Errata

Title & Document Type: **181A/AR Oscilloscope Operating and Service Manual**

Manual Part Number: **00181-90916**

Revision Date: **September 1976**

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.

Support for Your Product

Agilent no longer sells or supports this product. You will find any other available product information on the Agilent Test & Measurement website:

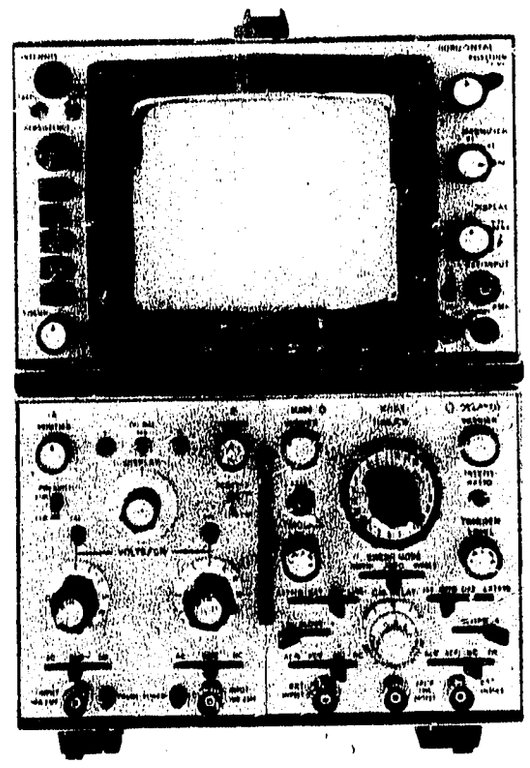
www.agilent.com

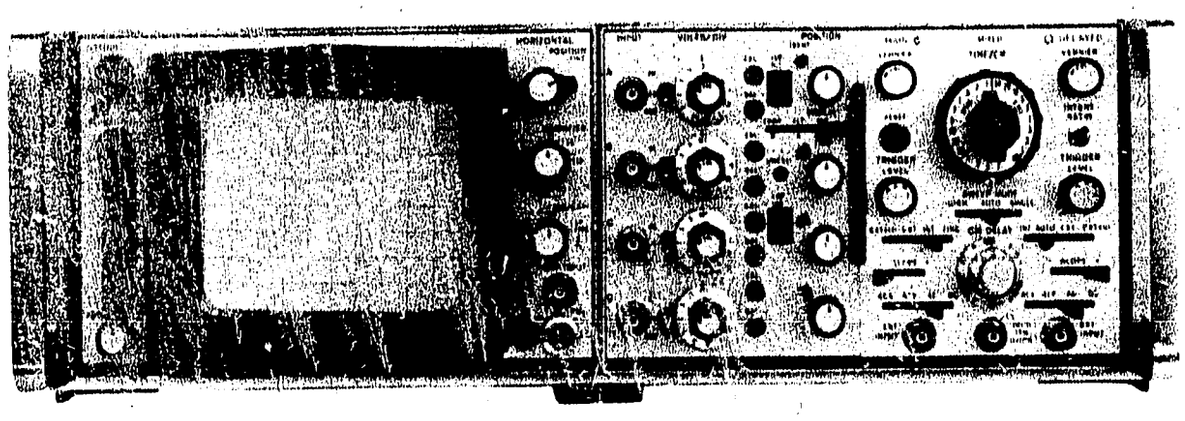
Search for the model number of this product, and the resulting product page will guide you to any available information. Our service centers may be able to perform calibration if no repair parts are needed, but no other support from Agilent is available.

Agilent Technologies

OPERATING AND SERVICE MANUAL

181A/AR
OSCILLOSCOPE





HEWLETT hp PACKARD

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.

OPERATING AND SERVICE MANUAL

MODEL 181A/AR OSCILLOSCOPE

(Including Options 003, 004, and 631)

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed **1409A (181A); 1347A (181AR).**

With changes described in Section VII, this manual also applies to instruments with serial numbers prefixed **748** through **1337A.**

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 00181-90916
Microfiche Part Number 00181-90816

PRINTED: SEPTEMBER 1976

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.

S6-2-1/76

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. The Model 181A/AR, is a lightweight, general purpose, variable persistence, storage oscilloscope with plug-in capability. The Model 181A and the Model 181AR as shipped from the factory are intended for bench use. The Model 181AR may be rack mounted as described in Section II.

1-3. The Model 181A/AR is convection cooled and operates within specifications as listed in table 1-1.

1-4. 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. Display persistence can readily be adjusted to eliminate flicker and still provide high resolution.

1-5. The storage feature of the 181A/AR 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.

1-6 The horizontal amplifier has a direct-coupled bandwidth of dc to 5 MHz. The ac-coupled bandwidth is 5 Hz to 5 MHz. With a dynamic range of ±20 volts, the amplifier has front-panel selectable deflection ranges of 1 v/div, 0.2 v/div and 0.1 v/div. A vernier control provides continuous adjustment between ranges. A magnified sweep accuracy of ±5% is maintained at selectable magnifications of X5 and X10; and a front panel BNC connector permits the use of external deflection signals. The external input has an input impedance of 1 megohm shunted by approximately 30 pf.

1-7. A rear panel BNC connector is provided for external control of CRT blanking. 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.

1-8. 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.

1-9. A square wave signal of approximately 1 kHz is available at the front panel for calibration purposes. Its amplitude of 10 volts peak-to-peak is accurate to ±1%, and it has a risetime of less than 3μsec. The signal may be used to adjust horizontal and vertical deflection factors and to compensate divider probes.

1-10. ACCESSORIES SUPPLIED.

1-11. The standard Model 181A/AR Oscilloscope is supplied with a mesh contrast filter, blue light filter, 230V fuse package, and a detachable power cord. Also included with the Model 181AR are a rack mounting kit and two clip-on probe holders.

1-12. EQUIPMENT AVAILABLE.

1-13. Testmobiles, 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.

1-14. INSTRUMENTS COVERED BY MANUAL.

1-15. 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.

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

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

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

Table 1-1. Specifications

HORIZONTAL AMPLIFIER

External Input
Bandwidth: dc coupled, dc to 5 MHz; ac coupled, 5 Hz to 5 MHz.
Deflection Factor (sensitivity): 1 v/div, ±5% on X1; 0.2 v/div ±5% on X5; 0.1 v/div ±5% on X10; vernier provides continuous adjustment between ranges. Dynamic range ±20 v.
Input RC: 1 megohm shunted by approximately 30 pf.
Sweep Magnifier: X5, X10; accuracy ±5%.

CALIBRATOR

Type: approximately 1 kHz square wave, less than 3 μsec rise time.
Voltage: 10v peak-to-peak, accuracy ±1%.

CATHODE RAY TUBE AND CONTROLS

Type: post-accelerator storage tube, 8.5 kv accelerating potential, aluminized P31 phosphor.
Graticule: 8 x 10 division parallax-free internal graticule marked in .95 centimeter squares. Subdivisions of 0.2 div on major axes. Front panel recessed TRACE ALIGN aligns trace with graticule. Y axis may be aligned to be perpendicular with X axis with internal control for accurate rise time measurements.
Writing Speed: Write mode; 20 div/msec.
Max write mode; >5 div/usec.
Erase: push-button erasure takes approximately 300 msec.
Brightness: greater than 100 foot-lamberts with entire screen faded positive.
Persistence: continuously variable from less than 0.2 second to more than one minute, or normal P31 persistence of approx 40 μsec.
Storage Time: From WRITE mode to STORE, traces may be stored at reduced intensity for more than one hour. To VIEW mode, traces may be viewed at normal intensity for more than one minute. From MAX WRITE mode to STORE, traces may be stored at reduced intensity for more than 5 minutes. To VIEW mode, traces may be stored at normal intensity for more than 15 seconds.
Intensity Modulation: Approximately +2V, 50 ns pulse width (≤ 10 MHz CW), will blank trace of normal intensity. Input Resistance, 5100 ohms.
Beam finder: pressing FIND BEAM control when operating in any mode except STORE or VIEW brings trace on CRT screen regardless of setting of horizontal or vertical controls.

OUTPUTS

Four emitter follower outputs for main and delayed gates, main and delayed sweeps. Maximum current available is ±3 ma. Outputs will drive impedances down to 1k ohm without distortion.

GENERAL

Environment: Model 181A/AR Oscilloscope with plug-ins operates within specifications over the following ranges:
Temperature: 0° C to +55° C.
Humidity: to 95% relative humidity to 40° C.
Altitude: to 15,000 ft.
Vibration: vibrated in three planes for 15 min each with 0.010 inch excursion, 10 to 55 Hz.

Power: 115 or 230 V ±10%, 48-440 CPS, less than 225 VA max with plug-ins, convection cooled (Other voltages available, see Options).

Weight: (without plug-ins) Model 181A; Net 10.9 kg (24 lb) Model 181AR (rack); Net, 11.8 kg (26 lb).

OPTIONS:

003: 100 or 200V operation
004: 110 or 220V operation
631: P31 phosphor, non-graticule

SECTION II

INSTALLATION

2-1. INTRODUCTION.

2-2. This section of the manual contains inspection and installation procedures for the Model 181A/AR Oscilloscope. In addition, packing and claims procedures are discussed in the event damage occurs during shipment.

2-3. INITIAL INSPECTION.

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

2-5. REPACKING FOR SHIPMENT.

2-6. If the instrument is to be shipped to a Hewlett-Packard Sales/Service Office, attach a tag to it showing owner's name, address, instrument model number and serial number, and a description of the service required.

2-7. Use the original shipping carton and packaging materials for reshipment. If they are not available, the HP Sales/Service Office will provide information and recommendations on material to be used.

2-8. PREPARATION FOR USE.

2-9. POWER REQUIREMENTS.

2-10. The Model 181A/AR requires a 115V or 230V ±10%, single-phase, 48 to 440 Hz power source capable of supplying 225 VA maximum.

2-11. 115V OPERATION. This instrument, as shipped, is ready for operation on 115V ac. Before applying power, check the rear-panel slide switch, labeled SELECTOR, for proper position. It should be set so that 115 is visible. Check the fuse to verify that it is the proper value to provide protection for 115V operation of the instrument.

2-12. 230V OPERATION. If the instrument is to be operated from a 230V ac power source, set the rear-panel SELECTOR slide switch to 230. Replace the fuse with the proper value for 230V operation.

2-13. THREE-CONDUCTOR POWER CABLE.

2-14. This instrument is equipped with a three-conductor power cable that, when connected to an appropriate receptacle, grounds the instrument through the offset pin. The power cable required depends on the ac input voltage, and the country in which the instrument is to be used. Figure 2-1 illustrates the standard power receptacle (wall outlet) configurations that are used throughout the United States and in other countries. The HP part number shown adjacent to each receptacle drawing is the part number for a power cable equipped with a mating plug for that receptacle. If the appropriate power cable is not included with the instrument, notify the nearest Hewlett-Packard Sales/Service Office and a replacement cable will be provided.

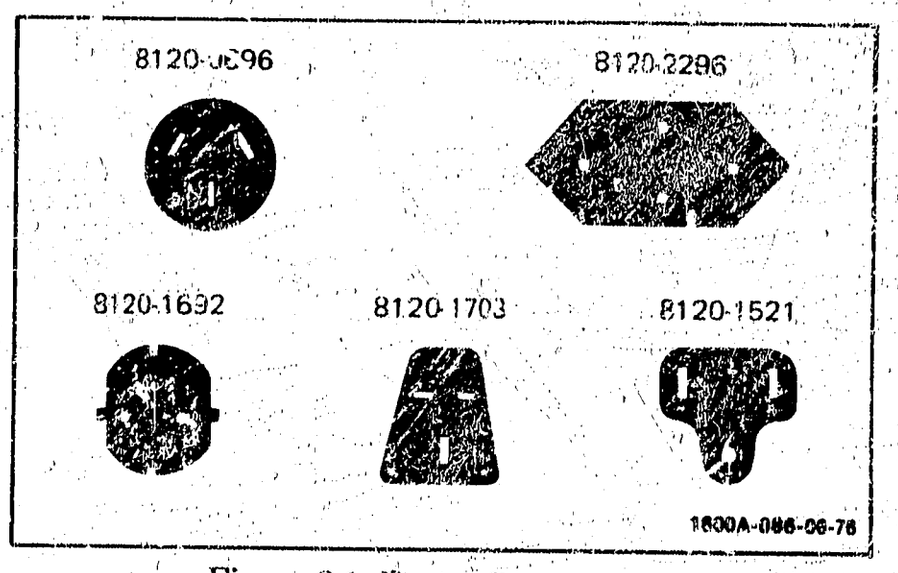


Figure 2-1. Power Receptacles

2-15. When operating the Model 181A/AR from a two-contact power outlet, use a three-conductor to two-conductor adapter. Preserve the safety feature by grounding the adapter fle. Ole (third) lead.

2-16. INSTRUMENT MOUNTING.

2-17. Both the Model 181A and the Model 181AR, as shipped from the factory, are intended for bench use. The Model 181AR, however, may be rack mounted. A kit for converting the Model 181AR to a rack mount 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 a thin blade tool.

c. Attach rack mounting flange in space from which trim strip was removed (use screws provided with kit).

Large notch of flange should be positioned at bottom of instrument.

2-18. INSTRUMENT COOLING.

2-19. The Model 181A/AR does not need forced-air cooling when operated in an ambient temperature of 0 to +55 degrees centigrade. Normal air circulation will maintain a reasonable temperature within the instrument.

2-20. CONTRAST FILTER.

2-21. The contrast filter is designed to be easily removed from the CRT bezel. Use of the contrast filter provides comfortable viewing when the instrument is operated in normal and high ambient light.

2-22. The contrast filter is located behind the light shield. When a camera is attached for use, removal of the filter may be desirable.

2-23. 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. Remove the contrast filter, which is held in the bezel by a loose pressure fit.

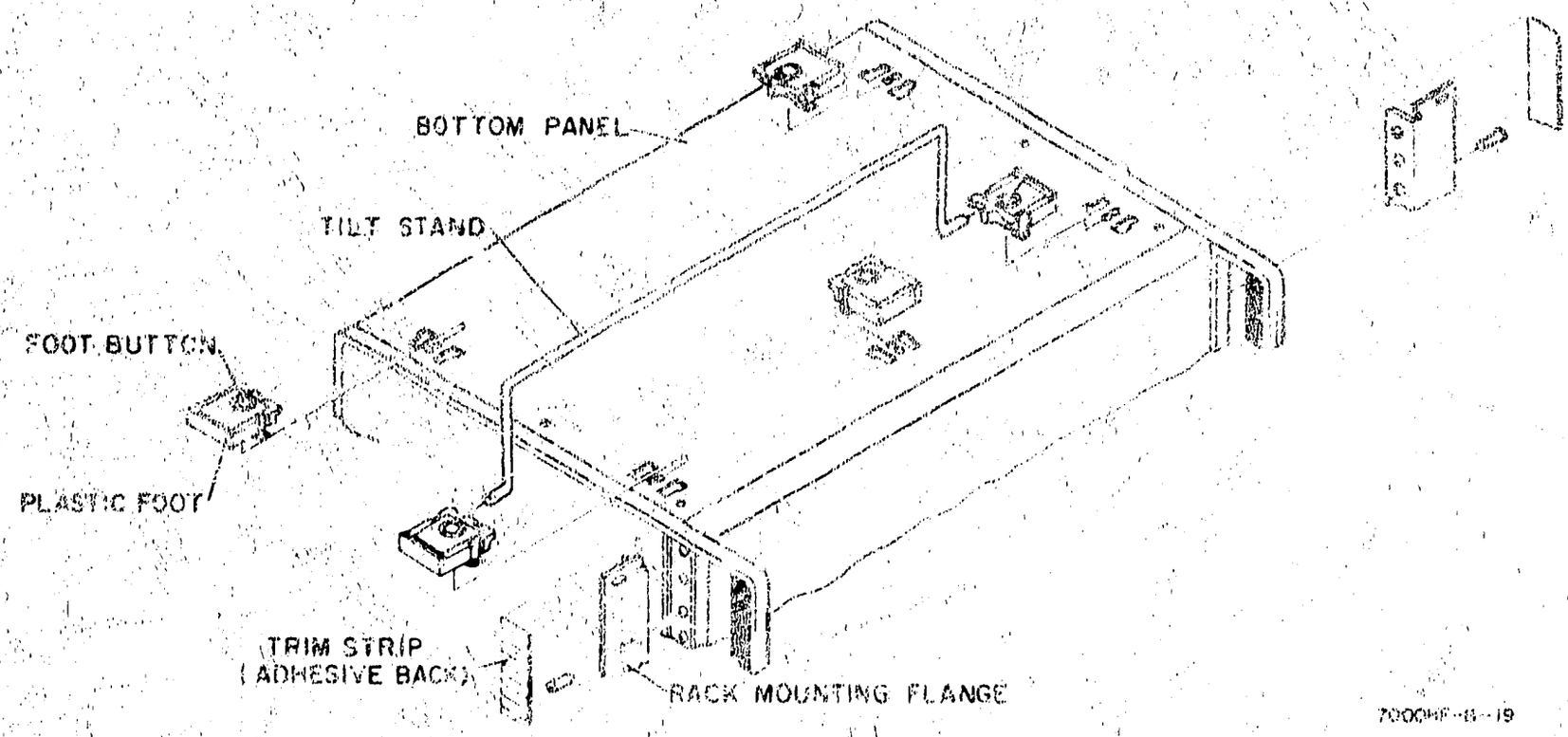


Figure 2-2. Rack Mount Procedure

OPERATION

SECTION III
OPERATION

3-1. INTRODUCTION.

3-2. The Model 181A/AR is a light weight, variable persistence, storage oscilloscope using plug-in vertical and horizontal modules. Both high and low voltage power supplies, a calibrator, the CRT, and circuitry for the variable persistence and storage operation are contained in the Model 181A/AR. A compartment for the horizontal and vertical plug-ins is located in the lower portion of the Model 181A and in the right hand portion of the Model 181AR. 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(see plug-in manuals).

3-3. OPERATING CONSIDERATIONS.

3-4. Prior to operating the Model 181A/AR, 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.

3-5. The following are steps that must be taken prior to applying power to the Model 181A/AR Oscilloscope.

a. Depress WRITE push button.

b. Set PERSISTENCE control fully ccw.

c. Set INTENSITY control fully ccw.

d. Apply power to Model 181A/AR

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.

3-6. CONTROLS AND CONNECTORS.

3-7. The location of operating controls and connectors is shown in Figure 3-1 together with a brief explanation of their functions. Additional information regarding some of these controls and connectors is provided below.

3-8. FRONT PANEL.

3-9. FOCUS AND ASTIGMATISM. These controls are provided to assure uniform focus of the trace over the entire CRT screen. To adjust, set the Presentation Selector to WRITE, center a low-intensity spot on the CRT screen, and adjust FOCUS and ASTIGMATISM controls for a small, round, sharply focused spot. Readjustment of the ASTIGMATISM control is seldom required except, for example, when the vertical plug-in is changed.

3-10. STORE. In order to retain whatever is visible on the CRT, depress the STORE push button. The signal will be stored at reduced intensity, resulting in a storage time of greater than one hour. The INTENSITY, PERSISTENCE, FOCUS, ERASE, and HORIZONTAL POSITION controls do not affect the presentation in the STORE mode.

3-11. 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 WRITE mode, then depress the STORE push button.

3-12. 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 VIEW push button 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.

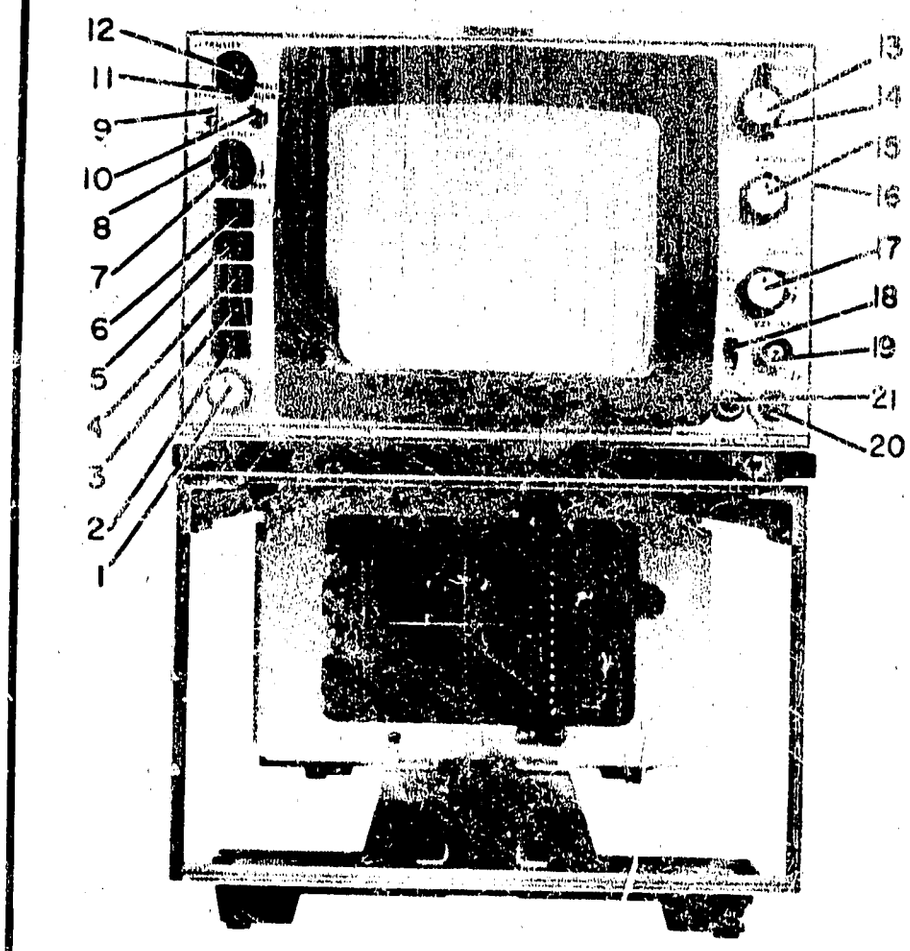
3-13. Several individual waveforms may also be stored, even though they are written at different times. Having stored a trace, for instance, the operator may choose to switch back to WRITE and record another trace, etc., prior to erasing. And by turning the Model 181A/AR power off, as few as one trace a day can be recorded for a week or more, depending on total time instrument is turned on, as storage time would decrease accordingly.

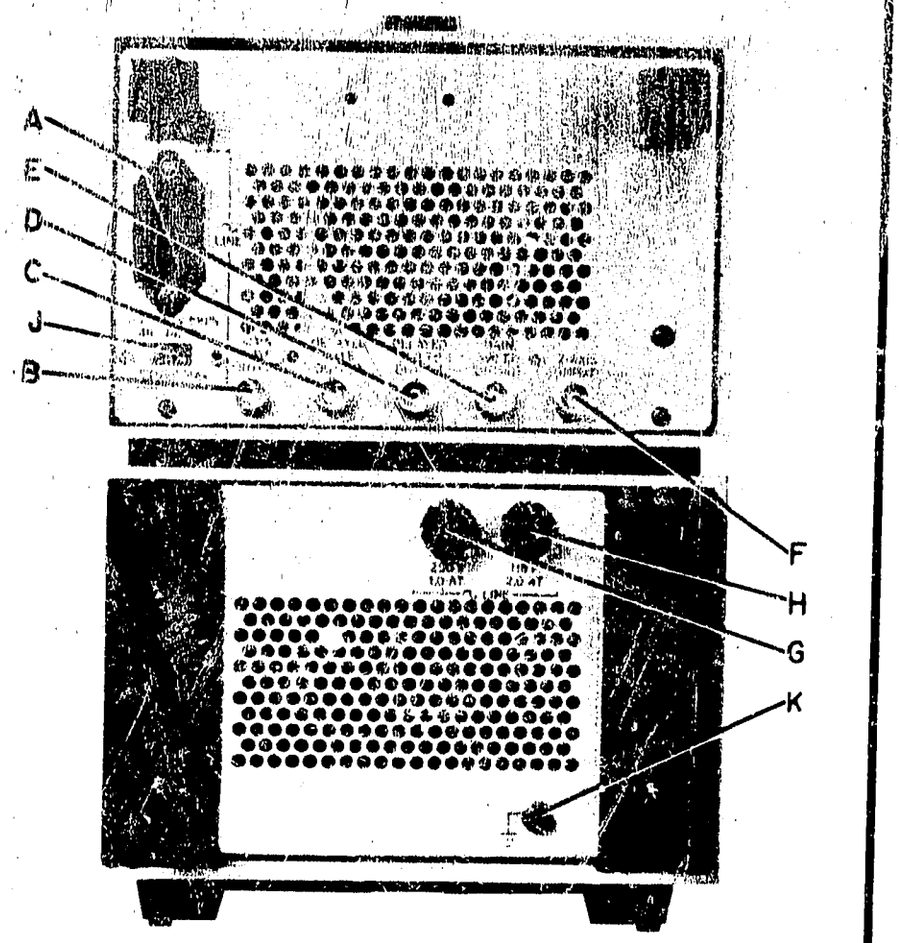
3-14. VIEW. To observe a previously stored display, depress the VIEW push button. The stored display will be intensified to a brightness level determined by the intensity and persistence values selected during the write process. Again, the INTENSITY, PERSISTENCE, FOCUS, ERASE and POSITION controls do not affect the display.

CAUTION

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

3-15. NORMAL. Selection of this 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 WRITE mode with minimum PERSISTENCE, for no blooming, then switch to NORMAL. Do not increase intensity beyond this level while in NORMAL.





181A-A-118

Note: Models 181A and 181AR differ only in power module location. All controls are identical. See Fig. 1-1.

1. FOCUS: Controls sharpness of writing beam.
2. STORE: Retains displayed signal at reduced intensity for long time storage.
3. VIEW: Intensifies stored display to brightness level for viewing.
4. NORMAL: Selects operation as standard oscilloscope. Note intensity level (refer to paragraph 3-15).
5. WRITE: Operates CRT at normal writing rate with variable persistence.
6. MAX WRITE: Operates CRT at maximum writing rate with variable persistence.
7. ERASE: Removes stored or written displays.
8. PERSISTENCE: Controls endurance time of displayed signal.
9. ASTIGMATISM: Adjust roundness of writing beam.
10. TRACE ALIGN: Rotates trace around center of CRT face.
11. FIND BEAM: Returns display to CRT.
12. INTENSITY: Controls brightness of display.
13. POSITION: Coarse adjustment of display's horizontal position.
14. FINE: Fine adjustment of display's horizontal position.
15. MAGNIFIER: Magnifies horizontal display.
16. PHASE/BANDWIDTH: Selects between normal operation (BANDWIDTH) and XY operation (PHASE). Located inside on board.
17. DISPLAY: Selects source of horizontal input signal.
18. AC/DC: Selects AC or DC coupling of an external horizontal input signal.
19. EXT INPUT: BNC connector for coupling an external horizontal input signal to oscilloscope.
20. POWER: Push-button switch with indicator light for turning oscilloscope on and off.
21. CALIBRATOR: Provides a 1-kHz square wave signal at 10v pk-pk.

REAR PANEL

A. AC INPUT: 3-wire ac power line input jack.
B. MAIN GATE OUTPUT: BNC for connecting main gate to external equipment.
C. DELAYED GATE OUTPUT: BNC for connecting delayed gate to external equipment.
D. DELAYED SWEEP OUTPUT: BNC for connecting delayed sweep to external equipment.
E. MAIN SWEEP OUTPUT: BNC for connecting main sweep to external equipment.
F. Z-AXIS INPUT: BNC for connecting external intensification or blanking signal.
G. FUSE: AC line fuse for 230vac operation.
H. FUSE: AC line fuse for 115vac operation.
J. LINE SWITCH: Input power switch for selection of 115vac or 230vac operation.
K. GROUNDING CONNECTOR: 3-way connector jack for instrument grounding.

Figure 3-1. Front and Rear Panel Controls and Connectors.

3-16. WRITE. Depressing the WRITE push button establishes the CRT in a condition for variable persistence display of a signal which can later be stored. Use the minimum INTENSITY and maximum PERSISTENCE required to obtain the desired display.

3-17. MAX WRITE. Operation in the Max Write mode (MAX W.) 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.

3-18. ERASE. Depressing the ERASE push button will remove stored signals from the CRT when either the WRITE or MAX W push button is depressed. Stored or written displays that remain visible after erasure, may require the ERASE push-button be held depressed for approximately 30 seconds.

3-19. PERSISTENCE AND INTENSITY. These controls determine the viewing time of a signal being displayed. The INTENSITY sets the brightness of the trace as it is written. The PERSISTENCE control is used to establish the desired duration of signal viewing without rewriting. It accomplishes this by varying the rate at which the displayed signal is erased.

3-20. TRACE ALIGN. The TRACE ALIGN adjustment control compensates for external magnetic fields that may affect the alignment of the horizontal trace with the graticule. The alignment should be checked when the instrument is moved to a new location and the adjustment made whenever necessary.

3-21. FIND BEAM. Off-screen positioning of the CRT beam may occur due to initial improper control settings or a very high dc input signal. The beam may be brought back on screen by depressing the FIND BEAM push button. Adjust the horizontal and vertical position controls to center the beam (refer to the plug-in manuals). Adjust the INTENSITY control to obtain a visible trace.

3-22. DISPLAY. This control determines the input signal to the horizontal amplifier. With the DISPLAY control set to EXT CAL, the external horizontal input signal is coupled directly to the horizontal amplifier. As the DISPLAY control is rotated counterclockwise, the external signal is increasingly attenuated. When the DISPLAY control is fully counterclockwise (INT), the external input signal is disconnected and the internal sweep is coupled directly to the horizontal amplifier. With the DISPLAY controls set to EXT CAL, the insertion of a 1v signal into the EXT INPUT jack will result in a 1-division deflection in X1, 5-division in X5, and a 10-division deflection in the X10 position.

3-23. MAGNIFIER. The MAGNIFIER provides switched gain levels in the horizontal amplifier of X1, X5, or X10. In the X5 or X10 positions, the horizontal gain is increased to provide an amplified display of five or ten times, respectively. The MAGNIFIER is usable in both internal and external sweep modes.

3-24. CALIBRATOR. A square wave signal of approximately 1 kHz. 10v can be used for vertical sensitivity calibration anc for probe compensation adjustment. The CALIBRATOR output amplitude is accurate within ±1%. Risetime of the square-wave output is less than 3 sec.

3-25. REAR PANEL.

3-26. OUTPUTS. Main and delayed sweep and gate signals are available at rear panel BNC connectors of the Model 181A/AR. These outputs are provided from separate isolation amplifiers which can supply 3 ma and will drive impedances as low as 1000 ohms without distortion. The plug-ins used in the Model 181A/AR and the control settings employed determine the output signals available.

3-27. Z-AXIS INPUT. An external signal can be utilized for control of CRT intensity. A rear-panel mounted BNC connector permits a direct connection to the CRT intensity gate amplifier. A signal of approximately +2 v_p, 50 ns pulse width (≤10 mHz CW) will blank a trace of normal intensity. Input of a negative signal can be used for beam intensification.

3-28. AC LINE INPUT. A three-conductor ac input jack is provided for power input. Also located on the rear panel is the 115/230v slide switch and the required fuses for 115 vac and 230 vac operation.

3-29. INTERNAL.

3-30. PHASE/BANDWIDTH. The Model 181A/AR can also be used for phase measurements. Positioning the PHASE/BANDWIDTH switch to PHASE causes the horizontal input signal to be delayed the same amount of time as the vertical input signal.

NOTE

Make certain the control is returned to the Bandwidth position after making phase measurements.

3-31. PLUG-IN UNITS.

3-32. The Model 181A/AR Oscilloscope 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 Model 181A/AR main frame. Consult the respective plug-in Operating and Service Manual for operation and capability information. Blank plug-ins, both single and dual, are available for customer fabrication of specialized vertical amplifier and time-base plug-ins. Refer to Table 4-1 for power supply current capabilities.

3-33. MAGNETIC INTERFERENCE.

3-34. The CRT is provided with a mu-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.

3-35. OPERATING CONDITIONS.

3-36. DEFINITIONS.

3-37. Several words and phrases, the definition of which may vary slightly from common usage, are used

to describe the operation of the Model 181A/AR. The definitions of these words and phrases which apply to the Model 181A/AR are as follows:

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

b. PERSISTENCE-The length of time a written display remains visible on the CRT screen (INTENSITY and sweep time constant).

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

d. VIEW-To redisplay on the CRT screen, at normal intensity, a stored display.

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

f. INTENSITY-The brightness of a display as it is written on the CRT screen (PERSISTENCE and Sweep Time Constant).

g. BLOOM-A visible, non-symmetrical expansion of a display written on the CRT screen.

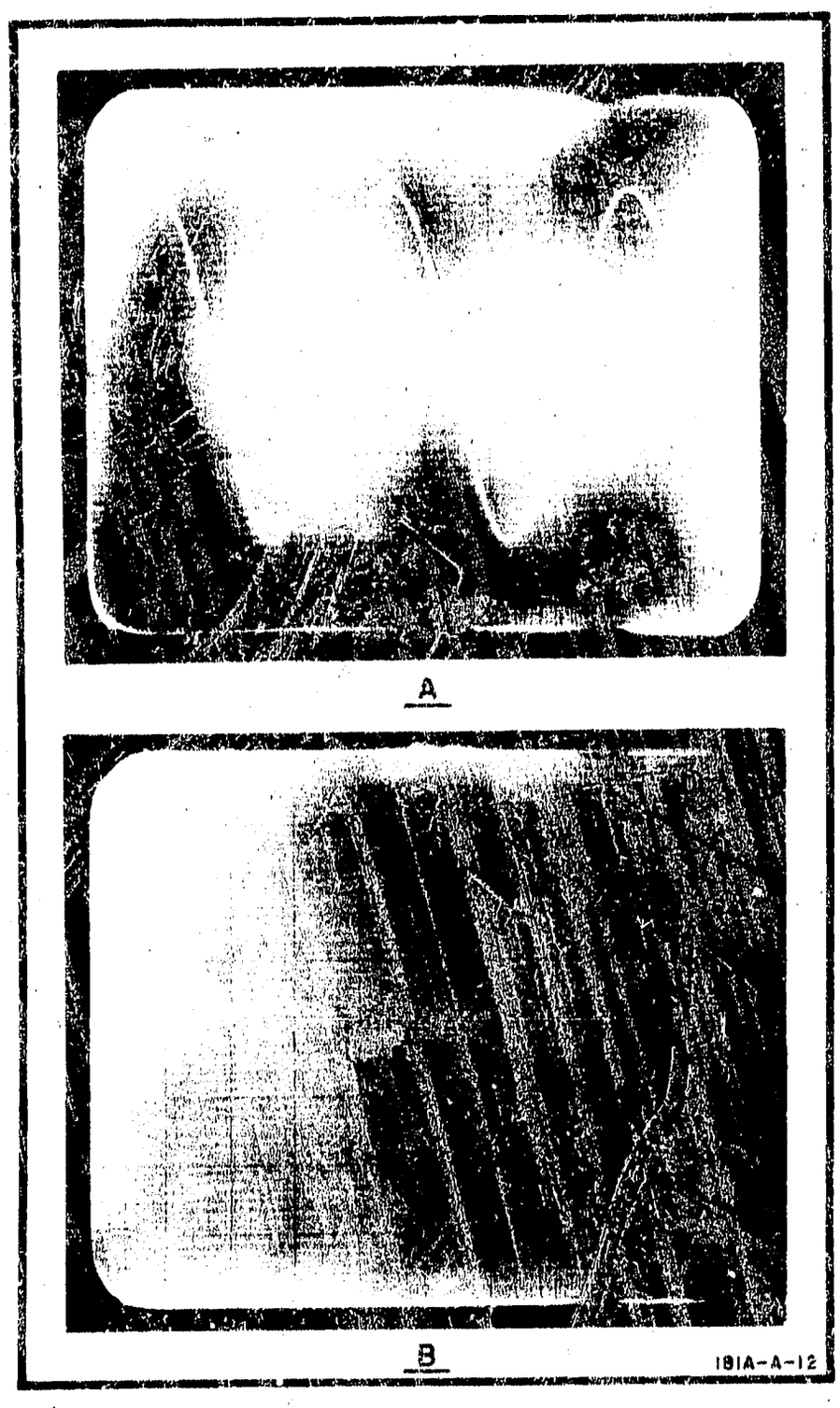


Figure 3-2. Fade Positive and Background Illumination.

h. FADE POSITIVE-Display obscured by slow blooming, see Figure 3-2A.

i. BACKGROUND ILLUMINATION-A green cloud of illumination visible on the CRT screen, see Figure 3-2B.

j. 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.

3-38. CONTROL FUNCTIONS.

3-39. PERSISTENCE AND INTENSITY. These controls contribute to 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. 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 and low intensity.

CAUTION

The storage mesh of the CRT is not easily damaged, however, a high-intensity repetitive trace or spot, written on the screen for an extended time, may not erase completely. To prevent CRT damage, use minimum INTENSITY which will give the desired display for a given PERSISTENCE setting.

3-40. PRESENTATION SELECTION. Push button controls select the mode in which the CRT functions. With ERASE push button depressed, the other three functions are disconnected and all stored and persisting displays are removed from the CRT. The WRITE and MAX W. modes are the only conditions in which a display may be written on the CRT screen. The STORE mode disconnects the WRITE and ERASE functions and retains written displays (at reduced intensity) on the CRT. INTENSITY, PERSISTENCE, and ERASE do not function in the STORE mode. The VIEW mode intensifies the stored display to a set brightness and again, INTENSITY, PERSISTENCE, and ERASE do not affect the display.

3-41. MAX WRITE. When MAX W. push button is depressed and then the ERASE push button is depressed and released, the storage surface is erased and then primed (or pre-fogged) 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.

3-42. OPERATING TIPS.

3-43. This information is provided to aid the operator in becoming familiar with the Model 181A/AR controls and their functions, and to serve as a guide for obtaining the desired CRT display.

a. For normal persistence operation, depress WRITE push button and turn PERSISTENCE control

fully ccw. Slowly rotate INTENSITY control cw to a point where no trace blooming appears. Depress NORMAL push button; do not increase INTENSITY while in NORMAL. If sweep speed is changed, always check for proper intensity using the above procedure.

CAUTION

When not actively using the oscilloscope, switch to STORE or VIEW mode, thus turning off the write gun and eliminating the possibility of burning the storage mesh. When in WRITE, NORM, or MAX W mode, any visible trace may cause permanent damage to the CRT if display is left for prolonged periods of time. To prevent this from happening, periodically erase the display or switch to STORE mode if you wish to retain the image.

b. For variable persistence operation, press the WRITE push button. Use minimum INTENSITY and maximum PERSISTENCE compatible with display.

c. Use MAX WRITE mode only for fast sweep time, single shot display, or to improve the uniformity of trace intensity. The MAX W. mode causes more rapid positive fading on the CRT and persistence or storage time of the display is thus reduced.

d. To store a display, press the WRITE push button, adjust the INTENSITY and PERSISTENCE for the desired display, and press the STORE push button.

e. To view a stored display, press the VIEW push button.

f. To store more than one display, press the WRITE push button, set PERSISTENCE fully clockwise and INTENSITY as required; allow first display to be written on the CRT. Set INTENSITY fully counterclockwise and connect the 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 the STORE push button.

g. A display which is stored when the Model 181 A/AR power is turned off will remain stored for several days. To redisplay the stored waveform, press the STORE pushbutton, turn POSITION controls fully ccw before turning power on. Apply power to Model 181A/AR and allow 5 minute warm-up.

h. To erase all persistent or stored displays, set mode to WRITE (or Max Write) and then the ERASE push button for approximately 2 seconds, then release.

i. If only a portion of a slow sweep display is desired, press the STORE push button when the trace has been written to the desired point; the write gun is blanked and the written portion is stored.

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

3-44. SINGLE-SHOT OPERATION.

3-45. 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. 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 set up should give maximum persistence to the single-shot display. After the signal has been written, press the STORE push button to retain the display.

3-46. Single-shot signals which require a sweep time faster than 20 microseconds per division can be written with more brightness by switching to the Max Write mode. The screen will be unevenly illuminated after erasing when in Max Write, Figure 3-2B; however, INTENSITY can be set high enough to make the display visible through the illumination. A display written in Max Write will be more rapidly obscured by positive fading than a signal written in NORMAL.

3-47. Single-shot signals which require a sweep time between 200 and 20 microseconds per division may have low brightness at the center of the screen. Fire a single-shot test signal with INTENSITY and PERSISTENCE fully clockwise and press the WRITE push button. If center screen brightness is low, wait for one to three minutes for the low brightness area to become brighter. Likewise, if the entire display brightness appears below a usable level, or the display is not visible at all, wait for one to five minutes for the display to appear.

THEORY

SECTION IV
PRINCIPLES OF OPERATION

4-1. INTRODUCTION.

4-2. This section provides circuit theory analysis of the Model 181A/AR Oscilloscope. Since variable persistence and storage techniques may be somewhat unfamiliar to the reader, basic theory of operation will be explained first to aid in grasping these concepts. An over-all block diagram is explained next, followed by a detailed description of the individual circuits.

4-3. VAR PERSISTENCE & STORAGE.

4-4. STORAGE PRINCIPLES.

4-5. The Model 181A/AR Storage CRT consists mainly of 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.

4-6. 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 the above reason we must pay attention to the intensity level in NORMAL as we are writing through these storage elements.

4-7. 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. 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

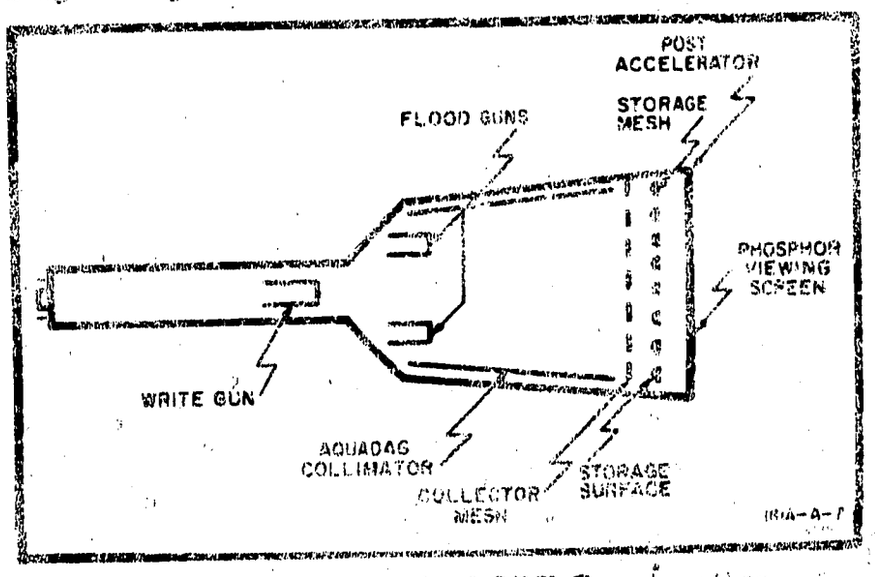


Figure 4-1. Simplified CRT Construction.

are further controlled by potentials on the storage mesh and surface.

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 non-conductive material. The storage of information takes place on the surface of this non-conductive material (storage surface).

4-9. The basis for storage of information on the non-conductive 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. 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 40ev of energy, the surface potential decreases because fewer electrons are leaving than arriving.

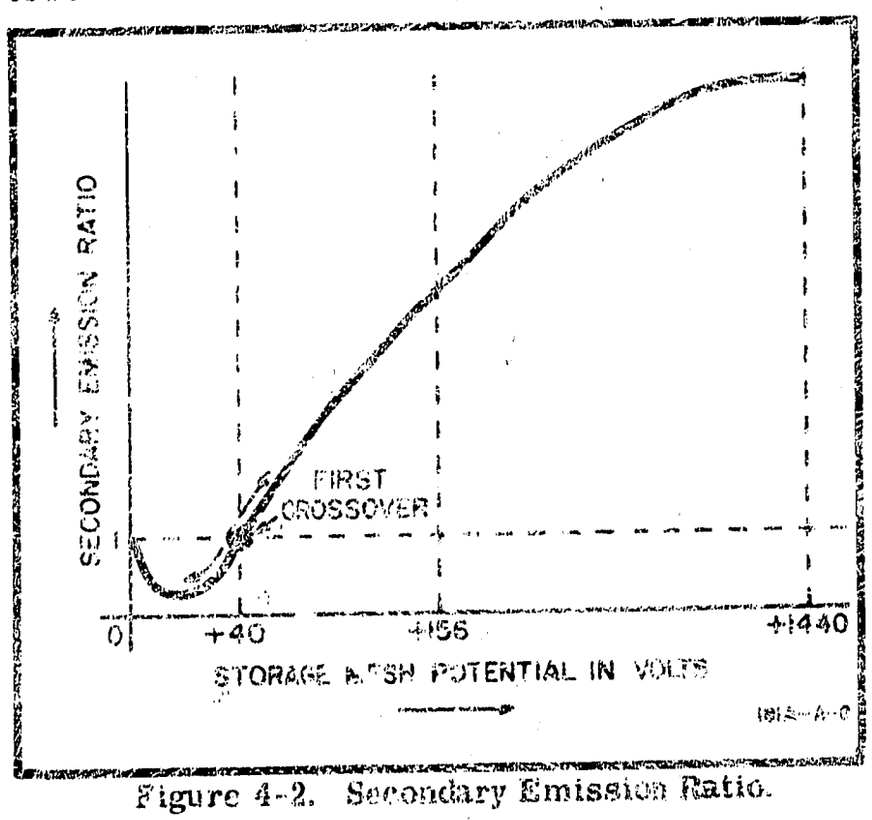


Figure 4-2. Secondary Emission Ratio.

4-10. When the ERASE push button 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.

4-11. When the ERASE push button is released, (see Figure 4-3) the storage mesh is now changed to +3.5 volts and the storage surface follows to the same potential by capacitive coupling. The surface potential

then decays to zero volts by action of the flood gun electrons (surface below first crossover, brought to flood gun cathode potential). After 100 milliseconds, the storage mesh is raised to +13.3 volts and held there for 200 milliseconds. The storage surface follows to +10 volts by capacitive coupling, but immediately starts decaying toward zero volts by capturing flood gun electrons. At the end of the 200 milliseconds, the storage mesh is brought back to +3.3 volts. The storage surface is consequently reduced from zero volts to -10 volts by capacitive coupling.

4-12. 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 very good insulator.

4-13. Those areas of the storage surface which are charged to near zero volts 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.

4-14. The secondary electrons emitted by the storage surface where the write gun electrons strike must charge the surface from its erased potential to about -5 volts before flood electrons can be captured by the post accelerator. Thus the writing speed of the CRT could be enhanced by erasing the surface to just below this "cutoff" level. This is what the MAX WRITE 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 MAX WRITE mode.

4-15. VARIABLE PERSISTENCE.

4-16. Figure 4-4 represents the method of obtaining variable persistence. The unwritten storage surface after erasure is at approximately -10 volts. Those areas of the storage surface which are struck by electrons from the write gun become charged to near zero volts. A +10 volt pulse applied to the storage mesh moves the unwritten areas of the storage surface to near zero volts and the written areas to near +10 volts. 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 10 volts. The unwritten areas of the storage surface return to a -10 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.

