TM 11-5527

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

MULTIMETERS

TS-352/U, TS-352A/U AND TS-352B/U

DEPARTMENT OF THE ARMY • OCTOBER 1956

AGO 1970A—Oct

TECHNICAL MANUAL No. 11-5527

DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *24 October 1956*

MULTIMETERS TS-352/U, TS-352A/U AND TS-352B/U

* This manual supersedes TM 11-5527, 1 November 1950, and TM 11-5527A, 26 March 1954.

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

a. This manual contains instructions for the operation, organizational and field maintenance, and a discussion of the theory of operation of Multimeters TS–352/U, TS–352A/U, and TS–352B/U.

b. Throughout this manual, Multimeter TS–352(*)/U represents Multimeters TS–352/U, TS–352A/U, and TS–352B/U (fig. 1); Multimeter ME–9(*)/U represents Multimeters ME–9/U, ME–9A/U, ME–9B/U, ME–9C/U, and ME–9G/U; and Multiplier Kit MX–815(*)/U represents Multiplier Kits MX–815/U, MX–815A/U, and MX–815B/U (fig. 1).

c. Forward comments on this publication directly to the Commanding Officer, The Signal Corps Publications Agency, Fort Monmouth, N. J.

2. Forms and Records

a. Unsatisfactory Equipment Report. Fill out and forward DA Form 468 (Unsatisfactory Equipment Report), to Commanding General, Signal Corps Engineering Laboratories, Fort Monmouth, N. J., as prescribed in AR 700–38.

b. Damaged or Improper Shipment. Fill out and forward DD Form 6 (Report of Damaged or Improper Shipment), as prescribed in AR 700–58 (Army); Navy Shipping Guide, Article 1850–4 (Navy); and AFR 71–4 (Air Force).

Section II. DESCRIPTION AND DATA

3. Description
(fig. 1)

The TS–352(*)/U is a volt ohm milliammeter that uses self-contained batteries, and is contained in a metal, immersion proof carrying case. Refer to paragraphs 6 and 7 for technical characteristics and a list of components.

4. Application

The TS–352(*)/U is used to measure alternating current (ac) voltage and direct current (dc) voltage; direct current in amperes, milliamperes, and microamperes; and resistance in ohms. Multiplier Kit MX–815(*)/U, part of the TS–352(*)/U, extends the range of the equipment to allow the measurement of higher dc voltages.

The following chart lists the nomenclature and the common names for the components of

5. Nomenclature and Common Names

the equipment covered in this manual is given below:

Nomenclature	Common name
Multimeter TS–352(*)/U	Multimeter set
Multimeter ME–9(*)/U	Multimeter
Multiplier Kit MX–815	Multiplier

6. Technical Characteristics

Type	Multirange instrument using a 50-microampere dc meter of the D'Arsonval type. Rectification for ac voltage measurements.
Frequency range	25 cycles to 5 kilocycles; useful to 20 kilocycles with a reduction in sensitivity.
Frequency error	±3 percent at 10 kilocycles; ±7 percent at 20 kilocycles.
Usable temperature range	—40° F to +131° F.
Meter sensitivity	1,000 ohms per volt for ac ranges; 1,000 or 20,000 ohms per volt for dc ranges.

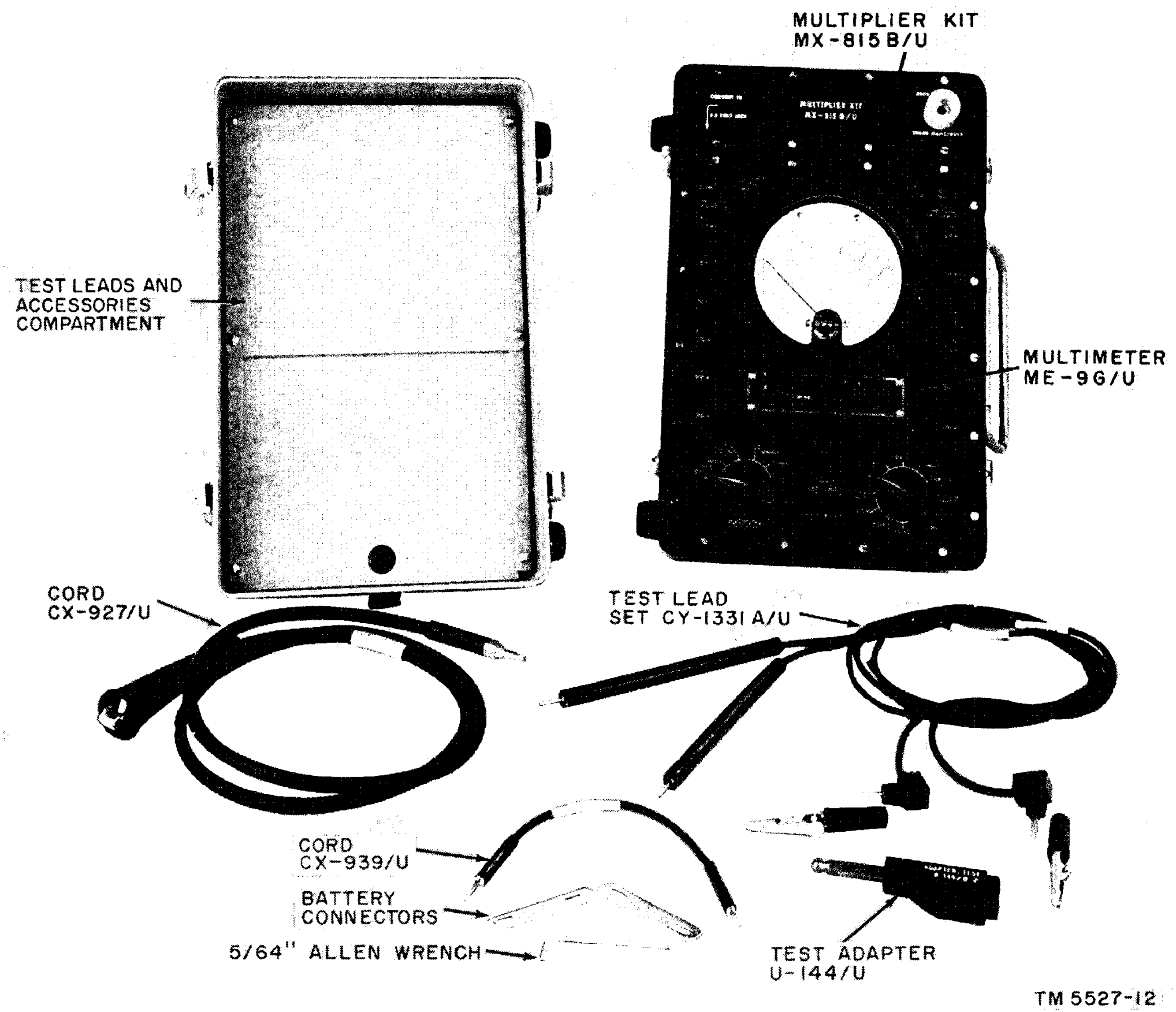

Figure 1. Multimeter TS-352B/U.

Accuracy:

- Dc ranges:
  - 0 to 1,000 volts and dc current (1,000 ohms per volt) ±6 percent at —40° F; ±3 percent at 77° F; ±5 percent at 131° F.
  - 0 to 1,000 volts (20,000 ohms per volt) ±8 percent at —40° F; ±4 percent at 77° F; ±6 percent at 131° F.
  - 0 to 5,000 volts (20,000 ohms per volt) ±9 percent at —40° F; ±6 percent at 77° F; ±8 percent at 131° F.
- Ac ranges:
  - 0 to 500 volts (1,000 ohms per volt) ±7 percent at —40° F; ±4 percent at 77° F; ±5 percent at 131°F.
  - 0 to 1,000 volts (1,000 ohms per volt) ±8 percent at —40° F; ±5 percent at 77° F; ±6 percent at 122° F.
- Resistance ranges ±6 percent at —40° F; ±3 percent at 77° F; ±5 percent at 131° F. (Percent values are in terms of meter arc length; not of ohms indicated by the meter pointer.)

Accuracy—Continued

Meter ranges:

Dc voltmeter .... 0 to 2.5, 10, 50, 250, 500, and 1,000 volts at 1,000 or 20,000 ohms per volt.
0 to 5,000 volts at 20,000 ohms per volt only.

Ac voltmeter .... 0 to 2.5, 10, 50, 250, 500, and 1,000 volts at 1,000 ohms per volt only.

Accuracy—Continued

Meter ranges—Continued

Resistance .... 0 to 1,000, 10,000, 100,000, 1,000,000, and 10,000,000 ohms.

Direct current .... 0 to 250 microamperes; 2.5, 10, 50, 100, 500 milliamperes; 2.5 and 10 amperes.

Power supply .... Supplied by batteries for ohmmeter operation (1.5 volts and 13.5 volts).

7. Components for Multimeter TS–352(*)/U

Item No.	Quantity	Component	Dimensions (in.)				Volume (cu ft)	Weight (lb)
			Height	Width	Depth	Length		
1	1	Multimeter ME–9(*)/U	9	7	5½		.2	4.69
2	1	Multiplier Kit MX–815(*)/U	2¼	7	5½		.0501	.5
3	1	Cord CX–939/U				8½		.02
4	1	Cord CX–927/U				48		.20
5	1	Cord CX–1332/U (TS–352/U and TS–352A/U)				48		.25
6	1	Cord CX–468/U (similar to Cord CX–1332/U) (TS–352/U only).				48		.25
7	1	Test Adapter U–144/U (TS–352B/U only)	2½					.25
8	1	Test Lead CX–529/U (red) (TS–352/U only)				48		.05
9	1	Test Lead CX–529/U (blk) (TS–352/U only)				48		.05
10	1	Test Lead Set CX–1331A/U (TS–352A/U and TS–352B/U).				49½		.13
11	4	Alligator clips				1½		.03

8. Differences Between Models

The TS–352/U, TS–352A/U, and TS–352B/U are similar except for the following:

a. The placement, connections, types, number, and values of resistors and rectifiers used on ac resistor board A 101 in the multimeter of the three models vary (figs. 11–13).

b. The placement and types of resistors used in the ME–9(*)/U of the three different models vary (figs. 11–13).

c. In the TS–352/U and the TS–352A/U, the connection from the +DC CURRENT jack to the wiper contact on section 2 of switch S101 is made to terminal 12; on the TS–352B/U, the connection is made to terminal 8 (fig. 16).

CHAPTER 2

SERVICE UPON RECEIPT OF EQUIPMENT

9. Unpacking

(fig. 2)

a. Packaging Data. The approximate dimensions, weight, and volume of a multimeter set, packed and unpacked follow:

	Dimensions (in.)			Volume (cu ft)	Weight (lb)
	Height	Width	Depth		
Unpacked	11⅜	8¼	6	.325	13.7
Packed	15	10	8½	.734	23

b. Unpacking.

(1) *Domestic packaging.*

(*a*) Slit the seam along the cover of the outer corrugated carton. Fold back the cover flaps and open the moisture-vaporproof barrier.

(*b*) Slit the top seam of the water-resistant inner corrugated carton, and open it.

(*c*) Remove the technical manuals.

(*d*) Remove the multimeter set from the package.

(2) *Export packaging.*

(*a*) Cut and fold back the metal straps.

(*b*) With a nail puller, remove the nails from the wooden cover of the wooden packing case. Do not attempt to pry off the wooden cover; the equipment may be damaged.

(*c*) Open the moistureproof barrier and expose the outer corrugated carton.

(*d*) Proceed as described in (1) above.

10. Checking

Note the condition of the multimeter set as soon as it is unpacked. Look for a cracked meter glass, broken knobs, or other damage. Check the items contained in the test leads and accessories compartment (fig. 1). Complete the appropriate form (par. 2) if necessary.

11. Battery Installation

(fig. 3)

a. Connect three batteries BA–31 in series; use the connectors supplied. Install the batteries in the battery compartment as indicated by the diagram on the battery compartment cover.

b. Place Battery BA–30 in the compartment provided so that the spring makes contact with the *bottom* of the battery.

Note. Batteries are not furnished with the TS–352(*)/U.

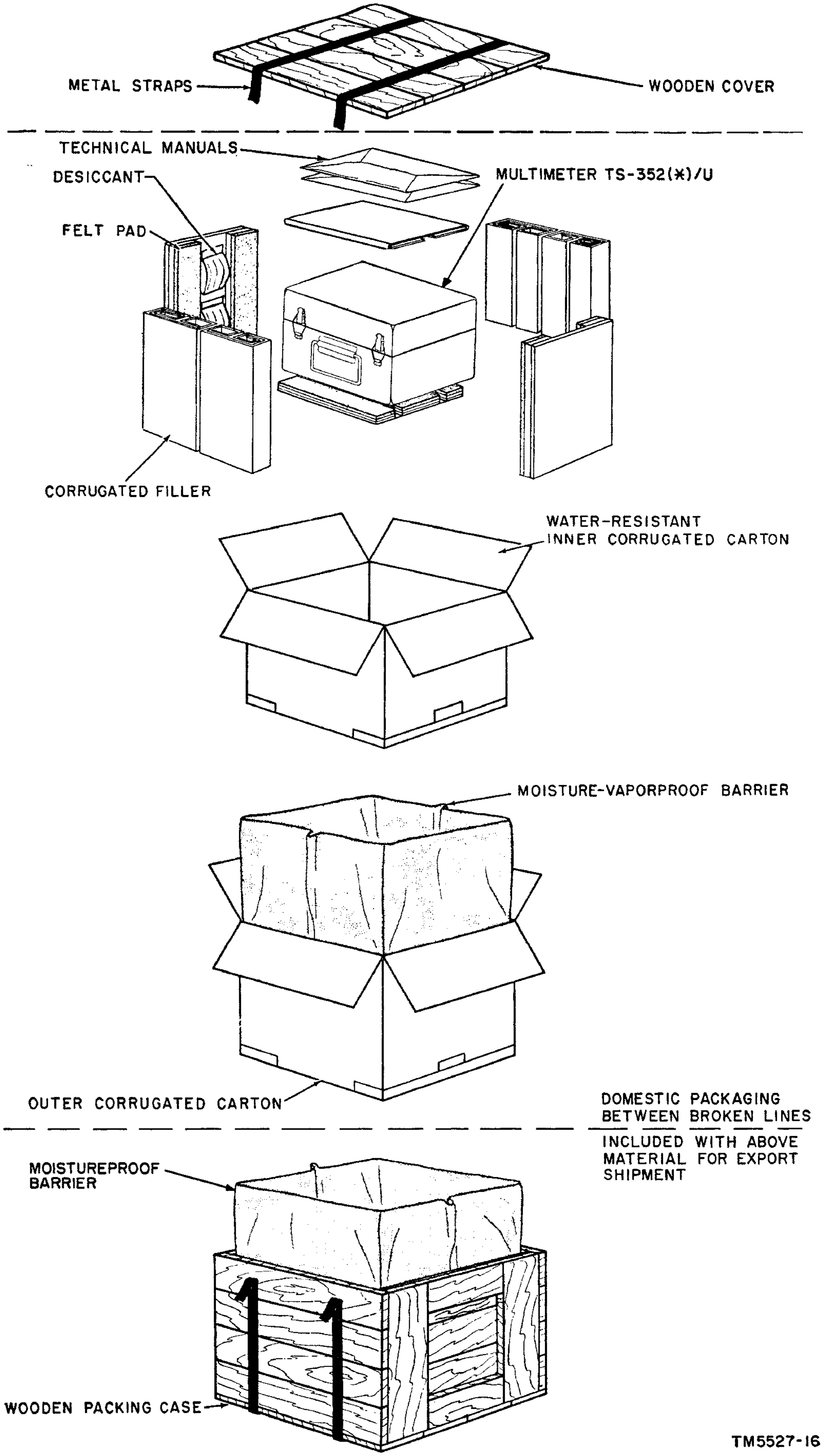

Figure 2. Packaging diagram.

