HP 141S

DISPLAY SECTION 141S

OPERATING AND SERVICE MANUAL

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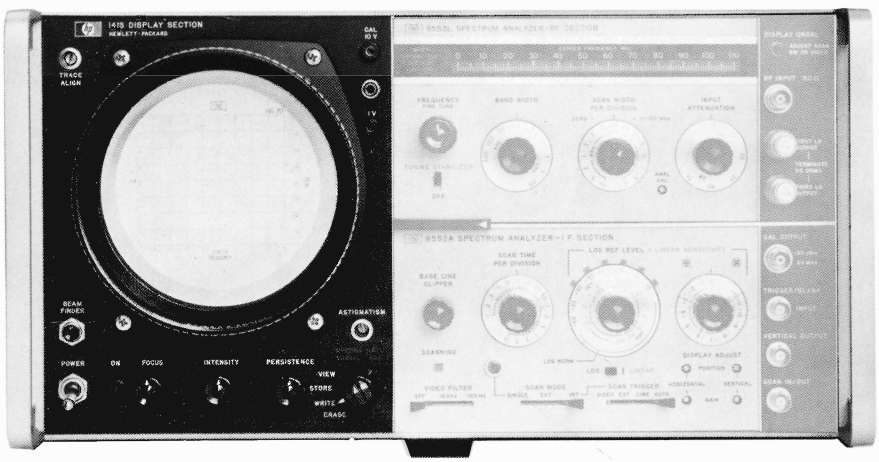
141S



HEWLETT hp PACKARD

HP 141S

OPERATING AND SERVICE MANUAL

MODEL 141S
DISPLAY SECTION

SERIALS PREFIXED: 825-

For Instruments With Other Serial Prefixes, See Section I.

1900 GARDEN OF THE GODS ROAD, COLORADO SPRINGS, COLORADO, U. S. A.

02639-1

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Table 1-1. Specifications

PLUG-INS:

Accepts Model 8552A IF Section and Model 8553L RF Section Spectrum Analyzers without the use of a center divider shield.

Also accepts all Model 1400-Series plug-ins. All plug-ins operate into horizontal and vertical compensation attenuators. 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; 7350 V accelerating potential; aluminized P31 phosphor; etched safety glass face plate reduces glare; transparent coating to reduce RFI.

Graticule:
8 x 10 divisions (approximately 6, 6 x 8, 2 cm); five subdivisions per major division on horizontal and vertical axes.

Intensity Modulation:
(Used only with 1400-series plug-ins.)

AC coupled, +20 V pulse will blank trace of normal intensity; input terminals on rear panel.

Warranty:
CRT specifications (persistence, writing rate, brightness, storage time) warranted for one year.

PERSISTENCE:

Normal:

Natural persistence of P31 phosphor (about 40 μsec to 10% of original brightness.

Variable:

NORMAL Writing Rate Mode: Continuously variable from less than 0.2 second to more than one minute (typically to two or three minutes).

MAX Writing Rate Mode: Typically variable from 0.2 second to 15 seconds.

ERASE:

Manual; erasure takes approximately 100 msec; scope ready to record immediately after erasure (see options for remote erase).

WRITING RATE:

Conventional operation (using an hp 197A camera with f/1.9 lens and Polaroid 3000 speedfilm): 100 cm/μsec.

Storage:

NORMAL Mode: greater than 20 cm/ms.
MAX Mode: greater than 1 cm/μsec.

STORAGE TIME:

	NORMAL Writing Rate Mode	MAX Writing Rate Mode
STORE Mode (dim display)	longer than 1 hour	typically 15 minutes
VIEW Mode (bright display)	longer than 1 minute (typically 2 or 3 minutes)	typically 15 seconds

Brightness:

Greater than 100 foot-lamberts in NORMAL or VIEW; typically 5 foot-lamberts in STORE.

CALIBRATOR:

(Used only with 1400-series plug-ins.)

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

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

BEAM FINDER:

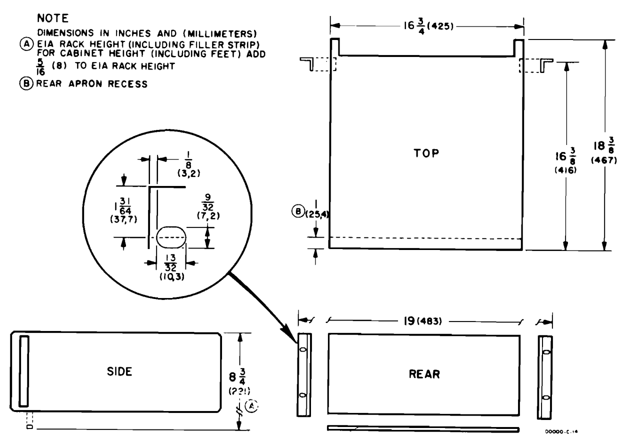
Pressing BEAM FINDER control brings defocused trace on screen regardless of setting of horizontal or vertical controls.

GENERAL:

Power Requirements:

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

Dimensions:



Weight:

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

OPTIONS: (Specify by option number.)

09: Remote erase. BNC input on rear panel; shorting to ground for at least 50 msec erases screen; input draws 20 ma from ground through a 600-ohm impedance to a -12 volt supply.

SECTION I
GENERAL INFORMATION

1-1. DESCRIPTION.

1-2. The Model 141S, Figure 1-1, is the Display Section of the HP Model 141S/8552A/8553L Spectrum Analyzer. Model 141S has the added features of variable persistence (duration of trace afterglow) and storage of CRT displays. Persistence is variable from 0.2 to more than 60 seconds; a display may be stored (at reduced intensity) for more than 1 hour or displayed at normal intensity for up to 1 minute. Stored displays can be erased in 100 milliseconds.

1-3. 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.

1-4. The storage feature of the Model 141S can be used to store single-shot waveforms and later to view or photograph the phenomena. Comparison of Waveforms can be accomplished by storing several displays separately and then viewing them simultaneously.

1-5. The Model 141S accepts Model 8552A IF Section and 8553L RF Section Spectrum Analyzer plug-ins and all HP Model 1400-series plug-in units. Amplifiers with bandwidths up to 20 MHz and sensitivities to 10 microvolts per centimeter are available as well as time-domain reflectometry and swept frequency indicator units. Complete specifications for the Model 141S Display Section are given in Table 1-1.

1-6. CATHODE-RAY TUBE.

1-7. The Model 141S uses an internal graticule, P31 aluminized phosphor CRT with a transparent coating to reduce RFI. Additional internal elements provide variable persistence and storage features. The tube is equipped with a nonglare safety face plate and the internal graticule eliminates parallax error in observing the display.

1-8. CRT WARRANTY.

1-9. The CRT used in the Model 141S is covered by a warranty separate from the instrument warranty. The CRT warranty is included in the back of this manual for use in the event of CRT failure during the warranty period listed thereon.

1-10. ASSOCIATED EQUIPMENT.

1-11. The Model 141S Display Section is designed specifically for use with Model 8552A/8553L Spectrum Analyzer Plug-in units. The Operation and service Manual for these units give complete information on installation and operation on the units.

Figure 1-1. Model 141S Oscilloscope

1-12. Model 141S also accepts all HP 1400-series time-domain plug-ins listed in the Hewlett-Packard Instrumentation Catalog. The Model 141S is normally operated with a vertical plug-in in the upper compartment. Both plug-in compartments are the same size and the plug-in instruments may be interchanged for any special application. The divider shield, which separates the two compartments, may be removed and one double sized plug-in installed. Blank plug-in kits, both single and double sized, are available for user fabrication of special circuits. See Table 4-1 for power supply current limitations.

1-13. MANUAL IDENTIFICATION.

1-14. Information in this manual applies directly to Model 141S instruments with serial prefix of 825-. The serial prefix is the first 3 digits of the eight-digit serial number (000-00000) used to identify each Hewlett-Packard instrument. If the serial prefix of a Model 141S is not 825-, a change sheet supplied with the manual will define the differences between that Model 141S and the one described in this manual. Corrections to this manual due to any errors which existed at the time of printing are called Errata and appear only on the change sheet supplied. For information pertaining to change sheets, contact the nearest Hewlett-Packard Sales/Service Office.

1-15. SCOPE OF MANUAL.

1-16. The intent of this manual is to provide the user of the Model 141S with all necessary information to apply this instrument to the full extent of its capabilities. Because the Model 141S Display Section may be used not only as a Spectrum Analyzer but also as a conventional oscilloscope, the manual contains information pertinent to both usages.

1-17. Primarily, the Model 141S is intended for use as the Display Section of the 141S/8552A/8553L Spectrum Analyzer. Therefore all discussions in succeeding sections of this manual will deal first with this application. Immediately following will be information applicable to conventional oscilloscope operation with HP Model 1400-series time-domain plug-ins.

1-18. In view of this treatment of subject material, the user should bear in mind that there may be variations in adjustments, checks and procedures depending on the use being made of this instrument.

SECTION II
INSTALLATION

2-1. INITIAL INSPECTION.

2-2. MECHANICAL CHECK. If external damage to the shipping carton is evident, ask the carrier's agent to be present when the instrument is unpacked. Check the instrument for external damage such as broken controls or connectors, and dents or scratches on the panel surfaces. If damage is found, see Paragraph 2-15 for recommended claim procedure. If the shipping carton is not damaged, check the cushioning material and note any signs of severe stress as an indication of rough handling in transit. If the instrument appears undamaged, perform the electrical check (Paragraph 2-3). Retain the packaging material for possible future use.

2-3. ELECTRICAL CHECK. Check the electrical performance of the Model 141S as soon as possible after receipt. Paragraphs 5-3 through 5-5 contain performance check procedures which will verify instrument operation within the specifications listed in Table 1-1. Initial performance and accuracy of the instrument are certified as stated on the inside front cover of this manual. If the instrument does not operate as specified, refer to Paragraph 2-15 for recommended claim procedure.

2-4. PREPARATION FOR USE.

2-5. POWER REQUIREMENTS.

CAUTION

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

2-6. The Model 141S Display Section requires a power source of either 115 or 230 volts ac, +10%, single phase, 50-60Hz, which can deliver approximately 300 watts. A rear panel switch provides appropriate transformer connections for the line voltage to be used.

2-7. 230-VOLT OPERATION. If the instrument is to be operated from a 230-volt source, set the rear panel switch to 230. The line fuse, F401, must be changed to a 2-amp slow-blow fuse for 230-volt operation. The fuse is accessible by removing the bottom cover of the Model 141S. It is identified in Figure 5-1.

2-8. THREE-CONDUCTOR POWER CABLE. National Electrical Manufacturers Association (NEMA) recommends that instrument panel and cabinet be grounded for the protection of operating personnel. The Model 141S is equipped with a detachable, three-conductor power cable which, when plugged into an appropriate receptacle, grounds the instrument. The offset (round) pin on the power cable connector is the ground pin. To preserve the protection feature when operating the Model 141S from a two-contact outlet, use a three-conductor to two-conductor adapter and connect the green lead on the adapter to ground at the power outlet.

2-9. INSTRUMENT MOUNTING.

2-10. MODULAR CABINET. The Model 141S is shipped from the factory as a bench instrument with the tilt stand, feet, and plastic trim in place. The top and bottom panel covers can be removed, giving complete accessibility to all components and adjustments. Sufficient space should be left around the sides of the cabinet to allow unrestricted air circulation.

2-11. RACK MOUNTING. A kit for converting the modular cabinet to a rack mount is supplied with each Model 141S. Instructions for making the conversion are given below. Refer to Figure 2-1 as an aid to identifying parts.

a. Detach tilt stand by pressing away from front feet; remove all plastic feet by depressing metal button and sliding foot free.

b. Aluminum trim strips (behind each front handle) on sides of instrument have an adhesive back; use a thin-blade tool to remove them.

c. Attach a rack-mounting flange, using screws provided in kit, in each space where trim strip was adhered; larger notch of flange should be positioned at instrument bottom.

d. If Model 141S is to be placed in a rack above or below another hp instrument, attach filler strip provided with kit between front panels of instruments.

2-12. INSTRUMENT COOLING.

2-13. The Model 141S uses a forced-air cooling system to maintain reasonable operating temperatures within the instrument. Warm air is exhausted through the side panel perforations. When operating the instrument, choose a location which provides at least three inches of clearance around the rear and both sides.

2-14. The cooling fan and air filter require periodic lubrication and cleaning. Refer to Paragraph 5-41 for maintenance instructions.

2-15. CLAIMS.

2-16. The warranty statement applicable to all Hewlett-Packard Company instruments and products is provided inside the front cover of this manual. If physical damage is found or if operation is not as specified when the instrument is first received, notify the carrier and the nearest Hewlett-Packard Sales/Service Office immediately. The Sales/Service Office will arrange for repair or replacement of the instrument without waiting for settlement of a claim with the carrier. For other than initial inspection warranty claims, contact the Sales/Service Office.

2-17. REPACKAGING FOR SHIPMENT.

2-18. If the Model 141S is to be shipped to a Hewlett-Packard Sales/Service Office for service or repair, attach a tag showing owner (with address), instrument model number, full serial number of the instrument (all 8 digits) and description of the service or repair required.

2-19. The original shipping carton and packaging material, with the exception of accordion-pleated pads, may be reused, if undamaged. The Sales/Service Office will provide information and recommendations on materials to be used if the original packaging material is not available. Materials used for shipping an instrument should include the following:

a. A double-walled carton, see Table 2-1 for test strength required.

Table 2-1. Shipping Carton Test Strengths

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

b. Heavy paper or sheets of cardboard to protect all instrument surfaces; use a nonabrasive material such as polyurethane or cushioned paper such as Kimpak around all projecting parts.

c. At least 4 inches of tightly-packed, industry approved, shock-absorbing material such as extra firm polyurethane foam.

d. Heavy-duty shipping tape for securing outside of carton.

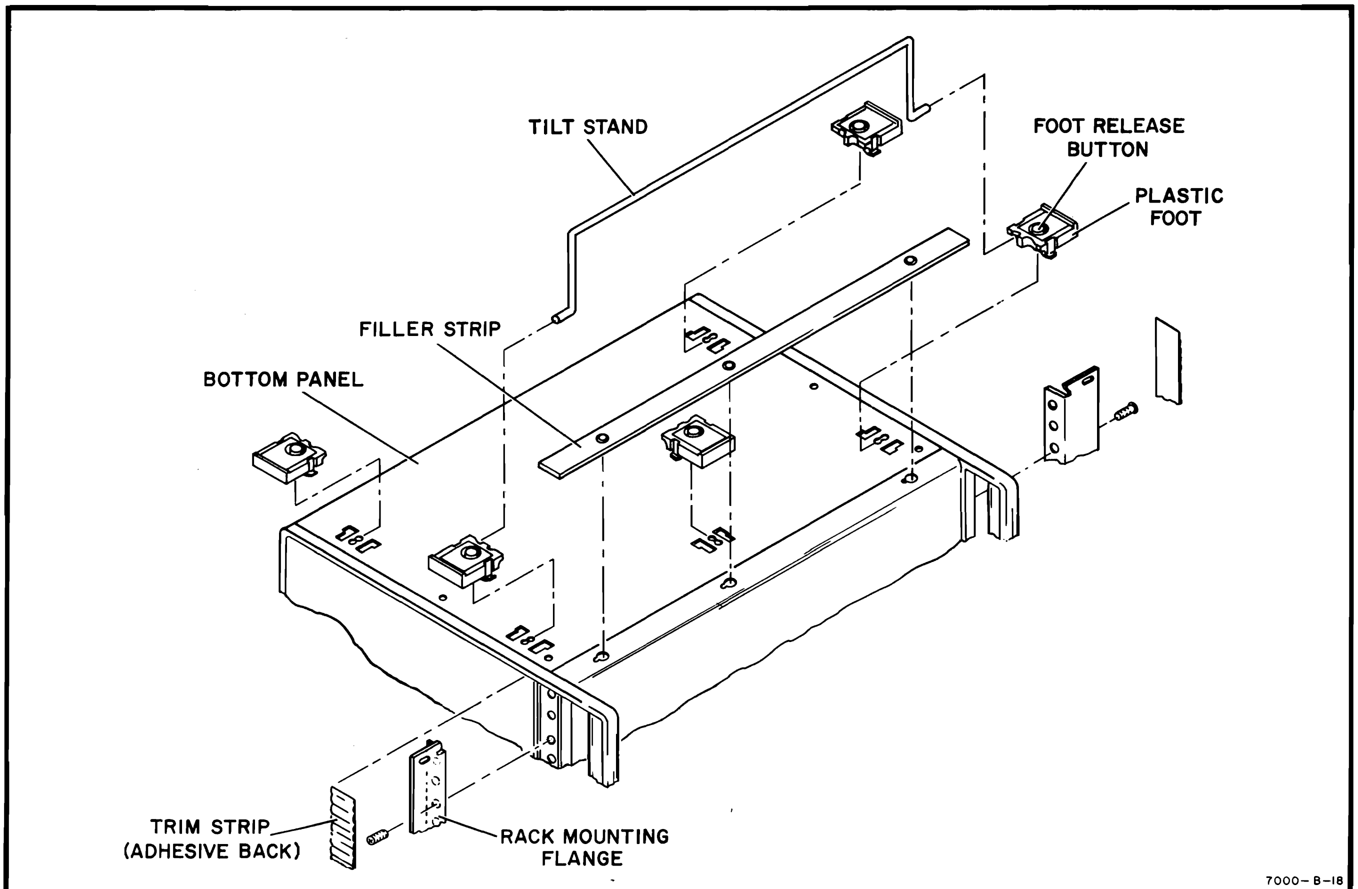


Figure 2-1. Rack Mounting Procedure

SECTION III
OPERATION

3-1. INTRODUCTION.

3-2. The Model 141S Display Section employs a variable persistence, storage type CRT and accepts Spectrum Analyzer or 1400 Series time-domain plug-ins. Controls which affect operation of the power supplies and cathode-ray tube are located on the Model 141S, all other controls are located on the plug-in units. The Model 141S includes the high and low voltage power supplies, a calibrator circuit with 1 and 10 volt pk-pk outputs, a compensation attenuator circuit, a pulse circuit for variable persistence and storage operation, and the CRT.

3-3. FRONT PANEL COMPONENTS.

3-4. Figure 3-1 identifies the front panel controls and gives a brief functional description of each. Additional information on some of the controls is given below. A more detailed description of some of the controls and their function in variable persistence and storage operation is given in Paragraph 3-17.

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

CAUTION

BEAM FINDER should be depressed only momentarily and then released. If it is held depressed, damage to the CRT may occur.

3-6. BEAM FINDER. A very high dc input signal may drive the trace off the CRT screen. When the BEAM FINDER is depressed, the trace is returned to the screen. Adjust the POSITION control to center the beam and when the BEAM FINDER is released, the trace should remain on screen. If the front panel INTENSITY control is fully counter-clockwise, the trace may not be visible. If the trace is not visible when the BEAM FINDER is depressed, set INTENSITY to 10 o'clock position.

3-7. ASTIGMATISM. The ASTIGMATISM adjustment is provided to insure uniform focus of the trace over the entire CRT screen. To adjust the ASTIGMATISM, set Presentation Selector to WRITE, center a low-intensity spot on the CRT screen (WRITING RATE and PERSISTENCE both in NORMAL) and adjust FOCUS and ASTIGMATISM for a small, round, sharply focused spot.

3-8. CALIBRATOR. To avoid damage to the Model 8553L RF Section do not connect the output of the Calibrator to the Spectrum Analyzer Plug-ins. Refer to the Operating and Service Manual of the 8552A/8553L for proper Calibration procedures when using Spectrum Analyzer plug-ins.

3-9. Paragraph 5-19 contains CALIBRATOR adjustment procedures when 1400 series plug-ins are employed.

3-10. REAR PANEL COMPONENTS.

3-11. 115/230 VOLT SWITCH. This switch, located at the bottom of the rear panel, must be set to the position which corresponds to the line voltage to be used. The Model 141S is shipped with a 4-amp fuse installed for 115-volt operation. If the Model 141S is to be connected to a 230-volt outlet, change the fuse to a 2-amp, slow-blow fuse supplied with the instrument.

3-12. Z-AXIS INPUT. When the Model 141S is used with Spectrum Analyzer plug-ins, the Z Axis terminals and selector switch on the rear panel are inoperative.

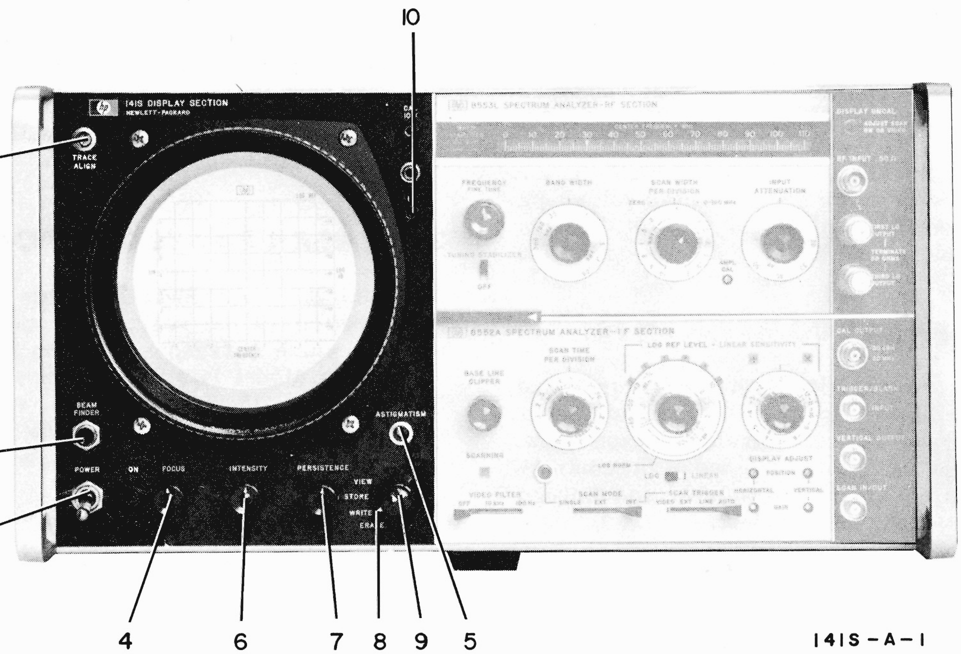
3-13. To modulate the trace intensity externally in conventional oscilloscope applications, set the switch to EXT, remove the shorting strap and connect the modulation signal to the terminals. The amplitude of the pulse required to blank the trace depends on the front panel INTENSITY control setting, and is approximately 20 volts positive for normal intensity settings. When not using external intensity modulation, connect the strap across the terminals and place the switch to INT.

3-14. PLUG-IN UNITS.

3-15. For operation as a Spectrum Analyzer, install Model 8552A IF Section and Model 8553L RF Section in plug-in compartment as outlined in Operating and Service Manual for these units.

3-16. When setting up for conventional oscilloscope operation, insert desired plug-in units in the upper and lower compartments. The compartment divider plate must be in place to provide proper shielding between the plug-ins. For double-size plug-in operation, remove the divider. All plug-ins should be securely locked in place with the front panel LOCK knob.

3-17. Deflection-plate sensitivity may vary slightly from one CRT to another. This may necessitate adjustment of the sensitivity calibration of plug-ins installed in the Model 141S for the first time, or when moved from one Model 141S to another. Refer to the Operating and Service Manual furnished with plug-in unit for the SENS/CAL adjustment procedure.



1. Adjustment to set trace parallel with horizontal graticule lines.
2. Momentary switch to return beam to CRT regardless of vertical and horizontal POSITION control settings. See CAUTION statement in Paragraph 3-6.
3. ON position connects AC power to Oscilloscope and lights POWER indicator.
4. Control for focusing beam on CRT.
5. Adjustment to set roundness of CRT beam.
6. Control for setting intensity (brightness) of CRT display. See CAUTION statement in Paragraph 3-18.
7. Control for setting trace persistence (afterglow) on CRT.
8. Presentation Selector, for selecting function of CRT.
9. Switch for selecting CRT writing rate.
10. 1 and 10-volt pk-pk, 60 Hz, calibrated square wave outputs.

CAUTION

Do not connect the CALIBRATOR output to the Spectrum Analyzer RF Section INPUT jack.

Figure 3-1. Model 141S Controls

3-18. OPERATING CONSIDERATIONS.

Note

The following sections apply to the Model 141S in all types of operation. Always allow at least 15 minutes warm up before attempting to use the Model 141S.

3-19. DEFINITIONS.

3-20. Several words and phrases, the definition of which may vary slightly from common usage are used to describe the operation of the Model 141S. The definitions of these words and phrases which apply to the Model 141S are as follows:

a. WRITE - To transform an input signal into 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. VIEW - To redisplay on the CRT screen, at normal intensity, a stored display.

