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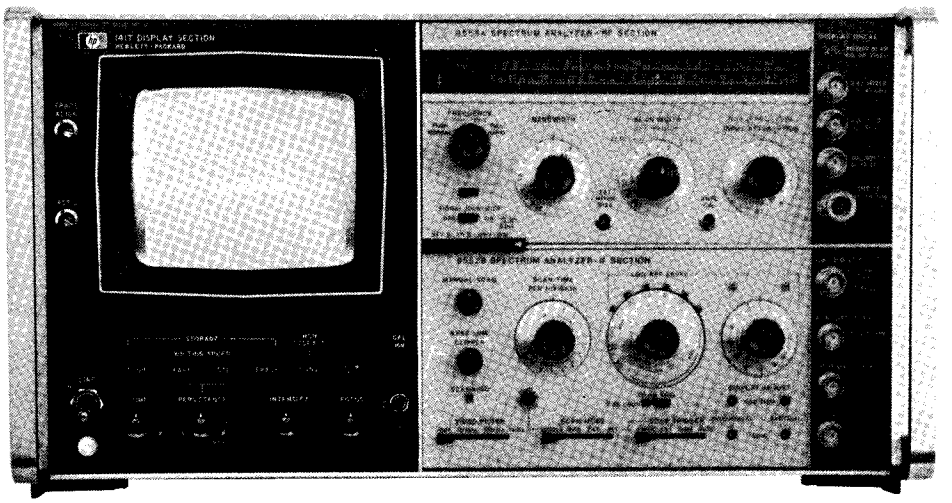
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OPERATING AND SERVICE MANUAL

DISPLAY SECTION
141T



HEWLETT hp PACKARD

CERTIFICATION

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

WARRANTY AND ASSISTANCE

This Hewlett-Packard product is warranted against defects in materials and workmanship for a period of one year from the date of shipment. The cathode-ray tube (CRT) in the instrument and any replacement CRT purchased from HP are also warranted against electrical failure for a period of one year from the date of shipment from Colorado Springs. BROKEN TUBES AND TUBES WITH PHOSPHOR OR MESH BURNS, HOWEVER, ARE NOT INCLUDED UNDER THIS WARRANTY. Hewlett-Packard will, at its option, repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard, and provided the preventive maintenance procedures in this manual are followed. Repairs necessitated by misuse of the product are not covered by this warranty. NO OTHER WARRANTIES ARE EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. HEWLETT-PACKARD IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

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

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

OPERATING AND SERVICE MANUAL

MODEL 141T
DISPLAY SECTION

(Including Option 009)

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed 1615A.

With changes described in Section VII, this manual also applies to instruments with serial numbers prefixed 950— through 1502A.

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

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

Manual Part Number 00141-90914
Microfiche Part Number 00141-90814

PRINTED: JUNE 1976

SAFETY SUMMARY

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

GROUND THE INSTRUMENT.

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

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE.

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

KEEP AWAY FROM LIVE CIRCUITS.

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

DO NOT SERVICE OR ADJUST ALONE.

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

USE CAUTION WHEN EXPOSING OR HANDLING THE CRT.

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

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT.

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

DANGEROUS PROCEDURE WARNINGS.

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

WARNING

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

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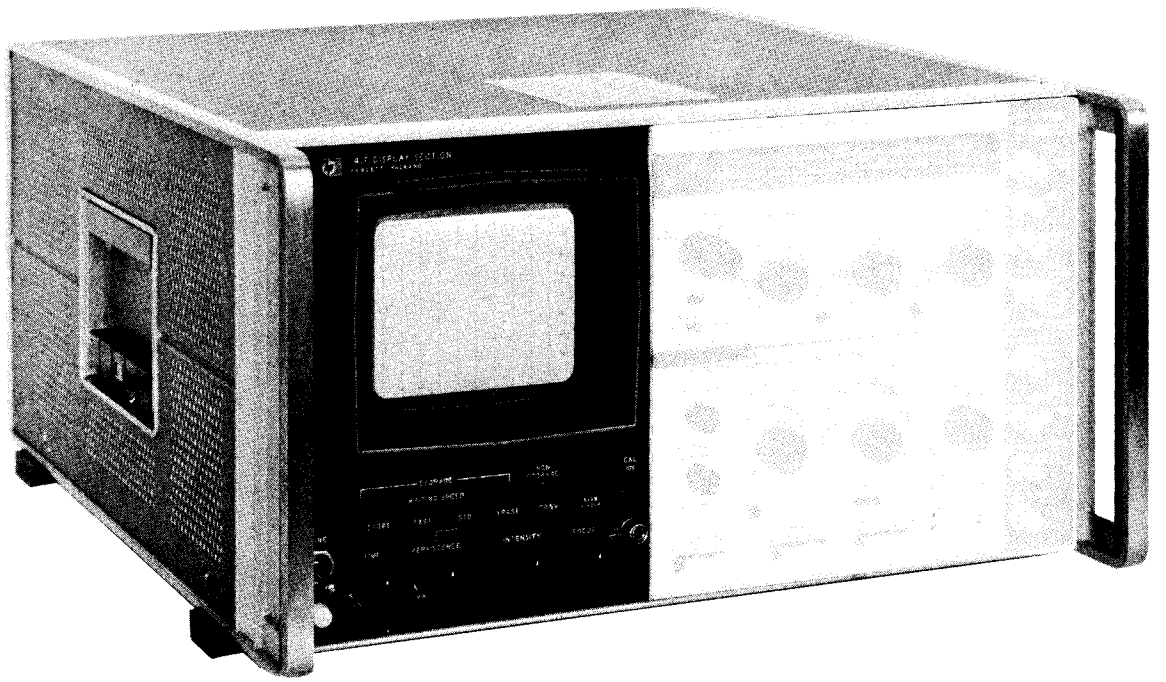
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Figure 1-1. Model 141T Display Section

SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. This manual provides operating and service information for the Hewlett-Packard Model 141T Display Section (figure 1-1). 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 a description of the Model 141T. The instrument specifications are listed in table 1-1. Table 1-2 lists and describes the abbreviations used in this manual except Section VI. The parts list is a computer printout and uses computer-supplied abbreviations. Table 1-3 contains a list of current plug-ins available for use with the Model 141T.

1-4. DESCRIPTION.

1-5. The Model 141T is designed for use as a display section for the HP Model 141T/8550-series plug-in spectrum analyzer and as an oscilloscope when used with HP Model 1400-series plug-ins. The instrument has variable persistence (duration of trace afterglow) and storage of CRT displays. Persistence is variable from 0.2 second to more than 60 seconds. A display can 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 to 20 MHz and sensitivities to 100 microvolts per division are available as well as time domain reflectometry and swept frequency indicator units.

1-9. CATHODE RAY TUBE.

1-10. The Model 141T uses a post-accelerator CRT with a non-glare rectangular faceplate. An internal graticule is located on the same plane as the display to eliminate parallax errors. The tube has a 9-kV accelerating potential, and 8 vertical by 10 horizontal divisions. A type P31 phosphor is used in the standard CRT.

CAUTION

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

1-11. WARRANTY.

1-12. The instrument (except the CRT) is certified and warranted as stated on the inside front cover of this manual. The CRT is covered by a separate warranty. The CRT warranty and a warranty claim form are located at the rear of this manual. Should the CRT fail within the time specified on the CRT warranty page, complete the warranty claim form and return it with the defective CRT. The procedure for returning a defective CRT is described on the CRT warranty page.

1-13. ASSOCIATED EQUIPMENT.

1-14. Plug-ins available for use with the instrument are listed in table 1-3 and in the Hewlett-Packard Instrumentation Catalog. The instrument is normally operated with an IF section plug-in in the lower compartment and an RF section plug-in in the upper compartment. The instrument can also be used as an oscilloscope 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 that separates the two compartments can be removed and one double sized plug-in installed. Blank plug-in kits, both single and double sized, are available for fabrication of special circuits. See table 4-1 for power supply current limitations.

Table 1-1. Specifications

PLUG-INS

Accepts Model 8550-series IF and RF Section spectrum analyzer plug-ins without the use of a center divider shield.

Also, accepts all HP Model 1400-series plug-ins. All plug-ins operate directly into the horizontal and vertical deflection plates. Center shield may be removed to provide double-sized compartment for use with 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.

Graticule:
8 x 10 divisions (approx. 7.1 x 8.9 cm) parallax-free internal graticule. Subdivisions of 0.2 div 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.

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 usec rise 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.

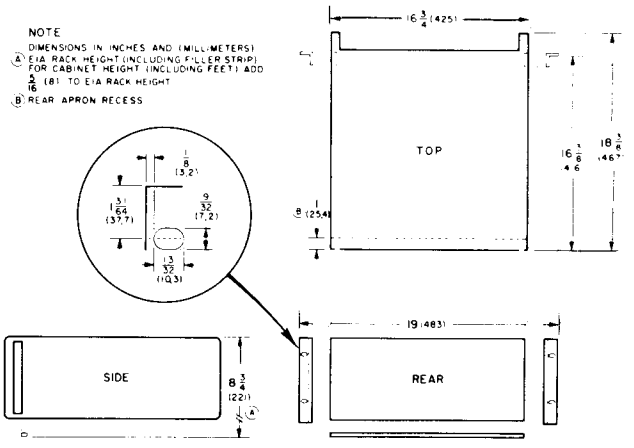
BEAM FINDER

Pressing BEAM FINDER pushbutton brings trace on screen regardless of setting of horizontal, or vertical position controls.

GENERAL

Power Requirements:
100, 120, 220 or 240 volts (+5 to —10%), 48 to 66 Hz (Option H16 48 to 440 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).

1-15. INSTRUMENT AND MANUAL IDENTIFICATION.

1-16. This manual applies directly to Model 141T instruments with a serial prefix number as listed on the manual title page. The serial prefix number is the first group of digits in the instrument serial number (figure 1-2). The instrument serial number is on a tag located on the rear panel.

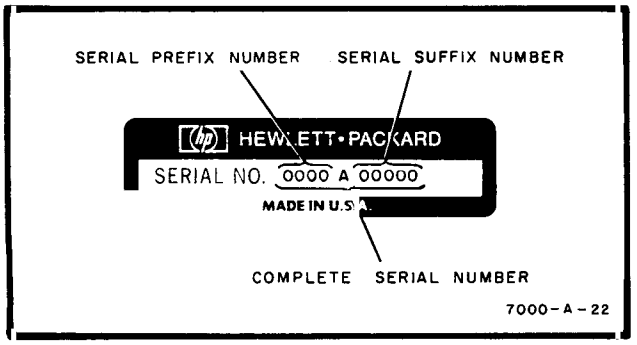


Figure 1-2. Instrument Serial Number

1-17. Check the serial prefix number of the instrument. If the serial prefix number is different from that listed on the title page of this manual, refer to Section VII for instructions to adapt this manual for proper instrument coverage.

1-18. Errors in the manual are listed under errata on an enclosed MANUAL CHANGES sheet (if any).

1-19. INQUIRIES.

1-20. Refer any questions regarding the manual, the change sheet, or the instrument to the nearest HP Sales/Service Office. Always identify the instrument by model number, complete name, and complete serial number in all correspondence. Refer to the inside rear cover of this manual for a world-wide listing of HP Sales/Service Offices.

Table 1-2. Reference Designators and Abbreviations

REFERENCE DESIGNATORS

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

ABBREVIATIONS

A	= ampere(s)	FET	= field-effect transistor(s)	n	= nano (10^{-9})	rfi	= radio frequency interference
ampl	= amplifier(s)			nc	= normally closed	rms	= root mean square
assy	= assembly			no.	= normally open	rwv	= reverse working voltage
ampltd	= amplitude	G	= giga (10^{9})	npn	= negative-positive-negative	SCR	= silicon controlled rectifier
bd	= board(s)	gnd	= ground(ed)	ns	= nanosecond	sec	= second(s)
bp	= bandpass	H	= henry(ies)	p	= pico (10^{-12})	std	= standard
c	= centi (10^{-2})	hr	= hour(s)	pc	= printed (etched) circuit(s)	trmr	= trimmer
C	= carbon	HP	= Hewlett-Packard	pk	= peak	u	= micro (10^{-6})
ccw	= counterclockwise	Hz	= hertz	pnp	= positive-negative-positive	usec	= microsecond
coax.	= coaxial	if.	= intermediate freq.	p/o	= part of	V	= volts
coef	= coefficient	intl	= internal	p-p	= peak-to-peak	var	= variable
com	= common	k	= kilo (10^{3})	prgm	= program	w/	= with
CRT	= cathode-ray tube	lb	= pound(s)	prv	= peak inverse voltage(s)	w/o	= without
cw	= clockwise	lpf	= low-pass filter(s)	ps	= picosecond	wiv	= working inverse voltage
d	= deci (10^{-1})	m	= milli (10^{-3})	pwv	= peak working voltage		
dB	= decibel	M	= mega (10^{6})	rf	= radio frequency		
ext	= external	ms	= millisecond				
F	= farad(s)						

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Table 1-3. Plug-ins for Model 141T Display Section

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	1402A 1430C	x	x		x		x				x		x	
TIME BASE PLUG-INS	1421A	x		x	x			x	x	x	x			
SPECTRUM ANALYZER PLUG-INS	8552A 8552B 8553B 8554B 8555A 8556A	Fixed or variable scan spectrum analysis. Spectrum analyzer IF section, 50 Hz bandwidth. Spectrum analyzer IF section, 10 Hz bandwidth. Spectrum analyzer RF section, 1 kHz to 110 MHz. Spectrum analyzer RF section, 100 kHz to 1250 MHz. Spectrum analyzer RF section, 10 MHz to 40 GHz. Spectrum analyzer LF section, 20 Hz to 300 kHz.													

*Time Domain Reflectometry.

SECTION II

INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains instructions for performing an initial inspection of the Model 141T. Installation procedures and precautions are presented in step-by-step order. The procedures for making a claim for warranty repairs and for repacking the instrument for shipment are also described in this section.

2-3. INITIAL INSPECTION.

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

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

2-6. PREPARATION FOR USE.

2-7. The instrument requires a power source of 100-, 120-, 220-, or 240-volt +5 - 10%, single phase, 48 to 440 Hz, that can deliver approximately 400 volt-amperes. A removable jumper board in power module A7, provides selection of the line voltage to be used (figure 2-1).

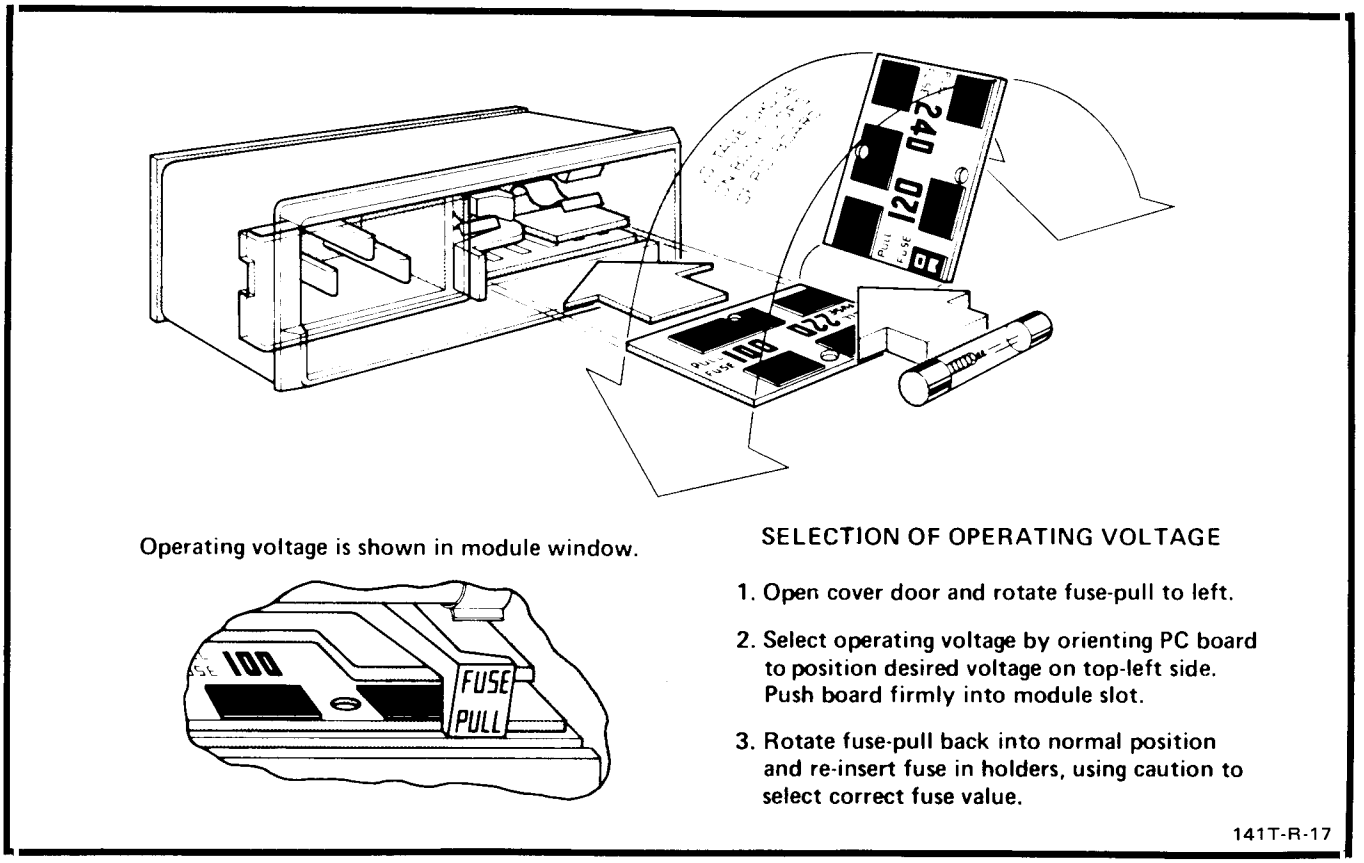


Figure 2-1. Voltage Selection

CAUTION

Before placing the Model 141T in operation, ensure that the operating voltage indicated in the power module window (figure 2-1) agrees with the line voltage being used.

To avoid damaging CRT perform Intensity adjustment (figure 3-2).

2-8. When operating the Model 141T from a 100V or 125V source, replace line fuse with a 4A slow-blow fuse. When operating from a 220V or 240V source, replace line fuse with a 2A slow-blow fuse.

2-9. THREE-CONDUCTOR AC POWER CABLE.

2-10. For the protection of operating personnel Hewlett-Packard Company recommends that the instrument panel and cabinet be grounded. This instrument is equipped with a three-conductor, ac power cable that, when connected to an appropriate receptacle, grounds the instrument through the offset pin. The power jack and mating plug of the power cord meet International Electro-technical Commission (IEC) safety standards.

2-11. INSTRUMENT MOUNTING.

2-12. The instrument is shipped from the factory as a bench instrument with the tilt stand, feet, and plastic trim in place. Four supports are mounted on the rear panel of the instrument for operation in a vertical position. Top, left side, and bottom panel covers can be removed, giving access to components and adjustments. Allow sufficient space around the cabinet for air circulation.

2-13. A kit for converting the modular cabinet to a rack mount is included. Instructions for making the conversion are given below (figure 2-2).

a. Detach tilt stand by pressing away from front feet A.

b. Remove plastic feet by pressing metal button and sliding each foot free.

c. Using thin-bladed tool, remove aluminum trim strips. These strips have adhesive backing, and are located on sides behind front handles.

d. Attach rack mounting flange, using screws provided in kit, in each space where trim strip was removed. Position large notch of flange at instrument bottom.

e. Rack-mounting kit contains filler strips that should be used as spacers between Model 141T and other equipment mounted in same rack.

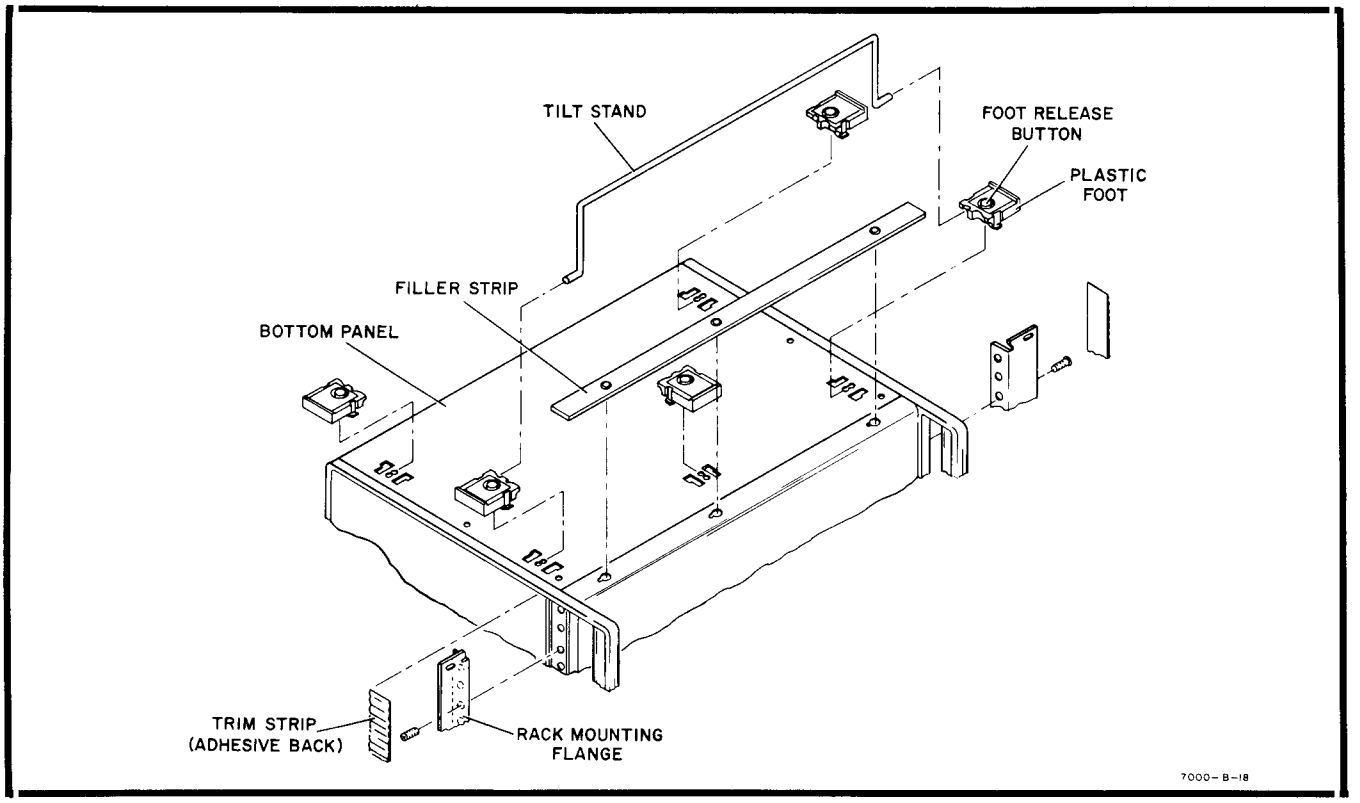


Figure 2-2. Rack Mounting Procedure

2-14. INSTRUMENT COOLING.

2-15. Forced-air cooling is used to maintain the 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. Allow at least 3 inches of clearance around the top, rear, and both sides of the instrument for cooling.

2-16. The cooling fan does not require lubrication, but the filter should be cleaned often enough to ensure sufficient air flow. A thermal switch is mounted on the fan to protect against over-heating.

2-17. CLAIMS.

2-18. The warranty statement applicable to this instrument is printed inside the front cover of this manual. Refer to the rear of this manual for the CRT warranty statement. If physical damage is found or if operation is not as specified when the instrument is received, notify the carrier and nearest HP Sales/Service Office immediately (refer to the list in back of this manual for addresses). The HP Sales/Service Office will arrange for repair or replacement without waiting for settlement of the claim with the carrier.

2-19. REPACKING FOR SHIPMENT.

2-20. If the instrument is to be shipped to a Hewlett-Packard Sales/Service Office for service or repair, attach a tag showing owner (with address), complete instrument serial number, and a description of the service required.

2-21. Use the original shipping carton and packing material. If the original packing material is not available, the Hewlett-Packard Sales/Service Office will provide information and recommendations on materials to be used.

SECTION III

OPERATION

3-1. INTRODUCTION.

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

3-3. CONTROLS AND CONNECTORS.

3-4. Figure 3-1 identifies the front panel controls and gives a brief functional description of each. The following paragraphs provide detailed descriptions of controls with multiple or complex functions.

3-5. TRACE ALIGN.

3-6. The TRACE ALIGN adjustment compensates for external magnetic fields that affect alignment of the horizontal trace with the graticule. The alignment should be checked when the instrument is moved to a new location and adjustment made when necessary.

3-7. BEAM FINDER.

3-8. A 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 press and hold the BEAM FINDER and gradually adjust the INTENSITY control until a visible trace is obtained and release BEAM FINDER. When used with 8550-series frequency domain plug-ins, the BEAM FINDER has no function.

3-9. FOCUS AND ASTIGMATISM.

3-10. These controls provide uniform focus of the trace over the entire CRT screen. Adjustment is made in the STD WRITING SPEED with a low intensity spot on the CRT screen. FOCUS and ASTIG are adjusted for a round, sharply focused spot.

3-11. Z-AXIS INPUT.

3-12. The Z-AXIS INPUT jack and selector switch are on the rear panel of the instrument (figure 6-3). To externally modulate the trace intensity, set the switch to EXT, 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 modulation, set the switch to INT.

3-13. PLUG-IN UNITS.

3-14. Available plug-ins for the Model 141T are listed in table 1-2. This instrument is normally operated with an RF section plug-in in the upper compartment and IF section plug-in in the lower compartment. The Operating and Service Manuals for the plug-in units contain detailed information for installing plug-ins.

3-15. Arrangement of plug-ins can be selected to suit special applications. For example, a vertical amplifier and time base plug-in can be reversed so that sweep is vertical and signal deflection is horizontal. A vertical plug-in can be used in each compartment to take X-Y measurements.

3-16. Double-sized plug-ins, such as the Model 1415A and Model 1416A, can be inserted into the instrument after removal of the divider shield between lower and upper compartments. Blank plug-ins, both single and double size, are available for customer fabrication of specialized vertical amplifier and time base plug-ins. Refer to table 4-1 for power supply current limitations.

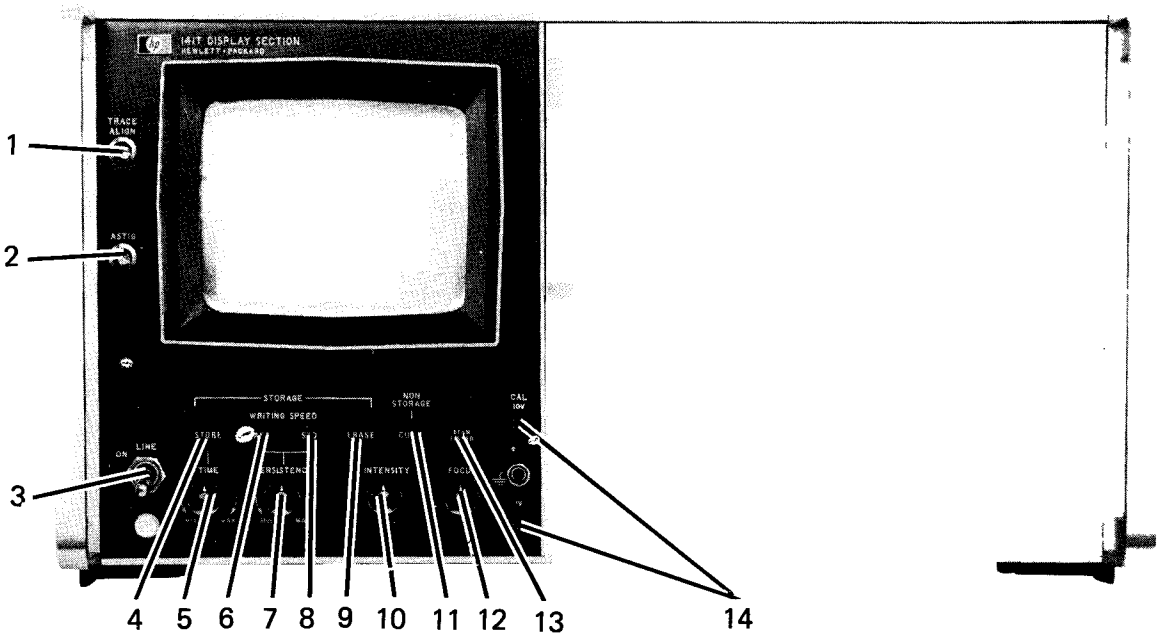
NOTE

For proper operation, the divider shield must be in place when using standard size plug-ins (does not apply to spectrum analyzer plug-ins).

3-17. **The Model 141T also accepts Model 1400-series plug-ins for standard oscilloscope use. When standard 1400-series oscilloscope plug-ins are used, plug-in shield (HP Part No. 00140-0601) must also be used. Order the shield from the nearest HP Sales/Service Office.**

CAUTION

Do not operate instrument above 45°C, when using real time plug-ins.



1. TRACE ALIGN: Adjustment to set trace parallel to horizontal graticule lines.

2. ASTIG: Adjustment to set roundness of CRT beam.

3. LINE: ON position connects ac power to oscilloscope and lights indicator.

4. STORE: Retains displayed signal at reduced intensity for viewing at a later time.

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 of CRT display.

11. CONV: Selects operation as standard oscilloscope.

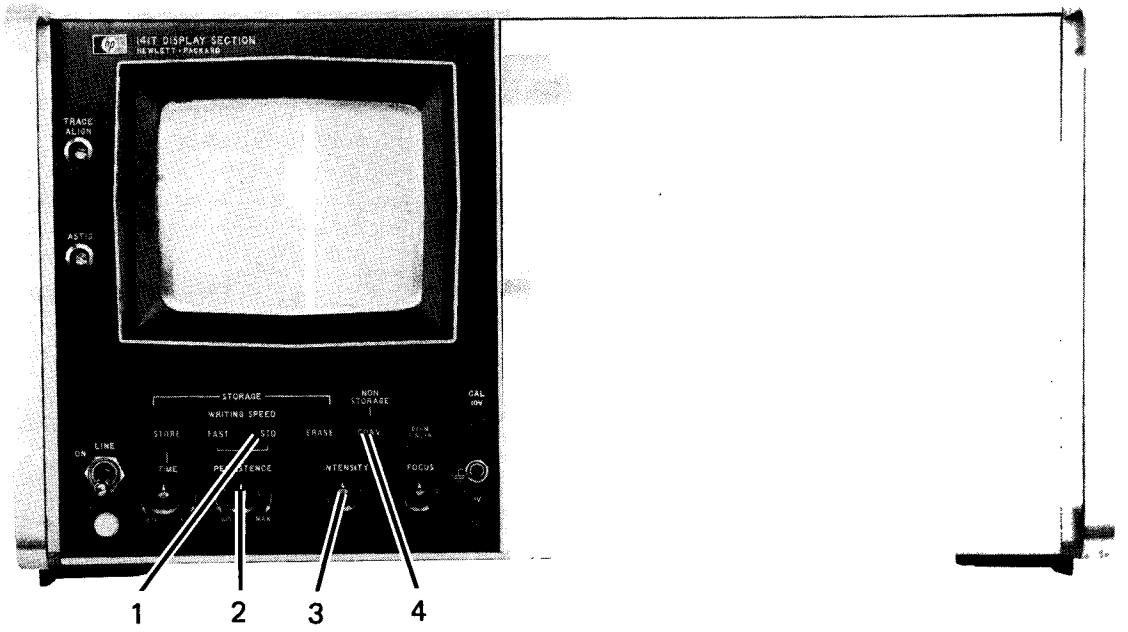
12. FOCUS: Control for focusing beam on CRT.

13. BEAM FINDER: Returns beam to CRT screen regardless of deflection potentials when used with 1400-series time-domain plug-ins. When used with 8550-series frequency-domain plug-ins, the BEAM FINDER pushbutton has no function.

14. CAL: 1-volt and 10-volt p-p, calibrated square wave outputs.

141T-R-10

Figure 3-1. Model 141T Controls and Connectors



VARIABLE PERSISTENCE MODE

1. Press STD pushbutton.
2. Rotate PERSISTENCE control fully ccw.
3. Adjust INTENSITY to less than that intensity which just eliminates trace blooming.

CONVENTIONAL

1. Press STD pushbutton.
2. Rotate PERSISTENCE control fully ccw.
3. Adjust INTENSITY to less than that intensity which eliminates trace blooming.
4. Press CONV pushbutton. Do not increase INTENSITY.

CAUTION

Trace blooming (figure 3-5) indicates excessive INTENSITY that can damage the CRT. Blooming does not occur in the CONV mode. Do not increase intensity when in CONV mode. Always repeat above procedure each time sweep speed or input signals change.

141T-R-11

Figure 3-2. Intensity Adjustment

3-18. Slight differences in CRT sensitivities, may require readjusting the sensitivity calibration of plug-ins installed in the instrument for the first time, or when moved from one display section mainframe to another. Refer to the Operating and Service Manual of the plug-in for the required adjustment procedure.

3-19. OPERATING CONSIDERATIONS.

3-20. DEFINITIONS.

3-21. The definition of some words and phrases used in this manual may vary slightly from common usage. 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.

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 that 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 mode, 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 WRITING SPEED modes.

3-22. 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.

3-23. Persistence and intensity determine the duration of display afterglow. Always set PERSISTENCE and INTENSITY as shown in figure 3-2. The PERSISTENCE control sets the rate that 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. The PERSISTENCE control sets the rate of erasing a written display. The brighter a trace the more time required to erase the display. Conversely, a display of low intensity will erase more rapidly. The same principle applies to a stored display of high and low intensity.

3-24. Pressing STORE pushbutton permits a written display to be stored at reduced intensity in the oscilloscope for comparison, measurement, or photography at a later time. Selection of the STORE configuration disconnects STD, FAST, ERASE, INTENSITY, PERSISTENCE, and CONV functions.

