TM 11-6625-213-35

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

FIELD AND DEPOT MAINTENANCE MANUAL

TEST SETS TS-538/U, TS-538A/U, TS-538B/U, AND TS-538C/U

This copy is a reprint which includes current pages from Changes 1

HEADQUARTERS, DEPARTMENT OF THE ARMY
8 MAY 1964

WARNING

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT

Be careful when working on the 160-volt cathode follower and amplifier circuits, or on the 117-volt ac line connections.

DO NOT TAKE CHANCES!

RADIATION HAZARD

Ni 63 or Co 60

Tube type OB2WA used in this equipment contains radioactive material (para 4, TM 11-6625-213-12). This tube is potentially hazardous when broken; see qualified medical personnel and the Safety Director if you are exposed to or cut by a broken tube. Use extreme care in replacing this tube (para 31, TM 11-6625-213-12).

Never place a radioactive tube in your pocket.

Use extreme care not to break a radioactive tube while handling it.

Never remove a radioactive tube from its carton until you are ready to use it.

Refer to paragraph 35, TM 11-6625-213-12 for handling, storage, and disposal of radioactive material.

CHANGE)
)
NO. 1)

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, *15 January 1986*

Direct Support, General Support, and Depot Maintenance Manual
TEST SETS TS-538/U, TS-538A/U, TS-538B/U, AND TS-538C/U
(NSN 6625-00-243-5174)

TM 11-6625-213-35, 8 May 1964, is changed as follows:

Title of the manual is changed as shown above.

Page 2. Paragraph *1d,* line 11. Change address to read: "Commander, US Army Communications-Electronics Command and Fort Monmouth, ATTN: DRSELME-MP, Fort Monmouth, New Jersey 07703-5007.

Paragraph 2 is superseded as follows:

2. Consolidated Index of Army Publications and Blank Forms. Refer to the latest issue of DA Pam 310-1 to determine whether there are new editions, changes or additional publications pertaining to the equipment.

Page 3. Change "radar" to "radiosonde" in the following places:

Paragraph *4a,* line 2.
Paragraph *4b,* line 2.
Paragraph *4c,* line 2.

Paragraph "45" to "50" in the following places:

Paragraph *5b,* line 9.
Paragraph *5e,* line 13.

Page 7. Paragraph *7e,* line 14. Change "45" to "50".

Page 8. Paragraph *8b(l),* line 2. Change "45" to "50".

Page 9. Paragraph *9b,* line 33. Change "XV" to "XV4".

Page 10. Paragraph *9b(2),* line 17. Change "45" to "50".

Page 11. Paragraph 10, line 24. Change "decibles" to "decibels".

Page 15. Paragraph *15b(4),* line 3. Change *"18d"* to *"18e"*.

Page 16. Paragraph 16. The chart is superseded as follows:

Test equipment	*Technical manual*	*Common name*
Mutimeter TS-352 (*)/U[a].	TM 11-5527	Multimeter.
Oscilloscope, AN/USM-281 or equivalent.	TM 11-6625-1703-15	Oscilloscope.
Test Set, Electron Tube TV-7(*)/U[b].	TM 11-6625-274-12	Tube tester.
Test Set, Electron Tube TV-2(*)/U[c].	TM 11-6625-316-12	Electron tube tester.

Page 17. Paragraph *18b* is superseded as follows:

b. Use of Chart. Troubleshooting at direct support, general support, and depot level must usually be performed without use of associated items of the rawinsonde system. A checklist for operational testing of the TS-538 without the rawinsonde set receiver is provided in paragrah *18d.*

Paragraph *18d* is superseded as follows:

d. Operational Tests. Operational testing of the test set may be performed without associated rawinsonde equipment by performing the steps in the following chart. The flow chart (para *18e)* may be used when troubleshooting the test set.

Step	*Action or Condition*	*Normal Condition*	*Corrective Measures*
1	*Perform the stirring* procedures *described in paragraph 13a* of TM 11-6625-213-12.		
2	Connect the ac power cable between the power receptacle on the lower right corner of the front panel and a 117-volt ac power source.		
3	Set tbe Power switch to ON and allow a 5-minute warmup period.		
4	Push the CRYSTAL CHECK switch to the left.	The power monitor meter should deflect the SET POWER point.	Calibrate the crystal check circuit (para 32.1 of TM 11-6625-213-12). Replace crystal CR2 Replace F1 or F2. Repair ac input circuit.
5	Rotate the RF POWER SET control fully clockwise, then rotate the OSCILLATOR FREQUENCY control from one limit tc the other.	The indication on the power monitor meter should not drop below the SET POWER point for any frequency setting.	Replace T2. Replace V5. Perform oscillator cathode tuning (para 38). Replace V4, repair oscillator (para 27 and 28).
6	Set the OSCILLATOR FREQUENCY control to the center (zero) mark. Use the FREQUENCY METER to measure the rf value.	The measured value should be 1,680 ±1 megahertz.	Aline OSCILLATOR FREQUENCY control dial (para 32.2 of TM 11-6625-213-12).
7	Place the MODULATION switch to ON and observe the signal at PULSE jack J3 with an oscilloscope.	The observed pulse should be similar to that shown in D of figure 2.	Repair modulation circuits V1, V2, V3.
8	Perform the calibration procedures (section II).		

Paragrah *18e* is added after paragraph *18d.*

e. Troubleshooting Chart. The troubleshooting flow chart in figure 9.1 is used in association with the operational tests to identify the local area containing a malfunctioning component.

Figure 9.1 is added after paragraph *18e.*

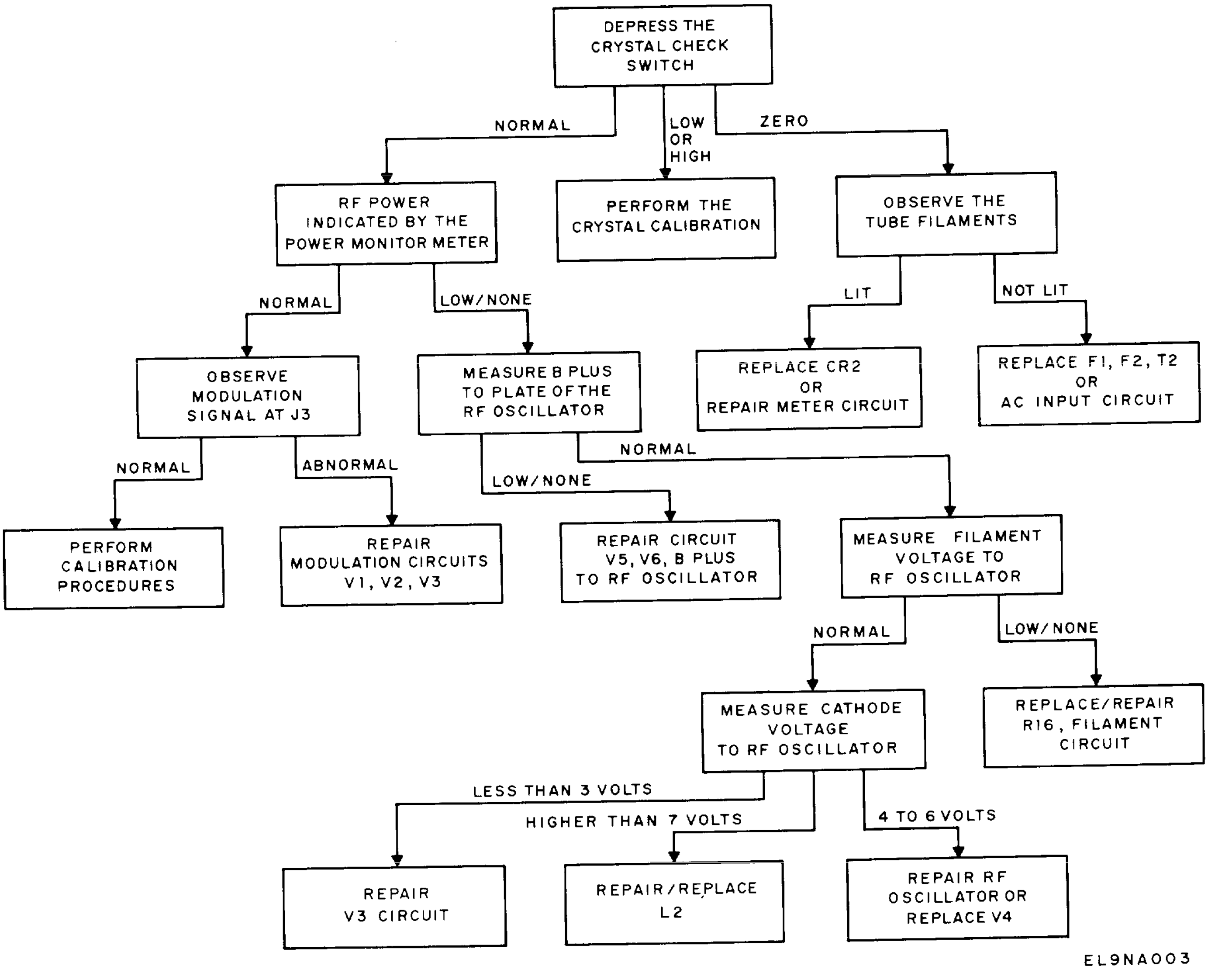

Figure 9.1 Troubleshooting Flow Chart, Test Set TS-538(*)/U.

Page 18. Paragraph 20. The chart is superseded as follows:

Transformer or coil	*Terminals*	*Ohms*
T1	1-2 3-4	Less than 1 Less than 1
T2	1-2 3-4 4-5 3-5 6-7	8 98 98 195 Less than 1
L1 L2		270 250

Figure 10 is superseded as follows:

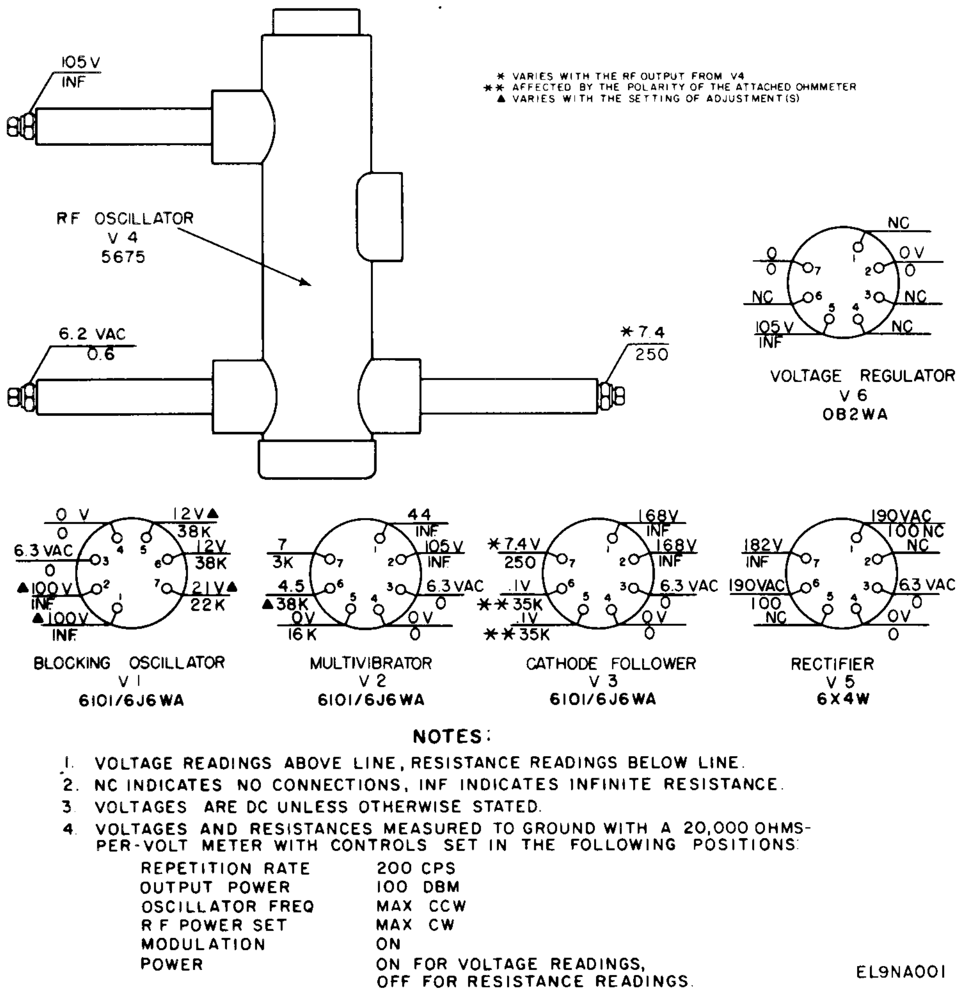

Figure 10. Test Sets TS-538/U, TS-538A/U, and TS-538B/U, Voltage and Resistance Measurements.

Page 19. Figure 11 is superseded as follows:

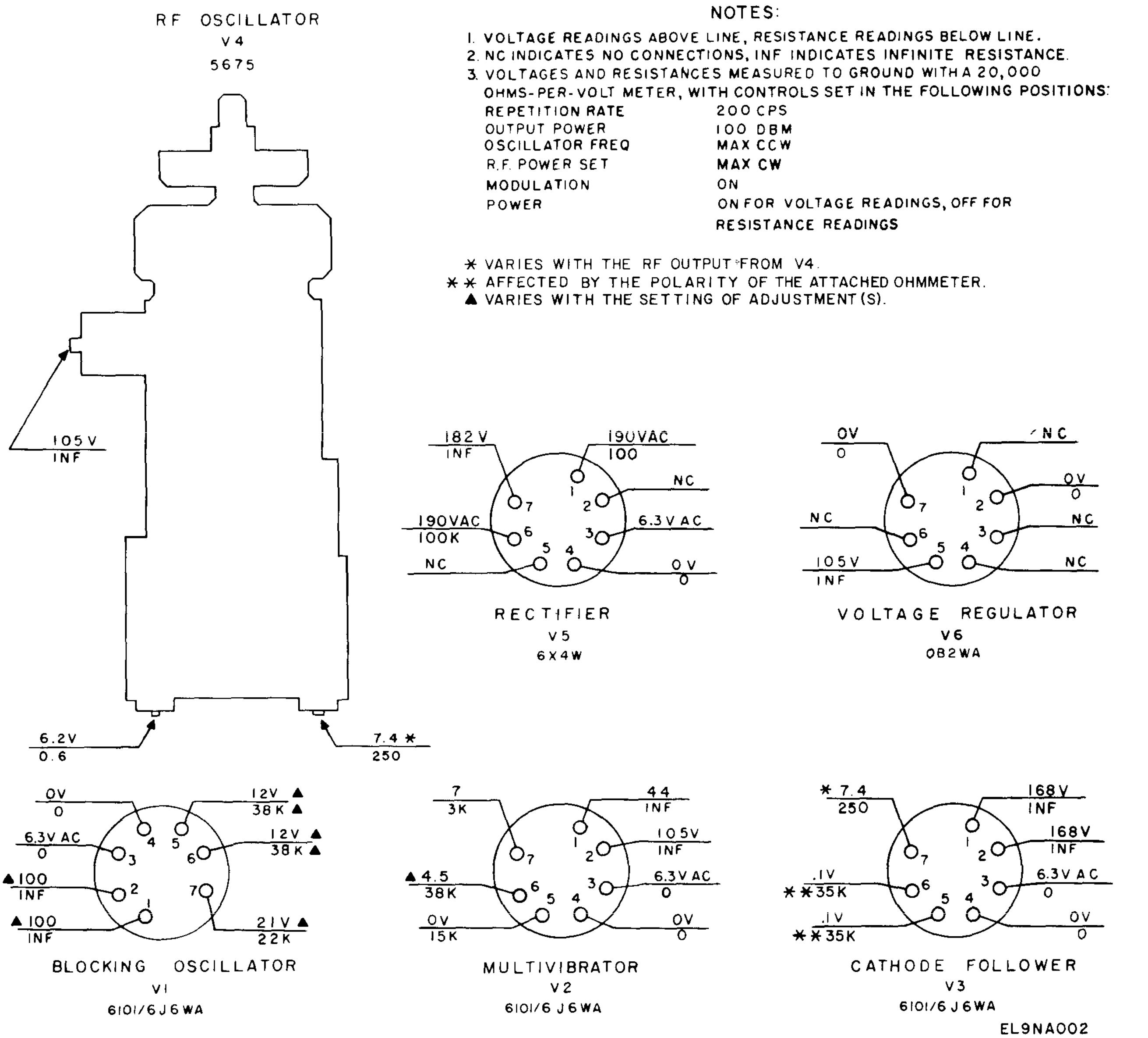

Figure 11. Test Set TS-538C/U, Voltage and Resistance Measurements.

Page 33. Paragraph 32 is superseded as follows:

32. Crystal Calibration. Perform the crystal calibration as described in paragraph 32.1 of TM 11-6625-213-12.

Page 34. Paragraph *34d,* line 6. Change "45" to "50".

Page 35. Paragraph *37b* is superseded as follows:

b. Perform step 1 through 4 of the operational steps (para *18d)* and the crystal calibration (para 32.1 of TM 11-6625-213-12).

Page 55. Appendix, line 3. Change "DA Pam 310-4 Index of Tecnical Manuals, Technical Bulletins, Supply Bulletins, Lubrication Orders and Modification Work Orders." to "DA Run 310-1 Consolidated Index of Army Publications and Blank Forms."

By Order of the Secretary of the Army:

JOHN A. WICKHAM JR.
General, United States Army
Chief of Staff

Official:

MILDRED E. HEDBERG
Brigadier General, United States Army
The Adjutant General

DISTRIBUTION:
To be distributed in accordance with DA Form 12-36 literature requirements for TS-538/U,A,B,C.

Technical Manual No. 11-6625-213-35

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON 25, D.C., *8 May 1964*

TEST SETS TS-538/U, TS-538A/U, TS-538B/U AND TS-538C/U

* This manual, together with TM 11-6625-213-12, 2 October 1963, supersedes TM 11-5014, dated 3 May 1957, including C1, 16 September 1957, C2, 9 April 1959, and C4, 22 March 1962, and replaces Signal Corps Repaired Equipment Standard No. 828, Issue No. 2, dated 17 April 1961.

CHAPTER 1

FUNCTIONING OF TS-538( )/U

Section I. GENERAL

1. Scope

a. This manual covers field and depot maintenance for Test Sets TS-538/U, TS-538A/U, TS-538B/U, and TS-538C/U. It includes instructions appropriate to third, fourth, and fifth echelons for troubleshooting, testing, calibrating, repairing the equipment, replacing maintenance parts, and repairing specified maintenance parts. It also lists tools, materials, and test equipment for third, fourth, and fifth echelon maintenance. Detailed functions of the test set are covered in the equipment functioning section.

b. The purpose, operation, and interoperation of the various circuits (electrical, electronic, mechanical, and electromechanical) in this equipment are explained in this chapter. Familiarity with the equipment, how it works, and why it works that way are valuable tools in troubleshooting the equipment rapidly and effectively.

c. The complete technical manual for this equipment includes TM 11-6625-213-12, TM 11-6625-213-20P, and TM 11-6625-213-35P.

d. The direct reporting, by the individual user, of errors, omissions, and recommendations for improving this equipment manual is authorized and encouraged. DA Form 2028 will be used for reporting these improvements. This form may be completed using pencil, pen, or typewriter. DA Form 2028 will be completed in triplicate and forwarded by the individual using the manual. The original and one copy will be forwarded direct to: Commanding Officer, U. S. Army Electronics Materiel Support Agency, ATTN: SELMS-MP, Fort Monmouth, New Jersey 07703. One information copy will be furnished to the individual's immediate supervisor (officer, noncommissioned officer, supervisor, etc).

Note: For other applicable forms and records, see paragraph 2, TM 11-6625-213-12.

2. Index of Publications

Refer to the latest issue of DA Pamphlet 310-4 to determine whether there are new editions, changes, or additional publications pertaining to this equipment. Department of the Army Pamphlet No. 310-4 is a current index of technical manuals, technical bulletins, supply manuals, (types 4, 6, 7, 8, and 9), supply bulletins, lubrication orders, and modification work orders that are available through publications supply channels. The index lists the invididual parts (-10, -20, -35P, etc) and the latest changes to and revisions of each equipment publication.

3. Internal Differences in Models

a. The oscillator tuning cavity in the TS-538C/U differs from that in the earlier models, and the oscillator wrench that fits this cavity also differs from the wrench designed for the earlier models (fig. 16 and 17).

b. Internal differences are listed in the chart below. For external differences and other internal differences, see TM 11-6625-213-12.

Item	Basic model	A model	B model	C model
Coil L3	Used	Used	Used	Not used
Coil L4	Used	Used	Used	Not used
Coil L5	Used	Used	Used	Designated as L3
Coil L6	Used	Used	Used	Not used

4. Signal Paths

(fig. 1)

a. When the test set is used for measuring the frequency of a radar transmitter, the transmitted signal is picked up by the antenna and then applied to the frequency meter, and to the crystal and meter circuits ,

b. When the test set is used for checking the output power of a radar transmitter, the transmitted signal is picked up by the antenna and then applied to the crystal and meter circuit.

c. When the test set is used as a signal source for checking radar receivers, blocking oscillator V1 is used to generate a series of pulses, These pulses are fed to multivibrator V2 which changes these pulses to rectangular pulses with negative-going spikes. These negative spikes are chopped off by limiter CR1. Cathode follower V3 couples the rectangular pulses to radio frequency (rf) oscillator V4. RF oscillator V4 generates a continuous rf wave which is interrupted (modulated) by the pulses from cathode follower V3. The rf modulated wave can then be fed directly to the antenna, or it can be sent through the output power attenuator to output power jack J1. The rf oscillator frequency output can also be monitored by the frequency meter, and by the crystal and meter circuits .

Section II. UNIT FUNCTIONING

5. Block Diagram

(fig. 1)

a. Blocking Oscillator V1. The blocking oscillator produces positive pulses which are used to trigger multivibrator V2 (A, fig. 2). The pulse repetition rate of the oscillator can be varied from 5 to 200 pulses per second by the REPETITION RATE control. The blocking oscillator is turn e d ON and OFF by MODULATION switch S1.

b. Multivibrator V2. The multivibrator is a flip-flop circuit having one stable and one unstable condition of conductivity. The multivibrator remains in the stable condition until a trigger pulse from the blocking oscillator switches it to the unstable condition. The multivibrator recovers its stable condition after several microsecends (normally adjusted to 45 microseconds), This action produces an output pulse which is rectangular shaped with a negative-going spike (B, fig. 2).

c. Limiter CR1. The limiter removes the negative-going spike from the multivibrator pulse and establishes a 0-volt direct-current (dc) reference level (C, fig. 2).

d. Cathode Follower V3. The cathode follower acts as an impedance matching device which matches the high impedance of the limiter output, with very little loss of multivibrator pulse voltage, to the impedance of the rf oscillator input, which is a relatively low impedance load (D, fig. 2).

e. Rf Oscillator V4. The rf oscillator is a pencil-type triode connected in a coaxial-line cavity which produces rf oscillations, The oscillator is tunable through the range of 1,630 megacycles (mc) to 1,730 mc (1,615 mc to 1,715 mc in the TS-538C/U), The rf output may be either continuous wave (CW) (F, fig. 2) or interrupted continuous wave (icw) (E, fig. 2), depending on the position of MODULATION switch S1. When the output is icw, the duration of the interruption is adjusted to 45 microseconds *(b* above) and the repetition rate is adjustable from 5 to 200 pulses per second *(a* above).

f. Output Power Attenuator. The output power attenuator is an adjustable waveguive-type assembly which controls the amount of rf power available at output jack J1.

g. Frequency Meter. The frequency meter is a coaxial cavity, the resonant frequency of which is adjustable, Resonance is indicated by a dip on meter Ml.

h. Crystal CR2 and Meter M1. The crystal rectifies the rf current from the rf oscillator so that the meter can monitor the output power from the rf oscillator. The meter also measures the frequency of the rf oscillator or any external oscillator, the frequency of which lies within the range of the frequency meter.

i. Rectifier V5. The rectifier rectifies the applied 117-volt alternating current (ac) voltage and produces dc voltage for the plate curcuits of tubes V3 and V6.

j. Voltage Regulator V6. The voltage regulator is a gas-filled regulator tube which produces a regulated +105 volts for the plate circuits of tubes V1, V2, and V4.

