TM 11-6625-368-50

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

DEPOT MAINTENANCE MANUAL

PULSE GENERATOR SETS AN/UPM-15 AND AN/UPM-15A

HEADQUARTERS, DEPARTMENT OF THE ARMY
SEPTEMBER 1960

HEADQUARTERS,
DEPARTMENT OF THE ARMY

WASHINGTON 25, D.C., *27 September 1960*

TM 11-6625-368-50 (a reprint of Air Force TO 33A1-8-6-13, 1 November 1959) is published for the use of Army personnel.

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NG: None.

USAR: None,

For explanation of abbreviations used, see AR 320-50.

TECHNICAL MANUAL)
)
NO. 11-6625-368-50)

HEADQUARTERS,
DEPARTMENT OF THE ARMY
Washington 25, D. C., 27 September 1960

DEPOT MAINTENANCE MANUAL

PULSE GENERATOR SETS AN/UPM-15 AND AN/UPM-l5A

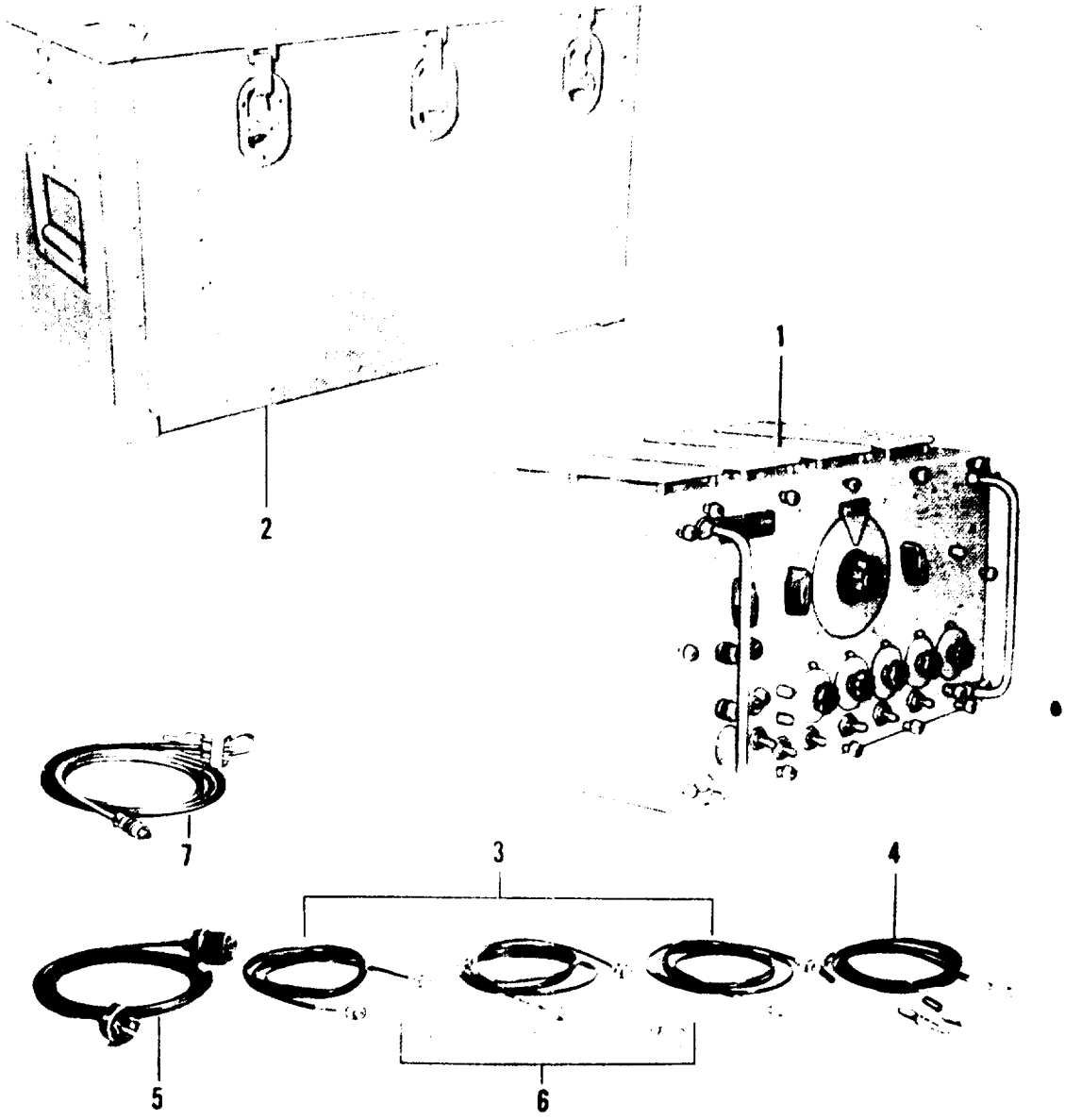
SECTION PAGE

* This manual, together with TM 11-6625-368-10, 27 September 1960, and TM 11-6625-368-24, 27 September 1960 supersedes TM 11-1177, 1 February 1957.

INTRODUCTION

The purpose of the Handbook of Overhaul Instructions is to provide adequate information which will aid the technician in servicing and repairing this equipment.

All symbols, reference designations, and abbreviations used in this manual are in accordance with JAN-STD-15, MIL-STD-16, and MIL-STD-12 respectively.



1. Pulse Generator TS-592A/UPM-l5, TS-592B/UPM-15 or SG-343/UPM-15A
2. Transit Case CY-672/U
3. Cord CX-409E/U
4. RF Cable Assembly CG-521/U
5. Cord CX-337/U (supplied with AN/UPM-15)
6. Adapter UG-273/U
7. Cable Assembly, Power Electrical CX-3135/U (supplied with AN/UPM-15A)

Figure 1-1. Pulse Generator Set AN/UPM-15 and AN/UPM-15A

SECTION I

DESCRIPTION AND LEADING PARTICULARS

1-1. GENERAL.

1-2. This publication comprises overhaul instructions for the Model AN/UPM-15 and AN/UPM-15A Pulse Generator Set manufactured by A. R. F. Products, Inc., River Forest, Illinois. In the Pulse Generator Set the main component is the pulse generator proper. All other items are merely cords, connector adapters and the transit case. The pulse generator has government type designations TS-592A/UPM-15 and TS-592B/UPM-15 for Model AN/UPM-15 and SG-343/UPM-15A for Model AN/UPM-15A.

SECTION II

TEST EQUIPMENT AND SPECIAL TOOLS

2-1. No special tools or test equipment are required to overhaul this equipment.

SECTION III

MAINTENANCE BEYOND THE CAPABILITIES OF FIELD

3-1. The Handbook of Service Instructions for this equipment provides complete information on the maintenance of this pulse generator.

SECTION IV

DISMANTLING AND DISASSEMBLY

4-1. GENERAL.

4-2. The pulse generator is completely an electronic unit and does not contain mechanical parts which require disassembly. To reach all the internal parts remove the dust cover assembly by loosening captive screws H1. Then pull out the chassis assembly. No further disassembly is required. The location of all the rest of the parts is shown in figures 4-1 through 4-6. When parts are referred to, the reference symbol and figure number will be given.

CAUTION

The original location of both the parts and the wiring should be maintained in order to prevent pickup between different circuits. Do not disturb the position of parts or wires.

