 1/4W	28480	0757-0736
A7R58	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A7R59	0683-0275	3	R:FXD COMP 2.7 OHM 5% 1/4W	01121	CB 2765
A7R60	0757-0388	1	R:FXD FLM 30.1 OHM 1% 1/8W	28480	0757-0388
A7R61	0757-0463		R:FXD MET FLM 82.5K OHM 1% 1/8W	28480	0757-0463
A7R62	0757-0792	1	R:FXD MET FLM 681K OHM 1% 1/4W	28480	0757-0792
A7R63	2100-2514		R:VAR CERMET 20K OHM 10% LIN 1/2W	28480	2100-2514
A7R64	2100-2514		R:VAR CERMET 20K OHM 10% LIN 1/2W	28480	2100-2514
A7R65	2100-2489		R:VAR FLM 5K OHM 10% LIN 1/2W	28480	2100-2489
A7R66	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A7R67	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A7R68	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A7R69	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A7R70	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A7R71	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A7R72	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A7R73	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A7R74	0687-8201	2	R:FXD COMP 82 OHM 10% 1/2W	01121	EB 8201
A7R75	0687-8201		R:FXD COMP 82 OHM 10% 1/2W	01121	EB 8201
A7R76	0757-0426		R' FXD MET FLM 1300 OHM 1% 1/8W	28480	0757-0426
A7U1	1820-0217	1	IC:OP. AMP. AVOL=20K MIN.	28480	1820-0217
A8	00184-66518		BOARD ASSY: HORIZONTAL AMPLIFIER	28480	00184-66518
A8C1	0180-0230	1	C:FXD ELECT 1.0 UF 20% 50VDCW	56289	150D105X0050A2-DYS
A8C2	0160-3443	1	C: FXD CER 0.1 UF +80-20% 50VDCW	72982	8131-050-651-104Z
A8C3	0160-0300	1	C:FXD MY 0.0027 UF 200VDCW	56289	192P27292-PTS
A8C4	0180-0100	1	C: FXD ELECT 4.7UF 10% 35VDCW	56289	150D475X9035B2-DYS
A8C5	0180-0309		C: FXD ELECT 4.7UF 20% 10VDCW	56289	150D475X0010A2-DYS
A8C6	0160-3443		C:FXD CER 0.1 UF +80-20% 50VDCW	72982	8131-050-651-104Z
A8C7	0160-0158	1	C:FXD MY 0.0056 UF 10% 200VDCW	56289	192P56292-PTS
A8C8	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023B101F103Z525-CDH
A8C9	0160-0158	1	C:FXD MY 0.0056 UF 10% 200VDCW	56289	192P56292-PTS
A8C10	0160-3451	1	C:FXD CER 0.01 UF +80-20% 100 VDCW	56289	C023B101F 103Z525 CO
A8C11	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023B101F103Z525-CDH
A8C12	0160-3443		C:FXD CER 0.1 UF +80-20% 50VDCW	72982	8131-050-651-104Z
A8C13	0160-3443		C:FXD CER 0.1 UF +80-20% 50VDCW	72982	8131-050-651-104Z
A8C14	0160-3451		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023B101F103Z525-CDH
A8CR1	1901-0026		DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
A8CR2	1901-0026		DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
A8CR3	1901-0026		DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
A8CR4	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A8CR5	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A8CR6	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A8L1	9100-2268		COIL:FXD 22.0 UH 10%	82142	09-1316-4K
A8Q1	1853-0036		TSTR:SI PNP	80131	2N3906
A8Q2	1854-0215		TSTR:SI NPN	80131	2N3904
A8Q3	1854-0215		TSTR:SI NPN	80131	2N3904
A8Q4	1854-0215		TSTR:SI NPN	80131	2N3904
A8Q5	1854-0215		TSTR:SI NPN	80131	2N3904
A8Q6	1854-0215		TSTR:SI NPN	80131	2N3904

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A8Q7	1854-0215		TSTR:SI NPN	80131	2N3904
A8Q8	1854-0215		TSTR:SI NPN	80131	2N3904
A8Q9	1853-0036		TSTR:SI PNP	80131	2N3906
A8Q10	1855-0317	1	TSTR:UNIJUNCTION SI	04713	MU4894
A8Q12	1854-0215		TSTR:SI NPN	80131	2N3904
A8Q13	1854-0215		TSTR:SI NPN	80131	2N3904
A8Q14	1854-0358		TSTR:SI NPN	28480	1854-0358
A8Q15	1854-0358		TSTR:SI NPN	28480	1854-0358
A8Q16	1854-0215		TSTR:SI NPN	80131	2N3904
A8Q17	1854-0215		TSTR:SI NPN	80131	2N3904
A8Q18	1854-0215		TSTR:SI NPN	80131	2N3904
A8Q19	1854-0215		TSTR:SI NPN	80131	2N3904
A8Q20	1853-0036		TSTR:SI PNP	80131	2N3906
A8Q21	1854-0215		TSTR:SI NPN	80131	2N3904
A8Q22	1853-0080		TSTR:SI PNP	80131	2N4888
A8Q23	1853-0036		TSTR: SI PNP	28480	1853-0036
A8R1	0757-0472		R: FXD MET FLM 200K OHM 1% 1/8W	28480	0757-0472
A8R2	0684-2231		R:FXD COMP 22K OHM 10% 1/4W	01121	CB 2231
A8R3	0684-2231		R:FXD COMP 22K OHM 10% 1/4W	01121	CB 2231
A8R4	0684-1531		R:FXD COMP 15K OHM 10% 1/4W	01121	CB 1531
A8R5	0757-0352	1	R:FXD MET FLM 150K OHM 1% 1/2W	28480	0757-0352
A8R6	0757-0290		R:FXD MET FLM 6.19K OHM 1% 1/8W	28480	0757-0290
A8R7	0757-0273		R:FXD MET FLM 3.01K OHM 1% 1/8W	28480	0757-0273
A8R8	2100-2489		R:VAR FLM 5K OHM 10% LIN 1/2W	28480	2100-2489
A8R9	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A8R10	2100-2522	1	R:VAR CERMET 10K OHM 10% LIN 1/2W	28480	2100-2522
A8R11	0684-2231		R:FXD COMP 22K OHM 10% 1/4W	01121	CB 2231
A8R12	0684-2231		R:FXD COMP 22K OHM 10% 1/4W	01121	CB 2231
A8R13	0684-2231		R:FXD COMP 22K OHM 10% 1/4W	01121	CB 2231
A8R14	0684-1531		R:FXD COMP 15K OHM 10% 1/4W	01121	CB 1531
A8R15	0684-1531		R:FXD COMP 15K OHM 10% 1/4W	01121	CB 1531
A8R16	0684-1531		R:FXD COMP 15K OHM 10% 1/4W	01121	CB 1531
A8R17	0757-0199	1	R:FXD MET FLM 21.5K OHM 1% 1/8W	28480	0757-0199
A8R18	0757-0288	1	R:FXD MET FLM 9.09K OHM 1% 1/8W	28480	0757-0288
A8R19	0684-2711	1	R:FXD COMP 270 OHM 10% 1/4W	01121	CB 2711
A8R20	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A8R21	2100-2514		R:VAR CERMET 20K OHM 10% LIN 1/2W	28480	2100-2514
A8R22	0684-1011		R:FXD COMP 100 OHM 10% 1/4W	01121	CB 1011
A8R23	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A8R24	2100-2514		R:VAR CERMET 20K OHM 10% LIN 1/2W	28480	2100-2514
A8R25	0757-0453		R:FXD MET FLM 30.1K OHM 1% 1/8W	28480	0757-0453
A8R26	0684-1531		R:FXD COMP 15K OHM 10% 1/4W	01121	CB 1531
A8R27	0757-0463		R:FXD MET FLM 82.5K OHM 1% 1/8W	28480	0757-0463
A8R28	0757-0472		R:FXD MET FLM 200K OHM 1% 1/8W	28480	0757-0472
A8R29	0684-1041	2	R:FXD COMP 100K OHM 10% 1/4W	01121	CB 1041
A8R30	0684-4741	2	R:FXD COMP 470K OHM 10% 1/4W	01121	CB 4741
A8R31	0684-4741		R:FXD COMP 470K OHM 10% 1/4W	01121	CB 4741
A8R32	0684-1531		R:FXD COMP 15K OHM 10% 1/4W	01121	CB 1531
A8R33	0684-2731	1	R:FXD COMP 27K OHM 10% 1/4W	01121	CB 2731
A8R34	0684-1031		R:FXD COMP 10K OHM 10% 1/4W	01121	CB 1031
A8R35	0757-0273	1	R: FXD TUBULAR 3.01K OHM 1% 1/8W	24546	C4-1/8-TO-3011-F
A8R36	0684-2731		R: FXD TUBULAR 27K OHM 10% 1/4W	01121	CB2731
A8R37	0684-1011		R: FXD CC 100 OHM 10% 1/4W	01121	CB1011
A8R38	0684-1041		R:FXD COMP 100K OHM 10% 1/4W	01121	CB 1041
A8R39	0684-2231		R:FXD COMP 22K OHM 10% 1/4W	01121	CB 2231
A8R40	0684-2231		R:FXD COMP 22K OHM 10% 1/4W	01121	CB 2231
A8R41	0684-1531		R:FXD COMP 15K OHM 10% 1/4W	01121	CB 1531
A8R42	0757-0456	1	R:FXD MET FLM 43.2K OHM 1% 1/8W	28480	0757-0456
A8R43	0757-0767		R:FXD FLM 43.2K OHM 1% 1/4W	28480	0757-0767
A8R44	0684-1051	1	R:FXD COMP 1MEGOHM 1% 1/4W	01121	CB 1051
A8R45	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A8R46	0684-1811	1	R:FXD COMP 180 OHM 10% 1/4W	01121	CB 1811
A8R47	0683-4715	1	R:FXD COMP 470 OHM 5% 1/4W	01121	CB 4715
A8R48	0684-2231		R:FXD COMP 22K OHM 10% 1/4W	01121	CB 2231
A8R49	0757-0439		R: FXD MET FLM 6810 OHM 1% 1/8W	28480	0757-0439
A8R50	0757-0459	1	R:FXD MET FLM 56.2K OHM 1% 1/8W	28480	0757-0459
A8R51	0757-0461	1	R:FXD MET FLM 24.3K OHM 1% 1/8W	28480	0757-0461
A8R52	0684-1531		R:FXD COMP 15K OHM 10% 1/4W	01121	CB 1531
A8R53	0684-1531		R:FXD COMP 15K OHM 10% 1/4W	01121	CB 1531
A8R54	0684-4721	1	R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A8R55	0684-1001	1	R:FXD COMP 10 OHM 10% 1/4W	01121	CB 1001
A8R56	0687-3311	1	R:FXD COMP 330 OHM 10% 1/2W	01121	EB 3311
A8R57	0684-2231		R:FXD COMP 22K OHM 10% 1/4W	01121	CB 2231
A8R58	0757-0767	1	R:FXD FLM 43.2K OHM 1% 1/4W	28480	0757-0767
A8R59	2100-2522	1	R:VAR CERMET 10K OHM 10% LIN 1/2W	28480	2100-2522
A8R60	0757-0124	1	R:FXD MET FLM 39.2K OHM 1% 1/8W	28480	0757-0124
A8R61	0757-0449		R:FXD FLM 20K OHM 1% 1/8W	28480	0757-0449
A8R62	0684-2231		R:FXD COMP 22K OHM 10% 1/4W	01121	CB 2231
A8R63	0684-2231		R:FXD COMP 22K OHM 10% 1/4W	01121	CB 2231
A8R64	0684-2231		R:FXD COMP 22K OHM 10% 1/4W	01121	CB 2231
A8R65	0684-2731		R: FXD TUBULAR 27K OHM 10% 1/4W	01121	CB2731

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A8U1	1820-0913	1	IC:TTL LP MONOSTABLE MULTIVIBRATOR	01295	SN74L122N
A8U2	1820-0587	2	IC:TTL LP TRIPLE 3-INPT NAND GATE	12040	DM74L10N
A8U3	1820-0587		IC:TTL LP TRIPLE 3-INPT NAND GATE	12040	DM74L10N
A8U4	1820-0584	2	IC:TTL LP QUAD 2-INPT NOR GATE	12040	DM74L02N
A8U5	1820-0584		IC:TTL LP QUAD 2-INPT NOR GATE	12040	DM74L02N
A8VR1	1902-0041	1	DIODE:BREAKDOWN 5.11V 5%	04713	SZ10939-98
A8XU1	1200-0441		SOCKET:IC 14 PIN MINIATURE	28480	1200-0441
A8XU2	1200-0441		SOCKET:IC 14 PIN MINIATURE	28480	1200-0441
A8XU3	1200-0441		SOCKET:IC 14 PIN MINIATURE	28480	1200-0441
A8XU4	1200-0441		SOCKET:IC 14 PIN MINIATURE	28480	1200-0441
A8XU5	1200-0441		SOCKET:IC 14 PIN MINIATURE	28480	1200-0441
A9	00184-61101		MULTIPLIER ASSY:HV(CAB)	28480	00184-61101
A9	00184-61103		MULTIPLIER ASSY:HV (RACK)	28480	00184-61103
A10	00180-66546		BOARD ASSY:SWEEP GATE	28480	00180-66546
A10C1	0180-0155	2	C:FXD ELECT 2.2 UF 20% 20VDCW	56289	150D225X0020A2-DYS
A10C2	0180-0155		C:FXD ELECT 2.2 UF 20% 20VDCW	56289	150D225X0020A2-DYS
A10E1	0360-1514	12	PIN:SQUARE	28480	0360-1514
A10L1	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A10L2	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A10Q1	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A10Q2	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A10Q3	1853-0016	2	TSTR:SI PNP	80131	2N3638
A10Q4	1853-0016		TSTR:SI PNP	80131	2N3638
A10R1	0757-0451	2	R:FXD MET FLM 24.3K OHM 1% 1/8W	28480	0757-0451
A10R2	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A10R3	0757-0436		R:FXD MET FLM 4.32K OHM 1% 1/8W	28480	0757-0436
A10R4	0757-0451		R:FXD MET FLM 24.3K OHM 1% 1/8W	28480	0757-0451
A10R5	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A10R6	0757-0436		R:FXD MET FLM 4.32K OHM 1% 1/8W	28480	0757-0436
A10R7	0757-0429		R: FXD MET FLM 1820 OHM 1% 1/8W	28480	0757-0429
A10R8	0757-0273		R: FXD MET FLM 3010 OHM 1% 1/8W	28480	0757-0273
A10R9	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A10R10	0757-0429		R: FXD MET FLM 1820 OHM 1% 1/8W	28480	0757-0429
A10R11	0757-0273		R: FXD MET FLM 3010 OHM 1% 1/8W	28480	0757-0273
A10R12	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A10R13	0683-0275		R:FXD COMP 2.7 OHM 5% 1/4W	01121	CB 2705
A10R14	0683-0275		R:FXD COMP 2.7 OHM 5% 1/4W	01121	CB 2705
A10R15	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438

Table 6-3. List of Manufacturers' Code

Mfr Code	Manufacturer Name	Address	Zip Code
00000	U.S.A. COMMON	ANY SUPPLIER OF U.S.A.	
00287	CEMCO	DANIELSON, CONN.	06239
00853	SANGAMO ELECTRIC CO. PICKENS DIV.	PICKENS, S.C.	29671
01121	ALLEN BRADLEY CO.	MILWAUKEE, WIS.	53204
01295	TEXAS INSTRUMENTS INC. SEMICONDUCTOR COMPONENTS DIV.	DALLAS, TEX.	75231
01538	SMALL PARTS INC.	COSTA MESA, CALIF.	92626
02114	FERROXCUBE CORP.	SAUGERTIES, N.Y.	12477
02660	AMPHENOL CORP.	BROADVIEW, ILL.	60153
02735	RCA SOLID STATE & RECEIVING TUBE DIV.	SOMERVILLE, N.J.	08876
04606	FISCHER SPECIAL MFG CO.	CINCINNATI, OH.	45202
04713	MOTOROLA SEMICONDUCTOR PROD. INC.	PHOENIX, ARIZ.	85008
04757	OAK INDUS INC. SW DIV.	CRYSTAL LAKE, IL.	60014
05820	WAKEFIELD ENGINEERING INC.	WAKEFIELD, MASS.	01880
07263	FAIRCHILD CAMERA & INST. CORP. SEMICONDUCTOR DIV.	MOUNTAIN VIEW, CALIF.	94040
08806	GE CO MINATURE LAMP PROD. DEPT.	CLEVELAND, OH.	44112
09134	TEXAS CAPACITOR CO. INC.	HOUSTON, TEX.	77042
09353	C & K COMPONENTS INC.	NEWTON, MASS.	02158
12040	NATIONAL SEMICONDUCTOR CORP.	DANBURY, CONN.	06810
15636	ELECTROL INC.	NORTHRIDGE, CALIF.	91325
24226	GOWANDA ELECTRONICS CORP.	GOWANDA, N.Y.	14070
24546	CORNING GLASS WORKS (C STYLE RES)	BRADFORD, PA.	16701
27264	MOLEX PROD. CO.	DOWNERS GROVE, ILL.	60515
28480	HEWLETT-PACKARD CO. CORPORATE HQ.	YOUR NEAREST HP OFFICE	
30983	MEPCO/ELECTRA CORP (VAR RES)	SAN DIEGO, CA.	92121
56289	SPRAGUE ELECTRIC CO.	N. ADAMS, MASS.	01247
66295	WITTEK MFG. CO.	CHICAGO, ILL.	60623
70903	BELDEN CORP.	CHICAGO, ILL.	60644
71400	BUSSMANN MFG. DIV. MC GRAW-EDISON CO.	ST. LOUIS, MO.	63017
71485	UNION CARD DIV. UTD CORP.	ATHOL, MASS.	01331
71744	CHICAGO MINIATURE LAMP WORKS	CHICAGO, ILL.	60640
71785	CINCH MFG. CO. DIV. TRW INC.	ELK GROVE VILLAGE, ILL.	60007
72136	ELECTRO MOTIVE MFG. CO. INC.	WILLIMANTIC, CONN.	06226
72656	INDIANA GENERAL CORP. ELECTRONIC DIV.	KEASBEY, N.J.	08832
72825	EBY HUGH H. INC.	PHILADELPHIA, PA.	19144
72982	ERIE TECHNOLOGICAL PROD. INC.	ERIE, PA.	16512
73734	FEDERAL SCREW PRODUCTS INC.	CHICAGO, ILL.	60618
75915	LITTELFUSE, INC.	DES PLAINES, ILL.	60016
76210	MARWEDEL CW	SAN FRANCISCO, CA.	94103
78189	ILLINOIS TOOL WORKS INC.	ELGIN, ILL.	60126
79136	WALDES KOHINOOR INC.	LONG IS. CITY, N.Y.	11101
80131	ELECTRONIC INDUSTRIES ASSOCIATION	WASHINGTON, D.C.	20006
82142	AIRCO SPEER ELECT. COMP.	DU BOIS, PA.	15801
82389	SWITCHCRAFT INC.	CHICAGO, ILL.	60630
91506	AUGAT INC.	ATTLEBORO, MASS.	02703
98291	SEALECTRO CORP.	MAMARONECK, N.Y.	10544
99800	DELEVAN ELECTRONICS CORP	E. AURORA, N.Y.	14052

See introduction to this section for ordering information

BACK DATING MANUAL CHANGES

SECTION VII

MANUAL CHANGES

7-1. INTRODUCTION.

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

7-3. MANUAL CHANGES.

7-4. This manual applies directly to 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. For 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
1228A	9 thru 1
1242A	9 thru 2
1247A	9 thru 3
1301A	9 thru 4
1304A	9 thru 5
1424A	9 thru 6
1433A	9 thru 7
1435A	9

CHANGE 1

Table 6-2,
- W6: Change to HP Part No. 00184-61613, CABLE: MAIN (RACK), Mfr. Code 28480, Mfr. Part No. 00184-61613.
- W6: Change to HP Part No. 00184-61601, CABLE: MAIN (CABINET), Mfr. Code 28480, Mfr. Part No. 00184-61601.
- A3: Change HP and Mfr. Part Nos. to 00184-66503.
- A3R1: Change to HP Part No. 0757-0431, R:FXD METFLM 2430 OHM 1% 1/8W, Mfr. Code 28480, Mfr. Part No. 0757-0431.
- A3CR5: Change to HP Part No. 1902-0766, DIODE: BREAKDOWN 18.2V, Mfr. Code 28480, Mfr. Part No. 1902-0766.
- A3L1: Change to HP Part No. 9140-0179, COIL: CHOKE 22.0 UH 10%, Mfr. Code 28480, Mfr. Part No. 9140-0179.
- DELETE: A3C3, A3R2, A3R3, A3Q2, A3CR2, and A3CR4.

Schematic 7,
- DELETE: A3C3, A3CR2, A3CR4, A3Q2, A3R2 and A3R3.
- A3R1: Change value to 2430.

CHANGE 2

Table 6-2,
- A6: Change to HP Part No. 00184-66506, BOARD ASSY:GATE, Mfr. Code 28480, Mfr. Part No. 00184-66506.
- A6CR12: Change to HP Part No. 1901-0040, DIODE:SILICON 30 MA 30 MW, Mfr. Code 07263, Mfr. Part No. FDG1088.
- A6R66: Change to HP Part No. 0698-6667, R:FXD FLM 15 MEGOHM 2% 1W, Mfr. Code 28480, Mfr. Part No. 0698-6667.
- DELETE: A6C24, A6CR13, A6R88, A6VR3, and A6VR4.

Schematic 7,
- DELETE: A6C24, A6CR13, A6R88, A6VR3, A6VR4, and connection to CRT, pin 5.

CHANGE 3

Table 6-2,
- DS1: Change to HP Part No. 2140-0352, LAMP: INCANDESCENT 18.0V 0.026 AMP, Mfr. Code 71744, Mfr. Part No. CM 7220.
- W6: Change to HP Part No. 00184-61620, CABLE: MAIN (RACK), Mfr. Code 28480, Mfr. Part No. 00184-61620.
- W6: Change to HP Part No. 00184-61619, CABLE: MAIN (CABINET), Mfr. Code 28480, Mfr. Part No. 00184-61619.
- A1: Change to HP Part No. 00184-60001, POWER MODULE:LOW VOLTAGE, Mfr. Code 28480, Mfr. Part No. 00184-60001.
- A1T1: Change to HP Part No. 9100-1117, TRANSFORMER:POWER, Mfr. Code 28480, Mfr. Part No. 9100-1117.
- A1A1: Change to HP Part No. 00184-66501, BOARD ASSY:LV RECTIFIER, Mfr. Code 28480, Mfr. Part No. 00184-66501.
- ADD: A1A1R5: HP Part No. 0687-8211, R:FXD COMP 820 OHM 10% 1/2W, Mfr. Code 01121, Mfr. Part No. EB 8211.

