DEPARTMENT OF THE ARMY TECHNICAL MANUAL **TM 11-6625-303-35**

DEPARTMENT OF THE AIR FORCE TECHNICAL ORDER **TO 33A1-5-72-2**

FIELD AND DEPOT MAINTENANCE

ELECTRICAL POWER TEST SETS

AN–UPM-93 AND AN-UPM-100

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DEPARTMENTS OF THE ARMY AND THE AIR FORCE

28 AUGUST 1959

CHANGE No. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D. C., *8 May 1968*

DS, GS, and Maintenance Manual

ELECTRICAL POWER TEST SETS AN/UPM-93B AN/UPM-93C, AND AN/UPM-100

TM 11-6625-303-35, 28 August 1959, is changed as follows:

This manual is changed to apply to Electrical Power Test Sets AN/UPM-93A AN/UMP-93B, and AN/UPM-93C also.

Change the title of the manual to read as shown above.

Delete "AN/UPM-93" and substitute "AN/UPM-93A, AN/UPM-93B, and AN/UPM-93C" in the following places:

Page 2, paragraph *1a,* line 3.

Subparagraph *b,* line 4.

Page 13, left column, line 4.

Page 2, paragraph 1. Make the following changes:

Delete subparagraph *c* and substitute:

c. Reporting of Equipment Manual Improvements. Report of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to DA Publications) and forwarded direct to Commanding General, U.S. Army Electronics Command, ATTN: AMSEL-ME-NMP-AD, Fort Monmouth, New Jersey 07703.

Add paragraph 1.1 after paragraph 1,

1.1. Indexes of Equipment Publications

a. *DA Pam 310-4.* Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

b. DA Pam 310-7. Refer to DA Pam 310-7 to determine whether there are modification work orders (MWO's) pertaining to the equipment.

Paragraph 2, chart. In the "TS-934/U" column. Delete "TS-934/U" and substitute: TS-934A/U and TS-934B/U.

Paragraph 3. Make the following changes:

Subparagraph *a.* Delete the first sentence and substitute:
For the AN/UPM-100, the input voltage is applied directly across voltmeter terminals P1 and P2 (fig. 1).

Add subparagraph *a.* 1 after subparagraph *a.*

a.1. For the AN/UPM-93A, AN/UPM-93-B, and AN/UPM-93C, the input voltage is applied directly accross Test Prod MX-1910/U terminals P1 and P2 (fig. 1.1). The parallel network of resistors R1 and R2 can be switched in or out of the circuit by action of the spring-loaded momentary on type toggle switch S1.

(1) When toggle switch S1 is in its nor-

mal spring-loaded, 300-volt ac position, the meter multiplier network (R1 and R2) is connected in series with the meter movement. Under this circuit condition, the multiplier network increases the voltmeter maximum range from 150 volts (inscribed on the dial face lower scale) to a maximum of 300 volts (inscribed on the dial face upper scale). The resistor network limits the current in the circuit to the amount required for full-scale pointer deflection at 300 volts.

(2) When toggle switch S1 is depressed to the left (when viewed from the front of the test set) and held in this position, the meter multiplier network (R1 and R2) is shorted out and the full input voltage is applied to the voltmeter meter movement, which has been calibrated to indicate full-stall pointer deflection at 150 volts.

Subparagraph *b*, line 2. Delete "(fig. 1 and 2)" and substitute: (fig. 1, 1.1, and 2).

Paragraph *4a*. Delete the first sentence and substitute: For the AN/UPM-100, the output of power circuit being tested is applied directly across the frequency meter (fig. 1).

Page 3, paragraph *4a*. Add subparagraph *a.1* after subparagraph *a*.

a.1. For the AN/UPM-93A, AN/UPM-93 B, and AN/UPM-93C, the output of the power circuit being tested is applied directly across the frequency meter through Test Prod MX-1910/U terminals P1 and P2 (fig. 1.1). Resistor R3 can be switched in or out of the circuit by action of spring-loaded momentary on type toggle switch S1.

(1) When toggle switch S1 is in its normal spring-loaded, 300-volt ac position, current-limiting resistor R3 is connected in series with the frequency meter coil. The series network, consisting of R3 and the frequency meter coil, is in parallel with the voltmeter circuit.

(2) When toggle switch S1 is depressed to the left (when viewed from the front of the test set) and held in this position, resistor R3 is shorted out and the full applied input current flows through the frequency meter coil.

Figure 1. Make the following changes:

Delete the caption and substitute: *Schematic diagram (TS-914, U only).*

Add figure 1.1 after figure 1:

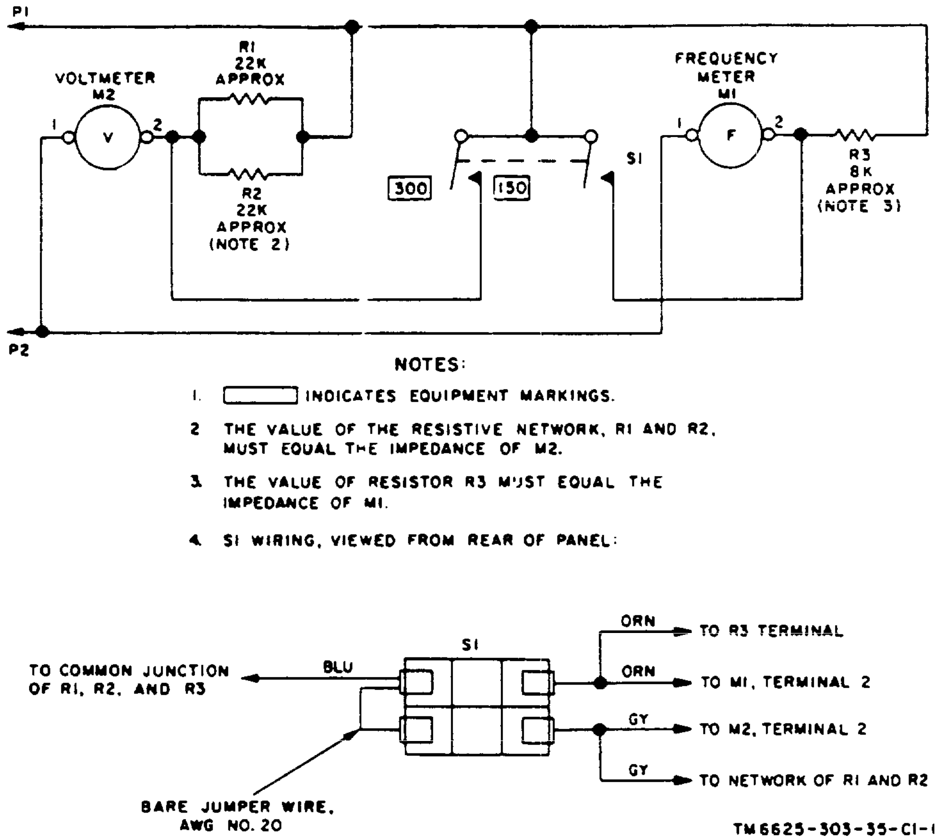

Figure 1.1. Schematic diagram (TS-934A/U and TS-934B/U only).