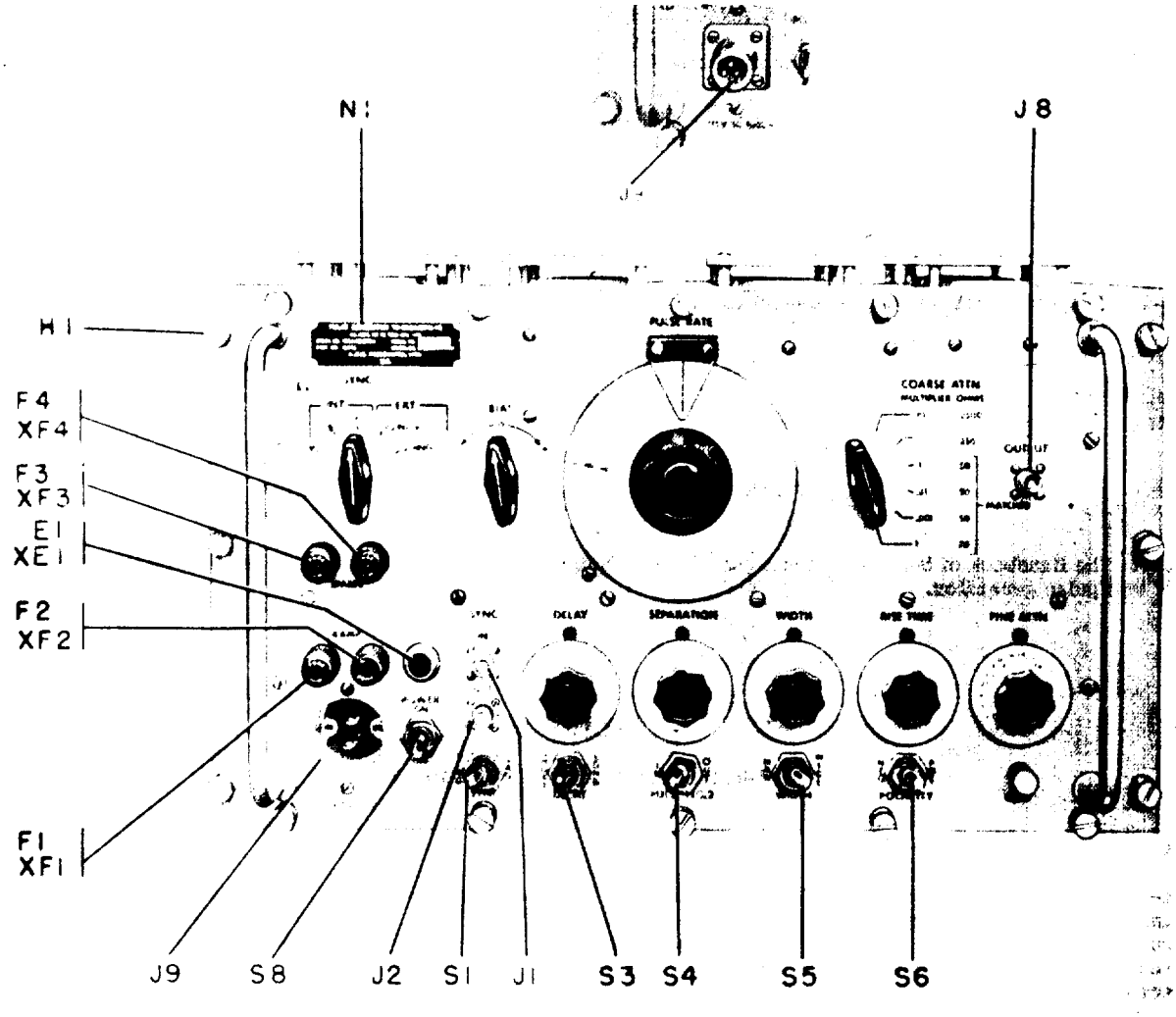


Figure 4-1. Front Panel TS-592A/UPM-15, TS-592B/UPM-15 and SG-343/UPM-15A

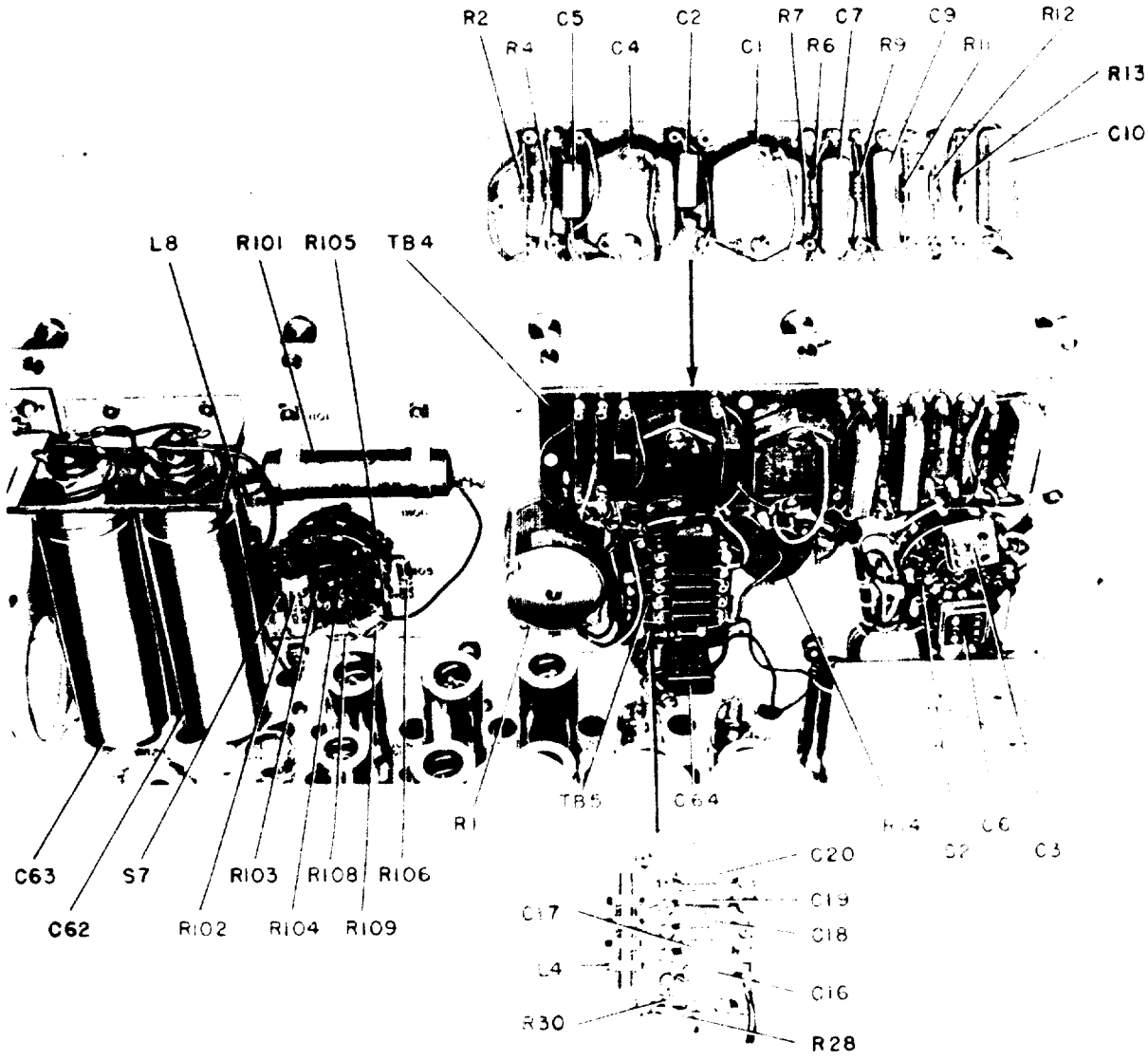


Figure 4-2. Front Panel, Inside Above Chassis TS-592A/UPM-15

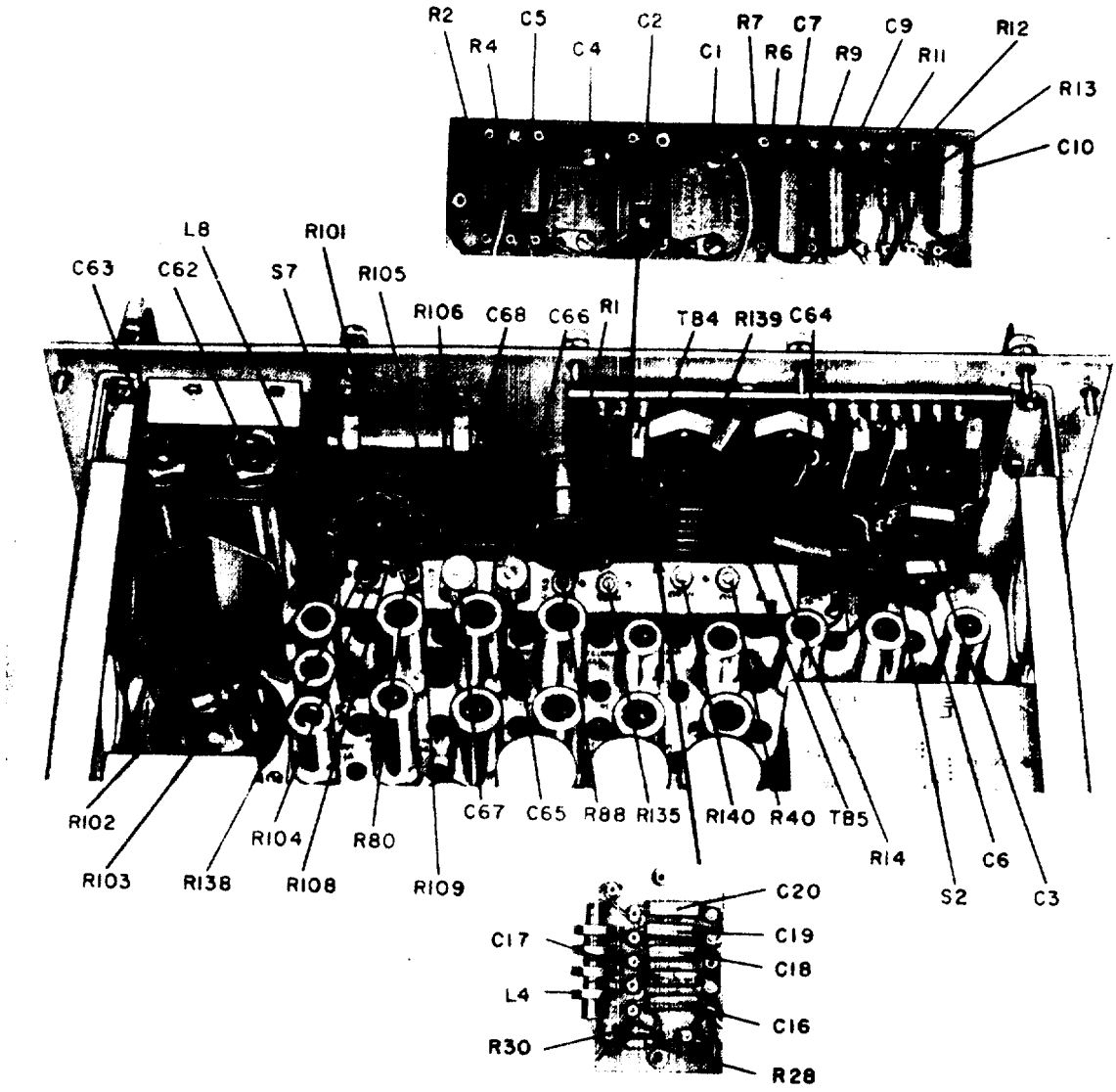


Figure 4-2A. Front Panel, Inside Above Chassis TS-592B/UPM-15 and SG-343/UPM-15A

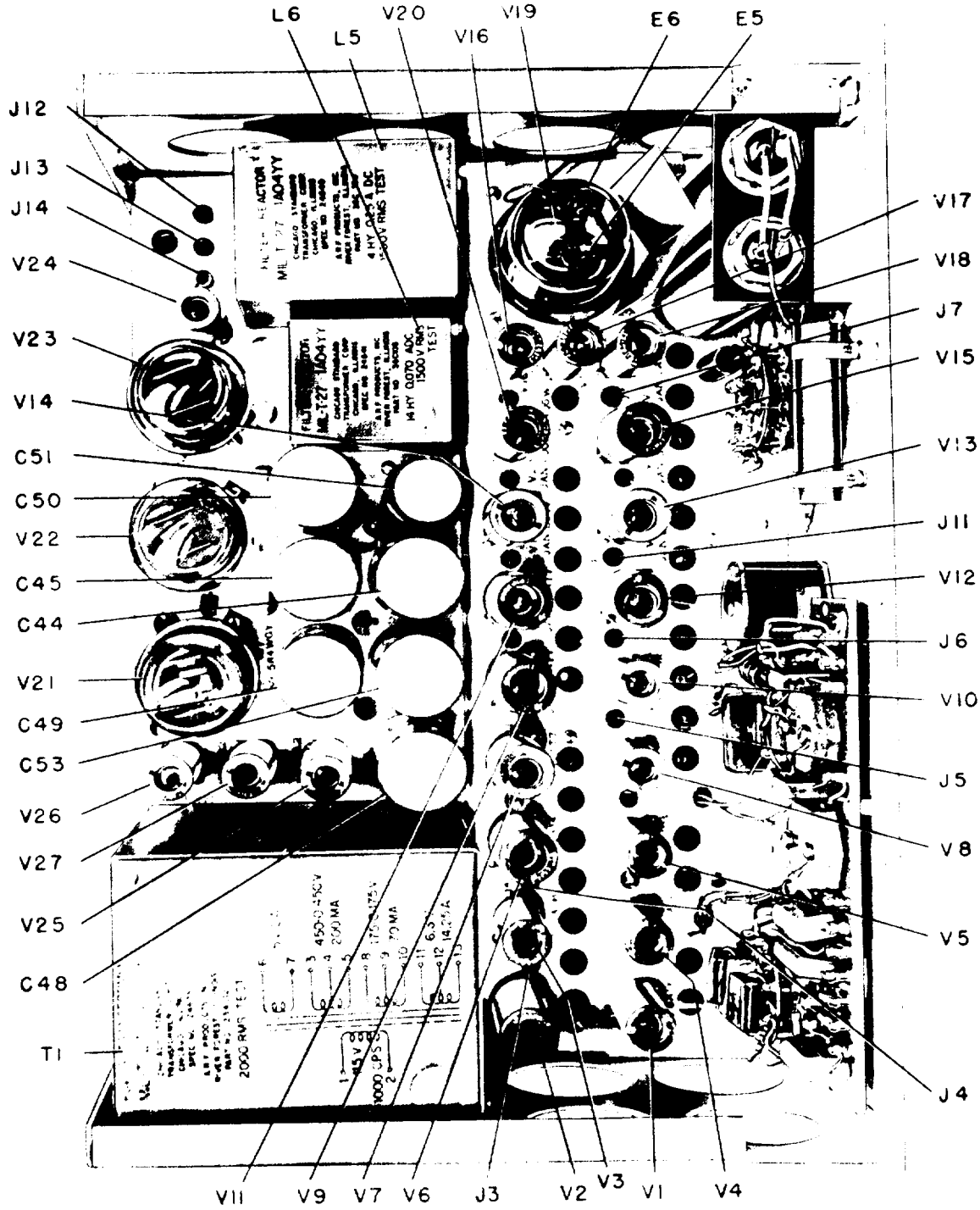


Figure 4-3. Chassis, Top View TS-592A/UPM-15 and TS-592B/UPM-15

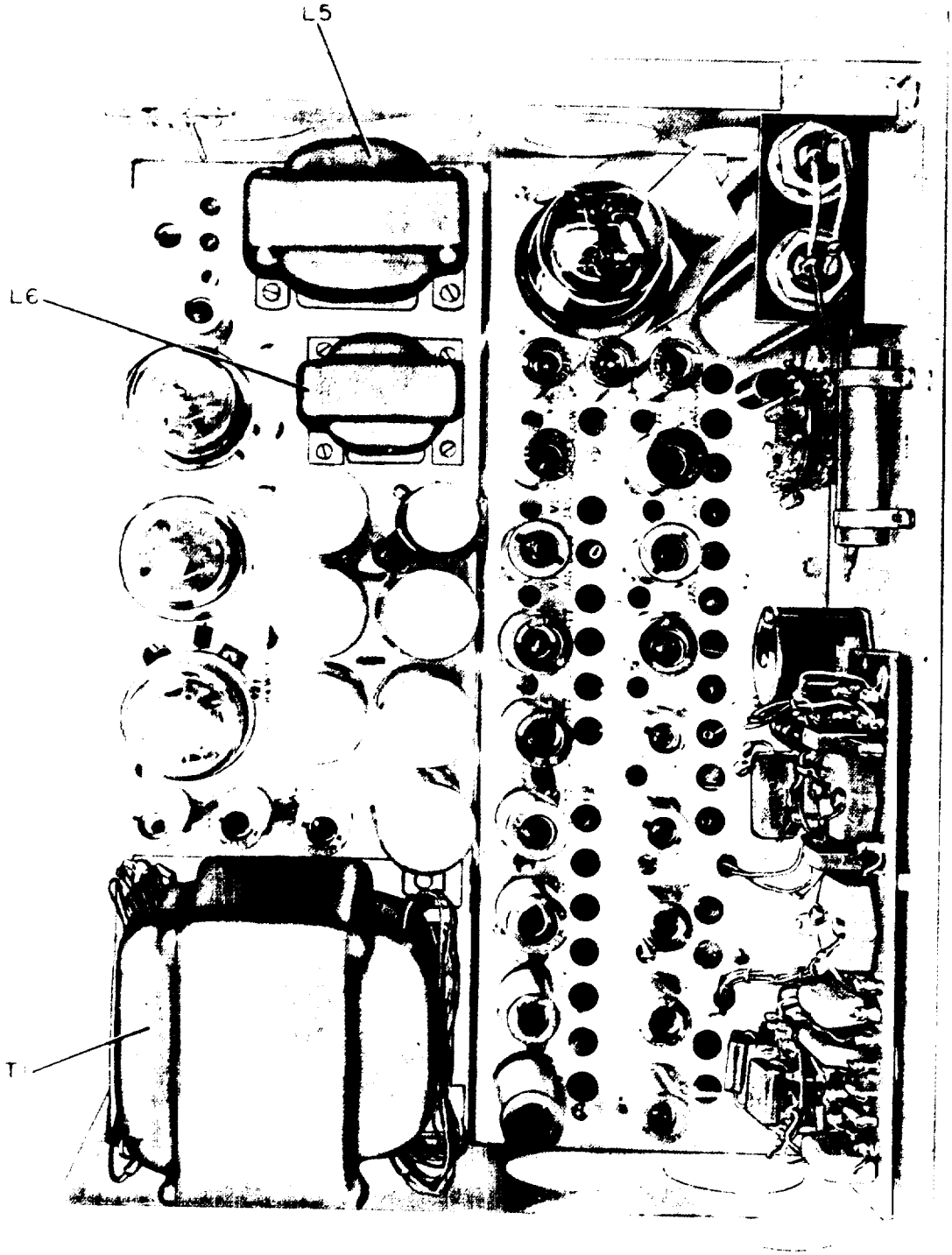


Figure 4-3A. Chassis, Top View SG-343/UPM-15A

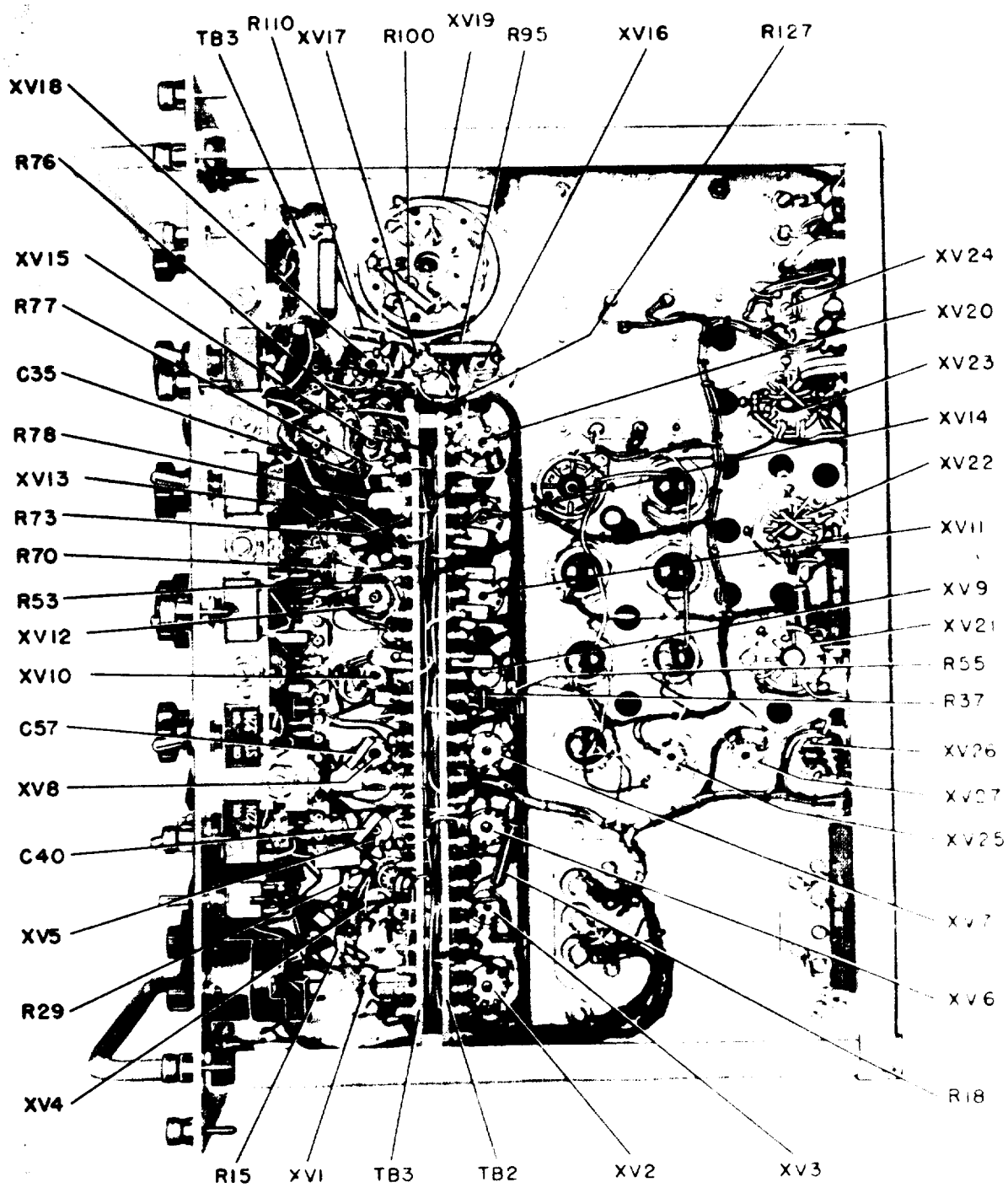


Figure 4-4. Chassis, Bottom View TS-592A/UPM-15

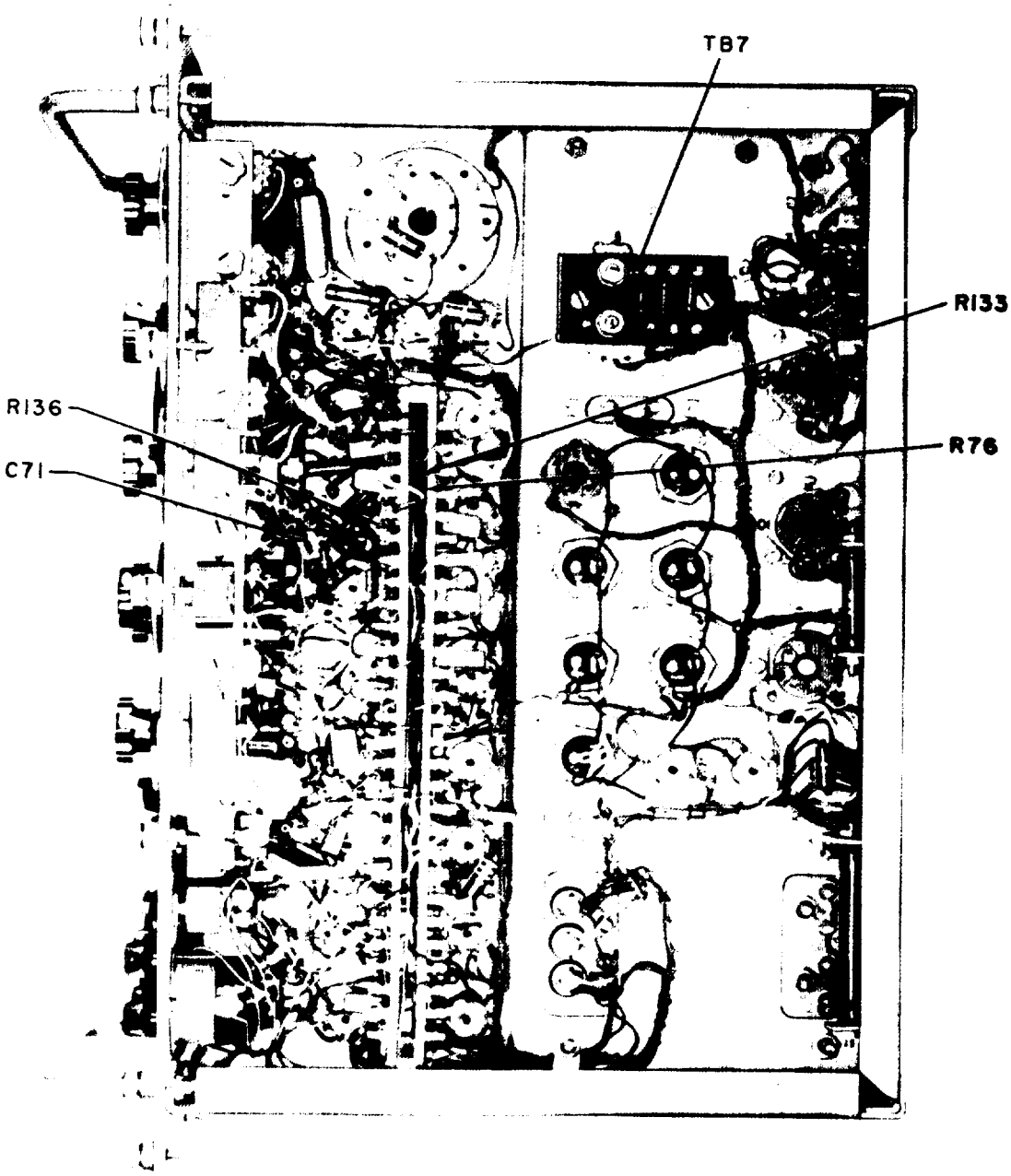