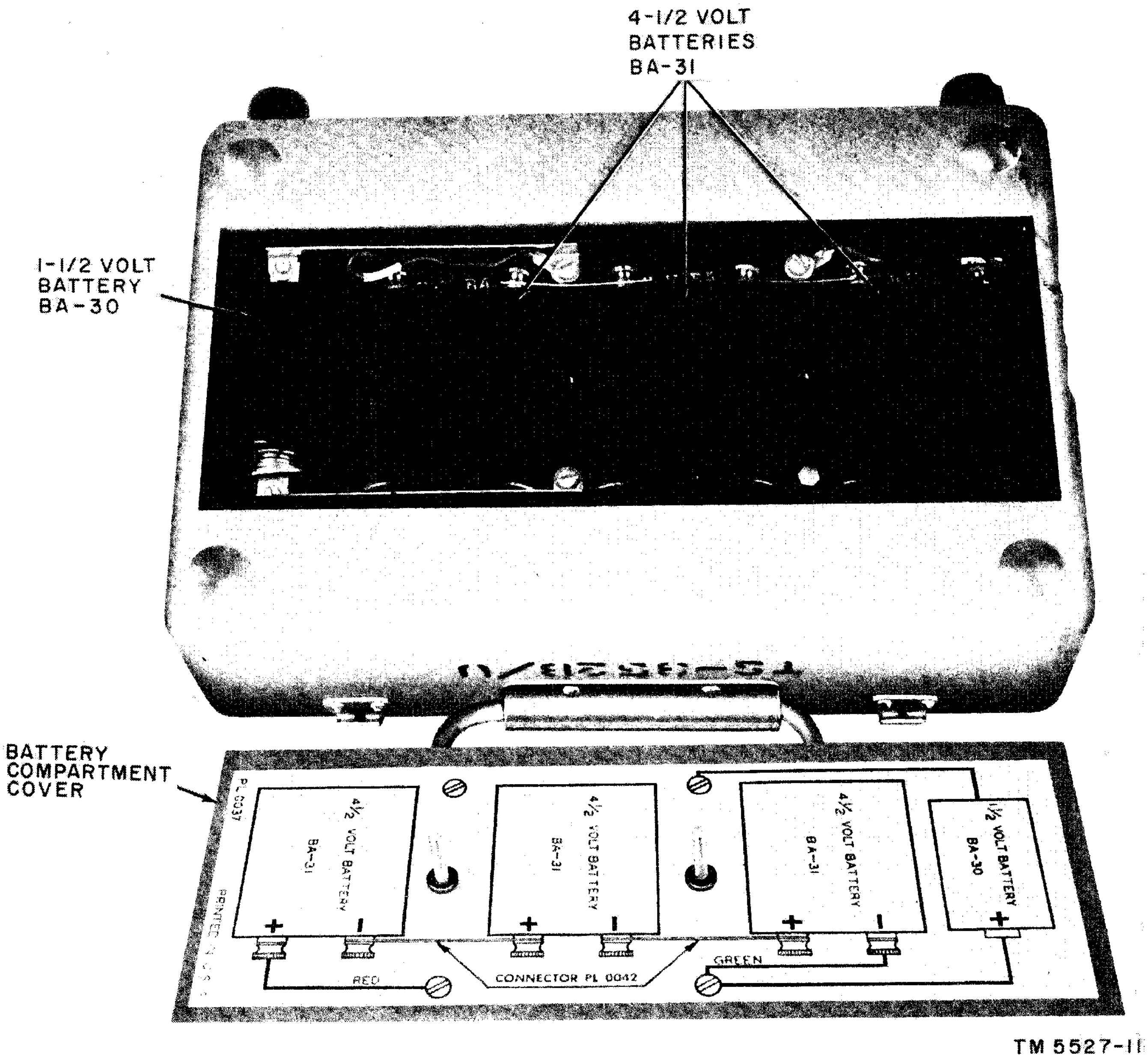

Figure 3. Battery compartment with batteries in position.

CHAPTER 3
OPERATION

Section I. CONTROLS AND CONNECTORS

12. General

Haphazard operation or improper setting of the controls can damage the multimeter set. It is important therefore, to know the function of the meter, controls, and connectors before operating the multimeter set.

13. Controls and Connectors (fig. 4)

The following chart lists the controls, meter, and connectors of the multimeter set and indicates their functions:

Item	Function
FUNCTION switch	Used to select the type of multimeter operation desired.
Range switch	Used to select one of the dc or resistance ranges.
OHMS ZERO ADJ. knob.	Used to adjust the meter pointer to zero on the ohms scale.
Meter	Indicates the value of voltage, resistance, or current measure.
OHMS —DC ±AC jack.	Common jack for all functions.
OHMS jack	Test lead connection for measuring resistance.
+DC CURRENT jack.	Red test lead connection for measuring direct current to 2.5 amperes.
+10 AMPS ONLY jack.	Red test lead connection for measuring direct current to 10 amperes.
20000 OHMS PER VOLT DC jacks.	Red test lead connections measururing dc voltages (20,000 ohms-per-volt function only).
1000 OHMS PER VOLT AC DC jacks.	Red test lead connections for measuring dc or ac voltages (1,000 ohms-per-volt function only).
CONNECT TO 2.5 VOLT jack.	Patch cord connection between the multiplier and the 2.5V jack.
5000 VOLTS DC 20000 OHMS/ VOLT jack.	High voltage test lead connection to multiplier.
CASE GROUND jack.	Ground lead connection between multimeter case and chassis of equipment under test.

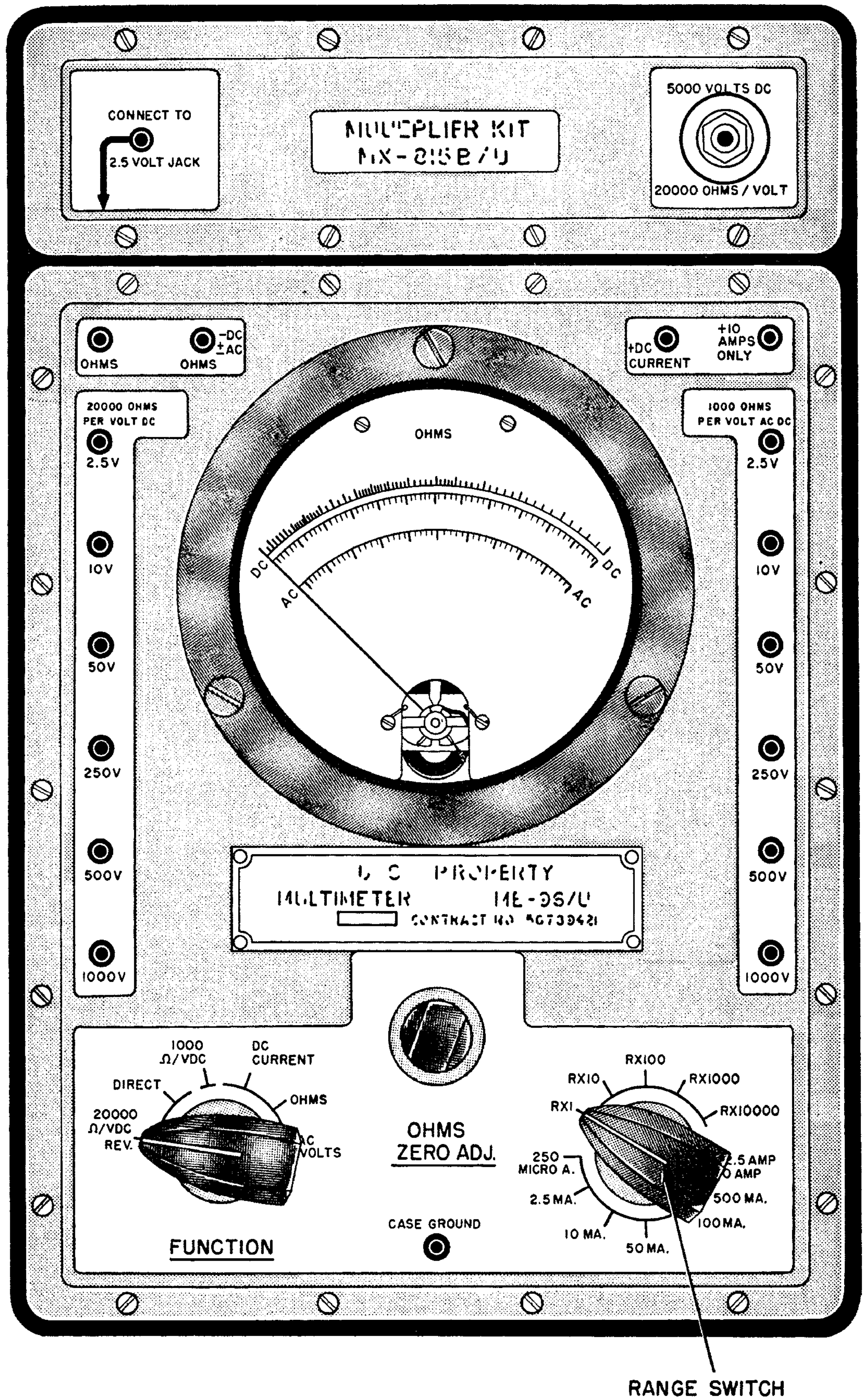

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Figure 4. Panel controls and jacks.

14. General

Before using the multimeter set, carefully read the operating instruction (pars. 15–17). For maximum accuracy in all measurements, use the range that will produce a meter indication as close to midscale as is possible.

Caution: When measuring unknown voltage or current values, start at the highest range and reduce the range a step at a time until midscale deflection is obtained on the meter.

15. Voltage Measurements

a. 0 to 1,000 Volts Dc (20,000 Ohms per Volt).

(1) Turn the FUNCTION switch to DIRECT (fig. 4).

(2) Plug the black test lead into the OHMS —DC ±AC jack.

(3) Plug the red test lead into the appropriate range jack in the 20,000 OHMS PER VOLT DC jacks column.

Warning: If equipment under test has high voltage, be sure that the power is turned off while connecting the test lead prods. Connect the multimeter CASE GROUND jack to the equipment ground or test bench ground as an added safety precaution.

(4) Connect the black test lead prod to the chassis (ground) and the red test lead prod to the test point of the equipment under test.

Note. Cord CX–1332/U (TS–352/U and TS–352A/U only), is terminated at one end by two plugs (red and black), and at the other end by telephone Plug PJ–055B. This cord is used for tests on equipment that have test jacks to facilitate certain voltage and current measurements. Test Adapter U–144/U (TS–352B only) (fig. 1), and Test Lead Set CY–1331A/U when used together, perform the same function as Cord CX–1332/U.

(5) If the meter pointer goes off scale to the left, turn the FUNCTION switch counterclockwise to the REV. position.

(6) Read the meter indication on the DC scale.

b. 0 to 5,000 Volts Dc (20,000 Ohms per Volt).

(1) Insert Cord CX–927/U (fig. 1) in the 5000 VOLTS DC 20000 OHMS/VOLT jack of the multiplier (fig. 4).

(2) Connect Cord CX–939/U (fig. 1) between the multiplier and the 2.5V jack (of the 20000 OHMS PER VOLT DC column) on the left side of the multimeter (fig. 4).

(3) Turn the FUNCTION switch to DIRECT.

(4) Plug the black test lead into the OHMS —DC ±AC jack.

(5) Connect the black test lead prod to the chassis (ground) and the clamp of Cord CX–927/U to the test point of the equipment under test and turn on the equipment.

(6) If the meter pointer goes off scale to the left, turn the FUNCTION switch counterclockwise to the REV. position.

(7) Read the meter indication on the 0 to 5 DC scale.

c. 0 to 1,000 Volts Dc (1,000 Ohms per Volt).

(1) Turn the FUNCTION switch to 1000Ω/VDC (fig. 4).

(2) Plug the black test lead into the OHMS —DC ±AC jack.

(3) Plug the red test lead into the appropriate jack in the 1000 OHMS PER VOLT AC DC jacks column.

(4) Connect the black test lead prod to the chassis (ground) and the red test lead prod to the test point of the equipment under test. (See note in *a* above.)

(5) If the meter pointer goes off scale to the left, reverse the test lead prods.

(6) Read the meter indication on the DC scale (fig. 4).

d. 0 to 1,000 Volts Ac.

(1) Turn the FUNCTION switch to AC VOLTS (fig. 4).

(2) Plug the black test lead into the OHMS —DC ±AC jack.

(3) Plug the red test lead into the appropriate jack in the 1000 OHMS PER VOLT AC DC jacks column.

(4) Connect the black test lead prod and the red test lead prod to the points in the circuit between which the voltage is to be measured. (See note in *a* above.)

(5) Read the meter indication on the AC scale (fig. 4).

16. Resistance Measurements

Caution: Turn off or disconnect the power from the equipment under test when measuring resistance. Damage will result from any external voltages which are applied to the ohms circuit of the multimeter.

a. Multimeter Zero Adjusting. Zero adjust the multimeter before making resistance measurements. Each time the range switch is turned to a different resistance range, repeat the zero adjusting procedures as follows:

(1) Turn the FUNCTION switch to OHMS (fig. 4).

(2) Plug the black test lead into the OHMS —DC ±AC jack.

(3) Plug the red test lead into the OHMS jack.