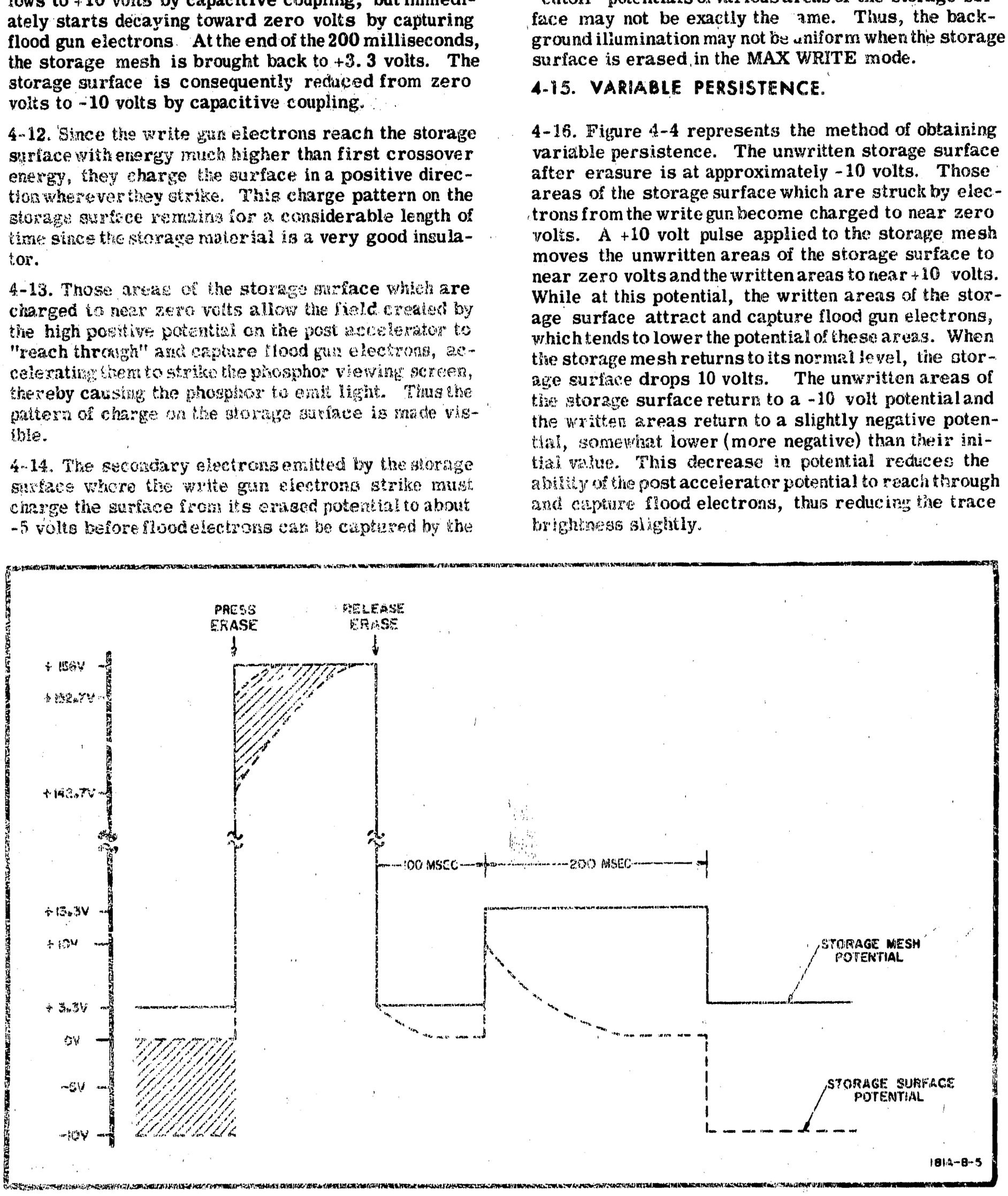


Figure 4-3. Storage Mesh and Surface Potentials During Erasure.

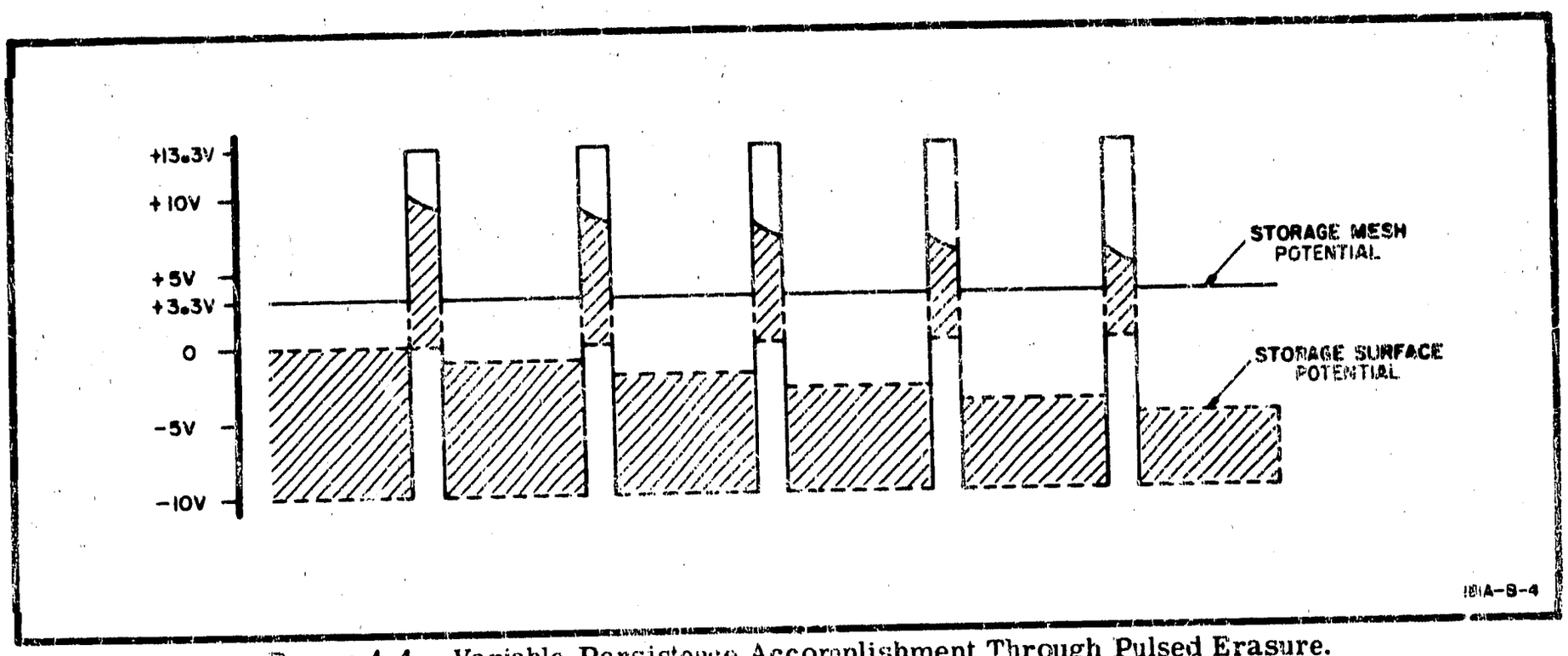


Figure 4-4. Variable Persistence Accomplishment Through Pulsed Erasure.

4-17. 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 duty cycle of the pulses applied to the storage mesh (or by varying the pulse width if the pulse repetition rate remains fixed).

4-18. 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.

4-19. NORMAL.

4-20. If the storage mesh potential is reduced to -25 volts it acts as a control grid to flood gun electrons and prevents them from reaching the phosphor. However, it has little affect on write gun electrons, allowing many of them to reach the phosphor viewing screen. Some of the write gun electrons strike the storage surface, charging it positive toward zero volts wherever they strike. Thus the CRT appears to act as a conventional CRT without variable persistence or storage. 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 -25 volts.

4-21. In order to view a stored trace for one minute or more, the storage mesh is held at a constant +3.3 volts. This may be accomplished by reducing the width 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.

4-22. 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 guns should be turned off. This is done in the STORE mode; however, the flood guns are turned on occasionally to permit viewing of the stored trace at a reduced intensity.

4-23. OVER-ALL DESCRIPTION.

4-24. GENERAL.

4-25. The Model 181A/AR Oscilloscope consists of a low-voltage power supply, a calibrator, four external output isolation amplifiers, a high voltage power supply, a gate amplifier, a horizontal amplifier, and storage and variable persistence pulse circuitry. Figure 4-5 shows the functional relationship of these circuits. The instrument may be operated as a general purpose, a variable persistence, or a storage oscilloscope. Circuit operation in all three modes is desscribed in this section.

4-26. Three input signals--intensity, horizontal deflection, and vertical deflection--are necessary to obtain a usable display on the CRT. The circuitry for the intensity and horizontal deflection signals is explained in the following paragraphs which are referenced to Figure 4-5. The vertical deflection signal is coupled to the CRT from the Vertical Plug-In.

4-27. INTERNAL.

4-28. Horizontal deflection signals may be obtained from the Horizontal Plug-In by positioning the HORIZONTAL DISPLAY switch to INT. This applies -100 volts to the plug-in, which produces an unblanking gate and generates an internal sweep signal.

4-29. The unblanking gate is coupled from the Horizontal Plug-In to the gate amplifier where it is summed with the Z-Axis Input, chopped blanking signals, and the unblanking signal from the storage pulse circuit. The resulting signal is amplified, coupled through the high voltage power supply, and applied to the CRT write gun grid to control the display intensity.

4-30. Each unblanking gate signal developed by the gate amplifier also generates an alternate trigger signal. This alternate trigger is directly coupled to the Vertical Plug-In. (The Operating and Service Manual for the Vertical Plug-In unit employed should be referred to for the signal function.)

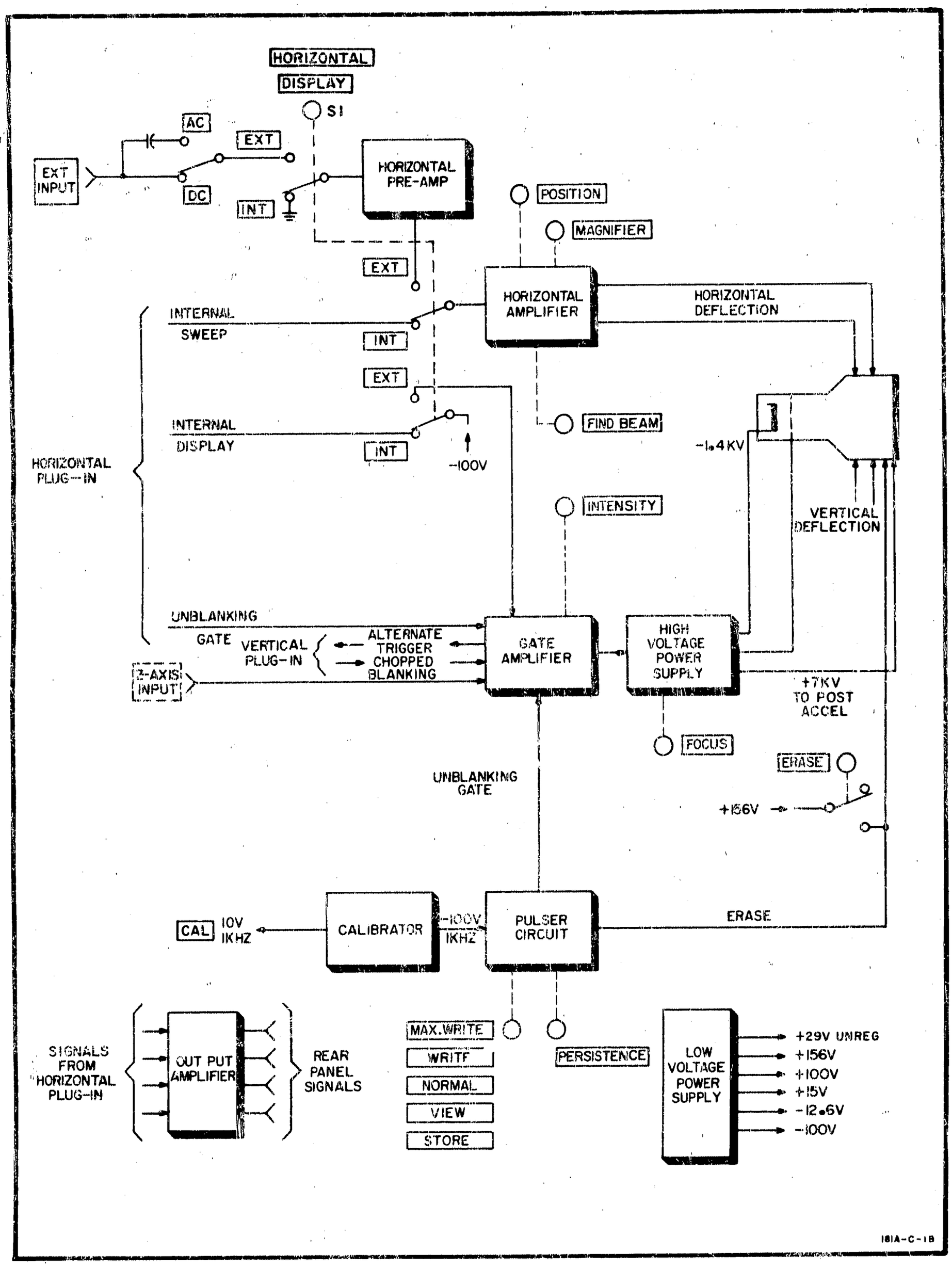


Figure 4-5. Overall Block Diagram

4-31. The internal sweep from the Horizontal Plug-In is coupled through the HORIZONTAL DISPLAY switch to the horizontal output amplifier. Here it is converted to a differential signal, amplified, and applied to the CRT horizontal deflection plates.

4-32. EXTERNAL.

4-33. Positioning the HORIZONTAL DISPLAY switch to EXT removes the internal display voltage from the Horizontal Plug-In. The unblanking gate and the internal sweep are therefore not generated by the plug-in.

4-34. Gate amplifier operation (and thus CRT intensification) is determined by: an externally applied Z-Axis Input signal, the chopped blanking signal from the Vertical Plug-In, and an unblanking signal from the storage pulse circuit. When in EXT, the gate amplifier will produce an alternate trigger only if the external input signal is similar to the normal unblanking gate.

4-35. The externally applied horizontal deflection signal is impedance matched, through source and emitter followers. It is then coupled to the output amplifier, converted to a differential output, and applied to the CRT horizontal deflection plates.

4-36. CIRCUIT DESCRIPTION.

4-37. The following paragraphs are a detailed description of the circuits and their functions in the Model 181 A/AR Oscilloscope.

4-38. LOW VOLTAGE POWER SUPPLY (LVPS).

4-39. The low voltage power supply produces six dc voltages plus the CRT write and flood gun filament power. The -100, -12.6, +15, +100, and +156 volt supplies are regulated and used throughout the Model 181A/AR and the plug-in units. An unregulated +29V is produced for use by the High Voltage Power Supply (HVPS) and the pilot lamp. A regulated +105v is also produced for use only within the LVPS.

4-40. Figure 4-6 illustrates a basic regulated power supply. The series regulator and the parallel combination of the load and the sensing device divide the entire applied voltage. If the load changes, thus changing the voltage drop across the load, the sensing device will detect it and cause the resistance of the series regulator to change in the required manner to restore the output to the desired voltage level.

4-41. Refer to the schematic diagram of the LVPS, Figure 8-23. The closing of S5 supplies power to the primary of T1. The dual primary windings of T1 may be connected in series for 230v operation or in parallel for 115v operation. S6, located on the rear panel of the instrument, switches these windings for 115v or 230v operation.

4-42. The ac voltages developed by the secondary windings of T1 are bridge rectified, filtered, fused and applied to the regulating circuits. Decoupling RC and LC filter networks are employed for circuit isolation where required.

4-43. The -100v output is used as a reference for the other regulating circuits. It must be adjusted first since its output will affect all other regulated LVPS outputs.

4-44. -100 VOLT SUPPLY. A portion of the dc voltage from the -100v rectifier-filter circuit is dropped across A7R5 and series regulator Q4. The remainder is dropped across the voltage divider network A8R35, A8R36, and A8R37. If the -100v supply were to decrease in amplitude, a small portion of the positive-going change would be felt on the base of A8Q12. This change would be coupled through A8V2 and A8Q11 to the emitter of A8Q12. The difference between the inputs to A8Q12, a positive-going signal, is coupled through current amplifier, A8Q10, to the base of series regulator, Q4. Less voltage is dropped by Q4, and the -100v supply increases to normal. A8C8 and A8R29 prevent high frequency oscillation of the series regulator. A8CR8 and A8CR9 protect A8Q11 and A8Q12 respectively from reverse voltage breakdown in case the output voltage is shorted. A8CR10 acts to prevent reverse charging of A8C10 in the event F6 opens. A8CR12 protects A8Q10 and series regulator Q4 from reverse voltage breakdown during instrument turn-on.

4-45. +100 VOLT SUPPLY. Operation of the +100v supply is similar to the -100v supply except that the base of A8Q2 is held at a constant voltage by A8V1. Any variations in the output are felt only on the base of A8Q3 and inverted prior to coupling through A8Q1 to the series regulator Q1.

4-46. +105 VOLT SUPPLY. A filtered dc voltage from A7CR1-4 and A7C1 is applied across A7R2, A8R1 and breakdown diode A8VR1. Zener action keeps the cathode of A8VR1 five volts more positive than the anode, which is at +100v. The +105v from A8VR1 is used to provide bias current for A8Q1 and A8Q3.

4-47. +156 VOLT SUPPLY. The rectified and filtered voltage from A7CR1-4 and A7C1 is applied across A7R1 and breakdown diode A7VR1. Zener action keeps the cathode of A7VR1 56.2 volts more positive than the anode, which is at +100v. The 156 volt potential at A7VR1 is applied to the CRT collector mesh, and is also used for the ERASE function.

4-48. -12.6 VOLT SUPPLY. The voltage from the -12.6v rectifier filter is dropped across the series regulator Q3, A8R22, and the load. Any variation in output is coupled through voltage amplifier A8Q9 and current amplifier A8Q7 to the base of the series regulator Q3. A8C6 and A8R20 prevent high frequency oscillation of the regulator.

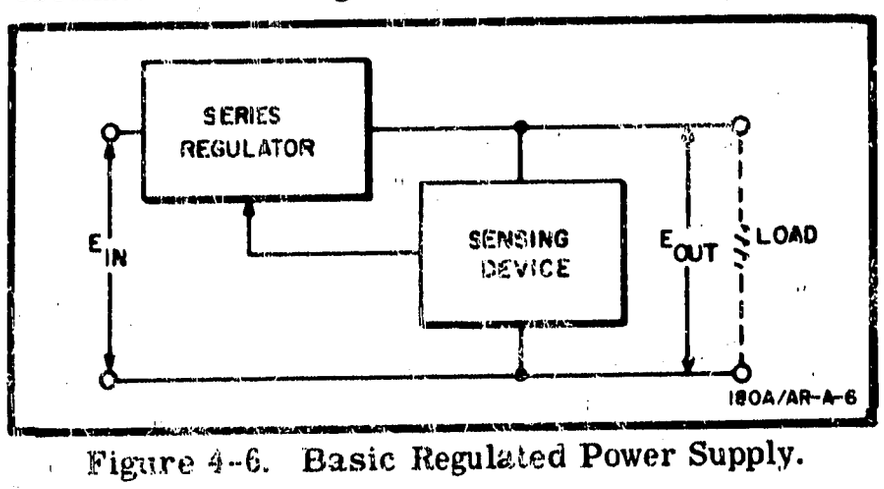


Figure 4-6. Basic Regulated Power Supply.

4-49. The current limiter, A8Q8, and A8R22 provide protection for the series regulator, Q3. If the output becomes shorted, the voltage drop across A8R22 turns on A8Q8. The negative signal from the collector of A8Q8 is coupled through the driver A8Q7 to the series regulator Q3, tending to turn it off. Output current is thus limited to only that required to keep A8Q8 conducting.

4-50. +15 VOLT SUPPLY. The +15 volt supply is similar to the -12.6v supply except that changes in the output are applied to the base of A8Q6 and inverted before being coupled through A8Q4 to the series regulator, Q2.

4-51. PLUG-IN POWER.

4-52. Blank plug-ins both single and dual width are available (See paragraph 1-16, accessories available) for customer fabrication of specialized vertical amplifier and time base plug-ins. Users desiring to design special purpose circuits should not exceed the capabilities shown in the Table 4-1. There is no minimum current requirement for any supply.

Table 4-1. LVPS Current Capabilities

Power Supply Voltages at J3	Pin No.	Maximum Safe Current Available
+100 VDC	30	160 ma
+15 VDC	29	900 ma
-12.6 VDC	28	900 ma
-100 VDC	27	80 ma
115 VAC	10 & 26	100 ma
115 VAC	16 & 32	100 ma

NOTE

With 115/230V switch in 115 VAC position and operating the unit from a 115V line, the available current from the primary winding connections on J3 is 200 ma for use with blank plug-ins. With 115/230V switch in 230 VAC position and operating the unit from a 230V line, the available current from the primary winding connection on J3 is 100 ma per winding. This load should be balanced between the two windings.

4-53. CALIBRATOR.

4-54. The calibrator circuit performs a dual function. It provides a square wave output signal at approximately 1 kHz with an amplitude of 10V pk-pk, ±1%, for calibration purposes; and a square wave signal of -100V amplitude for the storage pulse circuit (see Figure 8-16). A1Q6 and A1Q7 are used in a free-running multivibrator circuit. Diodes A1CR12 and A1CR14 provide voltage protection to the transistors. The collector of A1Q7 is disconnected from A1C15 by A1CR13 as A1Q7 turns off, providing a faster pulse rise-time. A1L2 and A1C16 isolate the multivibrator from the -100v supply, while A1R31 and A1C17 isolate it from the +15v supply. The 10v square wave output is applied to a front-panel connector for use in probe compensation and sensitivity calibration, and the -100v square wave output from the collector of A1Q6 is applied to the pulse circuit.

4-55. OUTPUT ISOLATION AMPLIFIERS.

4-56. Signals derived from the Horizontal Plug-In are coupled to rear panel BNC connectors J5-8 (refer to Figure 8-7). Four emitter followers, A2Q1-4, are employed as isolation amplifiers. The signals actually developed are determined by the Horizontal Plug-In used in the instrument; hence, the signals available can be determined by referring to the Operating and Service Manual for the applicable plug-in.

4-57. HIGH VOLTAGE POWER SUPPLY (HVPS).

4-58. Three regulated voltages are produced by the HVPS: -1440v, +7kv, and a control grid voltage of -1450v to -1500v (refer to Figure 4-7). A regulated oscillator is used to develop the required high voltages in transformer A5T1. The -1440v supply is sampled to provide control of the oscillator output and thus regulate all three voltages.

4-59. Unregulated +29v from the LVPS provides primary power to oscillator Q5 operating at approximately 45 kHz (see Figure 8-20). The outputs from the high voltage transformer A5T1 are coupled to two-half wave rectifier/filter circuits and to a voltage tripler/filter circuit. CRT control grid voltage is rectified by A5CR1 and filtered. The write gun cathode voltage is rectified by A5CR2 while A5R2 establishes the dc potential applied to its control grid. Voltage regulators, A1V1 and A1V2, limit the maximum potential

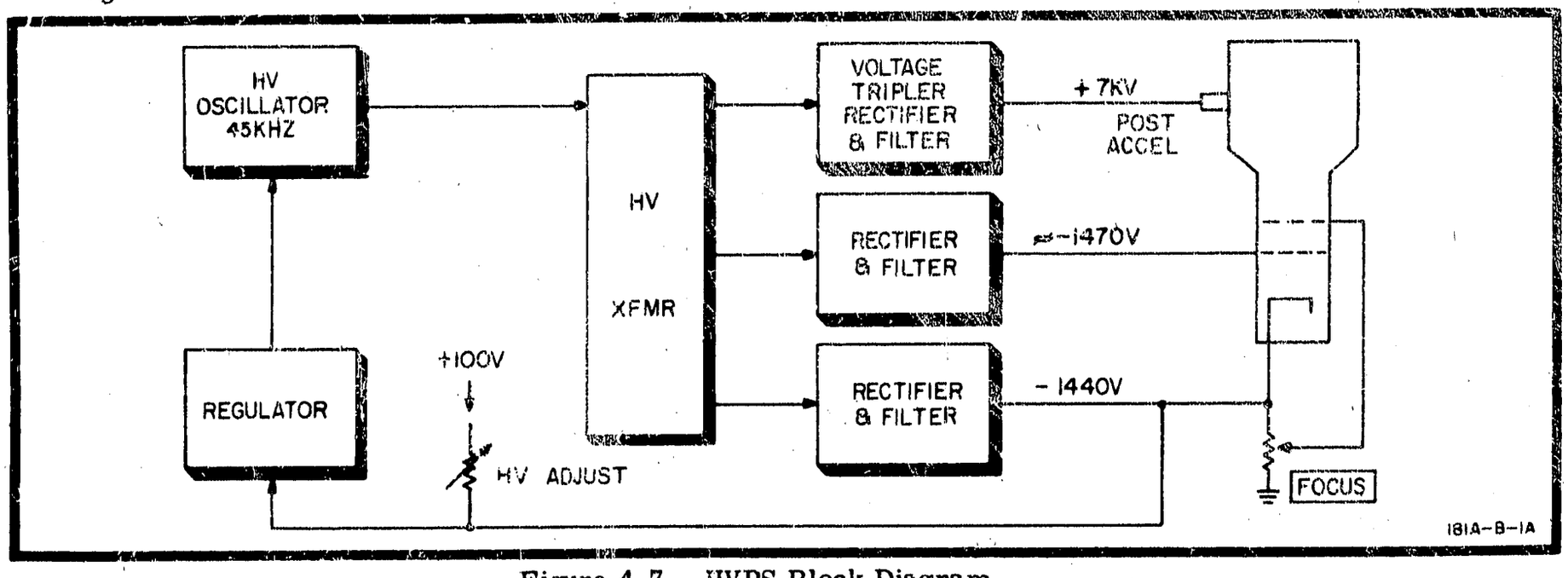


Figure 4-7. HVPS Block Diagram.

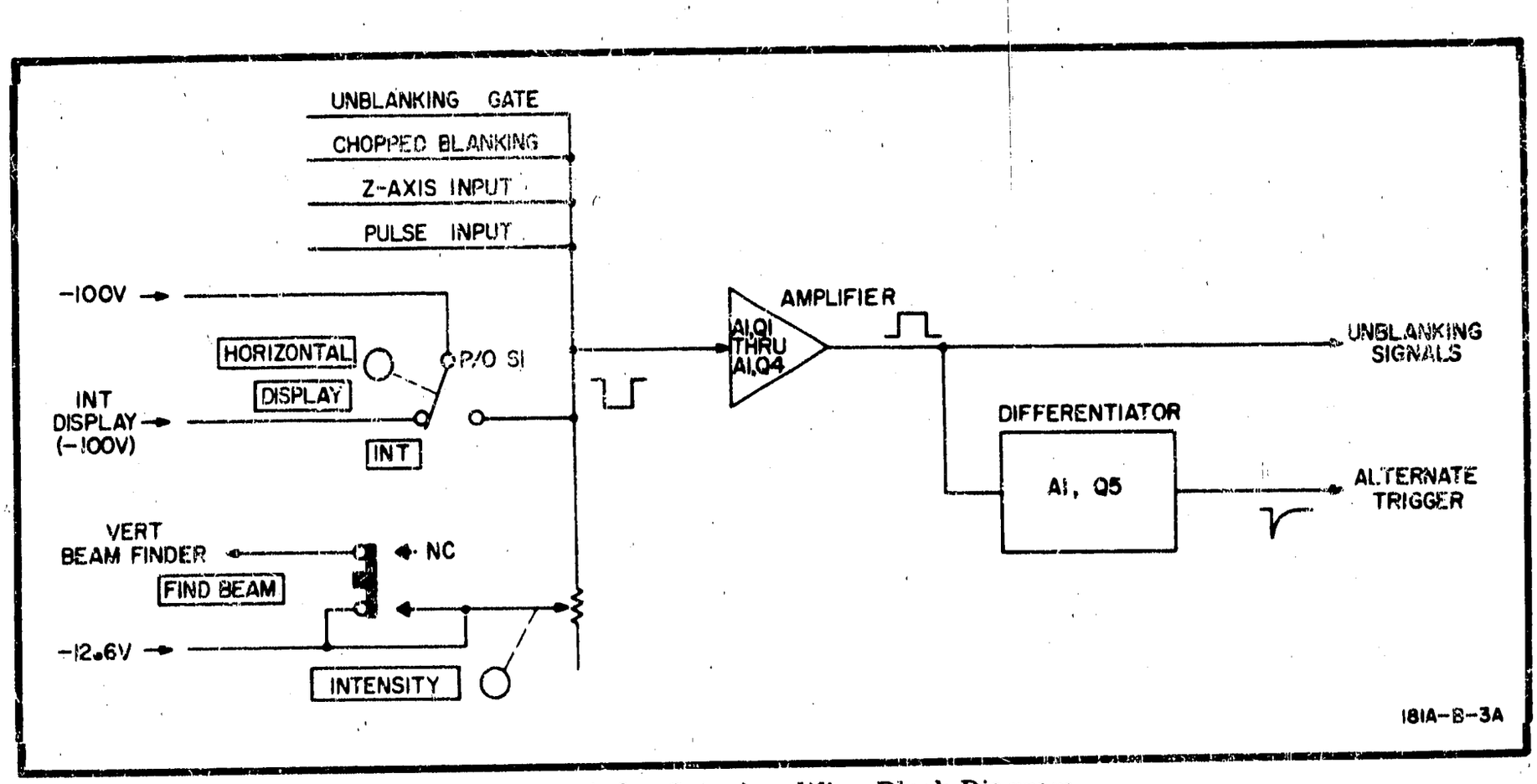


Figure 4-8. Gate Amplifier Block Diagram.

difference between the control grid and the cathode to 140v. The CRT focus voltage is obtained from the -1440 cathode voltage by a voltage divider network of which R5, the FOCUS control, is a part. Resistor, R6, maintains the write gun filament at cathode potential. The voltage tripler circuit of A9CR1-3 and A9C1-4 is contained on Assembly A9, the output of which (+7 kv) is applied to the CRT post-accelerator anode.

4-60. Changes in output of the -1440vdc supply are detected by the regulator A1Q8-A1Q10 to change the operating voltage of oscillator Q5. Assume that the -1440 supply voltage decreases (goes positive). A positive-going signal is applied through the regulator to the base of Q5, causing it to conduct for a greater portion of the input cycle. The oscillation amplitude is therefore varied so as to oppose the original change in output voltage. This causes a voltage change to appear on the primary of A5T1 and increases the voltage of the secondary. The steady state value of the CRT cathode voltage is established by A1R38, the High Voltage Adjust, by setting the normal dc value on the base of the A1Q8. Inductor A4L1 suppresses any possible high frequency parasitic oscillation.

4-61. GATE AMPLIFIER.

4-62. The inputs to the gate amplifier (refer to Figure 4-8) are the unblanking gate, the chopped blanking, the Z-AXIS INPUT, and the storage pulse circuit signals. These four signals may be present either singly or simultaneously, depending upon control settings. They are summed with a current established by two front panel controls--INTENSITY and HORIZONTAL DISPLAY. Setting HORIZONTAL DISPLAY to EXT SENS or EXT CAL supplies additional current to brighten the beam.

4-63. The gate amplifier, A1Q1-A1Q4, senses the input signal current, converts it to a voltage, amplifies it, and couples it to the control grid of the CRT write gun. And in addition, the output signal is also differentiated, clipped, and coupled to the Vertical plug-in for use as an alternate trigger signal.

4-64. The input currents to the gate amplifier (refer to Figure 8-7) are summed in the low impedance emitter circuit of A1Q1. The resulting current is coupled to the complementary feedback amplifier (a current fed operational amplifier), A1Q2-A1Q4, where it is converted to a voltage and coupled to the control grid of the CRT write gun. The large negative feedback from the collectors of A1Q3 and A1Q4 to the base of A1Q2 provides the complementary feedback amplifier with a very stable gain. Trimmer capacitors, A1C8 and A1C9, adjust the high frequency feedback. Diode A1CR6 provides temperature compensation for A1Q3, while A1CR7 and A1CR8 protect A1Q3 and A1Q4 from voltage breakdown. Diode A1CR10 and A1R57, isolate A1Q3 and A1Q4 from the high voltage in the control grid circuit of the CRT write gun in the event of a grid or cathode short to ground. The output from A1Q3 and A1Q4 is differentiated by A1C13, A1R22 and A1R23, and coupled through A1Q5 and the positive clipper, A1CR11, to the Vertical Plug-In for alternate triggering purposes.

4-65. HORIZONTAL AMPLIFIER.

4-66. The block diagram, Figure 4-9, illustrates the major circuit functions. The horizontal amplifier can be driven by either an internally derived signal or by an external signal applied to the HORIZONTAL EXT INPUT front panel BNC jack. Positioning the HORIZONTAL DISPLAY control to INT disconnects the external signal input and grounds the horizontal preamplifier input. The Internal Sweep signal is connected through the HORIZONTAL DISPLAY switch to the horizontal output amplifier.

4-67. The EXT INPUT BNC, J4, is connected to the input of the preamplifier when either EXT SENS or EXT CAL is selected; the preamplifier, in turn, is coupled to the output amplifier. Selections of EXT SENS permits varying the amplitude of the preamplifier output by adjustment of the HORIZONTAL DISPLAY con-

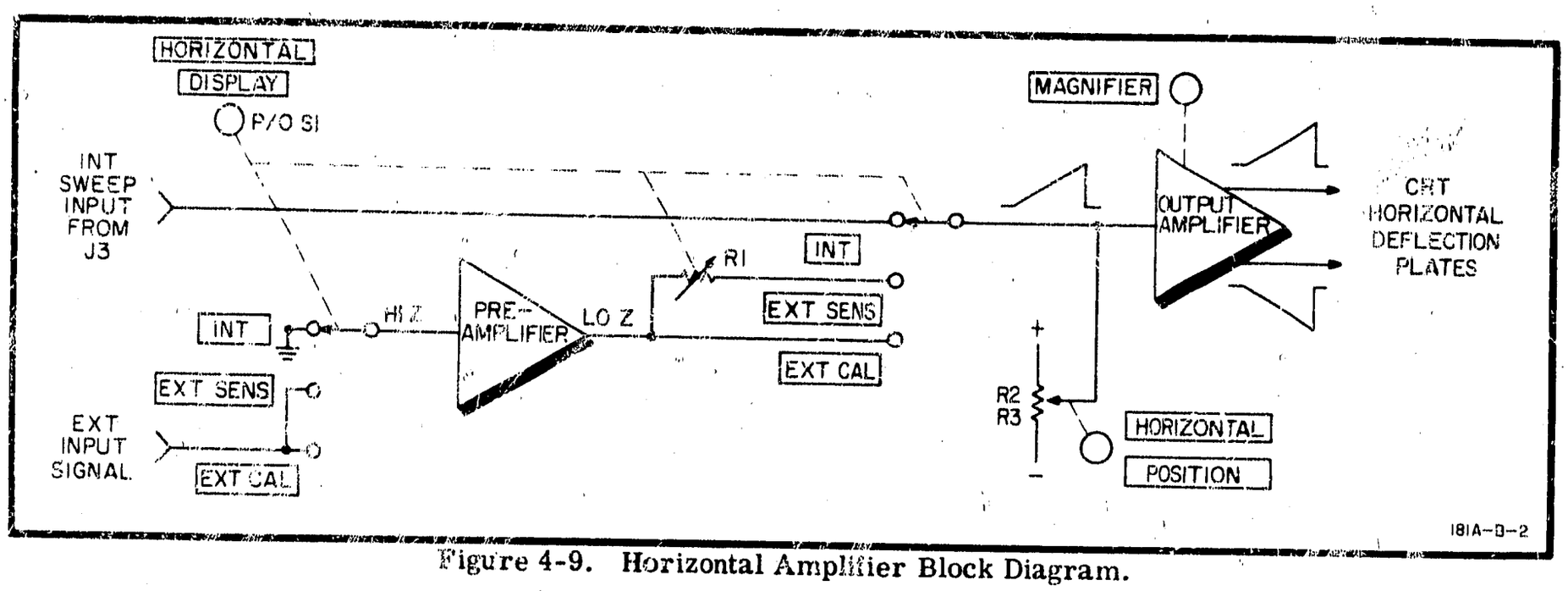


Figure 4-9. Horizontal Amplifier Block Diagram.

trol. When EXT CAL is selected, this control, R1, is shorted; the output amplitude, therefore, is determined by the amplitude of the input signal.

4-68. The signal selected is fed into the output amplifier where it is summed with a current established by the HORIZONTAL POSITION controls. The resultant current is converted to a differential signal, amplified, and applied to the CRT horizontal deflection plates.

4-69. External input signals are preamplified by A3Q1 and A3Q2 (refer to Figure 8-11.) The high input impedance of A3Q1 minimizes loading of the external input source. Diode A3CR1 protects A3Q1 from high level inputs. A3Q2 has a low output impedance suitable for driving A3Q3. The BANDWIDTH/PHASE Switch, A3S1, would be positioned in PHASE when accurate X-Y measurement is desired. In the PHASE position, A3C2 and A3C3 are switched in, decreasing the preamplifier bandwidth. The total horizontal amplifier signal delay is therefore made equal to signal delay in the Vertical Plug-In. The vernier balance, A3R7, is adjusted so that 0 vdc appears across the HORIZONTAL DISPLAY control, thus eliminating any horizontal dc shift as the control is operated.

4-70. Input signals to A3Q3 are summed in the low impedance emitter circuit with a current established by the setting of the POSITION controls A3R2 and A3R3. A3Q6 is driven by the low impedance of emitter follower A3Q4. The input signal to A3Q6 is coupled through the MAGNIFIER switch, S4, to the complementary driver A3Q7. S4 provides for selection of incremental gain levels by selecting the amount of emitter degeneration employed with A3Q6 and A3Q7. Increasing degeneration decreases gain. Adjustment A3R30 along with A3R31 controls the gain when in the X10 position, A3R32/A3R33 control the X5 gain, and A3R34/A3R35 determine the X1 horizontal gain. The dc balance of A3Q6 and A3Q7 is adjusted by A3R37 which controls the emitter potentials. Transistor A3Q5 provides a low impedance voltage source for the base of A3Q7. The differential signal at the collectors of A3Q6 and A3Q7 is applied to the complementary feedback amplifiers (current-fed amplifiers), A3Q8-Q10 and A3Q11-Q13, converted to a voltage, and coupled to the horizontal deflection plates of the CRT. A3CR3 prevents A3Q6 from saturating, while A3CR6 serves the same purpose for A3Q7. Diodes A3CR2/CR4 and A3CR7/CR8 limit the amplifier output to the CRT deflection plates to within +6v and +94v regardless of the amplitude of the input signal.

4-71. Depressing FIND BEAM switch S3 disables limiter A3CR7/CR8 and blocks the input signal to A3Q11. The differential gain is effectively reduced by half and the electron beam is confined to the horizontal limits of the CRT screen.

4-72. The gain of the complementary feedback amplifier is made very stable by coupling a generous amount of negative feedback from the collectors of A3Q9/Q10 to the base of A3Q8, and from the collectors of A3Q12/Q13 to the base of A3Q11. The high frequency feedback of each amplifier is adjusted by A3C6 or A3C19 individually, while A3C9 adjusts the feedback for both. Diodes A3CR5 and A3CR9 provide temperature compensation for A3Q10 and A3Q13.

4-73. PULSE CIRCUIT.

4-74. Pulses of adjustable level and width are used to control the variable persistence and storage capability of the Model 181A/AR Oscilloscope. They are applied to the CRT storage mesh when operating in the WRITE and MAX WRITE modes, applied to the flood gun accelerator in the STORE mode, and used to key the gate amplifier for CRT unblanking.

4-75. VARIABLE PERSISTENCE. The calibrator circuit, (Figure 8-7), is the source of ≈1 kHz square. wave signal. This signal, in turn, is applied to the pulse circuit which modifies the width and level of the pulse. A -100v square wave is obtained from the junction of A1C14 and A1R28 and fed to the base of A6Q3 through A6R8. Inverted and level-shifted by A6Q3, the resultant +15v square wave at the collector of A6Q3 is applied through A6CR2 and differentiated by A6R13/A6C2. Applied to the base of A6Q4 through A6CR3, the amplitude of the pulse at the anode of A6CR3 is established by the ratio of A6R12 and the PERSISTENCE control setting, R9. As a result of the charging time constant of A6C2/A6R13, the variable amplitude signal is felt as a variation in width (i. e. duration) at the base of A6Q4. By varying the conduction time of A6Q4, the time required to erase a trace has been controlled. In other words, varying the erase time is essentially the same as varying the display time, and this, in turn, is known as variable persistence.

4-76. NORMAL. Selection of this mode permits the Model 181A/AR to be employed as a conventional oscilloscope. With NORMAL activated, the junction of A6R16/A6R19 is grounded and the storage mesh falls to -25v. Because of this negative potential, the variable persistence and storage capabilities are therefore disabled.

4-77. WRITE and MAX WRITE. Operating in these modes allows normal viewing of the display and prepares it for storing. MAX WRITE is used only when necessary, such as in viewing fast single-shot signals.

4-78. To obtain display uniformity in the MAX WRITE mode, the CRT collimator voltage should be readjusted in this mode. To do so, a multivibrator consisting of A6Q16 and A6Q17 is used.

4-79. When the MAX W. push button is depressed, one side of the multivibrator conducts. Current flow through A6R47 and A6R46 holds A6Q16 on and A6Q17 off. Thus, the MAX WRITE ADJ pot A6R17 is paralleled with WRITE ADJ. At the same time, A6R9 is disabled and MAX WRITE COLLIMATION ADJ (A6R29) is enabled. The multivibrator is necessary so that proper collimation voltage is retained when the VIEW or STORE mode is selected.

4-80. The setting of the WRITE adjust, A6R18, adjusts the positive pulse level at the collector of A6Q4 when operating in the WRITE mode, while A6R18 in parallel with the MAX WRITE adjust, A6R17, adjusts the level in the MAX WRITE mode. Pulse level control of the 1 kHz pulses to the storage mesh affords depth of erasure control which directly affects writing rate. In other words, the more negative the storage surface becomes, the longer it will take it to build up to a level high enough to store a trace (refer to Figure 4-4).

4-81. STORE. When the STORE function is selected, the base of A6Q1 is grounded, turning it off. This allows the current flow through A6R2 and A6CR1 to turn A6Q2 on. Meanwhile, the +15v square wave signal at the collector of A6Q3 is differentiated by A6C1/A6R2 and applied to the base of A6Q2 through A6CR1. Thus A6Q2 has a negative voltage developed at its base during the charging time of A6C1 which turns it off. The time constant of A6C1/A6R2 is such that A6Q2 is off for about 50 microseconds each millisecond, and only during this short interval will a positive potential be applied to the flood gun accelerator grid.

4-82. While A6Q2 is on, the flood gun accelerator voltage is established by voltage divider network, A6R5/A6R6, at -9v. With A6Q2 switched off by the differentiated 1 kHz pulse, the accelerator voltage is +43v set by the divider network A6R4, and A6R6.

4-83. With the accelerator grid held at -9v, the flood gun electrons are repelled. Thus, when in the STORE mode, the flood guns are always on, but electrons are attracted to the storage mesh only when the accelerator grid is at a positive potential, about 5% of the time. This reduces the display brightness and provides for greatly increased storage time.

4-84. VIEW. Depressing the VIEW push button allows viewing a previously stored display at a brightness level determined by the intensity and persistence settings during the writing process. At least one minute of aggregate viewing is available without trace degradation.

4-85. When in VIEW, NORMAL, WRITE or MAX WRITE mode of operation, A6Q1 is turned on by the current flow through A6R1 to its base. This effectively grounds the base of A6Q2, holding it off and keeping the flood gun accelerator potential at +43v.

4-86. The flood gun grid level is set to provide an optimum flood gun electron distribution at the storage mesh. This is adjustable and is determined by the setting of A6R42, which is in series with A6R7 and the -100v supply. Stray ac signals on the flood gun grid lead are decoupled from the flood gun by A6C4.

4-87. ERASE. The push button operating mode selector switch does not permit energizing the erase circuitry unless the WRITE or MAX WRITE mode of operating has been selected. Activation of the ERASE switch S7 (refer to Figure 8-13) in either of these modes applies +156v to the CRT storage mesh and to the junction of A6R36 and A6CR6. The diode A6CR6 prevents application of this +156v to the collector of A6Q4 during ERASE, while A6CR4 prevents the collector from rising above +15v because of the +100v applied through the voltage divider formed by A6R15, A6CR5, A6R16 and A6R19. Normally nonconducting, A6Q13 is turned on by application of the +156v which in turn shuts off A6Q12. This permits A6C6 to charge positive through A6R33 and A6R37 to about +4.7v. The resultant current through A6R37 causes A6Q14 to conduct and A6Q15 to cease conduction. Current flowing through A6R43, A1CR15, A1R10 and into the emitter of A1Q1 causes the Gate Amplifier to operate so as to blank the CRT write gun. A clean erasure of the storage mesh is thereby assured since no writing of an input signal can take place during erasure.

4-88. Releasing the ERASE switch removes the +156v from the CRT storage mesh and from A6R36. Current no longer flows through the base of A6Q13 and conduction ceases. This permits A6Q12 to conduct due to the current flow through A6R34 into its base. The resulting 4.7v negative step at the collector of A6Q12 is differentiated by A6C6/A6R32 and applied to the base of A6Q11, causing it to cease conduction. As a result of the charging time constant of A6R32 and A6C6, A6Q11 will remain in a nonconducting state for approximately 100 milliseconds. During this time, A6C5 is being charged to +4.7v through A6R31, A6R38, and A6R27. Current flow through A6R38 and A6CR7 causes the Blanking Control Amplifier A6Q14/A6Q15 and the Gate Amplifier to operate and blank the CRT write gun.

4-89. Control of the voltage applied to the CRT collimator is desired during storage mesh erasure. A portion of the current through A6R31 also flows through A6R27, placing A6Q8 in a conducting state, and causing A6Q9 to cease conduction. The voltage on the base of A6Q10, therefore, rises to nearly +120v, causing heavy conduction through A6Q10. This results in its emitter rising to about +120v due to the voltage drop across A6R30. Since the collimator is connected to the emitter of A6Q10, the + 120v developed across A6R30 is applied to the collimator while erasing. This ensures a more uniform erasure of the storage mesh, particularly of the periphery of the display area.

4-90. At the end of the 100 millisecond initial erasing period, A1Q11 again starts conducting. The resulting 4.7v negative step at the collector of A6Q11 is differentiated by A6R26/A6C5 and applied to the base of A6Q7, turning it off. A6Q7 will be nonconducting for approximately 200 milliseconds, while A6Q7 is off. The current flow through A6R25, A6R39, and A6Q14 causes the CRT write gun to remain blanked. Also, the current flow through A6R24 into the base of A6Q6 drives it into conduction, effectively grounding the base of A6Q4. With A6Q4 in an off condition for the 200 millisecond period, the CRT storage mesh rises to about +13.3v when operating in the WRITE mode, and to about +7.5v in the MAX WRITE mode.

4-91. When the 200 millisecond interval is terminated, A6Q7 again conducts and turns off A6Q6. This allows current to flow through A6R13, A6CR3 and the base of A6Q4, turning it on, and reducing the storage mesh to the +3.3v level. Variable-width erase pulses are again applied to the storage mesh at the 1 kHz rate.

4-92. It is desirable to provide for inhibiting the CRT WRITE function for a short interval after erasing. The discharging time constant of A1C6/A1R10 through A1Q1 accomplishes this, and keeps the write gun turned off momentarily.

4-93. STORAGE PROTECTION. It is possible to manipulate the operating mode selector switch so that multiple functions or no function at all may be selected. This switch is interconnected to provide several operational features which protect the stored display from inadvertent erasure of overwriting. For instance, if no function is selected, the CRT write gun is blanked and the PERSISTENCE control is inoperative.

4-94. The write gun blanking is provided by current flow through A6R22 and A6R40 into the base of A6Q14, thus causing the Gate Amplifier to turn off the write gun.

4-95. The disabling of the PERSISTENCE control is obtained by utilizing the current flowing through A6R22 and A6R23 into the base of A6Q4. This holds A6Q4 in conduction and keeps the storage mesh at +3.3v. Current flowing into the base of A6Q4 prevents the variable amplitude 1 kHz pulse from turning off A6Q4.