Figure 4-4A. Chassis, Bottom View TS-592B/UPM-15

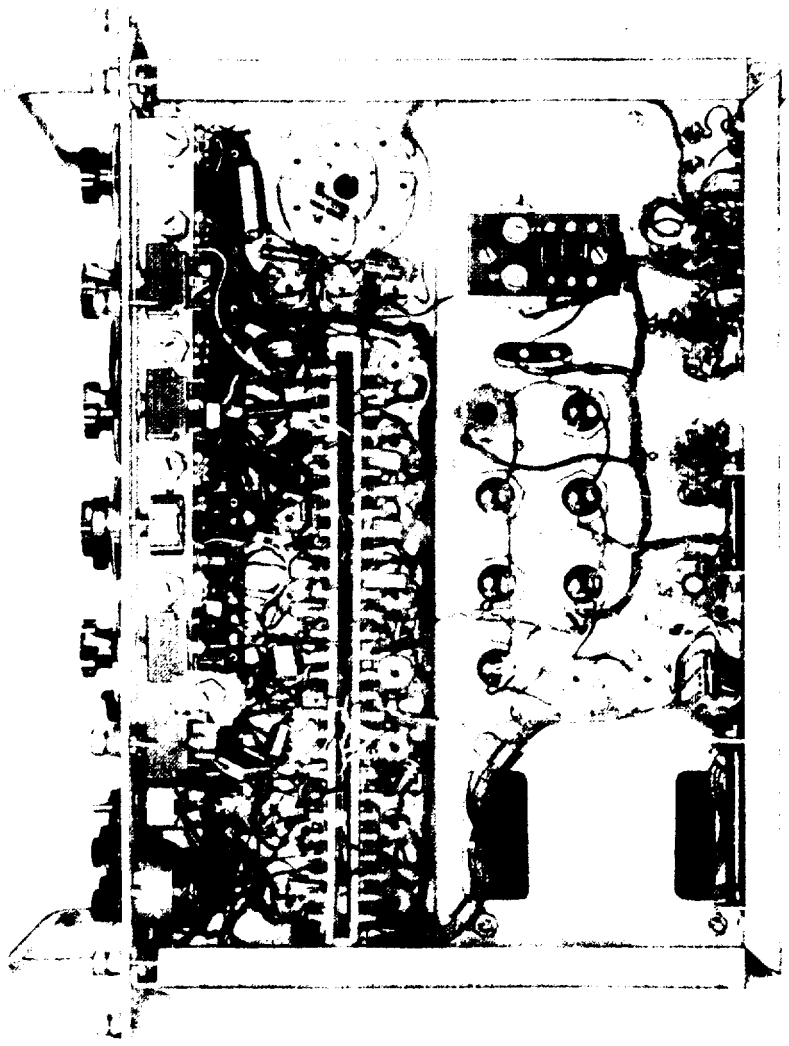


Figure 4-4B. Chassis, Bottom View SG-343/UPM-15A

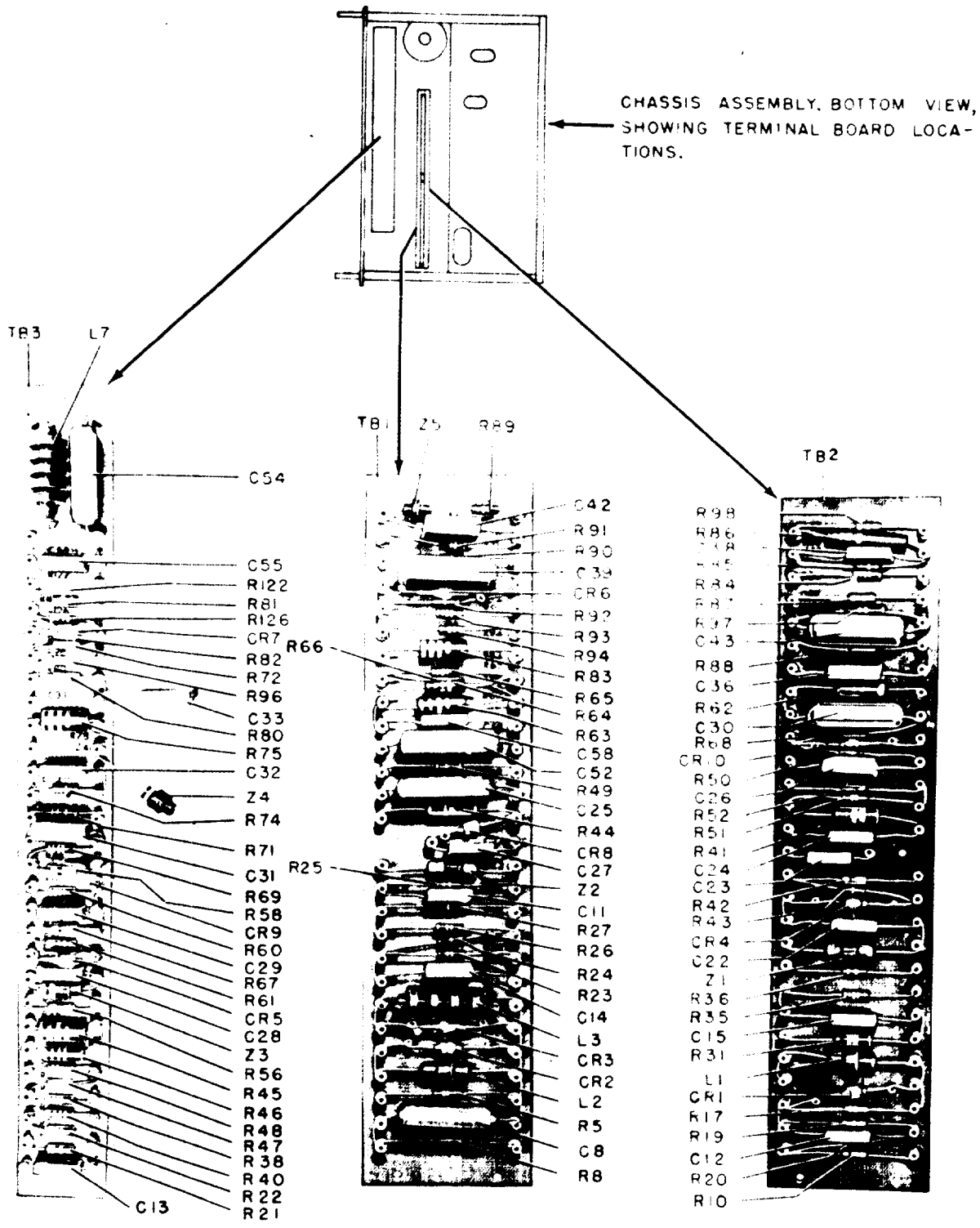


Figure 4-5. Terminal Boards TB1, TB2, and TB3 TS-592A/UPM-15

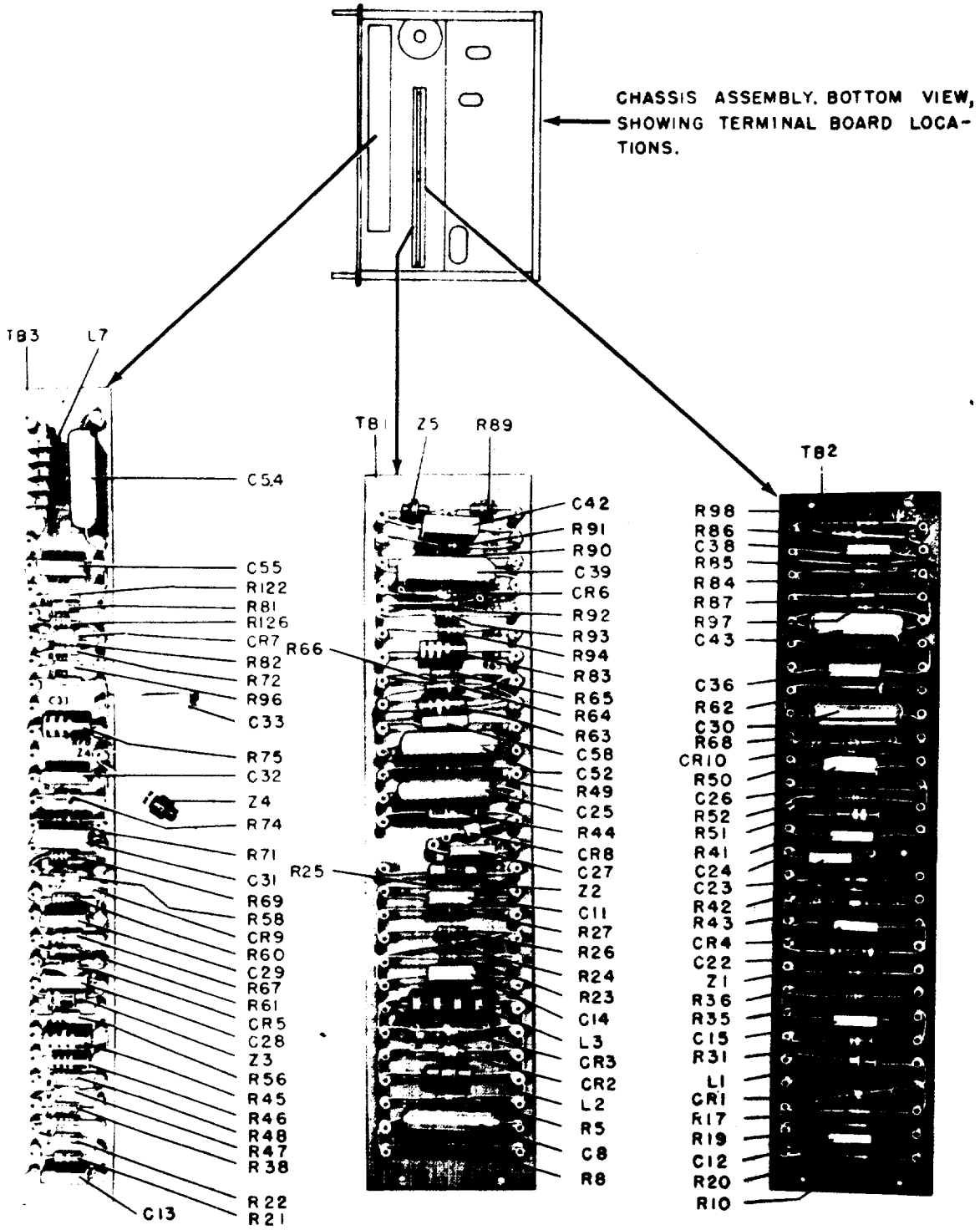


Figure 4-5A. Terminal Boards TB1, TB2, and TB3 TS-592B/UPM-15 and SG-343/UPM-15A

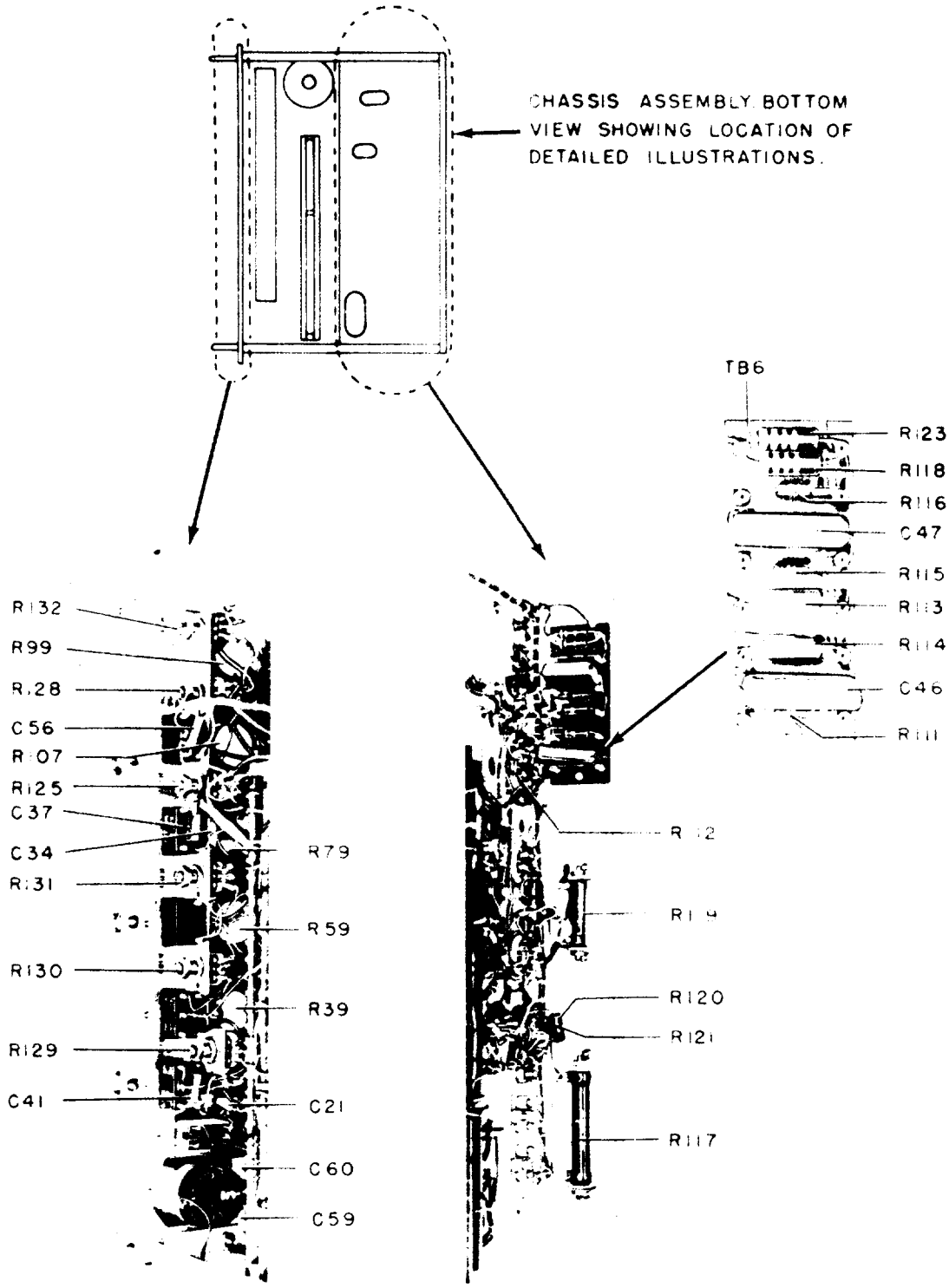


Figure 4-6. Front Panel, Inside Below Chassis, and Chassis, Inside Rear TS-592A/UPM-15

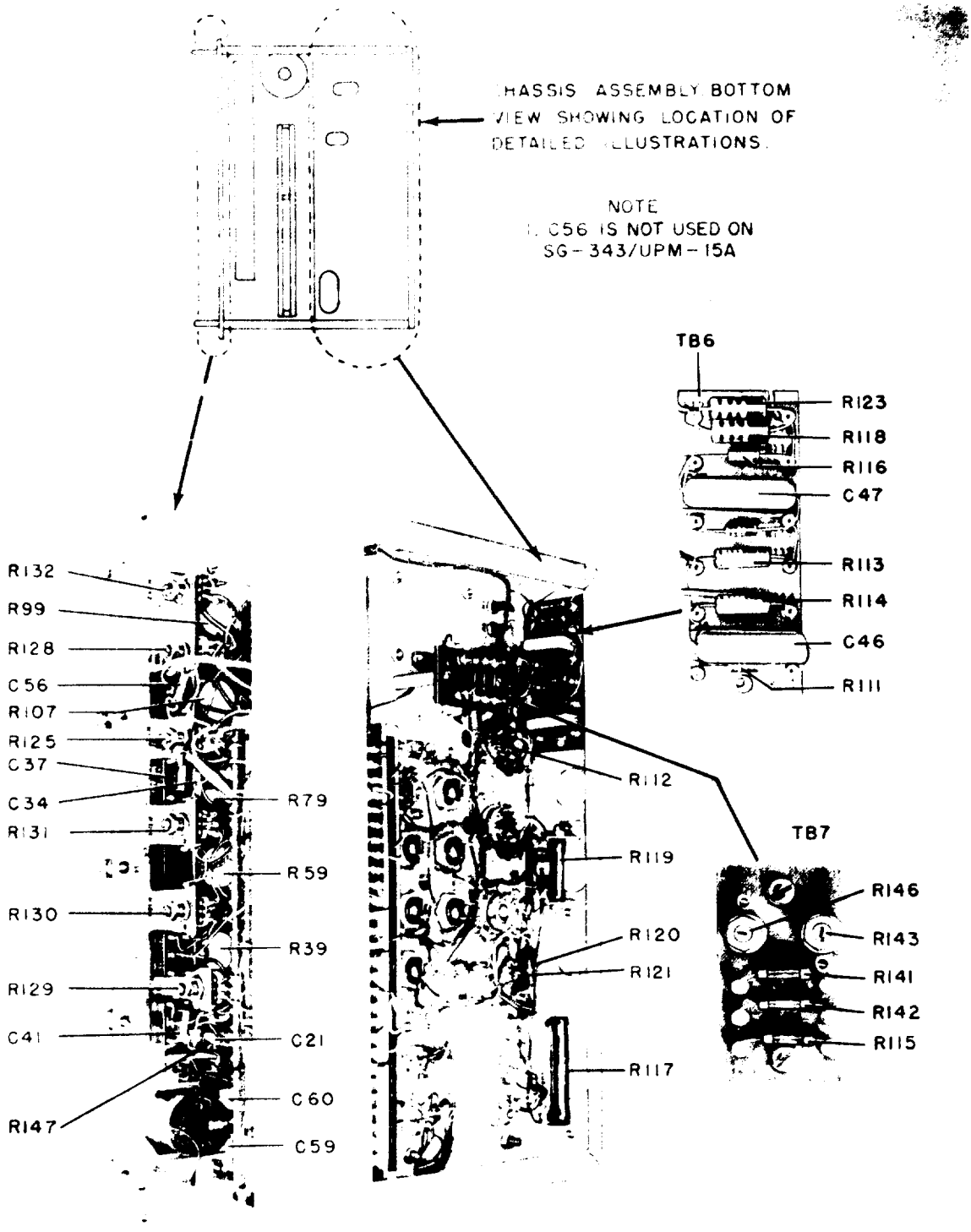


Figure 4-6A. Front Panel, Inside Below Chassis, and Chassis, Inside Rear TS-592B/UPM-15 and SG-343/UPM-15A

SECTION V

CLEANING