3-25. The TIME control varies the length of time a display is stored. The time ranges from 15 seconds, minimum TIME control setting when writing in FAST speed and transferring to STORE; to over 2 hours, maximum TIME control setting when writing STD speed and transferring to STORE. Light output is inversely proportional to storage time.

3-26. When the STD WRITING SPEED is used, pressing ERASE pushbutton establishes the CRT in a condition for variable persistence display of a signal that later can be stored. Use the minimum INTENSITY and maximum PERSISTENCE required to obtain the desired display. The STD and FAST writing speeds are the only configurations that a variable persistence display can be written.

3-27. When FAST WRITING SPEED is used, pressing ERASE primes the CRT storage surface to allow faster writing on the storage surface. The display however, has reduced contrast and fades positive more rapidly. Contrast and storage time are also reduced.

3-28. Pressing ERASE pushbutton removes stored or written displays from the CRT in either FAST or STD modes. A display that has been stored or written at a high level of INTENSITY may remain

visible after ERASE pushbutton has been released. It may be necessary to press and release ERASE pushbutton more than once to complete erasure of high intensity displays.

3-29. Selection of CONV 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.

3-30. OPERATING PROCEDURES.

NOTE

After applying power, allow instrument 15 minutes warm up before attempting to make measurements.

3-31. These operating procedures will familiarize the operator with instrument controls and aid in obtaining desired CRT display.

a. To improve persistence uniformity in STD mode adjust A5R45, STD collimator adjust. This will reduce size of useable display area.

b. For variable persistence operation, use minimum INTENSITY and maximum PERSISTENCE compatible with desired display (figure 3-4).

c. Use WRITING SPEED in FAST mode only for fast sweep time, single-shot displays, or to improve uniformity of trace intensity. FAST WRITING SPEED mode causes more rapid positive fading on CRT and reduced persistence or storage time.

d. To store a display, press STD pushbutton and adjust INTENSITY and PERSISTENCE for desired display and press STORE.

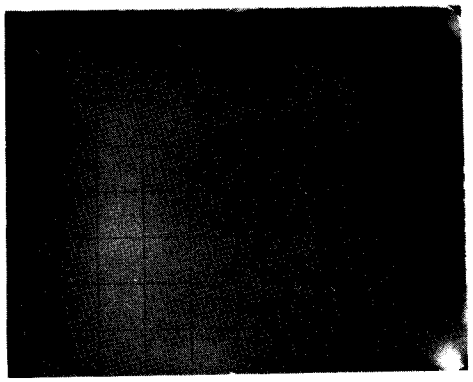


Figure 3-3. Background illumination immediately after erasing with WRITING SPEED in FAST and PERSISTENCE to MAX

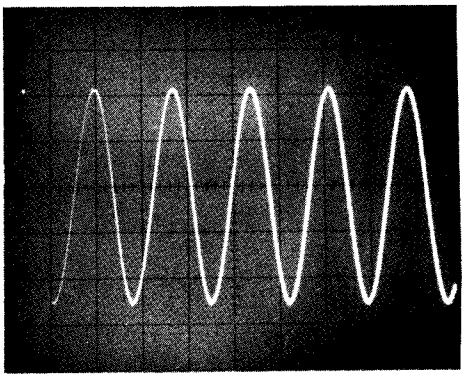


Figure 3-4. Variable persistence with a slow, repetitive sweep

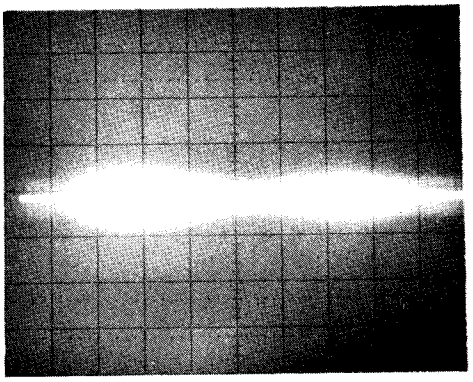


Figure 3-5. Single-shot trace bloom caused by INTENSITY and/or PERSISTENCE set too high

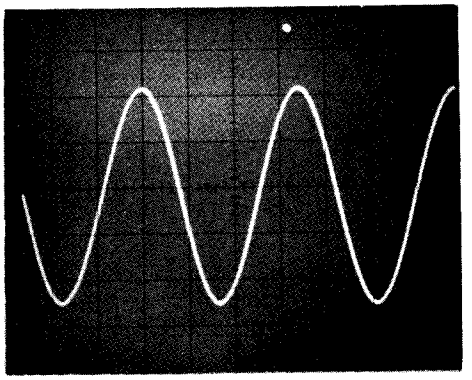


Figure 3-6. Single-shot display with INTENSITY and PERSISTENCE set the same as figure 3-5 and increased amplitude

141T-R-12

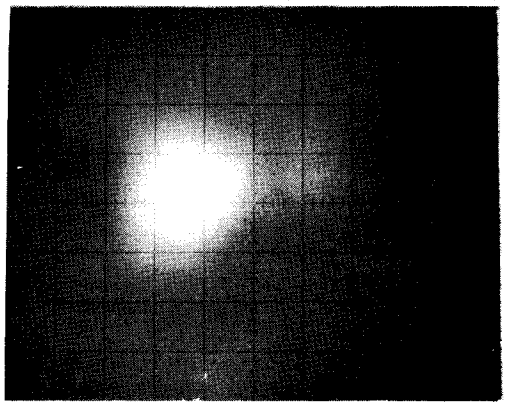


Figure 3-7. Fade positive after 2 to 4 minutes in STD mode.

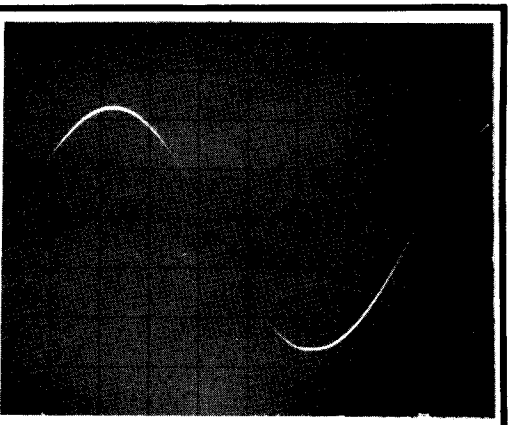


Figure 3-8. Single-shot 20 usec/div display

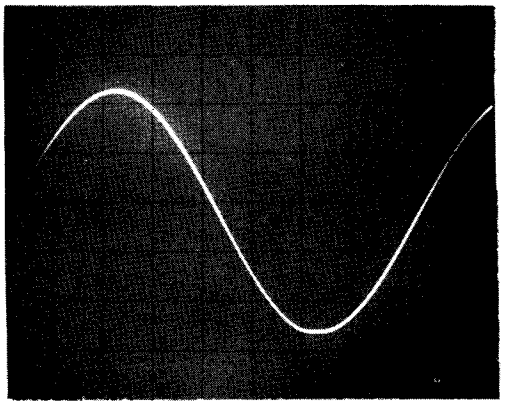


Figure 3-9. Same display as figure 3-8 after three minutes in STD mode

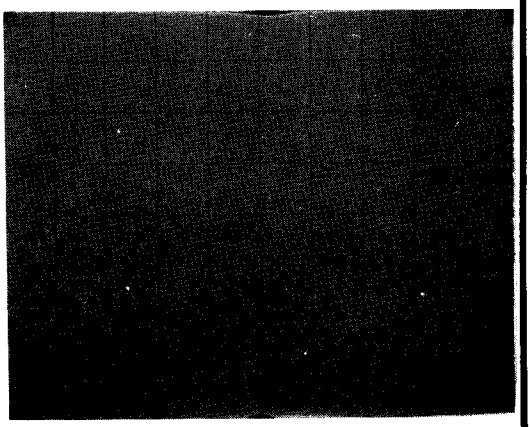


Figure 3-10. Small bright spots caused by minute imperfections in storage mesh

141T-R-13

e. To view a stored display, adjust TIME control until stored display has desired brightness.

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

g. A display stored when instrument power is turned off will remain stored for several days. To observe a stored display, press STORE, 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 stored displays, press STD or FAST and rotate the PERSISTENCE control fully ccw, or press ERASE for approximately one second, then release. (First method is not effective when WRITING SPEED is set to FAST).

3-32. SINGLE-SHOT OPERATION.

3-33. 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 blooming (figure 3-6). To determine the best INTENSITY setting, connect a signal which approximates the sweep time and amplitude of the single-shot signal to be written. Set PERSISTENCE fully cw and trigger a single sweep of the test signal. Set the INTENSITY as far cw 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 by pressing STORE and setting the TIME control to MAX.

3-34. Single-shot signals which require a beam speed faster than 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.

3-35. 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 cw 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).

SECTION IV

PRINCIPLES OF OPERATION

4-1. INTRODUCTION.

4-2. This section contains functional descriptions keyed to an overall block diagram of the instrument, and circuit descriptions keyed to simplified block diagrams of circuit groups. The schematics are located in Section VIII.

4-3. OVERALL FUNCTIONAL DESCRIPTION.

4-4. The Model 141T Display Section has five main circuits (figure 4-1): low-voltage power supply, high-voltage power supply, calibrator circuit, pulse circuit, and horizontal driver circuit. The horizontal and vertical amplifier circuits are in the plug-in units.

4-5. LOW-VOLTAGE POWER SUPPLY.

4-6. The low-voltage power supply operates on 100-, 120-, 220- or 240-volts, single phase, 48-440 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 power supply, calibrator, pulse circuits, and horizontal and vertical plug-ins. The low voltage transformer supplies 6.3 Vac to the main filament of the CRT and to the calibrator circuit.

4-7. CALIBRATOR.

4-8. The 6.3 Vac is applied to the calibrator circuit where it is shaped into a square wave (of line frequency) and applied to two front-panel connectors, 1V and 10V pk-pk. The 1-volt output is also applied to the vertical and horizontal plug-ins for sensitivity calibration. Accuracy of the calibrating signals is ±1%.

4-9. HIGH-VOLTAGE POWER SUPPLY.

4-10. A transistorized oscillator and a step-up transformer are used to generate negative and positive high voltages for the CRT. The negative 2350-volt supply is electronically regulated.

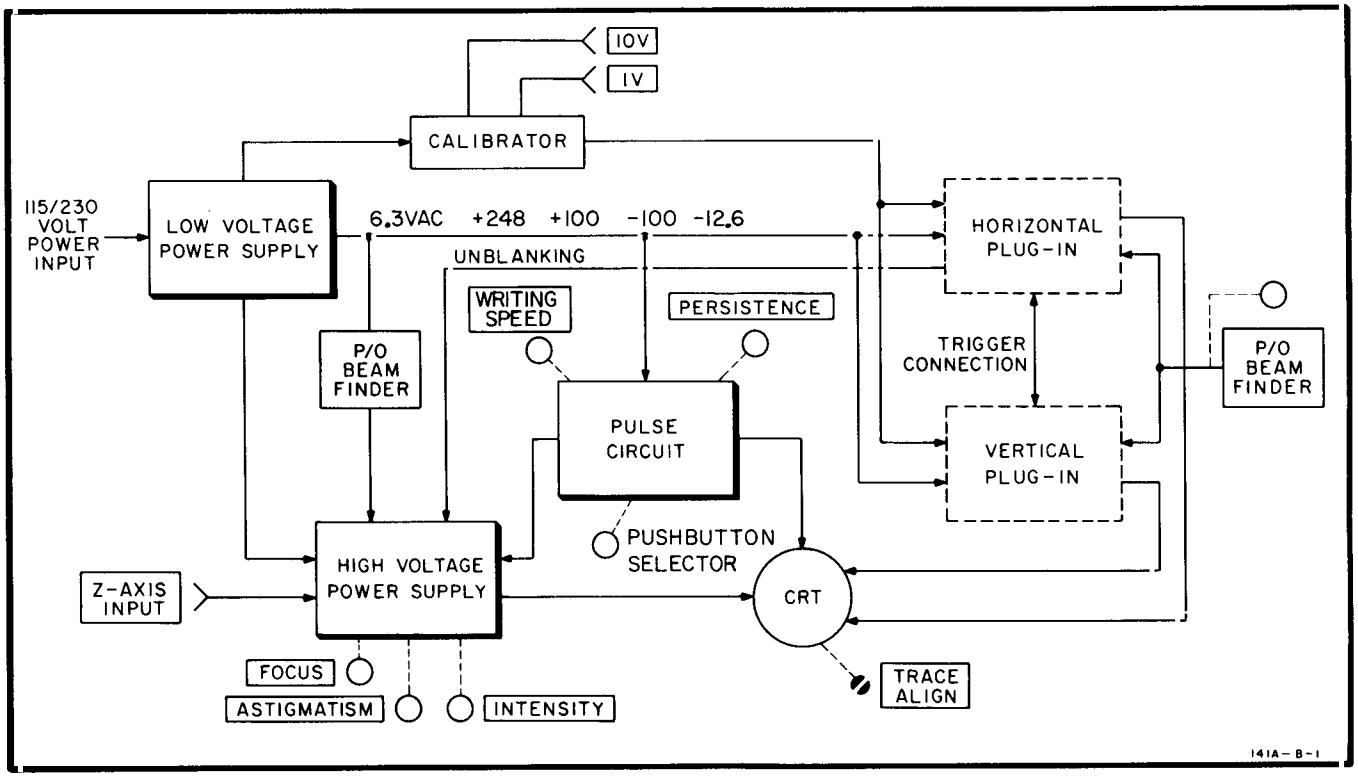


Figure 4-1. Model 141T Block Diagram

4-11. PULSE CIRCUIT.

4-12. 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. The low-voltage power supply provides all operating power for the pulse circuit.

4-13. HORIZONTAL DRIVER CIRCUIT.

4-14. The horizontal driver is an impedance converter circuit. The output from the horizontal amplifier circuit in the plug-in unit is applied to the input of the horizontal driver circuit, which in turn drives the horizontal plates of the CRT.

4-15. CIRCUIT DESCRIPTION.

4-16. LOW-VOLTAGE POWER SUPPLY.

4-17. The low-voltage power 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.

4-18. 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, maintaining the output voltage at a constant level.

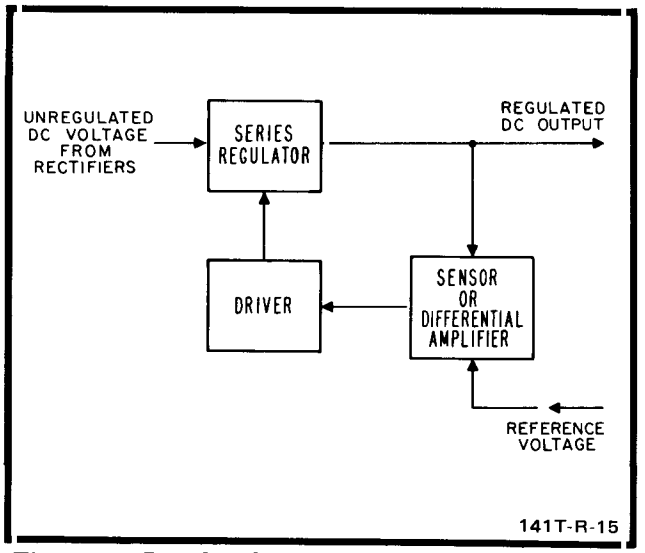


Figure 4-2. Regulated Power Supply Block Diagram

4-19. Figure 8-10 is a schematic diagram of the low voltage power supply. The primary winding is wired through a rear panel power module for conversion to 100-, 120-, 220- or 240-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. Each shunt is wired to a rear panel connector. The internal wiring of the plug-in determines whether the shunt is in the circuit or not.

4-20. +100-Volt Supply. The ac voltage from the 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 change in output voltage is applied to the base of driver A2Q3, which controls the bias on regulator Q2. Series regulator Q2, compensates for the change in output voltage by changing resistance and restores the output level to normal. The +100-volt output is adjusted by A2R11B and fuse A2F2 provides overload protection.

4-21. —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 brings 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.

4-22. +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.

4-23. —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 is a protective circuit for the series regulator and 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 flows through an external overload which limits the current required to keep A2Q10 on. Additional overload protection is provided by fuse, A12F4.

4-24. CALIBRATOR.

4-25. The calibrator circuit (figure 8-10) consists of three parts: a tunnel diode (square wave generator), a transistor switch, and a calibration network.

4-26. Input to tunnel diode A2CR19, is applied through A2R50. The tunnel diode 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 at a level set by breakdown diode A2VR6 and resistor A2R47B. When the negative-going portion of the square wave is applied to the base of A2Q12, the transistor increases conduction, effectively shorting the collector to ground. The output of the calibrator becomes zero. At the end of the negative input half-cycle (bias of A2Q12 returns to zero) the transistor is turned off, and the output returns to its previous value.

4-27. 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.

4-28. HIGH-VOLTAGE SUPPLY.

4-29. Figure 4-3 is a block diagram of the high-voltage power 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.

4-30. Figure 8-13 is a schematic diagram of the high-voltage supply and the CRT. Oscillator A2Q12 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.

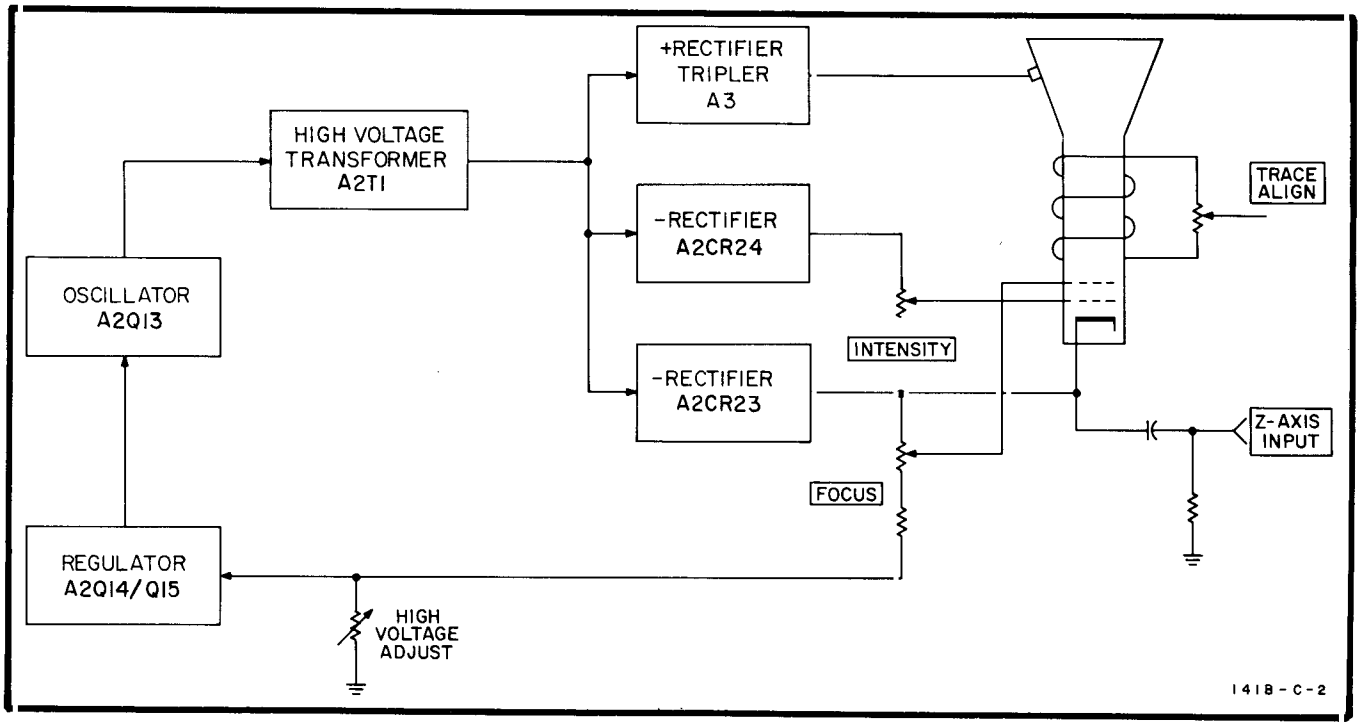


Figure 4-3. High-Voltage Power Supply Block Diagram

4-31. Two separate negative supplies are used, one for the control grid of the CRT, and one to provide the 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.

4-32. The voltage tripler circuit provides the 6.6 kV post-accerlerating voltage applies to the CRT.

4-33. The ASTIG adjustment, R8, adjusts the roundness of the spot, and the geometry adjustment, A2R72, is used to optimize pattern shape.

4-34. STORAGE CRT.

4-35. 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.

4-36. Flood Guns. Two flood guns are 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, that is emitted by the flood guns, is accelerated toward the CRT screen by collimator and collector mesh voltages. These electrons make stored or persisting display visible. They are also used to erase stored and persisting displays.

4-37. 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.

4-38. Collector Mesh. The collector mesh is between the flood guns and the storage mesh (closer to the storage mesh). It is alwasy 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.

4-39. Storage Mesh. The storage mesh is just behind the CRT screen and is coated with nonconducting material. It is statically held at a slightly positive potential (approximately +3 volts). When the electron beam from the writing gun strikes the mesh coating, secondary electrons are emitted. This secondary emission creates a pattern of positive potential identical to the movement of the beam. Flood gun electrons are accelerated by this positive potential pattern and strike the phosphor screen, creating a visible display.

4-40. The storage mesh is pulsed with pulses of approximately 10 microseconds duration. These pulses erase the positive pattern on the storage mesh by discharging the mesh coating. Time required for this erasing operation is determined by the pulse repetition rate. The positive pattern on the mesh may also be neutralized manually by connecting the collector and storage meshes (erase). The high positive potential (approximately +156 volts) allows more uniform discharging of the surface. When the storage mesh is disconnected from the collector mesh and returned to +3 volts, the coated surface is at a uniformly equal potential of —9 volts. In both cases, the screen has no illumination. The pattern may be lost by the storage mesh fading positive and allowing the entire screen to be illuminated. This occurs when positive ions from the flood gun raise the surface potential of the storage mesh in random areas sufficiently to allow flood gun electrons to strike the screen.

4-41. PULSE CIRCUIT.

4-42. 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 flood gun driver and output pulser. The flood gun driver applies pulses to the accelerator of the CRT to control storage time of the display.

4-43. 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 CRT. The CRT collimator voltage is supplied by a linear amplifier and is controlled by the selection of the writing speed at the front panel.

4-44. STD AND FAST MODES.

4-45. 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 con-

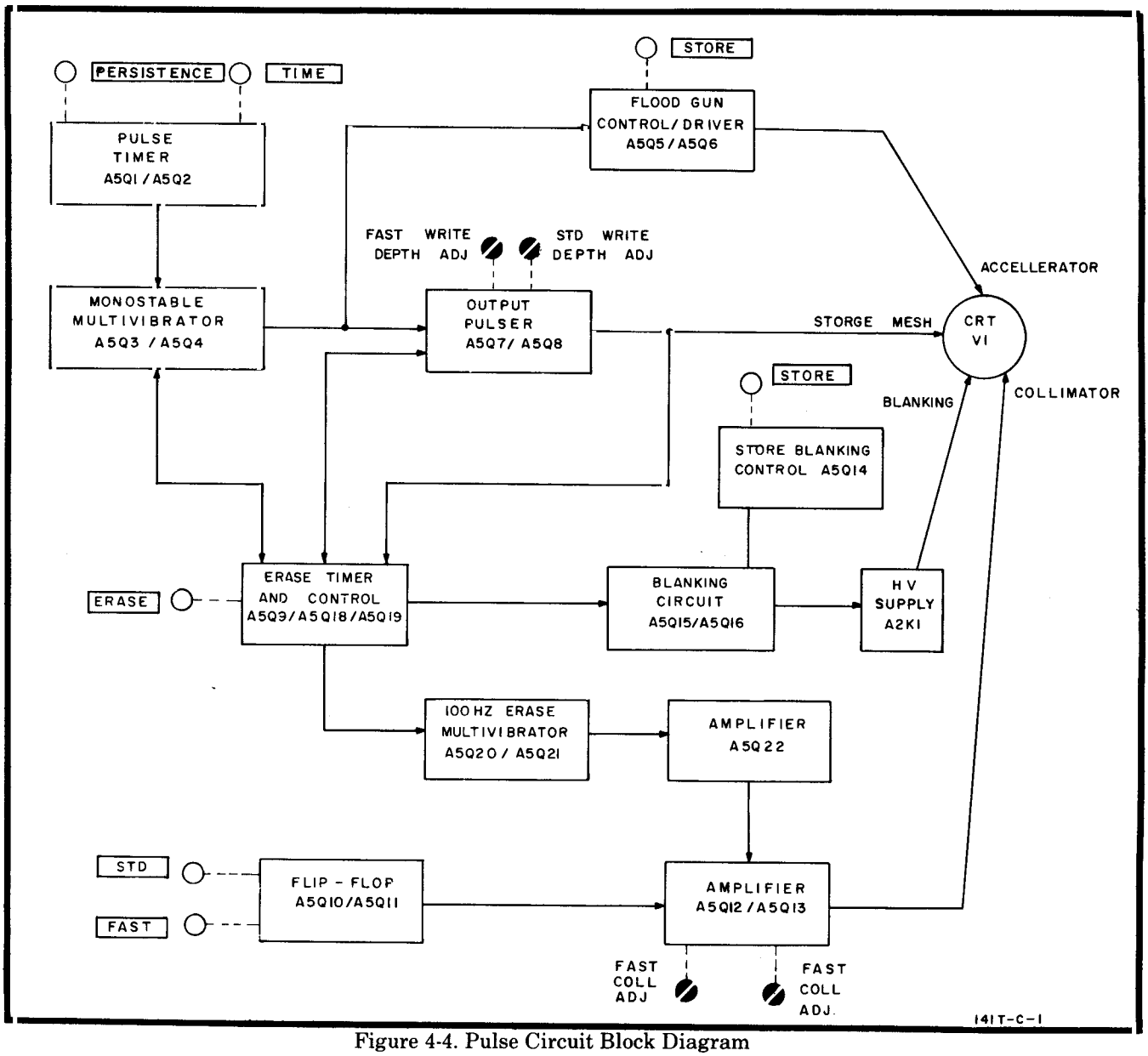


Figure 4-4. Pulse Circuit Block Diagram

trol. 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.

4-46. 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.

4-47. 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 STD 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.

4-48. Erase Timer. The erase timer circuits are in a quiescent state during operation in either STD 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.

4-49. When operating in the STD mode, 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 high voltage power supply board.

c. Zero volts on A5R17 reduces the output of amplifier A5Q7/A5Q8 by approximately —12 volts. A5Q18 turns on, turning A5Q19 off. 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. The erase multivibrator A5Q20/A5Q21 begins to free run at approximately 100 Hz. This signal is amplified through A5Q22 to drive A5Q12 and A5Q13 for an alternating collimation voltage to better erase the CRT.

d. The circuits remain in this state as long as the ERASE pushbutton is pressed.

4-50. When the ERASE pushbutton is released, the following circuit actions occur simultaneously:

a. A5Q9 is turned off.

b. The voltage on A5C8 begins to discharge from approximately 0 volt toward —12.6 volts.

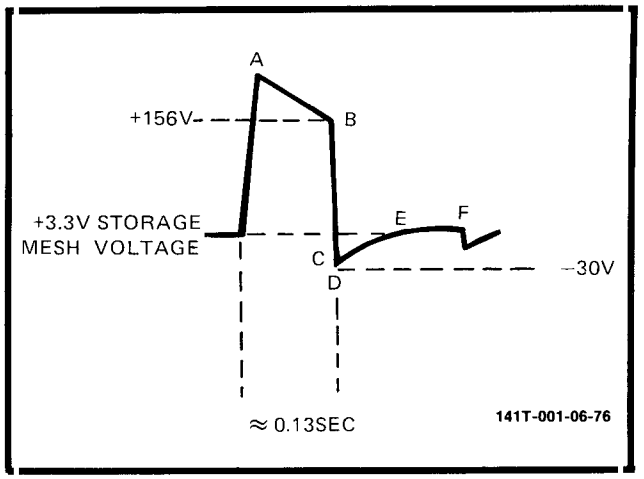


Figure 4-5. Erase Functional Waveform

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 standard write depth adjustment A5R10. When A5VR1 is no longer conducting, the ramp stops.

d. A5Q3 is held in saturation by A5R7. This establishes the output voltage of amplifier A5Q7/A5Q8.

e. When A5C8 voltage decreases to —12.6 volts, A5Q3 turns off (figure 4-5 point F), and the output pulser returns to the quiescent voltage of approximately 3.3 volts. A5Q20 and A5Q21 stop running and the collimator voltage returns to the nominal value.

4-51. Operation of the ERASE pushbutton when in the FAST mode is as described in paragraphs 4-49 and 4-50 except that the storage mesh potential drops less after releasing the ERASE pushbutton and remains constant until A5C8 voltage decreases to —12.6 volts. This action results from the forward-biasing of A5CR29 which prevents current flow through A5CR8 and allows the output of A5Q7 and A5Q8 to go to its maximum level as determined by the fast write depth adjustment.

4-52. At this point, all pulse circuits have returned to the condition they were in prior to pressing the ERASE pushbutton, and pulses from the pulse timer may again be applied to the storage mesh backing electrode.

4-53. PULSE CIRCUIT:STORE MODE.

4-54. Flood Gun 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.

4-55. 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.

4-56. The write gun is blanked by A5Q16 through the action of A5Q14 and A5Q15.

4-57. PULSE CIRCUIT:CONVENTIONAL MODE.

4-58. When the CONV pushbutton is pressed, a +100-volt potential is removed from A5R25. A5CR15 is forward biased by —100 volts through A5R26, A5CR14, and R25. This voltage divider sets 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.

4-59. When the oscilloscope is turned off, a display stored on the CRT is protected from unintentional erasure by A5Q17 and the associated circuit.

4-60. TRACE ALIGN.

4-61. 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.

4-62. PLUG-IN KIT FABRICATION.

4-63. 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 current capabilities in table 4-1.

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

SECTION V

PERFORMANCE CHECK AND ADJUSTMENTS

5-1. INTRODUCTION.

5-2. This section contains step-by-step procedures for checking the instrument specifications as given in table 1-1 of this manual. A table (performance check record) is provided at the end of the performance check for recording the measurements obtained in the first running of the procedure. This record may be used to compare measurements taken at later dates with the original. The procedures for making all internal adjustments are covered in paragraphs 5-21 through 5-33. A photograph showing the locations of all internal adjustment controls is presented in figure 5-1.

5-3. TEST EQUIPMENT.

5-4. Test equipment required for procedures in this section is listed in table 5-1. Test equipment equivalent to that recommended may be substituted, provided it meets the required characteristics listed in the table. For best results, use recently calibrated test equipment. Use a non-metallic screwdriver when making adjustments.

5-5. PERFORMANCE CHECK.

5-6. The following subparagraphs describe procedures to determine whether or not the instrument is operating within the specifications of table 1-1. This check can be used as part of an incoming inspection, as a periodic operational test, or to check calibration after repairs or adjustments have been made. Any one of the following checks can be made separately if desired.

5-7. The first time the performance check is made, enter the results on the performance check record at the end of the procedure. Remove the record from the manual and file it for future reference. Be sure to include the instrument serial number on the record for identification.

5-8. PRELIMINARY SETUP.

a. Install time base and vertical plug-ins.

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

Table 5-1. Recommended Test Equipment

Instrument		Characteristics Required	Required For
Type	Model		
Voltmeter Calibrator	HP 745A	Accuracy: 0.1% Output Voltages: 1V, 10V	Calibrator Performance Check Calibrator Adjustment
Digital Voltmeter	HP 3465A	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

c. Set vertical plug-in input switch to off or ground.

d. Set Model 141T controls as follows:

INTENSITY	MIN
PERSISTENCE	MIN
WRITING SPEED	STD

e. 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.

NOTE

The BEAM FINDER returns beam to CRT screen regardless of deflection potentials when used with the 1400-series time-domain plug-ins.

When used with the 8550-series frequency-domain plug-ins, the BEAM FINDER has no function.

a. Perform preliminary setup (paragraph 5-8).

b. Rotate vertical and horizontal position controls fully cw.

c. Press and hold BEAM FINDER pushbutton while slowly rotating INTENSITY cw until a trace becomes visible.

d. BEAM FINDER should return trace to CRT regardless of position of vertical or horizontal controls.

e. Adjust vertical and horizontal position controls until trace is centered on CRT display.

f. Release BEAM FINDER.

5-10. Paragraphs 5-11 through 5-14 contain preliminary operational checks of performance characteristics not listed in table 1-1. Because these characteristics are not specified, stated results are approximate.

5-11. FOCUS AND ASTIG.

5-12. FOCUS and ASTIG controls should give a sharply defined trace when set to approximately midrange positions. Adjust for sharpest trace possible and leave in that position.

5-13. TRACE ALIGN.

a. Perform preliminary setup (paragraph 5-8).

b. Adjust TRACE ALIGN until trace is parallel to center graticule line. This condition should occur near center of adjustment range.

5-14. CALIBRATOR.

a. Perform preliminary setup (paragraph 5-8).

b. Connect voltmeter calibrator to vertical input.

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

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

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

f. Disconnect voltmeter calibrator.

g. Connect Model 141T CAL 1V output to vertical input.

h. Observe deflection of 8 ±0.1 division.

i. Repeat steps a through g, using 10 volts from the voltmeter calibrator, 1 V/div vertical sensitivity, and CAL 10V.

5-15. VARIABLE PERSISTENCE.

a. Perform preliminary setup (paragraph 5-8).

b. Adjust INTENSITY for normal viewing level.

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

d. Slowly adjust PERSISTENCE cw and note that tail lengthens.

e. Rotate PERSISTENCE fully cw and turn INTENSITY fully ccw.

f. Observe that trace remains visible for one minute.

5-16. WRITING SPEED, FAST.

a. Perform preliminary setup (paragraph 5-8).

b. Set PERSISTENCE to MAX.

c. Set time base for 1 μsec/div sweep.

d. Set time base for single sweep.

e. Press FAST pushbutton and press ERASE. Observe that background appears foggy.

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

5-17. STORE TIME, FAST.

a. Perform preliminary setup (paragraph 5-8).

b. Rotate STORE TIME to MAX.

c. Press ERASE.

d. Trigger a single sweep and immediately press STORE.