Page 4, paragraph 6c(1), line 2. Delete the reference "(fig. 1)" and substitute: (fig. 1 or 1.1).

Page 5, paragraph 8. Make the following changes:

Subparagraph *a.* Make the following changes:

First sentence. After "meter," add: or associated circuit.

Second sentence. Delete and substitute: The location of parts mounted within the meter cases for the TS-914/U is indicated in figures 2 and 3. Because the TS-934A/U and TS-934B/U use sealed meters, the multiplier and current-limiting resistors for this model are mounted external to the meter cases (fig. 3.1).

Subparagraph c. After the heading, add: (TS-914/U).

Add subparagraph *d* after subparagraph c.

d. Troubleshooting Chart for TS-934A/U and TS-934B/U.

Symptom	*Probable trouble*	*Correction*
Voltmeter pointer will not adjust to zero	Defective voltmeter	Replace voltmeter (para 11*a*).
Both meters function properly when selector switch S1 is at 300, but neither meter operates when S1 is depressed and held at 150	Defective selector switch S1	Replace defective selector switch (para 13.1).
Voltmeter and frequency meter do not operate when test prods are connected to power source	Defective test lead	Check continuity of each test lead. Replace defective test lead.
Voltmeter does not operate when test prods are connected to power source (selector switch S1 at 300 and frequency meter operates normally)	Open resistor R1 or R2, or defective voltmeter M2	Select a 115-volt, ac signal source. Depress and hold selector switch at 150. If voltmeter indicates properly, resistor network, consisting of R1 and R2, is open. If there is no indication, voltmeter M2 is defective. Check resistances (para 9) and replace defective resistor (para 11*c*) or complete voltmeter (para 11*a*).
Frequency meter does not operate when test prods are connected to power source (selector switch S1 at 300 and voltmeter operates normally)	Open resistor R3, or defective frequency meter M1	Select a 115-volt, ac signal source. Depress and hold selector switch at 150. If there is no indication, frequency meter M1 is defective. Check resistances (para 9), and replace defective resistor (para 12.1) or complete frequency meter.
Broken or bent voltmeter pointer	Defective voltmeter	Replace voltmeter (para 11*a*).

Page 6, paragraph 9. Delete chart and substitute:

Measurement point	*Resistance (ohms)* *AN/UPM-93A or -93B (TS-934A/U)*	*AN/UPM-93C (TS-934B/U)*	*AN/UPM-100 (TS-914/U)*
Across test leads:			
a. With switch S1 at 150	3,500	4,840[a]	6,000
b. With switch S1 at 300	7,100	9,260[a]	12,000
Across voltmeter circuit (frequency meter disconnected):			
a. With switch S1 at 150	5,500	11,000[a]	15,000
b. With switch S1 at 300	11,000	22,000[a]	30,000
Across frequency meter circuit (voltmeter disconnected):			
a. With switch S1 at 150	10,000	8,000[a]	10,000
b. With switch S1 at 300	20,000	16,000[a]	20,000

[a]**Denotes typical resistance indications obtained with voltmeters having internal impedance of 11,000 ohms and with frequency meters having internal impedance of 8,000 ohms. Indications will vary considerably from these values for certain meter movements produced, which have different internal impedance values.**

Page 7 paragraph 10. Make the following changes:

Delete subparagraph *d* and substitute:

d. Use only the exact value of the original part when replacing a defective voltmeter multiplier resistor or frequency meter current-limiting resistor.

Add subparagraph *e* after subparagraph *d*.

e. In the TS-934A/U and TS-934B/U, the value of the resistive network, consisting of shunt-connected resistors R1 and R2 (fig. 1.1) must match the internal impedance of the voltmeter. Similarly, the value of current-limiting resistor R3 must match the internal impedance of the frequency meter. If the color coding on the defective resistor cannot be read because of scarring or blistering, use an impedance bridge (such as General Radio Co. type 1650-A Audio-Frequency Impedance Bridge, or equivalent) to measure the impedance of the meter. If R1 or R2 requires replacement select a replacement so that the parallel network's ohmic value equals the voltmeter impedance. If R3 requires replacement select a replacement resistor the ohmic value of which equals the frequency meter impedance.

Paragraph 11. Make the following changes:

Subparagraph *a.* Delete subparagraph (4) and substitute:

(4) Unsolder the leads connected at the back of the meter. (These leads are not shown for the AN/UPM-100. For the AN/UPM-93A, AN/UPM-93B, and AN/UPM-93 C, refer to figure 3.1.)

Subparagraph *b.* After the heading, add: (AN/UPM-100) .

Add subparagraph c after subparagraph *b.*

c. Replacement of Resistors R1 and R2 (AN/UPM-93A, AN/UPM-93B, and AN/UPM-93C).

(1) Perform the procedures indicated in a(1), (2), and (3) above.

(2) Unsolder the parallel network of re-

sisters R1 and R2 (fig. 3.1) from the two terminal boards mounted on the rear of the panel.

(3) Obtain the same resistance value network, as the original multiplier resistors, to match the internal impedance of the voltmeter, and solder the replacement network to the terminal boards.

Note. If the value of the replacement network is not the same as the original resistor network, the voltmeter will be out of calibration on the 300-volt range. Observe the color code on the defective resistors and replace with identical values. The value of the resistor network must equal the impedance of the voltmeter meter movement.

(4) Perform the voltmeter final test (para *17d).* If the test is satisfactory, secure the front panel to the case. If the final test is not satisfactory, this is an indication that the multiplier network does not match-the impedance of the meter movement. Use an impedance bridge (para 16) to measure the exact impedance of the meter movement. Then replace R1 and R2, so that the parallel value of the two resistors precisely match the meter movement impedance value, and retest.

Page 8, paragraph 12. Make the following changes:

Heading. After “R4,” add: (AN/UPM-100).

Add paragraph 12.1 after paragraph 12.

12.1. Replacement of Frequency Meter and Resistor R3 (AN/UPM-93A, AN/UPM-93B, and AN/UPM-93C)

a. Replacement of Frequency Meter.

(1) Perform the procedures indicated in paragraph 11a(1) through (9).

(2) Perform the frequency meter final test (para *17c).*

(3) Secure the panel to the case, replace the cover, and secure the latch.

b. Replacement of Resistor R3.

(1) Perform the procedures indicated in paragraph 11a(1), (2), and (3).

(2) Unsolder defective resistor R3 (fig. 3.1) from the two terminal boards mounted on the rear of the panel.

(3) Obtain the same ohmic value replacement resistor as the defective R3 to match the internal impedance of the frequency meter. Solder the replacement resistor to the two terminal boards.