5-1. CLEANING THE COMPLETE UNIT.

5-2. Blow out the dust cover and the chassis with 25-pound-per-square-inch dry, compressed air. Do not let the air blast bend any of the parts mounted be - tween switch terminals or on the back of the front panel.

5-3. Brush a small amount of unleaded gasoline on the rotors of switch S2AB and S7AB. Turn the switch knobs through all positions several times to carry the solvent to all contacts. Then blow out again with 25-pound per-square -inch dry, compressed air.

WARNING

Do not use carbon tetrachloride as a cleaning fluid.

SECTION VI

INSPECTION

6-1. GENERAL.

6-2. Routine inspection of the pulse generator should be confined to switches, connecting cords, and the structural parts.

6-3. SWITCHES. Snap all the toggle switches back and forth to prove that there is a good spring action. Turn the "SYNC" and "COARSE ATTN" knobs. There must be a click and good detent action at each switch position. If not, the internal spring has broken and the part must be removed and replaced with a new one.

6-4. CONNECTING CORDS. Check the five cords for continuity and condition of the connectors. Put aside for repair any cord with the metallic braid loosened from the shell of the connector.

6-5. STRUCTURAL INSPECTION. Probe all parts that are mounted with screws to prove that the fastenings are secure.

6-6. CIRCUIT INSPECTION.