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

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

g. BLOOM - A visible, non-symmetrical expansion of a display written on the CRT screen. (Figure 3-5.

h. FADE POSITIVE - Appears as random green areas on a dark background in MAX. PERSISTENCE. (Figure 3-7.)

i. BACKGROUND ILLUMINATION - A green cloud of illumination visible on the CRT screen. (Figure 3-3.)

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

k. FADE NEGATIVE - A condition in which a portion of the trace or screen begins to dim.

m. 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, MAX. WRITE modes.

3-21. CONTROL FUNCTIONS.

CAUTION

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

3-22. PERSISTENCE and INTENSITY. These controls contribute to the duration of afterglow of a display. Always set PERSISTENCE and INTENSITY as shown in Figure 3-2. The PERSISTENCE control sets the rate at which a display is erased; INTENSITY sets the brightness of the trace as it is written. Since the PERSISTENCE control sets the rate of erasing a written display, it follows that a brighter trace will require more time to be erased. Conversely, a display of low intensity will disappear more rapidly. The same principle applies to a stored display of high or low intensity.

3-23. PRESENTATION SELECTOR. This control selects the mode in which the CRT functions. In the ERASE position, the other three functions are disconnected and all stored and persisting displays are removed from the CRT. The WRITE position is the only position on the selector in which a display may be written on the CRT screen. The STORE position disconnects the WRITE function and retains written displays (at reduced intensity) on the CRT. INTENSITY and PERSISTENCE do not function in the STORE position. The VIEW position intensifies the stored display to a set brightness. Again, INTENSITY and PERSISTENCE do not affect the display.

3-24. WRITING RATE. In the MAX position, the rate of erasing a written display is decreased. Since the erasing rate is decreased, the entire screen becomes illuminated more rapidly and the display is obscured. The effective persistence and storage time are thus considerably reduced.

3-25. OPERATING TIPS.

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

a. The persistence uniformity in NORMAL writing rate can be considerably improved by reducing the size of the usable display area. To accomplish this, refer to Paragraph 5-20, w, except that the inner green rings may be moved in as much as one inch.

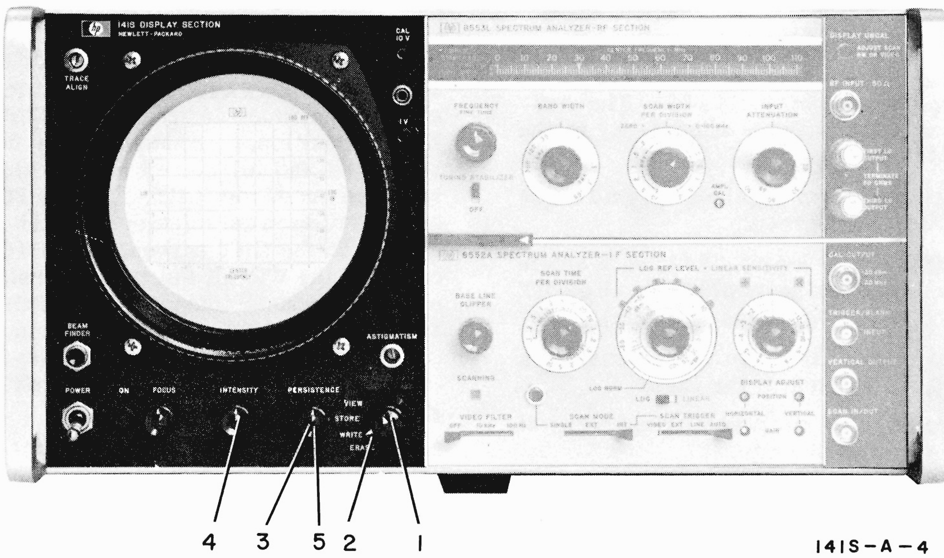
b. For variable persistence operation, use minimum INTENSITY and maximum PERSISTENCE compatible with the desired display. (See Figure 3-4.)

c. Use WRITING RATE in MAX only for fast sweep time, single-shot displays, or to improve the uniformity of trace intensity. The MAX position causes more rapid positive fading on the CRT and persistence or storage time of the display is thus reduced.

d. To store a display, set the Presentation Selector to WRITE, adjust the INTENSITY and PERSISTENCE for the desired display and rotate the presentation Selector to STORE.

e. To view a stored display, rotate the Presentation Selector to VIEW.

f. To store more than one display, set Presentation selector to WRITE, set PERSISTENCE fully clockwise and INTENSITY as required; allow first display to be written on the CRT. Set INTENSITY fully counterclockwise and connect second signal to be stored. Reset vertical POSITION if second display is not to be superimposed on first. Slowly rotate INTENSITY



141S-A-4

VARIABLE PERSISTENCE MODE

1. Rotate WRITING RATE to NORMAL position.
2. Rotate Presentation Selector to WRITE.
3. Rotate PERSISTENCE control ccw to, but not in, NORMAL detent.
4. Adjust INTENSITY to a point where no trace blooming appears.

NORMAL PERSISTENCE MODE

1. Rotate WRITING RATE to NORMAL position.
2. Rotate Presentation Selector to WRITE.
3. Rotate PERSISTENCE control ccw to, but not in, NORMAL detent.
4. Adjust INTENSITY to a point where no trace blooming appears.
5. Set PERSISTENCE fully ccw into NORMAL detent. DO NOT INCREASE INTENSITY.

CAUTION

Trace blooming, Figure 3-5, is the best indicator of excessive INTENSITY which can damage the CRT. However, blooming does not occur when PERSISTENCE is set to NORMAL. Therefore, DO NOT INCREASE INTENSITY WHEN PERSISTENCE IS SET TO NORMAL. Always be sure to repeat above procedure each time sweep speed or input signals change.

Figure 3-2. Proper Intensity Adjustment.

clockwise until second display appears. Rotate Presentation Selector to STORE and both displays are stored.

g. A display stored when instrument power is turned off, will remain stored for several days. To observe a stored display, set Presentation Selector to VIEW and vertical POSITION control ccw, before turning on the Model 141S.

h. To erase all persistent or stored displays, set Presentation Selector to WRITE and rotate PERSISTENCE control counterclockwise to (but not in) NORMAL detent; or rotate Presentation Selector to ERASE for approximately 1 second, then release. (First method not effective when WRITING RATE is set to MAX.)

i. When using the Model 141S for single sweep operation, the FOCUS control must be adjusted indirectly to obtain a well-defined trace. Set the sweep for single operation, erase the CRT, trigger the single sweep and note trace definition. Change FOCUS setting as necessary each time and repeat preceding until sharpest trace is obtained.

j. If only a portion of a slow sweep display is desired, switch the Presentation Selector to STORE when the trace has been written to the desired point; the write gun is blanked and the written portion is stored.

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

m. If high intensity is used to write a trace on the CRT, it may not completely erase with one ERASE operation. Continue to erase the CRT in the normal manner taking care not to keep the Presentation Selector in ERASE for more than 1 second at any one time.

n. Figures 3-3 through 3-10 are provided to show typical CRT displays with various control settings and input signals. They are examples which, if duplicated by the operator, will aid in understanding the operation of the Model 141S. Figure 3-10 shows small bright spots on the CRT screen which are caused by minute imperfections in the storage mesh.

3-27. SINGLE-SHOT OPERATION.

3-28. To write with persistence or store a single-shot phenomena, trial setting of INTENSITY is the best approach. The amplitude of the phenomena and the sweep-time required to display it will affect the persistence. For example, with maximum PERSISTENCE and some settings of INTENSITY, a single-shot straight-line trace may bloom, Figure 3-5, and a single-shot signal with amplitude variations of several divisions may not cause blooms, Figure 3-6. To determine the best INTENSITY setting, connect a signal which approximates the sweep time and amplitude of the single-shot signal to be written. Set PERSISTENCE fully clockwise and trigger a single sweep of the test signal. Set the INTENSITY as far clockwise as possible without causing blooming.

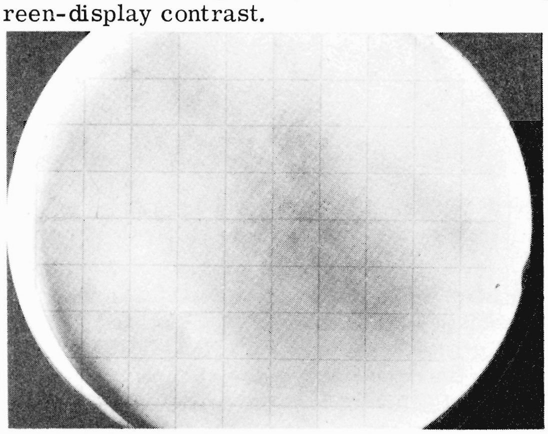


Figure 3-3. Background illumination occurs when erasing with WRITING RATE in MAX

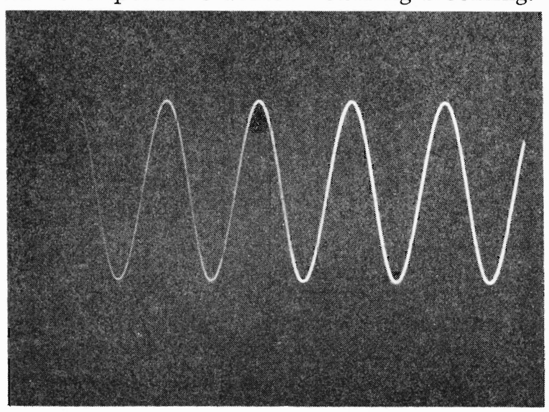


Figure 3-4. Variable persistence with a slow, repetitive sweep

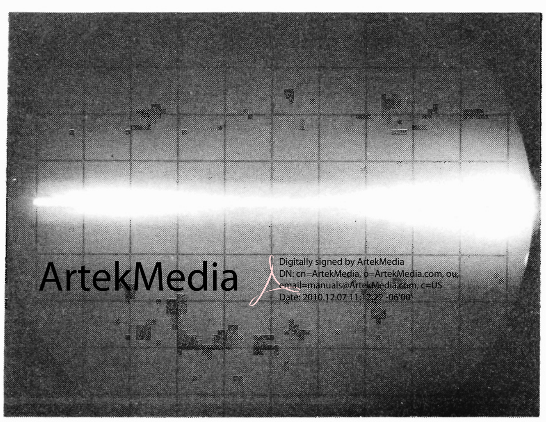


Figure 3-5. Single-shot trace bloom caused by INTENSITY and/or PERSISTENCE set too high

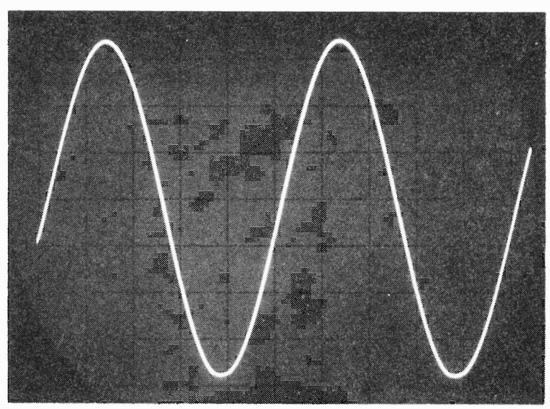


Figure 3-6. Single-shot display with INTENSITY and PERSISTENCE set the same as Figure 3-4

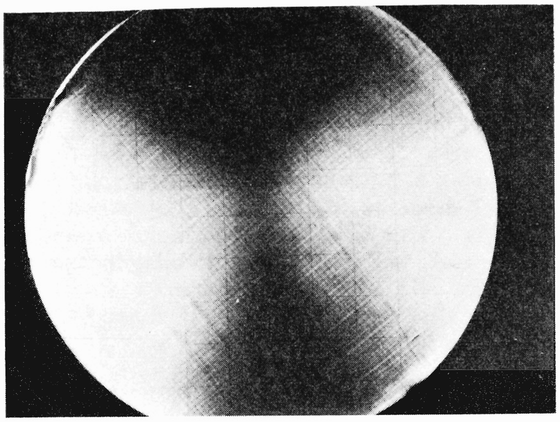


Figure 3-7. Fade positive which occurs after Presentation Selector is left in VIEW for 2 to 4 minutes

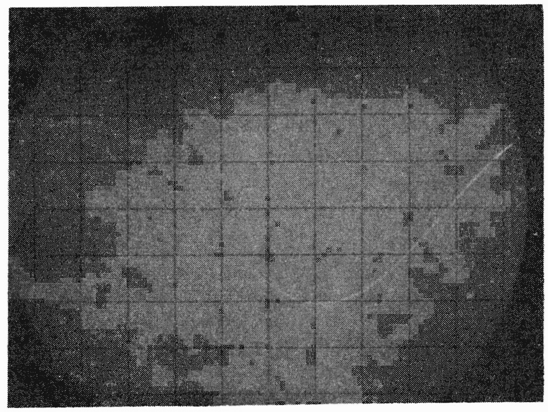


Figure 3-8. Single-shot 20 μsec/cm display

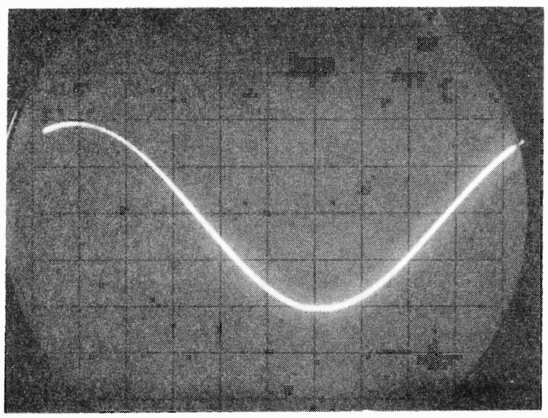


Figure 3-9. Same display as Figure 3-8 after 3 minutes in VIEW

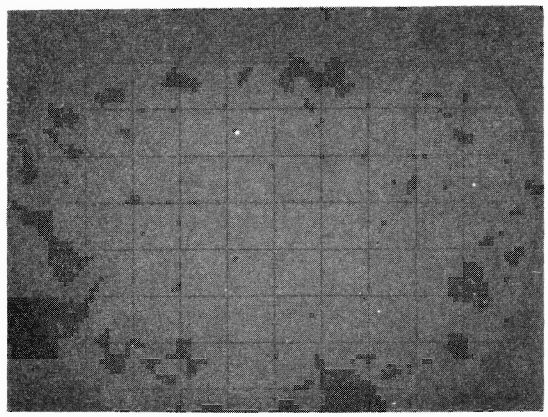


Figure 3-10. Small bright spots caused by minute imperfections in storage mesh

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, turn the Presentation Selector to STORE to retain the display.

3-29. Single-shot signals which require a sweep time faster than 20 microseconds per division can be written with more brightness by setting the WRITING RATE to MAX. The screen will be unevenly illuminated after erasing when WRITING RATE is in MAX, however the INTENSITY can be set high enough to make the display visible through the illumination. A display, written with WRITING RATE set to MAX, will be obscured by positive fading more rapidly than a display written with WRITING RATE set to NORMAL.

3-30. Single-shot signals which require a sweep time between 20 and 200 microseconds per centimeter may have low brightness at the center of the screen. Fire a single-shot test signal with INTENSITY and PERSISTENCE fully clockwise and WRITING RATE in NORMAL, 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 usuable 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.

3-31. For single-shot signals requiring a sweep time from one to five minutes, set PERSISTENCE and WRITING RATE to NORMAL and INTENSITY as required to prevent blooms. Fire the single-shot signal and after the sweep is completed, rotate Presentation Selector to VIEW and PERSISTENCE out of NORMAL. The complete display may then be viewed for up to one minute or stored (Presentation Selector to STORE) for up to one hour.

SECTION IV
PRINCIPLES OF OPERATION

4-1. FUNCTIONAL DESCRIPTION.

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

4-3. LOW-VOLTAGE SUPPLY. The Low-voltage supply uses 115 or 230 volts ac (rear panel switch), single phase, 50-60Hz. Output voltages are +100, -100, +250 and -12.6 volts dc; all outputs are fused and are electronically regulated. Voltages are distributed to the high-voltage supply, the calibrator, pulse circuit, compensation attenuator circuit, and to the horizontal and vertical plug-ins. 6.3 Vac is supplied from the low voltage transformer to the main filament of the CRT and as a signal to the calibrator.

CAUTION

Do not connect calibrator output to Spectrum Analyzer plug-ins.

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

4-5. HIGH VOLTAGE SUPPLY. A transistorized oscillator and a step-up transformer are used to generate negative and positive high voltages for the CRT. Both the +5000 volt and -2350 volt supplies are electronically regulated.

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

4-7. COMPENSATION ATTENUATOR. A compensation attenuator network is added to the Model 141S between the outputs of the horizontal and vertical deflection systems and the CRT deflection plates. Refer to paragraph 4-47 for a discussion of this circuit.

4-8. CIRCUIT DESCRIPTION.

4-9. LOW-VOLTAGE SUPPLY.

4-10. The low-voltage supply consists of: +100 volt supply, -100 volt supply, +250 volt supply and -12.6

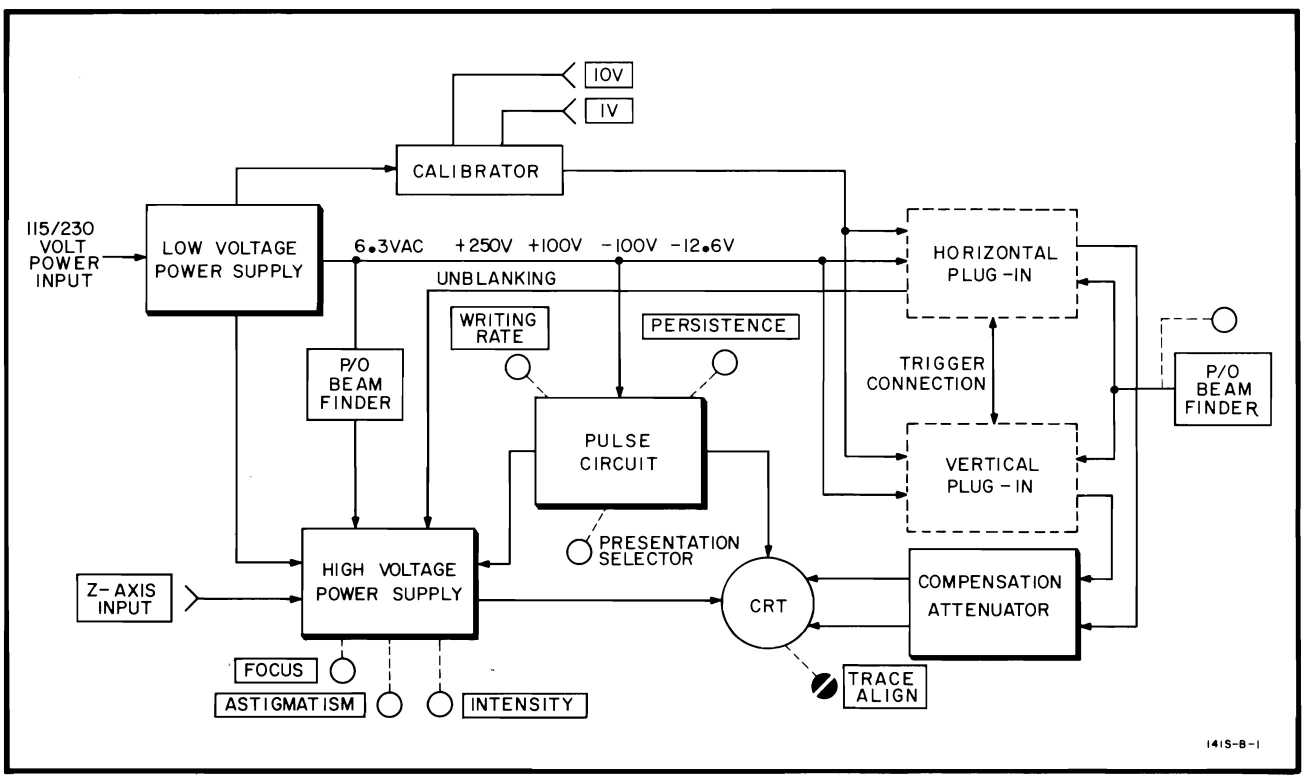


Figure 4-1. Model 141S Block Diagram

volt supply. The +100 volt supply is independent, and provides a reference voltage for the -100 volt supply. the +250 volt and -12.6 volt supplies are dependent on the -100 volt supply for reference voltages.

4-11. Figure 4-2 is a simplified block diagram of 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 (dc return for the supply). The driver (emitter follower or amplifier) controls the bias on the series regulator, which effectively controls the series resistance. Any change in output voltage is fed back to the series regulator. The change in series resistance and the resulting voltage drop is opposite to the output voltage change; thus the output voltage is maintained at a constant level.

4-12. Figure 5-7 is a schematic diagram of the low voltage supply. The primary winding of transformer T401 is wired through a rear panel switch for quick conversion to either 115 or 230 Vac operation. Line voltage is applied to the primary of T401 through an on-off switch, a fuse and a thermal switch. A pilot lamp is provided to indicate when power is applied to T401. Two shunt resistors are connected to the +250 volt supply to reduce series regulator power dissipation when high-current plug-ins are used. The shunts are wired one to each rear panel plug and the internal wiring of the plug-in determines whether the shunt is or is not used.

4-13. +100 VOLT SUPPLY. The ac voltage from secondary of T140 is rectified by CR441-CR444 and partially filtered by C441 and R441. The resulting dc voltage is applied through the Series Regulator, Q441, to the output. Differential Amplifier, Q447/Q448 compares the voltage across R447 and V441 with a sample of the output voltage. Any tendency of the output voltage to change is applied to the base of the Driver, Q442, which controls bias on Regulator, Q441. Series Regulator compensates for the change in output voltage by its change in series resistance and restores the output level to normal. The +100 volt output is adjusted by R453. Fuse F441 provides overload protection.

4-14. -100 VOLT SUPPLY. Reference voltage for the -100 volt supply is taken from the output of the +100 volt supply. The reference voltage across R467 is compared with a sample of -100 volt output across R473. The error voltage sensed by Differential Amplifier, Q463/Q464, is applied through the Driver, Q462, and Series Regulator Q461. Series Regulator brings the -100 volt supply back into proper balance with respect to the +100 volt supply. AC voltage from T401 is rectified by CR461-CR464, partially filtered by C461/C462/R461, and the resulting dc voltage is applied by the Series Regulator Q461, to the -100 volt output. Regulation is obtained as in the +100 volt supply. R471 adjusts the -100 volt output and fuse F461 provides overload protection.

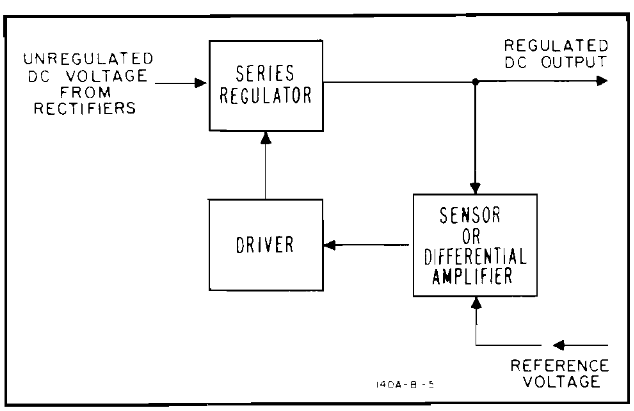


Figure 4-2. Regulated Power Supply Block Diagram

4-15. +250 VOLT SUPPLY. Sensor Amplifier, Q423, in the +250 volt supply senses any variation in the output voltage, with respect to -100 volts. The error voltage is amplified by Driver, Q422, which applies corrective bias to Series Regulator, Q421, R432 adjusts the +250 volt output and fuse F421 provides overload protection. CR427 provides temperature compensation for Q423 and is normally forward-biased.

4-16. 12.6 VOLT SUPPLY. Sensor Amplifier, Q484 senses any variation of output voltage with respect to -100 volts and applies the error voltage to Driver Amplifier, Q482. The Driver increases signal current to the level required to control Series Regulator, Q481. The -12.6 volt output is adjusted by R488. Current Limiter, Q483, a protective circuit for the Series Regulator, is normally biased off. If an overload occurs across the -12.6 volt output, the base of Q483 goes positive by the voltage drop across R483 minus the forward breakdown voltage of CR483, thus turning Q483 on. The decreased positive voltage on the collector of Q483 is applied through Q482 to the base of Series Regulator, Q481 reducing current flowing through Q481. The current which then flows through the overload is limited to the current required to keep Q483 on. Additional overload protection is provided by fuse, F481.

4-17. CALIBRATOR.

NOTE

Calibrator must not be connected to INPUT of Spectrum Analyzer plug-ins. Damage to RF Section will result.

4-18. The schematic diagram of the Calibrator circuit is shown in Figure 5-14. The circuit consists of three parts: a tunnel diode square wave generator, a transistor switch, and a calibration network.