(4) Seat the front panel in the case.

(5) Perform the frequency meter final test (para *17c).*

Paragraph 13, heading. After the heading, add (AN/UPM-100).

Add paragraph 13.1 after paragraph 13.

13.1. Replacement of Selector Switch (AN-UPM-93A, AN/UPM-93B, and AN/UPM-93C)

a. Removal.

(1) Perform the procedures indicated in paragraph 11a(1), (2), and (3).

(2) Unsolder and tag the blue, orange, and gray wires (fig. 1.1) from the terminals at the back of the selector switch (fig. 3.1).

(3) Use a spintite wrench, a nut driver, or an open-end wrench to loosen and remove the nine-sixteenths inch hexagonal nut that secures the selector switch to the front of the panel.

(4) Remove the defective switch from the rear of the panel.

b. Replacement.

(1) Solder a short length, approximately one-half inch long, of bare AWG No. 20 wire across the two terminals of the replacement selector switch (fig. 1.1).

(2) Remove the mounting hexagonal nut from the top of the bushing on the replacement switch.

(3) Working from the rear of the panel, insert the bushing of the replacement switch through the panel hole. Be sure that the spring-loaded bat handle of the switch is at 300 as inscribed on the front of the panel.

(4) Working from the rear of the panel, locate the positioning index on the lockwasher, supplied with the switch, so that the index seats in the indent provided on the rear of the panel.

(5) Working from the front of the panel, replace the mounting hexagonal nut on the

protruding bushing. Then tighten the mounting hexagonal nut so that the switch bushing is flat with the tip surface of the mounting hexagonal nut.

(6) Working from the rear of the panel, tighten the hexagonal jamming nut so that the selector switch is securely held in place on the panel.

(7) Resolder the blue, orange, and gray wires to the three terminals of the switch (fig. 1.1).

(8) Seat the front panel in the case.

(9) Perform the frequency meter final test (para *17c)* and the voltmeter final test (para *17d).*

Paragraph 14, heading. After the heading, add: (AN/UPM-100).

Page 9, figure 2. Add the figure caption: *(AN/UPM-100 only).*

Page 10, figure 3. Make the following changes:

After the figure caption, add: *(AN/UPM-100only).*

Add figure 3.1 after figure 3.

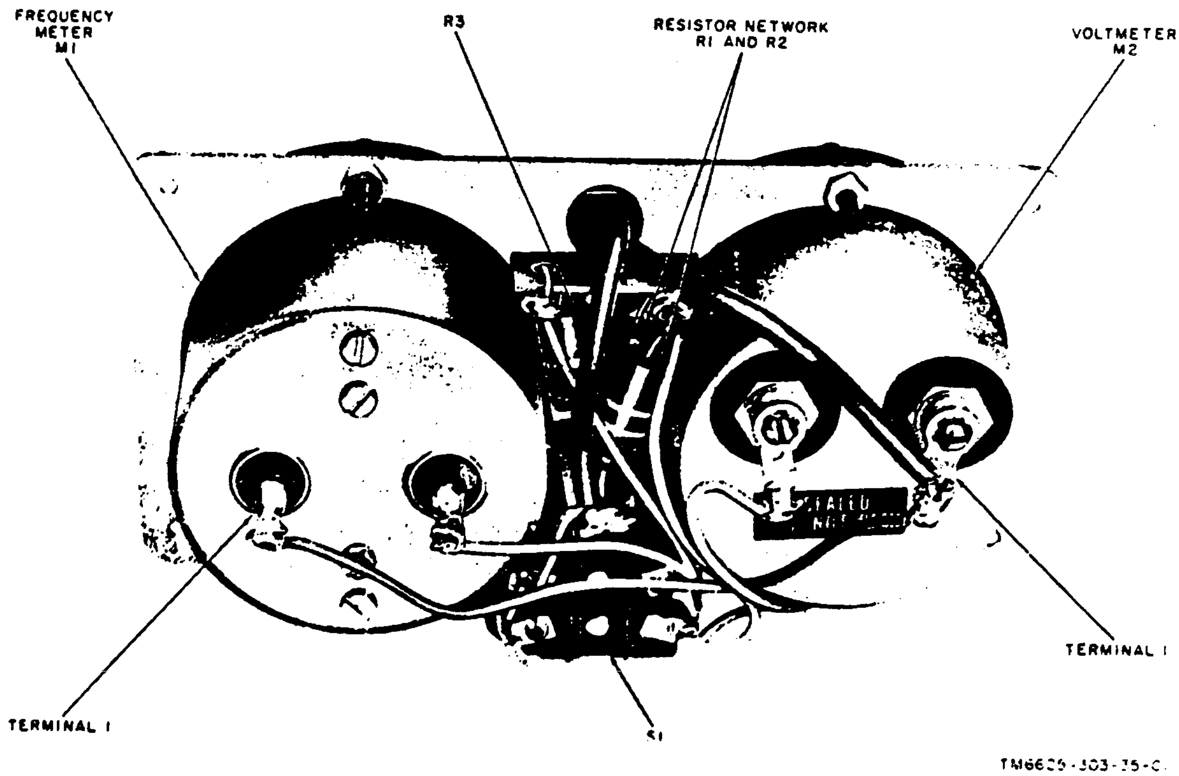

Figure 3.1. Electrical Power Test Sets TS-934A/U and TS-934B/U, rear panel view.

Page 11, paragraph 16 line 3. Delete and substitute: Test Set TS-914/U, TS-934A/U, or TS-934B U. unless otherwise specified.

Page 12, paragraph 17. Make the following changes:

Subparagraph c(3), line 4. Change "±5 percent" to: ±0.5 percent.

Subparagraph *d.* Make the following changes:

Delete subparagraph (2) and substitute:

(2) Four 24-inch long test cords are supplied with Meter Test Sets TS-682/GSM-1 and TS-682A/GSM-1. In the test procedures below, the test cords are arbitrarily

designated as shown in the chart below:

Cord No. designation	*Termination at one end*	*Termination at other end*
1	Spade-type terminal	Spade-type terminal
2	Spade-type terminal	Spade-type terminal
3	Spade-type terminal	Telephone Plug PL-55 (later designation PJ-055), with 0.25-inch diameter shank
4	Spade-type terminal	Telephone Plug PJ-068, with 0.2065-inch diameter shank

Subparagraph (4). Delete and substitute:

(4) Connect one end of cord No. 1 to either test prod of the TS-914/U, TS-934A/U, or TS-934B/U. Connect the other end of cord No. 1 to the meter test set COMMON binding post on the vertical panel.