Schematic 2,
ADD: R5 (820 ohms). Connect R5 between pin 5 of J2 and junction of A1A1CR9 and A1A1CR10. Connect pin 5 of J2 to one side of LINE lamp DS1. Connect other lead of DS1 to ground. Delete lamp driver winding of A1T1.

CHANGE 4

Figure 3-1,
Delete: items G and H from rear panel.
Paragraph 3-34,
Delete: last sentence.
Paragraph 3-70 and 3-71,
Delete: title and entire paragraph.
Paragraph 3-73,
Delete: step d.
Paragraph 5-15, step a,
Delete: STD WRITE SPD..... NORM
Paragraph 5-40, step a,
Delete: STD WRITE SPD..... NORM
Figure 6-2, detail B,
Delete, S6 and R11 and attaching parts.
Table 6-2,
Delete: E4, MP112, MP113, MP114, R11, S6, A8Q20, A8Q21, A8R60 through A8R64.
A8: Change HP and Mfr. Part Numbers to 00184-66508 (2 places).
MP93: Change HP and Mfr. Part Numbers to 00184-60201.
A8C9: Change to 0160-0155; C:FXD MY 0.0033 UF 10% 200 VDCW; 56289; 192P56292-PTS.
Figure 8-15, Pulse Circuit Component Identification:
Delete Q20, Q21, R60 through R64.
Figure 8-16, Schematic 6,
Delete: A8Q20, A8Q21, A8R60 through A8R64.
A8C9: Change to 3300.
A8U1: Connect pin 9 to +5V.
Delete: R11, S6, and associated wiring.

CHANGE 5

Table 6-2,
A2: Change HP and Mfr. Part Numbers to 00184-66502.
Delete: A2C2 thru A2C5, A2CR2, A2CR3, A2Q1, thru A2Q4, and A2R4 thru A2R11.
A8: Change HP and Mfr. Part Numbers to 00184-66514.
A8C10: Change to 0160-3466; C: FXD CER 100 PF 10% 240 VDCW; 56289; C157F251F101KS22-CDH.
Add: A8C15; HP Part No. 0160-3451; C: FXD CER 0.01 UF +80 —20% 100 VDCW; 56289; C023B101 F103ZS25-CDH.
A8Q12: Change to 1854-0358; TSTR: SI NPN; 28480; 1854-0358.
Delete: A8Q22.
A8R49: Change to 0757-0767; R: FXD FLM 43.2K OHM 1% 1/4W; 28480; 0757-0767.
A8R50: Change to 0698-3161; R: FXD MET FLM 38.3K OHM 1% 1/8W; 28480; 0698-3161.
A8R51: Change to 0757-0469; R: FXD FLM 150K OHM 1% 1/8W; 28480; 0757-0469.
A8R58: Change to 0757-0466; R: FXD MET FLM 110K OHM 1% 1/8W; 28480; 0757-0466.
A8R59: Change to 2100-2517; R: VAR FLM 50K OHM 10% LIN 1/2W; 28480; 2100-2517.
Figure 8-13, Mode Switch Component Identification,
Delete: A2C2 thru A2C5, A2CR2, A2CR3, A2Q1 thru A2Q4, A2R4 thru A2R11.
Remainder of A2 is unchanged.
Figure 8-14, Schematic 5,
Delete: A2C2 thru A2C5, A2CR2, A2CR3, A2Q1 thru A2Q4, A2R4 thru A2R11.
Change: Connection of ERASE switch (formerly connected to A2C2.) Connect directly to junction A2CR1/A2R2.
Figure 8-15, Pulse Circuit Component Identification,
Replace with figure 7-1.
Figure 8-16, Schematic 6,
Change: Circuits to pins c and 4 on A8 per figure 7-2.

CHANGE 6

Table 6-2:
MP42: Change HP Part No. and Mfr. Part No. to 00184-00202.
MP43: Change HP Part No. and Mfr. Part No. to 00184-00203.
MP80: Change HP Part No. and Mfr. Part No. to 00184-00204.
S2: Change to HP Part No. 3101-1785; SWITCH: SLIDE SPDT; Mfr. Code 28480; Mfr. Part No. 3101-1785.

CHANGE 7

Table 6-2:
A7: Change HP Part No. and Mfr. Part No. to 00184-66507.
Add: A7C14; HP Part No. 0180-0218; C:FXD ELECT 0.15UF 10% 35VDCW; Mfr. Code 28480; Mfr. Part No. 0180-0218.
Add: A7R51; HP Part No. 0757-0200; R:FXD MET FLM 5.62K OHM 1% 1/8W; Mfr. Code 28480; Mfr. Part No. 0757-0200.
Delete: A7R76.
Figure 8-10:
A7R27: Delete connection from A7R27 to junction of A7R76/A7C13. Connect instead to —12.6 V.
Delete: A7R76 and connections to —12.6V and to A7C13.
Add: A7R51 from junction of A7CR9/A7R50 to A7J2, pin 3.
Add: A7C14 from junction of A7R51/A7J2, pin 3 to ground.

CHANGE 8

Table 6-2:

A6: Change to HP Part No. 00184-66512; BOARD ASSY:GATE; Mfr. Code 28480; Mfr. Part No. 00184-66512.

Delete: A6C28 and A6C29.

Add: A6CR10; HP Part No. 1901-0040; DIODE: SWITCHING 50MA 30V MAX; Mfr. Code 28480; Mfr. Part No. 1901-0040.

Delete: A6CR14, A6CR15, and A6CR16.

Add: A6Q11 and A6Q12; HP Part No. 1854-0215; TSTR:SI NPN; Mfr. Code 80131; Mfr. Part No. 2N3904.

Add: A6Q13; HP Part No. 1853-0036; TSTR:SI PNP; Mfr. Code 80131; Mfr. Part No. 2N3906.

Delete: A6Q24, A6Q25, and A6Q26.

Add: A6R27; HP Part No. 2100-1618; V:VAR FLM 1 MEGOHM 10% LIN 1/2W; Mfr. Code 28480; Mfr. Part No. 2100-1618.

Add: A6R37; HP Part No. 0698-3162; R:FXD MET FLM 46.4K OHM 1% 1/8W; Mfr. Code 28480; Mfr. Part No. 0698-3162.

Add: A6R38; HP Part No. 0698-3162; R:FXD MET FLM 46.4K OHM 1% 1/8W; Mfr. Code 28480; Mfr. Part No. 0698-3162.

Add: A6R39; HP Part No. 0698-3162; R:FXD MET FLM 46.4K OHM 1% 1/8W; Mfr. Code 28480; Mfr. Part No. 0698-3162.

Add: A6R40; HP Part No. 0698-3162; R:FXD MET FLM 46.4K OHM 1% 1/8W; Mfr. Code 28480; Mfr. Part No. 0698-3162.

Add: A6R41; HP Part No. 0757-0449; R:FXD FLM 20K OHM 1% 1/8W; Mfr. Code 28480; Mfr. Part No. 0757-0449.

Add: A6R42; HP Part No. 0684-1011; R:FXD COMP 100 OHM 10% 1/4W; Mfr. Code 01121; Mfr. Part No. CB1011.

Add: A6R43; HP Part No. 2100-2650; R:VAR FLM 200K OHM 10% LIN 1/2W; Mfr. Code 28480; Mfr. Part No. 2100-2650.

Add: A6R44; HP Part No. 0757-0465; R:FXD MET FLM 100K OHM 1% 1/8W; Mfr. Code 28480; Mfr. Part No. 0757-0465.

Delete A6R90 through A6R106.

A8: Change to HP Part No. 00184-66516; BOARD ASSY:PULSE CIRCUIT; Mfr. Code 28480; Mfr. Part No. 00184-66516.

A8C4: Change to HP Part No. 0180-0291; C:FXD ELECT 1.0UF 10% 35 VDCW; Mfr. Code 56289; Mfr. Part No. 150D105X9035A2-DYS.

A8C5: Change to HP Part No. 0180-0197; C:FXD ELECT 2.2UF 10% 20 VDCW; Mfr. Code 56289; Mfr. Part No. 150D225X9020A2-DYS.

Delete: A8Q23.

A8R35: Change to HP Part No. 0684-6831; R:FXD COMP 68K OHM 10% 1/4W; Mfr. Code 01121; Mfr. Part No. CB 6831.

A8R36: Change to HP Part No. 0684-1531; R:FXD COMP 15K OHM 10% 1/4W; Mfr. Code 01121; Mfr. Part No. CB1531.

A8R37: Change to HP Part No. 0684-1031; R:FXD COMP 10K OHM 10% 1/4W; Mfr. Code 01121; Mfr. Part No. CB1031.

Delete: A8R65.

Figure 8-11,
Replace with figure 7-3.

Figure 8-12,
Replace with figure 7-4.

Figure 8-15,
Replace with figure 7-5.

Figure 8-16,
Replace with figure 7-6.

Figure 8-20,
Replace with figure 7-7

CHANGE 9

Table 6-2,

A6: Change HP Part No. and Mfr Part No. to 00184-66519.

A6C9: Change to HP Part No. 0160-2403, C:FXD CER 1500 PF 20% 5K VDCW, Mfr Code 72982, Mfr Part No. 828-025-X5R0-152M.

A6R26: Change to HP Part No. 0698-5678, R:FXD FLM 16.25 MEGOHM 5% 1W, Mfr Code 28480, Mfr Part No. 0698-5678.

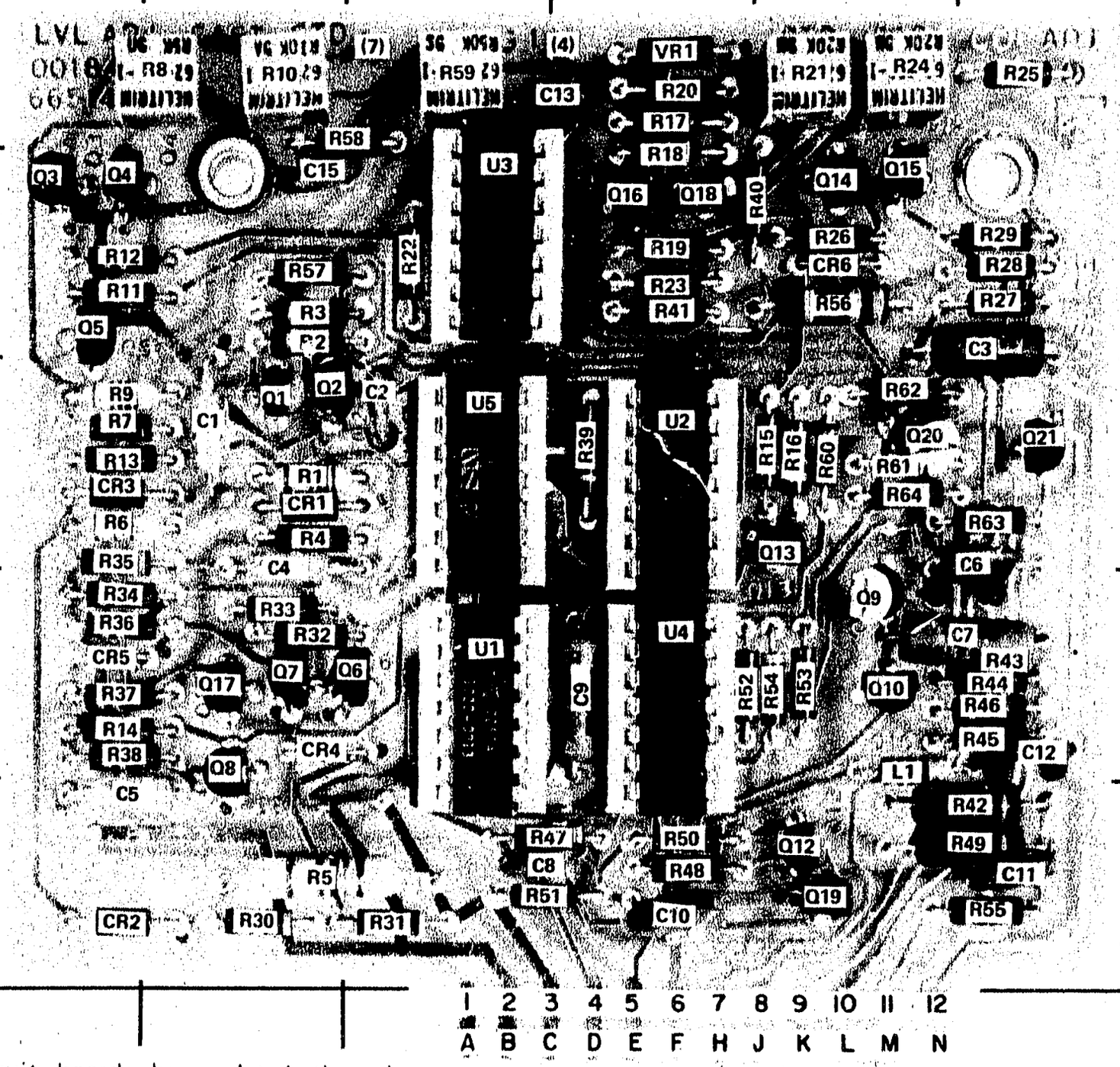
A6R90: Change to HP Part No. 0757-0145, R:FXD TUBULAR 750K OHM 1% 1/4W, Mfr Code 30983, Mfr Part No. MF52C1/4-T0-7503-F.

Schematic 4,

A6C9: Change value to 1500 PF.

A6R26: Change value to 16.25M.

A6R90: Change value to 750K and delete asterisk.



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

A8

REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	B-3	C15	B-2	Q7	B-4	R1	B-3	R15	E-3	R29	F-2	R43	F-4	R57	B-2
C2	C-3	CR1	B-3	Q8	B-4	R2	B-5	R16	E-3	R30	B-5	R44	F-4	R58	C-1
C3	F-2	CR2	A-5	Q9	E-4	R3	A-3	R17	D-1	R31	C-5	R45	F-4	R59	C-1
C4	B-3	CR3	A-3	Q10	E-4	R4	A-3	R18	D-2	R32	B-4	R46	F-4	R60	E-3
C5	A-5	CR4	B-4	Q12	E-5	R5	B-1	R19	D-2	R33	B-4	R47	D-5	R61	E-3
C6	F-3	CR5	A-4	Q13	E-3	R6	A-3	R20	D-1	R34	A-4	R48	D-5	R62	E-3
C7	F-4	CR6	E-2	Q14	E-2	R7	B-1	R21	E-1	R35	A-3	R49	F-5	R63	F-3
C8	D-5	L1	E-4	Q15	E-2	R8	A-2	R22	C-2	R36	A-4	R50	D-5	R64	E-3
C9	D-4	Q1	B-3	Q16	D-2	R9	A-2	R23	D-2	R37	A-4	R51	D-5	U1	C-4
C10	D-5	Q2	B-3	Q17	B-4	R10	A-3	R24	E-1	R38	A-4	R52	E-4	U2	D-3
C11	F-5	Q3	A-2	Q18	D-2	R11	A-4	R25	F-1	R39	D-3	R53	E-4	U3	C-2
C12	F-4	Q4	A-2	Q19	E-5	R12	E-3	R26	E-2	R40	E-2	R54	E-4	U4	D-4
C13	D-1	Q5	A-2	Q20	E-3	R13	E-3	R27	F-2	R41	D-2	R55	F-5	U5	C-3
C14	C-5	Q6	C-4	Q21	F-3	R14	D-1	R28	F-2	R42	F-5	R56	E-2	VR1	D-1

184A/B-R-12

Figure 7-1. Change 5 Effect on Assembly A8

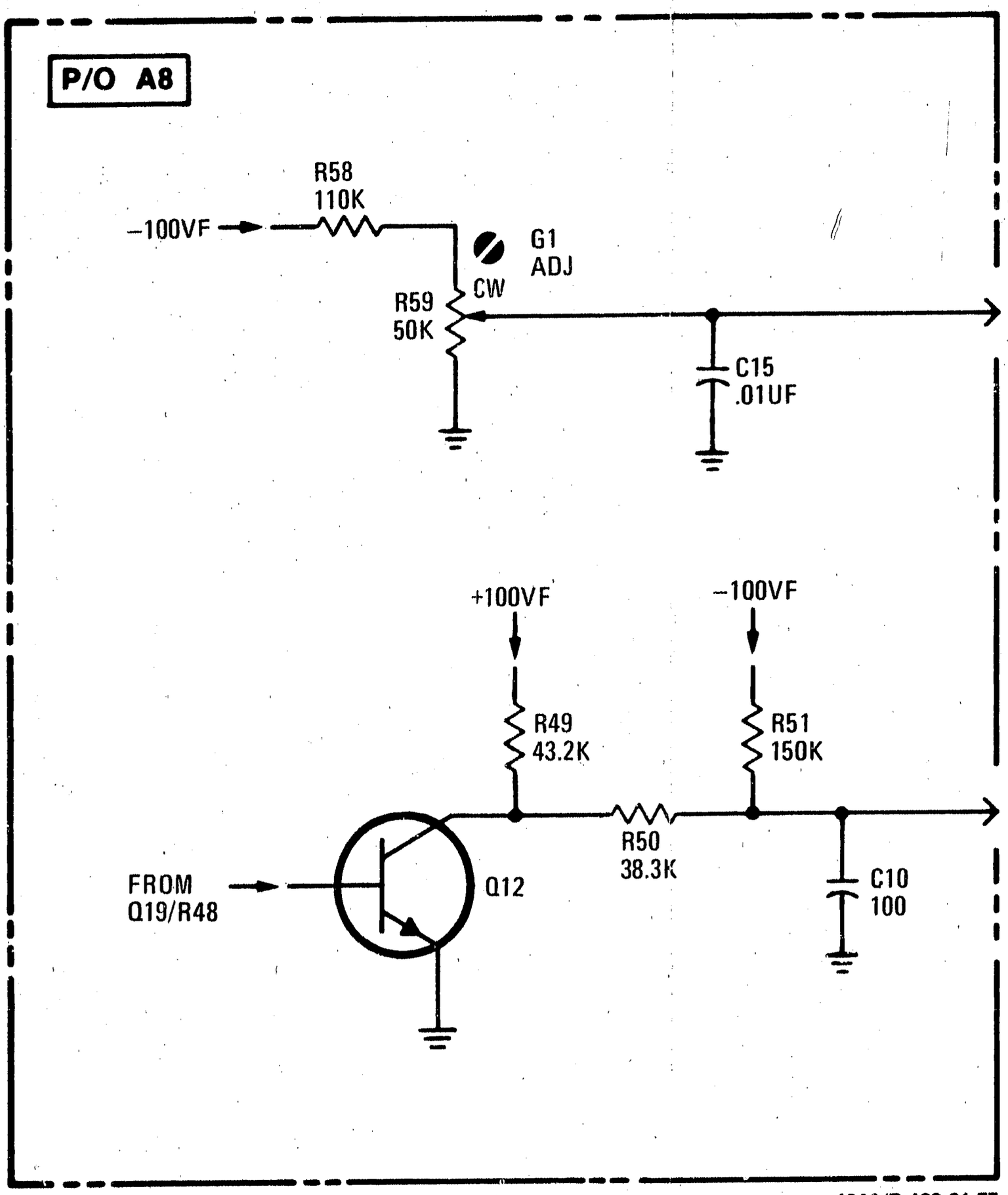
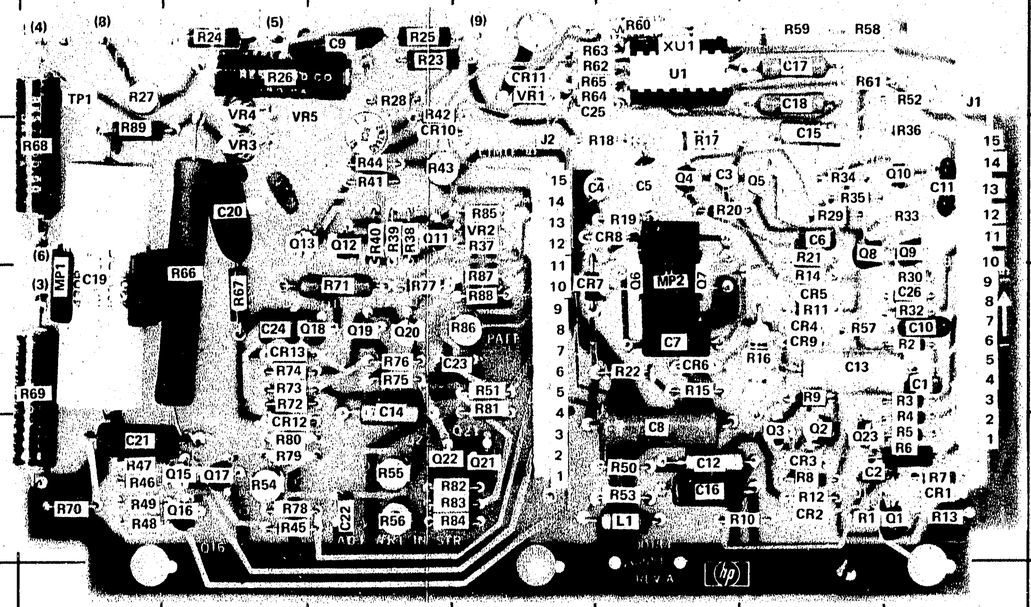