4-19. 6.3 volts ac is applied through R491 to tunnel diode CR490, which generates a square wave at line frequency. Transistor switch Q490 is off during the time of the positive half-cycle of the square wave (when the voltage at the base is close to zero), and the collector voltage is thus at a level set by dc voltage divider R493, R495, and R496. When the negative-going portion of the square wave is applied to the base of Q490, the transistor conducts heavily, effectively shorting the collector to ground. The output of the Calibrator is thus zero volts. At the end of the negative input half-cycle, the bias of Q490 returns to zero, the transistor is switched off, and the output returns to its previous value.

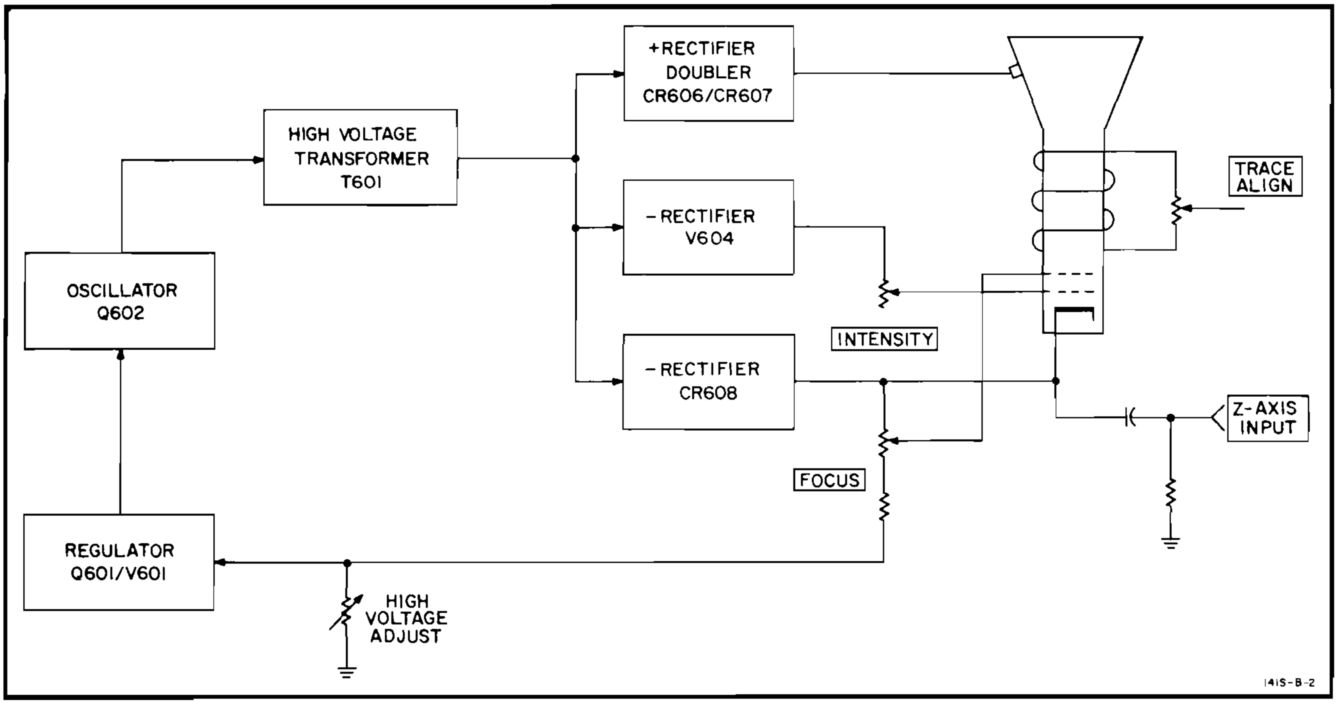


Figure 4-3. High Voltage Power Supply Block Diagram

4-20. Tunnel diode bias current is supplied through R492. The bias current sets an operating level for the diode which affects the symmetry of the square wave output. Cal Adj, R494, is used to set the dc voltage at the collector of Q490 to -10 volts when the transistor is off. Breakdown diode CR491 reduces the output impedance, and provides temperature compensation for the circuit. Voltage divider R495/R496, reduces the 10 volt output to 1 volt. Both 10 volt and 1 volt outputs are available on the front panel of the Model 141S and the 1 volt output is available to both plug-ins.

4-21. HIGH-VOLTAGE SUPPLY.

4-22. Figure 4-3 is a block diagram of the high-voltage supply. The output of a regulated transistor oscillator is stepped up in voltage and applied to a series of high voltage rectifiers. The positive output of the voltage doubler 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.

4-23. Figure 5-11 is a schematic diagram of the high-voltage supply and the CRT. Oscillator Q602 operates at a frequency of approximately 32 kHz. Any change in the output voltage is applied to the grid of V601, which converts the voltage change to a current change. This current change is applied, by Emitter Follower Q601, 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 R619 sets the amplitude of oscillation to produce the correct output voltage.

4-24. Two separate negative supplies are used, one for the control grid of the CRT, and one to provide CRT cathode focusing voltages. Both supplies use half wave rectifiers (V604 and CR608). 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, set S601 to INT to receive chopped blanking from a dual trace plug-in.

4-25. The voltage doubler circuit provides the 5 kV post-accelerating voltage applied to the CRT.

4-26. The ASTIGMATISM adjustment, R461, affects the roundness of the spot, and the Geometry adjustment, R643, is used for best pattern shape.

4-27. STORAGE CRT.

4-28. Refer to Figure 5-11 for the schematic diagram of the storage CRT, V 610. The CRT contains the conventional electron (writing) gun, deflection plates, post-accelerator, and phosphor screen. In addition, there are two flood guns (filaments, cathodes, and grids only), a collimator, a collector mesh and a storage mesh. These added elements make possible the variable persistence and storage functions of the Model 141S

4-29. FLOOD GUNS. The flood guns are physically located on the electron gun outside of the horizontal deflection plates. Horizontal Drivers, Q603, and Q604 prevent flood gun electrons from flowing through the deflection plates to the output stage of the plug-in. The gun operates continuously when the power switch is on. An electron cloud, which is emitted by the flood guns, is accelerated toward the CRT screen by collimator and collector mesh voltages. These electrons make stored or persisting displays visible. They are also used to erase stored and persisting displays.

4-30. 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 cloud electrons are formed into a column perpendicular to, and approximately equal to the diameter of, the CRT screen.

4-31. COLLECTOR MESH. The collector mesh is between the flood guns and the storage mesh (closest to the storage mesh). It is always positive with respect to the storage mesh except in the ERASE position of the Presentation Selector; 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.

4-32. STORAGE MESH. The storage mesh is just behind the CRT screen and is coated with non-conducting material. It is statically held at a slightly positive potential (approximatly +3 volts). When the electron beam from the writing gun strikes the mesh coating, secondary electrons are emitted. This secondary emission creates a pattern of positive potential identical to the movement of the beam. Flood gun electrons are accelerated by this positive potential pattern and strike the phosphor screen, thus creating a visible display.

4-33. The storage mesh is continuously pulsed with a variable width pulse of approximately -11 volts. 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 width of the negative pulse. 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.

4-34. PULSE CIRCUIT.

4-35. Figure 4-4 is a simplified block diagram of the Pulse Circuit. A free running Multivibrator triggers a Monostable Multivibrator. The pulse width of the Monostable Multivibrator is varied by the setting of the PERSISTENCE control. The output of the Monostable Multivibrator is applied to the CRT storage mesh in the WRITE mode to control the display persistence. In STORE, the Monostable Multivibrator output is amplified and applied to the CRT collimator.

4-36. Figure 5-14 is a schematic of the Pulse Circuit. The Multivibrator Q701/702 free-runs at approximately 1200 Hz. The square wave output is differentiated by C703. The negative spike is blocked by CR701 and the positive spike is applied to Q703. The positive spike turns Q703 on and C705 couples a negative-going signal through Q704 to start turning Q705 off. Q704, an emitter follower, isolates the variable load of the PERSISTENCE control from Q705. The turning off of Q705 generates a positive-going signal at its collector. R708 couples this signal to Q703 driving it to saturation. C705 is now charged to -11 volt and begins to discharge toward ground through R730 and the PERSISTENCE control. When C705 reaches approximately -9.5 volts Q705 begins turning on. When Q705 turns on a negative-going signal is coupled through R708 to Q703 turning it off. C705 then continues to discharge to ground through R730 and the PERSISTENCE control in parallel.

4-37. The WRITE function of the Presentation Selector allows the Model 141S to be used as a normal or variable persistence oscilloscope.

4-38. The STORE function of the Presentation Selector allows the Model 141S to store a previously written trace for periods of one hour or more at reduced intensity. In this position of the Presentation Selector the negative pulses from Q706 are amplified by a normally-off two

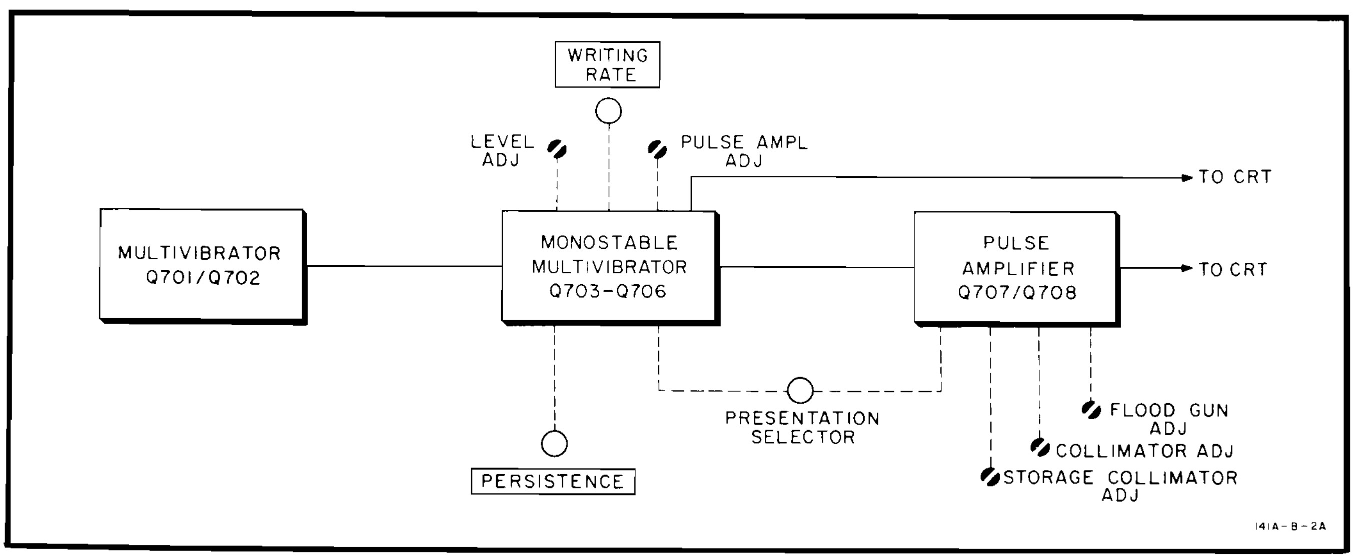


Figure 4-4. Pulse Circuit Block Diagram

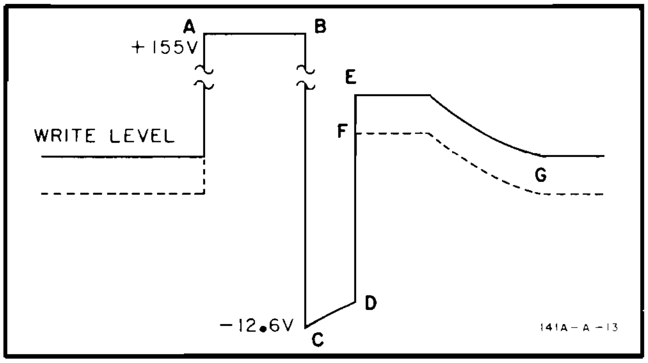


Figure 4-5. Erase: Functional Waveform

stage amplifier Q707/708. The output of Q708 is applied to the collimator. These negative pulses reduce the number of flood gun electrons reaching the storage mesh. In STORE, the Monostable Multivibrator has a fixed pulse width determined by R729 and R730.

4-39. The VIEW function of the Presentation Selector enables the Model 141S to display the stored trace at full intensity for a short time. This time is dependent on the WRITING RATE selected to write the trace. In VIEW, the Monostable Multivibrator is disabled and the collimator is held at a fixed positive level.

4-40. The WRITING RATE switch selects the collimator storage mesh potential. In NORMAL, the collimator is held at between +45 and +90 volts. In MAX, the collimator is held at between +36 and +61 volts.

4-41. The PERSISTENCE control has a NORMAL detented position which disconnects everything from the storage mesh but a -30 level determined by R737/738. This -30V level immediately discharges any positive potential or charge point occuring on the storage mesh due to electrons from the write beam striking the mesh. The persistence of the trace is then controlled entirely by the natural persistence of the phosphor coating.

4-42. CLAMP CIRCUIT.

4-43. The Clamp Circuit assists in erasing the CRT by momentarily clamping the storage mesh to -12.6 volts.

4-44. Figure 5-14 includes a schematic of the clamp circuit. With the Presentation Selector out of ERASE, Q710 is off. Turning the Presentation Selector to ERASE grounds C710 through R745, saturating Q710. This places the collector at -12.6 volts. Releasing Presentation Selector allows C710 to charge through R746. When Q710 has completely turned off, C709 begins to discharge and the storage mesh returns to a level determined by the selected Write Level control. Figure 4-5 is a graphic presentation of the ERASE function. Point A is the initiation point for the ERASE function; the Presentation Selector is rotated to the ERASE position. Point B is the point at which the Presentation Selector is released. Point C represents the voltage on the storage mesh immediately after the Presentation Selector is released. For practical purposes the time between B and C may be considered as instantaneous. Point D represents the point at which the clamp breaks and Q710 loses control of the voltage on the storage mesh. Note that there is a voltage difference between C and D of a few volts. Points E and F represent the selected Write Levels and show the "depth of erasure" of the CRT in the NORMAL and MAX positions of the WRITING RATE switch respectively. The "depth of erasure" term describes how well the CRT is erased. A more positive voltage at this point results in a deeper erasure. Point G is the voltage level of the storage mesh after erasure.

4-45. TRACE ALIGN.

4-46. The trace align coil, L602, is located on the neck of the CRT near the screen. Adjustment of Trace Align, R650A/B, varies the magnitude and direction of current through the coil, which has the effect of rotating the trace. In this way the trace is brought into alignment with the CRT graticule.

4-47. COMPENSATION ATTENUATOR.

4-48. Model 141S Display Section uses the same basic CRT as the Model 141A. However, the graticule is marked in divisions approximately 90% as large. For this reason, a Compensation Attenuator network is added to the Model 141S so that the deflection factor per CRT division remains effectively the same.

4-49. Emitter Followers, A605Q1/Q4, in the horizontal network provide a high impedance load for the horizontal plug-ins which typically have a higher output impedance than do vertical plug-ins. Transistors A605Q2/Q3 are included to present a low output impedance to the horizontal plates of the CRT.

4-50. Capacitors A605C625/C627/C629/C631 allow adjustable compensation of both horizontal and vertical networks for consistent broadband response.

4-51. PLUG-IN KIT FABRICATION.

4-52. The HP Model 10477A and Model 10478A Accessory Plug-Ins are blank plug-in units for the Model 141S Oscilloscope. These two units permit the user of the instrument to design his own special-purpose circuits. Current available from each of the Model 141S power supply voltages is shown in Table 4-1.

4-53. Pins 2 and 3 of the respective plug-in must be wired together if pin 9 of either J1 or J2 in the mainframe is to draw more than 50 ma. If pin 9 of both mainframe Jacks draws more than 50 ma, then pins 2 and 3 of each plug-in must be wired together.

Table 4-1. Current Capability

Supply Voltage and J1/J2 pin number		Current Available at each Jack
+250 Vdc	9	0-50 ma
+250 Vdc	9	50-100 ma (pin 2 must be wired to pin 2 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

Table 5-1. Equipment Required for Tests and Adjustments

Recommended Instrument	Model	Required for	Ref Par.	Required Characteristics
Voltmeter Calibrator	hp 738AR or 738 BR	Calibrator check; High-Voltage Adjustment; Calibrator Adjustment	5-5 5-13 5-17	Outputs of 1 v and 10 v pk-pk; -300 v dc; ± 0.2%
DC Voltmeter	hp 412A	Low-Voltage Adjustments	5-11	-100 to +100 volts, ± 1%
DC VTVM	hp 410B/C	High-Voltage Adjustment	5-13	May be adapted for high voltage (-2.5 kv) measurement. Provision for altering calibration.
Voltage Divider	hp 11044A hp 11045A	High-Voltage Adjustment	5-13	Provide 100:1 division for vtvm; 2.5 and 30 kv rating.
Oscillator	hp 204B/C or 200CD	Pulse Circuit Adjustment	5-18	800 Hz and 40 kHz.
Square Wave Generator	hp 211B	Compensation Attenuator adjustment	5-16	400 kHz output.

SECTION V
MAINTENANCE

5-1. INTRODUCTION.

5-2. This section covers maintenance, troubleshooting, and adjustment of the Model 141S Display Section A performance check is included which may be used at incoming inspection, or after adjustments have been made, to verify that the instrument meets specifications.

5-3. PERFORMANCE CHECK.

5-4. CRT CONTROLS.

5-5. When Spectrum Analyzer plug-ins are installed in the Model 141S Display Section, use installation procedures outlined in the Operating Manual furnished with Model 8552A/8553L Spectrum Analyzer.

5-6. The following procedure should be followed when using 1400 Series plug-ins.

a. Set INTENSITY fully counterclockwise.

b. Set PERSISTENCE counterclockwise just out of NORMAL detent and Presentation Selector to WRITE.

c. Set POWER switch to ON.

d. Check that CRT screen is lightly and evenly illuminated.

CAUTION

If the CRT screen is not lightly illuminated, turn POWER off and check that all CRT neck and bulb leads are connected. Do NOT rotate INTENSITY clockwise or the CRT may be damaged.

e. Rotate PERSISTENCE into NORMAL detent and press BEAM FINDER switch. A defocused spot should appear on the screen.

f. Set INTENSITY control to 12 o'clock and return beam to screen with POSITION controls. Check that counterclockwise rotation of INTENSITY control extinguishes beam; clockwise rotation gives brighter than normal intensity. Immediately return INTENSITY to 12 o'clock.

g. The FOCUS and ASTIGMATISM adjustments should defocus the beam in both extreme positions and should give a sharp, round spot when close to mid-range. Adjust both controls for the sharpest display.

h. Stray magnetic fields may affect the CRT trace alignment. Set a free-running trace and adjust the TRACE ALIGN to make the trace parallel with the horizontal graticule line.

i. Set a free-running, 1 MSEC/CM trace and center both POSITION controls.

j. Rotate INTENSITY control slowly clockwise until a trace appears.

k. Change sweep time to 0.2 SEC/CM and observe that the trace disappears and that the moving beam spot has no tail.

m. Rotate PERSISTENCE slowly clockwise and note that beam spot develops a tail; fully clockwise makes the complete trace remain on the screen.

n. Rotate INTENSITY fully counterclockwise; trace should remain visible for one minute.

p. Rotate INTENSITY slowly clockwise until trace blooms, then fully counterclockwise.

q. Rotate Presentation Selector to ERASE for one second and release; screen should be dark.

r. Rotate INTENSITY slowly clockwise until trace has normal intensity, then fully counterclockwise.

s. Rotate PERSISTENCE counterclockwise and screen should be lightly illuminated and trace should disappear; rotate PERSISTENCE fully clockwise and screen should be dark.

t. Repeat step r.

u. Rotate Presentation Selector to STORE; trace should remain visible at low intensity for one hour. Trace may be viewed, at normal intensity, any time during the hour of storage by rotating the Presentation Selector to VIEW. Viewing time decreases as time in storage increases.

v. Set sweep time to 1μSEC/CM, Presentation Selector to WRITE, and WRITING RATE to MAX.

w. Rotate Presentation Selector to ERASE for 1 second and release; screen should have a varying contrast across the graticule. (See "B", Figure 5-5).

x. Rotate INTENSITY slowly clockwise until trace appears.

y. Set horizontal plug-in for single sweep.

z. Rotate Presentation Selector to ERASE for 1 second and release.

aa. Arm sweep (if necessary) and trigger a single sweep.

bb. Trace should appear and remain on the screen for a short time, then the entire screen should slowly fade positive (total illumination).

5-7. CALIBRATOR.

a. Set: Vertical SENSITIVITY · · · · 0.05 V/CM
INPUT coupling · · · · · · · · · · · · DC
PERSISTENCE · · · · · · NORMAL detent

b. Connect 1 VOLT pk-pk from the Voltmeter Calibrator to vertical INPUT.

c. Adjust vertical VERNIER for exactly 8 division deflection.

d. Disconnect the Voltmeter Calibrator and connect the 1V CALIBRATOR output to the vertical INPUT.

e. Deflection should be 10 divisions.

f. Repeat steps a through e, using 0.5 V/CM vertical SENSITIVITY and 10 volts from the Voltmeter Calibrator.

5-8. ADJUSTMENTS.

5-9. The adjustment procedures for Model 141S Display Section used with Spectrum Analyzer plug-ins is in the Models 8552A/8553L Operating and Service Manual. Use following adjustments when Model 141S is used with 1400 Series plug-ins.

5-10. PRELIMINARY SET-UP. Install plug-ins in both compartments before adjusting power supplies; proper regulation may not occur with no load connected.

5-11. ADJUSTMENT COMPONENT IDENTIFICATION. All internal adjustments and components are identified in Figure 5-2 and Figure 5-3.

5-12. CONDENSED ADJUSTMENT PROCEDURE. Table 5-3 is a condensed adjustment procedure. The table may be useful after becoming familiar with the step-by-step procedure.

5-13. ADJUSTMENTS OF LOW-VOLTAGE SUPPLY.

5-14. Measure the output of each low-voltage supply, and adjust to the value in Table 5-2. Measure on any wire with indicated color code. Paragraph 5-24 gives allowable ripple.

Table 5-2. Low-Voltage Adjustments

Supply (Volts)	Wire Color Code	Adjustment
+100	White/Red	+100V Adj R453
-100	Violet	-100V Adj R471
-12.6	White/Violet	-12.6V Adj R488
+250	Red	+250V Adj R432

5-15. ADJUSTMENTS OF HIGH-VOLTAGE SUPPLY.

a. Connect the Voltage Divider to the DC probe of a Model 410B/C Voltmeter.

b. Set Voltmeter to 3 -volt -DC range.

c. Set the Voltmeter Calibrator for -300 volts DC output, and connect divider tip to the output.

d. Set Model 410B/C gain adjustment (on rear of instrument) for a reading of exactly 3 volts.

e. Set Voltmeter to 30-volt range, and measure the high voltage supply at the junction of R651 and R652.

f. Set High Voltage Adjust, R619, for -2350 volts.

g. Recalibrate the Model 410B/C.

5-16. INTENSITY LIMIT ADJUSTMENT.

a. Remove plug-ins; short pins 1 and 2 of J2.

b. Set R612, Intensity Limit, fully ccw.

c. Set INTENSITY control to 12 o'clock.

d. Adjust R612 until spot is just visible. Remove short and reinstall plug-ins.

5-17. ASTIGMATISM ADJUSTMENT.

a. Center a low-intensity spot on the CRT.

b. Adjust FOCUS and ASTIGMATISM for a small, round, sharply-focused spot.

5-18. GEOMETRY ADJUSTMENT.

a. SPECTRUM ANALYZER.

1. Set Spectrum Analyzer controls:

FREQUENCY	30 MHz
FINE TUNE	CENTERED
BAND WIDTH	100 kHz
SCAN WIDTH	0
INPUT ATTENUATOR	±10 dB
TUNING STABILIZER	ON
BASE LINE CLIPPER	CCW(max)
SCAN TIME/DIVISION	0.2 MSEC/DIV
LINEAR SENSITIVITY	2 mV/DIV
LOG LINEAR	LIN
VIDEO FILTER	OFF
SCAN MODE	INT
SCAN TRIGGER	AUTO

2. Set Signal Generator controls:

FREQUENCY	30 MHz
OUTPUT AMPLITUDE	-35 dBM
MODULATION SELECTION	EXT AM
MODULATION AMPLITUDE	100%

3. Set Audio Oscillator:

FREQUENCY	20 kHz

4. Check that analyzer plug-in is calibrated. Refer to Table 3 in 8552A/8553L Calibration Manual.

5. Turn FINE TUNE for maximum amplitude display on CRT.

6. Adjust 8552A LINEAR SENSITIVITY vernier control for a full vertical deflection to the LOG REF Graticule.

7. Check displayed pattern for excessive barrelling or pincushioning (Figure 5-1); if present, adjust the Geometry control, R643, to obtain the straightest possible edges on the rectangular pattern.

b. OSCILLOSCOPE.