PERFORMANCE CHECK

SECTION V
PERFORMANCE CHECK AND ADJUSTMENTS

5-1. INTRODUCTION.

5-2. This section provides the performance check and the adjustment procedures for the Model 181A/AR. Troubleshooting information, schematic diagrams, and component identification are in Section VIII.

5-3. TEST EQUIPMENT

5-4. Test equipment required to maintain and check the performance of the Model 181A/AR is listed in Table 5-1. Test equipment having characteristics similar to those listed in the table may be used for the performance check and adjustments.

5-5. PERFORMANCE CHECK.

5-6. The performance check verifies whether or not the Model 181A/AR is operating within the specifications listed in Table 1-1. This check may be used as part of an incoming quality control inspection, as a periodic operation check, or after repair and/or adjustments have been made. Recently calibrated test equipment should be used when performing the check.

Table 5-1. Recommended Test Equipment

Instrument		Required Characteristics	Required For
Type	Model		
Voltmeter Calibrator	HP Model 6920B	1, 2, 10V pk-pk ±0.2%	Calibrator Check Magnifier Check
Test Oscilloscope	HP Model 180C/D w/1801A & 1820C	Sensitivity 1 V/div Sweep Speed 1 usec Rise time 3 usec Sweep output	Calibrator Check Gate Ampl. Response
10:1 Divider Probe	HP Model 10004D	±3%	Gate Ampl. Response
Test Oscillator	HP Model 652A	50 kHz-50 MHz at 10V pk-pk	Horizontal Bandwidth Check
Digital Voltmeter	HP Model 3465A	±100 Vdc ±0.5% 2.5 ma ±2%	LVPS Adj. HVPS Adj.
1000:1 Divider Probe	HP Model K05-3440A	3000 Vdc, ±0.1%	HVPS Adj.
Square-wave Generator	HP Model 211B	200 kHz 1V pk-pk Rise time 30 usec	Horiz. Transient Response
Oscillator	HP Model 200CD	10 kHz 10V pk-pk	Trace Alignment Adj. Pulse Circuit Adj.
Time-mark Generator	HP 226A	1-ms markers 50 MHz	Horiz. Amplifier Gain Adj. & Horiz. Linearity

5-7. A performance check record form is included at the end of the performance checks. Use this form to record actual readings during the performance check. The form should then be removed from the manual and filed in a safe place so that readings taken at a later date can be compared with the original readings.

5-8. The performance check must be done in the sequence given below. Do not attempt to start the procedure in mid-sequence, because succeeding steps depend upon control settings and results of previous steps.

5-9. **PRELIMINARY SET UP.**

a. Install Horizontal and Vertical plug-in units in the Model 181A/AR.

b. Set INTENSITY control fully ccw.

c. Set PERSISTENCE control fully ccw.

d. Depress WRITE pushbutton.

e. Apply power to the Model 181A/AR. Entire screen should be evenly illuminated after three minutes.

f. Allow 15 minute warm-up.

CAUTION

To operate the Model 181A/AR in Normal mode, the following precautions should be taken. Set PERSISTENCE fully ccw and depress WRITE pushbutton. Rotate INTENSITY control cw until required intensity is obtained without blooming. Depress NORM pushbutton. Do not increase intensity while in Normal as CRT mesh may be damaged. A viewing hood may be necessary if use of NORM mode is required.

5-10. **CALIBRATOR.**

a. Set Model 181A/AR controls as follows:

CRT mode . . . . . WRITE
MAGNIFIER X5
HORIZONTAL DISPLAY . . . . . EXT CAL
HORIZONTAL Coupling . . . . . AC

b. Apply a 10v pk-pk signal from Voltmeter Calibrator to HORIZONTAL EXT INPUT connector.

c. Adjust INTENSITY, POSITION, and FOCUS controls to obtain a horizontal trace.

d. Adjust HORIZONTAL DISPLAY and POSITION controls for 10 divisions of display deflection.

e. Disconnect Voltmeter Calibrator and connect Model 181A/AR CALIBRATOR output to HORIZONTAL EXT INPUT connector, adjusting INTENSITY for a single dot at each side of the display.

f. Space between dots should be 10 ±0.1 div. divisions.

g. Set INTENSITY control fully ccw.

h. Monitor Model 181A/AR CALIBRATOR output.

i. Risetime of calibrator waveform should be 3 μsec or less.

5-11. **MAGNIFIER.**

a. Set MAGNIFIER control to X1 and HORIZONTAL DISPLAY control to EXT CAL.

b. Apply a 10v pk-pk sine wave signal from Voltmeter Calibrator to HORIZONTAL EXT INPUT connector, and adjust INTENSITY for a display.

c. Deflection is 10 ±0.3 div.

d. Repeat above procedure setting MAGNIFIER control to X5 with a 2v pk-pk signal and X10 with a 1v pk-pk signal. Adjust FINE POSITION control as required. Deflection is 10 ±0.5 div in each case.

e. Set INTENSITY control fully ccw.

5-12. **BANDWIDTH.**

a. Apply a 50-kHz signal from test oscillator to HORIZONTAL EXT INPUT connector.

b. Set MAGNIFIER control to X1 and adjust INTENSITY for visible display. Adjust test oscillator amplitude and Model 181A/AR POSITION controls for 10 div of display deflection. Note indication on test oscillator output meter.

c. Increase test oscillator frequency to 5 MHz and output to that noted in step b. Display deflection should be >7.1 div. If deflection is less than 7.1 div verify that phase Bandwidth switch, A3S1 is in bandwidth position.

5-13. **BEAM FINDER.**

a. Adjust INTENSITY and POSITION controls to obtain a display.

b. Set POSITION controls fully ccw.

c. Momentarily depress FIND BEAM pushbutton.

d. Beam appears on screen.

NOTE

The intensity of the beam is not increased.

5-14. **PERSISTENCE.**

a. Set Model 181A/AR controls as follows:

HORIZONTAL DISPLAY . . . . . INT
MAGNIFIER X1
CRT Mode . . . . . WRITE
PERSISTENCE . . . . . fully ccw

b. Set Vertical Plug-in controls as follows:

DISPLAY . . . . . A
Channel A Volts/Div 0.5
Input Coupling Switch . . . . . AC

c. Set Horizontal Plug-in controls as follows:

SWEEP DISPLAY (if applicable) . . . . MAIN
TIME/DIV (Main Sweep) . . . . . 0.2 sec
SWEEP MODE (Main Sweep) . . . . . AUTO
TRIGGER SOURCE (Main Sweep) . . . . . INT
TRIGGER COUPLING (Main Sweep) . . . . AC

d. Slowly rotate INTENSITY control cw until spot just appears. Use POSITION controls to bring spot on screen.

e. Observe the "tail" on the spot. "Tail" shall be no longer than 1 major division anywhere on the screen.

f. Rotate PERSISTENCE control cw. Length of tail shall increase as persistence is increased.

g. Set Horizontal Plug-in Time/Div (Main Sweep) control to 50 μsec.

h. Rotate PERSISTENCE control fully cw and INTENSITY control fully ccw. Display should remain visible for one minute.

i. Depress VIEW pushbutton. Display intensity should remain the same as WRITE mode.

j. Depress WRITE pushbutton. Depress ERASE pushbutton for 2 seconds and release, screen should be dark, except for possibly a few small spots (see Figure 5-1).

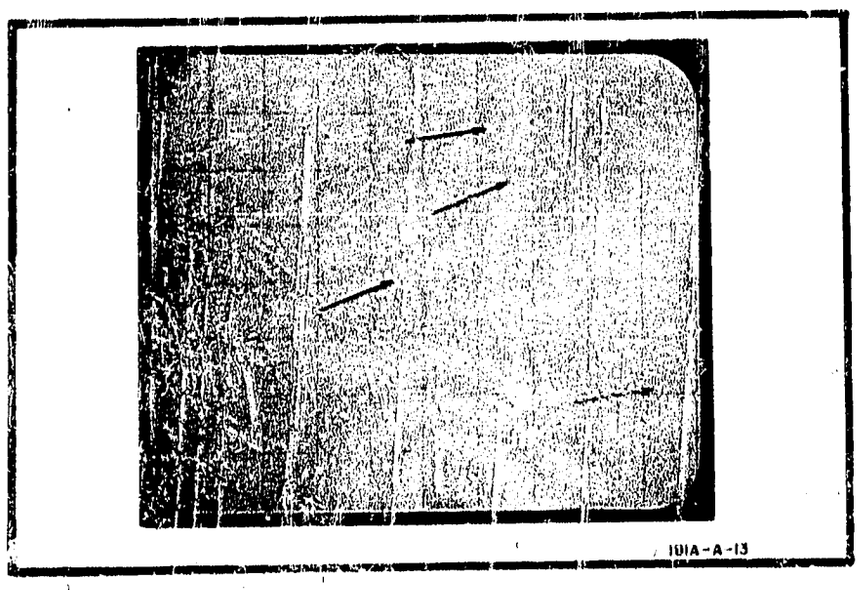


Figure 5-1. Bright Spots in CRT Display.

k. Rotate INTENSITY control slowly cw until display has normal intensity, then fully ccw.

l. Rotate PERSISTENCE control fully ccw. CRT background should become illuminated and display should disappear; rotate PERSISTENCE control fully cw and screen should be dark.

m. Set Horizontal plug-in Sweep Mode control to Single. Rotate INTENSITY control fully cw. Depress ERASE pushbutton for 2 seconds. Depress Horizontal Plug-in RESET pushbutton. Rotate Trigger Level (Main) control fully cw and then fully ccw to trigger the sweep. A display should be visible. It may be necessary to adjust FOCUS to obtain the sharpest trace.

CAUTION

Do not return Sweep Mode switch to Auto or Normal. Adjust FOCUS control slightly, depress ERASE pushbutton for 2 seconds, retrigger sweep and observe trace. Repeat as necessary depressing ERASE pushbutton each time FOCUS is changed.

n. Depress STORE pushbutton. A low intensity display should be visible, and remain visible for one hour.

o. Rotate INTENSITY control fully ccw. Depress MAX W pushbutton. Set Horizontal plug-in TIME/Div (Main) control to 1 μsec and Sweep Mode control to Single. Rotate INTENSITY control fully cw. Depress ERASE pushbutton for 2 seconds. CRT background should be non-uniformly illuminated with both dark and bright areas. A mesh pattern should also be visible. (See Figure 5-6F).

p. Depress Horizontal Plug-in RESET pushbutton and rotate Trigger Level (Main) control fully cw and then fully ccw to trigger the sweep. A display should be visible. It may be necessary to readjust FOCUS to obtain the sharpest trace.

CAUTION

Do not set Sweep Mode switch to Auto or Normal. Adjust FOCUS control slightly, depress ERASE pushbutton for 2 seconds, retrigger sweep and observe display. Repeat as necessary depressing ERASE pushbutton each time FOCUS is changed.

q. Depress WRITE pushbutton. Rotate INTENSITY and PERSISTENCE controls fully ccw.

5-15. COVER REMOVAL.

5-16. There are four separate instrument covers on both the Model 181A and the Model 181AR. The covers of the Model 181AR may be removed by removing the appropriate screws and lifting the cover free. Covers of the Model 181A are "L-Shaped." To remove the covers from the Model 181A, proceed as follows: Lower tilt stand, and stand instrument on rear end; Remove screws on each cover along the side of the instrument (where the panels meet); lift the cover along the side of the instrument and rotate toward top or bottom.

5-17. ADJUSTMENTS.

5-18. Procedures for adjusting the Model 181A and the Model 181AR are given in Paragraphs 5-19 through 5-43. Required test equipment is listed in Table 5-1. Test equipment with similar characteristics may be substituted if necessary. Figure 5-7 shows the location of adjustments in both Models 181A and 181AR.

5-19. The adjustment procedure must be done in the sequence given below. Do not attempt to start the procedure in mid-sequence, as succeeding steps depend upon control settings and results of previous steps.

5-20. PRELIMINARY SET UP.

5-21. Install Plug-ins in Model 181A/AR. Set INTENSITY and PERSISTENCE controls fully ccw. Depress WRITE pushbutton. Apply power to Model 181A/AR and allow a 15 minute warm-up. Make certain that Phase/Bandwidth switch is in Bandwidth position.

5-22. LOW VOLTAGE POWER SUPPLY (LVPS)

a. Connect Digital Voltmeter to each test point (in succession) in Table 5-2.

b. Make the proper adjustment to obtain the indicated voltage.

Table 5-2. Low Voltage Adjustments

Test Point	Measure	Adjust
A8TP4	-100v ±0.1v	A8R36
A8TP1	+100v ±0.1v	A8R10
A8TP3	-12.6v ±0.1v	A8R26
A8TP2	+15v ±0.1v	A8R18

5-23. HIGH VOLTAGE POWER SUPPLY (HVPS)

WARNING

High voltage (up to 7500 volts) is present and easily accessible during the following procedure. Observe extreme caution and use an insulated screwdriver when performing the adjustments.

a. Monitor -100 vdc at A8TP4 with DC Voltmeter using a 1000:1 Divider Probe.

b. Observe voltage reading and note result.

c. Multiply +1.440 by the result (absolute value) obtained in step b.

d. Monitor voltage at A1TP1 with DC Voltmeter using 1000:1 Divider Probe.

e. Adjust High Voltage Adj. A1R38 to obtain same voltage reading as calculated in step c.

5-24. ASTIGMATISM ADJ.

a. Set HORIZONTAL DISPLAY control to EXT CAL and Vertical Plug-in Display to A.

b. Slowly rotate INTENSITY control cw until spot appears. Set POSITION control as necessary to bring spot on screen.

c. Adjust FOCUS and ASTIGMATISM for a small round spot.

5-25. INTENSITY LIMIT ADJ.

a. Obtain a baseline display (Time Base in AUTO or FREE RUN). Adjust POSITION and INTENSITY controls for left end of baseline on screen.

b. Set HORIZONTAL DISPLAY control to INT, PERSISTENCE control fully cw, and depress MAX W pushbutton.

c. Set Sweep Mode (Main) control on Horizontal Plug-in to Single.

d. Depress ERASE pushbutton for 2 seconds and release. Slowly rotate INTENSITY control until spot appears or until INTENSITY control is fully cw. If spot appears prior to full cw rotation of INTENSITY control, adjust Intensity Limit control A5R2 (under hv cover) slightly ccw. Depress ERASE pushbutton for 2 seconds and release. Continue rotating INTENSITY control cw and adjusting A5R2 until spot is just extinguished with INTENSITY control fully cw. Depress ERASE pushbutton each time A5R2 is adjusted. Spot should not appear with INTENSITY control fully cw.

e. Set INTENSITY and PERSISTENCE controls fully ccw. Depress WRITE pushbutton.

5-26. TRACE ALIGNMENT ADJ.

a. Set MAGNIFIER to X1.

b. Set Horizontal Plug-in Sweep Mode (Main) control to Auto and Sweep Time/Div (Main) control to 0.1 μsec/div.

c. Rotate INTENSITY control slowly cw until display appears. Center trace horizontally, and position display on center graticule line using Vertical Position control.

d. Adjust R8 TRACE ALIGN (front panel) control so that display is parallel with center graticule line.

e. Set HORIZONTAL DISPLAY control to EXT CAL and apply 1 kHz signal from Oscillator to channel A input.

f. Set Vertical Plug-in controls as follows:

Channel A Polarity ..... +UP
Channel A Volts/Div 1
Channel A Vernier ..... CAL
Channel A Coupling ..... AC

g. Adjust INTENSITY, POSITION, and Oscillator amplitude for 8 div trace on graticule vertical center line. Adjust Y Align A3R53 so that display is parallel with graticule center line.

h. Adjust Pattern Adjust A1R56 for straightest line when positioning trace to extreme left and right graticule lines.

i. Set INTENSITY control fully ccw, and disconnect Oscillator from vertical input.

5-27. GATE AMPLIFIER RESPONSE ADJ.

a. Set Model 181A/AR controls as follows:

CRT Mode ..... WRITE
PERSISTENCE ..... fully ccw
HORIZONTAL DISPLAY ..... INT

b. Set Vertical Plug-in Channel A Position control to fully ccw.

c. Set Horizontal Plug-in controls as follows:

Time/Div (Main) ..... 0.1 μsec
Vernier (Main) ..... CAL
Sweep Mode (Main) ..... AUTO
Sweep Display (if applicable) ..... MAIN
Delayed Time/Div (if applicable) ..... OFF

d. Set Test Oscilloscope controls as follows:

Volts/Div 1
Input Coupling ..... DC
Time/Div ..... 0.1 μsec
Trigger Source ..... INT
Slope ..... +

e. Observe signal on collector of A1Q3 using 10:1 Divider Probe.

PERFORMANCE CHECK RECORD

Model 181A/AR

Instrument Serial Number _____ Date _____

Check		Specification	Measured
Screen Illumination		Light Green Illumination	_____
Calibrator	Amplitude	10 ±0.5 div	_____
	Risetime	⩽ 3 μsec	_____
Magnifier	X1	10 ±0.3 div	_____
	X5	10 ±0.5 div	_____
	X10	10 ±0.5 div	_____
Bandwidth	AC Coupling	⩾ 7.1 div	_____
Beam Finder		On Screen Display	_____
Persistence	Minimum	⩽ 1 div	_____
	Maximum	⩾ 1 minute	_____

f. Rotate INTENSITY control cw until bottom of waveform on Test Oscilloscope rises 0.2 div.

g. Adjust Gate Resp. Adj. No. 2 A1C8 and Gate Resp. Adj. No. 1 A1C9 for best risetime and flattest response.

h. Rotate INTENSITY control fully ccw.

i. Disconnect Probe from A1Q3.

5-28. HORIZONTAL AMPLIFIER.

5-29. DC BALANCE ADJ.

a. Set HORIZONTAL DISPLAY control to EXT CAL and center Vertical Plug-in Channel A Position control. Rotate INTENSITY control slowly cw until spot just appears.

b. Set MAGNIFIER control to X10 and center spot using HORIZONTAL POSITION control.

c. Set MAGNIFIER control to X1 and recenter spot by adjusting Dc Bal A3R37.

d. Repeat steps b and c until spot does not shift position when MAGNIFIER control is switched from X10 to X1.

5-30. VERNIER BALANCE ADJ.

a. Set MAGNIFIER control to X10.

b. Rotate HORIZONTAL DISPLAY control ccw until it is just out of INT and center spot using HORIZONTAL POSITION control.

c. Rotate HORIZONTAL DISPLAY control to EXT CAL and adjust Vernier Bal A3R7 to recenter spot.

d. Repeat steps b and c until spot does not shift when HORIZONTAL DISPLAY control is rotated from just out of INT to EXT CAL.

5-31. HORIZONTAL GAIN ADJ.

5-32. The following steps adjust the X1, X5, and X10 potentiometers.

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 is present at open lead of resistor.

c. Connect 40-kilohm, 0.1%, 1/2W resistor between +100V supply and emitter of A3Q3. 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 A3Q3, adjust X1 Gain Adj A3R34 for exactly 10 major divisions of separation between spot positions.

f. Set DISPLAY to INT.

g. Set time base 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 precisely 1 marker per division.

j. Set MAGNIFIER to X5.

k. Adjust X5 Gain Adj A3R32 to obtain display of exactly 1 marker every 5 divisions.

l. Set MAGNIFIER to X10.

m. Adjust X10 Gain Adj A3R30 to obtain display of exactly 1 marker every 10 divisions.

n. Disconnect time-mark generator.

5-33. PHASE ADJ.

a. Set controls as follows:

Phase/Bandwidth Switch	Phase
HORIZONTAL MAGNIFIER	X1
HORIZONTAL DISPLAY	EXT CAL
Channel A Coupling	DC

b. Connect 10-kHz sine-wave output of Oscillator to HORIZONTAL EXT INPUT and to Vertical plug-in Channel A input (Figure 5-2).

NOTE

Channel A of a multichannel Vertical plug-in is normally used for phase measurement. If another channel must be used, connect Oscillator to that channel instead of Channel A.

c. Adjust Oscillator output to obtain an 8-div display.

d. Adjust attenuator Comp. A3C1 for display of a single diagonal line (no phase shift).

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

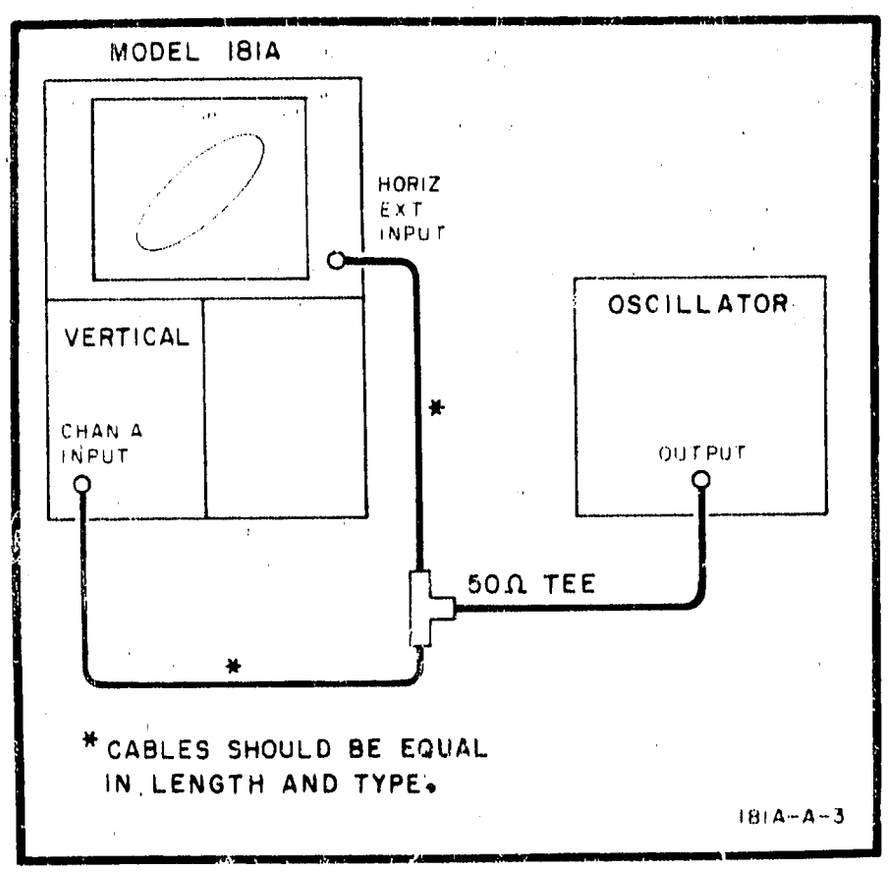


Figure 5-2. Phase Adj. Test Setup

f. Adjust Phase A3C2 for display of a signal diagonal line (no phase shift).

g. Disconnect Oscillator.

h. Return Phase/Bandwidth switch to bandwidth position.

5-34. TRANSIENT RESPONSE ADJ.

NOTE

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

a. Use test setup (Figure 5-3).

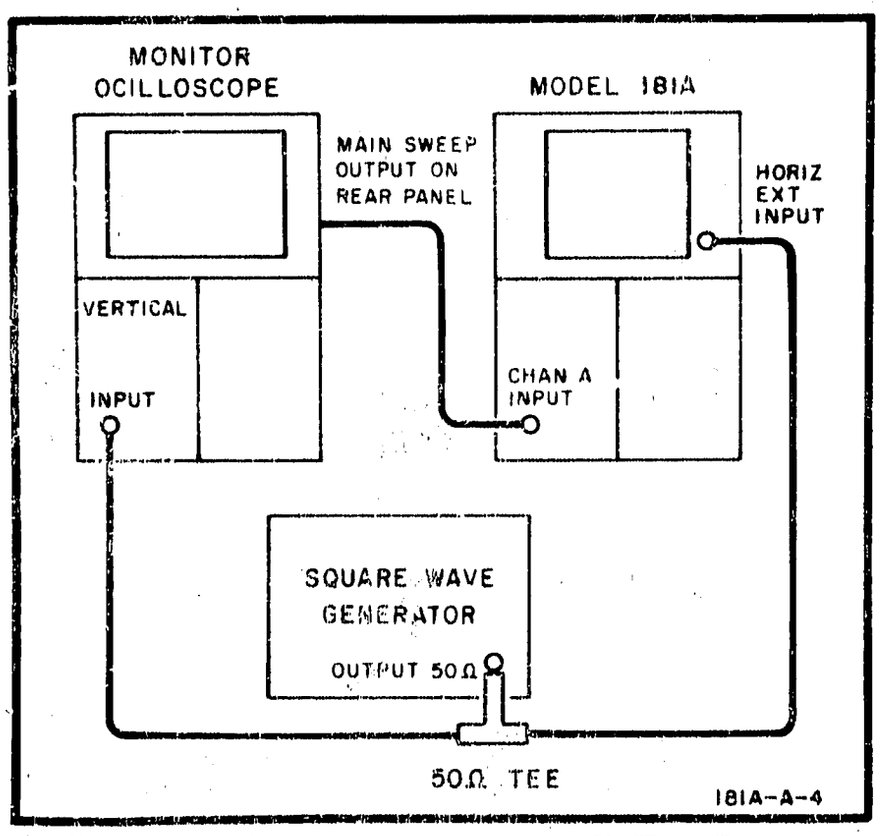


Figure 5-3. Transient Response Adj. Test Setup

b. Set DISPLAY to EXT CAL.

c. Connect 1 usec/div sweep signal from Monitor Oscilloscope rear-panel Main Sweep Output to Channel A input of Model 181A/AR Vertical plug-in.

d. Adjust Vertical plug-in VOLTS/DIV and Vernier controls to obtain an 8-div display.

e. Connect 1V p-p square wave at 200 kHz repetition rate from Square-wave Generator to HORIZONTAL EXT INPUT and to Monitor Oscilloscope Vertical input (Figure 5-3).

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

g. Using the POSITION controls and varying the frequency of the Square-wave Generator slightly, position a lower right-hand corner of the sideways square wave so that it is on screen.

NOTE

A spot at the lower right edge of the display may tend to bloom. If so, position the entire display so that the spot is off screen.

h. With viewing mode switch in NORMAL and intensity level set low, observe displayed waveform. At this stage of adjustment waveform will typically exhibit 5% (approximately 1/2 div) overshoot. If overshoot is greater, adjust HF Adj No. 1 A3C6, HF Adj No. 2 A3C9, and HF Adj No. 3 A3C19 to obtain flat-top response with approximately 5% overshoot on lower right-hand corner of displayed pulse.

NOTE

Capacitors for HF Adj No. 1 A3C6 and HF Adj No. 3 A3C19 should be adjusted so their slugs are almost equally extended.

5-35. HORIZONTAL LINEARITY ADJ.

NOTE

Ensure that Time Base has been properly calibrated before proceeding with this adjustment.

a. Set HORIZONTAL DISPLAY to INT.

b. Set HORIZONTAL MAGNIFIER to X10.

c. Connect 4V p-p 50 MHz sine-wave output from Time-mark Generator to Vertical plug-in Channel A input.

d. Select fastest sweep speed (0.05 or 0.1 usec/div) and obtain a display.

e. Adjust HF Adjust No. 1 A3C6, No. 2 A3C9 and No. 3 A3C19 for best overall linearity of center 80 di-

visions of available display. Use HORIZONTAL POSITION control to permit viewing the right, center, and left portions of the display. HF Adj No. 1 affects the right portion, HF Adj No. 2 the center portion and HF Adj No. 3 the left portion of the sweep.

f. Disconnect Time-mark Generator.

5-36. PULSE CIRCUIT ADJ.

5-37. COLLIMATION.

a. Set Model 181A/AR controls as follows:

CRT MODE	WRITE
HORIZONTAL DISPLAY	INT
INTENSITY	fully ccw
PERSISTENCE	fully ccw
Max Write Rate Adjust A6R17	fully cw
Write Adjust A6R18	fully cw
Floodgun Adjust	fully cw
Write Collimation Adjust A6R9	fully ccw
Max Write Collimation Adjust A6R29	fully ccw

b. Depress ERASE pushbutton for 2 seconds. Display should resemble Figure 5-5A. If the display does not resemble Figure 5-5A, but instead fills the entire screen, omit steps c and d and proceed with step e. See Figure 5-4 for location of adjustment.

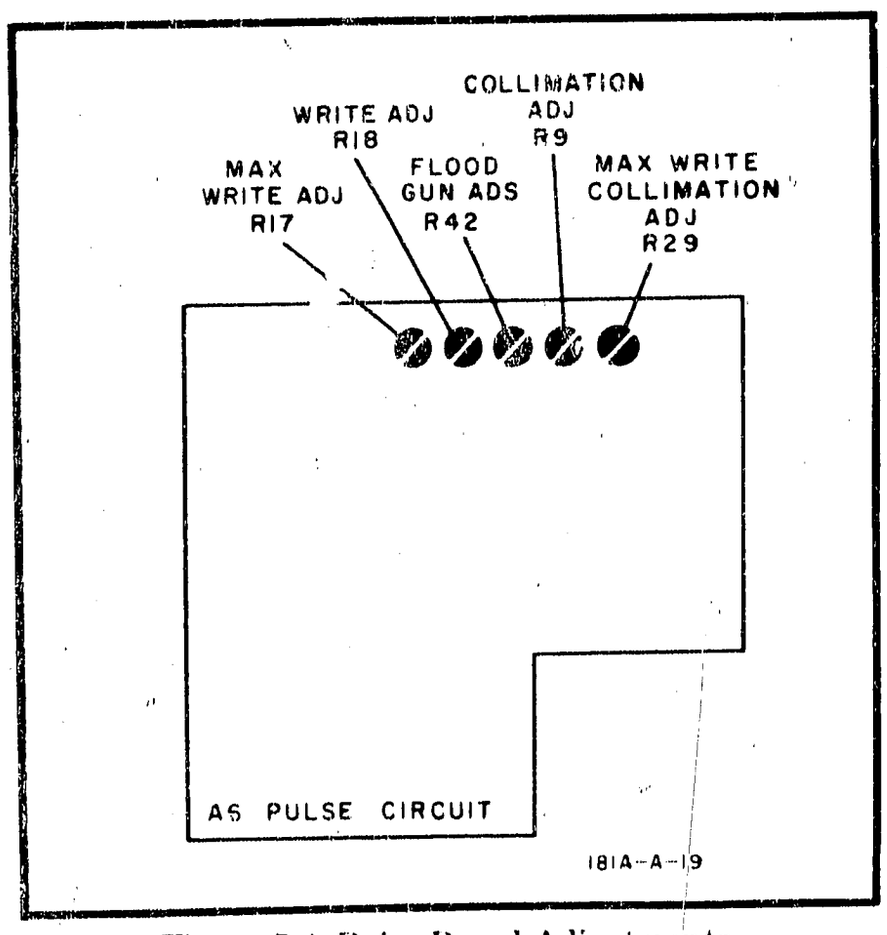


Figure 5-4. Pulse Board Adjustments

c. Adjust Floodgun Adjust A6R42 counterclockwise until background illumination just reaches maximum height.

NOTE

This variation in height is very minute and may be less than 0.1 div.

d. Depress ERASE pushbutton for 2 seconds. Adjust Write Collimation Adjust (A6R9) until background illumination just fills the CRT graticule area as shown in Figure 5-5C. Disregard slight dimple areas at top and bottom of display. These may cause a slight blank area when rest of CRT graticule is filled.

e. Depress ERASE pushbutton for 2 seconds. If display looks normal as shown in Figure 5-5C, proceed with Writing Rate check. If bright areas appear in any or all the corners of the CRT, adjust Write Collimation Adjust (A6R9) clockwise in small increments, depressing ERASE pushbutton for 2 seconds after each change of A6R9, until bright areas just disappear.

5-38. WRITING RATE (NORMAL).

a. Set Time Base Plug-In controls as follows:

SWEEP MODE (Main)	AUTO
TIME/DIV (Main)	1 MSEC
TRIGGER SOURCE (Main)	INT

b. Connect 800 Hz sine wave signal from Oscillator to Channel A INPUT. Rotate INTENSITY control slowly clockwise until trace just appears. Adjust Oscillator output and Channel A V/DIV control for an 8 division vertical display. Set Trigger Level (Main) for stable display.

c. Set Time Base Plug-In Sweep Mode control to SINGLE. Rotate INTENSITY control to 3 o'clock position and PERSISTENCE control fully clockwise.

d. Depress ERASE pushbutton for 2 seconds. Depress RESET button to trigger single sweep. An 800-Hz sine-wave display should be observed (see Figure 5-5D). It may be necessary to adjust FOCUS to obtain a sharp trace.

CAUTION

Do not set sweep mode switch to NORMAL or AUTO. Adjust FOCUS control slightly, depress ERASE pushbutton for 2 seconds, retrigger sweep and observe display. Repeat until sharpest display is obtained. Depress ERASE pushbutton for 2 seconds before retriggering sweep.

e. Figure 5-5D shows a display stored with non-uniform brightness across the screen, with some areas fading faster than others. Adjust Write Adjust (A6R18) counterclockwise in small increments until uniform storing is obtained (see Figure 5-5E). Depress ERASE pushbutton for 2 seconds and retrigger sweep each time A6R18 is changed. At least 80% of the display should be visible after 1 minute.

f. Depress ERASE pushbutton for 2 seconds. Background should be completely dark except for possibly a few small spots (see Figure 5-1). If some background illumination is present, adjust A6R18

slightly clockwise and depress ERASE pushbutton for 2 seconds. Repeat as necessary until background is dark.

5-39. WRITING RATE (MAX).

a. Depress MAX W pushbutton and rotate PERSISTENCE and INTENSITY fully counterclockwise. Depress ERASE pushbutton for 2 seconds. Display should resemble Figure 5-5A. Adjust Max Write Collimation Adjust (A6R29) clockwise until background illumination just fills CRT. Graticule area. Display should be like Figure 5-5A, within 1/2 div of outer graticule line.

b. Rotate PERSISTENCE fully clockwise. Depress ERASE pushbutton for 2 seconds. Adjust Max Write Adjust (A6R17) counterclockwise in small increments, depressing ERASE pushbutton for 2 seconds after each change of A6R17. Obtain a non-uniform background illumination with the best compromise between minimum and maximum background light. A mesh pattern will be visible (see Figure 5-5F).

c. Set Time Base controls as follows:

SWEEP MODE (Main) . . . . . AUTO
TIME/DIV (Main) . . . . . 20 USEC/DIV

d. Connect 200 kHz sine wave signal from Oscillator to Channel A INPUT. Rotate PERSISTENCE fully counterclockwise and rotate INTENSITY control slowly clockwise until trace just appears. Adjust Oscillator output and Channel A V/DIV control for an 8 division vertical display. Set TRIGGER LEVEL (MAIN) for a stable display.

e. Set Time Base Plug-In SWEEP MODE control to SINGLE. Rotate INTENSITY and PERSISTENCE controls fully clockwise.

f. Depress ERASE pushbutton for 2 seconds. Depress RESET button to trigger single sweep. A 200 kHz sine wave should be observed. It may be necessary to adjust FOCUS to obtain a sharp trace (see CAUTION). At least 80% of the display should be visible after 10 seconds.

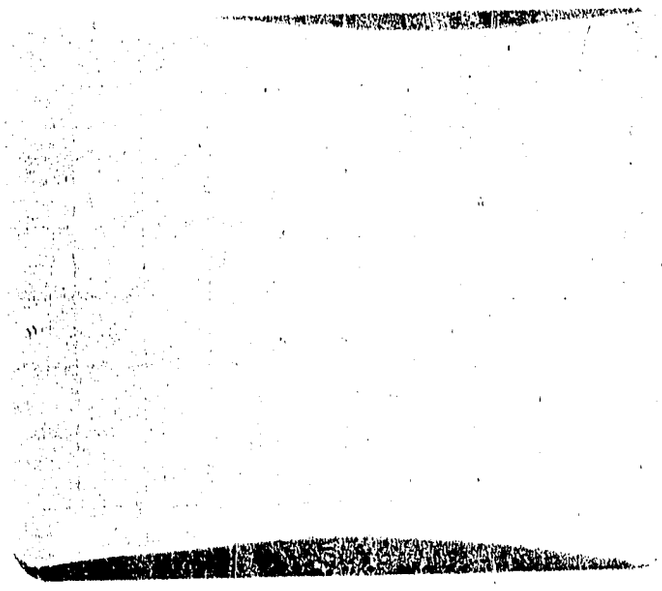
NOTE

If display fades positive too fast, adjust A6R17 slightly clockwise and repeat Max Writing Rate check. If display is not stored over entire area adjust A6R17 slightly counterclockwise and repeat Max Writing Rate check.

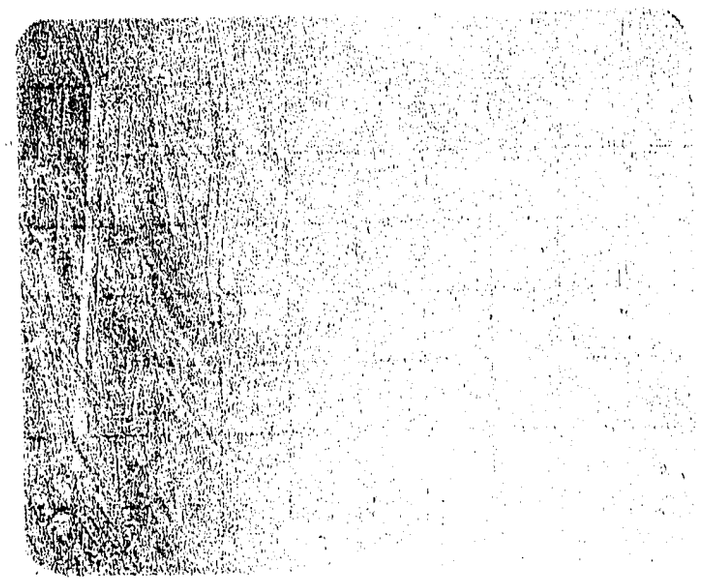
5-40. CALIBRATOR FREQUENCY.

5-41. This adjustment varies the calibrator frequency approximately ±25% and is set at the factory as close to 1 kHz as practical. The calibrator circuit is the source of the storage pulses used in the CRT. As the CRT ages, in some cases a point of electro/mechanical resonance is reached within the tube which results in an audible "singing". This resonance and resulting noise do not cause any change in instrument operation or performance; however, if allowed to continue indefinitely mechanical damage to the CRT may result. Therefore, if the instrument reaches this resonant point and begins to "sing", adjust Calibrator Frequency Adj A1R59 cw to increase the calibrator frequency until the noise stops. If the noise does not stop with the potentiometer set fully cw, decrease the frequency by adjusting the potentiometer ccw.

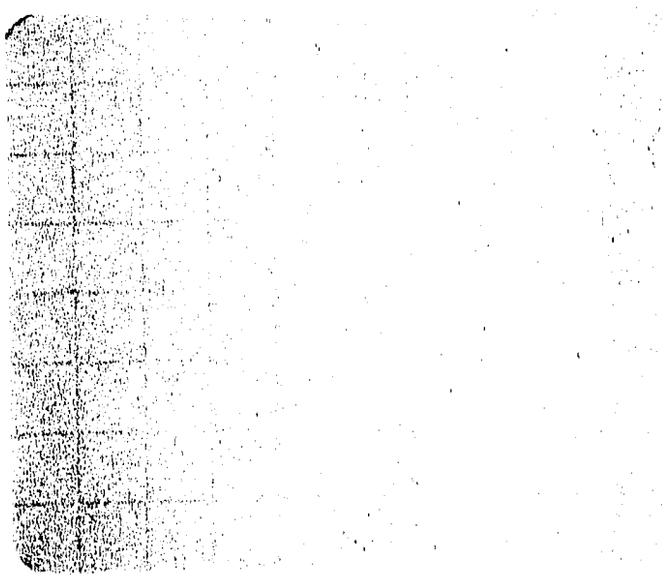
5-42. This completes the adjustment procedure. If desired, the instrument performance may be tested to Model 181A/AR specification using the Performance Check procedure. If satisfactory adjustment or instrument performance is not obtained refer to Section VIII of this manual for troubleshooting and waveform information.



A.

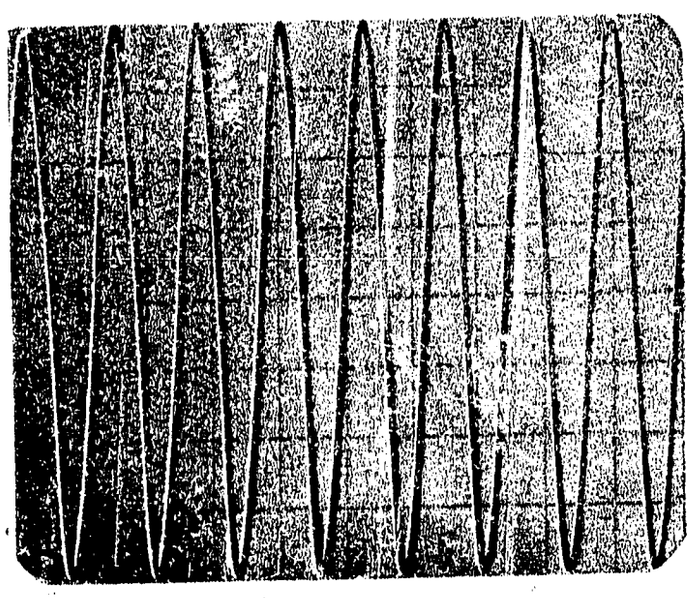


B.

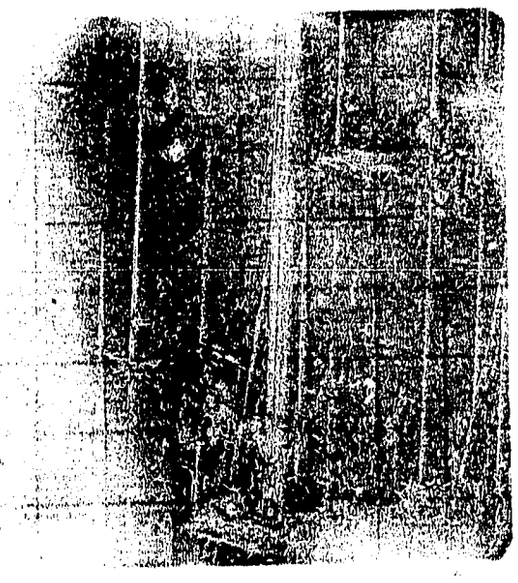


C.

D.



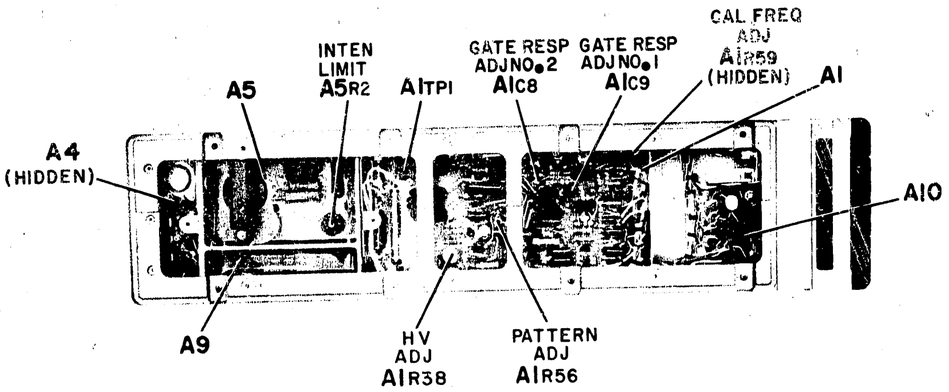
E.

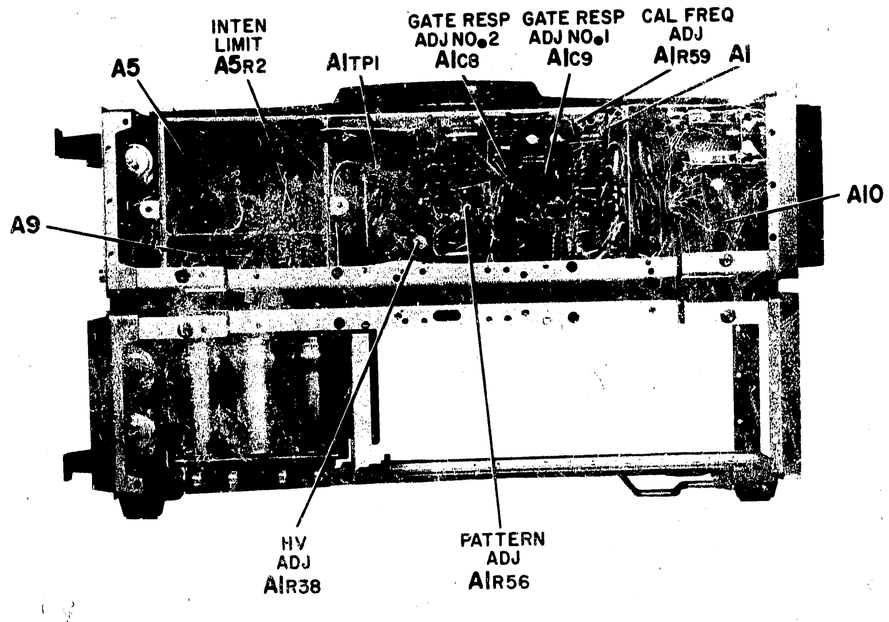


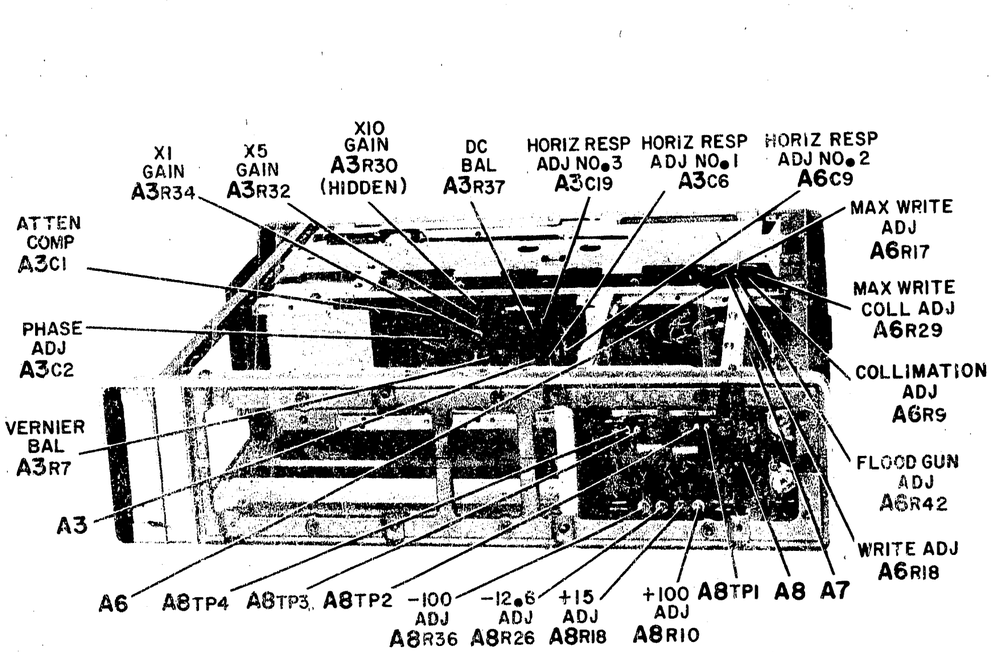
F.

