Errata

Title & Document Type: **141B Swept Oscilloscope Operating and Service Manual**

Manual Part Number: **00141-90910**

Revision Date: **April 1971**

About this Manual

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

HP References in this Manual

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

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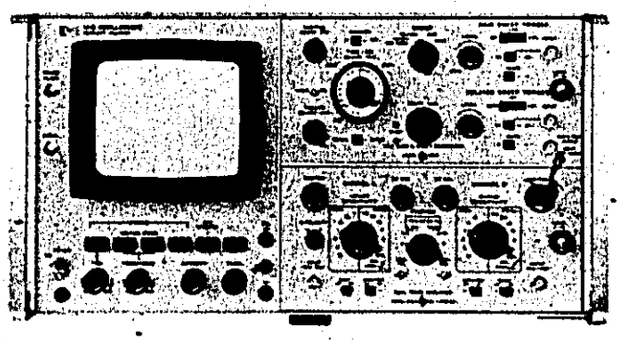
Agilent Technologies

HP 141B

OPERATING AND SERVICE MANUAL

OSCILLOSCOPE

141B



HEWLETT hp PACKARD

HP 141B

CERTIFICATION

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

WARRANTY AND ASSISTANCE

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

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

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

OPERATING AND SERVICE MANUAL

MODEL 141B
OSCILLOSCOPE

SERIALS PREFIXED: 1104A

Refer to Section VII for instruments with the following Serial Prefixes: **944, 972.**

Refer to Section VII for instruments with standard options: **001, 009.**

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

Manual Part Number 00141-90910
Microfiche Part Number 00141-90810

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Table 1-1. Specifications

PLUG-INS:

Accepts all Model 1400-series plug-ins; upper compartment for horizontal axis and lower compartment for vertical axis. Center shield may be removed to provide double-sized compartment for a single dual-axis Model 1400-series unit.

CATHODE-RAY TUBE:

Type:
Post-accelerator storage tube; 9000V accelerating potential; aluminized P31 phosphor; etched safety glass face plate reduces glare.

Graticule:
8 x 10 divisions (approx. 7.5 x 9.4 cm), parallax-free internal graticule including 10% to 90% lines for 6 and 8 division reference; 5 subdivisions per major division on major horizontal and vertical axes.

Intensity Modulation:
ac coupled, +20 volt pulse will blank trace of normal intensity; input terminals on rear panel.

PERSISTENCE:

Conventional:
Natural persistence of P31 phosphor (about 40 usec).

Variable:
STANDARD Writing Speed Mode: Continuously variable from less than 0.2 second to more than one minute.

FAST Writing Speed Mode: Typically variable from 0.2 second to 15 seconds.

ERASE:

Manual or optional remote (see Section VII options): Erasure takes approximately 350 msec; scope ready to record immediately after erasure.

WRITING SPEED PHOTOGRAPHIC:

Conventional operation (using a HP Model 197A camera with f/1.9 lens and Polaroid® 3000 speed-film): 100 div/usec.

WRITING SPEED:

Storage:
STANDARD Mode: greater than 20 div/ms.
FAST Mode: greater than 1 div/usec.

STORAGE TIME:

Standard Writing Speed: more than two hours at reduced brightness (typically four hours). Traces may be viewed at maximum brightness for more than one minute.

Fast Writing Speed: Traces may be stored at reduced brightness for more than 15 minutes (typically 30 minutes) or stored at maximum brightness for more than 15 seconds.

Brightness:
100 foot-lamberts in standard mode.

CALIBRATOR:

Type:
Line-frequency rectangular signal, approximately 0.5 usecrise time.

Voltage:
Two outputs: 1 volt and 10 volts peak-to-peak ±1% from 15°C to 35°C, ±3% from 0°C to 55°C.

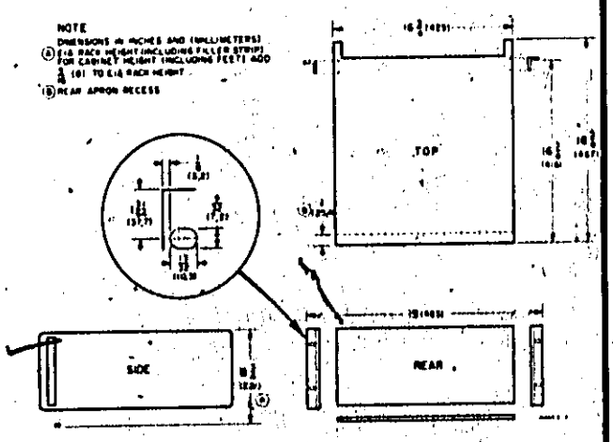
BEAMFINDER:

Pressing BEAMFINDER pushbutton brings trace on screen regardless of setting of horizontal or vertical position controls.

GENERAL:

Power Requirements:
115 or 230 volts, ±10%, 50 to 60 Hz, normally less than 285 watts (varies with plug-in units).

Dimensions:



Weight:
Net, 40 lbs. (18 kg) (without plug-ins). Shipping, 51 lbs. (23 kg).

SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. This manual provides operating and servicing information for the Hewlett-Packard Model 141B Oscilloscope. The manual is divided into eight sections, each covering a specific topic or aspect of the instrument. All schematics are located at the rear of the manual and can be unfolded and used for reference while reading any part of the manual.

1-3. This section contains complete instrument specifications, a description of features, warranty information, data for manual and instrument identification, and information regarding accessories available for use with the instrument.

1-4. INSTRUMENT DESCRIPTION.

1-5. The HP Model 141B, Figure 1-1, is a conventional, general purpose Oscilloscope with the added features of variable persistence (duration of trace afterglow) and storage of CRT displays. Persistence is variable from 0.2 to more than 60 seconds; a display may be stored (at reduced intensity) for more than 2 hours or displayed at normal intensity for up to 1 minute. Stored displays can be erased in 350 milliseconds.

1-6. Variable persistence is especially useful for viewing slow-sweep signals. The persistence of the signals from electrocardiograms or other bio-chemical phenomena can be adjusted to provide a complete trace, yet to fade fast enough to prevent interference with the next trace. Display persistence of swept frequency and time domain reflectometry measurement readouts can be adjusted to eliminate flicker and still provide high resolution.

1-7. The storage feature of the instrument can be used to store single-shot waveforms and to later view or photograph the phenomena. Comparison of waveforms can be accomplished by storing several displays separately and then viewing them simultaneously.

1-8. The instrument accepts all HP Model 1400-series plug-in units. Amplifiers with bandwidths up to 20 MHz and sensitivities to 100 microvolts per division are available as well as wide band sampling, time domain reflectometry, spectrum analysis and swept frequency indicator units. Complete specifications for the instrument are given in Table 1-1.

1-9. CATHODE RAY TUBE.

1-10. The instrument uses an internal graticule, P31 aluminized phosphor CRT with additional internal elements to provide the variable persistence and storage features. The tube is equipped with a nonglare, safety face plate and the internal graticule eliminates parallax error in observing the display.

1-11. WARRANTY.

1-12. This instrument is certified and warranted as stated on the inside front cover of this manual. The CRT is

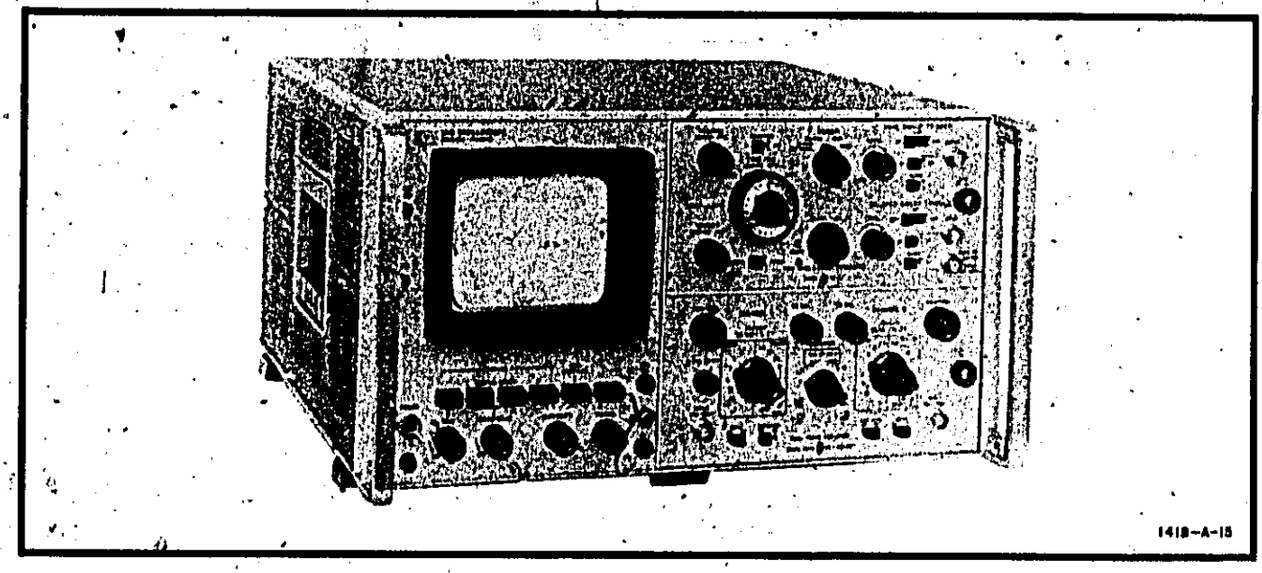


Figure 1-1. Model 141B Oscilloscope

covered by a separate warranty. The CRT warranty and warranty claim form are located at the rear of this manual. Should the CRT fail within the time specified on the warranty, fill out the failure report form on the reverse side of the warranty statement and return it with the CRT. In all correspondence with a Hewlett-Packard Sales/Service Office concerning an instrument, reference the complete serial number and model of the instrument.

NOTE

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

1-13. ASSOCIATED EQUIPMENT.

1-14. All of the plug-ins available for use with the Model 141B are listed in the Hewlett-Packard Instrumentation Catalog (see Table 1-2 for current plug-ins). The instrument is normally operated with a vertical plug-in in the lower compartment and a time base plug-in in the upper compartment. Both plug-in compartments are the same size, and the plug-in instruments may be interchanged for any special application. The divider shield, which separates the two compartments, may be removed and one double sized plug-in installed. Blank plug-in kits, both single and double sized, are available for user fabrication of special circuits. See Table 4-1 for power supply current limitations.

1-15. INSTRUMENT IDENTIFICATION.

1-16. Hewlett-Packard uses a two-section serial number for instrument identification (Figure 1-2). The first numerical group is the serial prefix number. It identifies a series of instruments. The last numerical group identifies a particular instrument in the series. The serial number appears on a plate located on the rear panel.

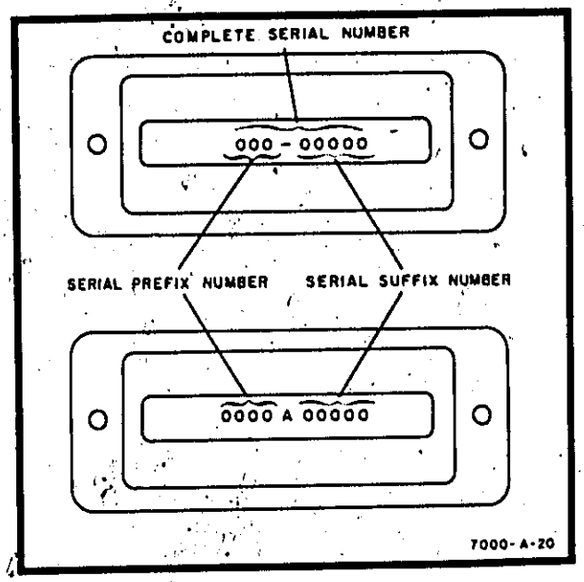


Figure 1-2. Instrument Identification

1-17. MANUAL IDENTIFICATION AND CHANGES.

1-18. This manual provides operating and service information for the HP Model 141B. Information in this manual applies directly to instruments (as manufactured) with a serial prefix as indicated on the title page. If the serial prefix of your instrument is different from that on the title page, a MANUAL CHANGES insert sheet, or Section VII of this manual will describe the changes necessary to adapt this manual to provide correct information.

1-19. Technical corrections (if any) to this manual due to known errors in print are called Errata and are shown on the manual changes sheet. For information on manual coverage of any HP instrument, contact the nearest HP Sales/Service Office (addresses are listed at the rear of this manual).

Table 1-2. Plug-ins for Model 141B Oscilloscope

FUNCTION	HP MODEL NUMBER	CAPABILITIES												
		Wide Band	Sampling	High Gain Differential	Dual Trace	Four Trace	X-Y	Delayed Sweep	No Drift	High CMR	Algebraic Addition	TDR*	Wide Band TDR	Swept Frequency
VERTICAL PLUG-INS	1400A			x			x							
	1400B			x			x			x				
	1401A				x		x				x			
	1402A	x			x		x				x			
	1403A			x			x			x	x			
	1404A	x				x	x				x			
	1405A	x			x		x				x			
	1406A			x			x		x	x				
	1407A			x			x		x	x				
	1408A			x	x		x			x	x			
	1410A		x		x		x				x			
	1411A		x		x		x				x		x	
	1430A		x										x	
	1431A		x											
	1432A		x											
COMPATIBLE TIME BASES	1420A	x		x	x				x	x	x			
	1421A	x		x	x			x	x	x	x			
	1422A			x	x			x	x	x	x			
	1423A	x		x	x				x	x	x			
	1424A		x		x						x		x	
	1425A		x		x			x			x		x	
DOUBLE SIZE PLUG-INS	1415A											x		
	1416A													x
BLANK PLUG-INS	10477A	Single-size for special purpose circuit.												
	10478A	Double-size for special purpose circuit.												
SPECTRUM ANALYZER	8552A 8552B 8553B 8553L 8554L 8555A 8556A	Fixed or variable scan spectrum analysis.												

* Time Domain Reflectometry.

INSTALLATION

SECTION II

INSTALLATION

2-1. INITIAL INSPECTION.

2-2. MECHANICAL CHECK. If the shipping carton is damaged, ask the carrier's agent to be present when the instrument is unpacked. Check the instrument for external damage such as broken controls or connectors, and dents or scratches on the panel surfaces. If damage is evident, see the recommended claim procedure below. If the shipping carton is not damaged, check the cushioning material, and note any signs of severe stress as an indication of rough handling in transit. If the instrument appears undamaged, perform the following electrical check. Retain the packaging material for possible future use.

2-3. ELECTRICAL CHECK. Check the electrical performance of the instrument as soon as possible after receipt. Section V, Performance Checks will verify instrument operation within the specifications listed in Table 1-1. Initial performance and accuracy of the instrument are certified as stated on the inside front cover of this manual. If the instrument does not operate as specified, refer to the following recommended claim procedure.

2-4. CLAIMS.

2-5. The warranty statement applicable to all Hewlett-Packard Company instruments and products is provided inside the front cover of this manual. If physical damage is found or if operation is not as specified when the instrument is first received, notify the carrier and the nearest Hewlett-Packard Sales/Service Office immediately. The Sales/Service Office will arrange for repair or replacement of the instrument without waiting for settlement of a claim with the carrier. For other than initial inspection warranty claims, contact the Sales/Service Office.

2-6. REPACKING FOR SHIPMENT.

2-7. When shipping an instrument to a Hewlett-Packard Sales/Service Office, attach a tag describing required service, and include model number, complete serial number, and return address.

2-8. Use the original shipping carton and packaging materials for reshipment. If the original material is neither available or reuseable, use the following:

a. A double walled carton (see Table 2-1 for test strength required).
b. Heavy paper or sheets of cardboard to protect all instrument surfaces (use a nonabrasive material such as polyurethane or a cushioned paper such as Kimpak around all projecting parts).
c. At least 4 inches of industry-approved, tightly packed, shock-absorbing material, such as extra firm polyurethane foam.
d. Heavy duty shipping tape to secure outside of carton.

Table 2-1. Shipping Carton Test Strength

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

2-9. PREPARATION FOR USE.

2-10. POWER REQUIREMENTS.

2-11. The instrument requires a power source of either 115 or 230 volts ac, ±10%, single phase, 50 to 60 Hz, which can deliver approximately 300 watts. A rear panel switch provides selection of the line voltage to be used.

CAUTION

Before placing this instrument in operation, be sure to set the rear panel switch to agree with the line voltage being used. Refer to Figure 3-2, Proper Intensity Adjustment, to avoid damaging CRT.

2-12. 230-VOLT OPERATION. When operating from a 230-volt source, set the rear panel switch to 230, and replace line fuse F1 with a 2-amp slow-blow type. The fuse, identified in Figure 8-4, is accessible by removing the bottom cover of the instrument.

2-13. THREE-CONDUCTOR POWER CABLE. The National Electrical Manufacturers' Association (NEMA) recommends that the instrument panel and cabinet be grounded for the protection of operating personnel. The instrument is equipped with a detachable, three-conductor power cable which, when plugged into an appropriate receptacle, grounds the instrument. The offset (round) pin on the power cable connector is the ground pin. To preserve the protection feature when operating the instrument from a two-contact outlet, use

a three-conductor to two-conductor adapter, and connect the green lead on the adapter to ground at the power outlet.

2-14. INSTRUMENT MOUNTING.

2-15. MODULAR CABINET. The instrument is shipped from the factory as a bench instrument with the tilt stand, feet, and plastic trim in place. Top, left side, and bottom panel covers can be removed, giving access to all components and adjustments. Leave sufficient space around the cabinet for air circulation.

2-16. RACK MOUNTING. A kit for converting the modular cabinet to a rack mount is included. Instructions for making the conversion are given below. Refer to Figure 2-1 to identify parts.

a. Detach tilt stand by pressing away from front feet; remove all plastic feet by pressing metal button and sliding each foot free.
b. Aluminum trim strips (behind each front handle) on sides of instrument have an adhesive back; use a thin-blade tool to remove them.
c. Attach a rack-mounting flange, using screws provided in kit, in each space where trim strip was adhered; position large notch of flange at instrument bottom.
d. Before placing the instrument in a rack above or below another HP instrument, attach filler strip provided with kit between front panels of instruments.

2-17. INSTRUMENT COOLING.

2-18. A forced-air cooling system is used to maintain required operating temperatures within the instrument. The air intake and filter are located on the rear of the instrument; warm air is exhausted through the side panel perforations. When operating the instrument, choose a location which provides at least three inches of clearance around the rear and both sides.

2-19. The cooling fan requires periodic lubrication, and the filter should be cleaned, as required, to prevent clogging and restriction of air flow. Refer to Section VIII for maintenance instructions.

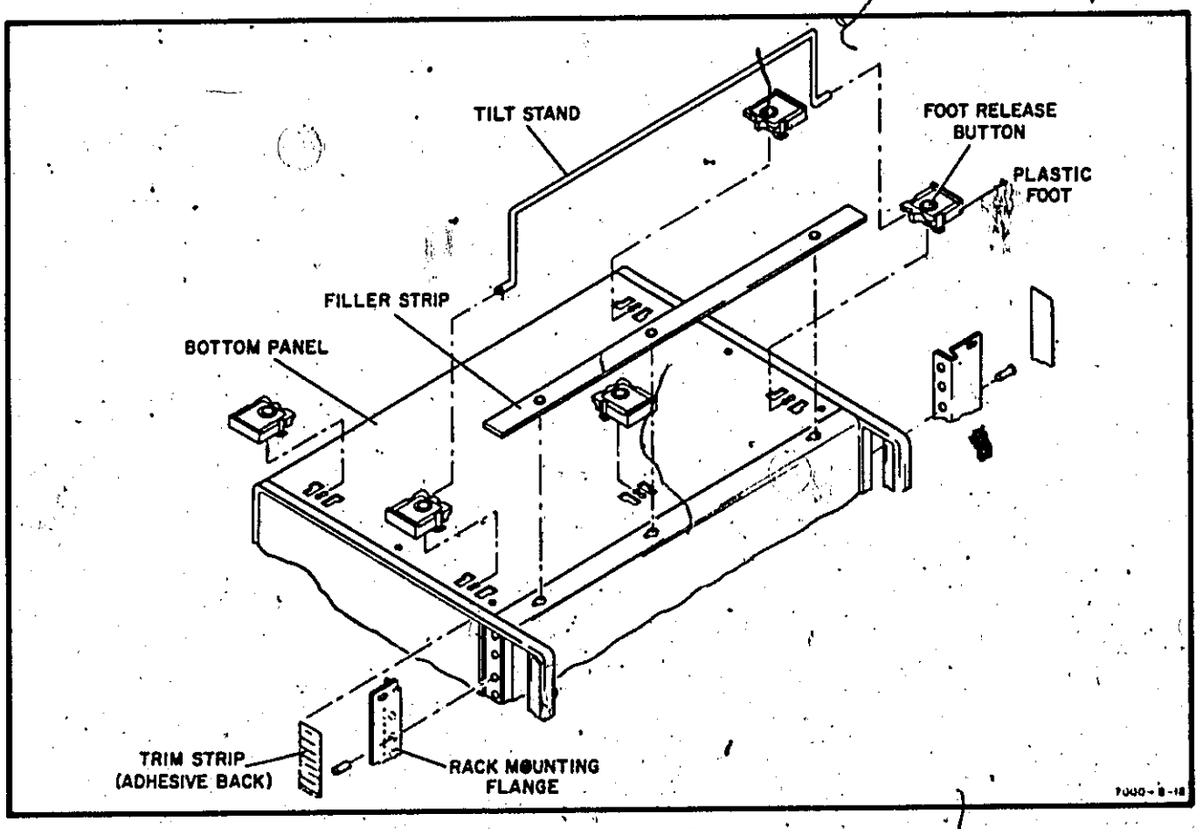


Figure 2-1. Rack Mounting Procedure

OPERATION

SECTION III

OPERATION

3-1. INTRODUCTION.

3-2. This section contains front panel control information and considerations for operating the instrument. Controls which affect the operation of the power supplies and cathode-ray tube are located on the instrument front panel; all other controls are located on plug-in units. The instrument includes the high and low-voltage power supplies, a calibrator circuit with 1 and 10 volt pk-pk outputs on the front panel, the CRT, and a pulse circuit for variable persistence and storage operation.

3-3. FRONT PANEL COMPONENTS.

3-4. Figure 3-1 identifies the front panel controls and gives a brief functional description of each. Additional information on some of the controls is given below. A more detailed description of some of the controls and their function in variable persistence and storage operation is given in this section under Control Functions.

3-5. TRACE ALIGN. The TRACE ALIGN adjustment is provided to compensate for manufacturing tolerances and external magnetic fields which may affect the CRT trace. The adjustment should be made when the trace does not appear parallel with the horizontal lines on the CRT graticule. To adjust the TRACE ALIGN, press the STD pushbutton, and adjust a free-running trace on the CRT; rotate the TRACE ALIGN adjustment as required to make the trace parallel to the graticule lines.

3-6. BEAM FINDER. A very high dc input signal may drive the trace off the CRT screen. When the BEAM FINDER pushbutton is pressed, the trace will be returned to the screen regardless of the setting of horizontal or vertical POSITION controls. If pressing the BEAM FINDER pushbutton does not return a beam to the viewing area, hold the BEAM FINDER depressed and gradually adjust the INTENSITY control to obtain a visible trace.

3-7. ASTIGMATISM. The ASTIGMATISM adjustment is provided to ensure uniform focus of the trace over the entire CRT screen. To adjust the ASTIGMATISM, press the STD pushbutton, center a low-intensity spot on the CRT screen (PERSISTENCE to MIN) and adjust FOCUS and ASTIGMATISM for a small, round, sharply focused spot.

3-8. REAR PANEL COMPONENTS.

3-9. 115/230 VOLT SWITCH. This switch, located at the bottom of the rear panel, must be set to the position which corresponds to the line voltage to be used. The instrument is shipped with a 4-amp fuse installed for 115-volt operation. If the instrument is to be connected to a 230-volt outlet, change the fuse to a 2-amp, slow-blow type.

3-10. Z-AXIS INPUT. The Z-AXIS INPUT terminals and selector switch are on the rear panel of the instrument. To externally modulate the trace intensity, set the switch to EXT, remove the shorting strap, and connect the modulation signal to the terminals. The amplitude of the pulse required to blank the trace depends on the front panel INTENSITY control setting, and is approximately 20 volts positive for normal intensity settings. When not using external intensity modulation, connect the strap across the terminals and set the switch to INT.

3-11. PLUG-IN UNITS.

3-12. For normal operation, install a vertical plug-in in the lower compartment and a time base plug-in in the upper compartment. The compartment divider must be used to provide proper shielding between the plug-ins. For double size plug-in operation, remove the divider. All plug-ins installed should be securely locked in place with the plug-in front panel lock knob.

3-13. Deflection-plate sensitivity may vary slightly from one CRT to another. This may necessitate adjustment of the sensitivity calibration of plug-ins installed in the instrument for the first time, or when moved from one instrument to another. Refer to the Operating and Service Manual furnished with the plug-in unit for the sensitivity calibration adjustment procedure.

3-14. OPERATING CONSIDERATIONS.

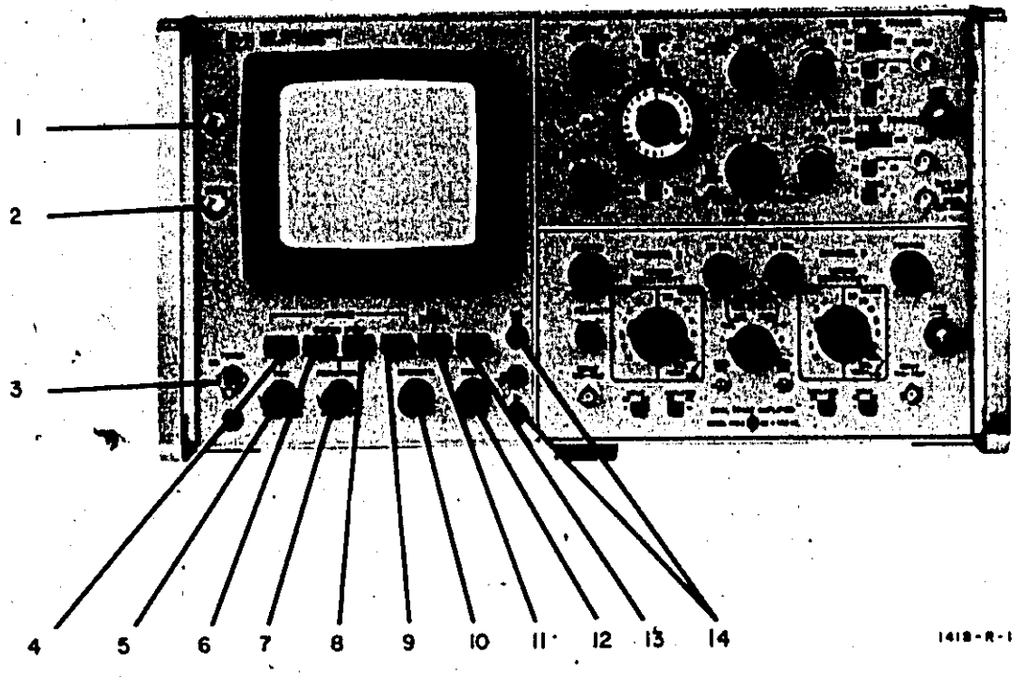
NOTE

Always allow at least 15 minutes warm up before attempting to use the instrument.

3-15. DEFINITIONS.

3-16. Several words and phrases, the definition of which may vary slightly from common usage, are used to describe the operation of the instrument. The definitions of these words and phrases are as follows:

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



1. TRACE ALIGN: Adjustment to set trace parallel with horizontal graticule lines.
2. ASTIGMATISM: Adjustment to set roundness of CRT beam.
3. POWER: ON position connects ac power to Oscilloscope and lights POWER indicator.
4. STORE: Retains displayed signal at reduced intensity for long time storage.
5. TIME: Control for setting storage time length.
6. FAST: Operates CRT at maximum writing speed with variable persistence.
7. PERSISTENCE: Controls endurance time of displayed signal.
8. STD: Operates CRT at normal writing speed with variable persistence.
9. ERASE: Removes stored or written displays.
10. INTENSITY: Control for setting intensity (brightness) of CRT display.
11. CONV: Selects operation as standard oscilloscope.
12. FOCUS: Control for focusing beam on CRT.
13. BEAMFINDER: Momentary switch to return beam to CRT screen regardless of vertical and horizontal POSITION control settings.
14. CALIBRATOR: 1 and 10-volt pk-pk, 60 Hz, calibrated square wave outputs.

Figure 3-1. Model 141B Controls

b. PERSISTENCE – The length of time a single sweep-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. ERASE – To remove all displays and blooms which have been stored or written with persistence on the CRT.
e. INTENSITY – The brightness of a display as it is written on the CRT screen (persistence and sweep time constant).
f. BLOOM – A visible, non-symmetrical expansion of a display written on the CRT screen, Figure 3-5.
g. FADE POSITIVE – Appears as random green areas on a dark background in MAX. PERSISTENCE, Figure 3-7.
h. BACKGROUND ILLUMINATION – A green cloud of illumination visible on the CRT screen, Figure 3-3.
i. SWEEP TIME – The time (in seconds, milliseconds, or microseconds) required for the beam to move horizontally one unit of distance (division) across the CRT screen, when writing a display.
j. FADE NEGATIVE – A condition in which a portion of the trace or screen begins to dim.
k. BURN – A burn is permanent damage to the CRT phosphor or mesh resulting from excessive intensity being maintained for too long a period. Phosphor burns appear as a discolored area on the CRT screen. Mesh burns appear as spots or traces that are darker than the background illumination in the MAX. PERSISTENCE, FAST WRITE modes.

3-17. CONTROL FUNCTIONS.

CAUTION

Excessive intensity may damage the CRT storage mesh. The INTENSITY setting for any sweep speed should be less than that intensity which just eliminates any trace blooming with minimum PERSISTENCE setting.

3-18. PERSISTENCE and INTENSITY. These controls contribute to the duration of display afterglow. Always set PERSISTENCE and INTENSITY as shown in Figure 3-2. 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.

3-19. PUSHBUTTON SELECTORS. These controls select the mode in which the CRT functions. In the STD or FAST modes, pressing the ERASE pushbutton removes all stored and persisting displays from the CRT. The STD and FAST modes are the only conditions in which a variable persistence display may be written on the CRT screen. The STORE mode disconnects the STD, FAST, ERASE, and CONV functions and retains written displays at reduced intensity on the CRT. The duration a stored display may be viewed is determined by the setting of the TIME control. INTENSITY, PERSISTENCE, and ERASE do not function in the STORE mode.

3-20. STD MODE. In the STD mode, pressing the ERASE pushbutton establishes the CRT in a condition for variable persistence display of a signal which later can be stored. Use the minimum INTENSITY and maximum PERSISTENCE required to obtain the desired display.

3-21. FAST MODE. In the FAST mode, when the ERASE pushbutton is pressed, the CRT storage surface is primed to allow much faster writing on the storage surface. However, the display has reduced contrast and fades positive more rapidly. Contrast and storage time are also reduced in this mode.

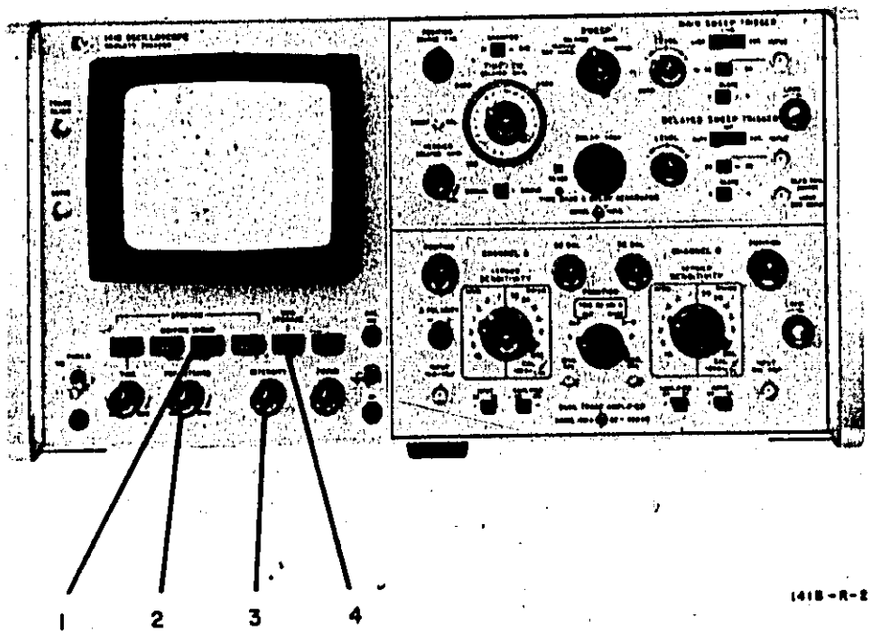
3-22. CONV. Selection of this operating mode disables the variable persistence and storage functions and the instrument operates as a conventional, general purpose, oscilloscope. Always adjust INTENSITY in STD mode with minimum PERSISTENCE so the display does not bloom, then switch to CONV. The PERSISTENCE control does not function in CONV mode.

3-23. STORE. Pressing the STORE pushbutton permits a written display to be stored at reduced intensity in the oscilloscope for comparison, measurement, or photography at a later time. The TIME control varies the length of time a display can be stored. This time varies from: 15 seconds with a minimum TIME control setting, when writing in FAST mode and transferring to STORE mode; to over 2 hours with a maximum TIME control setting when writing in STD mode and transferring to STORE mode. Light output is inversely proportional to storage time.

3-24. ERASE. Pressing the ERASE pushbutton removes stored or written displays from the CRT when operating in either FAST or STD modes. A display that has been stored or written at a high level of INTENSITY may remain partially visible after the ERASE pushbutton has been released. It may be necessary to press and release the ERASE pushbutton more than once to complete erasure of these displays.

3-25. OPERATING TIPS.

3-26. These operating tips will provide the operator with a familiarity with instrument controls and aid in obtaining desired CRT display.



VARIABLE PERSISTENCE MODE

1. Press the STD pushbutton.
2. Rotate PERSISTENCE control fully ccw.
3. Adjust INTENSITY to a point prior to the point trace blooming appears.

CONVENTIONAL

1. Press the STD pushbutton.
2. Rotate PERSISTENCE control fully ccw.
3. Adjust INTENSITY to a point prior to the point trace blooming appears.
4. Press the CONV pushbutton. Do not increase INTENSITY.

CAUTION

Trace blooming, Figure 3-5, is the best indicator of excessive INTENSITY which can damage the CRT. However, blooming does not occur in the CONV mode. Therefore, do not increase intensity when in CONV mode. Always be sure to repeat above procedure each time sweep speed or input signals change.

Figure 3-2. Proper Intensity Adjustment

a. The persistence uniformity in STD Writing Speed can be considerably improved by adjusting A5R45, STD Collimator Adjust, to reduce the size of the useable display area.
b. For variable persistence operation, use minimum INTENSITY and maximum PERSISTENCE compatible with the desired display. (See Figure 3-4).
c. Use Writing Speed in FAST only for fast sweep time, single-shot displays, or to improve the uniformity of trace intensity. The FAST WRITE 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 STD pushbutton and adjust INTENSITY and PERSISTENCE for the desired display and then press the STORE pushbutton.
e. To view a stored display, adjust the TIME control until the stored display has the desired brightness.
f. To store more than one display, press the STD pushbutton, set PERSISTENCE fully clockwise and INTENSITY as required; allow the first display to be written on the CRT. Set INTENSITY fully counterclockwise, and connect the second signal to be stored. Reset vertical POSITION if the second display is not to be superimposed on the first. Slowly rotate INTENSITY clockwise until the second display appears. Press the STORE pushbutton and both displays are stored.
g. A display stored when instrument power is turned off will remain stored for several days. To observe a stored display, press the STORE pushbutton, and set the vertical position control ccw before turning on the instrument. Then adjust the TIME control until the stored display is visible.
h. To erase all persistent or stored displays, press the STD pushbutton and rotate the PERSISTENCE control fully counterclockwise, or press the ERASE pushbutton for approximately one second, then release.

3-27. SINGLE-SHOT OPERATION.

3-28. To write with persistence or store a single-shot phenomena, 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 trace may bloom as shown in Figure 3-5, while a single-shot signal with amplitude variations of several divisions may not cause blooms (Figure 3-6). To determine the best INTENSITY setting, connect a signal

Figure 3-3. Background illumination immediately after erasing with WRITING SPEED in FAST and PERSISTENCE to MAX.

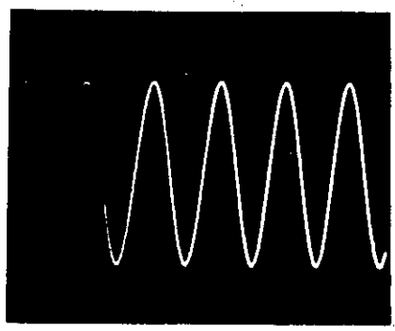


Figure 3-4. Variable persistence with a slow, repetitive sweep.