1. Set:

TRIGGER LEVEL	AUTO
SWEEP TIME	0.2 MSEC/CM

2. Connect a 400 kHz signal from the Audio Oscillator to the amplifier plug-in vertical INPUT.

3. Adjust vertical and horizontal controls to obtain a pattern 8 divisions high.

4. Adjust GEOMETRY, R643, to obtain the straightest possible edges on the rectangular pattern.

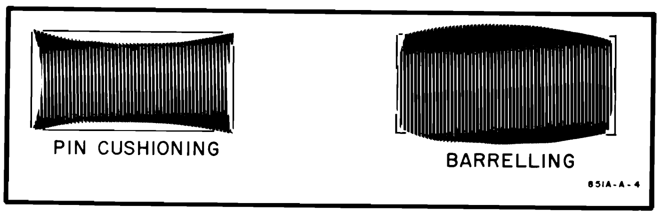


Figure 5-1. Pincushioning and Barrelling

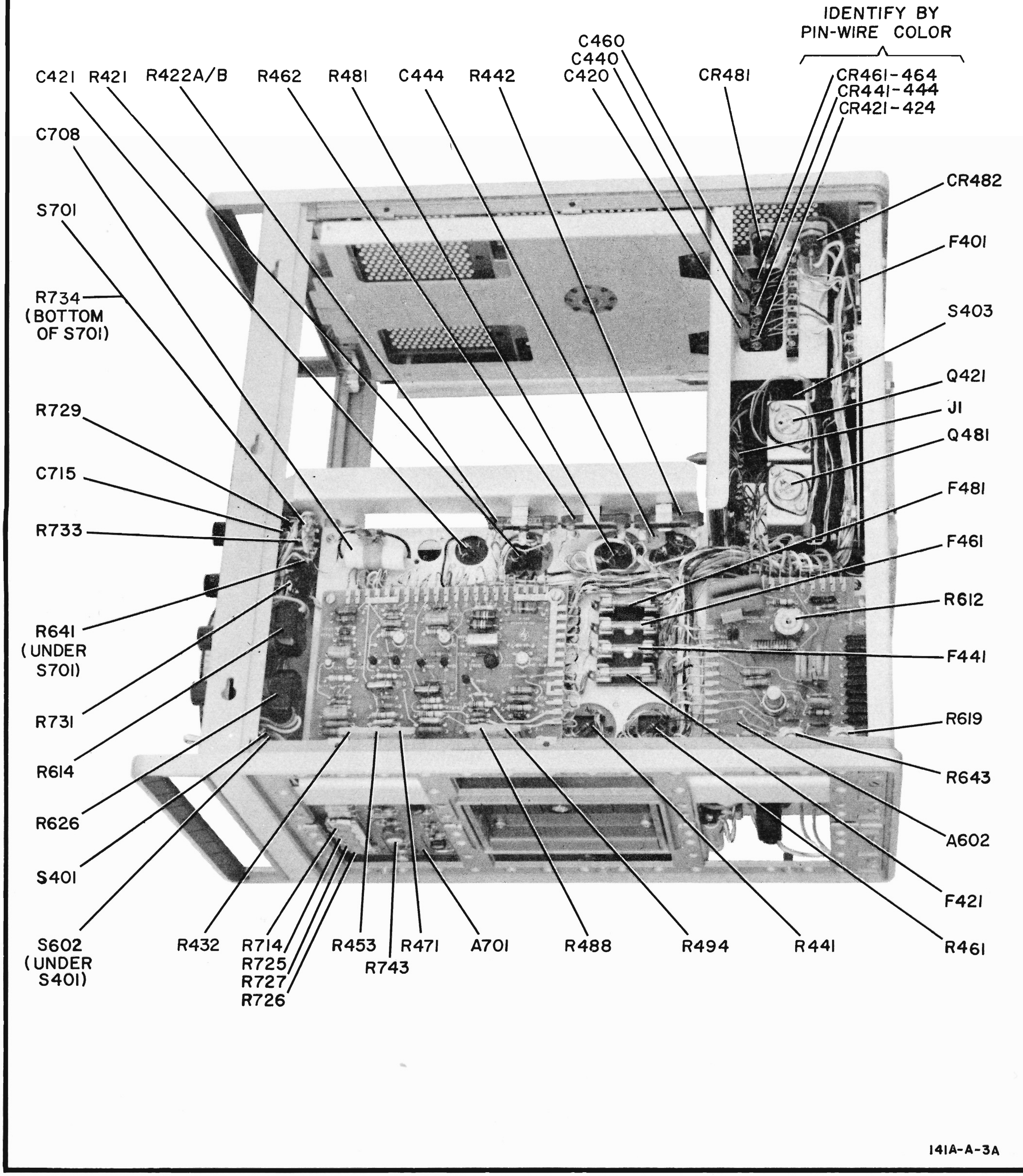


Figure 5-2. Adjustment and Component Locations, Bottom View

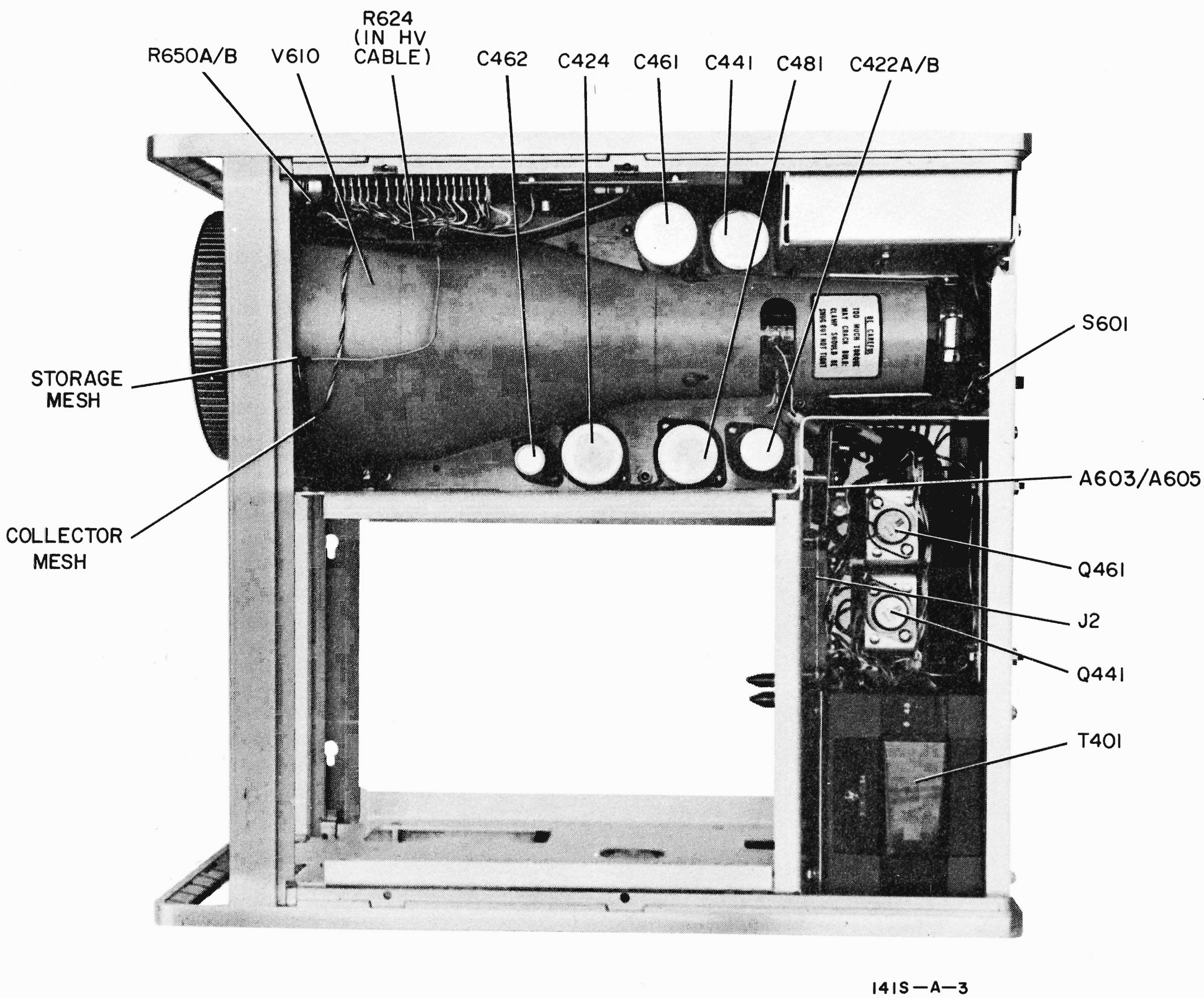


Figure 5-3. Component Locations, Top View

5-19. CALIBRATOR ADJUSTMENT.

Note

Do not attempt this adjustment with Spectrum Analyzer plug-ins in the Model 141S Refer to Calibration Manual for 8552A/8553L.

a. Connect a 10 VOLT pk-pk signal from the Voltmeter Calibrator to the vertical amplifier INPUT.

b. Set amplifier SENSITIVITY to 0.5 V/CM, INPUT coupling to DC.

c. Adjust vertical VERNIER for exactly 8 divisions deflection.

d. Disconnect the Voltmeter Calibrator, and connect the 10V CALIBRATOR output to the amplifier.

e. Set Cal Adj, R494, for exactly 8 division deflection.

5-20. PULSE CIRCUIT ADJUSTMENT.

5-21. The following procedure covers all five of the adjustments in the pulse circuit. The adjustments covered are: Normal Write Level (R743); Normal Write Collimator (R725); Maximum Write Level (R714); Maximum Write Collimator (R727); and Flood Gun (R726).

a. Set Presentation Selector to WRITE, PERSISTENCE counterclockwise to, but not in, NORMAL detent and WRITING RATE to MAX.

b. Set Normal Write Level Adjust, R743, fully counterclockwise.

c. Set Max Write Level Adj, R714, fully clockwise.

d. Set Normal Write Collimator, R725, halfway between stops.

e. Set Flood Gun Adj, R726, fully clockwise.

f. Rotate Presentation Selector to ERASE for 1 second and quickly release.

g. Rotate Max Write Coll Adj, R727, so that the non-concentric green rings of illumination visible within the viewing area of the screen are located with the outer green ring just touching the aluminum ring on either of the sides, opposite side should be within 1/6" of aluminum ring (see "A", Figure 5-5).

h. Rotate Presentation Selector to ERASE for 1 second and quickly release.

Table 5-3. Condensed Adjustment Procedure

Test	External Equipment Required	Procedure	Adjust
Low Voltage Supplies	DC Voltmeter	Measure: -100 v (Violet) -12.6 v (White/Violet) +100 v (White/Red) +250 v (Red)	 R471 R488 R453 R432
High Voltage Supply	DC VTVM; 100:1 Divider; Voltmeter Calibrator	a. Calibrate Divider - Voltmeter combination. b. Measure -2350 v	R619 for -2350 volts
Intensity Limit	None	a. Center a defocused spot. b. Set INTENSITY to 12 o'clock.	R612 until spot is just extinguished.
Astigmatism	None	Center a low-intensity spot.	FOCUS and ASTIGMATISM for sharp spot.
Geometry	Oscillator	a. TRIGGER LEVEL to AUTO SWEEP TIME to 0.2 MSEC/CM b. Connect 400 kHz sine wave to vertical INPUT. c. Obtain pattern 8 cm high.	R643 for straightest edges.
Calibrator	Voltmeter Calibrator	a. SENSITIVITY to 0.5 V/CM b. Apply 10 v pk-pk from Voltmeter Calibrator to vertical INPUT. c. Adjust vertical VERNIER for 10 cm deflection. d. Connect 10 V CALIBRATOR to vertical INPUT.	Cal Adj R494 for 10 cm deflection.

i. Adjust R726 counterclockwise until the inner ring on either side just disappears. Now rotate R726 20° clockwise. Overlap of non-concentric rings must now be visible after CRT is erased. Erase CRT after each change.

j. Rotate PERSISTENCE fully clockwise.

k. Rotate Presentation Selector to ERASE for 1 second and quickly release.

m. Rotate R714 counterclockwise in small increments, erasing after each change, for the most uniform light green background illumination of the screen. Background should be light enough to just see a fine wire mesh appearing with varying contrast across the entire graticule (see "B", Figure 5-5).

n. Set the sweep time to 10 μsec/cm, turn the INTENSITY off, sweep to Normal, Presentation Selector to WRITE, WRITING RATE to MAX, and PERSISTENCE counterclockwise to, but not in, NORMAL detent.

p. Connect Oscillator output to vertical plug-in input. Set Oscillator frequency to 40 kHz and slowly rotate INTENSITY until trace appears. Set vertical sensitivity for 10 cm deflection (see "C", Figure 5-5).

q. Set horizontal plug-in to single sweep.

r. Rotate INTENSITY approximately 90° clockwise from position where INTENSITY normally extinguishes and rotate PERSISTENCE fully clockwise.

s. Rotate Presentation Selector to ERASE for 1 second and quickly release.

t. Arm sweep and trigger a single sweep.

u. 80-90% of trace should remain on screen for at least 15 seconds and then slowly fade positive (total illumination). If necessary, readjust FOCUS for sharp trace without returning to Normal Sweep.

v. If trace rapidly fades into the surrounding green background, rotate R714 slightly clockwise to reduce the intensity of the background illumination. If the trace appears and then rapidly disappears into a dark background, rotate R714 counterclockwise to increase the brightness of the green background illumination.

w. Switch WRITING RATE to NORMAL, PERSISTENCE ccw to, but not in, NORMAL detent. Adjust R725, erasing the CRT after each change, so two non-concentric rings of illumination are brought into the viewing area of the screen. Readjust R725 so that the inner green rings on both sides are moved just off-screen behind the aluminum band. (Refer to "D", Figure 5-5). Occasionally these green rings may be off-center with respect to the aluminum mask. Storage and persistence uniformity may be improved by moving these inner rings back into the viewing area by not more than 1/16".

x. Set sweep time to 0.5 ms/cm, INTENSITY off, and sweep to normal.

y. Adjust Oscillator frequency to 800 Hz, then rotate INTENSITY slowly clockwise until sine wave trace appears. Adjust vertical sensitivity for 10 cm of deflection (see "E", Figure 5-5).

z. Set horizontal plug-in for single sweep.

aa. Rotate INTENSITY approximately 90° clockwise from point where intensity normally extinguishes, then rotate PERSISTENCE fully clockwise.

bb. Rotate Presentation Selector to ERASE for 1 second and quickly release.

cc. Arm sweep and trigger a single sweep.

dd. 80-90% of trace should remain on the screen for approximately one minute. A hood should be used for this check. If necessary, readjust FOCUS for sharp trace without returning to Normal sweep.

ee. If trace is not continous (see "F", Figure 5-5), adjust R743 clockwise in small increments, repeating steps bb through dd at each increment to obtain specified conditions.

Note

Adjusting R743 too far clockwise will cause green blotches to appear on screen after 1 second erase and the screen will rapidly fade positive, reducing storage time.

5-22. COMPENSATION ATTENUATION ADJUSTMENTS.

5-23. A square-wave generator is required to adjust the deflection Compensation Attenuator network.

a. SPECTRUM ANALYZER.

1. Remove Spectrum Analyzer plug-ins to allow access to J1 and J2.

2. Apply a 50 kHz square wave to pins 12 and 24 of J1, and a sweep signal to pins 12 and 24 of J2.

3. Adjust vertical gain to obtain a display 8 divisions high.

4. Adjust A605/C629/C631 for best flat-top square wave response on CRT display when both capacitors are set at approximately the same value.

5. Reverse connections at J1 and J2.

6. Increase square-wave frequency to 100 kHz.

7. Adjust horizontal gain to obtain a display 8 divisions high.

8. Adjust A605/C625/C627 for best flat-top square-wave response on CRT display when both capacitors are set to approximately the same value.

b. OSCILLOSCOPE PLUG-INS.

1. Install 1400-series time-base and vertical plug-ins in normal positions in Model 141S compartments and set SWEEP TIME to 10 μsec/cm.

2. Apply a 50 kHz square-wave to Vertical Input and adjust Vertical GAIN for a display 8 divisions high.

3. Adjust A605/C629/C631 for best flat-top square wave response when both capacitors are set at approximately the same value.

4. Reverse vertical and time base plug-ins in Model 141S compartments. Set SWEEP TIME to 2 μsec/cm. Increase square wave frequency to 100 kHz.

5. Adjust A605/C625/C627 for best flat-top square-wave response when both capacitors are set at approximately the same value.

c. When adjustment is completed, reverse and reinstall plug-ins.

5-24. TROUBLESHOOTING.

5-25. LOW-VOLTAGE SUPPLY.

5-26. TRANSISTORS. The series regulator transistors are located on the fan assembly. Each is easily replaced by removing the two screws and pulling the transistor from its socket. All other low voltage power supply transistors are located on the low-voltage circuit board.

5-27. DC voltages shown on the low voltage schematic diagram were measured to ground, with Model 1402A and 1421A plug-ins installed. Voltages may vary slightly when other plug-ins are used. Correct voltages for points not marked for voltage are generally obvious by being connected (directly or indirectly) to a supply output. Transistor base voltage in most cases should not measurably differ from emitter voltage when measured with respect to ground. Voltage drops across breakdown diodes are indicated on the schematic.

5-28. EXCESSIVE RIPPLE. Excessive 120 Hz ripple on any supply can usually be traced to either input filter or regulator circuit by comparing ripple voltages at the rectifier outputs with values given on the schematic. For ripple above specified value, check C421, C441, C461 or C481. 60 Hz ripple above specified value at these points indicates an open rectifier or low-gain amplifier transistor. Maximum ripple on supply outputs (at 115 Vac with maximum load on supply) is: 10 mv at +250v; 7 mv at +100v and -100v; and 2 mv at -12.6v.

5-29. FUSES. If the -12.6, -100, +100 or +250 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.

5-30. The -12.6 volt supply is fused, and employs a Current Limiter, Q483, for protection against brief shortings of the output to ground. The supply should immediately function normally upon removal of the short, provided the fuse has not blown.

5-31. ISOLATING TROUBLES. Trouble in the +100 volt supply can be reflected in the operation of all other low voltage power supply outputs. If +100 volt supply is incorrect, proper circuit repair may eliminate the trouble. If +100 volt supply is correct, follow these steps in their given order:

a. Check the -100 volt supply. The +250 volt and -12.6 volt supplies are referenced to this supply. A fault in the -100 volt supply can cause malfunction of either of the other two. If the the -100 volt supply is incorrect, proper circuit repair may eliminate trouble in the +250 volt or -12.6 volt supply. If the -100 volt supply is correct, proceed to the next step.

b. The +250 volt supply is referenced to the -100 volt supply. If trouble here has not been eliminated by checking the -100 volt supply, the trouble lies in this circuit and can be located by making the proper circuit and component checks as described in Paragraph 5-27.

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

5-32. HIGH-VOLTAGE SUPPLY.

5-33. 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.

5-34. If there is no high-voltage output, observe the waveforms at the collector of Q602 (blue wire). If an approximately 30 kHz 20-volt peak-to-peak sine wave appears for short intervals, the trouble is probably a defective component in the rectifier filter/divider networks. If no waveform appears, use Table 5-4.

5-35. If the high-voltage output is incorrect and cannot be adjusted to the correct value, use Table 5-5.

5-36. If the -2350 volt supply seems to be operating properly, the +5 kV post-accelerator potential may be checked by removing the left side instrument cover and measuring the 5 kV voltage at the board termination of the thick red lead.

5-37. PULSE CIRCUIT.

5-38. A good knowledge of the operating procedures and an understanding of the principles of operation of the Model 141S are helpful when troubleshooting the pulse circuit. Refer to Section III for operating procedures and Section IV for principles of operation. Always use the turn-on procedure given in Paragraph 5-4 if the Model 141S is not operating properly.

5-39. 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 isolate the trouble to one general circuit. If both supplies are correct, check the waveforms at test points shown on the schematic diagram, Figure 5-14. 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 5-13. The PERSISTENCE control should vary the pulse width of the waveforms observed at Test Points 4 through 8. With PERSISTENCE just out of NORMAL detent, Presentation Selector in WRITE, and no pulse present at Test Point 8, persistence will be maximum; this indicates a trouble in the multivibrator or pulse generator circuit. When a normal pulse, which is not variable, is present at Test Point 8, persistence is minimum; this indicates a malfunction in the PERSISTENCE control or Presentation Selector.

5-40. The pulse amplifier circuit functions only in the STORE position of the Presentation Selector. In all other positions, a steady dc voltage is applied to the collimator. If all modes, except STORE, operate properly, check waveforms 9, 10, and 11 in the pulse amplifier circuit.

Table 5-4. Troubleshooting High-Voltage Supply, No Voltage

1. Check Q602, L601, and the associated transformer primary for open circuits or shorts. Replace any bad components.

Procedure	Indication	Conclusion
2. Remove the edge-on connector which goes to the emitter of Q601 (yellow wire). Connect this lead through a 2K resistor to -12.6 volts (any white-violet wire).	Rectifier V604 filament lights.	Proceed to step 3.
	Filament doesn't light.	Proceed to step 4.
3. Replace edge-on connector, and change V601.	Filament lights.	Q601 was bad.
	Filament doesn't light.	Check biasing circuitry of V601. Then check Q601 and associated circuitry.
4. Check T601 and rectifier load circuit for opens or shorts. Then lift one lead of C613, C614, C615, C616, C617, C621, and turn instrument on again.	Filament lights.	Put capacitors back one at a time until the bad one causes filaments to go out.
	Filament doesn't light.	Trouble probably with transformer T601.

Table 5-5. Troubleshooting High-Voltage Supply, Incorrect Voltage

Procedure	Effect	Conclusion
1. Remove Nuvistor V601 from its socket.	Output drops to zero.	Proceed to step 2.
	Output remains at an incorrect value.	Q601 shorted.
2. Replace V601 in its socket, and lift one end of R601.	Output drops.	Trouble probably in the resistor divider network R611, R619 - R634.
	Output remains at an incorrect value.	V601 bad.

5-41. PERODIC MAINTENANCE.

5-42. ELECTRICAL MAINTENANCE.

5-43. Perform the electrical adjustments once every 6 months and after repair or component replacement.

5-44. MECHANICAL MAINTENANCE.

5-45. Inspect the air filter at the rear of the instrument frequently and clean it before air flow is restricted. To clean the filter, wash it throughly in warm water and detergent. Dry the filter thoroughly before installing it on the instrument. Oil the motor (one point) with light machine oil once every 6 months.

5-46. INSTRUMENT REPAIR.

5-47. Chassis-mounted components are identified in Figures 5-1 and 5-2. Components on circuit boards are identified in figures near the applicable schematic (also see Table 5-6).

5-48. Figure 6-1 is an exploded view drawing of the Model 141S frame. All parts are identified by description and HP part number.

5-49. MAJOR COMPONENT REPAIR.

5-50. CRT REMOVAL AND REPLACEMENT. To remove the CRT, proceed as follows:

WARNING

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

a. Remove top cover of instrument. (Top view drawing of Model 141S shown on inside of top cover.)

b. Remove bezel and discharge post-accelerator lead and CRT connection to chassis ground.

c. Disconnect the clip-on leads from the bulb of the CRT.

d. Disconnect the clip-on leads from the neck of the CRT.

e. Loosen the clamp at the CRT socket.

f. Remove the socket from the CRT base; loosen carefully.

g. Place one hand on the CRT face and, with the other hand, slide the CRT forward and out of the instrument. Use care since neck pins can damage the trace alignment coil.

h. To replace the CRT, first reconnect the white/blue collimator lead (routed through CRT shield on left) while CRT is about four inches out from front panel.

i. Reverse above procedure and be sure all bulb and neck leads are connected BEFORE turning power on.

j. Check the trace alignment, astigmatism and geometry adjustments, Paragraphs 3-5, 5-17 and 5-18 respectively.

5-51. FAN REMOVAL AND REPLACEMENT. Use the following procedure for removing, and reverse the procedure for replacing the cooling fan.

a. Remove the top and bottom covers of the Model 141S.

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

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

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

e. Lift out the fan assembly.

5-52. HV DECK REMOVAL AND REPLACEMENT. Most of the components on the high voltage deck can be replaced without removing the assembly. Other components can be removed and replaced by moving the deck part way out (without disconnecting wires). Refer to Figure 5-4 for location of mounting screws and wire identification; use the following procedure for removing the high voltage deck.

a. Remove the left side and top covers.

b. Disconnect the 6 wires from the board and remove the 4 mounting screws; see Figure 5-4 for wire and screw identification.

c. Disconnect the post-accelerator lead from the CRT and short the CRT pin and lead to the chassis.

d. Push the wires aside, tilt the deck away from the left side of the instrument and lift it out.

5-53. SERVICING CIRCUIT BOARDS.