Add subparagraph (4.1) after subparagraph (4):

(4.1) Connect the spade-type terminal of cord No. 3 to the second test prod of the TS-914/U, TS-934A/U, or TS-934B/U. Insert telephone plug PL-55 (or PJ-055) of cord No. 3 into the meter test set appropriate ac volts jack, depending on the setting of the ALT CURRENT-AC VOLTS-DC VOLTS COARSE and FINE controls. Set the meter test set left-hand selector switch for the full-scale range selected, and observe the meter pointer deflection on the standard ac meter. This meter is at the extreme left of the three meters mounted on the sloping panel of the meter test set.

Delete subparagraph (6) and substitute:

(6) The fill-scale reading on the TS-914/U or TS-934A/U and TS-934B/U should be within ±2 percent of the pointer deflection on the standard ac meter of the TS-682/-GSM-1 (147 to 153 volts on the 0-to 150-volts scale; 294 to 306 volts on the 0-to 300 - volts scale).

Add subparagraph (7) after subparagraph (6).

(7) The full-scale reading on the TS-934A/U and TS-934B/U should be within ±2 percent (147 to 153 volts) of the pointer deflection on the standard ac meter of the TS-682/GSM-1, for the 0-to 150-volt scale; and within ±3 percent (291 to 309 volts) of the pointer deflection on the standard ac meter of the TS-682/GSM- 1, for the 0-to 300-volt scale.

Add chapter 5 after chapter 4.

CHAPTER 5
DEPOT OVERHAUL STANDARDS

18. Applicability of Depot Overhaul 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.

19. Applicable References

a. Repair Standards. Applicable procedures of the depots performing these tests and the general standard for repaired electronic equipment given in TB SIG 355-1, TB SIG 355-2, and TB SIG 355-3 form a part of the requirements for testing this equipment.

b. Technical Publications. The technical publication applicable to the equipment to be tested is TM 11-6625-303-35.

c. Modification Work Orders. Perform all modification work orders applicable to this equipment before making the tests specified. DA Pam 310-7 lists all available MWO's.

20. Test Facilities Required

The following items are needed for depot testing:

Item	*Technical manual*	*Common name*
Frequency Meter AN/TSM-16	TM11-6625-218-12	Frequency meter
Voltmeter TS-340/U		Voltmeter
Transformer, Variable, Power CN-16(*)/U[a]	TM 11-5950-205-15P	Variable transformer

[a]Transformer, Variable, Power CN 16(*)/U represents Transformer, Variable, Power CN-16/U, CN-16A/U, and CN-16B/U.

21. General Test Requirements

Most of the tests will be performed under the conditions given below.

a. At normal room temperature.

b. With test sets energized by a power supply of suitable voltage and frequency. Supply must be capable of furnishing 150 and 300 volts at frequencies between 58 and 62 cps and between 380 and 420 cps, respectively.

c. The voltage range switch should operate with a smooth, positive action.

22. Frequency Meter Accuracy Test

a. Set the range change switch at 150 for the AN/UPM-93 and AN/UPM-100, respectively. Connect the AN/UPM-93 and AN/UPM-100 each across individual and separate power supplies. Apply voltage between 110 and 150 volts to each set.

b. Connect Transformer, Variable, Power CN-16/U across each of the power supplies. Adjust each for an output voltage of 50 volts or less.

c. Connect Frequency Meter AN/TSM-16 across the output side of each Transformer, Variable, Power CN-16/U for the AN/UPM-93 and AN/UPM-100, respectively.

d. Vary the frequency of the power supply between 58 and 62 cps for the AN/UPM-100 and between 380 and 420 cps for the AN/UPM-93. The frequency meter portion of the test set should read the same as the AN/TSM-16 within 0.3 percent (0.2 cycle) at all cardinal points of the AN/UPM-100 frequency meter, and within 0.3 percent (1.2 cycles) at all cardinal points of the AN/UPM-93 frequency meter.

e. Change the voltage range switch setting to 300 on the AN/UPM-93 and AN/UPM-100, respectively, and raise the power supply voltage of each to a point between 220 and 300 volts. Maintain the power supply connection to the CN-16/U so that the input voltage does not exceed 150 volts.

f. Repeat the procedure given in *d* above for the AN/UPM-93 and AN/UPM-100 respectively. The accuracy must remain the same as indicated in *d* above for each setting.

23. Voltmeter Accuracy Test

a. Set the power supply voltage to 75 volts for the AN/UPM-93 and AN/UPM-100, respectively.

b. Return the range change switch to 150 for each set, remove the AN/TSM-16 and CN-16/U from the circuit or test setup, and substitute the TS-340/U.

c. Hold the power supply frequency at 60 cps for the AN/UPM-100 and 400 cps for the AN/UPM-93, and vary the voltage over a range of 75 to 150 volts. Readings of the cardinal points of the AN/UPM-93 and AN/UPM-100 voltmeters should agree with those of the TS-340/U within 2 percent (3 volts) of full-scale value.

d. Set the AN/UPM-93 and AN/UPM-100 range change switch to 300.

c. With the power supply frequency held at 400 cps for the AN/UPM-93 and 60 cps for the AN/UPM-100, vary the voltage over a range of 150 to 300 volts. Readings at the cardinal points of the AN/UPM-93 and AN/UPM-100 voltmeters should agree with those of the TS-340/U within 2 percent (6 volts) of full-scale value.

Page 13, appendix. Delete the appendix and substitute:

APPENDIX

REFERENCES

Following is a list of applicable references available to direct support general support, and depot maintenance repairman of Electrical Power Test Sets AN/UPM-93A, AN/UPM-93B, AN/UPM-93C, and AN/UPM-100.

Da Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals (Types 7, 8, and 9), Supply Bulletins, and Lubrication Orders.
DA Pam 310-7	U. S. Army Equipment Index of Modification Work Orders.
TB SIG 355-1	Depot Inspection Standard for Repaired Signal Equipment.
TB SIG 355-2	Depot Inspection Standard for Refinishing Repaired Signal Equipment.
TB SIG 355-3	Depot Inspection Standard for Moisture and Fungus Resistant Treatment.
TM 11-2535A	Meter Test Equipments AN/GSM-1B and AN/GSM-1C.
TM 11-2535B	Meter Test Set TS-682A/GSM-1.
TM 11-5057	Frequency Meter AN/USM-26.
TM 11-5950-205-15P	Operator's, Organizational, Field and Depot Maintenance Repair Parts and Special Tool Lists and Maintenance Allocation Chart: Transformer, Variable, Power CN-16/U, CN-16A/U, and CN-16B/U.
TM 11-6625-218-12	Organizational Maintenance Manual: Frequency Meter AN/TSM-16.
TM 11-6625-303-12	Operator and Organizational Maintenance Manual: Electrical Power Sets AN/UPM-93 and AN/UPM-100.
TM 38-750	Army Equipment Record Procedures.

By Order of the Secretary of the Army:

HAROLD K. JOHNSON,
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Chief of Staff.

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  11-592
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NG: State AG (3); Units - Same as active Army except allowance is one copy per unit.