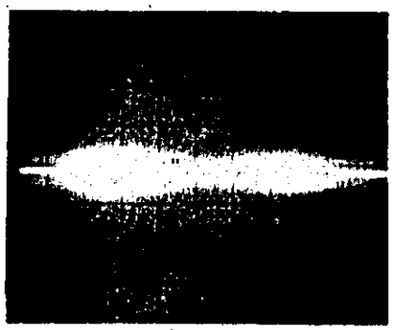


Figure 3-5. Single-shot trace bloom caused by INTENSITY and/or PERSISTENCE set too high.

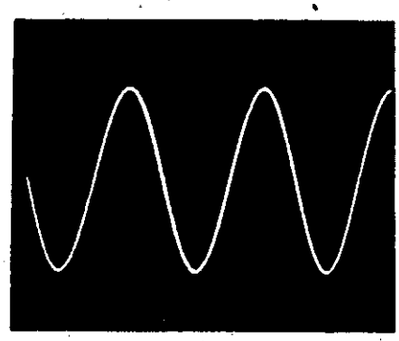


Figure 3-6. Single-shot display with INTENSITY and PERSISTENCE set the same as Figure 3-5.

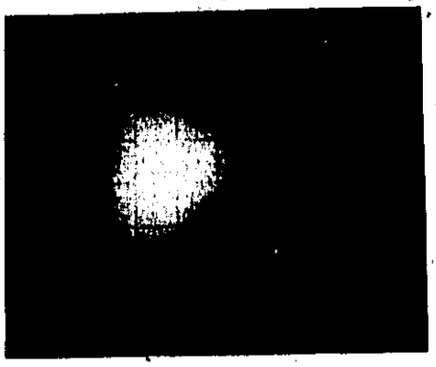


Figure 3-7. Fade positive which occurs after Pushbutton Selector is left in STD for 2 to 4 minutes.

Figure 3-8. Single-shot 20 usec/div display.

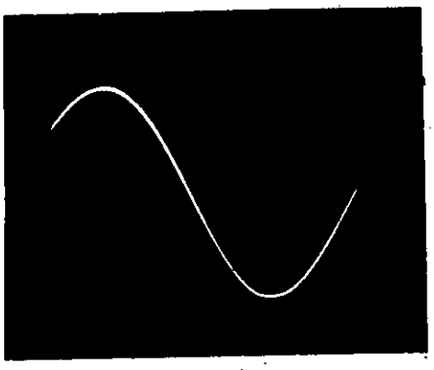


Figure 3-9. Same display as Figure 3-8 after three minutes in STD.

Figure 3-10. Small bright spots caused by minute imperfections in storage mesh.

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 clockwise as possible without causing blooming. Repeat the single sweep signal, erasing the display and setting the INTENSITY after each trace until the desired display is obtained. This setup should give maximum persistence to the single-shot display. After the single-shot signal has been written, the display may be retained for a long period of time by pressing the STORE pushbutton and setting the TIME control to MAX.

3-29. Single-shot signals which require a beam speed faster then 50 microseconds per division can be written with more brightness by setting the WRITING SPEED to FAST. The screen will be unevenly illuminated after erasing when WRITING SPEED is in FAST, however, the INTENSITY can be set high enough to make the display visible through the illumination. A display written with WRITING SPEED set to FAST will be obscured by positive fading more rapidly than a display written with WRITING SPEED set to STD.

3-30. Single-shot signals which require a beam speed between 20 and 200 microseconds per division may have low brightness at some location on the screen. Fire a single-shot test signal with INTENSITY and PERSISTENCE fully clockwise and WRITING SPEED in STD, and if the center 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 (Figures 3-8 and 3-9).

THEORY

SECTION IV

PRINCIPLES OF OPERATION

4-1. OVERALL FUNCTIONAL DESCRIPTION.

4-2. Refer to the block diagram, Figure 4-1, for this explanation. The Model 141B Oscilloscope has four main circuits: a low-voltage supply, a high-voltage supply, a calibrator circuit, and a pulse circuit. The horizontal and vertical amplifier circuits are in the plug-in units and operate directly into the CRT.

4-3. LOW-VOLTAGE SUPPLY. The low-voltage supply uses 115 or 230 volts ac (rear panel switch), single phase, 50-60 Hz. Output voltages are -12.6, -100, +100 and +248 volts dc; all outputs are fused and electronically regulated. Voltages are distributed to the high-voltage supply, the calibrator, pulse circuits, and to the horizontal and vertical plug-ins. The low voltage transformer supplies 6.3 Vac to the main filament of the CRT and as a signal to the calibrator.

4-4. CALIBRATOR. The 6.3 Vac applied to the calibrator circuit is shaped into a square wave (of line frequency) and applied to two front-panel connectors, 10V and 1V (peak-to-peak amplitude). The 1-volt output is also applied to the vertical and horizontal plug-ins for sensitivity calibration. Accuracy of the calibrating signals is ±1%.

4-5. HIGH-VOLTAGE SUPPLY. A transistorized oscillator and a step-up transformer are used to generate negative and positive high voltages for the CRT. Both the +6600-volt and -2350-volt supplies are electronically regulated.

4-6. PULSE CIRCUIT. This circuit generates pulses of variable level and rate. These pulses and other dc voltages from the circuit are applied to the storage and persistence elements in the CRT. All voltages from the low-voltage supply are used in the pulse circuit.

4-7. CIRCUIT DESCRIPTION.

4-8. LOW-VOLTAGE SUPPLY.

4-9. The low-voltage supply consists of +100-volt supply, -100-volt supply, +248 volt supply and -12.6 volt supply. The +100 volt supply is independent and provides a reference voltage for the -100 volt supply. The +248-volt and -12.6-volt supplies are dependent on the -100-volt supply for reference voltages.

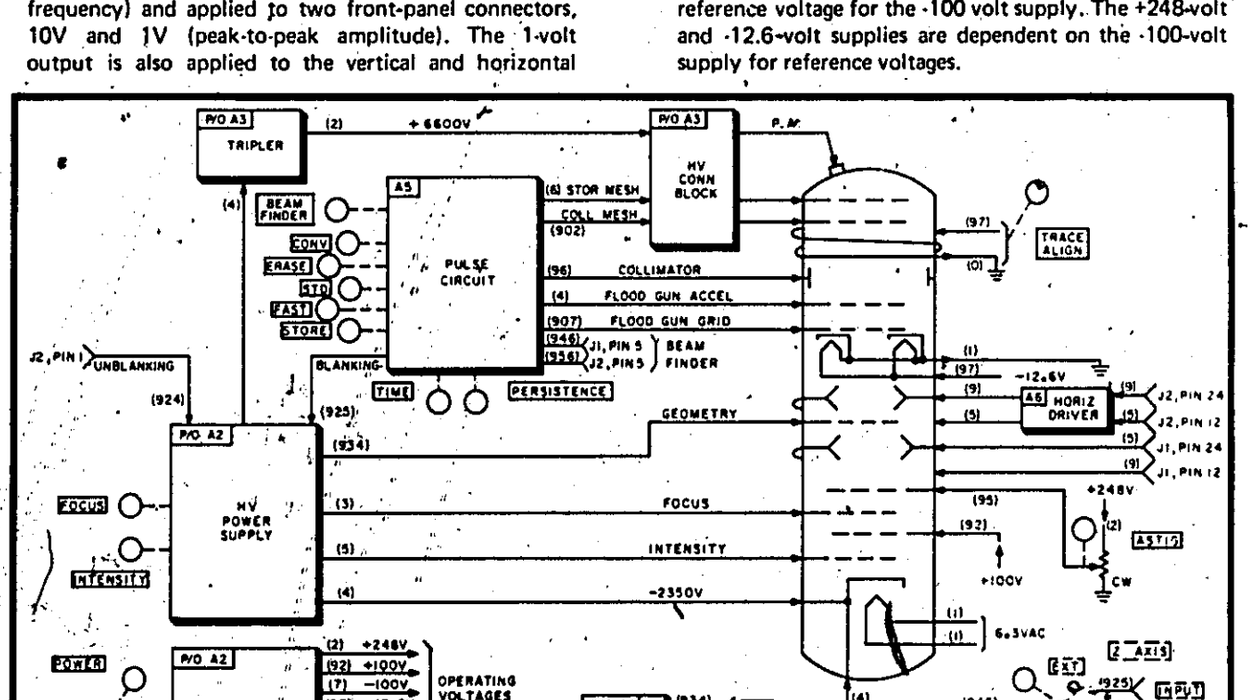


Figure 4-1. Model 141B Block Diagram

4-10. Figure 4-2 is a simplified block diagram of the regulator used in the low-voltage supply. The series regulator acts as a variable resistance in the regulated output. A sensor (or differential amplifier) compares the output voltage with a reference voltage. The driver (emitter follower or amplifier) controls the bias on the series regulator, which effectively controls the series resistance. Any change in output voltage is fed back to the series regulator. The change in series resistance and the resulting voltage drop is opposite to the output voltage change; thus, the output voltage is maintained at a constant level.

4-11. Figure 8-10 is a schematic diagram of the low voltage supply. The primary winding of transformer T1 is wired through a rear panel switch for quick conversion to either 115 or 230-Vac operation. Line voltage is applied to the primary of T1 through an on-off switch, a fuse and a thermal switch. Pilot lamp DS1 lights when power is applied to T1. Two shunt resistors are connected to the +248-volt supply to reduce series regulator power dissipation when high-current plug-ins are used. The shunts are wired one to each rear panel plug, and the internal wiring of the plug-in determines whether the shunt is or is not used.

4-12. +100 VOLT SUPPLY. The ac voltage from secondary of T1 is rectified by A1CR5-A1CR8 and partially filtered by C3 and A2R17. The resulting dc voltage is applied through the series regulator, Q2, to the output. Differential Amplifier, A2Q4/A2Q5 compares the voltage across A2V1 with a sample of the output voltage. Any tendency of the output voltage to change is applied to the base of driver A2Q3 which controls bias on regulator Q2. The series regulator Q2, compensates for the change in output voltage by its change in series resistance and restores the output level to normal. The +100 volt output is adjusted by A2R11B and fuse A2F2 provides overload protection.

4-13. -100 VOLT SUPPLY. Reference voltage for the -100-volt supply is taken from the output of the +100 volt supply. The reference voltage across A2R31 is compared with a sample of -100-volt output across A2R35. The error voltage sensed by differential amplifier A2Q7/A2Q8 is applied through driver A2Q6 and series regulator Q3. The series regulator bring the -100 volt supply back into proper balance with respect to the +100-volt supply. Ac voltage from T1 is rectified by A1CR9-A1CR12, partially filtered by C4/C5/A2R27, and the resulting dc voltage is applied by the series regulator, Q3, to the -100-volt output. Regulation is obtained as in the +100-volt supply. A2R11C adjusts the -100-volt output, and fuse A2F3 provides overload protection.

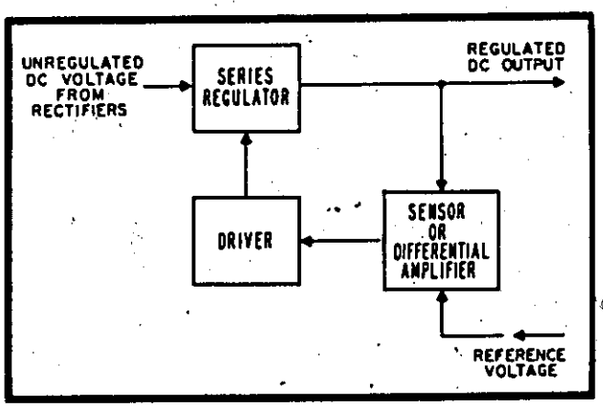


Figure 4-2. Regulated Power Supply Block Diagram

4-14. +248 VOLT SUPPLY. Sensor amplifier, A2Q2, in the +248-volt supply senses any variation in the output voltage with respect to -100 volts. The error voltage is amplified by driver A2Q1 which applies corrective bias to series regulator Q1. A2R11A adjusts the +248-volt output and fuse A2F1, provides overload protection. A2CR4 provides temperature compensation for A2Q2 and is normally forward-biased.

4-15. -12.6 VOLT SUPPLY. Sensor amplifier A2Q11 senses any variation of output voltage with respect to -100 volts and applies the error voltage to driver amplifier A2Q9. The driver increases signal current to the level required to control series regulator Q4. The -12.6-volt output is adjusted by A2R47A. Current limiter, A2Q10, a protective circuit for the series regulator, is normally biased off. If an overload occurs across the -12.6-volt output, the base of A2Q10 goes positive by the voltage drop across R11 minus the forward voltage drop across A2CR16, turning A2Q10 on. The collector of A2Q10 is applied through A2Q9 to the base of series regulator Q4, reducing the current flowing through Q4. The current which then flows through the external overload is limited to the current required to keep A2Q10 on. Additional overload protection is provided by fuse, A2F4.

4-16. CALIBRATOR.

4-17. The schematic diagram of the Calibrator circuit is shown in Figure 8-10. The circuit consists of three parts: a tunnel diode square wave generator, a transistor switch, and a calibration network.

4-18. 6.3 volts ac is applied through A2R50 to tunnel diode A2CR19, which generates a square wave at line frequency. Transistor switch A2Q12 is off during the time of the positive half-cycle of the square wave (when the voltage at the base is close to zero), and the collector voltage is thus at a level set by breakdown diode A2VR6 and A2R47B. When the negative-going portion of the square wave is applied to the base of A2Q12, the transistor conducts heavily, effectively shorting the collector to ground. The output of the Calibrator becomes zero volts. At the end of the negative input half-cycle, the bias of A2Q12 returns to zero, the transistor is switched off, and the output returns to its previous value.

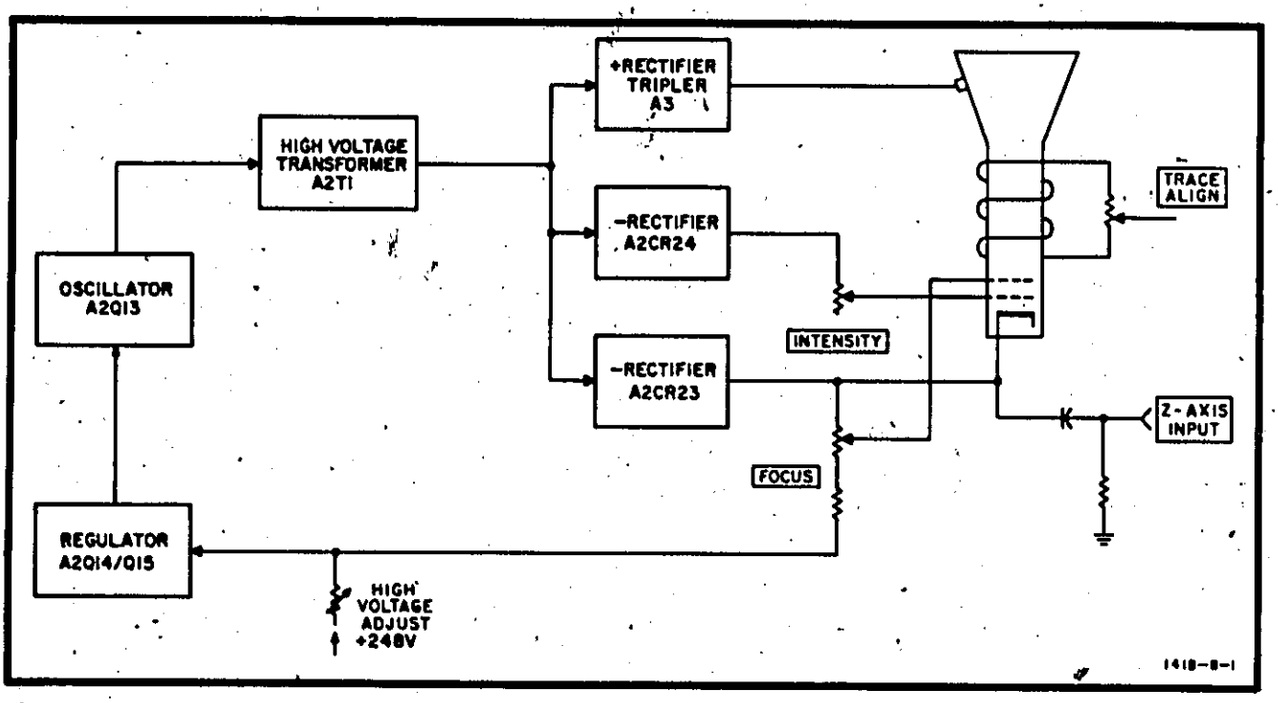


Figure 4-3. High-Voltage Power Supply Block Diagram

4-19. Tunnel diode bias current is supplied through A2R51. The bias current sets an operating level for the diode which affects the symmetry of the square wave output. Cal adj A2R47B, is used to set the dc voltage at the collector of A2Q12 to -10 volts when the transistor is off. Breakdown diode A2VR6 reduces the output impedance, and provides the temperature compensation for the circuit. Voltage divider A2R54/A2R55, reduces the 10-volt output to 1 volt. Both 10 and 1-volt outputs are available at the front panel of the instrument, and the 1-volt output is available to both plug-ins.

4-20. HIGH-VOLTAGE SUPPLY.

4-21. Figure 4-3 is a block diagram of the high-voltage supply. The output of a regulated transistor oscillator is stepped-up in voltage and applied to a series of high voltage rectifiers. The positive output of the voltage tripler is connected to the post-accelerator of the CRT. The negative output voltages are used in the gun assembly of the CRT and its associated controls. The Z-axis input can be used to apply intensity modulating signals to the CRT.

4-22. Figure 8-13 is a schematic diagram of the high-voltage supply and the CRT. Oscillator A2Q13 operates at a frequency of approximately 32 kHz. Any change in the output voltage is applied to A2Q15, which converts the voltage change to a current change. This current change is applied, by emitter follower A2Q14, to the base of the oscillator transistor. The amplitude of oscillations is changed in such a direction as to oppose the original output voltage change. High-voltage adjust A2R63 sets the amplitude of oscillation to produce the correct output voltage.

4-23. Two separate negative supplies are used, one for the control grid of the CRT, and one to provide CRT cathode and focusing voltages. Both supplies use half wave rectifiers (A2CR23 and A2CR24). The unblanking gate from the horizontal plug-in (pin 1, J2) is applied to the return side of the grid supply, and changes the negative grid voltage by about +50 volts to unblank the trace. A positive pulse of about 20 volts will blank the trace when applied to Z-axis input. When Z-axis input is not used, S4 is set to INT to receive chopped blanking from a dual-trace plug-in.

4-24. The voltage tripler circuit provides the 6.6 kV post-accelerating voltage applied to the CRT.

4-25. The ASTIGMATISM adjustment, R8, adjusts the roundness of the spot, and the Geometry adjustment, A2R72, is used to optimize pattern shape.

4-26. STORAGE CRT.

4-27. Refer to Figure 8-13 for the schematic diagram of the storage CRT, V1. The CRT contains the conventional electron (writing) gun, deflection plates, post-accelerator, and phosphor screen. In addition, there are two floodguns, a collimator, a collector mesh, and a storage mesh. These added elements make possible the variable persistence and storage functions of the instrument.

4-28. FLOOD GUNS. Two flood guns are physically located on the electron gun, outside of the horizontal deflection plates. Horizontal drivers, A6Q1 and A6Q2, prevent flood gun electrons from flowing through the deflection plates to the output stage of the plug-in. The

guns operate continuously when the power switch is on. An electron cloud, which is emitted by the flood guns, is accelerated toward the CRT screen by collimator and collector mesh voltages. These electrons make stored or persisting displays visible. They are also used to erase stored and persisting displays.

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

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

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

4-32. The storage mesh is pulsed with pulses of approximately 11 microseconds duration. These pulses erase the positive pattern on the storage mesh by discharging the mesh coating. Time required for this erasing operation is determined by the pulse repetition rate. The positive pattern on the mesh may also be neutralized manually by connecting the collector and storage meshes (ERASE). The high positive potential (approximately +156 volts) allows more uniform discharging of the surface. When the storage mesh is disconnected from the collector mesh and returned to +3 volts, the coated surface is at a uniformly equal potential of -9 volts. In both cases, the screen has no illumination. The pattern may be lost by the storage mesh fading positive and allowing the entire screen to be illuminated. This occurs when positive ions from the flood gun raise the surface potential of the storage mesh in random areas sufficiently to allow flood gun electrons to strike the screen.

4-33. PULSE CIRCUIT.

4-34. Figure 4-4 is a simplified block diagram of the pulse circuit. The pulse circuit supplies pulses of variable repetition rate to control the operation of the CRT. The pulse timer generates a pulse which triggers the monostable multivibrator. The two outputs of the monostable multivibrator are applied to the pulse stretcher and output pulser. The pulse stretcher applies pulses to the accelerator of the CRT to control storage time of the display.

4-35. The output pulser applies a positive voltage to the storage mesh of the CRT. The erase timer provides a signal to the monostable multivibrator and output pulser to generate an erase pulse and also triggers the blanking circuit. The blanking circuit energizes a relay in the high voltage supply which applies a blanking voltage to the

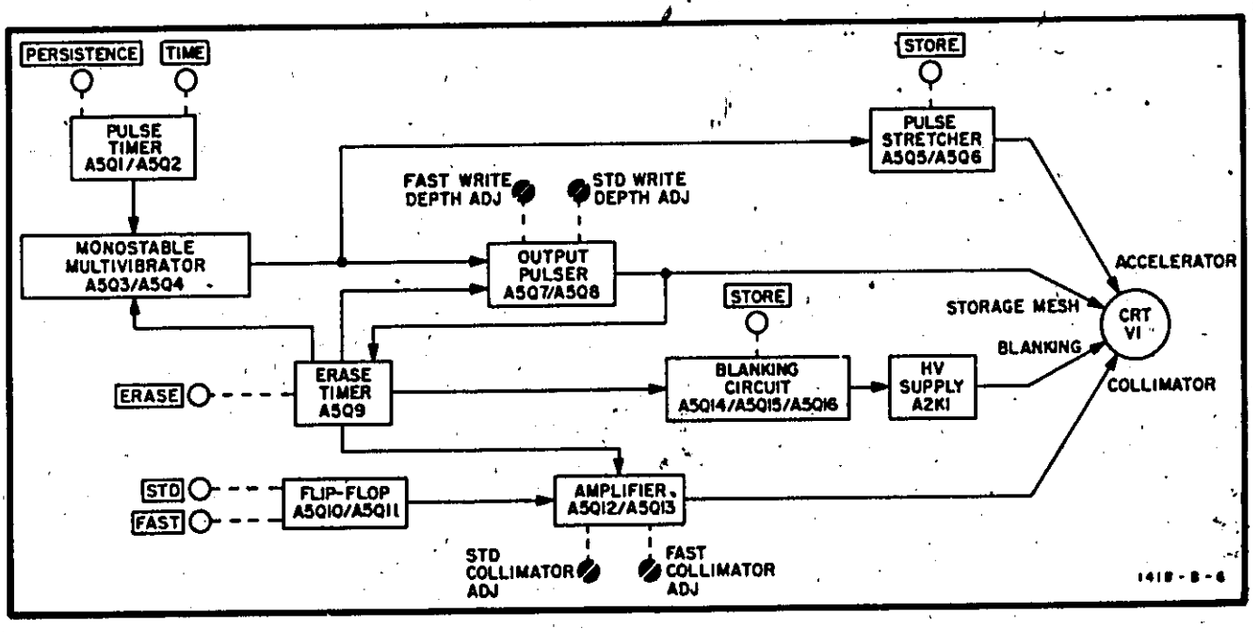


Figure 4-4. Pulse Circuit Block Diagram

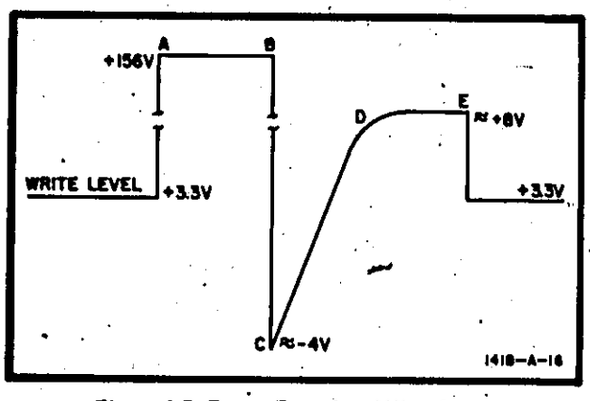


Figure 4-5. Erase: Functional Waveform

CRT. The CRT collimator voltage is supplied by a linear amplifier and controlled by the selection of the writing speed at the front panel.

4-36. STD AND FAST MODES.

4-37. PULSE TIMER. Figure 8-16 is a schematic diagram of the pulse circuit. Setting the front panel PERSISTENCE control, R10, determines the amount of current available from the pulse timer current source, A5Q1. A5C1 charges to a potential which turns A5Q2 on. A5C1 discharges through A5Q2, A5Q2 turns off, and A5C1 again begins to build a ramp voltage. The repetition rate of this action is controlled by the setting of the front panel PERSISTENCE control. The output of A5Q2 is a 0 to 10 kHz pulse with a very sharp spike which is coupled through A5C2 to the monostable multivibrator. This portion of the pulse circuit is active in all modes.

4-38. MONOSTABLE MULTIVIBRATOR. The multivibrator, A5Q3/A5Q4, operating in a monostable state, receives pulses from the pulse timer, and applies a negative-going pulse (approximately 10 usec wide) to A5CR3.

4-39. OUTPUT PULSER. The negative-going pulse from the monostable multivibrator allows A5CR7 to become forward biased with a current controlled by the setting of the fast write depth adjustment A5R14A, or the standard write depth adjustment, A5R10A, depending on whether FAST or STANDARD mode is being used. This current pulse is amplified and converted to a voltage pulse by A5Q7/A5Q8 and applied to the Storage Mesh Backing Electrode.

4-40. ERASE TIMER. The Erase Timer circuits are in a quiescent state during operation in either STANDARD or FAST write modes. When erase timer A5Q9 is turned off, A5CR8 in the erase pulse shaping circuit is back biased. This effectively disconnects the erase timer circuit from the output pulser.

4-41. At the instant the ERASE pushbutton is pressed, Figure 4-5 point A, the following actions take place simultaneously:

a. The collector mesh potential of +156 volts is applied to the junction of A5R27 and A5R28. This voltage causes A5CR14 to become reverse-biased, which protects A5Q7 and A5Q8.
b. The +156 volts applied to A5R27 turns A5Q9 on which charges A5C8 to 0 volts. This action turns on A5Q15/A5Q16 through A5R53 which blanks the CRT write gun by means of a relay closure on the power supply board.
c. Zero volts on A5R17 reduces the output of amplifier A5Q7/A5Q8 by approximately -12 volts. A5Q3 is turned on by current through A5R7 which allows amplifier A5Q7/A5Q8 to reach its full output amplitude, less the reduction in amplitude due to the current through A5R17. The result is approximately -4 volts.
d. The circuits remain in this state as long as the ERASE pushbutton is pressed.

4-42. When the ERASE pushbutton is released, Figure 4-5 point B, the following circuit actions occur simultaneously:

a. A5Q9 is turned off.
b. The voltage on A5C8 begins to discharge from approximately 0 volts toward -12.6 volts, Figure 4-5 point C.
c. The voltage change across A5R17/A5VR1 causes the output of amplifier A5Q7/A5Q8 to increase from about -4 volts. The increase is in the form of a ramp to the output voltage determined by the FAST or STD Write Depth Adjustment. When A5VR1 is no longer conducting the ramp stops, Figure 4-5 point D.
d. A5Q3 is held in saturation by A5R7. This establishes the output voltage of amplifier A5Q7/A5Q8 and also provides for over-collimation through A5R40, A5C9 and A5CR19.
e. When A5C8 voltage decreases to -12.6 volts, A5Q3 turns off (Figure 4-5 point E), and the output pulser returns to the quiescent voltage of approximately 3.3 volts. Collimator voltage returns to the nominal value.

4-43. At this point, all pulse circuits have returned to the condition they were in prior to pressing the ERASE

Table 4-1. Current Capability

Supply Voltage and J1/J2 pin number		Current Available at each Jack (J1 and J2)
+248 Vdc	9	0-50 ma
+248 Vdc	9	50-100 ma (pin 2 must be wired to pin 3 in the plug-in.)
+100 Vdc	2	0-137.5 ma
-100 Vdc	6	10-200 ma
-12.6 Vdc	21	0-0.9 amps
6.3 Vac	13-14	0-3.25 amps

pushbutton, and pulses from the pulse timer may again be applied to the storage mesh backing electrode.

4-44. PULSE CIRCUIT: STORE MODE.

4-45. FLOOD GUN GRID CONTROL. Pressing the STORE pushbutton removes +156 volts from A5R19 and A5R50. This turns off A5Q5 and pulses from the monostable multivibrator are now coupled through A5C5 to the base of A5Q6. During the 10 usec that A5Q4 output goes positive, A5C5 is charged. When A5Q4 output goes negative, A5CR9 is back biased and A5Q6 turns off. The collector of A5Q6 goes positive until A5C5 is charged and turns A5Q6 back on. This pulse has a duration of approximately 60 usec. This pulse is applied to the flood gun accelerator, which turns the flood gun on for the pulse duration.

4-46. The repetition rate of these positive pulses at the collector of A5Q6 is now determined by the setting of the STORE TIME control, R9, which replaces the PERSISTENCE control when the STORE pushbutton is pressed.

4-47. The write gun is blanked by A5Q16 through the action of A5Q14 and A5Q15.

4-48. PULSE CIRCUIT: CONVENTIONAL MODE.

4-49. When the CONV pushbutton is pressed, a +100 volt potential is removed from A5R25, and the voltage divider A5R25/A5R26/A5R27 brings the storage mesh backing electrode to approximately 29 volts. A5CR13 is reverse-biased, preventing output pulser signals from passing through. This action produces conventional oscilloscope operation by disabling the variable persistence mode.

4-50. When the oscilloscope is turned off, a display stored on the CRT is protected from unintentional erasure by A5Q17 and the associated circuit.

4-51. TRACE ALIGN.

4-52. The trace align coil, L1, is located around the CRT, near the screen. Adjustment of TRACE ALIGN, R7A/B changes the magnitude and direction of current through the coil and rotates the trace into alignment with the CRT graticule.

4-53. PLUG-IN KIT FABRICATION.

4-54. The HP Model 10477A and Model 10487A Accessory Plug-ins are blank plug-in units for the instrument. These two units permit the user to design his own special-purpose circuits. Current available from each of the instrument power supplies is shown in Table 4-1. Do not exceed the capabilities in Table 4-1.

PERFORMANCE CHECK

SECTION V

PERFORMANCE CHECK AND ADJUSTMENTS

5-1. INTRODUCTION.

5-2. Instrument performance checks and adjustment procedures are contained in this section. The purpose of this information is to indicate whether or not instrument operation is within the specifications of Table 1-1 and, if not, how to calibrate the instrument. Troubleshooting information, component location photographs and schematic diagrams are in Section VIII. Enter results of initial performance check in the Performance Check Record located in this section. Remove form from the manual and file for future reference.

5-3. TEST EQUIPMENT.

5-4. Test equipment required to check and maintain instrument performance is listed in Table 5-1. Equivalent test equipment can be substituted if necessary. For proper results, make sure that all test equipment has been recently calibrated. Use a non-metallic screwdriver when making adjustments.

5-5. PERFORMANCE CHECK.

5-6. PRELIMINARY SET UP.

5-7. a. Install time base and vertical plug-ins.

b. Adjust time base for a free-running 1 msec/div sweep.

c. Set vertical plug-in input switch to OFF or GND.

d. Set controls as follows:

INTENSITY . . . . . MIN.

PERSISTENCE . . . . . MIN.

MODE . . . . . STD.

5-8. Turn instrument on and allow a 15 minute warm-up period.

CAUTION

The INTENSITY control should never be set high enough to cause blooming. Excessive intensity can permanently damage the CRT storage mesh.

5-9. BEAM FINDER.

5-10. a. Rotate vertical and horizontal position controls fully clockwise.

Table 5-1. Recommended Test Equipment

Instrument		Required Characteristics	Required For
Type	Model		
Voltmeter - Calibrator	HP H01 738 BR	Accuracy: 0.1% Output Voltages: 1V, 10V	Calibrator Performance Check Calibrator Adjustment
Digital Voltmeter	HP 3439A With HP 3441A Plug-in	Accuracy: 0.1% Voltage Range: ±300V Input Impedance: 10.2MΩ	Low Voltage Power Supply Adjustment High Voltage Power Supply Adjustment
Voltage Divider Probe	HP K05 3440A	Accuracy: 1% Division Ratio: 1000:1 Maximum Voltage: 4 KV	High Voltage Power Supply Adjustment
Oscillator	HP 204C	Waveform: Sine Wave Frequency: 80 Hz to 400 kHz	Geometry Adjustment Pulse Circuit Adjustment

b. Push and hold BEAM FINDER pushbutton while slowly rotating INTENSITY clockwise until a trace becomes visible on the display.

c. The BEAM FINDER should return the trace to the display regardless of position of vertical or horizontal controls.

d. Adjust vertical and horizontal position controls until trace is centered on the display.

e. Release the BEAM FINDER.

5-11. FOCUS AND ASTIGMATISM.

5-12. Paragraphs 5-13 through 5-16 contain preliminary operational checks of performance characteristics not listed in Table 1-1. Since these characteristics are not specified, stated results are approximate.

5-13. FOCUS and ASTIGMATISM controls should give a sharply defined trace when set to approximately mid-range positions. Adjust for sharpest trace possible and leave in that position.

5-14. TRACE ALIGN.

5-15. Adjust TRACE ALIGN until trace is parallel to the graticule. This condition should occur near center of adjustment range.

5-16. CALIBRATOR.

5-17. a. Connect voltmeter calibrator to oscilloscope vertical input.

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

c. Set vertical amplifier sensitivity to .1V/div.

d. Adjust vertical vernier to display exactly 8 divisions of vertical deflection.

e. Disconnect voltmeter calibrator.

f. Connect CAL 1V output to oscilloscope vertical input.

g. Deflection should be 8 ± 0.1 div.

h. Repeat steps a through g, using 1 V/div vertical sensitivity, 1 volt from the Voltmeter Calibrator, and CAL 10V.

5-18. VARIABLE PERSISTENCE.

5-19. a. Adjust INTENSITY for normal viewing level.

b. Set time base to 2 sec/div and observe that trace line disappears and that spot develops a short tail.

c. Slowly adjust PERSISTENCE clockwise and note that tail lengthens.

d. Rotate PERSISTENCE fully clockwise and turn intensity fully counterclockwise.

e. Trace should remain visible for one minute.

5-20. WRITING SPEED, FAST.

5-21. a. Set time base for 1 μsec/div sweep.

b. Set up time base for single sweep.

c. Press FAST pushbutton and press ERASE. Background should appear foggy.

d. Repeatedly erase and trigger a single sweep, increasing INTENSITY slightly each time, until trace writes and remains visible for 15 seconds.

5-22. STORE TIME, FAST.

a. Rotate STORE TIME to MAX.

b. Press ERASE.

c. Trigger a single sweep and immediately press STORE.

d. After 15 minutes rotate STORE to MIN. Trace should still be visible.

5-24. WRITING SPEED, STANDARD.

5-25. a. Press STD.

b. Set time base for 50 μsec/div sweep.

c. Repeatedly erase and trigger a single sweep, increasing INTENSITY slightly each time, until trace writes and remains visible for one minute.

5-26. STORE TIME, STANDARD.

a. Rotate STORE TIME to MAX.

b. Press ERASE.

c. Trigger a single sweep and immediately press STORE.

d. After 2 hours, rotate STORE to MIN. Trace should still be visible.

5-27. This completes the Performance Check. If the instrument does not meet specifications, the adjustment procedure which follows should be done. If this does not result in satisfactory performance, refer to Section VIII for maintenance and troubleshooting information.

PERFORMANCE CHECK RECORD

Instrument Serial Number _____

Paragraph Reference	Check	Specification	Measured
5-9	BEAM FINDER	Returns trace to screen.	YES NO
5-16	CALIBRATOR	8 divisions ±0.1 division.	___ Divisions
5-19	VARIABLE PERSISTENCE	Spot develops short tail.	YES NO
		Trace remains visible for one minute.	YES NO
5-20	WRITING SPEED, FAST	Trace writes and remains visible for 15 seconds	YES NO
5-22	STORE TIME, FAST	Trace can be stored for 15 minutes	YES NO
5-24	WRITING SPEED, STANDARD	Trace writes and remains visible for one minute.	YES NO
5-26	STORE TIME, STANDARD	Trace can be stored for 2 hours.	YES NO

5-28. ADJUSTMENTS.

5-29. Adjustment procedures for the instrument are given in the following paragraphs. Perform them in sequence as control settings depend upon previous procedures. Test equipment having the characteristics listed in Table 5-1 may be substituted for that recommended in the table. If difficulty is encountered in making any adjustment, refer to Section VIII for trouble-shooting procedures.

5-30. PRELIMINARY SETUP. Plug-ins should be installed in both compartments before power supply adjustments are made; proper regulation may not occur without load connected. Remove top, bottom, left side and H. V. deck covers before applying power

5-31. ADJUSTMENT COMPONENT IDENTIFICATION. All internal adjustments are identified in Figure 5-1.