6. Blocking Oscillator V1
(fig. 3)

The blocking oscillator stage uses a dual-triode 6101/6J6WA tube connected as a single triode. The tube with its associated circuit is a free-running positive bias blocking oscillator that generates triggering pulses for the multivibrator at an adjustable repetition rate.

a. When MODULATION switch S1 is set to the ON position, plate voltage of +105 volts is applied to the plates of tube V1, This voltage makes V1 conduct and plate current will begin to flow from ground, up through resistor R5, through V1, through the primary windings (1 and 2) of transformer T1, and through R1. As plate current increases, a magnetic field builds up in the primary windings and induces a voltage in the secondary windings (3 and 4) of transformer T1. This induced voltage drives the grid of V1 positive (with respect to the cathode), more plate current flows through the primary of T1, and more voltage is induced in the secondary of T1. As the positive bias voltage on the grid of V1 increases, grid current will flow and the parallel combination of capacitors C1B and C2 will charge up to the voltage across the secondary of T1. This charge will occur almost instantaneously because the capacitors will charge through the cathode to grid resistance of V1, which is very low when V1 is conducting and grid current is flowing.

b. The actions described in *a* above will continue until V1 reaches plate current saturation. Saturation is the condition

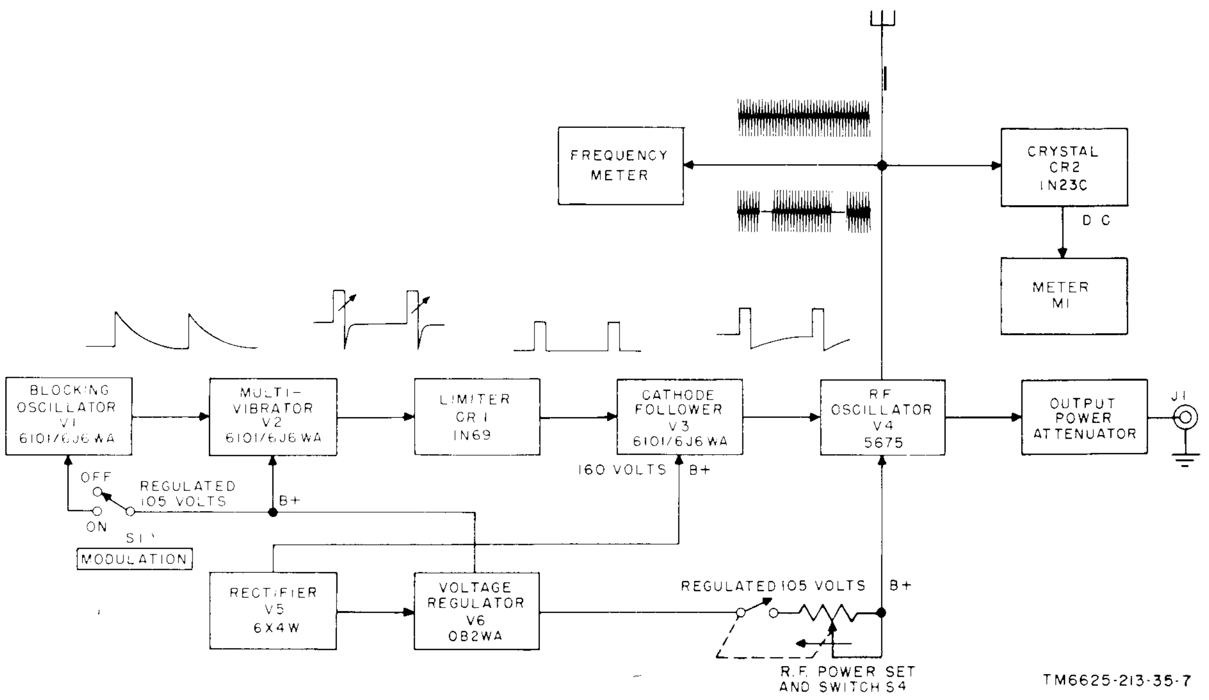

Figure 1. Test Set TS-538(*)/U, block diagram.

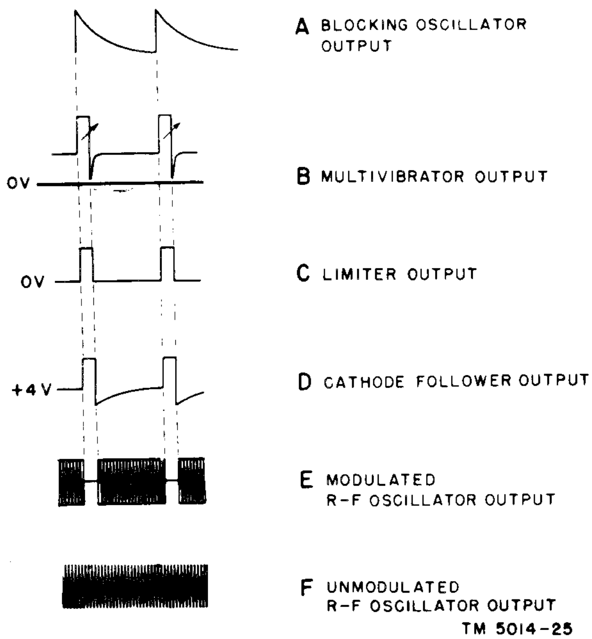

Figure 2. Test Set TS-538(*)/U, voltage waveforms and time relationships.

reached when a further increase in the positive grid bias voltage will not cause a corresponding increase in the plate current of V1. Whenthe rateofcurrentcharge through the primary starts to decrease, the magnetic field collapses and induces a large voltage of opposite polarity in the secondary of T1. This large induced voltage drives the grid of V1 negative (with respect to the cathode) and cuts off plate current in V1. When V1 cuts off, no current flows through the primary and no voltage is induced in the secondary of T1. Since there is no longer any voltage at the secondary of T1, C1B and C2 will discharge through R2, R3, and R4. Tube V1 will continue to be cut off, by the negative bias voltage across C1B and C2, until C1B and C2 discharge to the cutoff value of V1. Tube V1 will then conduct and the cycle will repeat.

c. The time required for the capacitors to discharge establishes the repetition rate of the blocking oscillater and is determined by resistors R2, R3, and R4. Variable resistor R3 is adjusted (para 33) so that REPETITION RATE control R4 gives a range of 5 to 200 pulses per second in accordance with the panel calibration.

d. The inductance of T1 and the circuit capacity are such that the tube tends to oscillate at a frequency of 2 megacycles during the conducting period. Capacitor C1A and resistor R1 form a decoupling filter to keep rf voltage from the power supply. When the tube conducts, the voltage at the cathode rises sharply because C3 can charge rapidly through the low plate resistance of V1. However, when the tube is cut off, the cathode voltage cannot fall rapidly because C3 must discharge through the large resistance of R5. The resulting waveform of the output voltage taken from the cathode of V1 is shown in A, figure 2.

7. Multivibrator V2

(fig. 4)

The multivibrator stage uses a dual-triode 6101/6J6WA tube connected in a one-shot cathode-coupled multivibrator circuit.

a. With no input trigger pulses from the blocking oscillator, one triode section of tube V2 is cut off while the other section is conducting. This condition is the result of the biasing arrangement used for the two triode sections. The grid of V2B is returned to the cathode through resistors R10 and R9. With no input from the blocking oscillator, no current flows through these resistors and the grid bias of V2B is zero; therefore, V2B conducts heavily. The plate current of V2B flowing through R7 causes a voltage drop across R7 with the polarity shown in figure 4. Since grid resistor R6 of V2A is connected to the negative end of R7 and the cathode to the positive end, the voltage drop across R7 is the bias voltage for V2A. This voltage is enough to keep V2A cut off in the absence of trigger pulses from the blocking oscillator.

b. The positive pulses from the cathode of V1 are applied to a differentiating circuit consisting of C4 and R6. Differentiation of the rapidly rising edge of the input voltage causes sharp, positive pulses of short duration to be developed across R6 which are applied to the grid of V2A.

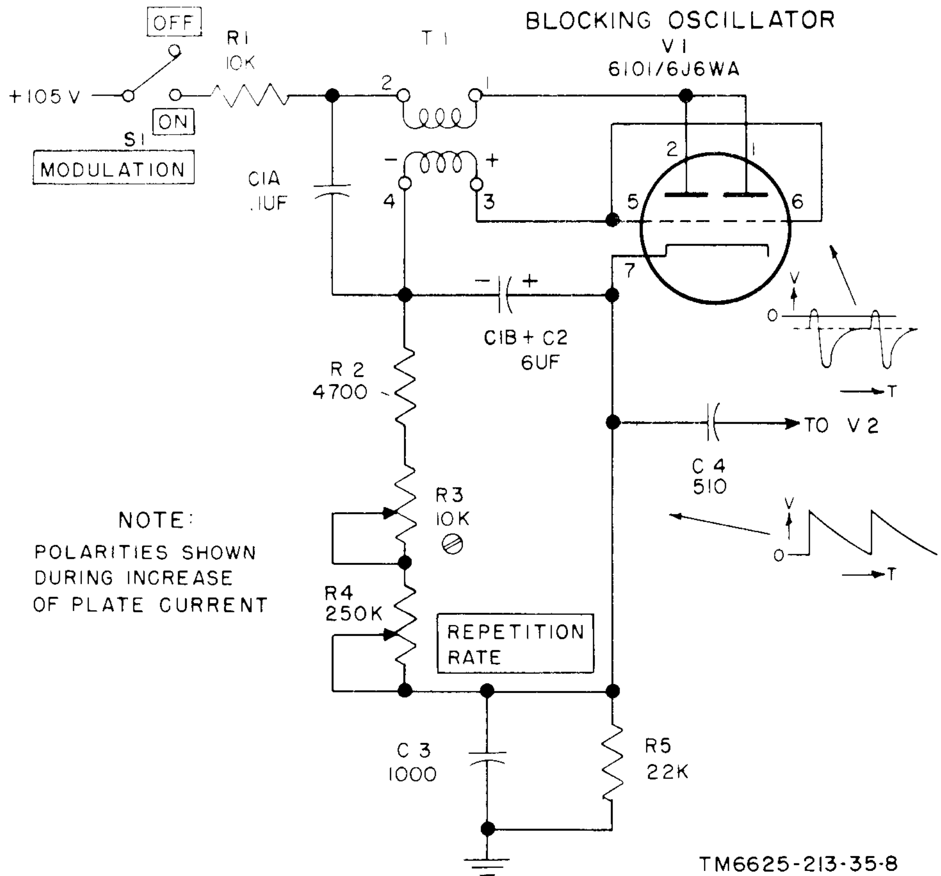

Figure 3. Test Set TS-538(*)/U, blocking oscillator V1, simplified schematic diagram.

c. While cut off, the voltage at the plate of V2A is the full supply voltage of +105 volts, and C5 charges to this voltage through R7 (the plate to grid resistance of V2B, which is very low when V2B is conducting) and R8. When a positive pulse from the differentiating circuit is applied to the grid, V2A will conduct and plate current will flow through R7 and R8. This plate current will result in a voltage drop across R8 which will decrease the amount of voltage at the plate of V2A. Capacitor C5 will then discharge to this decreased plate voltage through R10, R9, and the plate resistance of V2A, which is very low when V2A is conducting. This discharge current will result in a high negative bias voltage to be dropped across R10 and R9. This bias voltage will cut off V2B.

d. Triode section V2B remains cut off until C5 discharges enough to decrease the negative bias voltage on the grid of V2B. When the negative bias voltage decreases, V2B will conduct and plate current will flow through R7 and R11. The current through R7 will cause a negative bias voltage to be developed across R7 which will cut off V2A. When V2A is cut off, C5 will recharge to the value of the supply voltage. The multivibrator is now in its original state and will remain in this condition until the application of the next positive pulse to the grid of V2A.

e. During the time that V2B is cut off, its plate voltage is high. The output taken from this plate is, therefore, in the form of a positive rectangular pulse for each pulse from the blocking oscillator (A, fig. 2). The sharp negative spike immediately following the positive pulse is a result of a temporary high plate current in V2B when C5 charges. The charging current of C5 creates a high positive grid bias voltage across R10 and R9 which makes V2B conduct heavily. This positive grid bias voltage decreases steadily until C5 has become charged and the grid of V2B resumes its zero bias condition of stability. The duration of the positive pulse produced at the plate of V2B is determined by the length of time required for C5 to discharge. The time depends on the sum of the value of resistors R9, R10, and the plate resistance of V2A. Variable resistor R9 is adjusted to make this pulse width 45 microseconds ±5 (para 34).

8. Limiter CR1 and Cathode Follower V3 (fig. 4 and 5)

a. The limiter stage uses an IN43 or IN69 type crystal diode connected in a positive series diode limiter circuit.

(1) When cut off, the full supply voltage of +105 volts appears at the plate of V2B. Capacitor C6 charges to this voltage through R12 in parallel with R13 and CR1, and R11.

(2) When conducting, the voitage at the plate of V2B is decreased. Capacitor C6 discharges to this decreased value through R12, R7, and the plate resistance of V2B.

(3) Crystal diode CR1 has a low resistance when current flows against the arrow and a very high resistance when current tries to flow with the arrow. When C6 discharges, no current flows through R13. Therefore, when C6 charges, the voltage across R13 will be positive; when C6 discharges, the voltage across R13 will be zero.

b. The cathode follower stage uses a 6101/6J6WA dual-triode tube connected as a single triode.

(1) With no positive pulse app1ied across R13, the grid of V3 is at ground potential. The supply voltage of +160 volts is applied to the plate, and the plate current through V3 is limited to approximately 10 milliamperes by the plate resistance of the tube and the resistance of coil L2 in the cathode circuit. The cathode voltage at this time is approximately +4 volts. When a positive pulse is applied across

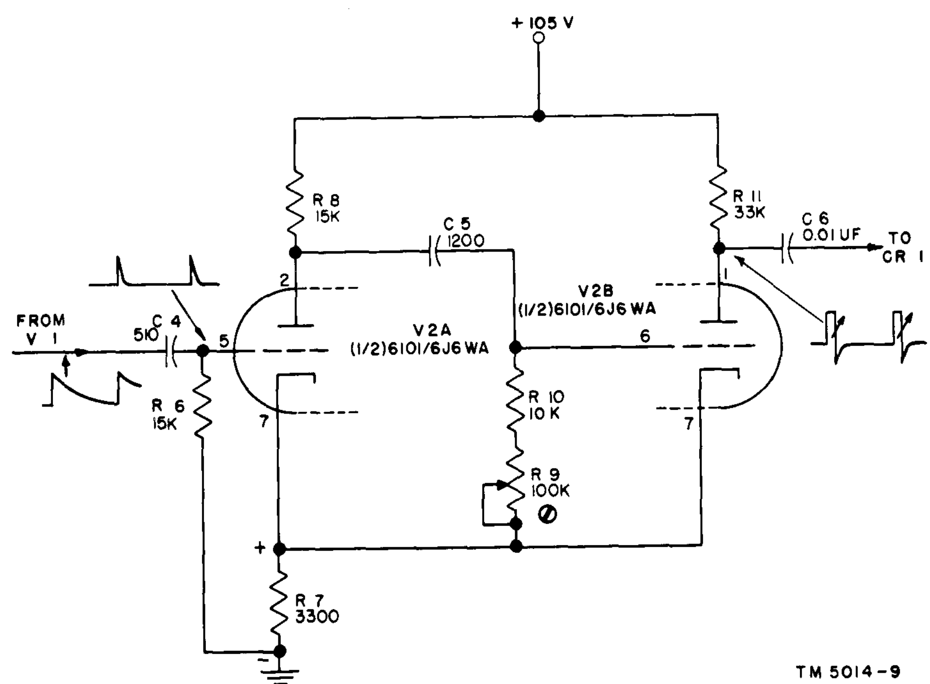

Figure 4. Test Set TS-538(*)/U, multivibrator V2, simplified schematic diagram.

R13, V3 is driven positive for the duration of the pulse (45 microseconds). The plate current of V3 increases and the cathode voltage rises above +4 volts during the input pulse. The rise in the cathode voltage is approximately equal to the rise in grid voltage.

(2) At the end of the positive pulse, the plate current of V3 is reduced sharply to its original value. The sudden decrease of current through the cathode coil causes a voltage to be induced in L2 which drives the cathode voltage below its original value of +4 volts; then, during the interval between pulses, the cathode voltage gradually rises to its original value of +4 volts in preparation for the next input pulse. The gradual rise in cathode voltage is caused by charging capacitor C8 (fig. 7) which is connected to the cathode of V3 through L4. In the TS-538C/U, L4 is omitted. The cathodes of V3 and V4 are connected together, through L4 (directly in TS-538C/U), so that the pulse voltage is the same at the two cathodes.

(3) The cathode of V3 is also connected to the PULSE jack on the front panel to allow convenient checking of the pulse width and rate.

9. Rf Oscillator V4

(fig. 6, 7, and 8)

The rf oscillator assembly consists of resonant cavities, oscillator tube V4, built-in isolation impedances for the supply leads, and a dual output provision: one for monitoring and one for delivering rf power to the apparatus under test. The assembly varies somewhat between models of the test set as described in *b* and *c* below.

a. Oscillator Tube Construction. The rf oscillator tube is a pencil-type, medium mu triode with coaxial cylindrical elements. The construction of the tube is shown in figure 6. The tube has a metal cylinder at each end, joined together by

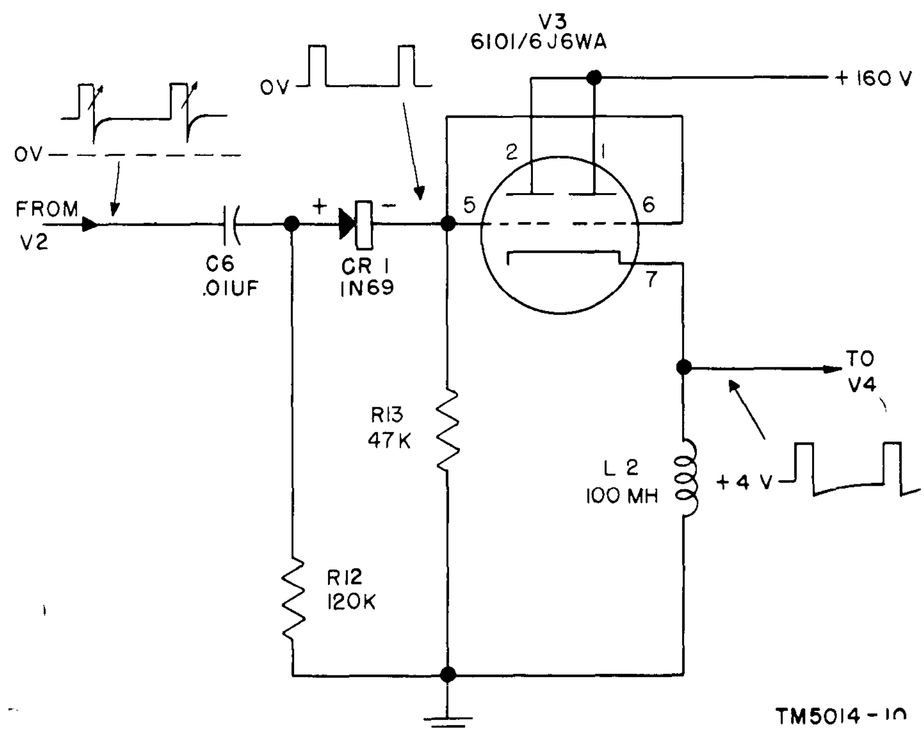

Figure 5 Test Set TS-538(*)/U, limiter CR1 and cathode follower V3, simplified schematic diagram.

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two glass cylinders. At the center of the tube is a large metal disk which supports the grid. The upper metal cylinder is the anode or plate. It is made of steel and heavily plated with silver to reduce resistance. The grid is a cylindrical mesh supported from one end by a steel and silver-plated grid support disk. The cathode, consisting of a Short length of nickel tubing, is connected to and supported by the metal cylinder at the lower end of the tube. Connections to the heater are made through two wires projecting through a glass button sealed in the lower end of the tube. A short copper exhaust tube is inserted in the upper end of the plate cylinder. The exhaust tube is sealed after the tube is evacuated.

b. Oscillator Assembly Construction in Test Set TS-538/U, TS-538A/U, and TS-538B/U. The parts that make up the oscillator assembly are shown in figure 18. Oscillator tube V4 is mounted in a coaxial resonant cavity within which it is supported by the grid support disk. Since the grid is to be kept at ground potential, grounding of the large diameter grid support disk physically separates, the plate and cathode circuits to provide effective isolation between them. The center conductor of the cathode coaxial cavity is the cathode support cylinder of the oscillator tube itself. Similarly, the center conductor of the plate coaxial cavity is the plate cylinder of the oscillator tube. To tune either the cathode or plate cavity, the length of the cavity (the point at which the center conductor is shorted to the outer conductor of the coaxial cavity) is adjusted. The cathode circuit is tuned by screwing the cathode plunger in or out according to the instructions in paragraph 38. The short between the outer and inner conductors is made capacitive rather than direct to enable the bias voltage and the modulating pulses to be applied to the cathode. These voltages are applied to the cathode through polyiron choke L4 and a cathode clip which is fastened to the cathode support cylinder of the oscillator tube. Connections to the heater are made through socket XV which is of the type used with subminiature tubes. One side of the heater is grounded and the other side is connected through polyiron choke L3 to the filament supply voltage. Tuning of the plate cavity is accomplished by adjusting the position of the plate plunger. The plate plunger has spring contacts which connect to the inner conductor, the plate cylinder, and to the outer conductor of the cavity, providing a capacitive short between the conductors. The position of the plunger along the axis is controlled through the tuning shaft and bellows arrangement, by the OSCILLATOR FREQUENCY dial on the front panel. The dc operating voltage is supplied to the plate cylinder through polyiron choke L6. The rf energy from the plate cavity is coupled to the attenuator assembly and to the frequency meter and detector unit assembly.

c. 0scillator Assembly Construction in Test Set TS-538C/U. The parts that comprise the oscillator assembly in Test Set TS-538C/U are shown in figure 19. They differ in several details from those of earlier models, especially in the construction of the cavities. Oscillator tube V4 is concentrically mounted in a coaxial resonant cavity and supported by the grid disk. In addition to supporting the tube, the grounded grid disk physically and electrically isolates the two cavities from each other. The center conductor of the cathode cavity is the cathode support cylinder of the oscillator tube itself. Similarly, the center conductor of the plate cavity is the plate cylinder contact of the tube, extended by the added plate line, E51. This plate line is centered at the inner end of the plate cavity by means of threaded teflon bead E50, keyed to its shaft. A wire threaded through this teflon bead conducts B+ potential from the outer wall of the cavity (plate and sleeve E49) to the plate line and thus to the plate of the tube. Capacitive tuning of the cavity is accomplished by adjusting the position of plate plunger E48 which is mechanically controlled by the tuning dial. The plate plunger is a metal ‘shaft and teflon bead assembly that is threaded to fit threads inside the plate sleeve. Tuning of the cathode cavity is accomplished as described in paragraph 38. Connections to the heater are made through socket XV4 which is of the subminiature type. One side of the filament is grounded through C7. The B+ potential is applied through feedthrough capacitors C13 and C12 and the section of transmission line. The rf energy is taken from the plate cavity through the attenuator and J1.

d. Oscillator Theory. The simplified schematic diagram of the rf oscillator circuit (fig. 7) represents the circuit used in Test Set TS-538(*)/U.

(1) The plate and cathode coaxial cavities are replaced by equivalent parallel resonant circuits, forming a tuned plate, tuned cathode, grounded grid oscillator. Polyiron choke L6 and capacitor C12 (C13 in the TS-538C/U) prevent rf energy from entering the B supply, polyiron choke L4 and capacitor C8 isolate the cathode follower from the rf currents, and polyiron choke L3 and capacitor C7 (fig. 33 and 34) isolate the filament supply. The rf energy is coupled from the plate tank circuit to output jack J1 (through the attenuator assembly) and to the frequency meter and detector unit assembly.

(2) Coil L2 is common to the cathode circuit of cathode follower V3 and oscillator V4. The voltage at the cathode of V3 is applied to the cathode of V4. When the MODULATION switch is turned off, the voltage at the cathode of V3 is approximately +4 volts. Since the grid of V4 is at ground potential, bias voltage of -4 volts is applied to the rf oscillator tube. Under this condition, V4 will oscillate continuously and supply a cw output. When the MODULATION switch is turned ON, the voltage at the cathode of V3 rises for the duration (45 microseconds) of the pulse from the multivibrator. The cathode voltage of V4 also rises and the rise is sufficient to interrupt the oscillations. At the end of the multivibrator pulse, the cathode voltage is reduced and the oscillations start again. If the cathode voltage is returned to +4 volts at the end of the pulse, oscillations would build up comparatively slowly. Actually, the cathode voltage is reduced to a value less than +4 volts at the end of the pulse so that the oscillations can build up more rapidly to their full amplitude.

(3) The rf oscillator circuit may be considered equivalent to that of a conventional Colpitts oscillator. The equivalent rf circuit, including the plate and cathode resonant circuits and the capacitance between plate and cathode C_{pk}, is shown in A, figure 8. The plate-to-grid capacitance is included in Cp (capacitance in the cathode tuned circuit) and the grid-to-cathode capacitance is included in C_k (capacitance in the cathode tuned circuit). Parts B and A of figure 8 are identical, except that the circuit elements have been rearranged. Parallel arrangement of C_k and L_k presents a capacitive reactance to the frequency of oscillation. This capacitive reactance forms a voltage divider with C_{pk} that supplies a grid-to-cathode voltage out of phase with the plate voltage; this satisfies a necessary condition for oscillation. When the cathode circuit is tuned to a frequency *below* the frequency of oscillation, it can be replaced by an equivalent capacitance C_1 (C, fig. 8). If the reactance of the cathode circuit were inductive, the phase of the grid-to-cathode vo1tage would be reversed and oscillations could not be sustained. Since at least one inductive reactance is required to form a tank circuit, the plate circuit must present an inductive reactance to the frequency of oscillation, This occurs when the plate circuit is tuned to a frequency above the frequency of oscillation. The plate circuit may then be replaced by an equivalent

inductance L_1 (C, fig. 8). The resulting equivalent circuit (C, fig. 8) is similar to that of a Colpitts oscillator.

(4) Capacitor C_1 (C, fig. 8) must be large in comparison to C_{pk} because only a small portion of the plate rf voltage must be applied between grid and cathode to maintain oscillations. In effect, the total capacitance in the tank circuit is determined by C_{pk} (C_{pk} and C_1 are connected in series) and is comparatively independent of the value of C1. For this reason, the tuning of the cathode cavity has relatively little effect upon the oscillator frequency. The cathode cavity is adjusted for maximum output from the oscillator tube. Tuning the plate cavity varies L_1 and has considerable effect on the oscillator frequency. The plate cavity is tuned by the OSCILLATOR FREQUENCY control which gives an oscillator frequency range of 1,630 to 1,730 mc (1,615 to 1,715 mc in the TS-538C/U).

(5) The R. F. POWER SET control (R20, fig. 7) adjusts the dc voltage applied to the plate of oscillator tube V4. The amount of output power obtained from the oscillator is controlled in this manner.