(4) Set the range switch to the desired position and touch the two test lead prods together.

(5) Turn the OHMS ZERO ADJ. knob until the meter pointer appears directly over the 0 on the right side of the OHMS scale (fig. 4).

(6) Separate the test lead prods.

b. Measuring Resistance.

(1) Repeat steps *a*(1) through (3) above.

(2) If the approximate resistance of the circuit under test is known, turn the range switch to the appropriate resistance range and zero adjust the meter (*a*(4)–(6) above).

(3) Connect the test prods across the resistance to be measured.

(4) Read the meter indication on the OHMS scale (fig. 4).

(5) If the resistance to be measured is unknown, proceed as follows:

(*a*) Set the range switch on the RX10000 range.

(*b*) Connect the test prods across the unknown resistance.

(*c*) Turn the range switch counterclockwise, one range at a time, until the meter pointer stops close to midscale.

(6) Zero adjust the meter (*a*(4)–(6) above) and read the meter indication on the OHMS scale.

17. Direct Current Measurements

Caution: When measuring current, always connect the multimeter *in series* with the circuit under test. Be sure that the test lead polarity is observed (black-negative and red-positive). Wrong connections may damage the multimeter. Do not measure more than 10 amperes.

a. Known Current Measurement.

(1) Turn the FUNCTION switch to DC CURRENT (fig. 4).

(2) Plug the black test lead into the OHMS —DC ±AC jack.

(3) If the current is known to be more than 2.5 amperes, but less than 10 amperes, plug the red test lead into the +10 AMPS ONLY jack and turn the range switch to 10 AMP (fig. 4).

(4) If the current is known to be less than 2.5 amperes, plug the red test lead into the ±DC CURRENT jack (fig. 4) and turn the range switch to the appropriate range.

(5) Connect the test lead prods to the points in the circuit in which the current is to be measured. (See note in paragraph 15*a*.)

(6) Read the meter indication on the DC scale (fig. 4).

b. Unknown Current Measurement.

(1) Determine whether the current to be measured is 10 amperes or less.

(2) Turn the FUNCTION switch to DC CURRENT (fig. 4).

(3) Plug the black test lead into the OHMS —DC +AC jack.

(4) Plug the red test lead into the +10 AMPS ONLY jack and turn the range switch to 10 AMP.

(5) Connect the test lead prods (*a*(5) above) and read the meter indication on the DC scale.

(6) If the meter pointer indicates between 2.5 and 10 amperes the range selection is correct; read the meter indication.

(7) If the meter pointer indicates less than 2.5 amperes, turn off the equipment under test and move the red test lead from the 10 AMPS ONLY jack to the

±DC CURRENT jack. Do not change the range switch setting.

(8) Turn on the equipment under test and read the meter indication on the DC scale.

(9) If the meter pointer does not move close to midscale, turn the range switch clockwise, one range at a time, until a midscale meter indication is obtained.

CHAPTER 4
ORGANIZATIONAL MAINTENANCE

Section I. FIRST ECHELON MAINTENANCE (OPERATOR)

18. Scope of Organizational Maintenance

The operator of the multimeter set is responsible for the daily and weekly preventive maintenance of the multimeter set. First echelon preventive maintenance procedures require general external cleaning and tightening of the multimeter set by the operator at specified intervals. The operator will not replace parts (except batteries) or adjust the multimeter set. The operator will note deficiencies and refer them to the unit mechanic for correction.

19. Preventive Maintenance Procedures

a. Tools and Materials. The tools and material required for preventive maintenance are Tool Equipment TK–21/G and Cleaning Compound (Federal stock No. 7930–395–9542).

b. Daily.

(1) Check the condition of the multimeter (par. 7), its accessories, and test leads.

(2) Remove dust, dirt, and moisture from the panel of the multimeter set with a lint-free cloth. Remove stubborn dirt with Cleaning Compound.

Warning: Prolonged breathing of Cleaning Compound is dangerous. Make sure adequate ventilation is provided. Cleaning Compound is flammable; do not use near a flame.

(3) Check the jacks, plugs, and prods for good contact. Check the condition of the knobs; tighten, if necessary, the knob set screws.

(4) Operate the multimeter set (pars. 14–17). If deficiencies are noted, turn in the equipment for repair.

c. Weekly.

(1) Perform all the daily checks (*b* above), but do not operate the multimeter set until the following checks are completed:

(*a*) Tighten, if necessary, all screws on the multimeter set panel and cover. Avoid overtightening; if the screw driver cannot turn the screw with normal hand-applied torque, leave the screw and go on to the next one.

(*b*) Check all exposed metal parts for rust and scaly paint. Remove rust and corrosion from the battery compartment. Use No. 000 Sandpaper and Cleaning Compound.

(*c*) Examine the test leads for cut wire, broken prods or plugs, or defective insulation.

(*d*) Examine the meter for damage. If the meter is damaged, turn in the equipment for repair.

(2) Operate the multimeter set (pars. 14–17). If any deficiencies are noted, turn in the equipment for repair.

Section II. SECOND ECHELON MAINTENANCE (UNIT MECHANIC)

20. Scope of Organizational Maintenance

The unit mechanic is responsible for performing the same preventive maintenance procedures as the operator (pars. 18 and 19). In addition, the unit mechanic corrects faults such as wiring troubles requiring soldering, and multimeter set parts replacement.

21. Tools, Materials, and Test Equipment Required

The following chart lists the tools, test equipment and material required by the unit mechanic.

Item	Used to
Tool Equipment TK-21/G	Remove and replace parts.
Multimeter TS-297/U	Make continuity checks.
Cleaning compound	Remove dirt and corrosion.

22. Preventive Maintenance Procedures

The unit mechanic will perform the preventive maintenance procedures as outlined for the operator (par. 19) and, in addition, perform the procedures in *a* through *g* below.

a. Remove the multimeter and the multiplier from the case.

b. Inspect the resistors, rectifiers, and insulators for defects such as discoloration, cracking, and insulation breakdown.

c. Clean the multimeter set parts, chassis, and switches with Cleaning Compound. Dry thoroughly to remove the Cleaning Compound residue.

d. Check the mounting and retaining screws. Hand-tighten if necessary. Check all resistor supports for firmness. Look for worn or loose parts.

e. Inspect the interior of the chassis for moistureproofing and fungiproofing.

f. Place the multimeter and the multiplier in the case and secure them with the panel screws.

g. Operate the multimeter set (pars. 14–17) and note the meter indications. If the meter indications are abnormal, turn in the equipment for repair.

Note. If the multimeter set is to be stored or packed for shipment, remove the batteries from the battery compartment.

23. Organizational Troubleshooting Chart

Symptom	Probable cause	Remedy
Meter does not indicate	Open test leads	Repair or replace test leads.
	Corroded or dirty test lead prods	Clean test lead prods (par. 19*b*(3)).
	Defective meter	Turn in multimeter set for repair.
With the FUNCTION switch in the OHMS position, meter cannot be zero adjusted on RX1, RX10, RX100, and RX1000 ranges.	Weak or defective Battery BA-30 (1.5 volts).	Replace battery.
With the FUNCTION switch in the OHMS position, meter cannot be zero adjusted on RX10000 range.	Weak or defective Batteries BA-31 (4½ volts each).	Replace batteries.
With the FUNCTION switch in the OHMS position, zero adjustment is erratic on all ranges, or meter cannot be zero adjusted on any range.	Poor connections on batteries	Clean and tighten the battery connectors.
	Defective test leads	Replace the test leads.
	Defective OHMS ZERO ADJ. potentiometer.	Turn in multimeter set for repair.

CHAPTER 5
THEORY

24. General Theory of Volt Ohm Milliammeter (fig. 5)

a. Multimeter TS–352(*)/U is a multirange, ac and dc volt ohm milliammeter using a single moving coil, 50-microampere meter of the D'Arsonval type with appropriate scales marked to indicate ac and dc volts, dc current, and resistance in ohms.

b. The voltmeter circuit is essentially a meter with series multiplier resistors. The multiplier resistors are the same for ac and dc measurements. However, since the meter is a dc milliammeter, the ac voltage input must be rectified before being applied to the meter.

c. Wafer switches are used in the switching circuits to control the functions and ranges of the multimeter. All meter shunt resistors and some multiplier resistors are selected by the positioning of the contacts in the switching circuits. The switching circuits also connect the battery, or batteries, and appropriate shunt and series resistors into the necessary circuit arrangements for resistance measurements in the different ohmmeter ranges.

d. All connections between the multimeter set and the equipment under test are made with a pair of test leads equipped with pin plugs which mate with the jacks (except for the banana jack used in the high voltage multiplier) located on the multimeter panel.

e. Voltmeter multiplier resistors are connected between the voltmeter jacks and the switching circuits and the desired range is selected by the use of the jack marked with the desired voltage value.

f. Direct current and ohmmeter ranges are selected by the range switch.

25. Dc Voltmeter Circuit (1,000 Ohms Per Volt) (fig. 6)

a. The application of a dc voltage (within the limits of the voltage values marked adjacent to the selected jacks) between the 1000V jack in the 1000 OHMS PER VOLT column, and the OHMS —DC ±AC jack, causes a current to flow as follows:

(1) Current flows from the OHMS —DC ±AC jack through FUNCTION switch S102 to the point of division (B, fig. 6).

(2) At point B, the current divides and flows through the shunt network consisting of resistors R112, R129, R138, R137, R136, R135, R134, and R132,

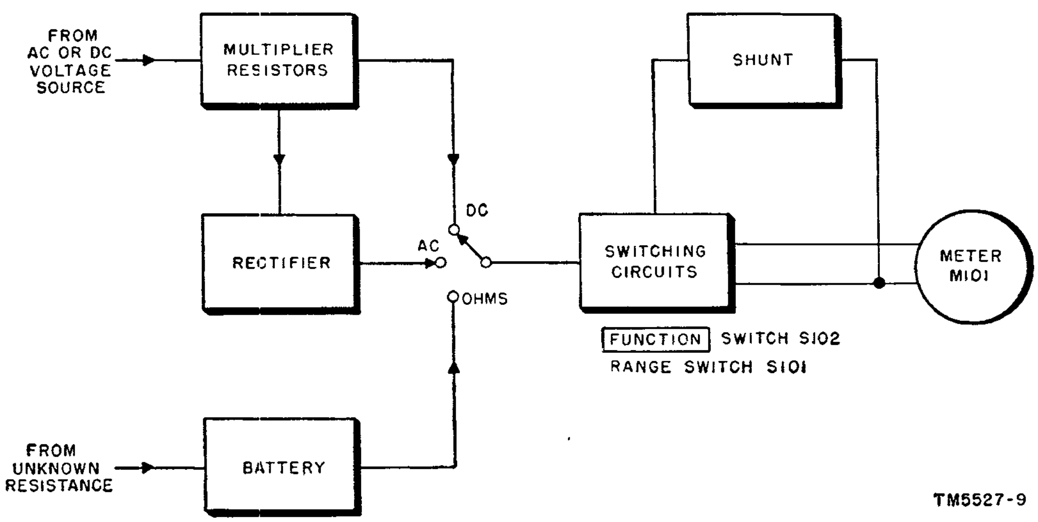

Figure 5. Block diagram of multimeter.

and also through the meter network consisting of meter M101, switch S102, resistors R139 and R131.

(3) At full scale deflection, the shunt resistors provide a current path for 950 microamperes around meter M101; only 50 microamperes will pass through the meter.

(4) The two currents meet at point A (fig. 6) and since FUNCTION switch S102 is in the 1000Ω/VDC position, the current passes through resistor R130 and switch S102.

(5) The current now flows through series-connected multiplier resistors R101, R102, R103, R104, and R105, and on to the 1000V jack.

b. The compensating network, consisting of resistor R139A and R139B, provides temperature compensation of the multimeter. When the temperature rises, the resistance of all the resistors rises slightly. The effect of the compensating network is to maintain a constant overall resistance value of the multimeter resistors to within the rated tolerances (par. 6).

c. With the application of a dc voltage between the 500V jack and OHMS —DC ±AC jack, the path taken by the current is the same as described in *a* above except that resistor R105, would be out of the circuit. Accordingly, if the 2.5V jack were used, all the series-connected multiplier resistors would be out of the circuit.

d. Since, as shown in *c* above, the use of lower value series-connected multiplier resistors are required in the measurement of a lower voltage, the principle governing the use of multipliers in the voltmeter circuit becomes evident. The *higher* the voltage being measured, the *higher* the resistance that must be placed in the current path to limit the current to that which the meter needs to deflect the pointer the required amount. The *lower* the voltage being measured, the *lower* the resistance required to limit the current through meter M101 to the proper value.

26. Dc Voltmeter Circuit (20,000 Ohms Per Volt) (fig. 7)

a. The principle governing the use of multiplier resistors in the 20,000-ohm-per-volt dc voltmeter circuit of the multimeter set is similar to the 1,000-ohm-per-volt dc voltmeter circuit described in paragraph 28. However, the omission of the shunt resistors and temperature compensating network, and the introduction of a polarity reversing circuit mark the chief differences between the two voltmeter circuits. The path taken by the current through the 20,000-ohm-per-volt voltmeter circuit is as follows:

(1) With the application of a dc voltage between the 1000V jack, and the OHMS —DC ±AC jack, current flows through the meter and through the series-connected multiplier resistors R106, R107, R108, R109, R110, and R111.

(2) With FUNCTION switch S102 in the 20000Ω/VDC DIRECT position, the terminals of the switches shown in figure 7 are connected in a circuit arrangement that directs the current through the meter as shown by the solid lines.