WARNING

VOLTAGES PRESENT IN THE HIGH VOLTAGE SUPPLY ARE DANGEROUS TO LIFE.

5-32. EQUIPMENT TURN-ON.

a. Rotate INTENSITY, PERSISTENCE, and STORE TIME to their fully counterclockwise positions.

b. Install plug-ins and apply power to the instruments. Wait 15 minutes before continuing to insure that equipment is completely stabilized.

5-33. LOW VOLTAGE POWER SUPPLY ADJUSTMENT.

a. Adjust low voltage regulators as indicated in Table 5-2. Since the +100-volt supply is a reference for the other mainframe supplies it must be set first. Voltage may be measured on any terminal with wire color shown in Table 5-2.

b. Recheck all supplies before proceeding. The +100V supply must be set as near to +100V as possible.

Table 5-2. Low Voltage Power Supply Adjustment

SUPPLY	ADJUST	LIMIT	MEASURE POINT WIRE COLOR
+100V	A2R11B	±1V	WHITE/RED
−100V	A2R11C	±1V	VIOLET
+248V	A2R11A	±2.5V	RED
−12.6V	A2R47A	±0.13V	WHITE/VIOLET

5-34. HIGH VOLTAGE POWER SUPPLY ADJUSTMENT.

a. Monitor +100 Vdc supply with digital voltmeter using 1000:1 high voltage probe. Note the exact reading.

b. Multiply value obtained in step a by 23.50.

c. While monitoring the high voltage (yellow wire or junction of A2R83 and A2R85), adjust A2R63 to obtain a voltage reading equal to the result obtained in step b. It should be −2350 ±25V.

d. This procedure will set the high voltage within 1% provided the +100V supply is set to indicate exactly +100V on the digital voltmeter.

e. Turn off power.

5-35. INTENSITY LIMIT ADJUST.

a. Remove plug-ins.

b. Short pins 1 and 2 of the upper compartment connector, J2, together.

c. Turn power ON.

d. Set intensity limit, A2R65, fully counterclockwise.

e. Set INTENSITY to 11 o'clock position.

f. Press STD.

g. Slowly adjust intensity limit, A2R65, clockwise until a spot is just visible.

h. Turn INTENSITY fully counterclockwise.

i. Turn power off.

j. Remove short from upper plug-in compartment connector J2.

k. Replace plug-ins.

l. Turn power ON.

5-36. GEOMETRY.

a. Set controls as follows:

Trigger Level . . . . . AUTO

Trigger Source . . . . . int (+)

Sweep Time . . . . . 0.5 msec/div

CRT mode . . . . . STD.

PERSISTENCE . . . . . MIN.

b. Slowly adjust INTENSITY for a normal viewing level.

c. Press ERASE.

d. Press CONV.

e. Adjust TRACE ALIGN and vertical position controls so that trace is parallel to center graticule line.

f. Connect 400 kHz oscillator output to vertical amplifier input.

g. Adjust vertical deflection factor to obtain slightly under 8 divisions of vertical deflection.

CAUTION

If it is necessary to increase intensity, do so only in STD mode. There is no indication of excessive beam intensity while in the CONV mode and CRT mesh can be burnt.

h. Adjust geometry, A2R72, for best compromise between distortion of vertical and horizontal edges of display. Vertical and horizontal controls may be adjusted to permit viewing of edges.

i. Set INTENSITY fully counterclockwise.

j. Disconnect oscillator.

5-37. CALIBRATOR ADJUSTMENT.

a. Press STD.

b. Connect 10V p-p output of voltmeter calibrator to vertical amplifier input.

c. Set vertical amplifier deflection sensitivity to 1V/div.

d. Slowly increase INTENSITY to normal viewing level.

e. Adjust vertical amplifier vernier to display exactly 8 divisions of vertical deflection.

f. Disconnect voltmeter calibrator.

g. Connect oscilloscope 10V CAL output to vertical amplifier input.

h. Adjust Calibrator cal adj A2R47B to obtain exactly 8 divisions of vertical deflection.

5-38. PULSE CIRCUIT ADJUSTMENTS.

5-39. FAST MODE ADJUSTMENTS.

a. Push FAST pushbutton.

b. Turn INTENSITY and PERSISTENCE fully counterclockwise.

c. Set time base for single sweep so that sweep will not occur during this portion of the procedure.

d. Set fast write depth adj A5R14A fully counterclockwise.

e. Adjust fast collimator adj A5R14B so that entire flood gun illumination pattern is visible.

f. Adjust flood gun adj A5R14C to obtain brightest and most uniform illumination.

g. Adjust fast collimator adj A5R14B so that flood gun illumination just fills CRT viewing area.

h. Set PERSISTENCE fully clockwise (MAX).

i. Press ERASE.

j. Adjust fast write depth adj A5R14A slowly clockwise in small steps, erasing after each step, until a good compromise between no light and saturated brightness is obtained on the CRT after ERASE button is pressed.

k. Adjust fast collimator adj A5R14B in small increments, erase and readjust fast write depth adj A5R14A (step j) between increments until the most uniform fogging is obtained.

l. Set controls as follows:

Sweep time . . . . . 0.2 msec/div

Sweep . . . . . Normal (recurrent)

INTENSITY . . . . . fully ccw

PERSISTENCE . . . . . MIN ccw

m. Connect 4 kHz oscillator sine wave output to vertical amplifier input.

n. Adjust vertical gain to obtain 8 divisions of vertical deflection.

o. Adjust INTENSITY for normal viewing level.

p. Increase vertical gain by a factor of 10. Do not adjust INTENSITY.

q. Set time base for single sweep operation.

r. Turn PERSISTENCE to MAX.

s. Turn INTENSITY up gradually while erasing CRT until beam writes evenly, but not to point where beam turns on.

t. Press ERASE pushbutton until no trace remains.

u. Erase, and immediately arm and trigger a single sweep. The resulting waveform should be viewable inside a 6 x 8 division rectangle for 15 seconds. If not, rotate fast write depth A5R14A clockwise until it is. If the CRT still will not hold the trace for 15 seconds, return to step g and reduce the illuminated area to no less than a 7.6 X 9.5 cm, centered, rectangle.

v. Rotate fast write depth adj A5R14A counterclockwise in small increments. Leave A5R14A at the point farthest counterclockwise that permits trace to remain viewable for 15 seconds.

5-40. STD. MODE ADJUSTMENTS.

a. Set INTENSITY fully counterclockwise.

b. Set PERSISTENCE to MIN.

c. Set std write depth adj A5R10A fully counterclockwise.

d. Push STD pushbutton.

e. Set time base to single sweep to prevent beam from sweeping.

f. Press ERASE for one second and release.

g. Turn std collimator adj A5R10B fully counterclockwise and then slowly clockwise until the illumination just fills CRT viewing area.

h. Set time base for sweep of 10 msec/div.

i. Set time base for recurrent sweep.

j. Connect 80 Hz oscillator sine wave output to vertical amplifier input.

k. Adjust vertical gain to obtain 8 divisions of vertical deflection.

l. Adjust INTENSITY for normal viewing level.

m. Increase vertical gain by a factor of 10. Do not adjust INTENSITY.

n. Set time base for single sweep operation.

o. Turn PERSISTENCE to MAX.

p. Turn INTENSITY up gradually while erasing CRT until beam writes evenly, but not to point where beam turns on.

q. Press ERASE. If the CRT does not erase completely, rotate standard write depth adj A5R10A clockwise in 10° increments, pushing ERASE each time. Repeat until CRT erases completely.

r. If the CRT can not be made to erase completely, rotate flood gun adj A5R14C clockwise in small increments, repeating the FAST MODE and STD MODE adjustment procedures with each flood gun adj increment until the CRT erases properly.

s. Press ERASE. Immediately arm and trigger a single sweep. The waveform should be viewable inside a 7 x 9 div rectangle for 60 seconds without positive fade (screen turning bright green). If trace is not continuous, adjust std write depth A5R10A clockwise in small increments until a continuous trace is obtained.

5-41. This completes the adjustment procedures. If satisfactory operation cannot be obtained, refer to Section VIII for troubleshooting information.

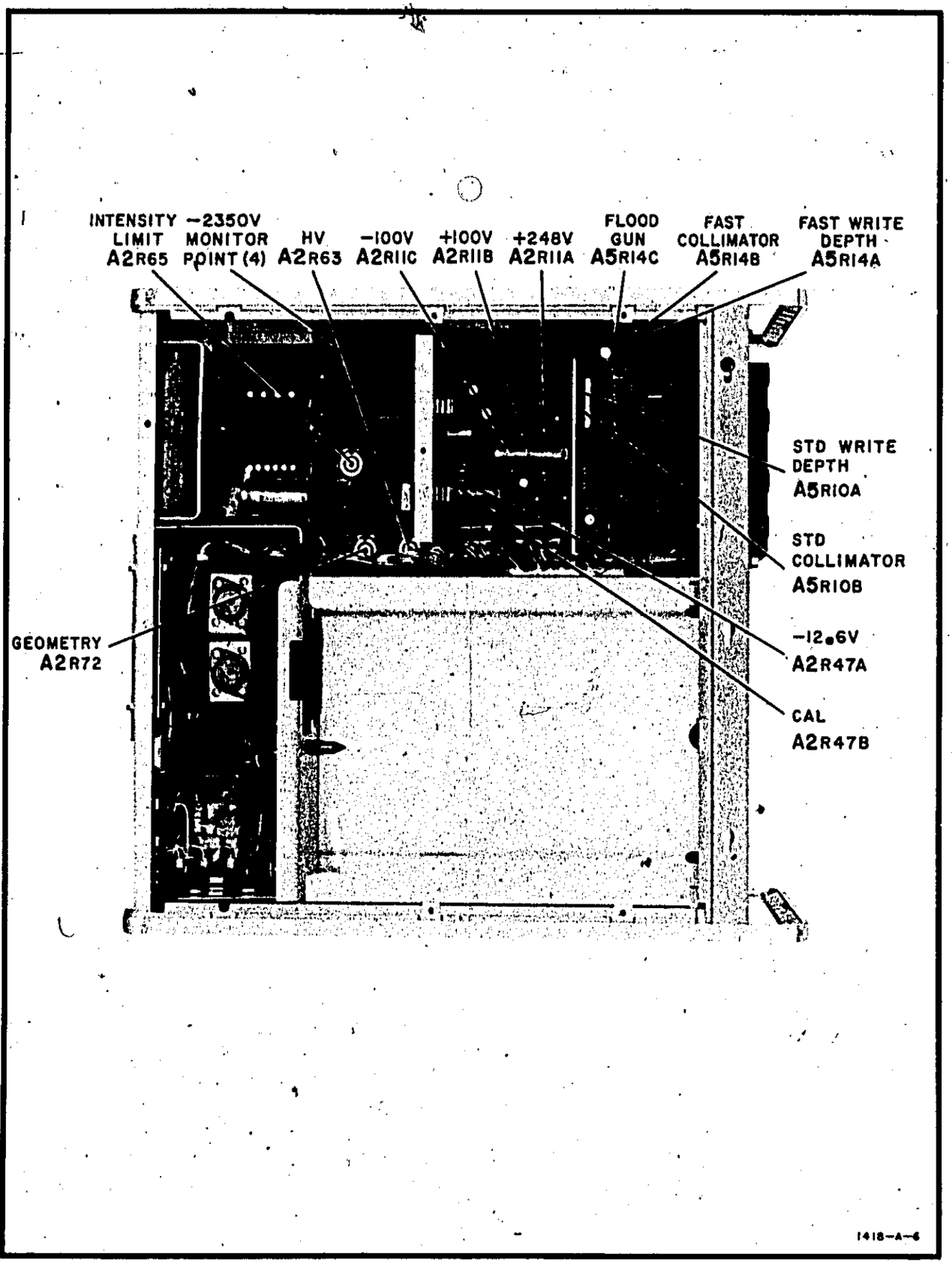


Figure 5-1. Adjustment Location

PARTS LIST

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	OBD	= order by description	SEC	= second(s)
C	= centi (10^{-2})	IF	= intermediate freq.	OH	= oval head	SECT	= section(s)
CAR	= carbon	IMPG	= impregnated	OX	= oxide	SI	= silicon
CCW	= counterclockwise	INCD	= incandescent			SIL	= silver
CER	= ceramic	INCL	= include(s)	P	= peak	SL	= slide
CMO	= cabinet mount only	INS	= insulation(ed)	PC	= printed (etched) circuit(s)	SP	= single pole
COAX	= coaxial	INT	= internal	PF	= picofarads	SPL	= special
COEF	= coefficient	K	= kilo (10^{3})	PHL	= Phillips	ST	= single throw
COMP	= composition	KG	= kilogram	PIV	= peak inverse voltage(s)	STD	= standard
CONN	= connector(s)	LB	= pound(s)	PNP	= positive-negative-positive	TA	= tantalum
CRT	= cathode-ray tube	LH	= left hand	P/O	= part of	TD	= time delay
CW	= clockwise	LIN	= linear taper	PORC	= porcelain	TFL	= teflon
D	= deci (10^{-1})	LOG	= logarithmic taper	POS	= position(s)	TGL	= toggle
DEPC	= deposited carbon	LPF	= low-pass filter(s)	POT	= potentiometer(s)	THYR	= thyristor
DP	= double pole	LVR	= lever	P-P	= peak-to-peak	TI	= titanium
DT	= double throw	M	= milli (10^{-3})	PRGM	= program	TNLDIO	= tunnel diode(s)
ELECT	= electrolytic	MEG	= mega (10^{6})	PS	= polystyrene	TOL	= tolerance
ENCAP	= encapsulated	MET FILM	= metal film	PWV	= peak working voltage	TRIM	= trimmer
EXT	= external	MET OX	= metal oxide			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				

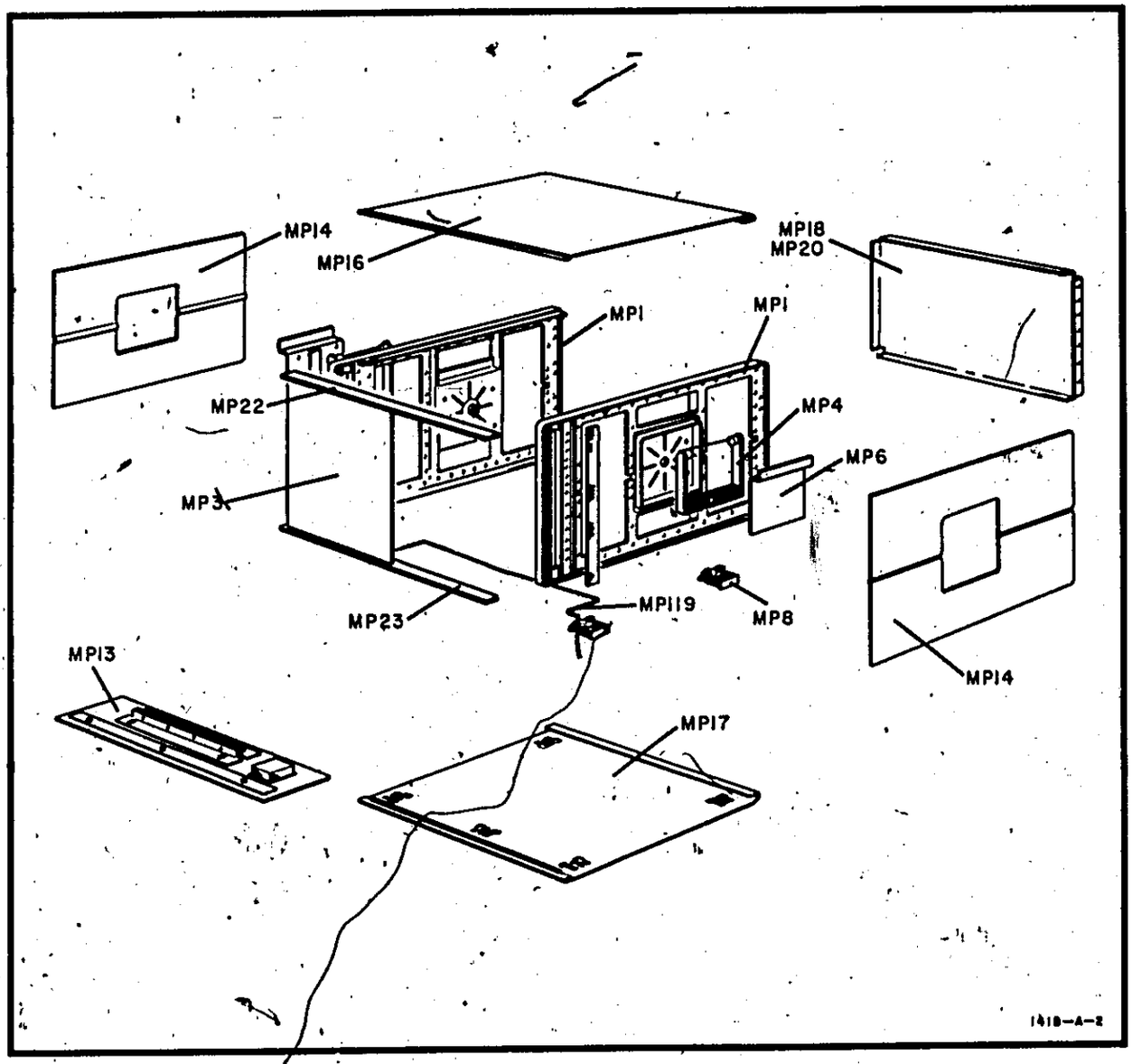


Figure 6-1. Cabinet Parts, Exploded View

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			CHASSIS PARTS		
A1	00141-66515		DIODE BOARD ASSY	28480	00141-66515
A2	00141-66518		POWER SUPPLY BOARD ASSY	28480	00141-66518
A3	00141-61101		HIGH VOLTAGE TRIPLER ASSY	28480	00141-61101
A4			NOT ASSIGNED		
A5	00141-66513		PULSE CIRCUIT BOARD ASSY	28480	00141-66513
A6	00141-66502		HORIZONTAL DRIVER ASSY	28480	00141-66502
B1	3160-0056	1	FAN:TUBEAXIAL	28480	3160-0056
C1	0180-0154	1	C:FXD ELECT 430UF +100 -10% 250VDCW	56289	D37361
C2	0180-0012	1	C:FXD ELECT 2X20 UF 450VDCW	56289	D32440
C3	0180-0046	1	C:FXD ELECT 600 UF 200VDCW	56289	D32569
C4	0180-0214	1	C:FXD ELECT 275 UF +50-10% 200VDCW	56289	D36037-DFP
C5	0180-0093	1	C:FXD ELECT 20 UF 150VDCW	56289	D33193
C6	0180-0213	1	C:FXD ELECT 5000 UF +75-10% 25VDCW	56289	D39556
CR1	1901-0032	2	DIODE:SILICON IN3209	04713	IN3209
CR2	1901-0032		DIODE:SILICON IN3209	04713	IN3209
DS1	1450-0048	1	LAMP:INDICATOR RED 115V	72765	599-124
F1	2110-0014	1	FUSE:CARTRIDGE 4 AMP 125V SLOW BLOW	71400	MDX-4
J1	1251-0054	2	CONNECTOR:FEMALE 24-CONTACT	28480	1251-0054
J2	1251-0054		CONNECTOR:FEMALE 24-CONTACT	28480	1251-0054
J3	1251-0148	1	CONNECTOR:POWER 3 PIN MALE	87930	1065-1
J4	1251-0202	2	CONNECTOR:BANANA JACK (CALIBRATOR)	83330	2218
J5	1251-0202		CONNECTOR:BANANA JACK (CALIBRATOR)	83330	2218
J6			NOT ASSIGNED		
J7	1510-0038	1	CONNECTOR:BINDING POST (GND)	28480	1510-0038
L1	5060-0435	1	COIL:ALIGNMENT Z AXIS	28480	5060-0435
MP1	5060-0736	2	FRAME ASSY	28480	5060-0736
MP3	00141-00209	1	PANEL:FRONT	28480	00141-00209
MP4	5060-0222	2	HANDLE ASSY:5H SIDE	28480	5060-0222
MP6	5060-0765	2	RETAINER-HANDLE ASSY	28480	5060-0765
MP8	5060-0767	5	FOOT ASSY:FM	28480	5060-0767
MP13	5060-0777	1	KIT;RACK MOUNT	28480	5060-0777
MP14	5000-0747	2	COVER:SIDE	28480	5000-0747
MP16	5060-0740	1	TOP COVER ASSY:16L FM	28480	5060-0740
MP17	5060-0752	1	BOTTOM COVER ASSY:16L FM	28480	5060-0752
MP18	00141-60201	1	PANEL ASSY:REAR	28480	00141-60201
MP20	0360-0042	1	TERMINAL:SOLDER LUG FOR #6 SCREW	28480	0360-0042
MP21	1400-0008	1	FUSEHOLDER:BRONZE CLIP	95915	3510-11
MP22	00140-24701	1	SUPPORT:TOP PANEL	28480	00140-24701
MP23	00140-24702	1	SUPPORT:BOTTOM PANEL	28480	00140-24702
MP24	00141-67401	1	KNOB:PUSHBUTTON ERASE	28480	00141-67401
MP25	00141-67402	1	KNOB:PUSHBUTTON FAST	28480	00141-67402
MP26	00141-67403	1	KNOB:PUSHBUTTON CONV	28480	00141-67403
MP27	00141-67404	1	KNOB:PUSHBUTTON STORE	28480	00141-67404
MP28	00141-67405	1	KNOB:PUSHBUTTON STANDARD	28480	00141-67405
MP29	00141-67406	1	KNOB:PUSHBUTTON BEAM	28480	00141-67406
MP30	0370-0084	4	KNOB:ROUND BLK 5/8 DIA (INTENSITY, TIME, FOCUS, PERSISTENCE)	28480	0370-0084
MP37	1200-0037	1	SOCKET:CRT TUBE	72825	97097
MP38	1200-0043	4	INSULATOR:TRANSISTOR MOUNTING, INCLUDES:	71785	293011
	1200-0044		SOCKET:TRANSISTOR	97464	M7(PB)
	1200-0081		BUSHING:NYLON	26365	974 SPECIAL
MP42	1200-0088	4	INSULATOR:DIODE	71785	293201
MP46	1200-0408	1	COVER:CRT SOCKET	28480	1200-0408
MP47	5020-0476	1	BEZEL	28480	5020-0476
MP48	5040-0440	1	COVER:CRT SOCKET	28480	5040-0440
MP49	5040-0444	1	SHIELD:LIGHT, SHORT	28480	5040-0444
MP50	5060-0428	1	FILTER ASSY:AIR	28480	5060-0428
MP56	00140-00104	1	GUSSET:SIDE	28480	00140-00104
MP57	00140-00601	1	SHIELD:PLUG-IN	28480	00140-00601
MP58	00140-01201	1	BRACKET:LATCH	28480	00140-01201
MP59	00140-01206	2	BRACKET:FAN	28480	00140-01206
MP61	00140-01208	4	BRACKET:PANEL	28480	00140-01208
MP65	00140-01209	2	BRACKET:GUSSET	28480	00140-01209
MP67	00140-01210	2	BRACKET:TRANSISTOR	28480	00140-01210
MP69	00140-24703	4	SUPPORT:PANEL BRACKET	28480	00140-24703
MP73	00140-29902	1	PANEL:EXTRUDED	28480	00140-29902
MP74	00141-00102	1	DECK:VERTICAL	28480	00141-00102
MP75	00141-00103	1	GUSSET:CENTER	28480	00141-00103
MP76	00141-00104	1	DECK:MAIN	28480	00141-00104
MP77	00141-01202	1	BRACKET:DIODE	28480	00141-01202
MP78	1400-0068	3	CLIP:FUSE	75915	104002
MP79	00141-01203	1	BRACKET:CAPACITOR	28480	00141-01203
MP88	00141-01204	1	CLAMP:CABLE RESISTOR	28480	00141-01204
MP89	00141-01205	1	CLAMP:CABLE RESISTOR	28480	00141-01205
MP90	00141-04101	1	COVER:CAPACITOR	28480	00141-04101
MP91	00141-04103	1	COVER:HIGH VOLTAGE BOARD	28480	00141-04103

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
MP92	00141-60603	1	SHIELD ASSY:CRT	28480	00141-60603
MP95	00180-01218	2	BRACKET:ALIGNMENT COIL	28480	00180-01218
MP97	01200-44703	1	SUPPORT:CRT SHIELD	28480	01200-44703
MP99	1606-1106	2	PIN:GUIDE	28480	1606-1106
MP102	1400-0068		CLIP:FUSE	75915	104002
MP105	1200-0050	10	PIN:CRT SOCKET	72825	9553
MP115	10178	1	SCREEN:CONTRAST	28480	10178
MP116	1410-0052	2	BUSHING:POTENTIOMETER	28480	1410-0052
MP117	5040-0709	1	TRIM:PLASTIC HANDLE	28480	5040-0709
MP118	5040-0710	1	TRIM:PLASTIC HANDLE	28480	5040-0710
MP119	1490-0030	1	STAND:TILT	28480	1490-0030
MP120	1520-0042	4	MOUNT:FAN SHOCK	28480	1520-0042
MP121	1540-0421	2	COVER:POT. INSULATOR	28480	5040-0421
Q1	1853-0252	1	TSTR:SI PNP	04713	SJ-1798
Q2	1854-0294	3	TSTR:SI NPN	04713	SJ-1318
Q3	1854-0294		TSTR:SI NPN	04713	SJ-1318
Q4	1854-0294		TSTR:SI NPN	04713	SJ-1318
R1	0687-3331	1	R:FXD COMP 33K OHM 10% 1/2W	01121	EB 3331
R2	0815-0031	1	R:FXD WW (2X1200) 2400 OHM 5% 10W	28480	0815-0031
R3	0811-2030	2	R:FXD WW 14 OHM 5% 10W	28480	0811-2030
R4	0811-2030		R:FXD WW 14 OHM 5% 10W	28480	0811-2030
R5	2100-1722	1	R:VAR COMP 1.5 MEGOHM 10% LIN 1/2W	28480	2100-1722
R6	2100-0374	1	R:VAR COMP 5 MEGOHM 30% LIN 1/2W	28480	2100-0374
R7	2100-0445	1	R:VAR COMP GANGED 2K OHM 30% LIN 1/2W	28480	2100-0455
R8	2100-0015	1	R:VAR CERMET 500K OHM 20% LIN 1/4W	28480	2100-0015
R9	2100-2897	2	R:VAR CERMET 1 MEGOHM 20% LIN 2W	28480	2100-2897
R10	2100-2897		R:VAR CERMET 1 MEGOHM 20% LIN 2W	28480	2100-2897
R11	0811-2994	1	R:FXD WW 0.27 OHMS 3% 5W	28480	0811-2994
S1	3101-0030	1	SWITCH:TOG SPST 15 AMP 125 VAC	88140	8906K368
S2	3101-0033	1	SWITCH:SLIDE DPDT INT-EXT	82389	11A-1008A
S3	3103-0009	1	SWITCH:THERMAL SPST	01295	20700L10-205
S4	3101-0011	1	SWITCH:SLIDE DPDT 115V/230V	82389	11A-1013
T1	9100-0184	1	TRANSFORMER:POWER	28480	9100-0184
TB1	0360-0104	1	TB:SCREW TYPE, CATCH (Z-AXIS)	71785	321-11-02-036
TB2	0360-0015	1	TB:THREE TERMINAL	76530	332-14-03-011
TB3	0360-0012	1	TB:TWO TERMINAL, LUG	06540	628-13
V1	5083-2552	1	CATHODE RAY STORAGE TUBE	28480	5083-2552
W1	8120-0078	1	CABLE ASSY:POWER CORD	28480	8120-0078
W2	00141-61621	1	CABLE:MAIN	28480	00141-61621
W3	00141-61624	1	CABLE:TWIN LEAD ASSY	28480	00141-61624
W4	00141-61625	1	CABLE:TWIN LEAD ASSY	28480	00141-61625
W5	00141-61622	1	CABLE:COAX P/O MAIN CABLE	28480	00141-61622
W6	00141-61623	1	CABLE:COAX P/O MAIN CABLE	28480	00141-61623

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
			ASSEMBLY PARTS		
A1	00141-66515	1	DIODE BOARD ASSY	28480	00141-66515
A1C1	0150-0052	7	C:FXD CER 0.05 UF 20% 400VDCW	56289	33C17A
A1C2	0150-0052		C:FXD CER 0.05 UF 20% 400VDCW	56289	33C17A
A1C3	0150-0052		C:FXD CER 0.05 UF 20% 400VDCW	56289	33C17A
A1CR1	1901-0028	13	DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A1CR2	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A1CR3	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A1CR4	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A1CR5	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A1CR6	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A1CR7	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A1CR8	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A1CR9	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A1CR10	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A1CR11	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A1CR12	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A1MP1	5020-0495	165	PIN:SQUARE	28480	5020-0495
A2	00141-66518	1	POWER SUPPLY BOARD ASSY	28480	00141-66518
A2C1	0160-0168	6	C:FXD MY 0.1 UF 10% 200VDCW	56289	192P10492-PTS
A2C2	0160-0168		C:FXD MY 0.1 UF 10% 200VDCW	56289	192P10492-PTS
A2C3	0160-0168		C:FXD MY 0.1 UF 10% 200VDCW	56289	192P10492-PTS
A2C4	0180-0100	2	C:FXD ELECT 4.7 UF 10% 35VDCW	56289	1500475X9035B2-3YS
A2C5	0150-0052		C:FXD CER 0.05 UF 20% 400VDCW	56289	33C17A
A2C6	0160-0168		C:FXD MY 0.1 UF 10% 200VDCW	56289	192P10492-PTS
A2C7	0180-0100		C:FXD ELECT 4.7 UF 10% 35VDCW	56289	1500475X9035B2-3YS
A2C8	0160-0207	1	C:FXD MYLAR 0.01UF 5% 200VDCW	28480	0160-0207
A2C9	0180-0097	1	C:FXD ELECT 47 UF 10% 35VDCW	56289	1590476X9035S2-3YS
A2C10	0180-0138	1	C:FXD ELECT 100UF -10+100% 40VDCW	56289	036254
A2C11	0180-0230	1	C:FXD ELECT 1.0 UF 20% 50VDCW	56289	150D105X9050A2-3YS
A2C12	0150-0052		C:FXD CER 0.05 UF 20% 400VDCW	56289	33C17A
A2C13	0160-0151	5	C:FXD CER 4700 PF +80-20% 4000VDCW	71590	DA045-040C0
A2C14	0160-0151		C:FXD CER 4700 PF +80-20% 4000VDCW	71590	DA045-040C0
A2C15	0160-0151		C:FXD CER 4700 PF +80-20% 4000VDCW	71590	DA045-040C0
A2C16	0160-0907	2	C:FXD CER 0.01 UF +80-20% 5000VDCW	14655	TM50R123Z-1
A2C17	0160-0907		C:FXD CER 0.01 UF +80-20% 5000VDCW	14655	TM50R123Z-1
A2C18	0160-0151		C:FXD CER 4700 PF +80-20% 4000VDCW	71590	DA045-040C0
A2C19	0160-0151		C:FXD CER 4700 PF +80-20% 4000VDCW	71590	DA045-040C0
A2CR2	1901-0040	30	DIODE:SILICON 30MA 30WV	07263	FDG1088
A2CR3	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A2CR4	1901-0096	1	DIODE:SILICON 120V	01295	UG-558
A2CR5	1910-0016	2	DIODE:GERMANIUM 100MA/0.85V 60PIV	93332	D2361
A2CR8	1901-0026	2	DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
A2CR10	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A2CR11	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A2CR13	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A2CR14	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A2CR15	1901-0026		DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
A2CR16	1901-0025	1	DIODE:SILICON 100MA/1V	07263	FD 2387
A2CR17	1910-0016		DIODE:GERMANIUM 100MA/0.85V 60PIV	93332	D2361
A2CR18	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A2CR19	1912-0006	1	DIODE TUNNEL:GERMANIUM	03508	1N3718 SPEC
A2CR21	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A2CR22	1901-0049	1	DIODE:SILICON 0.75A 50PIV	04713	SR1358-6
A2CR23	1901-0341	2	DIODE:SI 7000 PIV 50MA	28480	1901-0341
A2CR24	1901-0341		DIODE:SI 7000 PIV 50MA	28480	1901-0341
A2CR25	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A2CR26	1901-0436	2	DIODE:SILICON 1600 PIV	28480	1901-0436
A2CR27	1901-0436		DIODE:SILICON 1600 PIV	28480	1901-0436
A2CR28	1901-0029	1	DIODE:SILICON 600 PIV	28480	1901-0029
A2F1	2110-0004	1	FUSE:CARTRIDGE 1/4 AMP 250V	75915	3AG/CAT. 312.250
A2F2	2110-0033	1	FUSE:0.75A 250V	75915	F02GR750A
A2F3	2110-0012	1	FUSE:CARTRIDGE 0.5A 250V	28480	2110-0012
A2F4	2110-0003	1	FUSE:CARTRIDGE 3 AMP 250V	75915	312003
A2K1		1	RELAY:CONSISTS OF:		
A2K1L1	0490-0191	1	COIL:RELAY 600 OHM NOM. 12V DC	71707	U-12P
A2K1S1	0490-0199	1	RELAY:REED SPST	28480	0490-0199
A2L1	9140-0171	1	COIL:FXD 40 UH 10% 1A	82142	10608-1
A2L2	9140-0210	1	COIL:FXD RF 100 UH 5%	71895	1537-76
A2MP1	0340-0451	1	WASHER:INSULATED, TRANSISTOR	04713	14852600F03

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
A2MP2	2110-0269	8	CLIP: FUSE 0.250" DIA	91506	6008-32CN
A2MP3	2110-0269		CLIP: FUSE 0.250" DIA	91506	6008-32CN
A2MP4	2110-0269		CLIP: FUSE 0.250" DIA	91506	6008-32CN
A2MP5	2110-0269		CLIP: FUSE 0.250" DIA	91506	6008-32CN
A2MP6	2110-0269		CLIP: FUSE 0.250" DIA	91506	6008-32CN
A2MP7	2110-0269		CLIP: FUSE 0.250" DIA	91506	6008-32CN
A2MP8	2110-0269		CLIP: FUSE 0.250" DIA	91506	6008-32CN
A2MP9	2110-0269		CLIP: FUSE 0.250" DIA	91506	6008-32CN
A2MP10	5020-0496		PIN: SQUARE	28480	5020-0496
A2MP76	5040-0401	2	SUPPORT: CAPACITOR	28480	5040-0401
A2MP77	5040-0401		SUPPORT: CAPACITOR	28480	5040-0401
A2MP81	5040-0402	1	MOUNT:TRANSFORMER TOP	28480	5040-0402
A2MP82	5040-0430	1	MOUNT:TRANSFORMER BOTTOM	28480	5040-0430
A2MP83	01200-01101	1	HEAT SINK	28480	01200-01101
A2Q1	1854-0005	1	TSTR:SI NPN	80131	2N708
A2Q2	1853-0036	1	TSTR:SI PNP	80131	2N3906
A2Q3	1854-0022	2	TSTR:SI NPN	07263	S17843
A2Q4	1854-0087	1	TSTR:SI NPN	80131	2N3417
A2Q5	1854-0071	15	TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A2Q6	1854-0022		TSTR:SI NPN	07263	S17843
A2Q7	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A2Q8	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A2Q9	1854-0039	1	TSTR:SI NPN	80131	2N3053
A2Q10	1854-0215	1	TSTR:SI NPN	80131	2N3904
A2Q11	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A2Q12	1850-0099	1	TSTR:GE PNP	80131	2N404
A2Q13	1853-0084	1	TSTR:SI PNP	80131	2N4918
A2Q14	1853-0034	1	TSTR:SI PNP	28480	1853-0034
A2Q15	1855-0057	1	TSTR:SI FET N-CHANNEL	28480	1855-0057
A2R1	0687-1041	1	R:FXD COMP 100K OHM 10% 1/2W	01121	EB 1041
A2R2	0764-0033	1	R:FXD MET OX 33 OHM 5% 2W	28480	0764-0033
A2R3	0761-0007	1	R:FXD MET OX 27K OHM 5% 1W	14674	C-32 OBD
A2R4	0684-1021	6	R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A2R5	0683-1015	1	R:FXD COMP 100 OHM 5%,1/4W	01121	CB 1051
A2R6	0757-0044	1	R:FXD MET FLM 33.2K OHM 1% 1/2W	28480	0757-0044
A2R7	0757-0401	5	R:FXD MET FLM 100 OHM 1% 1/8W	14674	OBD
A2R8	0757-0273	2	R:FXD MET FLM 3.01K OHM 1% 1/8W	28480	0757-0273
A2R9	0757-0465	2	R:FXD MET FLM 100K 1% 1/8W	14674	OBD
A2R10	0757-0370	1	R:FXD MET FLM 49.9K OHM 1.0% 1/2W	28480	0757-0370
A2R11	2100-1589	1	R:VAR COMP 7K/3K/5K OHM 20% LIN 1/4W	28480	2100-1589
A2R12	0757-0367	2	R:FXD MET FLM 100K OHM 1% 1/2W	28480	0757-0367
A2R13	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	14674	OBD
A2R14	0766-0033	1	R:FXD MET FLM 2200 OHM 2% 3W	28480	0766-0033
A2R15	0757-0434	1	R:FXD MET FLM 3.65K OHM 1% 1/8W	28480	0757-0434
A2R16	0761-0006	1	R:FXD MET OX 10K OHM 5% 1W	14674	C-32 OBD
A2R17	0687-5631	4	R:FXD COMP 56K OHM 10% 1/2W	01121	EB 5631
A2R18	0687-5631		R:FXD COMP 56K OHM 10% 1/2W	01121	EB 5631
A2R19	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A2R20	0757-0399	2	R:FXD MET FLM 82.5 OHM 1% 1/8W	28480	0757-0399
A2R21	0684-5621	1	R:FXD COMP 5.6K OHM 10% 1/4W	01121	CB 5621
A2R22	0757-0764	2	R:FXD FLM 33.2K OHM 1% 1/4W	28480	0757-0764
A2R23	0757-0383	3	R:FXD FLM 30.1 OHM 1% 1/8W	28480	0757-0383
A2R24	0757-0436	2	R:FXD MET FLM 4.32K OHM 1% 1/8W	28480	0757-0436
A2R26	0757-0846	3	R:FXD MET FLM 22.1K OHM 1.0% 1/2W	28480	0757-0846
A2R27	0687-5631		R:FXD COMP 56K OHM 10% 1/2W	01121	EB 5631
A2R28	0687-5631		R:FXD COMP 56K OHM 10% 1/2W	01121	EB 5631
A2R29	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A2R30	0757-0399		R:FXD MET FLM 82.5 OHM 1% 1/8W	28480	0757-0399
A2R31	0757-0846	1	R:FXD MET FLM 30.1K OHM 1.0% 1/2W	28480	0757-0846
A2R32	0757-0772	1	R:FXD MET FLM 68.1K OHM 1% 1/4W	28480	0757-0772
A2R33	0757-0388		R:FXD FLM 30.1 OHM 1% 1/8W	28480	0757-0388
A2R34	0757-0436		R:FXD MET FLM 4.32K OHM 1% 1/8W	28480	0757-0436
A2R35	0757-0190	4	R:FXD MET FLM 20K OHM 1% 1/2W	28480	0757-0190
A2R36	0757-0764		R:FXD FLM 33.2K OHM 1% 1/4W	28480	0757-0764
A2R36	0727-0431	1	R:FXD DEPC 2.69K OHM 1% 1/2W	28480	0727-0431
A2R37	0757-0846		R:FXD MET FLM 22.1K OHM 1.0% 1/2W	28480	0757-0846