10. Output Power Attenuator

The rf energy from the plate cavity of the rf oscillator is propagated into a circular waveguide of variable length and is fed to output jack J1. This entire assembly, called the output power attenuator, is shown in figure 20. The inner diameter of the waveguide is less than one-half wave length of the rf oscillator frequency; therefore, the cutoff frequency of the waveguide is greater than the oscillator frequency so that the wave is attenuated as it passes through the waveguide. The attenuation caused by this type of waveguide is proportional to the length of the waveguide section. The OUTPUT POWER control on the front panel, through

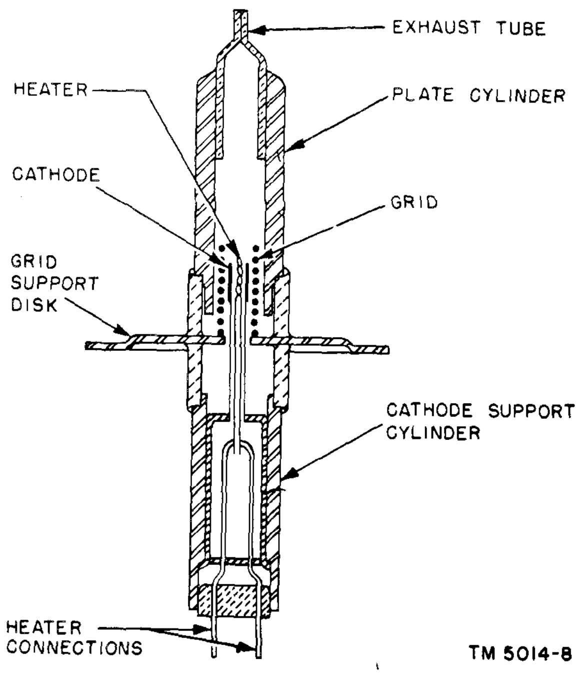


Figure 6. Test Set TS-538(*)/U, rf oscillator V4, cross-sectional view.

a rack drive gear and a sliding section of wave guide, controls the length of waveguide in use, and thereby controls the amount of power available at output jack J1. The output is picked up by a movable resistive loop (R22, fig. 33 and 34) which is connected to J1. The OUTPUT POWER control is calibrated directly in decibles referred to 1 milliwatt (dbm) to show the rf power available at J1. This calibration holds true only when the total rf power generated by the oscillator is at a fixed reference level. This level is set by turning the R. F. POWER SET control until the power monitor meter indication is at the SET POWER point, with the frequency meter detuned from resonance.

11. Frequency Meter

Part of the output of the rf oscillator is taken from the plate cavity by a resistive pickup loop (R21) and fed to the frequency meter cavity through an rf coupler, The entire frequency meter and detector unit assembly, including the frequency meter cavity, the rf coupler, and the crystal unit, is shown in figure 11 of

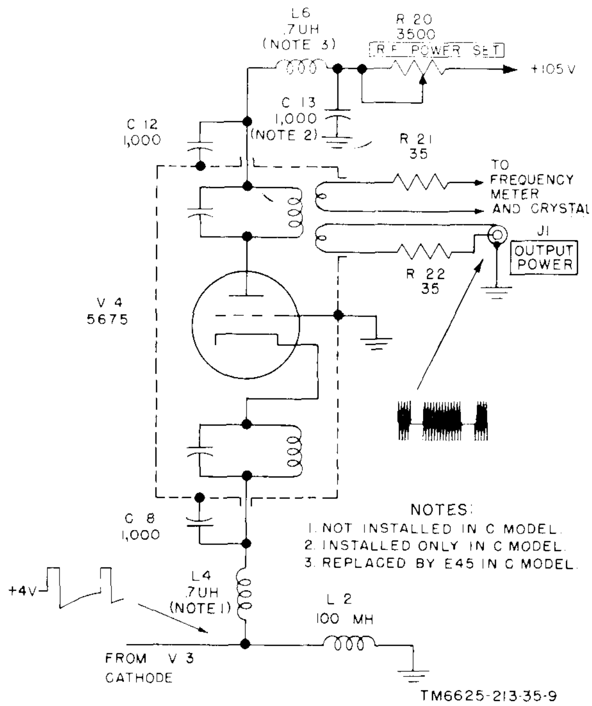


Figure 7. Test Set TS-538(*)/U, rf oscillator V4, simplified schematic diagram.

TM 11-6625-213-12. The frequency meter cavity is of the coaxial-line type. It consists of an adjustable quarter-wave section of coaxial line, The coaxial line is made up of a cylindrical cavity outer conductor and a solid rod inner conductor. The protrusion of the inner conductor into the cavity is controlled by the FREQUENCY METER knob on the front panel. The center conductor is short-circuited to the outer conductor at the threaded end. The projecting end is isolated and far enough away from the other end of the cavity to be effectively an open circuit. When the inner conductor projects into the cavity approximately one-quarter wave length for the frequency in the rf coupler, the cavity resonates. The high impedance of the cavity at resonance produces a large reflection loss and absorbs power; this reduces the power applied to the crystal circuit and registers as a dip on the power monitor meter for indicating purposes. The FREQUENCY METER dial is calibrated directly in mc, with a total range of 1,630 to 1,730 mc (1,615 to 1,715 mc in the TS-538C/U).

12. Crystal CR2 and Meter M1

(fig. 9)

a. Crystal CR2, which is either a type 1N21B or 1N23B, is connected to the same pickup loop that couples power fro-m the oscillator cavity to the frequency meter cavity. The crystal rectifies the rf current. When V4 is oscillating, rectified current flows through the crystal and through the meter circuit, causing deflection of the meter. Polyiron choke L5 and the capacitance to ground form an rf filter. Since the current through the meter is proportional to the rf power entering the crystal, the meter deflection is proportional to the rf output of the oscillator. When the frequency meter resonates, the current through the crystal and meter circuit is decreased, causing the meter pointer to dip sharply to the left as the frequency meter passes through resonance. When the FREQUENCY METER knob is adjusted for maximum dip of the meter pointer, the FREQUENCY METER dial indicates the true frequency of the test set output. An antenna may also be connected to the frequency meter and detector unit assembly and, when an external transmitter is located near the antenna, its frequency may be determined by use of the frequency meter. Current also flows through the crystal and meter circuit, causing deflection of the meter proportional to the transmitter output. If the transmitter is located at some fixed distance from the antenna of the test set, the test set meter may be calibrated. When Radiosonde Transmitter T-93/AMT-4 is held at a distance of 8 inches from the test set antenna, the meter should deflect into the GOOD section of the scale if the transmitter is acceptable. When the frequency meter is not tuned to resonance and the antenna is not attached to the test set, the crystal and meter circuit is used to set the output of the test set oscillator to a reference level. The R. F. POWER SET control is adjusted until the meter pointer is at the SET POWER point on the scale; then the calibration on the OUTPUT POWER dial indicates the amount of power in -dbm available at output jack J1.

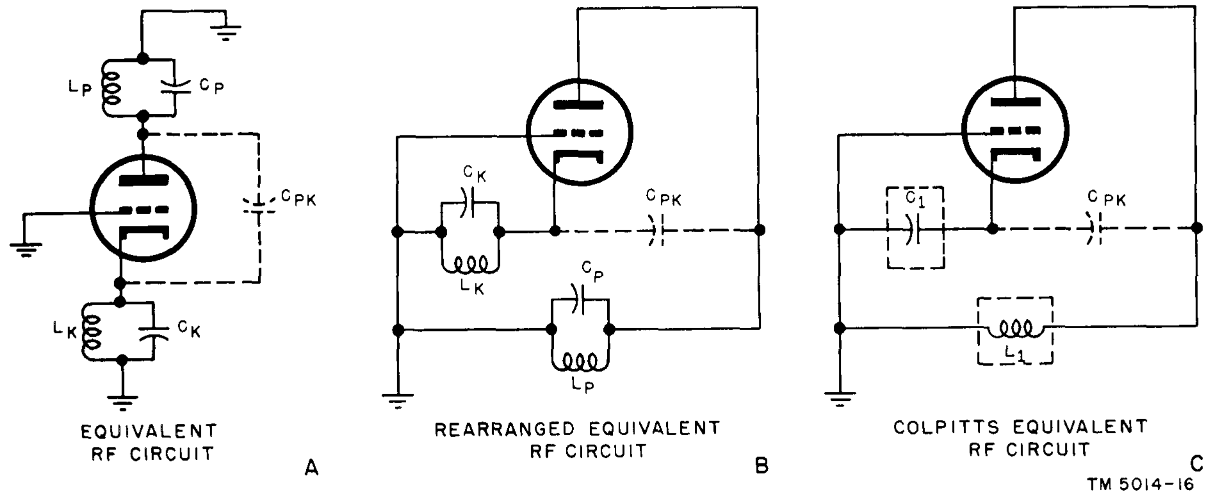


Figure 8. Test Set TS-538(*)/U, rf oscillator V4, equivalent circuits.

b. The operation of crystal CR2 can be checked by means of CRYSTAL CHECK switch S2 on the front panel. When the switch is held to the left, a portion of the filament voltage is applied to the crystal and meter circuit through switch section S2A. At the same time, switch section S2B makes rectifier V5 inoperative so that, with no B+ voltage, oscillator V4 does not function (fig. 33 and 34). With the switch held to the left, the power monitor meter indication should be approximately at the SET POWER point if the crystal is good. If the crystal is known to be good but the correct meter indication is not obtained, R17 should be adjusted while the CRYSTAL CHECK switch is held to the left until the correct meter reading is obtained.

13. Rectifier V5 and Voltage Regulator V6

(fig. 33 and 34)

a. The rectifier stage uses a duo-diode 6X4W tube connected in a full-wave rectifier circuit with a pi-type capacitor-input filter,

(1) When J2 is connected to a 117-volt ac power source and the POWER switch is set to the ON position, ac current will flow in the primary windings (1 and 2) of transformer T2. Fuses F1 and F2 protect the transformer against an overload in current and from shorts in the secondary circuits of T2.

(2) Windings 6 and 7 step down the voltage induced from the primary of T2 to 6.3 volts ac. This ac

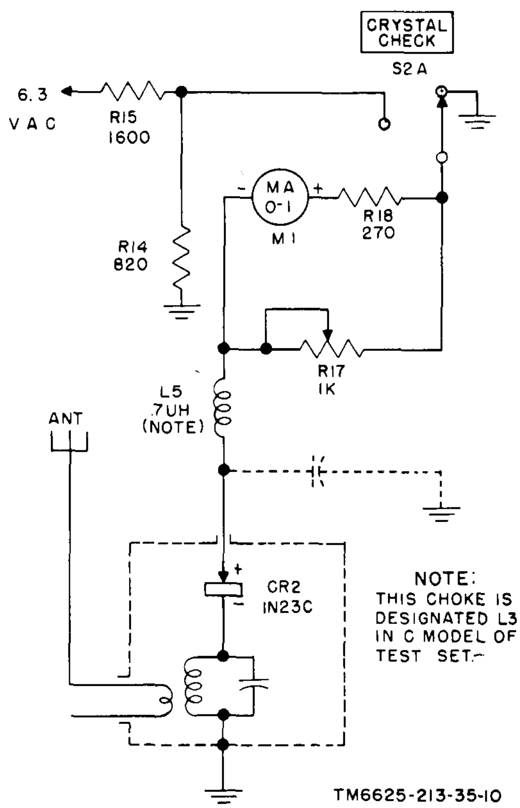


Figure 9. Test Set TS-538(*)/U, frequency meter, crystal, and panel meter circuit, simplified schematic diagram.

voltage is used to supply filament power for tubes V1, V2, V3, and V5.

(3) Windings 3, 4, and 5 step up the voltage induced from the primary of T2 to 370 volts ac. When the R. F. POWER SET control is set to a clockwise position, pin 4 of T2 is grounded, thereby completing the dc path for the rectifier circuit. The ac voltage across windings 3, 4, and 5 of T2 is constantly changing in polarity. When pin 3 becomes more positive than pin 5 of T2, current will flow from pin 3 to pin 4 of T2, up to capacitors C9 and C10, through coil L1, through pins 7 and 1 of V5, and back to pin 3 of T2. When pin 5 becomes more positive than pin 3 of T2, current will flow from pin 5 to pin 4 of T2, up to capacitors C9 and C10, through coil L1, through pins 7 and 6 of V5, and back to pin 5 of T2.

(4) The voltage across C9 is a pulsating dc. Coil L1 smooths out the pulsations so that the voltage across C10 is almost pure dc. The dc voltage across C10 is approximately 90 percent of the voltage across windings 3 and 4 or 4 and 5 of T2, or +160 volts. This voltage is applied directly to the plate of cathode follower V3.

b. The voltage regulator stage uses a gas-filled cold-cathode OB2WA tube.

(1) When V5 begins to conduct, the +160 volts developed across C10 is applied across voltage regulator tube V6. This voltage is enough to ionize the gas in the tube. The degree of ionization of this tube varies with the amount of current flowing through it. When a large current flows through the tube, the gas is highly ionized and the internal impedance of the tube is low; conversely, when a small current flows through the tube, the gas is ionized to a much smaller degree and the impedance of the tube is high. This condition keeps the voltage drop across the tube at a constant +105 volts.

(2) This voltage is applied to tubes V1, V2, and V4. The remaining +55 volts is dropped across R19. Resistor R19 is also used to limit the maximum amount of current flowing through V6 so that the current rating of the tube will not be exceeded.

CHAPTER 2

TROUBLESHOOTING

Section I. GENERAL TROUBLESHOOTING TECHNIQUES

Warning: Certain points located throughout the chassis of the test set operate at voltages above 150 volts. Do not touch these points while power is applied to the test set. Be very careful when handling or testing any part of the test set while it is connected to the power source.

14. General Instructions

Troubleshooting at field and depot maintenance level includes all the techniques outlined for organizational maintenance and any special or additional techniques required to isolate a defective part. The field maintenance and depot procedures are not complete in themselves but supplement the procedures described in TM 11-6625-213-12. The systematic troubleshooting procedure, which begins with the operational and sectionalization checks that can be performed at an organizational level, must be completed by means of sectionalizing, localizing, and isolating techniques.

15. Organization of Troubleshooting Procedures

a. General. The first step in servicing a defective test set is to sectionalize the fault, Sectionalization means tracing the fault to the major component (or in the case of the test set, to the major circuit responsible for the abnormal operation of the test set). The second step is to localize the fault. Localization means tracing the fault to the defective part responsible for the abnormal condition. Some faults, such as burned-out resistors, arcing, and shorted transformers often can be located by sight, smell, and hearing. The majority of faults, however, must be localized by checking voltages and resistances.

b. Sectionalization and Localization. The tests listed below will aid in isolating the trouble. The first step in tracing trouble is to locate the major circuit at fault, and then isolate the trouble within that circuit by voltage, resistance, and continuity measurements.

(1) *Visual inspection.* The purpose of visual inspection is to locate faults without testing or measuring the circuits. All meter readings or other visual signs should be observed and an attempt made to sectionalize the fault to a particular unit.

(2) *Operational tests.* Operational tests frequently indicate the general location of trouble. In many instances, the tests will help in determining the exact nature of the fault. The daily preventive maintenance checks and services chart (para 20, TM 11-6625-213-12) is a good operational test.

(3) *Voltage and resistance measurements.* Use resistor and capacitor color codes (fig. 31 and 32) to find the value of the components, Use voltage and resistance diagrams (fig. 10 and 11) to find normal readings, and compare them with readings taken.

(4) *Troubleshooting chart.* The trouble symptoms listed in the charts (TM 11-6625-213-12 andpara *18d)* will aid in localizing trouble to a component part.

(5) *Intermittent troubles.* In all these tests, the possibility of intermittent troubles should not be overlooked. If present, this type of trouble may be made to appear by tapping or jarring the equipment. Be very careful when doing this, because additional troubles may

occur. This is particularly true in the case of the rf oscillator, miniature tubes, crystals, etc. It is possible that some external connection may cause the trouble. Test the wiring (fig. 35 and 36) for loose connections and move the wires and components with an insulated tool, such as a pencil or fiber rod. This action may show where a faulty connection or component is located.

16. Test Equipment Required for Troubleshooting

The following chart lists test equipment required for troubleshooting Test Set TS-538(*)/U, the associated technical manuals, and the assigned common names.

Test equipm	Technical manual	Common name
Multimeter TS-352(*)/U[a].	TM 11-5527 ------	Multimeter.
Test Set, Electron Tube TV-7(*)/U[b].	TM 11-6625-274-12	Tube tester.
Test Set, Electron Tube TV-2(*)/U[c].	TM 11-6625-316-12	Electron tube tester.
Tool Equipment TK-87/U.	SB 11-526 --------	Tool Equipment.

[a]Indicates Multi meters TS-352/U, TS-352A/U, and TS-352B/U.
[b]Indicates Test Sets, Electron Tube TV-7/U, TV-7A/U, TV-7B/U, and TV-7D/U.
[c]Used at fifth echelon only and indicates Test Sets, Electron Tube TV-2/U, TV-2A/U, TV-2B/U, and TV-2C/U.

Section II. TROUBLESHOOTING TEST SET TS-538(*)/U

Caution: Do not attempt removal or replacement of parts before reading the instructions in paragraph 21.

17. Checking B+ Circuits for Shorts

a. *When to Check.* When any of the following conditions exist, check for short circuits and clear the trouble before applying power:

(1) When the test set is being serviced, and the nature of the abnormal symptoms is not known.

(2) When abnormal symptoms reported from operational tests indicate possible power supply troubles.

b. *Conditions for Tests.* Prepare for the short-circuit tests as follows:

(1) Remove the test set from its case (para 21).

(2) Set the MODUALTION switch to ON.

(3) Turn the R. F. POWER SET dial clockwise until the switch clicks.

(4) Turn or switch off all other switches.

c. *Measurements.* Make the resistance measurements indicated in the following chart. If abnormal results are obtained, make the additional isolating checks outlined, When the faulty part is found, repair the trouble before applying power to the unit.

Short-circuit tests

Point of measurement	Normal indication	Isolating procedure
Between pin 7 and pin 4 of tube V5 (fig. 10 and 11).	Infinite resistance -----------	If resistance is zero, check for shorted filter capacitor C9 or C10.
Between pin 5 and pin 2 of tube V6 (fig. 10 and 11).	Infinite resistance -----------	If resistance is zero, check for shorted capacitor C11. If resistance is low, check for a shorted bypass capacitor in one of the plate circuits of tubes V1 through V4 (fig. 33 and 34) or for leakage in one of the filter capacitors (C9, C10, or C11).

18. Localizing Troubles

a. General. In the troubleshooting chart (*d* below), procedures are outlined for localizing troubles to a stage within the sections of the test set. Parts locations are indicated in figures 12 through 15. Voltage and resistance measurements are shown in figures 10 and 11. Depending on the nature of the operational symptoms, one or more of the localizing procedures will be necessary. When trouble has been localized to a particular stage, use voltage and resistance measurements to isolate the trouble to a particular part.

b. Use of Chart. The troubleshooting chart is designed to supplement the operational checks detailed in TM 11-6625-213-12.

Caution: If operational symptoms are not known, or if they indicate the possibility of short circuits within the indicator, make the short-circuit checks described in paragraph 17 before applying power to the unit.

c. Conditions to Tests. All checks outlined in the chart are to be conducted with the test set connected to a 117-volt ac source.

d. Troubleshooting Chart.

Note: Perform the operations in the daily maintenance service and inspection chart (TM 11-6625-213-12) before using this chart, unless trouble has already been localized.

Symptom	Probable trouble	Correction
1. Filaments fail to light when POWER switch S3 is thrown to the ON position.	Fuses blown ------------------	Replace fuses F1 and F2. If they blow again, determine fault before renewing. Check C9, C10, C11, and C12.
	Heater winding or primary winding of transformer T2 open or shorted.	Make continuity tests of power transformer windings. Make resistance checks.
2. No deflection of power monitor meter when CRYSTAL CHECK switch is pushed to the left.	Same as above ---------------	Same as above.
	Defective crystal CR2 --------	Replace crystal CR2 (TM 11-6625-213-12).
	Defective meter or crystal circuit components.	Check components R14, R15, R18, M1, and S2.
3. Meter deflection more than 1/4 inch below SET POWER point when CRYSTAL CHECK switch is held to the left. Antenna not attached.	Defective crystal CR2 --------	Replace crystal. If reading is still incorrect after trying several crystals, recalibrate crystal circuit (para 32).
4. Power monitor meter does not deflect when R. F. POWER SET control is rotated clockwise, but deflection is normal for crystal check.	Defective rf plumbing --------	Check and replace plumbing.
	Defective rf circuit ----------	Check voltage at plate connection or rf oscillator assembly. Voltage should vary linearly from +70 to 105 volts as R. F. POWER SET control is varied. If voltage remains at +105, rf tube may be burned out. Before replacing tube, check entire rf circuit. Check fila- m volt Make continuity tests in plate and filament circuits.
5. Rf oscillator output is cw when MODULATION switch is in either the ON or OFF position.	Blocking oscillator inoperat	No plate voltage on tube V1. Check R1 and primary of transformer T1 for open circuit. Make voltage and resistance checks to localize trouble to a component.
	Multivibrator inoperative -----	Blocking oscillator signal not on grid of V2; check C4. Make resistance and voltage checks of entire circuit of V2.
	Cathode follower inoperative --	Check CR1, C6, and L2; replace if necessary. Make voltage and resistance checks.

19. Isolating Trouble Within Stage

When trouble has been localized to a stage, use the following techniques to isolate the defective part:

a. Test the tube involved, either in the tube tester or by substituting a similar type tube which is known to be operating normally.

b. Take voltage measurements at the tube sockets (fig. 10 and 11) and other points related to the stage in question.

c. If voltage readings are abnormal, take resistance readings (fig. 10 and 11) to isolate open and short circuits. Refer also to the dc resistances of transformers and coils in paragraph 20.

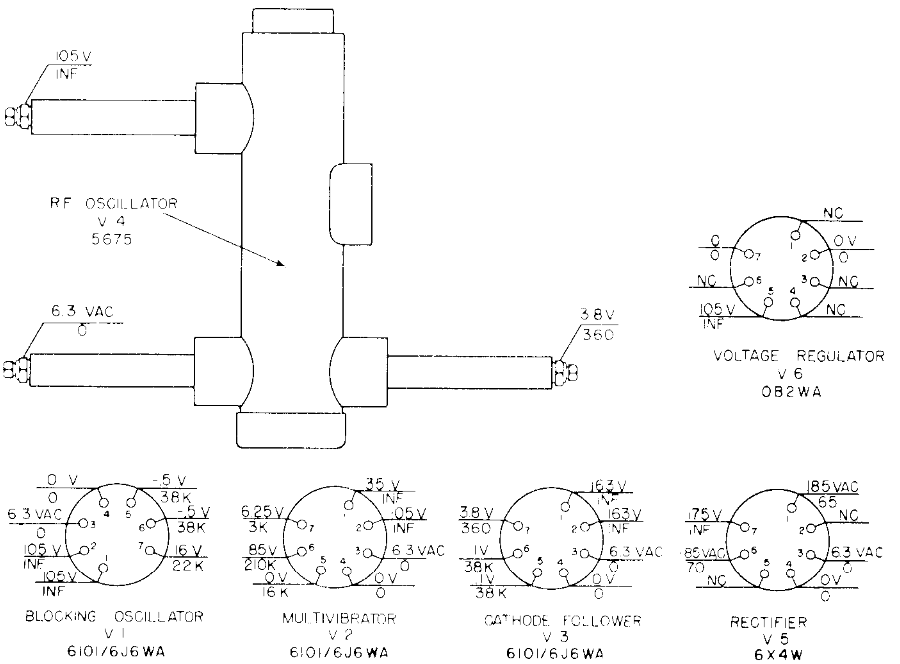
d. If all checks fail to indicate a defective part, check the calibration of the test set (para 31 through 38).

e. Use the wiring diagram (fig. 35 and 36) to trace circuits and to isolate the faulty component,

20. Dc Resistances of Transformers and Coils

The dc resistances of the transformer windings and the coils in the test set are listed below:

Transformer or coil	Terminals	Ohms
T1	1-2	Less than 1
	3-4	Less than 1
T2	1-2	8
	3-4	70
	4-5	70
	3-5	140
	6-7	
L1	---	308
L2	---	350



NOTES:

1 VOLTAGE READINGS ABOVE LINE, RESISTANCE READINGS BELOW LINE.
2 NC INDICATES NO CONNECTIONS, INF INDICATES INFINITE RESISTANCE
3 VOLTAGES ARE DC UNLESS OTHERWISE STATED.
4 VOLTAGES AND RESISTANCES MEASURED TO GROUND WITH A 20,000 OHMS-PER-VOLT METER WITH CONTROLS SET IN THE FOLLOWING POSITIONS

REPETITION RATE	200 CPS
OUTPUT POWER	100 DBM
OSCILLATOR FREQ	MAX CCW
R F POWER SET	MAX CW
MODULATION	ON
POWER	ON FOR VOLTAGE READINGS, OFF FOR RESISTANCE READINGS

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Figure 10. Test Sets TS-538/U, TS-538A/U, and TS-538B/U, voltage and resistance measurements.