USAR: None

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

TECHNICAL MANUAL
No. 11-6625-303-35
TECHNICAL ORDER
No. 33A1-5-72-2

DEPARTMENTS OF THE ARMY
AND THE AIR FORCE
WASHINGTON 25, D. C., *28 August 1959*

ELECTRICAL POWER TEST SETS
AN-UPM-93 AND AN-UPM-100

*This manual, together with TM 11-6625-303-12, 10 July 1959, supersedes TB SIG 318, 24 March 1958.

CHAPTER 1

THEORY

1. Scope

a. This manual covers field and depot maintenance for Electrical Power Test Sets AN/UPM-93 and AN/UPM-100. It includes instructions appropriate to third, fourth, and fifth echelons for troubleshooting, testing, and repairing the equipment, and replacing maintenance parts. It also lists tools, materials, and test equipment for third, fourth, and fifth echelon maintenance.

b. The complete technical manual for this equipment includes one other publication, TM 11-6625-303-12, Electrical Power Test Sets AN/UPM-93 and AN/UPM-100, Operation and Organizational Maintenance.

c. Forward comments concerning this manual to the Commanding Officer, U. S. Army Signal Publication Agency, Fort Monmouth, N. J.

Note. For applicable forms and records, see paragraph 2, TM 11-6625-303-12.

Item	TS-934/U	TS-914/U
Voltmeter	Measures 380 to 420-cps input.	Measures 58 to 62-cps input.
Frequency meter	Vibrating reeds have a resonant frequency of 380 to 420-cps.	Vibrating reeds have a resonant frequency of 58 to 62-cps.

2. Internal Differences in Models

Internal differences are listed in the chart below. For external differences, see TM 11-6625-303-12.

3. Voltmeter Theory

a. The input voltage is applied directly across voltmeter terminals P1 and P2 (fig. 1). Resistors R1 and R2 are meter multipliers. Resistor R1 is always in the circuit; resistor R2 can be switched in or out of the circuit by switch S1.

(1) When switch S1 is in the 150 position, resistor R2 is shorted out and the input voltage is applied to the voltmeter meter movement and resistor R1. Resistor R1, which is in series with the meter movement, limits the current in the circuit to the amount needed for full scale deflection at 150 volts.

(2) When selector switch S1 is in the 300 position, meter multiplier resistor R2 is connected in series with resistor R1 and the meter movement, thereby increasing the voltmeter range from 150 volts to a maximum of 300 volts.

b. Current through the stator coils of the meter movement (fig. 1 and 2) sets up a magnetic field. The rotor assembly, which is free to turn in the magnetic field, is displaced by the field. As current changes through the stator coils, the strength of the magnetic field also changes. The change in field strength repositions the rotor assembly. The voltmeter pointer is attached to the rotor assembly, and, as the rotor assembly moves in the field, the pointer indicates the amount of voltage applied to the tester. The zero adjustment pin (not shown), which fits between the arms of the zero adjust crank (fig. 2), permits the tension on the rotor assembly springs to be varied when adjusting the pointer for a zero indication (TM 11-6625-303-12).

4. Frequency Meter Theory

a. The output of the power circuit being tested is applied directly across the frequency meter (fig. 1). Resistors R3 and R4 and the frequency meter coil are connected in series with each other, but in parallel with the voltmeter circuit. Resistor R3 is always in the circuit; resistor R4 can be switched in or out of the circuit by switch S1.

(1) When switch S1 is in the 150 position, resistor R4 is shorted out and the meter current flows through resistor R3 and the frequency meter coil.

(2) When switch S1 is in the 300 position, resistor R4 is placed in series with resistor R3 and the frequency meter coil to limit the current flow in the circuit.

b. Current flow through the coil assembly if the frequency meter sets up a magnetic field. A reed assembly is mounted in this field. Each reed has a resonant frequency and shows maximum vibration at that frequency only. The frequency of the current in the coil assembly causes the reed resonant to the frequency to vibrate. This vibrating reed indicates the frequency of the power circuit. If the frequency being measured has a value midway between two adjacent reeds, both reeds will vibrate, but neither to its maximum amplitude. The power circuit frequency is then of a value halfway between the two vibrating reeds (fig. 4, TM 11-6625-303-12).

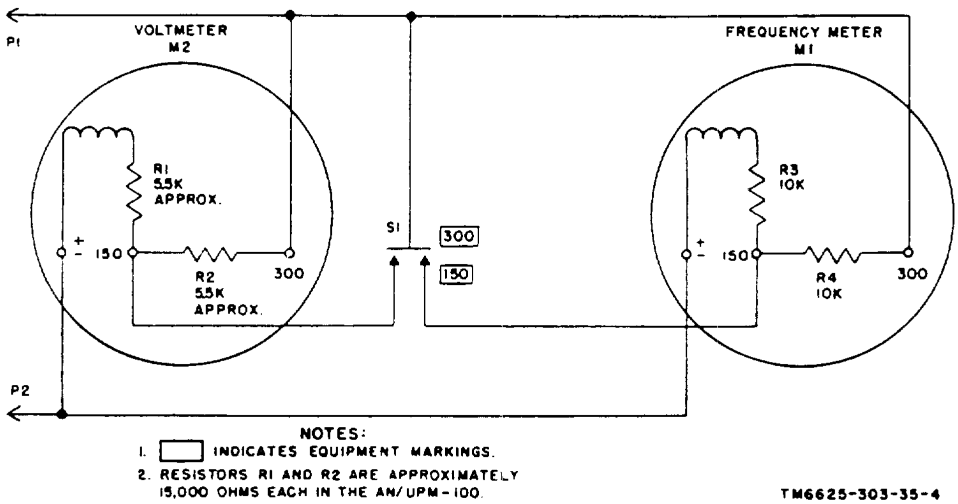

Figure 1. Schematic diagram.

CHAPTER 2

TROUBLESHOOTING

Section I. GENERAL TROUBLESHOOTING TECHNIQUES

5. General Instructions

Troubleshooting at field and depot maintenance levels includes all the techniques outlined for organizational maintenance (TM 11-6625-303-12) and any special or additional techniques required to isolate a defective part. The field and depot maintenance procedures are not complete in themselves but supplement the procedures described in TM 11-6625-303-12. 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 sectionalization, localization, and isolating techniques.

6. Troubleshooting Procedures

a. General. The first step in servicing a defective test set is to sectionalize the fault. Sectionalization means tracing the fault to a major component. The second step is to localize the fault. Localization means tracing the fault to a defective part responsible for the abnormal conditions. Some faults, such as a burned-out resistor, can often be located by sight or smell. The majority of faults, however, must be localized by checking resistances.

b. Sectionalization. The tester consists of two circuits: the voltmeter circuit and the frequency meter circuit. The first step in tracing trouble is to locate the circuit at fault by the following methods:

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

(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 equipment performance checklist (TM 11-6625-303-12) is a good operational test.

c. Localization and Isolation. The checks listed below will aid in isolating the trouble. First, localize the trouble to the voltmeter or frequency meter circuit and then, isolate the trouble within that circuit by resistance and continuity measurements.