Figure 7-2.
Change 5 Effect on Schematic 6



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	J-3	C17	I-1	CR8	H-2	Q6	H-3	Q22	F-4	R15	H-3	R32	J-3	R47	D-4	R63	G-1	R79	E-4
C2	I-4	C18	I-1	CR9	I-3	Q7	H-3	Q23	I-4	R16	I-3	R33	J-2	R48	D-4	R64	G-1	R80	E-4
C3	H-2	C19	D-3	CR10	F-2	Q8	J-2	R1	I-4	R17	H-2	R34	I-2	R49	D-4	R65	G-1	R81	G-3
C4	H-2	C20	E-2	CR11	G-1	Q9	J-2	R2	J-3	R18	H-2	R35	I-2	R50	H-4	R66	E-3	R82	F-4
C5	H-2	C21	D-4	CR12	E-4	Q10	J-2	R3	J-3	R19	H-2	R36	J-2	R51	G-3	R67	E-3	R83	F-4
C6	I-2	C22	F-4	CR13	E-3	Q11	F-2	R4	J-4	R20	H-2	R37	G-2	R52	J-7	R68	D-2	R84	F-4
C7	H-3	C23	G-3	J1	J-2	Q12	F-2	R5	J-4	R21	I-2	R38	F-2	R53	H-4	R69	D-3	R85	G-3
C8	H-4	C24	E-3	J2	G-2	Q13	F-2	R6	J-4	R22	H-3	R39	F-2	R54	E-4	R70	D-4	R86	G-3
C9	F-1	C25	G-1	L1	H-4	Q14	F-2	R7	J-4	R23	F-1	R40	F-2	R55	F-4	R71	F-3	R87	G-3
C10	J-3	C26	G-3	MP1	D-3	Q15	E-4	R8	I-4	R24	E-1	R41	F-2	R56	F-4	R72	E-3	R88	G-3
C11	J-2	CR1	J-4	MP2	H-3	Q16	E-4	R9	I-3	R25	F-1	R42	F-1	R57	I-3	R73	E-3	R89	D-2
C12	H-4	CR2	I-4	Q1	I-4	Q17	E-4	R10	I-4	R26	E-1	R43	F-2	R58	I-1	R74	E-3	TP1	D-1
C13	I-3	CR3	I-4	Q2	I-4	Q18	F-3	R11	I-3	R27	D-1	R44	F-2	R59	I-1	R75	F-3	U1	H-1
C14	F-3	CR4	I-3	Q3	I-4	Q19	F-3	R12	I-4	R28	F-1	R45	E-4	R60	H-1	R76	F-3	VR1	G-1
C15	I-2	CR5	I-3	Q4	H-2	Q20	F-3	R13	J-4	R29	I-2	R46	D-4	R61	I-1	R77	F-3	VR2	G-2
C16	H-4	CR6	H-3	Q5	I-2	Q21	G-4	R14	I-3	R30	J-3			R62	G-1	R78	E-4	VR3	E-2
		CR7	G-3															VR4	E-2
																		XU1	H-1

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Figure 7-3. Gate Amplifier Component Identification

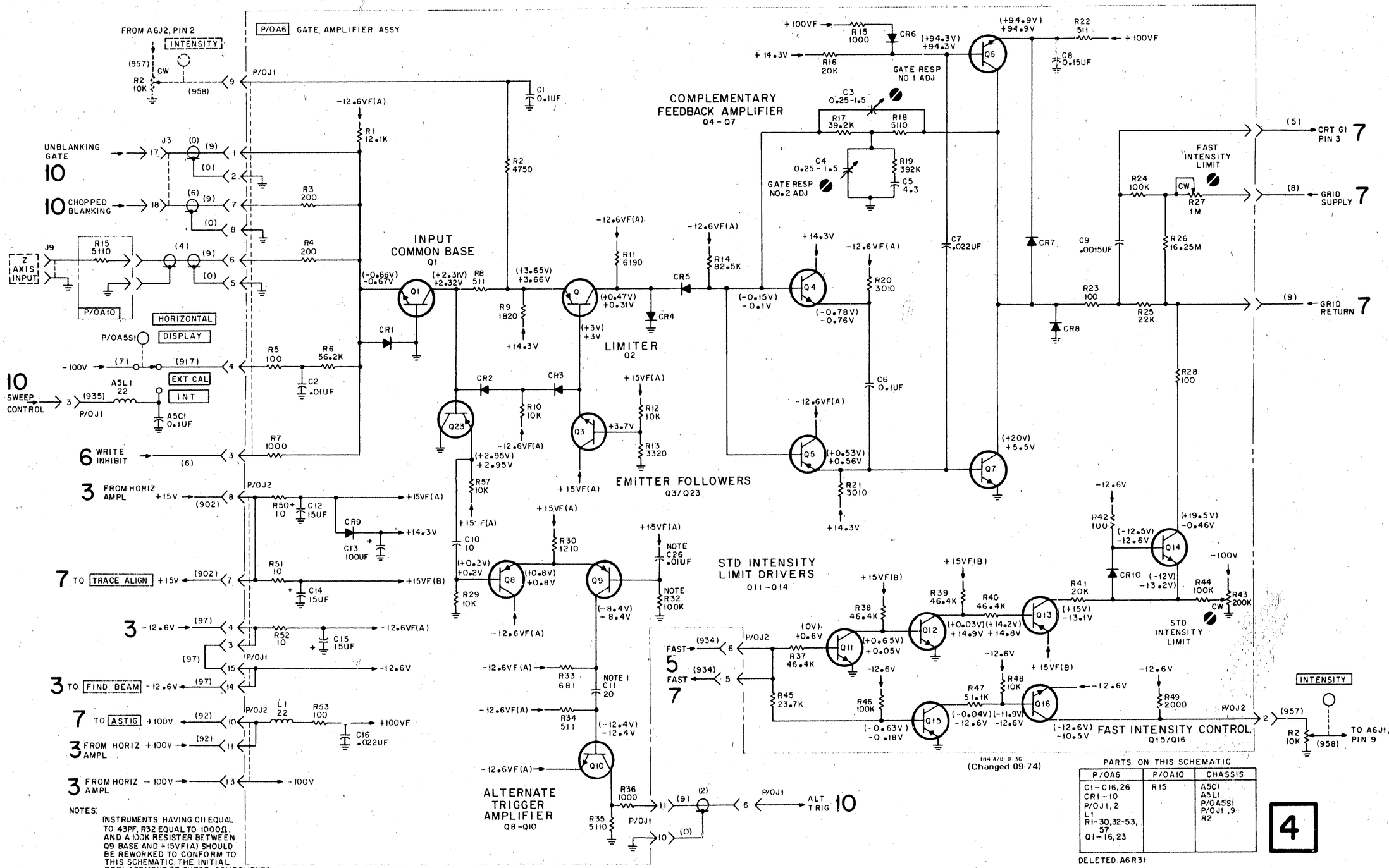
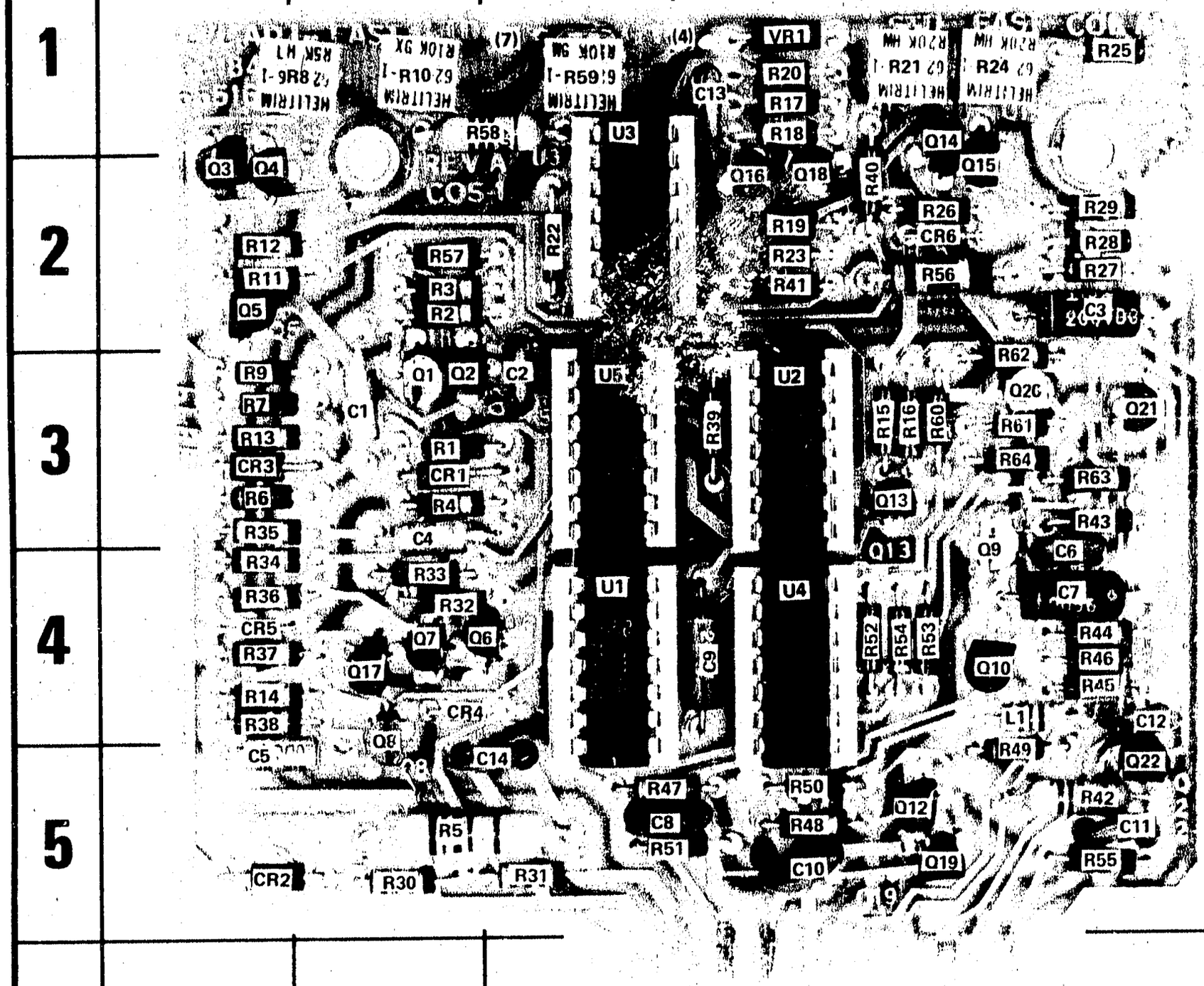


Figure 7-4.
Gate Amplifier
7-7



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	B-3	CR1	B-3	Q8	B-4	R1	B-3	R15	E-3	R29	F-2	R43	F-3	R57	B-2
C2	C-3	CR2	A-5	Q9	E-4	R2	B-5	R16	E-3	R30	B-5	R44	F-4	R58	C-1
C3	F-2	CR3	A-3	Q10	E-4	R3	A-3	R17	D-1	R31	C-5	R45	F-4	R59	C-1
C4	B-3	CR4	B-4	Q12	E-5	R4	A-3	R18	D-2	R32	B-4	R46	F-4	R60	E-3
C5	A-5	CR5	A-4	Q13	E-3	R5	B-1	R19	D-2	R33	B-4	R47	D-5	R61	E-3
C6	F-3	CR6	E-2	Q14	E-2	R6	A-3	R20	D-1	R34	A-4	R48	D-5	R62	E-3
C7	F-4	L1	E-4	Q15	E-2	R7	B-1	R21	E-1	R35	A-3	R49	E-4	R63	F-3
C8	D-5	Q1	B-3	Q16	D-2	R8	A-2	R22	C-2	R36	A-4	R50	D-5	R64	E-3
C9	D-4	Q2	B-3	Q17	B-4	R9	A-2	R23	D-2	R37	A-4	R51	D-5	U1	C-4
C10	D-5	Q3	A-2	Q18	D-2	R10	A-3	R24	E-1	R38	A-4	R52	E-4	U2	D-3
C11	F-5	Q4	A-2	Q19	E-5	R11	A-4	R25	F-1	R39	D-3	R53	E-4	U3	C-2
C12	F-4	Q5	A-2	Q20	E-3	R12	E-3	R26	E-2	R40	E-2	R54	E-4	U4	D-4
C13	D-1	Q6	C-4	Q21	F-3	R13	E-3	R27	F-2	R41	D-2	R55	F-5	U5	C-3
C14	C-5	Q7	B-4	Q22	F-5	R14	D-1	R28	F-2	R42	F-5	R56	E-2	VR1	D-1

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Figure 7-5. Pulse Circuit Component Identification

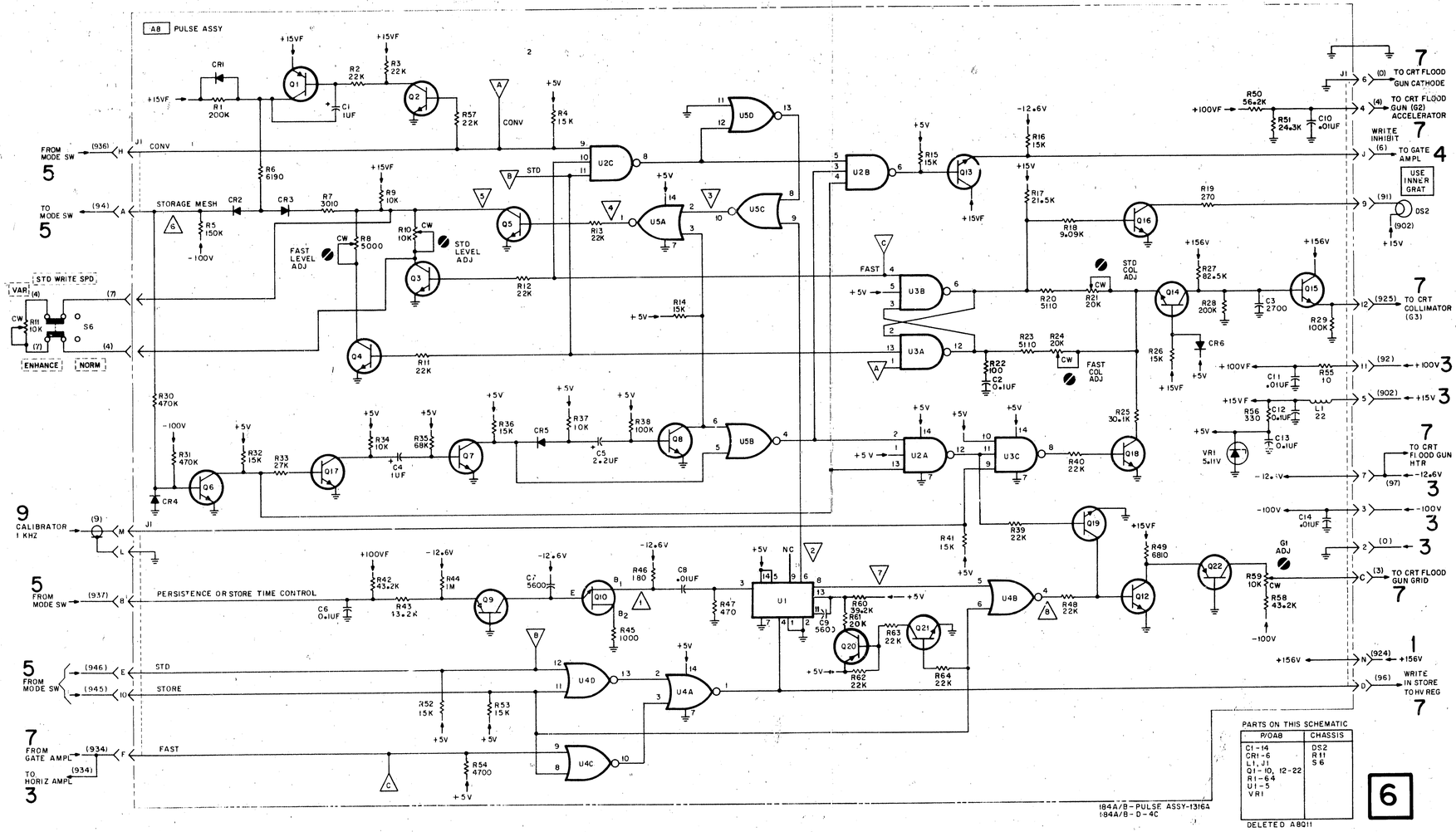


Figure 7-6.
Pulse Circuit Schematic

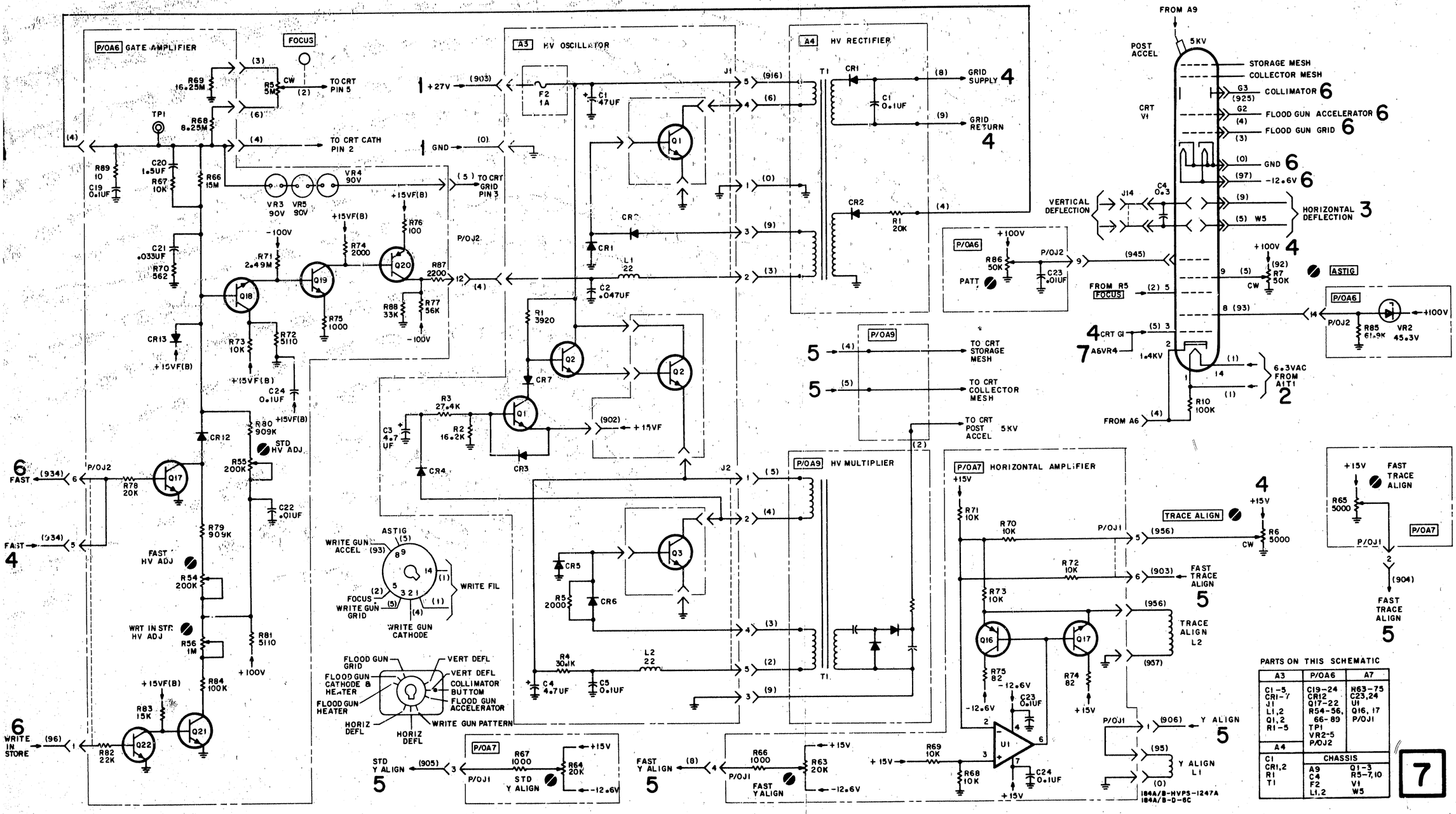


Figure 7-7. High-voltage Power Supply Schematic

SCHEMATIC DIAGRAMS TROUBLE-SHOOTING

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 cricuit 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 (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. 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.

CAUTION

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 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 measurements are also given if pertinent. Waveforms appearing during the store mode are shown in tables 8-7 and 8-11. Waveforms appearing in the standard mode are shown in table 8-8.

8-27. TEST POINTS.

8-28. Test points are shown on the schematics and refer to specific test point pins which are a part of the etched circuit board assembly.

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,
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 pin-pointing 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.

Note

Circuit board extender 00184-66513 is essential when servicing assembly A8 in Model 184B instruments.

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.

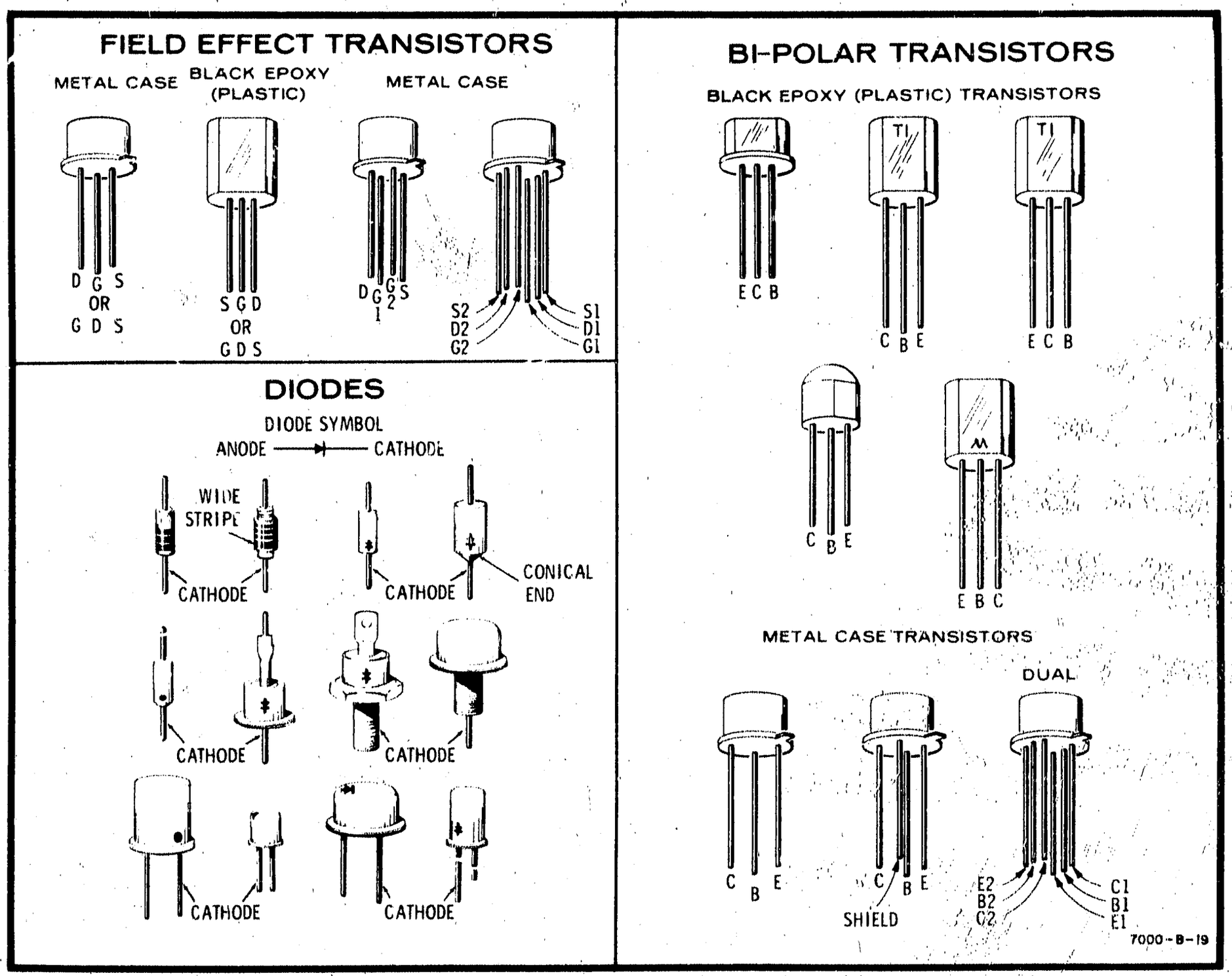


Figure 8-1. Semiconductor Terminal Identification

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.