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

5-18. WRITING SPEED, STANDARD.

a. Perform preliminary setup (paragraph 5-8).

b. Press STD.

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

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

5-19. STORE TIME, STANDARD.

a. Perform preliminary setup (paragraph 5-8).

b. Rotate STORE TIME to MAX.

c. Press ERASE.

d. Trigger a single sweep and immediately press STORE.

e. After 2 hours, rotate STORE TIME to MIN. Observe that trace is still visible.

5-20. 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.

5-21. ADJUSTMENTS.

5-22. The following paragraphs describe procedures to calibrate the instrument so that it will perform as specified in table 1-1. The entire adjustment procedure can be done in sequence, or any separate adjustment can be calibrated by following the steps outlined in the appropriate paragraph. The locations of adjustment controls are shown in figure 5-1, a photograph included at the end of the section on a foldout page.

5-23. Use a nonmetallic screwdriver and recently calibrated test equipment with characteristics as specified in table 5-1. After adjustments are complete, check instrument performance by doing the performance check procedure at the beginning of this section. If difficulty is encountered in making any adjustment, refer to Section VIII for troubleshooting procedures.

5-24. PRELIMINARY SETUP.

a. Install plug-ins in both compartments. Proper power supply regulation may not occur without load connected.

b. Remove top, bottom, left side and high voltage deck covers. All internal adjustments are identified in figure 5-1.

WARNING

Voltages present in the power supplies are dangerous.

c. Rotate INTENSITY, PERSISTENCE, and STORE TIME fully ccw.

d. Turn instrument on and allow 15 minutes warm-up period.

5-25. LOW VOLTAGE POWER SUPPLY ADJUSTMENT.

a. Perform preliminary setup (paragraph 5-24).

b. Adjust low voltage regulators as indicated in table 5-2.

NOTE

Because +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.

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

5-26. HIGH VOLTAGE POWER SUPPLY ADJUSTMENT.

a. Perform preliminary setup (paragraph 5-24).

b. Monitor +100 Vdc supply with digital voltmeter using voltage divider probe. Note exact reading.

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

c. Multiply value obtained in step b by 23.50.

d. While monitoring high voltage, —2350V MONITOR POINT (4), set HV adj A2R63, to obtain a voltage reading equal to result obtained in step c (—2350 ±25V).

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

5-27. INTENSITY LIMIT ADJUST.

NOTE

Method A must be used for Model 141T's with 1400-Series vertical and time-base plug-ins. Method B must be used for Model 141T's with spectrum analyzer plug-ins.

Method A.

a. Turn power off.

b. Remove 1400-Series plug-ins.

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

WARNING

Voltages present in the high voltage supply are dangerous.

d. Turn power ON.

e. Set intensity limit A2R65 fully ccw.

f. Set INTENSITY to 11 o'clock position.

g. Press STD pushbutton.

h. Slowly adjust A2R65 cw until a spot is just visible.

i. Turn INTENSITY fully ccw.

j. Turn power off.

k. Remove short from upper compartment connector J2.

l. Replace plug-ins.

Method B.

a. Turn power off.

b. Install spectrum analyzer plug-ins.

c. Set plug-ins for 0.5 ms SCAN mode and AUTO trigger.

d. Turn power ON.

e. Turn intensity limit A2R65 full ccw, extinguishing trace.

f. Set INTENSITY to 11 o'clock position.

g. Press STD pushbutton.

h. Set PERSISTENCE to MIN.

i. Turn A2R65 slowly cw until crest of trace is bright with rest of trace barely visible as shown in figure 5-1A.

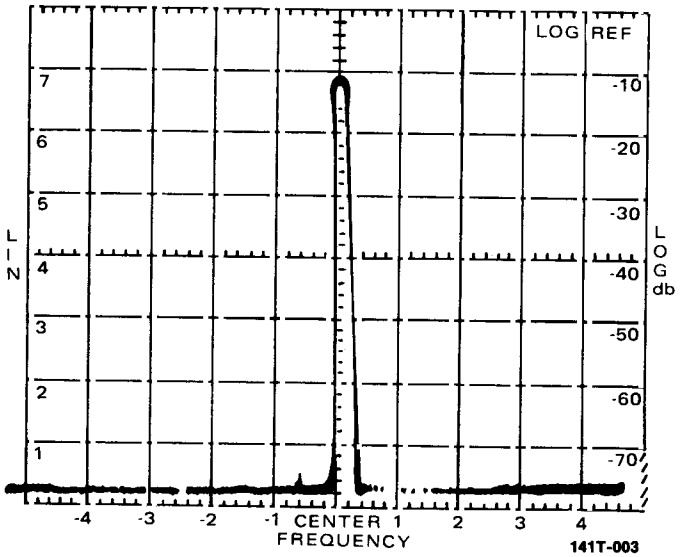


Figure 5-1A. Spectrum Analyzer Intensity Limit Adjust

5-28. GEOMETRY.

a. Perform preliminary setup (paragraph 5-24).

b. Set controls as follows:

trigger level ..... auto
trigger source ..... int (+)
sweep time ..... 0.5 msec/div
WRITING SPEED ..... STD.
PERSISTENCE ..... MIN

c. Slowly adjust INTENSITY for normal viewing level.

d. Press ERASE.

e. Press CONV.

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

g. Connect 400-kHz oscillator output to vertical amplifier input.

h. 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.

i. 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.

j. Set INTENSITY fully ccw.

k. Disconnect oscillator.

5-29. CALIBRATOR ADJUSTMENT.

a. Perform preliminary setup (paragraph 5-24).

b. Press STD.

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

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

e. Slowly increase INTENSITY to normal viewing level.

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

g. Disconnect voltmeter calibrator.

h. Connect Model 141T 10V CAL output to vertical amplifier input.

i. Set cal adj A2R47B to obtain exactly 8 divisions of vertical deflection.

5-30. PULSE CIRCUIT ADJUSTMENTS.

5-31. FAST MODE ADJUSTMENTS.

a. Perform preliminary setup (paragraph 5-24).

b. Press FAST pushbutton.

c. Turn INTENSITY and PERSISTENCE fully ccw.

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

e. Set fast write depth adj A5R14A fully ccw.

f. Set fast coll adj A5R14B so that entire flood gun illumination pattern is visible.

g. Adjust flood gun grid adj A5R14C to obtain most uniform CRT illumination. The normal flood gun grid adjustment is at or near 0 volt (A5R14C fully cw).

h. Adjust fast coll adj A5R14B so that flood gun illumination just fills graticule.

i. Set PERSISTENCE to MAX.

j. Press ERASE.

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

l. Adjust fast coll adj A5R14B in small increments. Erase and readjust fast write depth adj A5R14A (step k) between increments until uniform fogging is obtained.

m. Set controls as follows:

sweep time ..... 0.2 msec/div
sweep ..... normal (recurrent)
INTENSITY ..... fully ccw
PERSISTENCE ..... MIN

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

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

p. Adjust INTENSITY for normal viewing level.

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

r. Set time base for single sweep operation.

s. Set PERSISTENCE to MAX.

t. Increase INTENSITY gradually while erasing CRT until beam writes evenly, but not to point where beam is always on.

u. Press ERASE pushbutton until no trace remains.

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

NOTE

The 7.6 x 9.5 division rectangle is the minimum rectangle size allowable for this adjustment.

w. Rotate fast write depth adj A5R14A ccw in small increments. Leave A5R14A at point farthest ccw that permits trace to remain visible for 15 seconds.

5-32. STD. MODE ADJUSTMENTS.

a. Perform preliminary setup (paragraph 5-24).

b. Set INTENSITY fully ccw.

c. Set PERSISTENCE to MIN.

d. Set std write depth adj A5R10A fully ccw.

e. Press STD pushbutton.

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

g. Press ERASE for one second and release.

h. Turn std coll adj A5R10 fully ccw and then slowly cw until CRT face is uniformly illuminated to within 1 mm of aluminized CRT ring around perimeter of CRT. Collimator dimples may protrude up to 3 mm out from aluminized CRT ring but in no case may come into CRT graticule or nomenclature.

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

j. Set time base for recurrent sweep.

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

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

m. Adjust INTENSITY for normal viewing level.

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

o. Set time base for single sweep operation.

p. Set PERSISTENCE to MAX.

q. Increase INTENSITY gradually while erasing CRT until beam writes evenly, but not to the point where beam is always on.

r. Press ERASE. If CRT does not erase completely, rotate std write depth adj A5R10A, cw in 10° increments, pressing ERASE pushbutton each time. Repeat until CRT erases completely.

s. If CRT will not erase completely, adjust flood gun grid adj A5R14C slightly. Then recheck the FAST MODE and STD MODE adjustments. Repeat adjustments of A5R14C, FAST MODE, and STD MODE until CRT will erase properly.

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

5-33. This completes adjustment procedures. If satisfactory operation cannot be obtained, refer to Section VIII for troubleshooting information.

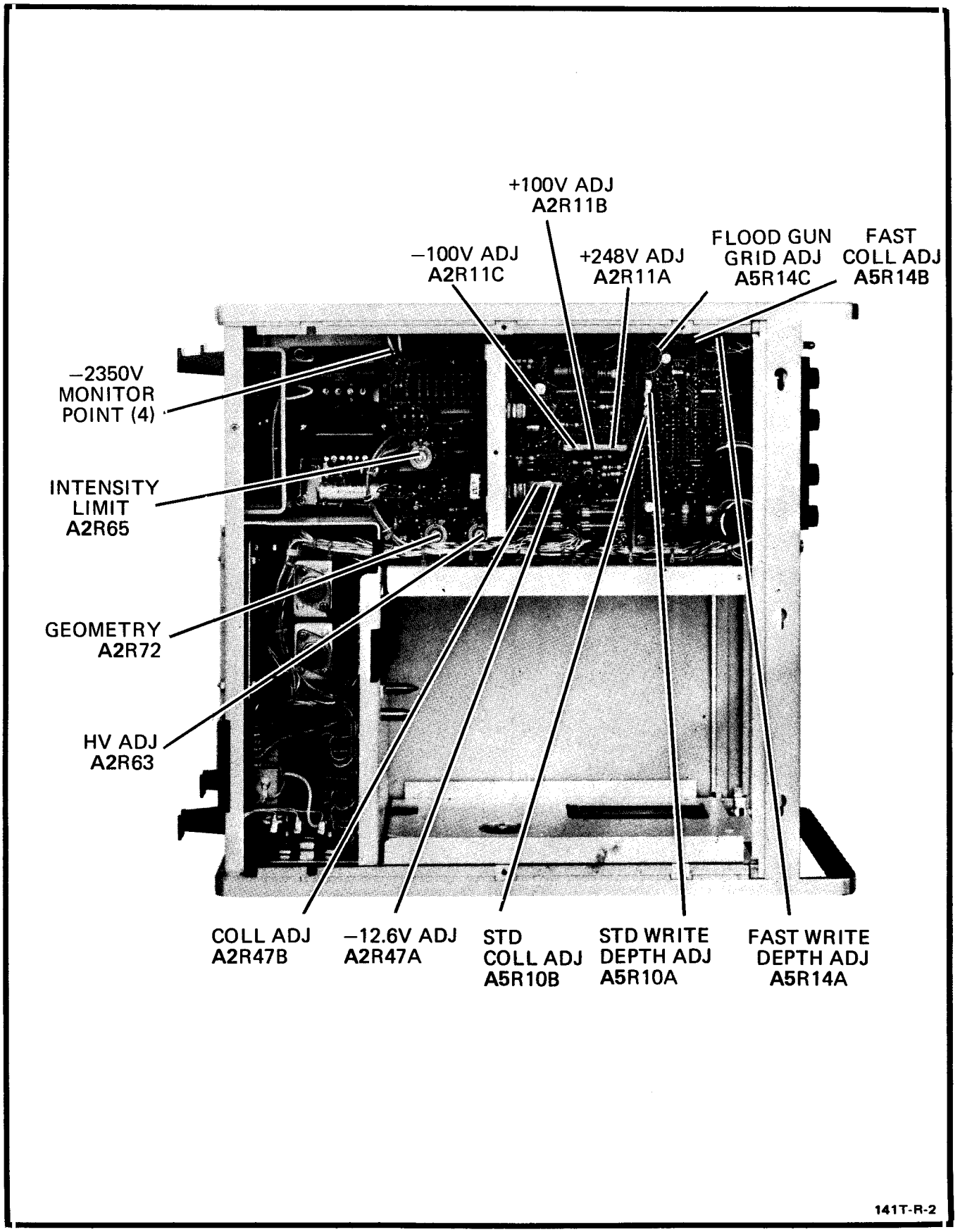


Figure 5-1. Adjustment Location

PERFORMANCE CHECK RECORD

141T

Instrument Serial Number _____

Paragraph Reference	Check	Specification	Measured
5-9	BEAM FINDER	Returns trace to screen.	YES NO
5-14	CALIBRATOR	8 divisions ±0.1 division.	——— Divisions
5-15	VARIABLE PERSISTENCE	Spot develops short tail.	YES NO
		Trace remains visible for one minute.	YES NO
5-16	WRITING SPEED, FAST	Trace writes and remains visible for 15 seconds	YES NO
5-17	STORE TIME, FAST	Trace can be stored for 15 minutes	YES NO
5-18	WRITING SPEED, STANDARD	Trace writes and remains visible for one minute.	YES NO
5-19	STORE TIME, STANDARD	Trace can be stored for 2 hours	YES NO

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 manufacturers' 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 items(s).

c. Quanity 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. Quanity 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	P	= peak	SIL	= silver
CER	= ceramic	INCL	= include(s)	PC	= printed (etched) circuit(s)	SL	= slide
CMO	= cabinet mount only	INS	= insulation(ed)	PF	= picofarads	SP	= single pole
COAX	= coaxial	INT	= internal	PHL	= Phillips	SPL	= special
COEF	= coefficient	K	= kilo (10^{3})	PIV	= peak inverse voltage(s)	ST	= single throw
COMP	= composition	KG	= kilogram	PNP	= positive-negative-positive	STD	= standard
CONN	= connector(s)	LB	= pound(s)	P/O	= part of	TA	= tantalum
CRT	= cathode-ray tube	LH	= left hand	PORC	= porcelain	TD	= time delay
CW	= clockwise	LIN	= linear taper	POS	= position(s)	TFL	= teflon
D	= deci (10^{-1})	LOG	= logarithmic taper	POT	= potentiometer(s)	TGL	= toggle
DEPC	= deposited carbon	LPF	= low-pass filter(s)	P-P	= peak-to-peak	THYR	= thyristor
DP	= double pole	LVR	= lever	PRGM	= program	TI	= titanium
DT	= double throw	M	= milli (10^{-3})	PS	= polystyrene	TNLDIO	= tunnel diode(s)
ELECT	= electrolytic	MEG	= mega (10^{6})	PWV	= peak working voltage	TOL	= tolerance
ENCAP	= encapsulated	MET FILM	= metal film			TRIM	= trimmer
EXT	= external	MET OX	= metal oxide	RECT	= rectifier(s)	U	= micro (10^{-6})
F	= farad(s)	MFR	= manufacturer	RF	= radio frequency	V	= volts
FET	= field-effect transistor(s)	MINAT	= miniature	RFI	= radio frequency interference	VAR	= variable
FH	= flat head	MOM	= momentary	RH	= round head or right hand	VDCW	= dc working volt(s)
FIL H	= fillister head	MTG	= mounting	RMO	= rack mount only	W	= watt(s)
FXD	= fixed	MY	= mylar	RMS	= root mean square	W/	= with
G	= giga (10^{9})	N	= nano (10^{-9})			WIV	= working inverse voltage
GE	= germanium	N/C	= normally closed			W/O	= without
GL	= glass	NE	= neon			WW	= wirewound
		N/O	= normally open				

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A0					
A1	00141-66515		DIODE BOARD ASSY	28480	00141-66515
A2	00141-66519		POWER SUPPLY BOARD ASSY	28480	00141-66519
A3	00141-61103		HIGH VOLTAGE TRIPLER ASSY	28480	00141-61103
A4			NOT ASSIGNED		
A5	00141-66520		PULSE CIRCUIT BOARD ASSY	28480	00141-66520
A6	00141-66502		HORIZONTAL DRIVER ASSY	28480	00141-66502
A7	5060-9421		ASSY:POWER MODULE	28480	5060-9421
B1	3160-0252	1	FAN:TUBE AXIAL 115V 50/60HZ 16W	92702	WS2107FL-570
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 600UF 200VDCW	56289	D32569
C4	0180-0214	1	C:FXD ELECT 275 UF +50-10% 200VDCW	56289	D 36037-DFP
C5	0180-0093	1	C:FXD ELECT 20UF 150VDCW	56289	D33193
C6	0180-0213	1	C:FXD ELECT 5000 UF +75-10% 25VDCW	56289	D39556
CR1	1901-0032	2	DIODE:SILICON 1N3209	04713	1N3209
CR2	1901-0032		DIODE:SILICON 1N3209	04713	1N3209
DS1	1450-0419	1	LIGHT:INDICATOR SELECTED NE-2H	28480	1450-0419
J1	1251-0054	2	CONNECTOR:FEMALE 24-CONTACT	28480	1251-0054
J2	1251-0054		CONNECTOR:FEMALE 24-CONTACT	28480	1251-0054
J3	1251-2357	1	SOCKET:3-PIN MALE POWER RECEPTACLE	82389	EAC-301
J4	1251-0202	2	CONNECTOR: BANANA JACK	83330	221B
J5	1251-0202		CONNECTOR: BANANA JACK	83330	221B
J6	1250-0083	1	CONNECTOR: BNC	02660	31-221-1020
J7	1510-0038	1	BINDING POST	28480	1510-0038
J8	1251-2366	1	CONNECTOR: R AND P 8 POSITIONS	71468	DCM 8W8S
J9	1251-2367	1	CONNECTOR: R & P, 8 INSERT POSITION	71468	DCM-8W8P
J10	1251-1286	1	CONNECTOR: R & P 12 CONTACT FEMALE	71468	DCM-17W5S
J10E1	1251-0180	3	INSERT: R & P CONNECTOR	08718	DM-53742-5001
J11	1251-2214	1	CONNECTOR: R & P 12 CONTACT MALE	71785	DCM-17W5P
J11E1	1251-0179	3	INSERT: R & P CONNECTOR	71468	DM-53740-5001
L1	5060-0435	1	COIL:ALIGNMENT Z AXIS	28480	5060-0435
MP1	5060-0736	2	FRAME ASSY	28480	5060-0736
MP3	00141-60205	1	PANEL:FRONT	28480	00141-60205
MP4	5060-0222	2	HANDLE ASSY:5H SIDE	28480	5060-0222
MP6	5060-8735	2	RETAINER HANDLE ASSY:OLIVE GRAY(STD)	28480	5060-8735
MP8	5060-0767	5	FOOT ASSY:FM	28480	5060-0767
MP14	5000-8727	2	SIDE COVER	28480	5000-8727
MP16	5060-8589	1	COVER ASSY:TOP 16L(OLIVE GRAY)	28480	5060-8589
MP17	5060-8713	1	BOTTOM COVER ASSY:16L FM(MINT GRAY)	28480	5060-8713
MP18	00141-60206	1	PANEL ASSY:REAR	28480	00141-60206
MP22	00140-24710	1	TOP PANEL SUPPORT	28480	00140-24710
MP23	00140-24711	1	BOTTOM PANEL SUPPORT	28480	00140-24711
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
MP34	0360-0015	2	BOARD:TERMINAL	76530	332-14-03-011
MP37	1200-0037	1	SOCKET:CRT 14-CONTACT	28480	1200-0037
MP38	1200-0044	4	INSULATOR: TSTR MOUNTING (TO-3), INCLUDES: SOCKET-TRANSISTOR	71785	293011
MP42	1200-0088	4	INSULATOR:DIODE	71785	293201
MP46	1200-0408	1	COVER:CRT SOCKET	28480	1200-0408
MP47	5020-0476	1	BEZEL:CRT	28480	5020-0476
MP48	5040-0440	1	COVER:CRT SOCKET	28480	5040-0440
MP49	5040-0508	1	SHIELD:LIGHT	28480	5060-053
MP50	5060-0428	1	FILTER ASSY:AIR	28480	5060-0428
MP56	00140-00104	1	GUSSET:SIDE	28480	00140-00104
MP57			NOT ASSIGNED		
MP58	00140-01201	1	BRACKET:LATCH	28480	00140-01201
MP59	00141-01209	2	BRACKET:FAN	28480	00141-01209
MP61	00140-01208	4	BRACKET:PANEL	28480	00140-01208
MP65	00140-01209	2	BRACKET:GUSSET	28480	00140-01209
MP67	00140-01210	2	BRACKET:TRANSISTOR (INCLUDES MP38)	28480	00140-01210
MP69	00140-24703	4	SUPPORT:PANEL BRACKET	28480	00140-24703

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
MP73	00140-29902	1	PANEL:EXTRUDED	28480	00140-29902
MP74	00141-00105	1	DECK:VERTICAL	28480	00141-00105
MP75	00141-00103	1	GUSSET:CENTER	28480	00141-00103
MP76	00141-00104	1	DECK:MAIN	28480	00141-00104
MP77	00141-01207	1	BRACKET:DIODE	28480	00141-01207
MP78	1400-0651	3	BRACKET:RESISTOR	28480	1400-0651
MP79	00141-01203	1	BRACKET:CAPACITOR	28480	00141-01203
MP88	00141-01204	1	BRACKET:RESISTOR	28480	00141-01204
MP89	00141-01208	1	BRACKET:RESISTOR	28480	00141-01208
MP90	00141-04101	1	COVER:CAPACITOR	28480	00141-04101
MP91	00141-04104	1	COVER:HIGH VOLTAGE BOARD	28480	00141-04104
MP92	00140-60602	1	SHIELD ASSY:CRT	28480	00140-60602
MP93	00141-04105	1	SIDE COVER:HIGH VOLTAGE BOARD	28480	00141-04105
MP94	00141-61206	1	BRACKET ASSY:CRT	28480	00141-61206
MP95	00180-01218	2	BRACKET:COIL	28480	00180-01218
MP97	00140-24712	1	SUPPORT:CRT SHIELD	28480	00140-24712
MP99	160B-110B	2	GUIDE:PLUG-IN	28480	160B-110B
MP105	1200-0050	10	CONTACT:CRT SOCKET	72825	9553-1
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	1520-0094	4	MOUNT:SHOCK	00000	OBD
MP121	5040-0421	2	INSULATOR COVER:POTENTIOMETER	28480	5040-0421
MP124	5000-0053	2	PLATE:FLUTED ALUMINUM	28480	5000-0053
MP125	00141-21001	4	FEET:REAR, LONG	28480	00141-21001
MP126	5000-8015	1	SHIELD:FAN	28480	5000-8015
Q1	1853-0252	1	TSTR:SI PNP	04713	SJ1798
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	2100-2962	1	R:VAR COMP 1.5 MEGOHM 30% LIN 1/2W	28480	2100-2962
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	2100-0445
R8	2100-0015	1	R:VAR COMP 500K OHM 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	3101-0056	1	SWITCH:TOGGLE DPDT	27191	8926K316
S3	3103-0009	1	SWITCH:THERMAL SPST	01295	20700L10-205
S4	3101-0011	1	SWITCH:SLIDE DPDT	82389	11A-1013
T1	9100-3285	1	TRANSFORMER:POWER	28480	9100-3285
TB2	0360-0015		BOARD:TERMINAL	76530	332-14-03-011
TB3	0360-0012	1	STRIP:TERMINAL, LUG TYPE	06540	628-13
V1	5083-2587	1	CATHODE RAY STORAGE TUBE	28480	5083-2587
W1	8120-1538	1	CABLE ASSY:POWER 7.5 FT.	28480	8120-1538
W2	00141-61632	1	CABLE:MAIN	28480	00141-61632
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
W10	00141-61627	1	CABLE ASSY	28480	00141-61627
W11	5060-0521	1	CABLE ASSY	28480	5060-0521
W11MP1	0510-0089	2	RING:RETAINING FOR 0.188" DIA SHAFT	79136	5100-18-C-MD
W11MP2	00140-23101	2	PIN:GUIDE	28480	00140-23101
W12	5060-1686	1	FLEX CIRCUIT (HV)	28480	5060-1686

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
A1	00141-66515	1	DIODE BOARD ASSY	28480	00141-66515
A1C1	0150-0052	8	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
A2	00141-66519	1	POWER SUPPLY BOARD ASSY	28480	00141-66519
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	150D475X9035B2-DYS
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	150D475X9035B2-DYS
A2C8	0160-0157	1	C:FXD MY 0.0047 UF 10% 200VDCW	56289	192P47292-PTS
A2C9	0180-0097	1	C:FXD TANT. 47 UF 10% 35VDCW	56289	150D476X9035S2-DYS
A2C10	0180-0138	1	C:FXD ELECT 100UF +100-10% 40VDCW	28480	0180-0138
A2C11	0180-0230	1	C:FXD ELECT 1.0 UF 20% 50VDCW	56289	150D105X0050A2-DYS
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	DA045-040CD
A2C14	0160-0151		C:FXD CER 4700 PF +80-20% 4000VDCW	71590	DA045-040CD
A2C15	0160-0151		C:FXD CER 4700 PF +80-20% 4000VDCW	71590	DA045-040CD
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	DA045-040CD
A2C19	0160-0151		C:FXD CER 4700 PF +80-20% 4000VDCW	71590	DA045-040CD
A2C20	0160-3448	1	C:FXD CER 1000 PF 10% 1000VDCW	56289	C067B251F102KS25-CD
A2C21	0160-3443		C:FXD CER 0.1UF 50VDCW	72982	8131-050-651-104Z
A2CR2	1901-0040	30	DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A2CR3	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A2CR4	1901-0096	1	DIODE:SILICON 120V	01295	UG-888
A2CR5	1910-0016	2	DIODE:GE 60 WIV	28480	1910-0016
A2CR8	1901-0026	2	DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
A2CR10	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A2CR11	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A2CR13	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A2CR14	1901-0040		DIODE:SILICON 50 MA 30 WV	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:GE 60 WIV	28480	1910-0016
A2CR18	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A2CR19	1912-0006	1	DIODE TUNNEL:GERMANIUM	03508	1N3718 SPEC
A2CR21	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A2CR22	1901-0049	1	DIODE:SILICON 50PIV	28480	1901-0049
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 50 MA 30 WV	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	2110-0067	1	FUSE:0.30A 250V	28480	2110-0067
A2F2	2110-0033	1	FUSE:0.75A 250V	75915	F02GR750A
A2F3	2110-0012	1	FUSE:0.5 AMP 250V	75915	312.500
A2F4	2110-0003	1	FUSE:CARTRIDGE 3 AMP 3 AG	75915	312003
A2K1			RELAY:CONSISTS OF:		
A2K1L1	0490-0191	1	COIL:RELAY 600 OHM NOM. 12V DC	71707	U-12P
A2K1S1	0490-0189	1	RELAY:REED SPST	95348	MR-306-1
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	14B52600F03
A2MP2	2110-0269	8	CLIP:FUSE 0.250" DIA	91506	6008-32CN

See introduction to this section for ordering information

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A2MP3	5040-0401	2	SUPPORT:CAPACITOR	28480	5040-0401
A2MP4	5040-0402	1	MOUNT: TRANSFORMER TOP	28480	5040-0402
A2MP5	5040-0430	1	MOUNT: TRANSFORMER BOTTOM	28480	5040-0430
A2MP6	01200-01101	1	HEAT SINK:TRANSISTOR	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	20	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	2N964
A2Q13	1853-0084	1	TSTR:SI PNP	80131	2N4918
A2Q14	1853-0034	1	TSTR:SI PNP(SELECTED FROM 2N3251)	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	28480	0761-0007
A2R4	0684-1021	9	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 1015
A2R6	0757-0044	2	R:FXD MET FLM 33.2K OHM 1% 1/2W	28480	0757-0044
A2R7	0757-0401	6	R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
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 OHM 1% 1/8W	28480	0757-0465
A2R10	0757-0370	2	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	28480	0757-0401
A2R14	0766-0033	1	R:FXD MET FLM 2000 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	28480	0761-0006
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	0757-0388	3	R:FXD FLM 30.1 OHM 1% 1/8W	28480	0757-0388
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	0757-0370		R: FXD MET FLM 49.9K OHM 1.0% 1/2W A2R31 AND A2R35 MUST BE REPLACED AS A SET FOR PROPER RESULTS.	28480	0757-0370
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	0757-0044		R: FXD MET FLM 33.2K OHM 1% 1/2W A2R31 AND A2R35 MUST BE REPLACED AS A SET FOR PROPER RESULTS.	28480	0757-0044
A2R36	0757-0764		R:FXD FLM 33.2K OHM 1% 1/4W	28480	0757-0764
A2R38	0727-0431	1	R:FXD DEPC 2.69K OHM 1% 1/2W	28480	0727-0431
A2R39	0757-0846		R:FXD MET FLM 22.1K OHM 1.0% 1/2W	28480	0757-0846
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	1	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	1	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	1	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 OHM 1% 1/8W	28480	0757-0428
A2R52	0761-0075	1	R:FXD MET OX 16K OHM 5% 1W	28480	0761-0075
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	0758-0054	1	R:FXD MET OX 330 OHM 5% 1/2W	28480	0758-0054
A2R58	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A2R59	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
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	0757-0057	1	R:FXD FLM 990K OHM 1% 1/2W	28480	0757-0057
A2R63	2100-0096	1	R:VAR COMP 1 MEGOHM 30% LIN 1/5W	28480	2100-0096
A2R64	0683-1535	1	R:FXD COMP 15K OHM 5% 1/4W	01121	CB 1535
A2R65	2100-2108	1	R:VAR COMP 1.5 MEGOHM 30% LIN 1/5W	28480	2100-2108
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	0761-0004	1	R:FXD MET OX 20K OHM 5% 1W	28480	0761-0004
A2R69	0757-0839	1	R:FXD MET FLM 10K OHM 1% 1/2W	28480	0757-0839
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 OHM 1% 1/8W	28480	0757-0465
A2R85	0684-2221	4	R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A2R86	0698-6286	1	R:FXD COMP 100 MEGOHM 10% 1/4W	28480	0698-6286
A2T1	00141-61102	1	TRANSFORMER ASSY	28480	00141-61102
A2V1	1940-0013	1	ELECTRON TUBE:82.0 +/- 1V	74276	Z82R7
A2V2	2140-0014	3	LAMP:GLOW 0.5 MILLIAMPS T-2 BULB	71744	4AB(NE-96)
A2V3	2140-0014		LAMP:GLOW 0.5 MILLIAMPS T-2 BULB	71744	4AB(NE-96)
A2V4	2140-0014		LAMP:GLOW 0.5 MILLIAMPS T-2 BULB	71744	4AB(NE-96)
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	1902-0064	1	DIODE BREAKDOWN:7.5V	28480	1902-0064
A2VR7					
A2VR7					
A3	00141-61103	1	HIGH VOLTAGE TRIPLER ASSY	28480	00141-61103
A3MP1			DELETED		
A3MP2	00181-47101	2	GASKET: SIDE	28480	00181-47101
A3MP3	00181-47102	1	GASKET: CENTER	28480	00181-47102
A4			NOT ASSIGNED		
A5	00141-66520	1	PULSE CIRCUIT BOARD ASSY	28480	00141-66520
A5C1	0160-0158	1	C: FXD MY 0.0056 UF 10% 200VDCW	56289	192P56292-PTS
A5C1	0160-0158	1	C:FXD MY 0.0056 UF 10% 200VDCW	56289	192P56292-PTS
A5C2	0160-2212	1	C:FXD MICA 560 PF 5% 300VDCW	28480	0160-2212
A5C3	0140-0204	1	C:FXD MICA 47 PF 5% 500VDCW	14655	RDM15E470J5C
A5C4	0140-0207	1	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 COGO 160J
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	150D226X9015B2-DYS
A5C10	0180-0376	1	C:FXD ELECT 0.47 UF 10% 35VDCW	56289	150D474X9035A2-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	150D225X0020A2-DYS
A5C14	0160-0157	1	C: FXD MY 4700 PF 10% 200VDCW	56289	192P47292PTS
A5C15	0180-1735	2	C: FXD ELECT 22 UF 10% 30VDCW	28480	0180-1735
A5C16	0180-1735		C: FXD ELECT 22 UF 10% 30VDCW	28480	0180-1735
A5C17	0150-0052		C: FXD CER 0.05 UF 20% 400VDCW	56289	33C17A
A5CR1	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5CR2	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5CR3	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5CR4	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5CR5	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5CR6	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5CR7	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5CR8	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5CR9	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5CR10	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5CR11	1901-0040		DIODE:SILICON 50 MA 30 WV	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

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
A5CR15			NOT ASSIGNED		
A5CR16	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5CR17	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5CR18	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5CR19	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5CR20	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5CR21	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5CR22	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5CR23	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5CR24	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5CR25	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5CR26	1901-0418	1	DIODE:SI 3A 400PRRV	04713	SR1846-12
A5CR27	1901-0033		DIODE:SILICON 100MA 180WV	07263	FD3369
A5CR28	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5CR29	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5L1	9100-1630	1	COIL/CHOKE 51.0 UH 5%	28480	9100-1630
A5Q1	1853-0020	1	TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A5Q2	1855-0317	1	TSTR:UNIJUNCTION SI	04713	MU4894
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
A5Q18	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A5Q19	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A5Q20	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A5Q21	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A5Q22	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A5R1	0757-0473	3	R:FXD MET FLM 221K OHM 1% 1/8W	28480	0757-0473
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	0757-0401		R:FXD FLM 100 OHM 1% 1/8W	24546	C4-1/8-T0-101-F
A5R5	0684-2221		R:FXD COMP 2200 OHM 10% 1/4W	01121	CB 2221
A5R6	0684-4731	1	R:FXD COMP 47K OHM 10% 1/4W	01121	CB 4731
A5R7	0684-2231	3	R:FXD COMP 22K OHM 10% 1/4W	01121	CB 2231
A5R8	0698-3155	1	R:FXD MET FLM 4.64K OHM 1% 1/8W	28480	0698-3155
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 X 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		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 X 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	3	R:FXD COMP 10 MEGOHM 10% 1/4W	01121	CB 1061
A5R19	0684-4741	2	R:FXD COMP 470K OHM 10% 1/4W	01121	CB 4741
A5R20	0698-4009	1	R:FXD FLM 50K OHM 1% 1/8W	28480	0698-4009
A5R21	0757-0476	2	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	0757-0128
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