181A-C01-09-76

Figure 5-5. Typical CRT Display







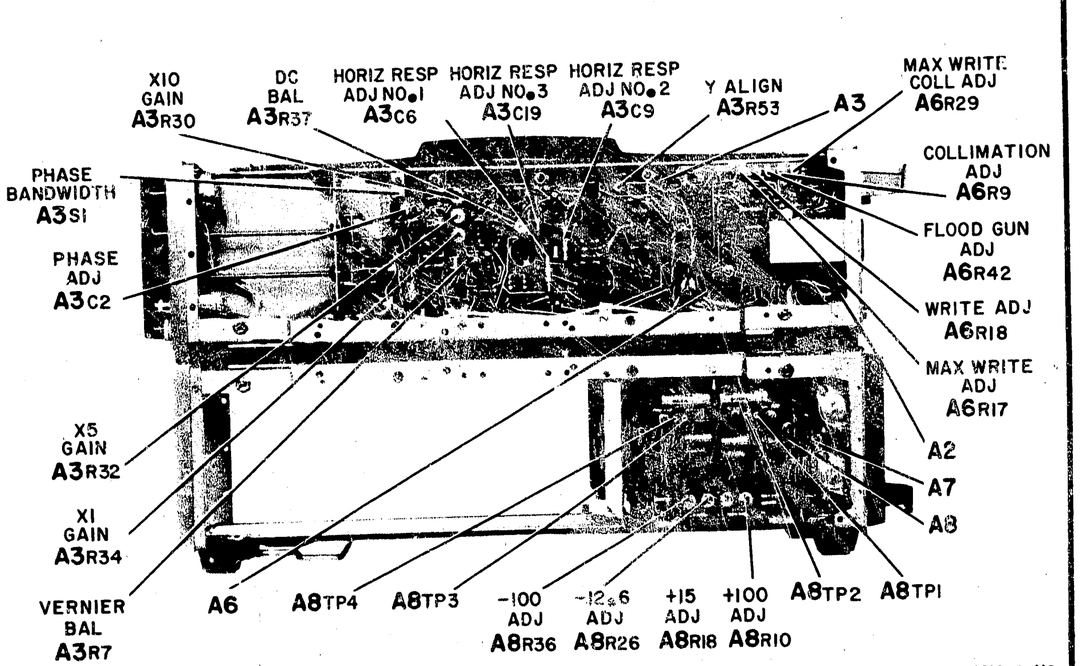
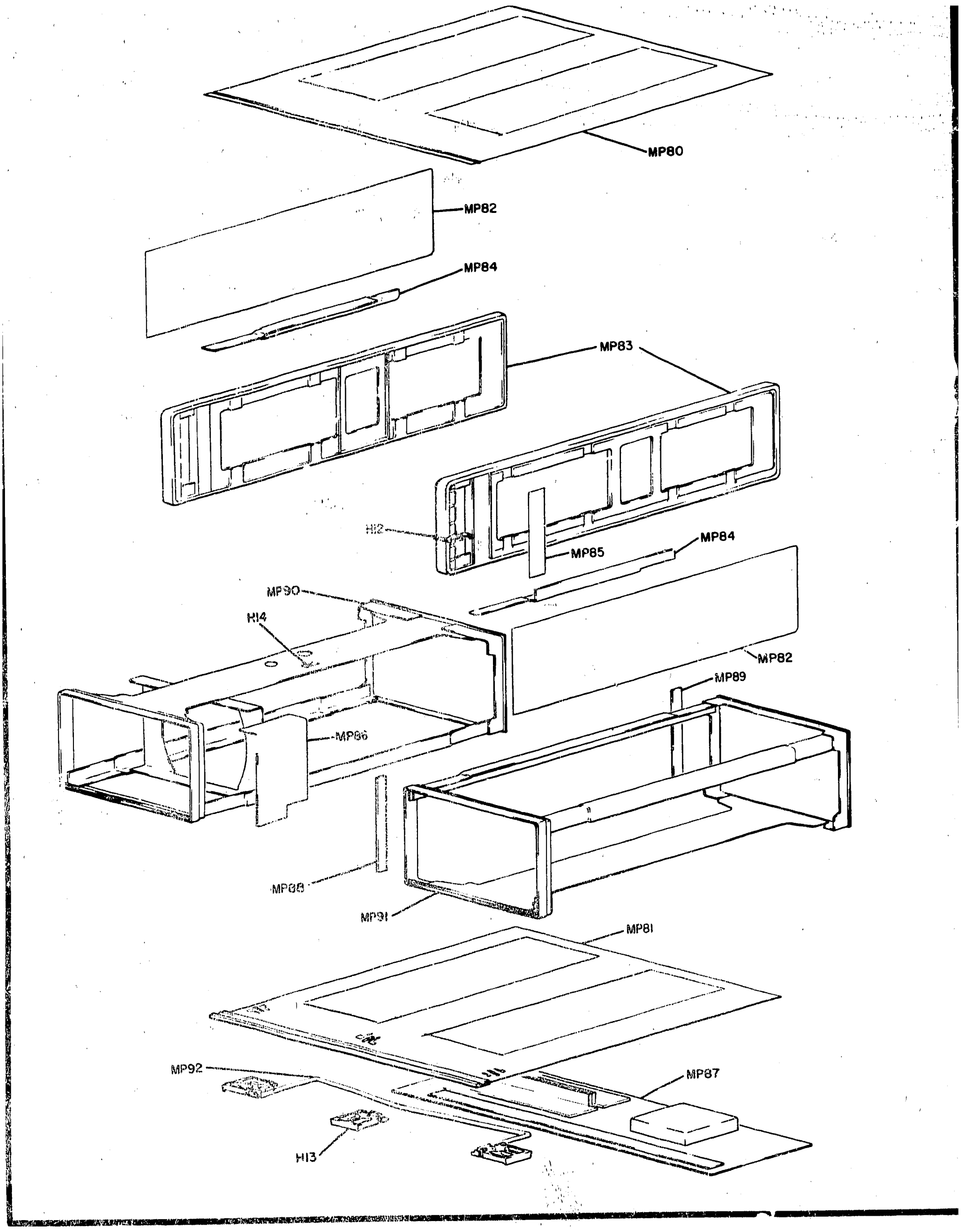
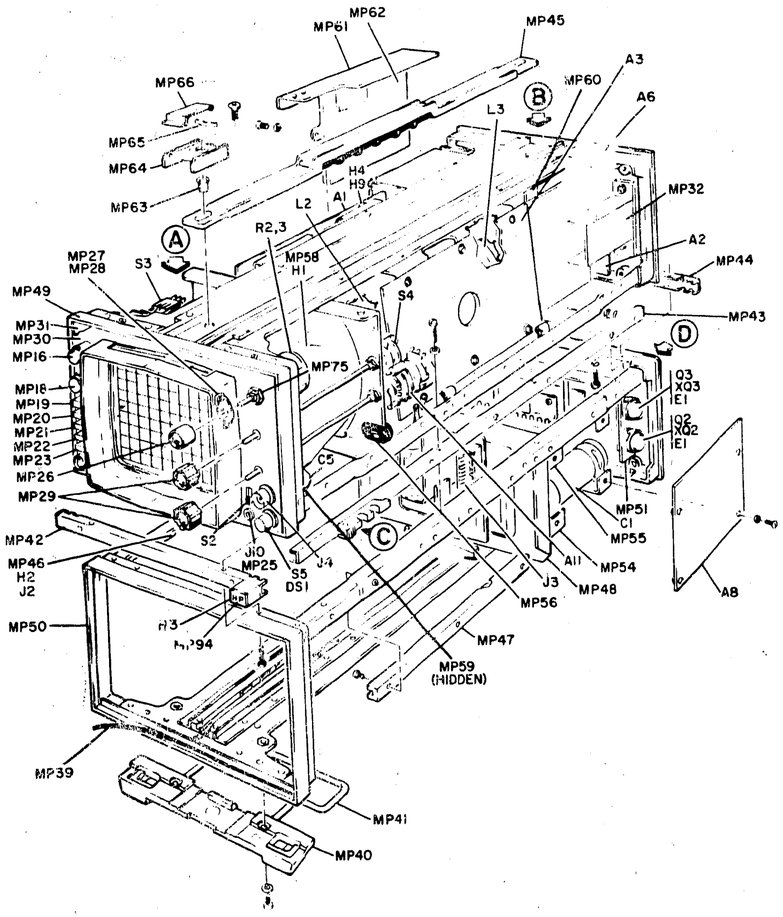
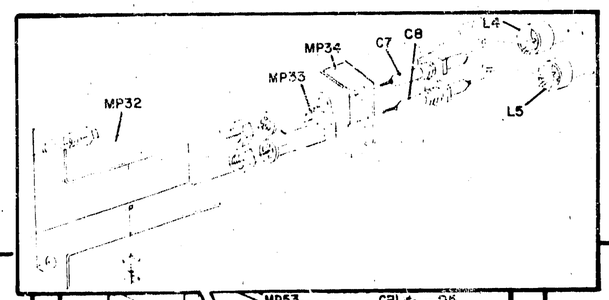


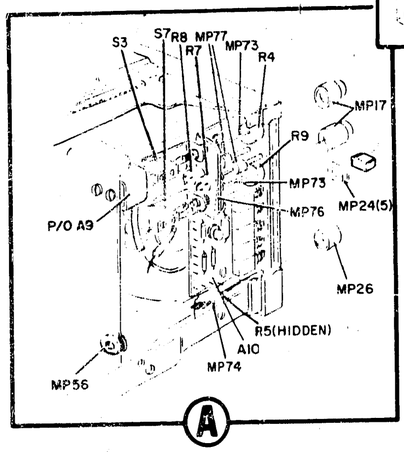
Figure 5-6.
Location of Adjustment and Test Points

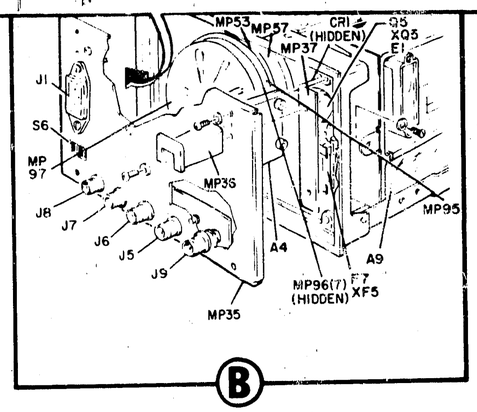
PARTS LIST

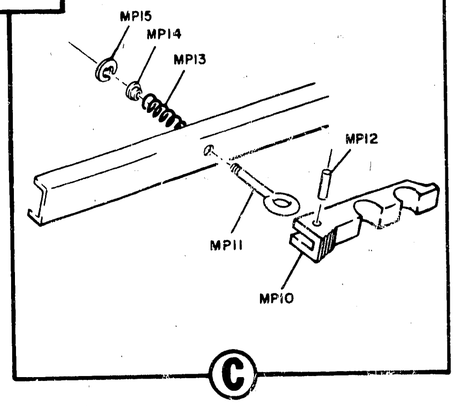

MP80
MP82
MP84
MP83
H12
MP85
MP84
MP90
H14
MP82
MP89
MP86
MP88
MP91
MP81
MP92
MP87
H13

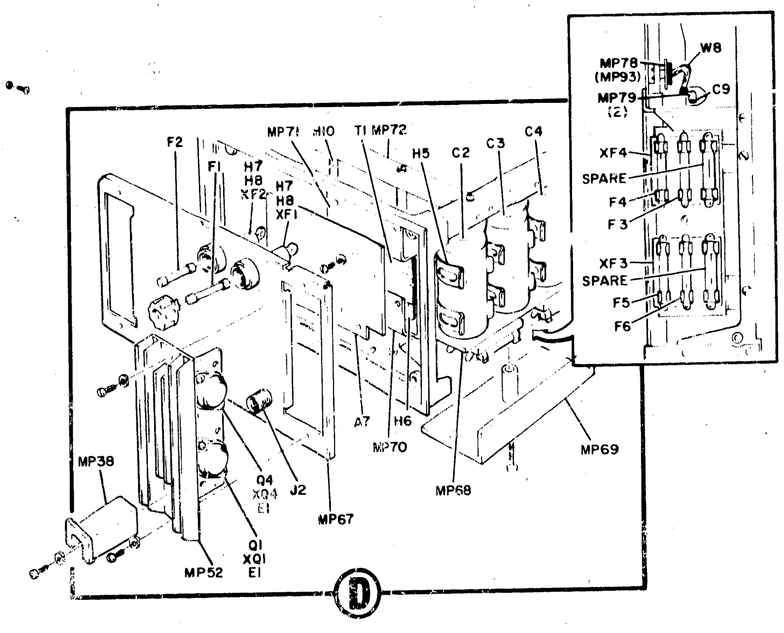


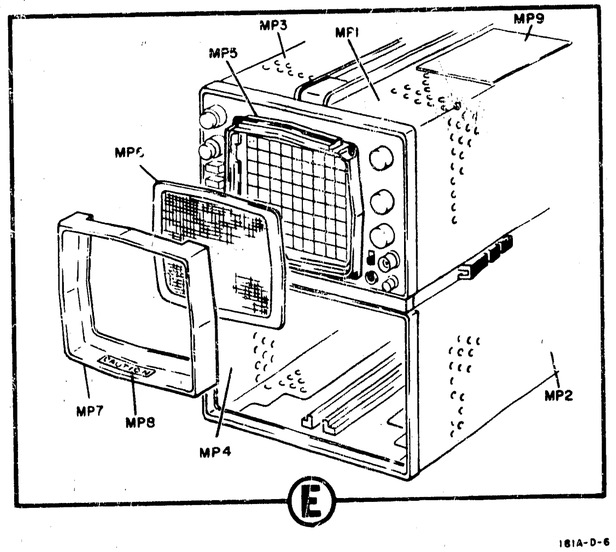












181A-D-6

Figure 6-1. Model 181A/AR Mechanical Parts Identification

Section VI

Replaceable Parts

6-1. INTRODUCTION.

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

6-3. ORDERING INFORMATION.

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

a. Instrument model and serial number.

b. HP Part Number of item(s).

c. Quantity of part(s) desired.

d. Reference designator of part(s).

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

a. Instrument model and serial number.

b. Description of the part, including function and location in the instrument.

c. Quantity desired.

Table 6-1. Abbreviations for Replaceable Parts List

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

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	00181-66512	1	ASSY:CALIBRATOR, GATE & HV CONTROL BD.	28480	00181-66512
A1C1	0160-0162	12	C:FXD MY 0.022 UF 10% 200VDCW	56289	192P22392-PTS
A1C2	0160-0162		C:FXD MY 0.022 UF 10% 200VDCW	56289	192P22392-PTS
A1C3	0160-0162		C:FXD MY 0.022 UF 10% 200VDCW	56289	192P22392-PTS
A1C4	0160-0207	1	C:FXD MYLAR 0.01UF 5% 200VDCW	28480	0160-0207
A1C5	0160-0162		C:FXD MY 0.022 UF 10% 200VDCW	56289	192P22392-PTS
A1C6	0180-0374	2	C:FXD ELECT 10.0 UF 10% 20VDCW	56289	150D106X9020B2-76
A1C7	0150-0059	1	C:FXD CER 3.3-0.25 PF 500VDCW	72982	301-000-COJ0-339C
A1C8	0121-0168	5	C:VAR TEFLON 0.25-1.50 PF 600VDCW	28480	0121-0168
A1C9	0132-0004	1	C:VAR POLY 0.7-3.0 PF 350VDCW	72982	535-009-4R
A1C10	0140-0180	1	C:FXD MICA 2000 PF 2%	28480	0140-0180
A1C11	0160-0162		C:FXD MY 0.022 UF 10% 200VDCW	56289	192P22392-PTS
A1C12	0160-0303	1	C:FXD MYLAR .15 UF 10% 200VDCW	28480	0160-0303
A1C13	0160-2150	1	C:FXD MICA 33 PF 5%	28480	0160-2150
A1C14	0160-2961	2	C:FXD MICA 5825 PF 2% 300VDCW	04062	RDM20E(5825)G3C
A1C15	0160-2961		C:FXD MICA 5825 PF 2% 300VDCW	04062	RDM20E(5825)G3C
A1C16	0180-0089	1	C:FXD ELECT 10UF-10%-100% 150VDCW	56289	30D106G150DF4
A1C17	0160-0155	3	C:FXD ELECT 2.2 UF 20% 20VDCW	56289	150D225X0020A2-DYS
A1C18	0180-0045	1	C:FXD ELECT 20UF 25VDCW	56289	30D206-G0-25DB-6MI
A1C19	0160-3008	5	C:FXD CER 4700 PF 20% 4KVDCW (LEFT FRONT LEAD)	72982	3808-024-Y5S0-472M
A1C20	0160-0380	2	C:FXD MY 0.22 UF 10% 200VDCW	28480	0160-0380
A1C21	0160-3007	6	C:FXD CER 4700 PF 20%4KVDCW (RIGHT FRONT LEAD)	72982	3808-024-Y5S0-472M
A1C22	0160-3008		C:FXD CER 4700 PF 20%4KVDCW (LEFT FRONT LEAD)	72982	3808-024-Y5S0-472M
A1C23	0160-3007		C:FXD CER 4700 PF 20%4KVDCW (RIGHT FRONT LEAD)	72982	3808-024-Y5S0-472M
A1C24	0160-3007		C:FXD CER 4700 PF 20%4KVDCW (RIGHT FRONT LEAD)	72982	3808-024-Y5S0-472M
A1C25	0160-3008		C:FXD CER 4700 PF 20%4KVDCW (LEFT FRONT LEAD)	72982	3808-024-Y5S0-472M
A1C26	0160-3007		C:FXD CER 4700 PF 20%4KVDCW (RIGHT FRONT LEAD)	72982	3808-024-Y5S0-472M
A1CR1	1901-0040	30	DIODE:SILICON 30MA 30WV	07263	FDG1088
A1CR2	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1CR3	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1CR4	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1CR5	1901-0179	1	DIODE:SILICON 15WV	28480	1901-0179
A1CR6	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1CR7	1901-0029	2	DIODE:SILICON 600 PIV	28480	1901-0029
A1CR8	1901-0029		DIODE:SILICON 600 PIV	28480	1901-0029
A1CR9			NOT ASSIGNED		
A1CR10	1901-0487	1	DIODE:SILICON 1500 PIV	28480	1901-0487
A1CR11	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1CR12	1901-0096	4	DIODE:SILICON 120V	01295	UG-888
A1CR13	1901-0096		DIODE:SILICON 120V	01295	UG-888
A1CR14	1901-0096		DIODE:SILICON 120V	01295	UG-888
A1CR15	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1L1	9100-1653	7	COIL/CHOKE 910 UH 5%	28480	9100-1653
A1L2	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A1Q1	1854-0019	5	TSTR:SI NPN	28480	1854-0019
A1Q2	1854-0019		TSTR:SI NPN	28480	1854-0019
A1Q3	1853-0038	3	TSTR:SI PNP	28480	1853-0038
A1Q4	1854-0271	1	TSTR:SI NPN	28480	1854-0271
A1Q5	1853-0036	1	TSTR:SI PNP	80131	2N3906
A1Q6	1854-0234	2	TSTR:SI NPN	80131	2N3440
A1Q7	1854-0234		TSTR:SI NPN	80131	2N3440
A1Q8	1854-0023	1	TSTR:SI NPN(SELECTED FROM 2N2484)	28480	1854-0023
A1Q9	1854-0071	25	TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A1Q10	1854-0039	3	TSTR:SI NPN	80131	2N3053
A1R1	0757-0407	7	R:FXD MET FLM 200 OHM 1% 1/8W	14674	ORDER BY DESCRIPTION
A1R2	0757-0407		R:FXD MET FLM 200 OHM 1% 1/8W	14674	ORDER BY DESCRIPTION
A1R3	0757-0401	9	R:FXD MET FLM 100 OHM 1% 1/8W	14674	ORDER BY DESCRIPTION
A1R4	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	14674	ORDER BY DESCRIPTION
A1R5	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	14674	ORDER BY DESCRIPTION
A1R6	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	14674	ORDER BY DESCRIPTION
A1R7	0757-0458	1	R:FXD MET FLM 51.1K OHM 1% 1/8W	91637	MF-1/10-32
A1R8	0757-0281	4	R:FXD MET FLM 2.74K OHM 1% 1/8W	28480	0757-0281
A1R9	0757-0274	1	R:FXD MET FLM 1.21K OHM 1% 1/8W	28480	0757-0274
A1R10	0757-0281		R:FXD MET FLM 2.74K OHM 1% 1/8W	28480	0757-0281
A1R11	0757-0290	1	R:FXD MET FLM 6.19K OHM 1% 1/8W	28480	0757-0290
A1R12	0757-0462	1	R:FXD MET FLM 75K OHM 1% 1/8W	28480	0757-0462
A1R13	0757-0724	1	R:FXD FLM 392 OHM 1% 1/4W	28480	0757-0724
A1R14	0757-0727	1	R:FXD MET FLM 562 OHM 1% 1/4W	28480	0757-0727

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
A1R15	0757-0757	2	R:FXD FLM 15K OHM 1% 1/4W	28480	0757-0757
A1R16	0757-0469	2	R:FXD FLM 150K OHM 1% 1/8W	28480	0757-0469
A1R17	0757-0757		R:FXD FLM 15K OHM 1% 1/4W	28480	0757-0757
A1R18	0757-0407		R:FXD MET FLM 200 OHM 1% 1/8W	14674	ORDER BY DESCRIPTION
A1R19	0757-0280	8	R:FXD MET FLM 1K OHM 1% 1/8W	14674	ORDER BY DESCRIPTION
A1R20	0757-0190	3	R:FXD MET FLM 20K OHM 1% 1/2W	28480	0757-0190
A1R21	0757-0416	1	R:FXD MET FLM 511 OHM 1% 1/8W	14674	ORDER BY DESCRIPTION
A1R22	0757-0441	2	R:FXD MET FLM 8.25K 1% 1/8W	14674	ORDER BY DESCRIPTION
A1R23	0757-0426	2	R:FXD FLM 1.3K OHM 1% 1/8W	28480	0757-0426
A1R24	0761-0083	1	R:FXD MET OX 68K OHM 5% 1W	28480	0761-0083
A1R25	0757-0438	8	R:FXD MET FLM 5.11K 1% 1/8W	14674	ORDER BY DESCRIPTION
A1R26	0757-0283	10	R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A1R27	0757-0424	1	R:FXD MET FLM 1.1K OHM 1% 1/8W	28480	0757-0424
A1R28	0757-0760	1	R:FXD FLM 20K OHM 1% 1/4W	28480	0757-0760
A1R29	0757-0466	3	R:FXD MET FLM 110K OHM 1% 1/8W	28480	0757-0466
A1R30	0757-0466		R:FXD MET FLM 110K OHM 1% 1/8W	28480	0757-0466
A1R31	0684-0271	2	R:FXD COMP 2.7 OHM 10% 1/4W	01121	CB 27G1
A1R32	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A1R33	0757-0393	1	R:FXD FLM 47.5 OHM 1% 1/8W	28480	0757-0393
A1R34	0757-0841	3	R:FXD MET FLM 12.1K OHM 1% 1/2W	28480	0757-0841
A1R35	0698-6612	1	R:FXD MET FLM 2K OHM 0.1% 1/8W	28480	0698-6612
A1R36	0698-5421	1	R:FXD MET FLM 17.82K OHM 0.1% 1/2W	28480	0698-5421
A1R37	0684-0271		R:FXD COMP 2.7 OHM 10% 1/4W	01121	CB 27G1
A1R38	2100-0943	1	R:VAR MET FLM 100K 20% LIN 3/4W	75042	CT150
A1R39	0727-0263	1	R:FXD DEPC 950K OHM 1% 1/2W	28480	0727-0263
A1R40	0757-0442	3	R:FXD MET FLM 10.0K 1% 1/8W	14674	ORDER BY DESCRIPTION
A1R41	0757-0442		R:FXD MET FLM 10.0K 1% 1/8W	14674	ORDER BY DESCRIPTION
A1R42	0757-0438		R:FXD MET FLM 5.11K 1% 1/8W	14674	ORDER BY DESCRIPTION
A1R43	0698-3553	1	R:FXD FLM 2.49 MEGOHM 1% 1/2W	28480	0698-3553
A1R44	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A1R45	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	14674	ORDER BY DESCRIPTION
A1R46	0757-0465	8	R:FXD MET FLM 100K 1% 1/8W	14674	ORDER BY DESCRIPTION
A1R47	0757-0814	1	R:FXD MET FLM 511 OHM 1% 1/2W	28480	0757-0814
A1R48	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	14674	ORDER BY DESCRIPTION
A1R49	0757-0465		R:FXD MET FLM 100K 1% 1/8W	14674	ORDER BY DESCRIPTION
A1R50	0698-8220	1	R:FXD FLM 15 MEGOHM 1% 3W	28480	0698-8220
A1R51	0687-1051	1	R:FXD COMP 1 MEGOHM 10% 1/2W	01121	EB1051
A1R52	0687-4721	1	R:FXD COMP 4700 OHM 10% 1/2W	01121	EB4721
A1R53	0698-5353	1	R:FXD FLM 8.25 MEGOHM 5% 1W	28480	0698-5353
A1R54	0698-6580	1	R:FXD FLM 16.25 MEGOHM 5% 1W	28480	0698-6580
A1R55	0757-0460	2	R:FXD MET FLM 61.9K OHM 1% 1/8W	28480	0757-0460
A1R56	2100-2031	4	R:VAR 50K OHM 10% LIN 1/2W	28480	2100-2031
A1R57	0687-1011	1	R:FXD COMP 100 OHM 10% 1/2W	01121	EB 1011
A1R58	0698-3510	1	R:FXD MET FLM 453 OHM 1% 1/8W	28480	0698-3510
A1R59	2100-2030	2	R:VAR FLM 20K OHM 10% LIN 1/2W	28480	2100-2030
A1TP1	1251-0206	5	CONNECTOR:SOCKET (TEST JACK)	98291	SKT-400
A1V1	2140-0018	2	LAMP:GLOW 1/10W	08806	NE 2E1
A1V2	2140-0018		LAMP:GLOW 1/10W	08806	NE 2E1
A1VR1	1902-0045	1	DIODE BREAKDOWN:7.32V 2% 400 MW	28480	ORDER BY DESCRIPTION
A1VR2	1902-0025	1	DIODE,BREAKDOWN:10.0V 5% 400 MW	28480	1902-0025
A1VR3	1902-0038	1	DIODE BREAKDOWN 45.3V 5% 400 MW	28480	1902-0038
A2	00181-66508	1	ASSY:SWEEP GATE OUTPUT BOARD	28480	00181-66508
A2C1	0180-0155		C:FXD ELECT 2.2 UF 20% 20VDCW	56289	150D225X0020A2-DYS
A2C2	0180-0155		C:FXD ELECT 2.2 UF 20% 20VDCW	56289	150D225X0020A2-DYS
A2L1	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A2L2	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A2Q1	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A2Q2	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A2Q3	1853-0016	2	TSTR:SI PNP	80131	2N3638
A2Q4	1853-0016		TSTR:SI PNP	80131	2N3638
A2R1	0757-0451	2	R:FXD MET FLM 24.3K OHM 1% 1/8W	28480	0757-0451
A2R2	0757-0438		R:FXD MET FLM 5.11K 1% 1/8W	14674	ORDER BY DESCRIPTION
A2R3	0757-0436	2	R:FXD MET FLM 4.32K OHM 1% 1/8W	28480	0757-0436
A2R4	0757-0451		R:FXD MET FLM 24.3K OHM 1% 1/8W	28480	0757-0451
A2R5	0757-0438		R:FXD MET FLM 5.11K 1% 1/8W	14674	ORDER BY DESCRIPTION
A2R6	0757-0436		R:FXD MET FLM 4.32K OHM 1% 1/8W	28480	0757-0436
A2R7	0757-0429	4	R:FXD MET FLM 1.82K OHM 1% 1/8W	28480	0757-0429
A2R8	0757-0273		R:FXD MET FLM 3.01K OHM 1% 1/8W	28480	0757-0273
A2R9	0757-0438		R:FXD MET FLM 5.11K 1% 1/8W	14674	ORDER BY DESCRIPTION
A2R10	0757-0429		R:FXD MET FLM 1.82K OHM 1% 1/8W	28480	0757-0429
A2R11	0757-0273		R:FXD MET FLM 3.01K OHM 1% 1/8W	28480	0757-0273
A2R12	0757-0438		R:FXD MET FLM 5.11K 1% 1/8W	14674	ORDER BY DESCRIPTION
A2R13	0683-0275	3	R:FXD COMP 2.7 OHM 5% 1/4W	01121	CB 27G5
A2R14	0683-0275		R:FXD COMP 2.7 OHM 5% 1/4W	01121	CB 27G5
A2R15	0757-0438		R:FXD MET FLM 5.11K 1% 1/8W	14674	ORDER BY DESCRIPTION

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A3	00181-66514	1	ASSY:HORIZONTAL AMPLIFIER BOARD	28480	00181-66514
A3C1	0121-0059	1	C:VAR CER 2-8 PF 300 VDCW	72982	538-006-COPO-89R
A3C2	0121-0105	1	C:VAR CER 9-35 PF	72982	538-006D-9-35
A3C3	0160-2201	1	C:FXD MICA 51 PF 5% 300 VDCW	72136	RDM15E510J1C
A3C4	0160-0162		C:FXD MY 0.022 UF 10% 200VDCW	56289	192P22392-PTS
A3C5	0160-0162		C:FXD MY 0.022 UF 10% 200VDCW	56289	192P22392-PTS
A3C6	0132-0007	3	C:VAR POLY 0.7 TO 3.0 PF 350VDCW	72982	535-033-4R
A3C7	0160-0162		C:FXD MY 0.022 UF 10% 200VDCW	56289	192P22392-PTS
A3C8	0170-0040	2	C:FXD MY 0.047 UF 10% 200VDCW	56289	192P47392-PTS
A3C9	0132-0007		C:VAR POLY 0.7 TO 3.0 PF 350VDCW	72982	535-033-4R
A3C10	0160-2235	1	C:FXD CER 0.75 PF 500 VDCW	72982	301-000-COKO 750C
A3C11	0160-0162		C:FXD MY 0.022 UF 10% 200VDCW	56289	192P22392-PTS
A3C12	0160-0162		C:FXD MY 0.022 UF 10% 200VDCW	56289	192P22392-PTS
A3C13	0180-0197	4	C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A3C14	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A3C15	0160-0162		C:FXD MY 0.022 UF 10% 200VDCW	56289	192P22392-PTS
A3C16	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A3C17	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A3C18	0180-0218	1	C:FXD ELECT 0.15 UF 10% 35VDCW	28480	0180-0218
A3C19	0132-0007		C:VAR POLY 0.7 TO 3.0 PF 350VDCW	72982	535-033-4R
A3C20	0160-0162		C:FXD MY 0.022 UF 10% 200VDCW	56289	192P22392-PTS
A3C21	0170-0040		C:FXD MY 0.047 UF 10% 200VDCW	56289	192P47392-PTS
A3C22	0160-2250		C:FXD CER 5.1 PF	72982	301-000-COHO-519C
A3CR1	1901-0040		DIODE:SILICON	07263	FDG 1088
A3CR2	1901-0040	4	DIODE:SILICON 30MA 30WV	07263	FDG1088
A3CR3	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A3CR4	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
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	FDG1088
A3CR8	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A3CR9	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A3L1	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A3L3	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A3L4	9170-0029	1	CORE:FERRITE BEAD	02114	56-590-65A2/4C
A3Q1	1855-0062	1	TSTR:SI FET	17856	FN578
A3Q2	1854-0215	1	TSTR:SI NPN	04713	SPS3611
A3Q3	1850-0158	1	TSTR:GE PNP	80131	2N2635
A3Q4	1854-0019		TSTR:SI NPN	28480	1854-0019
A3Q5	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A3Q6	1854-0019		TSTR:SI NPN	28480	1854-0019
A3Q7	1854-0019		TSTR:SI NPN	28480	1854-0019
A3Q8	1853-0009	2	TSTR:SI PNP	28480	1853-0009
A3Q9	1854-0419	2	TSTR:SI NPN	80131	1854-0419
A3Q10	1853-0038		TSTR:SI PNP	28480	1853-0038
A3Q11	1853-0009		TSTR:SI PNP	28480	1853-0009
A3Q12	1854-0419		TSTR:SI NPN	80131	1854-0419
A3Q13	1853-0038		TSTR:SI PNP	28480	1853-0038
A3R1	0698-5539	1	R:FXD METFLM 2 MEG 1% 1/2W	75042	CEC, T-0
A3R2	0757-0156	1	R:FXD METFLM 1.5 MEG 1% 1/2W	75042	CEC, T-0
A3R3	0757-0403		R:FXD MET FLM 100 OHM 1% 1/8W	14674	ORDER BY DESCRIPTION
A3R4	0757-0367	1	R:FXD METFLM 100K 1% 1/2W	75042	CEC, T-0
A3R5	0757-0280		R:FXD METFLM 1K 1% 1/8W	75042	CEA, T-0
A3R6	0781-0074	1	R:FXD METOX 15K 5% 1W	14674	C32
A3R7	2100-2514	1	R:VAR CERMET 20K 10% LIN 1/2W	73138	62-228-1
A3R8	0698-3153	1	R:FXD METFLM 3.83K 1% 1/8W	19701	MF4C-T-0
A3R9	0757-0426		R:FXD METFLM 1.3K 1% 1/8W	19701	MF4C-T-0
A3R10	0757-0463	2	R:FXD MET FLM 82.5K 1% 1/8W	14674	ORDER BY DESCRIPTION
A3R11	0757-0441		R:FXD MET FLM 8.25K 1% 1/8W	14674	ORDER BY DESCRIPTION
A3R12	0757-0792	1	R:FXD MET FLM 681K OHM 1% 1/4W	28480	0757-0792
A3R13	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	14674	ORDER BY DESCRIPTION
A3R14	0757-0460		R:FXD MET FLM 61.9K OHM 1% 1/8W	28480	0757-0460
A3R15	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	14674	ORDER BY DESCRIPTION
A3R16	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A3R17	0757-0764	3	R:FXD FLM 33.2K OHM 1% 1/4W	28480	0757-0764
A3R18	0757-0741	2	R:FXD MET FLM 2.43K OHM 1%/1/4W	28480	0757-0741
A3R19	0757-0281		R:FXD MET FLM 2.74K OHM 1% 1/8W	28480	0757-0281
A3R20	0757-0443	2	R:FXD MET FLM 11.0K OHM 1% 1/8W	91637	MF-1/10-32
A3R21	0757-0434	4	R:FXD MET FLM 3.65K OHM 1% 1/8W	28480	0757-0434
A3R22	0757-0736	2	R:FXD MET FLM 1.50K OHM 1% 1/4W	28480	0757-0736
A3R23	0757-0846	2	R:FXD MET FLM 22.1K OHM 1.0% 1/2W	28480	0757-0846
A3R24	0757-0413	2	R:FXD MET FLM 392 OHM 1% 1/8W	28480	0757-0413
A3R25	0757-0407		R:FXD MET FLM 200 OHM 1% 1/8W	14674	ORDER BY DESCRIPTION
A3R26	0757-0841		R:FXD MET FLM 12.1K OHM 1% 1/2W	28480	0757-0841
A3R27	0757-0448	1	R:FXD MET FLM 18.2K OHM 1% 1/8W	28480	0757-0448

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
A3R28	0683-0275		R:FXD COMP 2.7 OHM 5% 1/4W	01121	CB 2705
A3R29	0757-0388	5	R:FXD FLM 30.1 OHM 1% 1/8W	28480	0757-0388
A3R30	2100-1770	1	R:VAR WW 100 OHM 5% TYPE H 1W	28480	2100-1770
A3R31	0757-0284	1	R:FXD MET FLM 150 OHM 1% 1/8W	28480	0757-0284
A3R32	2100-1771	1	R:VAR WW 200 OHM 5% TYPE H 1W	28480	2100-1771
A3R33	0757-0411	1	R:FXD MET FLM 332 OHM 1% 1/8W	28480	0757-0411
A3R34	2100-1773	2	R:VAR WW 1K OHM 5% TYPE H 1W	28480	2100-1773
A3R35	0757-0428	1	R:FXD MET FLM 1.62K 1% 1/8W	14674	ORDER BY DESCRIPTION
A3R36	0698-3416	3	R:FXD MET FLM 21.5K OHM 1% 1/2W	28480	0698-3416
A3R37	2100-1775	1	R:VAR WW 5K OHM 5% 1W	28480	2100-1775
A3R38	0698-3416		R:FXD MET FLM 21.5K OHM 1% 1/2W	28480	0698-3416
A3R39	0757-0468	1	R:FXD FLM 130K OHM 1% 1/8W	28480	0757-0468
A3R40	0757-0440		R:FXD MET FLM 7.50K 1% 1/8W	14674	ORDER BY DESCRIPTION
A3R41	0757-0427	1	R:FXD MET FLM 1.5K 1% 1/8W	14674	ORDER BY DESCRIPTION
A3R42	0757-0741		R:FXD MET FLM 2.43K OHM 1%/1/4W	28480	0757-0741
A3R43	0757-0281		R:FXD MET FLM 2.74K OHM 1% 1/8W	28480	0757-0281
A3R44	0757-0200	4	R:FXD MET FLM 5.62K OHM 1% 1/8W	14674	ORDER BY DESCRIPTION
A3R45	0757-0443		R:FXD MET FLM 11.0K OHM 1% 1/8W	91637	MF-1/10-32
A3R46	0757-0434		R:FXD MET FLM 3.65K OHM 1% 1/8W	28480	0757-0434
A3R47	0757-0736		R:FXD MET FLM 1.50K OHM 1% 1/4W	28480	0757-0736
A3R48	0757-0413		R:FXD MET FLM 392 OHM 1% 1/8W	28480	0757-0413
A3R49	0757-0846		R:FXD MET FLM 22.1K OHM 1.0% 1/2W	28480	0757-0846
A3R50	0757-0407		R:FXD MET FLM 200 OHM 1% 1/8W	14674	ORDER BY DESCRIPTION
A3R51	0757-0941		R:FXD MET FLM 12.1K OHM 1% 1/2W	28480	0757-0841
A3R52	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	14674	ORDER BY DESCRIPTION
A3R53	2100-2030		R:VAR FLM 20K OHM 10% LIN 1/2W	28480	2100-2030
A3R54	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	14674	ORDER BY DESCRIPTION
A3R55	0757-0344	1	R:FXD METFLM 1.0 MEG 1% 1/4W	19701	MF62C-T-0
A3R56	0757-0447	1	R:FXD METFLM 16.2K 1% 1/8W	19701	MF4C-T-0
A3R57	0757-0401	1	R:FXD METFLM 100 OHM 1% 1/8W	19701	MF4C-T-0
A3R58	0757-0407	1	R:FXD METFLM 200 OHM 1% 1/8W	19701	MF4C-T-0
A3S1	3101-0982	1	SWITCH:SLIDE SPST 0.5A 125V	79727	GF124-0007
A4	00180-66523	1	ASSY:HV OSC BOARD	28480	00180-66523
A4C1	0180-0097	3	C:FXD ELECT 47 UF 10% 35VDCW	56289	150D476X9035S2-DYS
A4C2	0160-0380		C:FXD MY 0.22 UF 10% 200VDCW	28480	0160-0380
A4CR1	1901-0049	1	DIODE:SILICON 0.75A 50PIV	04713	SR1358-6
A4L1	9140-0071	1	COIL:FXD RF: 22UHY	28480	9140-0071
A5	00181-66502	1	ASSY:HIGH VOLTAGE RECTIFIER BOARD	28480	00181-66502
A5C1	0160-3008		C:FXD CER 4700 PF (LEFT FRONT LEAD)	72982	3808-024-Y5S0-472M
A5C2	0160-3007		C:FXD CER 4700 PF (RIGHT FRONT LEAD)	72982	3808-024-Y5S0-472M
A5C3	0160-3007		C:FXD CER 4700 PF (RIGHT FRONT LEAD)	72982	3808-024-Y5S0-472M
A5C4	0160-3008		C:FXD CER 4700 PF (LEFT FRONT LEAD)	72982	3808-024-Y5S0-472M
A5CR1	1901-0341	2	DIODE:SI 7000 PIV 50MA	28480	1901-0341
A5CR2	1901-0341		DIODE:SI 7000 PIV 50MA	28480	1901-0341
A5R1	0687-2231	1	R:FXD COMP 22K OHM 10% 1/2W	01121	EB2231
A5R2	2100-0918	1	R:VAR COMP 1 MEGOHM 20% LIN 1/5W	28480	2100-0918
A5R3	0836-0003	1	R:FXD FLM 29 MEGOHM 10% 1W	28480	0836-0003
A5T1	00181-60801	1	TRANSFORMER:HIGH VOLTAGE ASSY	28480	00181-60801
A6	00181-66518	1	ASSY:PULSE CIRCUIT BOARD	28480	00181-66518
A6C1	0160-2216	1	C:FXD MICA 820 PF 5%	28480	0160-2216
A6C2	0160-0154	1	C:FXD MICA MY 0.0022 UF 10% 200VDCW	56289	192P22292-PTS
A6C3	0140-0176	1	C:FXD MICA 100 PF 2%	28480	0140-0176
A6C4	0160-2930	3	C:FXD CER 0.01 UF +80-20% 100VDCW	91418	TA
A6C5	0180-0374		C:FXD ELECT 10.0 UF 10% 20VDCW	56289	150D106X902082-76
A6C6	0180-0100	3	C:FXD ELECT 4.7 UF 10% 35VDCW	56289	150D475X903582-DYS
A6C7	0160-2930		C:FXD CER 0.01 UF +80-20% 100VDCW	91418	TA
A6C8	0160-2930		C:FXD CER 0.01 UF +80-20% 100VDCW	91418	TA
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	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A6CR5	1901-0025	1	DIODE:SILICON 100MA/1V	07263	FD 2387
A6CR6	1901-0026	6	DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
A6CR7	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A6CR8	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A6CR9	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A6CR10	1901-0026		DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
A6CR11	1901-0026		DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
A6CR12	1901-0026		DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
A6Q1	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6Q2	1854-0022	4	TSTR:SI NPN	07263	S17843
A6Q3	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6Q4	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6Q5			NOT USED		
A6Q6	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A6Q7	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6Q8	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6Q9	1854-0022		TSTR:SI NPN	07263	S17843
A6Q10	1854-0022		TSTR:SI NPN	07263	S17843
A6Q11	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6Q12	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6Q13	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6Q14	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6Q15	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6Q16	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6Q17	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6Q18	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6Q19	1854-0022		TSTR:SI NPN	07263	S17843
A6R1	0687-2241	1	R:FXD COMP 220K OHM 10% 1/2W	01121	EB 2241
A6R2	0687-4741	7	R:FXD COMP 470K OHM 10% 1/2W	01121	EB 4741
A6R3	0687-4731	4	R:FXD COMP 47K OHM 10% 1/2W	01121	EB 4731
A6R4	0757-0767	1	R:FXD FLM 43.2K OHM 1% 1/4W	28480	0757-0767
A6R5	0757-0446	1	R:FXD MET FLM 15.0K OHM 1% 1/8W	28480	0757-0446
A6R6	0757-0469		R:FXD FLM 150K OHM 1% 1/8W	28480	0757-0469
A6R7	0757-0466		R:FXD MET FLM 110K OHM 1% 1/8W	28480	0757-0466
A6R8	0687-4741		R:FXD COMP 470K OHM 10% 1/2W	01121	EB 4741
A6R9	2100-2650	2	R:VAR FLM 200K OHM 10% LIN 1/2W	28480	2100-2650
A6R10	0687-8231	1	R:FXD COMP 82K OHM 10% 1/2W	01121	EB 8231
A6R11	0687-4731		R:FXD COMP 47K OHM 10% 1/2W	01121	EB 4731
A6R12	0687-5631	1	R:FXD COMP 56K OHM 10% 1/2W	01121	EB 5631
A6R13	0687-4741		R:FXD COMP 470K OHM 10% 1/2W	01121	EB 4741
A6R14	0757-0479	1	R:FXD MET FLM 392K OHM 1% 1/8W	28480	0757-0479
A6R15	0757-0442		R:FXD MET FLM 10.0K 1% 1/8W	14674	ORDER BY DESCRIPTION
A6R16	0757-0469	1	R:FXD MET FLM 150K OHM 1% 1/8W	28480	0757-0469
A6R17	2100-2031		R:VAR 50K OHM 10% LIN 1/2W	28480	2100-2031
A6R18	2100-2031		R:VAR 50K OHM 10% LIN 1/2W	28480	2100-2031
A6R19	0757-0135		R:FXD MET FLM 511K OHM 1% 1/2W	28480	0757-0135
A6R20	0757-0352	1	R:FXD MET FLM 150K OHM 1% 1/2W	28480	0757-0352
A6R21			NOT USED		
A6R22	0687-1841	2	R:FXD COMP 180K OHM 10% 1/2W	01121	EB 1841
A6R23	0687-1031	5	R:FXD COMP 10K OHM 10% 1/2W	01121	EB 1031
A6R24	0687-1031		R:FXD COMP 10K OHM 10% 1/2W	01121	EB 1031
A6R25	0687-1041	5	R:FXD COMP 100K OHM 10% 1/2W	01121	EB 1041
A6R26	0757-0482	2	R:FXD MET FLM 511K OHM 1% 1/8W	28480	0757-0482
A6R27	0687-1041		R:FXD COMP 100K OHM 10% 1/2W	01121	EB 1041
A6R28	0687-1041		R:FXD COMP 100K OHM 10% 1/2W	01121	EB 1041
A6R29	2100-2650		R:VAR FLM 200K OHM 10% LIN 1/2W	28480	2100-2650
A6R30	0687-1041		R:FXD COMP 100K OHM 10% 1/2W	01121	EB 1041
A6R31	0757-0770	2	R:FXD FLM 56.2K OHM 1% 1/4W	28480	0757-0770
A6R32	0757-0482		R:FXD MET FLM 511K OHM 1% 1/8W	28480	0757-0482
A6R33	0757-0770		R:FXD FLM 56.2K OHM 1% 1/4W	28480	0757-0770
A6R34	0687-4741		R:FXD COMP 470K OHM 10% 1/2W	01121	EB 4741
A6R35	0687-4741		R:FXD COMP 470K OHM 10% 1/2W	01121	EB 4741
A6R36	0687-4741		R:FXD COMP 470K OHM 10% 1/2W	01121	EB 4741
A6R37	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A6R38	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A6R39	0687-1031		R:FXD COMP 10K OHM 10% 1/2W	01121	EB 1031
A6R40	0687-1031		R:FXD COMP 10K OHM 10% 1/2W	01121	EB 1031
A6R41	0687-1841		R:FXD COMP 180K OHM 10% 1/2W	01121	EB 1841
A6R42	2100-2031		R:VAR 50K OHM 10% LIN 1/2W	28480	2100-2031
A6R43	0757-0190		R:FXD MET FLM 20K OHM 1% 1/2W	28480	0757-0190
A6R44	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A6R45	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A6R46	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A6R47	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A6R48	0757-0465		R:FXD MET FLM 100K 1% 1/8W	14674	ORDER BY DESCRIPTION
A6R49	0757-0465		R:FXD MET FLM 100K 1% 1/8W	14674	ORDER BY DESCRIPTION
A6R50	0687-4731		R:FXD COMP 47K OHM 10% 1/2W	01121	EB 4731
A6R51	0687-1041		R:FXD COMP 100K OHM 10% 1/2W	01121	EB 1041
A6R52	0687-4731		R:FXD COMP 47K OHM 10% 1/2W	01121	EB 4731
A6R53	0757-0453	1	R:FXD MET FLM 30.1K OHM 1% 1/8W	28480	0757-0453
A6R54	0757-0774	1	R:FXD FLM 82.5K OHM 1% 1/4W	28480	0757-0774
A6R55	0687-1031		R:FXD COMP 10K OHM 10% 1/2W	01121	EB 1031
A7	00181-66503	1	ASSY:LOW VOLTAGE RECTIFIER BOARD	28480	00181-66503
A7C1	0180-0091	1	C:FXD ELECT 10 UF +50-10% 100VDCW	56289	30D106F100DC2-DSM
A7CR1	1901-0028	12	DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A7CR2	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A7CR3	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A7CR4	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A7CR5	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9