6-7. When there are specific malfunctions of the pulse generator, inspect the parts forming that particular part of the circuit. Sect ion VI of the Handbook of Service Instructions points out a step by step method of determining proper operation. At the point where malfunction is found, check voltages and resistances in accordance with the Handbook of Service Instruct ions. When a reading is different from the listed value, the associated electron tubes, and electrical parts must be checked closely.

6-8. ELECTRON TUBE INSPECTION. Check all electron tubes on a standard tube checker. Tap the side of each electron tube several times and watch for changes in meter readings. Install new electron tubes whenever a test shows a 10 percent drop in the tube's rating.

6-9. Make a continuity check of the variable resistors. Check the overall resistance element by putting the ohmmeter prods on the two outside terminals. Check the wiper arm by putting one ohmmeter prod on the center terminal and one on an outside terminal. Turn the control dials. If readings do not change while turning a dial the variable resistor should be replaced.

NOTE

Do not change the setting of the trimmer controls.

6-10. ELECTRICAL INSPECTON. Look for signs of scorching due to arcs and short circuits. These may occur close to crowded wiring, resistors and capacitors. Look for dripping of melted insulating compound as a sign of faulty capacitors. Resistors that have been overloaded may be cracked or uneven in color. Refer to the schematic wiring diagram, figure 11-2 or 11-4, and the practical wiring diagram, figure 11-3, 11-5 or 11-6, to check circuit connections. The crystal diodes are all paralleled by other circuit components, but in a thorough electrical check, disconnect one end of each crystal and read across it with an ohmmeter and reverse the probes. There must be a large difference in resistance when the ohmmeter probes are reversed. The crystal diodes are liable to fail and must be checked thoroughly.

SECTION VII

REPAIR AND REPLACEMENT

7-1. REPLACING PARTS.

7-2. Replace any parts found to be faulty during inspection. When soldering small resistors, crystal diodes and capacitors, hold the lead wires close to the parts body with pliers. This absorbs heat which might otherwise harm the connection of the lead inside the part body. Work rapidly when soldering crystal diodes since they are sensitive to heat.

NOTE

Be careful to connect the "+" side of a crystal diode to the same point as the original part. The crystal diodes are used as rectifiers to allow current to flow in only one direction. Therefore the proper polarity of connect ions must be maintained.

SECTION VIII

REASSEMBLY AND TESTING OF SUBASSEMBLIES AND ASSEMBLIES

8-1. The pulse generator is a single unit which does not require disassembly. No reassembly and testing instructions are applicable in regard to subassemblies and assemblies.

SECTION IX

REASSEMBLY AND TESTING OF COMPONENTS

9-1. The pulse generator requires no specific reassembly instructions. Testing combines with Section XL Refer completely to the Handbook, Service Instructions, for all dial calibration instructions. Calibrate all dials.

SECTION X

FINAL ASSEMBLY

10-1. The pulse generator does not undergo disassembly during service or overhaul. The only instructions applicable are:

a. Replace electron tubes.
b. Connect plate clips to electron tube V19.

SECTION XI

INSPECTION AND TESTING

11-1. REQUIRED TEST CONDITIONS.

11-2. Turn power on and allow the pulse generator to warm up for at least 15 minutes so circuits can stabilize.

11-3. All test values are based upon the pulse generator remaining warmed up and an ambient temperature of 21° C (70° F). Tolerances are to be doubled if tests are made at the temperature extremes of -20° C (-4° F) to +55° C (+131° F).

11-4. Always use the connecting cords CG-409E/U and CG-521/U to assure consistent loading of the input and output circuits. Use the adapters UG-273/U when connectors do not match.

11-5. The standard instruments used in testing the pulse generator should themselves be calibrated for accuracy. Particularly, the oscilloscope should not distort video waveforms and should be accurate in its voltage and sweep time calibrations.

11-6. EQUIPMENT REQUIRED.

11-7. The following standard test equipment is needed to test the pulse generator:

a. Frequency counter, or audio oscillator calibrated within 1/2 percent.

b. Oscilloscope having a vertical band width of 10 megacycles per second or higher slave sweeps, markers calibrated to one percent or better, approximately 1/2 usec delay in vertical amplifier, voltage calibration, 10 to 1 or better stroboscopic sweep expansion.

c. Signal generator or positive and negative sawtooth waves and positive and negative 1 used pulses.

d. One 51-ohm resistor, JAN RC32GF510J.

e. One 75-ohm resistor, JAN RC32GF750J.

f. One 250-ohm resistor, JAN RC32GF251J.

NOTE

Select the above resistors to be within one percent of their nominal value.

11-8. PULSE RATE TESTING.

11-9. Preferably use the frequency counter connect - ed to the “SYNC OUT” connector (4, figure 11-1). If a counter is not available connect the audio oscillator to the horizontal input of the oscilloscope and connect the “SYNC OUT” connector to the vertical input of the oscilloscope.

TABLE 11-1. PULSE RATE TEST VALUES.

"SYNC SECECTOR' Knob Setting	"PULSE RATE" Dial Setting	Allowable Limits
	.05 kc	47.5-52.5 cps
“A”	.10 kc	95-105 cps
	.28kc	266-294 cps
	.28 kc	266-294 cps
“B”	.50 kc	475-525 cps
	1.6 kc	1,520-1,680 cps
	1.6 kc	1,520-1,680 cps
"C"	3.0 kc	2,850-3,150 cps
	10.0 kc	9,500-10,500 cps

11-10. Table 11-1 shows the “PULSE RATE” dial settings and acceptable test limits. The following conditions must be in effect when taking readings:

a. 10-volt pulse amplitude.

b. 10-usec width.

c. No second pulse.

d. Stationary or slowly changing oscilloscope pattern when audio oscillator is used instead of counter.

11-12. EXTERNAL TRIGGERING AND PHASE CONTROL.

11-13. Follow instructions given in step 19 of the Systems Trouble Analysis, in the Handbook of Service Instructions. This test confirms the ability of the pulse generator to trigger from external syncing which varies in frequency and phase.

11-14. SYNC PULSE TEST.

11-15. Set the internal pulse rate to 5,000 cycles. Connect the “SYNC OUT” connector (4, figure 11-1) to the vertical input of the oscilloscope. Synchronize the oscilloscope with the sync pulse and check the waveform for the following values;

a. Width - 1 to 2 usec.

b. Rise Time - not more than 0.1 usec.

c. Fall Time - not more than 0.4 usec.

d. Amplitude - 25 to 75 volts.

11-16. DELAY TEST.

11-17. SYNC LEAD CONDITION. Set the internal pulse rate to 2,500 cycles. Connect the "SYNC OUT" connector (4, figure 11-1) to the sync input of the oscilloscope and synchronize the oscilloscope sweep with the leading edge of this signal. Connect the "OUTPUT" connector (5) to the vertical input of the oscilloscope. Put the "SYNC" switch (11) into "LEAD" position. Set the "DELAY" switch (12) and the "DELAY" dial (13) to the positions shown in Table 11-2. Check the oscilloscope readings against the values in Table 11-2.

11-18. SYNC LAG CONDITION. Set internal pulse rate to 2,500 cycles. Connect the "OUTPUT" connector (5, figure 11-1) to the sync input of the oscilloscope. Connect the "SYNC OUT" connector (4) to the vertical input of the oscilloscope and synchronize the oscilloscope sweep with the leading edge of this signal. Put the "WIDTH" switch (16) into "NAR" position. Adjust the "WIDTH" dial (17) so that the output pulse is 1 usec in width. Put the "SYNC" switch (11) into "LAG" position. Set the "DELAY" switch (12) and the "DELAY" dial (13) to positions shown in Table 11-2. Check the oscilloscope readings against the values In Table 11-2.

TABLE 11-2. DEIAY TEST

"DE LAY" Switch	"DE LAY" Dial Setting	Allowable Limits	Jitter
"SHORT"	2 usec	1.8 to 2.2 usec	Not more than 0.1 usec for all readings.
	10 usec	9 to 11 usec	
	20 usec	18 to 22 usec	
"LONG"	20 usec	18 to 22 usec	
	100 usec	90 to 110 usec	
	200 usec	180 to 220 usec	

11-19. SEPARATION TEST.

11-20. Set the internal pulse rate to 5,000 cycles. Connect the "SYNC OUT" connector (4, figure 11-1) to the horizontal input of the oscilloscope. Set pulse width to approximately 1 usec. Connect "OUTPUT" connector (5) to the vertical input of the oscilloscope. Set "PULSE NO. 2" switch (14) to the "IN" position. Put the "SEPARATION" dial (15) into the following positions and check that the oscilloscope indication comes within the allowable limits.

TABLE 11-3. SEPARATION TEST

"SEPARATION" Dial Setting	Allowable Limits	Jitter
2 usec	1.8 to 2.2 usec	Not more than 0.1 usec for all readings
16 usec	14.4 to 17.6 usec	
30 usec	27 to 33 usec	

11-21. WIDTH TEST.

11-22. Set the internal pulse rate to 5,000 cycles. Connect the "SYNC OUT" connector (4, figure 11-1) to the horizontal input of the oscilloscope. Connect the "OUTPUT" connector (5) to the vertical input of the oscilloscope. Put "WIDTH" Switch (16) into "NAR" position. Put the "PULSE NO. 2" switch (14) into "IN'' position. Put the "SEPARATITON" dial in 30 usec position. Table 11-3 shows settings to be made on the "WIDTH" dial (17) and the allowable limits of readings on the oscilloscope. Take readings with both negative and positive polarity by moving the "POLARITY" switch (18). Jitter must be less than 0.1 usec. When width of both output pulses is not within calibration limits the trimmer controls allow width adjustments to be made. The crystals CR9 and CR10 cause the width-determining capacitors to charge to -150 volts. This fixed value in the circuit enables accurate adjustment of the pulse width.