(3) With FUNCTION switch S102 in the 20000Ω/VDC REV. position, the circuit is so arranged that multimeter jacks marked with the voltage values are connected to the *negative* side of the voltage source. Current flow through meter M101, however, remains in the same direction. This current path is shown in figure 7 as a broken line portion of the entire circuit.

b. The current flow through the 20,000-ohm-per-volt circuit is 50 microamperes when the meter indicates full scale. The function of all the series-connected multiplier resistors (*a*(1) above) is to drop the voltage applied to the multimeter jacks down to the value which causes only 50 microamperes to flow through the meter at full deflection.

c. Since the current flow through the 20,000-ohm-per-volt circuit is normally never higher than 50 microamperes, no shunt circuit is used across meter M101. The omission of the shunt circuit, and the use of extremely high values of series-connected multiplier resistors provides high sensitivity. The voltmeter may be placed across a voltage source in a very high resistance circuit and, because the voltmeter draws only

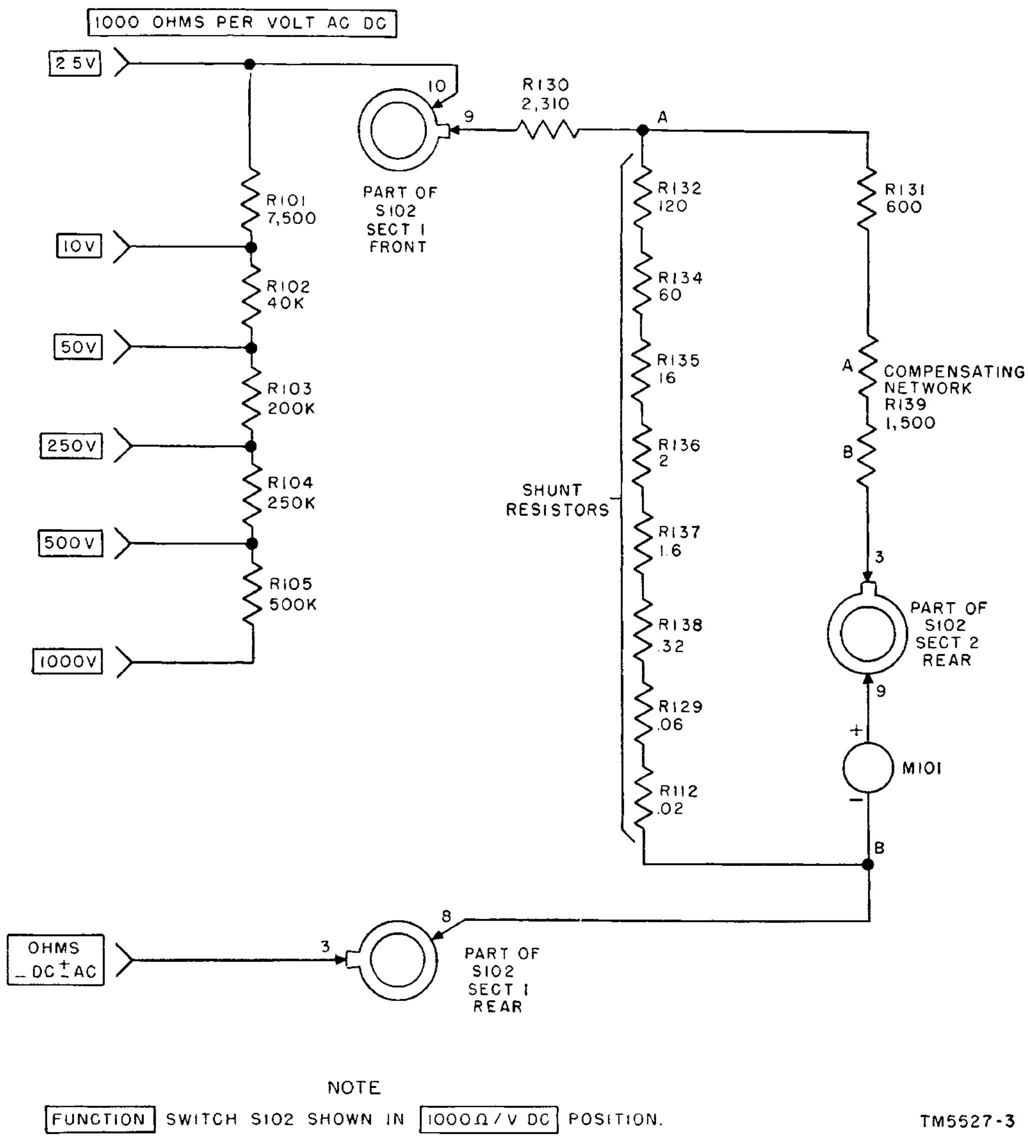

Figure 6. Dc voltmeter circuit (1,000 ohms per volt), simplified schematic diagram.

50 microamperes for full scale deflection, the voltage drop across this high resistance circuit will be very low; the voltmeter indication therefore will be nearer to the true value of voltage across that particular circuit.

d. The value of the high voltage multiplier resistor is such that with 5,000 volts applied between the banana jack marked 5000 VOLTS DC 20000 OHMS/VOLT, and the OHMS —DC ±AC jack, (fig. 16), only 2.5 volts will appear between the 2.5V jack and the OHMS —DC ±AC jack. Since the current flow in the 20,000-ohm-per-volt circuit is 50 microamperes, the meter will indicate the 2.5 volts in terms of 5,000 volts on the 0–5 scale; the marking 5 coincides with 2.5.

27. Ac Voltmeter Circuit
(fig. 8)

a. The theory of operation of the ac voltmeter circuit is similar to that described for the dc voltmeter circuits (pars. 25 and 26) except for the action of the full wave rectifier (on ac resistor board A 101) and its associated resistors. The same series-connected multiplier resistors are used (R101, R102, R103, R104, and R105) as in the 1,000-ohm-per-volt dc voltmeter circuit. However, regardless of the ac voltage applied to the jacks (within the marked values at the appropriate jacks), 2.5 volts ac will appear across the two input leads to the rectifier circuit for full scale meter deflection (these leads are marked

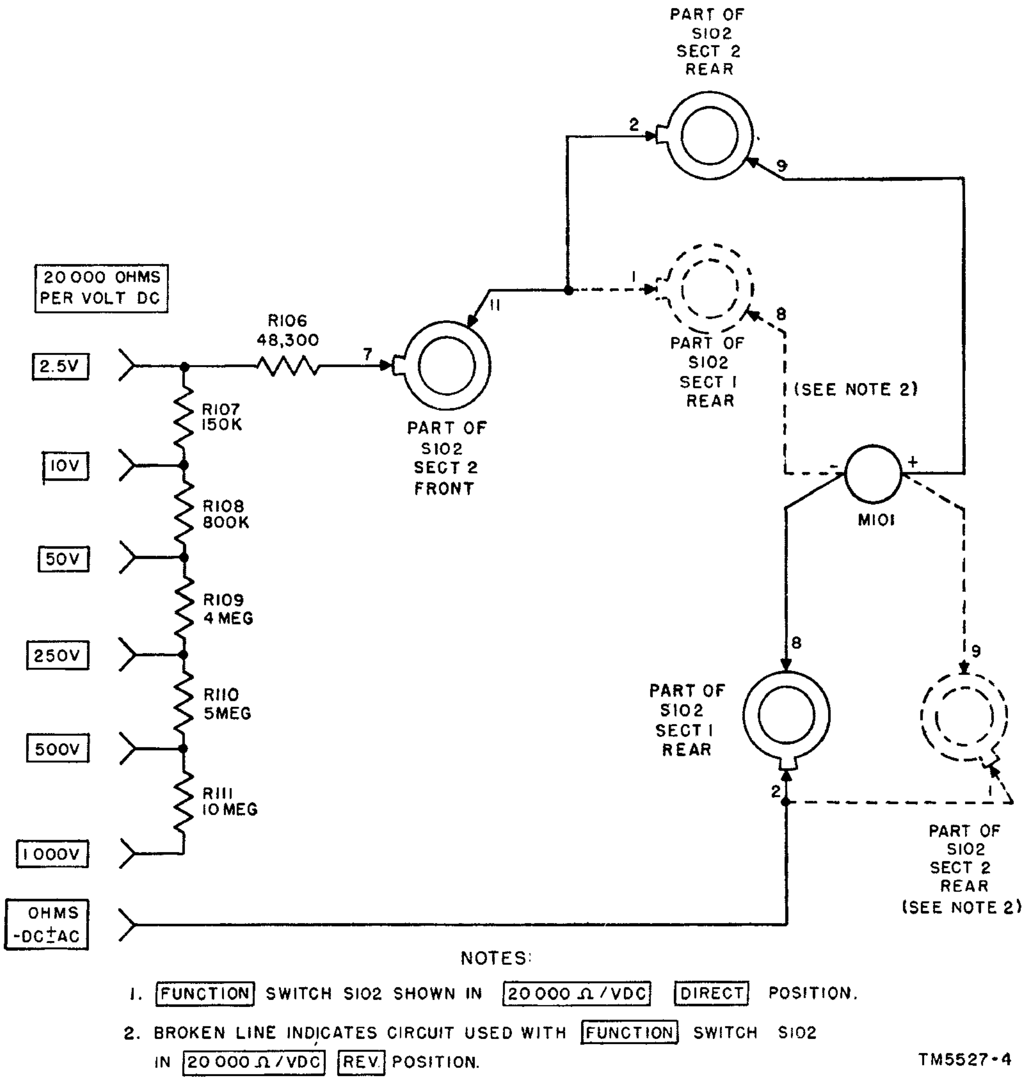

Figure 7. Dc voltmeter circuit (20,000 ohms per volt), simplified schematic diagram.

AC on fig. 8). The theory of the rectifier action is given in *b* below.

b. During the ac cycle when the polarity of the incoming ac is negative at the OHMS —DC ±AC jack, rectifier B (fig. 8) conducts and current flows through loading resistor R143, through the rectifier, resistors R141 and R145, and back to the other side of the incoming ac voltage source.

c. With a reversal in polarity of the incoming ac, current flows through resistors R145 and R141, rectifier A, loading resistor R144, and back to the source.

d. Resistors R143 and R144 are voltage dropping resistors across which the dc potentials are developed. The negative terminal of meter M101 is connected to the negative end of loading resistor R144 through terminals 6 and 8 of the rear of section 1 of FUNCTION switch S102. The positive terminal of meter M101 is connected to the positive end of loading resistor R143 through terminals 6 and 9 of the rear of section 2 of FUNCTION switch S102, current limiting resistor R140, and calibrating resistor R146. Calibrating resistor R146 compensates for slight differences in rectifier characteristics. Resistors R145, R141, and R142 form a T-pad which matches the rectifier circuit impedance with the impedance of the circuit external to the rectifier.

e. At full scale deflection of meter M101, 1 milliampere flows in the ac voltmeter circuit. Meter M101 draws 50 microamperes; the remaining 950 microamperes is drawn by the circuit made up of the rectifier and its associated resistors. Resistor R142, the shunt resistor of the T-pad, passes most of this current.

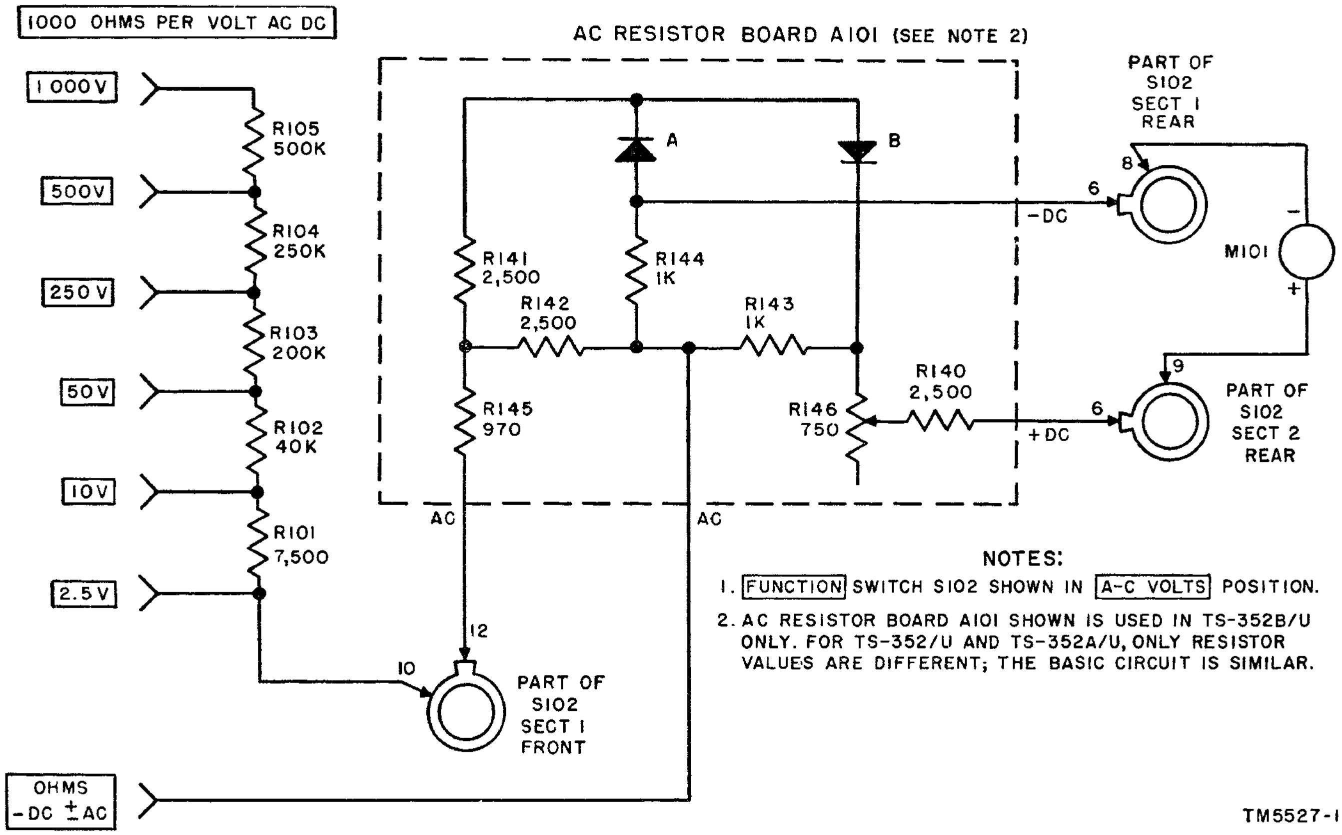

Figure 8. Ac voltmeter circuit, simplified schematic diagram.

28. Ohmmeter Circuit
(fig. 9)

a. General. The ohmmeter circuit used in the TS–352(*)/U is the voltage divider type. Different values of *shunt* resistors are in connected circuit combinations that tend to reduce meter scale crowding and provide more even distribution of the scale divisions for the five ohmmeter ranges of the multimeter. A 1.5-volt self-contained dry battery provides the operating current for all but the highest ohmmeter range. Three 4½-volt batteries and the 1½-volt battery in series (15 volts) provide the operating current for the highest range.

b. Lower Ohmmeter Ranges.

(1) With an unknown resistance connected between the OHMS —DC ±AC jack and the OHMS jack, FUNCTION switch S102 in the OHMS position, and range switch S101 in the RX1 position, the following circuit is established (fig. 9) ;

(*a*) Current flows from the negative terminal of the battery, through the unknown resistor to the junction of shunt resistor R117 and variable resistor R118 (OHMS ZERO ADJ.) where it divides. Part of the current flows through variable resistor R118 and resistor R120, through resistors R123 and R125, and back to the positive terminal of the 1.5-volt battery.