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
A2R40	0687-2221	1	R:FXD COMP 2200 OHM 10% 1/2W	01121	EB 2221
A2R41	0687-4731	1	R:FXD COMP 47K OHM 10% 1/2W	01121	EB 4731
A2R43	0757-0846		R:FXD MET FLM 22.1K OHM 1.0% 1/2W	28480	0757-0846
A2R44	0757-0190		R:FXD MET FLM 20K OHM 1% 1/2W	28480	0757-0190
A2R45	0757-0480	3	R:FXD FLM 432K OHM 1% 1/8W	28480	0757-0480
A2R46	0757-0388		R:FXD FLM 30.1 OHM 1% 1/8W	28480	0757-0388
A2R47	2100-1588	2	R:VAR COMP 2 X 1.5K OHM 30% LIN 1/4W	28480	2100-1588
A2R48	0757-0273		R:FXD MET FLM 3.01K OHM 1% 1/8W	28480	0757-0273
A2R49	0811-1746		R:FXD WW 0.36 OHM 5% 2W	28480	0811-1746
A2R50	0757-0421	1	R:FXD MET FLM 825 OHM 1% 1/8W	28480	0757-0421
A2R51	0757-0428	1	R:FXD MET FLM 1.62K 1% 1/8W	14674	OBD
A2R52	0757-0844	1	R:FXD MET FLM 16.2K OHM 1% 1/2W	28480	0757-0844
A2R54	0698-3555	1	R:FXD MET FLM 4.437K OHM 0.5% 1/2W	28480	0698-3555
A2R55	0698-3554	1	R:FXD MET FLM 493 OHM 0.5% 1/2W	28480	0698-3554
A2R56	0684-3331	1	R:FXD COMP 33K OHM 10% 1/4W	01121	CB 3331
A2R57	0758-0064	1	R:FXD METOX 330 OHM 5% 1/2W	28480	0758-0064
A2R58	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A2R59	0684-1241	1	R:FXD COMP 120K OHM 10% 1/4W	01121	CB 1241
A2R60	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A2R61	0727-0845	2	R:FXD FLM 1.78 MEGOHM 1% 1/2W	28480	0727-0845
A2R62	0727-0269	1	R:FXD DEPC 990K OHM 1% 1/2W	28480	0727-0269
A2R63	2100-0102	1	R:VAR COMP 500K OHM 30% LIN 1/5W	28480	2100-0102
A2R64	0683-1535	1	R:FXD COMP 15K OHM 5% 1/4W	01121	CB 1535
A2R65	2100-0096	1	R:VAR COMP 1 MEGOHM 30% LIN 1/5W	28480	2100-0096
A2R66	0698-6666	1	R:FXD FLM 33 MEGOHM 5% 1W	28480	0698-6666
A2R67	0757-0344	2	R:FXD MET FLM 1.00 MEGOHM 1% 1/4W	28480	0757-0344
A2R68	0757-0190		R:FXD MET FLM 20K OHM 1% 1/2W	28480	0757-0190
A2R69	0757-0190		R:FXD MET FLM 20K OHM 1% 1/2W	28480	0757-0190
A2R70	0757-0768	1	R:FXD FLM 47.5K OHM 1% 1/4W	28480	0757-0768
A2R71	0757-0454	1	R:FXD MET FLM 33.2K OHM 1% 1/8W	28480	0757-0454
A2R72	2100-0095	1	R:VAR COMP 100K OHM 30% LIN 1/5W	28480	2100-0095
A2R73	0727-0845		R:FXD FLM 1.78 MEGOHM 1% 1/2W	28480	0727-0845
A2R74	0698-3553	8	R:FXD FLM 2.49 MEGOHM 1% 1/2W	28480	0698-3553
A2R75	0698-3553		R:FXD FLM 2.49 MEGOHM 1% 1/2W	28480	0698-3553
A2R76	0698-3553		R:FXD FLM 2.49 MEGOHM 1% 1/2W	28480	0698-3553
A2R77	0698-3553		R:FXD FLM 2.49 MEGOHM 1% 1/2W	28480	0698-3553
A2R78	0698-3553		R:FXD FLM 2.49 MEGOHM 1% 1/2W	28480	0698-3553
A2R79	0698-3553		R:FXD FLM 2.49 MEGOHM 1% 1/2W	28480	0698-3553
A2R80	0698-3553		R:FXD FLM 2.49 MEGOHM 1% 1/2W	28480	0698-3553
A2R81	0698-3553		R:FXD FLM 2.49 MEGOHM 1% 1/2W	28480	0698-3553
A2R82	0757-0344		R:FXD MET FLM 1.00 MEGOHM 1% 1/4W	28480	0757-0344
A2R83	0757-0452	1	R:FXD MET FLM 27.4K OHM 1% 1/8W	28480	0757-0452
A2R84	0757-0465		R:FXD MET FLM 100K 1% 1/8W	14674	OBD
A2R85	0684-2221	4	R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A2T1	00141-61102	1	TRANSFORMER ASSY	28480	00141-61102
A2V1	1940-0013	1	ELECTRON TUBE:82.0V	74276	Z82R7
A2V2	2140-0014	3	LAMP:GLOW 75V 0.5 MA	24455	NE96
A2V3	2140-0014		LAMP:GLOW 75V 0.5 MA	24455	NE96
A2V4	2140-0014		LAMP:GLOW 75V 0.5 MA	24455	NE96
A2VR1	1902-3402	1	DIODE BREAKDOWN:80.6V 2%	28480	1902-3402
A2VR2	1902-0034	1	DIODE:5.76V 10%	28480	1902-0034
A2VR3	1902-3104	2	DIODE:BREAKDOWN 5.62V 5%	04713	SZ10939-110
A2VR4	1902-3385	2	DIODE BREAKDOWN:69.8V 2%	28480	1902-3385
A2VR5	1902-3385		DIODE BREAKDOWN:69.8V 2%	28480	1902-3385
A2VR6	1902-0044	1	DIODE BREAKDOWN:7.5V	23480	1902-0044
A3	00141-61101	1	HIGH VOLTAGE TRIPLER ASSY	28480	00141-61101
A3C1	0160-0224	4	C:FXD CER 620 PF +50-20% 10K VDCW	56289	706C1
A3C2	0160-0224		C:FXD CER 620 PF +50-20% 10K VDCW	56289	706C1
A3C3	0160-0224		C:FXD CER 620 PF +50-20% 10K VDCW	56289	706C1
A3C4	0160-0224		C:FXD CER 620 PF +50-20% 10K VDCW	56289	706C1
A3CR1	1880-0025	3	RECTIFIER:SEL HALF WAVE	03508	6RS 18PH110PH81
A3CR2	1880-0025		RECTIFIER:SEL HALF WAVE	03508	6RS 18PH110PH31
A3CR3	1880-0025		RECTIFIER:SEL HALF WAVE	03508	6RS 18PH110PH41
A3MP1	0360-0053	6	TERMINAL:SOLDER LUG FOR #10 HDW	00000	080
A3MP7	0362-0264	2	TERMINATION:CRIMP LUG FOR 0.046SQ PIN	00000	080
A3MP9	0362-0116	2	TERMINATION:CRIMP LUG	00000	080
A3MP10	0362-0116		TERMINATION:CRIMP LUG	00000	080
A3MP11	00141-25201	1	HOUSING:HIGH VOLTAGE SUPPLY	28480	00141-25201
A3MP12	00180-41214	1	CLAMP:CRT LEAD	28480	00180-41214
A3MP13	00181-04101	1	COVER:HIGH VOLTAGE CONNECTOR	28480	00181-04101
A3MP14	00181-47601	1	BLOCK:HIGH VOLTAGE CONNECTOR	28480	00181-47601
A3R1	0698-7804	1	R:FXD COMP 30 MEGOHM 5% 2W	01121	HS 3365
A3R2	0687-1051	1	R:FXD COMP 1 MEGOHM 10% 1/2W	01121	EB 1051

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A3W1	00141-61630	1	CABLE:SPECIAL PURPOSE	28480	00141-61630
A4			NOT ASSIGNED		
A5	00141-66513	1	PULSE CIRCUIT BOARD ASSY	28480	00141-66513
A5C1	0160-0156	1	C:FXD MY 0.0056 UF 10% 200VDCW	56289	192P56792-PTS
A5C2	0160-2212	1	C:FXD MICA 560 PF 5% 300VDCW	28480	0160-2212
A5C3	0160-2307	1	C:FXD MICA 47 PF 5%	28480	0160-2307
A5C4	0140-0207	2	C:FXD MICA 330 PF 5%	28480	0140-0207
A5C5	0160-0153	1	C:FXD MY 0.001 UF 10% 200VDCW	56289	192P10292-PTS
A5C6	0160-2262	1	C:FXD CER 16 PF 5% 500VDCW	72982	301-000 C0G 150J
A5C7	0160-2146	1	C:FXD CER 0.02 UF +80-20% 100VDCW	91418	TA
A5C8	0180-0228	1	C:FXD ELECT 22 UF 10% 15VDCW	56289	1500226X901537-DYS
A5C9	0160-0154	1	C:FXD MICA MY 0.0022 UF 10% 200VDCW	56289	192P22292-PTS
A5C10	0180-0376	1	C:FXD ELECT 0.47 UF 10% 35VDCW	56289	1500476X903542-DYS
A5C11	0160-0168		C:FXD MY 0.1 UF 10% 200VDCW	56289	192P10492-PTS
A5C12	0160-0168		C:FXD MY 0.1 UF 10% 200VDCW	56289	192P10492-PTS
A5C13	0180-0155	1	C:FXD ELECT 2.2 UF 20% 20VDCW	56289	1500225X9020A2-DYS
A5CR1	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A5CR2	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A5CR3	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A5CR4	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A5CR5	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A5CR6	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A5CR7	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A5CR8	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A5CR9	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A5CR10	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A5CR11	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A5CR12	1901-0033	4	DIODE:SILICON 100MA 180WV	07263	FD3369
A5CR13	1901-0033		DIODE:SILICON 100MA 180WV	07263	FD3369
A5CR14	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358:9
A5CR15	1901-0033		DIODE:SILICON 100MA 180WV	07263	FD3369
A5CR16	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A5CR17	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A5CR18	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A5CR19	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A5CR20	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A5CR21	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A5CR22	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A5CR23	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A5CR24	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A5CR25	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A5CR26	1901-0418	1	DIODE:SILICON 400PIV 1N5000	04713	1N5000
A5CR27	1901-0033		DIODE:SILICON 100MA 180WV	07263	FD3369
A5L1	9100-1630	1	COIL/CHOKE 51.0 UH 5%	28480	9100-1630
A5MP1	0340-0478	1	INSULATOR:COMPONENT BASE	28480	0340-0478
A5MP2	3050-0159	4	WASHER:NYLON #6	80120	060
A5MP3	3050-0159		WASHER:NYLON #6	80120	060
A5MP4	3050-0159		WASHER:NYLON #6	80120	060
A5MP5	3050-0159		WASHER:NYLON #6	80120	060
A5MP6	5020-0495		PIN:SQUARE	28480	5020-0495
A5Q1	1853-0020	1	TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A5Q2	1855-0317	1	TSTR:UNIJUNCTION SI	04713	MU4996
A5Q3	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A5Q4	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A5Q5	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A5Q6	1854-0358	3	TSTR:SI NPN	28480	1854-0358
A5Q7	1854-0358		TSTR:SI NPN	28480	1854-0358
A5Q8	1854-0358		TSTR:SI NPN	28480	1854-0358
A5Q9	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A5Q10	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A5Q11	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A5Q12	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A5Q13	1854-0234	1	TSTR:SI NPN	80131	2N3440
A5Q14	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A5Q15	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A5Q16	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A5Q17	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A5R1	0757-0476	3	R:FXD MET FLM 301K OHM 1% 1/8W	28480	0757-0476
A5R2	0684-1051	5	R:FXD COMP 1MEGOHM 1% 1/4W	01121	CB 1051
A5R3	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A5R4	0684-1811	2	R:FXD COMP 180 OHM 10% 1/4W	01121	CB 1811
A5R5	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A5R6	0684-4731	2	R:FXD COMP 47K OHM 10% 1/4W	01121	CB 4731
A5R7	0684-1041	5	R:FXD COMP 100K OHM 10% 1/4W	01121	CB 1041

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A5R8	0698-3155	1	R:FXD MET FLM 4.64K 1% 1/8W	91637	MFF-1/10-32
A5R9	0757-0430	1	R:FXD MET FLM 2.21K OHM 1% 1/8W	28480	0757-0430
A5R10	2100-0424	1	R:VAR COMP 2 K 50K OHM 20% LIN 1/4W	28480	2100-0424
A5R11	0757-0469	1	R:FXD FLM 150K OHM 1% 1/8W	28480	0757-0469
A5R12	0757-0473	2	R:FXD MET FLM 221K OHM 1% 1/8W	28480	0757-0473
A5R13	0757-0481	2	R:FXD MET FLM 475K OHM 1% 1/8W	28480	0757-0481
A5R14	2100-0983	1	R:VAR COMP 3 K 100K OHM 20% LIN 1/4W	28480	2100-0983
A5R15	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A5R16	0757-0466	1	R:FXD MET FLM 110K OHM 1% 1/8W	28480	0757-0466
A5R17	0684-1831	1	R:FXD COMP 18K OHM 10% 1/4W	01121	CB 1831
A5R18	0684-1061	4	R:FXD COMP 10 MEGOHM 10% 1/4W	01121	CB 1061
A5R19	0684-4761	2	R:FXD COMP 470K OHM 10% 1/4W	01121	CB 4761
A5R20	0698-4009	1	R:FXD FLM 50K OHM 1% 1/8W	28480	0698-4009
A5R21	0757-0476		R:FXD MET FLM 301K OHM 1% 1/8W	28480	0757-0476
A5R22	0757-0456	1	R:FXD MET FLM 43.2K OHM 1% 1/8W	28480	0757-0456
A5R23	0757-0128	1	R:FXD MET FLM 200K OHM 1% 1/2W	28480	0757-0129
A5R24	0684-1061		R:FXD COMP 10 MEGOHM 10% 1/4W	01121	CB 1061
A5R25	0757-0850	3	R:FXD MET FLM 39.2K OHM 1.0% 1/2W	28480	0757-0850
A5R26	0757-0367		R:FXD MET FLM 100K OHM 1% 1/2W	28480	0757-0367
A5R27	0757-0481		R:FXD MET FLM 475K OHM 1% 1/8W	28480	0757-0481
A5R28	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A5R29	0684-5611	1	R:FXD COMP 560 OHM 10% 1/4W	01121	CB 5611
A5R30	0757-0793	1	R:FXD FLM 825K OHM 1.0% 1/4W	28480	0757-0793
A5R31	0684-2241	1	R:FXD COMP 220K OHM 10% 1/4W	01121	CB 2241
A5R32	0684-1031	4	R:FXD COMP 10K OHM 10% 1/4W	01121	CB 1031
A5R33	0684-1051		R:FXD COMP 1MEGOHM 1% 1/4W	01121	CB 1051
A5R34	0684-1031		R:FXD COMP 10K OHM 10% 1/4W	01121	CB 1031
A5R35	0684-1031		R:FXD COMP 10K OHM 10% 1/4W	01121	CB 1031
A5R36	0684-1031		R:FXD COMP 10K OHM 10% 1/4W	01121	CB 1031
A5R37	0684-1051		R:FXD COMP 1MEGOHM 1% 1/4W	01121	CB 1051
A5R38	0684-4721	3	R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A5R39	0684-1061		R:FXD COMP 10 MEGOHM 10% 1/4W	01121	CB 1061
A5R40	0684-4731		R:FXD COMP 47K OHM 10% 1/4W	01121	CB 4731
A5R41	0757-0480		R:FXD FLM 432K OHM 1% 1/8W	28480	0757-0480
A5R43	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A5R44	0757-0480		R:FXD FLM 432K OHM 1% 1/8W	28480	0757-0480
A5R46	0757-0791	1	R:FXD FLM 619K OHM 1.0% 1/4W	28480	0757-0791
A5R47	0757-0476		R:FXD MET FLM 301K OHM 1% 1/8W	28480	0757-0476
A5R48	0761-0083	1	R:FXD MET OX 68K OHM 5% 1W	28480	0761-0083
A5R49	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A5R50	0684-4741		R:FXD COMP 470K OHM 10% 1/4W	01121	CB 4741
A5R51	0684-1051		R:FXD COMP 1MEGOHM 1% 1/4W	01121	CB 1051
A5R52	0684-1041		R:FXD COMP 100K OHM 10% 1/4W	01121	CB 1041
A5R53	0684-1041		R:FXD COMP 100K OHM 10% 1/4W	01121	CB 1041
A5R54	0684-1061		R:FXD COMP 10 MEGOHM 10% 1/4W	01121	CB 1061
A5R55	0684-2731	1	R:FXD COMP 27K OHM 10% 1/4W	01121	CB 2731
A5R56	0684-1041		R:FXD COMP 100K OHM 10% 1/4W	01121	CB 1041
A5R57	0684-2211	1	R:FXD COMP 220 OHM 10% 1/4W	01121	CB 2211
A5R58	0684-8231	1	R:FXD COMP 82K OHM 10% 1/4W	01121	CB 8231
A5R59	0684-1051		R:FXD COMP 1MEGOHM 1% 1/4W	01121	CB 1051
A5R60	0684-1811		R:FXD COMP 180 OHM 10% 1/4W	01121	CB 1811
A5R61	0698-3647	1	R:FXD MET OX 15K OHM 5% 2W	28480	0698-3647
A5R62	0684-1041		R:FXD COMP 100K OHM 10% 1/4W	01121	CB 1041
A5R64	0757-0473		R:FXD MET FLM 221K OHM 1% 1/8W	28480	0757-0473
A5S1	3101-1259	1	SWITCH:16 SECTIONS	28480	3101-1259
A5VR1	1902-3104		DIODE:BREAKDOWN 5.62V 5%	04713	SZ10939-110
A5VR2	1902-0597	1	DIODE BREAKDOWN:56.2V 5% 1W	28480	1902-0597
A6	00141-66502	1	HORIZONTAL DRIVER ASSY	28480	00141-66502
A6C1	0150-0052		C:FXD CER 0.05 UF 20% 400VDCW	56289	33C17A
A6C2	0150-0052		C:FXD CER 0.05 UF 20% 400VDCW	56289	33C17A
A6Q1	1853-0038	2	TSTR:SI PNP	28480	1853-0038
A6Q2	1853-0038		TSTR:SI PNP	28480	1853-0038
A6R1	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	14674	OBD
A6R2	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	14674	OBD
A6R3	0757-0850		R:FXD MET FLM 39.2K OHM 1.0% 1/2W	28480	0757-0850
A6R4	0757-0850		R:FXD MET FLM 39.2K OHM 1.0% 1/2W	28480	0757-0850
A6R5	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	14674	OBD

See Introduction to this section for ordering information

Table 6-3. List of Manufacturers' Codes

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) and their latest supplements. The date of revision and the date of the supplements used appear at the bottom of each page. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 Handbooks.

Code No.	Manufacturer	Address
00000	U.S.A Common	Any supplier of U.S.
00136	McCoy Electronics	Mount Holly Springs, Pa.
00213	Sage Electronics Corp.	Rochester, N.Y.
00287	Cemco, Inc.	Danielson, Conn.
00334	Humidial	Colton, Calif.
00348	Mictron, Co., Inc.	Valley Stream, N.Y.
00373	Garlock Inc.	Cherry Hill, N.J.
00656	Aerovox Corp.	New Bedford, Mass.
00779	Amp, Inc.	Harrisburg, Pa.
00781	Aircraft Radio Corp.	Boonton, N.J.
00809	Crowen, Ltd.	Whitby, Ontario, Canada
00815	Northern Engineering Laboratories, Inc.	Burlington, Wis.
00853	Sangamo Electric Co., Pickens Div.	Pickens, S.C.
00866	Goe Engineering Co.	City of Industry, Cal.
00891	Carl E. Holmes Corp.	Los Angeles, Cal.
00929	Microlab Inc.	Livingston, N.J.
01002	General Electric Co., Capacitor Dept.	Hudson Falls, N.Y.
01009	Aldea Products Co.	Brockton, Mass.
01121	Allen Bradley Co.	Milwaukee, Wis.
01255	Litton Industries, Inc.	Beverly Hills, Cal.
01281	TRW Semiconductors, Inc.	Lawndale, Cal.
01295	Texas Instruments, Inc., Transistor Products Div.	Dallas, Texas
01349	The Alliance Mfg. Co	Alliance, Ohio
01538	Small Parts Inc.	Los Angeles, Cal.
01589	Pacific Relays, Inc.	Van Nuys, Cal.
01670	Oddebrod Bros. Silk Co.	New York, N.Y.
01930	Amerock Corp.	Rockford, Ill.
01960	Pulse Engineering Co	Santa Clara, Cal.
02114	Ferroxcube Corp. of America	Saugerties, N.Y.
02116	Wheelock Signals, Inc.	Long Branch, N.J.
02286	Cole Rubber and Plastics Inc	Sunnyvale, Cal.
02660	Amphenol-Borg Electronics Corp.	Broadview, Ill.
02735	Radio Corp. of America, Semiconductor and Materials Division	Somerville, N.J.
02771	Vocaline Co. of America, Inc.	Old Saybrook, Conn.
02777	Hopkins Engineering Co.	San Fernando, Cal.
02875	Hudson Tool & Die	Newark, N.J.
03296	Nylon Molding Corp.	Springfield, N.J.
03508	G.E. Semiconductor Prod. Dept.	Syracuse, N.Y.
03705	Apex Machine & Tool Co.	Dayton, Ohio
03797	Eldema Corp.	Compton, Calif.
03818	Parker Seal Co.	Los Angeles, Cal.
03877	Transitron Electric Corp.	Wakefield, Mass.
03888	Pyrofilm Resistor Co., Inc.	Cedar Knolls, N.J.
03954	Singer Co., Diehl Div., Finderne Plant	Somerville, N.J.
04009	Arrow, Hart and Hegeman Elect. Co.	Hartford, Conn.
04013	Tarvus Corp.	Lambertville, N.J.
04062	Arco Electronic Inc.	Great Neck, N.Y.
04217	Essex Wire	Los Angeles, Cal.
04222	Hi-Q Division of Aerovox	Myrtle Beach, S.C.
04354	Precision Paper Tube Co.	Wheeling, Ill.
04404	Palo Alto Division of Hewlett-Packard Co.	Palo Alto, Cal.
04651	Sylvania Electric Products, Microwave Device Div.	Mountain View, Cal.
04673	Dakota Engr. Inc.	Culver City, Cal.
04713	Motorola Inc. Semiconductor Prod. Div.	Phoenix, Arizona
04732	Filtron Co., Inc. Western Div.	Culver City, Cal.
04773	Automatic Electric Co.	Northlake, Ill.
04796	Sequoia Wire Co.	Redwood City, Cal.
04811	Precision Coil Spring Co.	El Monte, Cal.
04870	P.M. Motor Company	Westchester, Ill.
04919	Component Mfg. Service Co.	W. Bridgewater, Mass.
05006	Twentieth Century Plastics, Inc.	Los Angeles, Cal.
05277	Westinghouse Electric Corp. Semiconductor Dept.	Youngwood, Pa.
05347	Ultronix, Inc.	San Mateo, Cal.
05397	Union Carbine Corp., Elect. Div.	New York, N.Y.
05513	Viking Ind. Inc.	Canoga Park, Cal.
05593	Icore Electro-Plastics Inc.	Sunnyvale, Cal.
05616	Cosmo Plastic (c/o Electrical Spec. Co.)	Cleveland, Ohio
05624	Barber Colman Co.	Rockford, Ill.
05728	Tiffen Optical Co.	Roslyn Heights, Long Island, N.Y.
05729	Metro-Tel Corp.	Westbury, N.Y.
05783	Stewart Engineering Co.	Santa Cruz, Cal.
05820	Wakefield Engineering Inc.	Wakefield, Mass.
06004	Bassick Co., Div. of Stewart Warner Corp.	Bridgeport, Conn.
06090	Raychem Corp.	Redwood City, Cal.
06475	Bausch and Lomb Optical Co.	Rochester, N.Y.
06402	E.T.A. Products Co. of America	Chicago, Ill.
06540	Amatom Electronic Hardware Co., Inc.	New Rochelle, N.Y.
06555	Beede Electrical Instrument Co., Inc.	Penacook, N.H.
06666	General Devices Co., Inc.	Indianapolis, Ind.
06751	Components Inc., Ariz. Div.	Phoenix, Arizona
06812	Torrington Mfg. Co., West Div.	Van Nuys, Cal.
06980	Varian Assoc. Eimac Div.	San Carlos, Cal.
07088	Kelvin Electric Co.	Van Nuys, Cal.
07126	Digitran Co.	Pasadena, Cal.
07137	Transistor Electronics Corp.	Minneapolis, Minn.
07138	Westinghouse Electric Corp., Electronic Tube Div.	Elmira, N.Y.
07149	Filmohm Corp.	New York, N.Y.
07233	Cinch-Graphik Co.	City of Industry, Cal.
07256	Silicon Transistor Corp.	Carle Place, N.Y.
07261	Avnet Corp.	Culver City, Cal.
07263	Fairchild Camera & Inst. Corp., Semiconductor Div.	Mountain View, Cal.
07322	Minnesota Rubber Co.	Minneapolis, Minn.
07387	Birtcher Corp, The	Monterey Park, Cal.
07397	Sylvania Elect. Prod. Inc., Mt. View Operations	Mountain View, Cal.
07700	Technical Wire Products Inc.	Cranford, N.J.
07829	Bodine Elect. Co.	Chicago, Ill.
07910	Continental Device Corp.	Hawthorne, Cal.
07933	Raytheon Mfg. Co., Semiconductor Div.	Mountain View, Cal.
07980	Hewlett-Packard Co., New Jersey Division	Rockaway, N.J.
08145	U.S. Engineering Co.	Los Angeles, Cal.
08289	Bliss, Delbert Co.	Pomona, Cal.
08358	Burgess Battery Co.	Niagara Falls, Ontario, Canada
08524	Deutsch Fastener Corp.	Los Angeles, Cal.
08664	Bristol Co., The	Waterbury, Conn
08717	Sloan Company	Sun Valley, Cal.
08718	ITT Cannon Electric Inc., Phoenix Div.	Phoenix, Arizona
08727	National Radio Lab. Inc.	Paramus, N.J.
08792	CBS Electronics Semiconductor Operations, Div. of CBS Inc	Lowell, Mass.
08806	General Electric Co., Miniature Lamp Dept.	Cleveland, Ohio
08984	Mel-Rain	Indianapolis, Ind.
09026	Babcock Relays Div.	Costa Mesa, Cal.
09097	Electronic Enclosures Inc.	Los Angeles, Calif.
09134	Texas Capacitor Co.	Houston, Texas
09145	Tech. Ind. Inc. Atohm Elect.	Burbank, Cal.
09250	Electro Assemblies, Inc.	Chicago, Ill.
09353	C & K Components Inc.	Newton, Mass.
09569	Mallory Battery Co. of Canada, Ltd.	Toronto, Ontario, Canada
09795	Pennsylvania Florocarbon.	Clifton Heights, Penn.
09922	Burady Corp.	Norwalk, Conn.
10214	General Transistor Western Corp.	Los Angeles, Cal.
10411	Ti-Tal, Inc.	Berkeley, Cal.
10646	Carborundum Co.	Niagara Falls, N.Y.
11236	CTS of Berne, Inc.	Berne, Ind.
11237	Chicago Telephone of California, Inc.	So. Pasadena, Cal.
11242	Bay State Electronics Corp.	Waltham, Mass.
11312	Teledyne Inc., Microwave Div.	Palo Alto, Cal.
11314	National Seal	Downey, Cal.
11453	Precision Connector Corp.	Jamaica, N.Y.
11534	Duncan Electronics Inc.	Costa Mesa, Cal.
11711	General Instrument Corp., Semiconductor Division Products Group	Newark, N.J.
11717	Imperial Electronic, Inc.	Buena Park, Cal.
11870	Melabs, Inc,	Palo Alto, Cal.
12136	Philadelphia Handle Co.	Camden, N.J.
12361	Grove Mfg. Co., Inc.	Shady Grove, Pa.
12574	Gulton Ind. Inc., Data System Div.	Albuquerque, N.M.
12697	Clarostat Mfg. Co.	Dover, N.H.
12728	Elmar Filter Corp	W. Haven, Conn.
12859	Nippon Electric Co., Ltd.	Tokyo, Japan
12881	Metex Electronics Corp.	Clark, N.J.
12930	Delta Semiconductor Inc.	Newport Beach, Cal.
12954	Dickson Electronics Corp.	Scottsdale, Arizona
13019	Airco Supply Co., Inc.	Witchita, Kansas
13061	Wilco Products	Detroit, Mich.
13103	Thermoloy	Dallas, Texas
13327	Solitron Devices Inc.	Tappan, N.Y.
13396	Telefunken (GmbH)	Hanover, Germany
13835	Midland-Wright Div. of Pacific Industries, Inc.	Kansas City, Kansas
14099	Sem-Tech	Newbury Park, Cal.
14193	Calif. Resistor Corp	Santa Monica, Cal.
14298	American Components, Inc.	Conshohocken, Pa.
14433	ITT Semiconductor, a Div. of Int. Telephone and Telegraph, Corporation	West Palm Beach, Fla.
14483	Hewlett-Packard Company	Loveland, Colo.
14655	Cornell Dublier Electric Corp	Newark, N.J.
14674	Corning Glass Works	Corning, N.Y.
14752	Electro Cube Inc.	San Gabriel, Cal.
14960	Williams Mfg. Co.	San Jose, Cal.
15106	The Sprague Co., Inc.	Little Falls, N.J.
15203	Webster Electronics Co.	New York, N.Y.
15287	Scionics Corp.	Northridge, Cal.
15291	Adjustable Bushing Co.	N. Hollywood, Cal.
15558	Micron Electronics, Garden City, Long Island, N.Y.	
15566	Amprobe Inst. Corp.	Lynbrook, N.Y.
15631	Cabletronics	Costa Mesa, Cal.
15772	Twentieth Century Coil Spring Co.	Santa Clara, Cal.
15801	Fenwal Elect. Inc.	Framingham, Mass.
15818	Ameleo Inc.	Mountain View, Cal.
16037	Spruce Pine Mica Co.	Spruce Pine, N.C.
16179	Omni-Spectra Inc.	Detroit, Ill.
16352	Computer Diode Corp.	Lodi, N.J.
16554	Electroid Co.	Union, N.J.
16585	Boots Aircraft Nut Corp.	Pasadena, Cal.
16688	Ideal Prec. Meter Co., Inc., De Jur-Meter Div.	Brooklyn, N.Y.
16758	Delco Radio Div. of G.M. Corp.	Kokomo, Ind.
17109	Thermonetics Inc.	Canoga Park, Cal.
17474	Tranex Company	Mountain View, Cal.
17675	Hamlin Metal Products Corp.	Akron, Ohio
17745	Angstrohm Prec. Inc.	No. Hollywood, Cal.
17856	Siliconix Inc.	Sunnyvale, Cal.
17870	McGraw-Edison Co.	Manchester, N.H.
18042	Power Design Pacific Inc.	Palo Alto, Cal.
18083	Clevite Corp. Semiconductor Div.	Palo Alto, Cal.
18324	Signetics Corp.	Sunnyvale, Cal.
18476	Ty-Car Mfg. Co., Inc.	Holliston, Mass.
18486	TRW Elect. Comp. Div.	Des Plaines, Ill.
18565	Chomerics	Plainville, Mass.
18583	Curtis Instrument, Inc.	Mt. Kisco, N.Y.
18612	Vishay Instruments Inc.	Malvern, Pa.
18873	E.I. DuPont and Co., Inc.	Wilmington, Del.
18911	Durant Mfg. Co.	Milwaukee, Wis.
19315	The Bendix Corp., Navigation & Control Div.	Teterboro, N.J.
19500	Thomas A. Edison Industries, Div. of McGraw-Edison	West Orange, N.J.
19589	Coacos	Baldwin Park, Cal.