(1) *Resistance measurements.* Use the schematic diagram (fig. 1) to find the value of the components. Use resistance measurements (par. 9) to find the value for normal readings, and compare them with readings taken.

(2) *Troubleshooting chart.* The symptoms listed in the troubleshooting chart (par. 8c) will aid in localizing trouble to a component part.

(3) *Intermittent troubles.* In all these tests, the possibility of intermittent troubles should not be overlooked. If present, this type of trouble often may be made to appear by tapping or jarring the equipment. Check the wiring and connections to the tester.

Tools, material, and test equipment	Common name
Multimeter AN/URM-105	Multimeter
Tool Equipment TK-21/C	Tool equipment
Sealing compound (Sig C 6G199.1 or equal).	Sealing compound

7. Tools, Material, and Test Equipment Required

The following chart lists the tools, material, and test equipment required for troubleshooting the test set, and the assigned common names.

Section II. TROUBLESHOOTING ELECTRICAL POWER TEST SET

***Caution:* Do not attempt removal or replacement of parts before reading the instructions in paragraph 10.**

8. Localizing Troubles

a. General. In the troubleshooting chart (*c* below) procedures are outlined for sectionalizing troubles to the voltmeter or the frequency meter, and for localizing troubles to a component of the defective meter. Parts locations are indicated in figures 2 and 3. Depending on the nature of the operational symptoms, one or more of the localizing procedures will be necessary. When trouble has been localized to the particular circuit, use resistance measurements (par. 9) to isolate the trouble to a particular part.

b. Use of Chart. Use the troubleshooting chart as a supplement to the equipment performance checklist (TM 11-6625-303-12).

c. Troubleshooting Chart.

Symptom	Probable trouble	Correction
Voltmeter pointer will not adjust to zero	Defective voltmeter	Replace voltmeter assembly (par. 11a).
Both meters function properly when selector switch S1 is set at 300, but neither meter operates when the selector switch is set at 150	Defective selector switch S1.	Replace defective selector switch (par. 13).
Voltmeter and frequency meter do not operate when test prods are connected to power source	Defective test lead	Check continuity of each test lead. Replace defective test lead.
Voltmeter does not operate when test prods are connected to power source (selector switch S1 set at 300 and frequency meter operates normally).	Open resistor R1 or R2, or defective voltmeter M2	Select a 115-volt, ac signal source. Set selector switch at 150. If the voltmeter indicates properly, resistor R2 is open. If there is no indication, voltmeter M2 is defective or resistor R1 is open.
		Check resistances (par. 9) and replace defective resistor (par. 11b) or complete voltmeter assembly (par. 11a).
Frequency meter does not operate when test prods are connected to power source (selector switch S1 set at 300 and voltmeter operates normally).	Open resistor R3 or R4. or defective frequency meter M1	Select a 115-volt, ac signal source. Set selector switch at 150. If the frequency meter indicates properly, resistor R4 is open. If there is no indication, frequency meter M1 is defective, or resistor R3 is open.
		Check resistances (par. 9) and replace defective resistor (par. 12b) or complete frequency meter assembly (par. 12a).
Broken or bent voltmeter pointer	Defective voltmeter	Replace voltmeter assembly (par. 11a).
	Defective selector switch S1 (switch contacts remain in 150 positions when knob is set at 300)	Check switch S1 before final testing equipment. Replace if necessary.

9. Resistance Measurements

Use Multimeter AN/URM-105 to check the tester for opens or shorts. The dc resistances of the tester circuits are listed in the chart below.

Measurement point	Resistance (ohms)	
	Switch S1 set at 150	Switch S1 set at 300
Across test leads	6,000 3,550a	12,000 7,100a
Across voltmeter terminals (frequency meter disconnected)	15,000 5,500a	30,000 11,000a
Across frequency meter terminals (voltmeter disconnected)	10,000	20,000

a Where resistances differ, a denotes AN/UPM-93.

CHAPTER 3

REPAIRS AND REPLACEMENT

10. General Parts Replacement Techniques

All components of the tester are mounted on the rear of the front panel. Components can be replaced without the use of special tools. The following precautions apply specifically to this equipment:

a. Tag each lead after unsoldering it from a component.

b. Remove meters carefully; they are easily damaged.

c. Make solder connections quickly at the meters. Excessive heat may damage them.

d. Use only the exact value when replacing a resistor.

11. Replacement of Voltmeter and Resistors R1 and R2 (fig. 2)

a. Replacement of Voltmeter.

(1) Unsnap the latch and remove the cover from the tester (fig 1, TM 11-6635-303-12).

(2) Remove the screws from the corners of the front panel.

(3) Lift the front panel out of the case.

(4) Unsolder the leads (not shown) connected at the back of the meter.

(5) Remove the screws that hold the meter in the panel.

(6) Withdraw the meter.

(7) Seat a new meter in the panel and replace the screws that hold the meter in position.

(8) Resolder the leads to the connections at the back of the meter.

(9) Seat the front panel in the case.

(10) Perform the voltmeter final test (par. 17d). If the final test is satisfactory. secure the front panel to the case, replace the cover, and secure the latch. If the voltmeter accuracy is not within the limits specified in the final tests, select resistors R1 and R2 *(b* below) until the final test is satisfactory.

b. Replacement of Resistors R1 and R2.

(1) Perform the procedures indicated in a(1) through (6) above.

(2) Remove the three small screws that secure the meter case to the meter base.

(3) Lift the meter case out of the base.

(4) Remove the screws from the dial face.

***Caution: When* removing or replacing the voltmeter dial face, be careful to slide the face in and out without bending the meter pointer.**

(5) Disconnect the leads from the resistor being replaced.

(6) Unscrew the center stud and remove the resistor.

(7) Secure the new resistor with the center stud and reconnect the leads.

(8) Secure the dial face to the meter case.

(9) Position the meter case on the meter base.

(10) Replace the three small screws around the outside of the meter base.

(11) Seat the meter in the panel and replace the screws that hold the meter in position.

(12) Resolder the leads to the connections at the back of the meter (not shown) and seat the front panel in the case.

(13) Perform the voltmeter final test (par. 17d). If the test is satisfactory, secure the front panel to the case, If the final test is not satisfactory, replace resistor R1 or R2 and repeat the final test.

12. Replacement of Frequency Meter and Resistors R3 and R4 (fig. 3)

a. Replacement of Frequency Meter.

(1) Perform the procedures indicated in paragraph 11a(1) through (9).

(2) Perform the frequency meter final test (par *17b* or *c).*

(3) Secure the panel to the case, replace the cover, and secure the latch.

b. Replacement of Resistors R3 or R4.

(1) Perform the procedures indicated in paragraph 11(1) through (6).

(2) Remove the three small screws that secure the meter case to the meter base.