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.

8-42. 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 supplies are current foldback 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 oscillator, 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. 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.)

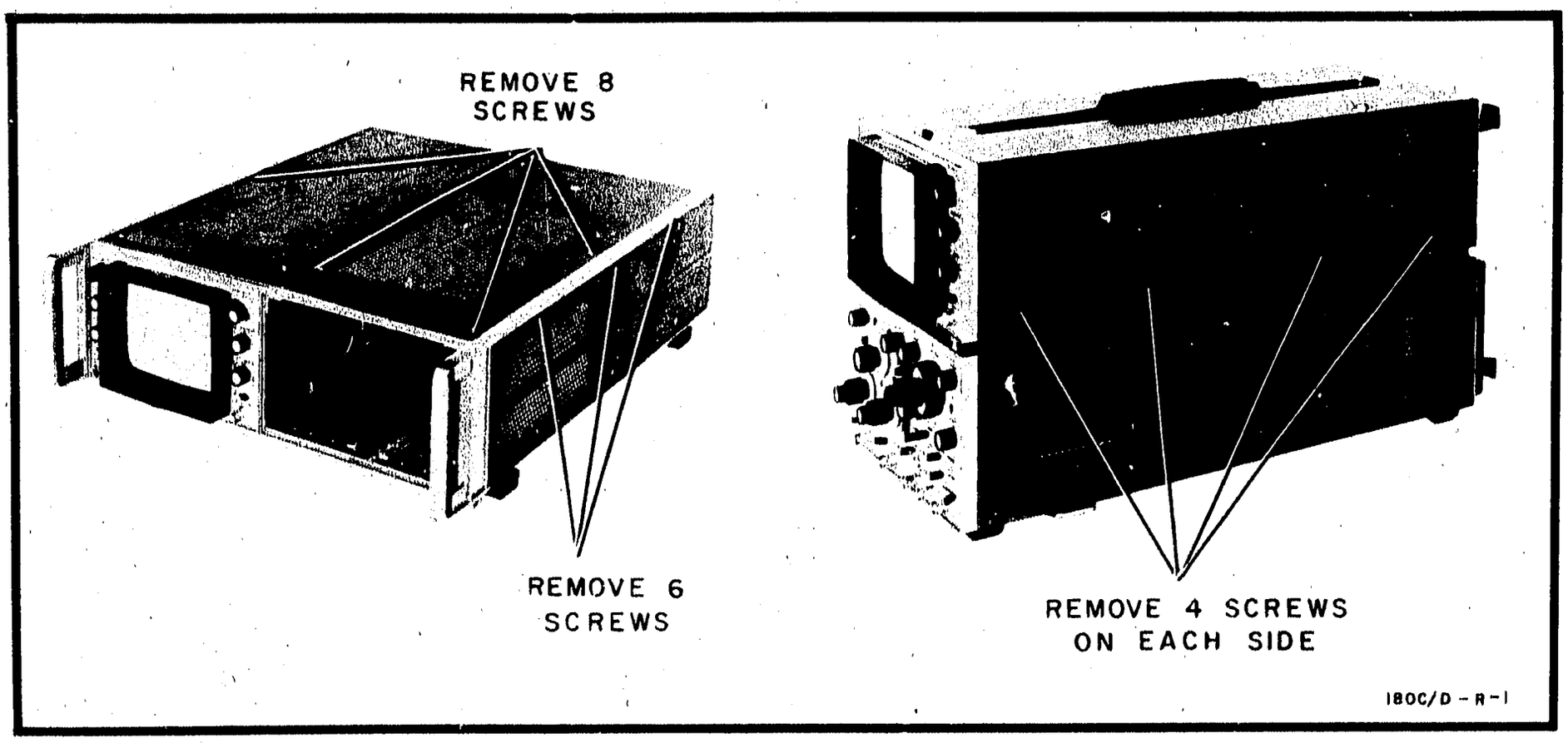


Figure 8-2. Cover Removal

8-57. Remove Model 184A 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.

8-58. Remove Model 184B 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.

8-59. POWER MODULE REMOVAL.

8-60. 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.

8-61. To remove the power module, first disconnect the ac line power input. Then proceed as follows:

a. Remove bottom covers from Model 184A, or top and bottom covers from Model 184B.

b. Set instrument on rear end.

c. Remove four screws located on underside of power module.

d. Return instrument to horizontal position.

e. On Model 184A remove two nuts from screws extending into module from bottom feet. On Model 184B 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. On Model 184A, 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. On Model 184A, 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.

8-62. CRT REMOVAL AND REPLACEMENT.

8-63. 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 184A or top and bottom covers from Model 184B.

c. On Model 184B, 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. Remove flexible, three-conductor CRT lead from connector block. Do not attempt to remove flexible lead from CRT.

e. Remove collimator button connection from CRT.

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.

h. Remove four screws holding metal bezel on front panel.

i. Loosen clamp at rear of CRT.

j. Carefully loosen and pry socket from CRT base.

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. Gently clean any oxidation from neck pins, being careful to not bend pins or scratch glass.

m. To replace CRT, reverse above procedure. Before tightening clamp, align CRT to place graticule lines square with oscilloscope frame.

8-64. After replacing the CRT, perform the adjustment procedure provided in Section V.

8-65. HIGH VOLTAGE SUPPLY REPLACEMENT.

8-66. 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 184A top left cover and top rear panel or Model 184B left side cover and left rear panel.

b. Remove cover to high voltage compartment (two screws).

c. Disconnect two plug connectors from oscillator assembly.

d. Disconnect white (9), gray (8), and yellow (4) wires from gate and high voltage regulator assembly.

e. Remove four screws from corners of high voltage rectifier assembly.

f. Remove high voltage rectifier assembly from high voltage multiplier compartment. Plugs on attached wires will slide through hole 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.

g. Remove flexible, three-conductor CRT lead from connector block.

h. Disconnect yellow (4) and green (5) wires from mode switch assembly. This releases connector block from instrument and CRT. High voltage multiplier assembly is also free and can be removed from supporting bracket.

i. Remove two screws holding high voltage oscillator assembly to its mounting bracket.

j. Disconnect three square-pin connectors and two multi-pin connectors from underside of oscillator circuit board.

k. From top of instrument, remove one screw holding oscillator transistor to mounting bracket and from rear of instrument, remove screws holding remaining transistors to mounting bracket. (Two mica insulating washers are between each transis-

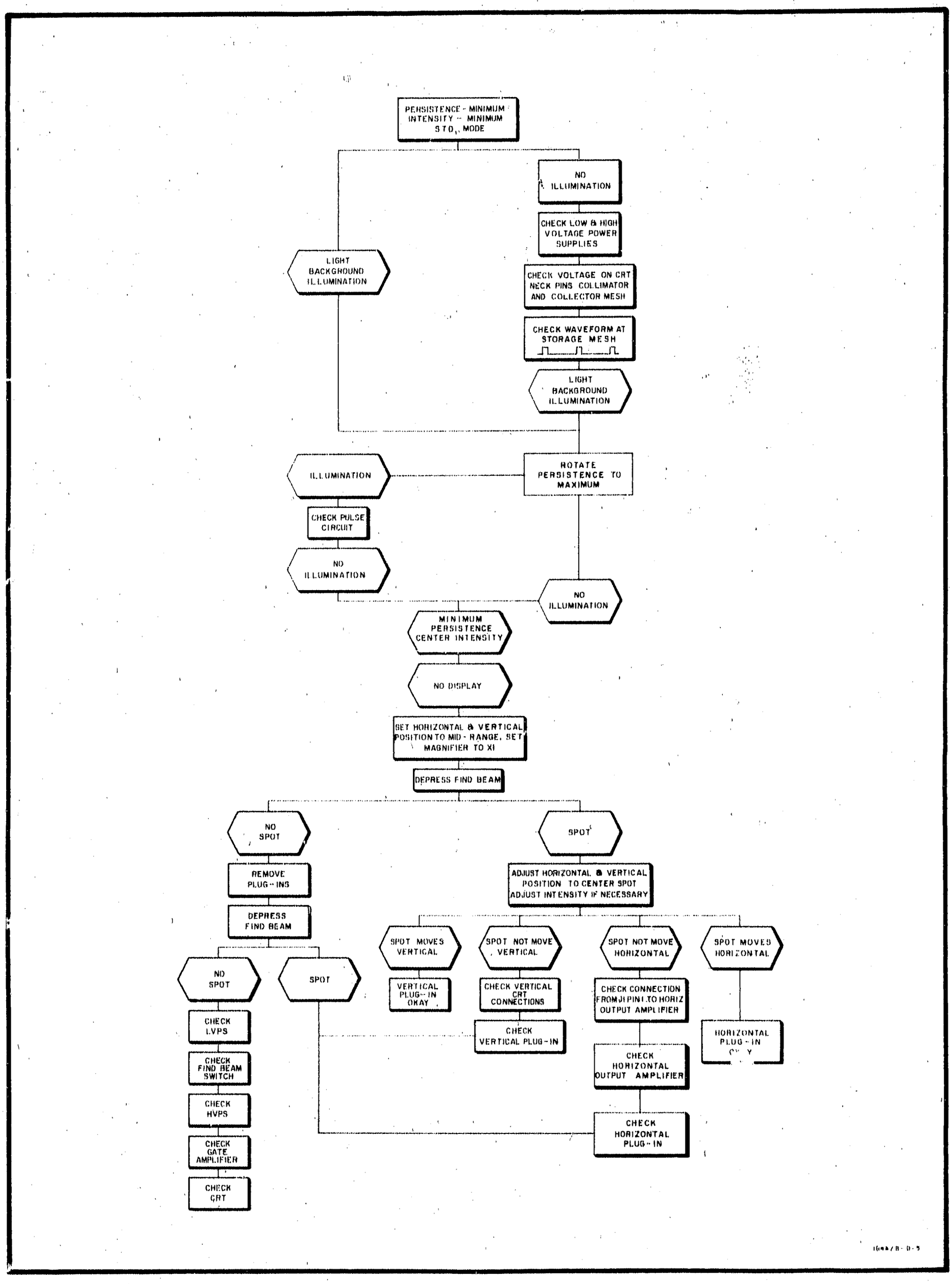


Figure 8-3. Overall Troubleshooting Tree

Table 8-1. Schematic Notes

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

= Etched circuit board

= Front-panel marking

= Rear-panel marking

= Front-panel control

= Screwdriver adjustment

P/O = Part of

CW = Clockwise end of variable resistor

NC = No connection

= Waveform test point (with number)

= Common electrical point (with letter) not necessarily ground

= Single-pin connector on board

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

= Coaxial cable connected to snap-on jack

= Coaxial cable connected directly to board

= Wire connected to pressure-fit socket on board

= Main signal path

= Primary feedback path

= Secondary feedback path

= Field-effect transistor (P-type base)

= Field-effect transistor (N-type base)

= Breakdown diode (voltage regulator)

= Tunnel diode

= Step-recovery diode

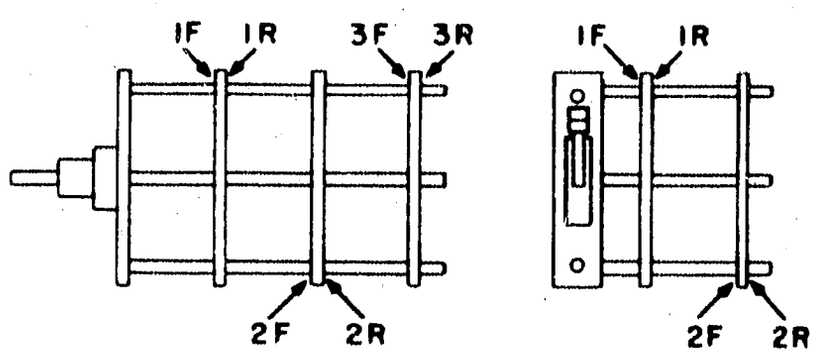
= Circuits or components drawn with dashed lines (phantom) show function only and are not intended to be complete. The circuit or component is shown in detail on another schematic.

(925) = Wire colors are given by numbers in parentheses using the resistor color code

[(925) is wht-red-grn]

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

Switch wafers are identified as follows:



* = 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

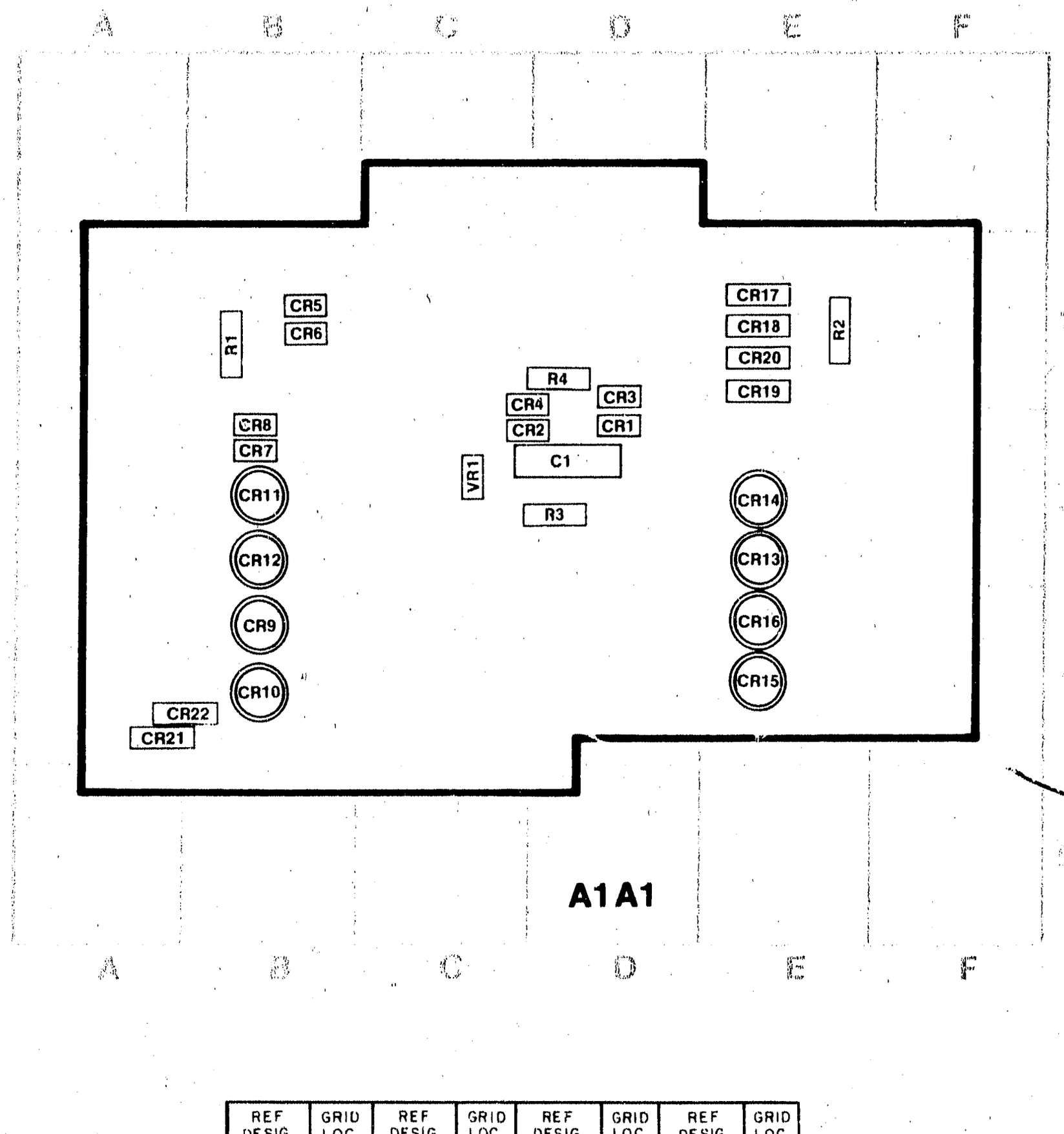
Table 8-2. Miscellaneous Troubleshooting Tips

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	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. High H.V. 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.

tor and mounting bracket.) This step may be omitted and transistors left mounted if desired. If left in place, exercise care to properly seat transistors in sockets when replacing board.

l. Oscillator assembly may be removed by pulling it straight out, being careful to disengage transistors from their sockets without bending leads if not previously unmounted.

m. To assist in heat transfer from oscillator transistors to chassis, good thermal contact is required to mounting surface. Coat both sides of each mica insulating washer with Dow Corning 5 silicone compound or equivalent before fastening transistor to chassis. Dow Corning 5 compound is available from Hewlett-Packard; order HP Part No. 8500-0059.



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

184 A/B-002
(Changed 09-74)

Figure 8-4. Low voltage Rectifier Component Identification

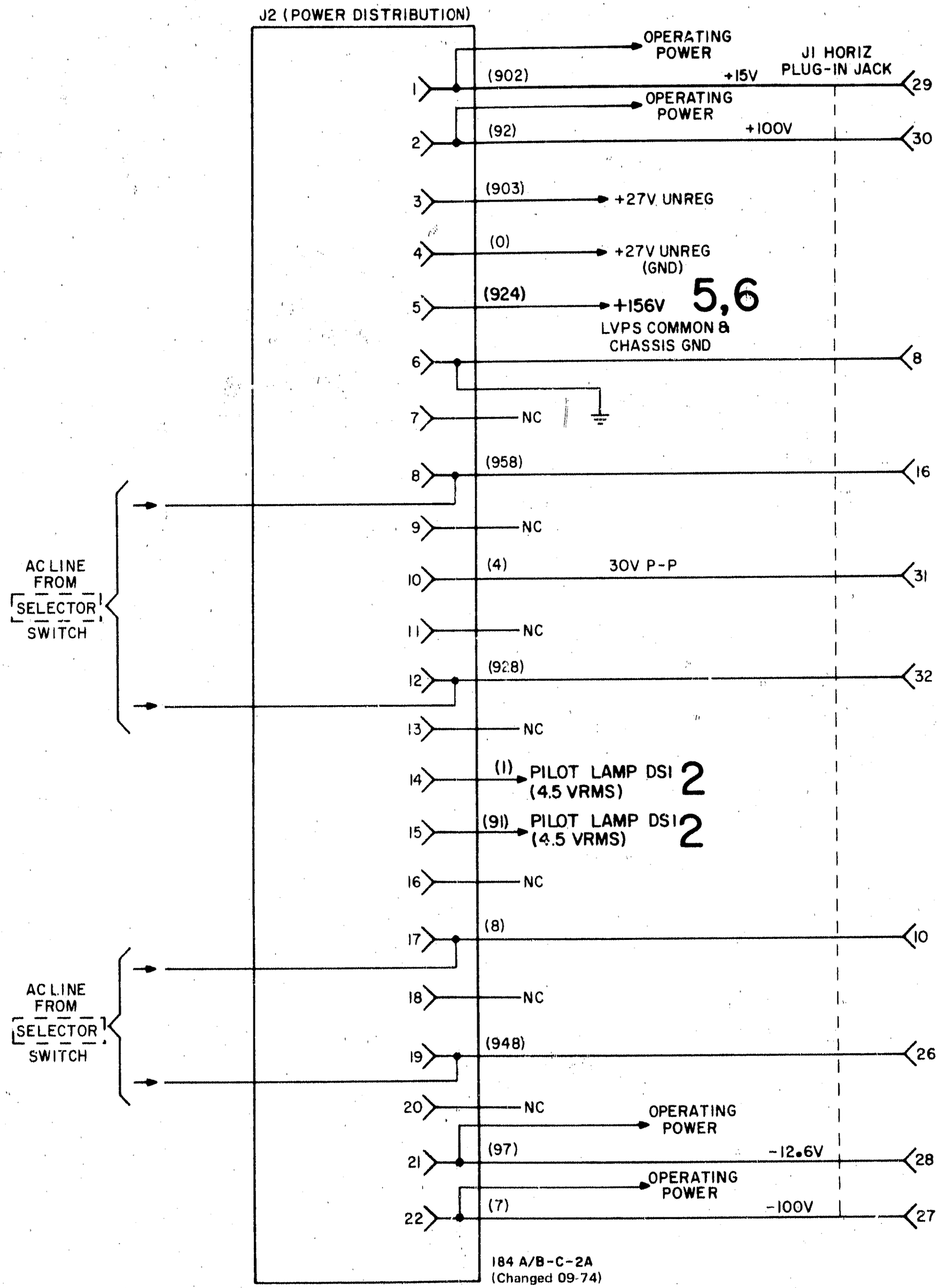
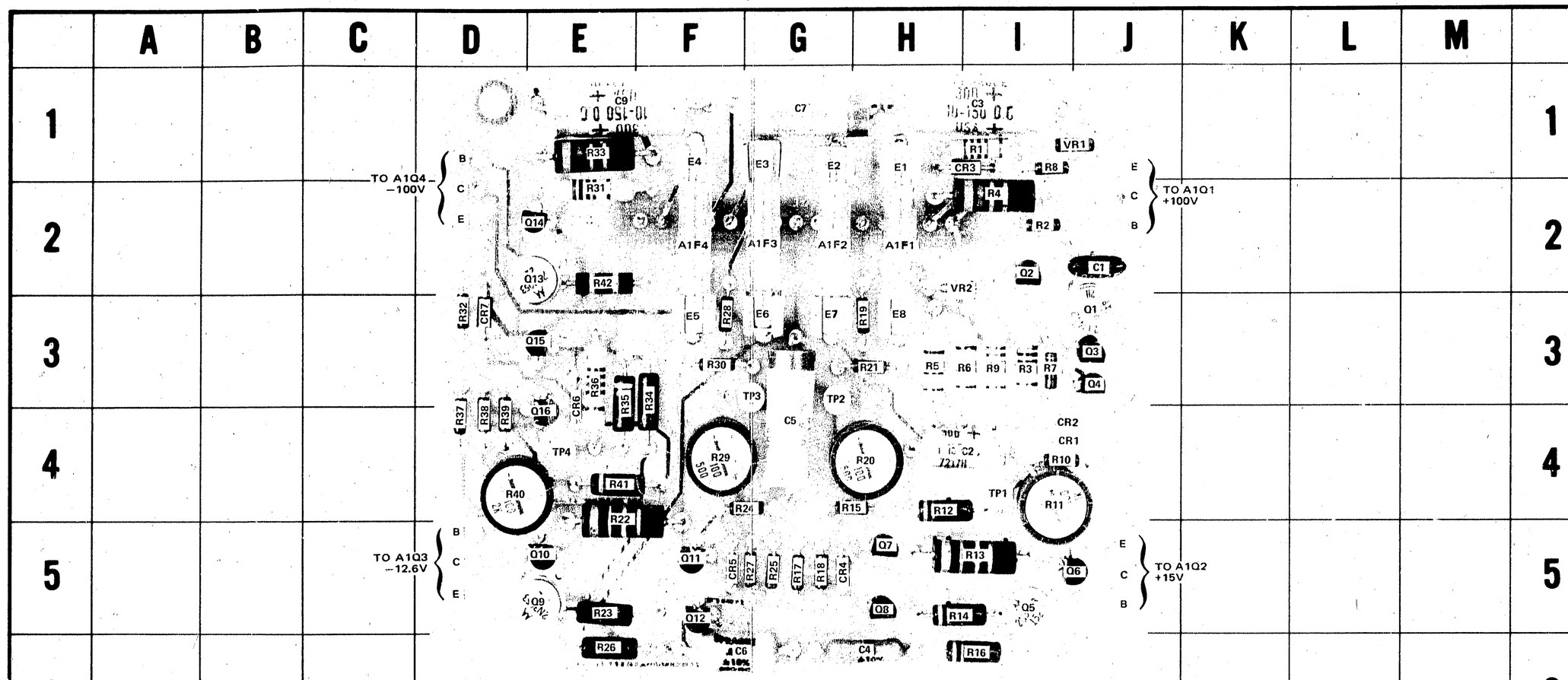