5-54. The Model 141S has circuit boards of the plated through type. When servicing this type board, components can be removed and replaced by applying a soldering iron tip to the component connection on either side of the board. When removing a component with multiple leads, such as potentiometers, move the soldering iron tip from lead to lead while applying moderate pressure to the component to lift it from the board. Excessive solder can be removed by applying heat and rotating a wooden toothpick in the hole. Hewlett-Packard Service Note M-20D contains additional information on the repair of the circuit boards; important considerations are as follows:

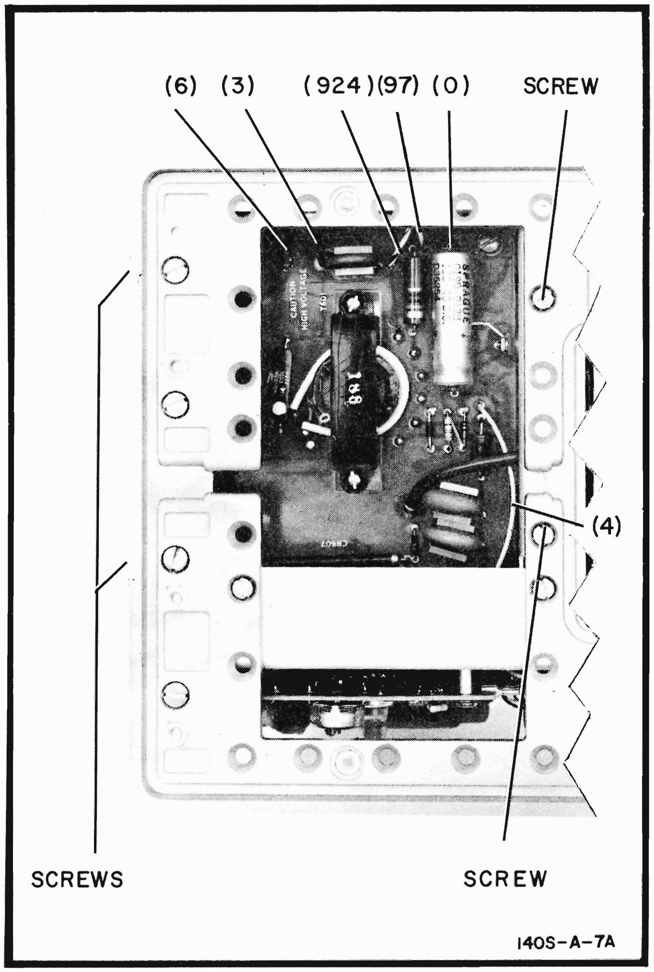


Figure 5-4. High Voltage Deck Removal

a. Do not apply excessive heat.

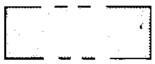
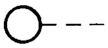
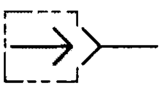
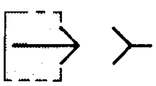
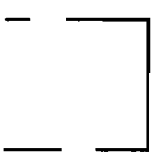
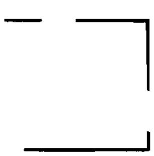
b. Apply heat to component leads and remove component with a straight pull away from the board.

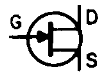
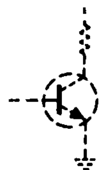
c. Do not force replacement component lead into the hole.

5-55. 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 good conducting bare wire to the conductor so it bridges the break.

Table 5-6. Schematic Diagram Notes

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

	=	Etched circuit board
	=	Front panel marking
	=	Rear panel marking
	=	Front panel control
	=	Screwdriver adjustment
P/O	=	Part of
CW	=	Clockwise end of variable resistor
N C	=	No connection
	=	Waveform test point (with number)
	=	Common electrical point (with letter) not necessarily ground
	=	Single pin connector on board
	=	Pin of a plug-in board (with letter or number)
	=	Main signal path
	=	Primary feedback path
	=	Secondary feedback path
*	=	Optimum value selected at factory, average value shown; part may have been omitted.
	=	Module outline
	=	Assembly outline

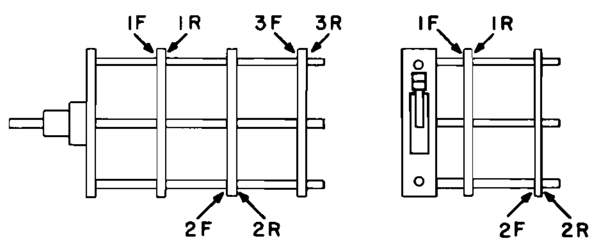
	=	Field effect transistor (N-channel)
	=	Breakdown diode
	=	Tunnel diode
	=	Step recovery diode
	=	Circuits or components drawn with dashed lines (phantom) show function only and are not intended to be complete. The circuit or component is shown in detail on another schematic.

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

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

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

Switch wafers are identified as follows:



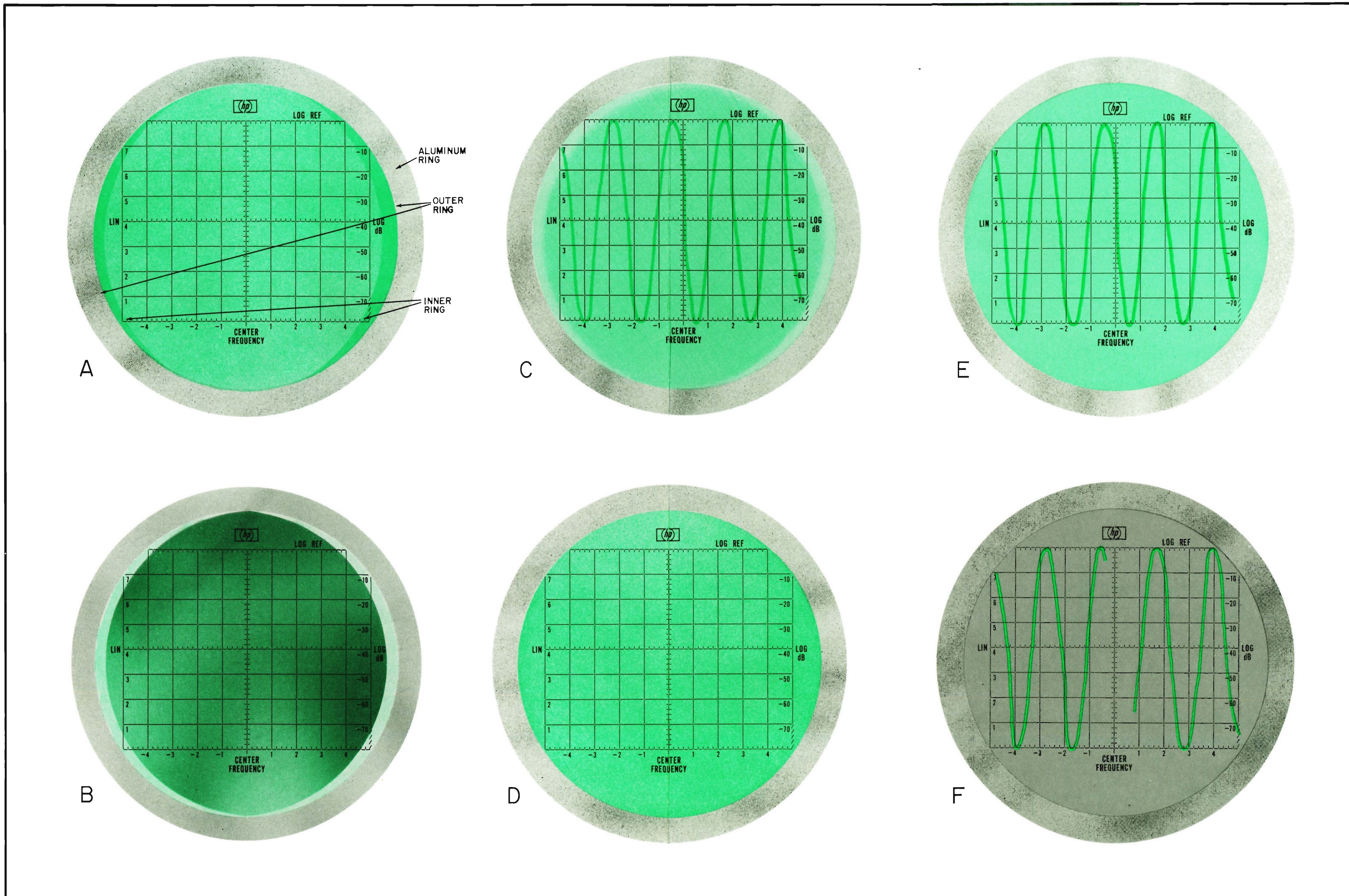


Figure 5-5. CRT Appearance, Pulse Circuit Adjustments

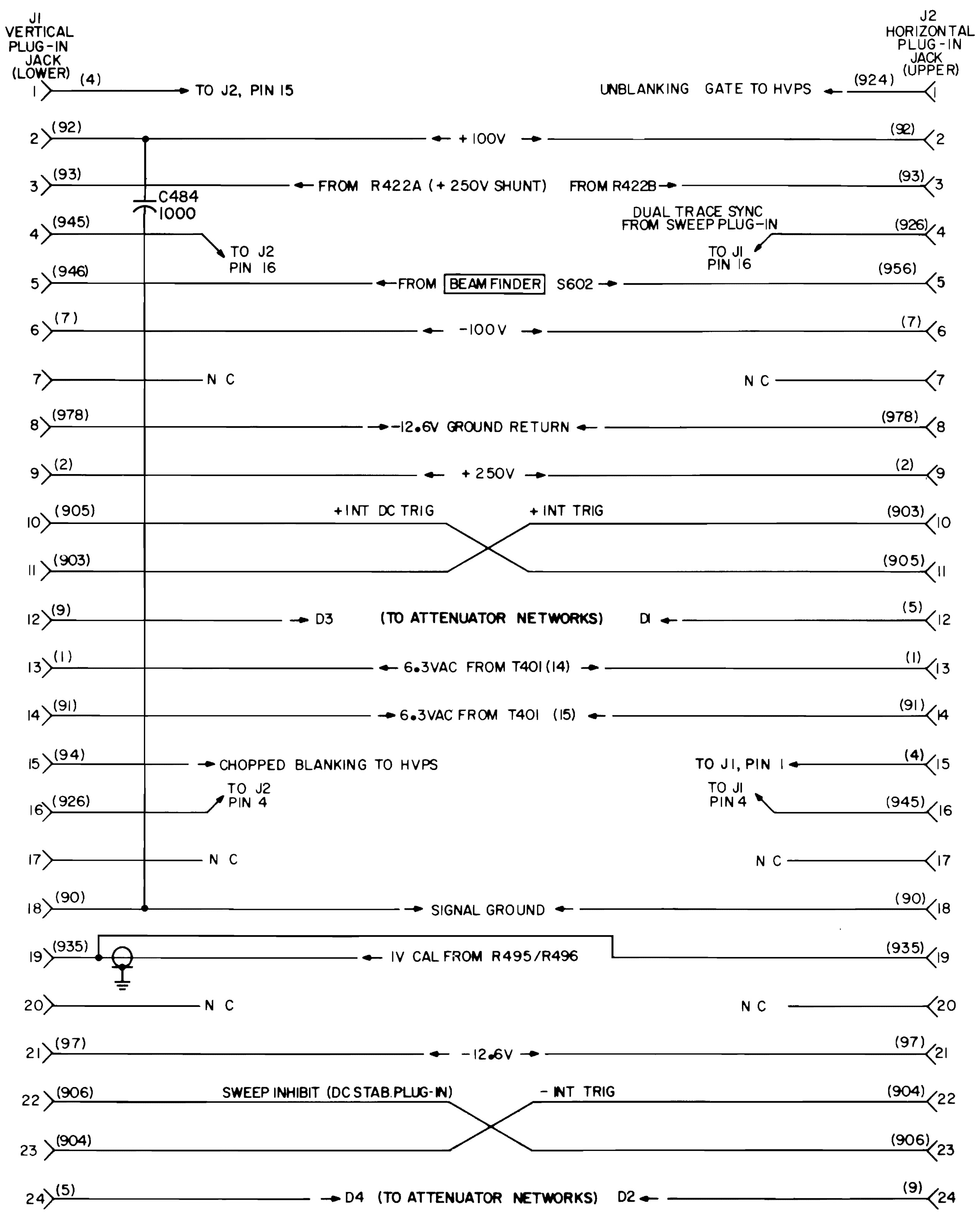


Figure 5-6. Oscilloscope Plug-in Jack Diagram

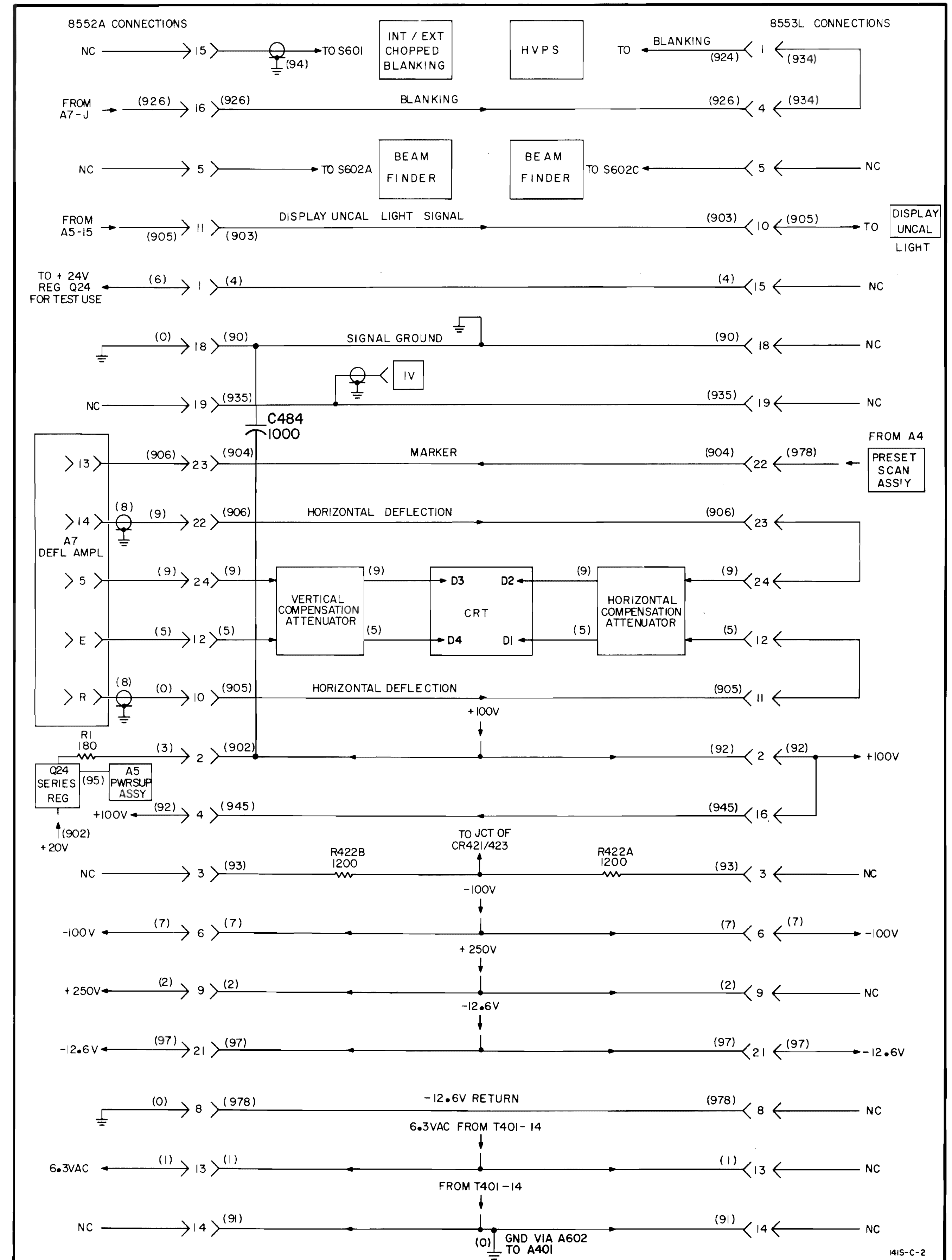


Figure 5-7. Spectrum Analyzer Plug-in Jack Diagram

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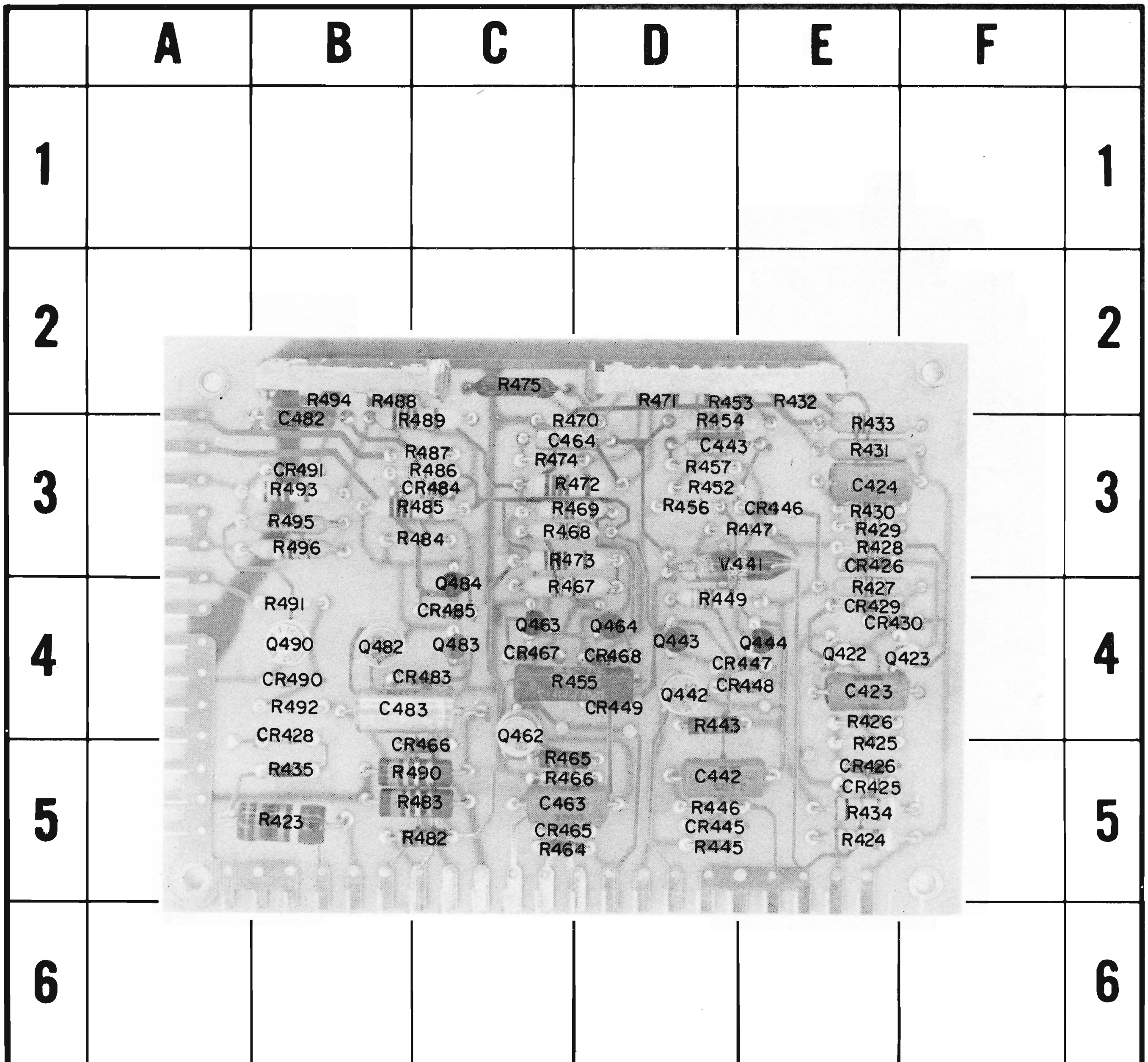


REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C423	E-4	CR447	D-4	Q444	E-4	R430	E-3	R456	D-3	R483	B-5
C424	E-3	CR448	D-4	Q462	C-4	R431	E-3	R457	D-3	R484	B-3
C442	D-5	CR449	D-4	Q463	C-4	R432	E-2	R464	C-5	R485	B-3
C443	D-3	CR465	C-5	Q464	D-4	R433	E-3	R465	C-5	R486	B-3
C463	C-5	CR466	B-5	Q482	B-4	R434	E-5	R466	C-5	R487	B-3
C464	C-3	CR467	C-4	Q483	C-4	R435	B-5	R467	C-4	R488	B-2
C482	B-3	CR468	D-4	Q484	C-4	R443	D-4	R468	C-3	R489	B-3
C483	B-4	CR483	B-4	Q490	B-4	R445	D-5	R469	C-3	R490	B-5
CR425	E-5	CR484	B-3	R423	B-5	R446	D-5	R470	C-3	R491	B-4
CR426	E-3	CR485	C-4	R424	E-5	R447	D-3	R471	D-4	R492	B-4
CR427	E-3	CR490	B-4	R425	E-5	R449	D-4	R472	C-3	R493	B-3
CR428	B-4	CR491	B-3	R426	E-4	R452	D-3	R473	C-3	R494	B-2
CR429	E-4	Q422	E-4	R427	E-4	R453	D-2	R474	C-3	R495	B-3
CR430	E-4	Q423	E-3	R428	E-3	R454	D-3	R475	C-2	R496	B-3
CR445	D-5	Q442	D-4	R429	E-3	R455	C-4	R482	B-5	V441	D-3
CR446	E-3	Q443	D-4								