(3) Lift the meter case out of the base.

(4) Remove the screws from the dial face.

(5) Disconnect the leads from resistor R3 or R4.

(6) Perform the procedures indicated in paragraph 11b(6) through (10).

(7) Seat the meter in the panel and replace the screws that hold the meter in position.

(8) Resolder the leads to the connections at the back of the meter.

(9) Seat the front panel in the case.

(10) Perform the frequency meter final test (par *17b* or *c).*

(11) Secure the front panel to the case, replace the cover, and secure the latch.

13. Replacement of Selector Switch

a. Removal.

(1) Remove the cover from the case.

(2) Remove the selector switch knob (fig. 1, TM 11-6625-303-12).

(3) *Loosen* the round retaining nut that secures the selector switch to the front panel. Set a small punch against either of the two blind holes on the top surface of the nut, and drive the nut counterclockwise.

(4) Remove the screws from the corners of the front panel and lift the panel out of the case.

(5) Unsolder and tag all leads connected to the switch.

(6) Remove the retaining nut and the switch.

b. Replacement.

(1) Put in a replacement switch and hand-tighten the retaining nut.

(2) Reconnect the leads to the switch.

(3) Replace the front panel and secure it to the case.

(4) Secure the retaining nut and replace the selector switch knob.

(5) Secure the cover on the test set.

14. Replacement of Meter Window Glass

a. Removal.

(1) Perform the procedures indicated in paragraph 11a(1) through (6).

(2) Remove the three small screws that secure the meter case to the meter base.

(3) Lift the meter case out of the base.

(4) Force the retaining ring from the inside surface of the meter case flange.

(5) Remove all bits of broken glass and sealing compound from the inner surface of the meter case flange.

b. Replacement.

(1) Place new sealing compound (par. 7) around the inner surface of the meter case flange.

(2) Check to see that the zero adjustment pin (not shown) on the new voltmeter glass is in exactly the same position as on the original window glass.

(3) Seat the new window glass in place and press it firmly against the sealing compound. Check to see that the voltmeter zero adjustment pin lies within the opening of the zero adjust crank (fig. 2) of the meter movement.

(4) Replace the retaining ring.

(5) Position the meter case on the meter base.

(6) Replace the three small screws around the outside of the meter base.

(7) Seat the meter in the panel and replace the screws that hold the meter in position.

(8) Resolder the leads to the meter connections, secure the front panel to the case, and replace the cover.

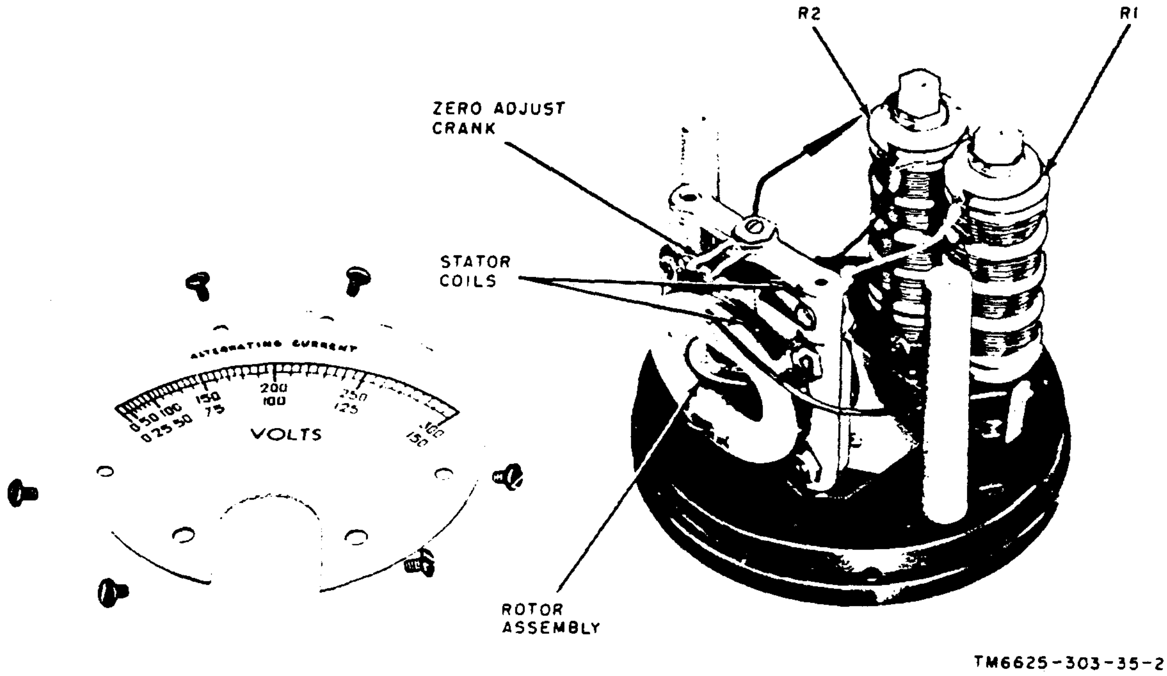

Figure 2. Voltmeter M2, interior view.