Figure 8-5.
Low-voltage Power Connections



A1A2

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	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	J-2	CR4	G-5	E-7	G-3	Q5	I-5	Q15	E-3	R9	I-3	R19	H-3	R29	F-4	R39	D-4
C2	I-4	CR5	F-5	E-8	H-3	Q6	J-5	Q16	E-4	R10	I-4	R20	H-4	R30	F-3	R40	D-4
C3	I-1	CR6	E-4	A1F1	H-1	Q7	H-4	R1	I-1	R11	I-4	R21	H-3	R31	E-2	R41	E-4
C4	H-6	CR7	D-3	A1F2	G-2	Q8	H-4	R2	I-2	R12	H-4	R22	E-4	R32	D-3	R42	E-2
C5	G-4	E1	H-1	A1F3	G-2	Q9	E-5	R3	I-3	R13	I-5	R23	E-5	R33	E-1	TP1	I-4
C6	F-6	E-2	G-1	A1F4	F-2	Q10	E-5	R4	I-2	R14	H-5	R24	F-4	R34	F-3	TP2	G-3
C7	G-1	E-3	G-1	Q1	J-3	Q11	F-5	R5	H-3	R15	G-4	R25	G-5	R35	E-3	TP3	G-3
C9	E-1	E-4	F-1	Q2	I-2	Q12	F-5	R6	I-3	R16	I-6	R26	E-6	R36	E-3	TP4	E-4
CR1	I-4	E-5	F-3	Q3	J-3	Q13	E-2	R7	I-3	R17	G-5	R27	G-5	R37	D-4	VR1	J-1
CR2	I-4	E-6	G-3	Q4	J-3	Q14	E-2	R8	I-2	R18	G-5	R28	F-3	R38	D-4	VR2	H-2
CR3	I-1																

184A/B – A – 16

Figure 8-6. Low Voltage Regulator Component Identification

Table 8-3. Low Voltage Power Supply Troubleshooting Tips

Symptom	Suggested Checks
All supplies low or high and unregulated.	Check +100V supply and A1A2VR2. Check ac input line voltage and position of rear-panel SELECTOR switch (115 or 230V). (+100V supply is used as reference for −100V, +15V, −12.6V supplies, A1A2VR2 provides reference voltage for +100V supply).
One supply high and unregulated with high ripple.	Check comparator and series regulator.
One supply low.	Check comparator. Check for excessive current drain.
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 rectifier diodes. Check ac line voltage and position of rear panel SELECTOR switch. Check filter capacitors. Check power transformer.

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 – megohm input impedance).

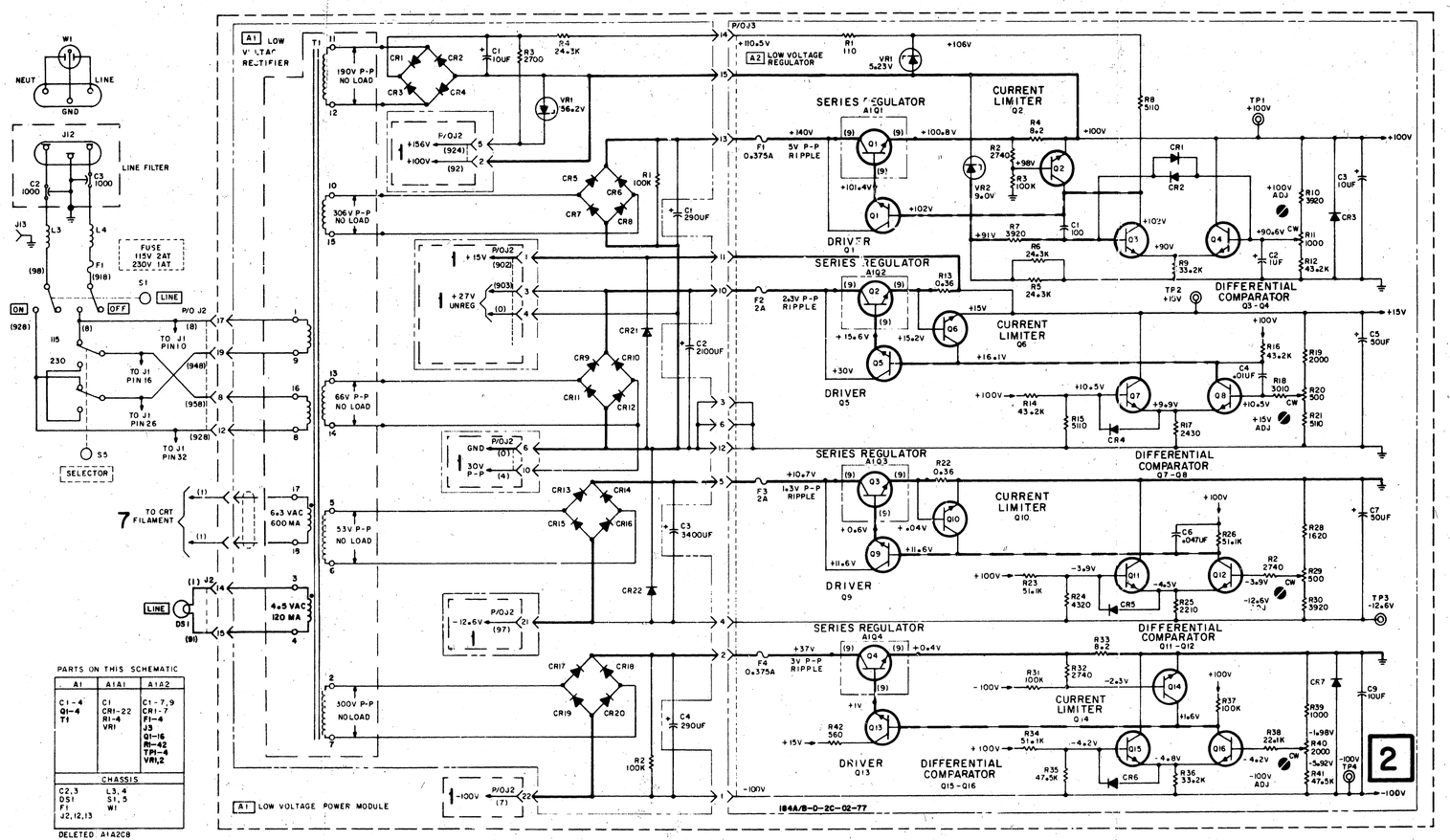
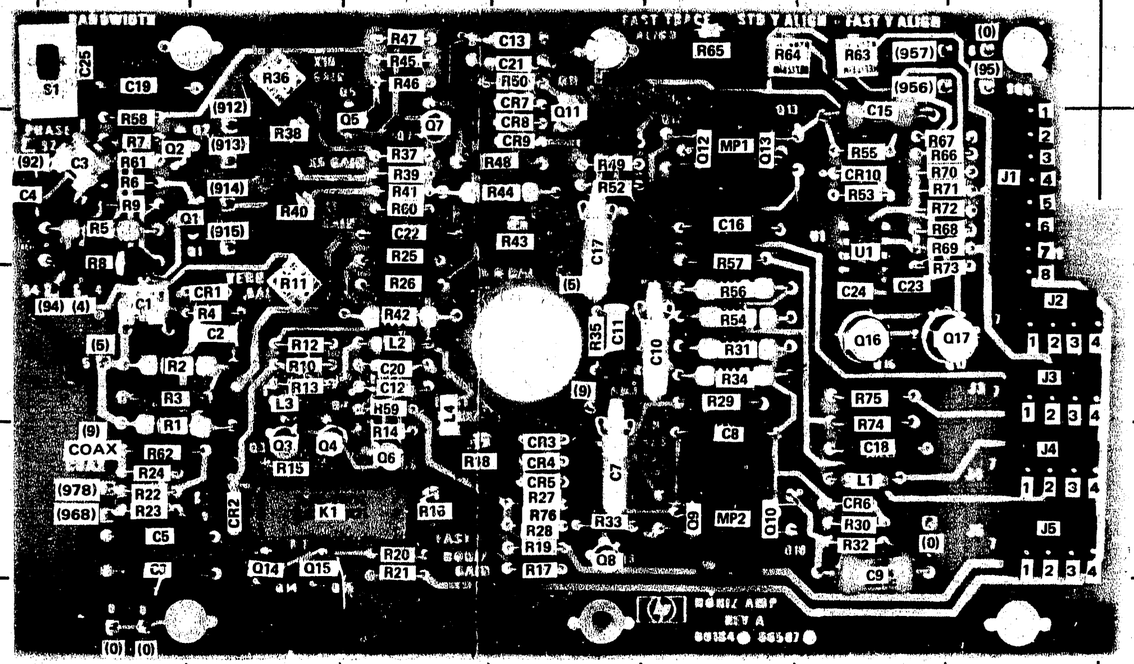


Figure 8-7.
Low-voltage Power Supply Schematic



A7

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	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	D-3	C11	G-3	C22	I-2	CR7	G-1	L1	I-4	Q5	F-2	Q15	E-4	R8	D-2	R18	F-4	R28	G-4	R38	E-2	R48	G-2	R59	F-3	R69	I-2
C2	E-3	C12	F-3	C23	I-3	CR8	G-2	L2	F-3	Q6	F-4	Q16	I-3	R9	D-2	R19	G-4	R29	H-3	R39	F-2	R49	G-2	R60	F-2	R70	I-2
C3	D-2	C13	G-1	C24	I-3	CR9	G-2	L3	E-3	Q7	F-2	Q17	J-3	R10	E-3	R20	F-4	R30	I-4	R40	E-2	R50	G-1	R61	D-2	R71	I-2
C4	C-2	C15	I-2	C25	D-1	CR10	I-2	L4	F-3	Q8	G-4	R1	D-4	R11	E-3	R21	F-4	R31	H-3	R41	F-2	R52	G-2	R62	D-4	R72	I-2
C5	D-4	C16	H-2	CR1	E-3	J1	J-2	MP1	H-2	Q9	H-4	R2	D-3	R12	E-3	R22	D-4	R32	I-4	R42	F-2	R53	I-2	R63	I-1	R73	I-3
C6	D-4	C17	G-3	CR2	E-4	J2	J-3	MP2	H-4	Q10	H-4	R3	D-3	R13	E-3	R23	D-4	R33	G-4	R43	G-2	R54	H-3	R64	H-1	R74	I-4
C7	G-4	C18	I-4	CR3	G-4	J3	J-3	Q1	D-2	Q11	G-2	R4	E-3	R14	F-4	R24	D-4	R34	H-5	R44	G-2	R55	I-2	R65	H-1	R75	I-3
C8	H-4	C19	D-1	CR4	G-4	J4	J-4	Q2	D-2	Q12	H-2	R5	D-2	R15	E-4	R25	F-2	R35	G-3	R45	F-1	R56	H-3	R66	I-2	R76	G-4
C9	I-4	C20	F-3	CR5	G-4	J5	J-5	Q3	E-4	Q13	H-2	R6	D-2	R16	F-4	R26	F-3	R36	E-1	R46	F-1	R57	H-3	R67	I-2	S1	D-1
C10	H-3	C21	G-1	CR6	I-4	K1	E-4	Q4	E-4	Q14	E-4	R7	D-2	R17	G-4	R27	G-4	R37	F-2	R47	F-1	R58	D-2	R68	I-2	U1	I-2

184A/B-B-4A
(Changed 09-74)

Figure 8-8. Horizontal Amplifier Component Identification

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

   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 – megohm input impedance).

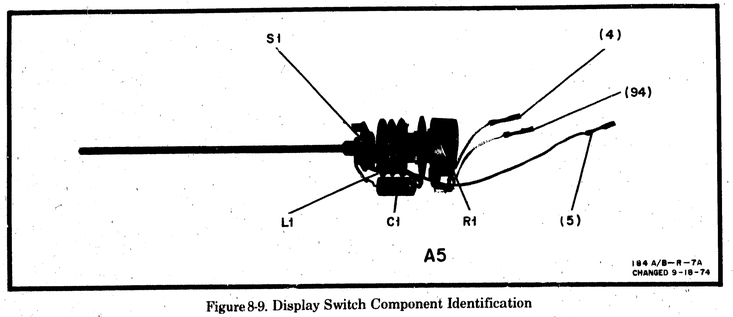


Figure 8-9. Display Switch Component Identification

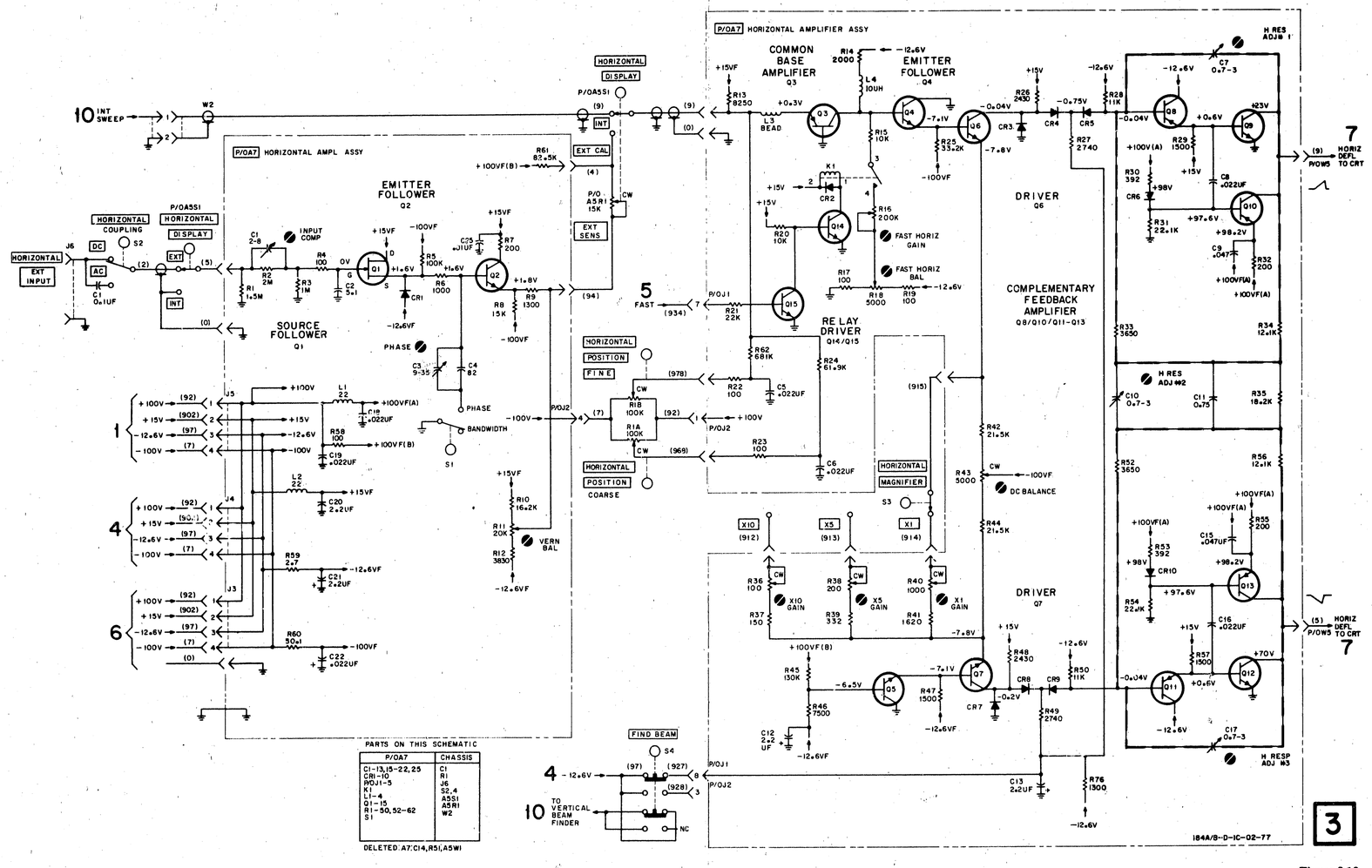
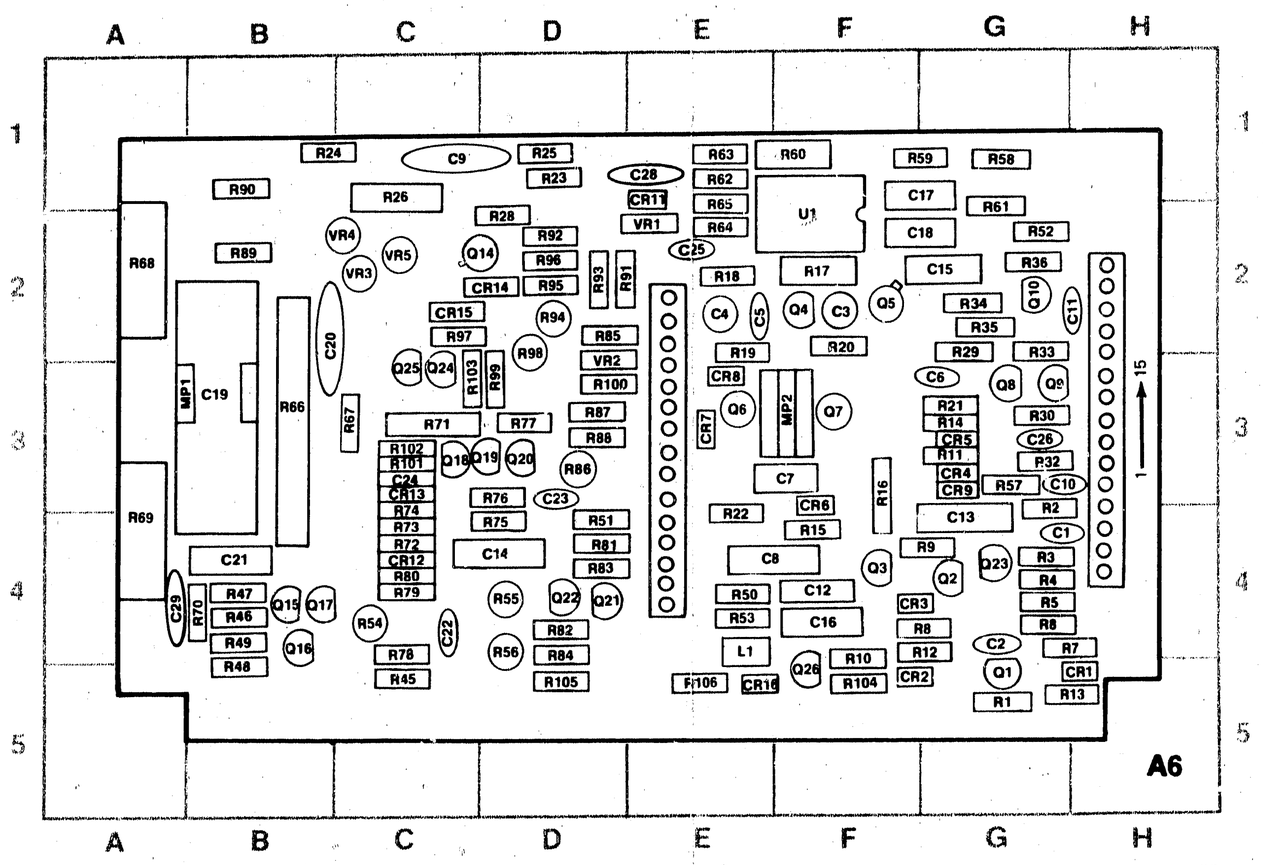