141A-A-7B

Figure 5-8. Component Identification, Low-Voltage Board, A401

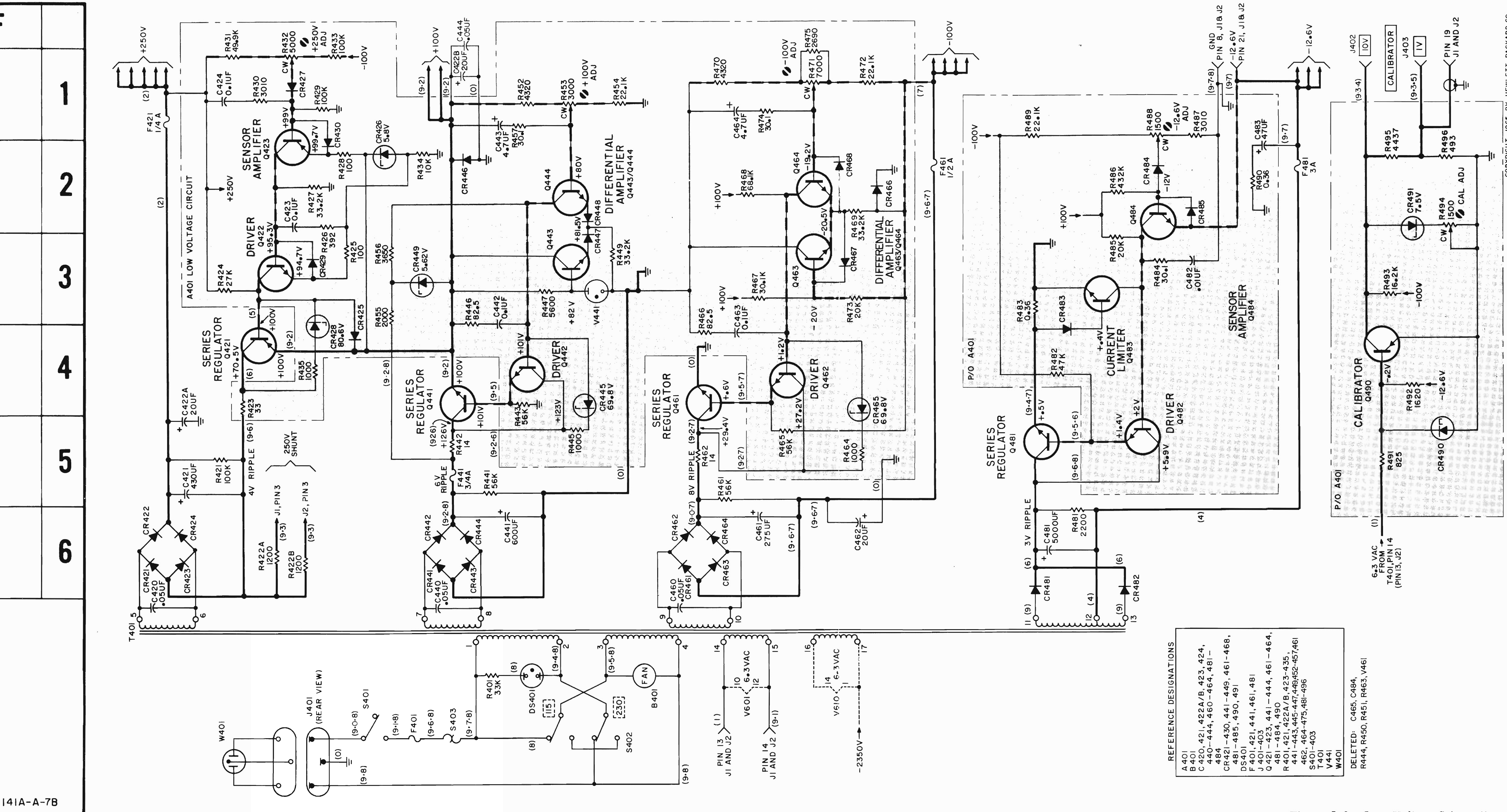


Figure 5-9. Low-Voltage Schematic Diagram

Scans by ArtekMedia => 2010

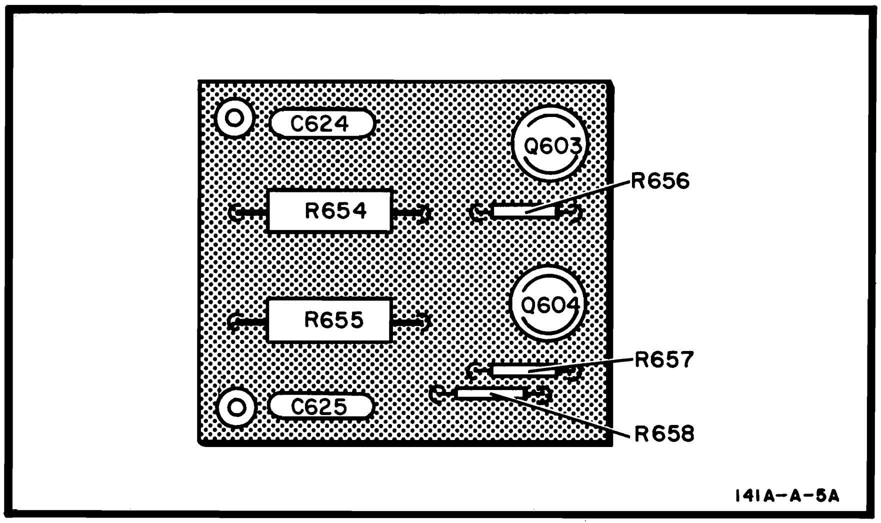
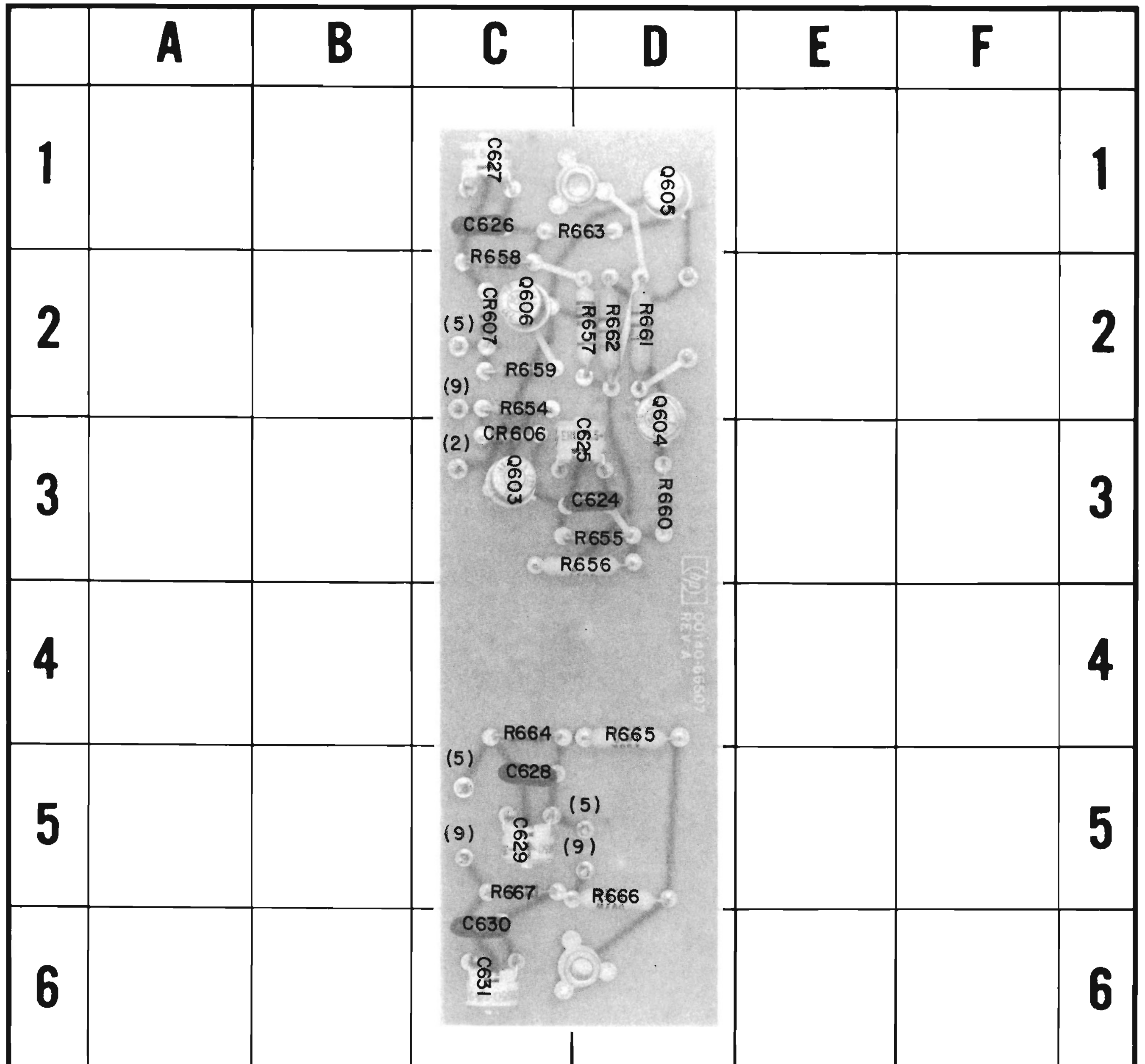


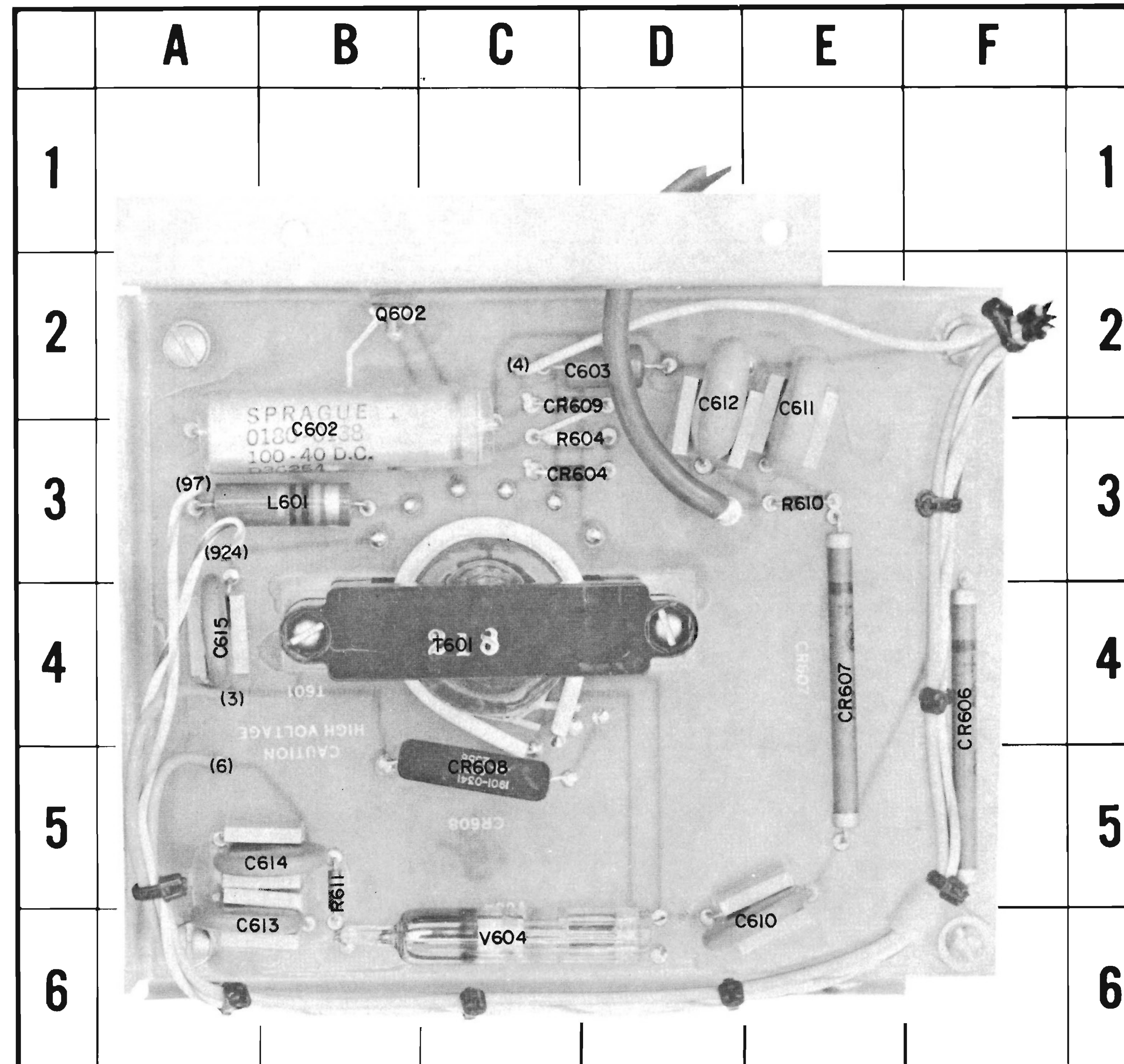
Figure 5-10. Component Identification, Horizontal Driver Board, A603



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C624	D-3	C631	C-6	R654	C-2	R661	D-2
C625	D-3	CR606	C-3	R655	D-3	R662	D-2
C626	C-1	CR607	C-2	R656	D-3	R663	D-4
C627	C-1	Q603	C-3	R657	D-2	R664	C-4
C628	C-5	Q604	D-3	R658	C-2	R665	D-4
C629	C-5	Q605	D-1	R659	C-2	R666	D-5
C630	C-6	Q606	C-2	R660	D-3	R667	C-5

140S-A-2

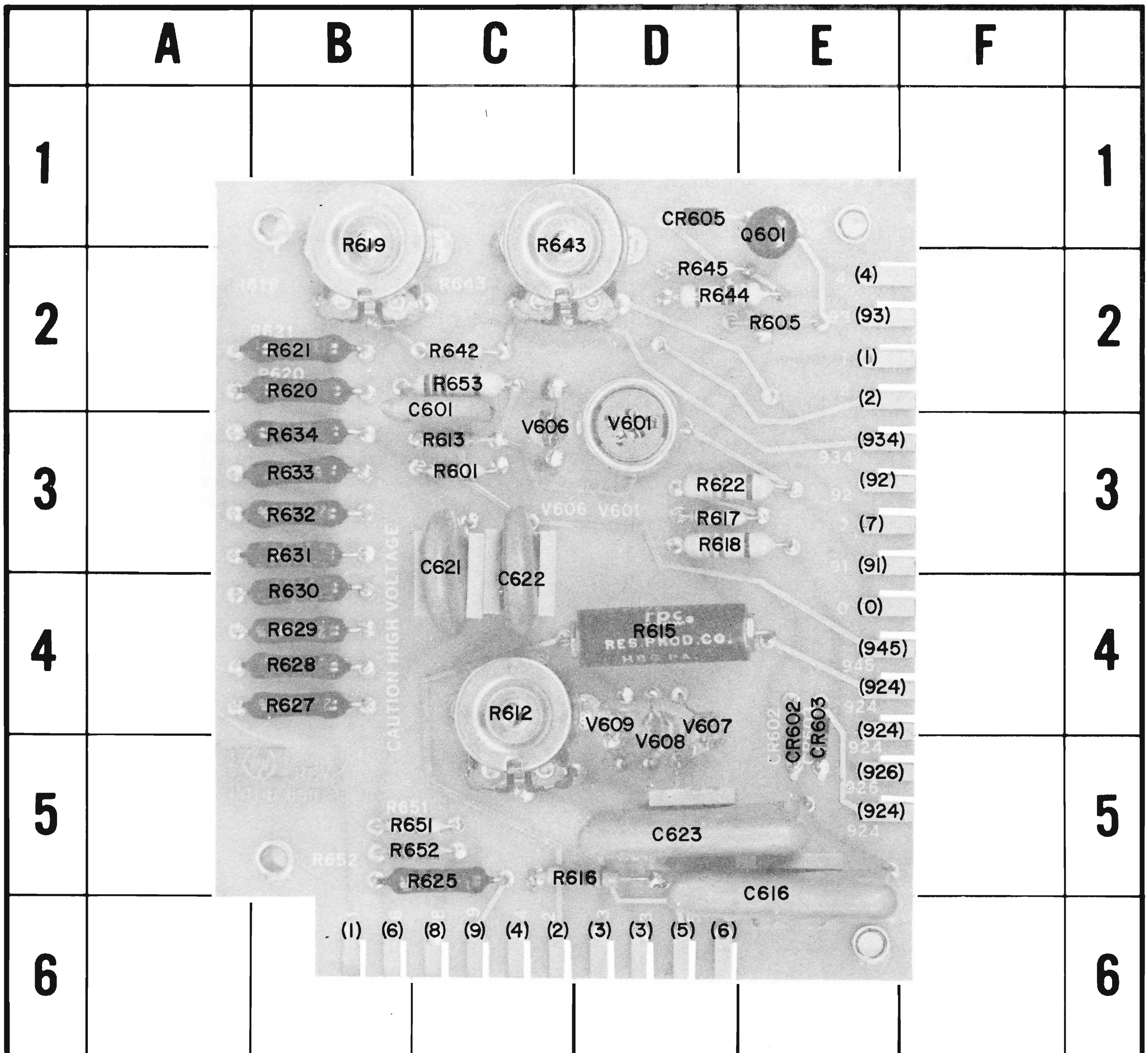
Figure 5-11. Component Identification Compensation Attenuator Board, A605



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C602	B-3	C613	A-6	CR607	E-4	R604	D-3
C603	D-2	C614	B-5	CR608	C-5	R610	E-3
C610	E-6	C615	A-3	CR609	C-2	R611	B-5
C611	E-2	CR604	C-3	L601	B-3	T601	C-4
C612	D-2	CR606	F-4	Q602	B-2	V604	C-6

140S-A-1A

Figure 12. Component Identification High-Voltage Rectifier Board, A601



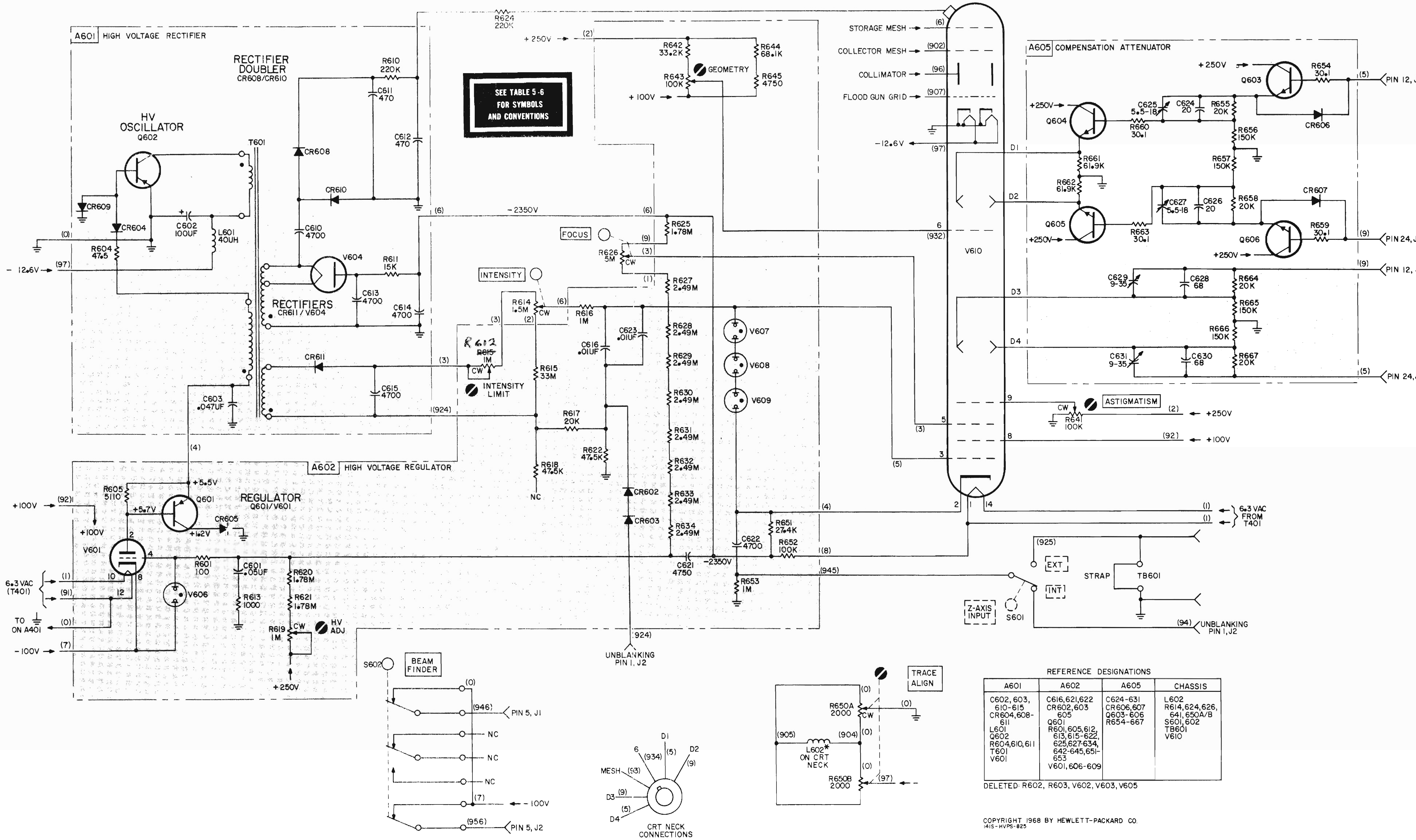
REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C601	C-2	R616	D-5	R633	B-3
C616	E-5	R617	D-3	R634	B-3
C621	C-3	R618	D-3	R642	C-2
C622	C-4	R619	B-1	R643	C-1
C623	D-5	R620	B-2	R644	D-2
CR602	E-4	R621	B-2	R645	D-2
CR603	E-4	R622	D-3	R651	C-5
CR605	D-1	R625	C-5	R652	C-5
Q601	E-1	R627	B-4	R653	C-2
R601	C-3	R628	B-4	V601	D-3
R605	E-2	R629	B-4	V606	C-3
R612	C-4	R630	B-4	VR607	D-4
R613	C-3	R631	B-3	VR608	D-5
R615	D-4	R632	B-3	VR609	D-4

141A-A-6A

Figure 5-13. Component Identification, High-Voltage Regulator Board A602

1
2
3
4
5
6

141A-A-6A



REFERENCE DESIGNATIONS

A601	A602	A605	CHASSIS
C602, 603, 610-615 CR604, 608-611 L601 Q602 R604, 610, 611 T601 V601	C616, 621, 622 CR602, 603 605 Q601 R601, 605, 612, 613, 615-622, 625, 627-634, 642-645, 651-653 V601, 606-609	C624-631 CR606, 607 Q603-606 R654-667	L602 R614, 624, 626, 641, 650A/B S601, 602 TB601 V610

DELETED: R602, R603, V602, V603, V605

Figure 5-14. High-Voltage Schematic Diagram

CONDITIONS FOR WAVEFORM MEASUREMENT

For numbers 1 thru 3 and 5 thru 8:

Model 141S;

Presentation Selector	WRITE
PERSISTENCE	fully ccw
WRITING RATE	NORMAL
INTENSITY	fully ccw

Test Oscilloscope;

SENSITIVITY	0.2 V/CM
SWEEP TIME	0.2 MS/CM

For number 4, same as 1 thru 3 and 5 thru 8 except:

Text Oscilloscope;

SENSITIVITY	0.5 V/CM

For number 9 same as 1 thru 3 and 5 thru 8 except:

Model 141S;

Presentation Selector	STORE

Test Oscilloscope;

SENSITIVITY	0.1 V/CM
SWEEP TIME	0.1 MS/CM

For number 10 same as 9 except:

Test Oscilloscope;

SWEEP TIME	20 μS/CM

For number 11 same as 10 except:

Test Oscilloscope;

SENSITIVITY	2 V/CM

Note

The voltage levels given in the following waveforms are intended for reference only and may vary somewhat with the adjustment of the Model 141S.

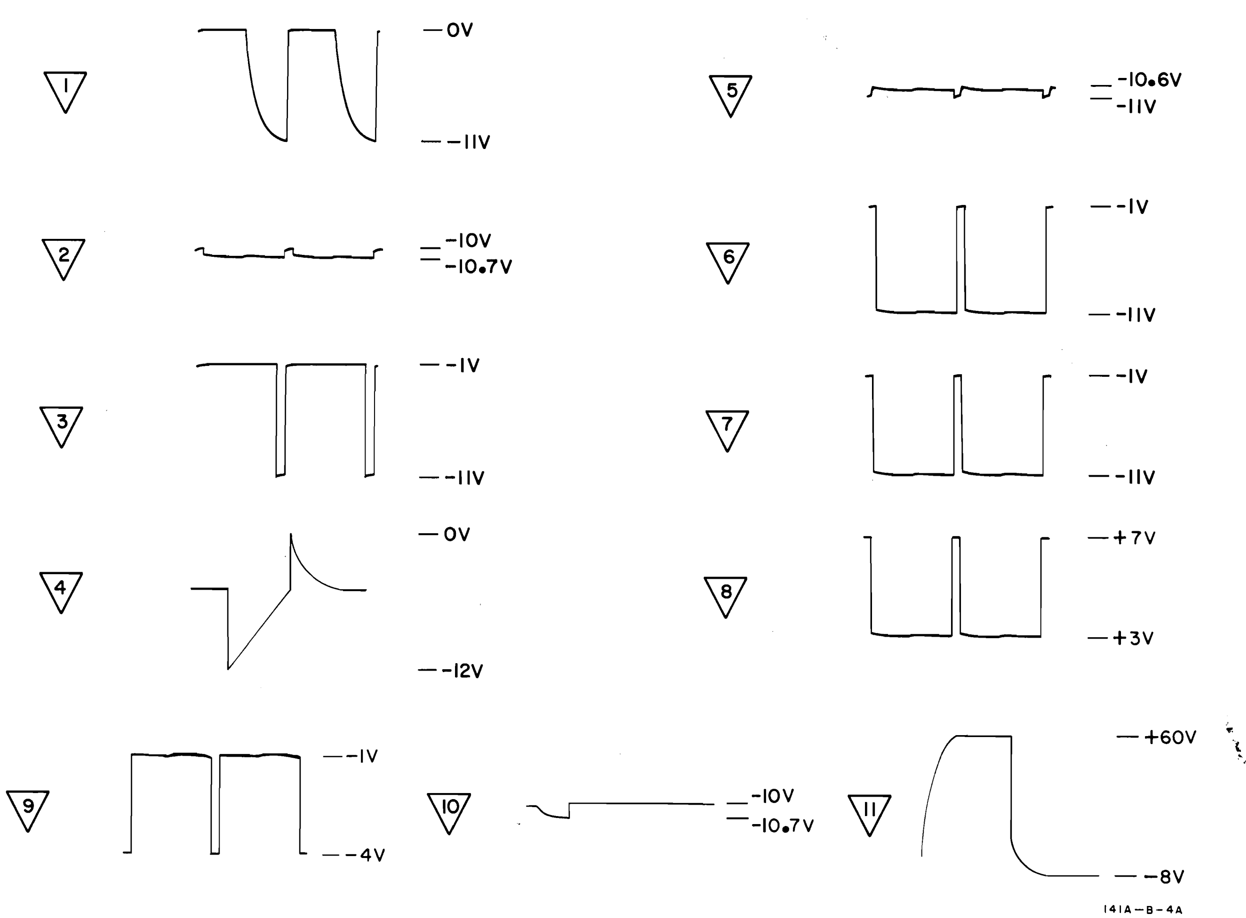
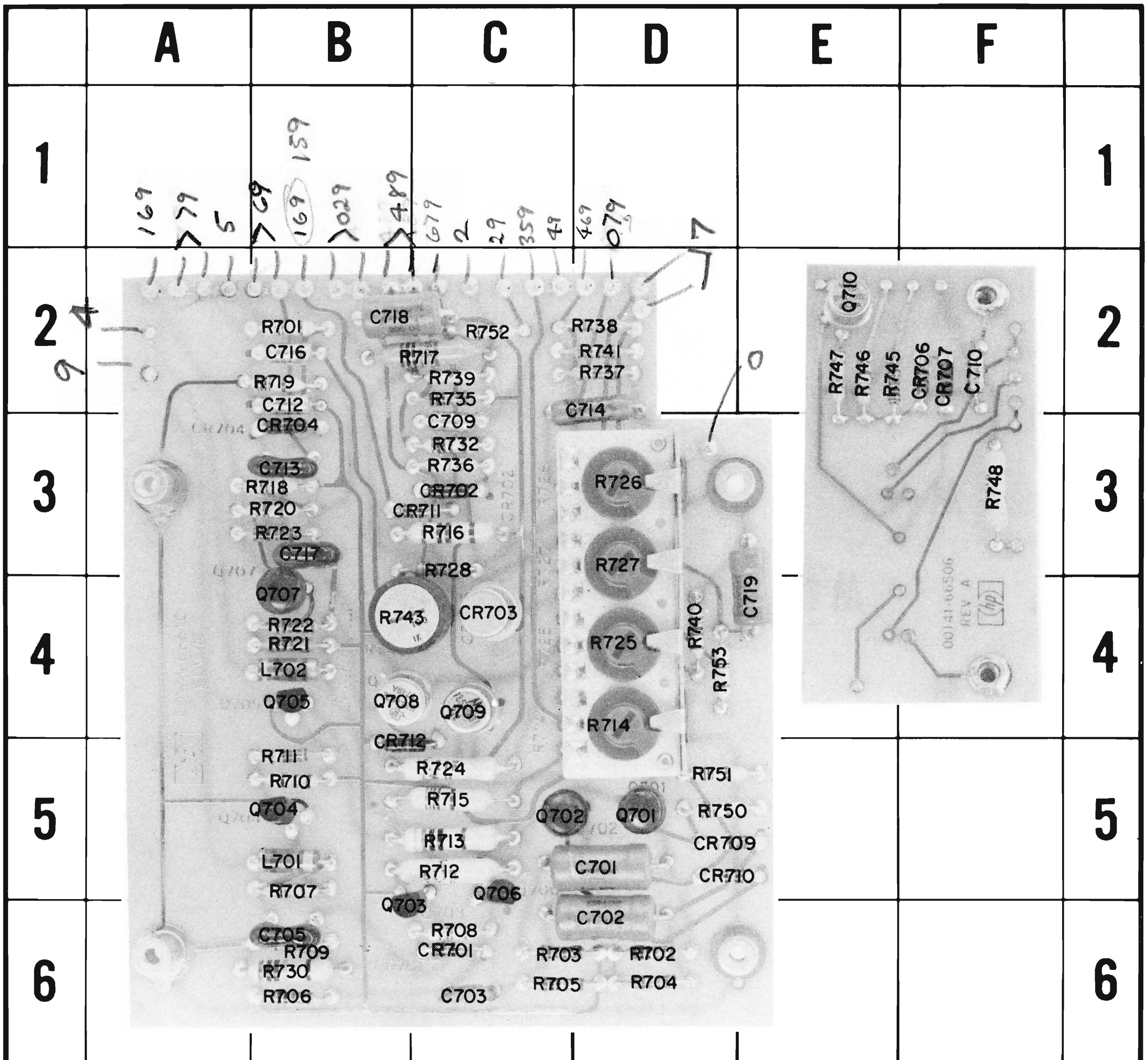