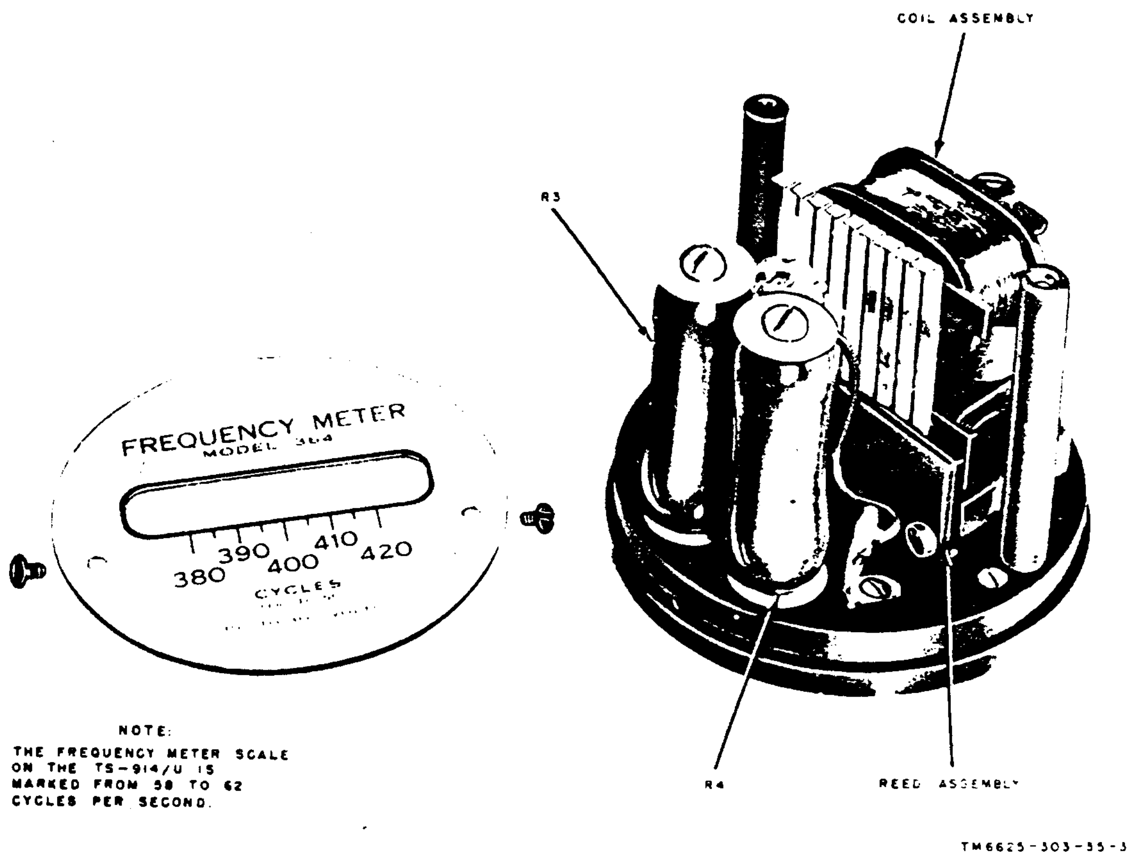

Figure 3. Frequency meter M1, interior view (TS-934/U).

CHAPTER 4

FINAL TESTING

15. Purpose of Final Testing

The tests outlined in this chapter are designed to measure the performance capability of a repaired equipment. Equipment that meets the minimum standards stated in the tests will furnish satisfactory operation equivalent to that of new equipment.

16. Test Equipment Required for Final Testing

The test equipment listed in the chart below is required for final testing Electrical Power Test Set TS-914/U or TS-934/U.

Item	Technical manual	Common name
Frequency Meter FR-40/GSM-1	TM 11-2535A	Frequency meter
Frequency Meter AN/USM-26	TM 11-5057	Frequency counter
Meter Test Set TS-682/GSM-1	TM 11-2535A	Meter test set
Test leads		Test leads

17. Tests

The tests will be performed under the conditions listed below and illustrated in figure 4.

a. Test Setup.

(1) Connect the frequency counter and the meter test set to a 115-volt, 60-cycle alternating-current (ac) power source.

(2) Allow 15 minutes for the test equipment to warm up before using.

b. Frequency Meter Test (TS-914/U) (A, fig. *4).*

(1) Connect the test leads of the tester to a 115-volt, 60-cycle ac test signal

(2) Connect two test leads from the frequency meter to the same test signal ((1) above).

(3) Compare the reading on the frequency meter to that indicated on the tester. The frequency indicated on the tester should be within ±5 percent of that indicated on the frequency meter.

c. Frequency Meter Test (TS-934/U) (B, fig. 4).

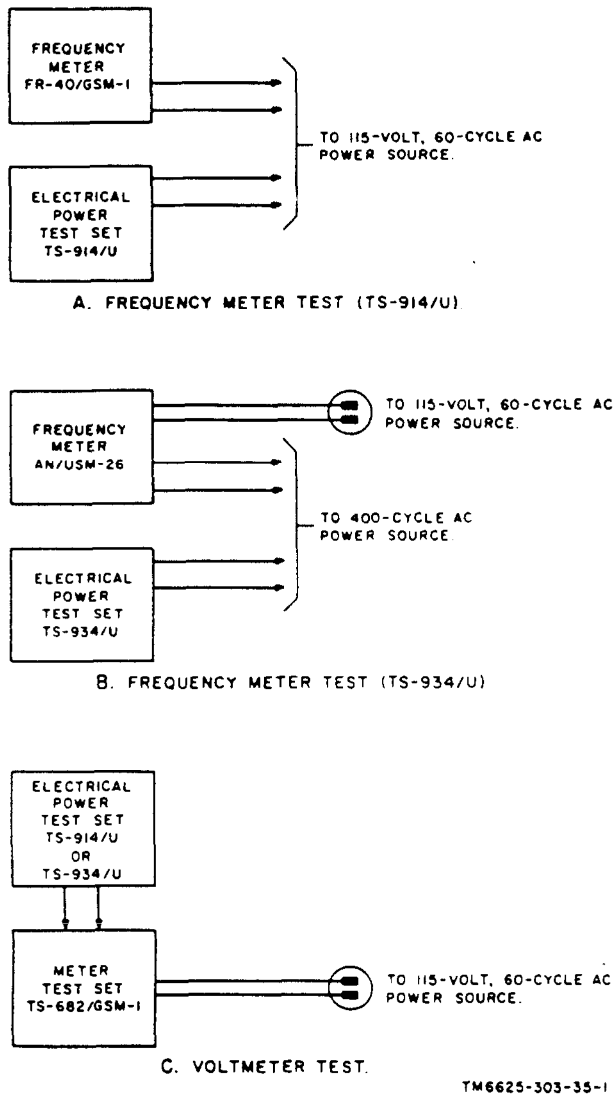

Figure 4. Connections for final tests.

(1) Connect the SIGNAL INPUT jack on the frequency counter to a 400-cycle test signal source.

(2) Connect the tester to the same source.

(3) Compare the reading on the frequency counter to the reading on the tester. The frequency indicated on the tester should be within ± 5 percent of that indicated on the frequency counter.

d. Voltmeter test (C, fig. 4).

Note. Connect the alligator clips to the test prods of the tester.

(1) Set up the meter test set to indicate ac voltage.

(2) Connect the spade-lug end of the test cord that has Plug PL-55 at the other end to either test prod of the tester. Connect one end of the cord that has a spade-lug at each end to the other test prod. Connect the other spade-lug to the COMMON binding post on the meter test set.

(3) Check to see that the voltmeter pointer is directly over zero. Zero adjust the voltmeter (TM 11-6625-303-12) if necessary.

(4) Insert Plug PL-55 into the appropriate ac VOLTS jack on the front panel of the meter test set.

(5) Compare the reading on the tester voltmeter with the reading on the standard ac meter of the meter test set.

(6) The full scale reading on the tester should be within ±2 percent of the reading on the meter test set standard (within 3 volts on the zero to 150-volt scale; within 6 volts on the zero to 300-volts scale).

APPENDIX

REFERENCES

Following is a list of applicable references available to the field and depot maintenance repairman of Electrical Power Test Sets AN/UPM-93 and AN/UPM-100:

TM 11-6625-303-12.	Electrical Power Test Sets AN/UPM-93 and AN/UPM-100 Operation and Organizational Maintenance.
TM 11-2535A	Meter Test Equipments AN/GSM-1B and AN/GSM-1C.
TM 11-5057	Frequency Meter AN/USM-26.

[AG 413.44 (23 July 1959)]

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