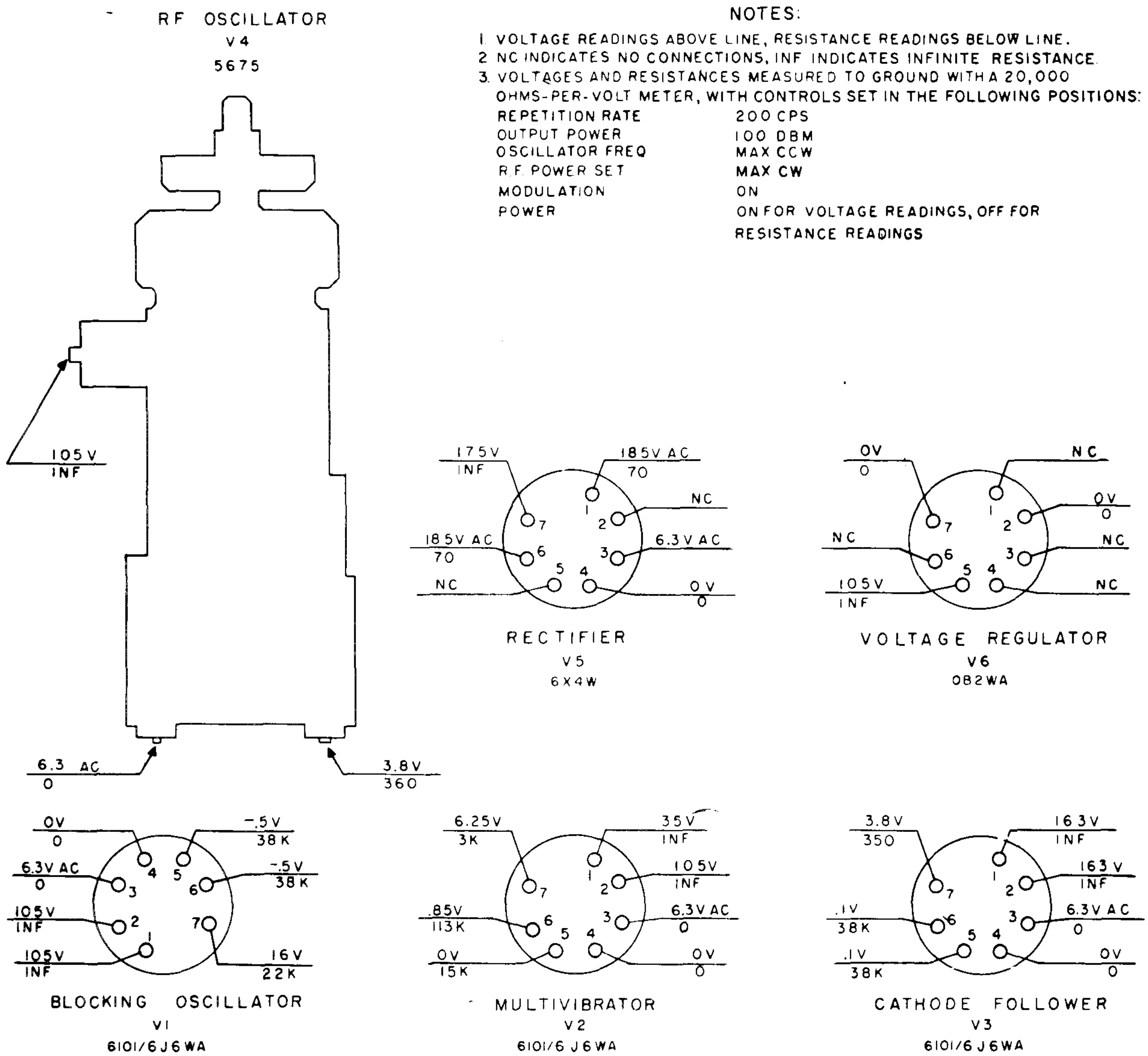


Figure 11. Test Set TS-538C/U, voltage and resistance measurements.

CHAPTER 3

REPAIRS AND CALIBRATION

Section I. REPAIRS

21. General

When the attenuator. frequency meter and detector unit, and rf oscillator assemblies are removed from the test set chassis, the calibration of the test set is affected. When reassembling these parts, refer to paragraphs 31 through 38 for calibration procedures. Refer to figures 12 through 15 for location of parts.

22. Removal and Replacement of Attenuator Assembly

The attenuator assembly must be removed before either the frequency meter and detector unit assembly or the rf oscillator assembly can be removed.

a. Removal.

(1) Loosen the six captive screws (fig. 4, TM 11-6625-213-12) on the front panel and lift the test set out of its metal case.

(2) Turn the OUTPUT POWER dial completely counterclockwise.

(3) Remove the four screws and lockwashers that hold the attenuator assembly to the rf oscillator assembly (fig. 13 and 14). Do not disturb the setting of the shaft collars (fig. 20).

(4) On the side of the chassis, remove the four screws and lockwashers that hold the attenuator cover in place. These screws are placed just above and below output jack J1.

(5) Under the cover plate, remove the two screws, nuts, and lockwashers that hold the end of the attenuator assembly to the side of the chassis.

(6) Carefully slide off the gear rack and attenuator assembly from the drive shaft pinion gear.

b. Replacement.

(1) Replace the attenuator assembly in the chassis, mating the gear rack with the drive shaft pinion gear.

(2) Secure the attenuator assembly to the oscillator assembly with the four screws and lockwashers *(a(3)* above).

(3) Secure the attenuator assembly to the chassis with the two screws, nuts, and lockwashers *(a(5)* above).

(4) Replace the cover plate and secure it with the four screws and lockwashers *(a(4)* above).

(5) Recalibrate the OUTPUT POWER control (para 37).

23. Removal and Replacement of Frequency Meter and Detector Unit Assembly

Before the frequency meter and detector unit assembly can be removed, the attenuator assembly must be removed as described in paragraph 21.

Note: When removing nuts and setscrews that have been covered with glyptal, dissolve the glyptal with acetone or other suitable paint remover before attempting to loosen the nuts or setscrews. Apply glyptal to each nut or setscrew that is replaced.

a. Removal.

(1) Loosen the two setscrews that hold the FREQUENCY METER dial knob.

(2) Remove the four screws and lockwashers that hold the frequency meter cavity to the underside of the chassis.

(3) Remove the two mounting screws, lockwashers, and nuts that hold the antenna. socket bracket (fig. 15) to the front panel.

(4) Remove the four screws and lockwashers that hold the frequency meter and detector unit assembly to the oscillator assembly.

(5) Remove the tube shields and tubes VI and V2 (fig. 15) directly in back of the frequency meter cavity.

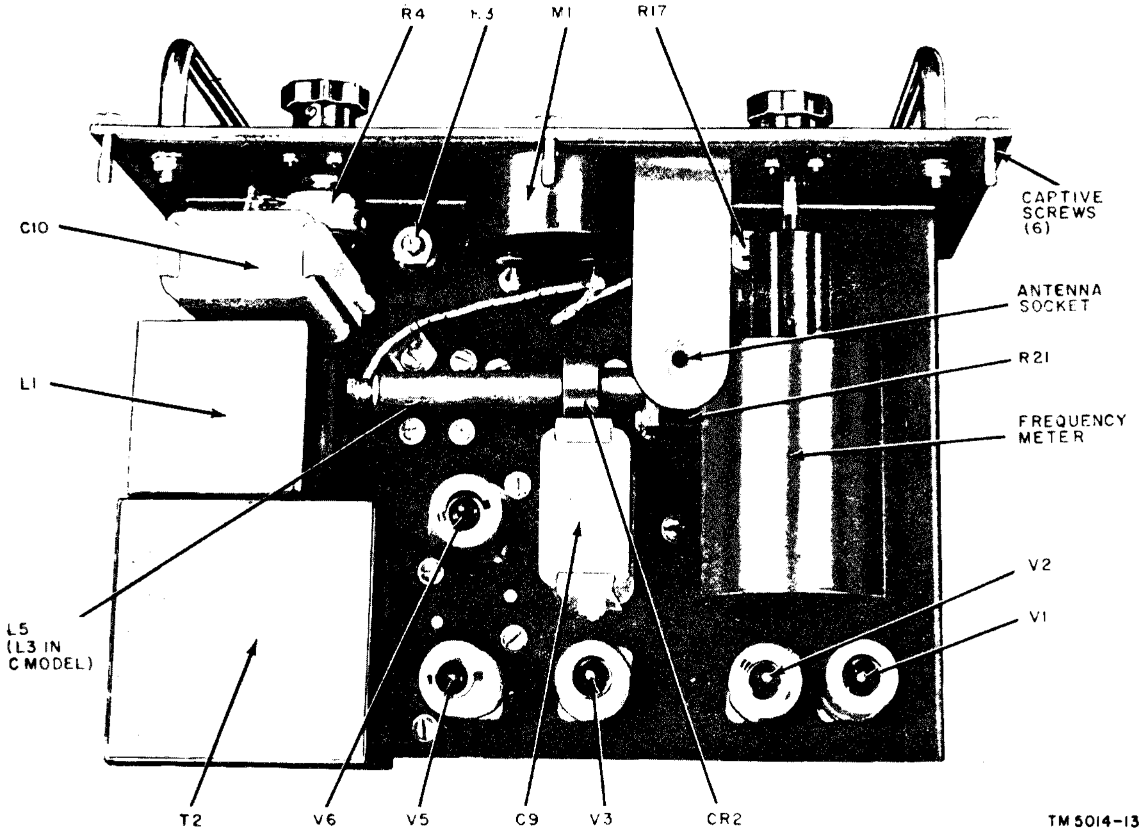


Figure 12. Test Set TS-538(*)/U, top view of chassis.

(6) Swing the frequent y meter cavity about 90°. On the top side of the chassis, remove the power monitor lead from L5 (fig. 12).

(7) Carefully pull the frequency meter and detector unit assembly away from the chassis:

b. Replacement.

(1) Replace the power monitor lead removed from L5.

(2) Secure the frequency meter cavity to the oscillator assembly with the four screws and lockwashers *(a(4)* above).

(3) Secure the frequency meter cavity to the chassis with the four screws and lockwashers *(a(2)* above).

(4) Secure the antenna socket bracket to the chassis with the two screws, lockwashers, and nuts *(a(3)* above).

(5) Replace the FREQUENCY METER dial and tighten the setscrews.

(6) Replace V1 and V2 in their sockets and replace their shields.

(7) Recalibrate the FREQUENCY METER dial (para 36).

24. Removal and Replacement of Rf Oscillator Assembly

Before removing the rf oscillator assembly, remove the attenuator assembly and the frequent y meter and detector unit assembly (para 36).

Note: When removing nuts and setscrews that have been covered with glyptal, dissolve the glyptal with acetone or other suitable paint remover before attempting to loosen the nuts or setscrews. Apply glyptal to each nut or setscrew that is replaced.

a. Removal.

(1) Loosen the two setscrews that

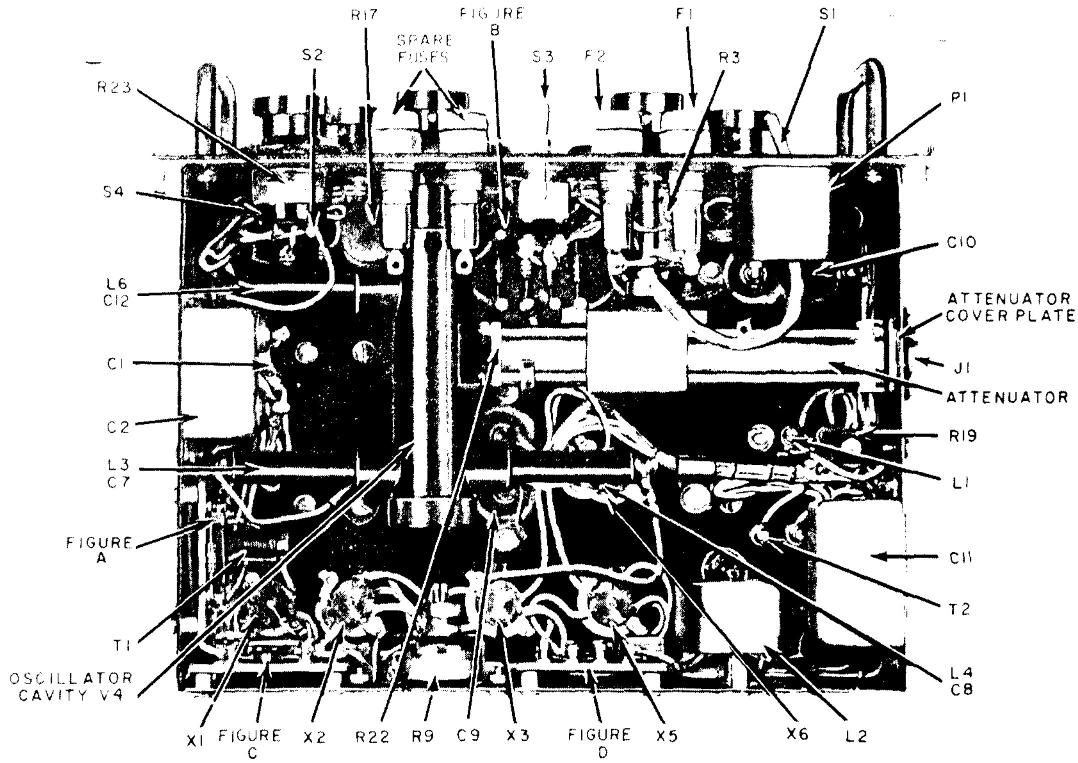


FIG. A

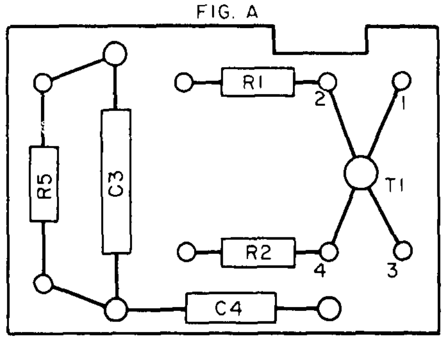


FIG. B

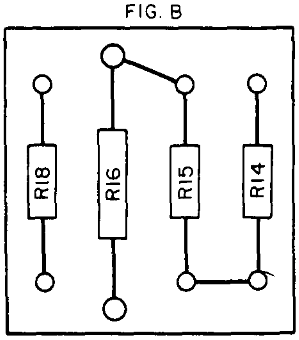


FIG. C

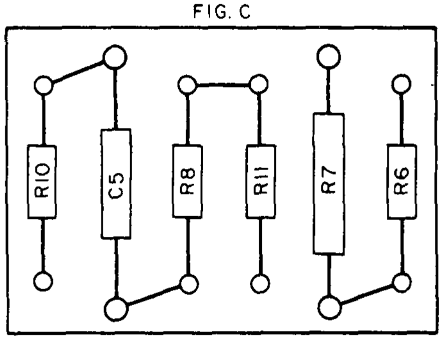
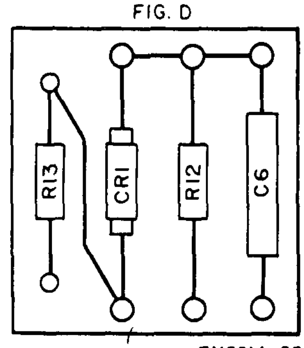
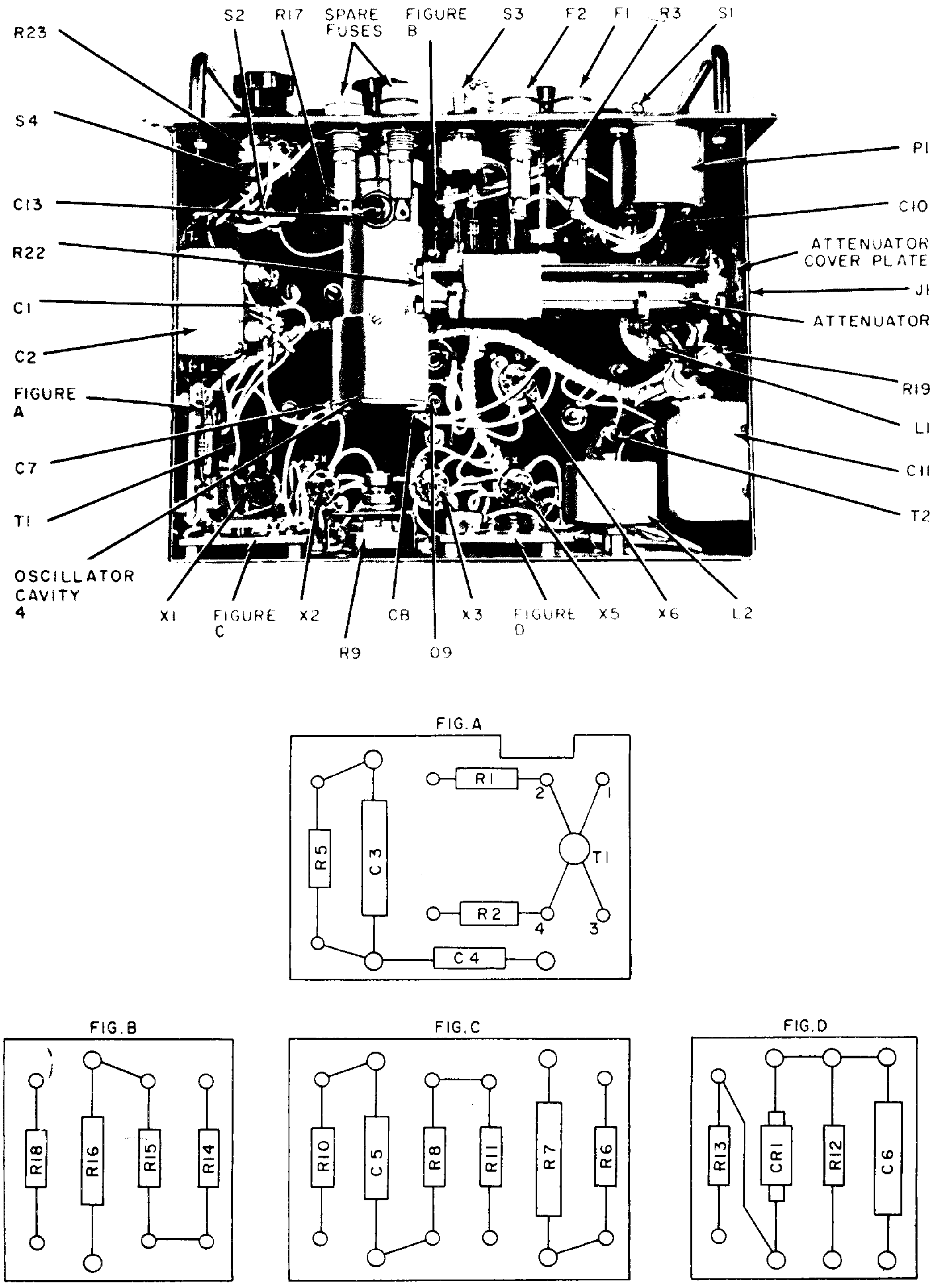


FIG. D



TM5014-53

Figure 13. Test Sets TS-538/U, TS-538A/U, and TS-538B/U, bottom view of chassis.



TM5014-57

Figure 14. Test Set TS-538C/U, bottom view of chassis.

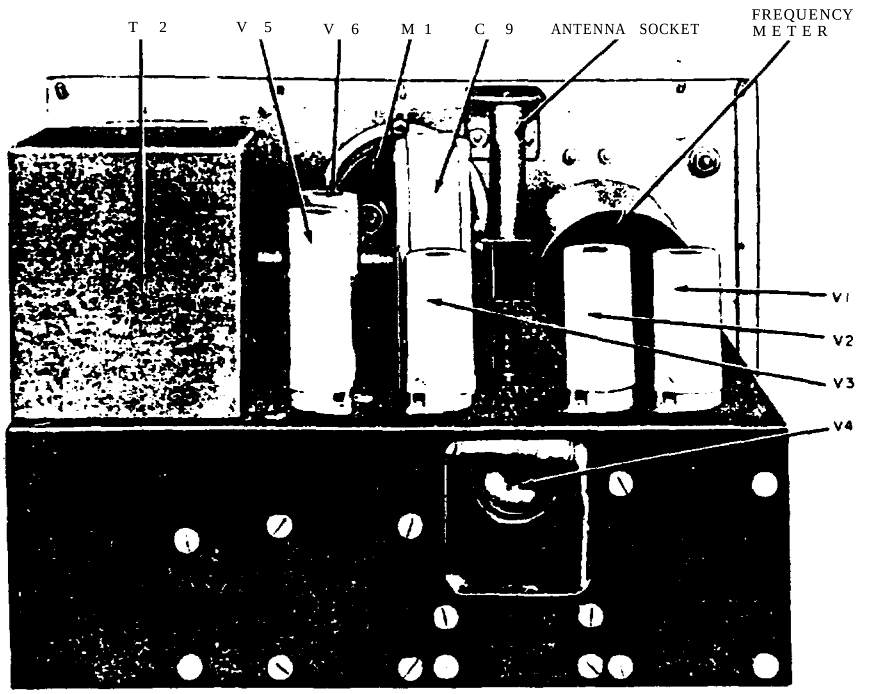


Figure 15. Test Set TS-538(*)/U, rear view of chassis.

hold the OSCILLATOR FREQUENCY dial knob. Remove this knob.

(2) From the top side of the chassis, remove the two screws and lockwashers that hold the rf oscillator assembly to the chassis.

(3) Pull the rf oscillator assembly away from the chassis. Remove the three wire leads attached to L3, L4, and L6; (fig. 13) tag these leads. In Test Set TS-538C/U, these leads are attached to C7, C8, and Cl3 (fig. 14). Remove the assembly from the test set.

b. Replacement.

(1) Place the oscillator assembly in the chassis so that the tuning shaft is below the fuseholders. Reconnect the leads to L3, L4, and L6.

(2) Place the tuning shaft in the hole in the front panel. Fasten the oscillator assembly to the chassis with the two screws and lockwashers (a(2) above).

(3) Recalibrate the oscillator (para 35).

25. Removal and Replacement of Rf Oscillator Tube in Test Sets TS-538/U, TS-538A/U, and TS-538B/U

a. Removal. The tube may be removed through the cathode end of the cavity assembly without removing the assembly from the chassis. Remove the test set from its case, place it bottom side up on the workbench, and proceed as follows:

(1) Remove the end cap (fig. 15).

(2) Use a pair of tweezers or long-nosed pliers and carefully pull out socket XV4 and the cathode clip (fig. 18). Be careful not to damage the leads. Insert the pliers through the square hole in the rear of the chassis (fig. 15).

(3) Remove the retainer ring with the special oscillator wrench. The hooked end of the wrench (fig. 16) is compressed and inserted in the oscillator cavity so that the holes

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along the inner diameter of the retainer ring are engaged. When the wrench is properly engaged, the retainer ring is screwed out of the cavity.

(4) Remove the bakelite pressure ring. The cathode cavity and the oscillator tube will now slide out of the assembly. *Carefully* pull the oscillator tube from the cathode cavity. Do not lose the mica insulator.

b. Replacement. When replacing the rf oscillator tube, use figure 18 as a guide and proceed as follows:

(1) Replace tube V4.
(2) Replace the mica insulator and the cathode cavity.
(3) Screw the cathode plunger in place.
(4) Replace the pressure ring.
(5) Use the special oscillator wrench (fig. 16) and replace the retainer ring.
(6) Use the long-nosed pliers and carefully replace the cathode clip and socket XV4. Be careful not to damage the filament leads.
(7) Replace the end cap by turning it clockwise.
(8) Recalibrate the OSCILLATOR FREQUENCY control (para 35) and tune the oscillator cathode (para 38).

26. Removal ond Replacement of Rf Oscillator Tube in Test Set TS-538C/U

a. Removal. The tube may be removed through the cahode end of the cavity assembly without removing the assembly from the chassis. Remove the chassis from its case, place it bottom side up on the workbench, and proceed as follows:

(1) Remove the cathode shield by loosening the setscrew and pulling it free of the cavity (fig. 19).
(2) With a pair of tweezers or long-nosed pliers, carefully pull out socket XV4. Be careful not to damage the two small filament leads. Insert the pliers through the square hole at the rear of the chassis (fig. 15).
(3) Remove the cathode plunger from the cathode housing; use the special oscillator wrench (fig. 17). To reach the plunger, insert the wrench through the square hole at the rear of the chassis. The wrench

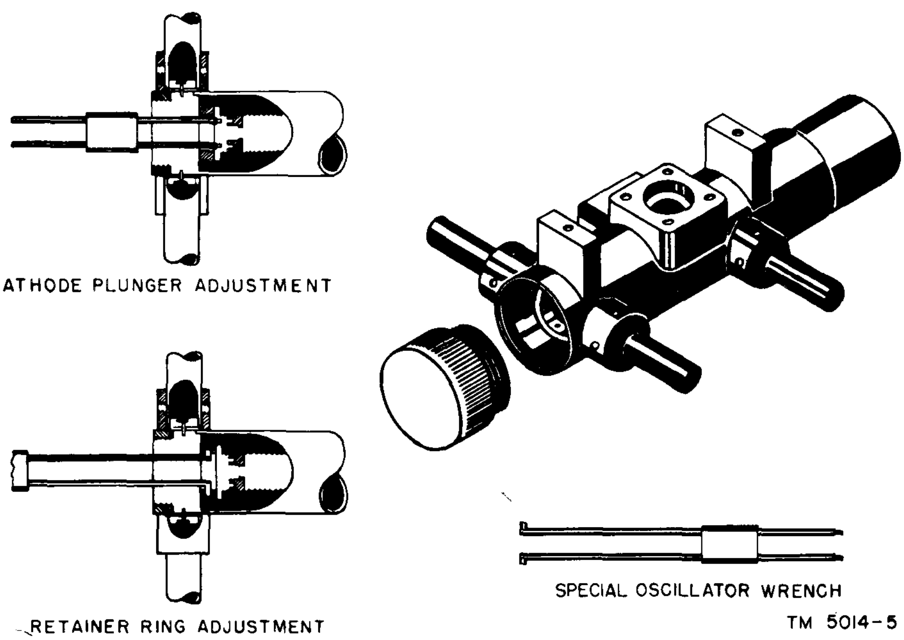

Figure 16. Test Sets TS-538/U, TS-538A/U, and TS-538B/U, use of special oscillator wrench.

engages the holes on the face of the cathode plunger, and the plunger is then screwed out of the cathode housing,

(4) Unscrew the cathode housing. The oscillator tube will slide out of the cavity.

b. Replacement. When replacing the rf oscillator tube, use figure 19 as a guide and proceed as follows:

(1) Replace oscillator tube V4.

(2) Screw the cathode housing back in place.

(3) Use the oscillator wrench (fig. 17) to replace the cathode plunger.

(4) With a pair of tweezers or long-nosed pliers, carefully replace socket XV4. Be careful not to damage the filament leads.

(5) Replace the cathode shield and tighten the setscrew that holds it in place.

(6) Recalibrate the OSCILLATOR FREQUENCY control (para 35) and tune the oscillator cathode (para 38).