(*b*) Meter M101, acting as a voltmeter connected through limiting resistor R123, is across resistor R117, part of a voltage dividing network consisting of shunt resistors R125, R117, and the unknown resistor. The meter indicates the voltage drop across resistor R117.

(2) If the ohmmeter test leads were shorted, the meter would indicate full scale. However, if a low value of resistance is placed between the ohmmeter test leads ((1) above), less current will flow through the shunt resistors; the voltage drop will be less and, therefore, the meter indication

will be less than full scale. Actually, the meter is indicating the lower voltage in terms of a lower value of ohms of dc resistance.

(3) With range switch S101 in the RX10 position, shunt resistors R119 and R126 are connected across the battery. Since the value of these resistors is approximately 10 times the value of the resistors used in the RX1 range, only about one-tenth of the current will flow through them. Consequently, the voltage drop across resistor R119 will be about the same as it was across resistor R117. Therefore, meter M101 will indicate 10 times the resistance with the same amount of needle deflection. In other words, the indication of 30 ohms on the RX1 range is read as 300 ohms on the RX10 range.

(4) Variable resistor R118 compensates for changes in battery voltage because of age and also for heavy current drain from the lower value shunt resistors. Resistor R120 maintains a minimum value shunt across the meter to prevent more than a 50-microampere current from flowing through the meter regardless of the resistance values selected by the range switch.

(5) On the RX1000 range, meter M101 indicates the voltage drop across variable resistor R118 and resistor R120. Resistors R128, R123, and the unknown resistor then become part of the voltage dividing network.

c. Highest Ohmmeter Range.

(1) The circuit selected by FUNCTION switch S102 and range switch S101 for the highest ohmmeter range (RX-10000) is the same as the circuit used for the RX1000 range except that resistor R124 is substituted for resistor R128 ((5) above) and 15 volts are used instead of 1.5 volts. Meter M101, acting as a voltmeter, indicates the voltage drop across variable resistor R118 and resistor R120.

(2) With an unknown resistance between the OHMS jack and the OHMS —DC ±AC jack, the current flow is as follows:

(*a*) From the negative terminal of the 1.5-volt battery the current flows through the unknown resistor, through shunt resistors R118 and R120, through resistors R123 and R124, to the positive terminal of the 13.5-volt battery (three 4½-volt batteries connected in series).

(*b*) The circuit is completed through the batteries to the OHMS jack. Since the 1.5-volt battery is connected in series with the 13.5-volt battery, the total is 15 volts. The 15-volt power supply is required on the RX10000 range to develop the necessary voltage drop for meter M101 to indicate full scale with zero resistance between the ohmmeter test leads.

29. Direct Current Circuit

(fig. 10)

a. With FUNCTION switch S102 in the DC CURRENT position and range switch S101 in the 2.5 AMP position, the direct current circuit is arranged to divert all the current entering and leaving the multimeter through resistors R112 and R129 except for the 50 microamperes required for full scale deflection of meter M101. As shown in figure 10, meter M101 is connected across the shunt resistor network through resistor R139A and its compensating element R139B which make up the temperature compensating network.

b. In the other positions of the range switch, shunt resistors are added in predetermined amounts across the meter to divert all but the required 50 microamperes of current for a full scale deflection. Figure 10 shows that the value of shunt resistor R137 is approximately five times the value of shunt resistor R138. Refer to the multimeter panel designations that correspond to the switch positions using these shunt resistors. Note that the 500 MA. position uses a shunt resistor (R138) approximately one-fifth of the value of the resistor (R137) used in the 100 MA. position. In other words, the higher the current range of the meter, the lower the value of the shunt circuit around the meter. The

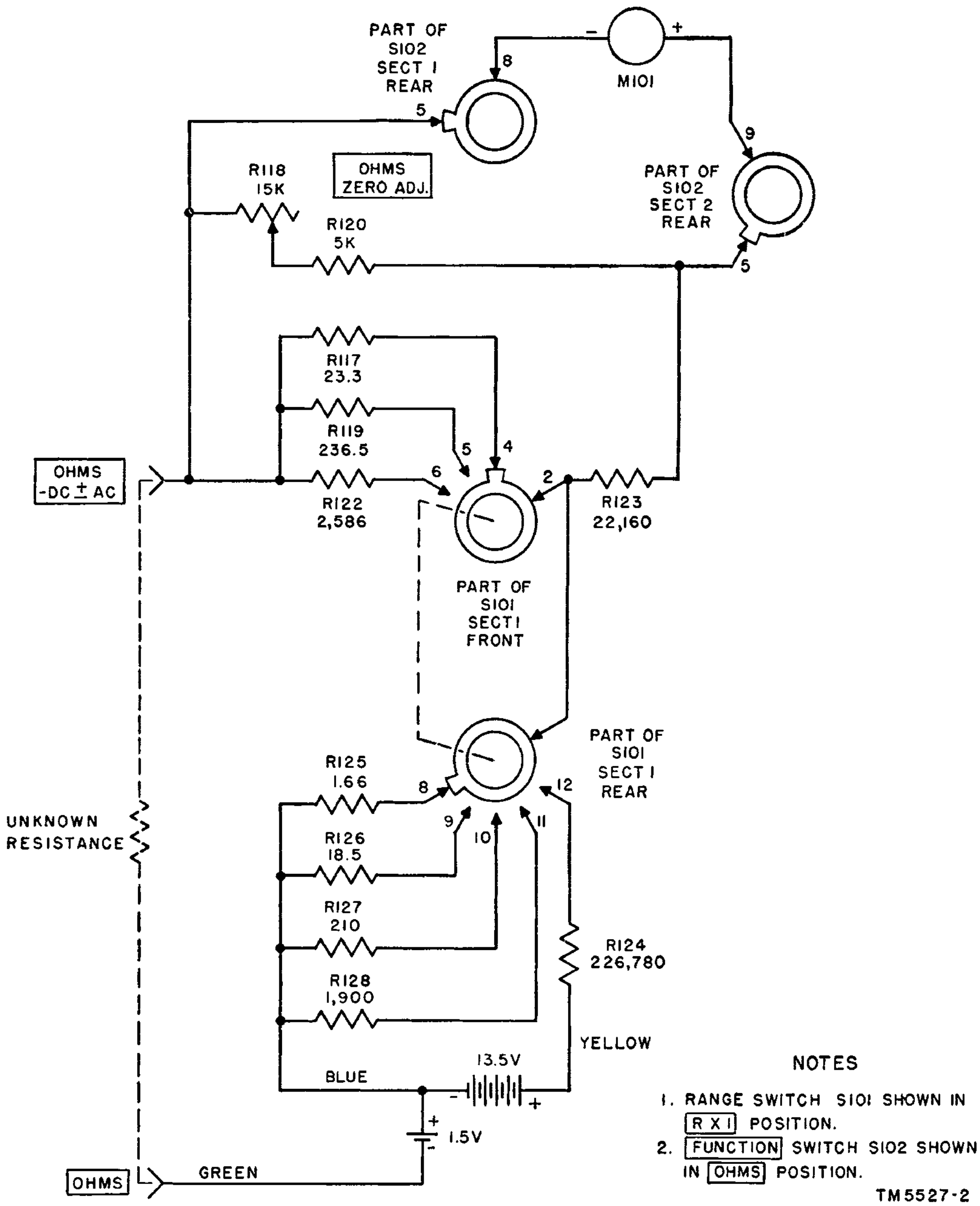

Figure 9. Ohmmeter circuit, simplified schematic diagram.

lower the current range, the higher the shunt value. Regardless of the amount of the current being measured, the meter passes only 50 microamperes for full scale deflection.

c. In the 2.5 AMP position of the range switch, the multimeter will also indicate on the 10-ampere range of the meter. In this position of the range switch, shunt resistor R112 (actually a short length of wire) carries the 10 amperes less the 50 microamperes used to operate the meter. The meter is connected to the +10 AMPS ONLY jack and the OHMS —DC ±AC jack through compensating network R139A and R139B, and resistor R129.

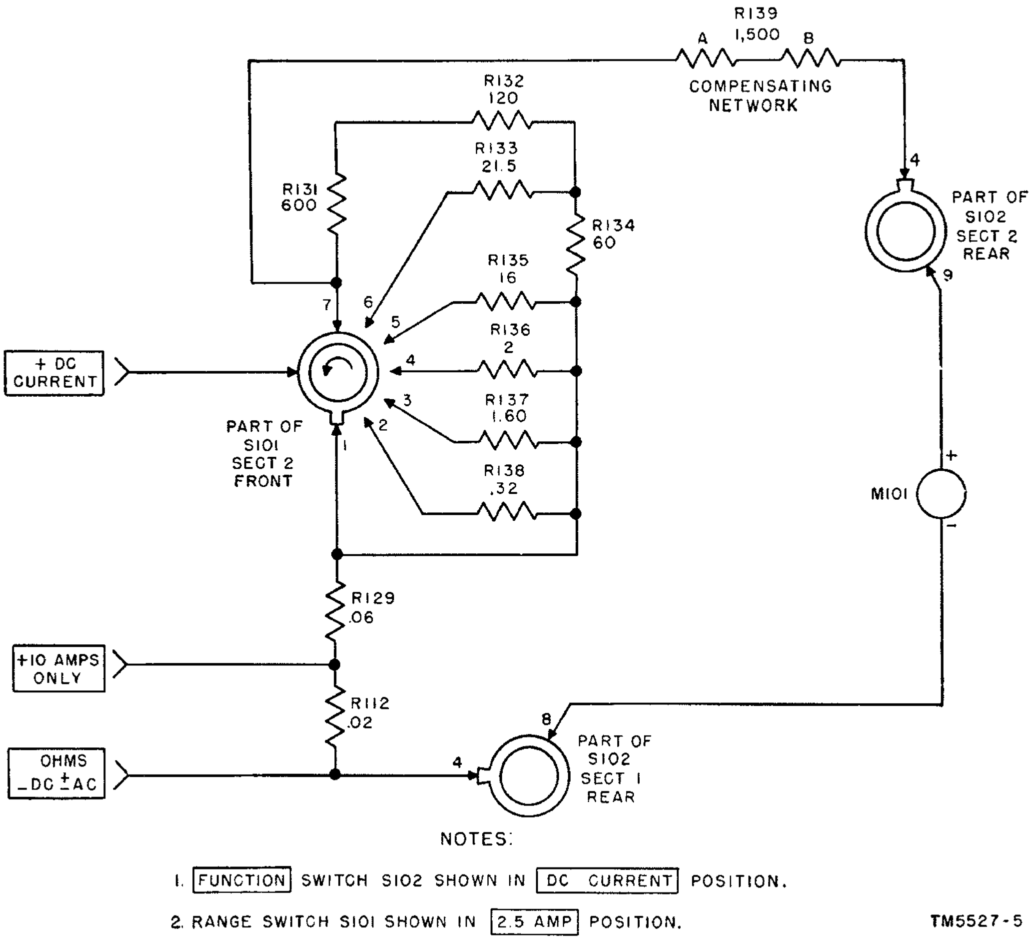

Figure 10. Direct current circuit, simplified schematic diagram.

CHAPTER 6
FIELD MAINTENANCE

Note. This chapter contains information for field maintenance. The amount of repair that can be performed by units having field maintenance responsibilities is limited only by the tools, test equipment, and replacement parts available, and by the skill of the mechanic.

Section I. TROUBLESHOOTING

30. General

Examine the shunt and multiplier resistors, connectors, soldered connections, and the meter for defects before setting up elaborate test equipment. If the multimeter operator's complaint is available, study it for possible clues to causes of trouble. Avoid looking for the unusual trouble. Some troubles can be located by consulting the troubleshooting procedures (par. 31) and the troubleshooting chart (par. 32).

31. Troubleshooting Procedures

a. Tools and Test Equipment Required. Tools and test equipment required for troubleshooting at the field maintenance level are Tool Equipment TK–21/G and Multimeter TS–352(*)/U.

b. Troubleshooting Precautions.

(1) The TS–352(*)/U ohmmeter circuit used for testing the multimeter requires considerable current for its operation; the lower the range, the greater the amount of operating current. Therefore, do not attempt to check the continuity of meter M101 suspected of being open. Meter M101 has a 50-microampere movement and will be damaged by the excessive current flow.

(2) Before concluding the values of resistance in a circuit under test, always consult the schematic diagram (fig. 16) or the simplified diagram showing the circuit concerned (fig. 6–10). Switches S101 and S102 place resistors in series and in shunt with meter M101 and, before final ohmmeter readings can be considered conclusive, these series and shunt circuit values must be considered. It is good practice to unsolder a resistor from the circuit before measuring its value. This does not apply to an open series multiplier resistor, such as resistors R101 through R105 and resistors R106 through R111. These resistors are series resistors with no shunting circuits; also, their continuity can be determined by using the appropriate multimeter jacks as points of connection by the testing multimeter.

(3) Voltages across circuits being checked for continuity can damage the ohmmeter circuits of the testing multimeter. Therefore, before applying test leads to the testing points on the multimeter chassis, be sure the battery of the multimeter being checked is disconnected.

(4) The dc resistance of the multimeter set high voltage multiplier resistor is too high to be indicated accurately on the TS–352(*)/U ohmmeter. Therefore, do not accept the slight ohmmeter needle flicker as being indicative of normal dc resistance of this high voltage multiplier resistor. Instead, connect the high voltage multiplier to a mulitmeter known to be good and measure dc volts (par. 38).

(5) On the TS–352B/U, the +DC CURRENT jack is connected to terminal 8 of section 2 of range switch S101; on the TS–352/U and TS–352A/U, the

+DC CURRENT jack is connected to terminal 12 of the same section of the range switch. Therefore, when checking the continuity of the direct current circuit in which this lead or switch is used, consult the schematic diagram (fig. 16) and avoid false ohmmeter indications.

(6) Consult the three different diagrams of ac resistor board (fig. 16) used with three models of the multimeter covered in this manual. Multimeters, bearing the same model designation (TS–352/U, TS–352A/U, and TS–352B/U) but of different manufacture, have minor ac resistor board A 101 wiring and circuit differences (although functionally alike) that are not represented on figure 16. Therefore, if ac resistor board A 101 in one of these multimeters is suspected of being faulty (false ac voltage indication on the multimeter), try another identical ac resistor board and note the difference in ac voltage indication (par. 38).

(7) The dry batteries used in the multimeter have an end voltage below which the batteries are useless. Inability to bring the ohmmeter pointer to zero on the right end of the ohmmeter scale is an indication of exhausted batteries. Therefore, a normal indication of battery voltage on the scale of a 1,000-ohm-per-volt voltmeter may be false. Either measure the battery voltage with a suitable load or replace the suspected battery.

