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.

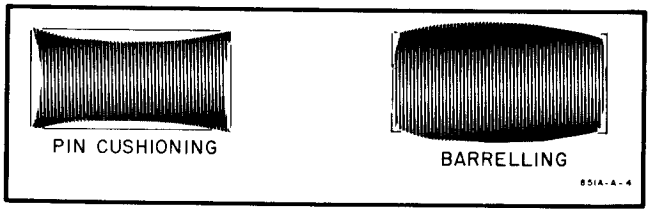

Figure 5-1. Pincushioning and Barrelling

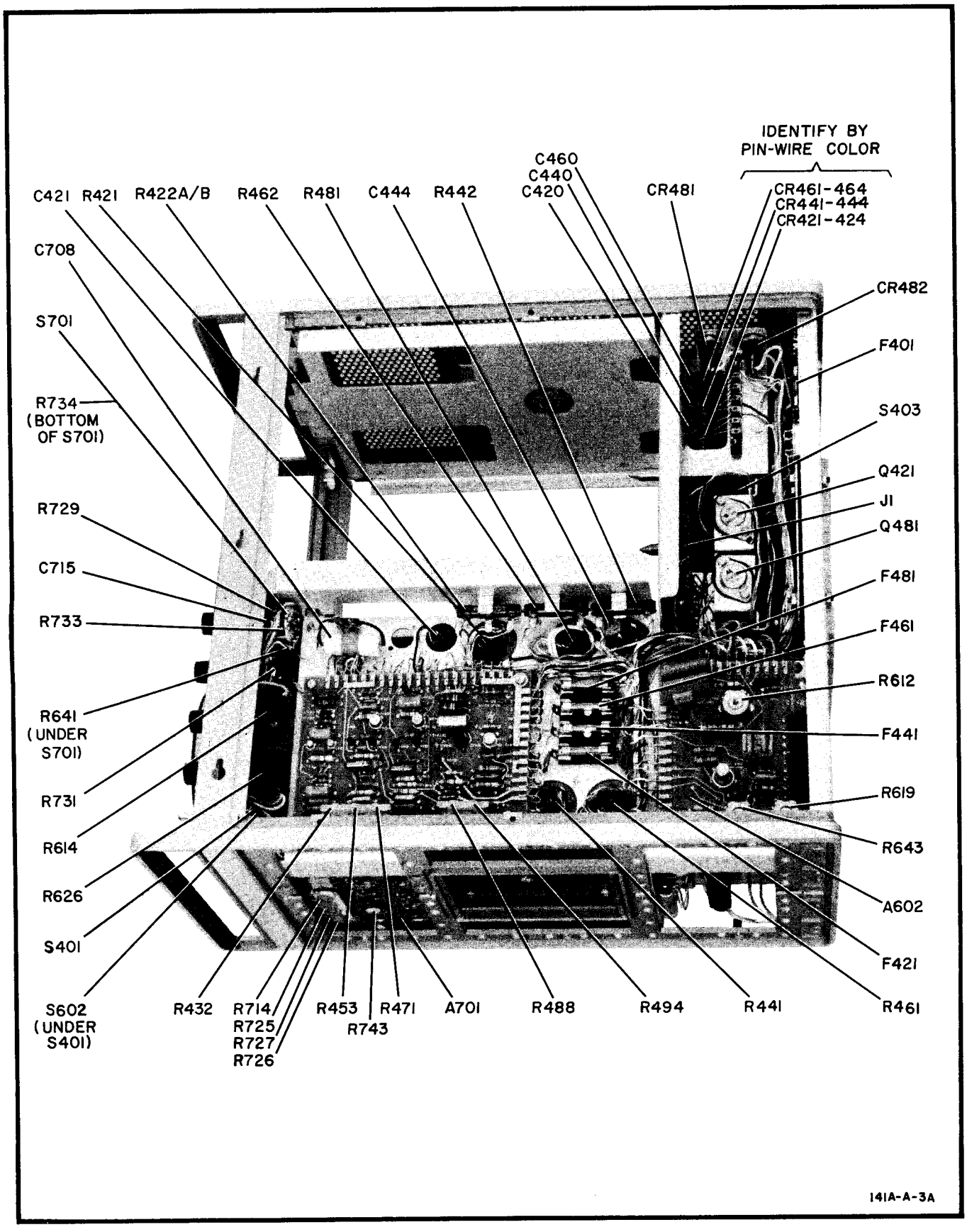