Figure 8-10.
Horizontal Amplifier Schematic



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	G-4	Q14	C-2	R56	D-4
C2	G-4	Q15	B-4	R57	G-3
C3	F-2	Q16	B-4	R58	G-1
C4	E-2	Q17	B-4	R59	F-1
C5	E-2	Q18	C-3	R60	F-1
C6	G-3	Q19	D-3	R61	G-2
C7	F-3	Q20	D-3	R62	E-1
C8	E-4	Q21	D-4	R63	E-2
C9	C-1	Q22	D-4	R64	E-2
C10	G-3	Q23	G-4	R65	B-3
C11	G-2	Q24	C-3	R66	C-3
C12	F-4	Q25	C-3	R67	A-2
C13	G-4	Q26	F-5	R68	A-4
C14	D-4	R1	G-5	R69	B-4
C15	G-2	R2	G-4	R70	C-3
C16	F-4	R3	G-4	R71	C-4
C17	F-2	R4	G-4	R72	C-4
C18	F-2	R5	G-4	R73	C-4
C19	B-3	R6	G-4	R74	C-4
C20	B-2	R7	G-4	R75	D-4
C21	B-4	R8	F-4	R76	D-3
C22	C-4	R9	F-4	R77	D-3
C23	D-3	R10	F-5	R78	C-4
C24	C-3	R11	G-3	R79	C-4
C25	E-2	R12	F-4	R80	C-4
C26	G-3	R13	G-5	R81	D-4
C28	E-1	R14	G-3	R82	D-4
C29	A-4	R15	F-4	R83	D-4
CR1	H-5	R16	F-3	R84	D-4
CR2	F-5	R17	F-2	R85	D-2
CR3	F-4	R18	E-2	R86	D-3
CR4	G-3	R19	E-3	R87	D-3
CR5	G-3	R20	F-2	R88	D-3
CR6	F-4	R21	G-3	R89	B-2
CR7	E-3	R22	E-4	R90	B-1
CR8	E-3	R23	D-1	R91	D-2
CR9	G-3	R24	B-1	R92	D-2
CR11	E-2	R25	D-1	R93	D-2
CR12	C-4	R26	C-1	R94	D-2
CR13	C-3	R28	D-2	R95	D-2
CR14	D-2	R29	G-3	R96	D-2
CR15	C-2	R30	G-3	R97	C-2
CR16	E-5	R32	G-3	R98	D-3
J1	H-2	R33	G-3	R99	D-3
J2	E-2	R34	G-2	R100	D-3
L1	E-4	R35	G-2	R101	C-3
MP1	A-3	R36	G-2	R102	C-3
MP2	F-3	R45	C-5	R103	C-3
Q1	G-5	R46	B-4	R104	F-5
Q2	G-4	R47	B-4	R105	D-5
Q3	F-4	R48	B-5	R106	E-5
Q4	F-2	R49	B-4	U1	F-2
Q5	F-2	R50	E-4	VR1	E-2
Q6	E-3	R51	D-4	VR2	D-3
Q7	F-3	R52	G-2	VR3	C-2
Q8	G-3	R53	E-4	VR4	C-2
Q9	G-3	R54	C-4	VR5	C-2
Q10	G-2	R55	D-4		

Figure 8-11. Gate Amplifier Component Identification

Table 8-6. Gate 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
FOCUS	fully ccw
POSITION	fully ccw
DISPLAY	EXT CAL
MAGNIFIER	X1
operating mode	STD

5. For voltages shown in parenthesis, set INTENSITY to obtain +20V at collectors of A6Q6 and A6Q7 and set operating mode to FAST.
6. All voltages referenced to ground.
7. All voltages measured with HP Model 414A Auto Voltmeter (100-megohm input impedance).

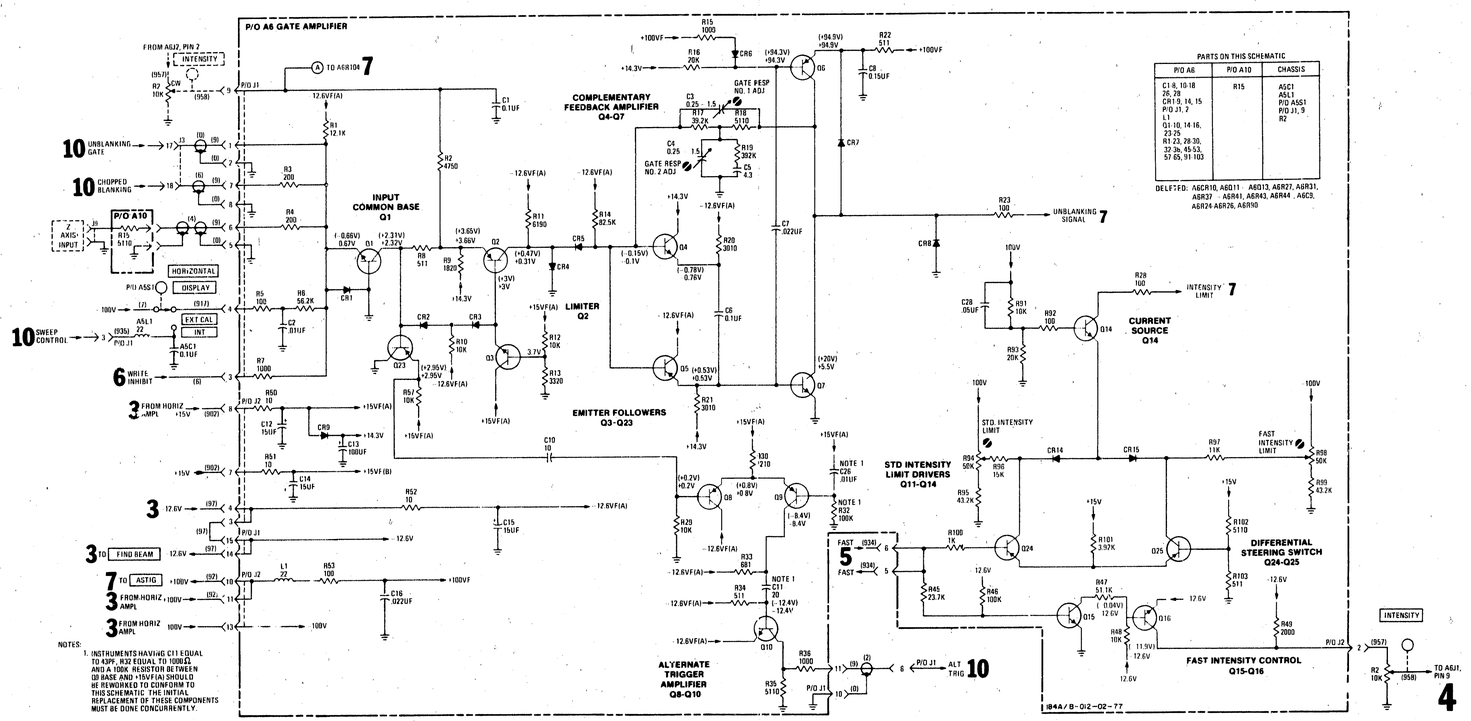
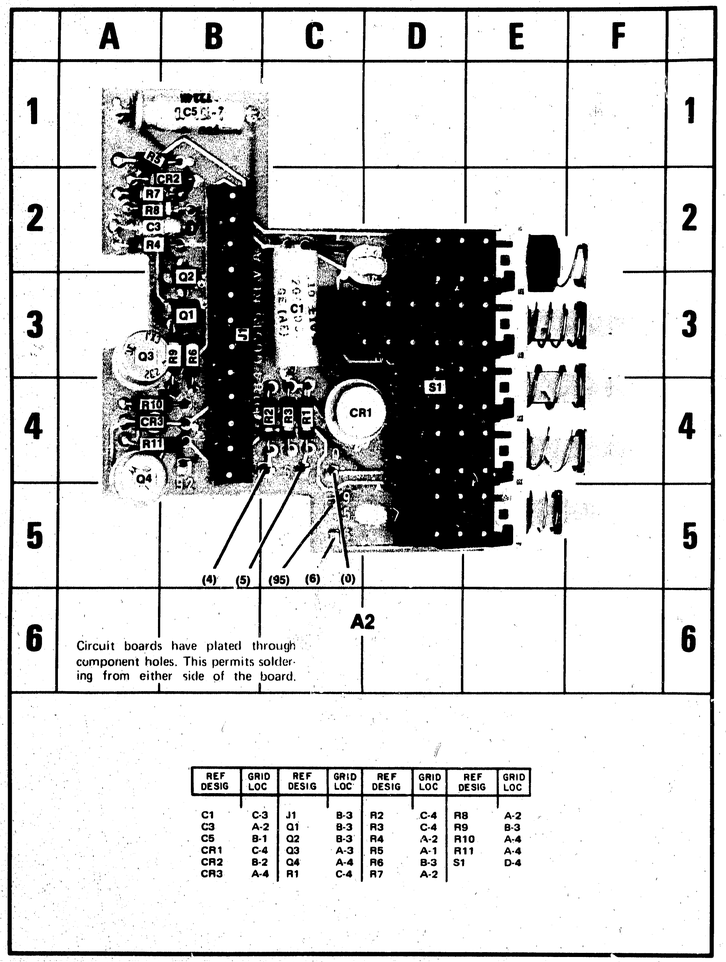


Figure 8-12.
Gate Amplifier Schematic
8-17



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	C-3	J1	B-3	R2	C-4	R8	A-2
C3	A-2	Q1	B-3	R3	C-4	R9	B-3
C5	B-1	Q2	B-3	R4	A-2	R10	A-4
CR1	C-4	Q3	A-3	R5	A-1	R11	A-4
CR2	B-2	Q4	A-4	R6	B-3	S1	D-4
CR3	A-4	R1	C-4	R7	A-2		

Figure 8-13. Mode Switch Component Identification

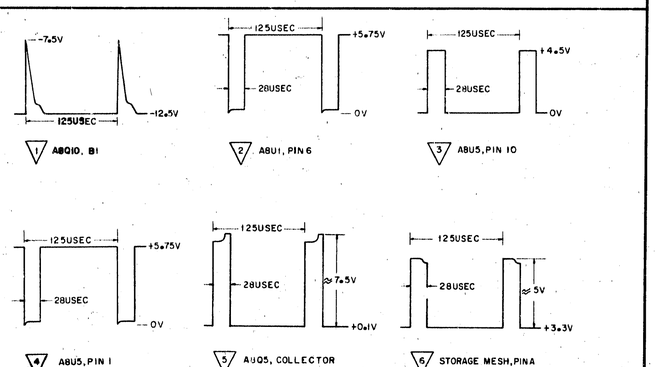
Table 8-7. Standard Mode Troubleshooting Measurements

1. Plug-ins not installed.
2. Set Model 184A/B controls as follows:
   a. PERSISTENCE . . . . . fully ccw
   b. INTENSITY . . . . . fully ccw
   c. operating mode . . . . . STD
3. Level: H = ⩾+2.4V; L = ⩾+0.4V.

Measurement Point	Level	Measurement Point	Level	Measurement Point	Level
U5 pin 3	L	U3 pin 1	H	U4 pin 1	H
12	H	2	L	4	L
13	L	3	H	9	H
		4	H	11	H
U2 pin 9	H	13	L	12	L
10	H	6	L		
11	L	12	H	Junction of A8CR2 and A8CR3	≈+4.5V
8	H				
6	L				

Table 8-8. Standard Mode Waveforms

1. Plug-ins not installed.
2. Set Model 184A/B controls as follows:
   a. PERSISTENCE . . . . . fully ccw
   b. INTENSITY . . . . . fully ccw
   c. operating mode . . . . . STD



184A/B-8-6

Table 8-9. Conventional Mode Troubleshooting Measurements

1. Plug-ins not installed.
2. Set Model 184A/B controls as follows:
   a. PERSISTENCE . . . . . fully ccw
   b. INTENSITY . . . . . fully ccw
   c. operating mode . . . . . CONV
3. Level: H = ⩾+2.4V; L = ⩽+0.4V.

Measurement Point	Level
U2 pin 9	L
10	H
11	H
8	H
6	L
U3 pin 6	L
12	H
U4 pin 4	L
Junction of A8CR2 and A8CR3	−30V

Table 8-10. Fast Mode Troubleshooting Measurements

1. Plug-ins not installed.
2. Set Model 184A/B controls as follows:
   a. PERSISTENCE . . . . . fully ccw
   b. INTENSITY . . . . . fully ccw
   c. operating mode . . . . . FAST
3. Level: H = ⩾+2.4V; L = ⩽+0.4V.

Measurement Point	Level
U3 pin 1	H
2	H
3	L
4	L
13	H
6	H
12	L
U2 pin 9	H
10	L
11	H
8	H
6	L
U4 pin 4	L
1	H
9	L
11	H
12	H
Junction of A8CR2 and A8CR3	≈+4V

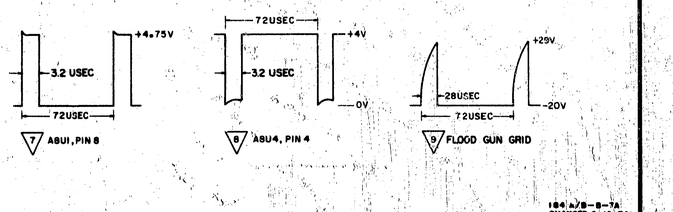
Note

Waveforms shown in table 8-8 apply for operation in FAST mode. However, the pulse amplitude applied to the storage mesh is reduced in this mode (waveforms 5 and 6).

Table 8-11. Store Mode Troubleshooting Measurements and Waveforms

1. Plug-ins not installed.
2. Set Model 184A/B controls as follows:
   a. PERSISTENCE ..... fully ccw
   b. INTENSITY ..... fully ccw
   c. STORAGE TIME ..... fully ccw
   d. operating mode ..... STORE
3. Level: H = ≥+2.4V; L = ≤+0.4V.

Measurement Point	Level
U4 pin 2	H
9	H
11	L
12	H
1	H
U2 pin 9	H
10	H
11	H
8	L
6	H
U5 pin 10	L



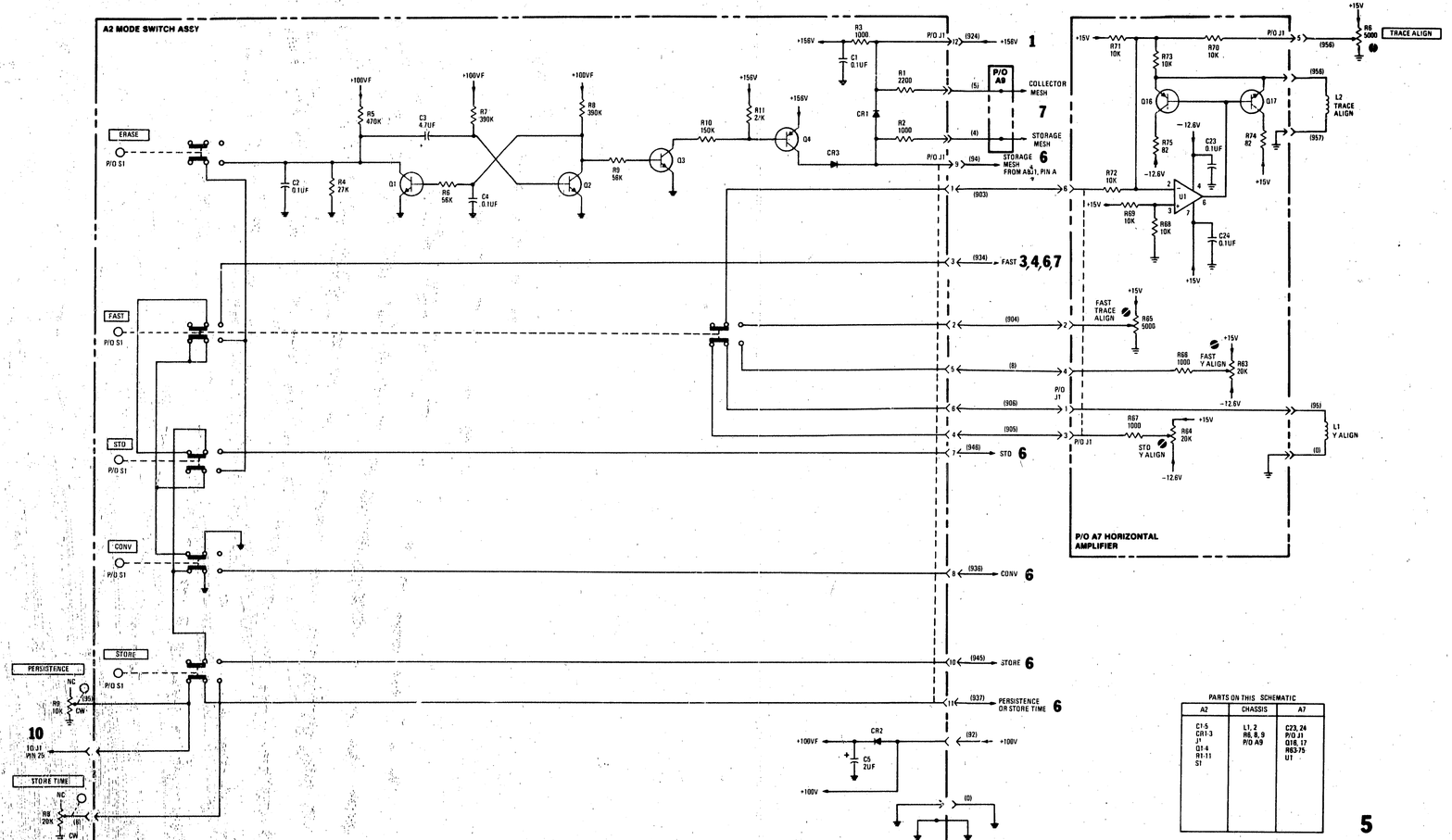


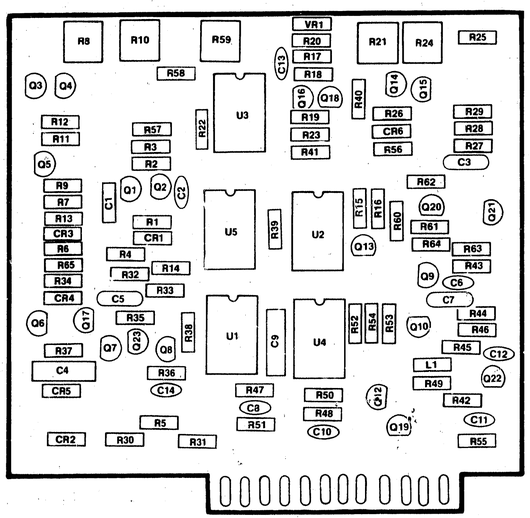
Figure 8-14.
Mode Switch Schematic

Table 8-12. Standard/Store Mode Troubleshooting Measurements

1. Plug-ins not installed. 2. Set Model 184A/B controls as follows: a. PERSISTENCE . . . . . fully ccw b. INTENSITY . . . . . fully ccw c. STORAGE TIME . . . . . fully ccw d. operating mode . . . . . STD/STORE 3. Level: H = ⩾+2.4V; L = ⩽+0.4V.	Measurement Point	Level
	U4 pin 8	L
	9	H
	10	L
	11	L
	12	L
	13	H
	1	L
	U2 pin 6	L
	11	L
	8	H

Table 8-13. Fast/Store Mode Troubleshooting Measurements

1. Plug-ins not installed. 2. Set Model 184A/B controls as follows: a. PERSISTENCE . . . . . fully ccw b. INTENSITY . . . . . fully ccw c. STORAGE TIME . . . . . fully ccw d. operating mode . . . . . FAST/STORE 3. Level: H = ⩾+2.4V; L = ⩽+0.4V.	Measurement Point	Level
	U4 pin 8	L
	9	L
	10	H
	1	L
	U3 pin 1	H
	4	L
	13	H
	2	H
	3	L



A8

REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	B-3	CR2	B-5	Q10	E-4	R2	B-3	R16	E-2	R30	B-5	R44	F-4	R58	C-2
C2	C-3	CR3	A-3	Q12	E-5	R3	B-2	R17	D-2	R31	C-5	R45	E-4	R59	C-1
C3	E-3	CR4	A-4	Q13	D-3	R4	B-5	R18	D-2	R32	B-4	R46	F-4	R60	E-3
C4	B-4	CR5	A-5	Q14	E-2	R5	B-5	R19	D-2	R33	C-4	R47	C-5	R61	E-3
C5	B-4	CR6	E-2	Q15	E-2	R6	A-3	R20	D-1	R34	A-4	R48	D-5	R62	E-3
C6	E-4	L1	E-4	Q16	D-2	R7	A-3	R21	E-1	R35	B-4	R49	E-5	R63	F-3
C7	E-4	Q1	B-3	Q17	B-4	R8	B-1	R22	C-2	R36	B-5	R50	D-5	R64	E-3
C8	C-5	Q2	C-3	Q18	D-2	R9	A-3	R23	D-2	R37	A-4	R51	C-5	R65	A-3
C9	D-4	Q3	A-2	Q19	E-5	R10	B-1	R24	E-1	R38	C-4	R52	D-4	U1	C-4
C10	D-5	Q4	B-2	Q20	E-3	R11	A-2	R25	F-1	R39	D-3	R53	E-4	U2	D-3
C11	F-5	Q5	A-3	Q21	F-3	R12	A-2	R26	E-2	R40	D-2	R54	E-4	U3	C-2
C12	F-4	Q6	A-4	Q22	F-5	R13	A-3	R27	F-2	R41	D-2	R55	F-5	U4	D-4
C13	D-2	Q7	B-4	Q23	B-4	R14	C-4	R28	F-2	R42	E-5	R56	E-2	U5	C-3
C14	C-5	Q8	C-4	R1	B-3	R15	D-3	R29	F-2	R43	F-3	R57	B-2	VR1	D-1
CR1	B-3	Q9	E-4												