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
A7CR6	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A7CR7	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A7CR8	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A7CR9	1901-0415	8	DIODE:SILICON 50 PIV 3A	28480	1901-0415
A7CR10	1901-0415		DIODE:SILICON 50 PIV 3A	28480	1901-0415
A7CR11	1901-0415		DIODE:SILICON 50 PIV 3A	28480	1901-0415
A7CR12	1901-0415		DIODE:SILICON 50 PIV 3A	28480	1901-0415
A7CR13	1901-0415		DIODE:SILICON 50 PIV 3A	28480	1901-0415
A7CR14	1901-0415		DIODE:SILICON 50 PIV 3A	28480	1901-0415
A7CR15	1901-0415		DIODE:SILICON 50 PIV 3A	28480	1901-0415
A7CR16	1901-0415		DIODE:SILICON 50 PIV 3A	28480	1901-0415
A7CR17	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A7CR18	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A7CR19	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A7CR20	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A7R1	0760-0016	1	R:FXD MET OX 2700 OHM 2% 1W	14674	C-32 080
A7R2	0757-0060	3	R:FXD MET FLM 24.3K OHM 1% 1/2W	28480	0757-0060
A7R3	0811-1788	1	R:FXD WW 15 OHM 5% 2W	28480	0811-1788
A7R4	0757-0465		R:FXD MET FLM 100K 1% 1/8W	14674	ORDER BY DESCRIPTION
A7R5	0811-1678	1	R:FXD WW 10 OHM 5% 2W	28480	0811-1678
A7R6	0757-0465		R:FXD MET FLM 100K 1% 1/8W	14674	ORDER BY DESCRIPTION
A7VR1	1902-0597	1	DIODE BREAKDOWN:6.2V 5% 1W	28480	1902-0597
A8	00181-66509	1	ASSY:LOW VOLTAGE POWER SUPPLY BOARD	28480	00181-66509
A8C1	0160-0160	6	C:FXD MY 0.1 UF 10% 200VDCW	56289	192P10492-PTS
A8C2	0180-0100		C:FXD ELECT 4.7 UF 10% 35VDCW	56289	150D475X9035B2-DYS
A8C3	0180-1810	2	C:FXD ELECT 18 UF +50-10% 150VDCW	56289	600D186F150DG4-DHE
A8C4	0160-0168		C:FXD MY 0.1 UF 10% 200VDCW	56289	192P10492-PTS
A8C5	0180-0097		C:FXD ELECT 47 UF 10% 35VDCW	56289	150D476X9035S2-DYS
A8C6	0160-0168		C:FXD MY 0.1 UF 10% 200VDCW	56289	192P10492-PTS
A8C7	0180-0097		C:FXD ELECT 47 UF 10% 35VDCW	56289	150D476X9035S2-DYS
A8C8	0160-0168		C:FXD MY 0.1 UF 10% 200VDCW	56289	192P10492-PTS
A8C9	0180-0100		C:FXD ELECT 4.7 UF 10% 35VDCW	56289	150D475X9035B2-DYS
A8C10	0180-1810		C:FXD ELECT 18 UF +50-10% 150VDCW	56289	600D186F150DG4-DHE
A8CR1	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A8CR2	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
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
A8CR7	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A8CR8	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A8CR9	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A8CR10	1901-0026		DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
A8CR11	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A8CR12	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A8Q1	1854-0090	2	TSTR:SI NPN(SIMILAR TO 2N3053)	28480	1854-0090
A8Q2	1854-0087	2	TSTR:SI NPN	80131	2N3417
A8Q3	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A8Q4	1854-0039		TSTR:SI NPN	80131	2N3053
A8Q5	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A8Q6	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A8Q7	1854-0039		TSTR:SI NPN	80131	2N3053
A8Q8	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A8Q9	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A8Q10	1854-0090		TSTR:SI NPN(SIMILAR TO 2N3053)	28480	1854-0090
A8Q11	1854-0087		TSTR:SI NPN	80131	2N3417
A8Q12	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A8R1	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	14674	ORDER BY DESCRIPTION
A8R2	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	14674	ORDER BY DESCRIPTION
A8R3	0757-0407		R:FXD MET FLM 200 OHM 1% 1/8W	14674	ORDER BY DESCRIPTION
A8R4	0757-0848	3	R:FXD MET FLM 30.1K OHM 1.0% 1/2W	28480	0757-0848
A8R5	0757-0200		R:FXD MET FLM 5.62K OHM 1% 1/8W	14674	ORDER BY DESCRIPTION
A8R6	0757-0438		R:FXD MET FLM 5.11K 1% 1/8W	14674	ORDER BY DESCRIPTION
A8R7	0757-0764		R:FXD FLM 33.2K OHM 1% 1/4W	28480	0757-0764
A8R8	0757-0388		R:FXD FLM 30.1 OHM 1% 1/8W	28480	0757-0388
A8R9	0757-0200		R:FXD MET FLM 5.62K OHM 1% 1/8W	14674	ORDER BY DESCRIPTION
A8R10	2100-1774	1	R:VAR WW 2K OHM 5% TYPE H 1W	28480	2100-1774
A8R11	0757-0855	1	R:FXD MET FLM 68.1K OHM 1% 1/2W	28480	0757-0855
A8R12	0757-0388		R:FXD FLM 30.1 OHM 1% 1/8W	28480	0757-0388
A8R13	0757-0044	1	R:FXD MET FLM 33.2K OHM 1% 1/2W	28480	0757-0044
A8R14	0811-1746	2	R:FXD WW 0.36 OHM 5% 2W	28480	0811-1746
A8R15	0757-0463		R:FXD MET FLM 82.5K 1% 1/8W	14674	ORDER BY DESCRIPTION
A8R16	0757-0480	1	R:FXD FLM 432K OHM 1% 1/8W	28480	0757-0480
A8R17	0757-0434		R:FXD MET FLM 3.65K OHM 1% 1/8W	28480	0757-0434
A8R18	2100-1772	2	R:VAR WW 500 OHM 5% TYPE H 1W	28480	2100-1772

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
A8R19	0757-0060		R:FXD MET FLM 24.3K OHM 1% 1/2W	28480	0757-0060
A8R20	0757-0388		R:FXD FLM 30.1 OHM 1% 1/8W	28480	0757-0388
A8R21	0757-0848		R:FXD MET FLM 30.1K OHM 1.0% 1/2W	28480	0757-0848
A8R22	0811-1746		R:FXD WW 0.36 OHM 5% 2W	28480	0811-1746
A8R23	0757-0965	1	R:FXD FLM 51K 2% 1/8W	14674	ORDER BY DESCRIPTION
A8R24	0757-0477	1	R:FXD MET FLM 332K OHM 1% 1/8W	28480	0757-0477
A8R25	0757-0434		R:FXD MET FLM 3.65K OHM 1% 1/8W	28480	0757-0434
A8R26	2100-1772		R:VAR WW 200 OHM 5% TYPE H 1W	28480	2100-1772
A8R27	0757-0060		R:FXD MET FLM 24.3K OHM 1% 1/2W	28480	0757-0060
A8R28	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	14674	ORDER BY DESCRIPTION
A8R29	0757-0399	1	R:FXD MET FLM 12.5 OHM 1% 1/8W	28480	0757-0399
A8R30	0757-0848		R:FXD MET FLM 30.1K OHM 1.0% 1/2W	28480	0757-0848
A8R31	0757-0200		R:FXD MET FLM 5.62K OHM 1% 1/8W	14674	ORDER BY DESCRIPTION
A8R32	0757-0764		R:FXD FLM 33.2K OHM 1% 1/4W	28480	0757-0764
A8R33	0757-0465		R:FXD MET FLM 100K 1% 1/8W	14674	ORDER BY DESCRIPTION
A8R34	0757-0388		R:FXD FLM 30.1 OHM 1% 1/8W	28480	0757-0388
A8R35	0757-0435	1	R:FXD FLM 3920 OHM 1% 1/8W	28480	0757-0435
A8R36	2100-1773		R:VAR WW 1K OHM 5% TYPE H 1W	28480	2100-1773
A8R37	0698-3416		R:FXD MET FLM 21.5K OHM 1% 1/2W	28480	0698-3416
A8TP1	1251-0206		CONNECTOR:SOCKET (TEST JACK)	98291	SKT-400
A8TP2	1251-0206		CONNECTOR:SOCKET (TEST JACK)	98291	SKT-400
A8TP3	1251-0206		CONNECTOR:SOCKET (TEST JACK)	98291	SKT-400
A8TP4	1251-0206		CONNECTOR:SOCKET (TEST JACK)	98291	SKT-400
A8V1	1940-0025	2	ELECTRON TUBE:VOLTAGE REF. 83.0V+/-1.0V	74276	Z833A
A8V2	1940-0025		ELECTRON TUBE:VOLTAGE REF. 83.0V+/-1.0V	74276	Z833A
A8VR1	1902-3096	1	DIODE BREAKDOWN:5.23V 5% 400 MW	28480	1902-3096
A8VR2	1902-3354	2	DIODE BREAKDOWN:54.9V 5% 400 MW	28480	1902-3354
A8VR3	1902-3354		DIODE BREAKDOWN:54.9V 5% 400 MW	28480	1902-3354
A9	00181-61104	1	ASSY:HIGH VOLTAGE TRIPLER BOARD (RACK)	28480	00181-61104
A9	00181-61103	1	ASSY:HIGH VOLTAGE TRIPLER BOARD (CABINET)	28480	00181-61103
A9C1			N.S.R. PART OF A9		
A9C2			N.S.R. PART OF A9		
A9C3			N.S.R. PART OF A9		
A9C4			N.S.R. PART OF A9		
A9CR1			N.S.R. PART OF A9		
A9CR2			N.S.R. PART OF A9		
A9CR3			N.S.R. PART OF A9		
A9R1			N.S.R. PART OF A9		
A9R2			N.S.R. PART OF A9		
A10	00181-66517	1	ASSY:MODE SWITCH	28480	00181-66517
A10C1	0160-0168		C:FXD MY 0.1 UF 10% 200VDCW	56289	192P10492-PTS
A10C2	0160-3443	1	C:FXD CER 0.1 UF +80-20% 50 VDCW	72982	8131-050-651-104Z
A10C3	0180-1746	3	C:FXD ELECT 15 UF 10% 20 VDCW	56289	0180-1746
A10C4	0180-0197		C:FXD ELECT 2.2 UF 10% 20 VDCW	56289	150D225X9020A2-DYS
A10CR1	1901-0418		DIODE:SILICON 400PIV 1N5000	04713	1N5000
A10CR2	1901-0040		DIODE:SI 30 MA 30 WV	07263	FDG1088
A10CR3	1901-0028	1	DIODE:SI 0.75A 400 PIV	04713	SR 1358-9
A10Q1	1854-0215	1	TSTR:SI NPN	80131	2N3904
A10Q2	1854-0215		TSTR:SI NPN	80131	2N3904
A10Q3	1854-0232		TSTR:SI NPN (SELECTED FROM 2N3440)	28480	1854-0232
A10Q4	1853-0336		TSTR:SI PNP	04713	SPS 6781
A10R1	0684-1021	3	R:FXD COMP 1K OHM 10% 1/4W	01121	CB 1021
A10R2	0684-1021		R:FXD COMP 1K OHM 10% 1/2W	01121	CB 1021
A10R3	0684-1021		R:FXD COMP 1K OHM 10% 1/2W	01121	CB 1021
A10R4	0684-1041		R:FXD COMP 100K OHM 10% 1/4W	01121	CB 1041
A10R5	0684-5631		R:FXD COMP 56K OHM 10% 1/4W	01121	CB5631
A10R6	0684-5631		R:FXD COMP 56KOHM 10% 1/4W	01121	CB5631
A10R7	0684-1541		R:FXD COMP 150K OHM 10% 1/4W	01121	CB 1541
A10R8	0684-2231		R:FXD COMP 22K OHM 10% 1/4W	01121	CB 2231
A10R9	0684-2231		R:FXD COMP 22K OHM 10% 1/4W	01121	CB 2231
A10R10	0684-1541		R:FXD COMP 150K OHM 10% 1/4W	01121	CB 1541
A10R11	0684-5631		R:FXD COMP 56K OHM 10% 1/4W	01121	CB 5631
A10S1	3101-1167		SWITCH	28480	3101-1167
A11	00180-61904		ASSY:SWITCH DISPLAY	28480	00180-61904
A11C6	0160-0168		C:FXD MY 0.1 UF 10% 200VDCW	56289	192P10492-PTS
A11L1	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A11R1			N.S.R. PART OF A11S1		
A11S1	3100-1344		SWITCH:ROTARY, DISPLAY	28480	3100-1344

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
C1	0180-1808		C:FXD ELECT 450 UF +50-10% 200VDCW	56289	32D431F200AC2A/DQC
C2	0180-1865		C:FXD ELECT 2100 UF +75-10% 40VDCW	56289	32D212G040AB2A-DQC
C3	0180-1809		C:FXD ELECT 3400 UF +75-10% 25VDCW	56289	32D342G025AB2A-DQC
C4	0180-1807		C:FXD ELECT 290 UF +50-10% 200VDCW	56289	32D291F200AB2A-DQC
C5	0170-0022		C:FXD MY 0.1UF 20% 600VDCW	09134	TYPE 24
C6		1	DELETED		
C7	0160-3484	1	C:FXD CER 1000 PF 20% 1000VDCW	72982	2432
C8	0160-3484	1	C:FXD CER 1000 PF 20% 1000VDCW	72982	2432
CR1	1901-0040	1	DIODE:SILICON 30MA 30WV	07263	FDH1088
DS1	2140-0245	1	LAMP:INCANDESCENT 28V 0.04A	71744	CM 387
E1	1200-0043	2	INSULATOR:TRANSISTOR MOUNTING	71785	293011
E2	00181-00601	1	SHIELD:CRT	28480	00181-00601
E3	5020-0496	152	PIN: SQUARE	28480	5020-0495
E4	0362-0116	10	TERMINAL: CRIMP, 18 GA (USED WITH E3)	91886	2611225-6
E5	1251-2039	28	CONNECTOR:TEST POINT, CORD JACK	28480	1251-2039
E6	0362-0264	113	TERMINAL: CRIMP, 24 GA. (USED WITH E3)	91886	2611225-14
E7	1251-2039	9	TERMINAL: CRIMP (USED ON CRT NECK PINS)	07567	3367-1-03
F1	2110-0006	2		75915	313002
F2	2110-0007	1	FUSE:CARTRIDGE 2.0 AMP (SLOW-BLOW)	75915	313001
F3	2110-0012	1	FUSE:CARTRIDGE 1.0 AMP (SLOW-BLOW)	75915	312500
F4	2110-0002	3	FUSE:CARTRIDGE 0.5 AMP	75915	312002
F5	2110-0002	3	FUSE:CARTRIDGE 2 AMP	75915	312.002
F6	2110-0067	1	FUSE:CARTRIDGE 2 AMP	28480	2110-0067
F7	2110-0012		FUSE:0.3AG 250V	28480	2110-0012
H1	00180-09105		FUSE:CARTRIDGE 0.5A	28480	00180-09105
H2	00180-09104	1	CLIP:GROUND	28480	00180-09104
H3	00180-44701	1	CLIP:GROUND	28480	00180-44701
H4	00180-24702	1	SPACER:TRADEMARK	28480	00180-24702
H5	1400-0091	8	STANDOFF:GATE BOARD	37942	TH25
H6	00180-24701	4	CLIP:COMPONENT FOR 1-3/8" DIA	28480	00180-24701
H7	1400-0090	2	STANDOFF:TRANSFORMER	00000	080
H8	2950-0038	2	WASHER:RUBBER 5/8" OD	75915	903-12
H9	0570-0031	1	NUT:HEX SST 1/2-24 X 11/16	00000	080
H10	0380-0724	2	SCREW:NYLON	00000	0808
H11	1205-0063	1	SPACER:POST TYPE	05820	NF224
H12	5040-0464	1	HEAT SINK:SEMICONDUCTOR	28480	5040-0464
H13	5060-0767	5	HANGER:PROBE	28480	5060-0767
H14	00180-41208	1	FOOT ASSY: (RACK PART)	28480	00180-41208
J1	1251-2357	1	CLIP:HORIZONTAL (RACK PART)	87930	1251-2357
J2	1510-0038	1	CONNECTOR:POWER 3 PIN MALE	28480	1510-0038
J3	00180-27601	1	BINDING POST	02660	26-4200-325
J4	1250-0083	1	RECEPTACLE:32 CONTACT	02660	31-221-1020
J5	1250-0083	6	CONNECTOR:BNC	02660	31-221-1020
J6	1250-0083		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	00180-21702		CONNECTOR:BNC	02660	31-221-1020
J11	0363-0006	1	CONNECTOR:BANANA, FEMALE	28480	00180-21702
L1		2	CONTACT:CONNECTOR, VERTICAL, PLUG-IN	28480	0363-0006
L2	5060-0443		DELETED		
L3	00191-66004	1	COIL:TRACE ALIGNMENT	28480	5060-0443
L4	9170-0013	1	COIL:ALIGNMENT, Y AXIS	28480	00191-66004
L5	9170-0013	2	COIL:CORE, TOROID, GREEN	72656	CF-102-N
MP1	00180-04134		COIL:CORE, TOROID, GREEN	72656	CF-102-N
MP2	00180-04130	1	COVER:TOP RIGHT (CABINET PART)	28480	00180-04134
MP3	00180-04136	1	COVER:BOTTOM RIGHT (CABINET PART)	28480	00180-04130
MP4	00180-04132	1	COVER:TOP LEFT (CABINET PART)	28480	00180-04136
MP5	5020-0476	1	COVER:BOTTOM LEFT (CABINET PART)	28480	00180-04132
MP6	10178A	1	BEZEL	28480	5020-0476
MP7	5040-0444	1	FILTER:CONTRAST	28480	10178A
		1	SHIELD:LIGHT, BLACK NYLON	28480	5040-0444

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
MP8		1	NOT USED		
MP9		1	NOT USED		
MP10	5040-0463	2	HANGER:PROBE (CABINET PART)	28480	5040-0463
MP11	5020-0499	2	HINGE:PROBE HANGER (CABINET PART)	28480	5020-0499
MP12	0510-0705	1	PIN:SPRING	00287	0BD#
MP13	1460-0706	6	SPRING:COMPRESSION (CABINET PART)	00000	0BD#
MP14	3050-0441	1	WASHER:SHOULDER	28480	3050-0441
MP15	0510-0952	6	RING:RETAINING	79136	XSE33-9-5-MD
MP16	00180-67405	1	KNOB:RND BLK (FIND BEAM)	28480	00180-67405
MP17	0370-0348	2	KNOB:RND BLK	28480	0370-0348
MP18	01201-67401	1	PUSHBUTTON (ERASE)	28480	01201-67401
MP19	00181-67402	1	PUSHBUTTON (MAX WRITE)	28480	00181-67402
MP20	01331-67402	1	PUSHBUTTON ASSY (WRITE)	28480	01331-67402
MP21	00181-67401	1	PUSHBUTTON (NORM)	28480	00181-67401
MP22	01331-67403	1	PUSHBUTTON (VIEW)	28480	01331-67403
MP23	01331-67404	1	PUSHBUTTON ASSY (STORE)	28480	01331-67404
MP24	0370-0451	5	BEZEL:PUSHBUTTON KNOB BLK NYLON	28480	0370-0451
MP25	00180-45403	3	INSULATOR:BUSHING, CALIBRATOR	28480	00180-45403
MP26	00180-67402	2	KNOB ASSY:POSITION	28480	00180-67402
MP27	0370-0432	1	KNOB:LEVER	28480	0370-0432
MP28	00180-05002	1	LEVER:HORIZONTAL POSITION	28480	00180-05002
MP29	00180-67404	2	KNOB ASSY:BAR WITH BLACK ARROW	28480	00180-67404
MP30	00181-00201	1	PANEL:FRONT	28480	00181-00201
MP31	00181-00202	1	PANEL:FRONT SUB	28480	00181-00202
MP32	00182-00601	1	SHIELD:LINE FILTER	28480	00182-00601
MP33	00180-01246	1	BRACKET:GROUND LINE FILTER	28480	00180-01246
MP34	00182-01208	1	BRACKET:LINE FILTER (CAP)	28480	00182-01208
MP35	00181-00209	1	PANEL:REAR DISPLAY (INCLUDES J1 AND MP32)	28480	00181-00209
MP36	5040-0447	2	FOOT:REAR(LONG) (CABINET PART)	28480	5040-0447
MP37	00180-01206	1	BRACKET:TRANSISTOR	28480	00180-01206
MP38	5040-0446	2	FOOT:REAR, SHORT (CABINET PART)	28480	5040-0446
MP39	4320-0231	1	RUBBER:RFI	00000	0BD#
MP40	5040-0445	2	FOOT:BOTTOM (CABINET PART)	28480	5040-0445
MP41	1490-0710	1	STAND:TILT (CABINET PART)	28480	1490-0710
MP42	00180-24728	1	SPACER:FRONT (CABINET PART)	28480	00180-24728
MP43	00180-24726	2	SPACER:SIDE (CABINET PART)	28480	00180-24726
MP44	00180-24727	1	SPACER:REAR (CABINET PART)	28480	00180-24727
MP45	5040-0459	1	HANDLE	28480	5040-0459
MP46	0403-0128	1	GUIDE:PLUG-IN LEFT	28480	0403-0128
MP47	0403-0129	1	GUIDE:PLUG-IN RIGHT	28480	0403-0129
MP48	00180-01209	1	BRACKET:CONNECTOR PLUG-IN	28480	00180-01209
MP49	00180-60117	1	CHASSIS:DISPLAY (CABINET PART)	28480	00180-60117
MP50	00180-60116	1	CHASSIS:POWER (CABINET PART)	28480	00180-60116
MP51	00180-61104	1	TRANSISTOR:HEAT SINK LH	28480	00180-61104
MP52	00180-61103	1	TRANSISTOR:HEAT SINK RH	28480	00180-61103
MP53	00180-41207	2	BRACKET:PLASTIC, CRT	28480	00180-41207
MP54	00180-01210	1	BRACKET:TRANSFORMER (FRONT)	28480	00180-01210
MP55	00180-01214	1	BRACKET:TRANSFORMER (FRONT)	28480	00180-01214
MP56	0400-0010	2	GROMMET:VINYL 0.250" ID	00000	0BD#
MP57	1400-0026	1	CLAMP:STAINLESS STEEL	66295	3BH
MP58	00181-00601		SHIELD:CRT	28480	00181-00601
MP59	00181-00602	1	SHIELD:CALIBRATOR	28480	00181-00602
MP60	00181-01201	1	BRACKET:CRT CLAMP	28480	00181-01201
MP61	00180-04128	1	COVER:PLATE HVPS	28480	00180-04128
MP62	00180-25402	1	PLEXIGLASS:HV	28480	00180-25402
MP63	00180-24718	2	SPACER:HANDLE (CABINET PART)	28480	00180-24718

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
MP64	00180-22301	2	KEEPER:HANDLE (CABINET PART)	28480	00180-22301
MP65	00180-09103	2	SPRING:INSERT (CABINET PART)	28480	00180-09103
MP66	00180-07201	2	INSERT:KEEPER (CABINET PART)	28480	00180-07201
MP67	00181-00211	1	PANEL:REAR, POWER	28480	00181-00211
MP68	00180-01212	1	BRACKET:CAPACITOR	28480	00180-01212
MP69	00181-04101	1	COVER:FUSE	28480	00181-04101
MP70	00180-01215	1	BRACKET:TRANSFORMER (REAR)	28480	00180-01215
MP71	00180-01211	1	BRACKET:TRANSFORMER (REAR)	28480	00180-01211
MP72	00180-04703	1	SUPPORT:TRANSFORMER	28480	00180-04703
MP73	00180-23701	2	SHAFT:BEAM FINDER	28480	00180-23701
MP74	5040-0453	1	COVER:POTENTIOMETER(FOCUS)	28480	5040-0453
MP75	00180-24301	1	NUT:HORIZONTAL POSITION POT	28480	00180-24301
MP76	00181-01202	1	BRACKET:CRT CONTROL MOUNTING	28480	00181-01202
MP77	00181-23201	2	COUPLER:SHAFT	28480	00181-23201
MP78	00180-01249	1	BRACKET:VERTICAL LEADS (CABINET PART)	28480	00180-01249
MP79			NOT USED		
MP80	00180-04138	1	COVER:TOP (RACK PART)	28480	00180-04138
MP81	00180-64110	1	COVER:BOTTOM (RACK PART)	28480	00180-64110
MP82	00180-04137	2	COVER:SIDE (RACK PART)	28480	00180-04137
MP83	5060-0431	2	FRAME ASSY:SIDE (RACK PART)	28480	5060-0431
MP84	00180-01217	2	BRACKET:COVER (RACK PART)	28480	00180-01217
MP85	5000-0051	2	TRIM STRIP (RACK PART)	28480	5000-0051
MP86	00180-00601	1	SHIELD:POST ACCELERATOR (RACK PART)	28480	00180-00601
MP87	5060-0552	1	KIT:5 H RACK MOUNT (RACK PART)	28480	00180-0552
MP88	5000-0449	1	SPACER:FRONT (RACK PART)	28480	5000-0449
MP89	5000-0469	1	SPACER:REAR (RACK PART)	28480	5000-0469
MP90	00180-60103	1	CHASSIS ASSY:DISPLAY (RACK PART)	28480	00180-60103
MP91	00180-60104	1	CHASSIS ASSY:POWER (RACK PART)	28480	00180-60104
MP92	1490-0030	1	STAND:TILT (RACK PART)	28480	1490-0030
MP93	00180-01250	1	BRACKET:VERTICAL LEADS (RACK PART)	28480	00180-01250
MP94	7120-1254	1	TRADEMARK (HP)	28480	7120-1254
MP95	1200-0037	1	SOCKET:CRT TUBE	72825	97097
MP96	1200-0050	7	CONTACT:CRT SOCKET	72825	9553-1
MP97	1200-0408	1	COVER:CRT SOCKET	28480	1200-0408
MP98	5060-0548	1	KIT,CONTRAST FILTER' BLUE	28480	5060 0548
Q1	1854-0063	4	TSTR:SI NPN	80131	2N3055
Q2	1854-0063		TSTR:SI NPN	80131	2N3055
Q3	1854-0063		TSTR:SI NPN	80131	2N3055
Q4	1854-0063		TSTR:SI NPN	80131	2N3055
Q5	1854-0291	1	TSTR:SI NPN	28480	1854-0291
R1			DELETED		
R2	2100-3287	1	R:VAR COMP 2 X 100K OHM 20% LIN	28480	2100-3287
R3			N.S.R. PART OF R2		
R4	2100-2602	1	R:VAR COMP 10K OHM 20% LIN 1/4W	28480	2100-2602
R5	2100-2563	1	R:VAR COMP 5 MEGOHM 20% LIN 1/2W	28480	2100-2563
R6	0683-1045	1	R:FXD COMP 100K OHMS 5% 1/4W	01121	CB 1045
R7	2100-1717	1	R:VAR COMP 50K OHM 20% LIN 1/2W	28480	2100-1717
R8	2100-2086	1	R:VAR COMP 5K OHM 20% LIN 1/2W	28480	2100-2086
R9	2100-2608	1	R:VAR COMP 10K OHM 20% LOG 1/4W	28480	2100-2608
S1			DELETED		
S2	3101-0070	1	SWITCH:SLIDE	79727	G-126
S3	3101-0977	2	SWITCH:PUSHBUTTON DPDT	82389	12S-1032
S4	3100-1345	1	SWITCH:ROTARY 1 SECTION 3 POSITION	28480	3100-1345
S5	3101-0965	1	SWITCH:PUSHBUTTON SPDT (INCLUDES DS1)	87034	54-61681-27-387
S6	3101-1237	1	SWITCH:SLIDE DPDT (115/230V OPERATION)	82389	3101-1237

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
S7	3101-0977		SWITCH:PUSHBUTTON DPDT (ERASE)	82389	12S-1032
T1	9100-1117	1	TRANSFORMER:POWER	28480	9100-1117
V1	5083-1972	1	CATHODE RAY TUBE:STANDARD	28480	5083-1972
V1	5083-1971	1	CATHODE RAY TUBE:(NON-GRATICULE) OPTION 631	28480	5083-1971
W1	8120-1521	1	CABLE ASSY:POWER CORD	28480	8120-1521
W2	00181-61617	1	CABLE ASSY:T1 (181A ONLY)	28480	00161-61617
W2	00181-61620	1	CABLE ASSY:T1 (181AR ONLY)	28480	00181-61620
W3	00180-61616	1	CABLE ASSY:COAX, DISPLAY SWITCH (CABINET)	28480	00180-61616
W3	00180-61617	1	CABLE ASSY:COAX, DISPLAY SWITCH (RACK)	28480	00180-61617
W4			NOT ASSIGNED		
W5	00180-61657	1	CABLE ASSY:HORIZONTAL MAGNIFIER	28480	00180-61657
W6	00181-61605	1	CABLE:HORIZONTAL CRT CONNECTION (CABINET)	28480	00181-61605
W6	00181-61606	1	CABLE:HORIZONTAL CRT CONNECTION (RACK)	28480	00181-61606
W7			NOT ASSIGNED		
W8	00180-61685	1	CABLE:CRT VERTICAL	28480	00180-61685
W9			NOT ASSIGNED		
W10			NOT ASSIGNED		
W11	00181-61613	1	CABLE:SWEEP, GATE OUTPUT	28480	00181-61613
W12	00180-61682	1	CABLE ASSY:T1 PRIMARY (INCLUDES L4)	28480	00180-61682
W13	00180-61683	1	CABLE ASSY:LINE (INCLUDES L5)	28480	00180-61683
W14	00181-61633	1	CABLE ASSY:MAIN HARNESS (CABINET)	28480	00181-61633
W14	00181-61634	1	CABLE ASSY:MAIN HARNESS (RACK)	28480	00181-61634
W15			NOT ASSIGNED		
W16	00180-61653	1	CABLE ASSY:LOW VOLTAGE POWER SUPPLY	28480	00180-61653
W17	00181-61617	1	CABLE ASSY:LOW VOLTAGE TRANSFORMER	28480	00181-61617
W18	00180-61652	1	CABLE:COAX, DISPLAY	28480	00180-61652
XF1	1400-0084	2	FUSEHOLDER:EXTRACTOR POST TYPE	75915	342014
XF2	1400-0084		FUSEHOLDER:EXTRACTOR POST TYPE	75915	342014
XF3	1400-0123	2	FUSEHOLDER:3 POLE FOR 1/4" DIA	75915	35 7003
XF4	1400-0123		FUSEHOLDER:3 POLE FOR 1/4" DIA	75915	35 7003
XF5	1400-0083	1	FUSEHOLDER:BRONZE CLIP	95915	3510-11
XQ1	1200-0041	5	SOCKET:TRANSISTOR	71785	133-32-10-013
XQ2	1200-0041		SOCKET:TRANSISTOR	71785	133-32-10-013
XQ3	1200-0041		SOCKET:TRANSISTOR	71785	133-32-10-013
XQ4	1200-0041		SOCKET:TRANSISTOR	71785	133-32-10-013
XQ5	1200-0041		SOCKET:TRANSISTOR	71785	133-32-10-013

Table 6-3. List of Manufacturers' Codes

MFR. NO.	MANUFACTURER NAME	ADDRESS	ZIP CODE
00287	CEMCO, INC.	DANIELSON, CT.	06239
01121	ALLEN BRADLEY CO	MILWAUKEE, WI.	53212
01295	TEXAS INSTRUMENTS, INC.	DALLAS, TX.	75231
02660	BUNKER RAMO CORP.	BROAD VIEW, IL.	60153
04062	ELECTRO MOTIVE MFG. CO.	WILLIMATIC, CT.	06226
04713	MOTOROLA INC.	PHOENIX, AZ.	85036
05820	WAKEFIELD ENGINEERING INC.	WAKEFIELD, MA.	01880
07263	FAIRCHILD CAMERA	MOUNTAIN VIEW, CA.	94040
07557	CAMPION CO. INC.	PHILADELPHIA, PA.	19102
08806	GE MINIATURE LAMP DIV	CLEVELAND, OH.	44112
09134	TEXAS CAPACITOR CO.	HOUSTON, TX.	77036
14674	CORNING GLASS WORKS	CORNING, NY.	14830
17856	SILICONIX, INC.	SANTA CLARA, CA.	95050
19701	MEPCO/ELECTRA CORP.	MINERAL WELLS, TX.	76067
37942	P.R. MALLORY & CO	INDIANAPOLIS, IN.	46206
56289	SPRAGUE ELECTRIC CO.	N. ADAMS, MA.	01247
66295	WITTEK MFG. CO.	CHICAGO, IL.	60623
71744	CHICAGO MINIATURE LAMP WORKS	CHICAGE, IL.	60640
71785	CINCH MFG. CO.	CHICAGO, IL.	60007
72656	INDIANA GENERAL CORP.	KEASBY, N.J.	08832
72925	HUGH EBY INC.	PHILADELPHIA, PA.	19144
72982	ERIE TECHNOLOGICAL PROD. INC.	ERIE, PA.	16512
73138	HELIPOT DIV. OF BECKMAN INC.	FULLERTON, CA.	92634
74276	SIGNALITE, INC.	NEPTUNE, NJ.	07753
75042	TRW, INC	PHILADELPHIA, PA.	19108
75915	LITTLEFUSE, INC.	DES PLAINES, IL.	60016
78136	WALDES KOHINOOR, INC.	LONG ISLAND CITY, NY.	11101
79727	C/W INDUSTRIES	WARMINISTER, PA.	18974
80131	ELECTRONIC INDUSTRIES ASSN.	WASHINGTON, DC.	20006
82389	SWITCHCRAFT, INC.	CHICAGO, IL.	60630
87034	MARCO INDUSTRIES	ANAHEIM, CA.	92803
87930	TOWER MFG. CORP.	PROVIDENCE, R.I.	02903
91418	RADIO MATERIALS CO.	CHICAGO, IL.	60646
91637	DALE ELECTRONICS, INC.	COLUMBUS, NE.	68601
91506	MALCO MFG., INC.	CHICAGO, IL.	60650
95015	SJ OGREN TOOL & MACHINE CO.	AUBURN, MA.	01501
98291	SEALECTRO CORP.	MAMARONECH, NY.	10544

BACK DATING MANUAL CHANGES

SECTION VII

MANUAL CHANGES AND OPTIONS

7-1. INTRODUCTION.

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

7-3. MANUAL CHANGES.

7-4. This manual applies directly to the instrument with the 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 the 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
748	16 thru 1
811	16 thru 2
814	16 thru 3
827	16 thru 4
838	16 thru 5
840	16 thru 6
923	16 thru 7
936	16 thru 8
961 - (181A)	16 thru 9
962 - (181AR)	16 thru 9
977 - (181A)	16 thru 10
978 - (181AR)	16 thru 10
989 - (181A)	16 thru 11
996	16 thru 12
997	16 thru 12
1130A	16 thru 13
1144A	16 thru 13
1219A	16 thru 13
1221A	16 thru 13
1230A	16 thru 14
1252	16 thru 14
1308A	16 thru 14
1313A - (181A)	16 thru 15
1315A - (181AR)	16 thru 15
1324A - (181A)	16
1337A - (181AR)	16

CHANGE 1

Table 6-2,
A10: Change to HP Part No. 00181-66506.
F1: Change to HP Part No. 2110-0021; 1.25 A.
F2: Change to HP Part No. 2110-0016; 0.6 A.
MP67: Change to HP Part No. 00181-00206.
Delete: A10, A10CR1, A10C1, A10R1, A10R2, A10R3, A10S1.
Figure 8-13,
Replace with Figure 7-1.
Figure 8-14,
Replace with Figure 7-2.

CHANGE 2

Table 6-2,
CR1: Delete.
Figure 8-19,
CR1: Delete.

CHANGE 3

Table 6-2,
A1: Change to HP Part No. 00181-66501.
A1L1, A1L2: Change to HP Part No. 9140-0047; L: FXD 20 μH.
A1R52: Change to HP Part No. 0684-1531; R: FXD COMP 15K OHMS 10% 1/4W.
A1R58: Delete.
Figure 8-19,
A1R52: Change value to 15K OHMS.
A1R58: Delete.

CHANGE 4

Table 6-2,
A1R58: Change to HP Part No. 0757-0280; R: FXD METFLM 1K OHM 1% 1/8W.
Figure 8-19,
A1R58: Change value to 1000 OHMS.

CHANGE 5

Table 6-2,
A6R16: Change to HP Part No. 0757-0485; R: FXD METFLM 51.1K OHMS 1% 1/8W.
A6R19: Change to HP Part No. 0757-0767; R: FXD METFLM 43.2K OHMS 1% 1/4W.
Figure 8-16,
A6R16: Change value to 51.1K OHMS.
A6R19: Change value to 43.2K OHMS.

CHANGE 6

Page 5-7,
Delete paragraph 5-38.
Page 5-8,
Delete paragraph 5-39.
Figures 5-3 and 8-4,
A1R59: Delete. CALIB. FREQ. ADJ.
Table 6-2,
A1: Change to HP Part No. 00181-66511.
A1R29, A1R30: Change to HP Part No. 0757-0468; R: FXD METFLM 130K OHMS 1% 1/8W.
A1R33: Change to HP Part No. 0757-0407; R: FXD METFLM 200 OHMS 1% 1/8W.
A1R34: Change to HP Part No. 0757-0760; R: FXD METFLM 20K OHMS 1% 1/4W.
A1R59: Delete.
Figure 8-7,
A1R29, A1R30: Change value to 130K OHMS.
A1R33: Change value to 200 OHMS.
A1R34: Change value to 20K OHMS.
A1R59: Delete, make ground connection to bottom end of A1R29 and A1R30.

CHANGE 7

Table 6-2,
Delete: C7, C8, C9, L4, L5, MP1, MP3, MP32, MP33, MP34, MP35, MP40, MP78, MP93, W10, W12, W13, W14, W15.
Add: 5000-0447; COVER: BOTTOM RIGHT.
5000-0448; SLIDE: LATCH.
MP2: Change to HP Part No. 5000-0448.
MP4: Change to HP Part No. 5000-0539.
MP35: Change to HP Part No. 00180-00205.
MP43: Change to HP Part No. 5020-0481.
MP44: Change to HP Part No. 5020-0480.
MP45: Change to HP Part No. 5020-0502.
MP46: Change to HP Part No. 00180-43101.
MP47: Change to HP Part No. 00180-43102.
MP49: Change to HP Part No. 00180-60101.
MP50: Change to HP Part No. 00180-60102.
MP67: Change to HP Part No. 00180-00203.
MP81: Change to HP Part No. 5000-0455.
W2: Change to HP Part No. 00180-61603.
W8: Change to HP Part No. 00180-61604.
W9: Change to HP Part No. 00180-61605.
A1C12: Change to HP Part No. 0180-0039, C: FXD 100 µF 12 VDCW.
A3R3: Change to HP Part No. 0757-0399, R: FXD METFLM 82.5 OHMS 1% 1/8W.
Figure 8-7,
A1CR8: Delete connection to emitter of A1Q3 and connect to +100 VF.
C12: Change value to 100 µF.
Figure 8-19,
Delete: C9.
Figure 8-22,
Revise power input circuit as shown in Figure 7-3.
A8R3: Change value to 82.5 OHMS.

CHANGE 8

Figure 8-22,
Delete connections between T1-1 to J3-10 and T1-8 to J3-26.
Figure 8-23,
Delete connections between T1-1 to J3-10 and T1-8 to J3-26.

CHANGE 9

Table 6-2,
MP16: Change to HP Part No. 0370-0350.
MP18: Change to HP Part No. 0370-0454.
MP19: Change to HP Part No. 0370-0456.
MP20: Change to HP Part No. 0370-0457.
MP21: Change to HP Part No. 0370-0455.
MP22: Change to HP Part No. 0370-0452.
MP23: Change to HP Part No. 0370-0458.
A2L1, A2L2: Change to HP Part No. 9140-0047, L: FXD 20 µH.
A8R35: Change to HP Part No. 0757-0436, R: FXD METFLM 4.32K OHMS 1% 1/8W.
A8V1, A8V2: Change to HP Part No. 1940-0013, V: voltage reference 82 ±1.0V.
Figure 8-7, Schematic,
L1, L2: Change value to 20 µH.
Figure 8-23,
A8R35: Change value to 4320 OHMS.
A8V1, V2: Change value to 82V.

CHANGE 10

Table 6-2,
Delete: A3C22, A3R55, A3R56, A3R57.
Add: A3L2; L: FXD 22 µH.
Change: Parts as shown in Table 7-2.
Figure 8-11,
Revise Schematic as shown in Figure 7-4.

Table 7-2. Change 10, HP Part Numbers

Reference Designator	Change to HP Part Number	Description
A3	00181-66507	A: HORIZONTAL AMPLIFIER BOARD
A3C1	0150-0075	C: FXD CER 4700 PF
A3C2	0131-0004	C: VAR MICA 16-150 PF
A3C3	0140-0231	C: FXD MICA 440 PF
A3R1	0757-0465	R: FXD METFLM 100K OHMS 1% 1/8W

Table 7-2. Change 10, HP Part Numbers

Reference Designator	Change to HP Part Number	Description
A3R2	0757-0344	R: FXD METFLM 1 MEGOHM 1% 1/4W
A3R4	0761-0076	R: FXD METFLM 18K OHMS 5% 1W
A3R5	0757-0282	R: FXD METFLM 221 OHMS 1% 1/8W
A3R6	0757-0847	R: FXD METFLM 27.4K OHMS 1% 1/2W
A3R7	2100-1418	R: VAR CAR COMP 50K OHMS 20% 1/2W
A3R8	0757-0440	R: FXD METFLM 7.5K OHMS 1% 1/8W
A3R9	0698-5420	R: FXD METFLM 3.87K OHMS 1% 1/8W
A3R53	2100-2030	R: VAR 20K OHMS 30% LIN
A3Q1	1855-0020	TSTR: FET
A3Q2	1854-0083	TSTR: SI NPN
A3CR1	1901-0096	DIODE: SI
MP49	00180-00113	CHASSIS: DISPLAY
MP50	00180-00114	CHASSIS: POWER

CHANGE 11

Table 6-2,
Add: MP98; HP Part No. 5020-0549, POWER PLUG SPACER.
Change: Parts as shown in Table 7-3.

Figure 6-1,
Replace with Figure 7-5.

Figure 8-23,
F1: Change value to 1.6 AMP.
F2: Change value to 0.8 AMP.

Table 7-3. Change 11, HP Part Number Changes

Reference Designator	Change to HP Part Number	Description
F1	2110-0005	FUSE: 1.6 AMP (SLOW BLOW)
F2	2110-0020	FUSE: 0.8 AMP (SLOW BLOW)
J1	1251-0148	CONNECTOR: POWER
MP32	5020-0550	SHIELD: LINE FILTER
MP34	00180-01247	BRACKET: LINE FILTER (CAP)
MP35	00181-00208	PANEL:REAR, DISPLAY
MP67	00180-00235	PANEL: REAR, POWER
W1	8120-0078	POWER CORD

CHANGE 12

Table 6-2:
MP1: Change to HP Part No. 5000-8424; COVER: TOP RIGHT (CABINET PART); Mfr. Code 28480; Mfr. Part No. 5000-8424.
MP2: Change to HP Part No. 5000-8422; COVER: BOTTOM RIGHT (CABINET PART); Mfr. Code 28480; Mfr. Part No. 5000-8422.
MP3: Change to HP Part No. 5000-8425; COVER: TOP LEFT (CABINET PART); Mfr. Code 28480; Mfr. Part No. 5000-8425.
MP4: Change to HP Part No. 5000-8423; COVER: BOTTOM LEFT (CABINET PART); Mfr. Code 28480; Mfr. Part No. 5000-8423.
MP80: Change to HP Part No. 5000-0446; COVER: TOP (RACK PART); Mfr. Code 28480; Mfr. Part No. 5000-0446.
MP81: Change to HP Part No. 5000-0592; COVER: BOTTOM (RACK PART); Mfr. Code 28480; Mfr. Part No. 5000-0592.
MP82: Change to HP Part No. 5000-0444; COVER: SIDE (RACK PART); Mfr. Code 28480; Mfr. Part No. 5000-0444.
MP87: Change to HP Part No. 5060-0775; KIT: 5 H RACK MOUNT; Mfr. Code 28480; Mfr. Part No. 5060-0775.

CHANGE 13

Table 6-2:
Add: C9; HP Part No. 0160-3502; C:FXD TI DIOXIDE 0.30 PF 5% 500 VDCW; Mfr. Code 78488; Mfr. Part No. GA.
Add: MP79; HP Part No. 00180-06101; LUG:CRT PIN; Mfr. Code 28480; Mfr. Part No. 00180-06101.
R2: Change to HP Part No. 2100-2076; R:VAR COMP 2 x 100K OHM 20% LIN; Mfr. Code 28480; Mfr. Part No. 2100-2076.
MP75: Change to HP Part No. 00180-25703; NUT: HORIZONTAL POSITION POT; Mfr. Code 28480; Mfr. Part No. 00180-25703.

MP87: Change to HP Part No. 5060-8740; KIT: 5 H RACK MOUNT; Mfr. Code 28480; Mfr. Part No. 5060-0775.
Delete: MP98.

CHANGE 14

Table 6-2:
A1R12: Change to HP Part No. 0757-0461; R:FXD MET FLM 68.1K OHM 1% 1/8W; Mfr. Code 91637; Mfr. Part No. MF-1/10-32.
A1R15 and A1R17: Change to HP Part No. 0757-0756; R:FXD FLM 13K OHM 1% 1/4W; Mfr. Code 28480; Mfr. Part No. 0757-0756.
Figure 8-7:
A1R12: Change value to 68.1K.
A1R15 and A1R17: Change value to 13K.

CHANGE 15

Table 1-2:
Under Writing Speed change Max write mode to 1000 div/msec.
Table 6-2:
A10: Change to HP Part No. 00181-66510; ASSY: MODE SWITCH; Mfr. Code 28480; Mfr. Part No. 00181-66510.
Delete: A10C2 through A10C4, A10CR2, A10CR3, A10Q1 through A10Q4, A10R4 through A10R11.
A10R1 through A10R3: Change to HP Part No. 0687-1021; R:FXD COMP 1000 OHM 10% 1/2W; Mfr. Code 01121; Mfr. Part No. EB 1021.
V1: Change HP Part No. to 5083-1952.
W14: Change HP Part No. to 00181-61616.
W15: Change HP Part No. to 00181-61618.
Paragraph 7-10c:
Change HP Part No. to 5083-1951.
Figure 8-14:
Replace with figure 7-9.
Figure 8-16:
Delete: A10C2 through A10C4, A10CR2, A10CR3, A10Q1 through A10Q4, A10R4 through A10R11.
Add: Wire (94) from S7 to A10 wire (94) output.
Replace: A10 Mode Switch Board Schematic with figure 7-10.

CHANGE 16

Table 6-2:
A6: Change to HP Part No. 00181-66505; ASSY: PULSE CIRCUIT BOARD; Mfr. Code 28480; Mfr. Part No. 00181-66505.
Add: A6Q5; HP Part No. 1854-0071; TSTR:SI NPN (SELECTED FROM 2N3704); Mfr. Code 28480; Mfr. Part No. 1854-0071.
A6R16: Change to HP Part No. 0757-0462; R:FXD MET FLM 75K OHM 1% 1/8W; Mfr. Code 28480; Mfr. Part No. 0757-0462.
A6R19: Change to HP Part No. 0757-0190; R:FXD MET FLM 20K OHM 1% 1/2W; Mfr. Code 28480; Mfr. Part No. 0757-0190.
Add: A6R21; HP Part No. 0687-4741; R:FXD COMP 470K OHM 10% 1/2W; Mfr. Code 01121; Mfr. Part No. EB 4741.
A10: Change to HP Part No. 00181-66516; ASSY: MODE SWITCH; Mfr. Code 28480; Mfr. Part No. 00181-66516.
Figure 8-16:
Add: A6Q5 and A6R21 as shown in figure 7-8.
A6R16: Change value to 75K.
A6R19: Change value to 20K.