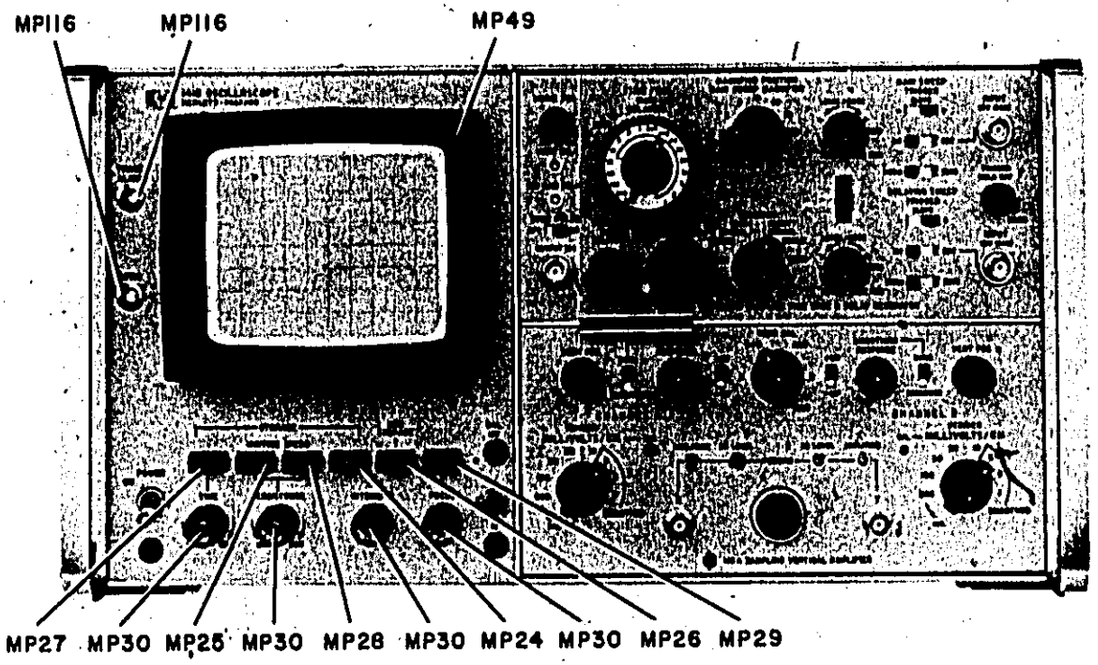


Figure 6-2. Mechanical Parts, Front View

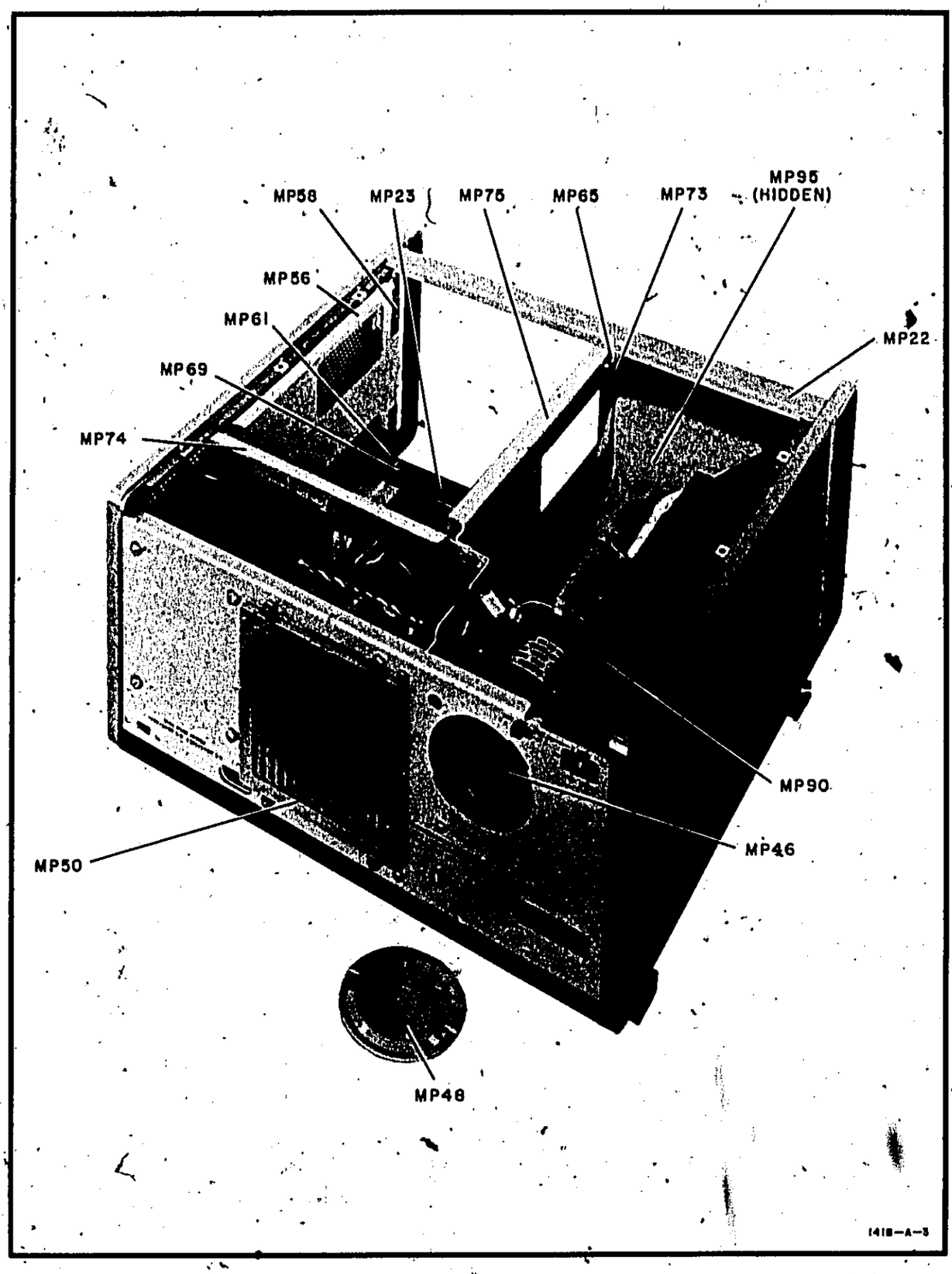


Figure 6-3. Mechanical Parts, Rear View

Table 6-3. List of Manufacturers' Codes

Code No.	Manufacturer	Address
19644	LRC Electronics	Horseheads, N.Y.
19701	Electra Mfg. Co.	Independence, Kansas
20183	General Atronics Corp.	Philadelphia, Pa.
21236	Executone, Inc.	Long Island City, N.Y.
21355	Fafnir Bearing Co., The	New Britian, Conn.
21520	Fansteel Metallurgical Corp.	N. Chicago, Ill.
23020	General Reed Co.	Metuchen, N.J.
23042	Texsan Corp.	Indianapolis, Ind.
23783	British Radio Electronics Ltd.	Washington, D.C.
24455	G.E. Lamp Division, Nela Park,	Cleveland, Ohio
24655	General Radio Co.	West Concord, Mass.
24681	Memcor Inc., Comp Div.	Huntington, Ind.
26365	Gries Reproducer Corp.	New Rochelle, N.Y.
26462	Grobert File Co. of America, Inc.	Carlstadt, N.J.
26851	Compac Hollister Co.	Hollister, Cal.
26992	Hamilton Watch Co.	Lancaster, Pa.
28480	Hewlett-Packard Co.	Palo Alto, Cal.
28520	Heyman Mfg. Co.	Kenilworth, N.J.
30817	Instrument Specialties Co., Inc.	Little Falls, N.J.
33173	G.E. Receiving Tube Dept.	Owensboro, Ky.
35434	Lectrohm Inc.	Chicago, Ill.
36196	Stanwyck Coil Products, Ltd.	Hawkesbury, Ontario, Canada
36287	Cunninghani, W.H. & Hill, Ltd.	Toronto, Ontario, Canada
37942	P.R. Mallory & Co., Inc.	Indianapolis, Ind.
39543	Mechanical Industries Prod. Co.	Akron, Ohio
40920	Miniature Precision Bearings, Inc.	Keene, N.H.
40931	Honeywell Inc.	Minneapolis, Minn.
42190	Mutor Co.	Chicago, Ill.
43990	C.A Norgren Co.	Englewood, Colo.
44655	Ohmite Mfg. Co.	Skokie, Ill.
46384	Penn Eng. & Mfg. Corp.	Doylestown, Pa.
47904	Polaroid Corp.	Cambridge, Mass.
48620	Precision Thermometer & Inst. Co.	Southampton, Pa.
49956	Microwave & Power Tube Div.	Waltham, Mass.
52090	Rowan Controller Co.	Westminster, Md.
52983	BP Co., Med. Elec. Div.	Waltham, Mass
54294	Shallcross Mfg. Co.	Selma, N.C.
55026	Simpson Electric Co.	Chicago, Ill.
55933	Sonotone Corp.	Elmsford, N.Y.
55938	Raytheon Co. Commercial Apparatus & System Div.	So. Norwalk, Conn.
56137	Spaulding Fibre Co., Inc.	Tonawanda, N.Y.
56289	Sprague Electric Co.	North Adams, Mass.
58474	Superior Elect. Co.	Bristol, Conn.
59446	Telex Corp.	Tulsa, Okla.
59730	Thomas & Betts Co.	Elizabeth, N.J.
60741	Triplett Electrical Inst. Co.	Bluffton, Ohio
61775	Union Switch and Signal Div. of Westinghouse Air Brake Co.	Pittsburgh, Pa.
62119	Universal Electric Co.	Owosso, Mich.
63743	Ward-Leonard Electric Co.	Mt. Vernon, N.Y.
64959	Western Electric Co., Inc.	New York, N.Y.
65092	Weston Inst. Inc. Weston-Newark.	Newark, N.J.
66295	Wittek Mfg. Co.	Chicago, Ill.
66346	Minnesota Mining & Mfg. Co. Revere-Mincom Div.	St. Paul, Minn.
70276	Allen Mfg. Co.	Hartford, Conn.
70309	Allied Control	New York, N.Y.
70318	Allmetal Screw Product Co., Inc.	Garden City, N.Y.
70417	Amplex, Div. of Chrysler Corp.	Detroit, Mich.
70485	Atlantic India Rubber Works, Inc.	Chicago, Ill.
70563	Amperite Co., Inc.	Union City, N.J.
70674	ADC Products Inc.	Minneapolis, Minn.
70903	Belden Mfg. Co.	Chicago, Ill.
70998	Bird Electric Corp.	Cleveland, Ohio
71002	Birnbach Radio Co.	New York, N.Y.
71034	Birley Electric Co., Inc.	Erie, Pa.
71041	Boston Gear Works Div. of Murray Co. of Texas	Quincey, Mass.
71218	Bud Radio, Inc.	Willoughby, Ohio
71279	Cambridge Thermionics Corp.	Cambridge, Mass.
71286	Camloc Fastener Corp.	Paramus, N.J.
71313	Cardwell Condenser Corp.	Lindenhurst, L.I., N.Y.
71400	Bussmann Mfg. Div. of McGraw-Edison Co.	St. Louis, Mo.
71436	Chicago Condenser Corp.	Chicago, Ill.
71447	Calif. Spring Co., Inc.	Pico-Rivera, Cal.
71450	CTS Corp.	Elkhart, Ind.
71468	ITT Cannon Electric Inc.	Los Angeles, Cal.
71471	Cinema, Div. Aeruvox Corp.	Burbank, Cal.
71482	C.P. Clare & Co.	Chicago, Ill.
71590	Centralab Div. of Globe Union Inc.	Milwaukee, Wis.
71616	Commercial Plastics Co.	Chicago, Ill.
71700	Cornish Wire Co., The	New York, N.Y.
71707	Coto Coil Co., Inc.	Providence, R.I.
71744	Chicago Miniature Lamp Works	Chicago, Ill.
71785	Cinch Mfg. Co., Howard B. Jones Div.	Chicago, Ill
71984	Dow Corning Corp.	Midland, Mich.
72136	Electro Motive Mfg. Co., Inc.	Willimantic, Conn.
72619	Dialight Corp.	Brooklyn, N.Y.
72656	Indiana General Corp., Electronics Div.	Keasby, N.J.
72699	General Instrument Corp., Cap Division	Newark, N.J.
72765	Drake Mfg. Co.	Harwood Heights, Ill
72825	Hugh H. Eby Inc.	Philadelphia, Pa
73076	H.M. Harper Co.	Chicago, Ill.
73138	Helipot Div. of Berkman Inst., Inc.	Fullerton, Cal.
73293	Hughes Products Division of Hughes Aircraft Co.	Newport Beach, Cal.
73445	Amperex Elect. Co.	Hicksville, L.I., N.Y.
73506	Bradley Semiconductor Corp.	New Haven, Conn.
73559	Carling Electric, Inc.	Hartford, Conn.
73586	Circle F Mfg. Co.	Trenton, N.J.
73682	George K. Garrett Co., Div. MSL Industries, Inc.	Philadelphia, Pa.
73734	Federal Screw Products, Inc.	Chicago, Ill.
73743	Fischer Special Mfg. Co.	Cincinnati, Ohio
73793	General Industries Co., The	Elyria, Ohio
73846	Goshen Stamping & Tool Co.	Goshen, Ind.
73899	JFD Electronics Corp.	Brooklyn, N.Y.
73905	Jennings Radio Mfg. Corp.	San Jose, Cal.
73957	Growe-Pin Corp.	Ridgefield, N.J.
74276	Signalite Inc.	Neptune, N.J.
74455	J.H. Winns, and Sons	Winchester, Mass
74861	Industrial Condenser Corp.	Chicago, Ill.
74868	R.F. Products Division of Amphenol-Borg Electronic Corp.	Danbury, Conn.
74970	E.F. Johnson Co.	Waseca, Minn.
75042	International Resistance Co.	Philadelphia, Pa.
75263	Keystone Carbon Co., Inc.	St. Marys, Pa.
75378	CTS Knights, Inc.	Sandwich, Ill.
75382	Kulka Electric Corp.	Mt. Vernon, N.Y.
75818	Lenz Electric Mfg. Co.	Chicago, Ill.
75915	Littlefuse, Inc.	Des Plaines, Ill.
76005	Lord Mfg. Co.	Erie, Pa.
76210	C.W. Marwedel	San Francisco, Cal.
76433	General Instrument Corp., Micamold Division	Newark, N.J.
76487	James Millen Mfg. Co., Inc.	Malden, Mass
76493	J.W. Miller Co.	Los Angeles, Cal.
76530	Cinch-Monadnock, Div. of United Carr Fastener Corp.	San Leandro, Cal.
76545	Mueller Electric Co.	Cleveland, Ohio
76703	National Union	Newark, N.J.
76854	Oak Manufacturing Co.	Crystal Lake, Ill.
77068	The Bendix Corp., Electrodynamics Div.	N. Hollywood, Cal.
77079	Pacific Metals Co.	San Francisco, Cal.
77221	Phaostron Instrument and Electronic Co.	So. Pasadena, Cal.
77252	Philadelphia Steel and Wire Corp.	Philadelphia, Pa.
77342	American Machine & Foundry Co. Potter & Brumfield Div.	Princetop, Ind.
77630	TRW Electronic Components Div.	Camden, N.J.
77638	General Instrument Corp., Rectifier Division	Brooklyn, N.Y.
77764	Resistance Products Co.	Harrisburg, Pa.
77969	Rubbercraft Corp. of Calif.	Torrance, Cal.
78189	Shakeproof Division of Illinois Tool Works	Elgin, Ill.
78277	Sigma	So. Braintree, Mass
78283	Signal Indicator Corp.	New York, N.Y.
78290	Struthers-Dunn Inc.	Pitman, N.J.
78452	Thompson-Bremer & Co.	Chicago, Ill
78471	Tilley Mfg. Co	San Francisco, Cal
78488	Stackpole Carbon Co.	St. Marys, Pa
78493	Standard Thomson Corp	Waltham, Mass
78553	Tinnerman Products, Inc	Cleveland, Ohio
78790	Transformer Engineers	San Gabriel, Cal
78947	Ucinite Co.	Newtonville, Mass
79136	Waldes Kohinoor Inc.	Long Island City, N.Y.
79142	Veeder Root, Inc.	Hartford, Conn.
79251	Wenco Mfg. Co.	Chicago, Ill
79727	Continental-Wirt Electronics Corp.	Philadelphia, Pa.
79963	Zierick Mfg. Corp.	New Rochelle, N.Y.
80031	Mepco Division of Sessions Clock Co.	Morristown, N.J.
80033	Prestole Corp.	Toledo, Ohio
80120	Schnitzer Alloy Products Co.	Elizabeth, N.J.
80131	Electronic Industries Association. Standard tube or semi-conductor device, any manufacturer.	
80207	Unimax Switch, Div. Maxon Electronics Corp.	Wallingford, Conn.
80223	United Transformer Corp.	New York, N.Y.
80248	Oxford Electric Corp.	Chicago, Ill
80294	Bourns Inc.	Riverside, Cal
80411	Arco Div. of Robertshaw Controls Co.	Columbus, Ohio
80486	All Star Products Inc.	Defiance, Ohio
80509	Avery Label Co.	Monrovia, Cal
80583	Hammarlund Co., Inc.	Mars Hill, N.C.
80640	Stevens, Arnold, Co., Inc.	Boston, Mass
80813	Dimco Gray Co.	Dayton, Ohio
81030	International Inst. Inc.	Orange, Conn.
81073	Grayhill Co.	LaGrange, Ill
81095	Triad Transformer Corp.	Venice, Cal
81312	Winchester Elec. Div. Litton Ind., Inc.	Oakville, Conn.
81349	Military Specification	
81483	International Rectifier Corp.	El Segundo, Cal
81541	Airpax Electronics, Inc.	Cambridge, Maryland
81860	Barry Controls, Div. Barry Wright Corp.	Watertown, Mass
82042	Carter Precision Electric Co.	Skokie, Ill.
82047	Sperti Faraday Inc., Copper Hewitt Electric Div.	Hoboken, N.J.
82116	Electric Regulator Corp.	Norwalk, Conn
82142	Jeffers Electronics Division of Speer Carbon Co.	Du Bois, Pa.
82170	Fairchild Camera & Inst. Corp., Space & Defense Systems Div.	Paramus, N.J.
82209	Magurie Industries, Inc.	Greenwich, Conn.
82219	Sylvania Electric Prod., Inc Electronic Tube Division	Emporium, Pa
82376	Astron Corp.	East Newark, Harrison, N.J.
82389	Switchcraft, Inc.	Chicago, Ill
82647	Metals & Controls Inc., Spencer Products	Attleboro, Mass.
82768	Phillips-Advance Control Co.	Joliet, Ill.
82866	Research Products Corp.	Madison, Wis.
82877	Rolton Mfg. Co., Inc.	Woodstock, N.Y.
82893	Vector Electronic Co.	Glendale, Cal
83058	Carr Fastener Co.	Cambridge, Mass.
83086	New Hampshire Ball Bearing, Inc.	Peterborough, N.H.
83125	General Instrument Corp., Capacitor Div.	Darlington, S.C.
83148	ITT Wire and Cable Div.	Los Angeles, Cal
83186	Victory Eng. Corp.	Springfield, N.J.
83298	Bendix Corp., Red Bank Div.	Red Bank, N.J.
83315	Bubbell Corp.	Mundelein, Ill.
83324	Rosan Inc.	Newport Beach, Cal.
83330	Smith, Herman H., Inc.	Brooklyn, N.Y.
83332	Tech Labs	Palisades Park, N.J.
83385	Central Screw Co.	Chicago, Ill
83501	Gavitt Wire and Cable Co., Div. of Amerace Corp.	Brookfield, Mass.
83594	Burroughs Corp., Electronic Tube Div.	Plainfield, N.J.
83740	Union Carbide Corp., Consumer Prod. Div.	New York, N.Y.
83777	Model Eng. and Mfg., Inc.	Huntington, Ind.
83821	Loyd Scruggs Co.	Festus, Mo.
83942	Aeronautical Inst. & Radio Co.	Lodi, N.J.
84171	Arco Electronics Inc.	Great Neck, N.Y.
84396	A.J. Glesener Co., Inc.	San Francisco, Cal.
84411	TRW Capacitor Div.	Ogallala, Neb.

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Table 6-3. List of Manufacturers' Codes

Code No.	Manufacturer	Address
04870	Sarkes Tarzian, Inc.	Bloomington, Ind.
05454	Boonton Molding Company	Boonton, N.J.
05471	A. B. Boyd Co.	San Francisco, Cal.
05474	R. M. Bracamonte & Co.	San Francisco, Cal.
05660	Kolled Kords, Inc.	Hamden, Conn.
05911	Seamless Rubber Co.	Chicago, Ill.
06174	Fafnir Bearing Co.	Los Angeles, Calif.
06197	Clifton Precision Products Co., Inc.	Clifton Heights, Pa.
06579	Precision Rubber Products Corp.	Dayton, Ohio
06604	Radio Corp. of America, Electronic Comp. & Devices Division	Harrison, N.J.
06928	Seastrom Mfg. Co.	Glendale, Cal.
07034	Marco Industries	Anaheim, Cal.
07216	Philco Corporation (Lansdale Division)	Lansdale, Pa.
07473	Western Fibrous Glass Products Co.	San Francisco, Cal.
07664	Van Waters & Rogers Inc.	San Francisco, Cal.
07930	Tower Mfg. Corp.	Providence, R.I.
08140	Cutler-Hammer, Inc.	Lincoln, Ill.
08220	Gould-National Batteries, Inc.	St. Paul, Minn.
08698	General Mills, Inc.	Buffalo, N.Y.
09231	Graybar Electric Co.	Oakland, Cal.
09473	G.E. Distributing Corp.	Schenectady, N.Y.
09479	Security Co.	Detroit, Mich.
09665	United Transformer Co.	Chicago, Ill.
90030	United Shoe Machinery Corp.	Beverly, Mass.
90179	U. S. Rubber Co., Consumer Ind. & Plastics Prod. Div.	Passaic, N.J.
90365	Belleville Speciality Tool Mfg., Inc.	Belleville, Ill.
90783	United Carr Fastener Corp.	Chicago, Ill.
90970	Bearing Engineering Co.	San Francisco, Cal.
91146	ITT Cannon Elect. Inc., Salem Div.	Salem, Mass.
91260	Connor Spring Mfg. Co.	San Francisco, Cal.
91345	Miller Dial & Nameplate Co.	El Monte, Cal.
91418	Radio Materials Co.	Chicago, Ill.
91506	Augat Inc.	Attleboro, Mass.
91637	Dale Electronics, Inc.	Columbus, Nebr.
91662	Elco Corp.	Willow Grove, Pa.
91673	Epiphone Inc.	New York, N.Y.
91727	Gremar Mfg. Co., Inc.	Wakefield, Mass.
91827	K F Development Co.	Redwood City, Cal.
91836	Maico Mfg., Inc.	Chicago, Ill.
91929	Honeywell Inc., Micro Switch Division	Freeport, Ill.
91961	Nahm-Bros. Spring Co.	Oakland, Cal.
92180	Tru-Connector Corp.	Peabody, Mass.
92367	Elgeet Optical Co., Inc.	Rochester, N.Y.
92607	Tensolite Insulated Wire Co., Inc.	Tarrytown, N.Y.
92702	IMC Magnetics Corp.	Westbury, L.I., N.Y.
92966	Hudson Lamp Co.	Kearney, N.J.
93332	Sylvania Electric Prod. Inc., Semiconductor Div.	Woburn, Mass.
93369	Robbins & Myers Inc.	Palisades Park, N.J.
93410	Stemco Controls, Div. of Essex Wire Corp.	Mansfield, Ohio
93632	Waters Mfg. Co.	Culver City, Cal.
93929	G.V. Controls	Livingston, N.J.
94137	General Cable Corp.	Bayonne, N.J.
94144	Raytheon Co., Comp. Div., Ind. Comp. Operations	Quincy, Mass.
94148	Scientific Electronics Products, Inc.	Loveland, Colo.
94154	Wagner Elect. Corp., Tung-Sol Div.	Newark, N.J.
94197	Curtiss-Wright Corp., Electronics Div.	East Patterson, N.J.
94222	South Chester Corp.	Chester, Pa.
94330	Wire Cloth Products, Inc.	Bellwood, Ill.
94375	Automatic Metal Products Co.	Brooklyn, N.Y.
94682	Worcester Pressed Aluminum Corp.	Worcester, Mass.
94696	Magnecraft Electric Co.	Chicago, Ill.
95023	George A. Philbrick Researchers, Inc.	Boston, Mass.
95146	Alco Elect. Mfg. Co.	Lawrence, Mass.
95236	Allies Products Corp.	Diania, Fla.
95238	Continental Connector Corp.	Woodside, N.Y.
95263	Leecraft Mfg. Co., Inc.	Long Island, N.Y.
95265	National Coil Co.	Sheridan, Wyo.
95275	Vitramon, Inc.	Bridgeport, Conn.
95348	Gordos Corp.	Bloomfield, N.J.
95354	Methode Mfg. Co.	Rolling Meadows, Ill.
95566	Arnold Engineering Co.	Marengo, Ill.
95712	Dage Electric Co., Inc.	Franklin, Ind.
95984	Stemon Mfg. Co.	Wayne, Ill.
95987	Weckesser Co.	Chicago, Ill.
96067	Microwave Assoc., West, Inc.	Sunnyvale, Cal.
96095	Hi-Q Div. of Aerovox Corp.	Olean, N.Y.
96256	Thordarson-Meissner Inc.	Mt. Carmel, Ill.
96296	Solar Mfg. Co.	Los Angeles, Cal.
96396	Microswitch, Div. of Minn.-Honeywell	Freeport, Ill.
96330	Carlton Screw Co.	Chicago, Ill.
96341	Microwave Associates, Inc.	Burlington, Mass.
96501	Excel Transformer Co.	Oakland, Cal.
96508	Xcelite, Inc.	Orchard Park, N.Y.
96733	San Fernando Elec. Mfg. Co.	San Fernando, Cal.
96881	Thomson Ind. Inc.	Long Island, N.Y.
97464	Industrial Retaining Ring Co.	Irvington, N.J.
97539	Automatic & Precision Mfg.	Englewood, N.J.
97979	Reon Resistor Corp.	Yonkers, N.Y.
97983	Litton System Inc., Adler-Westrex Commun. Div.	New Rochelle, N.Y.
98141	R-Tronics, Inc.	Jamaica, N.Y.
98159	Rubber Teck, Inc.	Cardena, Cal.
98220	Hewlett-Packard Co., Medical Elec. Div.	Pasadena, Cal.
98278	Microdot, Inc.	So. Pasadena, Cal.
98291	Sealectro Corp.	Mamaroneck, N.Y.
98376	Zero Mfg. Co.	Burbank, Cal.
98410	Etc Inc.	Cleveland, Ohio
98731	General Mills Inc., Electronics Div.	Minneapolis, Minn.
98734	Paeco Division of Hewlett-Packard Co.	Palo Alto, Cal.
98821	North Hills Electronics, Inc.	Glen Cove, N.Y.
98978	International Electronic Research Corp.	Burbank, Cal.
99109	Columbia Technical Corp.	New York, N.Y.
99313	Varian Associates	Palo Alto, Cal.
99378	Atlee Corp.	Winchester, Mass.
99515	Marshall Ind., Capacitor Div.	Monrovia, Cal.
99707	Control Switch Division, Controls Co. of America	El Segundo, Cal.
99800	Delevan Electronics Corp.	East Aurora, N.Y.
99848	Wilco Corporation	Indianapolis, Ind.
99928	Branson Corp.	Whippany, N.J.
99934	Rembrandt, Inc.	Boston, Mass.
99942	Hoffman Electronics Corp., Semiconductor Division	El Monte, Cal.
99987	Technology-Instrument Corp. of California	Newbury Park, Cal.

The following HP Vendors have no number assigned in the latest supplement to the Federal Supply Code for Manufacturers Handbook.

0000F	Maico Tool and Die	Los Angeles, Calif.
0000Z	Willow Leather Products Corp.	Newark, N.J.
000AB	ETA	England
000BB	Precision Instrument Comp. Co.	Van Nuys, Cal.
000CS	Hewlett-Packard Co., Colorado Springs Div.	Colorado Springs, Colorado
000MM	Rubber Eng. & Development	Hayward, Cal.
000NN	A "N" D Mfg. Co.	San Jose, Cal.
000QQ	Coiltron	Oakland, Cal.
000WW	California Eastern Lab	Burlington, Cal.
000YY	S.K. Smith Co.	Los Angeles, Cal.

* From: Handbook Supplements H4-1 Dated January 1970

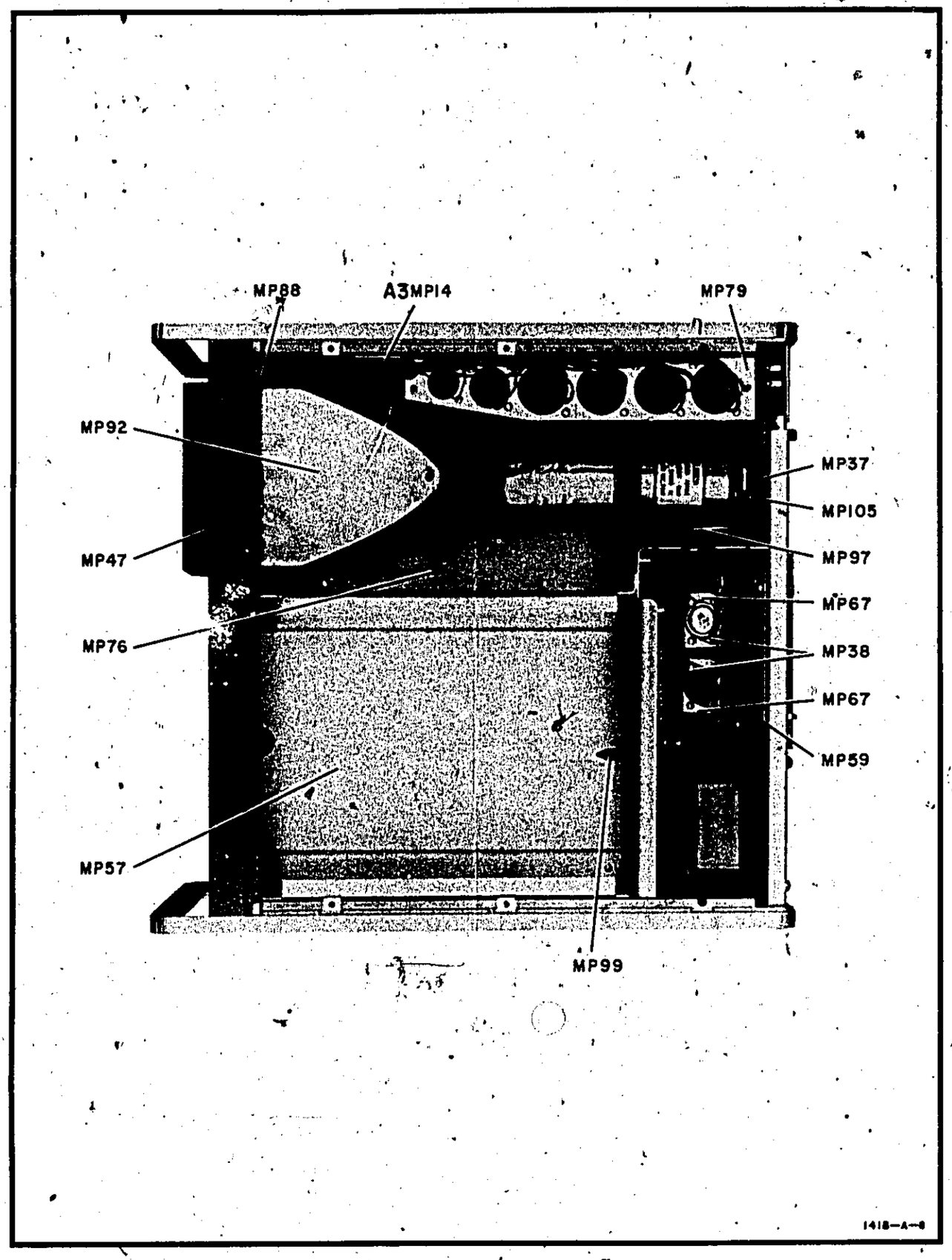


Figure 6-4. Mechanical Parts, Top View

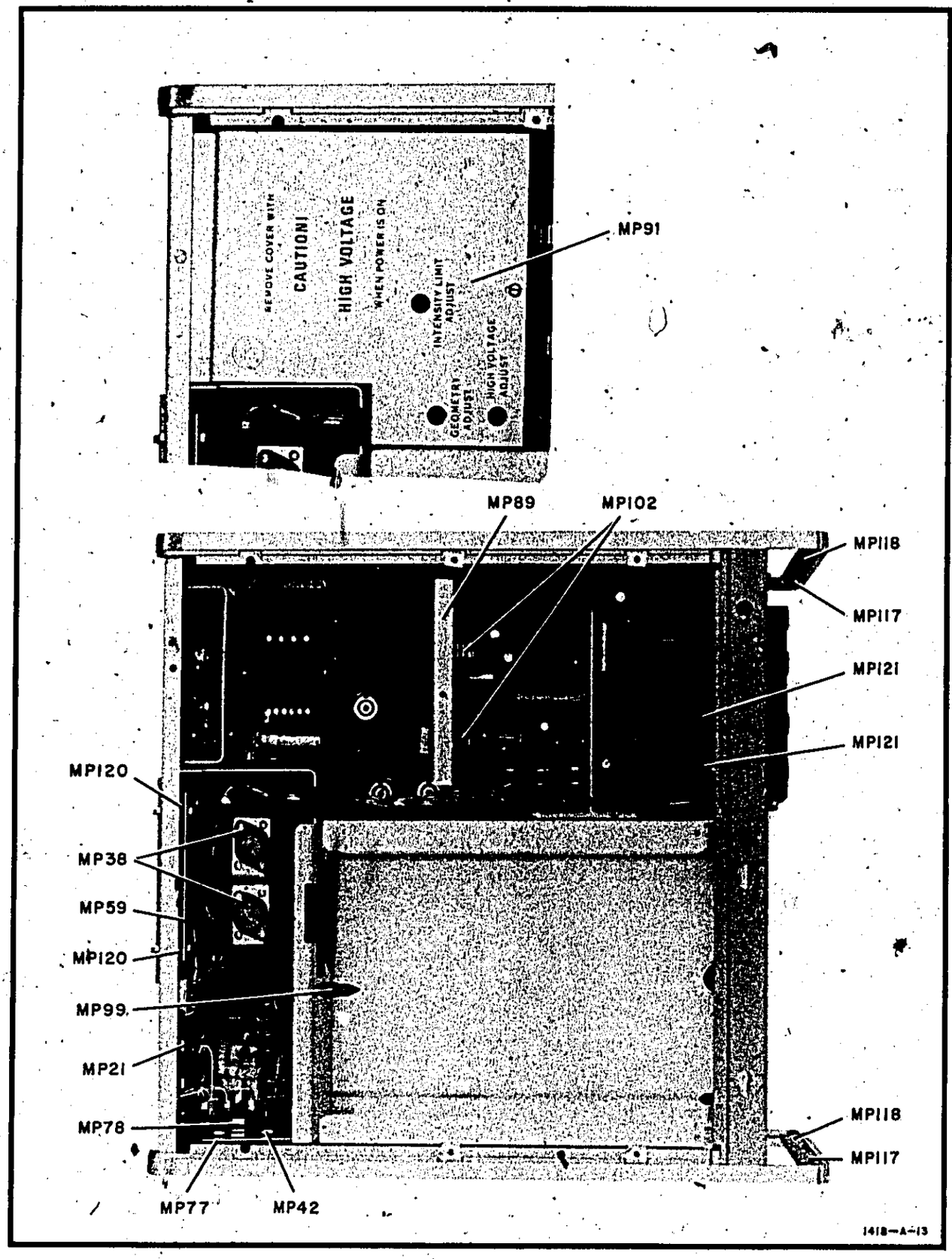


Figure 6-5. Mechanical Parts, Bottom View

Figure 6-5. Mechanical Parts, Bottom View
located inside fold.

MANUAL CHANGES

OPTIONS

SECTION VII

MANUAL CHANGES AND OPTIONS

7-1. INTRODUCTION.

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

7-3. MANUAL CHANGES.

7-4. This manual applies directly to the instrument having a serial prefix as shown on the manual title page. If the serial prefix of the instrument is not the same as the one on the title page, refer to Table 7-1 for changes necessary to backdate the manual to the instrument. When making changes from Table 7-1, make the change with the highest number first. If the serial prefix of the instrument is not listed either in the title page or in Table 7-1, refer to an enclosed MANUAL CHANGES sheet for updating information. Also, if a MANUAL CHANGES sheet is supplied, make all indicated ERRATA corrections.

Table 7-1. Manual Changes

Serial Prefix	Make Changes
944–	1, 2
972–	2

CHANGE 1

Page 6-7, Table 6-2,
A3R1: Change to HP Part No. 0692-2065, TQ1, R: fxd comp 20 megohms 5% 2W.
Page 8-13, Figure 8-13,
A3R1: Change value to 20 megohms.

CHANGE 2

Page 4-2, Paragraph 4-15,
Line 10: Change R11 to A2R42.
Page 6-3, Table 6-2,
A2: Change to HP Part No. 00141-66514.
Page 6-4, Table 6-2,
R11: Delete.
Page 6-5, Table 6-2,
A2: Change to HP Part No. 00141-66514.
Page 6-7, Table 6-2,
Add: A2R42, HP Part No. 0811-1746, TQ2, R: fxd ww 0.36 ohm 5% 2W.
Page 8-10, Figure 8-8,
Add: R42 between R3 and R46.
Page 8-11, Figure 8-10,
R11: Delete.
Add: A2R42, value 0.36 ohm. Connect from anode of A2CR16 to emitter of A2Q10.
Page 8-12, Figure 8-12,
Add: R42 between R3 and R46.

7-5. SPECIAL OPTIONS.

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

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

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

7-9. STANDARD OPTIONS.

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

7-11. The following options are available for the Model 141B at the present time:

a. OPTION 001: 230V operation set at factory.

b. OPTION 009: This option provides for a remote erase function through a BNC connector on the rear panel. Complete wiring information is shown in Figure 7-1 and replaceable parts are listed in Table 7-2.

Table 7-2. Option 009 Replaceable Parts

HP Part No.	Description
00141-66517	Remote ERASE board
1250-0083	Connector: BNC female
1901-0040	Diode
0490-0199	Switch: relay
0490-0191	Coil: relay

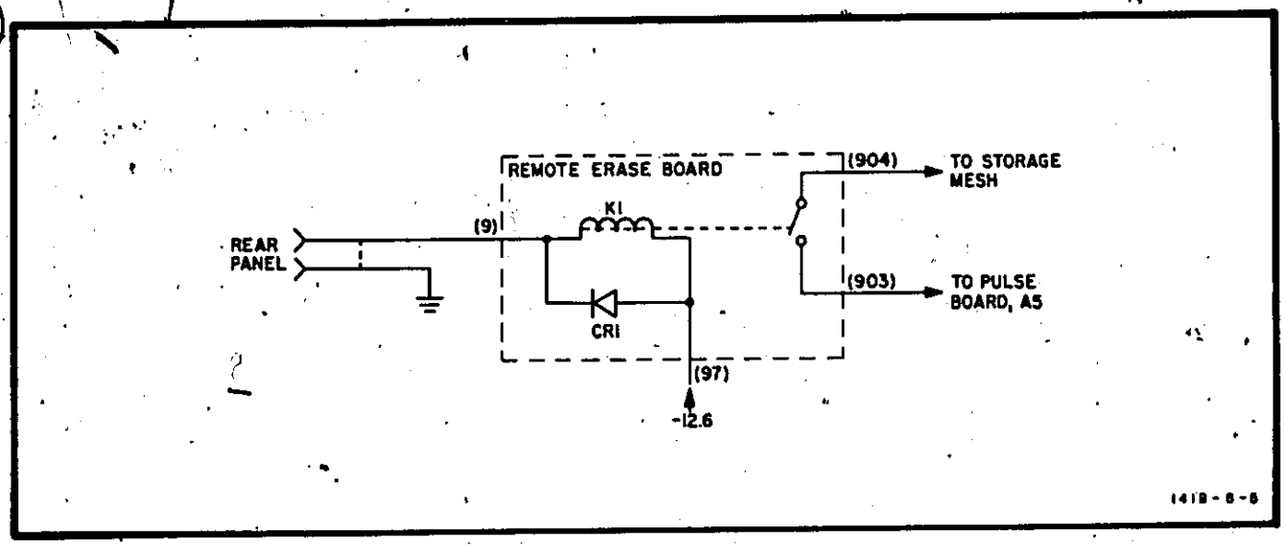


Figure 7-1. Option 009 Schematic Diagram

HEWLETT hp PACKARD

OPERATING AND SERVICE MANUAL

MODIFICATIONS

MODEL 141B /OPTION Y75

Model 141B /Option Y75 is a standard HP Model 141B modified by being painted according to customer specifications.