Figure 5-15. Waveforms

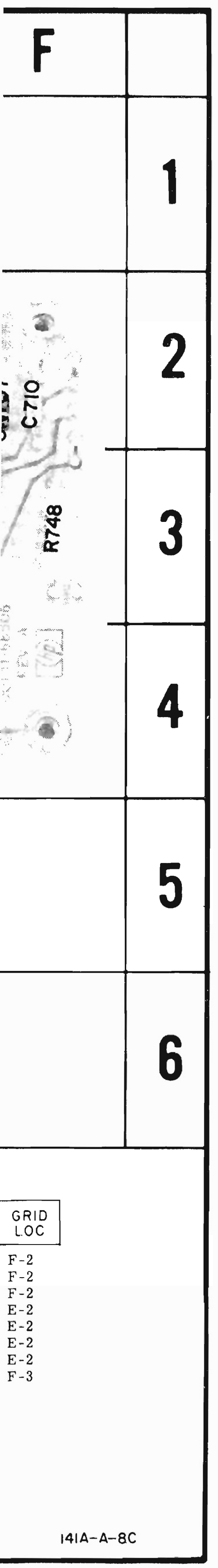


REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C701	D-5	CR704	B-3	Q709	C-4	R715	C-5	R732	C-3
C702	D-6	CR709	D-5	R701	B-2	R716	C-3	R735	C-2
C703	C-6	CR710	D-5	R702	D-6	R717	C-2	R736	C-3
C705	B-6	CR711	B-3	R703	C-6	R718	B-3	R737	D-2
C709	C-3	CR712	B-5	R704	C-6	R719	B-2	R738	D-2
C712	B-2	L701	B-5	R705	C-6	R720	B-3	R739	C-2
C713	B-3	L702	B-4	R706	B-6	R721	B-4	R740	D-4
C714	D-2	Q701	D-5	R707	B-5	R722	B-4	R741	D-2
C716	B-2	Q702	C-5	R708	C-6	R723	B-3	R743	B-4
C717	B-3	Q703	B-6	R709	B-6	R724	C-5	R750	D-5
C718	B-2	Q704	B-5	R710	B-5	R725	D-4	R751	D-5
C719	E-4	Q705	B-4	R711	B-5	R726	D-3	R752	C-2
CR701	C-6	Q706	C-5	R712	C-5	R727	D-3	R753	D-4
CR702	C-3	Q707	B-4	R713	C-5	R728	C-3		
CR703	C-4	Q708	B-4	R714	D-4	R730	B-6		

REF DESIG	GRID LOC
C710	F-2
CR706	F-2
CR707	F-2
Q710	E-2
R745	E-2
R746	E-2
R747	E-2
R748	F-3

141A-A-8C

Figure 5-16. Component Identification Pulse Board, A701, and Clamp Board, A704



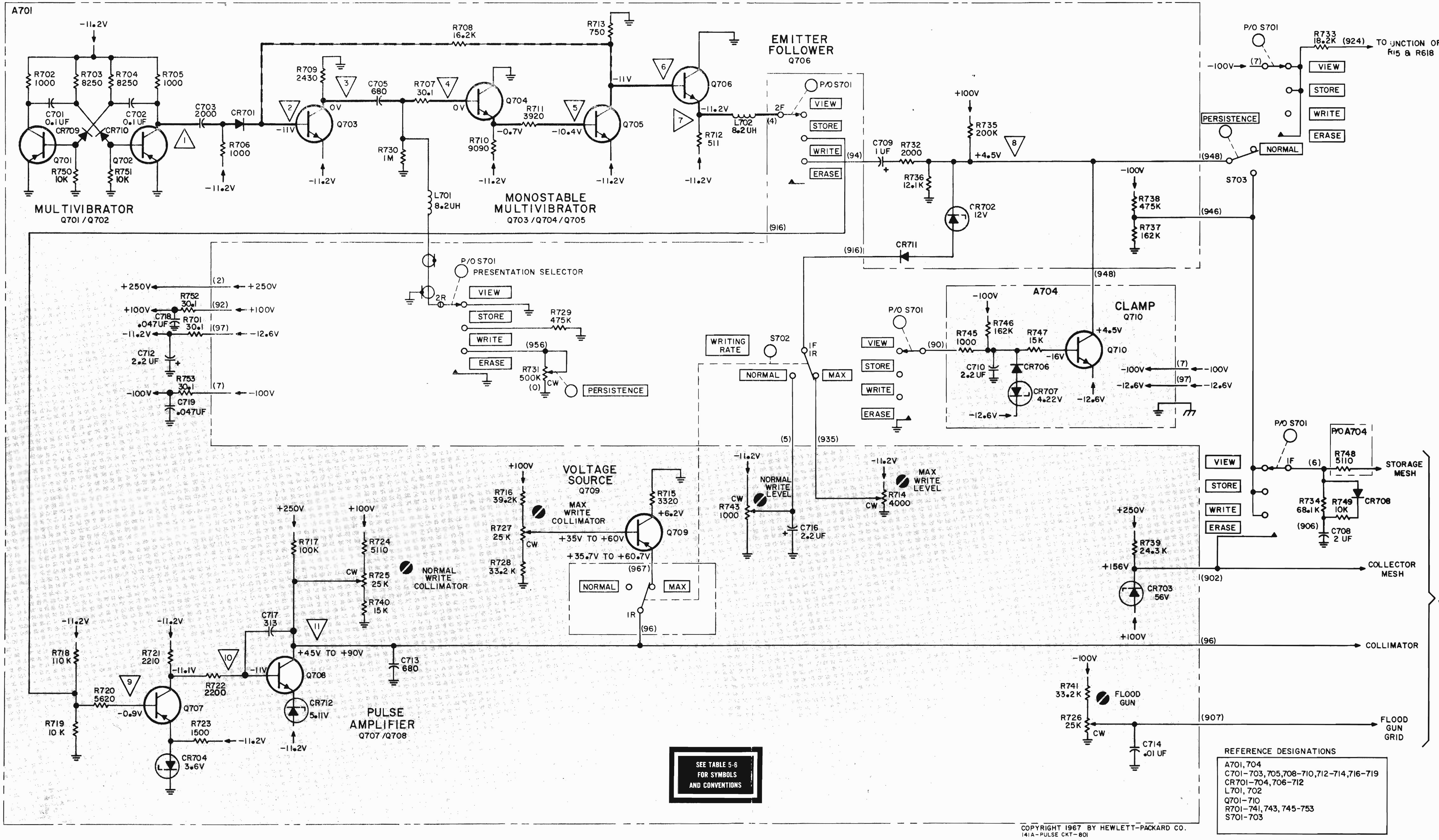


Figure 5-17. Pulse and Clamp Circuit Schematic Diagram

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section contains the information necessary for ordering replaceable parts. Table 6-2 provides the following information:

a. hp Part Number.

b. Total Quantity (TQ) used in the instrument; given only the first time a part number is listed.

c. Description of part; see Table 6-1 for a list of the reference designators and abbreviations used.

6-3. Miscellaneous parts are listed at the end of Table 6-2. Cabinet parts are listed in Figure 6-1.

6-4. ORDERING INFORMATION.

6-5. To order replacement part(s), direct the order or inquiry to the nearest Hewlett-Packard Sales/Service Office (see list at back of this manual). Provide the following information:

a. hp Part Number of item(s).

b. Model number and eight-digit serial number of instrument.

c. Quantity of part(s) desired.

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

a. Model number and eight-digit serial number of instrument.

b. Part description, including function and location.

Note

Upon request, information will be supplied to allow ordering of applicable parts from manufacturers other than Hewlett-Packard. Contact the hp Sales/Service Office for details.

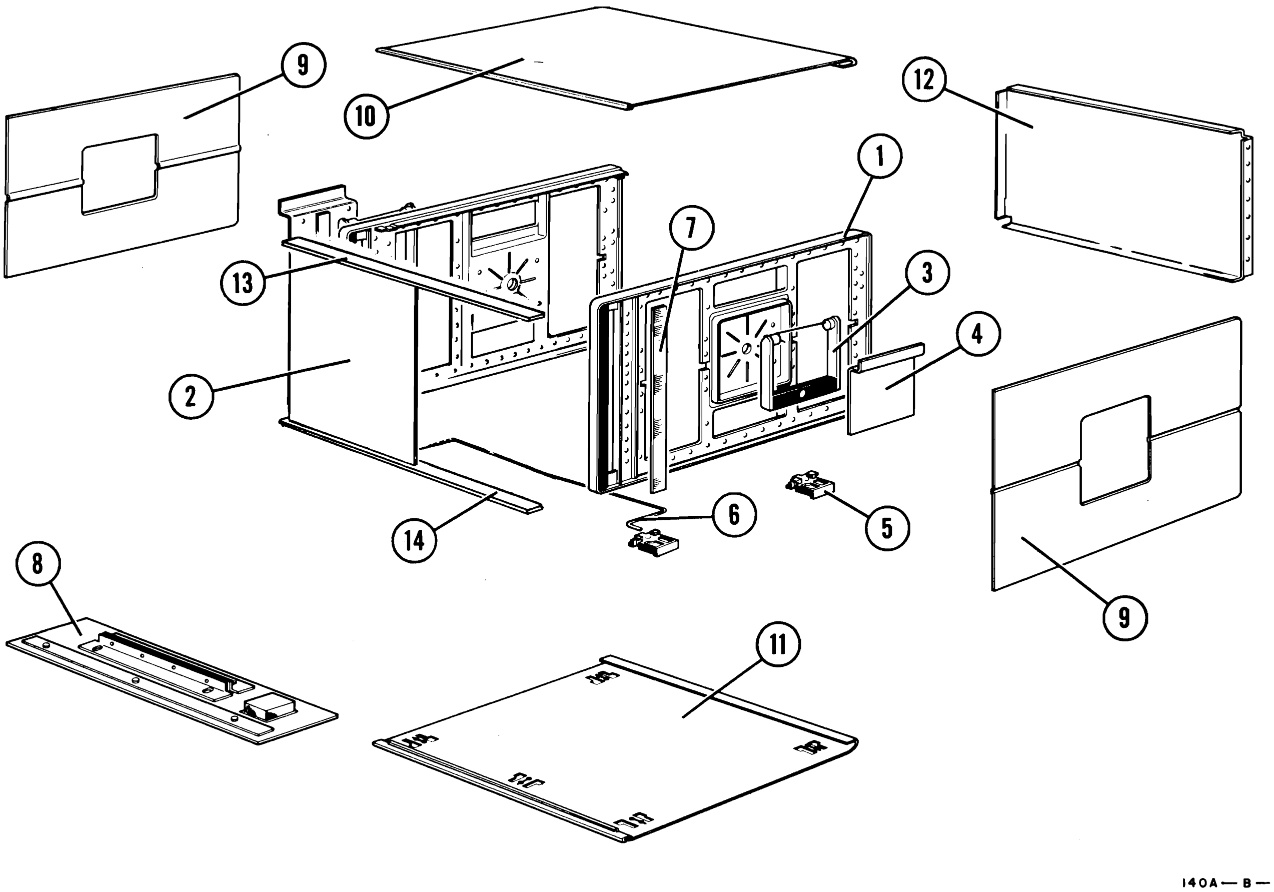
Table 6-1. Reference Designators And Abbreviations

REFERENCE DESIGNATORS

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

ABBREVIATIONS

amp	= amperes	gl	= glass	mtg	= mounting	rf	= radio frequency
ampl	= amplifier	grd	= ground(ed)	my	= mylar		
						s-b	= slow-blow
		h	= henries	n	= nano (10^{-9})	Se	= selenium
bp	= bandpass	Hg	= mercury	n/c	= normally closed	sect	= section(s)
		hr	= hour(s)	ne	= neon	semicon	= semiconductor
car	= carbon	hp	= Hewlett-Packard	n/o	= normally open	Si	= silicon
ccw	= counterclockwise			npo	= negative positive zero (zero temperature coefficient)	sil	= silver
cer	= ceramic	if.	= intermediate freq.			sl	= slide
coef	= coefficient	impg	= impregnated			spl	= special
com	= common	incd	= incandescent	nsr	= not separately replaceable		
comp	= composition	incl	= include(s)			Ta	= tantalum
conn	= connector	ins	= insulation(ed)			td	= time delay
crt	= cathode-ray tube	int	= internal	obd	= order by description	tgl	= toggle
cw	= clockwise			ox	= oxide	Ti	= titanium
		k	= kilo (10^3)			tol	= tolerance
depc	= deposited carbon			pc	= printed circuit	trim	= trimmer
		lin	= linear taper	pf	= picofarads = 10^{-12} farads		
elect	= electrolytic	log	= logarithmic taper				
encap	= encapsulated	lpf	= low pass filter	piv	= peak inverse voltage	μ	= micro (10^{-6})
ext	= external			p/o	= part of		
		m	= milli (10^{-3})	porc	= porcelain	var	= variable
f	= farads	meg	= mega (10^6)	pos	= position(s)		
fet	= field effect transistor	metflm	= metal film	pot	= potentiometer	w	= watts
		met ox	= metal oxide	pk-pk	= peak-to-peak	w/	= with
fxd	= fixed	mfr	= manufacturer			w/o	= without
		minat	= miniature			wvdc	= dc working volts
Ge	= germanium	mom	= momentary	rect	= rectifier	ww	= wirewound



Part	Part Number	Quantity
1. Frame Assembly	5060-0736	2
2. Front Panel	00141-00201	1
3. Side Handle Assembly	5060-0763	2
4. Handle Retainer	5060-0765	2
5. Foot Assembly	5060-0767	5
6. Tilt Stand	1490-0030	1
7. Plastic Trim	6980-0004	2
8. Rack Mount Kit	5060-0777	1
9. Side Cover	5000-0747	2
10. Top Cover Assembly	5060-0740	1
11. Bottom Cover Assembly	00140-04402	1
12. Rear Panel	00140-00202	1
13. Top Panel Support	00140-24701	1
14. Bottom Panel Support	00140-24702	1

Figure 6-1. Cabinet Parts, Exploded View

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

Ref Desig	hp Part No.		TQ	Description (See Table 6-1.)		
A2	00141-60402		1	A: hv deck		
A401	00140-66508		1	A: low-voltage supply board		
A402	2100-1589		1	A: r var 3 sect 7000, 3000, 5000 ohms 20%		
A403	2100-1588		1	A: r var 2 sect 1500 30% (each)		
A601	00140-66511		1	A: high-voltage rectifier board		
A602	00140-66509		1	A: high-voltage regulator board		
A603	00141-66502		1	A: horizontal driver board		
A605	00140-66507		1	A: compensation attenuator board		
A701	00141-66510		1	A: pulse generator board		
A702	00141-61905		1	A: mode switch		
A703	2100-1441		1	A: r var car. comp type H4 sect 3 x 25k ohms 30% 4k ohms 30% 1/4w (includes R714, R725, R726, R727)		
A704	00141-66506		1	A: clamp circuit board		
B401	3160-0056		1	B: fan-tube axial		
C420	0150-0052		6	C: fxd cer 0.05 μf 20% 400vdcw		
C421	0180-0154		1	C: fxd elect 430 μf -10 +50% 250vdcw		
C422	0180-0012		1	C: fxd elect 2 x 20 μf 450vdcw		
C423	0160-0168		7	C: fxd my 0.1 μf 10% 200vdcw		
C424	0160-0168			C: fxd my 0.1 μf 10% 200vdcw		
C440	0150-0052			C: fxd cer 0.05 μf 20% 400vdcw		
C441	0180-0046		1	C: fxd elect 600 μf -10 +50% 200vdcw		
C442	0160-0168			C: fxd my 0.1 μf 10% 200vdcw		
C443	0180-0100		2	C: fxd elect 4.7 μf 10% 35vdcw		
C444	0150-0052			C: fxd cer 0.05 μf 20% 400vdcw		
C460	0150-0052			C: fxd cer 0.05 μf 20% 400vdcw		
C461	0180-0214		1	C: fxd elect 275 μf -10 +50% 200vdcw		
C462	0180-0093		1	C: fxd elect 20 μf 150vdcw		
C463	0160-0168			C: fxd my 0.1 μf 10% 200vdcw		
C464	0180-0100			C: fxd elect 4.7 μf 10% 35vdcw		
C465				Deleted		
C481	0180-0213		1	C: fxd elect 5000 μf 25vdcw		
C482	0160-0207		2	C: fxd my 0.01 μf 5% 200vdcw		
C483	0180-0097		1	C: fxd elect 47 μf 10% 35vdcw		
C484	0160-0153		2	C: fxd my 1000 pf 10% 200vdcw		
C601	0150-0052			C: fxd cer 0.05 μf 20% 400vdcw		
C602	0180-0138		1	C: fxd elect 100 μf -10 +100% 40vdcw		
C603	0160-0168			C: fxd my 0.1 μf 10% 200vdcw		
C610	0160-0151		6	C: fxd cer 4700 pf -80 +20% 400vdcw		

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

Ref Desig	hp Part No.		TQ	Description (See Table 6-1.)		
C611	0150-0036		2	C: fxd cer 470 pf 20% 6kv		
C612	0150-0036			C: fxd cer 470 pf 20% 6kv		
C613	0160-0151			C: fxd cer 4700 pf -80 +20% 400vdcw		
C614	0160-0151			C: fxd cer 4700 pf -80 +20% 400vdcw		
C615	0160-0151			C: fxd cer 4700 pf -80 +20% 400vdcw		
C616	0160-0907		2	C: fxd cer 0.01 μf -80 +20% 5000vdcw		
C621	0160-0151			C: fxd cer 4700 pf -80 +20% 400vdcw		
C622	0160-0151			C: fxd cer 4700 pf -80 +20% 400vdcw		
C623	0160-0907			C: fxd cer 0.01 μf -80 +20% 5000vdcw		
C624	0160-0153			C: fxd my 1000 pf 10% 200vdcw		
C625	0150-0052			C: fxd cer 0.05 μf 5% 200vdcw		
C701	0160-0168			C: fxd my 0.1 μf 10% 200vdcw		
C702	0160-0168			C: fxd my 0.1 μf 10% 200 vdcw		
C703	0150-0023		1	C: fxd cer 2000 pf 20% 1000vdcw		
C705	0140-0208		2	C: fxd mica 680 pf 5% 300vdcw		
C708	0160-0323		1	C: fxd my 2 μf 10% 200vdcw		
C709	0180-0230		1	C: fxd ta elect 1 μf 20% 50vdcw		
C710	0180-0155		3	C: fxd ta 2.2 μf 20vdcw		
C712	0180-0155			C: fxd ta 2.2 μf 20% 20vdcw		
C713	0140-0208			C: fxd mica 680 pf 5% 300vdcw		
C714	0160-0207			C: fxd my 0.01 μf 5% 200vdcw		
C716	0180-0155			C: fxd ta 2.2 μf 20% 20vdcw		
C717	0140-0207		1	C: fxd mica 330 pf 5% 300vdcw		
C718	0170-0040		2	C: fxd my .047 μf 10% 200vdcw		
C719	0170-0040			C: fxd my .047 μf 10% 200vdcw		
CR421	1901-0028		12	CR: si		
CR422	1901-0028			CR: si		
CR423	1901-0028			CR: si		
CR424	1901-0028			CR: si		
CR425	1910-0016		2	CR: ge		
CR426	1902-0034		1	CR: breakdown 5.8v 10% 400 mw		
CR427	1901-0096		1	CR: si		
CR428	1902-3402		1	CR: breakdown 80.6v 2% 400 mw		
CR429	1901-0040		8	CR: si		
CR430	1901-0040			CR: si		
CR441	1901-0028			CR: si		
CR442	1901-0028			CR: si		
CR443	1901-0028			CR: si		
CR444	1901-0028			CR: si		
CR445	1902-3385		2	CR: breakdown si 69.8v 2% 400 mw		
CR446	1901-0026		2	CR: si		
CR447	1901-0040			CR: si		
CR448	1901-0040			CR: si		
CR449	1902-3104		1	CR: si 5.62v		
CR461	1901-0028			CR: si		
CR462	1901-0028			CR: si		
CR463	1901-0028			CR: si		

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

Ref Desig	hp Part No.		TQ	Description (See Table 6-1.)		
CR464	1901-0028			CR: si		
CR465	1902-3385			CR: breakdown si 69.8v 2% 400 mw		
CR466	1901-0026			CR: si		
CR467	1901-0040			CR: si		
CR468	1901-0040			CR: si		
CR481	1901-0032		2	CR: rectifier si 15 amp 1N3209		
CR482	1901-0032			CR: rectifier si 15 amp 1N3209		
CR483	1901-0025		1	CR: si		
CR484	1910-0016			CR: ge		
CR485	1901-0040			CR: si		
CR490	1912-0006		1	CR: ge tunnel		
CR491	1902-0064		1	CR: breakdown si 7.5v 5% 400 mw		
CR602	1901-0487		2	CR: si		
CR603	1901-0487			CR: si		
CR604	1901-0049		2	CR: si		
CR605	1901-0049			CR: si		
CR606	1880-0025		2	CR: selenium 6990 piv		
CR607	1880-0025			CR: selenium 6990 piv		
CR608	1901-0341		1	CR: si 7000 piv		
CR609	1901-0040			CR: si		
CR701	1901-0040			CR: si		
CR702	1902-0031		1	CR: breakdown 12.7v 5% 400 mw		
CR703	1902-3357		1	CR: breakdown si 56.2v 5% 400 mw		
CR704	1902-0062		1	CR: breakdown 3.74v 10% 400 mw		
CR706	1902-0040			CR: si		
CR707	1902-3070		1	CR: breakdown 4.22v 5% 400 mw		
CR708	1901-0033		1	CR: si		
CR709	1901-0040			CR: si		
CR710	1901-0040			CR: si		
CR711	1901-0040			CR: si		
CR712	1901-0041		1	CR: breakdown 5.11v 5% 400 mw		
DS401	1450-0048		1	DS: neon		
F401	2110-0014		1	F: cartridge 4 amp slow-blow (for 115v operation)		
F401	2110-0006		1	F: cartridge 2 amp slow-blow (for 230v operation)		
F421	2110-0004		1	F: cartridge 1/4 amp 250v		
F441	2110-0033		1	F: 3/4 amp 250v		
F461	2110-0012		1	F: cartridge 1/2 amp 250v		
F481	2110-0003		1	F: cartridge 3 amp 3 AG		
FL1	9100-2818		1	FL: filter, line		
J1	1251-0054		2	J: 24 contact female		
J2	1251-0054			J: 24 contact female		
J401	1251-0148		1	J: power		
J402	1251-0202		2	J: calibrator		
J403	1251-0202			J: calibrator		
L601	9140-0171		1	L: fxd 40 μh 10% 1 amp		
L602	5060-0457		1	L: alignment		
L701	9140-0105		2	L: fxd 8.2 μh 10%		
L702	9140-0105			L: fxd 8.2 μh 10%		