7-5. STANDARD OPTIONS.

7-6. The following standard options are modifications installed on HP instruments at the factory and are available on request.

OPTION 003: Operation with 100/200V input power. Circuit change shown in figure 7-6.

OPTION 004: Operation with 110/220V input power. Circuit change shown in figure 7-7.

OPTION 631: Standard CRT (V1) is replaced by non-graticule P31 phosphor CRT.

OPTION H49 (not covered in this manual): Remote program capability is provided for the MAX WRITE, WRITE, NORM, STORE, and ERASE functions of the instrument. Front-panel pushbutton control is still available for the operator.

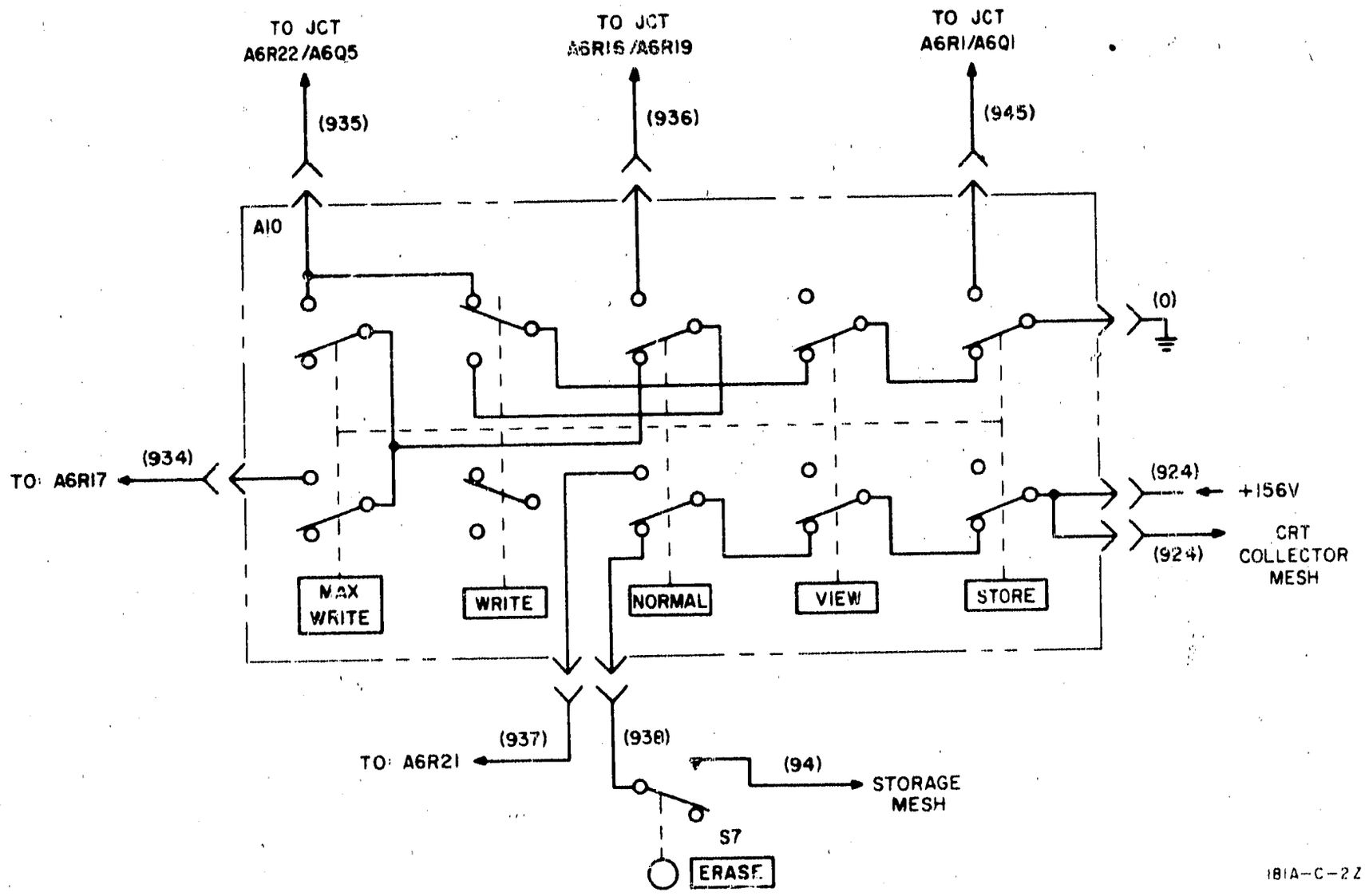


Figure 7-1. Mode Switch Schematic

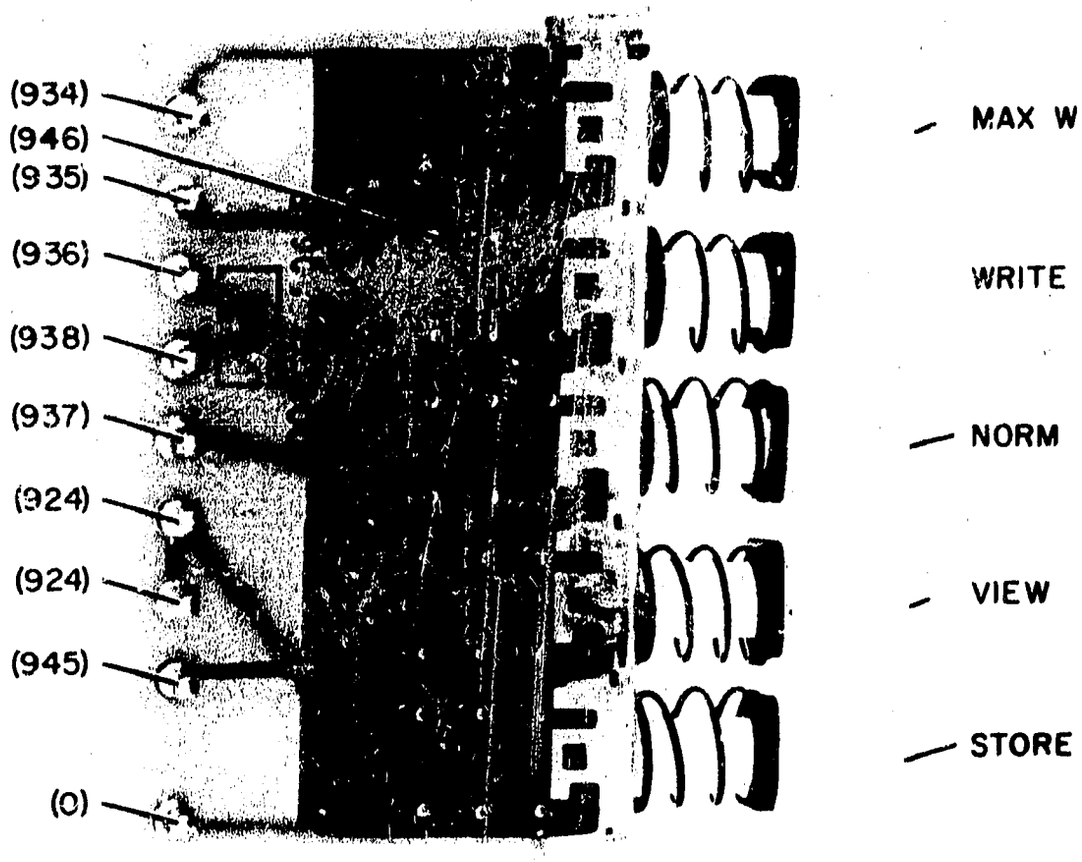
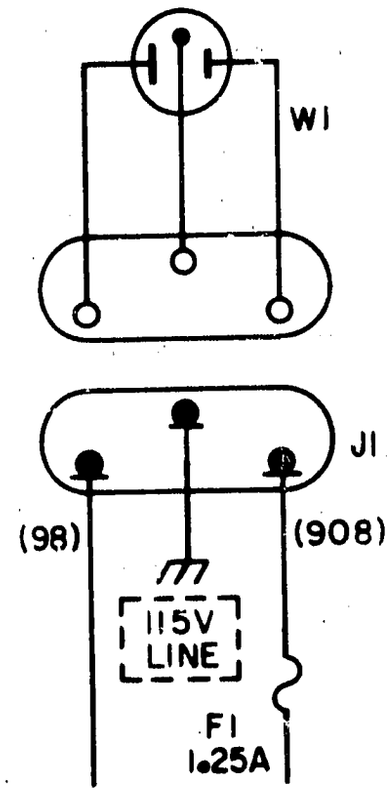
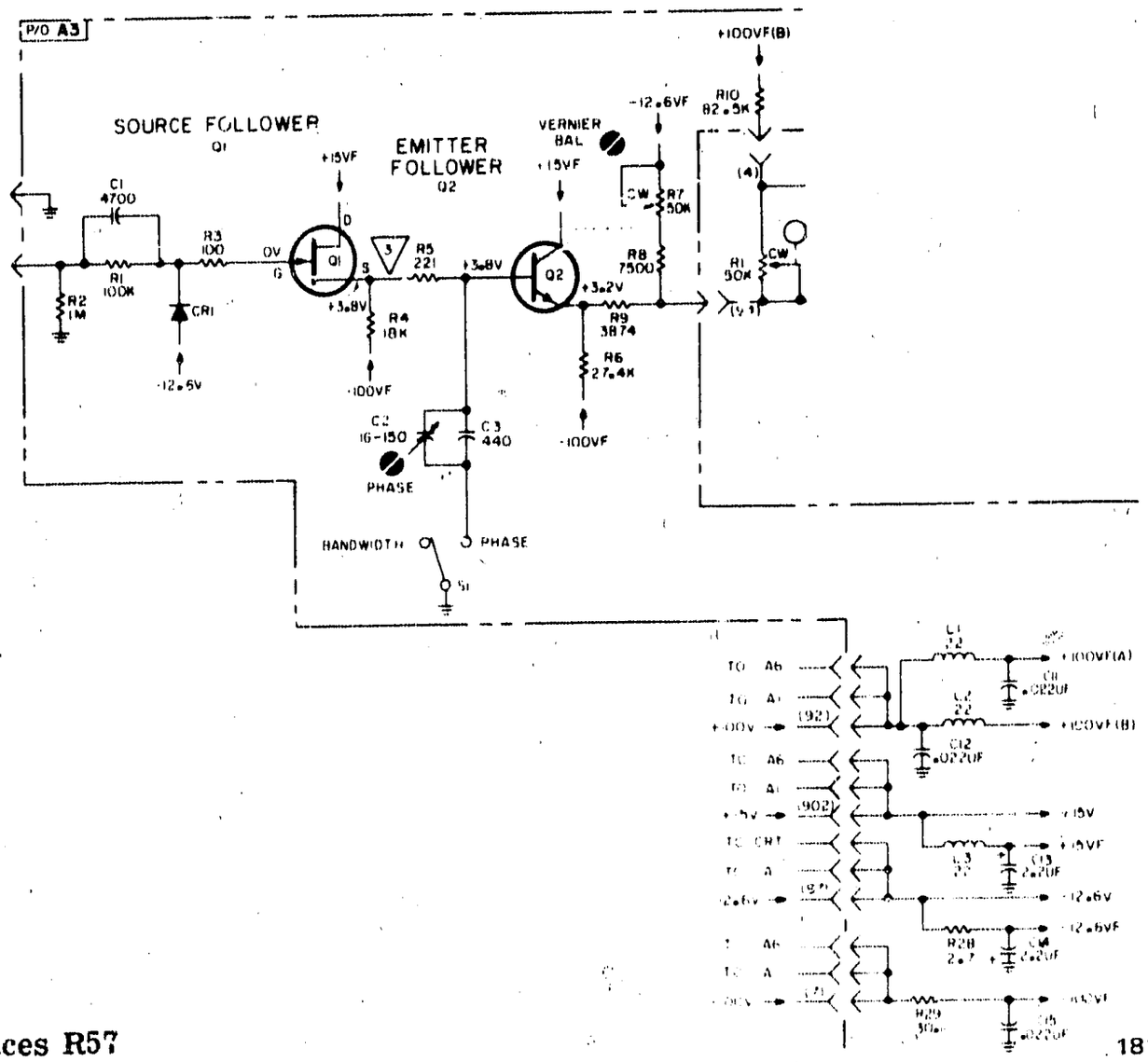


Figure 7-2. Mode Switch Connections



181A/AR-004

Figure 7-3. Power Line Receptacle



NOTE: L2 replaces R57

181A/AR-005

Figure 7-4. Horizontal Amplifier External Input

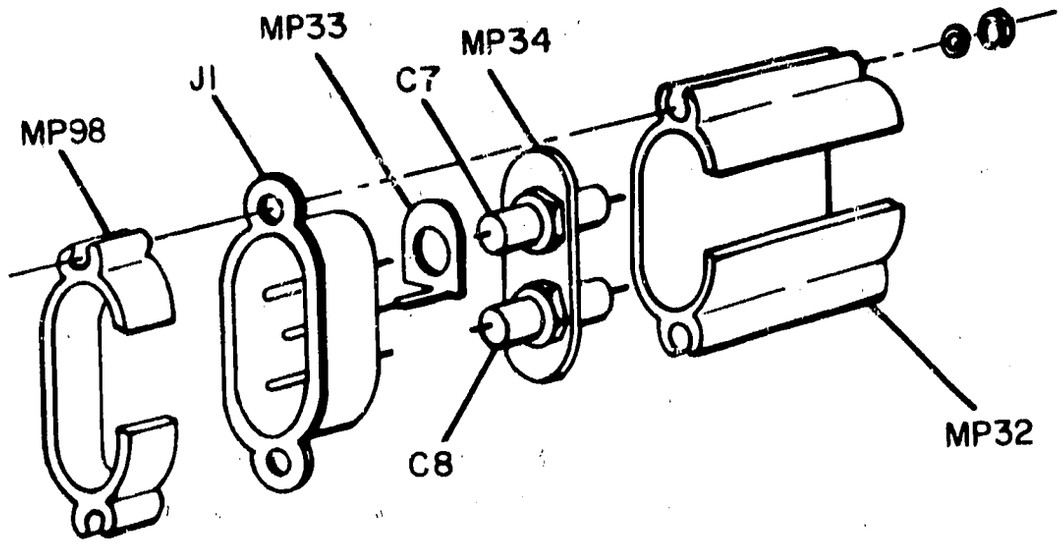


Figure 7-5. Line Filter

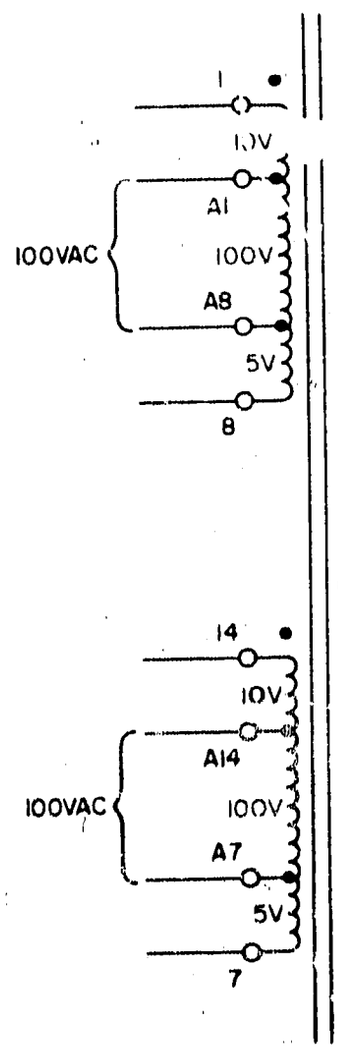


Figure 7-6. Option 003

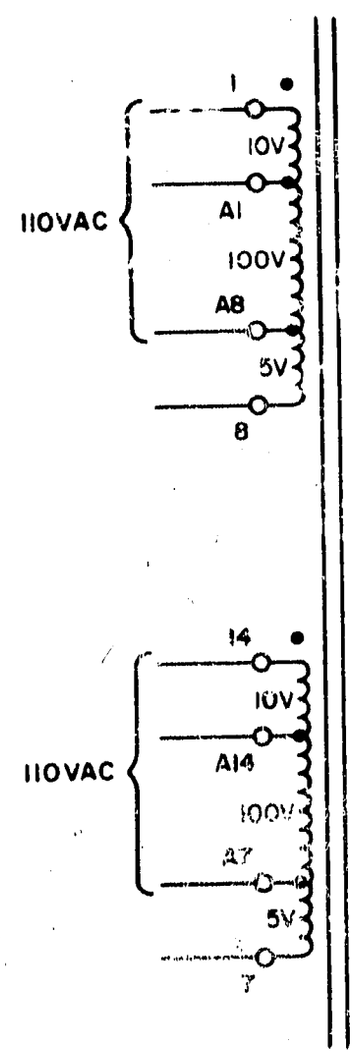


Figure 7-7. Option 004

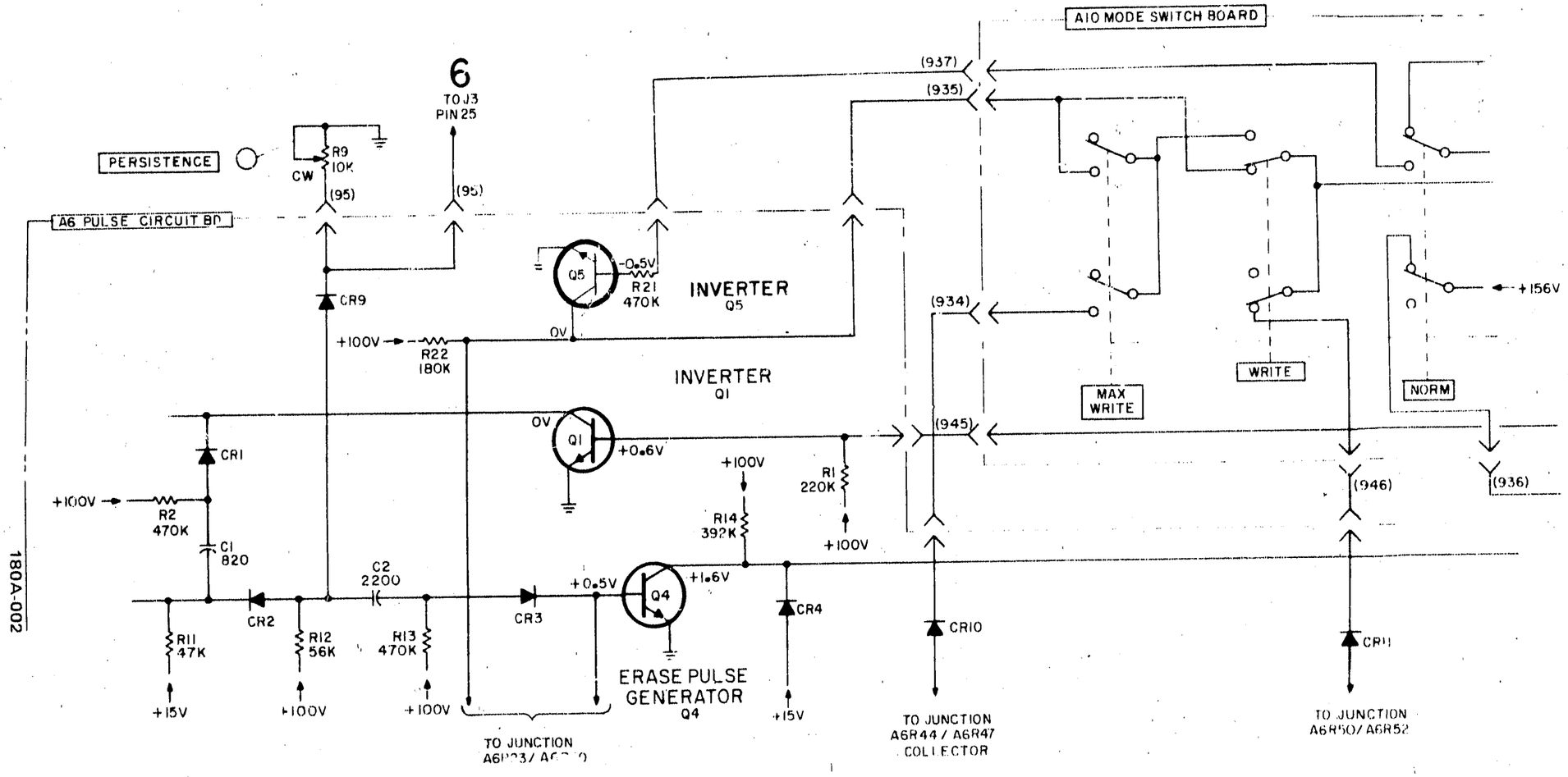


Figure 7-8. Addition of A6Q5 and A6R21 to Schematic 3

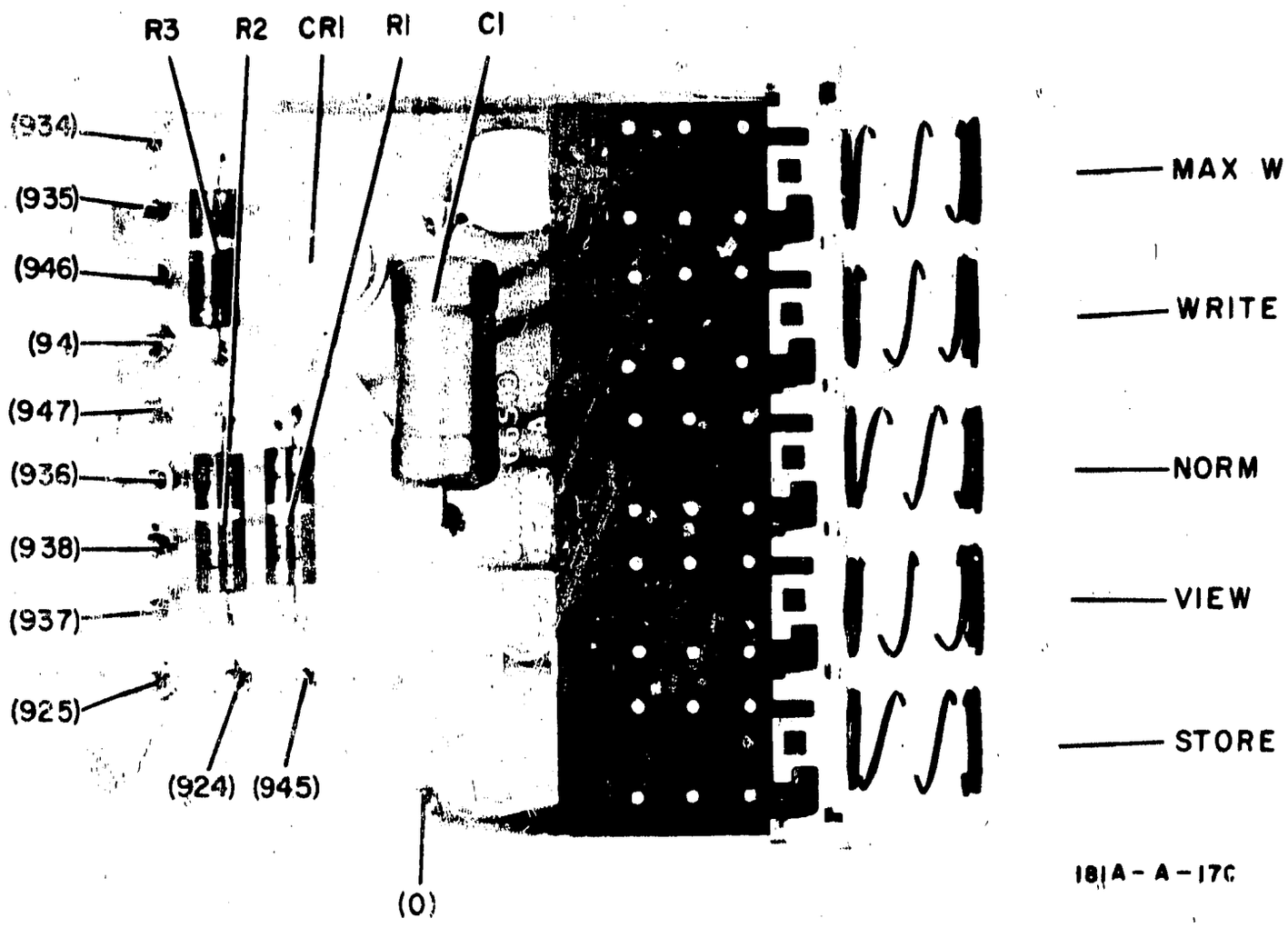


Figure 7-9. Mode Switch (A10) Wiring and Component Identification

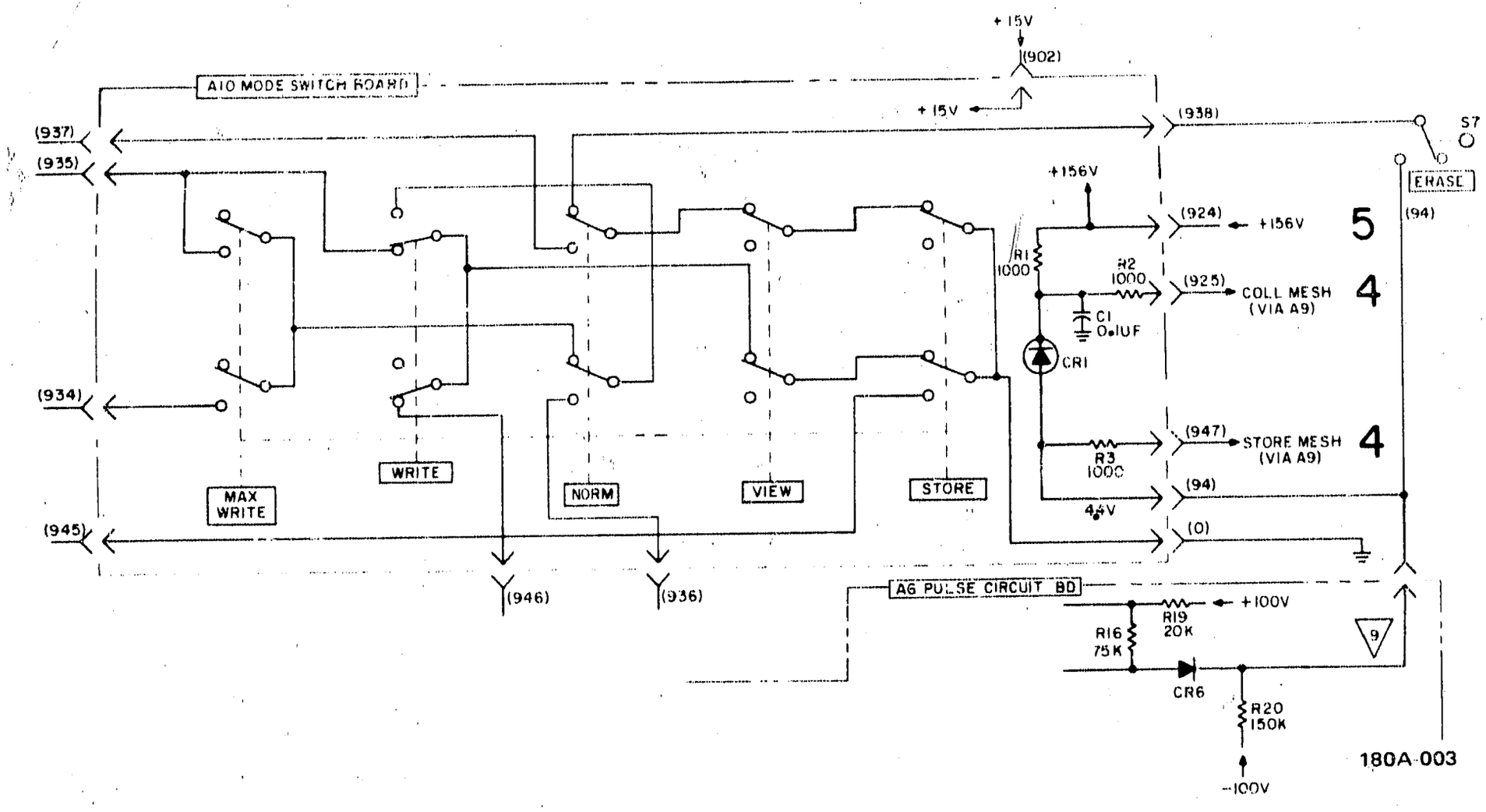


Figure 7-10. Mode Switch (A10) Schematic

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, waveforms, test conditions and an overall troubleshooting tree. Figure 8-2 provides a guide to locating possible problems. Table 8-1 defines symbols and conventions used on the schematics. A disassembly procedure for removing the cathode ray tube (CRT) is also contained in this section.

8-3. SCHEMATICS.

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

8-5. The schematics are numbered in sequence with a bold number in a box at the lower right-hand corner of each page. These numbers are used to cross reference signal connections between schematics. At each circuit breaking point, a notation is made of the signal name and a number (in bold type). This number indicates the associated schematic which contains the source or destination of the signal. To find the source or destination of any point on a given schematic, turn to the schematic referred to by number and find the name of the signal in question.

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

8-7. All components within the shaded areas of a schematic are physically located on etched circuit boards. Components not physically located on an etched circuit board are shown in the unshaded areas of the schematic.

8-8. Transistors and diodes packaged in metal cans having one lead in common with the can will have the connection shown on the schematic by a heavy dot.

8-9. REFERENCE DESIGNATIONS.

8-10. The unit system of reference designations used in this manual is in accordance with the provisions of USA Standard Y32.16-1968, Reference Designations for Electrical and Electronics Parts and Equipments, dated March 1, 1968. Minor variations from the standard, due to design and manufacturing practices, may be noted.

8-11. Each electrical component is assigned a class letter and number. This letter-number combination is the basic reference designation. Components which are not part of an assembly have only the basic reference designation. Components which are part of an assembly have, in addition to the basic designation, a prefix designation indicating the assembly of which the component is a part (resistor R23 on assembly A1 is called A1R23).

8-12. Assemblies are numbered consecutively. If an assembly reference designation is assigned and later deleted, that number is not reused.

8-13. COMPONENT LOCATIONS.

8-14. Locations of components on assemblies and subassemblies are illustrated in photos adjacent to the schematics. Since the schematics are drawn to show function, portions of a particular assembly may appear on several different schematics. Note that a small dot etched on the board identifies the emitter lead of transistors, the source lead of a field effect transistor (FET), the cathode lead of diodes, and the positive side of electrolytic capacitors. The component-location photo is printed next to the schematic that shows most of the circuitry on the assembly. Components located on the chassis are identified in Figure 8-3. The location of all adjustments are shown in Section V. An exploded-view drawing that shows mechanical (and some electrical) parts is located in Section VI.

8-15. BOARD CONNECTIONS.

8-16. Square-pin connectors are identified on circuit boards by the color code of the connecting wire.

8-17. SEMICONDUCTOR REPLACEMENT.

8-18. Figure 8-1 is included to help identify the leads in the common shapes and sizes of semiconductor devices. When removing a semiconductor, use long-nosed pliers as a heat sink between the device and the soldering iron. When replacing a semiconductor, ensure sufficient lead length to dissipate the soldering heat by using the same length of exposed lead as was used for the original part.

8-19. TROUBLESHOOTING.

8-20. The most important prerequisite for successful troubleshooting is understanding how the instrument is designed to operate and correct use of front-panel controls. Suspected malfunctions may be caused by improper control settings or circuit connections. Before doing the test and/or troubleshooting procedures, read Section III (Operation) for an explanation of controls and general operating considerations, and Section IV (Principles of Operation) for an explanation of circuit theory.

8-21. If trouble is suspected, visually inspect the instrument. Look for loose or burned components that might suggest a source of trouble. Check to see that all circuit board connections are making good

contact and are not shorting to an adjacent circuit. If no obvious trouble is found, check the power supply voltages in the unit. Prior to any extensive trouble-shooting, check the external power sources also. Figure 8-2 lists several of the most common malfunctions and probable sources of trouble.

8-22. DC VOLTAGES.

8-23. DC voltages are indicated on the schematics for active components (transistors, etc). Conditions for making the voltage measurements are given in Table 8-2.

8-24. TEST POINTS.

8-25. Test points are shown on the schematics with this symbol (⊙), and correspond to test point jacks on etched circuit boards. They do not necessarily correspond to waveform measurement points.

8-26. WAVEFORMS.

8-27. Waveform measurement points (▽ with a number enclosed) are placed on the schematics along main signal paths. The numbers inside the measurement point symbols (▽) are keyed to corresponding waveforms adjacent to each schematic. Conditions for making the waveform measurements are given in Table 8-2.

8-28. REPAIR AND REPLACEMENT.

8-29. The following paragraphs provide procedures for replacing components in the instrument and basic considerations when repairing etched circuit boards. Section VI provides a detailed parts list to allow ordering of replacement parts. If satisfactory repair (or operation) cannot be obtained, contact the nearest hp Sales/Service Office (addresses at rear of this manual). If shipment of the instrument to the Sales/Service Office for repair is recommended, see Section II of this manual for repackaging and shipping information.

8-30.HIGH VOLTAGE SUPPLY REPAIR.

8-31. The following procedure should be used when replacing the High Voltage Rectifier Assembly (A5), and the High Voltage Tripler Assembly (A9).

CAUTION

To prevent CRT damage when troubleshooting the H. V. supply, disconnect the CRT socket and disconnect second anode connection (H. V. connector block). This will leave the capacitive load of this tripler on the H. V. transformer and maintain the normal 45 kHz oscillation.

a. Remove the top left side cover of Model 181A or top cover and left side cover of Model 181AR.

b. Remove two screws from hv cover and lift up.

c. Remove four screws holding rear panel of display chassis and let hang.

d. Unsolder the five wires from small printed circuit board mounted to A5T1.

e. Remove the white, gray, red/blue, and red/white wires from printed circuit board A1 (HV Control Assy).

NOTE

To remove A5 and A9 as a unit, omit steps f through h.

f. Remove four screws from HV Rectifier Assembly (A5).

g. Remove the gray wire and the yellow wire coming from the HV Tripler Assembly (A9).

h. The A5 Assembly can now be removed by pulling out and toward front of instrument.

i. Unsolder wires on H. V. connector block that is mounted on chassis.

8-32. HEAT SINK REMOVAL.

8-33. There are two types of heat sinks used in the 181A/AR. The friction type heat sink is used on A1 and A3 assemblies. The transistors can be removed from the heat sink by carefully pulling the transistors from heat sink with a pair of long nosed pliers. A heat dissipater casting type of heat sink is used in the low voltage power supply (LVPS). They are shown in the exploded view in Section VI. The transistors may be removed by removing the two screws which secure them to their sockets.

8-34. CRT REMOVAL AND REPLACEMENT.

8-35. Remove the CRT as follows:

WARNING

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

a. Remove plug-ins from the oscilloscope.

b. Remove all four covers from the Model 181A or the top and bottom covers from the Model 181AR.

c. On the Model 181AR, remove the shield)two screws) next to the CRT post accelerator lead (shield is between CRT and plug-in compartment).

d. Remove the flexible three conductor CRT lead from the connector block.

e. Remove the connections from the neck pins on the CRT (use long nose pliers through access holes).

f. Remove rear display panel.

g. Loosen clamp at rear of CRT.

h. Carefully remove CRT socket.

i. Remove front-panel CRT light shield by squeezing at midpoint, top and bottom.

j. Remove CRT bezel by removing four retaining screws.

CAUTION

Do not place CRT face down after removing. This may cuase damage to CRT by placing charged particules on storage mesh of tube.

k. Place one hand on the face of the CRT and, with the other hand, slide the CRT forward and out of the instrument being careful not to catch neck pins on the trace align coil.

8-36. To install a CRT, reverse the above procedure. After the CRT is installed, perform the adjustment procedure in Section V.

8-37 SERVICING CIRCUIT BOARDS.

8-38. 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

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 and 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 with a toothpick or "solder sucker." Sharp pointed metalic 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 (refer to Paragraph 8-21). side of the board, greater care is required to avoid damage to the components, especially semi-conductors. 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.

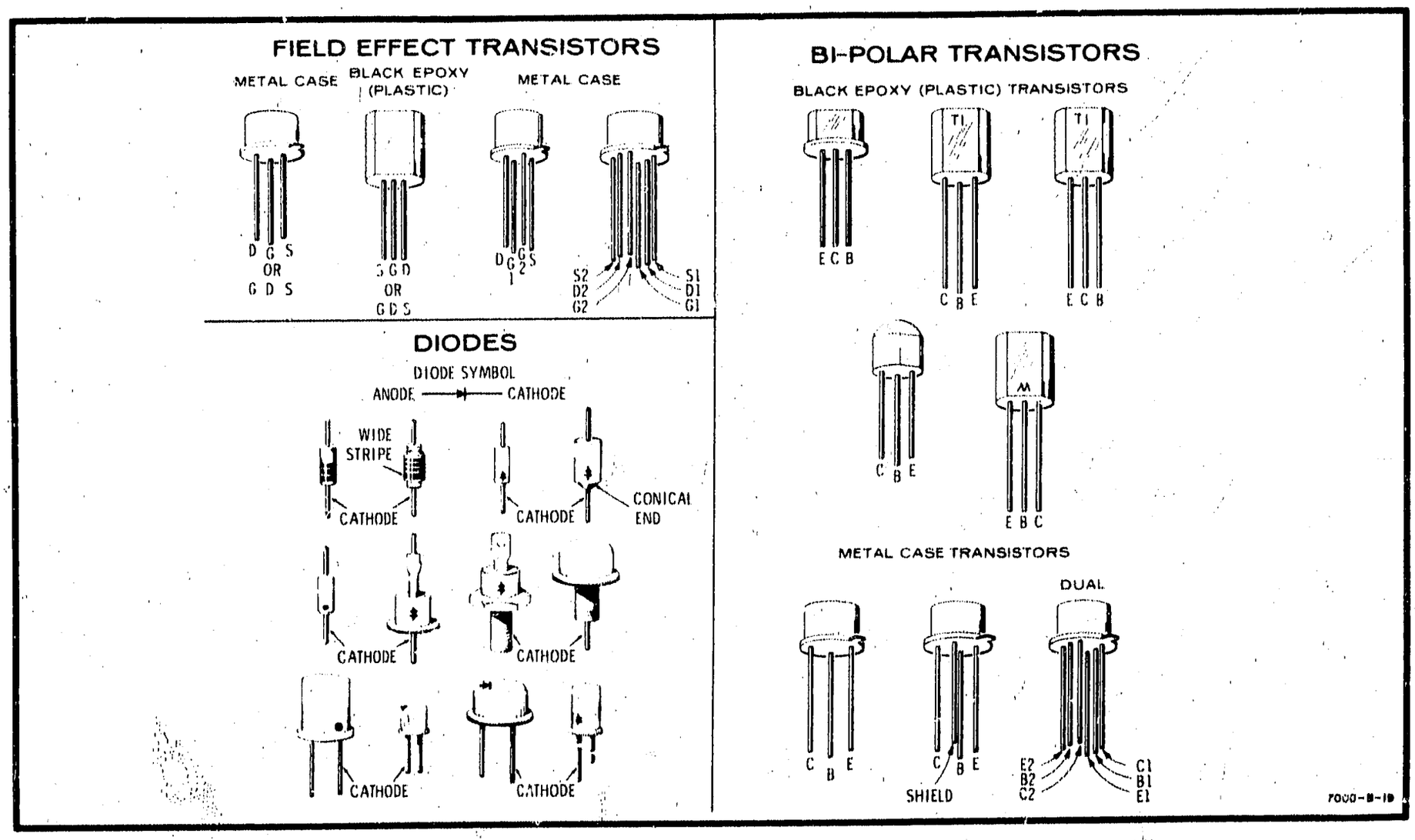


Figure 8-1. Semiconductor Terminal Identification

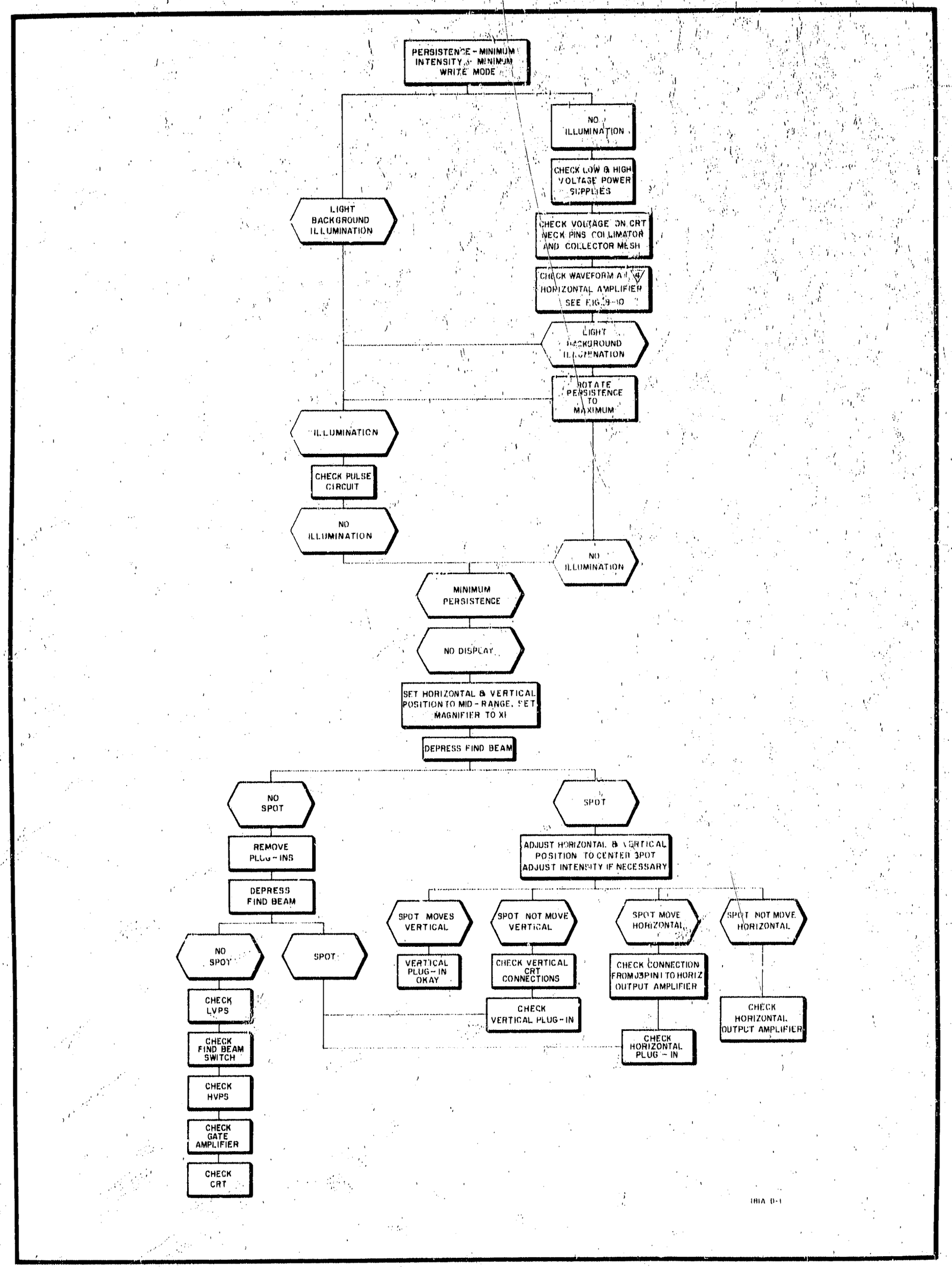


Figure 8-2. Overall Troubleshooting Tree

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)

= High Voltage

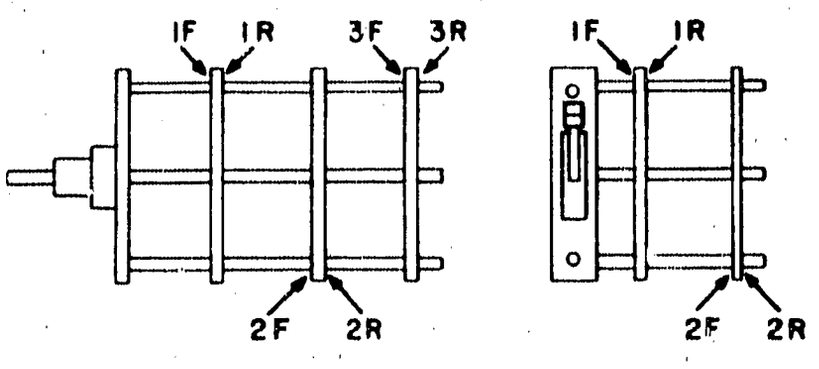
= Circuits or components drawn with dashed lines (phantom) show function only and are not intended to be complete. The circuit or component is shown in detail on another schematic.

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

[(925) is wht-red-grn]

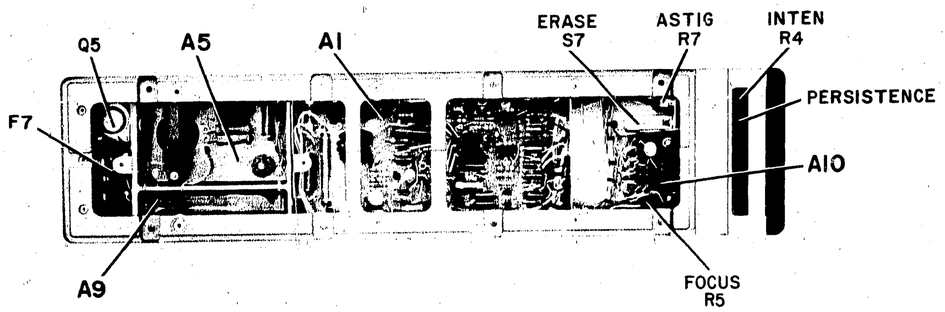
0 - Black	5 - Green
1 - Brown	6 - Blue
2 - Red	7 - Violet
3 - Orange	8 - Gray
4 - Yellow	9 - White

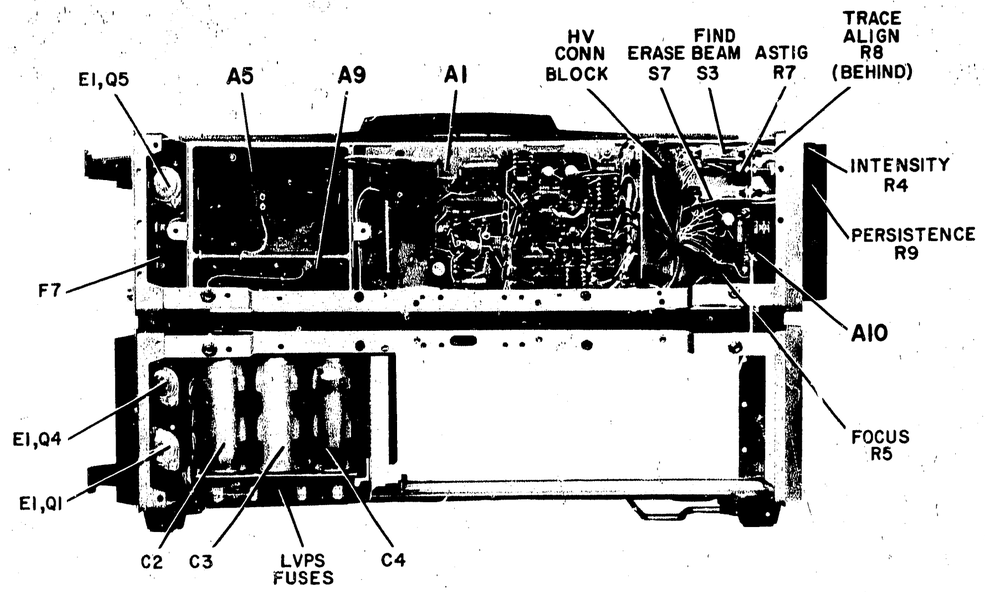
Switch wafers are identified as follows:

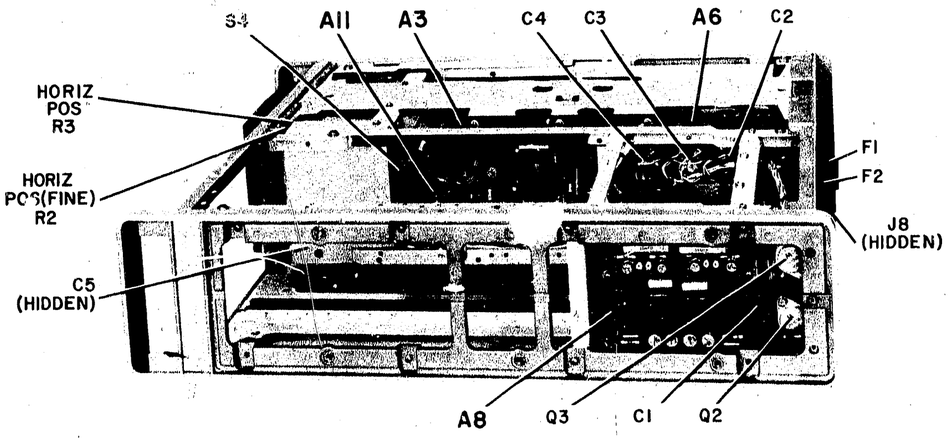


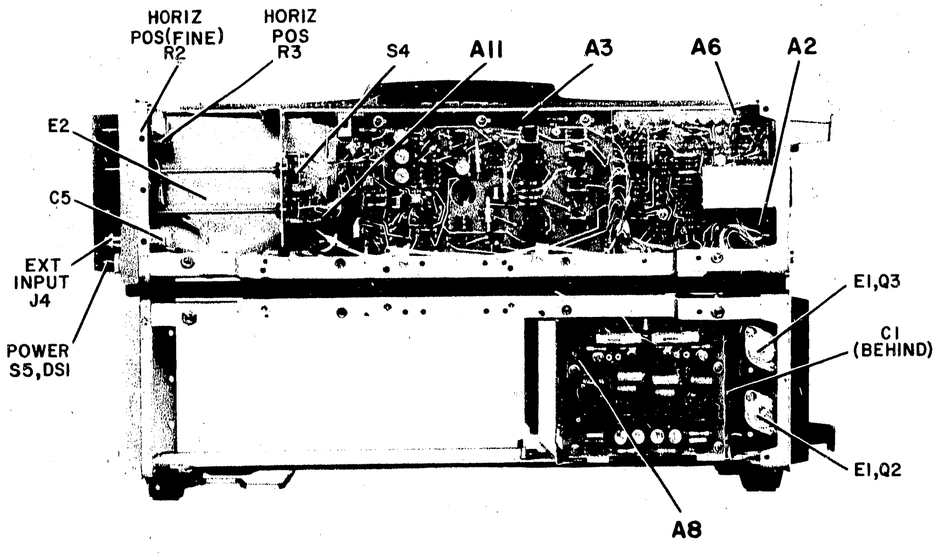
* = Optimum value selected at factory, typical value shown; part may have been omitted.