(8) Resistor R112 is the shunt resistor for the 0- to 10-ampere range of the dc current function of the multimeter. This shunt resistor is a short length of bare wire resembling a piece of bus wire commonly used as grounding leads (figs. 11, 12, and 14). Do not shorten, cut, unsolder and resolder this resistor. Its dc resistance is too low to be measured accurately with a TS–352(*)/U. On the lowest resistance scale of the multimeter, resistor R112 (as well as resistor R129, shunt resistor for the 2.5 AMP circuit) will be indicated as practically full scale or zero ohms.

(9) The tolerance of most of the resistors used in the multimeter set is plus or minus ½-percent. The accuracy of the TS–352(*)/U ohmmeter circuit is approximately plus or minus 3 percent in terms of the ohmmeter scale length (not in ohms of dc resistance). Therefore, if symptoms indicate the value of a particular resistor, shunt or series, to be off tolerance, the TS–352(*)/U ohmmeter cannot be used to determine how much off it is. Replace the resistor with a known good one and note whether the symptom(s) disappear.

32. Troubleshooting Chart

Symptom	Probable cause	Remedy
Multimeter fails to operate on any function.	Defective test leads	Repair or replace test leads.
	Defective meter M101	Replace meter M101.
	Defective FUNCTION switch S102	Replace FUNCTION switch S102.
	Defective jacks	Repair or replace jacks.
Multimeter indicates low on all functions.	Defective meter M101	Replace meter M101.
Multimeter cannot be zero adjusted on any resistance range.	Weak batteries	Replace batteries (par. 31*b*(7)).
	Range switch S101 open	Repair or replace range switch S101.
Multimeter does not indicate on RX1 through RX1000 ranges.	Battery BA–30 dead	Replace Battery BA–20 (par. 31*b*(7)).
	Resistor R123, or one of resistors R125 through R128 open.	Replace resistor R123, or one of resistors R125 through R128 (par. 31*b*(2) and (9)).
Multimeter does not indicate on RX10000 range.	Battery BA–31 or BA–30 dead	Replace Battery BA–31 or BA–30 (par. 31*b*(7)).
	Resistors R123 or R124 open	Replace resistors R123 or R124.

Symptom	Probable cause	Remedy
Multimeter does not indicate on one or more ranges of the 20,000-ohm-per-volt function.	One of resistors R106 through R111 open.	Replace one of resistors R106 through R111.
Multimeter does not indicate on 5,000 volt range of the 20,000-ohm-per-volt function.	Open Cord CX-939/U	Replace Cord CX-939/U (par. 19).
	Open Cord CX-927/U	Replace Cord CX-927/U.
	Open multiplier resistor in multiplier.	Replace multiplier (par. 31*b*(4)).
Multimeter does not indicate on one or more ranges of the 1,000-ohm-per-volt function.	One of multiplier resistors R101 through R105 open.	Replace one of multiplier resistors R101 through R105.
Multimeter indicates low on all ac ranges.	Defective rectifiers	Replace rectifiers CR101 (TS-352/U only) (par. 31*b*(6)). Replace rectifiers CR101A and CR101B (TS-352A/U only). Replace rectifiers CR101 and CR102 (TS-352B/U only).
Multimeter does not indicate on any direct current range (current or voltage).	Resistor R139A or R139B open	Replace resistor R139A or R139B (par. 31*b*(2) and (9)).
Erratic multimeter operation	Contacts on switches S101 and S102 oxidized.	Clean switch contacts with Cleaning Compound (par. 22).

Section II. CALIBRATION

33. General

The only calibration procedure to be performed on the multimeter is covered in paragraph 34. The equipment required for calibration is Meter Test Set TS-682/GSM-1.

34. Calibration Procedure

The procedures listed below pertain only to the models of the multimeter covered in this manual. If the repairman has a multimeter that differs slightly from those mentioned here, adapt the most applicable procedure to the model on hand.

a. TS-352/U (fig. 11).

(1) Remove the multimeter chassis from the case.

(2) Remove the screws that secure ac resistor board A 101 to the chassis. Do not disconnect any wires.

(3) Set the multimeter for operation on the 10 volts ac range (par. 15*d*).

(4) Set the output voltage of Meter Test Set TS-682/GSM-1 at 10 volts ac.

(5) Connect the multimeter test leads to the TS-682/GSM-1.

(6) Adjust the calibration resistor (slide-wire resistor mounted on A 101) until the meter pointer indicates 10 volts ac.

(7) Reassemble the TS-352/U multimeter.

b. TS-352A/U (figs. 12 and 13).

(1) Remove the multimeter chassis from the case.

(2) Repeat the steps described in *a*(3) through (5) above.

(3) Adjust calibration resistor R141 until the meter pointer indicates 10 volts ac.

(4) Reassemble the multimeter.

c. TS-352B/U (figs. 14 and 15).

(1) Remove the multimeter chassis from the case.

(2) Remove the nuts that secure ac resistor board A 101 to the chassis. Do not disconnect any wires.

(3) Repeat the steps described in *a*(3) through (5) above.

(4) Adjust calibration resistor R146 until the meter pointer indicates 10 volts ac.

(5) Reassemble the multimeter.

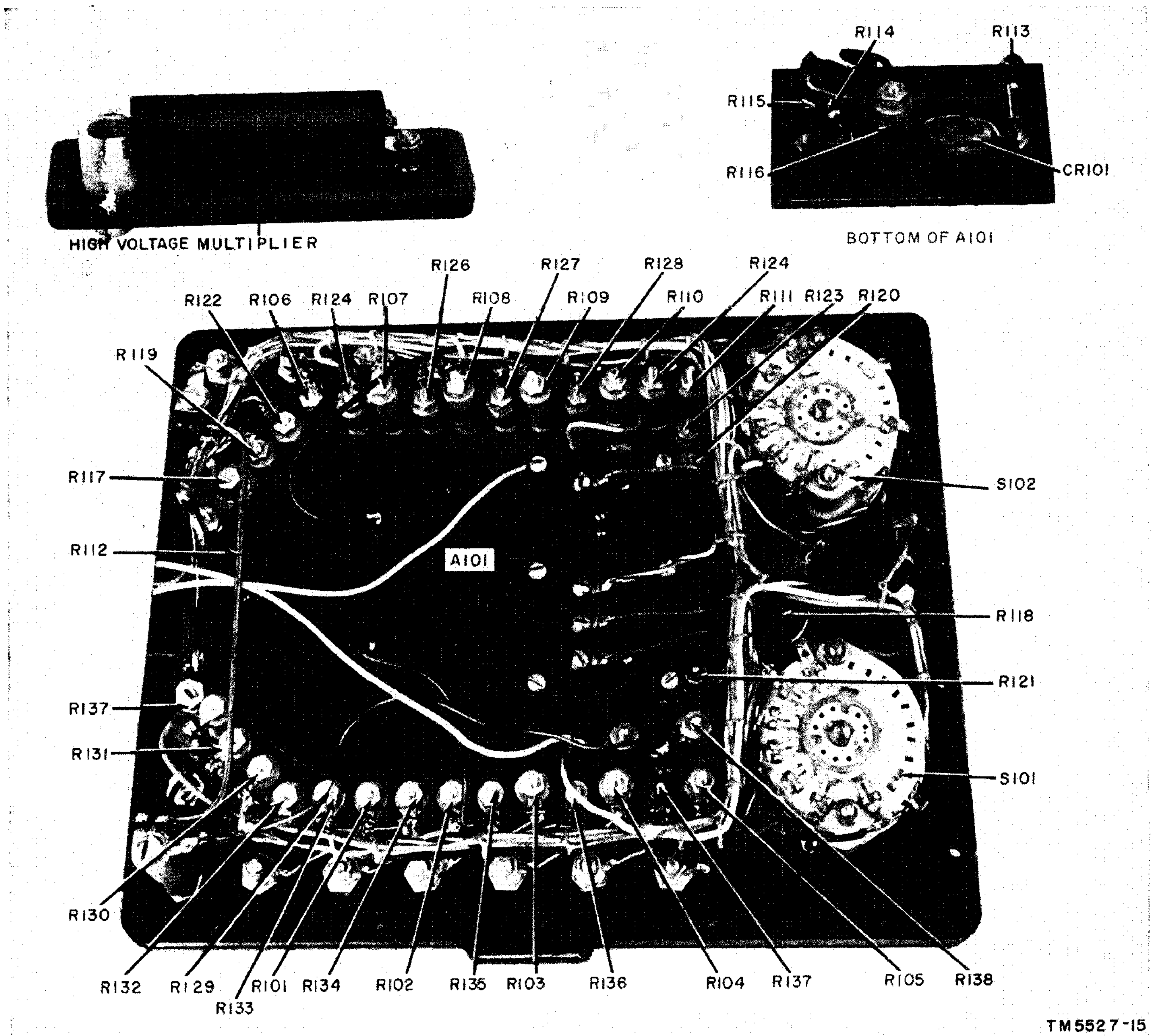

Figure 11. Rear view of Multimeter TS–352/U.

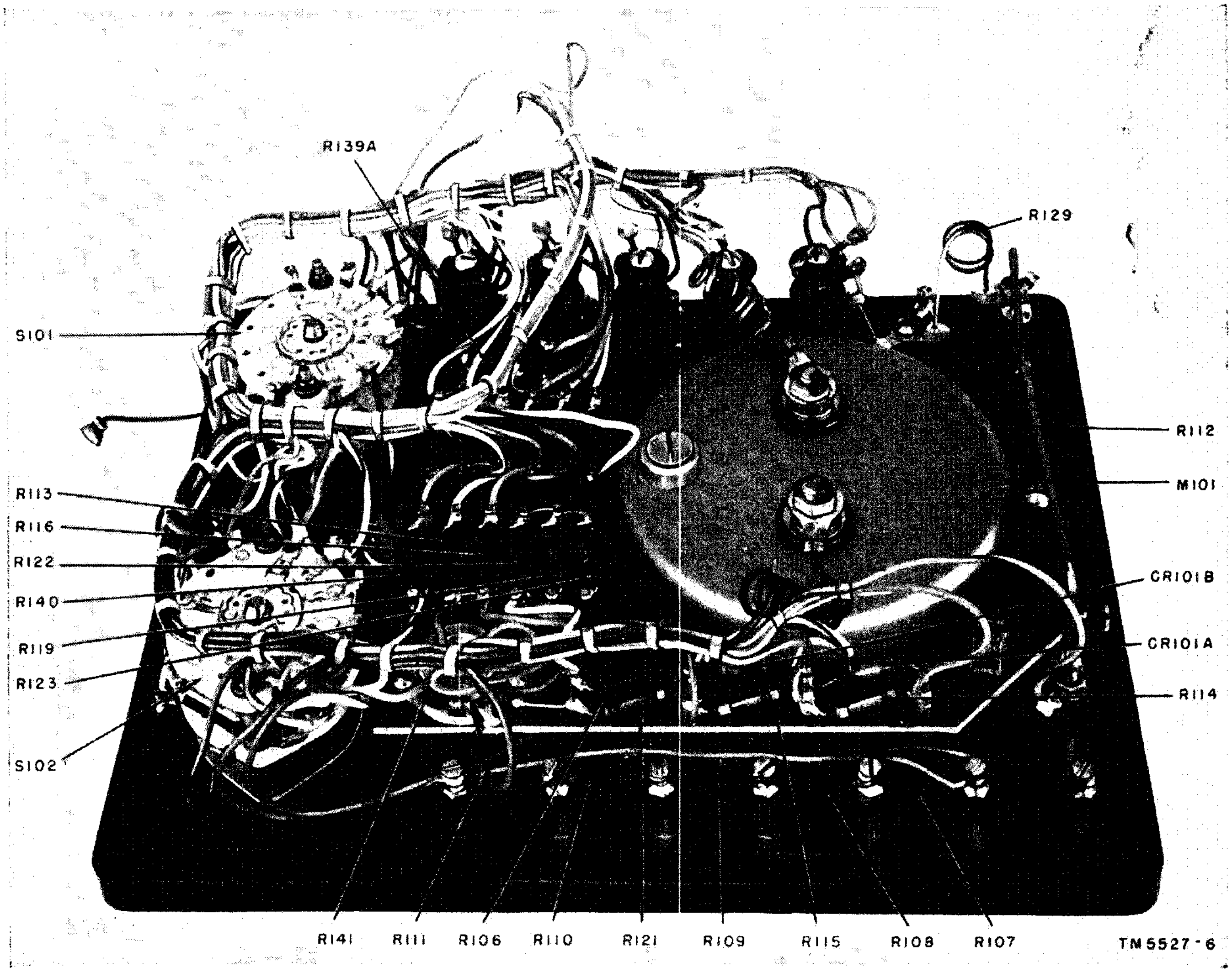

Figure 12. Partial rear view of Multimeter TS-352A/U, right side.