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A5R37	0684-1051		R:FXD COMP 1MEGOHM 1% 1/4W	01121	CB 1051
A5R38	0684-4721	7	R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
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	5	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	1	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
A5R65	0684-1041		R:FXD COMP 100K OHM 10% 1/4W	01121	CB 1041
A5R66	0684-2231		R:FXD COMP 22K OHM 10% 1/4W	01121	CB 2231
A5R67	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A5R68	0684-6831	2	R:FXD COMP 68K OHM 10% 1/4W	01121	CB 6831
A5R69	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A5R70	0684-3321	2	R:FXD COMP 3300 OHM 10% 1/4W	01121	CB 3321
A5R71	0684-6831		R:FXD COMP 68K OHM 10% 1/4W	01121	CB 6831
A5R72	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A5R73	0684-3321		R:FXD COMP 3300 OHM 10% 1/4W	01121	CB 3321
A5R74	0684-2231		R:FXD COMP 22K OHM 10% 1/4W	01121	CB 2231
A5R75	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A5R76	0683-1555	1	R:FXD COMP 1.5 MEGOHM 5% 1/4W	01121	CB 1555
A5R77	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A5R80	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A5R81	0683-5635	1	R:FXD 56K OHM 5% 1/4W	01121	CB 5635
A5S1	3101-1259	1	SWITCH:6 SECTIONS	28480	3101-1259
A5VR1	1902-3104	1	DIODE:BREAKDOWN 5.62V 5%	04713	SZ10939-110
A5VR2	1902-0597		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
A6L1	9170-0029	2	CORE:MAG, SHIELDING BEAD	02114	56-590-65A2/4A
A6L2	9170-0029		CORE:MAG, SHIELDING BEAD	02114	56-590-65A2/4A
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	28480	0757-0401
A6R2	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
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	28480	0757-0401
A7	0960-0443	1	ASSY:POWER MODULE	28480	0960-0443
A7E1	5020-8122	1	LINE VOLTAGE SELECTION CARD	28480	5020-8122
A7F1	2110-0014		FUSE: CARTRIDGE 4 AMP 125V SLOW BLOW (100V OR 120V OPERATION ONLY)	75915	313004
A7F1	2110-0303	1	FUSE: CARTRIDGE 2 AMP 250V SLOW BLOW (220V OR 240V OPERATION ONLY)	71400	MDX-24

See introduction to this section for ordering information

Table 6-3. List of Manufacturers' Codes

MFR NO.	MANUFACTURER NAME	ADDRESS	ZIP CODE
	NO M/F DESCRIPTION FOR THIS MFG NUMBER		
00000	U.S.A. COMMON	ANY SUPPLIER OF U.S.A.	
01121	ALLEN BRADLEY CO.	MILWAUKEE, WIS.	53204
01295	TEXAS INSTRUMENTS INC. SEMICONDUCTOR COMPONENTS DIV.	DALLAS, TEX.	75231
03508	G.E. CO. SEMICONDUCTOR PROD. DEPT.	SYRACUSE, N.Y.	13201
04713	MOTOROLA SEMICONDUCTOR PROD.INC.	PHOENIX, ARIZ.	85008
06540	AMATOM ELECT. HARDWARE CO. INC.	NEW ROCHELLE, N.Y.	10801
07263	FAIRCHILD CAMERA & INST. CORP. SEMICONDUCTOR DIV.	MOUNTAIN VIEW, CALIF.	94040
08718	NO M/F DESCRIPTION FOR THIS MFG NUMBER		
14655	CORNELL DUBLIER ELECT. DIV.FEDERAL PACIFIC ELECT. CO.	NEWARK, N.J.	07105
26365	GRIES REPRODUCER CORP.	NEW ROCHELLE, N.Y.	10802
27191	CUTLER-HAMMER INC. POWER DIST. & CONTROL DIV.	MILWAUKEE, WISC.	53216
28480	HEWLETT-PACKARD CO. CORPORATE HQ	YOUR NEAREST HP OFFICE	
56289	SPRAGUE ELECTRIC CO.	N. ADAMS, MASS.	01247
58474	SUPERIOR ELECTRIC CO. THE	BRISTOL, CONN.	06010
71400	BUSSMANN MFG. DIV. MC GRAW-EDISON CO.	ST. LOUIS, MO.	63017
71468	ITT CANNON ELECT. INC.	LOS ANGELES, CALIF.	90031
71590	GLOBE UNION INC. CENTRALAB DIV.	MILWAUKEE, WISC.	53201
71707	COTO COIL CO. INC.	PROVIDENCE, R.I.	02905
71744	CHICAGO MINIATURE LAMP WORKS	CHICAGO, ILL.	60640
71785	CINCH MFG. CO. DIV TRW INC.	ELK GROVE VILLAGE, ILL.	
72825	EBY HUGH H. INC.	PHILADELPHIA, PA.	19144
72982	ERIE TECHNOLOGICAL PROD. INC.	ERIE, PA.	16512
74276	SIGNALITE INC.	NEPTUNE, N.J.	07753
75915	LITTELFUSE INC.	DES PLAINES, ILL.	60016
76530	CINCH MONADNOCK MILLS DIV. TRW INC.	CITY OF INDUSTRY, CALIF.	91746
79136	WALDES KOHINOOR INC.	LONG IS. CITY, N.Y.	11101
80131	ELECTRONIC INDUSTRIES ASSOCIATION	WASHINGTON D.C.	20006
82142	AIRCO SPEER ELECT. COMP.	DU BOIS, PA.	15801
82389	SWITCHCRAFT INC.	CHICAGO, ILL.	60630
83330	SMITH HERMAN H. INC.	BROOKLYN, N.Y.	11207
91418	RADIO MATERIALS CO.	CHICAGO, ILL.	60646
91506	AUGAT INC.	ATTLEBORO, MASS.	02703
92702	IMC MAGNETICS CORP.	WESTBURY, L.I., N.Y.	11590
95348	GORDOS CORP.	BLOOMFIELD, N.J.	07003
97464	INDUSTRIAL RETAINING RING CO.	IRVINGTON, N.J.	07111

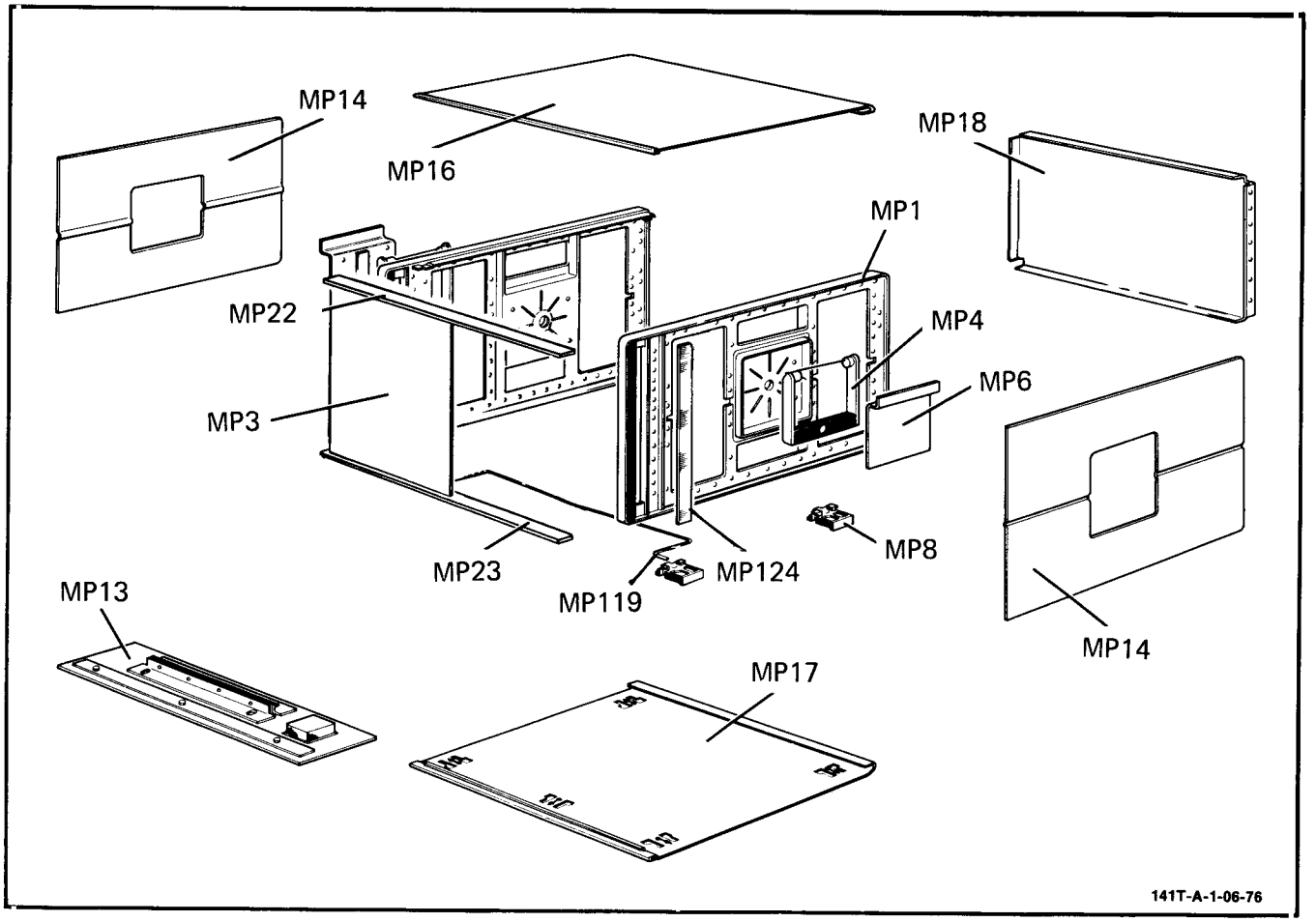


Figure 6-1. Cabinet Parts, Exploded View

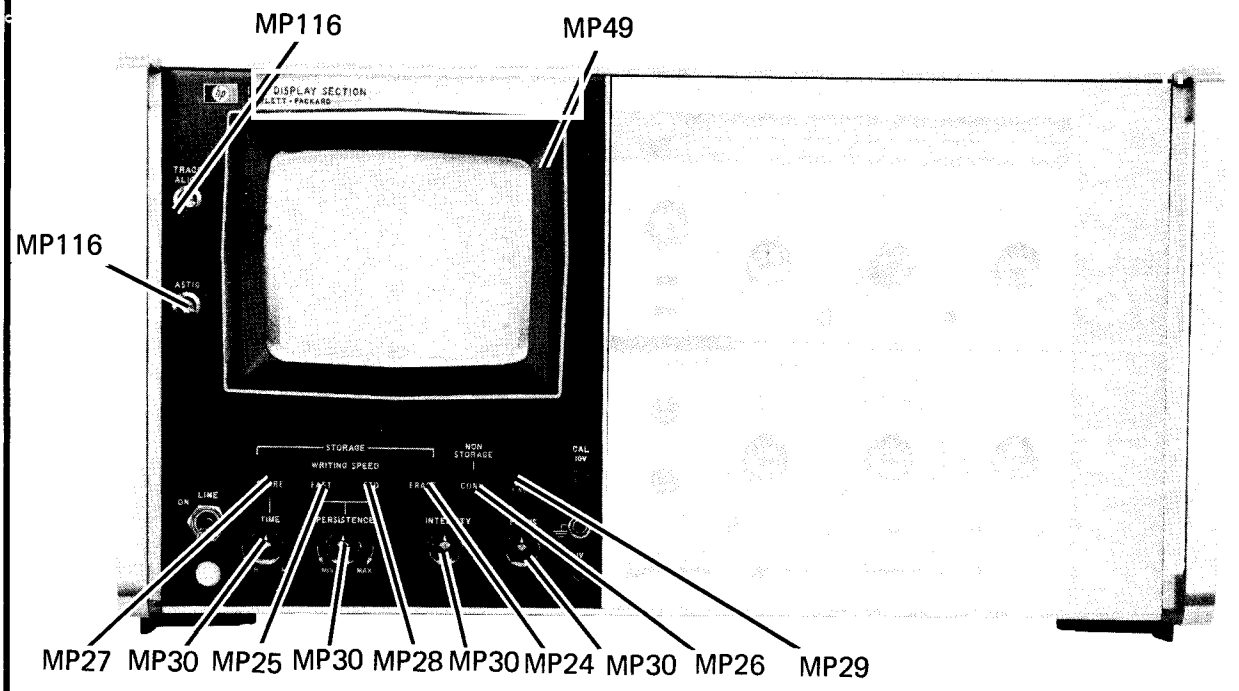


Figure 6-2. Mechanical Parts, Front View

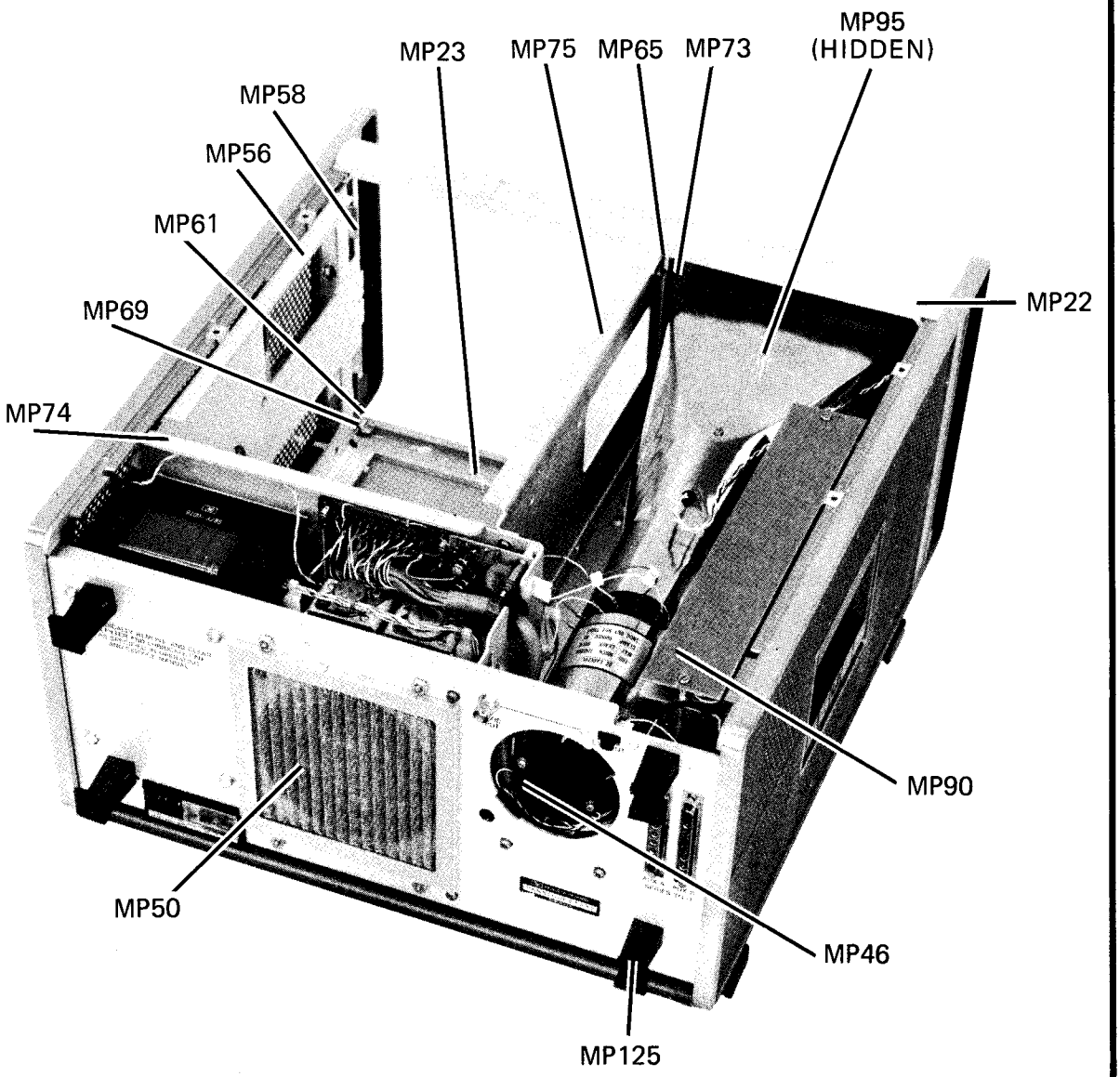


Figure 6-3. Mechanical Parts, Rear View

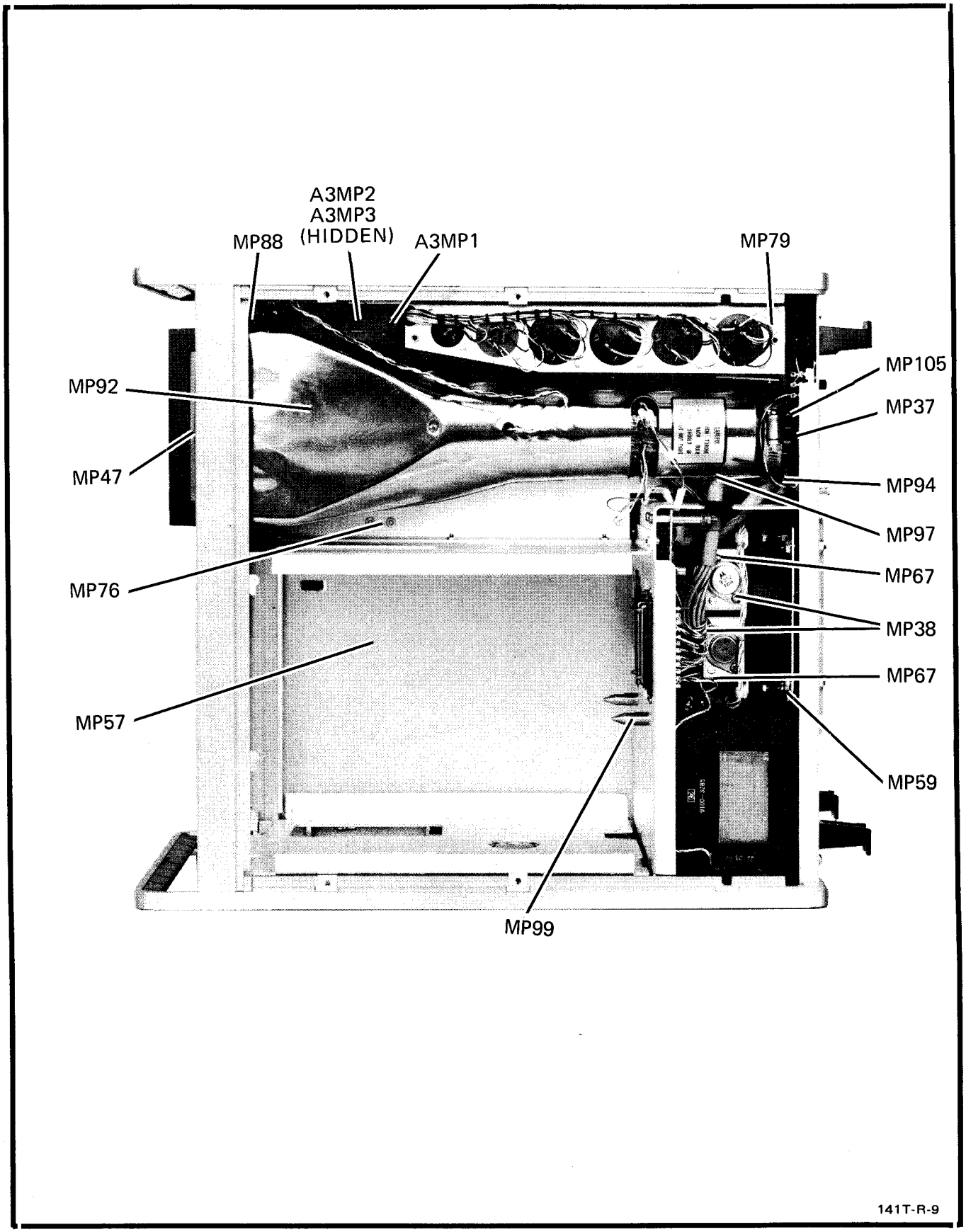


Figure 6-4. Mechanical Parts, Top View

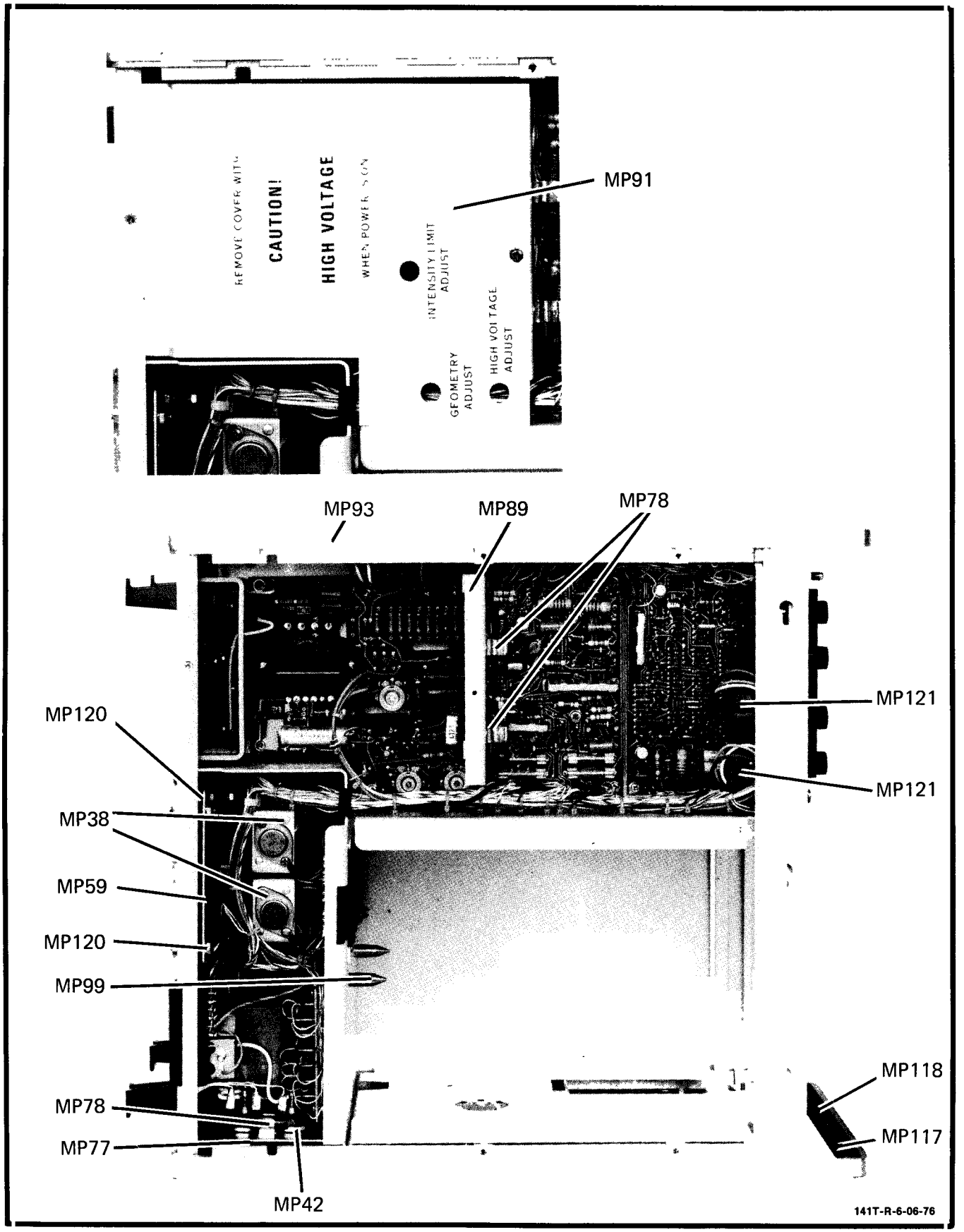


Figure 6-5. Mechanical Parts, Bottom View

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. Description of special options and standard options are also in this section.

7-3. MANUAL CHANGES.

7-4. This manual applies directly to the instrument having the same serial prefix shown on the manual title page. If the serial prefix of the instrument is not the same as the one on the title page, find your serial prefix in table 7-1 and make the changes to the manual that are listed for that serial prefix. When making changes listed in table 7-1, make the change with the highest number first. Example: if backdating changes 1, 2, and 3 are required for your serial prefix, do change 3 first, then change 2, and finally change 1. If the serial prefix of the instrument is not listed either in the title page or in table 7-1, refer to an enclosed MANUAL CHANGES sheet for updating information. Also, if a MANUAL CHANGES sheet is supplied, make all indicated ERRATA corrections.

Table 7-1. Manual Changes

Serial Prefix	Make Changes
950—, 973—	12 through 1
1047A	12 through 2
1112A	12 through 3
1113A	12 through 4
1141A	12 through 5
1145A	12 through 6
1147A	12 through 7
1218A	12 through 8
1223A, 1232A	12 through 9
1250A, 1315A, 1320A,	12 through 10
1337A	12 and 11
1502A	12

CHANGE 1

Paragraph 4-18,
Sentence 5: Change R11 to A2R42.
Table 6-2,
A2: Change to HP Part Number 00141-66514, Qty 1; POWER SUPPLY BOARD ASSY; Mfr. Code 28480; Mfr. Part No. 00141-66514.
Add: A2R42; HP Part Number 0811-1746; Qty 1; R: FXD WW 0.36 OHM 5% 2W; Mfr. Code 28480; Mfr. Part Number 0811-1746.

Figures 8-8, 8-10,
Add: R42 (between R3 and R46 on A2 assembly photo).
Add: R42 (0.36 ohms) between the anode of A2CR16 and the base of A2Q10.

CHANGE 2

Table 6-2,
MP18: Change to HP Part Number 00141-60202.
FL1: Change to HP Part Number 9100-2818; Qty 1; FILTER:LINE 115/230 VAC; Mfr. Code 56289; Mfr. Part Number JN10-1991A1.
J3: Change to HP Part Number 1251-0148, Qty 1; J:NSR P/O FL1; Mfr. Code 87930; Mfr. Part Number 1065-1.
S4: Change to HP Part Number 3101-0011; Qty 1; SWITCH: SLIDE DPDT; Mfr. Code 82389; Mfr. Part Number 11A-1013.
W1: Change to HP Part Number 8120-0078; Qty 1; CABLE ASSY: CORD SET (7.5'); Mfr. Code 70903; Mfr. Part Number KH-4147.

CHANGE 3

Table 6-2,
Delete: J10, J10E1, J11, J11E1.
Delete: W11, W11MP1, W11MP2.
Section VIII,
Delete: Auxilliary B portion of figure 8-7.

CHANGE 4

Table 6-2,
MP3: Change to HP Part Number 00141-00212; Qty 1; PANEL:FRONT; Mfr. Code 28480; Mfr. Part Number 00141-00212.
MP6: Change to HP Part Number 5060-0765; Qty 2; RETAINER: HANDLE ASSY; Mfr. Code 28480; Mfr. Part Number 5060-0765.
MP13: Change to HP Part Number 5060-0777; Qty 2; KIT: RACK MOUNT; Mfr. Code 28480; Mfr. Part Number 5060-0777.
MP14: Change to HP Part Number 5000-0747; Qty 2; COVER: SIDE; Mfr. Code 28480; Mfr. Part Number 5000-0747.
MP16: Change to HP Part Number 5060-0740; Qty 1; COVER ASSY: TOP; Mfr. Code 28480; Mfr. Part Number 5060-0740.
MP17: Change to HP Part Number 5060-0752; Qty 1; COVER ASSY: BOTTOM; Mfr. Code 28480; Mfr. Part Number 5060-0752.
MP22: Change to HP Part Number 00141-24701; Qty 1; SUPPORT: TOP PANEL; Mfr. Code 28480; Mfr. Part Number 00141-24701.

MP23: Change to HP Part Number 00141-24702; Qty 1; SUPPORT: BOTTOM PANEL; Mfr. Code 28480; Mfr. Part Number 00141-24702.
MP49: Change to HP Part Number 5040-0444; Qty 1; SHIELD: LIGHT; Mfr. Code 28480; Mfr. Part Number 5040-0444.

CHANGE 5

Table 6-2,
A2: Change to HP Part Number 00141-66518; Qty 1; POWER SUPPLY BOARD ASSY; Mfr. Code 28480; Mfr. Part Number 00141-66518.
B1: Change to HP Part Number 3160-0218; Qty 1; FAN: TUBEAXIAL 50/60 HZ; Mfr. Code 28480; Mfr. Part Number 3160-0218.
Delete: A2R86.
Figures 8-8, 8-12,
Delete: R86.
Figure 8-13,
Delete: A2R86.

CHANGE 6

Table 6-2,
MP125: Change to HP Part Number 5040-0447; Qty 4; FEET: REAR LONG; Mfr. Code 18480; Mfr. Part Number 5060-0447.

CHANGE 7

Table 6-2,
A5: Change to HP Part Number 00141-66513; Qty 1; PULSE CIRCUIT BOARD ASSY; Mfr. Code 28480; Mfr. Part Number 00141-66513.
V1: Change to HP Part Number 5083-2572; Qty 1; CATHODE RAY STORAGE TUBE; Mfr. Code 28480; Mfr. Part Number 5083-2572.
A5: Change to HP Part Number 00141-66513; Qty 1; PULSE CIRCUIT BOARD ASSY; Mfr. Code 28480; Mfr. Part Number 00141-66513.
Add: A5C9; HP Part Number 0160-0154; Qty 1; C: FXD MICA MY 0.0022 UF 10% 200 VDCW; Mfr. Code 56289; Mfr. Part Number 192P22292-PTS.
Delete: A5C14, A5C15, A5C16, A5C17.
Delete: A5CR28, A5CR29.
Delete: A5Q18, A5Q19, A5Q20, A5Q21, A5Q22.
A5R7: Change to HP Part Number 0684-1041; Qty 5; R: FXD COMP 100K OHM 10% 1/4W; Mfr. Code 01121; Mfr. Part Number CB 1041.
Add: A5R39; HP Part Number 0684-1061; Qty 1; R: FXD COMP 10 MEGOHM 10% 1/4W; Mfr. Code 01121; Mfr. Part Number CB 1061.
Add: A5R40; HP Part Number 0684-4731; Qty 1; R: FXD COMP 47K OHM 10% 1/4W; Mfr. Code 01121; Mfr. Part Number CB 4731.
Delete: A5R65, A5R67, A5R68, A5R70, A5R71, A5R72, A5R73, A5R74, A5R75, A5R76, A5R77, A5R80.
Figure 8-14,
Replace figure 8-14 with figure 7-1.
Figure 8-16,
Replace figure 8-16 with figure 7-2.

CHANGE 8

Table 1-1,
Change Power Requirements to: 115 or 230 volts, ±10%, 50 to 60 Hz, normally less than 285 watts (varies with plug-in units).
Paragraph 2-7,
Replace with the following: 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.

Paragraph 2-7a,
Add the following paragraph (2-7a) after paragraph 2-7: 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 is accessible by removing the bottom cover of the instrument.
Figure 2-1,
Delete figure 2-1.
Paragraph 4-5,
Change first sentence to read: The low-voltage supply uses 115 or 230 volts ac (rear panel switch), single phase, 50-60 Hz.
Table 6-2,
Delete: A7.
Add: F1; HP Part Number 2110-0014; Qty 1; FUSE: CARTRIDGE 4 AMP 125V SLOW BLOW; Mfr. Code 71400; Mfr. Part Number MDX-4.
Add: F1; HP Part Number 2110-0303; Qty 1; FUSE: CARTRIDGE 2 AMP 250V SLOW BLOW; Mfr. Code 71400; Mfr. Part Number MDX-2A.
Add: FL1; HP Part Number 9100-3173; Qty 1; FILTER:LINE 230 VAC 10% 50-60 Hz; Mfr. Code 56289; Mfr. Part Number JN10-2270A.
Add: J3; HP Part Number 1251-2357; Qty 1; CONNECTOR:POWER 3 PIN MALE; Mfr. Code 82389; Mfr. Part Number EAC-301.
MP18: Change to HP Part Number 00141-60203; Qty 1; PANEL ASSY:REAR; Mfr. Code 28480; Mfr. Part Number 00141-60203.
Add: S2; HP Part Number 3101-1234; Qty 1; SWITCH: SLIDE 115/230V DPDT; Mfr. Code 82389; Mfr. Part Number 11A-1242A.
T1: Change to HP Part Number 9100-0184; Qty 1; TRANSFORMER: POWER; Mfr. Code 28480; Mfr. Part Number 9100-0184.

W1: Change to HP Part Number 8120-1545; Qty 1; CABLE ASSY: AC POWER CORD 7.5 FT; Mfr. Code 70903; Mfr. Part Number KH 7171.
W2: Change to HP Part Number 00141-61621; Qty 1; CABLE: MAIN; Mfr. Code 28480; Mfr. Part Number 00141-61621.
Delete: A2C20.
Delete: A7, A7E1, A7F1.

Figure 8-10,
Replace power input (line voltage) section with figure 7-3.
Delete: C20 (between CR17 plate and ground).

CHANGE 9

Table 6-2,
MP97: Change to HP Part Number 01200-44703.

CHANGE 10

Table 6-2,
Add: A5CR15; HP Part Number 1901-0033; Qty 1; DIODE: SILICON 100 MA 180 WV; Mfr. Code 07263; Mfr. Part Number FD3369.
Delete: A5R81.

Figure 8-16,
Replace A5R81 with A5CR15.