Unless otherwise indicated:
resistance in ohms
capacitance in picofarads
inductance in microhenries



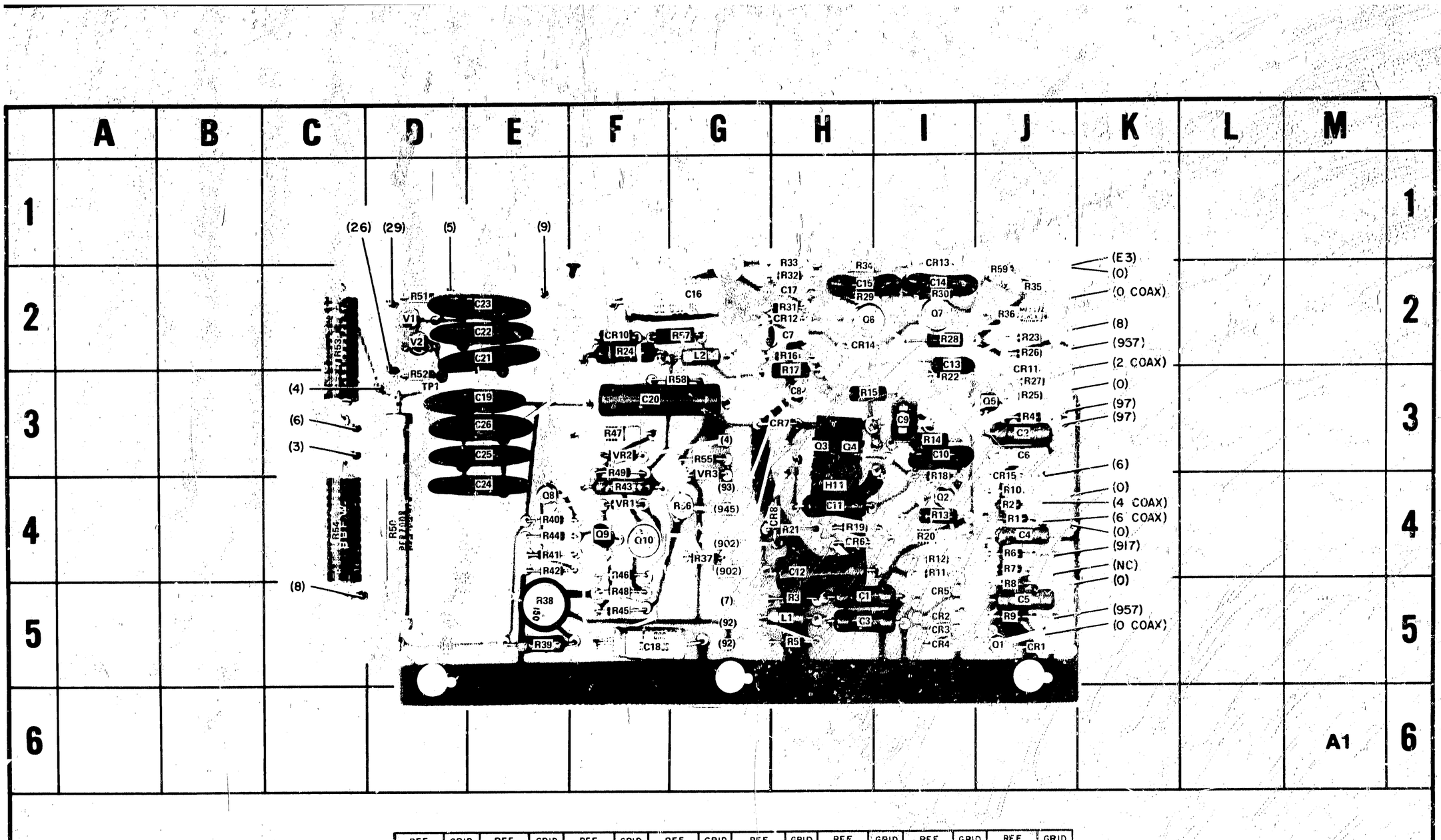






131A-B-10C

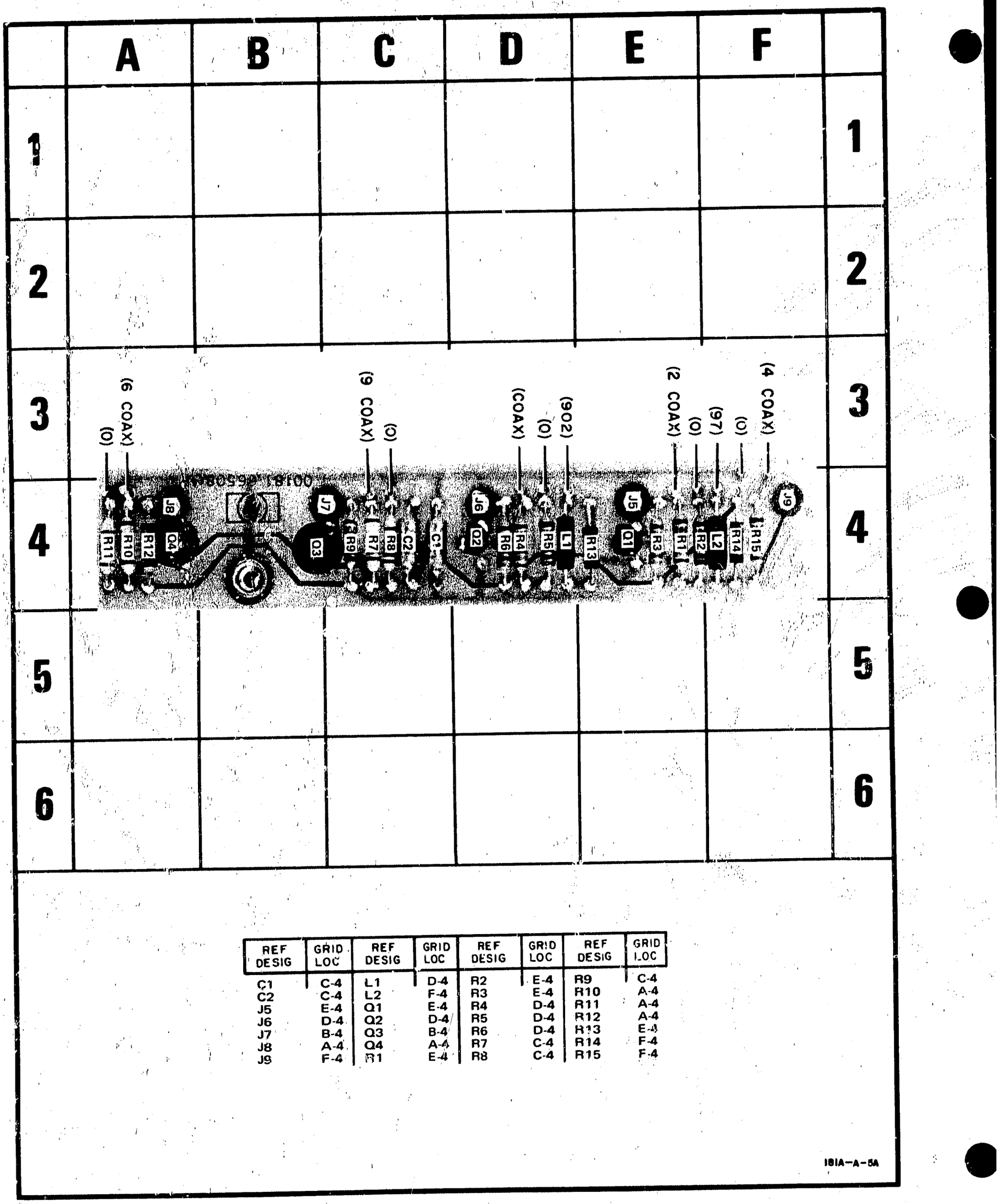
Figure 8-3.
Chassis Mounted Component Identification



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	H-5	C16	G-2	CR5	I-5	Q4	H-3	R9	J-5	R23	J-2	R37	G-4	R51	D-2
C2	J-3	C17	H-2	CR6	H-4	Q5	J-3	R10	J-4	R24	F-2	R38	E-5	R52	D-3
C3	H-5	C18	F-5	CR7	H-3	Q6	H-2	R11	I-4	R25	J-3	R39	E-5	R53	C-2
C4	J-4	C19	E-3	CR8	H-4	Q7	I-2	R12	I-4	R26	J-2	R40	E-4	R54	C-4
C5	J-5	C20	F-3	CR10	F-2	Q8	E-4	R13	I-4	R27	J-3	R41	E-4	R55	G-3
C6	J-3	C21	E-2	CR11	J-3	Q9	F-4	R14	I-3	R28	I-2	R42	E-4	R56	G-4
C7	H-2	C22	E-2	CR12	H-2	Q10	F-4	R15	H-3	R29	H-2	R43	F-4	R57	G-2
C8	H-3	C23	E-2	CR13	I-2	R1	J-4	R16	H-2	R30	I-2	R44	E-4	R58	G-3
C9	I-3	C24	E-4	CR14	H-2	R2	J-4	R17	H-3	R31	H-2	R45	F-5	R59	J-2
C10	I-3	C25	E-3	CR15	J-4	R3	H-5	R18	I-4	R32	H-2	R46	F-4	TP1	D-3
C11	H-4	C26	E-3	L1	H-5	R4	J-3	R19	H-4	R33	H-2	R47	F-3	V1	D-2
C12	H-4	CR1	J-5	L2	G-2	R5	H-5	R20	I-4	R34	H-2	R48	F-5	V2	D-2
C13	I-2	CR2	I-5	Q1	J-5	R6	J-4	R21	H-4	R35	J-2	R49	F-4	VR1	F-4
C14	I-2	CR3	I-5	Q2	I-4	R7	J-4	R22	I-3	R36	J-2	R50	D-4	VR2	F-3
C15	H-2	CR4	I-5	Q3	H-3	R8	J-5							VR3	G-4

1818-8-98
(Changed 09-74)

Figure 8-4. Component Identification, Assy A1



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	C-4	L1	D-4	R2	E-4	R9	C-4
C2	C-4	L2	F-4	R3	E-4	R10	A-4
J5	E-4	Q1	E-4	R4	D-4	R11	A-4
J6	D-4	Q2	D-4	R5	D-4	R12	A-4
J7	B-4	Q3	B-4	R6	D-4	R13	E-4
J8	A-4	Q4	A-4	R7	C-4	R14	F-4
J9	F-4	R1	E-4	R8	C-4	R15	F-4

181A-A-5A

Figure 8-5. Component Identification, Assy A2

Table 8-2, Waveform and DC Voltage Measurement Conditions

WAVEFORMS

The test point waveforms, as given in figures preceding the schematic diagrams, were taken under the following conditions:

MODEL 181A/AR OSCILLOSCOPE

- Mode ..... WRITE
- PERSISTENCE ..... MINIMUM
- DISPLAY ..... INT
- INTENSITY ..... MINIMUM
- HORIZONTAL
  - Time/Div 20μsec
- VERTICAL
  - Polarity ..... +UP
  - Display ..... ALT
- TRIGGERING
  - Trigger Mode ..... AUTO
  - Trigger ..... INT
  - Slope ..... +

MODEL 180A/AR (MONITOR OSCILLOSCOPE)

- DISPLAY ..... INT
- MAGNIFIER X1
- HORIZONTAL
  - Triggering ..... INT
  - Slope ..... +
  - Sweep Mode ..... AUTO
- VERTICAL
  - Polarity ..... +UP
  - Display ..... channel A
  - Input ..... AC

Note

Any exceptions to these conditions are noted adjacent to the applicable waveform photo.

DC VOLTAGES

The DC voltage readings, as given on the schematic diagrams, were taken under the conditions listed below.

- Mode ..... WRITE
- PERSISTENCE ..... MINIMUM
- HORIZONTAL POSITION ..... CENTERED
- DISPLAY ..... INT
- INTENSITY ..... MINIMUM
- MAGNIFIER X1
- Line Voltage 115V

NO PLUG-INS

Exceptions (if any) are noted in the waveform figure preceding the individual schematic.

All voltages measured with reference to chassis ground.

Voltage readings are considered normal if within 10% of voltage given on schematic.

See Table 8-2 for Measurement Conditions

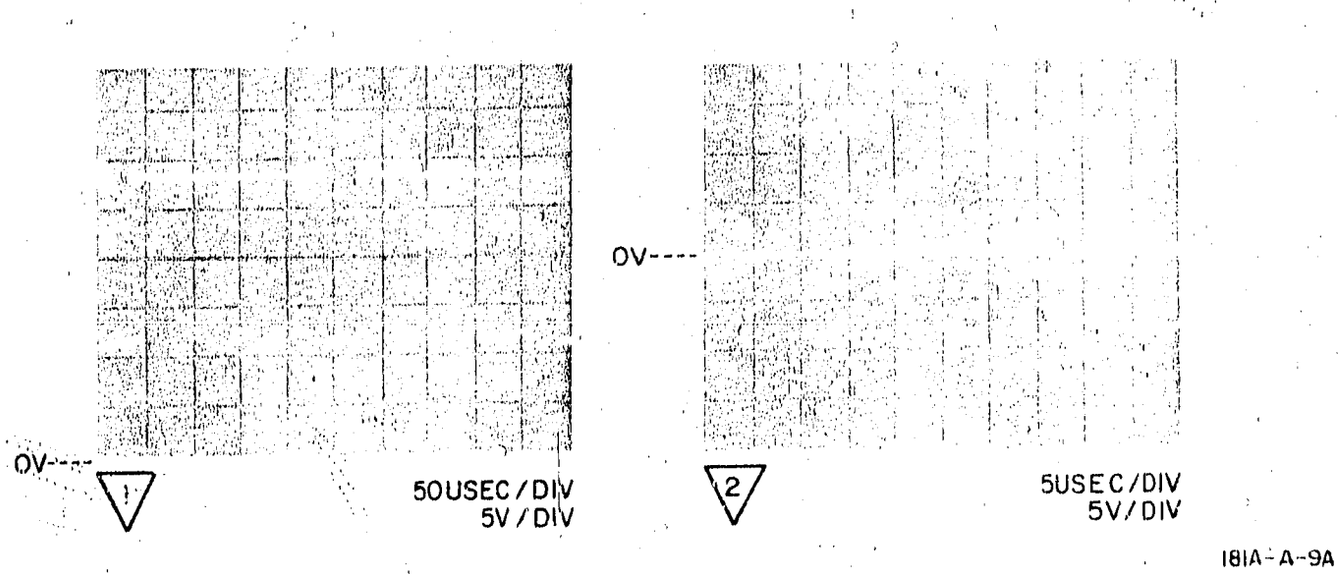
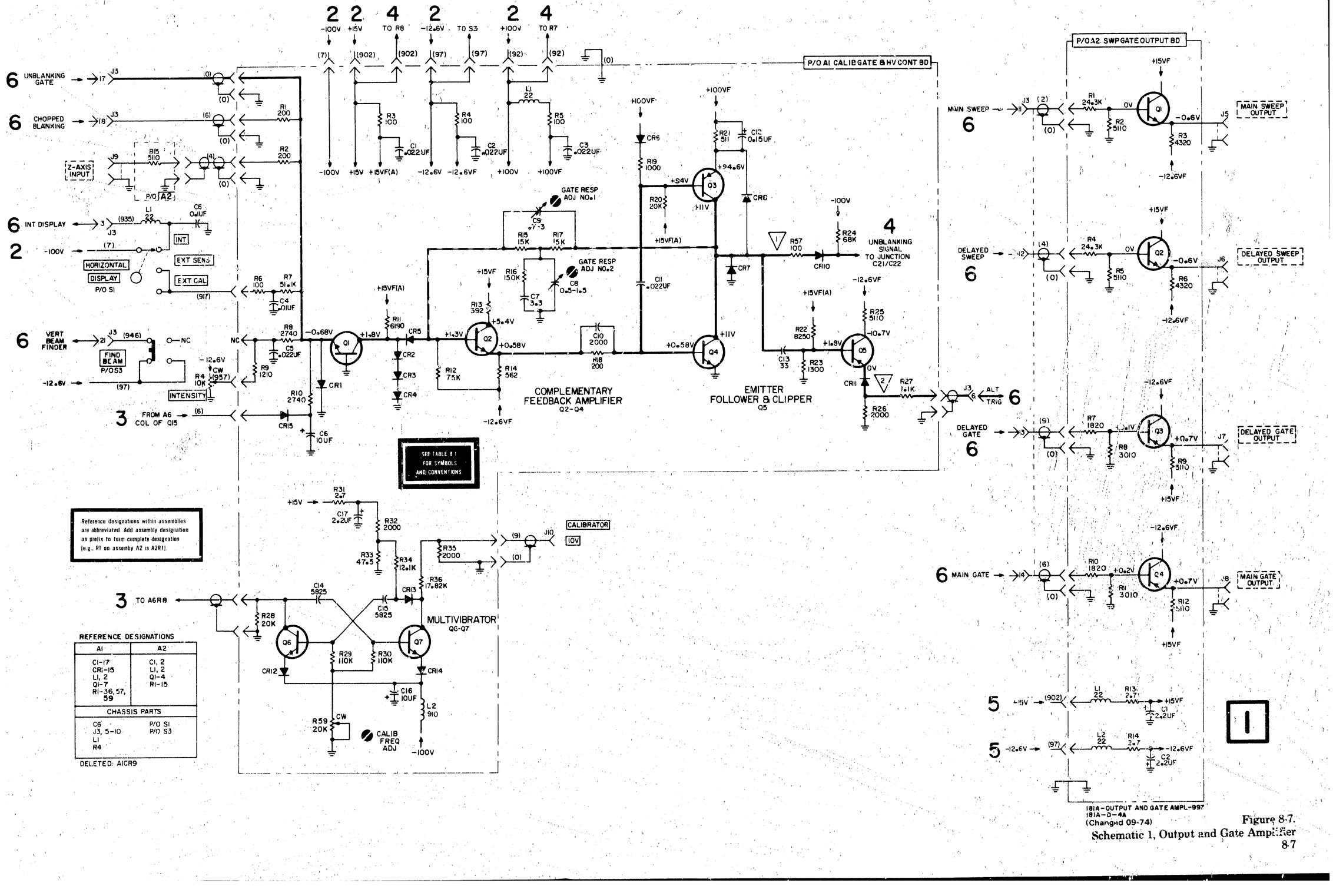


Figure 8-6. Waveform at Test Points in Output and Gate Amplifier circuit.

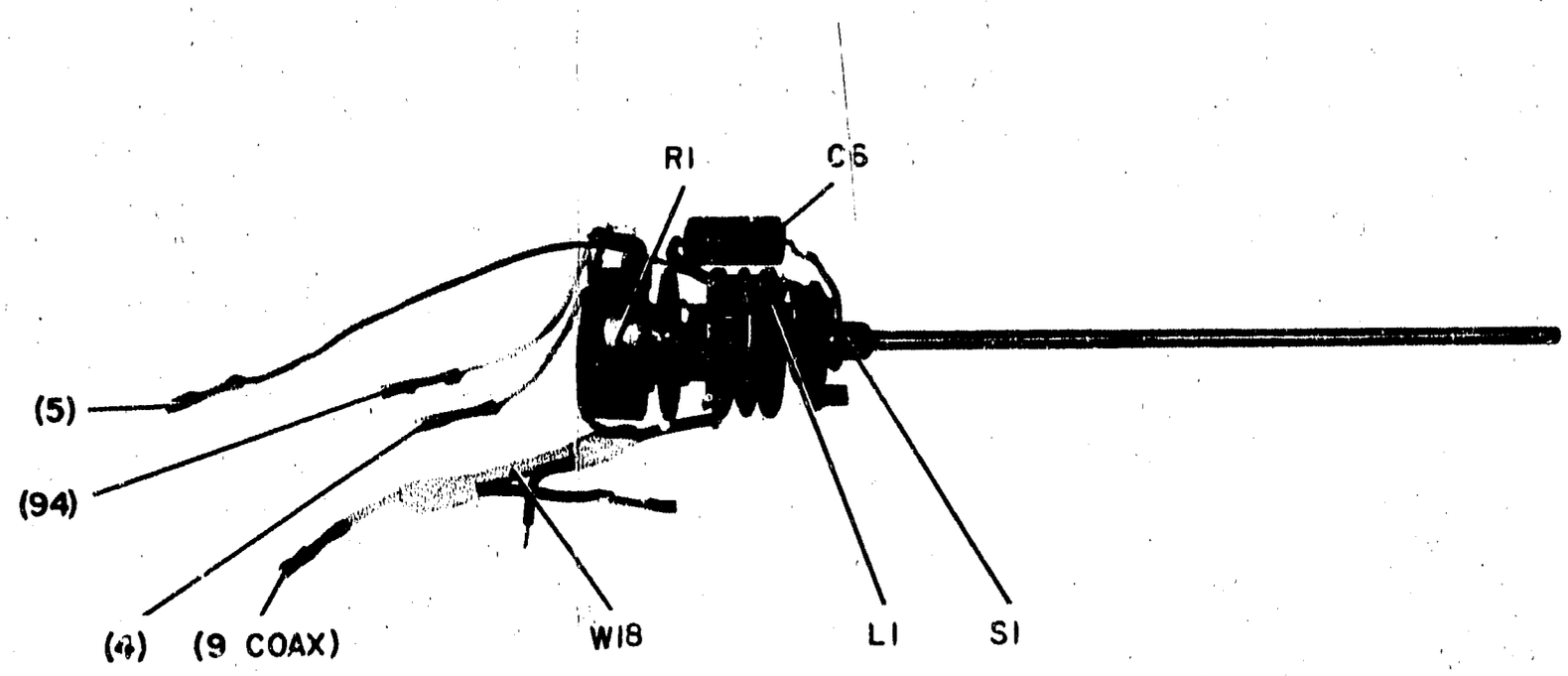


REFERENCE DESIGNATIONS

A1	A2
C1-17 CR1-15 L1, 2 Q1-7 R1-36, 57, 59	C1, 2 L1, 2 Q1-4 R1-15
CHASSIS PARTS	
C6 J3, 5-10 L1 R4	P/O S1 P/O S3

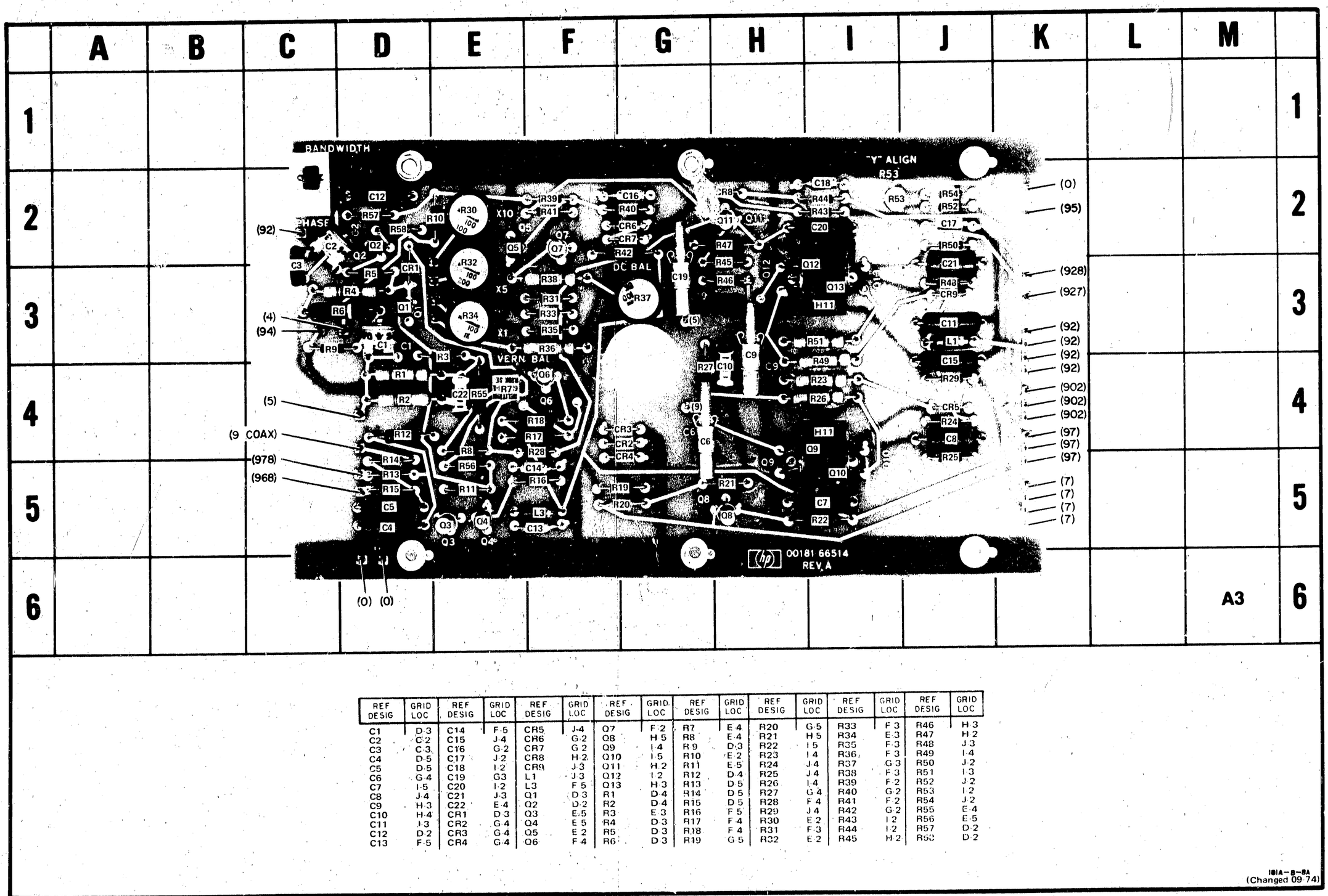
DELETED: A1CR9

Figure 8-7.
Schematic 1, Output and Gate Amplifier



180A-4-21A
(Changed 09-74)

Figure 8-8. Component Identification, Assy A11



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	C14	F-5	CR5	J-4	Q7	F-2	R7	E-4	R20	G-5	R33	F-3	R46	H-3
C2	C-2	C15	J-4	CR6	G-2	Q8	H-5	R8	E-4	R21	H-5	R34	E-3	R47	H-2
C3	C-3	C16	G-2	CR7	G-2	Q9	I-4	R9	D-3	R22	I-5	R35	F-3	R48	J-3
C4	D-5	C17	J-2	CR8	H-2	Q10	I-5	R10	E-2	R23	I-4	R36	F-3	R49	I-4
C5	D-5	C18	I-2	CR9	J-3	Q11	H-2	R11	E-5	R24	J-4	R37	G-3	R50	J-2
C6	G-4	C19	G-3	L1	J-3	Q12	I-2	R12	D-4	R25	J-4	R38	F-3	R51	I-3
C7	I-5	C20	I-2	L3	F-5	Q13	H-3	R13	D-5	R26	I-4	R39	F-2	R52	J-2
C8	J-4	C21	J-3	Q1	D-3	R1	D-4	R14	D-5	R27	G-4	R40	G-2	R53	I-2
C9	H-3	C22	E-4	Q2	D-2	R2	D-4	R15	D-5	R28	F-4	R41	F-2	R54	J-2
C10	H-4	CR1	D-3	Q3	E-5	R3	E-3	R16	F-5	R29	J-4	R42	G-2	R55	E-4
C11	I-3	CR2	G-4	Q4	E-5	R4	D-3	R17	F-4	R30	E-2	R43	I-2	R56	E-5
C12	D-2	CR3	G-4	Q5	E-2	R5	D-3	R18	F-4	R31	F-3	R44	I-2	R57	D-2
C13	F-5	CR4	G-4	Q6	F-4	R6	D-3	R19	G-5	R32	E-2	R45	H-2	R58	D-2

181A-8-8A
(Changed 09-74)

Figure 8-9. Component Identification, Assy A3

See Table 8-2 for measurement conditions.

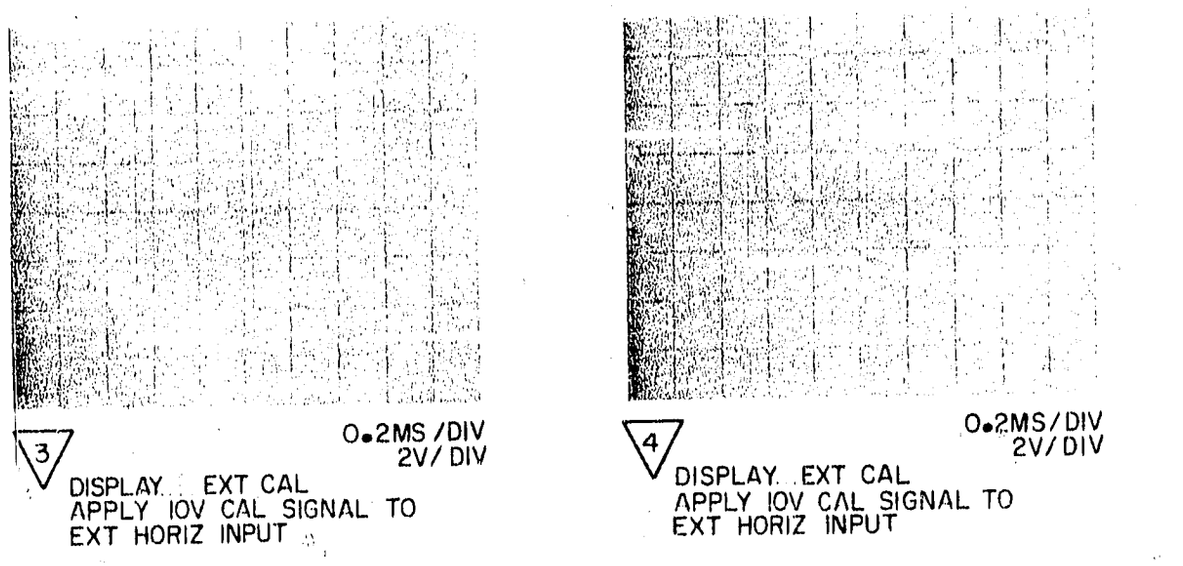


Figure 8-10. Waveforms at Test Points in Horizontal Amplifier Circuit

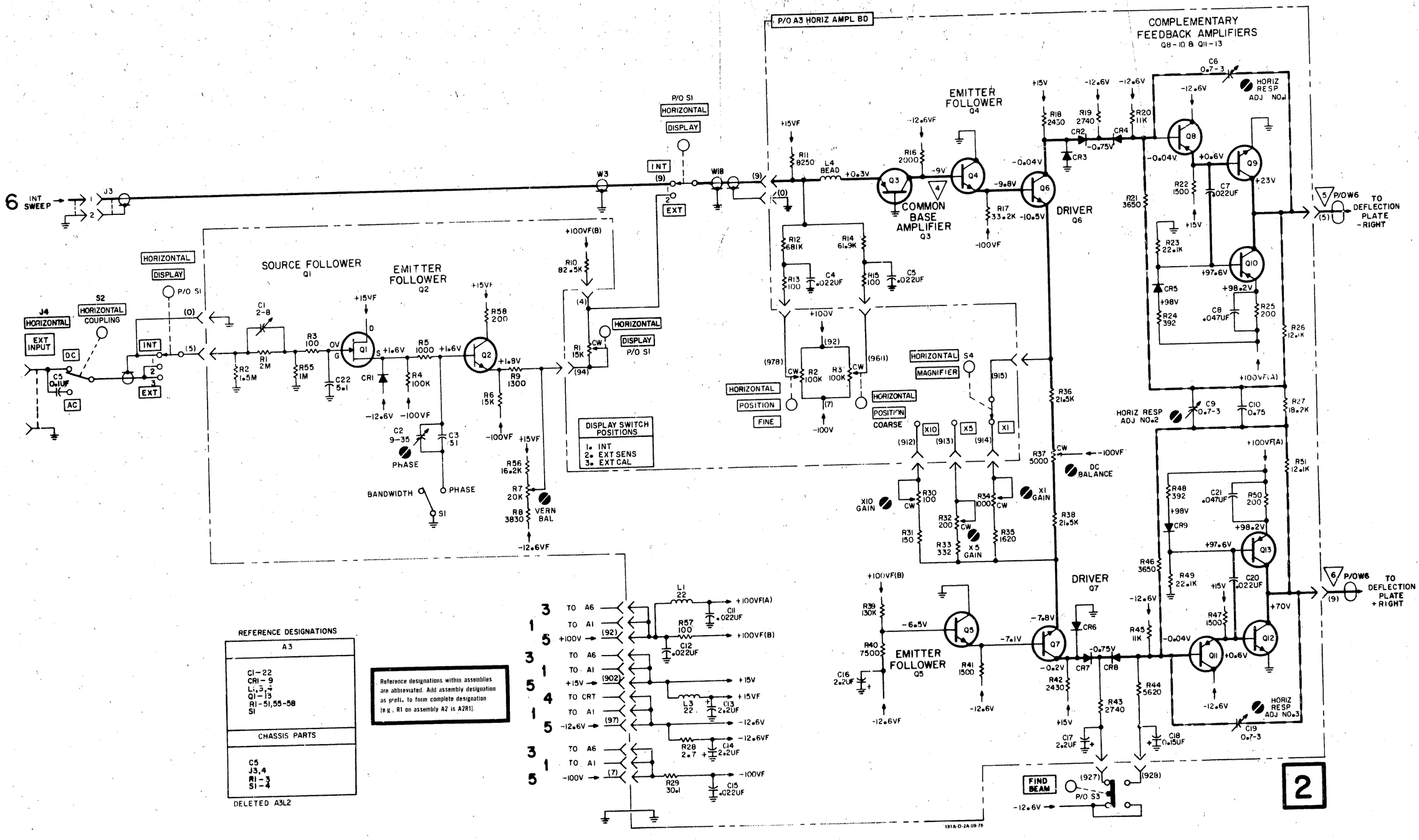


Figure 8-11.
Schematic 2, Horizontal Amplifier

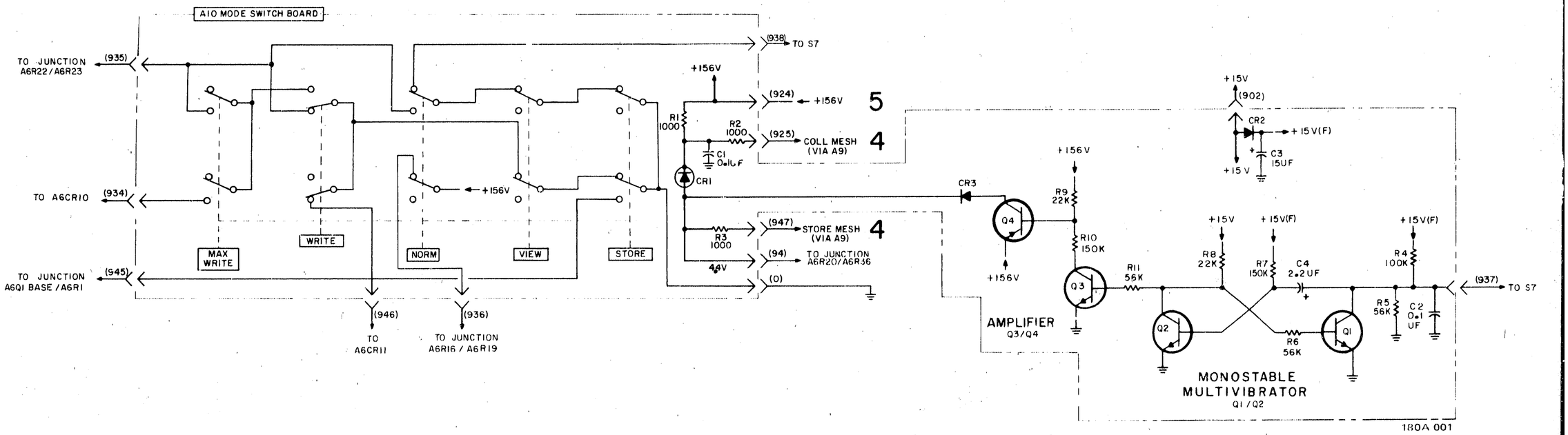
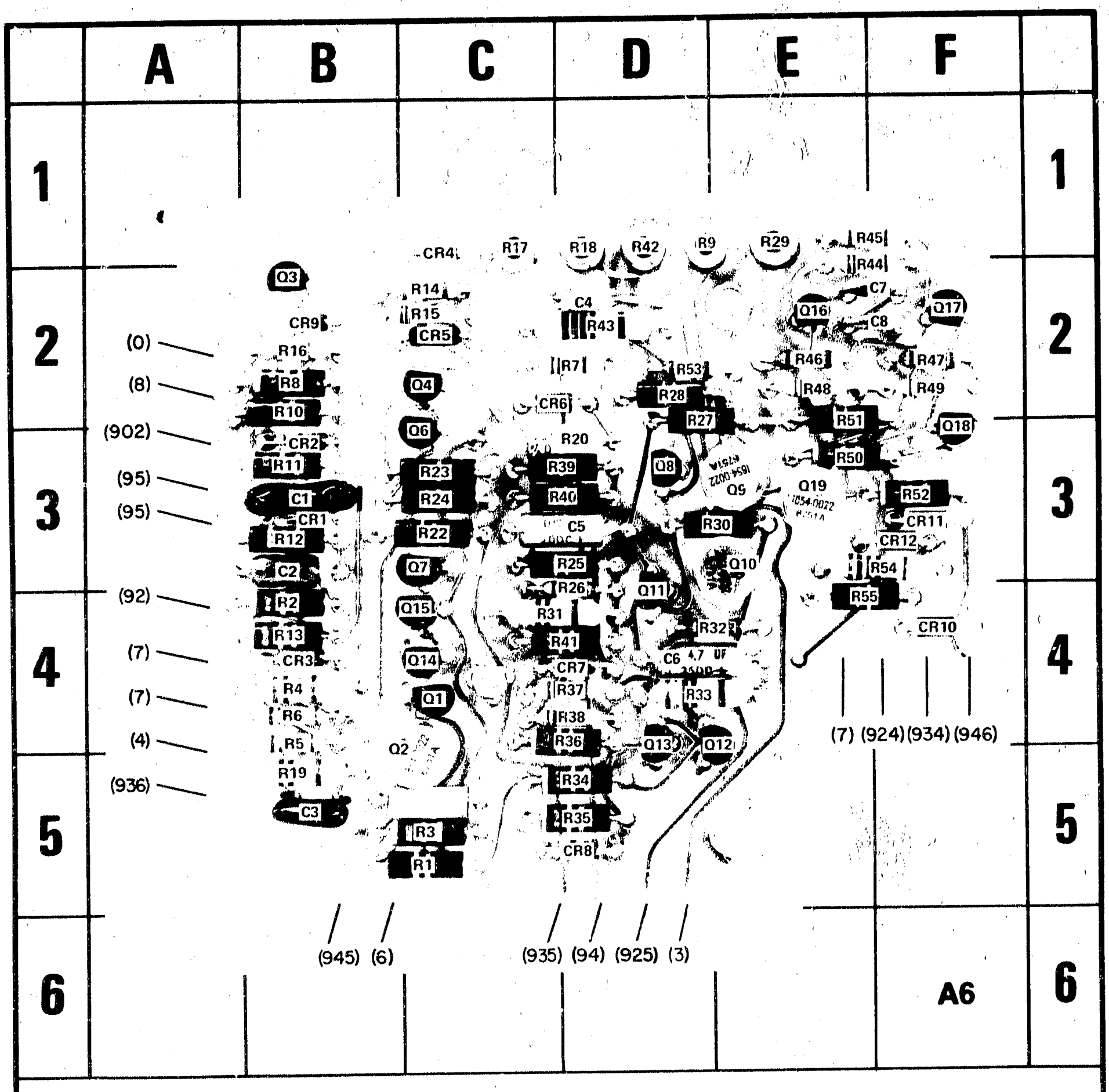


Figure 8-12. Mode Switch Schematic Diagram



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	CR5	C-2			Q17	F-2	R10	B-2	R22	C-3	R34	D-5	R45	F-1
C2	B-3	CR6	C-2	Q6	C-3	Q18	F-3	R11	B-3	R23	C-3	R35	D-4	R46	E-2
C3	B-5	CR7	D-4	Q7	C-3	Q19	E-3	R12	B-3	R24	C-3	R36	D-5	R47	F-2
C4	D-2	CR8	D-5	Q8	D-3	R1	C-5	R13	B-4	R25	D-3	R37	D-4	R48	E-2
C5	D-3	CR9	B-2	Q9	E-3	R2	B-4	R14	C-2	R26	D-3	R38	D-4	R49	F-2
C6	D-4	CR10	F-4	Q10	E-3	R3	C-5	R15	C-2	R27	D-2	R39	D-3	R50	E-3
C7	F-2	CR11	F-3	Q11	D-4	R4	B-4	R16	B-2	R28	D-2	R40	D-3	R51	E-3
C8	F-2	CR12	F-3	Q12	E-4	R5	B-4	R17	C-1	R29	E-1	R41	D-4	R52	F-3
CR1	B-3	Q1	C-4	Q13	D-4	R6	B-4	R18	D-1	R30	E-3	R42	D-1	R53	D-2
CR2	B-3	Q2	C-5	Q14	C-4	R7	D-2	R19	B-5	R31	C-4	R43	D-2	R54	F-3
CR3	B-4	Q3	B-2	Q15	C-4	R8	B-2	R20	D-3	R32	D-4	R44	F-2	R55	E-4
CR4	C-1	Q4	C-2	Q16	E-2	R9	D-1			R33	D-4				

181A-A-68
(Changed 09-74)

Figure 8-13. Component Identification, Assy A6

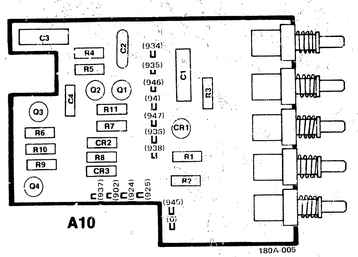


Figure 8-14. Mode Switch (A10) Wiring and Compone... Identification

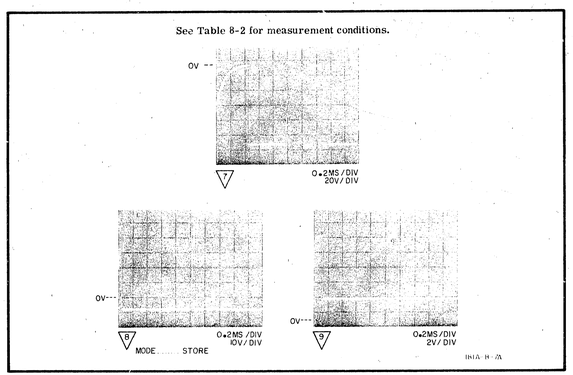


Figure 8-15. Waveforms at Test Points in Pulse Circuit.