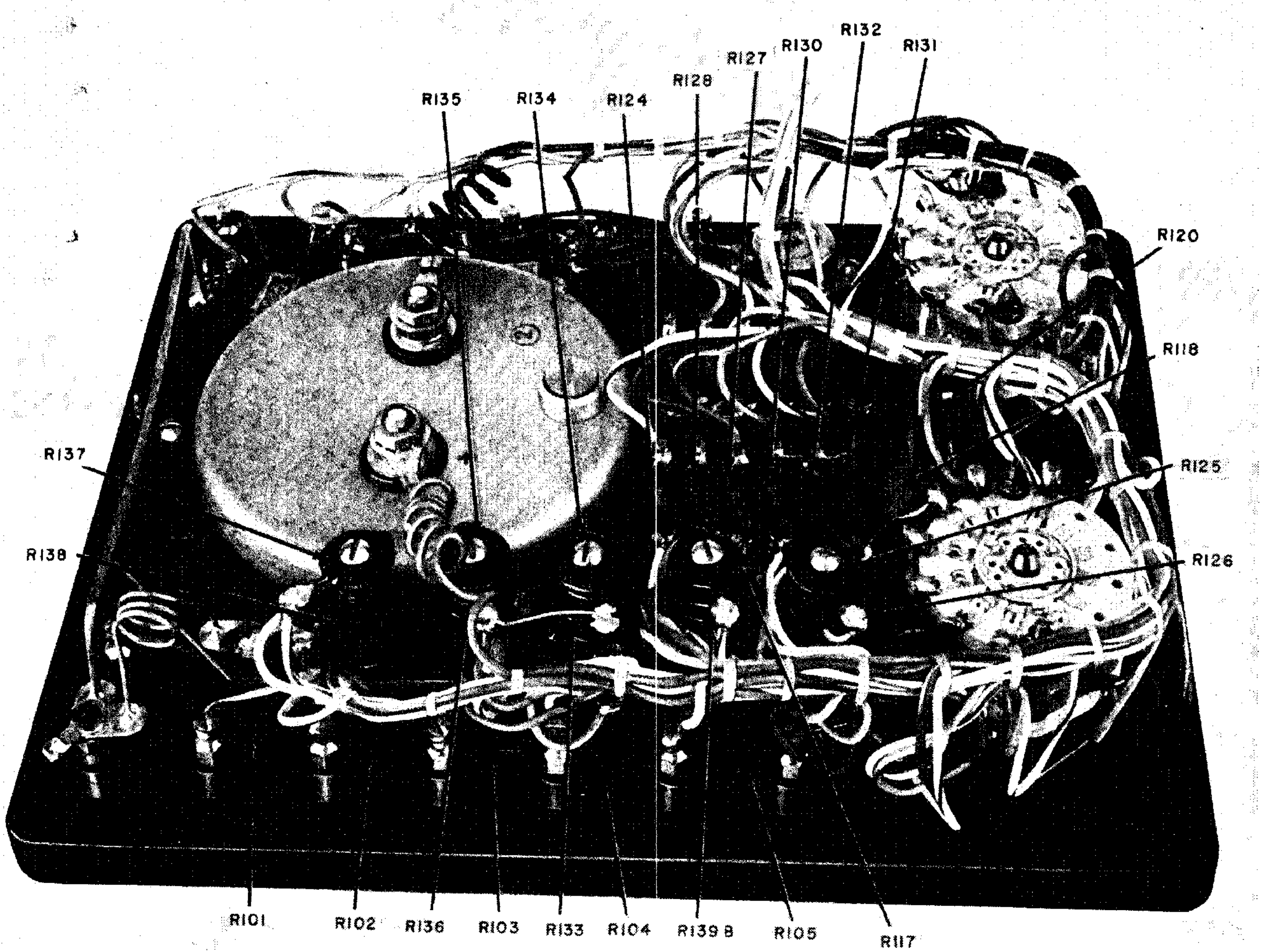

Figure 13. Partial rear view of Multimeter TS–352A/U, left side.

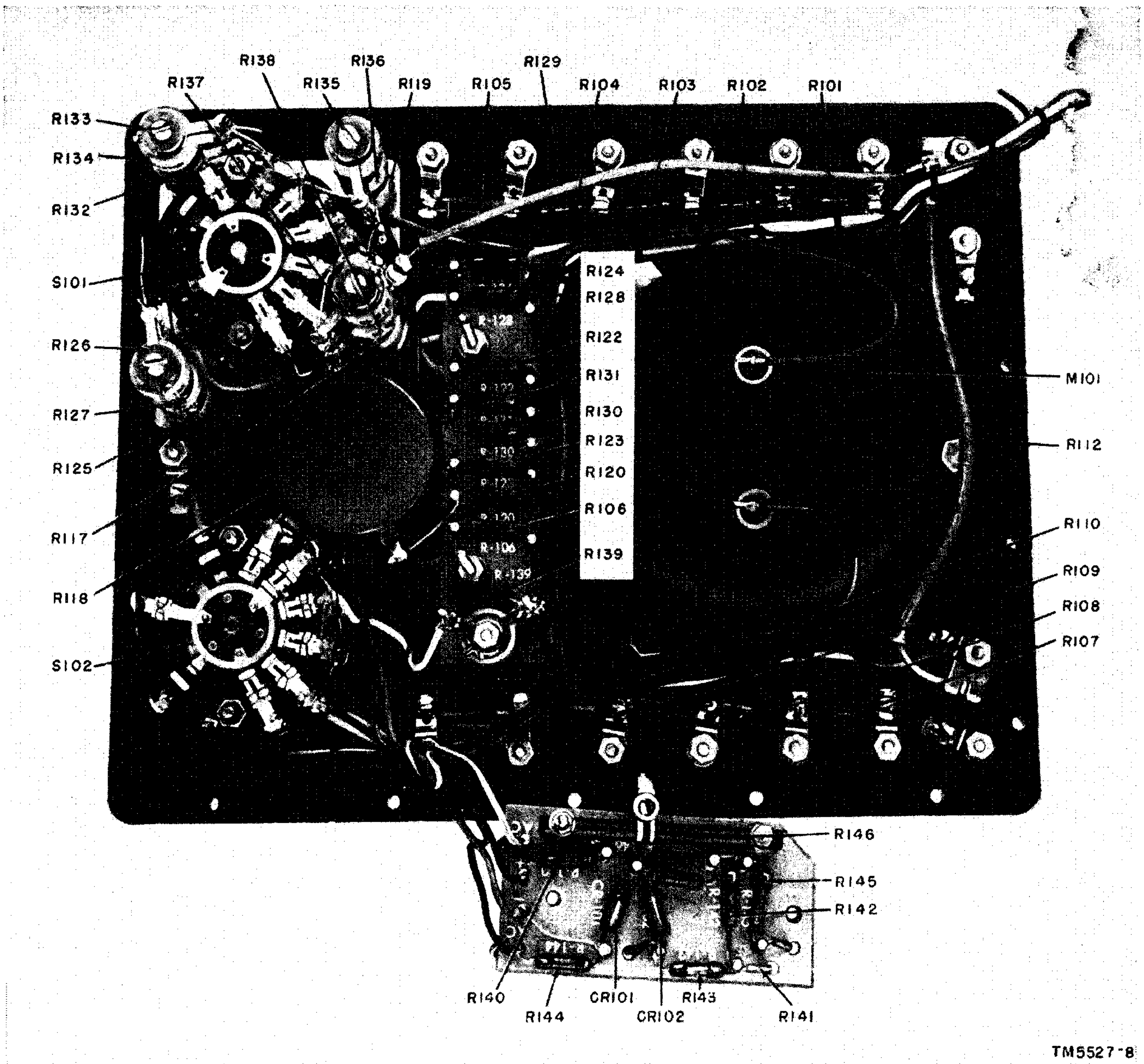

Figure 14. Rear view of Multimeter TS-352B/U.

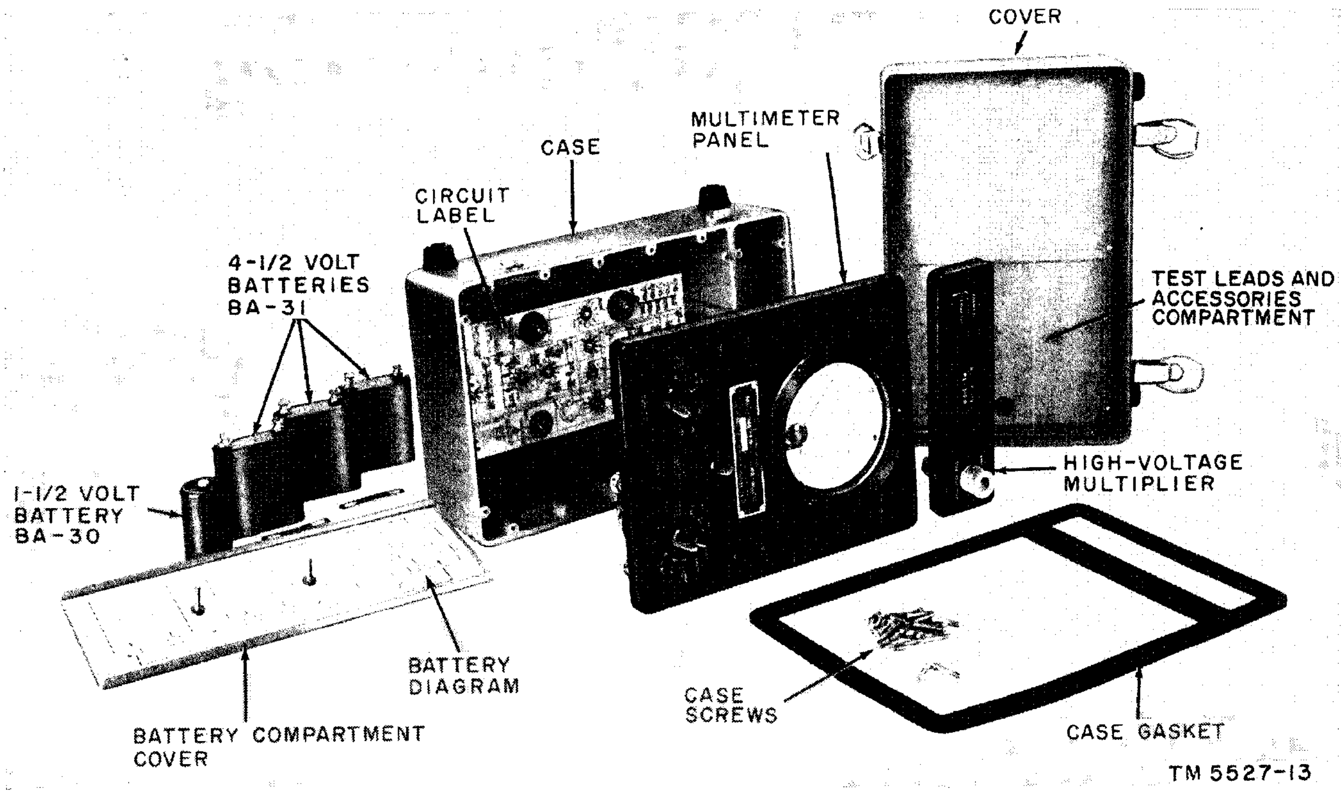

Figure 15. Multimeter TS-352B/U, exploded view.

Section III. FINAL TESTING

35. General

The testing procedures in this section are used to determine the quality of a repaired multimeter. The minimum test requirements outlined in paragraphs 37 through 39 will be performed only by personnel with adequate tools and test equipment, and with the required training and skills.

36. Tools and Test Equipment Required

The following tools and test equipment are required for final testing.

Tools and test equipment	Technical manual
Tool Equipment TK-21/G	
Meter Test Set TS-682/GSM-1	TM 11-2535B
Decade Resistor ZM-16/U	TM 11-5012

37. Testing Ohmmeter Function

a. Set the multimeter for operation as an ohmmeter and zero adjust the meter (par. 16).

b. Check the accuracy of the ohmmeter by comparing the multimeter ohmmeter indication with the resistance settings on Decade Resistor ZM-16/U as follows:

(1) Turn range switch S101, in succession, to the positions listed in column 1 of the chart in (3) below.

(2) Set the ZM-16/U at the resistance values listed in column 2.

(3) The multimeter, if normal, will indicate the resistance values listed in column 2, ±3 percent (meter arc length, not ohmic value).

Range switch S101 setting	ZM-16/U setting (ohms)
RX1	25
RX10	250
RX100	2,500
RX1000	25,000
RX10000	250,000

38. Testing Voltage Measurement Circuits

a. Testing 20,000-ohm-per-volt Dc Function.

(1) Set the multimeter for operation on the 20,000-ohm-per-volt dc function (par. 15*a*).

(2) Plug the red test lead into the range jacks of the multimeter, in succession, to the positions listed in column 1 of the chart in (4) below.

(3) Set the output voltage of Meter Test Set TS–682/GSM–1 to the voltages listed in column 2.

(4) The multimeter, if normal, will indicate the voltages listed in column 3 at the tolerances shown.

Range switch S101 setting	TS–682/GSM–1 setting (dc volts)	TS–352(*)/U indication (dc volts)
2.5V	1.25	1.25 ±4%
10V	5	5 ±4%
50V	25	25 ±4%
250V	125	125 ±4%
500V	250	250 ±4%
1000V	500	500 ±4%
5000V (using the multiplier, (par. 15*b*)).	1,000	1,000 ±6%

b. Testing 1,000-ohm-per-volt Dc Function.

(1) Set the multimeter for operation on the 1,000-ohm-per-volt dc function (par. 15*c*).

(2) Repeat the steps described in *a*(2) through (4) above except for the following:

(*a*) The 5,00-volt (multiplier) test does not apply.

(*b*) The meter indications are within ±3 percent tolerance.

c. Testing 1,000-ohm-per-volt Ac Function.

(1) Set the multimeter for operation on the 1,000-ohm-per-volt ac function (par. 15*d*).

(2) Repeat the steps described in *a*(2) through (4) above except for the following:

(*a*) The 5,000-volt (multiplier) test does not apply.

(*b*) The meter indications are within ±3 percent on this function, except for the 1,000-volt range which is ±5 percent.

39. Testing Current Measurement Circuits

a. Testing 10-ampere Direct Current Function.

(1) Set the multimeter for operation on the 0- to 10-ampere direct current function (par. 17*a*).

(2) Set the output current of Meter Test Set TS–682/GSM–1 to 5 amperes dc.

(3) The multimeter should indicate 5 amperes ±5 percent.

b. Testing 0- to 2.5-amperes Direct Current Function.

(1) Set the multimeter for operation on the 0- to 2.5-ampere direct current function (par. 17*a*).

(2) Turn range switch, in succession, to the positions listed in column 1 of the chart in (4) below.

(3) Set the output current of Meter Test Set TS–682/GSM–1 to the direct current values listed in column 2.

(4) The multimeter should indicate the direct current values listed in column 3, ±3 percent.

Range switch S101 setting	TS–682/GSM–1 setting (direct current)	TS–352(*)/U indication (±3%)
2.5 AMP	1.25 amperes	1.25 amperes
500 MA.	250 milliamperes	250 milliamperes
100 MA.	50 milliamperes	50 milliamperes
10 MA.	5 milliamperes	5 milliamperes
2.5 MA.	1.25 milliamperes	1.25 milliamperes
250 MICRO A.	125 microamperes	125 microamperes

CHAPTER 7

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

40. Repacking for Shipment and Limited Storage

a. The original packing materials may be used to repack the multimeter. Repack the equipment as shown in figure 2.

Note. Be sure that the batteries are not left in the battery compartment.

b. Pack the multimeter securely to prevent damage during transit or limited storage. Use sufficient wadding. Protect the equipment from rain and snow.

41. Methods of Destruction

Some or all of the following demolition procedures will be used to prevent the enemy from using or salvaging this equipment and will be accomplished only upon the order of the commander.

a. Smash. Smash the meter, panel, chassis, case, cover, resistors, connectors, switches, and accessory parts; use sledges, axes, pickaxes, hammers, or other heavy tools.

b. Cut. Cut the test leads, wires, and cords; use axes, handaxes, or machetes.

c. Burn. Burn the test leads, wires, diagrams, and technical manuals; use gasoline, kerosene, flame throwers, or incendiary grenades.

d. Explode. If explosives are necessary, use firearms, grenades, or TNT.

e. Dispose. Bury or scatter the destroyed parts in any convenient hole, or throw them into streams.