TABLE 11-4. WIDTH TEST, NARROW PULSES

"WIDTH" Dial Setting	Allowable Limits
0.5 usec	0.35 to 0.65 usec
5 usec	8.9 to 11.1 usec
10 usec	8.9 to 11.1 usec

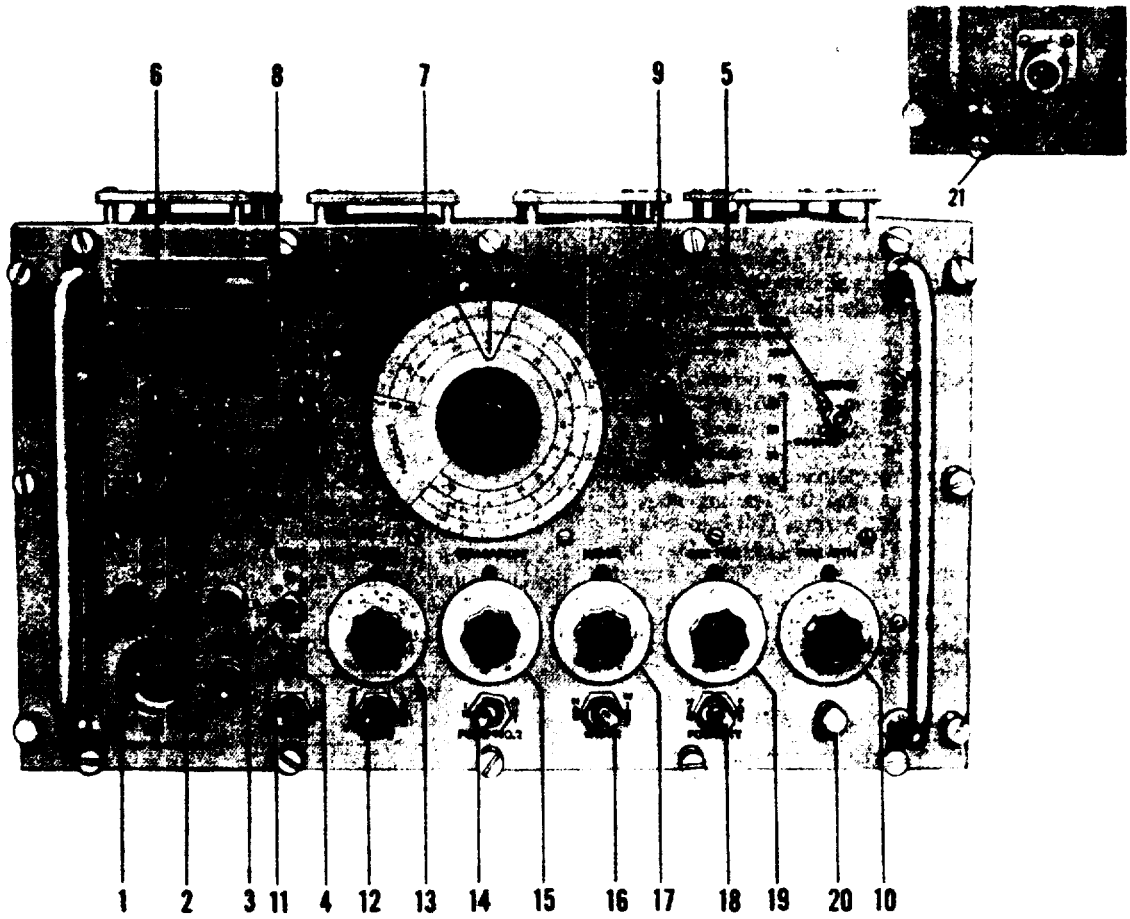
11-23. Change "WIDTH" switch (16, figure 11-1) to "WIDE" position. Put "PULSE NO. 2" switch (14, figure 11-1) into "OUT" position. Table 11-5 shows what "WIDTH" dial settings to make and allowable readings on the oscilloscope. Check these readings with both positive and negative pulse polarity. Jitter must be less than 0.1 usec.

TABLE 11-5. WIDTH TEST, WIDE PULSES

"WIDTH" Dial Setting	Allowable Limits
20 usec	18 to 22 usec
50 usec	45 to 55 usec
100 usec	90 to 110 usec

11-24. FINE AND COARSE ATTENUATION TEST.

11-25. Set the internal pulse rate to 5,000 cycles. Connect the "SYNC OUT" connector (4, figure 11-1)



1. “POWER” connector (AN/UPM-15)
2. ‘‘POWER” switch
3. “SYNC IN” connector
4. “SYNC OUT” connector
5. “OUTPUT” connector
6. “SYNC” selector knob
7. “PULSE RATE” dial
8. ‘‘BIAS” knob
9. ‘‘COARSE ATTN” knob
10. “FINE ATTN” dial
11. ‘‘SYNC” switch
12. “DELAY” switch
13. “DELAY” dial
14. “PULSE NO. 2” switch
15. ‘‘SEPARATION” dial
16. “WIDTH” switch
17. “WIDTH” dial
18. ‘‘POLARITY” switch
19. “RISE TIME” dial
20. “GND” connector
21. “POWER” connector (AN/UPM-15A)

Figure 11-1. Operating Controls

to the horizontal input of the oscilloscope, and the "OUTPUT" connector (5) to the vertical input through the high impedance probe. Adjust the pulse generator to produce a single positive pulse, 2 usec wide with a sync lead of 2 usec. Set the "COARSE ATTN" knob (9) to the white number "1" on the front panel. Turn the "FINE ATTN" dial (10) to the following positions and check the reading on the oscilloscope against the allowable readings.

TABLE 11-6. FINE ATTENUATION

"FINE ATTN" Dial Setting (Black Numbers)	Allowable Limits
2	1.8 to 2.2 volts
10	9 to 11 volts
20	18 to 22 volts

11-26. Leaving other controls as they were in paragraph 11-25 turn the "FINE ATTN" dial (10, figure 11-1) to black number ''20". In Table 11-7, the loading of matched positions of the "COARSE ATTN" knob (9) is specified. Use the resistors listed in paragraph 11-7. Shunt them from the center terminal of the connecting cord to the chassis ground of the oscilloscope. As directed in Table 11-7 turn the "COARSE ATTN" knob (9) and compare the oscilloscope readings with the allowable limits.

TABLE 11-7. COARSE ATTENUATION

"COARSE ATTN" Knob Setting	Allowable Limits of Amplitude
10	180 to 220 V
1	18 to 22 V
.1	1.8 to 2.2 V 51 ohm load
.01	0.18 to 0.22 V 51 ohm load
.001	0.018 to 0.022 V 51 ohm load
1 (red), "FINE ATTN" at 3.0 (red)	2.7 to 3.3 V 75 ohm load

11-27. WAVE SHAPE TEST.

11-28. Set the internal pulse rate to 1,000 cycles. Connect the "OUTPUT" connector (5, figure 11-1) to the vertical input of the oscilloscope. Load the circuit with 51 ohms resistance. Use the internal sync of the oscilloscope and sync on the leading edge of the output pulse. With the "COARSE ATTN" knob (9) in the white number .1 position, set the pulse generator controls for a 2 volt positive, 100 usec wide pulse. Set the "RISE TIME" dial (19) for minimum rise time. Check overshoot and flatness of the pulse. The overshoot must be less than .1 volt. The drop-off from the initial amplitude at the trailing edge must be less than 0.28 volt.

11-29. RISE TIME CALIBRATION. Measure with "FINE ATTN" (10, figure 11-1) at 10 and with "COARSE ATTN" (9) at .1-50 ohms. With an oscilloscope measure from the 10 PCT to the 90 PCT amplitude points. Turn the "RISE TIME" dial (19) and compare the oscilloscope readings with the allowable limits.

TABLE 11-8. RISE TIME CALIBRATION

"RISE TIME" Dial Setting	Allowable Limits
0.05 usec	0.045 to 0.055 usec
0.1 usec	0.9 to 0.11 usec
0.25 usec	0.225 to 0.275 usec

11-30. USE OF SCREEN ROOMS. The pulse generator need not be entirely overhauled in a screen room. Radiation from the unit will only occur if it is operated without the dust cover enclosing the chassis.

11-31. GENERAL OVERHAUL PROCEDURES.

11-32. The type of problem most likely to occur in inspection and testing is apparently inaccurate control dial readings. It may be a definite fact that the pulse amplitude or width or delay can be controlled within limits when observed on an oscilloscope, but the control dial readings differ by more than the allowed plus or minus 10 percent. A helpful corrective step is to loosen the set screws of a dial assembly and change its position on the control shaft when it is certain that the readings are uniformly distributed in a higher or lower direction. The correct dial position for TS-592B/UPM-15 and SG-343/UPM-15A pulse generators is found by turning the dial fully clockwise; at this point the indicator should align with slot in dial. On TS-592A/UPM-15 pulse generators the correct position is found by trial and error.

11-33. It is also suggested that a calibration card be made up for a pulse generator if a series of certain precise outputs are desired. The particular dial readings can be listed on the calibration card after being determined with the oscilloscope. Thus time will be saved in securing specific output values.

11-34. MARKING.

11-35. Marking of equipments required by Government T.O.'s or other instructions, to indicate overhaul or the incorporation of changes, shall be applied during inspection and test (if not previously applied to the sub-assemblies, assemblies, or components during overhaul and assembly).

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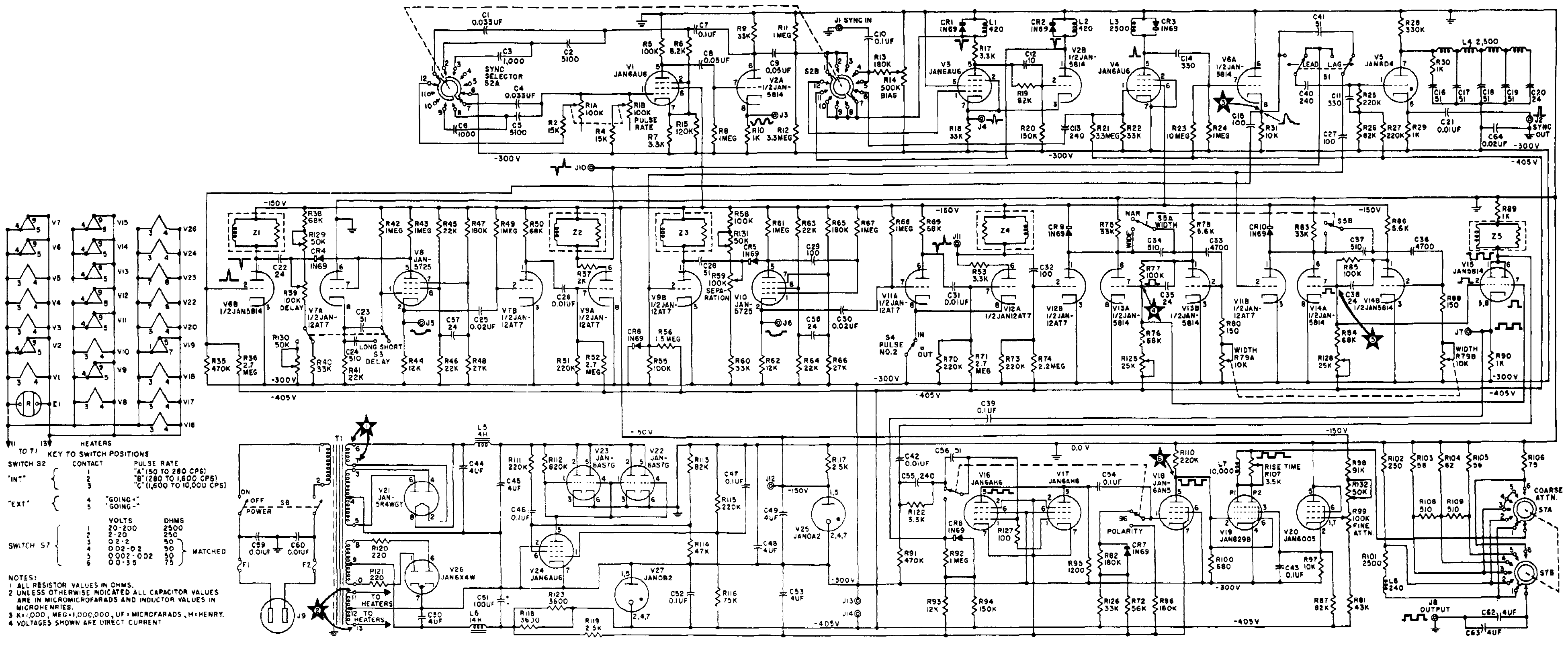