Figure 5-2. Adjustment and Component Locations, Bottom View

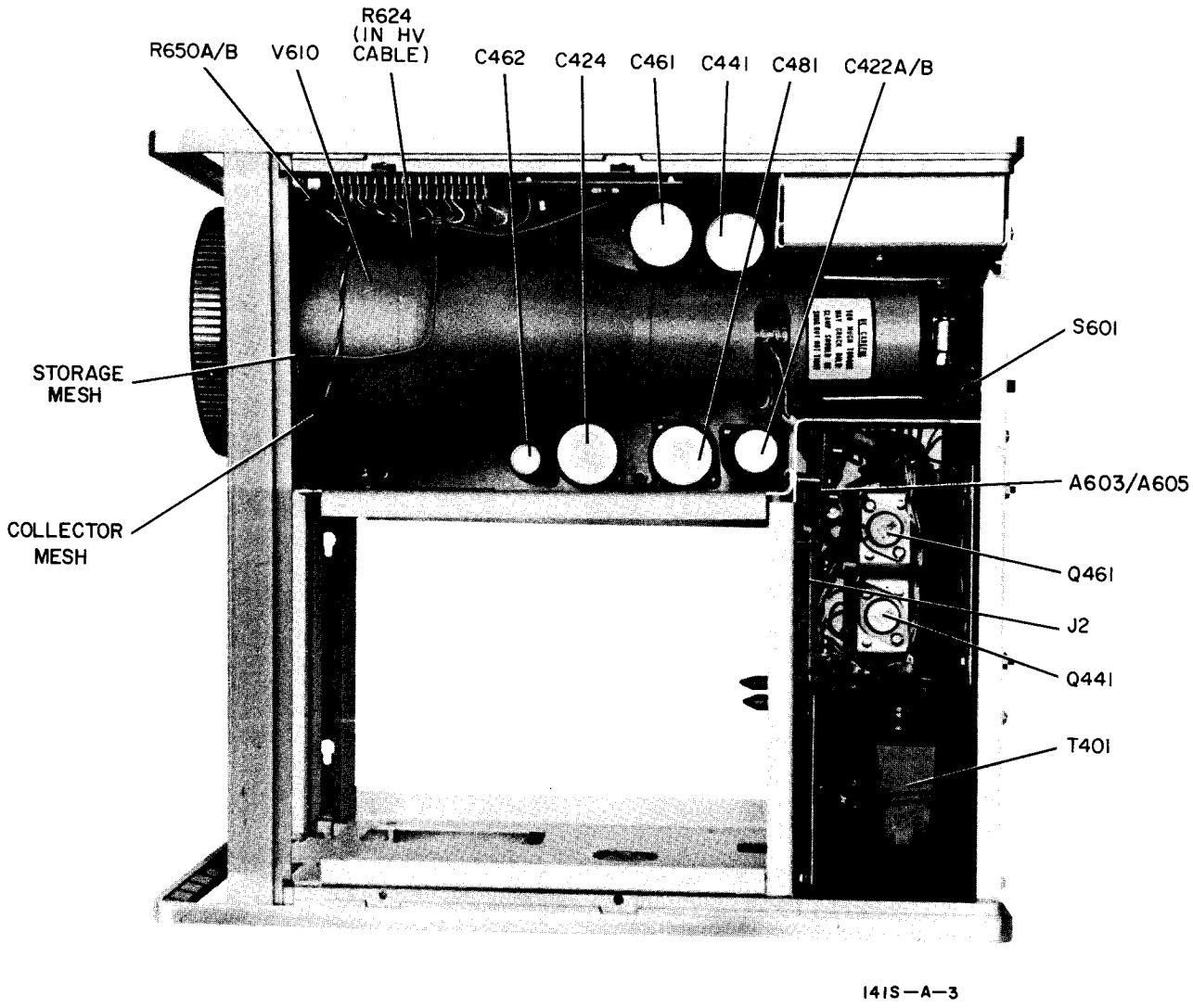

Figure 5-3. Component Locations, Top View

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.