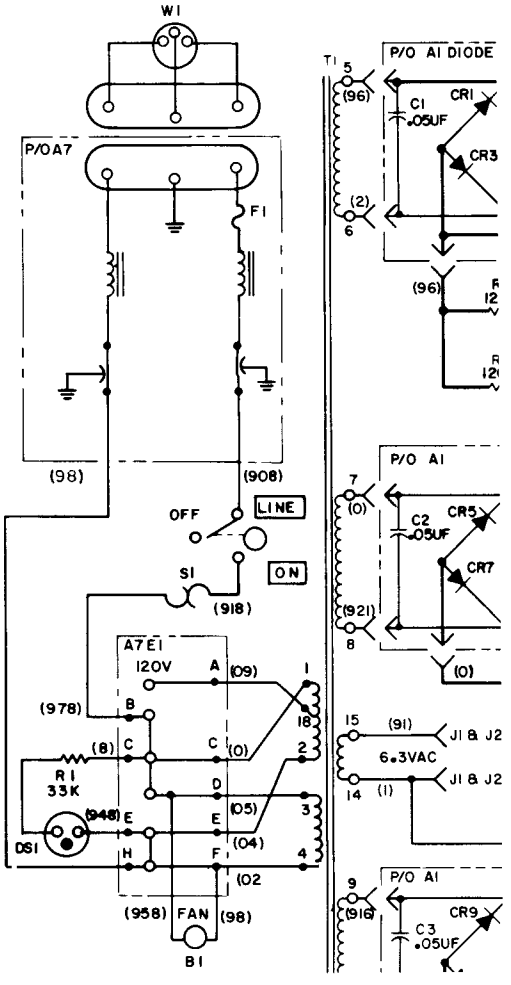


Figure 7-1A. Effect of Change 11

CHANGE 11

Table 6-2,
S1: Change to HP Part No. 3101-0030; Qty 1; SWITCH TOGGLE SPST ON - NONE - OFF; Mfr. Code 27191; Mfr. Part Number 8906K368.

Figure 8-10,
Modify the input ac power circuit according to figure 7-1A.

CHANGE 12

Table 6-2,
MP59: Change HP Part No. and Mfr. Part No. to 00140-01206.
MP74: Change HP Part No. and Mfr. Part No. to 00141-00102.
MP120: Change HP Part No. to 1520-0042.

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.

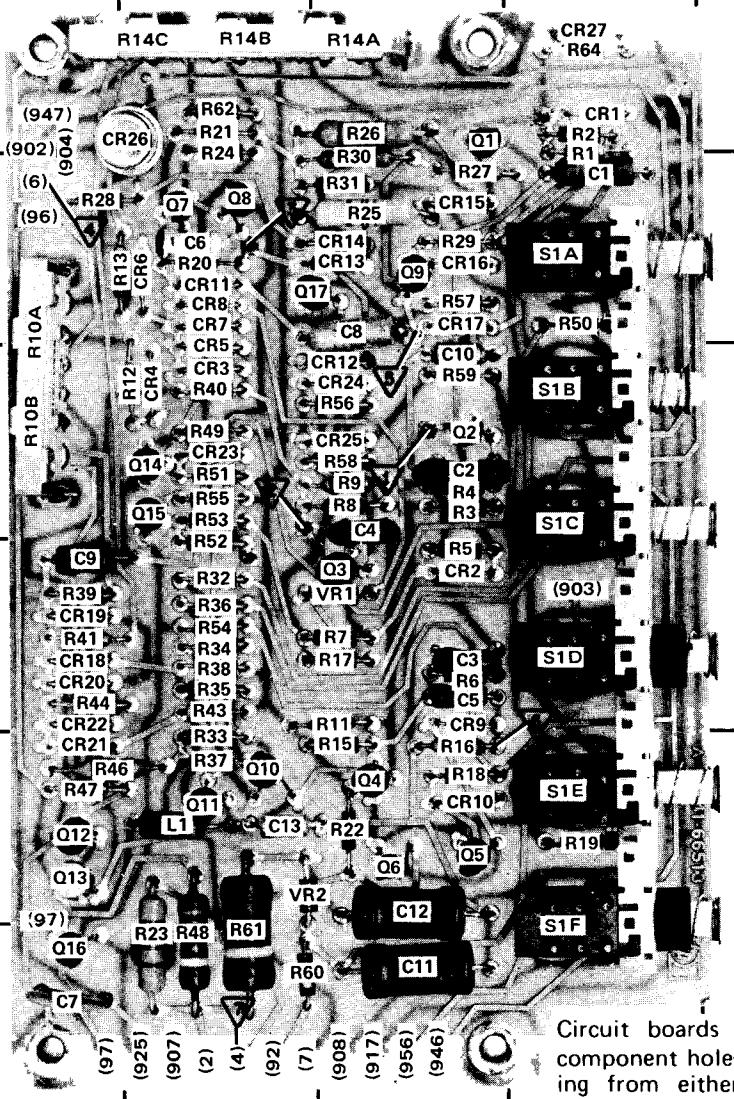
7-10. Standard options are modifications installed on HP instruments at the factory and are available on request. Contact the nearest Hewlett-Packard Sales/Service Office for information concerning standard options.

7-11. Standard options presently available are described in the following paragraphs.

7-12. Option 009 provides for a remote erase function through a BNC connector on the rear panel. Complete wiring information is shown in figure 7-4 and replaceable parts are listed in table 7-2.

Table 7-2. Option 009 Replaceable Parts

HP Part No.	Description
00141-61628	Cable: remote erase
00141-66517	Remote ERASE board
1250-0083	Connector: BNC female
1901-0040	Diode
0490-0199	Switch: relay
0490-0191	Coil: relay

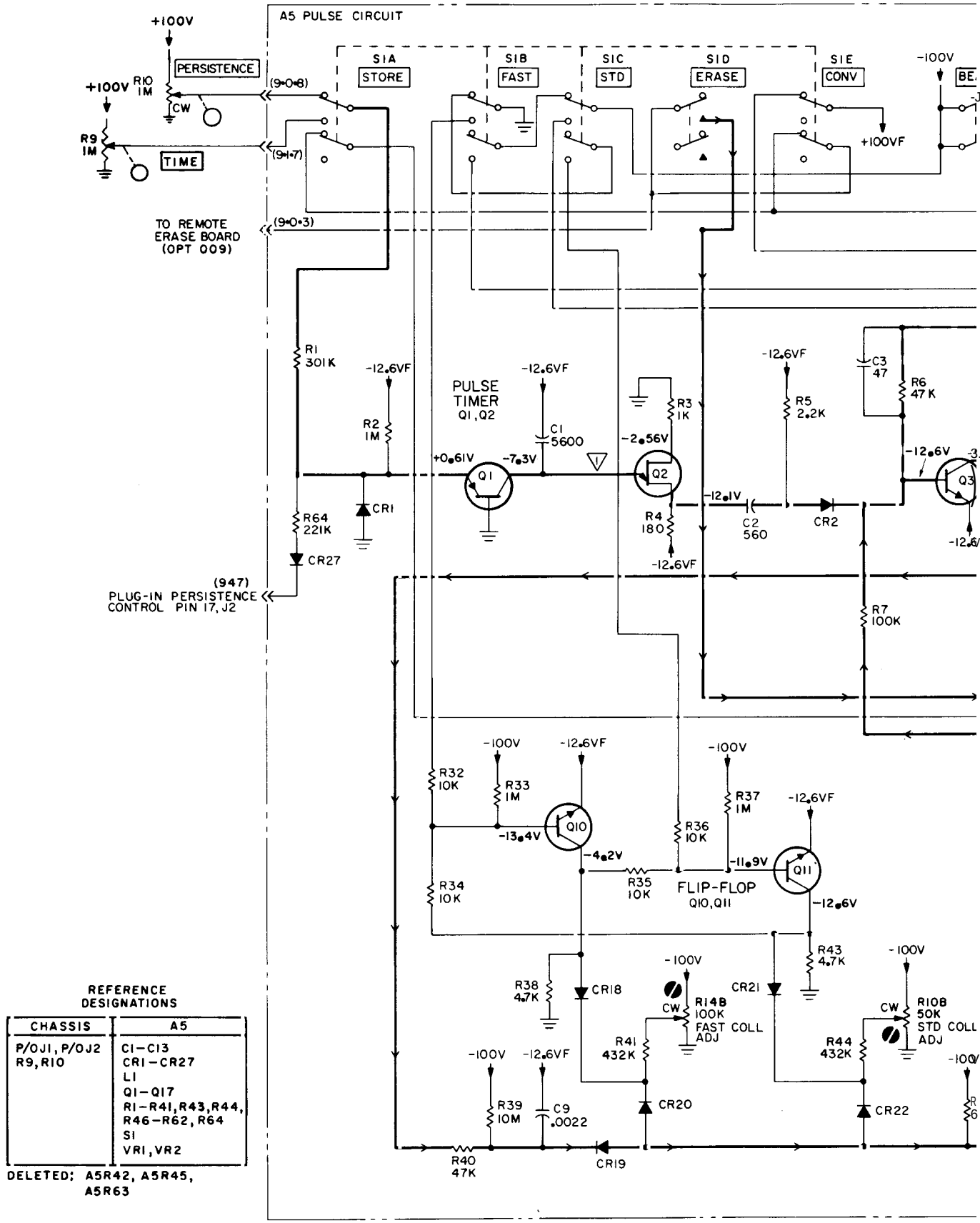


Circuit boards have plated through component holes. This permits soldering from either side of the board.

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

1418-A-7

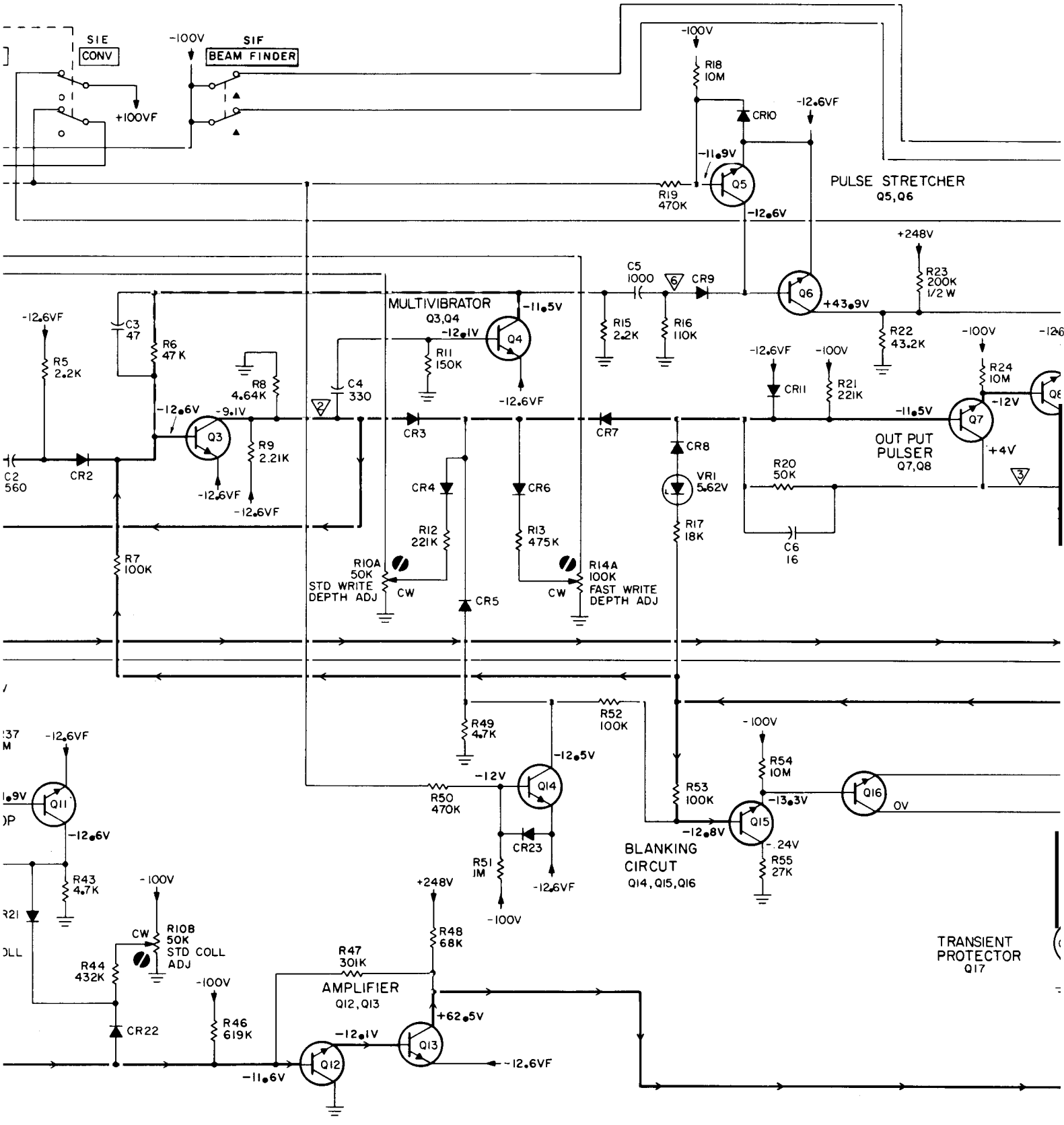
Figure 7-1. Component Identification Pulse Circuit A5



REFERENCE DESIGNATIONS

CHASSIS	A5
P/OJ1, P/OJ2 R9, R10	C1-C13 CR1-CR27 L1 Q1-Q17 R1-R41, R43, R44, R46-R62, R64 S1 VR1, VR2

DELETED: A5R42, A5R45, A5R63


SIE
CONV
+100VF
-100V
SIF
BEAM FINDER
-100V
R18
10M
CR10
-12.6VF
-11.9V
Q5
R19
470K
-12.6V
PULSE STRETCHER
Q5,Q6
+248V
R23
200K
1/2 W
C5
1000
CR9
Q6
+43.9V
R22
43.2K
-12.6VF
R5
2.2K
C3
47
R6
47K
MULTIVIBRATOR
Q3,Q4
-11.5V
-12.1V
Q4
R11
150K
R15
2.2K
R16
110K
-12.6VF
R8
4.64K
C4
330
-12.6V
-9.1V
Q3
R9
2.21K
CR3
CR7
-100V
R24
10M
-12V
Q7
-11.5V
OUT PUT
PULSER
Q7,Q8
+4V
CR11
R21
221K
CR8
VR1
5.62V
R20
50K
C6
16
R17
18K
C2
560
CR2
R7
100K
CR4
R12
221K
CR6
R13
475K
R10A
50K
STD WRITE
DEPTH ADJ
CW
CR5
R14A
100K
FAST WRITE
DEPTH ADJ
CW
R49
4.7K
R52
100K
-12.5V
Q14
-12V
R50
470K
CR23
R51
1M
-12.6VF
-100V
R53
100K
-12.8V
Q15
-13.3V
Q16
0V
-.24V
R55
27K
BLANKING
CIRCUT
Q14,Q15,Q16
R54
10M
-12.6VF
Q11
-12.6V
R43
4.7K
-100V
R108
50K
STD COLL
ADJ
CW
R44
432K
CR22
-100V
R46
619K
+248V
R48
68K
R47
301K
AMPLIFIER
Q12,Q13
+62.5V
-12.1V
Q13
Q12
-11.6V
-12.6VF
TRANSIENT
PROTECTOR
Q17

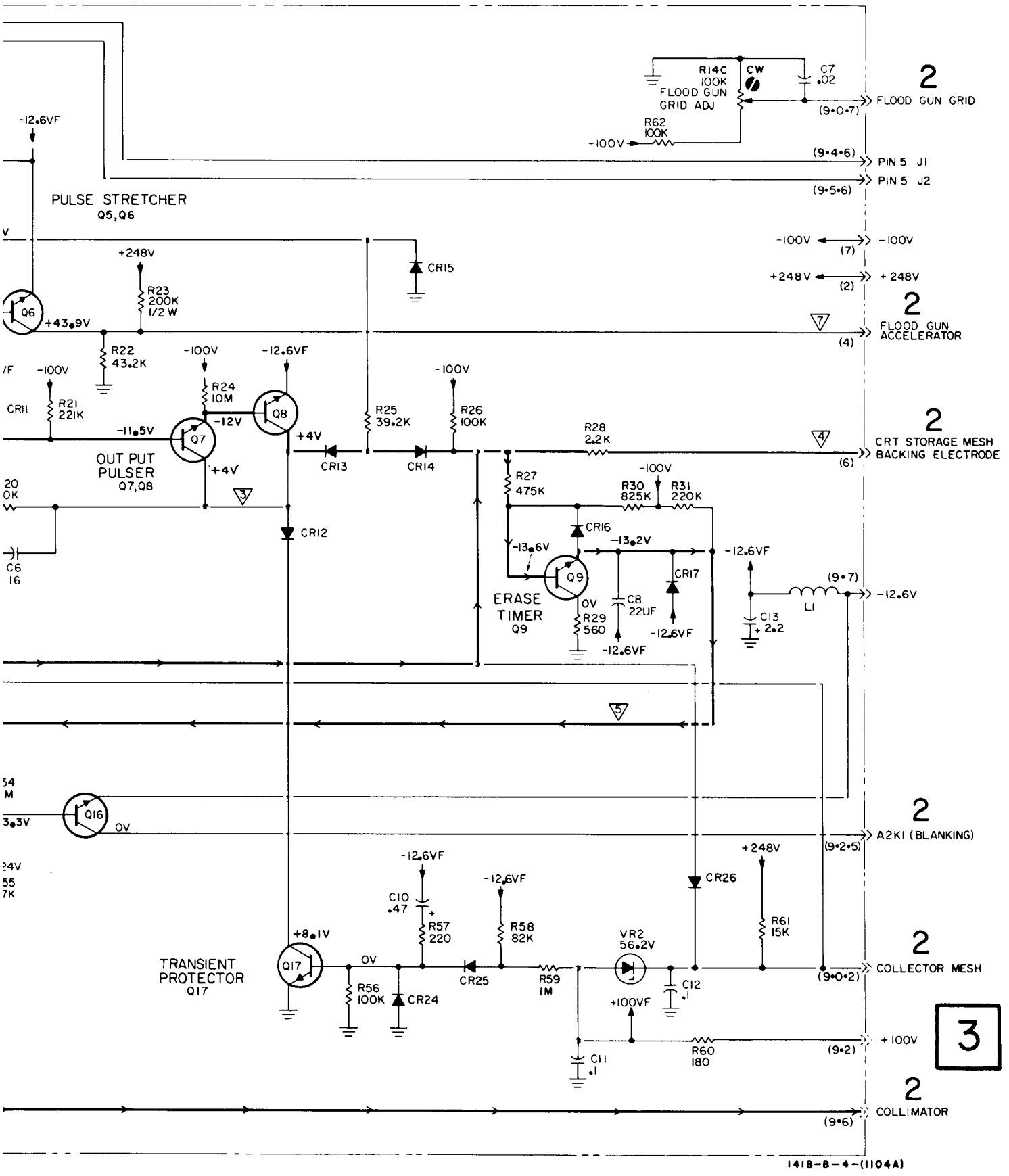


Figure 7-2
Pulse Circuit Schematic

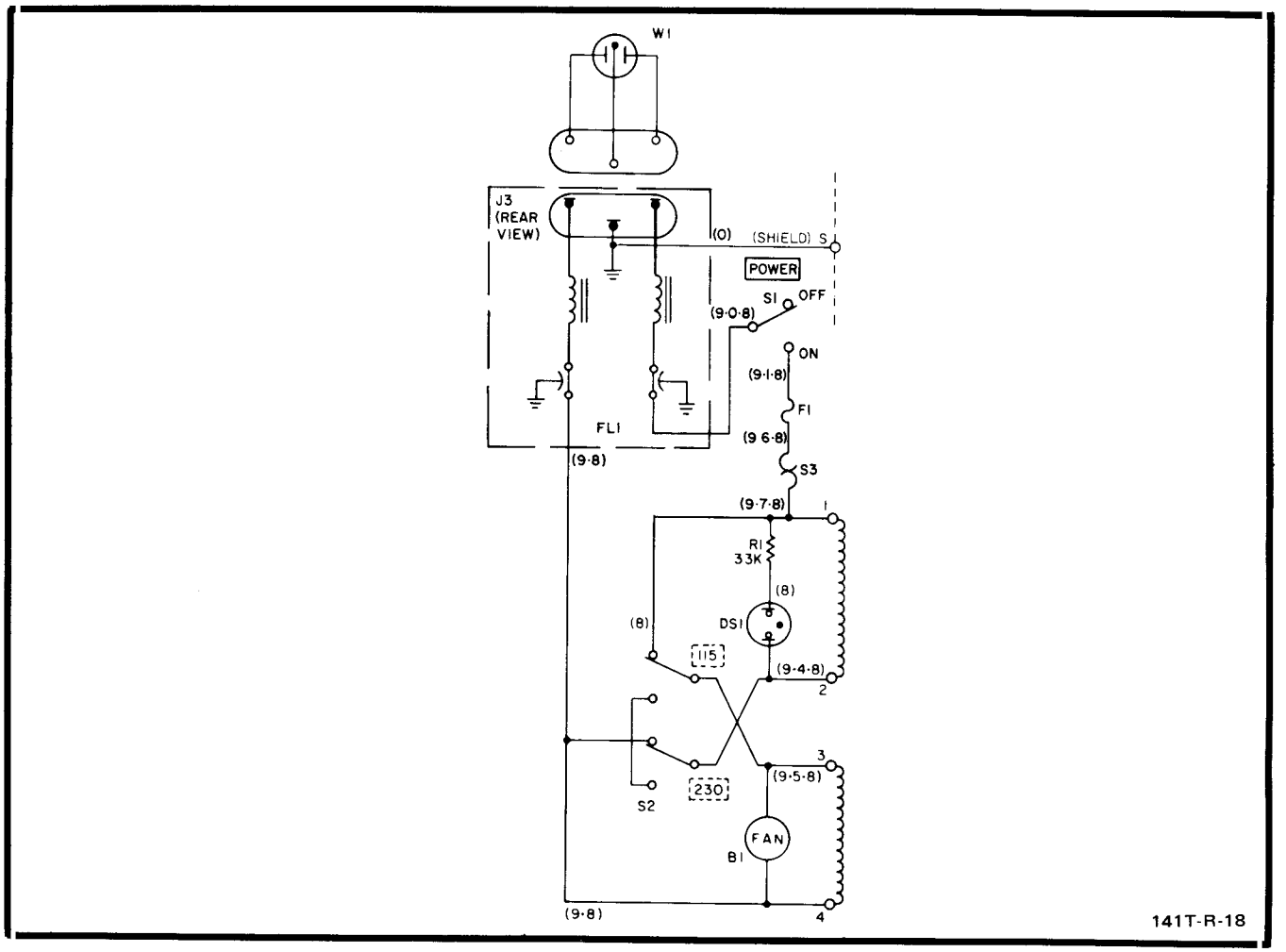


Figure 7-3. Line Voltage Schematic

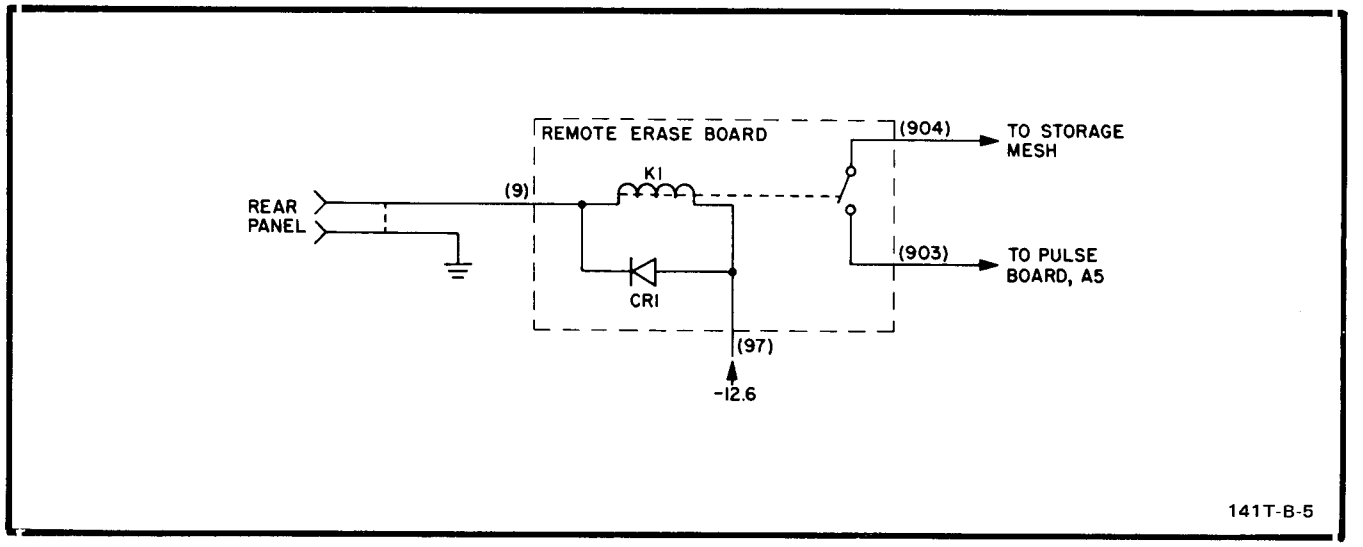


Figure 7-4. Option 009 Schematic Diagram

SECTION VIII

SCHEMATICS AND TROUBLESHOOTING

8-1. INTRODUCTION.

8-2. This section contains schematics, repair/replacement and troubleshooting information, component-location and component-identification illustrations, and waveforms for Model 141T. Tables 8-1 and 8-2 provide guides to locating possible high voltage supply problems. Table 8-3 defines symbols and conventions used on the schematics. Disassembly procedures for removing the CRT and cooling fan for repair and replacement are also contained in this section.

8-3. SCHEMATICS.

8-4. Schematics are printed on foldout pages for easy reference to the text and figures in other sections. The schematics are drawn to show the electronic function of the circuits. Any one schematic may include all or part of several different physical assemblies.

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

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

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

8-8. REFERENCE DESIGNATIONS.

8-9. The unit system of reference designations used in this manual is in accordance with the provisions of USA Standard Y32.16-1968, Reference Designations for Electrical and Electronics Parts and Equipments, dated March 1, 1968. Minor variations from the standard, due to design and manufacturing practices, may be noted.

8-10. Each electrical component is assigned a class letter and number. This letter-number combination is the basic reference designation. Components which are not part of an assembly have only the basic reference designation. Components which are part of an assembly have, in addition to the basic designation, a prefix designation indicating the assembly of which the component is a part (resistor R23 on assembly A1 is called A1R23).

8-11. Assemblies are numbered consecutively. If an assembly reference designation is assigned and later deleted, that number is not reused.

8-12. COMPONENT LOCATIONS.

8-13. Locations of components on assemblies and subassemblies are illustrated in photos adjacent to the schematics. Since the schematics are drawn to show function, portions of a particular assembly may appear on several different schematics. The component-location photo is printed next to the schematic that shows most of the circuitry on the assembly. Components located on the chassis are identified in figures 8-2 through 8-5. The locations of all adjustments are shown in Section V. Cabinet parts and other mechanical parts are shown in drawings located in Section VI.

8-14. PREVENTIVE MAINTENANCE.

8-15. DELETED.

8-16. DELETED.

8-17. FILTER MAINTENANCE.

8-18. This instrument uses a wire-mesh air filter over the cooling blower. If the filter becomes clogged with dirt, the blower will not provide adequate cooling for the instrument. Check the filter periodically and clean it when necessary. To clean, remove the filter and use a warm soap and water solution. Rinse the filter in clear water and allow it to dry before reinstalling.

8-19. ELECTRICAL MAINTENANCE.

8-20. Do the electrical adjustments in Section V once every 6 months and after repair or component replacement.

8-21. REPAIR AND REPLACEMENT.

8-22. The following paragraphs provide information for repair, removal and replacement of assemblies, subassemblies, and components in the Model 141T. Special servicing instructions for the circuit boards are covered under paragraphs 8-33 through 8-35. Section VI provides a detailed parts list for use in ordering replacement parts.

8-23. INSTRUMENT REPAIR.

8-24. Chassis-mounted components are identified in figures 8-2 through 8-5. Components on circuit boards are identified in figures near the applicable schematic (also see table 8-3).

8-25. 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.

8-26. CRT REMOVAL AND REPLACEMENT.

8-27. Remove the CRT as follows:

WARNING

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

a. Remove 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 (W12, figure 8-2) from connector block.

d. Disconnect clip-on leads from CRT neck.

e. Loosen clamp at CRT socket.

f. Carefully remove socket from CRT base.

CAUTION

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

g. Place one hand on CRT face, and use other hand to slide CRT forward and out of instrument.

8-28. To install a CRT, reverse the above procedure. Insure that connector block and neck leads are connected before turning power on. After the CRT is installed, do performance checks and geometry adjustment procedure in Section V.

8-29. FAN REMOVAL AND REPLACEMENT.

8-30. Use the following procedure for removing, and reverse the procedure for replacing the cooling fan.

a. Remove top and bottom covers of instrument.

b. Disconnect white-gray and white-green-gray wires from fan terminals.

c. Remove all transistor heat sinks from fan assembly and push out of way.

d. Remove four fan mounting nuts on rear panel of instrument.

e. Lift out fan assembly.

8-31. SEMICONDUCTOR REPLACEMENT.

8-32. Figure 8-1 is included to help identify the leads in the common shapes and sizes of semiconductor devices. When removing a semiconductor, use long-nosed pliers as a heat sink between the device and the soldering iron. When replacing a semiconductor, ensure sufficient lead length to dissipate the soldering heat by using the same length of exposed lead as was used for the original part.

8-33. SERVICING CIRCUIT BOARDS.

8-34. This instrument uses circuit boards with plated-through component holes. This allows components to be removed or replaced by unsoldering or soldering from either side of the board. When removing large components, such as potentiometers, rotate the soldering iron tip from lead to lead while applying pressure to the part to lift it from the board. HP Service Note M-20E contains additional information on 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 straight pull away from board.

c. Do not force replacement leads into holes.

8-35. 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.

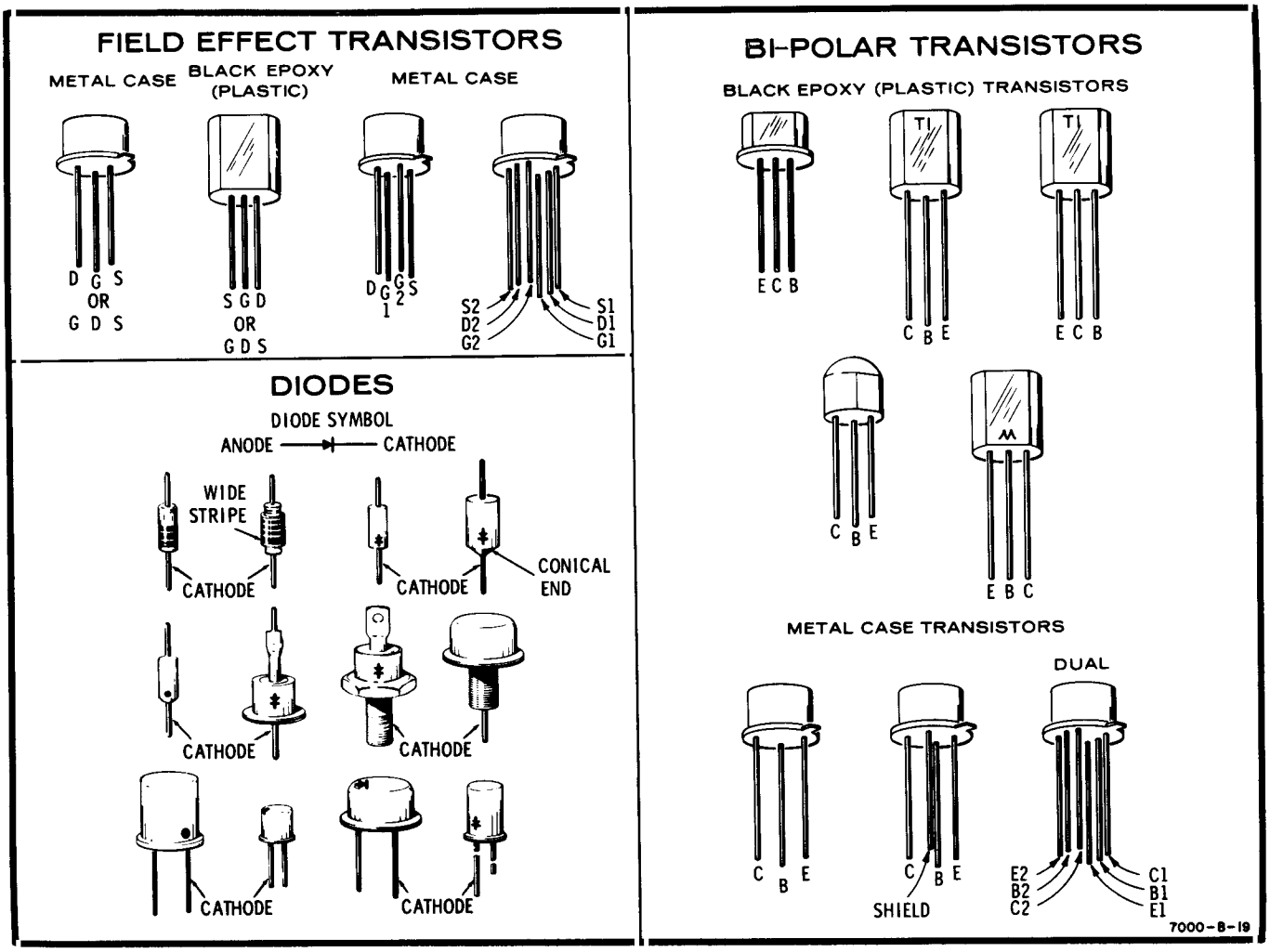


Figure 8-1. Semiconductor Terminal Identification

8-36. OVERALL TROUBLESHOOTING.

8-37. The most important prerequisite for successful troubleshooting is understanding how the instrument is designed to operate and correct use of front panel controls. Improper control settings or circuit connections can cause apparent malfunctions. Read Section III (operating procedures) for an explanation of controls and connectors and general operating considerations. Read Section IV (principles of operation) for explanations of circuit theory.

8-38. 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 as necessary.

8-39. FRONT PANEL CONTROLS.