27. Disassembly and Reassembly of Rf Oscillator Assembly in Test Sets TS-538/U, TS-538A/U, and TS-538B/U (fig. 18)

a. Disassembly. If it is necessary to completely disassemble the rf oscillator assembly, use the following procedure.

(1) Remove the rf oscillator assembly from the chassis, as instructed in paragraphs 22, 23, and 24.

(2) Remove the cap.

(3) With a pair of tweezers or long-nosed pliers, *carefully* pull out socket XV4 and the cathode clip.

(4) With the special oscillator wrench (fig. 16), remove the retainer ring.

(5) Remove the bakelite pressure ring. Remove the cathode cavity that contains the oscillator tube. Carefully pull the tube out of the cavity. Remove the cathode plunger and the mica insulator.

(6) With a No. 4 Allen-head wrench, loosen and remove the setscrew on the oscillator cavity that holds the bellows cover. This setscrew is located on a raised insert of the oscillator cavity. Carefully unscrew' the bellows cover from the oscillator cavity.

(7) Remove the bellows assembly and the plate plunger by pulling them straight out from the oscillator cavity.

(8) Disassembly of the bellows assembly and plate plunger should be kept to an absolute minimum. If necessary, however, remove the lockring and then the bellows. Remove the four screws and plastic washers that hold the polyiron sleeve to the spring contact. The plate plunger and spring contact will now separate. The polyiron sleeve will remain on the plate plunger.

(9) Remove the setscrew on the bellows cover. Unscrew the tuning shaft from the bellows cover.

(10) On L3, L4, and L6, remove the nut, lockwasher, flat washer, and bakelite insulator.

b. Reassembly.

(1) Replace the bakelite insulator, flat washer, lockwasher, and nut on L3, L4, and L6.

(2) Replace the spring contact on the polyiron sleeve at the end of the plate plunger and secure with the four plastic washers and screws (*a(8)* above).

(3) Replace the plate plunger in the bellows and secure with the lockring.

(4) Replace the tuning shaft in the bellows cover. Do not tighten the setscrew, because this will prevent the tuning shaft from movin and out of the oscillator cavity.

(5) Screw the bellows into the oscillator cavity and tighten the setscrew.

(6) Carefully replace the tube in the oscillator cavity; be sure that the end of the tube fits into the spring contact on the end of the plate plunger.

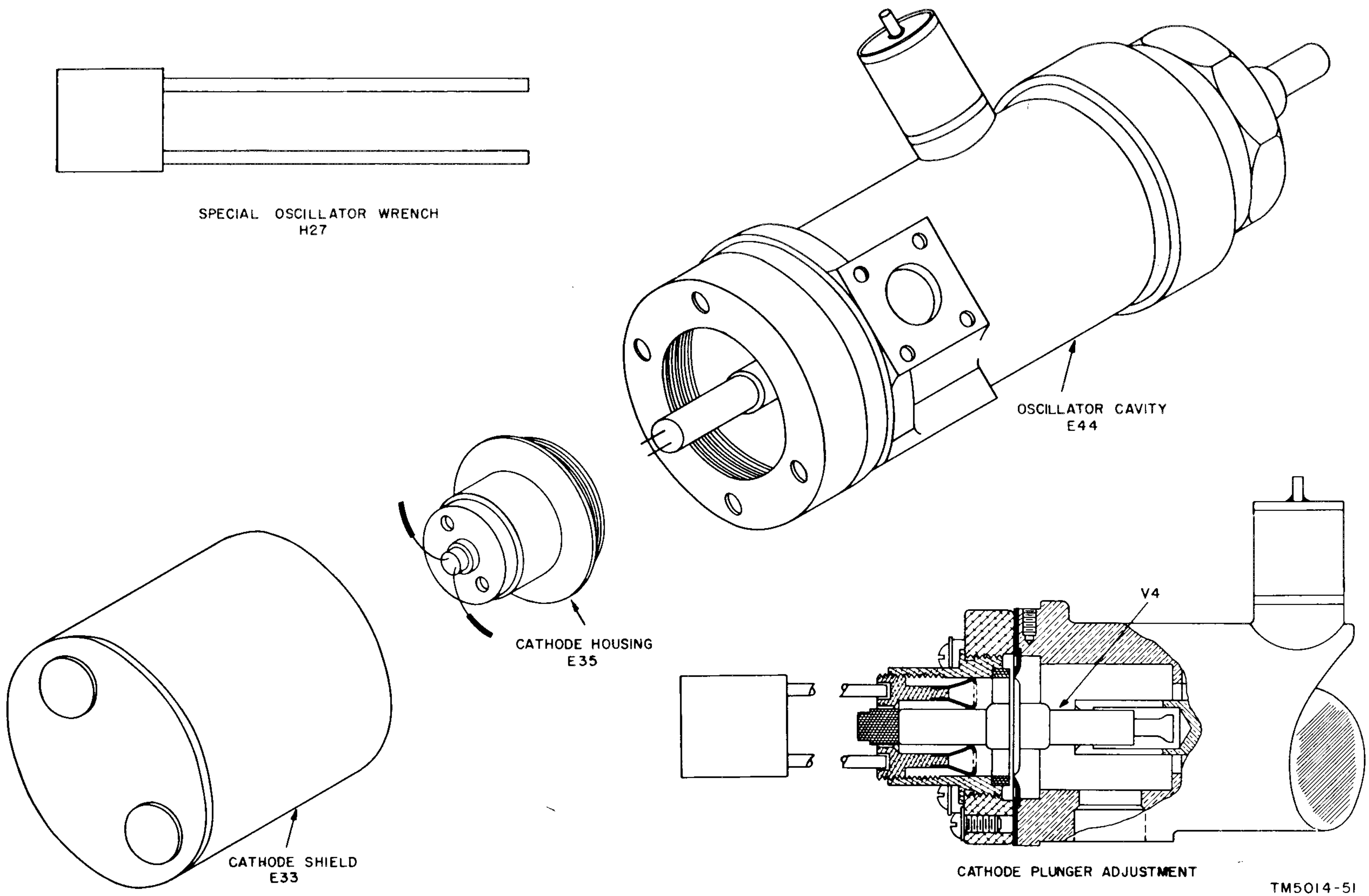

Figure 17. Test Set TS-538C/U, use of special oscillator wrench.

(7) Place the mica insulator over the tube.
(8) Screw the cathode plunger into the cathode cavity with the special oscillator wrench.
(9) Place the pressure ring on top of the cathode cavity and screw the retaining ring into the oscillator cavity with the special oscillator wrench.
(10) Carefully replace the cathode clip on the tube and replace the socket.
(11) Replace the cap on the oscillator cavity.
(12) Replace the rf oscillator assembly as outlined in paragraph *23b*.
(13) Recalibrate the OSCILLATOR FREQUENCY control (para 35) and tune the oscillator cathode (para 38).

28. Disassembly and Reassembly of Rf Oscillator Assembly in Test Set TS-538C/U
(fig. 19)

a. Disassembly. To completely disassemble the rf oscillator assembly, proceed as follows:

(1) Remove the rf oscillator assembly according to the procedures given in paragraphs 22 and 24.
(2) Remove the setscrew on the cathode shield and slip the shield off the cathode cavity.
(3) Use a pair of tweezers or long-nosed pliers and *carefully* pull out socket XV4.
(4) Remove the screws that hold the terminal lugs to the cathode ring.
(5) Remove the cathode plunger; use the special oscillator wrench (fig. 17).
(6) Unscrew the cathode housing and carefully remove oscillator tube V4.
(7) Keep disassembly of the remainder of the oscillator cavity to an absolute minimum. If necessary, however, remove the cathode ring and ‘insulating washer E43 by removing the four screws and associated washers and insulators.
(8) To disassemble the plate cavity, remove the locknut and the plate cap. Unscrew the plate plunger until it is free of the plate sleeve. Unscrew the plate line and associated teflon bead.

b. Reassembly.

(1) To reassemble the plate cavity of the oscillator assembly, replace insulator disk E62. Replace the plate line and teflon bead, Screw the plate plunger in place, and replace the plate cap and the locknut.
(2) To reassembly the oscillator cavity, replace the insulator and cathode ring and the four screws and washers.
(3) Replace oscillator tube V4.
(4) Replace the cathode housing.
(5) Replace the cathode plunger with the special wrench (fig. 17).
(6) Fasten the terminal lugs to the cathode ring.
(7) Use a pair of tweezers or long-nosed pliers and carefully replace socket XV4.
(8) Replace the cathode shield on the cathode cavity and fasten it in place with the setscrew.
(9) Recalibrate the OSCILLATOR FREQUENCY control (para 35), and tune the oscillator cathode (para 38).

29. Disassembly and Reassembly of Frequency Meter and Detector Unit Assembly
(fig. 11, TM 11-6625-213-12)

a. Disassembly.

(1) Remove ‘the attenuator and frequency meter assemblies from the c h ass is. Follow the procedure given in paragraphs 22 and 23.
(2) Unscrew the coupling nut that holds L5 (L3 in the TS-538C/U) to the rf coupler,
(3) Remove L5 (or L3), crystal CR2, and the spacer.
(4) Remove the four screws and lockwashers that hold the rf coupler to the frequency meter.

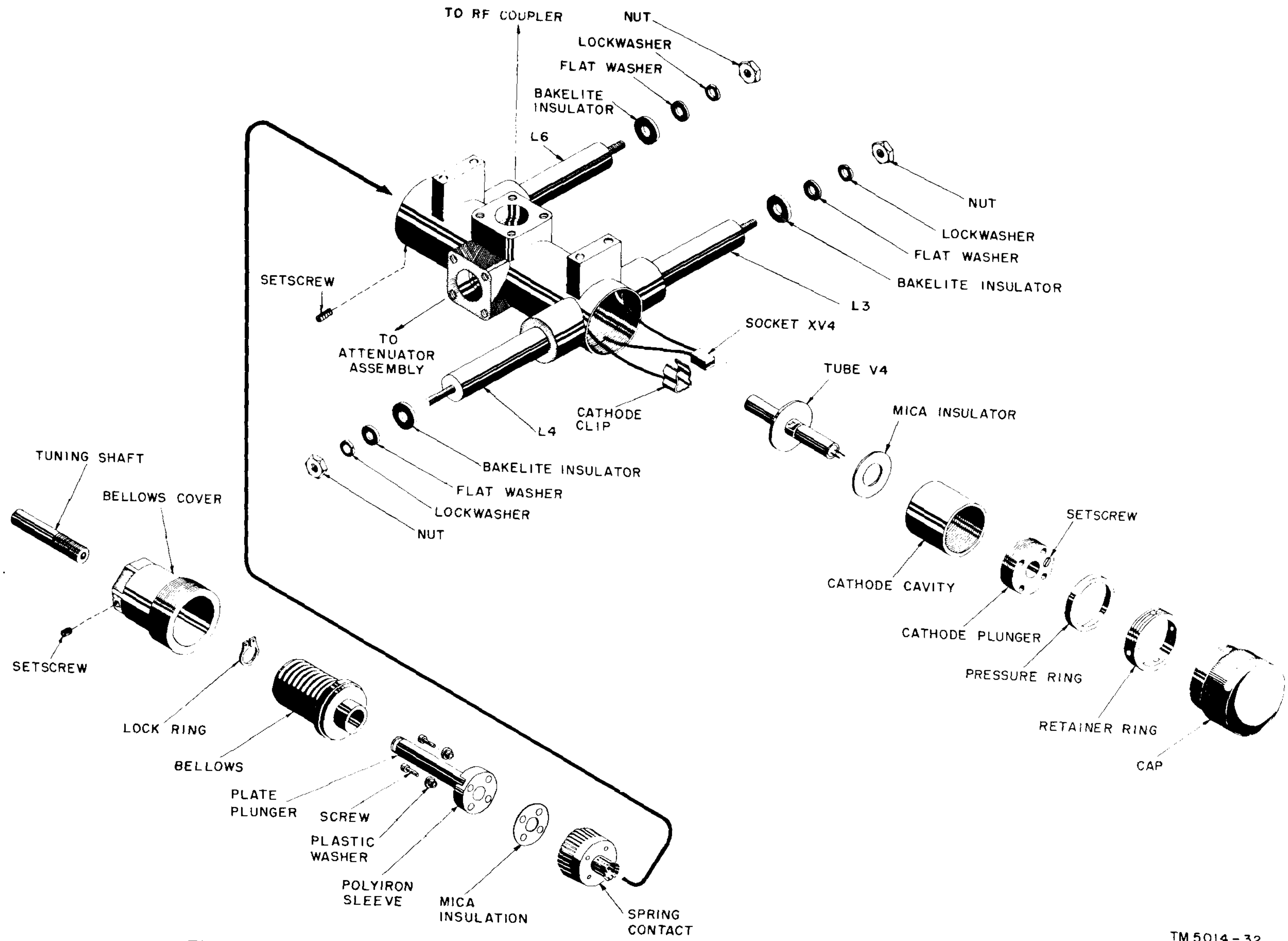

Figure 18. Test Sets TS-538/U, TS-538A/U, and TS-538B/U, exploded view of rf oscillator assembly.

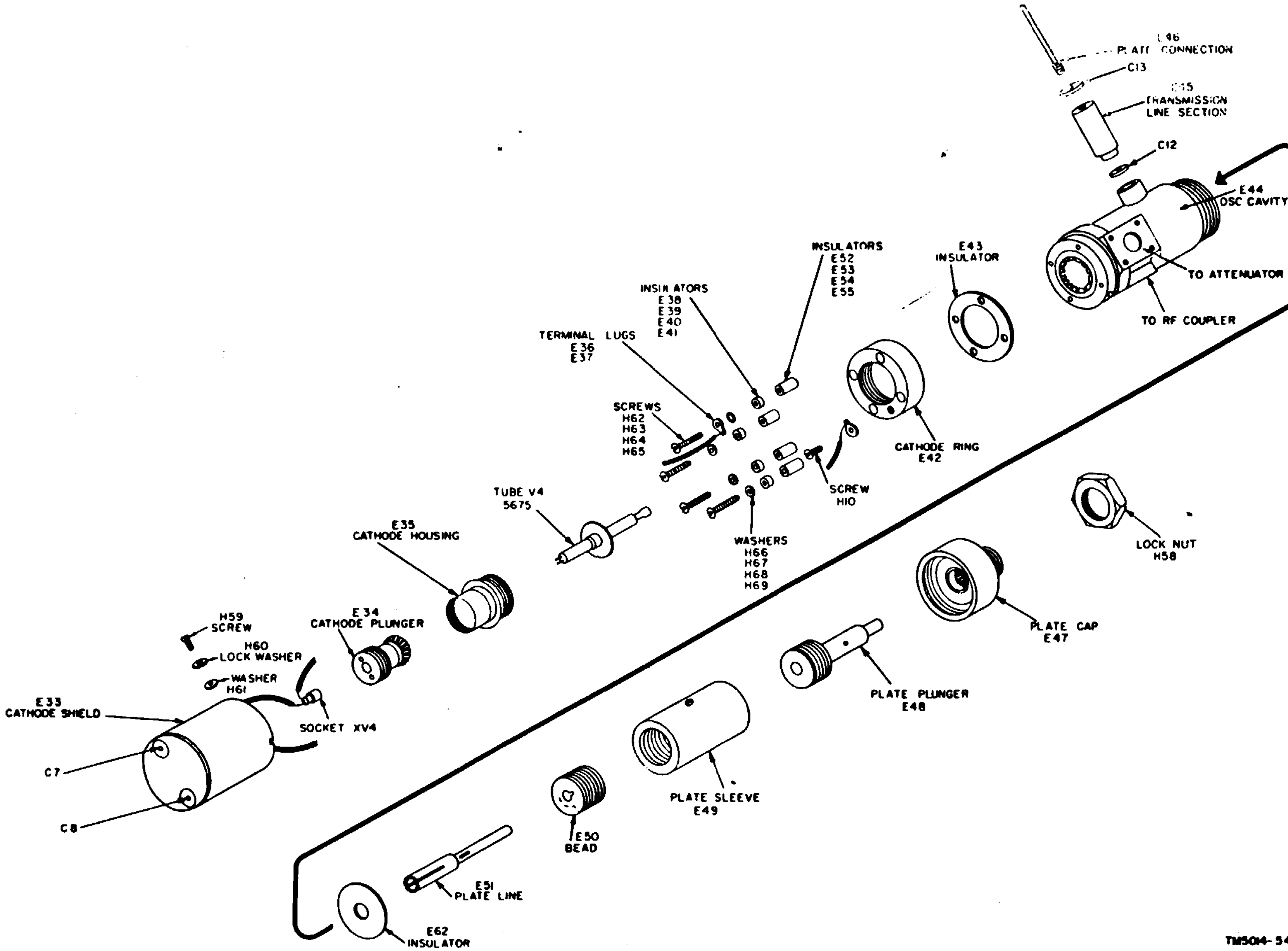

Figure 19. Test Set TS-538C/U, exploded view of rf oscillator assembly.

b. Reassembly.

(1) Replace the rf coupler and secure it with the four screws and lockwashers *(a(4)* above).

(2) Replace the spacer in the rf coupler.

(3) Replace crystal CR2 in the rf coupler; be sure to touch the rf coupler with the hand that holds the crystal before inserting the crystal. This will prevent a static discharge from harming the crystal.

(4) Reconnect L5 to the rf coupler; use the coupling nut.

(5) Replace the frequency meter and detector unit assembly as outlined in paragraph 23.

(6) Recalibrate the FREQUENCY METER control (para 36).

30. Disassembly and Reassembly of Attenuator Assembly

(fig. 20)

a. Disassembly.

(1) Remove the attenuator assembly from the chassis,

(2) Remove the four screws, nuts, and lockwashers that hold rf output jack J1 and the inner conductor to the waveguide assembly, Remove rf output jack J1 to which the inner conductor is fastened.

(3) On the other end of the attenuator, remove the two hexagonal nuts and lockwashers that secure the parallel guide bars to the wave guide. Mark the position of the shaft collars on the guide bars. Loosen the two shaft collar stop setscrews. Remove the two parallel guide rods.

(4) Remove the two screws and lockwashers that hold the pin plate to the rack gear. Remove the pin plate.

(5) Lift off the rack gear.

(6) *Gently* force the attenuator coupling loop sliding assembly out at either end of the wave guide.

b. Reassembly of Attenuator Assembly.

(1) Replace the attenuator coupling loop sliding assembly in the waveguide so that the end with the opening for the inner conductor is facing the end of the waveguide from which J1 was removed.

(2) Replace the rack gear on the waveguide and secure it with the pin plate, screws, and lockwashers *(a* (4) above).

(3) Replace the parallel guide rods and shaft collars. Tighten the setscrews on the shaft collars when the shaft collars are in place along the guide rods. Secure the guide rods with the lockwashers and hexagonal nuts *(a(3)* above).

(4) Replace rf output jack J1 and slide the inner conductor into the attenuator coupling loop sliding assembly inside the waveguide. Secure J1 with the four screws, lockwashers, and hexagonal nuts *(a(2)* above).

(5) Replace the attenuator assembly (para 22).

(6) Recalibrate the OUTPUT POWER control (para 37).

Section II. CALIBRATION PROCEDURES

31. Test Equipment Required for Calibration

The following chart lists test equipment required for calibrating Test Set TS-538(*)/U, the associated technical manuals, and the assigned common names.

Test equipment	Technical manua	Common name
Oscilloscope AN/(*)[b]	TM 11-5129 ------	Oscilloscope.
Oscillator Audio TS-382 (*)/U[a].	TM 11-6625-261-12	Audio oscillator.
Frequency Meter AN/ URM-32.	TM 11-5120 ------	Fr m
Wattmeter AN/ URM-98.	TM 11-5124 ------	Wattmeter.

[a]Indicates Audio Oscillators TS-382 A/U, TS-382B/U, TS-382D/U, TS-382E/U, and TS-382F/U.

[b]Indicates Oscilloscope AN/USM-50, AN/USM-50A, AN/USM-50B, and AN/USM-50C.

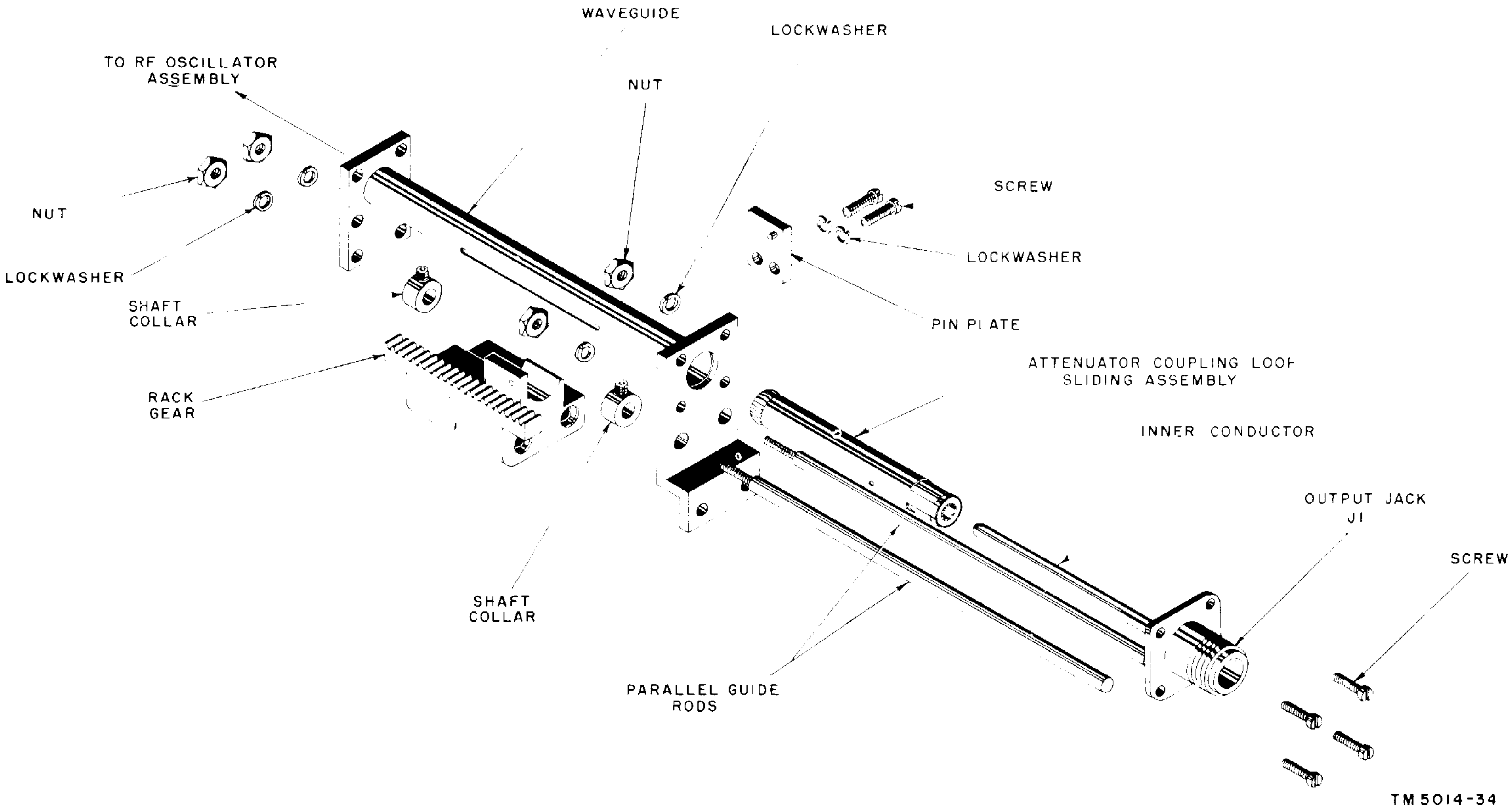

Figure 20. Test Set TS-538(*)/U, attenuator assembly, exploded view.

32. Crystal Calibration

a. Connect the power cable to a 117-volt ac source and to the test set, and turn the POWER switch to the ON position. Wait 10 minutes for the test set to become warm.

b. Push the CRYSTAL CHECK switch to the left. The power monitor meter should deflect to the SET POWER point,. If the meter deflection is not near the SET POWER point, and the line voltage is known to be 117 volts ac, the trouble is probably in crystal CR2. Release the CRYSTAL CHECK switch and snap the POWER switch to the OFF position.

c. Replace crystal CR2 as outlined in paragraph 32, TM 11-6625-213-12. Make sure that the replacement is new.

d. Turn the POWER switch to the ON position. Push the CRYSTAL CHECK switch to the left again. If the new crystal is operating properly, the test set meter circuit is properly adjusted and the line voltage is 117 volts ac. The power monitor m e t e r then will deflect to the SET POWER point.

e. If the meter deflection is still not correct, check the OUTPUT POWER calibration as given in paragraph 37.

f. If necessary, push the CRYSTAL CHECK switch to the left and adjust crystal calibrate screwdriver control R17 (fig. 12) until the power monitor meter is exactly at the SE T PO WER point. Recalibrate the OUTPUT POWER control (para 37).

33. REPETITION RATE Calibration
(fig. 21)

a. Rotate the REPETITION RATE dial knob fully clockwise.

b. Loosen the two setscrews on the dial knob.

c. Rotate the loosened dial knob until the 5-cps mark is opposite the pointer.

d. Tighten the dial setscrews and set the dial to the 200-cps mark.

e. Connect the vertical amplifier of the oscilloscope to PULSE test jack J3 of the test set (fig. 23). Connect Audio Oscillator TS-382(*)/U to the horizontal amplifier of Oscilloscope AN/USM-50(*).

f. Connect the power cable to the test set and to a 117-volt ac source. Turn the POWER and the MODULATION switches to ON.

g. Turn on the oscilloscope and the audio oscillator. Be sure that the audio oscillator has warmed up. Set the audio oscillator to 200 cps. Set the oscilloscope SYNC selector switch to tie LO EXT position so that the horizontal sweep will be obtained from the audio oscillator and, therefore, will have a frequency of 200 cps.

h. Adjust repetition rate calibration control R3 (fig. 14), until the two signals are synchronized on the oscilloscope. As the blocking oscillator frequency approaches that of the audio oscillator (200 cps), the speed with which the pulse moves across the scope screen decreases. When R3 is properly adjusted, the pulse should be almost stationary. The oscilloscope waveform should approximate the waveform illustrated in figure 21.