Figure 8-15. Pulse Circuit Component Identification

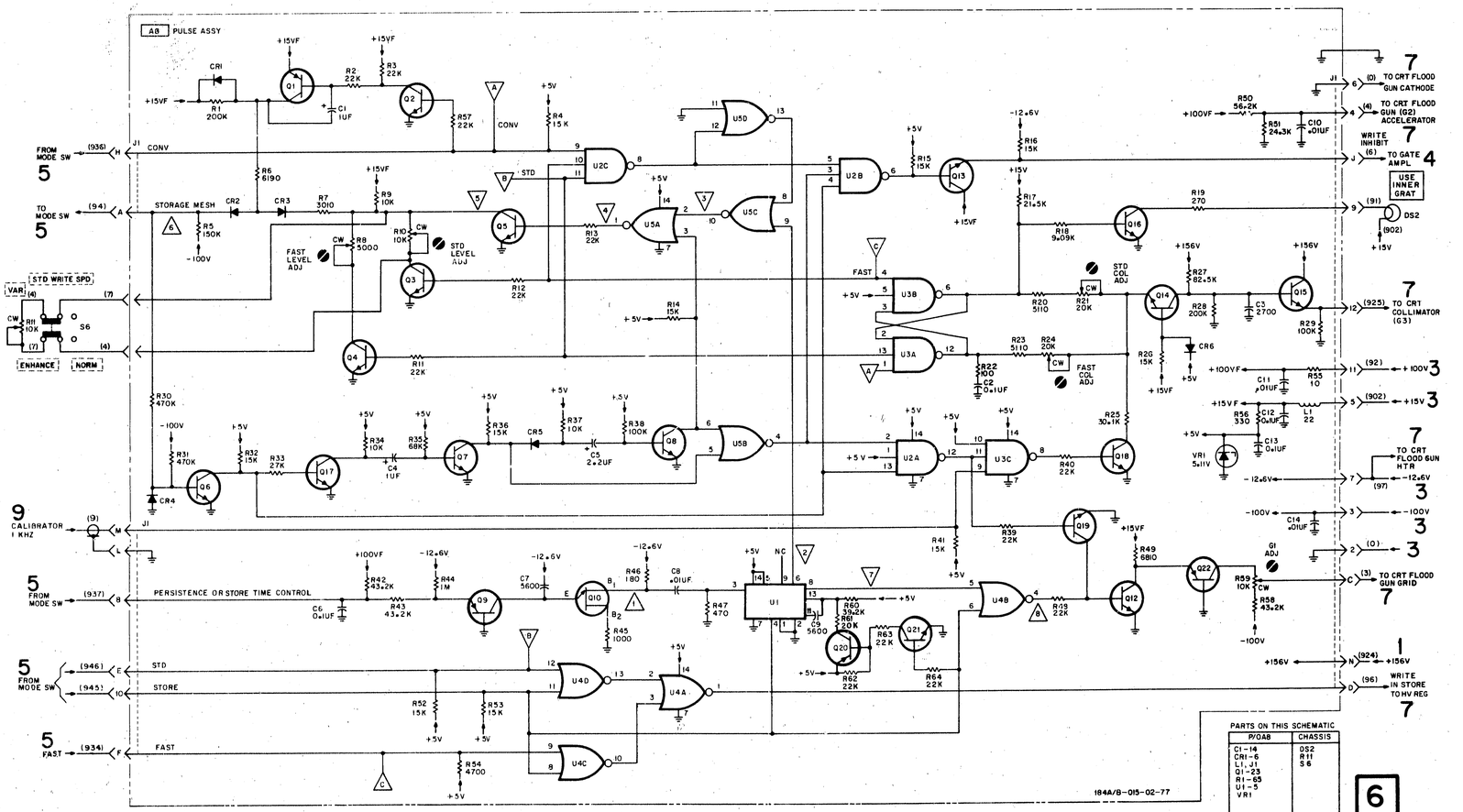


Figure 8-16.
Pulse Circuit Schematic
8-21

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

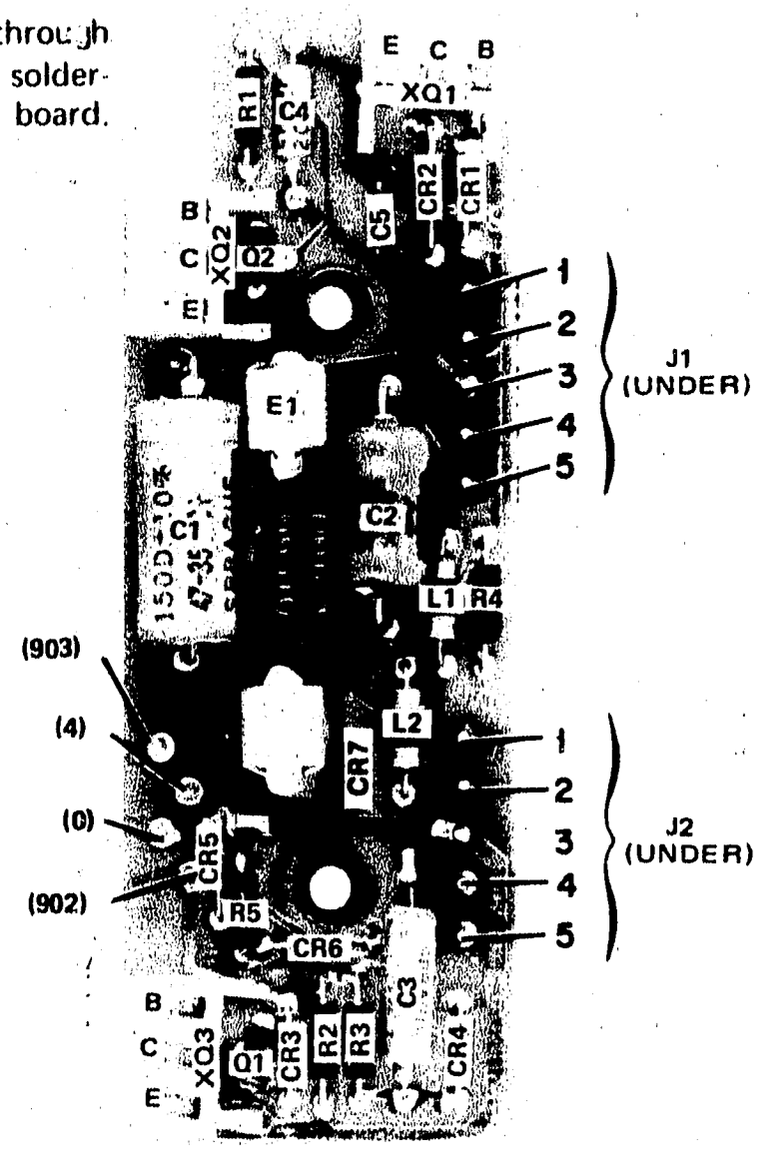


Figure 8-17. H. V. Oscillator Component Identification

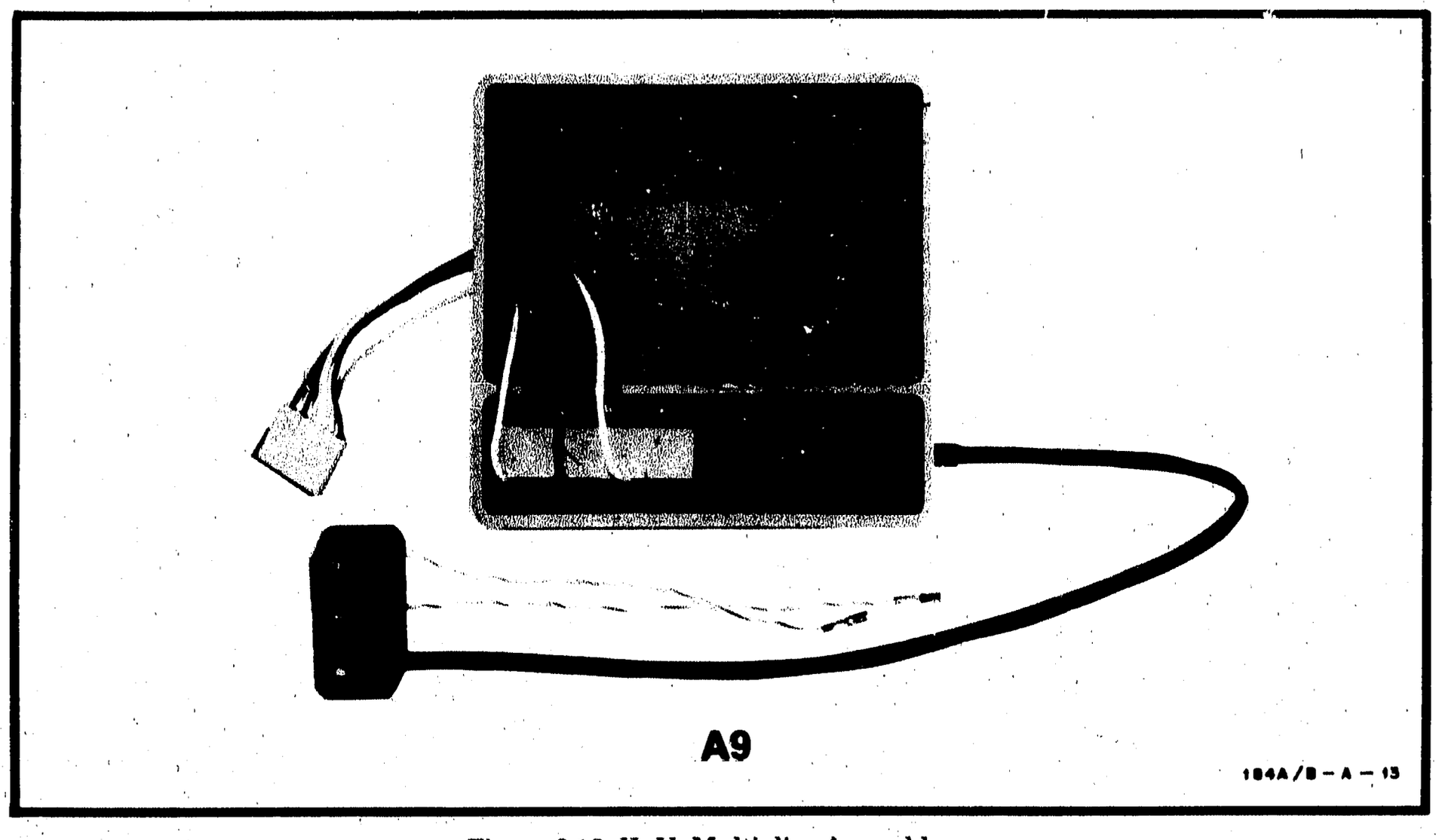


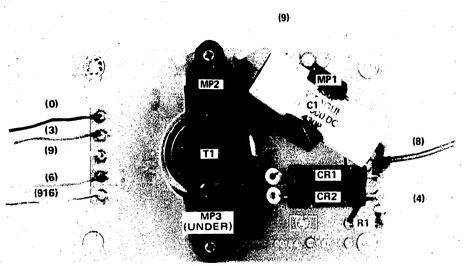
Figure 8-18. H. V. Multiplier Assembly

Table 8-14. 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.	Increased resistance in regulator feedback loop. Check H.V. adjustments. Check regulator components and feedback loop.
Voltage too low.	Decreased resistance in regulator feedback loop or CRT loading supply. Check H.V. Adjust. Check regulator components and feedback loop.

Note

Refer to CRT intensity troubleshooting tips for additional checks.



A4

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

184A/B-R-4

Figure 8-19. H. V. Rectifier Component Identification

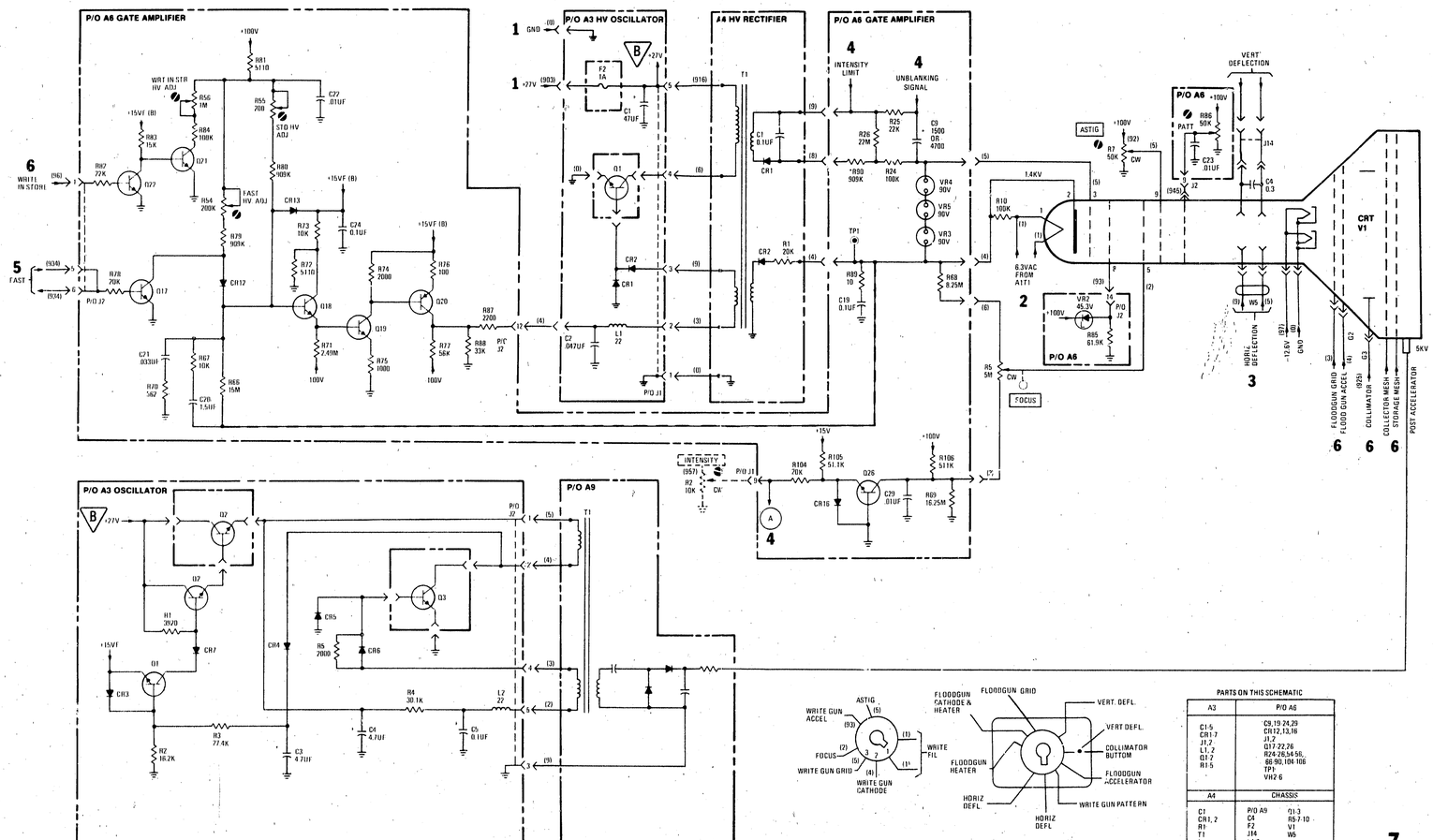
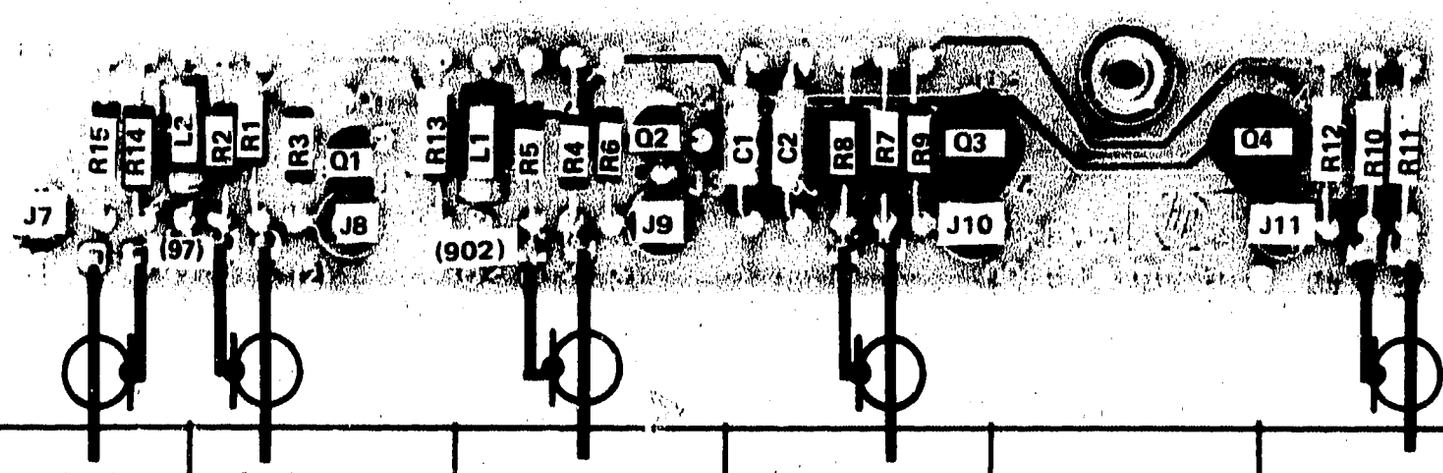


Figure 8-20.
High Voltage Power Supply Schematic

SCHEMATIC DIAGRAMS

CON'T

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



A10

REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	D-3	Q2	C-3	R7	D-3
C2	D-3	Q3	D-3	R8	D-3
J7	A-4	Q4	F-3	R9	D-3
J8	B-4	R1	B-3	R10	F-4
J9	C-4	R2	B-3	R11	F-4
J10	D-4	R3	B-3	R12	F-3
J11	F-4	R4	C-3	R13	B-3
L1	C-3	R5	C-3	R14	A-3
L2	A-3	R6	C-3	R15	A-3
Q1	B-4				

180C/D - R - 7

Figure 8-21. Sweep Gate Amplifier Component Identification

Table 8-15. CRT Intensity Troubleshooting Tips

Symptom	Suggested Checks
Low intensity	Check CRT. Check intensity limit adjustments, Check low voltage supplies. Check high voltage supply. Check gate amplifier. (See notes below for additional tips.)
High intensity.	Check H.V. power supply diodes. Make checks listed for low intensity. Check CRT for grid-cathode leakage. Check CRT for open grid circuit. (See notes below 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 below for additional tips.)

WARNING

Lethal voltages are exposed when oscilloscope is operated with the H.V. power supply cover removed, or the CRT post-accelerator lead disconnected.

Note 1

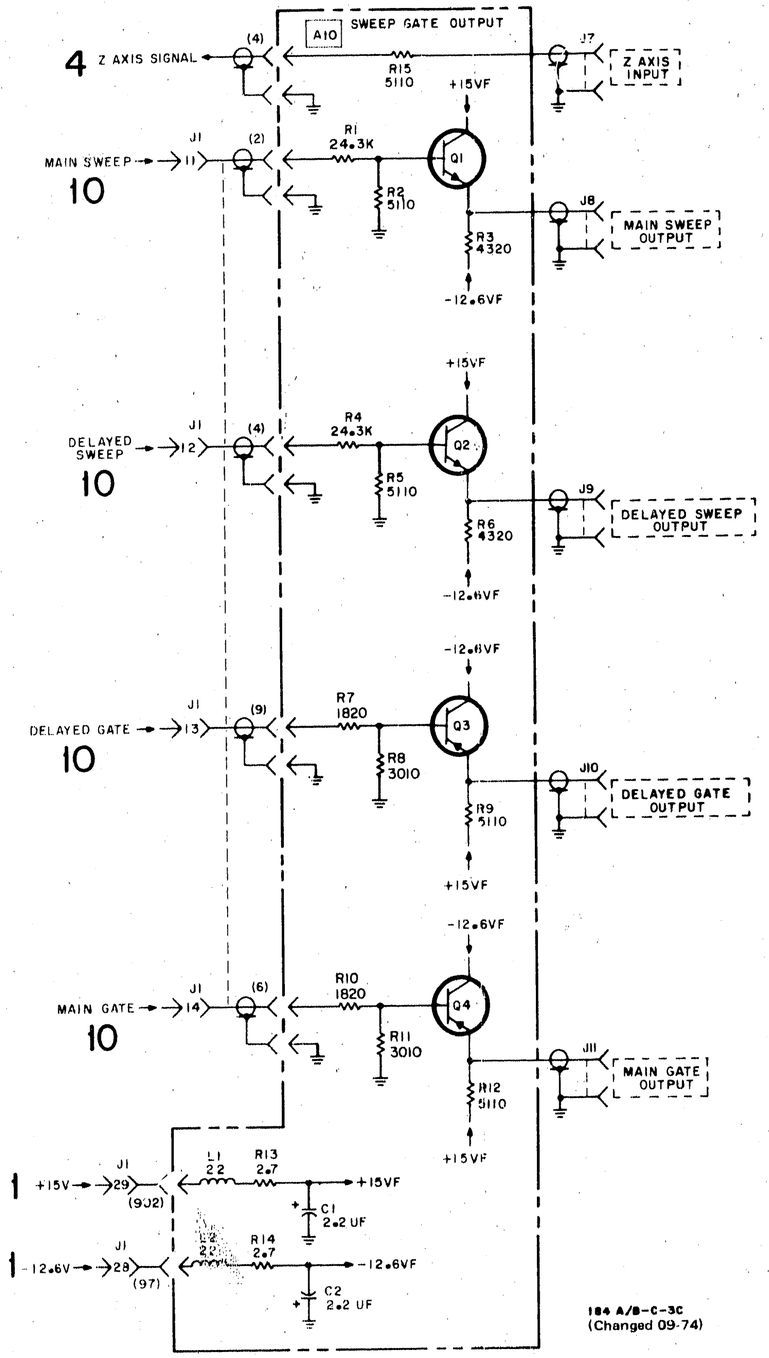
When troubleshooting the high voltage power supply or CRT, it is helpful to isolate the CRT. Do this by disconnecting CRT base socket and post-accelerator high voltage connection. With CRT disconnected, the high voltage circuit is not loaded by the CRT if it is at fault, and the CRT is protected if the high voltage supply is faulty.

Note 2

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. VTVM should be insulated for at least 3 kV.
(Voltmeter input terminals must be isolated from ground, i.e.: floating, since grid and cathode are at high voltage in relation to ground.)
In the STD mode and 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 70V. Operating in the FAST mode, grid should be more negative than cathode by about 20V at maximum intensity setting and more negative by about 100V at minimum intensity setting.

Note 3

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.