8-40. Equipment troubles are frequently caused simply by 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.

8-41. VISUAL CHECKS.

8-42. After localizing the trouble to a specific area of the instrument, make a 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.

8-43. WAVEFORMS AND VOLTAGES.

8-44. Allow the instrument to warm-up for about fifteen minutes before making any measurements. Note the conditions for measuring waveforms and dc voltages. These conditions are stated in the detailed troubleshooting procedures or listed adjacent to each schematic and must be followed to obtain proper readings. Waveform measurement points (▽1) with a number enclosed are placed on the schematics along main signal paths. The numbers inside the measurement point symbols (▽2) are keyed to corresponding waveforms 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.

8-45. FINAL CHECKS.

8-46. Review the theory of operation in Section IV to learn how the 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.

8-47. DETAILED TROUBLESHOOTING.

WARNING

Voltages present in the power supplies are dangerous.

8-48. LOW-VOLTAGE SUPPLY.

8-49. 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.

8-50. 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 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.

8-51. Excessive ripple in line frequency is usually caused by a faulty input filter or regulator circuit. Compare the ripple voltages at the rectifier outputs with values given on the schematic. For ripple above the specified value, check C1, C3, C4 or C6. Line frequency 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 2 mV at —12.6V.

8-52. If the —12.6. —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.

8-53. 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.

8-54. 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 —100 volt supply. The +248 volt and —12.6 volt supplies are referenced to this supply. A fault in —100 volt supply can cause malfunction of either of other two supplies. If —100 volt supply is incorrect, proper circuit repair may eliminate trouble in +248 volt or —12.6 volt supply. If —100 volt supply is correct, proceed to next step.

b. The +248 volt supply is referenced to —100 volt supply. If trouble here has not been eliminated by checking —100 volt supply, trouble lies in this circuit and can be located by making proper circuit and component checks as described in paragraph 8-50.

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

8-55. HIGH-VOLTAGE SUPPLY.

8-56. 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.

8-57. 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

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.

probably a defective component in the rectifier filter/divider networks. If no waveform appears, use table 8-1.

8-58. If the high-voltage output is incorrect and cannot be adjusted to the correct value, use table 8-2.

8-59. If the —2350 volt supply seems to be operating properly, the 6.6 kV post-accelerator potential may be checked as follows:

a. Remove top and left side instrument cover.

b. Remove high voltage connector block, A3-MP1, figure 6-4.

c. Remove high voltage connector block cover and rubber insulation.

d. Check 6.6 kV at high voltage lead pin connection.

8-60. PULSE CIRCUIT.

8-61. 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.

8-62. 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 correct, 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 correct, check the waveforms at test points shown on schematic diagram, figure 8-16.

8-63. 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.

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

NC = No connection

= Waveform test point (with number)

= Common electrical point (with letter) not necessarily ground

= Single-pin connector on board

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

= Coaxial cable connected to snap-on jack

= Coaxial cable connected directly to board

= Wire connected to pressure-fit socket on board

= Main signal path

= Primary feedback path

= Secondary feedback path

= Field-effect transistor (P-type base)

= Field-effect transistor (N-type base)

= Breakdown diode (voltage regulator)

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

(925) = Wire colors are given by numbers in parentheses using the resistor color code
[(925) is wht-red-grn]

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

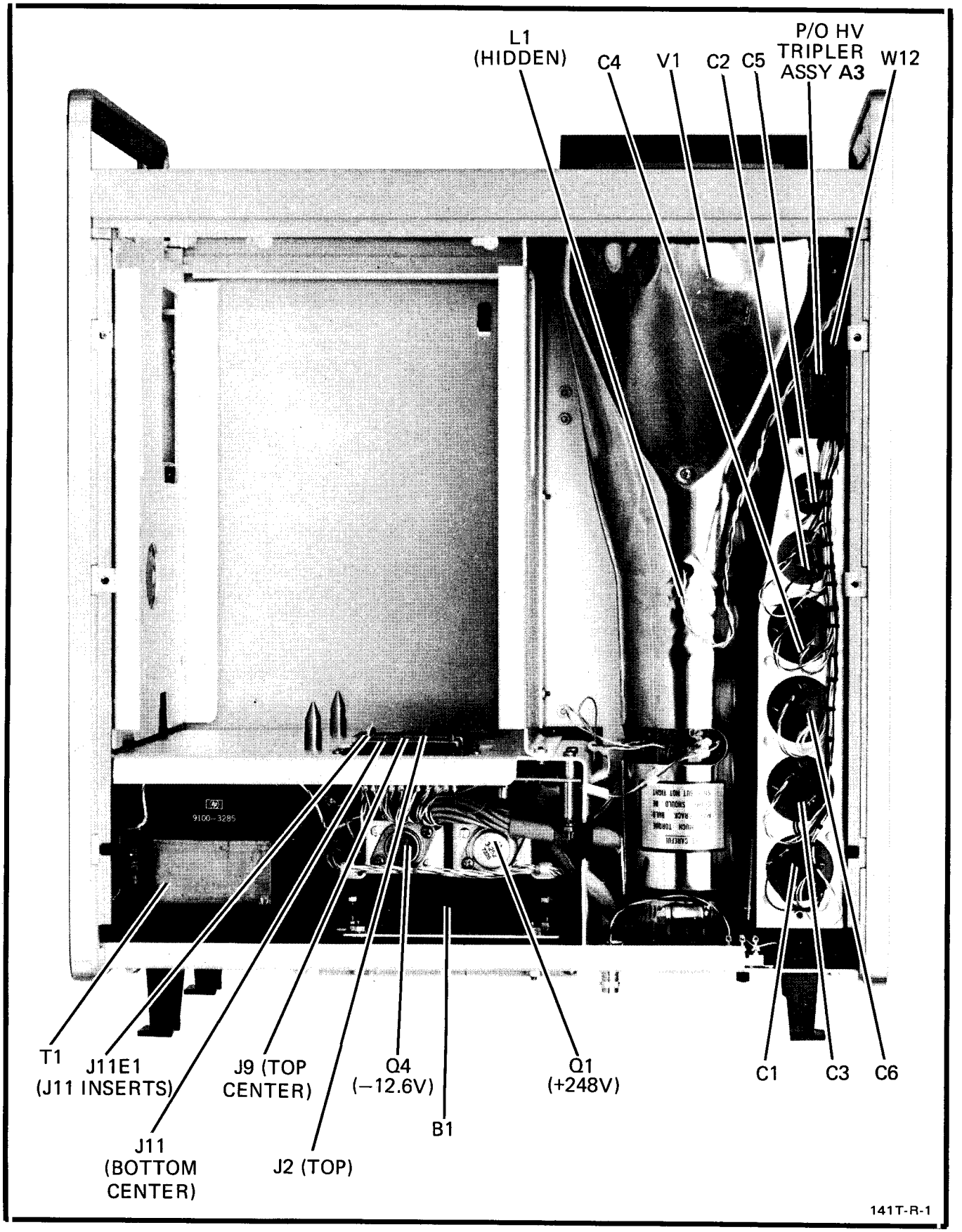


Figure 8-2. Component Location, Top View

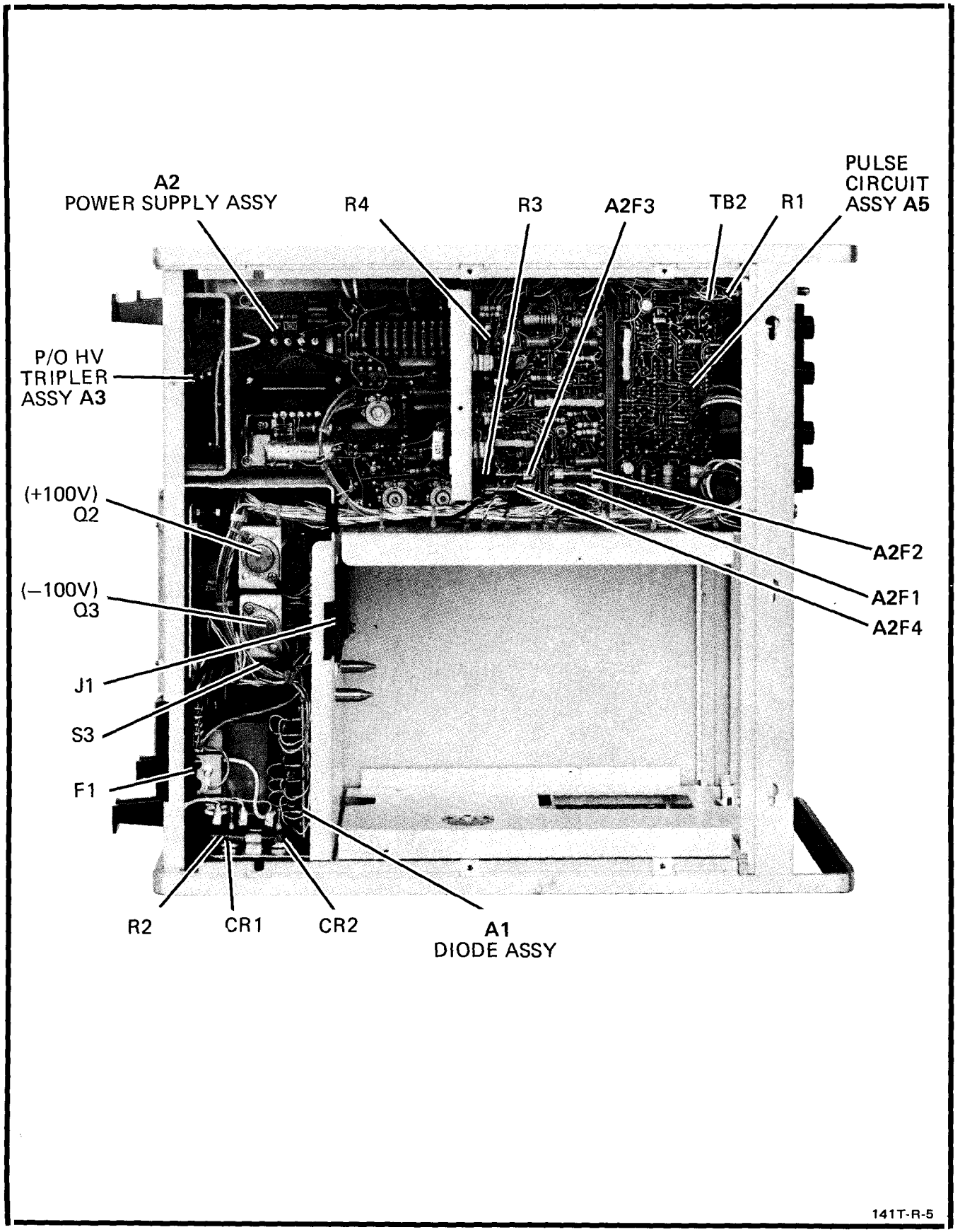


Figure 8-3. Component Location, Bottom View

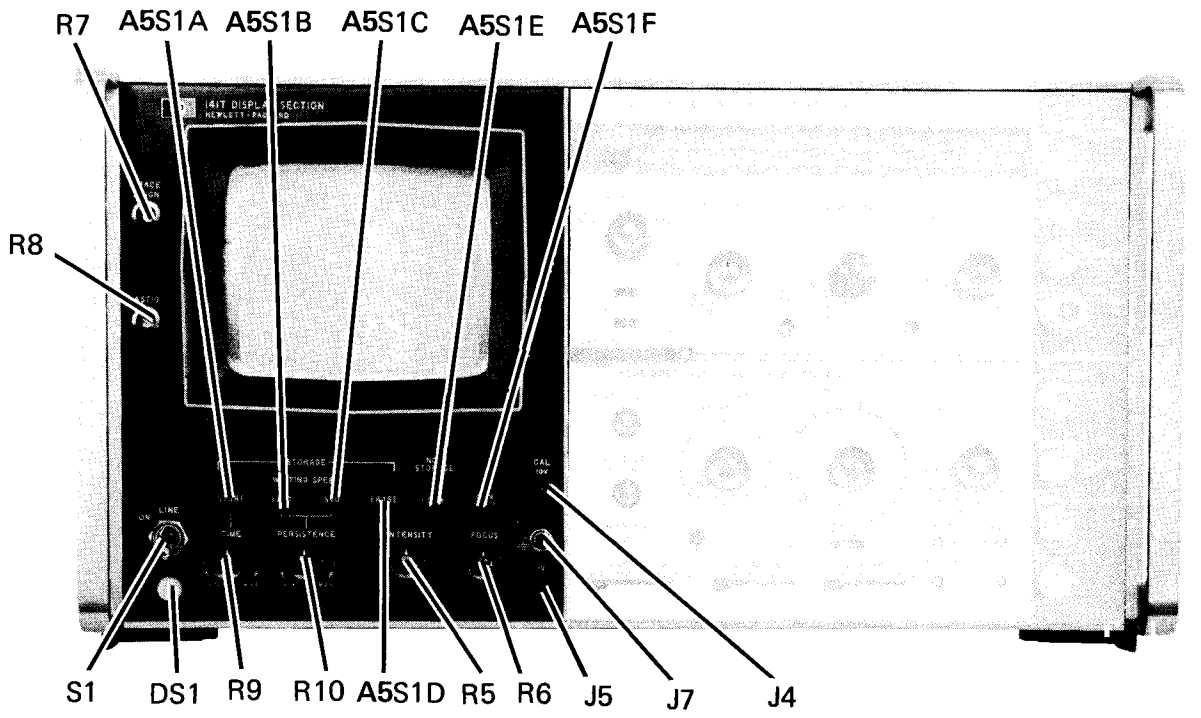


Figure 8-4. Component Location, Front View

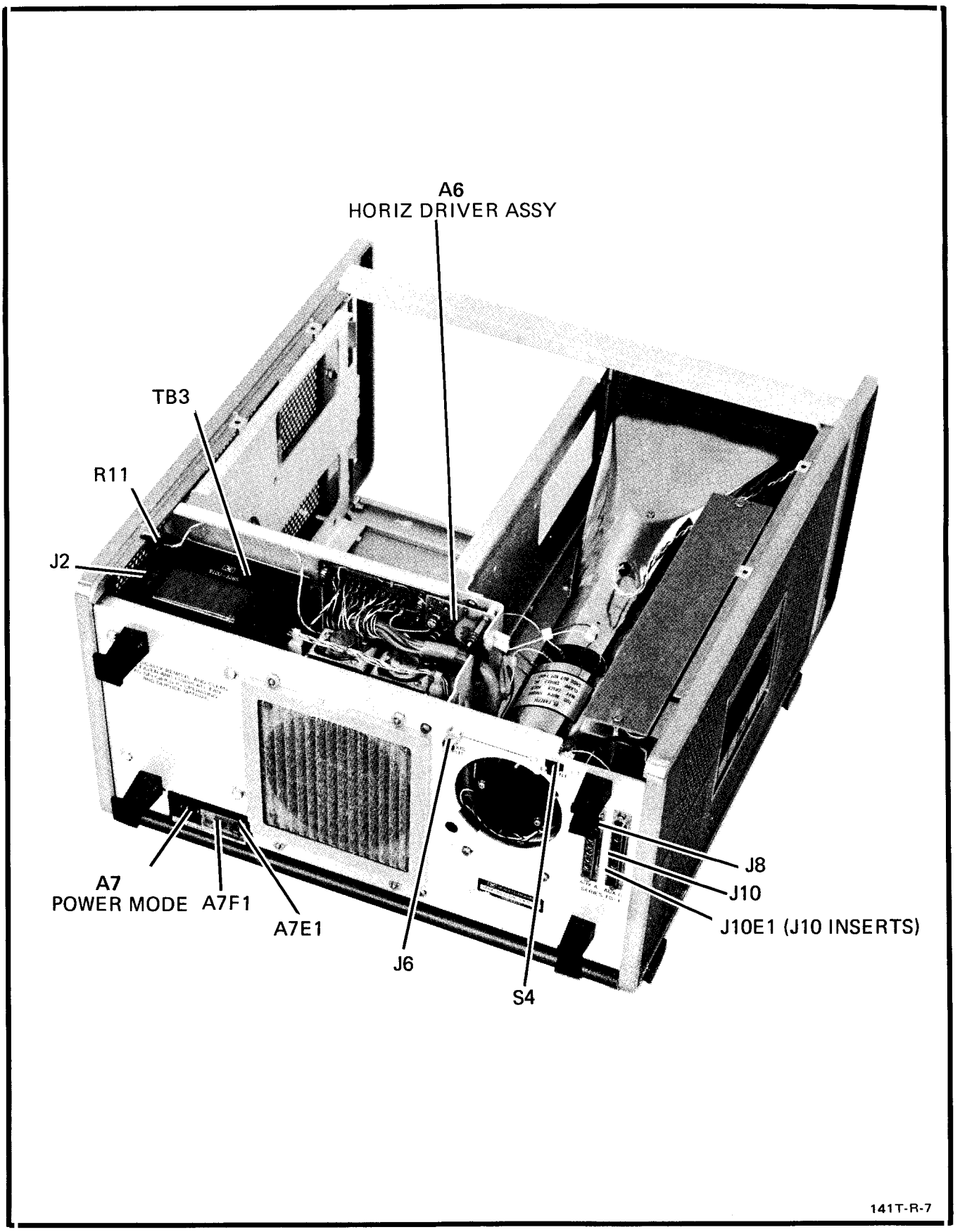


Figure 8-5. Component Location, Rear View

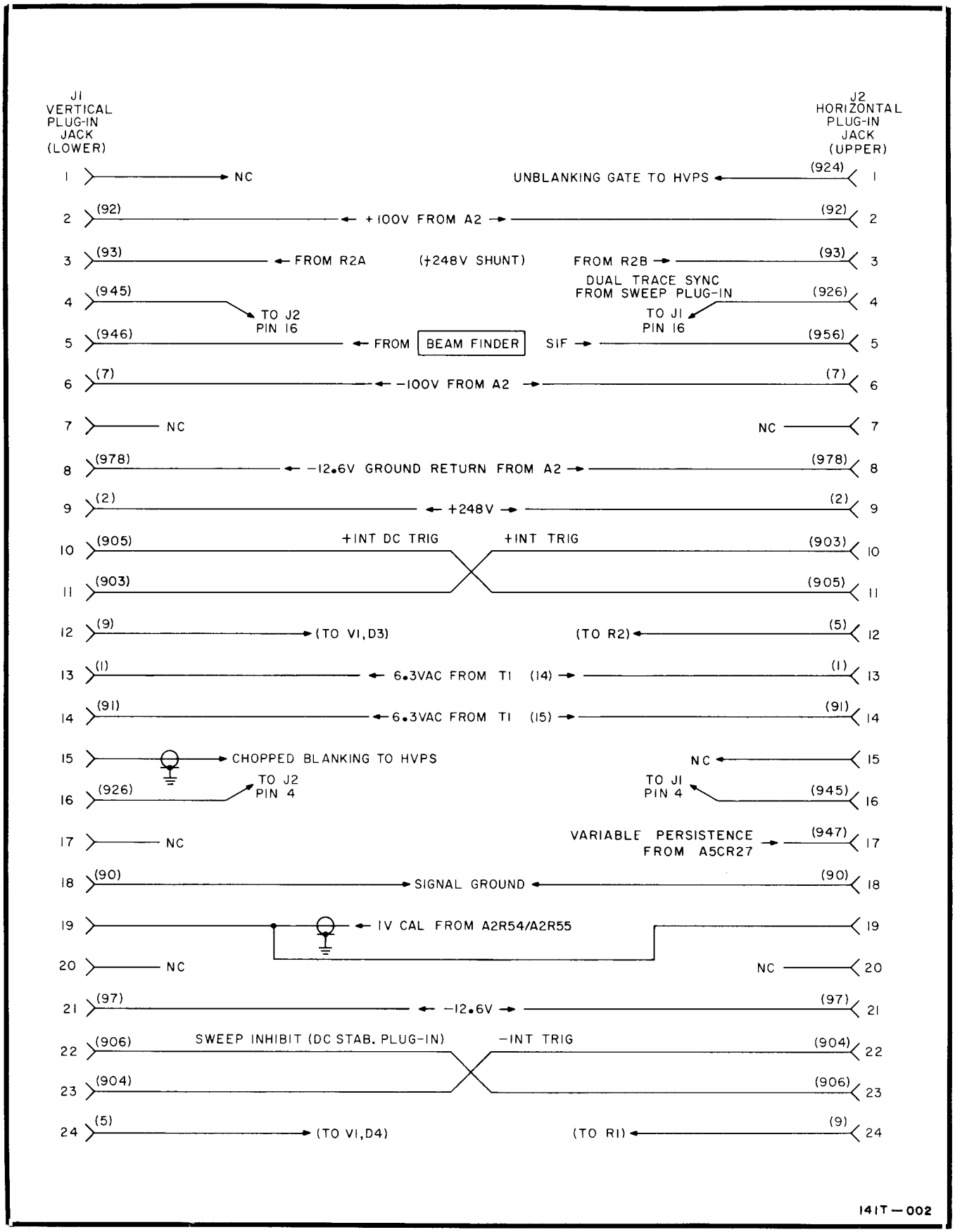


Figure 8-6. Plug-in Jack Connections

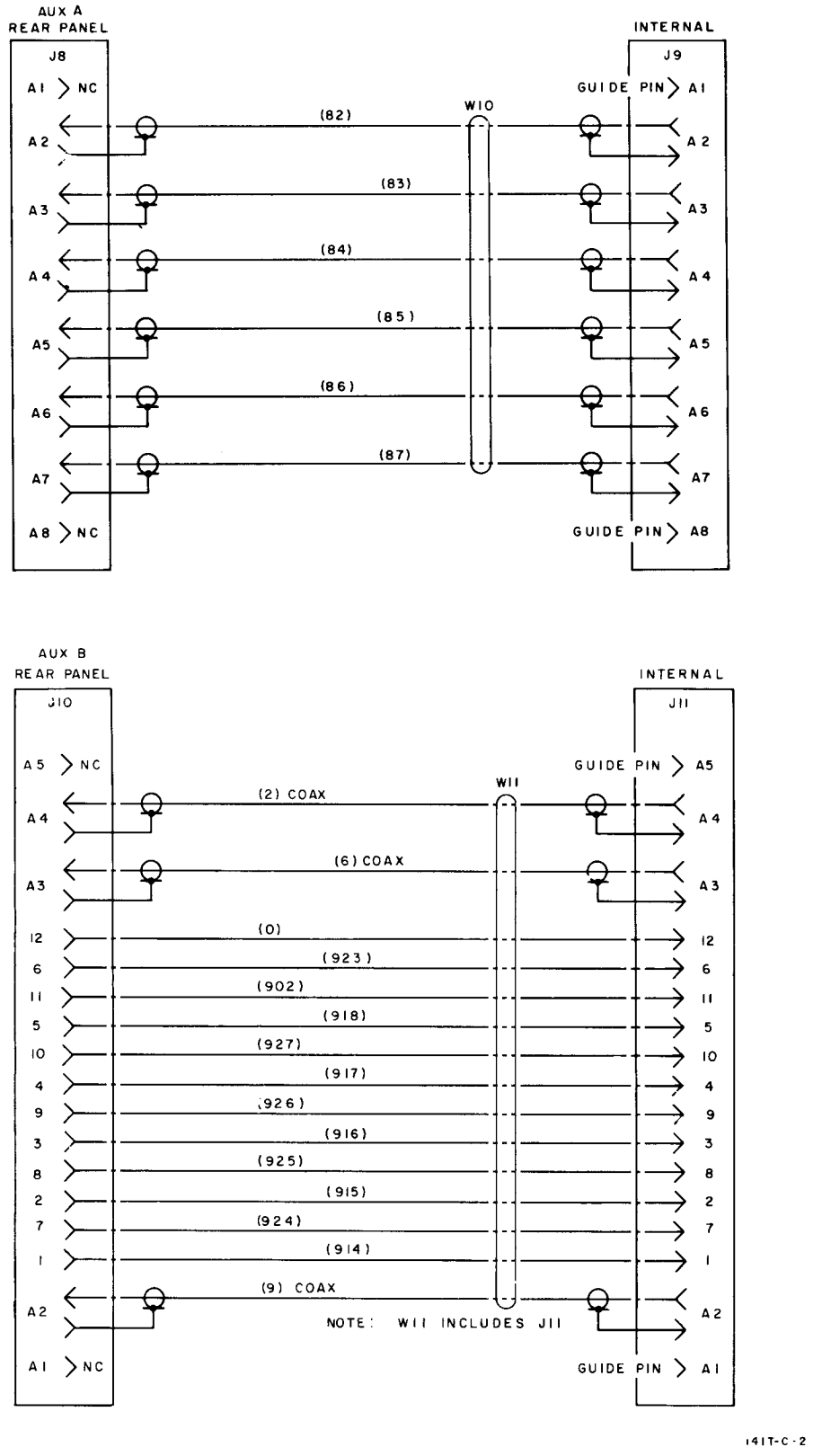
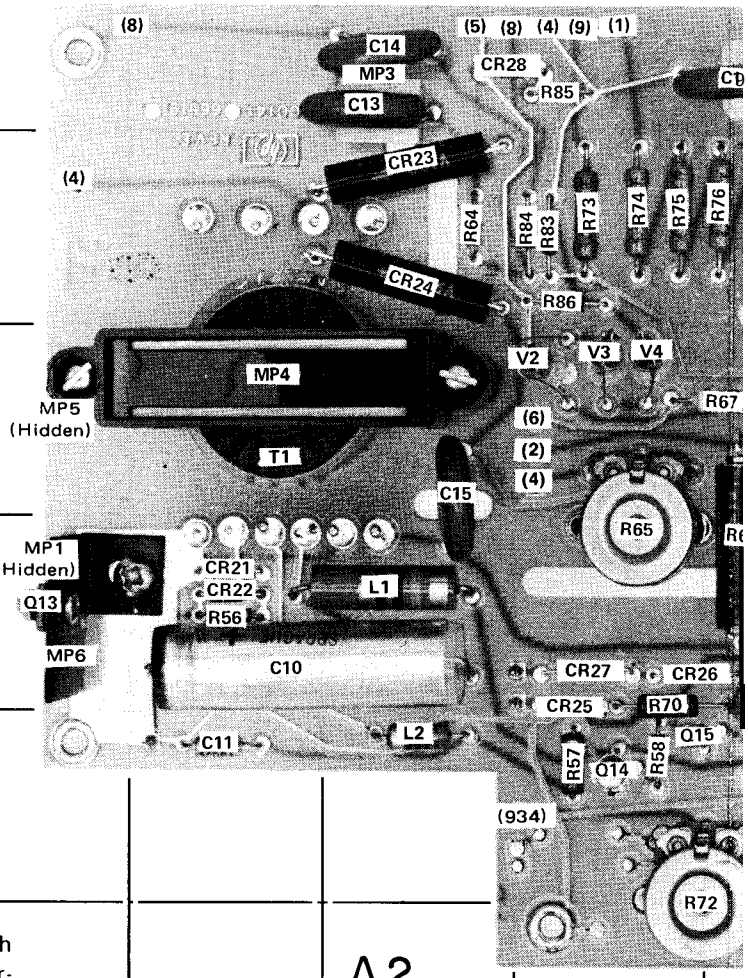


Figure 8-7. Auxiliary A and Auxiliary B Wiring Diagram

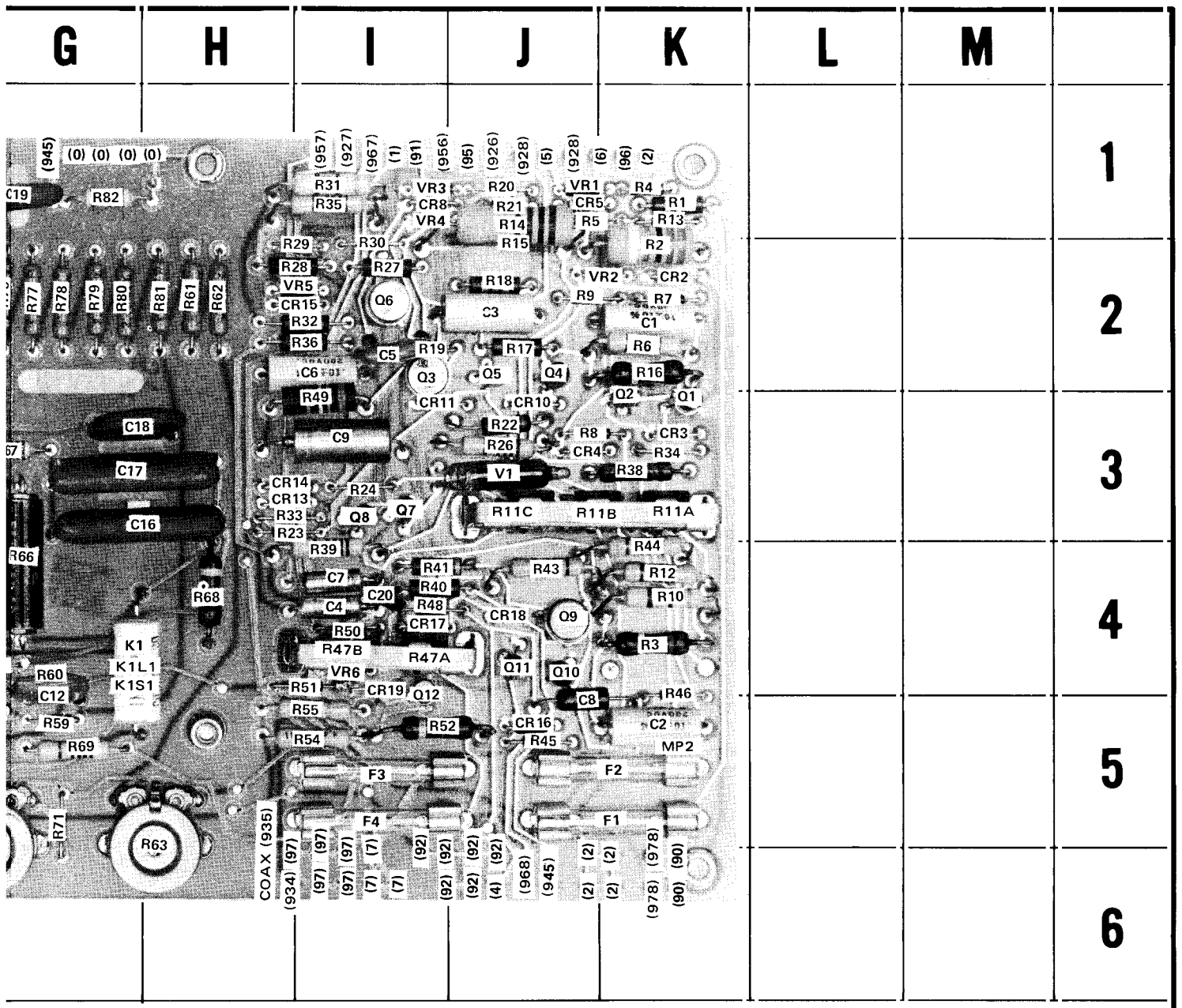
	A	B	C	D	E	F
1						
2						
3						
4						
5						
6						



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

A2

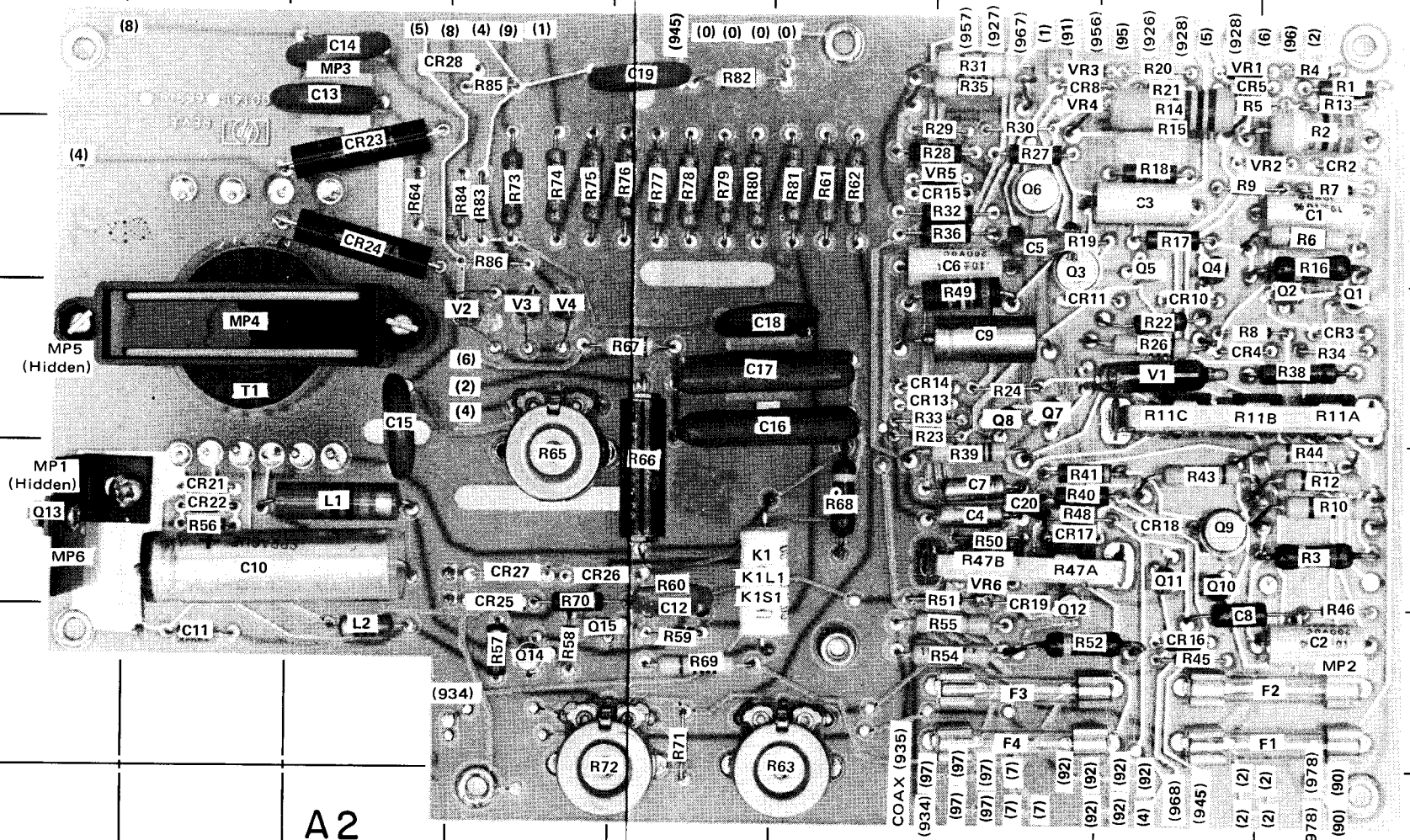
REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	K-2	C17	G-3	CR18	J-4	K1L1	G-4	Q6	I-2
C2	K-5	C18	G-3	CR19	I-4	K1S1	G-4	Q7	I-3
C3	J-2	C19	G-1	CR21	D-4	L1	E-4	Q8	I-3
C4	I-4	C20	I-4	CR22	D-4	L2	E-5	Q9	J-4
C5	I-2	CR2	K-2	CR23	E-2	MP1	C-4	Q10	J-4
C6	I-2	CR3	K-3	CR24	E-2	MP2	K-5	Q11	J-4
C7	I-4	CR4	J-3	CR25	F-4	MP3	E-1	Q12	I-4
C8	J-5	CR5	J-1	CR26	F-4	MP4	D-3	Q13	C-4
C9	I-3	CR8	I-1	CR27	F-4	MP5	C-3	Q14	F-5
C10	D-4	CR10	J-3	CR28	E-1	MP6	C-4	Q15	F-5
C11	D-5	CR11	I-3	F1	K-5	Q1	K-3	R1	K-1
C12	G-5	CR13	I-3	F2	K-5	Q2	K-3	R2	K-2
C13	E-1	CR14	I-3	F3	I-5	Q3	I-2	R3	K-4
C14	E-1	CR15	I-2	F4	I-5	Q4	J-2	R4	K-1
C15	E-3	CR16	J-5	K1	G-4	Q5	J-2	R5	J-1
C16	G-3	CR17	I-4						