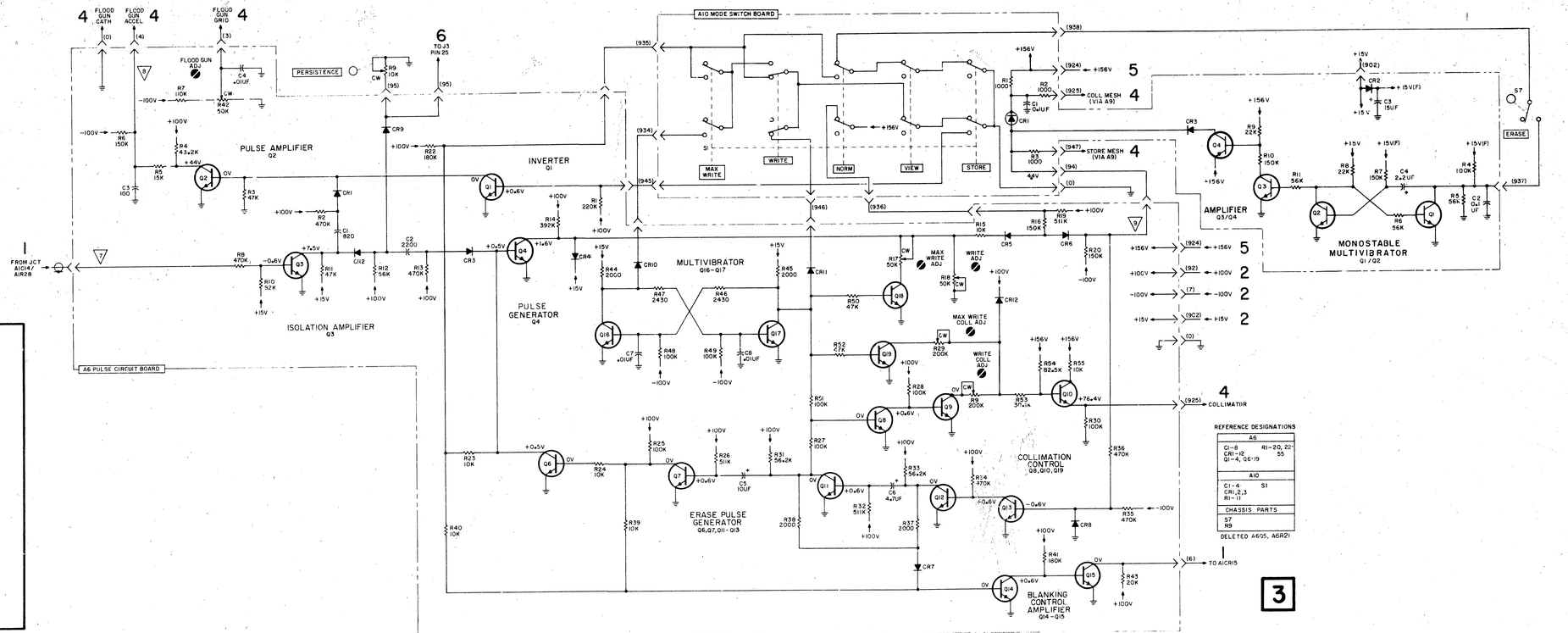


Figure 8-16.
Schematic 3, Pulse Circuit
8-11

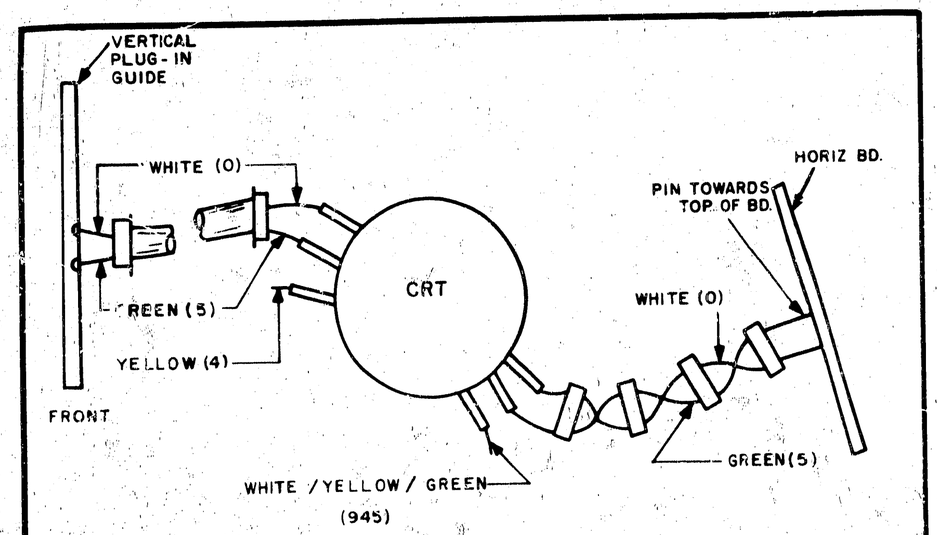
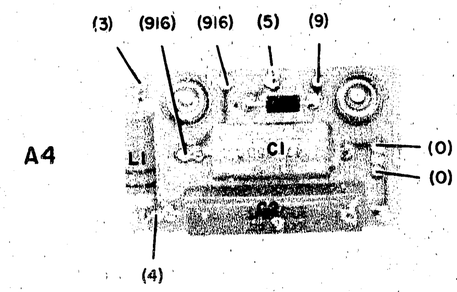
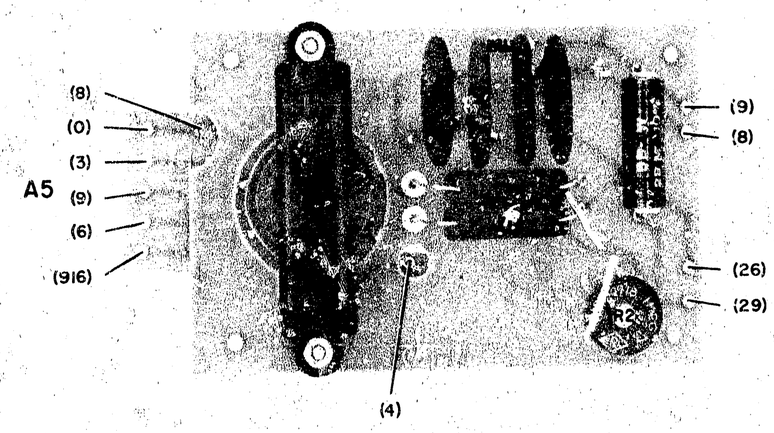
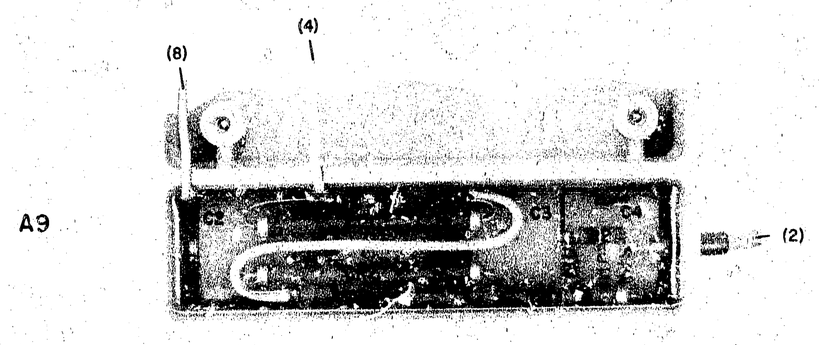


Figure 8-17. Vertical and Heriaontal CRT Connections







181A-A-189

Figure 8-18. Component Identification, Assys A4, A5, and A9

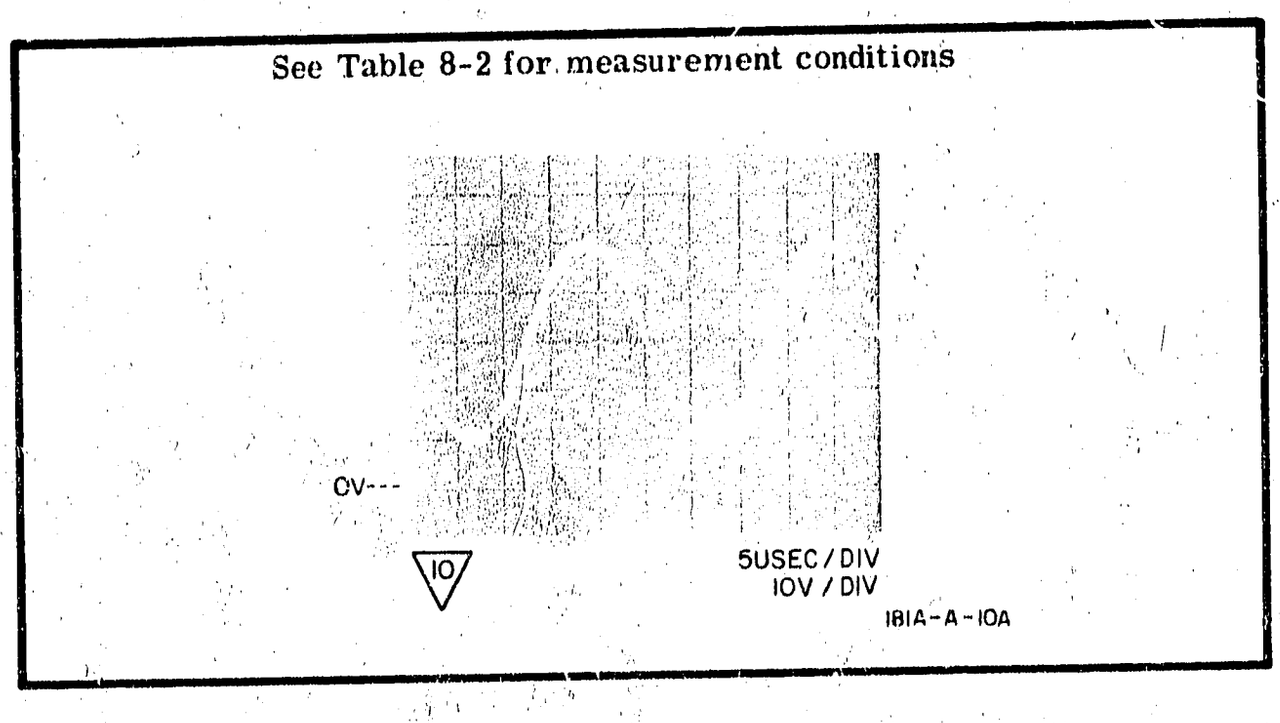
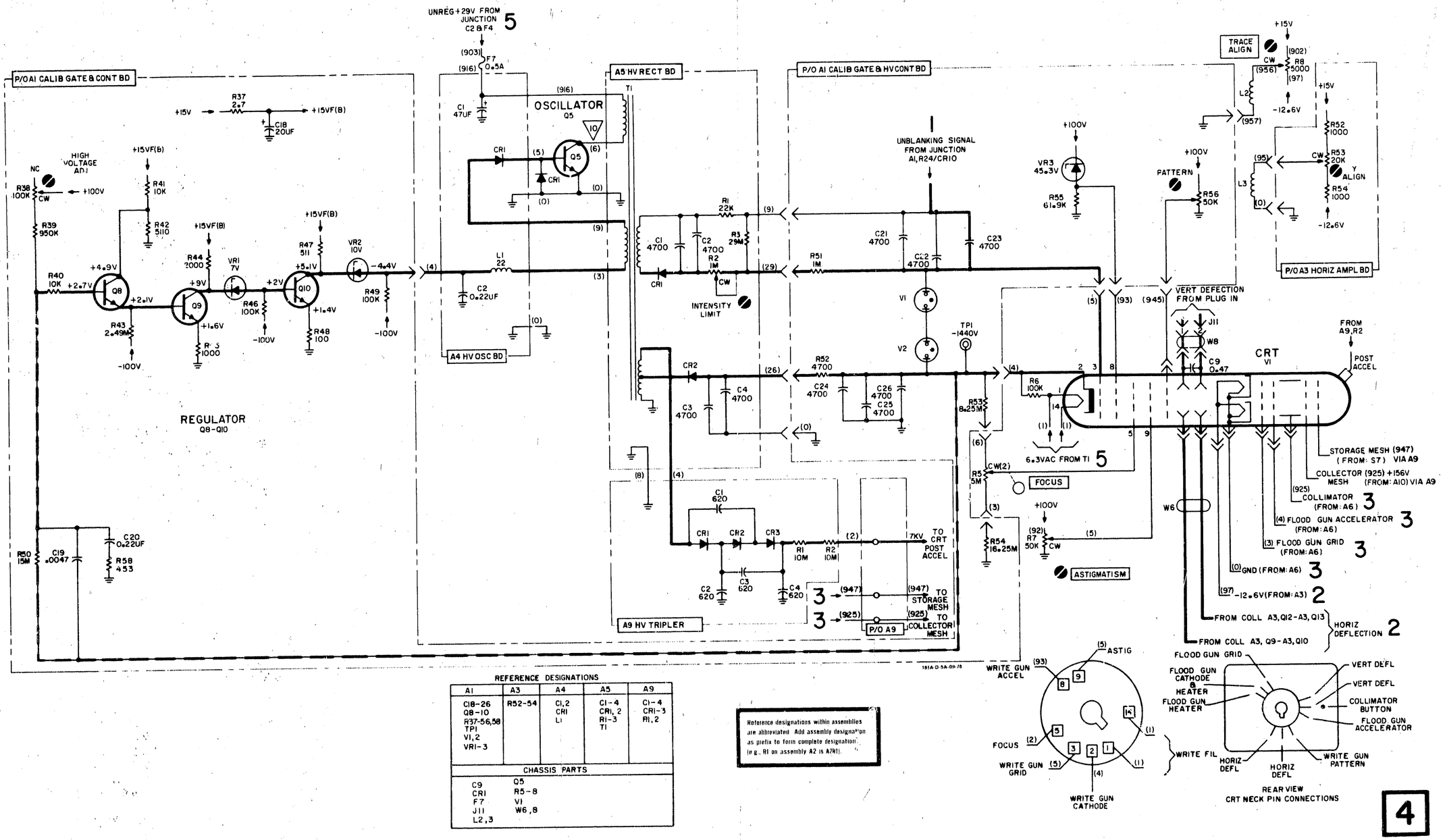


Figure 8-19. Waveform at Test Point in HV Oscillator Circuit.



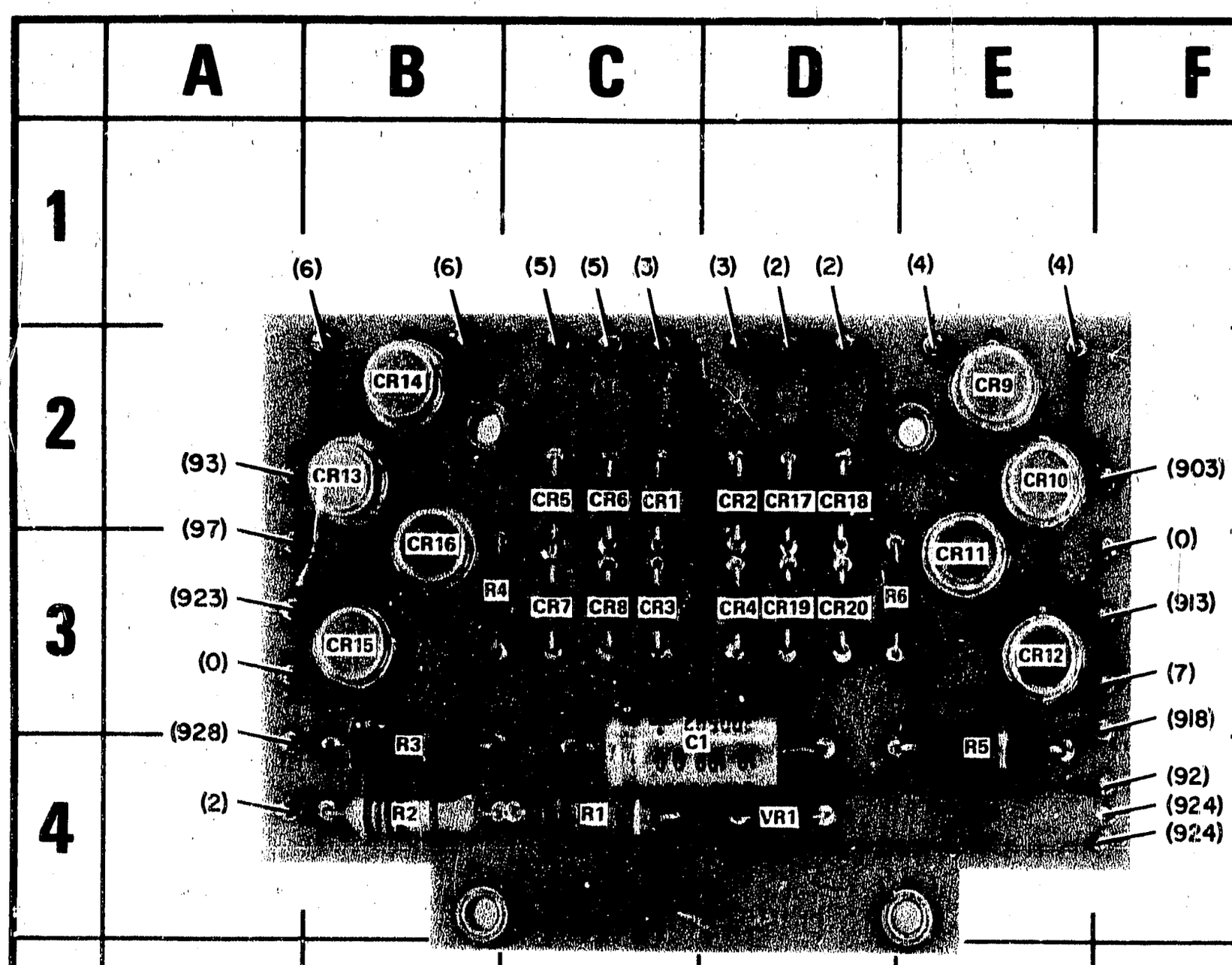
REFERENCE DESIGNATIONS

A1	A3	A4	A5	A9
C18-26 Q8-10 R37-56,58 TP1 V1,2 VR1-3	R52-54	C1,2 CR1 L1	C1-4 CR1, 2 R1-3 T1	C1-4 CR1-3 R1,2

CHASSIS PARTS	
C9	Q5
CR1	R5-8
F7	V1
J11	W6,8
L2,3	

Reference designations within assemblies are abbreviated. Add assembly designation as prefix to form complete designation (e.g., R1 on assembly A2 is A2R1).

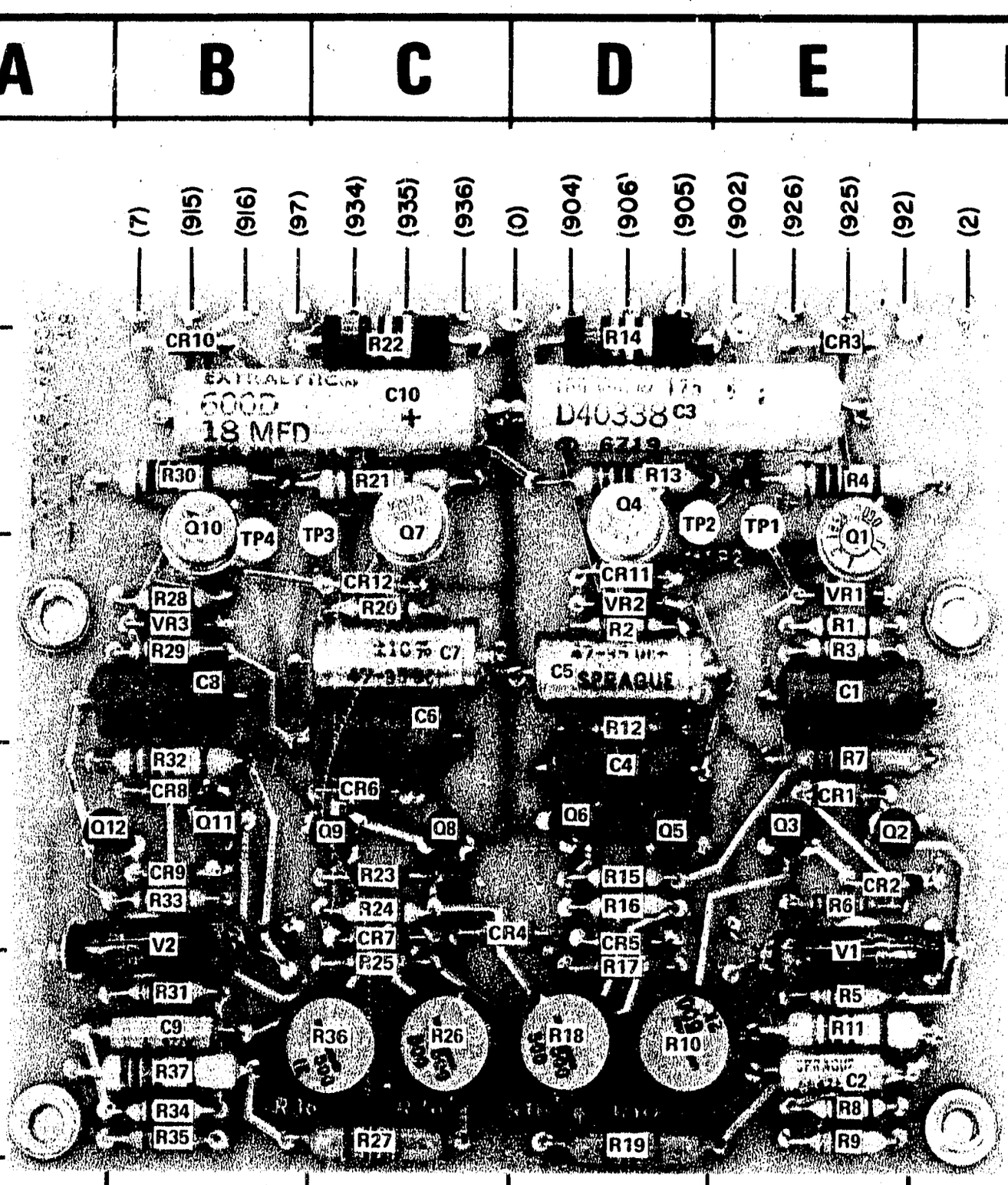
Figure 8-20.
Schematic 4, High Voltage Power Supply



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	C-4	CR7	C-3	CR14	B-2	R1	C-4
CR1	C-2	CR8	C-3	CR15	B-3	R2	B-4
CR2	D-2	CR9	E-2	CR16	B-3	R3	B-4
CR3	C-3	CR10	E-2	CR17	D-2	R4	B-3
CR4	D-3	CR11	E-3	CR18	D-2	R5	E-4
CR5	C-2	CR12	E-3	CR19	D-3	R6	D-3
CR6	C-2	CR13	B-2	CR20	D-3	VR1	D-4

181A-A-2A

Figure 8-21. Component Identification, Assy A7



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	E-3	CR3	E-2	Q3	E-4	R3	E-3	R14	D-2	R25	C-5	R36	C-5
C2	E-5	CR4	C-4	Q4	D-2	R4	E-2	R15	D-4	R26	C-5	R37	B-5
C3	D-2	CR5	D-4	Q5	D-4	R5	E-5	R16	D-4	R27	C-5	TP1	E-2
C4	D-4	CR6	C-4	Q6	D-4	R6	E-4	R17	D-5	R28	B-3	TP2	D-2
C5	D-3	CR7	C-4	Q7	C-2	R7	E-4	R18	D-5	R29	B-3	TP3	C-2
C6	C-3	CR8	B-4	Q8	C-4	R8	E-5	R19	D-5	R30	B-2	TP4	B-3
C7	C-3	CR9	B-4	Q9	C-4	R9	E-5	R20	C-3	R31	B-5	V1	E-4
C8	B-3	CR10	B-2	Q10	B-2	R10	D-5	R21	C-2	R32	B-4	V2	B-4
C9	B-5	CR11	D-3	Q11	B-4	R11	E-5	R22	C-2	R33	B-4	VR1	E-3
C10	C-2	CR12	C-3	Q12	A-4	R12	D-3	R23	C-4	R34	B-5	VR2	D-3
CR1	E-4	Q1	E-3	R1	E-3	R13	D-2	R24	C-4	R35	B-5	VR3	B-3
CR2	E-4	Q2	E-4	R2	D-3								

181A-A-1A

Figure 8-22. Component Identification, Assy A8.

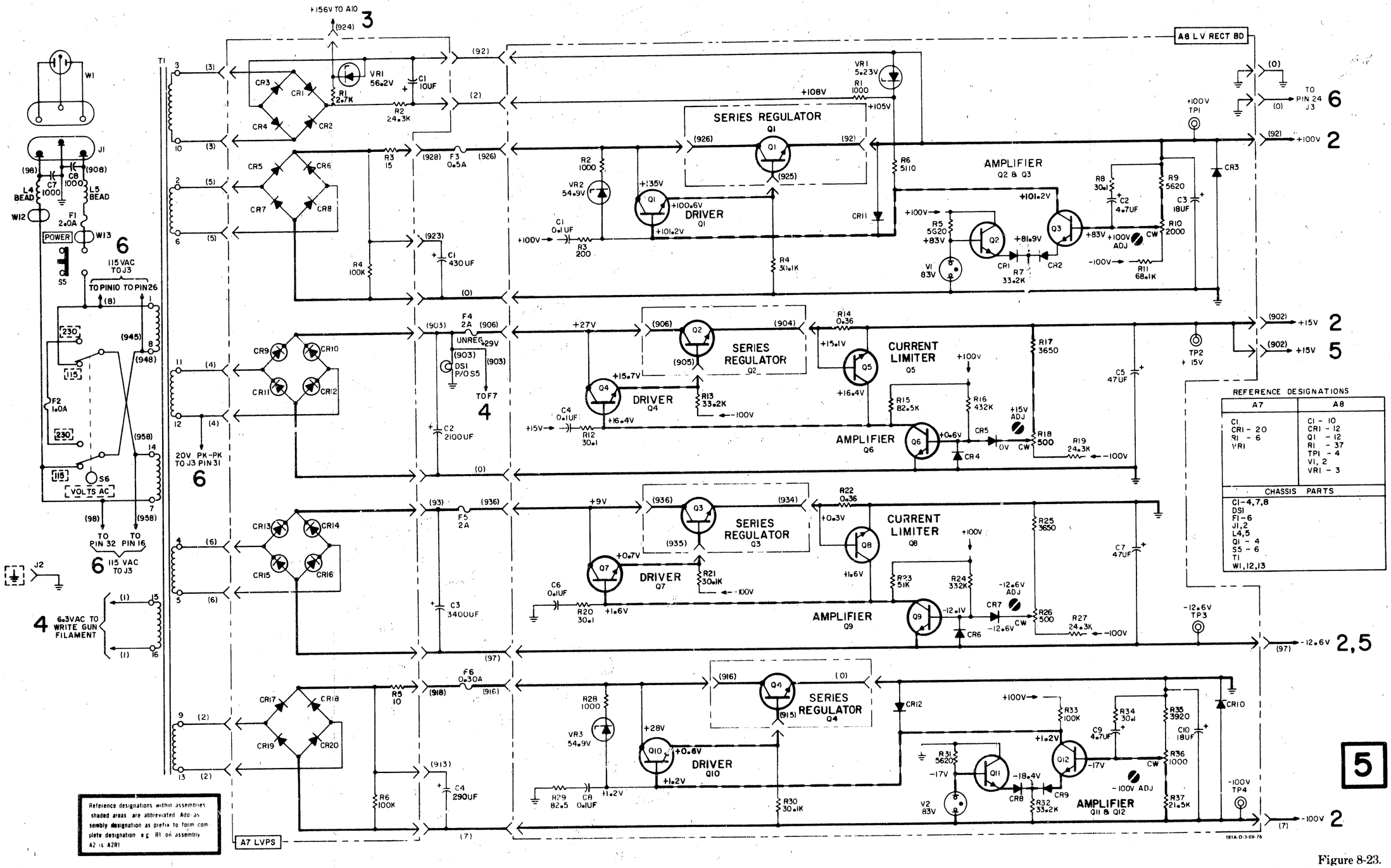


Figure 8-23.
Schematic 5, Low Voltage Power Supply

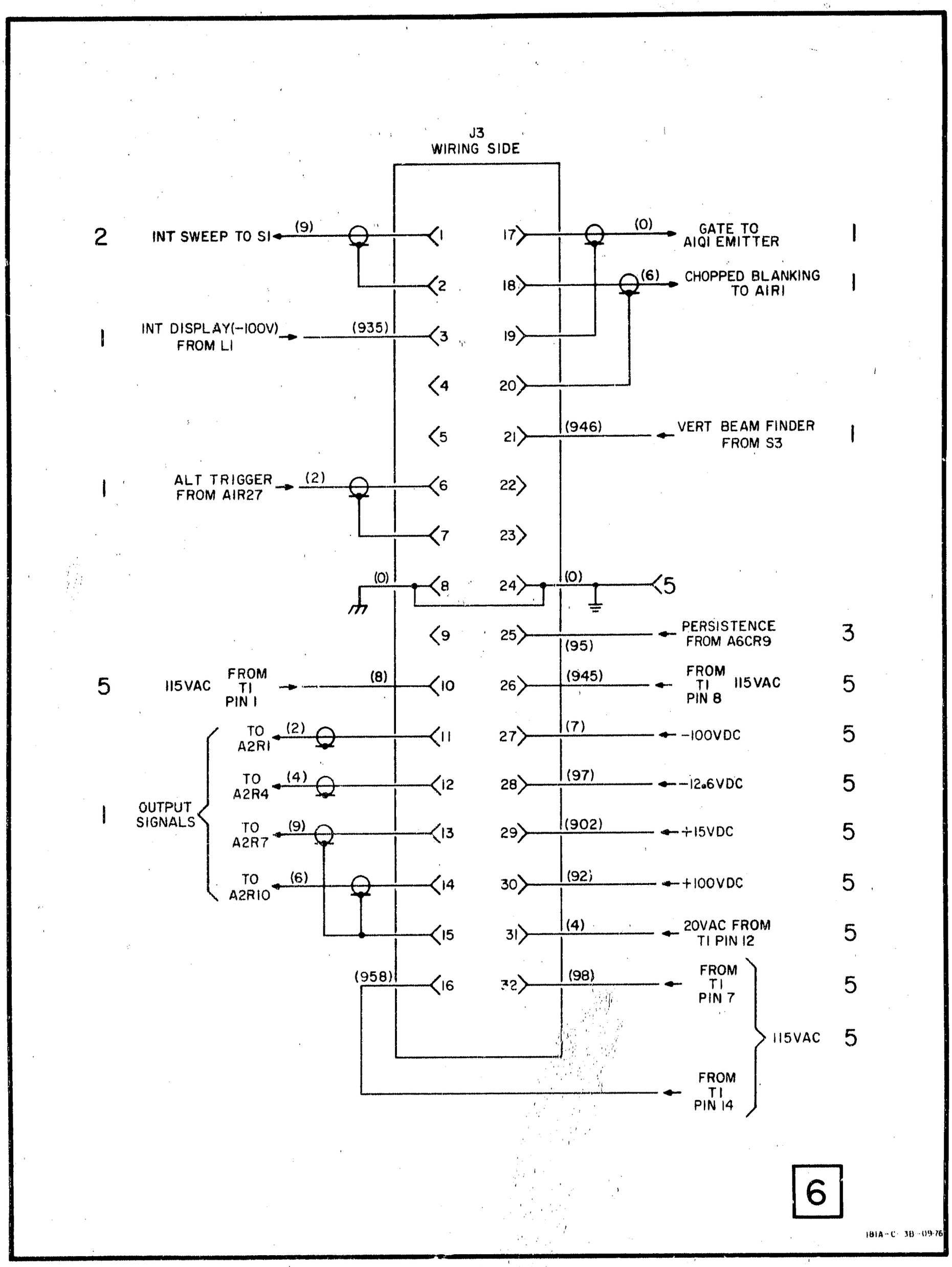


Figure 8-24. Interconnection Jack (J3) Wiring

MANUAL CHANGES

MANUAL CHANGES

MANUAL IDENTIFICATION

Model Number:	181A/AR
Date Printed:	September 1976
Part Number:	00181-90916

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
1913A	1
2045A (181A) 2043A (181AR)	1,2
2112A(181A) 2120A(181AR)	1,2,3

Serial Prefix or Number	Make Manual Changes

▲ NEW ITEM

ERRATA

Table 6-2. Replaceable Parts,

Change: A1R54, HP Part No. 0699-0169, RF 16.25M 5% 1W, Mfr Code 28480, Mfr Part No. 0699-0169.

Change: A5R3, HP Part No. 0698-8427, RF 29M 10% 1W, Mfr Code 28480, Mfr Part No. 0698-8427.

Change: A10CR1, HP Part No. 1901-0036, DIODE-HV RECT 1KV 600 MA DO-29, Mfr Code 04713, Mfr Part No. SR1358-12.

Change: MP35, HP Part No. and Mfr Part No. to 00181-00224.

Change: MP45, HP Part No. and Mfr Part No. to 1440-0152.

Add: MP99, HP Part No. 0905-0779, GASKET-LIGHT SEAL, Mfr Code 28480, Mfr Part No. 0905-0779.

Delete: XF1.

Add: XF1A, HP Part No. 2110-0564, FUSE POST, Mfr Code 28480, Mfr Part No. 2110-0564.

Add: XF1B, HP Part No. 2110-0565, FUSE CARRIER, Mfr Code 23490, Mfr Part No. 2110-0565.

Add: XF1C, HP Part No. 2110-0569, NUT-PLASTIC, Mfr Code 28480, Mfr Part No. 2110-0569.

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.

HEWLETT PACKARD

Printed in U.S.A.

CHANGE 1

Table 6-2,
Add: H15, HP Part No. 2190-0018, Qty 2, WASHER-LK HLCL NO. 6 .141-IN-ID, Mfr Code 28480, Mfr Part No. 2190-0018.
Add: H16, 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: H17, HP Part No. 3050-0010, Qty 2, WASHER-FL MTLC NO. 6 .147-IN-ID, Mfr Code 28480, Mfr No. 3050-0010.
Change: L3, HP and Mfr Part Nos. to 01741-66001.
Change: MP58, HP and Mfr Part Nos. to 00181-00605.

CHANGE 2

Table 6-2, Replaceable Parts,
Change A7, HP Part No. and Mfr Part No. to 00181-66522.
Add: A7C2, HP Part No. 0160-2903, Qty 2, C:FXD CER .05UF ±20% 500VDCW, Mfr Code 28480, Mfr Part No. 0160-2903.
Add: A7C3, HP Part No 0160-3494, Qty 2, C:FXD ELECT .47UF ±5% 200VDCW, Mfr Code 28480, Mfr Part No. 0160-3494
Add: A7C4, HP Part No. 0160-3494, C:FXD ELECT .47UF ±5% 200VDCW, Mfr Code 28480, Mfr Part No. 0160-3494.
Add: A7C5, HP Part No. 0160-2903, C:FXD CER .05UF ±20% 500VDCW, Mfr Code 28480, Mfr Part No. 0160-2903.

Figure 8-23. Schematic 5,
Make changes shown in figure 1 of this manual change sheet.

▲ CHANGE 3

Page 6-7, Table 6-2. Replaceable Parts,
Change A8 HP and Mfr Part Number to 00181-66523.
Change A8C2 to HP Part Number 0180-0269, C:FXD ELECT 1UF +50-10% 150 VDCW, Mfr Code 56289, Mfr Part Number 30D105G150BA2-DSM.
Add A8C11, HP and Mfr Part Number 0140-0176, C:FXD MICA 100PF 2% 300 VDCW, Mfr Code 28480.
Add A8C12, HP and Mfr Part Number 0140-0176, C:FXD MICA 100PF 2% 300 VDCW, Mfr Code 28480.
Change A8R5 to HP and Mfr Part Number 0757-0060, R:FXD MET FLM 24.3K OHM 1% 1/2 W, Mfr Code 28480.
Change A8R8 to HP and Mfr Part Number 0757-0060, R:FXD MET FLM 24.3K OHM 1% 1/2 W, Mfr Code 28480.
Change A8R9 to HP and Mfr Part Number 0757-0435, R:FXD MET FLM 3920 OHM 1% 1/8 W, Mfr Code 28480.
Change A8R10 to HP and Mfr Part Number 2100-1773, R:VAR WW 1000 OHM 5% TYPE H 1W, Mfr Code 28480.
Change A8R11 to HP and Mfr Part Number 0757-0767, R:FXD MET FLM 43.2K OHM 1% 1/4W, Mfr Code 28480.

Page 6-8, Table 6-2. Replaceable Parts,
Delete A8R31.
Add A8R38, HP and Mfr Part Number 0757-0770, R:FXD MET FLM 56.2K OHM 1% 1/4 W, Mfr Code 28460.
Add A8R39, HP and Mfr Part Number 0757-0766, R:FXD MET FLM 39.2K OHM 1% 1/4 W, Mfr Code 28480.
Delete A8V1 and A8V2.
Add A8VR4, HP Part Number 1902-0787, DIODE BREAKDOWN:9.0V 5% 500 MW, Mfr Code 04713, Mfr Part Number 1N937.

Page 8-15, Figure 8-22,
Replace A8 Component Identification with Figure 2 of this manual change sheet.

Page 8-15, Figure 8-23,
Make changes shown in Figure 3 of this manual change sheet.

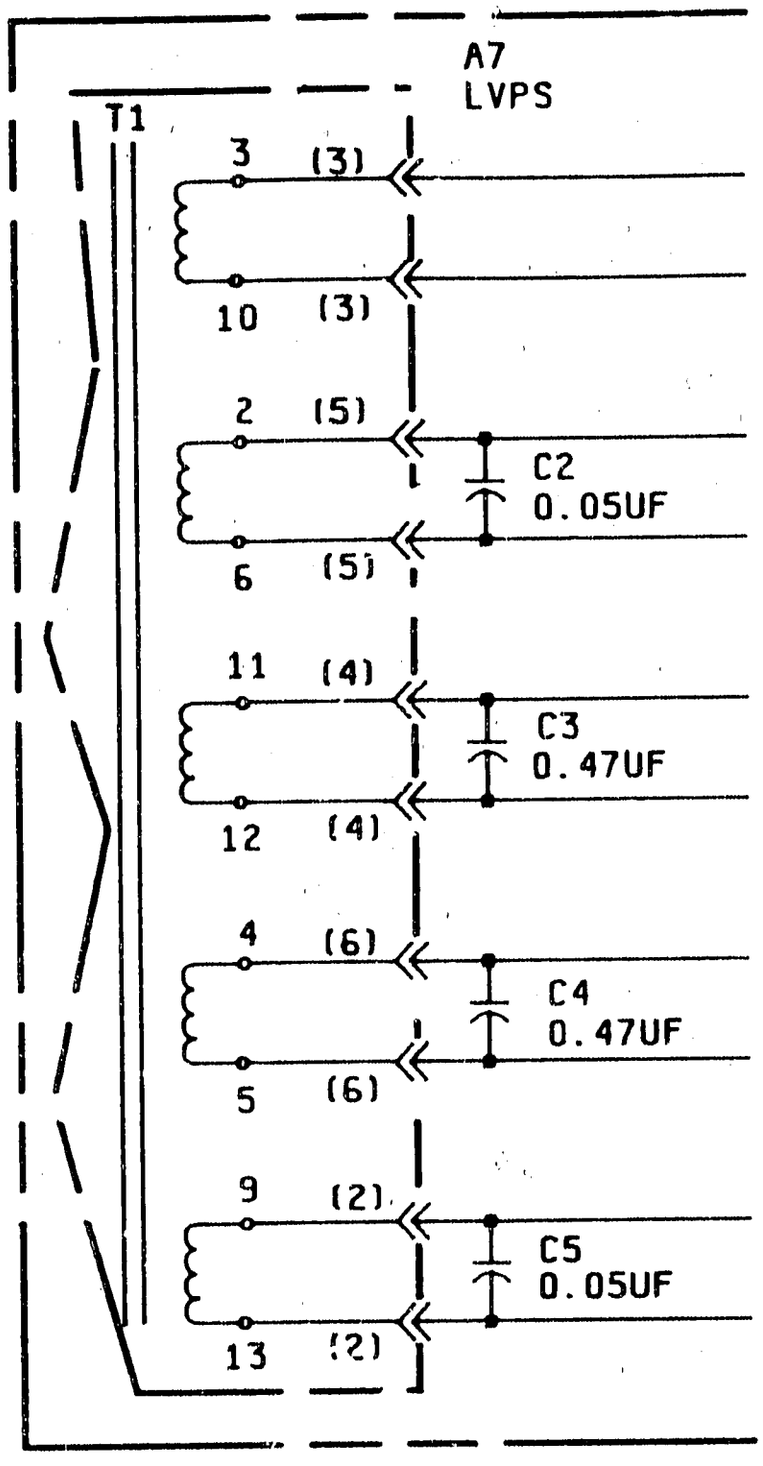
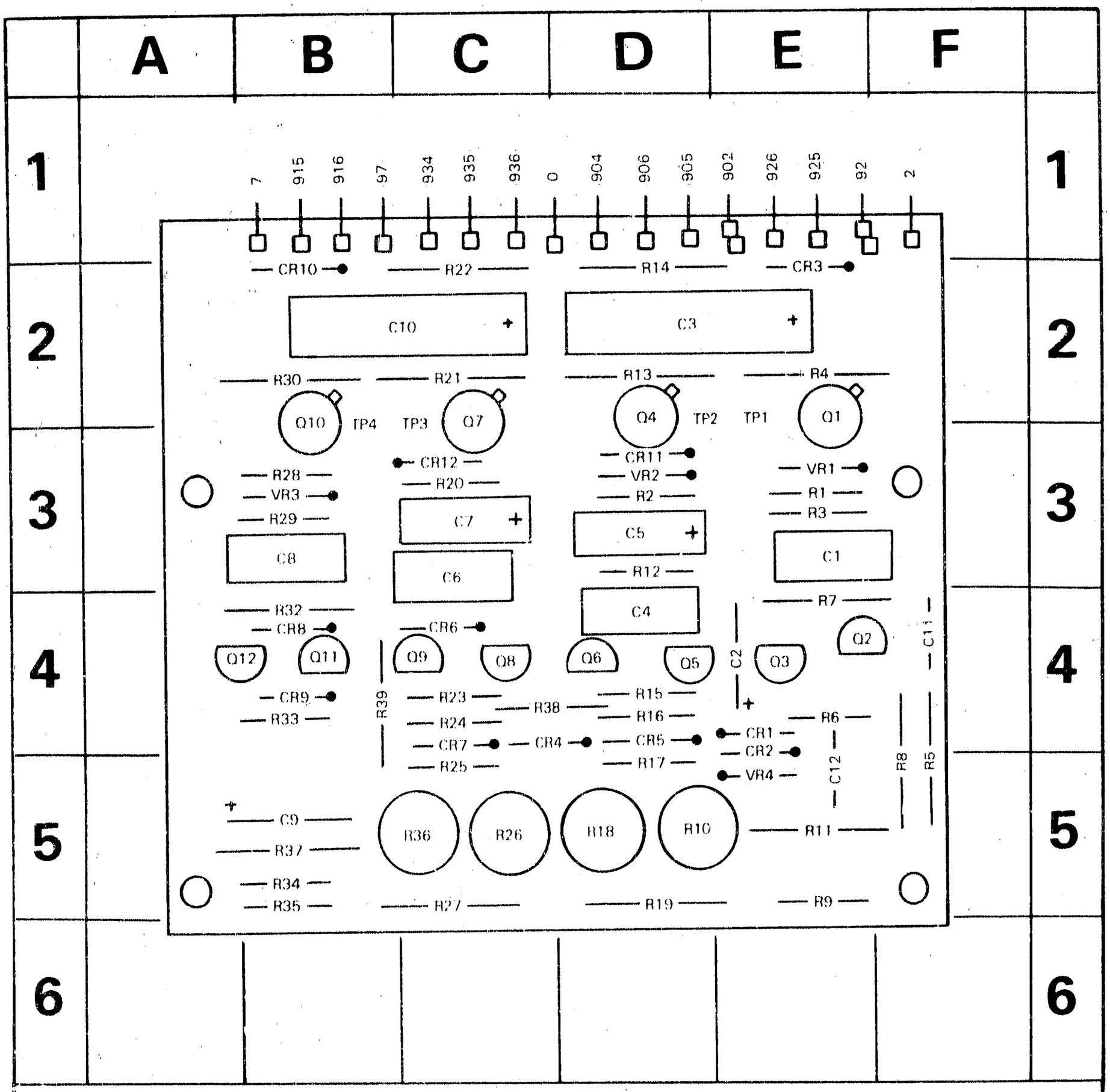


Figure 1. Additions to Figure 8-23. Schematic 5,



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	E 3	CR1	E 4	Q1	E 3	R1	E 3	R13	D 2	R25	C 5	R38	C 4
C2	E 4	CR2	E 5	Q2	E 4	R2	D 3	R14	D 2	R26	C 5	R39	B 4
C3	D 2	CR3	E 2	Q3	E 4	R3	E 3	R15	D 4	R27	C 5	TP1	E 2
C4	D 4	CR4	C 5	Q4	D 3	R4	E 2	R16	D 4	R28	B 3	TP2	D 2
C5	D 3	CR5	D 5	Q5	D 4	R5	E 5	R17	D 5	R29	B 3	TP3	C 2
C6	C 3	CR6	C 4	Q6	D 4	R6	E 4	R18	D 5	R30	B 2	TP4	B 2
C7	C 3	CR7	C 5	Q7	C 3	R7	E 4	R19	D 5	R32	B 4	VR1	E 3
C8	B 3	CR8	B 4	Q8	C 4	R8	E 5	R20	C 3	R33	B 4	VR2	D 3
C9	B 5	CR9	B 4	Q9	C 4	R9	E 5	R21	C 2	R34	B 5	VR3	B 3
C10	C 2	CR10	B 2	Q10	B 3	R10	D 5	R22	C 2	R35	B 5	VR4	E 5
C11	E 4	CR11	D 3	Q11	B 4	R11	E 5	R23	C 4	R36	C 5		
C12	E 5	CR12	C 3	Q12	A 4	R12	D 3	R24	C 4	R37	B 5		

Figure 2. Replacement for A8 Component Identification

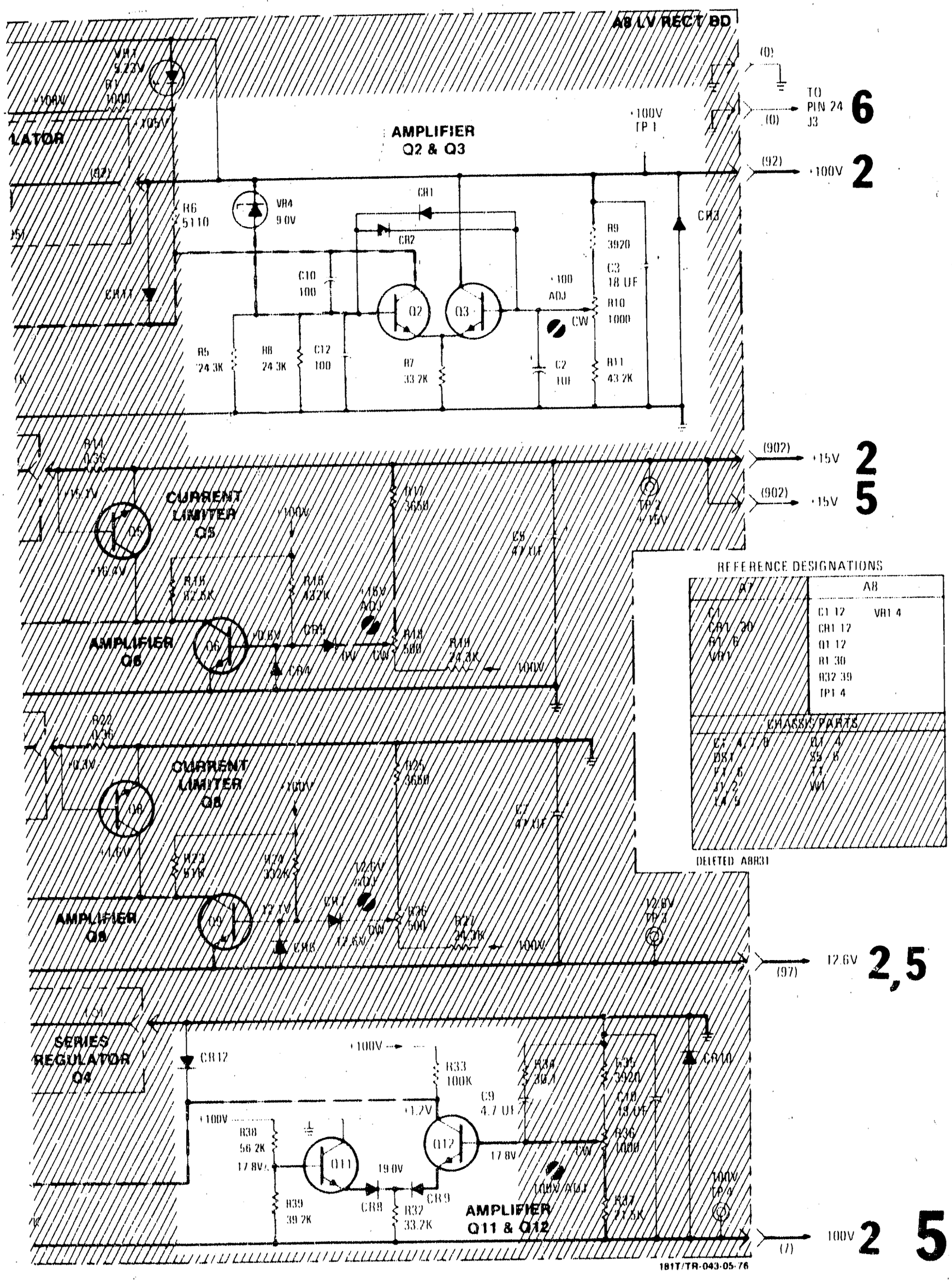


Figure 3. Changes to Figure 8-23 (Schematic 5)