REFERENCE DESIGNATIONS

A10	CHASSIS
C1,2 L1,2 Q1-4 R1-15	P/O J1,7-11

184 A/B-C-3C
(Changed 09-74)

Figure 8-22.
Sweep Gate Output Amplifier Schematic
8-25/8-26

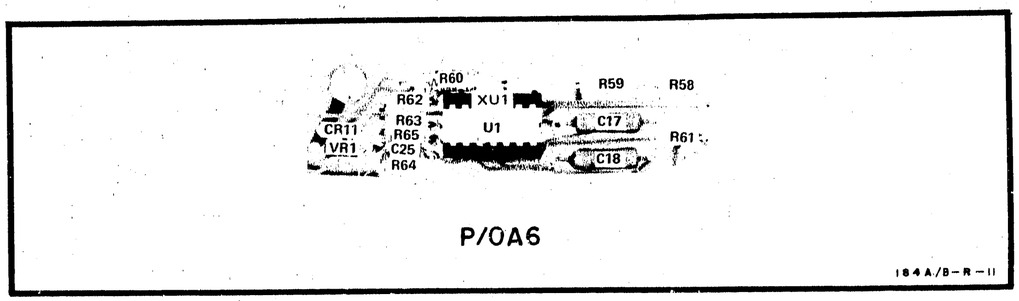


Figure 8-23. Calibrator Component Identification

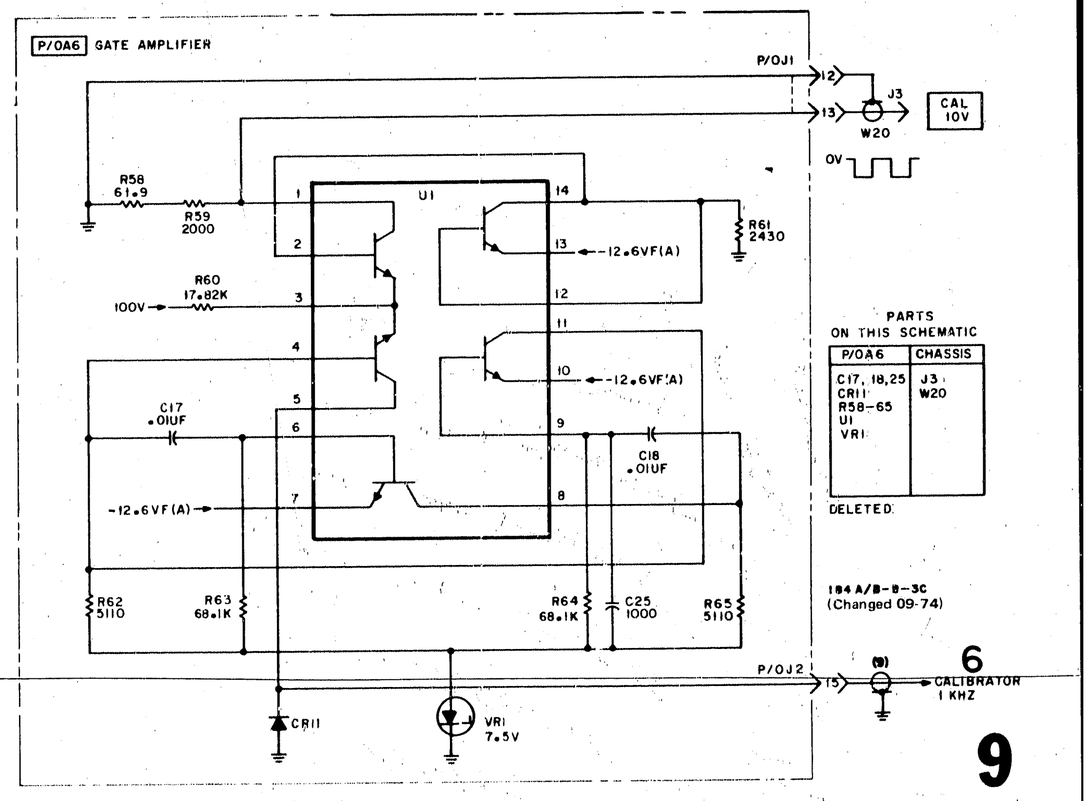


Figure 8-24. Calibrator Schematic

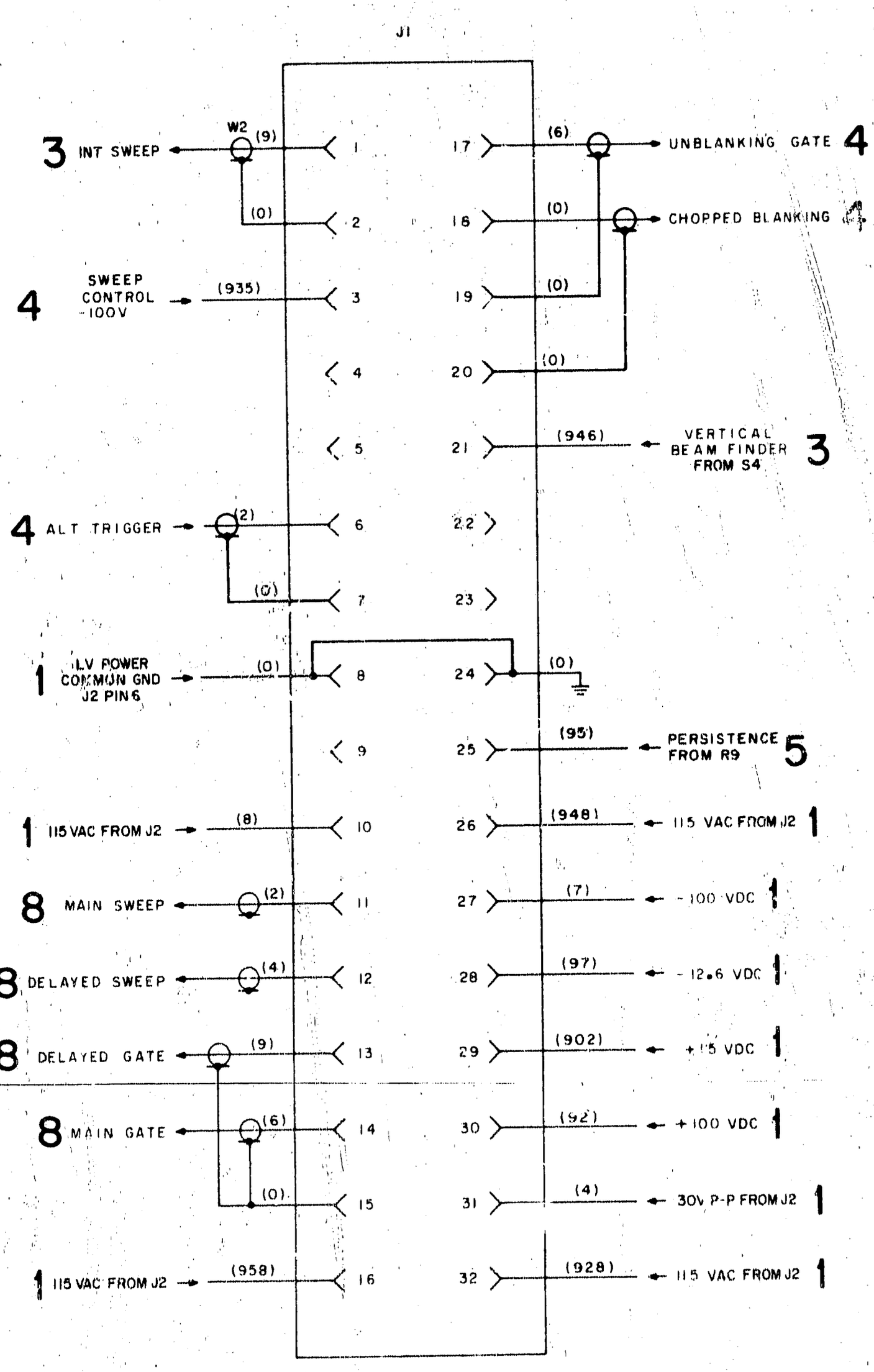


Figure 8-25: Time Base Plug-in Connections

MANUAL

CHANGES

MANUAL CHANGES

MANUAL IDENTIFICATION

Model Number:	184A/B
Date Printed:	FEBRUARY 1977
Part Number:	00184-90904

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

To use this supplement:

Make all ERRATA corrections.

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

Serial Prefix or Number	Make Manual Changes
1916A	1
2017A	1,2
2119A	1,2,3

Serial Prefix or Number	Make Manual Changes

▲ NEW ITEM

ERRATA

Paragraphs 1-21/1-22. OPTIONS,

Change OPTION 005 paragraph as follows:

OPTION 005. This option offers a fast storage CRT and viewing hood. Change table 1-1, specifications, to read: Storage Writing Speed, Fast (Option 005): 400 cm/usec (to be viewed using hood MP118). In paragraph 5-39, step t, change the frequency to 34 MHz. In paragraph 5-39, step u, add: and set MAGNIFIER to X5. Refer to Section VI for the HP Part No. for the Option 005 CRT and viewing hood, MP118.

Paragraph 5-39. Collimation and Writing Rate Adjustment,

Change step e as follows:

e. Adjust STD COL ADJ A8R21 so that display area is filled at most uniform brightness level to within ≤ 1 mm on any two sides or ≤ 2 mm on any single side.

Table 6-2. Replaceable Parts,

Change: MP98 (COUPLER: SHAFT) HP and Mfr Part Nos. to 1500-0497.

Add: MP145, HP Part No. 0905-0779, GASKET: LIGHT SEAL, Mfr Code 28480, Mfr Part No. 0905-0779.

NOTE

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

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Printed in U.S.A.

Add: MP146, HP Part No. 1520-0063, FOAM STRIP (CRT STABILIZATION), Mfr Code 28480, Mfr Part No. 1520-0063.
Add: MP147, HP Part No. 5020-8767, BRACKET: SUPPORT (LV PWR MODULE), Mfr Code 28480, Mfr Part No. 5020-8767.
Change: A1E1 (XSTR INSULATOR) HP and Mfr Part Nos. to 0340-0875.
Change: A1MP7 (LVPS SPACER) HP and Mfr Part Nos. to 2360-0139.

Page 8-21. Figures 8-15 and 8-16,
Replace Figure 8-15 with page 3 of this change sheet and Figure 8-16 with page 4 of this change sheet.

CHANGE 1

Table 6-2,
Add: MP148, HP Part No. 2190-0018, Qty 2, WASHER-LK HLCL NO. 6 .141-IN-ID, Mfr Code 28480, Mfr Part No. 2190-0018.
Add: MP149, HP Part No. 2360-0195, Qty 2, SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI, Mfr Code 28480, Mfr Part No. 2360-0195.
Add: MP150, HP Part No. 3050-0010, Qty 2, WASHER-FL MTLC NO. 6 .147-IN-ID, Mfr Code 28480, Mfr Part No. 3050-0010.
Change: L1, HP and Mfr Part Nos. to 01741-66001.
Change: MP41, HP and Mfr Part Nos. to 00181-00605.

CHANGE 2

Table 6-2,
Change: A3, HP and Mfr Part Nos. to 00184-66522.
Change: A7, HP and Mfr Part Nos. to 00184-66524.
Change: A2, HP and Mfr Part Nos. to 00184-66523.
Change: A6, HP and Mfr Part Nos. to 00184-66525.
Change: W6 (Cabinet), HP and Mfr Part Nos. to 00184-61632.
Change: W20, HP and Mfr Part Nos. to 00184-61624.
Change: W21, HP and Mfr Part Nos. to 00184-61630.
Change: A3J1, HP Part No. to 1251-6133 and Mfr Part No. to 09-72-1111.
Change: A3J2, HP Part No. to 1251-6011 and Mfr Part No. to 09-70-1051.
Change: A7J1, HP Part No. to 1251-6012 and Mfr Part No. to 09-70-1081.
Change: A7J2,3,4,5, HP Part No. to 1251-6101 and Mfr Part No. to 09-70-1041.
Change: A2J1, HP Part No. to 1251-6015 and Mfr Part No. to 09-70-1121.
Change: A6J1,2, HP Part No. to 1251-6013 and Mfr Part No. to 09-70-1151.

▲ CHANGE 3

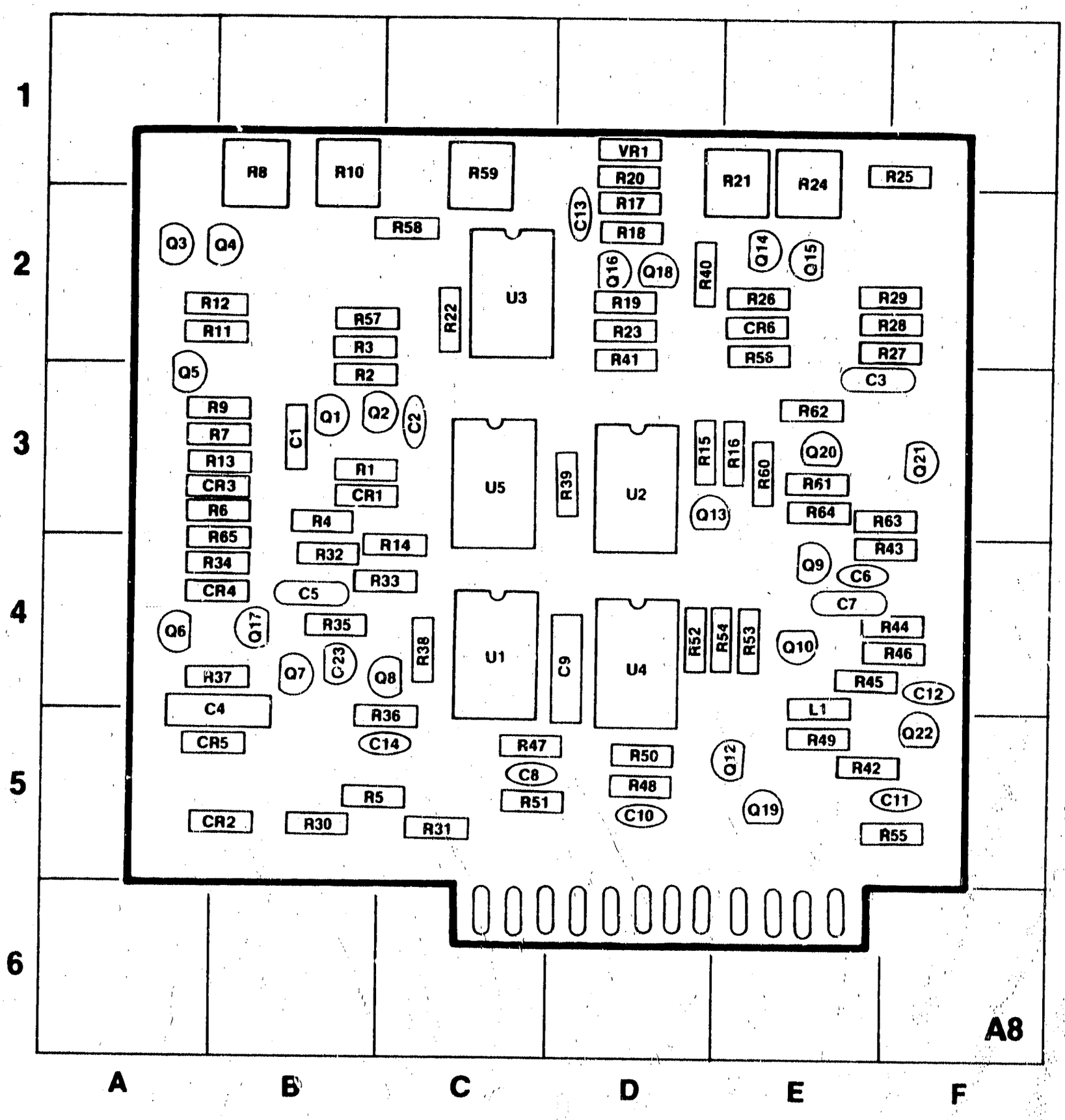
Page 4-4. Figure 4-5,
Change the reference to 5 kV on the post accelerator of the CRT to 7 kV.

Page 4-8. Paragraph 4-69,
Change: 5 kV to 7 kV.

Page 4-8. Paragraph 4-72,
Change: 5 kV to 7 kV.

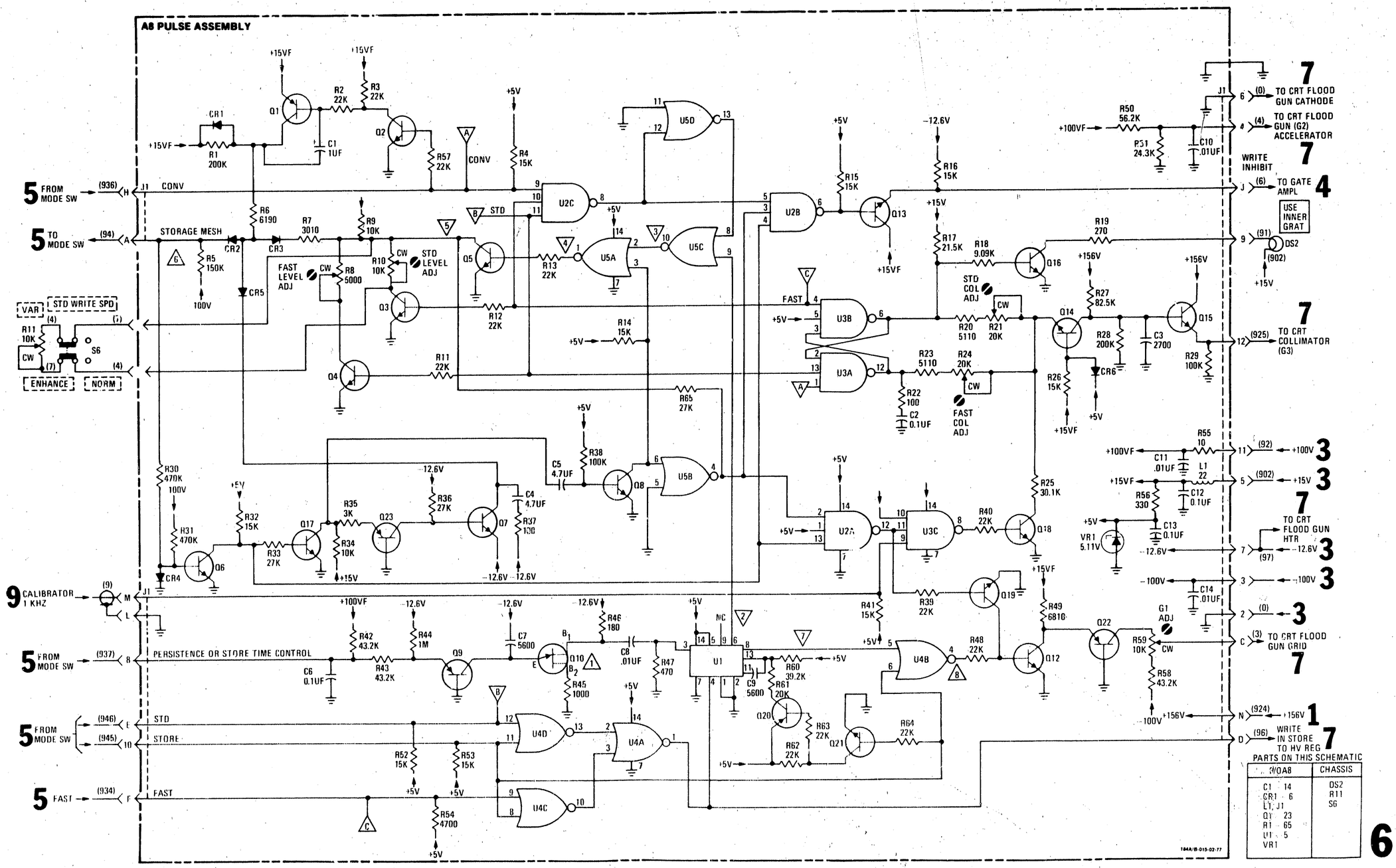
Table 6-2,
Change: First A9 to 00184-61104, MULTIPLIER ASSY: HV, 28480, 00184-61104.
Delete: Second A9, 00184-61103.

Page 8-23. Figure 8-20,
At the CRT post accelerator, on the right end of the CRT, change 5 kV to 7 kV.



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	B-3	CR2	B-5	Q10	E-4	R2	B-3	R16	E-3	R30	B-5	R44	F-4	R58	C-2
C2	C-3	CR3	A-3	Q12	E-5	R3	B-2	R17	D-2	R31	C-5	R45	E-4	R59	C-1
C3	E-3	CR4	A-4	Q13	D-3	R4	B-3	R18	D-2	R32	B-4	R46	F-4	R60	E-3
C4	B-4	CR5	A-5	Q14	E-2	R5	B-5	R19	D-2	R33	C-4	R47	C-5	R61	E-3
C5	B-4	CR6	E-2	Q15	E-2	R6	A-3	R20	D-1	R34	A-4	R48	D-5	R62	E-3
C6	E-4	L1	E-4	Q16	D-2	R7	A-3	R21	E-1	R35	B-4	R49	E-5	R63	F-3
C7	E-4	Q1	B-3	Q17	B-4	R8	B-1	R22	C-2	R36	B-5	R50	D-5	R64	E-3
C8	C-5	Q2	C-3	Q18	D-2	R9	A-3	R23	D-2	R37	A-4	R51	C-5	R65	A-3
C9	D-4	Q3	A-2	Q19	E-5	R10	B-1	R24	E-1	R38	C-4	R52	D-4	U1	C-4
C10	D-5	Q4	B-2	Q20	E-3	R11	A-2	R25	F-1	R39	D-3	R53	E-4	U2	D-3
C11	F-5	Q5	A-3	Q21	F-3	R12	A-2	R26	E-2	R40	D-2	R54	E-4	U3	C-2
C12	F-4	Q6	A-4	Q22	F-5	R13	A-3	R27	F-2	R41	D-2	R55	F-5	U4	D-4
C13	D-2	Q7	B-4	Q23	B-4	R14	C-4	R28	F-2	R42	F-5	R56	E-2	U5	C-3
C14	C-5	Q8	C-4	R1	B-3	R15	D-3	R29	F-2	R43	F-3	R57	B-2	VR1	D-1
CR1	B-3	Q9	E-4												

Replacement for Figure 8-15. Pulse Circuit Component Identification



Replacement for Figure 8-16.
Pulse Circuit Schematic
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