Figure 11-2 Pulse Generator TS-592A UPM-15, Overall Schematic Wiring Diagram

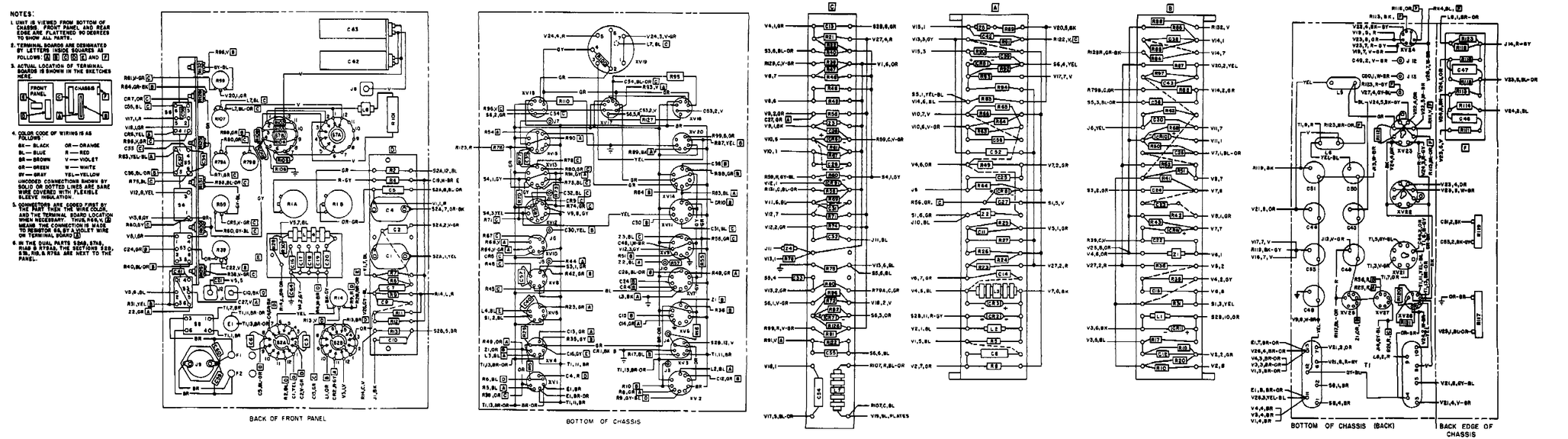

Figure 11-3 Pulse Generator TS-592A UPM-15, Practical Wiring Diagram

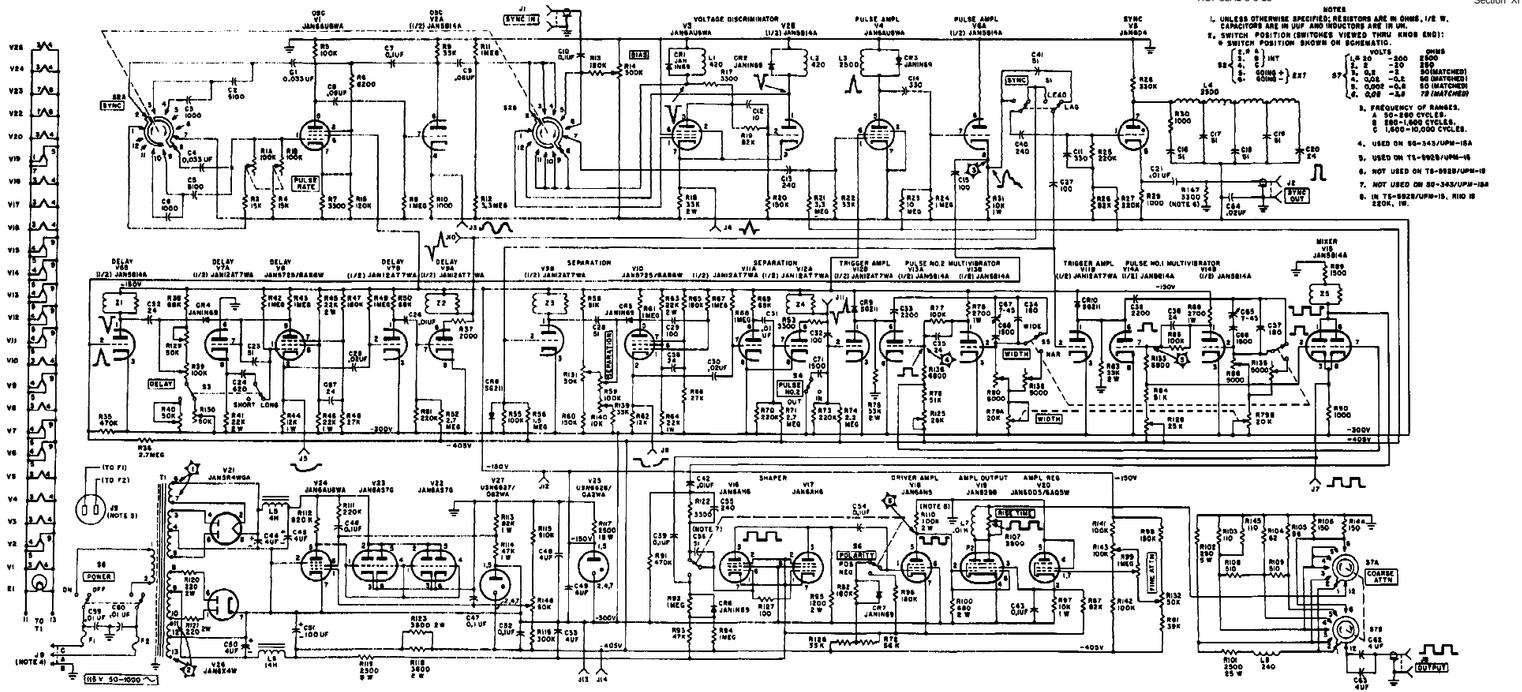

Figure 11-4. Pulse Generator TS-592B/UPM-15 and SG-343/UPM-15A, Overall Schematic Wiring Diagram

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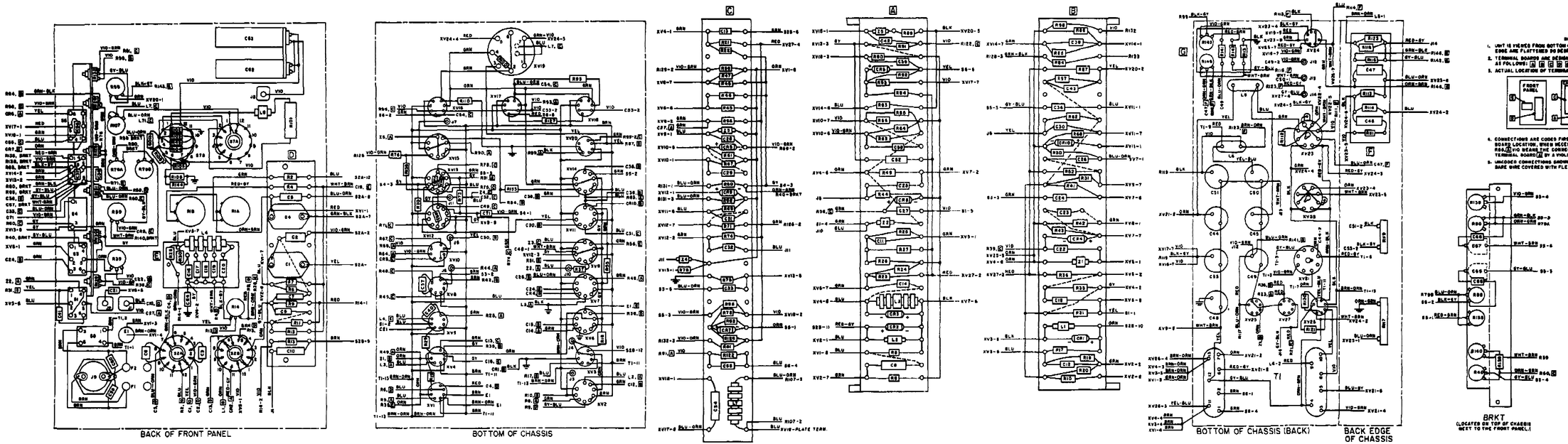

Figure 11-5. Pulse Generator TS-591B/UPM-15, Practical Wiring Diagram

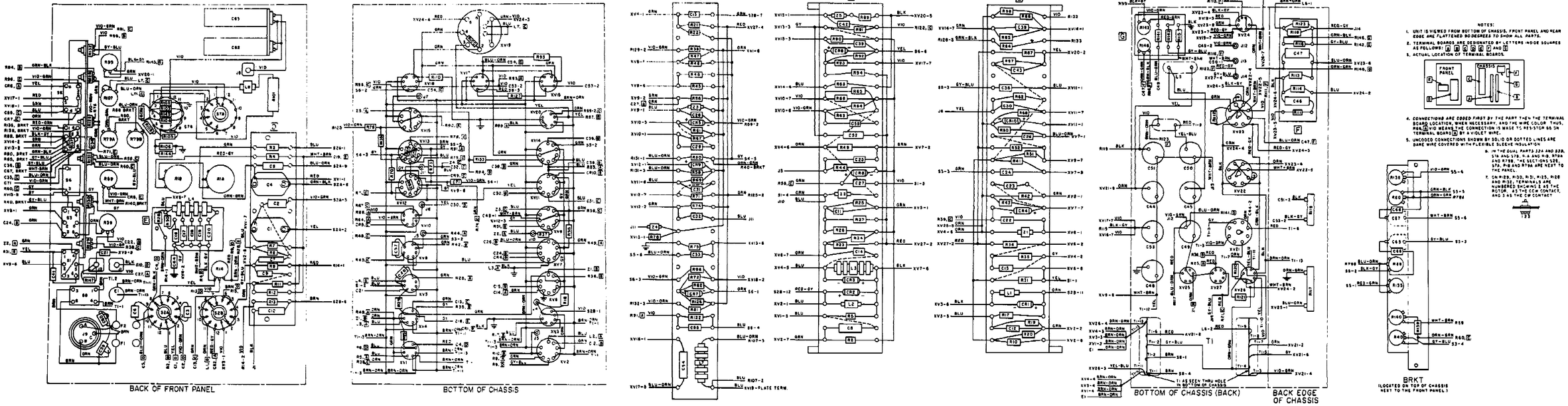

Figure 11-6. Pulse Generator SG-343/UPM-15A, Practical Wiring Diagram