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

Ref Desig	hp Part No.		TQ	Description (See Table 6-1.)		
Q421	1850-0422		1	Q: ge pnp selected		
Q422	1854-0005		1	Q: si npn 2N708		
Q423	1853-0036		1	Q: si pnp 2N3906		
Q441	1854-0294		3	Q: si npn selected		
Q442	1854-0090		2	Q: si npn		
Q443	1854-0087		1	Q: si npn		
Q444	1854-0071		8	Q: si npn		
Q461	1854-0294			Q: si npn selected		
Q462	1854-0090			Q: si npn		
Q463	1854-0071			Q: si npn		
Q464	1854-0071			Q: si npn		
Q481	1854-0294			Q: si npn selected		
Q482	1854-0039		1	Q: si npn		
Q483	1854-0215		1	Q: si npn		
Q484	1854-0071			Q: si npn		
Q490	1850-0062		1	Q: ge pnp		
Q601	1853-0016		4	Q: si pnp		
Q602	1853-0084		1	Q: si pnp 2N4918		
Q603	1853-0038		2	Q: si pnp		
Q604	1853-0038			Q: si pnp		
Q701	1853-0016		3	Q: si pnp 2N3638		
Q702	1853-0016			Q: si pnp 2N3638		
Q703	1854-0071			Q: si npn		
Q704	1854-0071			Q: si npn		
Q705	1854-0071			Q: si npn		
Q706	1854-0071			Q: si npn		
Q707	1853-0016			Q: si pnp 2N3638		
Q708	1854-0022		2	Q: si npn		
Q709	1853-0037		1	Q: si pnp		
Q710	1854-0022			Q: si npn		
R401	0687-3331		1	R: fxd comp 33k ohms 10% 1/2w		
R421	0687-1041		1	R: fxd comp 100k ohms 10% 1/2w		
R422A/B	0815-0031		1	R: fxd ww 2400 ohms each sect 1200 ohms 5% 10w		
R423	0764-0033		1	R: fxd metox 33 ohms 5% 2w		
R424	0761-0007		1	R: fxd metox 27k ohms 5% 1w		
R425	0757-0401		5	R: fxd metflm 100 ohms 1% 1/8w		
R426	0757-0413		1	R: fxd metflm 392 ohms 1% 1/8w		
R427	0757-0044		1	R: fxd metflm 33.2k ohms 1% 1/2w		
R428	0757-0401			R: fxd metflm 100 ohms 1% 1/8w		
R429	0757-0465		2	R: fxd metflm 100k ohms 1% 1/8w		
R430	0757-0273		2	R: fxd metflm 3010 ohms 1% 1/8w		
R431	0757-0370		1	R: fxd metflm 49.9k ohms 1% 1/2w		
R432				NSR: p/o A402		

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

Ref Desig	hp Part No.		TQ	Description (See Table 6-1.)		
R433	0757-0367		2	R: fxd metflm 100k ohms 1% 1/2w		
R434	0761-0006		1	R: fxd metflm 10k ohms 5% 1w		
R435	0757-0338		1	R: fxd metflm 1000 ohms 1% 1/4w		
R441	0687-5631		4	R: fxd comp 56k ohms 10% 1/2w		
R442	0811-2030		2	R: fxd ww 14 ohms 5% 10w		
R443	0687-5631		3	R: fxd metflm 56k ohms 10% 1/2w		
R444				Deleted		
R445	0757-0280		7	R: fxd metflm 1000 ohms 1% 1/8w		
R446	0757-0399		2	R: fxd metflm 82.5 ohms 1% 1/8w		
R447	0684-5621		1	R: fxd metflm 5600 ohms 1% 1/8w		
R449	0757-0764		2	R: fxd metflm 33.2k ohms 1% 1/4w		
R450				Deleted		
R452	0757-0436		2	R: fxd metflm 4320 ohms 1% 1/2w		
R453				NSR: p/o A402		
R454	0757-0846		3	R: fxd metflm 22.1k ohms 1% 1/2w		
R455	0766-0033		1	R: fxd metflm 2000 ohms 1% 1/2w		
R456	0757-0434		1	R: fxd metflm 3650 ohms 1% 1/2w		
R457	0757-0388		9	R: fxd metflm 30.1 ohms 1% 1/8w		
R461	0687-5631			R: fxd comp 56k ohms 10% 1/2w		
R462	0811-2030			R: fxd ww 14 ohms 5% 10w		
R463				Deleted		
R464	0757-0280			R: fxd metflm 1000 ohms 1% 1/8w		
R465	0687-5631			R: fxd comp 56k ohms 10% 1/2w		
R466	0757-0399			R: fxd metflm 82.5 ohms 1% 1/8w		
R467	0757-0848		1	R: fxd metflm 30.1k ohms 1% 1/8w		
R468	0757-0772		2	R: fxd metflm 68.1k ohms 1% 1/4w		
R469	0757-0764			R: fxd metflm 33.2k ohms 1% 1/4w		
R470	0757-0436			R: fxd metflm 4320 ohms 1% 1/2w		
R471				NSR: p/o A402		
R472	0757-0846			R: fxd metflm 22.1k ohms 1% 1/2w		
R473	0757-0190		2	R: fxd metflm 20k ohms 1% 1/2w		
R474	0757-0388			R: fxd metflm 30.1 ohms 1% 1/8w		
R475	0727-0431		1	R: fxd metflm 2690 ohms 1% 1/2w		
R481	0687-2221		1	R. fxd comp 2200 ohms 10% 1/2w		
R482	0687-4731		1	R: fxd metflm 47k ohms 1% 1/4w		
R483	0811-1746		2	R: fxd ww 0.36 ohms 5% 2w		
R484	0757-0388		7	R: fxd metflm 30.1 ohms 1% 1/8w		
R485	0757-0190			R: fxd metflm 20k ohms 1% 1/2w		
R486	0757-0480		1	R: fxd metflm 432k ohms 1% 1/8w		
R487	0757-0273			R: fxd metflm 3010 ohms 1% 1/8		
R488				NSR: p/o A403		
R489	0757-0846			R: fxd metflm 22.1k ohms 1% 1/2w		
R490	0811-1746			R: fxd ww 0.36 ohms 5% 2w		
R491	0757-0421		1	R: fxd metflm 825 ohms 1% 1/8w		
R492	0757-0428		1	R: fxd metflm 1.62k ohms 1% 1/8w		
R493	0757-0844		1	R: fxd metflm 16.2k ohms 1% 1/2w		
R494				NSR: p/o A403		
R495	0698-3555		1	R: fxd metflm 4437 ohms 1/2% 1/2w		
R496	0698-3554		1	R: fxd metflm 493 ohms 1/2% 1/2w		
R601	0757-0401			R: fxd metflm 100 ohms 1% 1/8w		
R602				Deleted		
R603				Deleted		
R604	0757-0393		1	R: fxd metflm 47.5 ohms 1% 1/8w		
R605	0757-0438		1	R: fxd metflm 5110 ohms 1% 1/8w		

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

Ref Desig	hp Part No.		TQ	Description (See Table 6-1.)		
R610	0683-2245		1	R: fxd comp 220k ohms 5% 1/2w		
R611	0683-1535		1	R: fxd comp 15k ohms 5% 1/2w		
R612	2100-0096		2	R: var comp 1 megohm 30% lin 1/5w		
R613	0757-0280			R: fxd metflm 1000 ohms 1% 1/8w		
R614	2100-1722		1	R: var 30 clog comp 1.5 megohm 10%		
R615	0698-6666		1	R: fxd depc 33 megohm 5% 1w		
R616	0757-0344		3	R: fxd metflm 1 megohm 1% 1/4w		
R617	0757-0449		1	R: fxd metflm 20k ohms 1% 1/8w		
R618	0757-0768		2	R: fxd metflm 47.5k ohms 1% 1/4w		
R619	2100-0096			R: var comp 1 megohm 30% lin 1/5w		
R620	0727-0845		3	R: fxd car. flm 1.78 megohms 1% 1/2w		
R621	0727-0845			R: fxd car. flm 1.78 megohms 1% 1/2w		
R622	0757-0768			R: fxd metflm 47.5k ohms 1% 1/4w		
R624	0687-1061		1	R: fxd comp 10 megohms 10% 1/2w		
R625	0727-0845			R: fxd car. flm 1.78 megohms 1% 1/2w		
R626	2100-0374		1	R: var comp 5 megohms 30% lin 1/2w		
R627	0698-3553		8	R: fxd car. flm 2.49 megohms 1% 1/2w		
R628	0698-3553			R: fxd car. flm 2.49 megohms 1% 1/2w		
R629	0698-3553			R: fxd car. flm 2.49 megohms 1% 1/2w		
R630	0698-3553			R: fxd car. flm 2.49 megohms 1% 1/2w		
R631	0698-3553			R: fxd car. flm 2.49 megohms 1% 1/2w		
R632	0698-3553			R: fxd car. flm 2.49 megohms 1% 1/2w		
R633	0698-3553			R: fxd car. flm 2.49 megohms 1% 1/2w		
R634	0698-3553			R: fxd car. flm 2.49 megohms 1% 1/2w		
R461	2100-2024		1	R: var comp 100k ohms 10% lin 2w		
R462	0757-0454		3	R: fxd metflm 33.2k ohms 1% 1/8w		
R643	2100-0095		1	R: var comp 100k ohms 30% lin 1/5w		
R644	0757-0772		1	R: fxd metflm 68.1k ohms 1% 1/4w		
R645	0757-0437		1	R: fxd metflm 4750 ohms 1% 1/8w		
R650A/B	2100-0445		1	R: var comp 2 x 2k ohms 30% lin		
R651	0757-0452		1	R: fxd metflm 27.4k ohms 1% 1/8w		
R652	0757-0465			R: fxd metflm 100k ohms 1% 1/8w		
R653	0757-0344			R: fxd metflm 1 megohm 1% 1/4w		
R654	0757-0850		2	R: fxd metflm 39.2k ohms 1% 1/2w		
R655	0757-0850			R: fxd metflm 39.2k ohms 1% 1/2w		
R656	0757-0388			R: fxd metflm 30.1 ohms 1% 1/8w		
R657	0757-0388			R: fxd metflm 30.1 ohms 1% 1/8w		
R658	0757-0401			R: fxd metflm 100 ohms 1% 1/8w		
R701	0757-0388			R: fxd metflm 30.1 ohms 1% 1/8w		
R702	0757-0280			R: fxd metflm 1000 ohms 1% 1/8w		
R703	0757-0441		2	R: fxd metflm 8250 ohms 1% 1/8w		
R704	0757-0441			R: fxd metflm 8250 ohms 1% 1/8w		
R705	0757-0280			R: fxd metflm 1000 ohms 1% 1/8w		
R706	0757-0280			R: fxd metflm 1000 ohms 1% 1/8w		
R707	0757-0388			R: fxd metflm 30.1 ohms 1% 1/8w		

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

Ref Desig	hp Part No.		TQ	Description (See Table 6-1.)		
R708	0757-0447		1	R: fxd metflm 16.2k ohms 1% 1/8w		
R709	0757-0431		1	R: fxd metflm 2430 ohms 1% 1/8w		
R710	0757-0288		1	R: fxd metflm 9090 ohms 1% 1/8w		
R711	0757-0435		1	R: fxd metflm 3920 ohms 1% 1/8w		
R712	0757-0814		1	R: fxd metflm 511 ohms 1% 1/2w		
R713	0757-0817		1	R: fxd metflm 750 ohms 1% 1/2w		
R714				NSR: p/o A703		
R715	0757-0743		1	R: fxd metflm 3320 ohms 1% 1/4w		
R716	0757-0766		1	R: fxd metflm 39.2k ohms 1% 1/4w		
R717	0757-0367			R: fxd metflm 100k ohms 1% 1/2 w		
R718	0757-0466		1	R: fxd metflm 110k ohms 1% 1/8w		
R719	0757-0442		4	R: fxd metflm 10k ohms 1% 1/8w		
R720	0757-0200		1	R: fxd metflm 5620 ohms 1% 1/8w		
R721	0757-0430		2	R: fxd metflm 2210 ohms 1% 1/8w		
R722	0757-0430			R: fxd metflm 2210 ohms 1% 1/8w		
R723	0757-0427		1	R: fxd metflm 1500 ohms 1% 1/8w		
R724	0757-0833		2	R: fxd metflm 5110 ohms 1% 1/2w		
R725				NSR: p/o A703		
R726				NSR: p/o A703		
R727				NSR: p/o A703		
R728	0757-0454			R: fxd metflm 33.2k ohms 1% 1/8w		
R729	0757-0481		2	R: fxd metflm 475k ohms 1% 1/8w		
R730	0757-0344			R: fxd metflm 1 megohm 1% 1/4w		
R731	2100-1721		1	R: var 500k ohms 30% 10 clog taper 1/3w (incl S703)		
R732	0757-0283		1	R: fxd metflm 2000 ohms 1% 1/8w		
R733	0757-0448		1	R: fxd metflm 18.2k ohms 1% 1/8w		
R734	0757-0461		1	R: fxd metflm 68.1k ohms 1% 1/8w		
R735	0757-0472		1	R: fxd metflm 200k ohms 1% 1/8w		
R736	0757-0444		1	R: fxd metflm 12.1k ohms 1% 1/8w		
R737	0757-0470		2	R: fxd metflm 162k ohms 1/8w		
R738	0757-0481			R: fxd metflm 475k ohms 1% 1/8w		
R739	0757-0451		1	R: fxd metflm 24.3k ohms 1% 1/8w		
R740	0757-0446		2	R: fxd metflm 15k ohms 1% 1/8w		
R741	0757-0454			R: fxd metflm 33.2k ohms 1% 1/8w		
R743	2100-0755		1	R: var ww 1000 ohms 5% (preferred replacement)		
R745	0757-0280			R: fxd metflm 1000 ohms 1% 1/8w		
R746	0757-0470			R: fxd metflm 162k ohms 1% 1/8w		
R747	0757-0446			R: fxd metflm 15k ohms 1% 1/8w		
R748	0757-0833			R: fxd metflm 5110 ohms 1% 1/2w		
R749	0757-0442			R: fxd metflm 10k ohms 1% 1/8w		
R750	0757-0442			R: fxd metflm 10k ohms 1% 1/8w		
R751	0757-0442			R: fxd metflm 10k ohms 1% 1/8w		
R752	0757-0388			R: fxd metflm 30.1 ohms 1% 1/8w		
R753	0757-0388			R: fxd metflm 30.1 ohms 1% 1/8w		
S401	3101-0030		1	S: toggle power		
S402	3101-0033		1	S: slide 115-230v		
S403	3103-0009		1	S: thermal		
S601	3101-0011		1	S: slide Z-axis		
S602	3101-0048		1	S: push button, beam finder		
S701	3100-1371		1	S: rotary (includes S702)		
S702				NSR: p/o S701		
S703				NSR: p/o R731		
T401	9100-0184		1	T: power		
T601	00140-86001		1	T: high voltage		

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

Ref Desig	hp Part No.		TQ	Description (See Table 6-1.)		
TB601	0360-0104		1	TB: Z-axis		
V441	1940-0013		1	V: reference 82v		
V461				Deleted		
V601	1921-0013		1	V: 6CW4		
V602				Delete		
V603				Delete		
V604	1920-0001		1	V: 5642		
V605				Delete		
V606	2140-0008		3	V: neon NE2		
V607	2140-0008			V: neon NE2		
V60	2140-0008			V: neon NE2		
V610	5083-1452		1	V: cathode-ray storage		
W401	8120-0078		1	W: power		
XV601	1200-0086		1	XV: nuvistor 5 pin		
				MISCELLANEOUS		
	120A-20A		1	Bezel: CRT		
	5040-0466		1	Retainer: CRT shield		
	0360-0362		1	Strip: diode terminal		
	0370-0084		3	Knob: focus, intensity, and persistence		
	0370-0099		1	Knob: mode switch		
	0370-0102		1	Knob: writing rate		
	0380-0046		4	Spacer: 3/8"		
	0380-0156		4	Spacer: 3/8" long threaded		
	0380-0306		4	Spacer: 9/16"		
	0400-0001		1	Grommet: rubber		
	0510-0123		1	Clamp: pilot light		
	0905-0050		1	Gasket: felt		
	1200-0037		1	Socket		
	1200-0043		4	Insulator: anodized alum.		
	1200-0050		10	Pin: CRT socket		
	1200-0085		1	Cover: CRT socket		
	1200-0088		4	Insulator: anodized alum.		
	1200-0184		1	Connector: high voltage		
	1400-0087		3	Clip: CRT contact		
	1520-0042		4	Mount: vibration		
	2950-0034		2	Nut: 11/16" hex		
	5000-0747		2	Cover: side		
	5040-0400		2	Support: cap		
	5040-0401		4	Support: cap		
	5040-0402		2	Mount: transformer		
	5040-0421		2	Insulator: pot		

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

Ref Desig	hp Part No.		TQ	Description (See Table 6-1.)		
	5060-0428		1	Air filter		
	5080-0441		1	Lead: electrical		
	9150-0014		1	Form: coil		
	00140-00102		1	Deck: vertical		
	00140-00104		1	Gusset: side		
	00140-00180		1	Deck: hv		
	00140-00106		1	Deck: main		
	00140-00202		1	Panel: rear		
	00140-00601		1	Shield: plug-in		
	00140-01201		1	Bracket: latch		
	00140-01202		1	Bracket: diode		
	00140-01206		2	Bracket: fan		
	00140-01208		4	Bracket: panel		
	00 40-01209		2	Bracket: gusset		
	00140-01210		2	Bracket: transistor		
	00140-24703		4	Support· panel bracket		
	00140-61611		1	Twin lead assembly		
	00141-61608		1	Twin lead assembly		
	00140-61616		1	Cable: hv		
	00140-61607		1	Cable: power		
	00141-00101		1	Gusset: center		
	00141-00201		1	Panel: front		
	00141-60602		1	Shield: CRT		
	00141-61602		1	Cable: CRT		
	00141-61604		1	Cable: shielded		

APPENDIX I

MANUAL CHANGES AND OPTIONS

IA-1. OPTIONS.

IA-2. At the present time only one option, 09, is offered for the hp 141S Display Section. This option is a standard hp Model 141S Display Section modified to provide a remote ERASE capability. The Pulse Board A701 has additional circuitry to accomodate a reed relay.

IA-3. Figure IA-1 is a schematic of the added circuit. The relay is actuated by a contact closure to ground via the BNC connector on the back panel.

IA-4. Note that earlier instruments may have option 09 installed on an etched circuit board mounted adjacen to the Pulse Board, A701.

Table IA-1. Replaceable Parts Added For Option 09

hp Part No.	Description
1250-0018	Connector, BNC female
0490-0308	Coil: relay
0490-0199	Switch: relay
0490-0473	Switch: relay

IA-6. MANUAL CHANGES.

IA-7. This portion of the Appendix contains information on changes required to adapt this manual to an instrument with a serial prefix listed in the table below. Check your instrument's serial prefix and make the changes indicated. Note that these changes adapt the manual to cover a particular instrument as manufactured and therefore will not apply to an instrument subsequently modified in the field. Refer to Section I for information on errata in this manual and on any other instrument serial prefix not covered in this appendix.

Instrument Serial Prefix Number	Incorporate Change(s) Numbered
No backdating changes are required at the present time.	

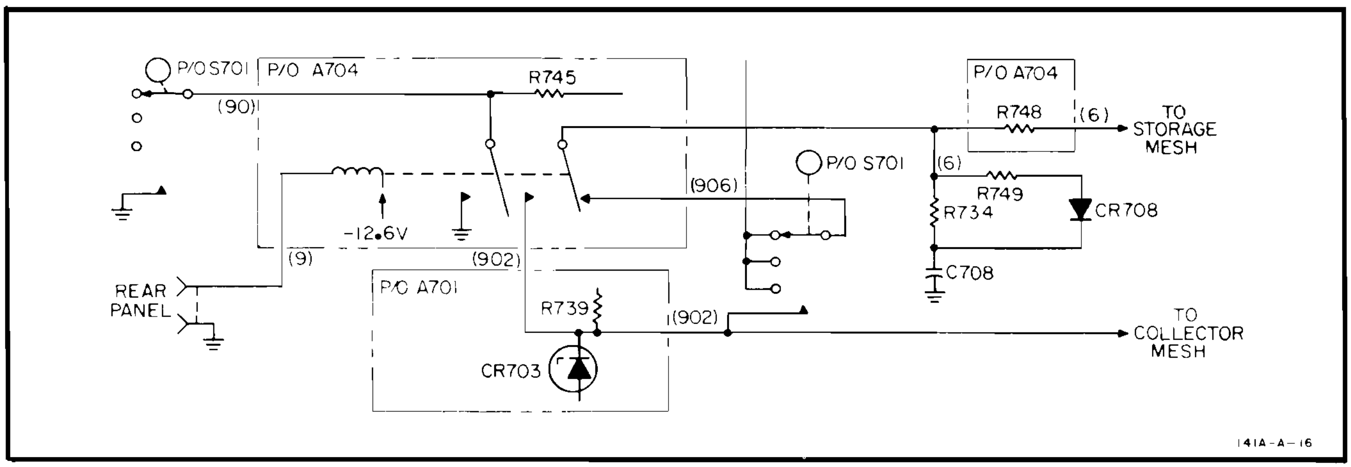


Figure IA-1. Remote ERASE Circuit

CATHODE-RAY TUBE WARRANTY

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

Your nearest Hewlett-Packard Sales/Service Office (listed at rear of instrument manual) maintains a stock of replacement tubes and will assist in processing the warranty claim.

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

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

Attention: CRT QA

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

SHIPPING INSTRUCTIONS

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

1. Carefully wrap the tube in 1/4 inch thick cotton batting or other soft padding material.

2. Wrap the above in heavy kraft paper.

3. Pack wrapped tube in a rigid container which is at least 4 inches larger than the tube in each dimension.

4. Surround the tube with at least 4 inches of packed excelsior or similar shock absorbing material; be sure the packing is tight all around the tube.

Thank you,

CRT Department

CATHODE-RAY TUBE FAILURE REPORT

DATE ____________________

FROM:

NAME ____________________

COMPANY ____________________

ADDRESS ____________________

1. hp INSTRUMENT MODEL NO. ____________________
2. hp INSTRUMENT SERIAL NO. ____________________
3. CRT SERIAL NO. ____________________
4. Please describe the failure and, if possible, show the trouble on the appropriate CRT face below.

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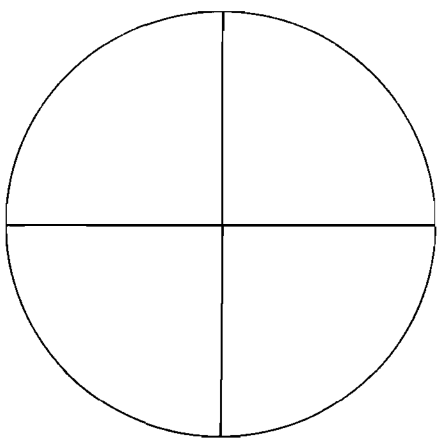
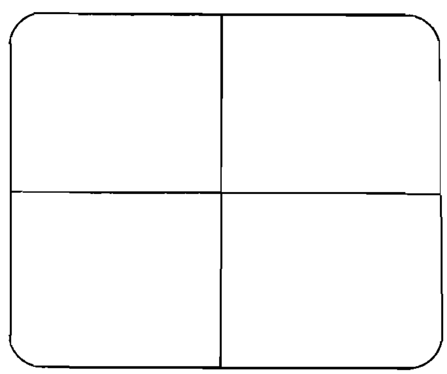
CUT ALONG DOTTED LINE





5. Is the CRT within warranty? Yes________ No________
6. hp Sales/Service Office ________________ Repair Order No. ________

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