Note: If a 60-cycle source of power is available, calibrate the audio oscillator at 180 cps. Use the test oscilloscope for this check.

34. Pulse Width Calibration
(fig. 22)

a. Connect the vertical amplifier of Oscilloscope AN/USM-50A to PULSE test jack J3 of the test set (fig. 22).

b. Turn on the test set and the oscilloscope. For this test, the oscilloscope should be able to supply markers at 5- or 20-microsecond intervals. Set the scope controls to give a 100-microsecond sweep, triggered by the external signal.

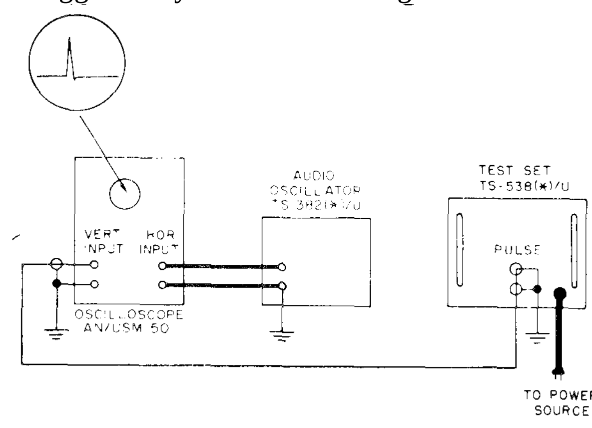

Figure 21. Test Set TS-538(*)/U, calibration, REPETITION RATE connection diagram.

c. On the test set, place the MODULATION switch in the ON position. Set the REPETITION RATE control to 200 cycles.

d. Adjust screwdriver control R9 at the inside rear of the chassis (fig. 13) until the pulse on the oscilloscope is 45 microseconds wide. The oscilloscope waveform should be similar to the waveform illustrated in figure 22.

35. OSCILLATOR FREQUENCY Calibration (fig. 23)

The OSCILLATOR FREQUENCY calibration must be performed whenever the oscillator assembly has been removed and replaced in the test set, or whenever the rf oscillator tube has been replaced.

a. Connect the test set to Frequency Meter AN/URM-32 as shown in figure 23. Connect both equipments to the 117-volt ac power line. Turn on the frequency meter to allow it to warm up. Mount the antenna rod in its socket.

b. Activate a radiosonde transmitter (part of Radiosonde AN/AMT-4(*)) and bring it near enough to the antenna of the test set to deflect the meter needle into the green area.

c. Rotate the FREQUENCY METER dial of the test set until a maximum dip (minimum reading) is indicated by the needle; disregard the dial reading. Turn off and remove the radiosonde transmitter. The FREQUENCY METER dial of the test set is now roughly tuned to 1,680 mc.

d. Throw the POWER switch of the test set to ON and allow 2 minutes for the tubes to warm up; then throw on the switch controlled by the R. F. POWER SET knob. Turn the OSCILLATOR (FREQUENCY dial until it has no further influence on the meter needle; then adjust the R. F. POWER SET knob until the meter needle indicates SET POWER. Turn the OUTPUT POWER control to -20 dbm.

e. Turn the OSCILLATOR FREQUENCY dial until the needle again indicates maximum dip. The oscillator is now at approximately 1,680 mc.

f. Set the frequency meter at 168 mc; the 10th harmonic (1,680 mc) will be used to zero beat with the oscillator in the test set. Put on the headset.

g. Rock the OSCILLATOR FREQUENCY dial slowly to find a beat note audible in the headset; then adjust the dial for zero beat. The OSCILLATOR FREQUENCY is now exactly at 1,680 mc; do not disturb the shaft setting until the dial has been reset on the shaft.

h. Loosen the two setscrews on the OSCILLATOR FREQUENCY dial, Withdraw the dial from the shaft and turn the dial until the zero mark lines up with the pointer on the panel; then reset the dial on the shaft. Listen to the zero beat during this operation; any audible note indicates that the shaft has turned slightly and must be reset to zero beat. Tighten the setscrews firmly.

i. Check the FREQUENCY METER dial calibration (para 36).

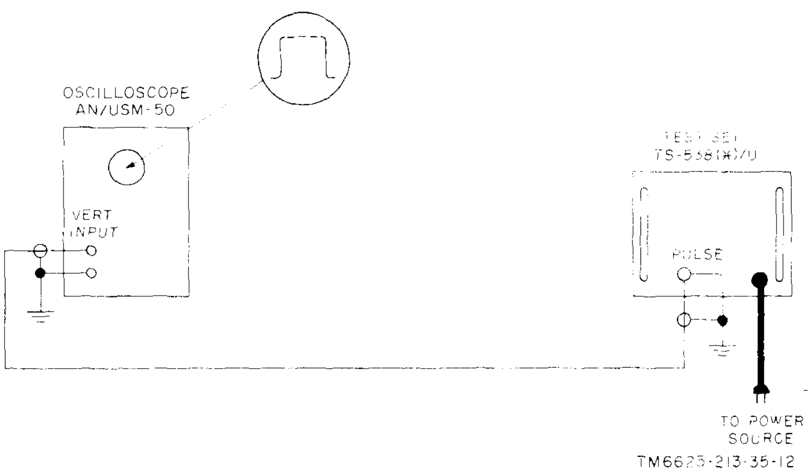

Figure 22. Test Set TS-538(*)/U, pulse width calibration, connection diagram.

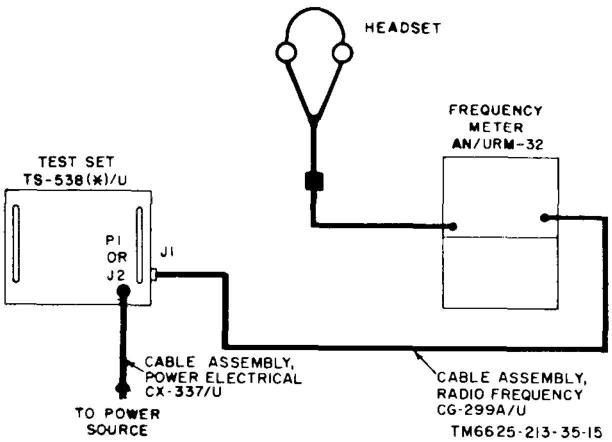

Figure 23. Test Set TS-538(*)/U, OSCILLATOR FREQUENCY calibration, connection diagram.

36. FREQUENCY METER Calibration

The FREQUENCY METER calibration must be performed whenever the frequency meter assembly has been removed and replaced in the test set.

a. Connect the set to the 117-volt ac power line and turn on the POWER switch. After 2 minutes, turn on the switch controlled by the R. F. POWER SET knob.

b. After the calibration procedure in paragraph 35 has been performed, tune the rf oscillator to 1,680 mc by setting the OSCILLATOR FREQUENCY dial to zero.

c. Adjust the R. F. POWER SET knob until the meter needle reads approximately POWER SET.

d. Turn the FREQUENCY METER dial until a maximum dip (minimum reading) of the needle is obtained. Loosen the two setscrews on the dial and remove it from its shaft, If this action disturbs the needle deflection, the maximum dip can be obtained again by turning the shaft with the fingers. Turn the dial until 1,680 lines up with the pointer on the panel; then replace the dial on the shaft and tighten the setscrews again. Observe the meter needle during this operation and correct any disturbance of the shaft setting.

e. Recheck the zero setting of the OSCILLATOR FREQUENCY dial with the frequency meter (para 35).

37. OUTPUT POWER Calibration (fig. 24)

The OUTPUT POWER calibration must be performed whenever the attenuator assembly has been removed and replaced in the test set.

a. Connect the test set to Wattmeter AN/URM-98 (fig. 24). Use a matching network such as a triple stub tuner or polyblock match. Keep the standing wave ratio low by connecting all cables properly.

b. Turn on the test set and check crystal CR2 (para 32).

c. Adjust the RF POWER SET control until the power monitor meter is at the SET POWER point.

d. Adjust the OUTPUT POWER control until the power monitor meter indicates that the test set output is 10 microwatt.

e. If 10 microwatt of output power cannot be obtained, check the oscillator cathode tuning (para 38).

f. When the power monitor meter indicates that the test output is 10 microwatt, loosen the setscrews that hold the OUTPUT POWER dial and set the dial to read -20 dbm. *Do not move the shaft control while turning the dial.* Tighten the setscrews.

g. Recheck the reading of the power monitor meter and, if necessary, readjust the dial setting to -20 dbm.

38. Oscillator Cathode Tuning

The oscillator cathode tuning must be performed whenever the power monitor meter drops below the SET POWER point with the R. F. POWER SET control fully clockwise, when the test set output cannot be adjusted to 10 microwatt (para 37), or when the rf oscillator tube V4 is replaced (para 25 and 26).

Note: The power monitor meter may drop below the SET POWER point when the frequency of the rf oscillator is the same as that of the FREQUENCY METER. Do *not* tune the oscillator cathode to compensate for *this* drop.

a. Set the FREQUENCY METER dial to 1,630 mc.

b. Tune the OSCILLATOR FREQUENCY dial to the highest frequency at which the meter still registers above the SET POWER point (turning the OSCILLATOR

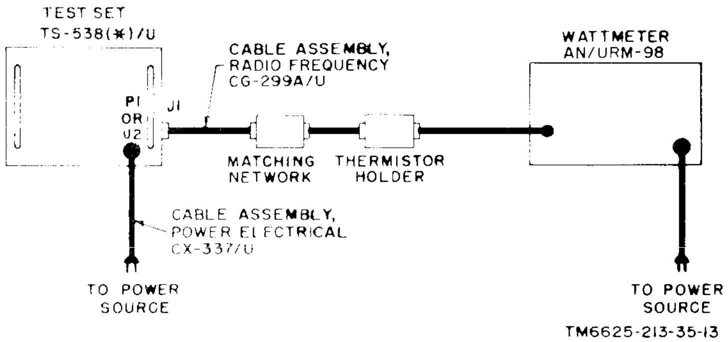

Figure 24. Test Set TS-538(*)/U, OUTPUT POWER calibration, connection diagram.

FREQUENCY dial counterclockwise raises the frequency).

c. Remove the cap from the rf oscillator assembly (fig. 15). Use the special oscillator wrench (fig. 16 and 17) to loosen the retainer ring. Loosen the small setscrew on the cathode plunger. Insert the oscillator wrench into the cathode plunger and turn 1 or 2 turns in the direction that causes the power monitor meter to show an increase in output.

d. If the output cannot be increased, replace the rf oscillator tube (para 25 and 26).

e. Tune the OSCILLATOR FREQUENCY dial until the meter just begins to dip again below the SET POWER point.

f. Repeat the procedure in c and e until the dial can be turned through its entire range with the meter registering at or above the SET POWER point,

g. Turn the cathode plunger *out* three-fourths turn beyond this point.

h. Tighten the setscrew on the cathode plunger and retainer ring. Replace the cap.

CHAPTER 4

FOURTH ECHELON TESTING PROCEDURES

39. General

a. Testing procedures are prepared for use by Signal Field Maintenance Shops and Signal Service Organizations responsible for fourth echelon maintenance of signal equipment to determine the acceptability of repaired equipment. These procedures set forth specific requirements that repaired equipment *must* meet before it is returned to the using organization. These procedures may also be used as a guide for testing equipment that has been repaired at third echelon if the proper tools and test equipments are available. A summary of the performance standards is given in paragraph 49.

b. Comply with the instructions preceding each chart before proceeding to the chart. Perform each step in sequence. Do not vary the sequence. For each step, perform all the actions required in the *Test equipment control settings* and *Equipment under test control settings* columns; then perform each specific test procedure and verify it against its performance standard.

40. Test Equipment

All test equipment required to perform the testing procedures given in this chapter are listed in the following chart and are authorized under TA 11-17, Signal Field Maintenance Shops, and TA 11-100(11-17), Allowances of Signal Corps Expendable Supplies for Signal Field Maintenance Shop, Continental United States.

Nomenclature	Federal stock No.	Technical manual
Multimeter TS-352(*	6625-242-5023	TM 11-5527
Signal Generator AN/URM-64(*)[b].	6625-570-5721	TM 11-6625-299-15.
Audio Oscillator TS-382(*	6625-091-9489	TM 11-6625-261-12.
Oscilloscop AN/USM-50[d].	6625-668-4676	TM 11-5129
Frequency Meter TS-186D/UP.	6625-376-1662	TM 11-2691-15.
Wattmeter AN/URM-98.	6625-566-4990	TM 11-5124
Electric Light Assembly MX-1292/PAQ.	6695-537-4470	TM 11-5540
Headset HS-30/U ---	5965-164-7259	
Transformer, Variable Power CN-16/U.	5950-235-2086	

[a]Indicates Multimeters TS-352/U, TS-352A/U, and TS-352B/U.
[b]Indicates Signal Generators AN/URM-64 and AN/URM-64A.
[c]Indicates Audio Oscillators TS-382A/U, TS-382B/U, TS-382D/U, TS-382E/U, and TS-382F/U.
[d]Indicates Oscilloscopes AN/USM-50, AN/USM-50A, AN/USM-50B, and AN/USM-50C.

41. Modification Work Orders

The performance standards listed in the tests (para 43 through 48) are based on the assumption that the modification work order listed below has been performed. A listing of current modification work orders will be found in DA Pamphlet 310-4.

MWO No.	Date	Priority	Echelon	Location of MWO marking	Remarks
MWO SIG 11-5014-1	5 May 54	Normal	3	Adjacent to nameplate	None.

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42. Physical Tests and Inspections

a. *Test Equipment and Materials.*
Electronic Light Assembly MX-1292/PAQ.

b. *Test Connections and Conditions.*
(1) No connections necessary.
(2) Remove test set chassis from its case.

c. *Procedure*

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	None.	Controls may be in any position.	a. Inspect case and chassis for damage, missing parts, and condition of paint. *Note:* Touchup painting is recommended in lieu of refinishing whenever practical; screw heads, binding posts, receptacles, and other plated parts will not be painted or polished with abrasives. b. Inspect all controls and mechanical assemblies for loose or missing screws, bolts, and nuts. c. Inspect all connectors, sockets, and receptacles, fuseholders, and meter for looseness, damage, or missing parts.	a. No damage evident or parts missing. External surfaces intended to be painted will not show bare metal. Panel lettering will be legible. b. Screws, bolts, and nuts will be tight. None missing. c. No loose parts or damage. No missing parts.
2	None.	Controls may be in any position.	a. Rotate all panel controls throughout their limits of travel. b. Inspect dial stops for damage or bending, and for proper operation. c. Operate all switches, including the R. F. POWER SET control located on the attenuator. d. Install the stub antenna in its receptacle.	a. Controls will rotate freely without binding or excessive looseness. b. Stops will operate properly without evidence of damage. c. Switches will operate properly. *Note:* The CRYSTAL CHECK switch is spring-loaded and should return to the left when released. d. Antenna must seat properly. Threads must be in good condition.
3	*MX-1292/PAQ* a. Connect mercury vapor lamp. b. Install wide transmission filter in the lamp.	Controls may be in any position.	Turn on the mercury vapor lamp and expose the portion of the equipment that has been repaired or disturbed to the direct rays of the lamp.	All repaired or disturbed electrical components and chassis surfaces will be covered. There must be *no* varnish on switch contacts or moving parts of mechanical assemblies. *Note:* Moisture-fungiproofing varnish glows gray-green under the rays of a mercury vapor lamp.

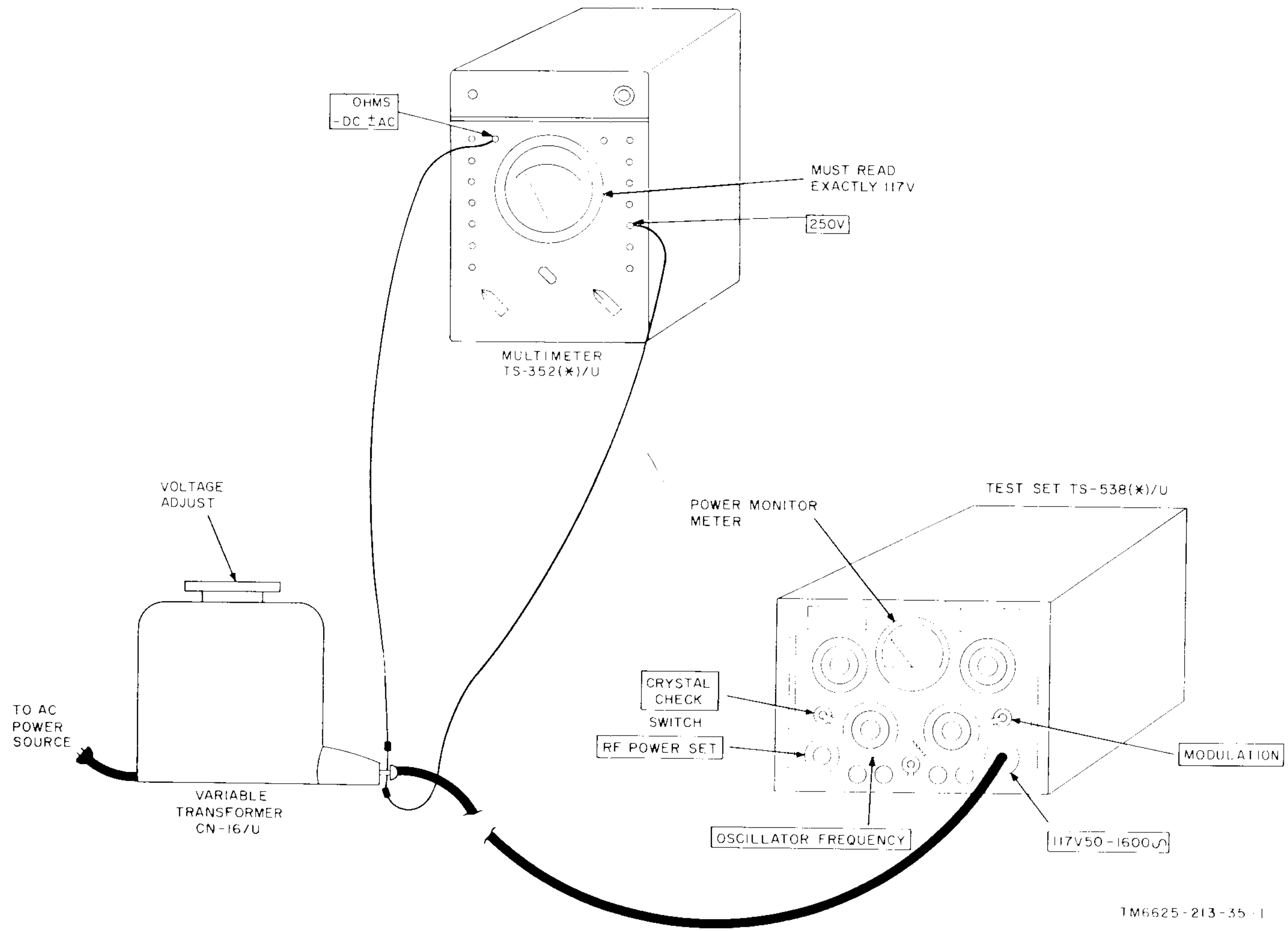

Figure 25. Crystal check and power set test connections.

43. Crystal Check and Power Set Tests

a. Test Equipment and Material.
Transformer, Variable Power CN-16/U.
Multimeter TS-352(*)/U.

b. Test Connections and Conditions. Connect the equipment as shown in figure 25.

c. Procedure. The following procedure is applicable to Test Sets TS-538A/U and TS-538B/U.

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	*CN-16/U* Voltage control to 117. *TS-352(*)/U* a. Function: AC VOLTS. b. Range Scale: 250 VAC.	a. POWER: ON b. R. F. POWER SET: OFF. c. MODULATION: OFF.	a. Adjust voltage control on CN-16/U until output measured on TS-352(*)/U is 117 v. b. While observing the power monitor meter on TS-538(*)/U test set, press CRYSTAL CHECK switch to left. Observe performance standard. Release switch and proceed to step 2.	a. None. b. Meter must indicate SET POWER point (no tolerance).
2	Leave controls in positions last indicated in step 1.		a. Turn R. F. POWER SET control fully clockwise. b. Turn OSCILLATOR FREQUENCY dial throughout its entire range (50-0-50) while observing the power monitor meter.	a. None. b. Meter must not indicate below SET POWER line at any time (See note.) *Note:* The power monitor meter will dip when the oscillator frequency is the same as that of the frequency meter.

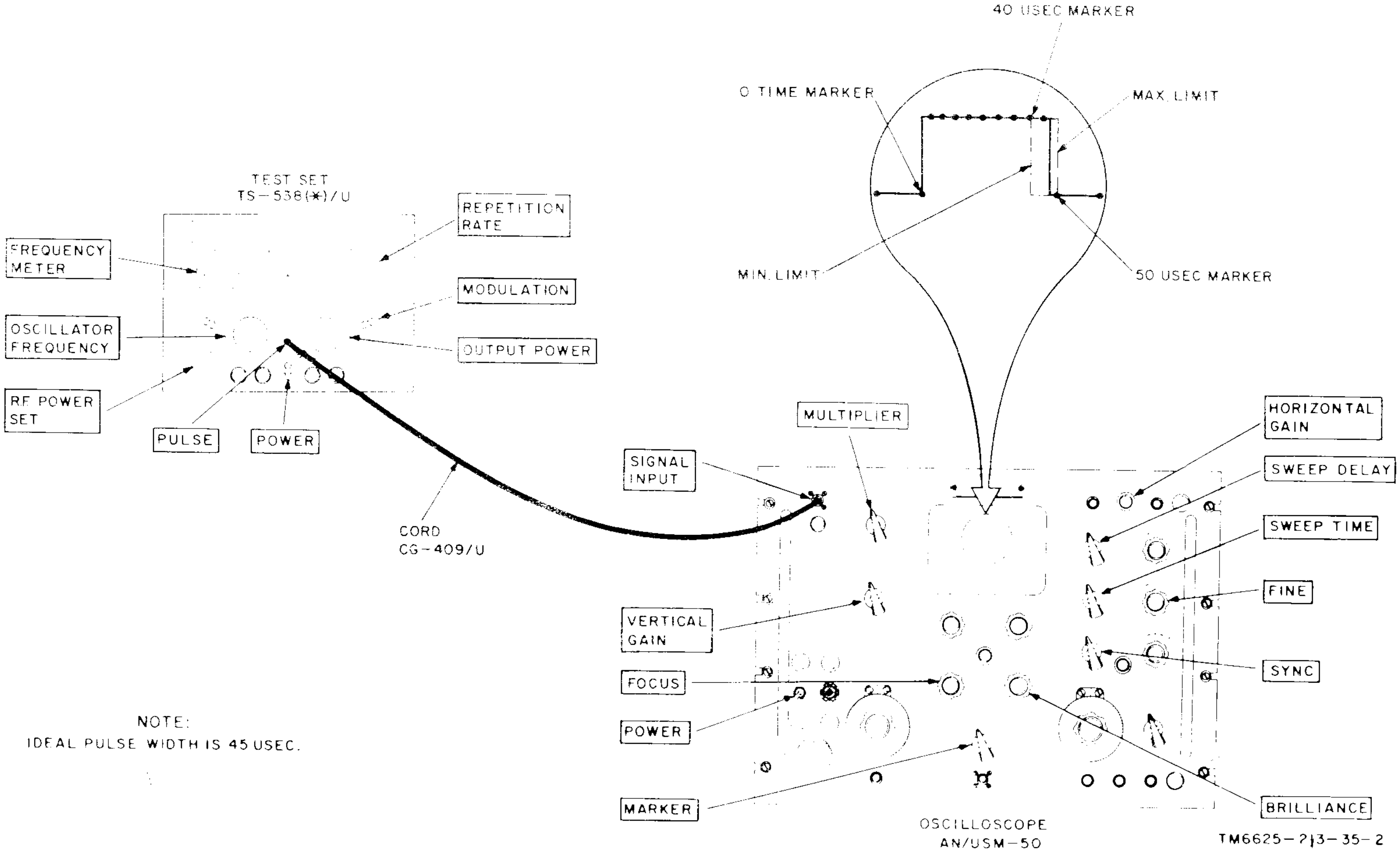

Figure 26. Modulation pulse width test connections.

44. Modulation Pulse Width Test

a. Test Equipment and Materials.
Oscilloscope AN/USM-50(*).

b. Test Connections and Conditions. Connect the equipment as shown in figure 26.

c. Procedure.

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	*a.* MULTIPLIER: 100. *b.* SWEEP TIME: 100. *c.* SYNCH: SIGNAL. *d.* MARKER USEC: 5. *e.* SWEEP DELAY: OUT.	*a.* FREQUENCY METER: 1630. OSCILLATOR FREQUENCY: 0. *b.* MODULATION: ON. *c.* REPETITION RATE: 100.	*a.* Turn on the oscilloscope and Test Set TS-538(*)/U and allow a few minutes warmup period before proceeding. Adjust R. F. POWER SET on TS-538(*)/U until POWER MONITOR meter indicates SET POWER. *b.* Adjust VERTICAL GAIN, HORIZONTAL GAIN, FINE SWEEP TIME, and SYNCH controls on the oscilloscope until a single pulse appears on the screen similar to that shown in figure 26. *c.* Note and record the width of the pulse in microseconds. (The distance between each dot on the pulse is 5 microseconds.)	*a.* None. *b.* None. *c.* Pulse width must be 45 ±5 microseconds.