Mechanically and electrically, the Model 141B /Option Y75 is identical to the standard instrument. The operating and service manual supplied applies directly to this special instrument.

Encl:

141B Manual

sbm/ 4-71

7000-A-12

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

HEWLETT PACKARD

OPERATING AND SERVICE MANUAL

MODIFICATIONS

MODEL 141B /OPTION Y76

Model 141B /Option Y76 is a standard HP Model 141B modified by being painted according to customer specifications.

Mechanically and electrically, the Model 141B/Option Y76 is identical to the standard instrument. The operating and service manual supplied applies directly to this special instrument.

Encl:

141B Manual

sbm/8-73

7000-A-12

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

SCHEMATIC DIAGRAMS TROUBLE-SHOOTING

SECTION VIII

SCHEMATICS AND TROUBLESHOOTING

8-1. INTRODUCTION.

8-2. This section contains schematics, component location diagrams, repair, replacement, and trouble-shooting information for the Model 141B. All schematics are on fold-out pages to allow reference to the text and figures in other sections. Schematic symbols and conventions are explained in Table 8-3, and Figure 8-7 shows plug and jack connections. An over-all block diagram is in Section IV.

8-3. SCHEMATICS.

8-4. Schematics are on right hand pages that unfold outside the right edge of the manual. The throw clear pages allow viewing the schematics while referring to another section. Text can be followed by unfolding the appropriate throw clear page.

8-5. Schematics are drawn primarily to show the electronic function of an instrument. A given schematic may include all or part of several assemblies. Schematics also include dc voltages and waveform measurement test points. Waveforms applicable to each schematic are shown opposite that schematic. DC voltage and waveform measurement conditions are shown above the waveforms. Information about symbols and conventions used on these schematics is provided by Table 8-3.

8-6. COMPONENT LOCATION.

8-7. Assembly components are shown, with a grid locator, near each schematic for ease of location. Chassis mounted components are shown in Figures 8-3 through 8-6. Mechanical parts listed in the replaceable parts list are shown in Figures 6-1 through 6-5.

8-8. REFERENCE DESIGNATIONS.

8-9. The unit system of reference designation, used in this manual, is in accordance with the provisions of the American Standard Electrical and Electronics Reference Designations. Minor variations, due to design and manufacturing, may be noted. A brief explanation is presented here for those unfamiliar with the designation system.

8-10. Each component is identified by a letter-number combination. For example R1, R2, . . . C1, C2; etc. This letter-number combination is the basic designation for each component. Components which are separately replaceable and are part of an assembly have, in addition to the basic designator, a prefix designation which identifies the assembly on which the component is located. Components not mounted on an assembly have only the basic reference designation.

8-11. Figure 8-1 is used as an example. The basic reference designation (R1) appears four times, however each R1 is identified by a designation formed by

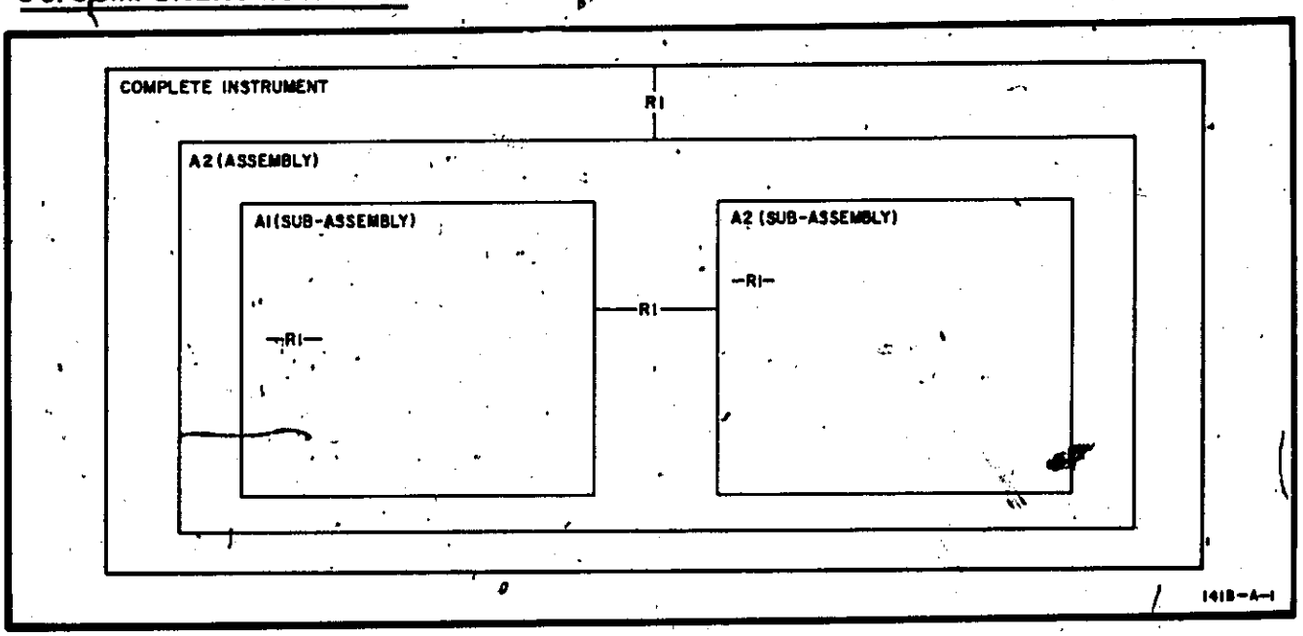


Figure 8-1. Unit System Reference Designation

combining component, assembly and sub-assembly designators. Consider the R1 on subassembly A1. The complete designation of that resistor is A2A1R1. Now, R1 connected between assembly A2 and the complete instrument has only the designation R1 because it is not mounted on an assembly. This system applies to all classes of components, C, CR, Q, etc.

8-12. OVER-ALL TROUBLESHOOTING.

8-13. Troubleshooting is much easier if more than one symptom of a trouble is evident. Observe the instrument and note all indications of faulty operation. If symptoms indicate more than one trouble, treat each problem individually and locate one trouble at a time. Don't waste time making random checks. Instead, follow the logical procedure presented here, and refer to other areas of information in this manual if necessary.

8-14. FRONT PANEL CONTROLS.

8-15. Equipment troubles are frequently due simply to improper front panel control settings. Refer to the operating procedures in Section III for a complete explanation of each control's function along with typical operating instructions if in doubt. Possibly the intensity control on the oscilloscope front panel is not turned up, or the level control on the time base plug-in is misadjusted. Use the controls as a guide to help isolate a trouble to a specific area.

8-16. VISUAL CHECKS.

8-17. After localizing the trouble to a specific area of the instrument, make a good visual check of that area. Check for burned or broken components, loose wires or circuit board connections, faulty switch contacts, or any similar condition suggesting a source of trouble. If everything appears normal, proceed to the next step.

8-18. WAVEFORMS AND VOLTAGES.

8-19. Allow the instrument to warm-up for about fifteen minutes before making any measurements. Conditions for measuring waveforms and dc voltages are stated adjacent to each schematic. These conditions must be observed to obtain the proper readings. A ▽ with an enclosed number is shown at key locations throughout the schematics. These are waveform measurement points and are referenced to the waveform photographs adjacent to each schematic. Waveforms can be used to measure gain or pin-point a defective stage. Use a probe with a needle tip to avoid creating a short circuit. DC voltages are shown on the schematics near active components such as transistors. As an aid to locating measurement points, note a small dot etched on the circuit boards near the emitter of transistors, source of field effect transistors, cathode of diodes, and positive lead of electrolytic capacitors. Refer to Figure 8-2 for semiconductor information.

8-20. FINAL CHECKS.

8-21. Read the theory of operation in Section IV to learn how a circuit should operate. With the aid of this information, it will be easier to discover why a defective circuit is inoperative. Finally make resistance checks to uncover the faulty component. If it appears necessary to calibrate the instrument, refer to Section V for the proper procedures.

8-22. DETAILED TROUBLESHOOTING.

8-23. LOW-VOLTAGE SUPPLY.

8-24. TRANSISTORS. The series regulator transistors are located on the fan assembly. Each is easily replaced by removing the two screws and pulling the transistor from its socket. All other low voltage power supply transistors are located on the power supply board.

8-25. DC voltages shown on the low voltage schematic diagram were measured to ground, with Model 1402A and 1421A plug-ins installed. Voltages may vary slightly when other plug-ins are used. Correct voltages for points not marked for voltage are generally obvious by being connected (directly or indirectly) to a supply output. Transistor base voltage in most cases should not measurably differ from emitter voltage when measured with respect to ground. Voltage drops across breakdown diodes are indicated on the schematic.

8-26. EXCESSIVE RIPPLE. Excessive 120 Hz ripple on any supply can usually be traced to either the input filter or regulator circuit by comparing ripple voltages at the rectifier outputs with values given on the schematic. For ripple above the specified value, check C1, C3, C4 or C6. 60 Hz ripple above specified value at these points indicates an open rectifier or low-gain amplifier transistors. Maximum ripple on supply outputs (at 115 Vac with maximum load on supply) is: 10 mV at +248V; 7 mV at +100V and -100V; and 2mV at -12.6V.

8-27. FUSES. If the +100, -100 or +248 volt supply should be accidentally shorted to ground, the fuse for that particular supply will blow. This cuts off current in the supply and protects the transistors.

8-28. The -12.6 volt supply is fused and employs a current limiter, A2Q10, for protection against brief shortings of the output to ground. The supply should function normally upon removal of the short, provided the fuse has not blown.

8-29. ISOLATING TROUBLES. Trouble in the +100 volt supply can be reflected in the operation of all other low voltage power supply outputs. If the +100 volt supply is incorrect, proper circuit repair may eliminate the trouble. If the +100 volt supply is correct, follow these steps in their given order:

a. Check the -100 volt supply. The +248 volt and -12.6 volt supplies are referenced to this supply. A

fault in the -100 volt supply can cause malfunction of either of the other two. If the -100 volt supply is incorrect, proper circuit repair may eliminate trouble in the +248 volt or -12.6 volt supply. If the -100 volt supply is correct, proceed to the next step.

b. The +248 volt supply is referenced to the -100 volt supply. If trouble here has not been eliminated by checking the -100 volt supply, the trouble lies in this circuit and can be located by making the proper circuit and component checks as described in Paragraph 8-25.

c. A trouble that appeared to be in the -12.6 volt supply may have been eliminated by the above procedure. If not, it will be necessary at this point to make thorough voltage and component checks of the supply.

8-30. HIGH-VOLTAGE SUPPLY.

8-31. If one high-voltage supply output is zero but other outputs are normal, one of the rectifiers is likely at fault. Normal dc voltages are given on the high voltage schematic.

8-32. If there is no high-voltage output, observe the waveforms at the collector of A2Q14 (blue wire). If an approximately 30 kHz, 20-volt peak-to-peak sine wave appears for short intervals, the trouble is probably a defective component in the rectifier filter/divider networks. If no waveform appears, use Table 8-1.

8-33. If the high-voltage output is incorrect and cannot be adjusted to the correct value, use Table 8-2.

8-34. If the -2350 volt supply seems to be operating properly, the 6.6 kV post-accelerator potential may be checked as follows:

a. Remove the top and left side instrument cover.
b. Remove the high voltage connector block, A3MP14, Figure 6-4.
c. Remove high voltage connector block cover and rubber insulation.
d. Check the 6.6 kV at the high voltage lead pin connection.

8-35. PULSE CIRCUIT.

8-36. A good knowledge of the operating procedures and an understanding of the principles of operation of the instrument are helpful when troubleshooting the pulse circuit. Refer to Section III for operating procedures and Section IV for principles of operation. Always perform the preliminary set up procedure given in Section V, Performance Check, if the instrument is not operating properly.

8-37. All dc voltages from the low-voltage supply are used in the pulse circuit. When a malfunction occurs, check all voltages connected to the pulse circuit board. If all low voltages are O.K., check the high voltages at the high-voltage circuit board. These checks will, by elimination, isolate the trouble to one general circuit. If both supplies are O.K., check the waveforms at test points shown on the schematic diagram, Figure 8-16.

8-38. Check dc voltages to isolate defective components in a stage where an improper, or no, waveform is present. Conditions for measurements and waveforms for test points are given in Figure 8-15.

8-39. PERIODIC MAINTENANCE.

8-40. ELECTRICAL MAINTENANCE.

8-41. Do the electrical adjustments in Section V once every 6 months and after repair or component replacement.

8-42. MECHANICAL MAINTENANCE.

8-43. Inspect the air filter at the rear of the instrument and clean it before it becomes clogged and restricts air flow. To clean the filter, wash it thoroughly in warm water and detergent. Dry the filter thoroughly before installing it on the instrument: Oil the motor (one point), with light machine oil, once every 6 months.

8-44. INSTRUMENT REPAIR.

8-45. Chassis-mounted components are identified in Figures 8-3 through 8-6. Components on circuit boards are identified in figures near the applicable schematic (also see Table 8-3).

8-46. Figure 6-1 is an exploded view drawing of the instrument frame. All parts are keyed to Table 6-2 by reference designators. Other mechanical parts are identified in Figures 6-2 through 6-5.

8-47. MAJOR COMPONENT REPAIR.

8-48. CRT REMOVAL AND REPLACEMENT. To remove the CRT, proceed as follows:

WARNING

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

a. Remove the top and left side cover of instrument.
b. Remove bezel and discharge post-accelerator lead and CRT connection to chassis ground.
c. Remove flexible three conductor CRT lead from connector block.
d. Disconnect the clip-on leads from the CRT neck.
e. Loosen the clamp at the CRT socket.
f. Remove the socket from the CRT base; pry loose carefully.

Table 8-1. Troubleshooting High-Voltage Supply, No Voltage

Procedure	Indication	Conclusion
1. Check A2Q13, A2L1, and the associated transformer primary for open circuits or shorts. Replace any defective components.		
2. Check voltage at emitter of A2Q14.	Voltage is not more negative than -2 volts.	Check A2Q14 and A2Q15.
3. Check voltage at emitter of A2Q13.	Voltage is not approximately -0.6 volts	Check A2Q13
4. Check A2T1 and rectifier load circuit for opens or shorts. Then lift one lead of A2C13, A2C14, A2C15, A2C16, A2C17, A2C18, and turn instrument on again	Oscillations occur.	Replace capacitor leads one at a time until oscillations stop. The capacitor that stops oscillations is defective.
	Oscillations do not occur.	Trouble probably with transformer A2T1.

Table 8-2. Troubleshooting High-Voltage Supply, Incorrect Voltage

Procedure	Indication	Conclusion
1. Voltage too high.		
a. Lift one lead of A2R58	Output drops to zero	Check A2Q15.
	Output remains at incorrect value.	A2Q13 or A2Q14 is leaky
b. Replace A2R58 lead, and lift one lead of A2R56.	Output drops.	Replace A2R56 with a resistor of approx. twice the present value.
	Output remains at incorrect value.	Proceed to step 1.c.
c. Replace A2R56 lead, and compare voltages at gate and source of A2Q15.	Voltages are within 1 volt of being the same.	Trouble probably in divider network A2R61, A2R62, A2R63, R6, A2R73 thru A2R81.
2. Voltage too low.		
a. Compare voltages at gate and source of A2Q15.	Gate voltage more negative.	Trouble probably in divider network A2R61, A2R62, R6, A2R73 thru A2R81.
	Gate voltage more positive.	Check A2Q14 and A2Q15.
b. Check voltage at emitter of A2Q14.	Voltage approx. -12 volts	Replace A2R57 with a 560 ohm resistor.
c. Steps a and b do not correct fault.	Voltage remains too low.	Perform troubleshooting procedure of Table 8-1.

CAUTION

Use care since neck pins can damage the trace alignment coil.

g. Place one hand on the CRT face and, with the other hand, slide the CRT forward and out of the instrument.
h. To replace the CRT, reverse above procedure, and be sure that the connector block and neck leads are connected before turning power on.
i. Do the Performance Checks and the GEOMETRY adjustment procedure given in Section V.

8-49. FAN REMOVAL AND REPLACEMENT. Use the following procedure for removing, and reverse the procedure for replacing the cooling fan.

a. Remove the top and bottom covers of the instrument.
b. Disconnect the white-gray and white-green-gray wires from the fan terminals.
c. Remove all transistor heat sinks from the fan assembly and push them out of the way.
d. Remove the four fan mounting nuts on the rear panel of the instrument.
e. Lift out the fan assembly.

8-50. SERVICING CIRCUIT BOARDS.

8-51. The instrument has plated through circuit boards. When servicing this type board, components can be removed and replaced by applying a soldering iron tip to the component connection on either side of the board. To remove a component with multiple leads, such as potentiometers, move the soldering iron tip from lead to lead while applying moderate pressure to the component to lift it from the board. Excessive solder can be removed by applying heat and rotating a wooden toothpick in the hole. Hewlett-Packard Service Note M-20E contains additional information on the repair of circuit boards; important considerations are as follows:

a. Do not apply excessive heat.
b. Apply heat to component leads and remove component with a straight pull away from the board.
c. Do not force replacement component leads into the holes.

8-52. If the metal conductor lifts from the board, it can be cemented back with a quick-drying acetate base cement having good insulating properties. If the metal conductor is broken, solder a wire to the conductor to bridge the break.

8-53. SEMICONDUCTOR REPLACEMENT.

8-54. Semiconductor devices are available in a wide variety of shapes and sizes. This can make it confusing to identify the leads. Examples of some of the most common configurations are shown in Figure 8-2.

8-55. When removing a semiconductor, use a pair of long nose pliers as a heat sink between the device and the soldering iron. And, when replacing a semiconductor, ensure sufficient lead length to dissipate soldering heat by using the same length of exposed lead as used for the original part.

Table 8-3. Schematic Diagram 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

N C = 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)

= Main signal path

= Primary feedback path

= Secondary feedback path

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

= Erase signal path

G D S = Field effect transistor (N-channel)

= Breakdown diode

= Tunnel diode

= Step recovery diode

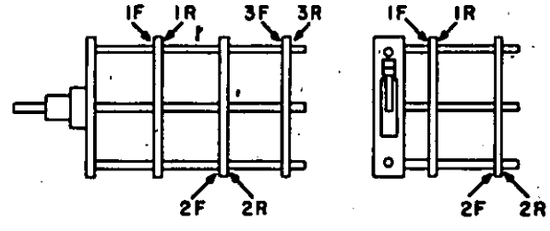
= Circuits or components drawn with dashed lines (phantom) show function only and are not intended to be complete. The circuit or component is shown in detail on another schematic.

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

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:



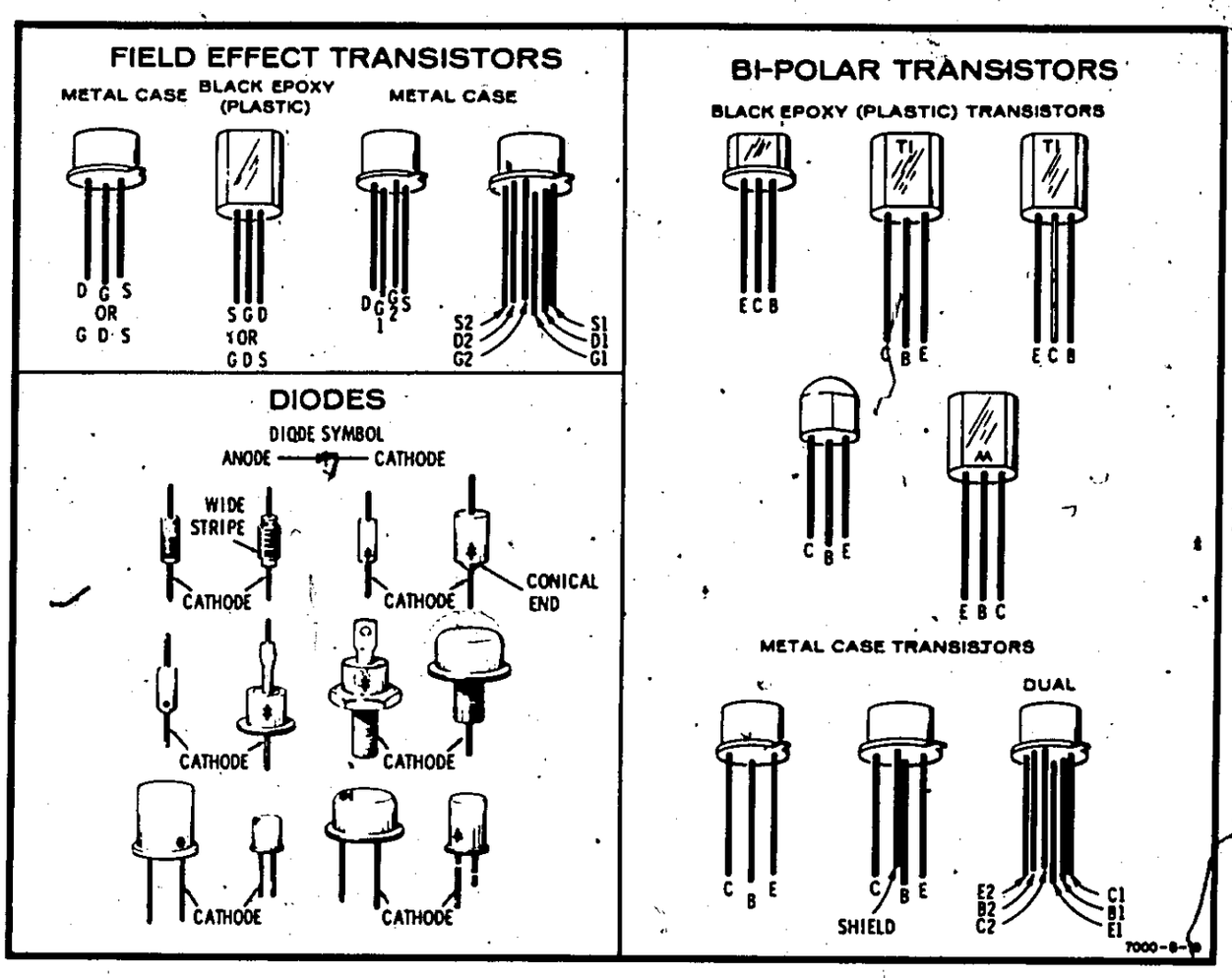


Figure 8-2. Semiconductor Identification

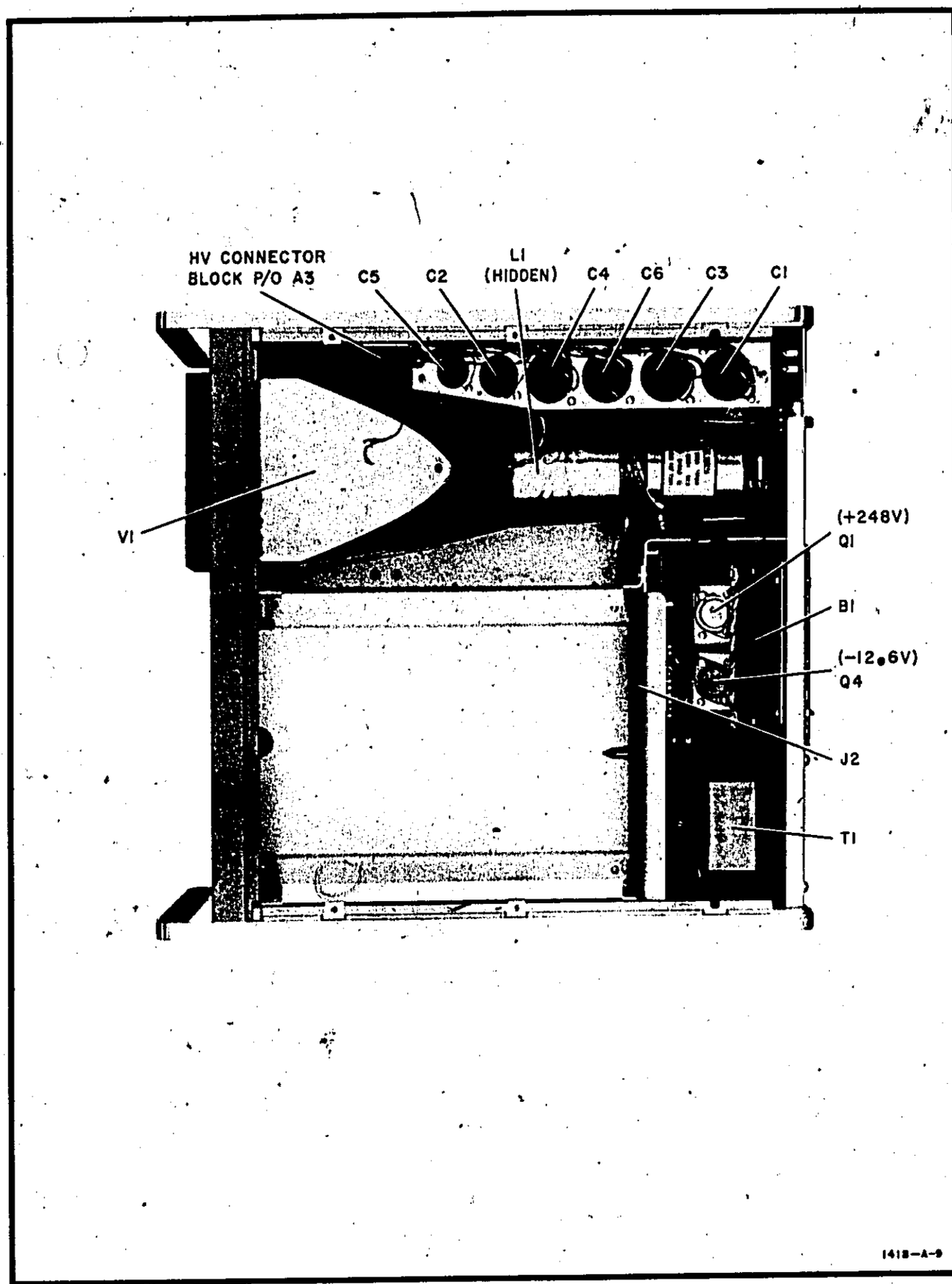


Figure 8-3. Component Location, Top View

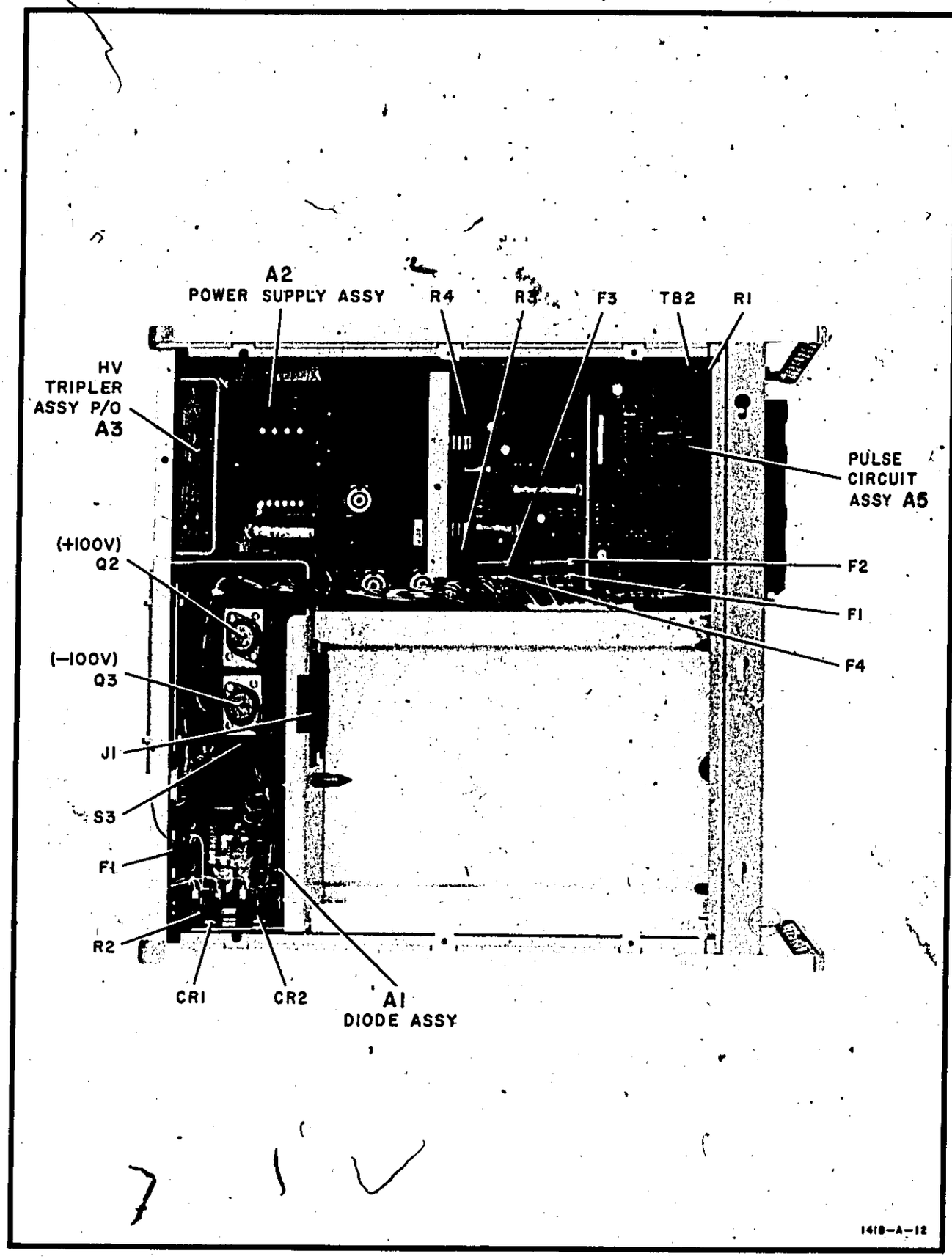


Figure 8-4 Component Location, Bottom View

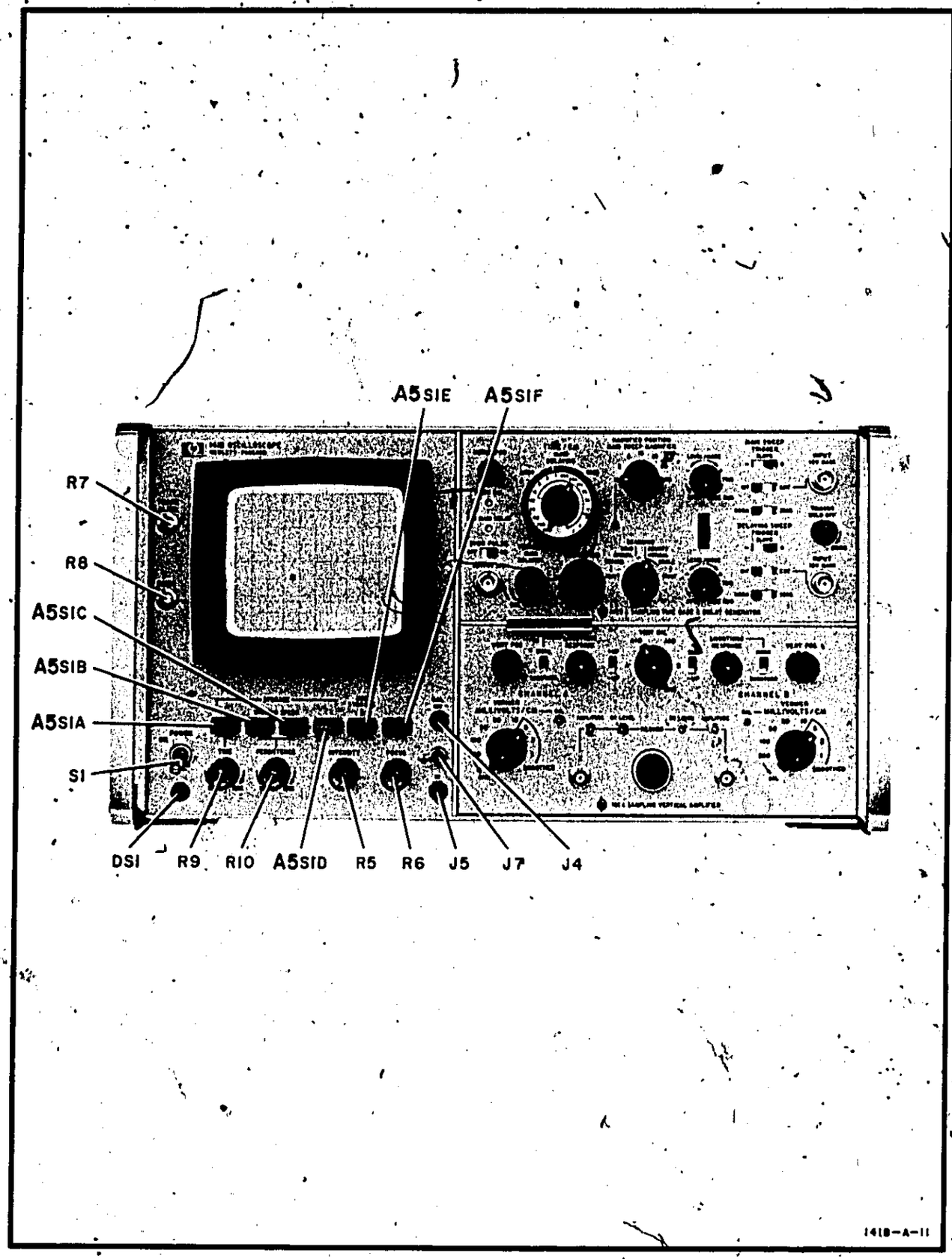


Figure 8-5. Component Location, Front View

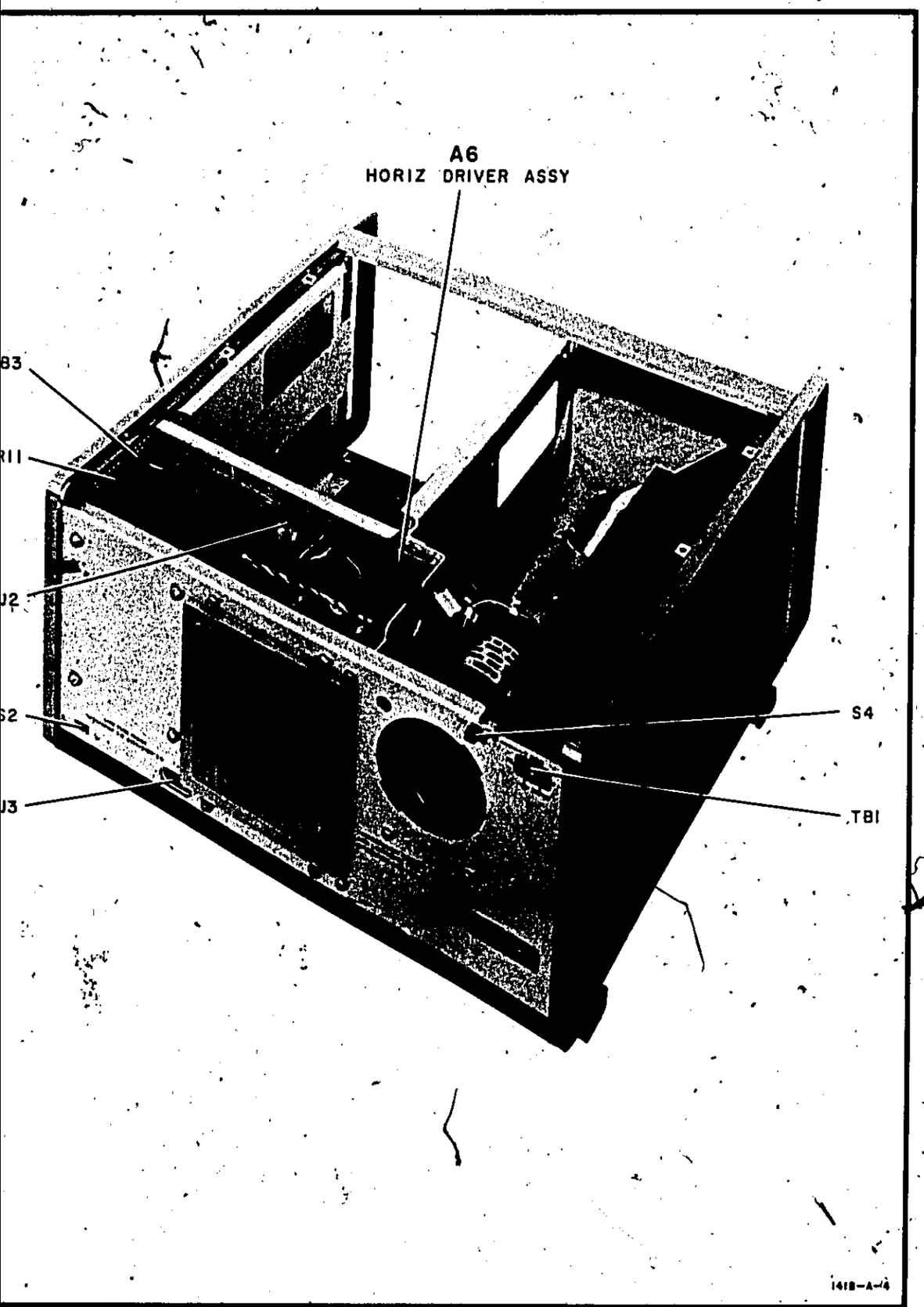


Figure 8-6. Component Location, Rear View

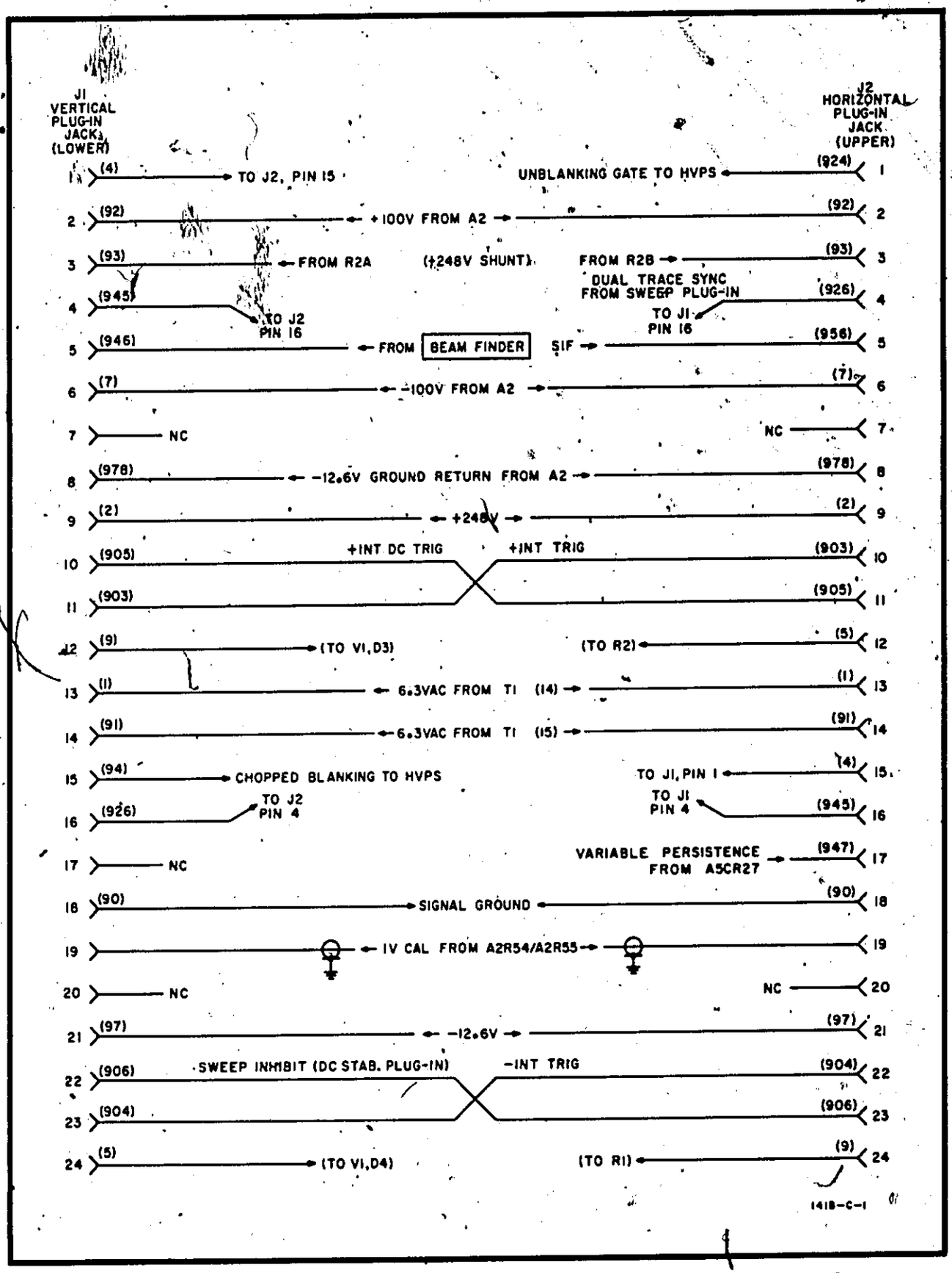
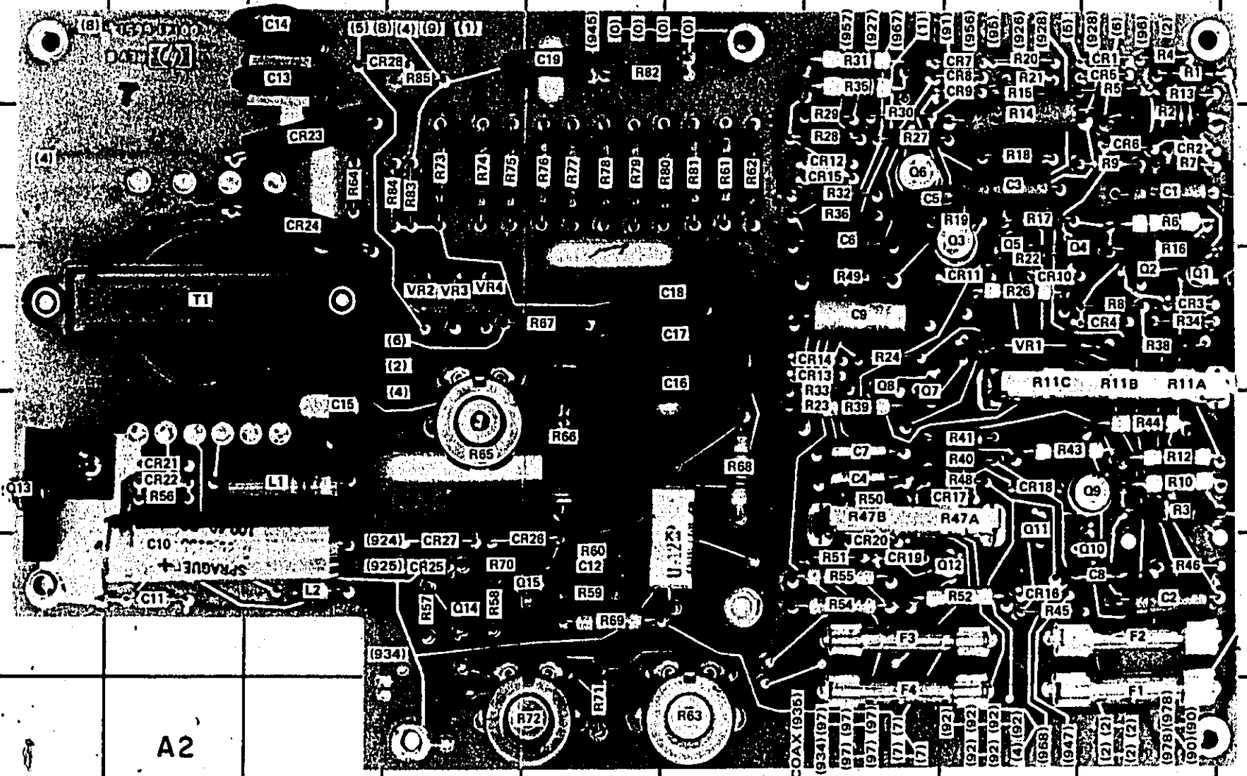


Figure 8-7. Plug-in Jack Connections

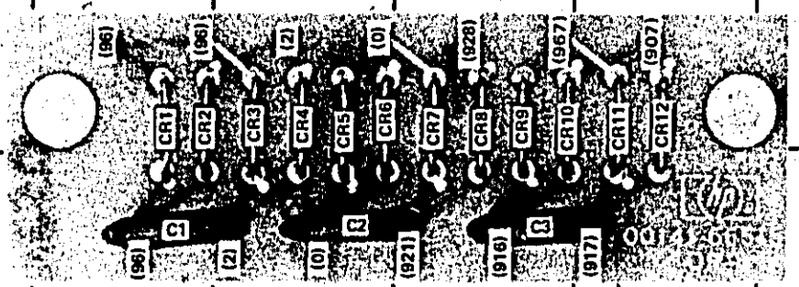


Circuit boards have plated through component holes. This permits soldering from either side of the board.

REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	K-2	C16	H-3	CR12	I-2	CR27	F-5	Q7	I-3	R7	K-2	R20	J-1	R36	I-2	R52	J-5	R68	H-4	R83	F-2
C2	K-5	C17	H-3	CR13	I-3	CR28	E-1	Q8	I-3	R8	K-3	R21	J-1	R38	K-3	R54	I-5	R69	G-5	R84	F-2
C3	J-2	C18	H-3	CR14	I-3	F1	K-6	Q9	K-4	R9	K-2	R22	J-3	R39	I-4	R55	I-5	R70	F-5	R85	F-1
C4	I-4	C19	G-1	CR15	I-2	F2	K-5	Q10	K-5	R10	K-4	R23	I-4	R40	J-4	R56	D-4	R71	G-6	T1	D-3
C5	I-2	CR1	K-1	CR16	J-5	F3	I-5	Q11	J-4	R11A	K-3	R24	I-3	R41	J-4	R57	F-5	R72	G-6	VR1	J-3
C6	I-2	CR2	K-2	CR17	J-4	F4	I-6	Q12	J-5	R11B	K-3	R26	J-3	R43	J-4	R58	F-5	R73	F-2	VR2	F-3
C7	I-4	CR3	K-3	CR18	J-4	K1	H-5	Q13	C-4	R11C	J-3	R27	I-2	R44	K-4	R59	G-5	R74	F-2	VR3	F-3
C8	K-5	CR4	K-3	CR19	I-5	L1	E-4	Q14	F-5	R12	K-4	R28	I-2	R45	J-5	R60	G-5	R75	F-2	VR4	F-3
C9	I-3	CR5	K-1	CR20	I-5	L2	E-5	Q15	G-5	R13	K-1	R29	I-2	R46	K-5	R61	H-2	R76	G-2		
C10	D-5	CR6	K-2	CR21	D-4	Q1	K-3	R1	K-1	R14	J-2	R30	I-2	R47A	J-4	R62	H-2	R77	G-2		
C11	D-5	CR7	J-1	CR22	D-4	Q2	K-3	R2	K-2	R15	J-1	R31	I-1	R47B	I-4	R63	H-6	R78	G-2		
C12	G-5	CR8	J-1	CR23	E-2	Q3	J-2	R3	K-4	R16	K-3	R32	I-2	R48	J-4	R64	E-2	R79	G-2		
C13	E-1	CR9	J-1	CR24	E-2	Q4	J-2	R4	K-1	R17	J-2	R33	I-3	R49	I-3	R65	F-4	R80	H-2		
C14	E-1	CR10	J-3	CR25	F-5	Q5	J-2	R5	K-1	R18	J-2	R34	K-3	R50	I-4	R66	G-4	R81	H-2		
C15	E-4	CR11	J-3	CR26	G-5	Q6	I-2	R6	K-2	R19	J-2	R35	I-1	R51	I-5	R67	G-3	R82	G-1		

1418-8-3

Figure 8-8. Component Identification, Power Supply A2



A1

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

REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	B-4	CR6	C-3
C2	C-4	CR7	D-3
C3	D-4	CR8	D-3
CR1	B-3	CR9	D-3
CR2	B-3	CR10	D-3
CR3	C-3	CR11	E-3
CR4	C-3	CR12	E-3
CR5	C-3		

141B-A-14

Figure 8-9. Component Identification, Diode Assy A1

P/O A1 DIODE ASSY
P/O A2 POWER SUPPLY (LOW VOLTAGE)
SERIES REGULATOR Q1
DRIVER Q1
SENSOR AMPLIFIER Q2
SERIES REGULATOR Q2
DRIVER Q3
DIFFERENTIAL AMPLIFIER Q4/Q5
CALIBRATOR Q12
SERIES REGULATOR Q3
DIFFERENTIAL AMPLIFIER Q7/Q8
SERIES REGULATOR Q4
DRIVER Q6
DRIVER Q9
CURRENT LIMITER Q10
SENSOR AMPLIFIER Q11
+248V SHUNT
+248V ADJ
+100V ADJ
CAL ADJ
-100V ADJ
-12.6V ADJ
DELETED: J6, A2CR1, A2CR6, A2CR7, A2CR9, A2CR12, A2CR20, A2R25, A2R37, A2R42, A2R53

REFERENCE DESIGNATIONS		
CHASSIS	A1	A2
B1	C1-C3	C1-C9
C1-C6	CR1-CR12	CR2-CR5, CR8, CR10, CR11, CR13-CR19
CR1, CR2		F1-F4
DS1		Q1-Q12
F1		R1-R24, R26-R36, R38-R41, R43-R52, R54, R55
P/O J1, P/O J2		
J3-J5, J7		
Q1-Q4		
R1-R4, R11		
S1-S3		
T1		
W1		

1418-D-2 (1104A)

Figure 8-10. Low Voltage Schematic

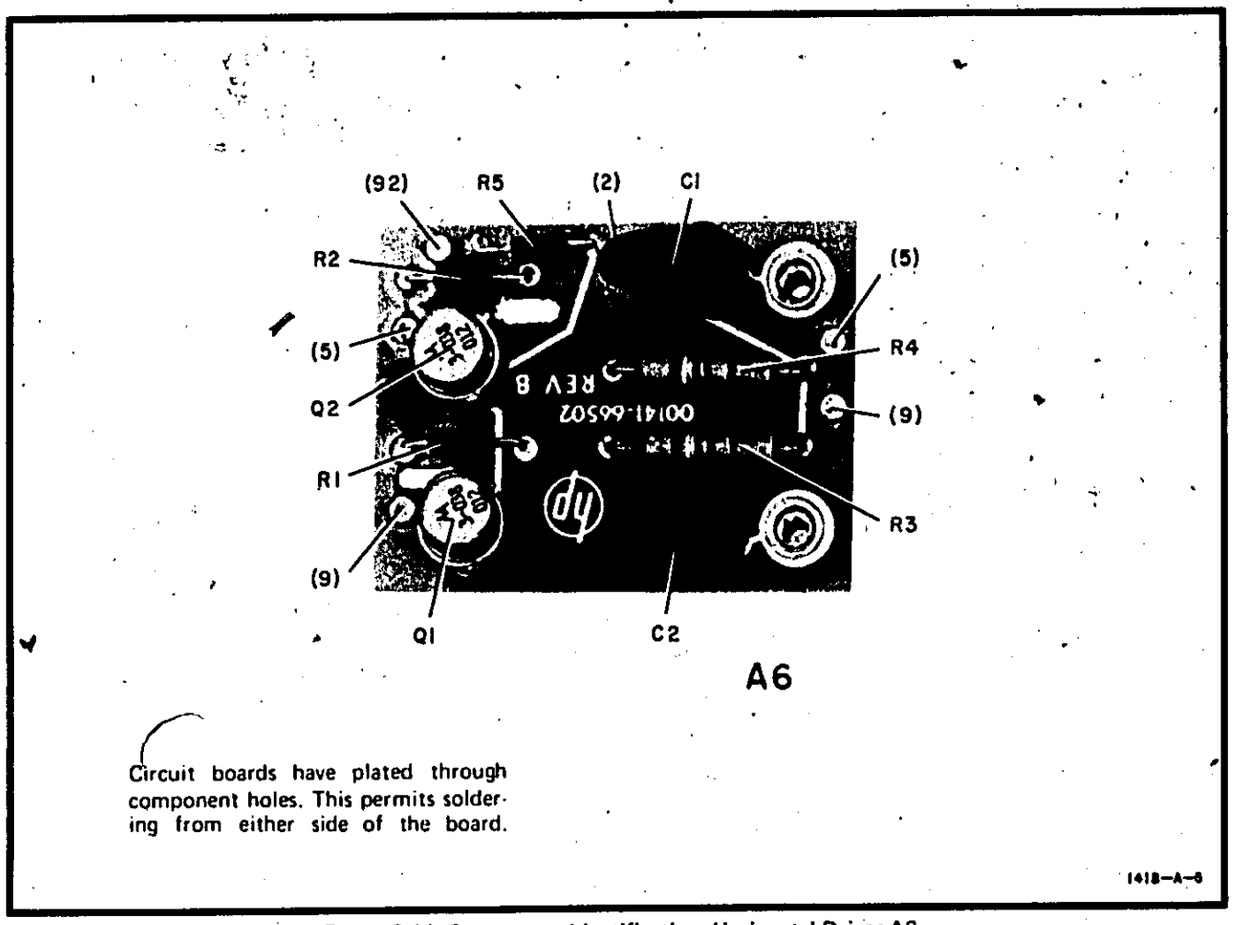
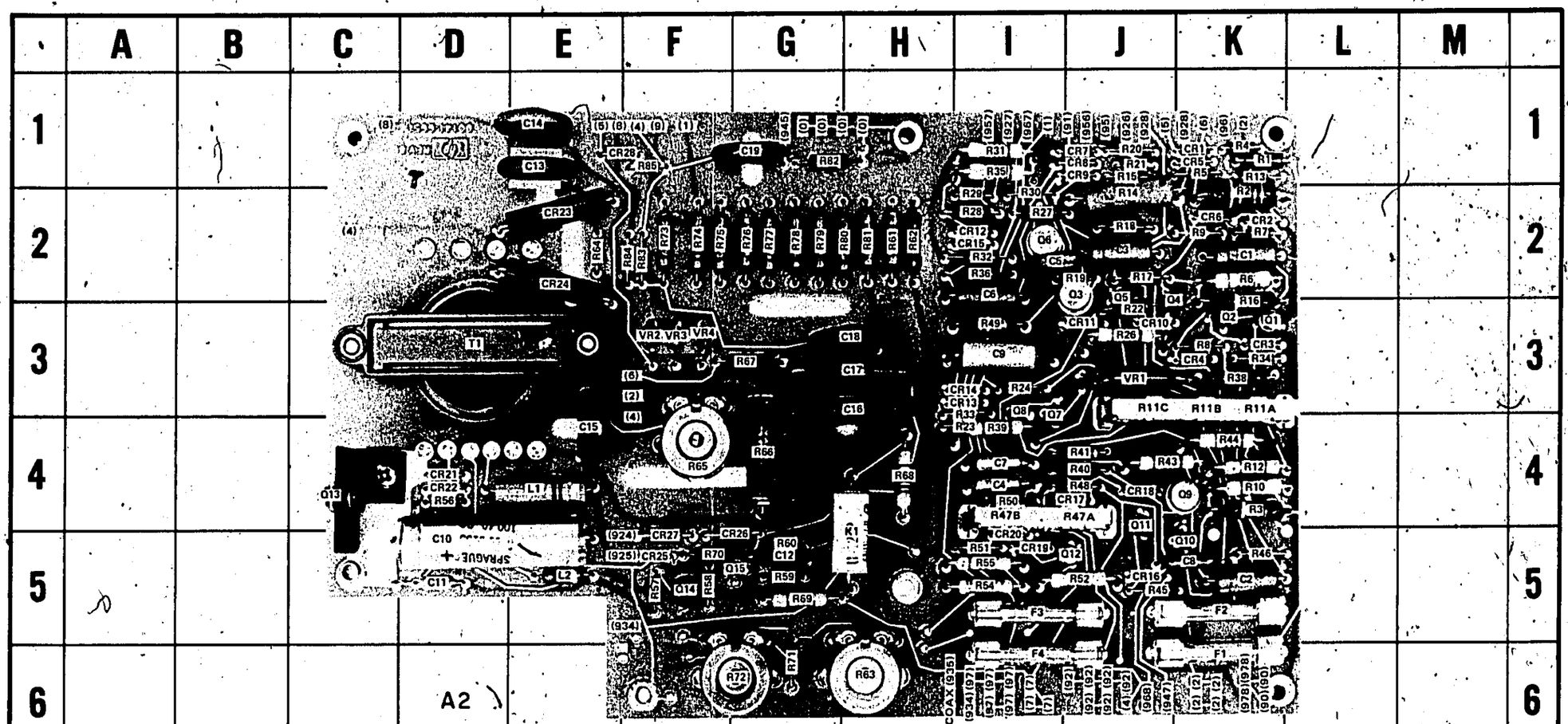


Figure 8-11. Component Identification, Horizontal Driver A6



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

REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	K-2	C16	H-3	CR12	I-2	CR27	F-5	Q7	I-3	R7	K-2	R20	J-1	R36	I-2	R52	J-5	R68	H-4	R83	F-2
C2	K-5	C17	H-3	CR13	I-3	CR28	E-1	Q8	I-3	R8	K-3	R21	J-1	R38	K-3	R54	I-5	R69	G-5	R84	F-2
C3	J-2	C18	H-3	CR14	I-3	F1	K-6	Q9	K-4	R9	K-2	R22	J-3	R39	I-4	R55	I-5	R70	F-5	R85	F-1
C4	I-4	C19	G-1	CR15	I-2	F2	K-5	Q10	K-5	R10	K-4	R23	I-4	R40	J-4	R56	C-4	R71	G-6	T1	D-3
C5	I-2	CR1	K-1	CR16	J-5	F3	I-5	Q11	J-4	R11A	K-3	R24	I-3	R41	J-4	R57	F-5	R72	G-6	VR1	J-3
C6	I-2	CR2	K-2	CR17	J-4	F4	I-6	Q12	J-5	R11B	K-3	R26	J-3	R43	J-4	R58	F-5	R73	F-2	VR2	F-3
C7	I-4	CR3	K-3	CR18	J-4	K1	H-5	Q13	C-4	R11C	J-3	R27	I-2	R44	K-4	R59	G-5	R74	F-2	VR3	F-3
C8	K-5	CR4	K-3	CR19	I-5	L1	E-4	Q14	F-5	R12	K-4	R28	I-2	R45	J-5	R60	G-5	R75	F-2	VR4	F-3
C9	I-3	CR5	K-1	CR20	I-5	L2	E-5	Q15	G-5	R13	K-1	R29	I-2	R46	K-5	R61	H-2	R76	G-2		
C10	D-5	CR6	K-2	CR21	D-4	Q1	K-3	R1	K-1	R14	J-2	R30	I-2	R47A	J-4	R62	H-2	R77	G-2		
C11	D-5	CR7	J-1	CR22	D-4	Q2	K-3	R2	K-2	R15	J-1	R31	I-1	R47B	I-4	R63	H-6	R78	G-2		
C12	G-5	CR8	J-1	CR23	E-2	Q3	J-2	R3	K-4	R16	K-3	R32	I-2	R48	J-4	R64	E-2	R79	G-2		
C13	E-1	CR9	J-1	CR24	E-2	Q4	J-2	R4	K-1	R17	J-2	R33	I-3	R49	I-3	R65	F-4	R80	H-2		
C14	E-1	CR10	J-3	CR25	F-5	Q5	J-2	R5	K-1	R18	J-2	R34	K-3	R50	I-4	R66	G-4	R81	H-2		
C15	E-4	CR11	J-3	CR26	G-5	Q6	I-2	R6	K-2	R19	J-2	R35	I-1	R51	I-5	R67	G-3	R82	G-1		

1418-8-3

Figure 8-12. Component Identification, Power Supply A2

P/O A3 TRIPLER ASSEMBLY

P/O A2 POWER SUPPLY (HIGH VOLTAGE)

HV OSCILLATOR

HIGH VOLTAGE REGULATOR

REGULATOR Q14, Q15

RELAY K1

A6 HORIZONTAL DRIVERS Q1/Q2

P/O A3 CONNECTOR BLOCK

TRACE ALIGN

FOCUS

GEOMETRY

INTENSITY

INTENSITY LIMIT

ASTIG

HV ADJ

Z-AXIS INPUT

CHOPPED BLANKING

FLEXIBLE HV LEAD

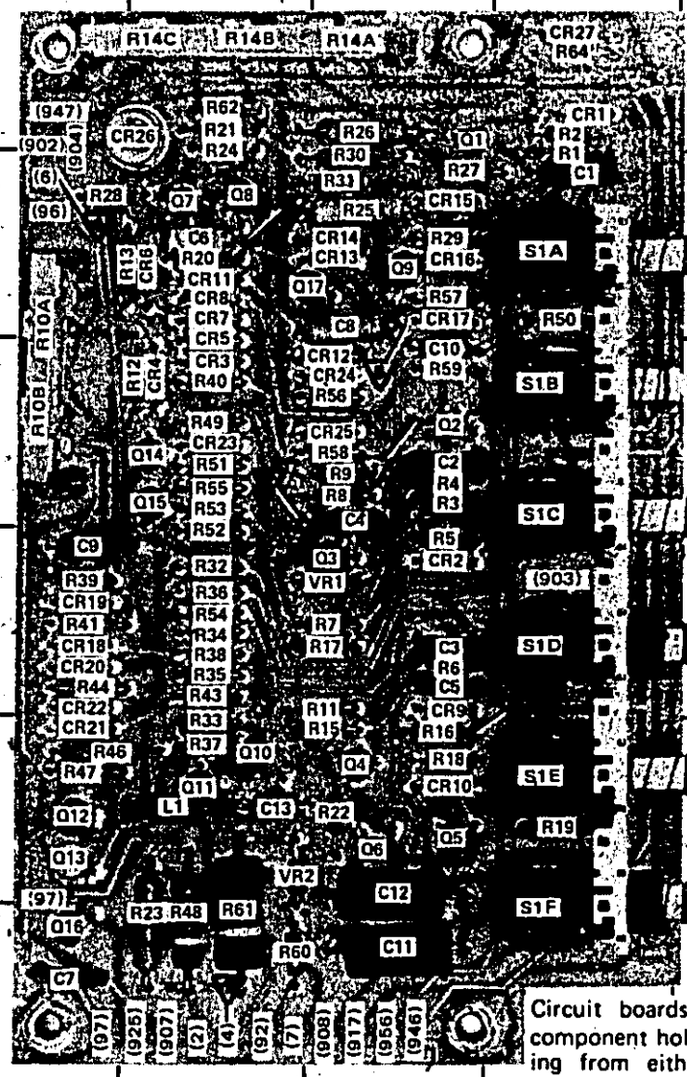
CRT NECK CONNECTIONS

REFERENCE DESIGNATIONS

CHASSIS	A2	A3	A6
P/OJ1 P/OJ2	C10-C19	C1-C4	C1,C2
L1	CR21-CR28	CR1-CR3	Q1,Q2
R5-R8	K1	R1,R2	R1-R5
S4	L1,L2		
TB1	Q13-Q15		
V1	R56-R85		
	T1		
	V2-V4		

DELETED:

Figure 8-13. High Voltage Schematic



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

REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	E-2	CR4	C-3	CR20	B-4	Q8	C-2	R7	D-4	R20	C-2	R36	C-4	R55	C-3
C2	D-3	CR5	C-3	CR21	B-5	Q9	D-2	R8	D-3	R21	C-1	R37	C-5	R56	D-3
C3	D-4	CR6	C-2	CR22	B-4	Q10	C-5	R9	D-3	R22	D-5	R38	C-4	R57	D-2
C4	D-3	CR7	C-2	CR23	C-3	Q11	C-5	R10A	B-2	R23	C-6	R39	B-4	R58	D-3
C5	D-4	CR8	C-2	CR24	D-3	Q12	B-5	R10B	B-3	R24	C-1	R40	C-3	R59	D-3
C6	C-2	CR9	D-4	CR25	D-3	Q13	B-5	R11	D-4	R25	D-2	R41	B-4	R60	C-6
C7	B-6	CR10	D-5	CR26	C-1	Q14	C-3	R12	C-3	R26	D-1	R43	C-4	R61	C-6
C8	D-2	CR11	C-2	CR27	E-1	Q15	C-3	R13	C-2	R27	D-2	R44	B-4	R62	C-1
C9	B-4	CR12	D-3	L1	C-5	Q16	B-6	R14A	D-1	R28	B-2	R46	B-5	R64	E-1
C10	D-3	CR13	D-2	Q1	D-1	Q17	C-2	R14B	C-1	R29	D-2	R47	B-5	S1A	E-2
C11	D-6	CR14	D-2	Q2	D-3	R1	E-1	R14C	C-1	R30	D-2	R48	C-6	S1B	E-3
C12	D-5	CR15	D-2	Q3	D-4	R2	E-1	R15	D-5	R31	D-2	R49	C-3	S1C	E-3
C13	C-5	CR16	D-2	Q4	D-5	R3	D-3	R16	D-5	R32	C-4	R50	E-2	S1D	E-4
CR1	E-1	CR17	D-2	Q5	D-5	R4	D-3	R17	D-4	R33	C-5	R51	C-3	S1E	E-5
CR2	D-4	CR18	B-4	Q6	D-5	R5	D-4	R18	D-5	R34	C-4	R52	C-4	S1F	E-5
CR3	C-3	CR19	B-4	Q7	C-2	R6	D-4	R19	E-5	R35	C-4	R53	C-3	VR1	D-4
												R54	C-4	VR2	C-5

141B-A-7

Figure 8-14. Component Identification, Pulse Circuit A5

CONDITIONS FOR WAVEFORM MEASUREMENT

1. Set the PERSISTENCE and INTENSITY controls fully ccw and the sweep time and vertical deflection as indicated for each waveform. All waveforms are referenced to chassis ground.

2. DC voltage measurements shown on the schematic diagram are measured in the STD mode of operation and referenced to chassis ground. The PERSISTENCE and INTENSITY controls are set fully ccw.

NOTE

Voltage levels shown in the following waveforms are intended for reference only and may vary somewhat with the adjustment of each instrument.

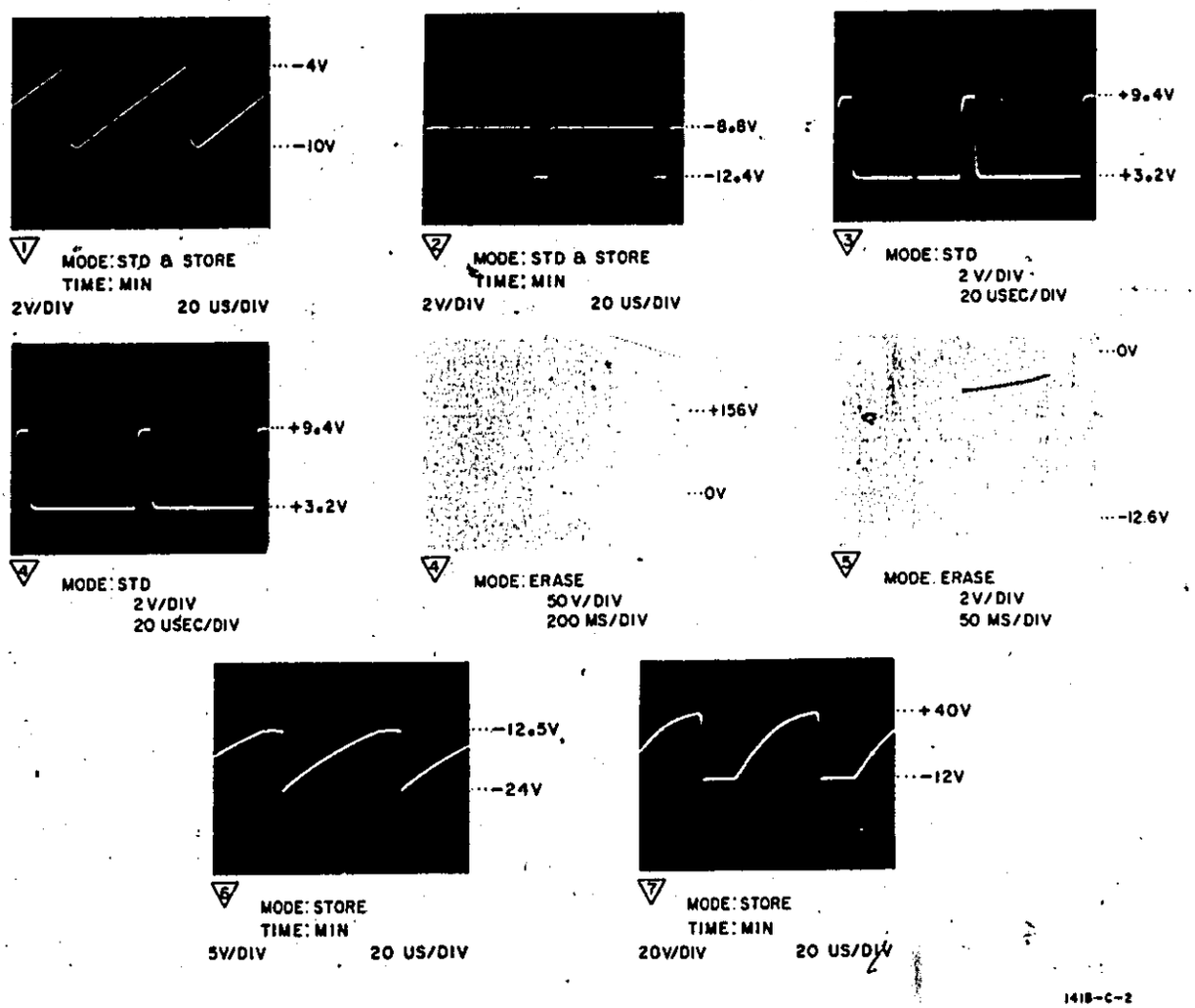


Figure 8-15. Waveforms

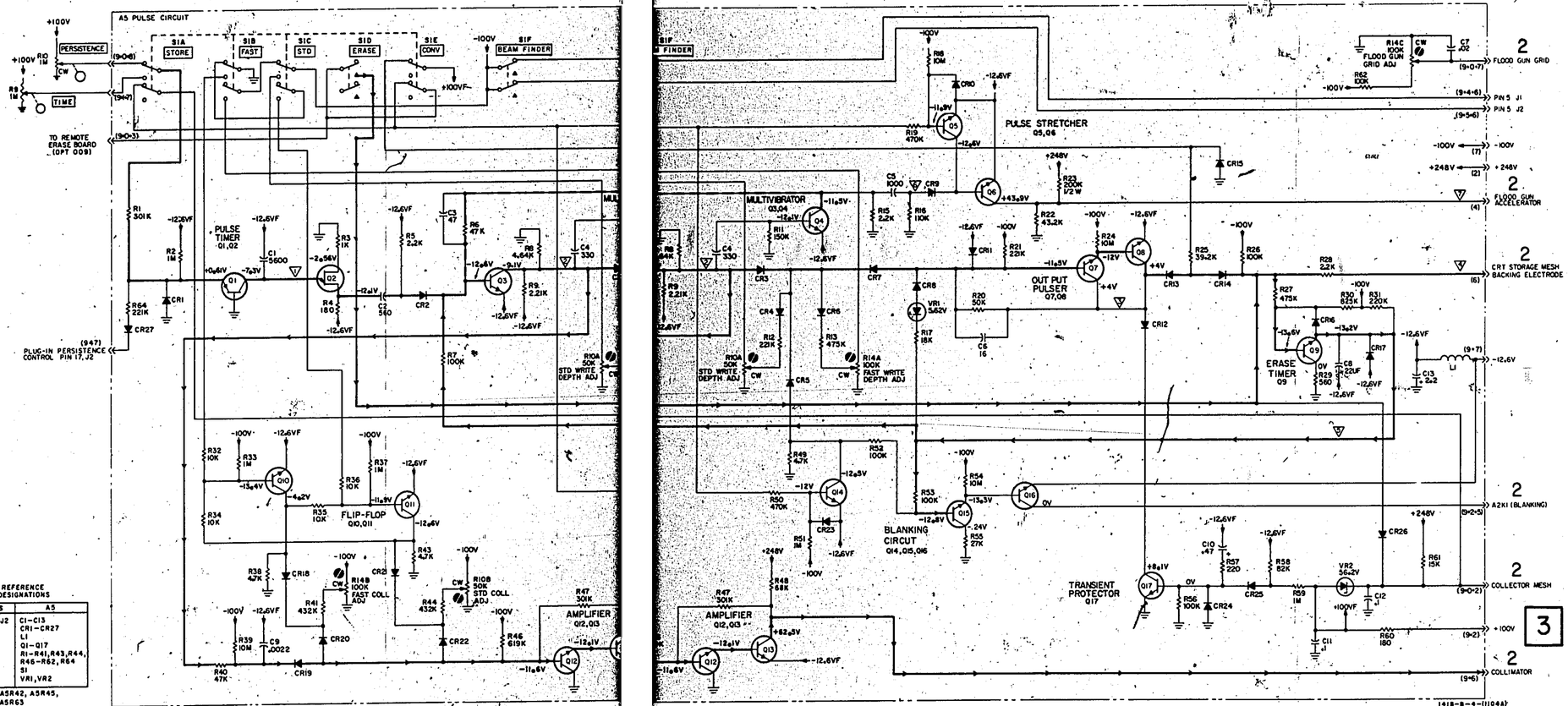


Figure 8-16. Pulse Circuit Schematic

HEWLETT hp PACKARD

CATHODE-RAY TUBE WARRANTY

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

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

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

Attention: CRT QA

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

SHIPPING INSTRUCTIONS

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

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

Thank you,

CRT Department

5950-7124

HEWLETT hp PACKARD

CATHODE-RAY TUBE FAILURE REPORT

DATE _____

FROM:

NAME _____

COMPANY _____

ADDRESS _____

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

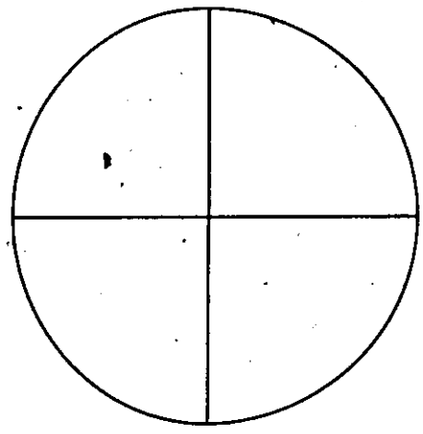
_____

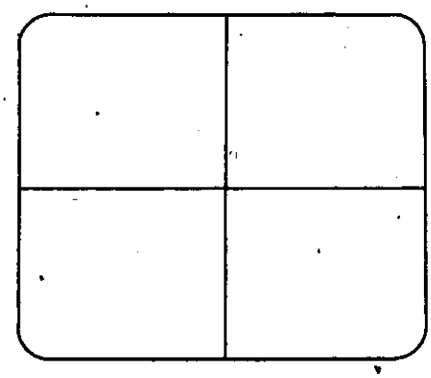
_____

_____

_____

_____





5. Warranty claimed ? Yes _____ No _____
6. HP Sales/Service Office _____ Repair Order No. _____

SERVICE NOTES

SERVICE NOTE

Supersedes:

None

HP MODEL 141B/T STORAGE OSCILLOSCOPES

S/N 1104A 00385 and below (141B)

S/N 1047A 01300 and below (141T)

PREFERRED REPLACEMENTS

A2Q14 should be replaced with a HP Part No. 1853-0034 and A2R57 should be replaced with a 330 Ω resistor HP Part No. 0758-0054. Both of these components should be replaced together.