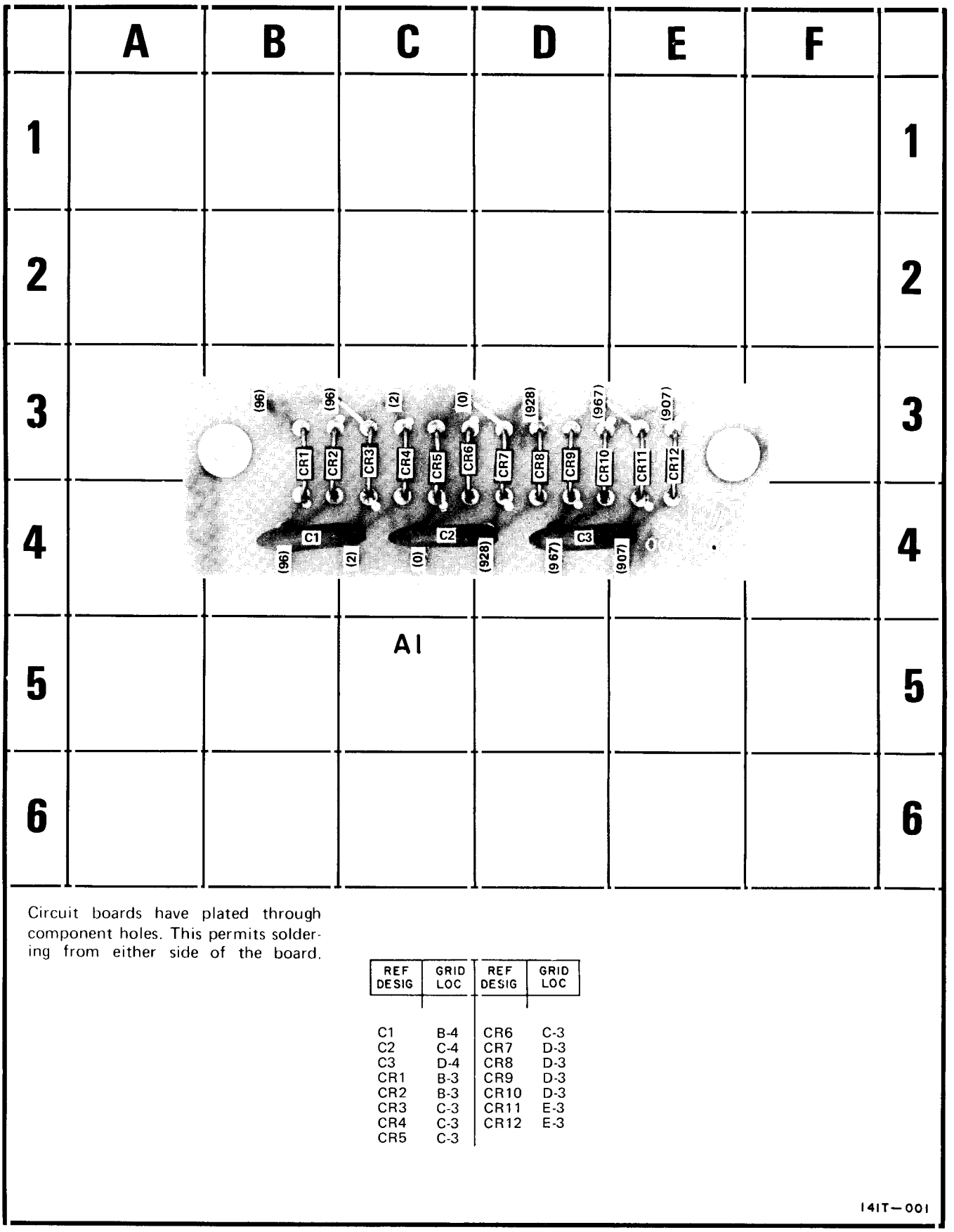


REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
R6	K-2	R19	I-2	R35	I-1	R51	I-4	R67	G-3	R83	F-2
R7	K-2	R20	J-1	R36	I-2	R52	I-5	R68	H-4	R84	F-2
R8	J-3	R21	J-1	R38	K-3	R54	I-5	R70	F-4	R85	F-1
R9	J-2	R22	J-3	R39	I-4	R55	I-5	R71	G-5	R86	F-2
R10	K-4	R23	I-3	R40	I-4	R56	D-4	R72	F-5	T1	D-3
R11A	K-3	R24	I-3	R41	I-4	R57	F-5	R73	F-2	V1	J-3
R11B	K-3	R26	J-3	R43	J-4	R58	F-5	R74	F-2	V2	F-3
R11C	J-3	R27	I-2	R44	K-4	R59	G-5	R75	F-2	V3	F-3
R12	K-4	R28	I-2	R45	J-5	R60	G-4	R76	G-2	V4	F-3
R13	K-1	R29	I-2	R46	K-4	R61	H-2	R77	G-2	VR1	J-1
R14	J-1	R30	I-2	R47A	E-4	R62	H-2	R78	G-2	VR2	K-2
R15	J-2	R31	I-1	R47B	E-4	R63	H-6	R79	G-2	VR3	I-1
R16	K-2	R32	I-2	R48	I-4	R64	E-2	R80	G-2	VR4	I-1
R17	J-2	R33	I-3	R49	I-3	R65	F-4	R81	H-2	VR5	I-2
R18	J-2	R34	K-4	R50	I-4	R66	G-4	R82	G-1	VR6	I-4

141T-B-1-06-76

Figure 8-8. Component Identification, Power Supply A2

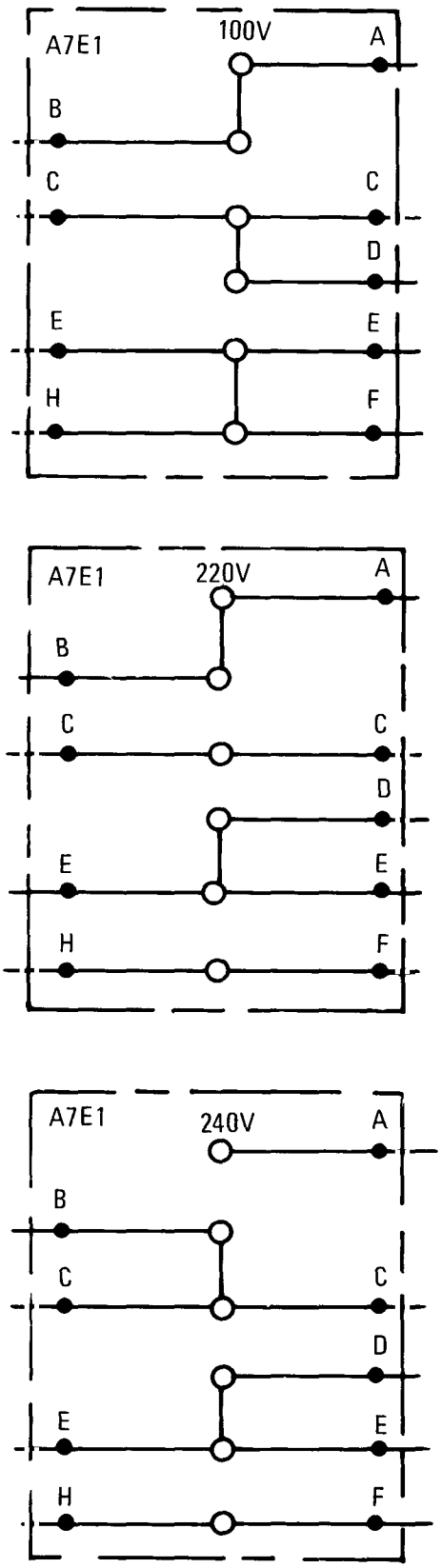

C D E F G H I J K
(8)
(5) (8) (4) (9) (1)
(945)
(0) (0) (0) (0)
(957) (927) (967) (1) (91) (956) (95) (926) (928) (5) (928) (6) (96) (2)
C14
MP3
C13
CR28
R85
C19
R82
R31
R35
VR3
CR8
VR4
R20
R21
R14
R15
VR1
CR5
R5
R4
R1
R13
R2
(4)
CR23
R64
R84
R83
R73
R74
R75
R76
R77
R78
R79
R80
R81
R61
R62
R29
R30
R28
R27
VR5
CR15
R32
R36
Q6
C3
R18
R9
VR2
CR2
R7
C1
CR24
R86
C5
R19
R17
R6
C6
Q3
Q5
Q4
R16
R49
CR11
CR10
Q2
Q1
MP4
V2
V3
V4
C18
C9
R22
R26
R8
CR3
CR4
R34
R38
MP5
(Hidden)
R67
C17
V1
T1
(6)
(2)
(4)
CR14
CR13
R33
R23
R24
Q8
Q7
R11C
R11B
R11A
C15
C16
R65
R66
R39
R44
MP1
(Hidden)
CR21
CR22
L1
C7
R41
R43
R12
Q13
R56
C4
C20
R40
R48
R10
R68
CR17
CR18
Q9
R50
R3
MP6
C10
CR27
CR26
R60
K1
K1L1
K1S1
R47B
R47A
Q11
Q10
VR6
R51
CR19
Q12
C8
R46
CR25
R70
C12
R55
C2
C11
L2
Q15
R59
R52
CR16
R45
MP2
R57
Q14
R58
R54
R69
F3
F2
(934)
F4
F1
R72
R71
R63
COAX (935)
(934) (97) (97) (97) (97) (7) (7) (7) (92) (92) (92) (92) (92) (4) (968) (945) (2) (2) (2) (978) (978) (90) (90)
A2



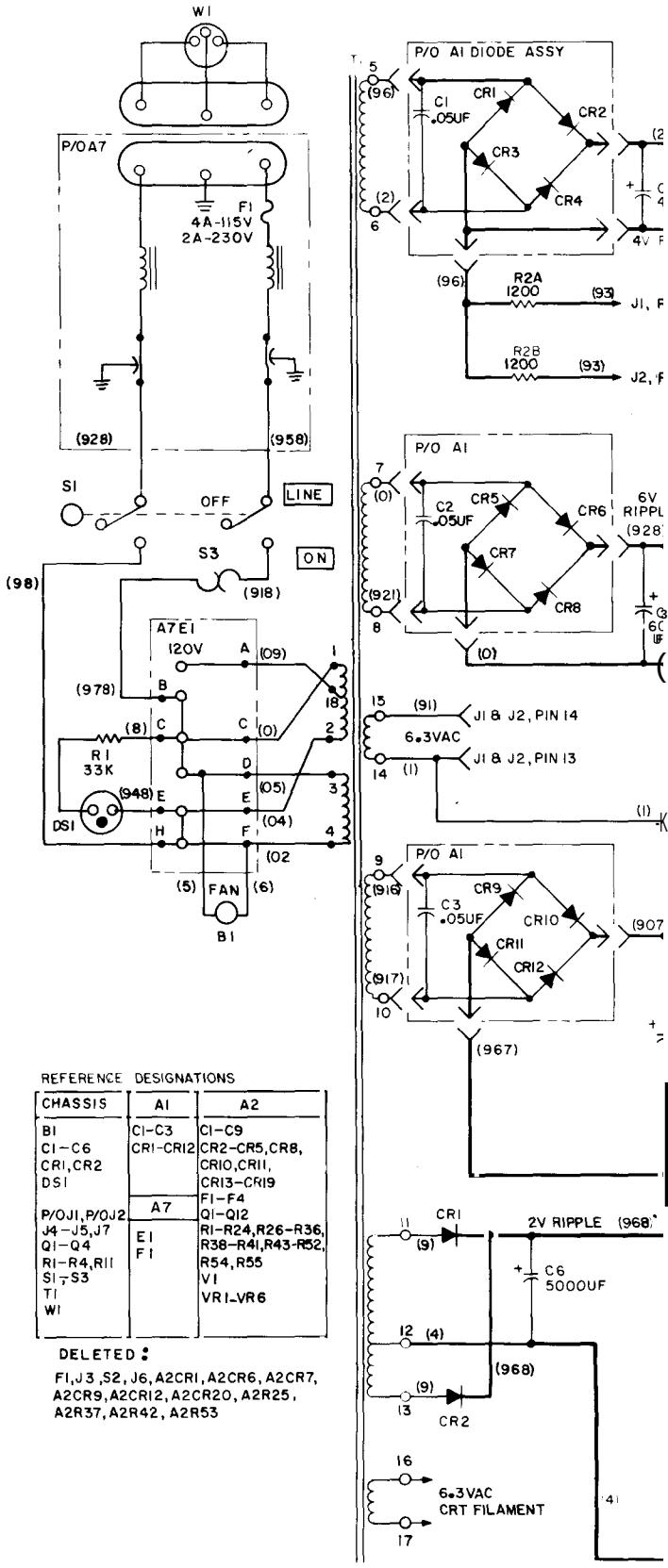
Circuit boards have plated through component holes. This permits soldering from either side of the board.

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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		

Figure 8-9. Component Identification, Diode Assy A1



100V, 220V, and 240V Input Power Connections

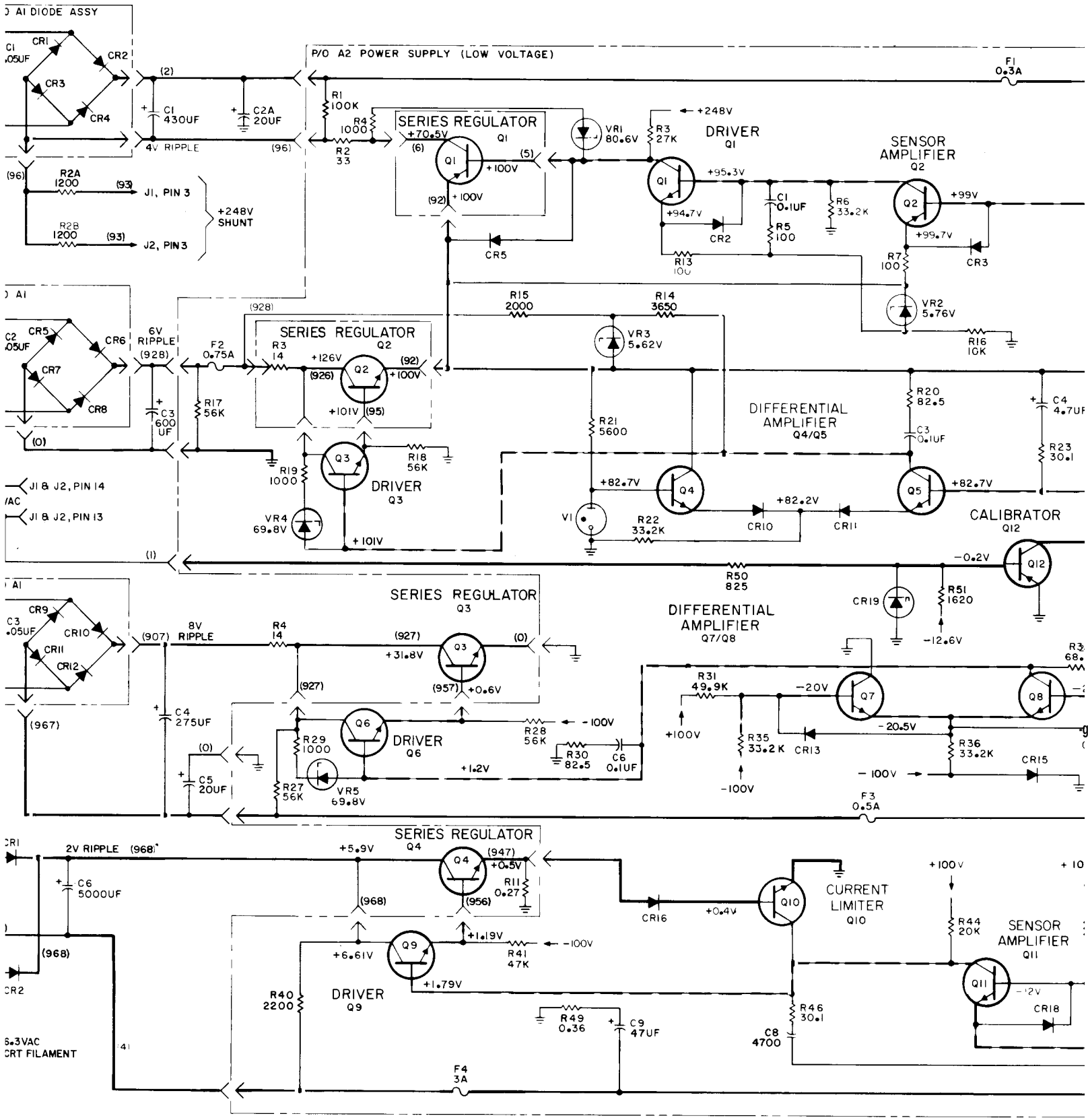


REFERENCE DESIGNATIONS

CHASSIS	A1	A2
B1 C1-C6 CR1,CR2 DS1	C1-C3 CR1-CR12	C1-C9 CR2-CR5,CR8, CR10,CR11, CR13-CR19 F1-F4
P/OJ1,P/OJ2 J4-J5,J7 Q1-Q4 R1-R4,R11 S1-S3 T1 W1	A7 E1 F1	Q1-Q12 R1-R24,R26-R36, R38-R41,R43-R52, R54,R55 V1 VR1-VR6

DELETED:

F1,J3,S2,J6,A2CR1,A2CR6,A2CR7,
A2CR9,A2CR12,A2CR20,A2R25,
A2R37,A2R42,A2R53


A1 DIODE ASSY
CR1
CR2
CR3
CR4
C1 .05UF
C1 430UF
C2A 20UF
4V RIPPLE
(2)
(96)
R2A 1200
R2B 1200
(93)
J1, PIN 3
J2, PIN 3
+248V SHUNT
P/O A2 POWER SUPPLY (LOW VOLTAGE)
F1 0.3A
R1 100K
R4 1000
R2 33
SERIES REGULATOR Q1
+70.5V
(6)
(5)
+100V
(92)
VR1 80.6V
R3 27K
+248V
DRIVER Q1
+95.3V
+94.7V
CR2
CR5
R13 100
C1 0.1UF
R5 100
R6 33.2K
SENSOR AMPLIFIER Q2
+99V
+99.7V
CR3
R7 100
VR2 5.76V
R16 10K
A1
CR5
CR6
CR7
CR8
C2 .05UF
6V RIPPLE
(928)
C3 600 UF
(0)
F2 0.75A
SERIES REGULATOR Q2
R3 14
+126V
(926)
+101V
(95)
R17 56K
R19 1000
VR4 69.8V
Q3
DRIVER Q3
R18 56K
+101V
R15 2000
R14 3650
VR3 5.62V
R21 5600
DIFFERENTIAL AMPLIFIER Q4/Q5
R20 82.5
C3 0.1UF
C4 4.7UF
R23 30.1
+82.7V
Q4
Q5
+82.2V
CR10
CR11
V1
R22 33.2K
CALIBRATOR Q12
-0.2V
Q12
R50 825
CR19
R51 1620
-12.6V
J1 & J2, PIN 14
J1 & J2, PIN 13
(1)
A1
CR9
CR10
CR11
CR12
C3 .05UF
8V RIPPLE
(907)
(967)
SERIES REGULATOR Q3
R4 14
(927)
+31.8V
(957)
+0.6V
C4 275UF
(0)
C5 20UF
R29 1000
R27 56K
VR5 69.8V
Q6
DRIVER Q6
+1.2V
R28 56K
-100V
R30 82.5
C6 0.1UF
DIFFERENTIAL AMPLIFIER Q7/Q8
R31 49.9K
-20V
Q7
Q8
-20.5V
+100V
R35 33.2K
CR13
-100V
R36 33.2K
CR15
-100V
F3 0.5A
CR1
2V RIPPLE (968)
C6 5000UF
(968)
CR2
6.3VAC CRT FILAMENT
SERIES REGULATOR Q4
+5.9V
Q4
(947)
+0.5V
(956)
R11 0.27
CR16
+0.4V
Q10
CURRENT LIMITER Q10
+100V
R44 20K
SENSOR AMPLIFIER Q11
Q11
-12V
CR18
+6.61V
Q9
+1.19V
R41 47K
-100V
+1.79V
R40 2200
DRIVER Q9
R49 0.36
C9 47UF
R46 30.1
C8 4700
F4 3A

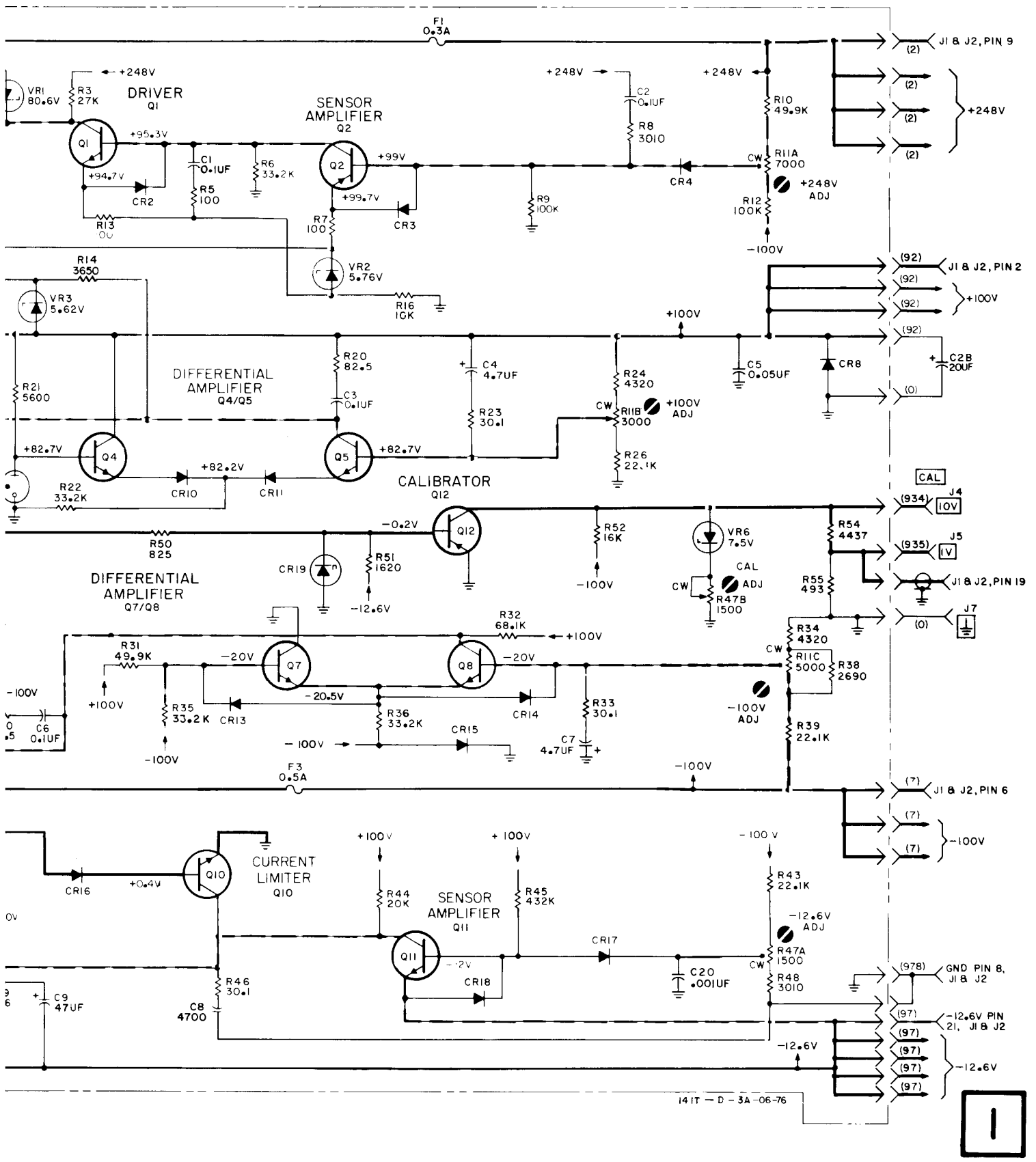
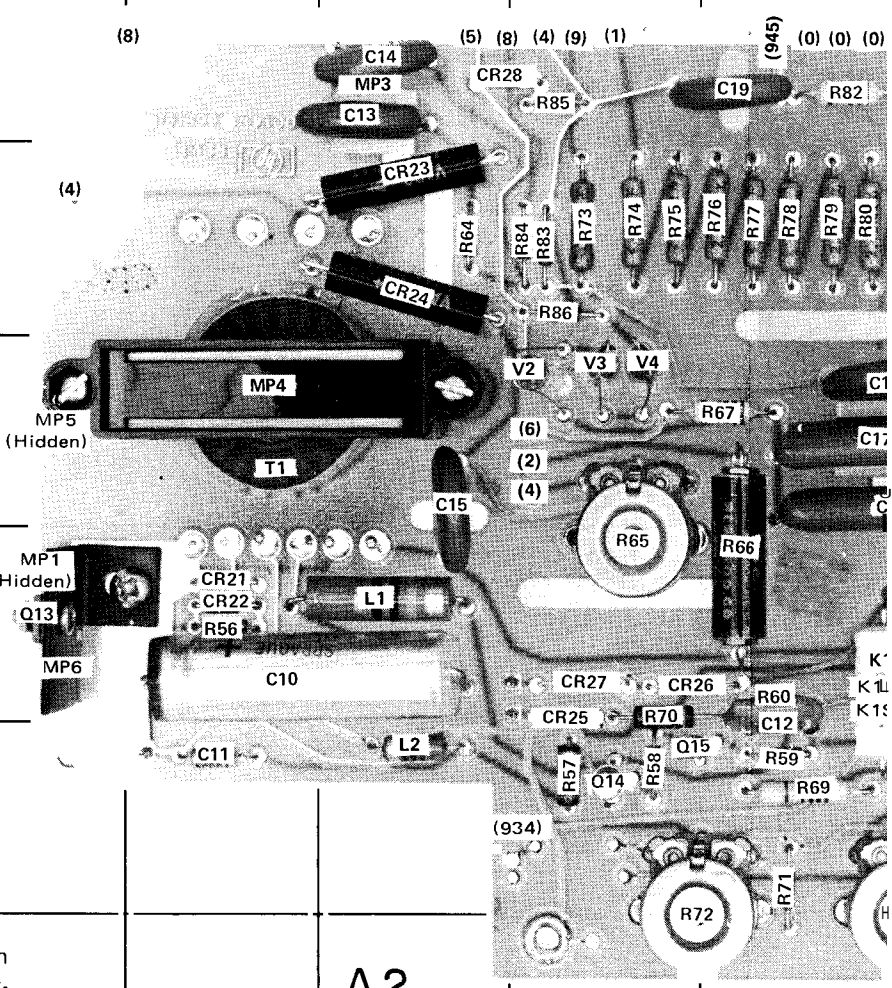


Figure 8-10.
Low Voltage Schematic

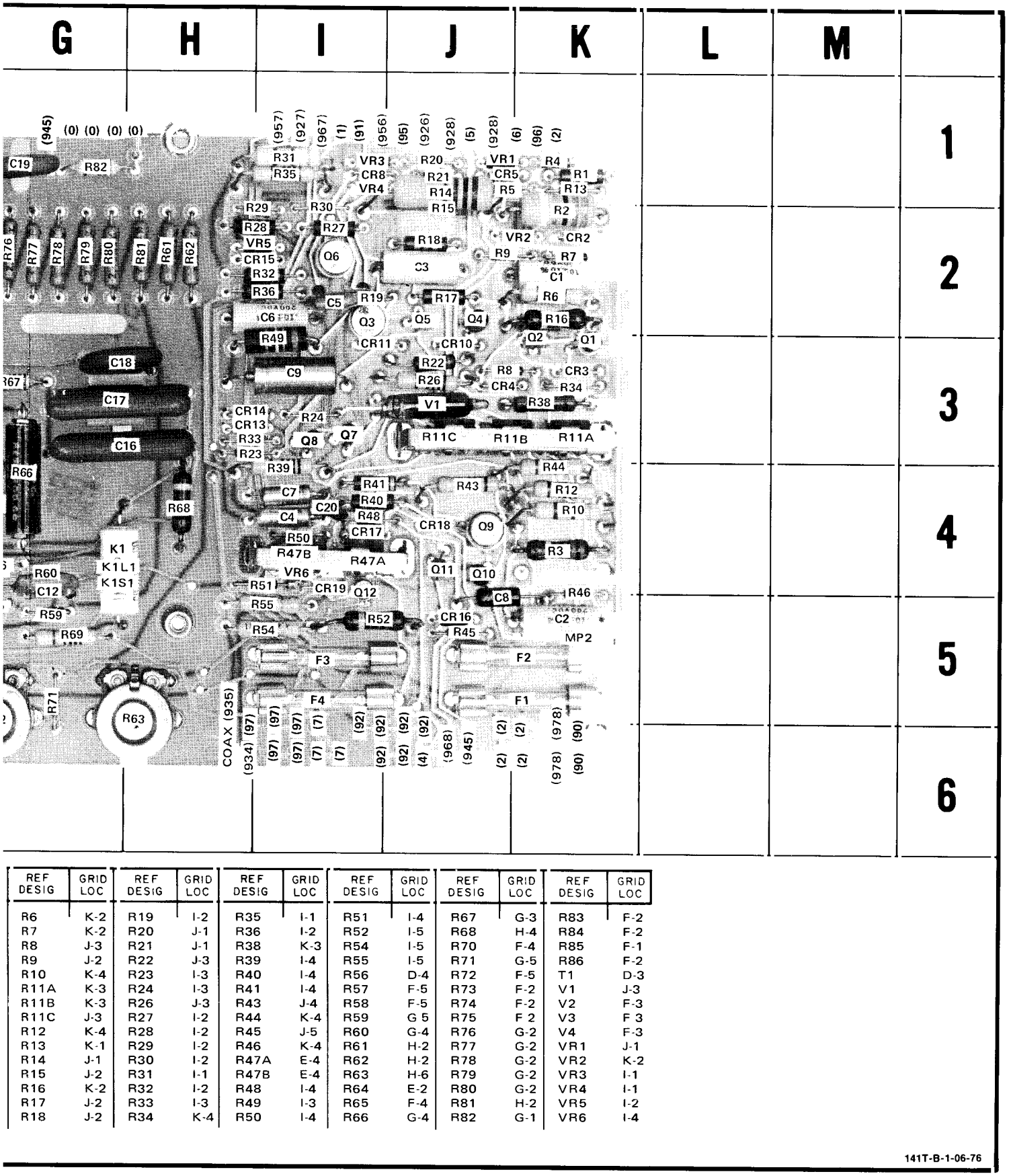
	A	B	C	D	E	F	G
1							
2							
3							
4							
5							
6							



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

A2

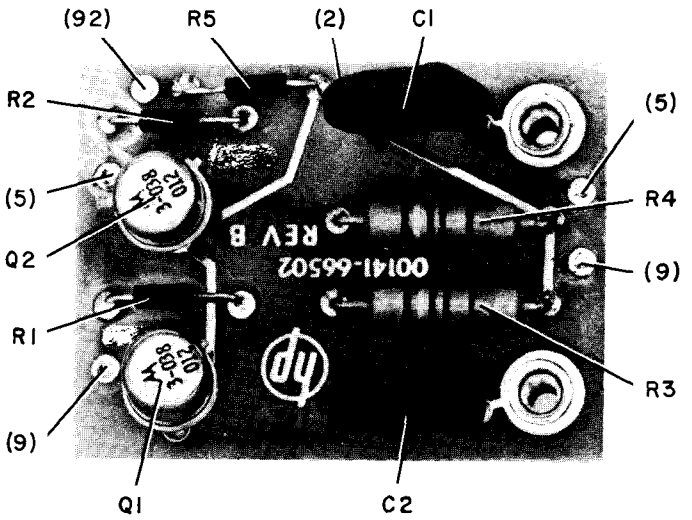
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C2	K-5	C18	G-3	CR19	I-4	K1S1	G 4	Q7	I-3	R7	K-2
C3	J-2	C19	G-1	CR21	D-4	L1	E-4	Q8	I-3	R8	J-3
C4	I-4	C20	I-4	CR22	D-4	L2	E-5	Q9	J-4	R9	J-2
C5	I-2	CR2	K-2	CR23	E-2	MP1	C-4	Q10	J-4	R10	K-4
C6	I-2	CR3	K-3	CR24	E-2	MP2	K-5	Q11	J-4	R11A	K-3
C7	I-4	CR4	J-3	CR25	F-4	MP3	E-1	Q12	I-4	R11B	K-3
C8	J-5	CR5	J-1	CR26	F-4	MP4	D-3	Q13	C-4	R11C	J-3
C9	I-3	CR8	I-1	CR27	F-4	MP5	C-3	Q14	F-5	R12	K-4
C10	D-4	CR10	J-3	CR28	E-1	MP6	C-4	Q15	F-5	R13	K-1
C11	D-5	CR11	I-3	F1	K-5	Q1	K-3	R1	K-1	R14	J-1
C12	G-5	CR13	I-3	F2	K-5	Q2	K-3	R2	K-2	R15	J-2
C13	E-1	CR14	I-3	F3	I-5	Q3	I-2	R3	K-4	R16	K-2
C14	E-1	CR15	I-2	F4	I-5	Q4	J-2	R4	K-1	R17	J-2
C15	E-3	CR16	J-5	K1	G-4	Q5	J-2	R5	J-1	R18	J-2
C16	G-3	CR17	I-4								