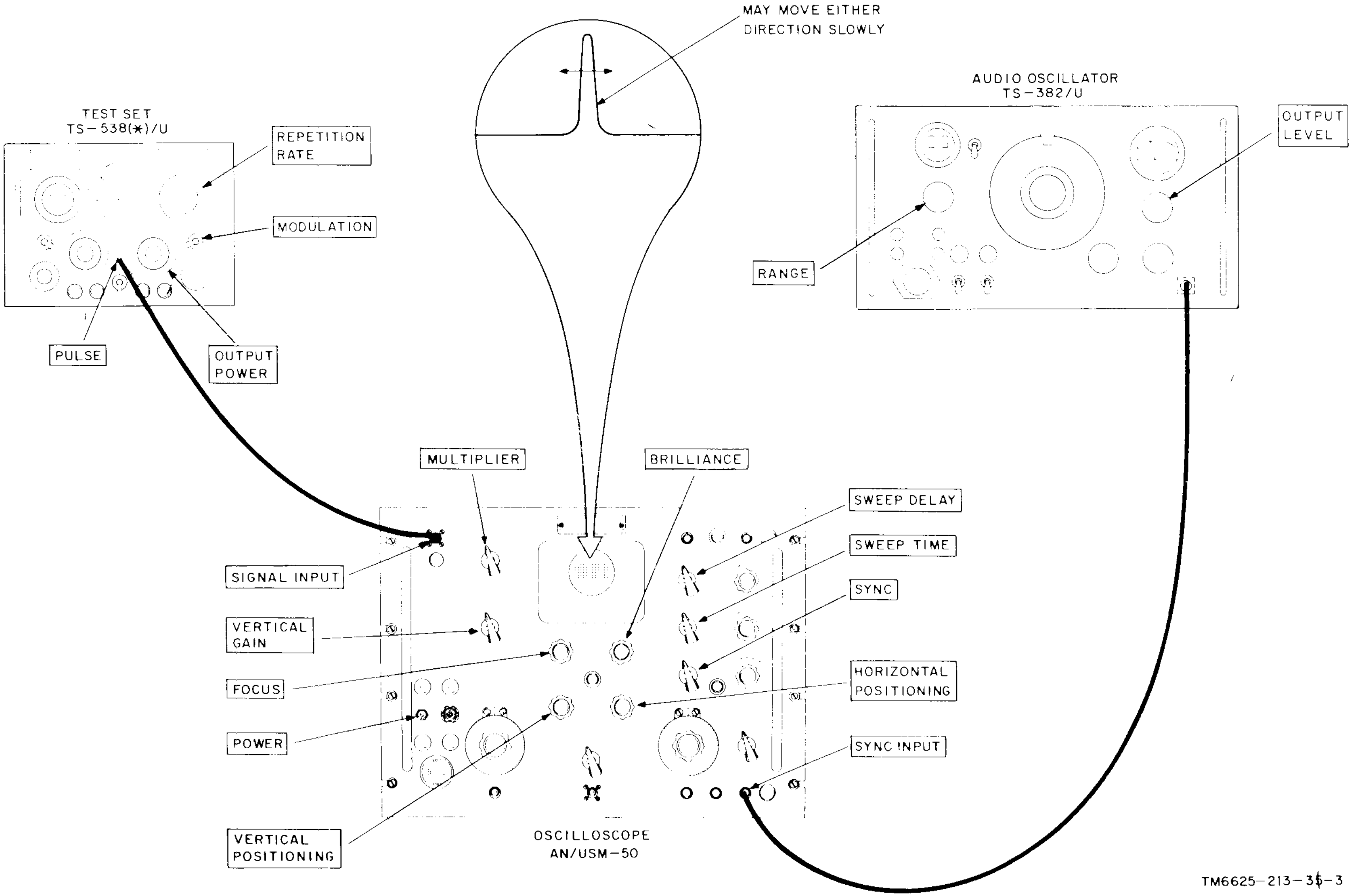

Figure 27. Modulation repetition rate test connections.

45. Modulation Repetition Rate Test

a. Test Equipment and Materials.

(1) Audio Oscillator TS-382(*)/U.

(2) Oscilloscope AN/USM-50(*).

b. Test Connections and Conditions. Connect the equipment as shown in figure 27.

c. Procedure.

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
1	*AN/USM-50* a. MULTIPLIER: 100. b. SWEEP TIME: HOR AMP ON. c. SYNCH: SIGNAL. d. SWEEP DELAY: OUT.	a. FREQUENCY METER: 1630 OSCILLATOR FREQUENCY: 0. b. MODULATION: ON.	a. Turn on the test equipment and Test Set TS-538(*)/U and allow a few minutes warmup period before proceeding. Adjust OUTPUT control on TS-382(*)/U until output meter indicates .4.	a. None.
			b. Set TUNING on audio oscillator and REPETITION RATE on TS-538(*)/U to 25.	b. None.
			c. Adjust oscilloscope controls VERTICAL GAIN, HORIZONTAL GAIN, positioning, BRILLANCE and FOCUS to obtain a picture similar to that shown in figure 27.	c. None.
			d. Adjust audio oscillator TUNING until vertical pulse on the scope becomes stationary or drifts slowly.	d. None. *Note:* Vertical pulse will wave back and forth across horizontal trace.
			e. Repeat c through d above for each of the oscillator and TS-538(*)/U REPETITION RATE settings listed below:	e. Audio oscillator TUNING setting must be within ±15% of REPETITION RATE setting when the vertical trace is stationary.

Audio oscillator TUNING	*TS-538(*)/U REPETITION RATE*
25	25
50	50
75	75
100	100
125	125
150	150
175	175
200	200

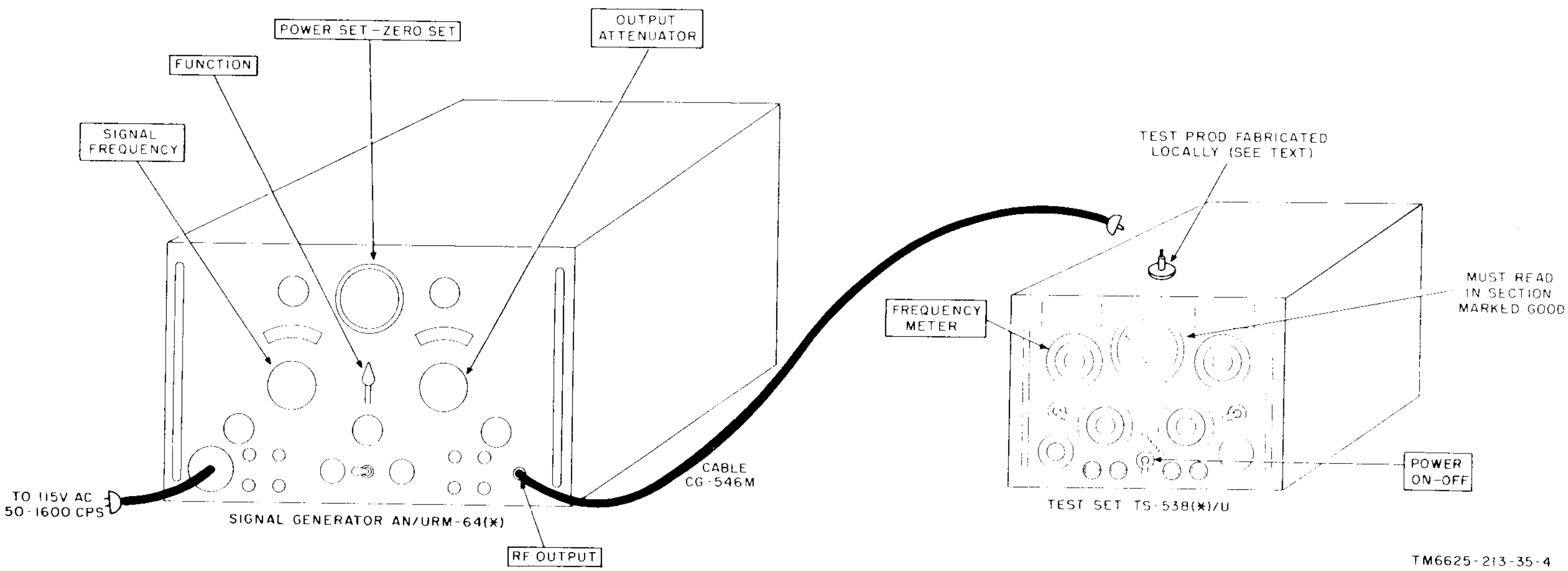

Figure 28. Power monitor sensitivity test connections.

46. Power Monitor Sensitivity Test

a. Test Equipment and Materials.

(1) Signal Generator AN/URM-64(*).

(2) Test prod, 1/8-inch by 2-1/4-inch (fabricated locally).

b. Test Connections and Conditions.

(1) Connect the equipment as shown in figure 28.

(2) Do *not* connect the test set to a power source for this test.

c. Procedure.

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	*a.* SIGNAL FREQUENCY 1680 mc. *b.* OUTPUT ATTENUATOR: -3 db. *c.* FUNCTION: CW.	*a.* POWER: OFF. *b.* FREQUENCY METER: 1630.	*a.* Turn on the signal generator and allow 5 minutes warmup time before proceeding. *b.* Set FUNCTION switch on AN/URM-64(*) to ZERO SET and adjust ZERO SET control for ZERO SET indication on the meter. *c.* Set FUNCTION switch on AN/URM-64(*) to CW and adjust the R. F. POWER SET control for +3-db indication on the meter. *d.* Repeat *b* and *c* above until there is no further interaction. *e.* Touch center conductor of connector on free end of the test stub protruding from the antenna socket of the test set.	*a.* None. *b.* None. *c.* None. *d.* None. *e.* Power monitor meter on TS-538(*)/U must indicate on the line between BAD and GOOD section ± the width of the pointer.

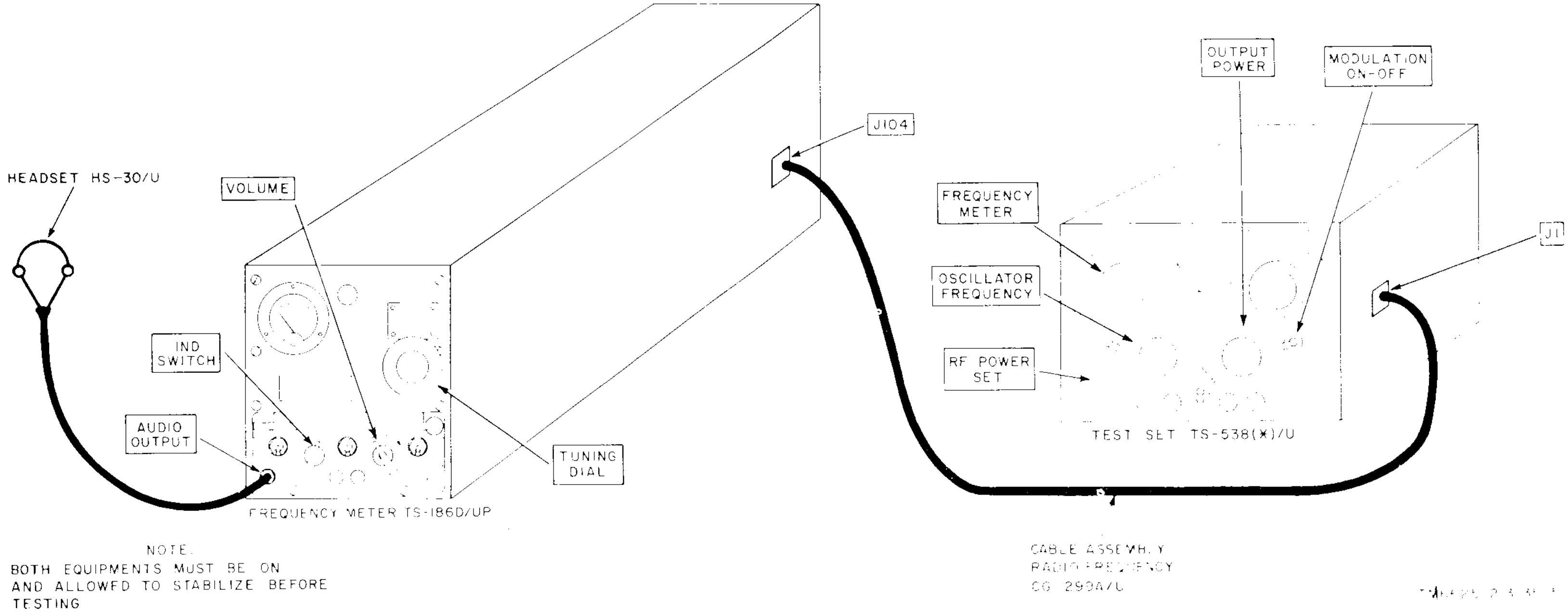

Figure 29. Frequency meter and oscillator frequency test connections.

47. Frequency Meter and Oscillator Frequency Test

a. Test Equipment and Materials.

(1) Frequency Meter TS-186D/UP.

(2) Headset HS-30/U.

b. Test Connections and Conditions.

(1) Connect the equipment as shown in figure 29.

(2) Allow the equipment to heat at least 30 minutes before test procedure is started.

c. Procedure.

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	*TS-186D/UP* *a.* POWER: OFF. *b.* IND switch: BEAT IND. *c.* XTAL CAL: ON. *d.* VOLUME: max ccw. *e.* HET OSC: ON.	*a.* R. F. POWER SET: OFF. *b.* OSCILLATOR FREQUENCY: 0. *c.* FREQUENCY METER: 1630. *d.* MODULATION: OFF. *e.* OUTPUT POWER: 20. *f.* POWER: ON.	*a.* Turn on the frequency meter and the test set and allow a minimum of 20 minutes warmup period before proceeding. *b.* Calibrate TS-186D/UP as follows: (1) Turn the IND SWITCH to each of its positions and compare the meter indications with those listed in the following chart. Leave the switch in HET OSC position. *IND SWITCH pos* — *Meter indication* BEAT IND — .8 - .9 DET — .2 - .4 XTAL — .02 - .05 HET OSC — .6 - .95 (2) Determine the dial setting corresponding to the 840 MC and set the TUNING DIAL assembly accordingly. (Refer to the calibration book.) (3) Put on the headset and adjust the VOLUME control until the background noise is at a comfortable listening level. (4) Adjust the TUNING DIAL in the vicinity of the setting determined in *b* above, for a zero beat. Be careful not to move the TUNING DIAL during the remainder of this set.	*a.* None. *b.* None. (1) None. (2) None. (3) None. (4) OSCILLATOR FREQUENCY dial must indicate 0 ±1 division.
2	N/A.	Controls remain as at end of step 1.	*a.* Turn off the TS-186D/UP. *b.* Adjust the FREQUENCY METER dial on the TS-538(*)/U for a dip on the power monitor meter.	*a.* None. *b.* FREQUENCY METER dial must indicate 1680 (no tolerance allowed).

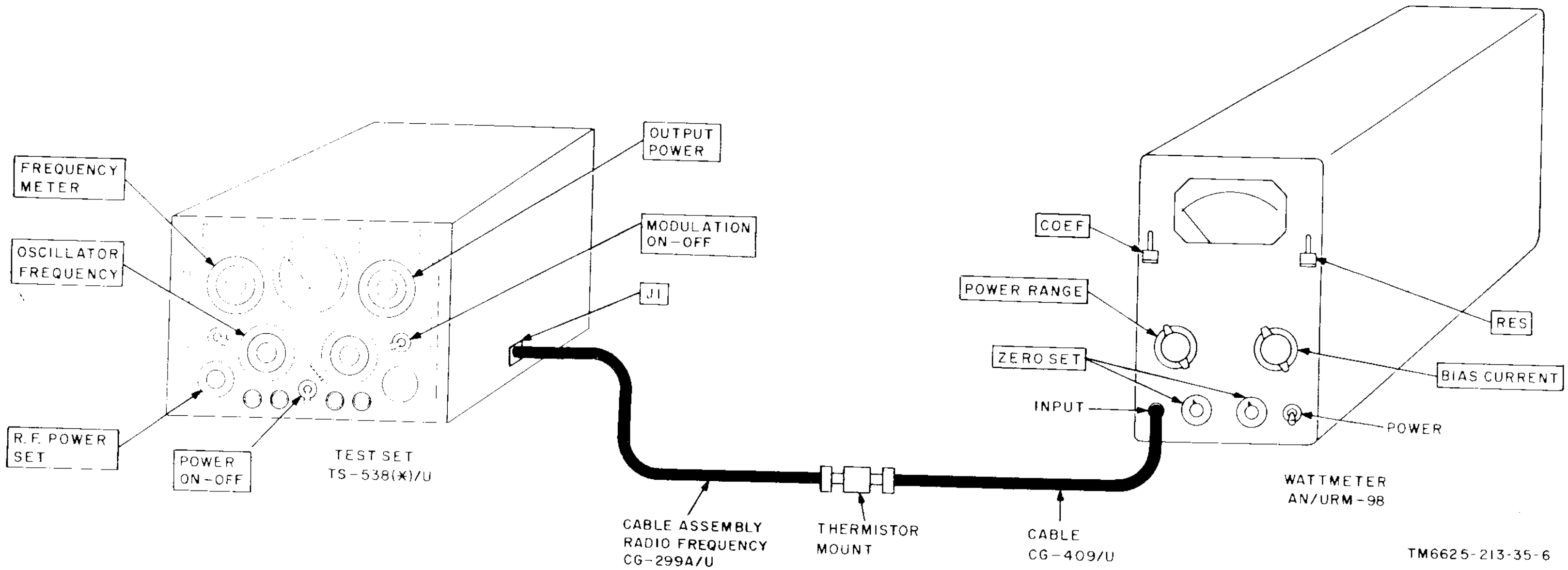

Figure 30. Power output test connections.

48. Power Output Test

a. Test Equipment and Materials.
(1) Wattmeter AN/URM-98.
(2) Thermistor Mount.

b. Test Connections and Conditions.
(1) Connect the equipment as shown in figure 30.
(2) Allow the equipment to heat at least 30 minutes before test procedure is started.

c. Procedure.

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	*AN/URM-89* *a.* BIAS CURRENT: OFF. *b.* PWR RANGE: .10. *c.* POWER: OFF. *d.* COEF: NEG. *e.* RES: 200.	*a.* POWER: OFF. *b.* MODULATION: OFF. *c.* OSCILLATOR FREQUENCY: 0. *d.* FREQUENCY METER: 1630. *e.* R. F. POWER SET: OFF. *f.* OUTPUT POWER: 20.	*a.* Turn power switches on both the test set and the wattmeter to ON. *b.* Set BIAS CURRENT switch on wattmeter to second position in 10-16 ma sector (fig. 30). *c.* Adjust FINE and COARSE ZERO SET controls on wattmeter for zero indication on the meter. *d.* After wattmeter has become reasonably stable, proceed to step 2. *Note:* The adjustment is critical. Also, meter will drift for approximately 1 hour, requiring frequent readjustment.	*a.* None. *b.* None. *c.* None. *d.* None.
2	Controls remain as at end of step 1.	Controls remain as at end of step 1.	*a.* Adjust ZERO SET controls on wattmeter for zero indication on wattmeter meter. *b.* Adjust R. F. POWER SET control on test set until power monitor meter indicates SET POWER line. *c.* Turn R. F. POWER SET to OFF and readjust ZERO SET controls on the wattmeter. *d.* Repeat *a* through *c* above several times and use average result to compare with the performance standard.	*a.* None. *b.* None. *c.* Wattmeter must indicate .1 ±1/2 division. *d.* None.

49. Test Data Summary

Personnel may find it convenient to arrange the checklist in a manner similar to that shown below:

1. CRYSTAL CHECK AND POWER TEST	
a. Crystal check	Meter indicates SET POWER (red line)
b. Power set	Meter indicates above SET POWER
2. MODULATION PULSE WIDTH TEST	45 ±5 microseconds.
3. MODULATION PULSE REPETITION RATE	AUDIO OSCILLATOR TUNING
1. 25	21.25 - 28.75
2. 50	42.5 - 57.5
3. 75	63.75- 86.25
4. 100	85.0 - 115.0
5. 125	106.25- 143.75
6. 150	127.5 - 172.5
7. 175	148.75 - 201.25
8. 200	170.0 - 230.0
4. POWER MONITOR SENSITIVITY TEST	Meter indicates on line between BAD and GOOD sections, ± width or pointer.
5. FREQUENCY METER AND OSCILLATOR FREQUENCY TEST	1680 (no tol).
6. POWER OUTPUT TEST	Wattmeter indicates .1 ±1/2 division.

CHAPTER 5

DEPOT INSPECTION STANDARDS

50. Applicability of Depot Inspection Standards

The tests outlined in this chapter are designed to measure the performance capability of a repaired equipment. Equipment that is to be returned to stock should meet the standards given in these tests.

51. Applicable References

a. Repair Standards. Applicable procedures of the depot performing these tests and its general standards for repaired electronic equipment form a part of the requirements for testing this equipment.

b. Technical Publication. The technical publication applicable to the equipment to be tested is: Operator and Organizational Maintenance Manual Test Sets TS-538/U, TS-538A/U, TS-538B/U, and TS-538C/U.

c. Modification Work Orders (para 41). Perform all modification work orders applicable to this equipment before making the tests specified. DA Pamphlet 310-4 lists all applicable MWO's.

52. Test Facilities Required

The test equipment and materials required in determining compliance with the requirements of the specific standard are given in paragraph 40.

53. Tests

Perform the tests given in paragraphs 42 through 48 to verify the proper operation of this equipment.

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APPENDIX

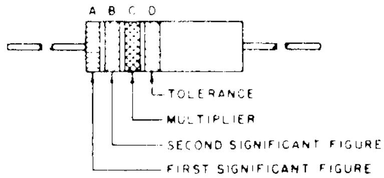
REFERENCES

Following is a list of applicable references available to the field and depot maintenance personnel of Test Set TS-538(*)/U:

DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals (types 4, 6, 7, 8, and 9), Supply Bulletins, Lubrication Orders, and Modification Work Orders
SB 11-526	Conversion of Tool Equipment TE-113 to Tool Kits TK-87 ( )/U and TK-88 ( )/U
TM 11-2432	Radiosonds AN/AMT-4
TM 11-2691-15	Frequency Meter TS-186D/UP
TM 11-5120	Frequency Meters AN/URM-32 and AN/URM-32A and Power Supply PP-1243/U
TM 11-5124	Wattmeter AN/URM-98
TM 11-5129	Oscilloscope AN/USM-50A, -50B, -50C
TM 11-5527	Multimeters TS-352/U, TS-352A/U, and TS-352B/U
TM 11-5540	Electric Light Assembly MX-1292/PAQ
TM 11-6625-213-12	Operator and Organizational Maintenance Manual, Test Sets TS-538/U, TS-538A/U, TS-538B/U, and TS-538C/U
TM 11-6625-213-20P	Organizational Maintenance Repair Parts and Special Tool Lists, Test Sets TS-538/U, TS-538A/U, TS-538B/U, and TS-538C/U.
TM 11-6625-213-35P	Field and Depot Maintenance Repair Parts and Special Tool Lists, Test Sets TS-538/U, TS-538A/U, TS-538B/U, and TS-538C/U
TM 11-6625-261-12	Operator's and Organizational Maintenance Manual, Audio Oscillators TS-382A/U, TS-382B/U, TS-382D/U, TS-382E/U; and TS-382F/U
TM 11-6625-274-12	Operator's and Organizational Maintenance Manual, Test Sets, Electron Tube TV-7/U, TV-7A/U, TV-7B/U, and TV-7D/U
TM 11-6625-299-15	Operator, Organizational, Field, and Depot Maintenance Manual, Generators Signal AN/URM-64 and AN/URM-64A
TM 11-6625-316-12	Operator and Organizational Maintenance Manual, Test Sets, Electron Tube TV-2/U, TV-2A/U, TV-2B/U, and TV-2C/U.
TM 11-6660-206-10	Operator's Manual, Rawin Sets AN/GMD-1A and AN/GMD-1B.

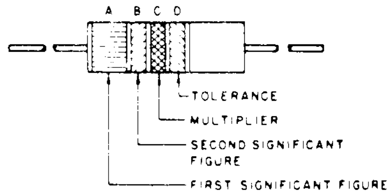
COLOR CODE MARKING FOR MILITARY STANDARD RESISTORS

COMPOSITION-TYPE RESISTORS



BAND A— Equal Width Band Signifies Composition-Type

WIREWOUND-TYPE RESISTORS



BAND A— Double Width Signifies Wire-wound Resistor

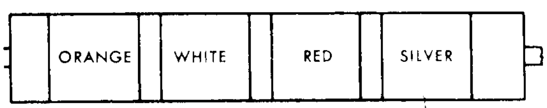
COLOR CODE TABLE

BAND A		BAND B		BAND C		BAND D*	
COLOR	FIRST SIGNIFICANT FIGURE	COLOR	SECOND SIGNIFICANT FIGURE	COLOR	MULTIPLIER	COLOR	RESISTANCE TOLERANCE (PERCENT)
BLACK	0	BLACK	0	BLACK	1		
BROWN	1	BROWN	1	BROWN	10		
RED	2	RED	2	RED	100		
ORANGE	3	ORANGE	3	ORANGE	1,000		
YELLOW	4	YELLOW	4	YELLOW	10,000	SILVER	± 10
GREEN	5	GREEN	5	GREEN	100,000	GOLD	± 5
BLUE	6	BLUE	6	BLUE	1,000,000		
PURPLE (VIOLET)	7	PURPLE (VIOLET)	7				
GRAY	8	GRAY	8	SILVER	0.01		
WHITE	9	WHITE	9	GOLD	0.1		

EXAMPLES OF COLOR CODING

BAND

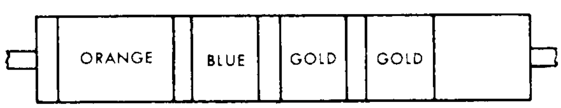
A B C D*



3 9 X100 ± 10%

BAND

A B C D*



3 6 X0.1 ± 5%

NOMINAL RESISTANCE	3,900 Ohms	3.6 Ohms
RESISTANCE TOLERANCE	± 10 percent	± 5 percent

STD-R2

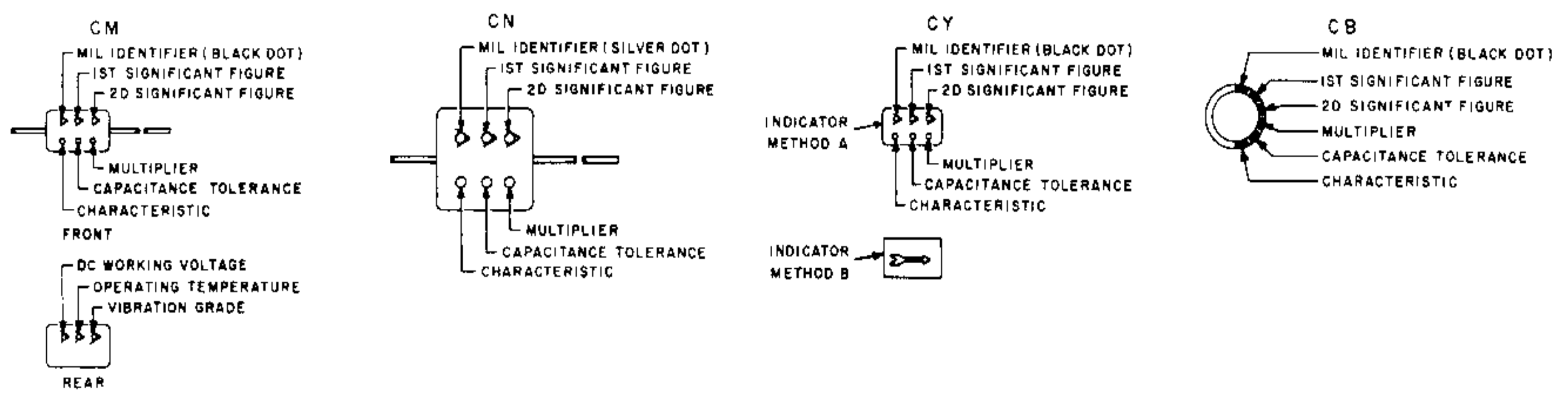
*If Band D is omitted, the resistor tolerance is ± 20%, and the resistor is not Mil-Std.