Changing A2Q14 and A2R57 will increase the gain of the regulator circuit and insure regulation of the HV power supply during erasure.

A2CR26 and A2CR27 should be replaced with a HP Part No. 1901-0436.

This diode has proven to be much more reliable than the previous type.

Make the appropriate changes in the operating and service manual to reflect the preferred parts.

TR/bw/WO

9/71-08

HEWLETT hp PACKARD

For more information, call your local HP Sales Office or East (201) 265-5000 • Midwest (312) 677-0400 • South (404) 436-6181 West (213) 877-1282. Or, write: Hewlett-Packard, 1501 Page Mill Road, Palo Alto, California 94304. In Europe, 1217 Meyrin-Geneva

PRINTED IN U.S.A.

SERVICE NOTE

Supersedes:

None

HP MODEL 141B/T STORAGE OSCILLOSCOPES

S/N 1145A00565 and below (141B)
S/N 1113A02200 and below (141T)

Preferred Replacements for A2R31, A2R35, and A2R52

A2R31 should be replaced with a 49.9 KΩ resistor HP Part No. 0757-0370 and A2R35 should be replaced with a 33.2 KΩ resistor HP Part No. 0757-0044. Both of these components should be changed together.

Changing the values of A2R31 and A2R35 will insure proper power dissipation in A2R31.

A2R52 should be replaced with a 16 KΩ, 1 watt resistor HP Part No. 0761-0075.

Changing A2R52 will insure proper power dissipation in it.

Make the appropriate changes in the Operating and Service Manual to reflect the preferred parts.

TR/mh/WO

1/72-8

HEWLETT hp PACKARD

For more information, call your local HP Sales Office or East (201) 265-5000 • Midwest (312) 677-0400 • South (404) 436-6181
West (213) 877-1282. Or, write: Hewlett-Packard, 1501 Page Mill Road, Palo Alto, California 94304. In Europe, 1217 Meyrin-Geneva

PRINTED IN U.S.A.

P-1854-0234

SERVICE NOTE

SUPERSEDES:

None

H-P PART NUMBER 1854-0234

SILICON TRANSISTOR

H-P MODELS 141 B/T

The preferred replacement for A5Q13 is 1854-0234.

Change the parts list in the Operating and Service Manual to reflect the preferred part.

DS/bw/WO 7/70-08

HEWLETT hp PACKARD

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MANUAL CHANGES

MANUAL CHANGES

MODEL 141B

OSCILLOSCOPE

Manual Serials Prefixed: 1104A
Manual Printed: APRIL 1971

Make all changes listed below as Errata. Check the following table for your instrument serial prefix and/or serial number and make listed change(s) to the manual:

Serial Prefix or Number	Make Changes
1121A	1
1145A	1,2
1218A	1, 2, 3
1225A	1, 2, 3, 4

Serial Prefix or Number	Make Changes
1348A	1 through 5
1321A	1, 2, 3, 4
1503A	1 through 6

ERRATA

Change: Every reference to (50-60 Hz) found in the manual to (48 to 66 Hz).

Page 1-0, Table 1-1,
PERSISTENCE: Delete specification for FAST writing speed mode.

Page 2-2, Paragraph 2-19,
In the first sentence, delete these words: . . . requires periodic lubrication, and the . . .

Add the following cautionary statement after the last paragraph in Section III:

CAUTION

This instrument is fitted with a plexiglass CRT safety faceplate (HP Part No. 5020-8728) for operator protection. To clean the CRT faceplate, use a soft cloth or tissue. Never use coarse or abrasive tissues because these will scratch the plexiglass.

Page 4-1, Figure 4-1,
TRACE ALIGN: Change (97) to (904) and (0) to (905). Remove the ground from (905). Z AXIS INPUT: Change (94) to (0) COAX.

Page 4-6, Paragraph 4-49,
Change: A5R25/A5R26/A5R27 to A5R26/A5CR14/A5R25/A5CR15.
Change: 29 volts to −29 volts.

Page 5-2, Paragraph 5-17h,
Change: 1 volt to 10 volts from the Voltmeter Calibrator.

Page 5-5/5-6; Paragraph 5-39, step u,
Change: Last line to read 7 x 9 division, centered, rectangle (described by dashed lines).

Page 5-5/5-6, Paragraph 5-40, step g,
Add: the following sentence: Floodgun electrons must illuminate the entire graticule, except for collimation dimples (small shaded areas around CRT face).

Page 6-3, Table 6-2,
DS1: Change HP Part Number to 1450-0419, Qty 1, LIGHT: INDICATOR SELECTED NE-2H, Mfr Code 28480, Mfr Part No. 1450-0419.
Add: F1, HP Part No. 2110-0303, Qty 1, FUSE:CARTRIDGE 2 AMP SLOW BLOW (230V OPERATION), Mfr Code 71400, Mfr Part Number MDX-2A.
MP13: Change HP Part Number to 5060-8742, Mfr Part No. to 5060-8742.

Page 6-4, Table 6-2,
Delete: MP92.
Add: MP93, HP Part No. 00140-60602, Qty 1, SHIELD: ASSY: CRT, Mfr Code 28480, Mfr Part No. 00140-60602.
Add: MP94, HP Part No. 00141-61206, Qty 1, BRACKET ASSY: CRT, Mfr Code 28480, Mfr Part No. 00141-61206.
MP95: Change HP Part No. to 00180-01218.
MP97: Change HP Part No. to 00140-24712, Mfr Part No. to 00140-24712.
MP115: Change HP Part No. to 10178A, Mfr Part No. 10178A.
Add: MP124, HP Part No. 00181-04101, COVER, HIGH VOLTAGE CONNECTOR, Mfr Code 28480, Mfr Part No. 00181-04101.
R5: Change HP Part No. to 2100-2962, R: VAR COMP 1.5 MEGOHM 30% LIN 1/2W, Mfr Code 28480, Mfr Part No. 2100-2962.
S2: Change HP Part No. to 3101-1234; SWITCH: SLIDE DPDT (115V/230V), Mfr Code 82389, Mfr Part No. 11A-1242.
S4: Change Description to SWITCH:SLIDE DPDT (INT/EXT).

16 January 1975

Δ = Latest additions to this change sheet.

This change sheet supersedes all prior change sheets for this manual.

Supplement A for
00141-90910

ERRATA (Cont'd)

Page 6-5, Table 6-2,
Δ A2C10: Change to HP Part No. 0180-1819, C:FXD ELECT 100 UF +75–10% 50VDCW, Mfr Code 56289, Mfr Part No. 30D107G050DH2-DSM.
Page 6-7, Table 6-2,
Δ A2R62: Change to HP Part No. 0757-0057, R:FXD MET FLM 990K OHM 1% 1/2W, Mfr Code 28480, Mfr Part No. 0757-0057.
A3MP7: Change HP Part No. to 0362-0265.
A3MP9, A3MP10: Change HP Part No. to 0362-0227.
Page 6-8, Table 6-2,
Δ A5C3: Change to HP Part No. 0140-0204, C:FXD MICA 47 PF 5% NPO 500VDCW, Mfr Code 14655, Mfr Part No. RDM15E470J5C.
A5R1: Change HP Part Number to 0757-0473, R: FXD MET FLM 221K OHM 1% 1/8W, Mfr Part No. 0757-0473.
Page 7-2, Paragraph 7-11a,
Change to read: OPTION 001: 230V operation set at factory, use F1, 2110-0303 as replaceable part.
Page 8-2, Paragraph 8-26,
Third Sentence: Change 60 Hz to 120 Hz.
Page 8-2, Paragraph 8-32,
First Sentence: Delete the words (blue wire).
Page 8-10, Figure 8-7,
Delete: (4) on J1, pin 1 and J2, pin 15.
Add: (935) and (0) COAX. on J1, pin 19.
Add: (935) on J2, pin 19.
Change: (94) to (0) COAX. on J1, pin 15.
Page 8-10, Figure 8-8,
Change: Component identification to comply with Table 1 of this change sheet.

Table 1.

Old Ref Desig	New Ref Desig	Grid Loc
CR1	VR1	K-1
CR6	VR2	K-2
CR7	VR3	J-1
CR9	VR4	J-1
CR12	VR5	I-2
CR20	VR6	I-5
VR1	V1	J-3
VR2	V2	F-3
VR3	V3	F-3
VR4	V4	F-3

Page 8-11, Figure 8-9,
Change: (921) to (928), (16) to (967).
Page 8-11, Figure 8-10,
Change: (918) wire from ON terminal of S1 connects to F1. The (946) wire then goes to S3, and the (978) wire completes the circuit to T1, terminal 1.
Change: T1, Terminal 8 wire from (921) to (928). T1, Terminal 9 wire from (916) to (967).
Delete: (6) from wire connecting cathodes of CR1 and CR2.
Identify: Coaxial lead to J1 and J2, pin 19 as (0).
Page 8-12, Figure 8-10,
Change: Component Identification to comply with Table 1 of this change sheet.
Page 8-13, Figure 8-13,
Change: CHOPPED BLANKING wire (94) to (0) COAX.
Change: Trace Align Circuit to conform to Figure 1 of this change sheet.
Identify: Intensity potentiometer, 1.5M as R5.
Page 8-15/8-16, Figure 8-16,
S1C: Change switch position down.
R1: Change value to 221K.
R21: Change value to 301K.

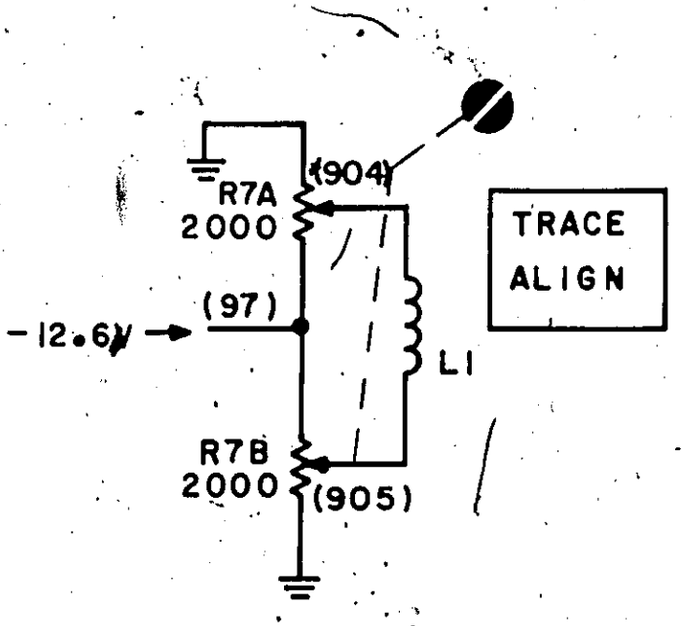


Figure 1.

CHANGE 1

Page 6-3, Table 6-2,
J3: Change HP Part No. to 1251-2357, SOCKET: 3-PIN MALE POWER RECEPTACLE, Mfr Code 82389, Mfr Part No. EAC-301.
MP18: Change HP Part No. to 00141-60204, Mfr Part No. 00141-60204.
Page 6-4, Table 6-2,
S2: Change HP Part No. to 3101-1234, SWITCH: SLIDE DPDT (115V/230V) Mfr Code 82389, Mfr Part No. 11A-1242.

Page 6-4, Table 6-2 (Cont'd),
W1: Change HP Part No. to 8120-1545, CABLE ASSY: AC POWER CORD 7.5-ft., Mfr Part No. 8120-1545.
Add: MP122, HP Part No. 00141-00217, Qty 1, PANEL: REAR, Mfr Code 28480 Mfr Part No. 00141-00217.

CHANGE 2

Page 6-3, Table 6-2,
A2: Change to HP Part No. 00141-66519, POWER SUPPLY BOARD ASSY, Mfr Code 28480, Mfr Part No. 00141-66519.
Page 6-5, Table 6-2,
A2: Change to HP Part No. 00141-66519, POWER SUPPLY BOARD ASSY, Mfr Code 28480, Mfr Part No. 00141-66519.
A2C8: Change to HP Part No. 0160-0157, C: FXD MY 0.0047 UF 10% 200 VDCW, Mfr Code 56289, Mfr Part No. 192P47892-PTS.
Δ Add: A2C20, HP Part No. 0160-3448, C:FXD CER 1000 PF 10% 1000VDCW, Mfr Code 56289, Mfr Part No. C067B251F102KS25-CD.
Add: A2C21, HP Part No. 0160-3443, C:FXD CER 0.1 UF +80–20% 50VDCW, Mfr Code 72982, Mfr Part No. 8131-050-651-104Z.
A2F1: Change to HP Part No. 2110-0067, FUSE: 0.30A 250V, Mfr Code 28480, Mfr Part No. 2110-0067.
Page 6-6, Table 6-2,
A2R31: Change to HP Part No. 0757-0370, R:FXD MET FLM 49.9K OHM 1.0% 1/2W, Mfr Code 28480, Mfr Part No. 0757-0370.
A2R35: Change to HP Part No. 0757-0044, R:FXD MET FLM 33.2K OHM 1% 1/2W, Mfr Code 28480, Mfr Part No. 0757-0044.

NOTE

A2R31 and A2R35 must both be in the listed values for proper results.

Page 6-7, Table 6-2,
A2R52: Change to HP Part No. 0761-0075, R: FXD MET FLM 16K OHM 1% 1/2W, Mfr Code 28480, Mfr Part No. 0761-0075.
A2R63: Change to HP Part No. 2100-0096, R: VAR COMP 1 MEGOHM 30% LIN 1/5W, Mfr Code 28480, Mfr Part No. 2100-0096.
A2R65: Change to HP Part No. 2100-2108, R: VAR COMP 1.5 MEGOHM 30% LIN 1/10W, Mfr Code 28480, Mfr Part No. 2100-2108.
A2R68: Change to HP Part No. 0761-0004, R: FXD METOX 20K OHM 5% 1W, Mfr Code 28480, Mfr Part No. 0761-0004.
A2R69: Change to HP Part No. 0757-0839, R: FXD MET FLM 10K OHM 1% 1/2W, Mfr Code 28480, Mfr Part No. 0757-0839.
Add: A2R86, HP Part No. 0698-6286, R: FXD COMP 100 MEGOHM 10% 1/4W, Mfr Code 28480, Mfr Part No. 0698-6286.
Page 8-10, Figure 8-8,
Add: R86, GRID OC IF. Connect one end to junction of C19/R83/R85 and the other end to junction of CR28/(5).
Page 8-11, Figure 8-10,
A2C8: Change value to 4700 pF.
Add: A2C20 (1000 pF) between A2CR17 cathode and ground.
A2F1: Change value to 0.3A.
A2R8: Change value to 3010.
A2R31: Change value to 49.9K.
A2R35: Change value to 33.2K.
A2R52: Change value to 16K.
Page 8-13, Figure 8-13,
Add: A2C21 (0.1 UF) in parallel with A2C12.
A2R63: Change value to 1.0M.
A2R65: Change value to 1.5M.
A2R69: Change value to 10K.
Add: A2R86 (100M) in parallel with series string of A2V2, A2V3, A2V4.

CHANGE 3

Page 6-4, Table 6-2,
Add: MP123, HP Part No. 5060-0548, Qty 1, Kit: CONTRAST FILTER, Mfr Code 28480, Mfr Part No. 5060-0548.

CHANGE 4

Page 6-3, Table 6-2,
A5: Change to HP Part No. 00141-66520, A: PULSE CIRCUIT BOARD ASSY, Mfr Part No. 00141-66520.

Page 6-4, Table 6-2,
V1: Change to HP Part No. 5083-2585, Mfr Part No. 5083-2585.

Page 6-8, Table 6-2,
A5: Change to HP Part No. 00141-66520, A: PULSE CIRCUIT BOARD ASSY, Mfr Part No. 00141-66520.
Delete: A5C9.
Add: A5C14, HP Part No. 0160-0157, Qty 1, C: FXD MY 4700 PF 10% 200V, Mfr Code 56289, Mfr Part No. 192P47292-PT5.
Add: A5C15, A5C16, HP Part No. 0180-1735, Qty 2, C: FXD ELECT 0.22 UF 10% 35V, Mfr Code 28480, Mfr Part No. 0180-1735.
Add: A5C17, HP Part No. 0150-0052, Qty 1, C: FXD CER 0.05 UF 20% 400 VDCW, Mfr Code 56289, Mfr Part No. 1233C 24A1 CDH.
Add: A5CR28, A5CR29, HP Part No. 1901-0040, Qty 2, DIODE: SILICON 30 MA 30 WV, Mfr Code 07263, Mfr Part No. FDG1088.
Add: A5Q18, A5Q19, A5Q20, A5Q21, A5Q22, HP Part No. 1854-0071, Qty 5, TSTR: SI NPN (SELECTED FROM 2N3704), Mfr Code 28480, Mfr Part No. 1854-0071.
A5R7: Change to HP Part No. 0684-2231, R: FXD COMP 22K OHM 10% 1/4W, Mfr Part No. CB 2231.

Page 6-9/6-10, Table 6-2,
Delete: A5R39, A5R40.
Add: A5R65, HP Part No. 0684-1041, Qty 1, R: FXD COMP 100K OHM 10% 1/4W, Mfr Code 01121, Mfr Part No. CB 1041.
Add: A5R66, A5R74, HP Part No. 0684-2231, Qty 2, R: FXD COMP 22K OHM 10% 1/4W, Mfr Code 01121, Mfr Part No. CB 2231.
Add: A5R67, A5R69, A5R72, A5R75, HP Part No. 0684-4721, Qty 4, R: FXD COMP 4700 OHM 10% 1/4W, Mfr Code 01121, Mfr Part No. CB 4711.
Add: A5R68, A5R71, HP Part 0684-6831, Qty, 2, R: FXD COMP 68K OHM 10% 1/4W, Mfr Code 01121, Mfr Part No. CB 6831.
Add: A5R70, A5R73, HP Part No. 0684-3321, Qty 2.
Add: A5R76, HP Part No. 0683-1555, Qty 1, R: FXD COMP 1.5 MEGOHM 5% 1/4W, Mfr Code 01121, Mfr Part No. CB 1555.
Add: A5R77, A5R80, HP Part No. 0684-1021, Qty 2, R: FXD COMP 1000 OHM 10% 1/4W, Mfr Code 01121, Mfr Part No. CB 1021.

Page 8-14, Figure 8-14,
Replace with new Figure 8-14 provided as part of this change sheet.

Page 8-15/8-16, Figure 8-16,
Replace with new Figure 8-16 provided as part of this change sheet.

CHANGE 5

Page 6-8, Table 6-2,
Delete; A5CR15.

Page 6-9/6-10, Table 6-2,
Add: A5R81, HP Part No. 0683-5635, R: FXD COMP 56K OHMS 5% 1/4W, Mfr Code 01121, Mfr Part No. CB 5635.

Schematic 3,
A5CR15: Change symbol to resistor. Designate as A5R81, 56K ohms.

Δ CHANGE 6

Page 6-4, Table 6-2,
S1: Change to HP Part No. 3101-0056, SWITCH; TOGGLE DPDT LINE POWER, Mfr Code 27191, Mfr Part No. 8926K316.
W2: Change HP Part No. and Mfr Part No. to 00141-61634.

Schematic-1,
Modify the input ac power circuit according to figure 2 of this manual changes sheet.

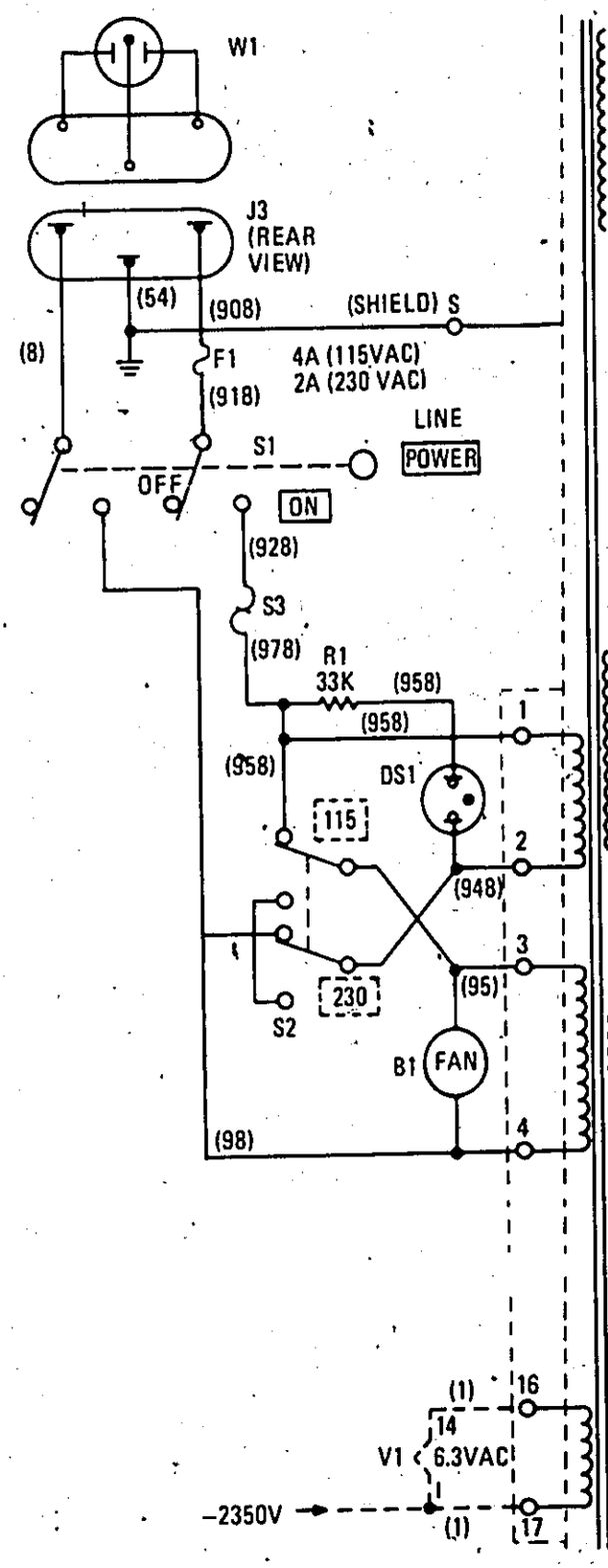


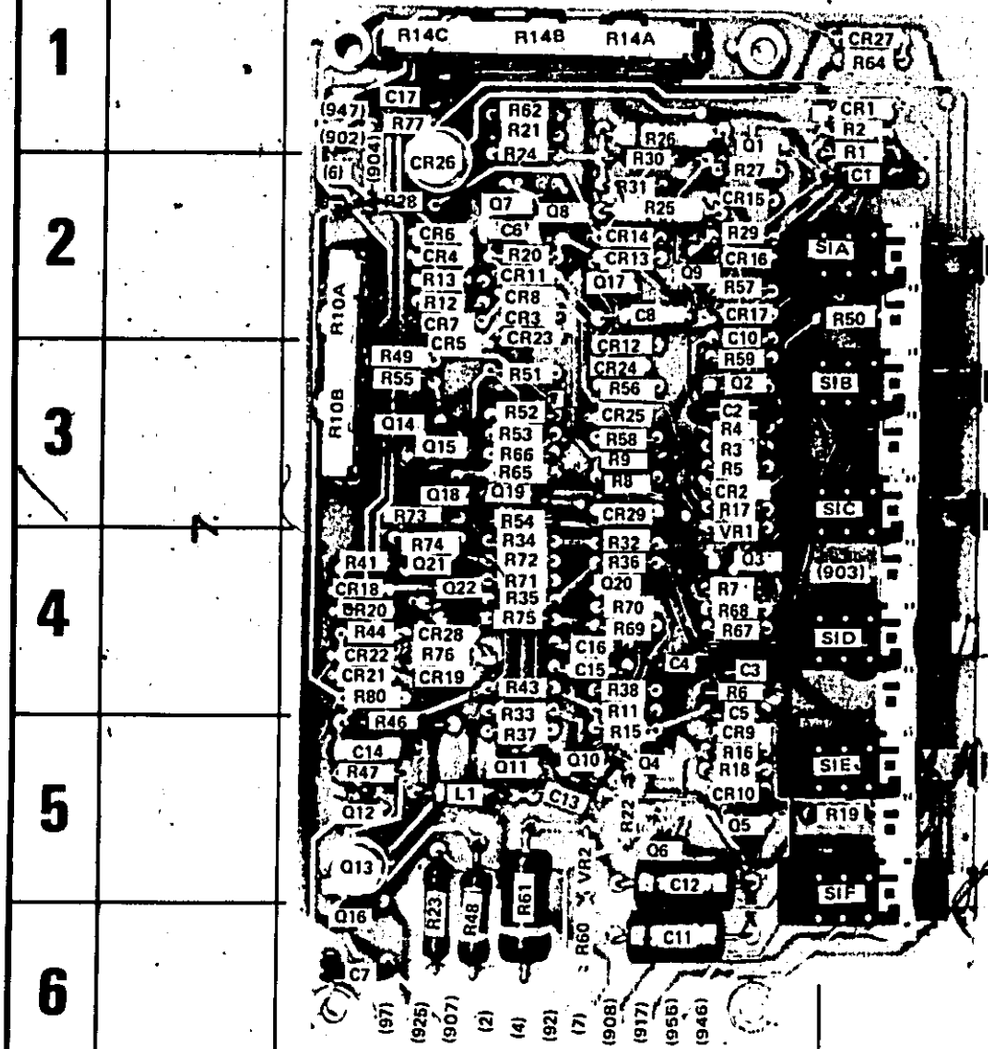
Figure 2. Schematic Effect of Change 5

OPTIONS

OPTION 631

This Option replaces the standard CRT with one having type P31 phosphor and no internal graticule.

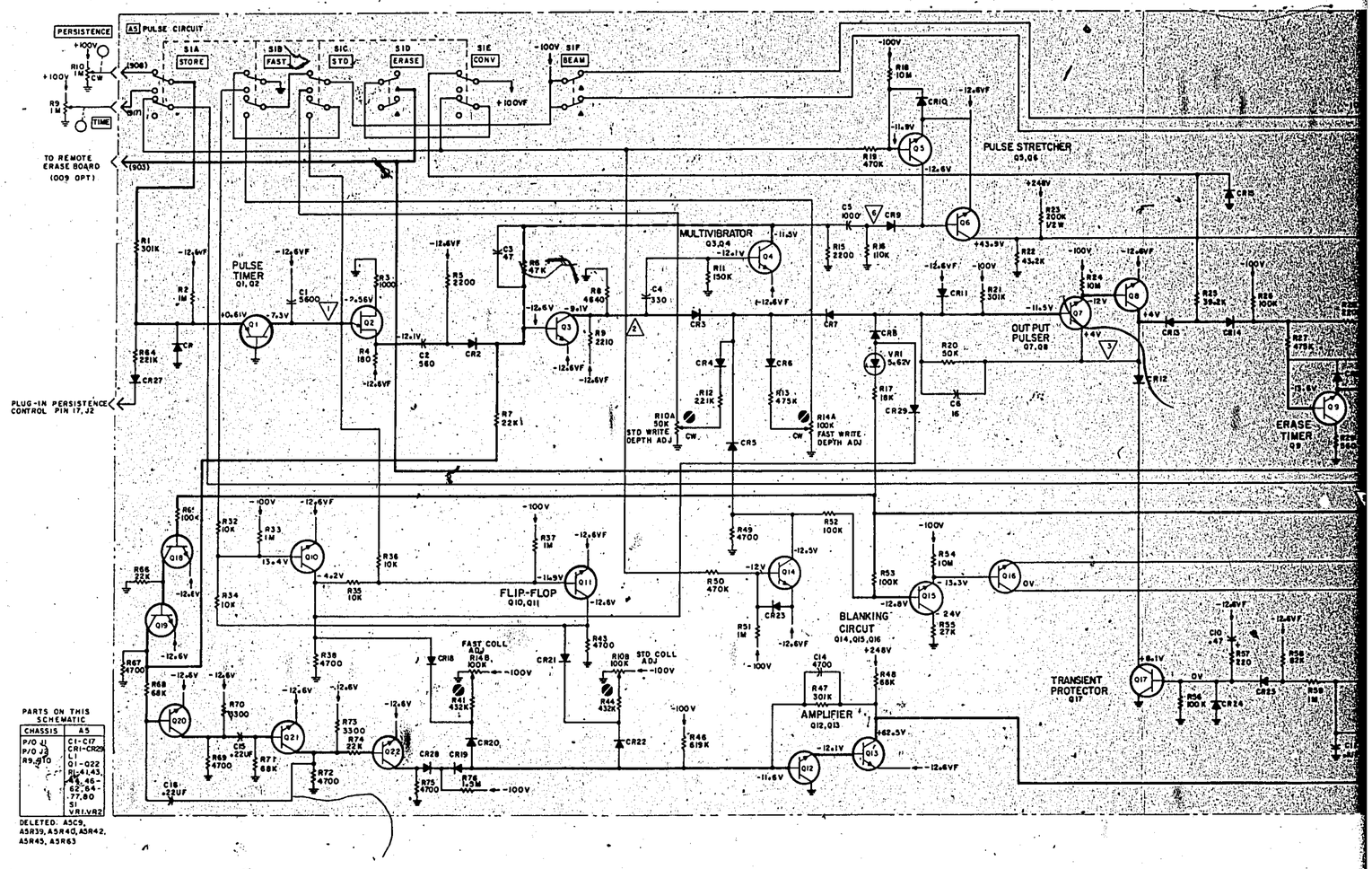
HP Part Number	Description
5083-2586	V: CRT P31 phosphor aluminized without internal graticule.



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-2	CR6	B-2	CR27	E-1	Q19	C-3	R16	D-5	R38	C-4	R65	C-3
C2	D-3	CR7	B-2	CR28	B-4	Q20	C-4	R17	D-3	R41	B-4	R66	C-3
C3	D-4	CR8	C-2	CR29	C-3	Q21	B-4	R18	D-5	R43	C-4	R67	D-4
C4	D-4	CR9	D-5	L1	C-5	Q22	B-4	R19	E-5	R44	B-4	R68	D-4
C5	D-4	CR10	D-5	Q1	D-1	R1	E-1	R20	C-2	R46	B-4	R69	C-4
C6	C-2	CR11	C-2	Q2	D-3	R2	E-1	R21	C-1	R47	B-5	R70	C-4
C7	B-6	CR12	C-2	Q3	D-4	R3	D-3	R22	C-5	R48	C-6	R71	C-4
C8	D-2	CR13	C-2	Q4	D-5	R4	D-3	R23	B-6	R49	B-3	R72	C-4
C10	D-2	CR14	C-2	Q5	D-5	R5	D-3	R24	C-1	R50	E-2	R73	B-3
C11	D-6	CR15	D-2	Q6	D-5	R6	D-4	R25	D-2	R51	C-3	R74	B-4
C12	D-5	CR16	D-2	Q7	C-2	R7	D-4	R26	D-1	R52	C-3	R75	C-4
C13	C-5	CR17	D-2	Q8	C-2	R8	C-3	R27	D-2	R53	C-3	R76	B-4
C14	B-5	CR18	B-4	Q9	D-2	R9	C-3	R28	B-2	R54	C-3	R77	B-1
C15	C-4	CR19	B-4	Q10	C-5	R10A	B-2	R29	D-2	R55	B-3	R80	B-4
C16	C-4	CR20	B-4	Q11	C-5	R10B	B-3	R30	D-1	R56	C-3	S1A	E-2
C17	B-1	CR21	B-4	Q12	B-5	R11	C-4	R31	C-2	R57	D-2	S1B	E-3
CR1	E-1	CR22	B-4	Q13	B-5	R12	B-2	R32	C-4	R58	C-3	S1C	E-3
CR2	D-3	CR23	C-2	Q14	B-3	R13	B-2	R33	C-4	R59	D-3	S1D	E-4
CR3	C-2	CR24	C-3	Q15	B-3	R14A	C-1	R34	C-4	R60	C-6	S1E	E-5
CR4	B-2	CR25	C-3	Q16	B-6	R14B	C-1	R35	C-4	R61	C-5	S1F	E-6
CR5	B-2	CR26	B-2	Q17	C-2	R14C	B-1	R36	C-4	R62	C-1	VR1	D-3
				Q18	B-3	R15	C-5	R37	C-5	R64	E-1	VR2	C-5

141T-R-1

Figure 8-14. Component Identification, Pulse Circuit A5



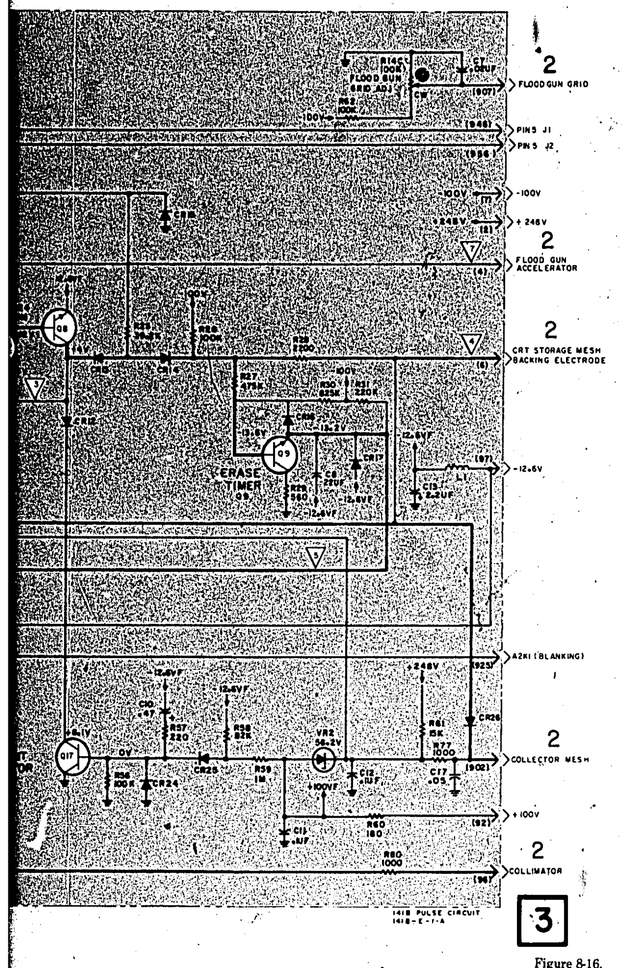


Figure 8-16.
Pulse Circuit Schematic
8-15/8-16