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
R6	K-2	R19	I-2	R35	I-1	R51	I-4	R67	G-3	R83	F-2
R7	K-2	R20	J-1	R36	I-2	R52	I-5	R68	H-4	R84	F-2
R8	J-3	R21	J-1	R38	K-3	R54	I-5	R70	F-4	R85	F-1
R9	J-2	R22	J-3	R39	I-4	R55	I-5	R71	G-5	R86	F-2
R10	K-4	R23	I-3	R40	I-4	R56	D-4	R72	F-5	T1	D-3
R11A	K-3	R24	I-3	R41	I-4	R57	F-5	R73	F-2	V1	J-3
R11B	K-3	R26	J-3	R43	J-4	R58	F-5	R74	F-2	V2	F-3
R11C	J-3	R27	I-2	R44	K-4	R59	G 5	R75	F 2	V3	F 3
R12	K-4	R28	I-2	R45	J-5	R60	G-4	R76	G-2	V4	F-3
R13	K-1	R29	I-2	R46	K-4	R61	H-2	R77	G-2	VR1	J-1
R14	J-1	R30	I-2	R47A	E-4	R62	H-2	R78	G-2	VR2	K-2
R15	J-2	R31	I-1	R47B	E-4	R63	H-6	R79	G-2	VR3	I-1
R16	K-2	R32	I-2	R48	I-4	R64	E-2	R80	G-2	VR4	I-1
R17	J-2	R33	I-3	R49	I-3	R65	F-4	R81	H-2	VR5	I-2
R18	J-2	R34	K-4	R50	I-4	R66	G-4	R82	G-1	VR6	I-4

141T-B-1-06-76

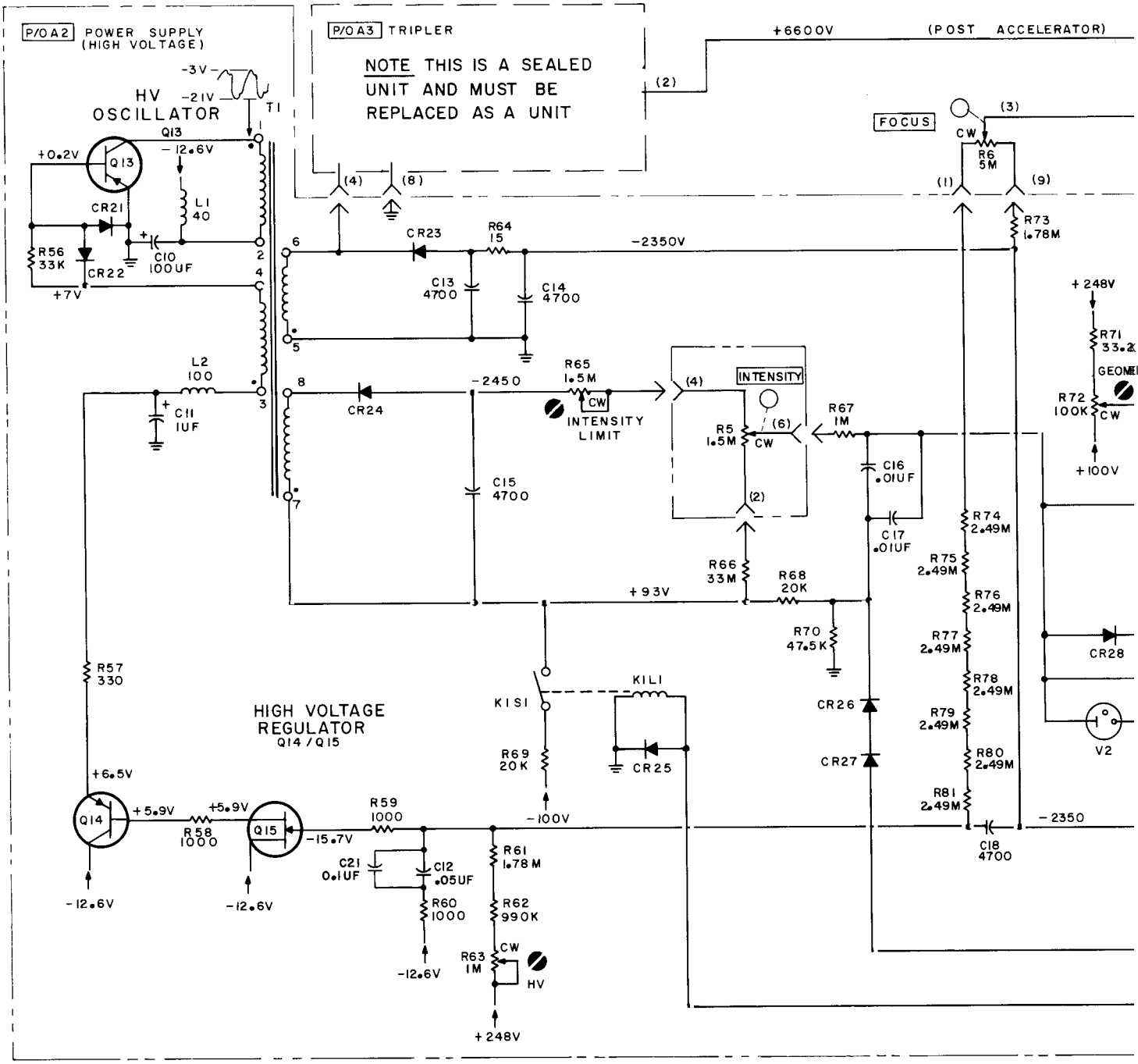
Figure 8-11. Component Identification, Power Supply A2

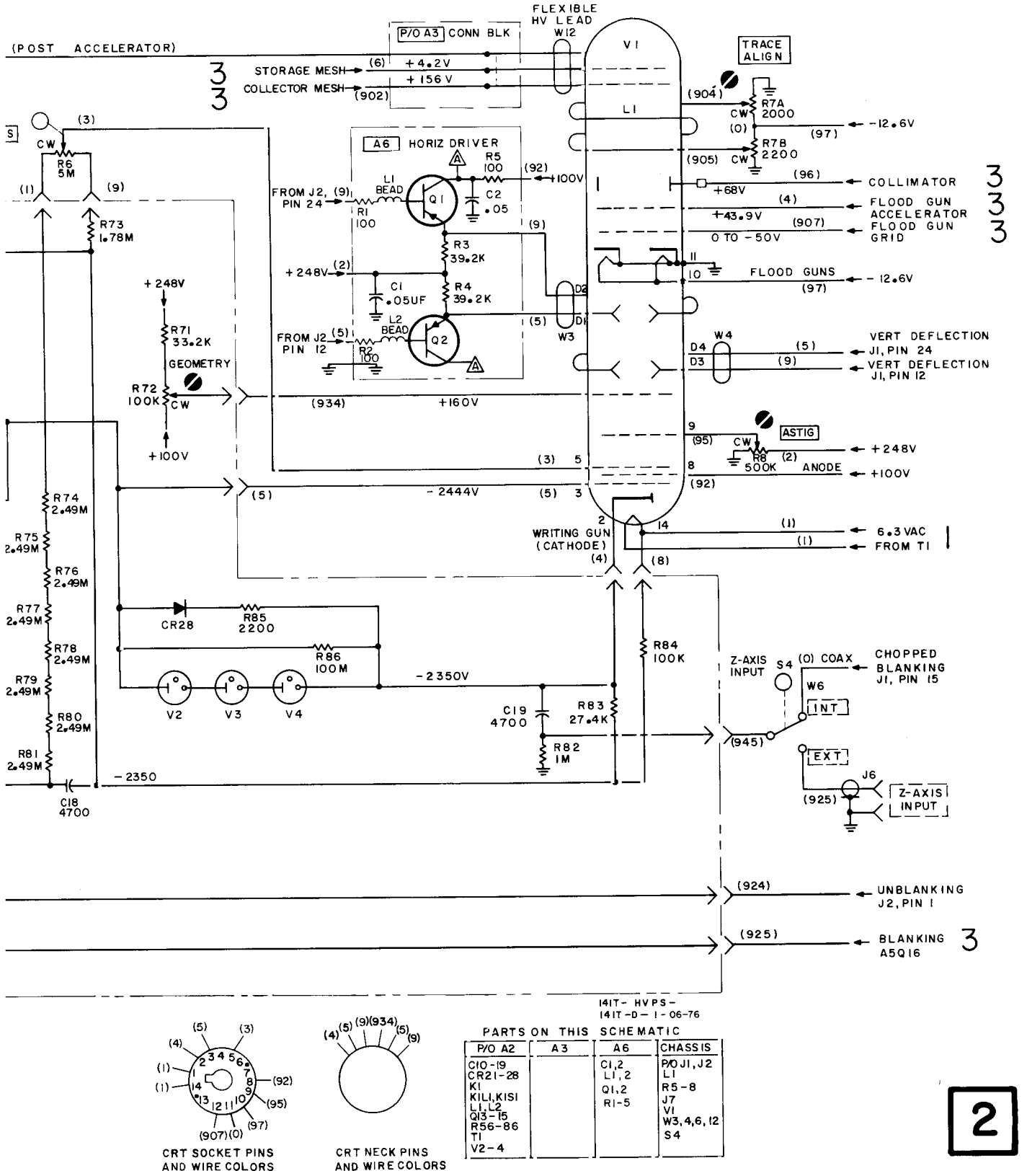


Circuit boards have plated through component holes. This permits soldering from either side of the board.

141B—A—5

Figure 8-12. Component Identification, Horizontal Driver A6


P/O A2 POWER SUPPLY (HIGH VOLTAGE)
P/O A3 TRIPLER
NOTE THIS IS A SEALED UNIT AND MUST BE REPLACED AS A UNIT
+6600V
(POST ACCELERATOR)
HV OSCILLATOR
-3V
-21V
T1
Q13
+0.2V
-12.6V
L1 40
CR21
CR22
R56 33K
C10 100UF
+7V
CR23
R64 15
-2350V
C13 4700
C14 4700
L2 100
C11 1UF
CR24
-2450
R65 1.5M
CW
INTENSITY LIMIT
INTENSITY
R5 1.5M
R67 1M
C15 4700
C16 .01UF
C17 .01UF
R66 33M
R68 20K
+93V
R70 47.5K
R74 2.49M
R75 2.49M
R76 2.49M
R77 2.49M
R78 2.49M
R79 2.49M
R80 2.49M
R81 2.49M
C18 4700
-2350
FOCUS
R6 5M
R73 1.78M
+248V
R71 33.2K
GEOM
R72 100K
+100V
CR28
V2
R57 330
HIGH VOLTAGE REGULATOR Q14/Q15
KIS1
KIL1
R69 20K
CR25
CR26
CR27
-100V
+6.5V
Q14
+5.9V
R58 1000
Q15
-15.7V
R59 1000
C21 0.1UF
C12 .05UF
R60 1000
R61 1.78M
R62 990K
R63 1M
HV
-12.6V
+248V



CRT SOCKET PINS AND WIRE COLORS

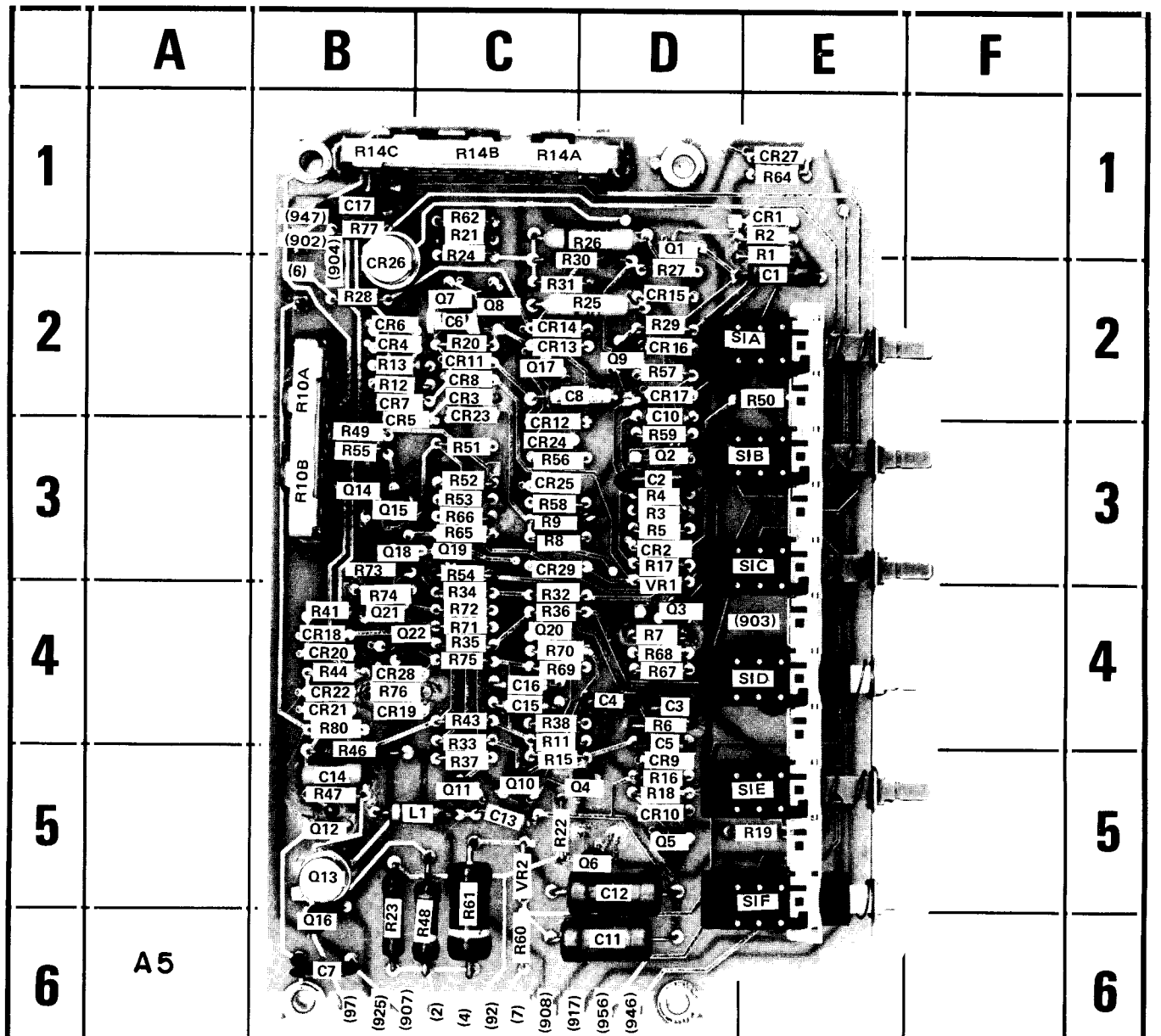
CRT NECK PINS AND WIRE COLORS

PARTS ON THIS SCHEMATIC

P/O A2	A3	A6	CHASSIS
C10-19 CR21-28 K1 K1L1,K1S1 L1,L2 Q13-15 R56-86 T1 V2-4		C1,2 L1,2 Q1,2 R1-5	P/O J1,J2 L1 R5-8 J7 V1 W3,4,6,12 S4

2

Figure 8-13.
High Voltage Schematic
8-17



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

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.

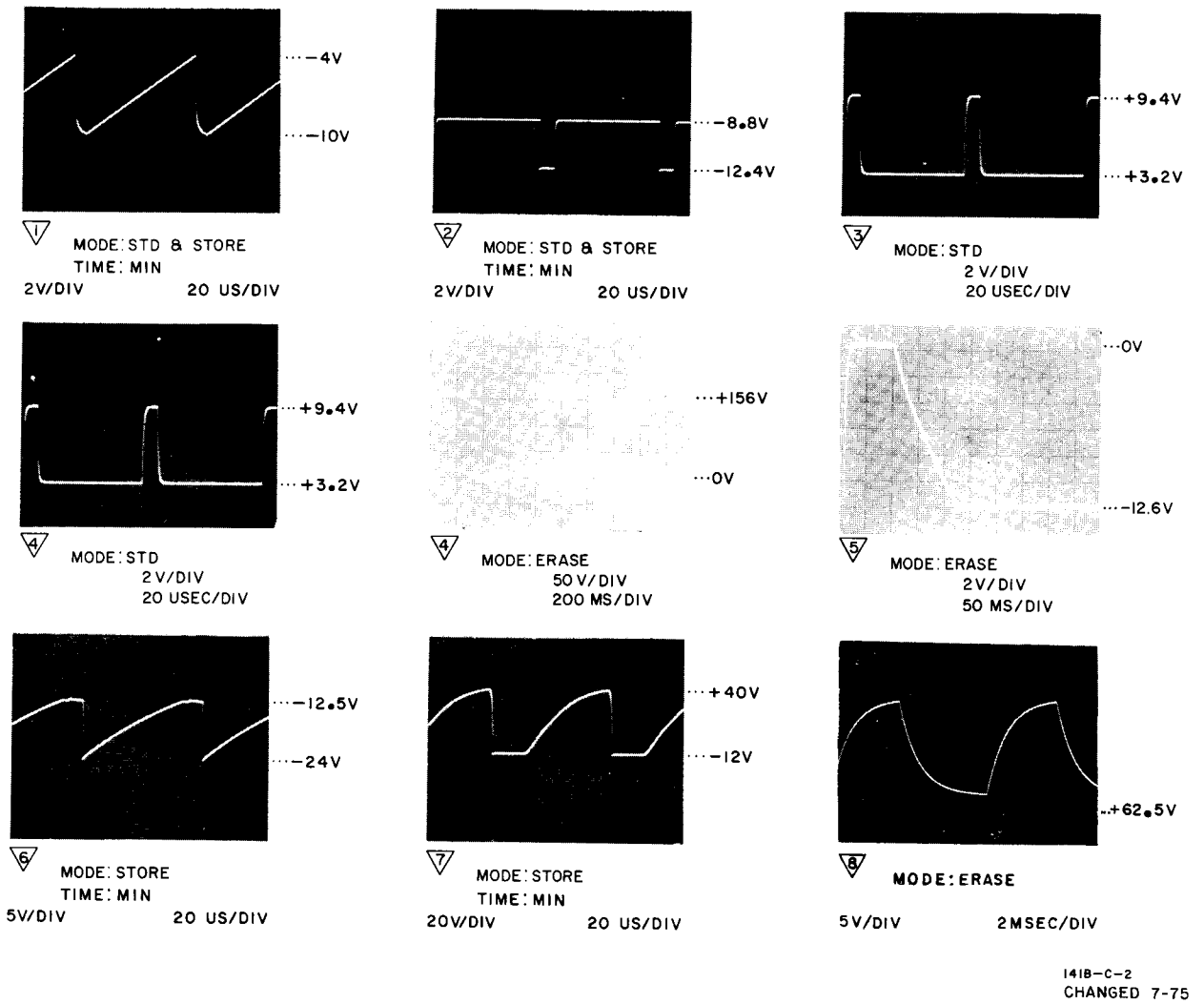
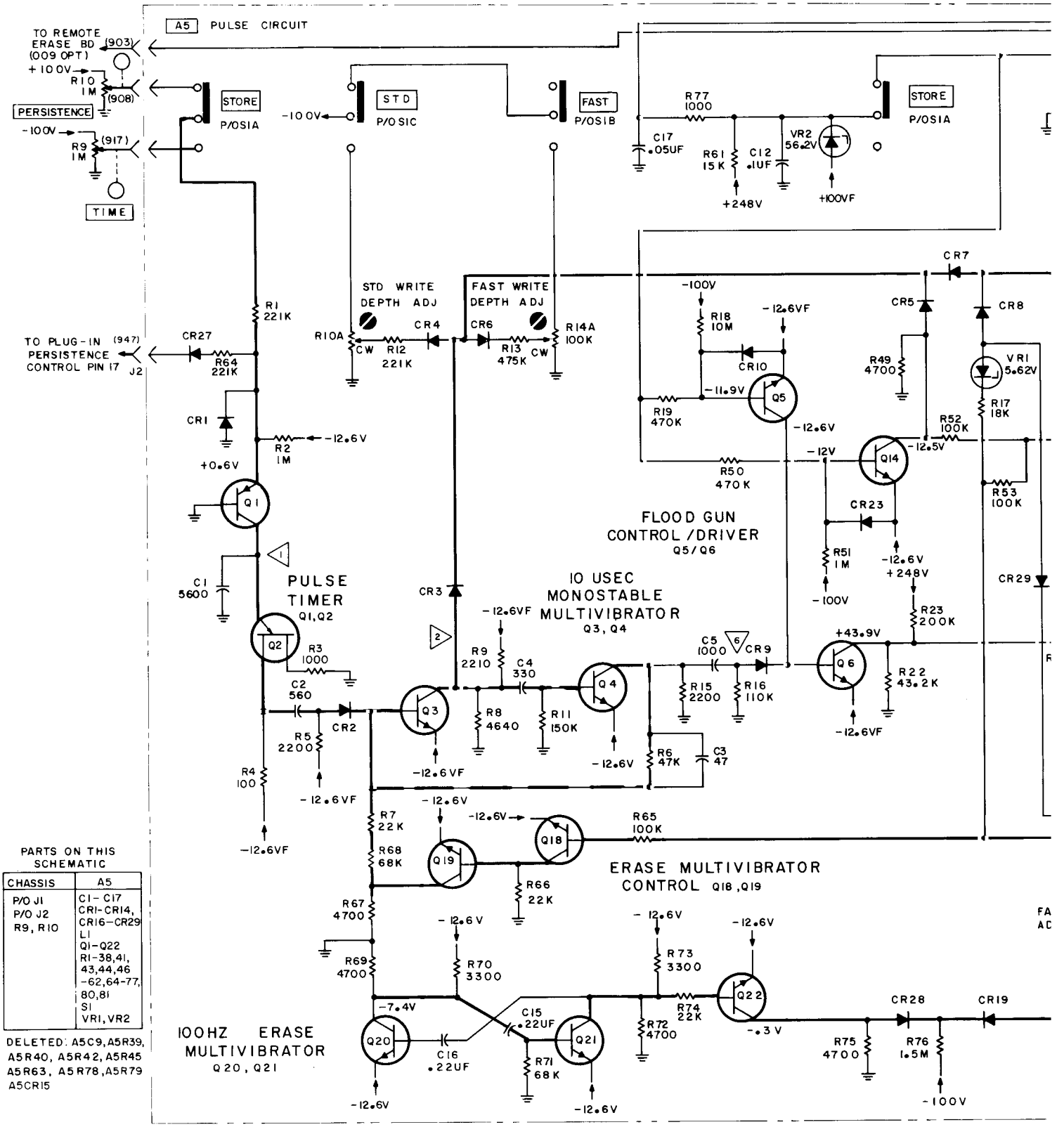


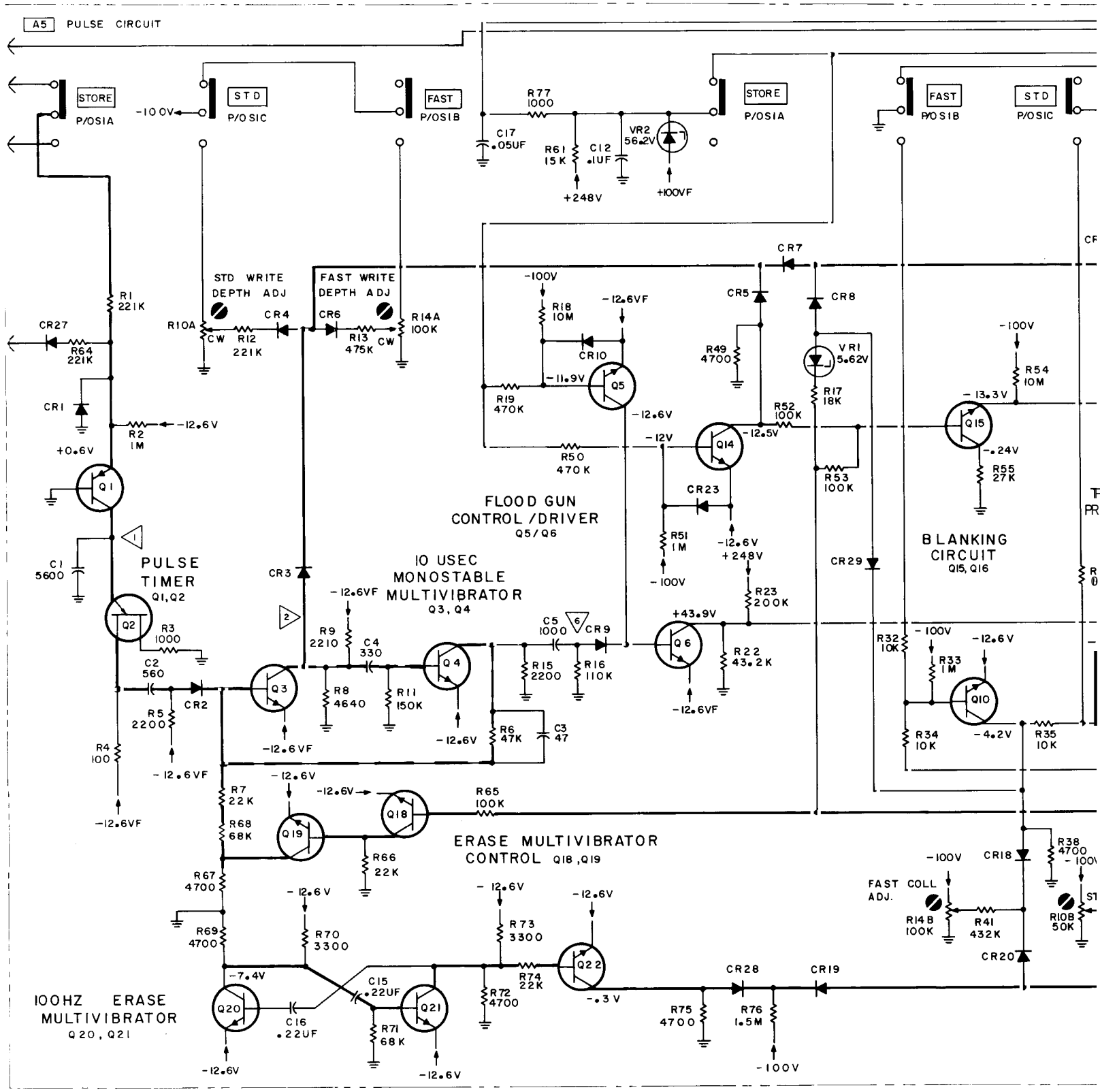
Figure 8-15. Waveforms

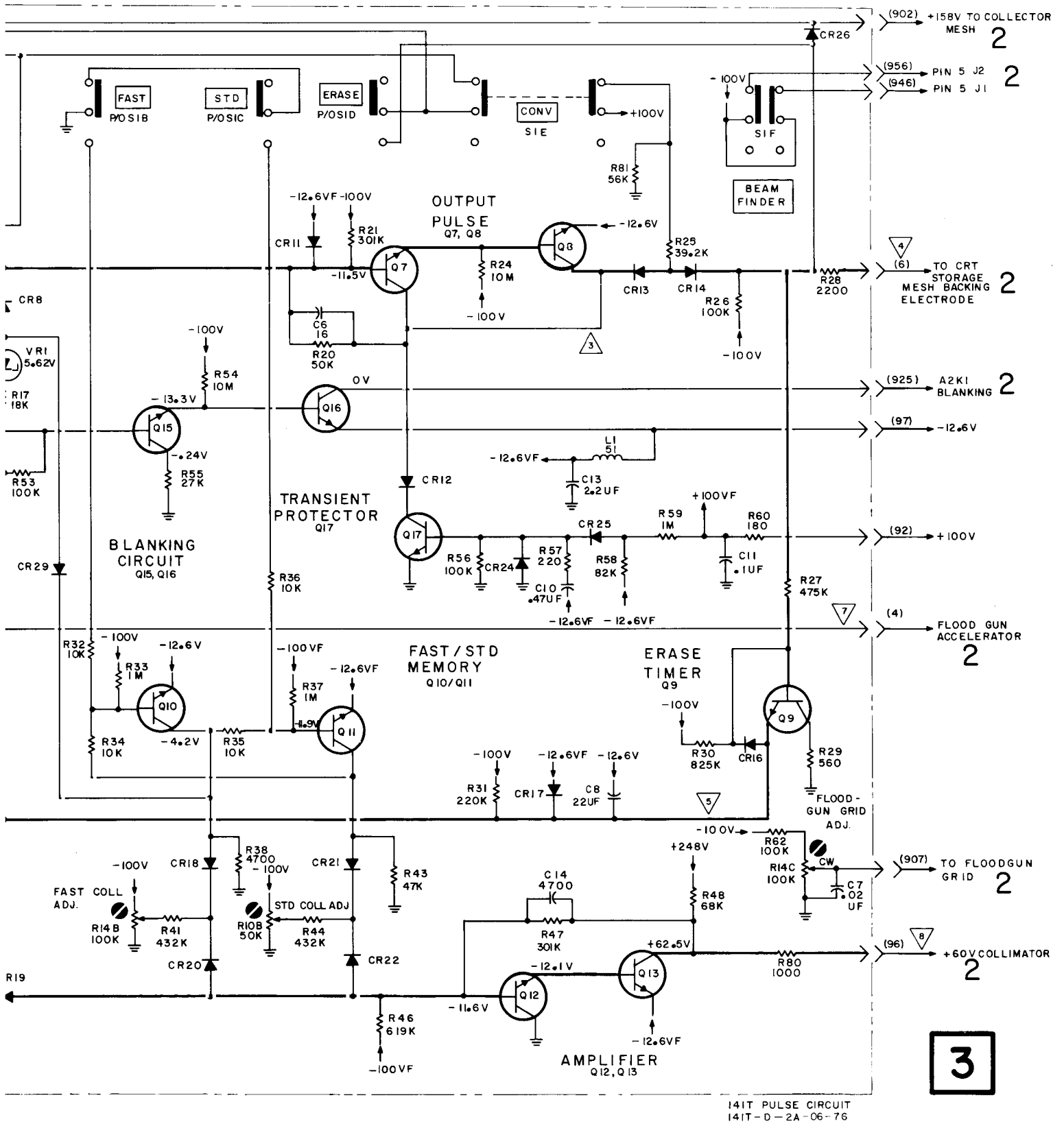


PARTS ON THIS SCHEMATIC

CHASSIS	A5
P/O J1 P/O J2 R9, R10	C1-C17 CR1-CR14, CR16-CR29 L1 Q1-Q22 R1-38,41, 43,44,46 -62,64-77, 80,81 S1 VR1, VR2

DELETED: A5C9, A5R39, A5R40, A5R42, A5R45 A5R63, A5R78, A5R79 A5CR15


A5 PULSE CIRCUIT
STORE P/OS1A
STD P/OS1C
FAST P/OS1B
-100V
R77 1000
C17 .05UF
R61 15K
C12 .1UF
VR2 56.2V
+248V
+100VF
STD WRITE DEPTH ADJ
FAST WRITE DEPTH ADJ
R10A
CW R12 221K
CR4
CR6
R13 475K CW
R14A 100K
R1 221K
CR27
R64 221K
CR1
R2 1M
-12.6V
+0.6V
Q1
C1 5600
PULSE TIMER Q1,Q2
Q2
R3 1000
C2 560
CR2
R5 2200
R4 100
-12.6VF
CR3
10 USEC MONOSTABLE MULTIVIBRATOR Q3, Q4
R9 2210
C4 330
R8 4640
R11 150K
Q3
Q4
R6 47K
C3 47
-12.6V
FLOOD GUN CONTROL /DRIVER Q5/Q6
-100V
R18 10M
-12.6VF
CR10
-11.9V
Q5
R19 470K
R50 470K
-12.6V
-12V
CR5
CR7
CR8
R49 4700
VR1 5.62V
R17 18K
R52 100K
-12.5V
Q14
R53 100K
CR23
R51 1M
-12.6V +248V
-100V
R23 200K
CR29
C5 1000
CR9
+43.9V
Q6
R22 43.2K
R15 2200
R16 110K
-12.6VF
BLANKING CIRCUIT Q15, Q16
-100V
R54 10M
-13.3V
Q15
-.24V
R55 27K
R32 10K
-100V
-12.6V
R33 1M
Q10
-4.2V
R34 10K
R35 10K
R7 22K
R68 68K
-12.6V
Q19
Q18
R65 100K
R66 22K
ERASE MULTIVIBRATOR CONTROL Q18, Q19
R67 4700
R69 4700
R70 3300
-12.6V
-7.4V
Q20
C16 .22UF
C15 .22UF
Q21
R71 68K
-12.6V
100HZ ERASE MULTIVIBRATOR Q20, Q21
R73 3300
R74 22K
Q22
-.3V
R72 4700
CR28
CR19
R75 4700
R76 1.5M
-100V
CR18
R38 4700
FAST COLL ADJ.
R14B 100K
R41 432K
R10B 50K
CR20



141T PULSE CIRCUIT
141T-D-2A-06-76

Figure 8-16.
Pulse Circuit Schematic



00141-90914

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