[AG 413.6 (20 Sep 56)]

By Order of *Wilber M. Brucker*, Secretary of the Army:

MAXWELL D. TAYLOR,
General, United States Army,
Chief of Staff.

Official:
JOHN A. KLEIN,
Major General, United States Army,
The Adjutant General.

Distribution:

Active Army:

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  CSIGO (30)
Tec Svc Bd (1)
Hq CONARC (5)
CONARC Bd (Incl ea Test Sec) (1)
Army AA Comd (2)
OS Maj Comd (5)
OS Base Comd (5)
Log Comd (5)
MDW (1)
Armies (5)
Corps (2)
Div (2)
Armd Gp (2)
AAA Gp (2)
Armd Bn (2)
AAA Bn (2)
Armd Co (2)
AAA Btry (2)
Ft & Cp (2)
Sp Wpn Comd (2)
Army Cml Cen (9)
USMA (5)
Gen & Br Svc Sch (5) except
  Sig Sch (25)
Gen Depots (2) except
  Atlanta Gen Depots (none)
Sig Sec, Gen Depots (10)
Sig Depots (17)
US Army Tng Cen (2)
POE (OS) (2)
Trans Terminal Comd (2)
Army Terminals (2)
OS Sup Agencies (2)
WRAMC (5)
Madigan Army Hosp (5)
Wm Beaumont Hosp (5)
Army Elct PG (1)
Aberdeen PG (5)
Dugway PG (5)
Jeffersonville PG (5)
Joliet Arsenal (5)

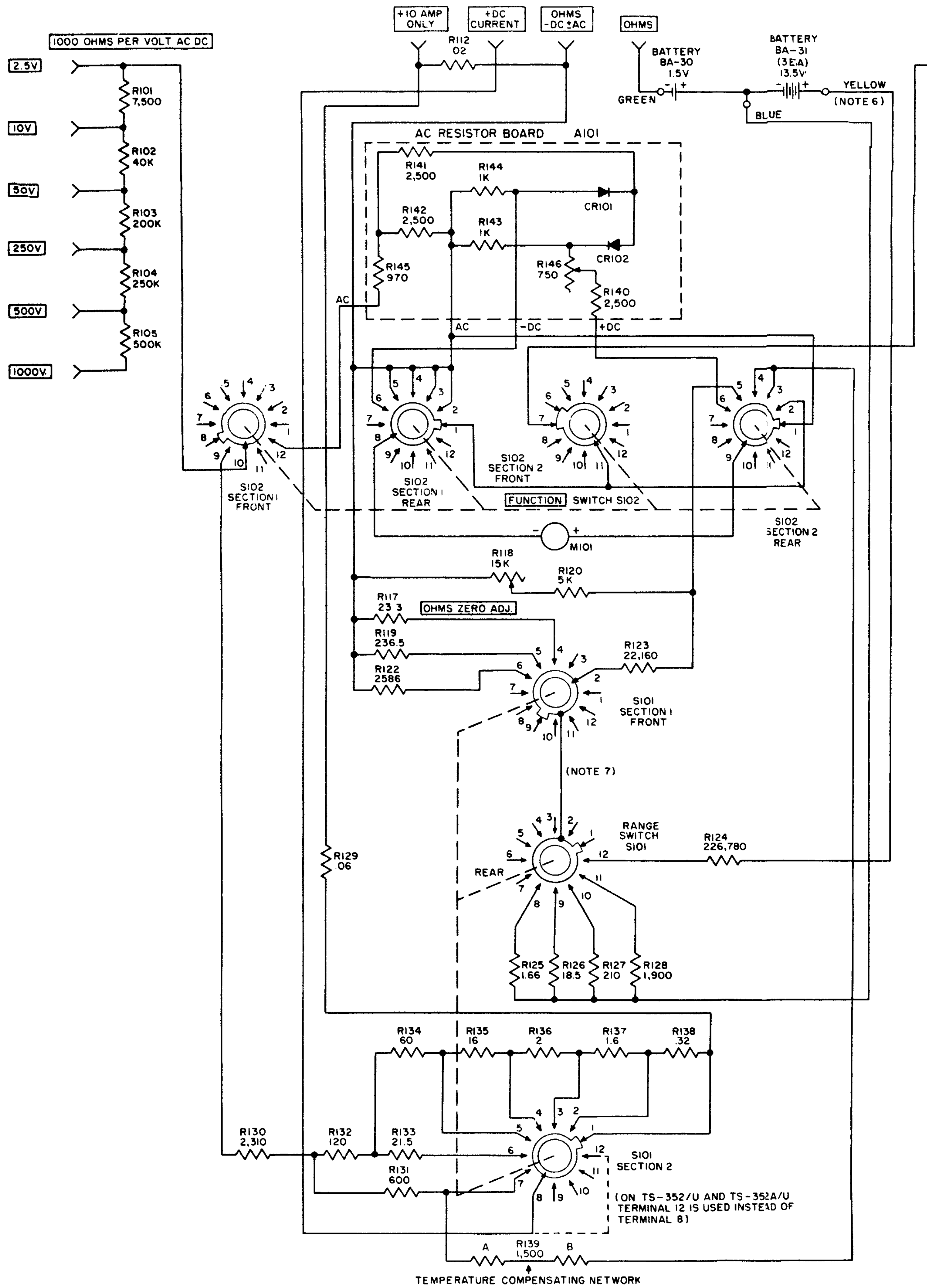
Redstone Arsenal (5)
Pine Bluff Arsenal (5)
Sig Fld Maint Shops (3)
Sig Lab (5)
PSYWAR Cen (5)
ACS (3)
Mil Dist (1)
Mil Msn (2)
Units org under fol TOE:
1–207C (2)
3–266R (2)
5–15C (2)
5–16C (2)
5–17C (2)
5–35R (2)
5–36R (2)
5–37R (2)
5–192C (2)
5–215R (2)
5–216R (2)
5–217R (2)
5–225C (2)
5–226C (2)
5–227C (2)
5–346R (2)
5–348R (2)
5–415R (2)
5–416R (2)
5–500R (AA–AD) (2)
5–525R (2)
5–526R (2)
6–100C (2)
6–101C (2)
6–115R (2)
6–116R (2)
6–125C (2)
6–126C (2)
6–135C (2)
6–136C (2)
6–200C (2)
6–201C (2)
6–225C (2)
6–226C (2)
6–235C (2)
6–236C (2)
6–300C (2)
6–301C (2)
6–315C (2)
6–316C (2)
6–325C (2)
6–326C (2)
6–401C (2)
6–415R (2)
6–416R (2)
6–435R (2)
6–501C (2)
6–515R (2)
6–525C (2)
6–535R (2)
6–536R (2)
6–537R (2)
6–545C (2)
6–558C (2)
6–575C (2)
6–576C (2)
6–577C (2)
6–615R (2)
6–616R (2)
7–11C (2)
7–12C (2)
7–15C (2)
7–16C (2)
7–25R (2)
7–26R (2)
7–27R (2)
7–31C (2)
7–32C (2)
7–35C (2)
7–36C (2)
7–95R (2)
7–96R (2)
8–7C (2)
8–75C (2)
8–76C (2)
8–500C (AA–AH) (2)
9–7R (2)
9–35C (2)
9–37C (2)
9–65R (2)
9–66R (2)
9–500R (AA–AC) (2)
9–510R (2)
11–7C (2)
11–15C (2)
11–16C (2)
11–18C (2)
11–57C (2)
11–95R (2)
11–96R (2)
11–97R (2)
11–98R (2)
11–117R (2)
11–127R (2)
11–128C (2)
11–500R (2)
11–537R (2)
11–557C (2)
11–587R (2)
11–592R (2)
11–597R (2)
12–17R (2)
19–27C (2)
19–35R (2)
19–37C (2)
19–55R (2)
19–56R (2)
19–57R (2)
19–97C (2)
19–217R (2)
19–500R (AA–AE) (2)
20–45R (2)
20–46R (2)
20–300R (2)
20–511R (2)
20–512R (2)
32–51R (2)
32–55R (2)
32–56R (2)
32–57R (2)
32–500R (2)
33–2C (2)
33–510R (2)
51–16C (2)
55–16R (2)
55–56R (2)
55–57C (2)
55–68R (2)
55–116R (2)
55–500R (AA–AE) (2)
55–515R (2)
55–516R (2)
57–57C (2)

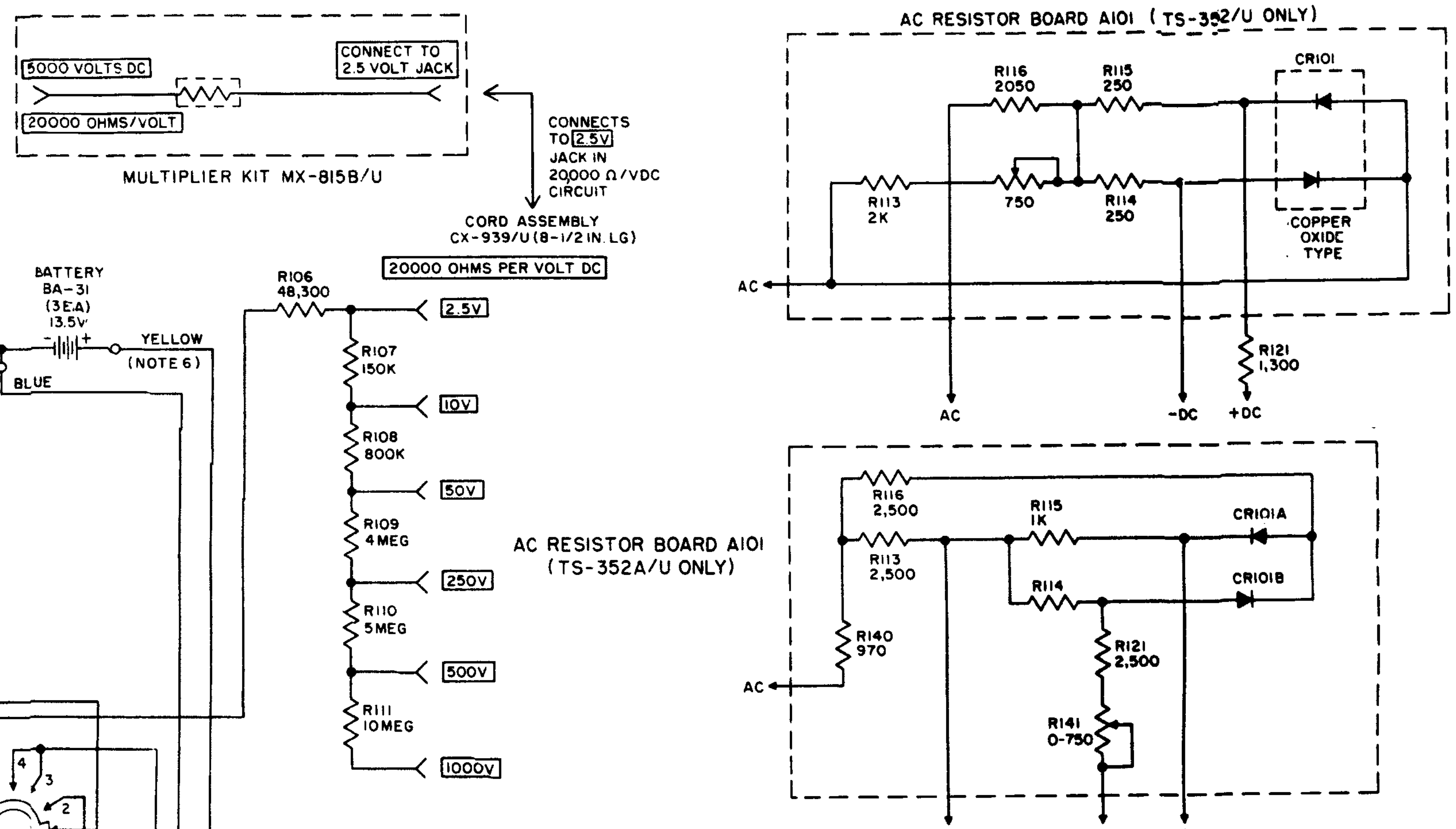
NG: State AG (6); units—same as Active Army except allowance is one copy to each unit.

USAR: None.

For explanation of abbreviations used, see SR 320–50–1.

U. S. GOVERNMENT PRINTING OFFICE: 1956—400504.





NOTES:

1. ALL RESISTANCES ARE IN OHMS.
2. [ ] INDICATES EQUIPMENT MARKING.
3. RANGE SWITCH S101 AND [FUNCTION] SWITCH S102 ARE VIEWED FROM END FARTHEST FROM KNOB. SECTIONS DESIGNATED 1 ARE CLOSEST TO KNOB.
4. RANGE SWITCH S101 SHOWN IN [2.5 AMP] POSITION.
5. [FUNCTION] SWITCH S102 SHOWN IN [20000 Ω/V DC] [REV.] POSITION.
6. BLUE, GREEN, AND YELLOW WIRES CONNECT MULTIMETER TO BATTERIES THRU INSULATED CHASSIS-MOUNTED TERMINALS.
7. CONNECTION BETWEEN FRONT AND REAR WAFERS OF SECTION 1 OF SWITCH S101 IS A RIVET.
8. SWITCH POSITIONS AND CONTACTS MADE:

RANGE SWITCH S101

SWITCH POSITION	CONTACTS MADE	
	SECTION 1	SECTION 2
2.5 AMP / 10 AMP		* 8,1
500 MA.		8,2
100 MA.		8,3
50 MA.	2F, 4F	8,4
10 MA.	2F, 5F	8,5
2.5 MA.	2F, 6F	8,6
250 MICRO A		8,7
R X 1	2F, 8R	
R X 10	2F, 9R	
R X 100	2F, 10R	
R X 1000	2F, 11R	
R X 10000	2F, 12R	

F = FRONT WAFER
R = REAR WAFER

* FOR TS-352/U AND TS-352A/U SUBSTITUTE 12 FOR 8 IN SECTION 2 COLUMN ONLY

FUNCTION SWITCH S102

SWITCH POSITION	CONTACTS MADE			
	SECTION 1		SECTION 2	
	FRONT	REAR	FRONT	REAR
20000 Ω/VDC REV.		8,1	11,7	9,1
DIRECT		8,2	11,7	9,2
1000 Ω/V D-C	10,9	8,3		9,3
DC CURRENT		8,4		9,4
OHMS		8,5		9,5
AC VOLTS	10,12	8,6		9,6

TM5527-10

Figure 16. Multimeter TS-352(*)/U, schematic diagram.

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