Figure 31. Color code marking for MIL-STD resistors.

GPO 806-202-5

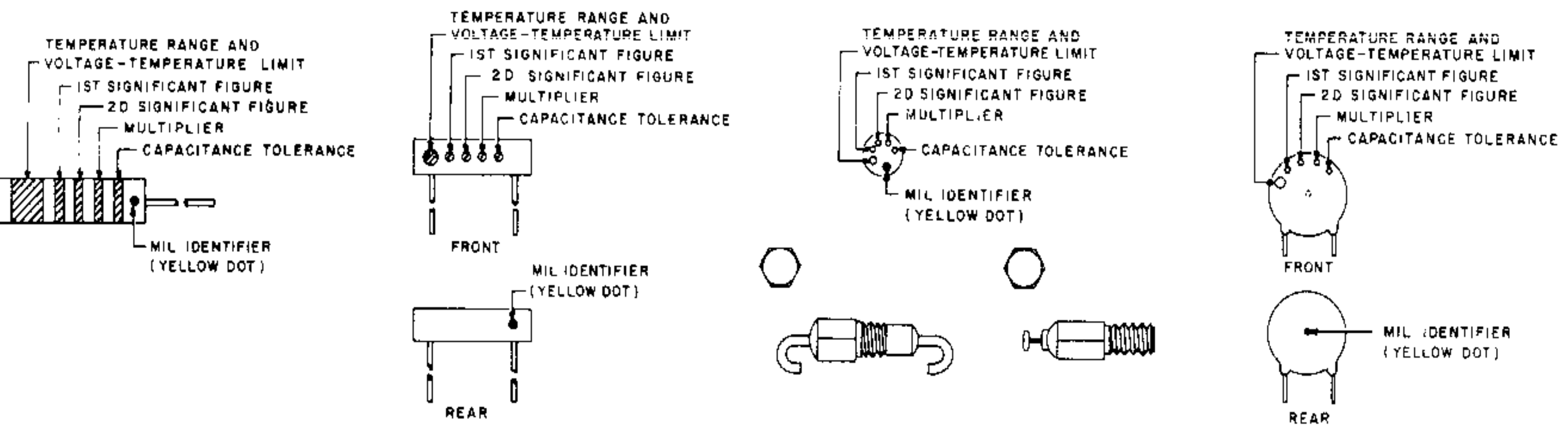
COLOR CODE MARKING FOR MILITARY STANDARD CAPACITORS

GROUP I Capacitors, Fixed, Various-Dielectrics, Styles CM, CN, CY, and CB



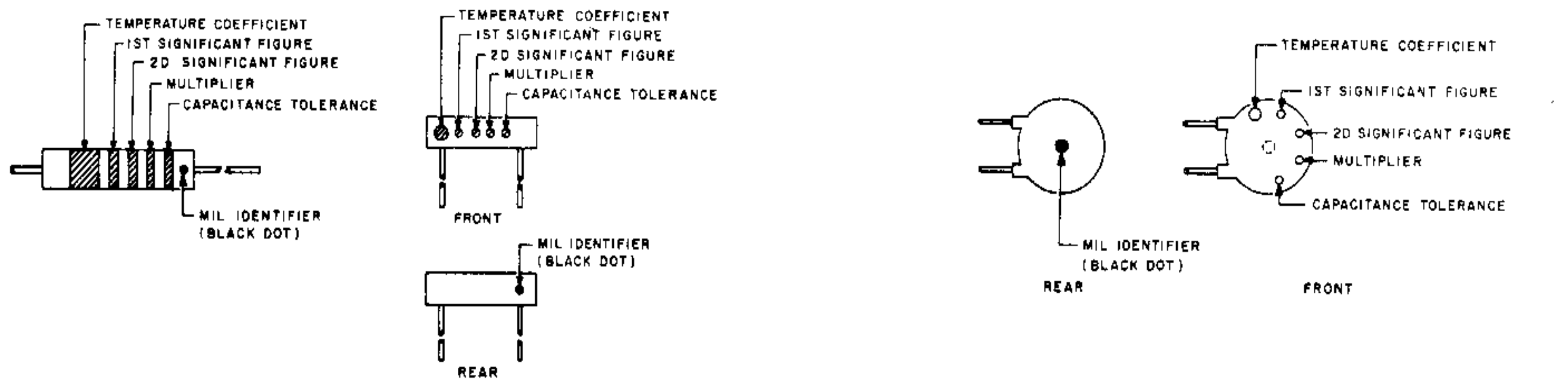
MICA-DIELECTRIC | PAPER-DIELECTRIC | GLASS-DIELECTRIC, GLASS CASE | MICA, BUTTON TYPE

GROUP II Capacitors, Fixed Ceramic-Dielectric (General Purpose) Style CK



AXIAL LEAD | RADIAL LEAD | FEED-THROUGH | STAND-OFF | DISK-TYPE

GROUP III Capacitors, Fixed, Ceramic-Dieletric (Temperature Compensating) Style CC



AXIAL LEAD | RADIAL LEAD | DISK-TYPE

COLOR CODE TABLES

TABLE I – For use with Group I, Styles CM, CN, CY and CB

COLOR	MIL ID	1st SIG FIG	2nd SIG FIG	MULTIPLIER[1]	CAPACITANCE TOLERANCE				CHARACTERISTIC[2]				DC WORKING VOLTAGE	OPERATING TEMP. RANGE	VIBRATION GRADE
					CM	CN	CY	CB	CM	CN	CY	CB	CM	CM	CM
BLACK	CM, CY CB	0	0	1			± 20%	± 20%		A				−55° to +70°C	10–55 cps
BROWN		1	1	10					B	E		B			
RED		2	2	100	± 2%		± 2%	± 2%	C		C			−55° to +85°C	
ORANGE		3	3	1,000		± 30%			D			D	300		
YELLOW		4	4	10,000					E					−55° to +125°C	10–2,000 cps
GREEN		5	5		± 5%				F				500		
BLUE		6	6											−55° to +150°C	
PURPLE (VIOLET)		7	7												
GREY		8	8												
WHITE		9	9												
GOLD				0.1			± 5%	± 5%							
SILVER	CN				± 10%	± 10%	± 10%	± 10%							

TABLE II – For use with Group II, General Purpose, Style CK

COLOR	TEMP. RANGE AND VOLTAGE – TEMP. LIMITS[3]	1st SIG FIG	2nd SIG FIG	MULTIPLIER	CAPACITANCE TOLERANCE	MIL ID
BLACK		0	0	1	± 20%	
BROWN	AW	1	1	10	± 10%	
RED	AX	2	2	100		
ORANGE	BX	3	3	1,000		
YELLOW	AV	4	4	10,000		CK
GREEN	CZ	5	5			
BLUE	BV	6	6			
PURPLE (VIOLET)		7	7			
GREY		8	8			
WHITE		9	9			
GOLD						
SILVER						

TABLE III – For use with Group III, Temperature Compensating, Style CC

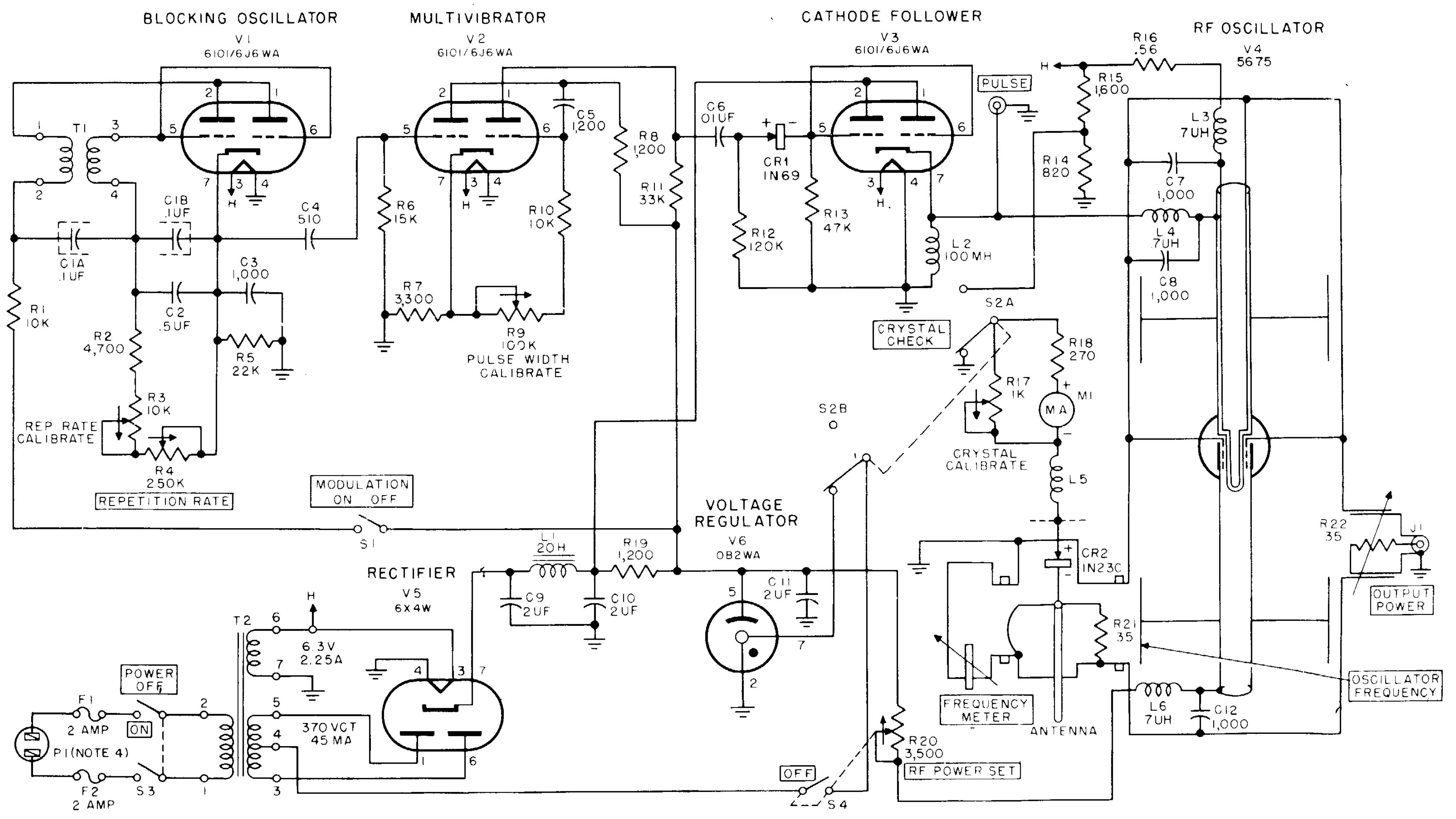
COLOR	TEMPERATURE COEFFICIENT[4]	1st SIG FIG	2nd SIG FIG	MULTIPLIER[1]	CAPACITANCE TOLERANCE		MIL ID
					Capacitances over 10uuf	Capacitances 10uuf or less	
BLACK	0	0	0	1		± 2.0uuf	CC
BROWN	30	1	1	10	± 1%		
RED	80	2	2	100	± 2%	± 0.25uuf	
ORANGE	150	3	3	1,000			
YELLOW	−220	4	4				
GREEN	330	5	5		± 5%	± 0.5uuf	
BLUE	470	6	6				
PURPLE (VIOLET)	750	7	7				
GREY		8	8	0.01			
WHITE		9	9	0.1	± 10%		
GOLD	+100					± 1.0uuf	
SILVER							

1. The multiplier is the number by which the two significant (SIG) figures are multiplied to obtain the capacitance in uuf.
2. Letters indicate the Characteristics designated in applicable specifications: MIL–C–5, MIL–C–91, MIL–C–11272, and MIL–C–10950 respectively.
3. Letters indicate the temperature range and voltage-temperature limits designated in MIL–C–11015.
4. Temperature coefficient in parts per million per degree centigrade.

STD–C2

GPO 806-202-6

Figure 32. Color code marking for MIL-STD capacitors.



NOTES:

1 UNLESS OTHERWISE SHOWN, RESISTORS ARE IN OHMS, CAPACITORS ARE IN UUF.
2 CONTROLS MARKED CALIBRATE ARE ON CHASSIS.
3 ARROWS ON VARIABLE RESISTORS INDICATE CW DIRECTION.
4 ON A AND B MODELS P1 IS CHANGED TO J2
5 ▭ INDICATES EQUIPMENT MARKING

TM6625-213-35-14

Figure 33. Test Sets TS-538/U, TS-538A/U, and TS-538B/U, schematic diagram.

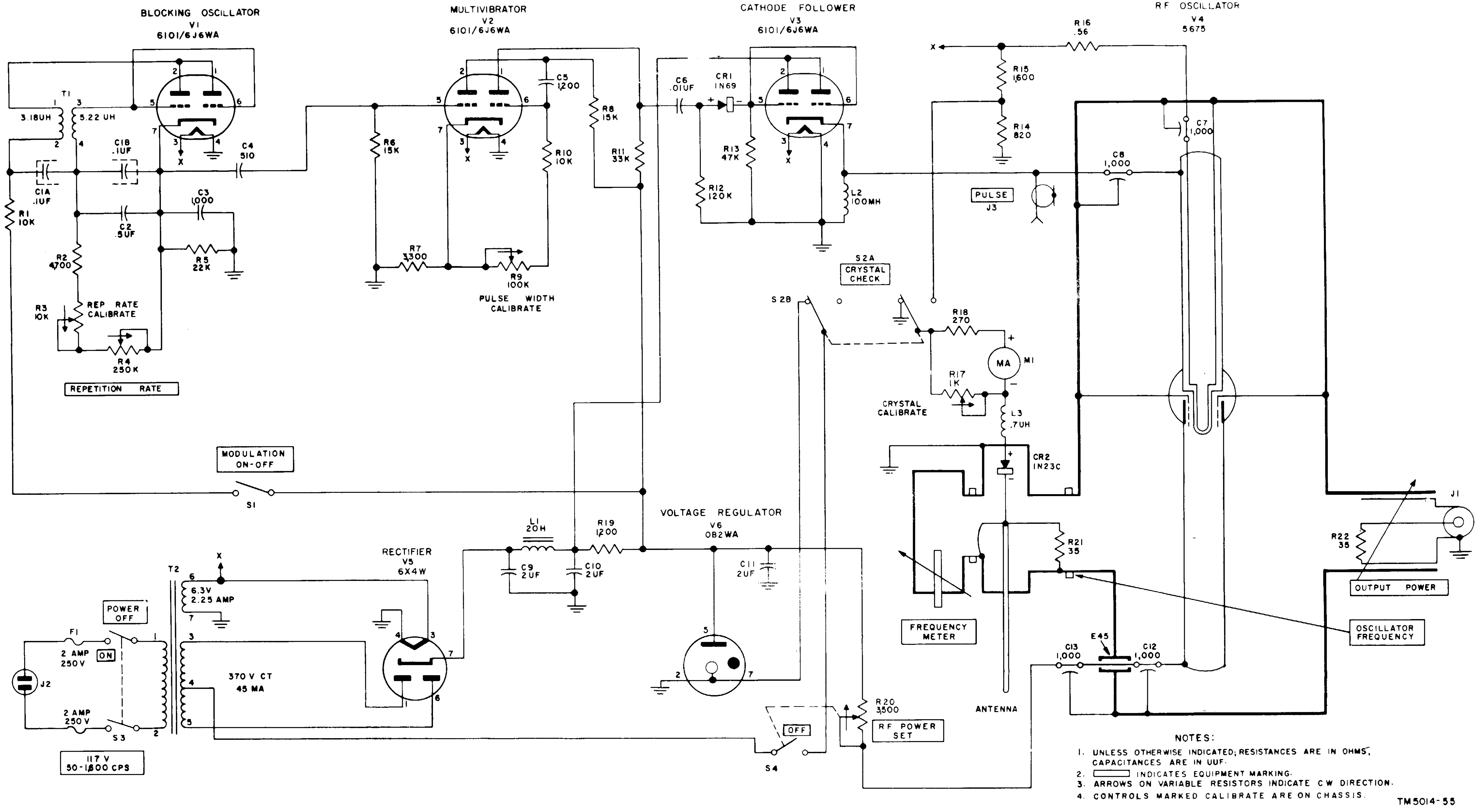
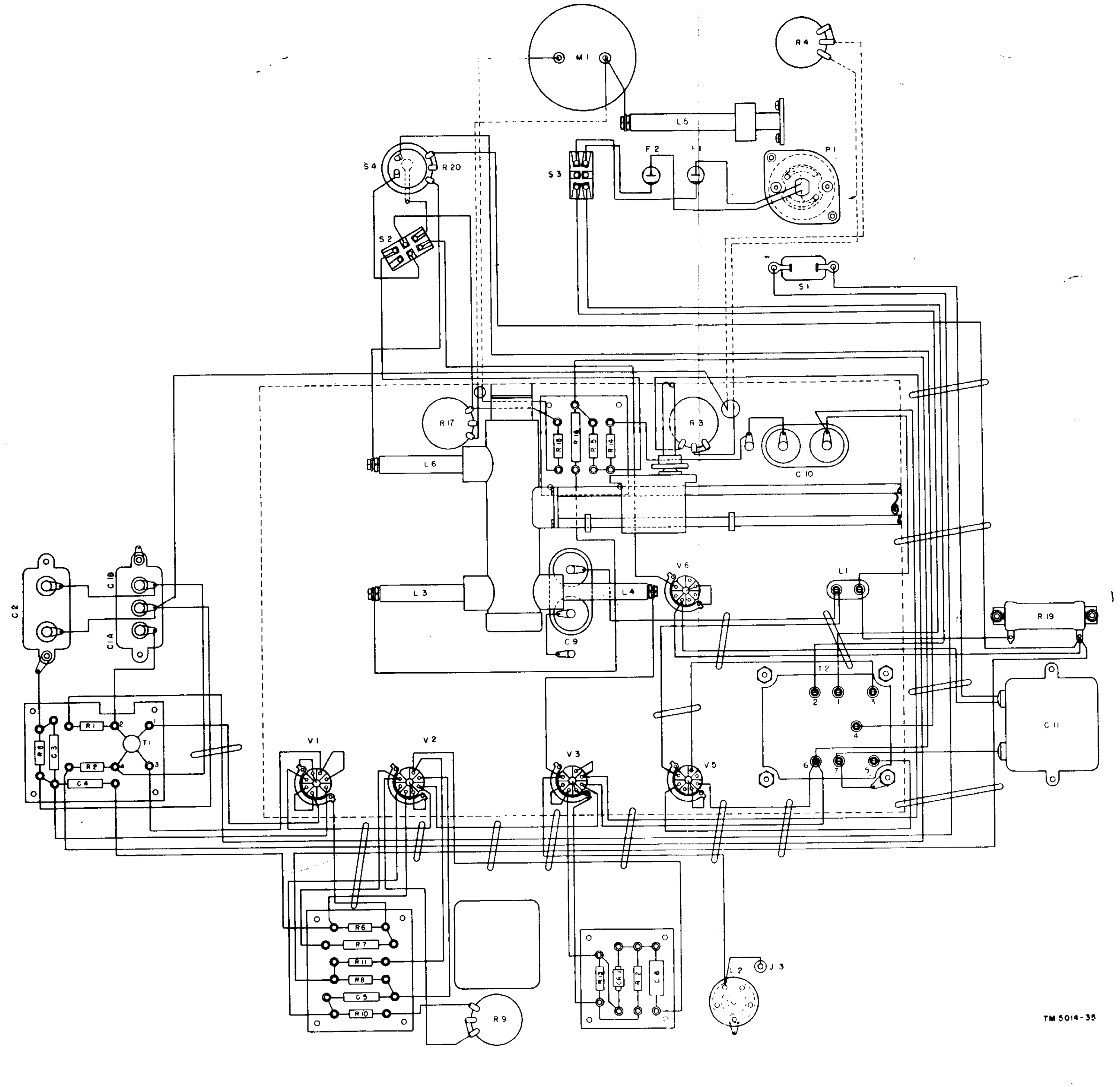


Figure 34. Test Set TS-538C/U, schematic diagram.



GPO 901-202-7

Figure 35. Test Sets TS-538/U, TS-538A/U, and TS-538B/U, wiring diagram.

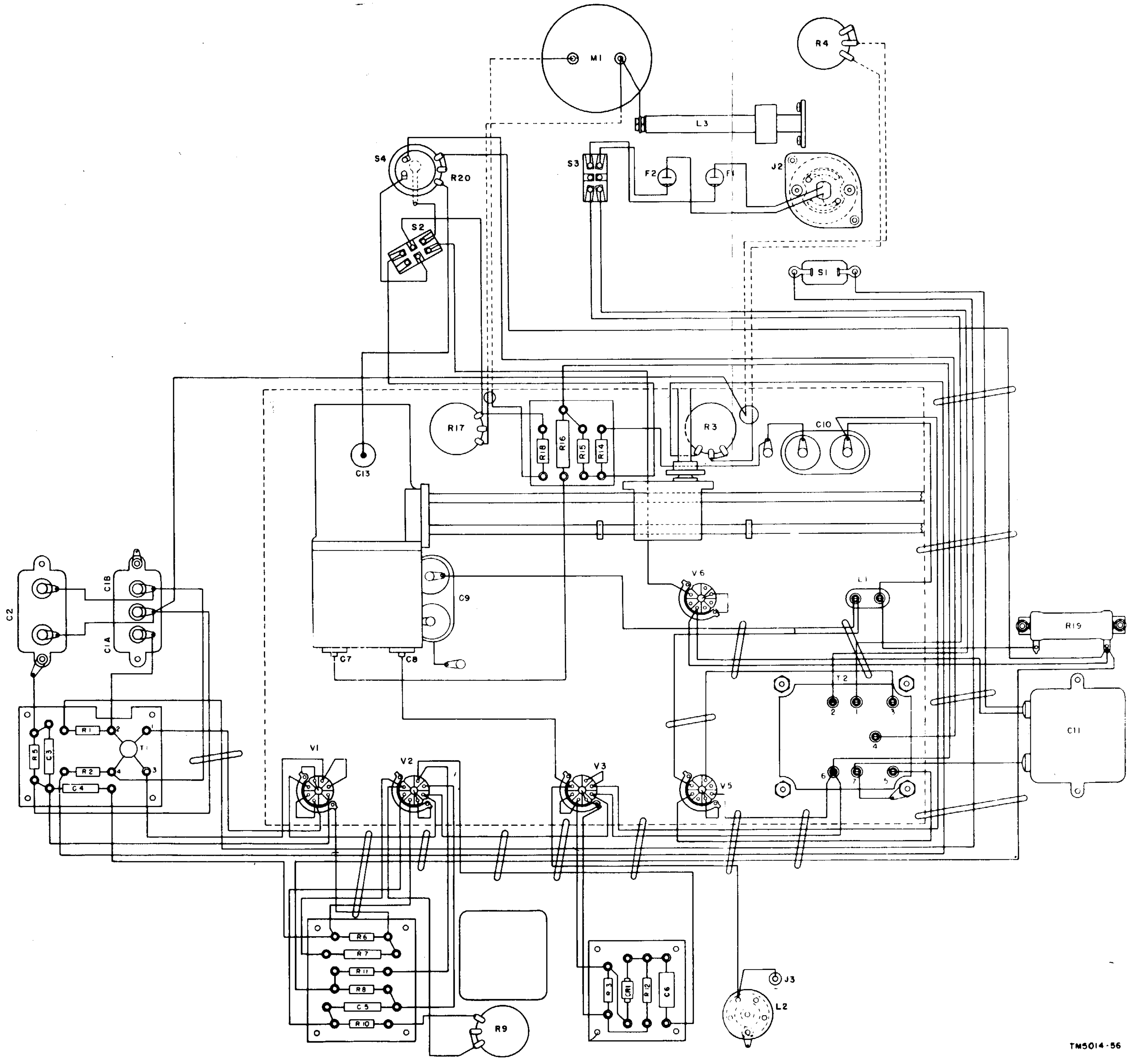


Figure 36. Test Set TS-538C/U, wiring diagram.

INDEX

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

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